

**Performance Report  
For Cooperative Agreement No:NA06OAR4810162**

***(September, 2009 to February 28, 2010)***



***Submitted by***

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**National Oceanic and Atmospheric Administration-  
Cooperative Remote Sensing Science and Technology  
Center**

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## Executive Summary

CREST thrust areas continue to be focused in three clusters: **(1) Remote Sensing Applications to Climate and Air Quality (CARS and TRAQ)** **(2) Marine and Coastal Remote Sensing** **(3) Remote Sensing Applications in Water Resources and Hydrology** Within these, CREST programs provide strong support to NOAA's Climate, Weather, Water, and Ecosystem missions in a manner integrated with NOAA activities in the areas of: atmospheric trace gases and aerosols, optical properties of coastal waters, hydro climate and precipitation, land, and data compression as related to enabling technology.

### **Remote Sensing Applications to Climate (CARS).**

CARS research has helped refine the OMPS LP ozone profile retrieval algorithms, building on validation studies of the SAGE (Stratospheric Aerosol and Gas Experiment) III limb scattering measurements. The algorithm improvements developed during the SAGE III validation studies have now been applied to the OMPS LP retrieval algorithms, and ongoing research uses proxy data developed from the OSIRIS and SCIAMACHY. This effort is also supported by ground ozone detection based on SBUV/Brewer/Umkehr instrumentation critical for both long-term ozone trend analyses. Latest efforts include combining ozone profiles obtained in UV-region (from SBUV/Brewer/Umkehr measurements) with ozone data obtained in IR-region (IASI and NAST-I observations) leading to a more consistent ozone data sets and better understanding of the retrieval accuracy.

Furthermore, sophisticated linear-nonlinear long-term trend analysis have been applied including the effects of calibration and drift issues and consistency for NOAA-16, NOAA-17, NOAA-18, and NOAA-19 SBUV/2 ozone retrievals. This effort is also complementary to a number of long term trend analysis including trace gases, aerosols and cirrus clouds. These climatologies are being further enhanced with complementary Calipso Lidar Measurements. New activities include: developing Global Ozone Chemistry And Related trace gas Data records for the Stratosphere (GOZCARDS) which will provide a commonly-formatted Earth System Data Record (ESDR) for stratospheric composition, of significance to ozone decline and recovery, assessing the new HALOE water vapor data product as part of Stratospheric Processes and their Role in Climate (SPARC) Water Vapor Assessment (WAVAS) and Tropical cyclone studies with A-Train and GOES data

Other activities include incorporating Polar satellite Hyper-spectral Sounder (PHS) data into processing of the Advanced Baseline Imager (ABI) data in order to achieve the important mesoscale sounding objectives of the GOES program based on combining the high horizontal and temporal resolution radiance data to be observed by the GOES-R/S ABI with the high vertical resolution sounding radiance data to be obtained by the PHS (MetOp IASI and NPP/NPOESS CrIS). In particular, the processing of cloudy observations has been incorporated into retrieval algorithms to enhance overall performance

Furthermore, the needs of the Hyperspectral community require robust data compression

methods. While non-parametric prediction methods which have been studied has better compression performance, it is quite computationally expensive. Optimized compression based on tradeoffs in speed and accuracy were based on breaking the image into disjoint tiles and obtaining transformations for each tile separately. These tools are also being applied to quantitative Image Restoration for risk reduction including demonstrations on the damaged 1.6 micron channel of MODIS Aqua.

Cloud Research Activities include using CALIPSO data to assess Polar Mesospheric Clouds (PMC) and Polar Stratospheric Clouds (PSCs) to GCM models as well as analyzing satellite and in situ data to study tropical convection and hurricanes and to assess various theoretical models for onset of hurricane formation. In particular, a complete analysis of the annual variations of tropical convection, with a focus on the Intertropical Convergence Zones (ITCZ) and monsoons, is being performed and non-linear analysis procedureis now being applied to the Madden-Julian oscillation (MJO) case study.

In addition, global synthesis using multisensory approaches is being pursued. Comparison and Evaluation of Global Products including radiative flux and other variables crucial to energy balance, Global Energy/Water Cycle Studies through complementary sophisticated statistical approaches including Development of Non-linear analysis approaches

**Tropospheric Air Quality research (TRAQ)** CREST air quality work is centered on monitoring and studying *regional* and *urban* air quality in the eastern United States, including the refinement of urban surface model and the impact of Air Quality on the regional and global climate in the long term. Furthermore, HU, UMBC and CUNY have expanded their interaction with NESDIS's Satellite Air Quality group including the use of polar and geostationary satellites to assess aerosols and to assess current algorithms such as GASP and the use of lidar vertical profile data, in support of regional Air Quality model validation and satellite products.

UMBC continues in leading the management activities of the new World Meteorological Organization Global Atmosphere Watch Atmospheric Lidar Network (WMO-GALION), Lidar operations at all sites are being performed within the WMO-GALION framework, with at least of a minimum of 2 days of operations (Monday and Thursday), weather permitting. Significant lidar observations are being made to assess and point out problems PBL predictions such as CMAQ and the Real-Time Mesoscale Analysis (RTMA), used by plume dispersion modelers.

In addition, the CREST LIDAR network has now been successfully extended to Hampton and UPRM providing multiwavelength lidar measurements ad successfully observing Saharan dust plumes.

Further efforts include improved Sampling and Speciation Protocols using a combined Scanning Electron Microscopy/Energy Dispersive Spectroscopy (SEM/EDS) method for aerosol chemistry and erecting relationships with the aerosol optical depth products, such as the MODIS 550 nm AOD product. The new SEM/EDS procedure that was enacted for the first time allowed the aerosols to be categorized on the basis of morphology.

Finally, CREST Air Quality activities continue to provide better local urban models based on GIS and statistical tools for health exposure including definitive correlations between aerosol sources and health impacts as well as unique studies in identifying trace metals and other markers in aerosol formation in urban areas.

**Marine and Coastal Remote Sensing** CREST's activities include in-situ coastal water measurements, comparing them with satellite data, and algorithm development in support of retrievals of chlorophyll, and other water constituents. This thrust area has made major strides in the development of satellite retrieving algorithms suitable for applications in coastal waters, with their higher turbidities and chlorophyll concentrations, and are traditional blue-green algorithms suitable for the open ocean break down. Furthermore unique algorithms for the accurate detection of harmful algal blooms have been developed and applied to various locations of interest including Gulf of Mexico using existing satellites MODerate Image Spectrometer (MODIS) as well as MERIS. Further efforts include the development of unique shipborne polarimetric sensors to decouple turbidity from chlorophyll as well as the complete development and instrumentation of a Coastal Observatory in Long Island Sound (LISCO) for validation of Ocean Color satellites and for time series monitoring of coastal waters in LIS. Both multispectral (SeaPRISM) and hyperspectral sensors (HyperSAS) are being coordinated and data are available at AERONET site. Further field measurements are also being performed regularly. These efforts are greatly leveraged with support from the Office of Naval Research (ONR).

**Remote Sensing Applications in Water Resources and Hydrology.** Under this thrust area several Hydro Climate tasks have been evolved dedicated to validating the existing precipitation retrieval algorithms by the researchers at CREST/CUNY; UPRM and Hampton, including adjustment of the spatial discrepancies between the satellite and radar rainfall estimations. In addition, significant efforts to NOW-CASTING have also been implemented using the Satellite Receiving Station including comprehensive comparisons at multiple sites between RDT and SatCast Algorithms

Further work include the measurement of snow dynamics with reference to the land cover and changes and improve measurements in presence of variable land cover and in conjunction with NESDIS and NWS, on snow grain size estimation and detection of ice on large water bodies and on using satellite radiometry for rain and snowfall estimation in mountain gap areas.

Significant efforts are also being made in developing coastal resources analysis tools to optimize benefits for the environment, the economy, and public safety and costs including development of global-scale water resources indicators. assessment of the interactions between soil moisture and climate simulated using the GISS Model E and evaluated with satellite-based precipitation time series, with application to drought forecasting and seasonal variability streamflow and snowmelt in the Northeast US from ground-based and satellite measurements. New efforts include *developing soil moisture retrieval algorithms using active and passive microwave remote sensing* for real time estimation of soil moisture in support of SMAP and analyzing satellite and in-situ data to study tropical convection and hurricanes

**Education:** Since 2001, CREST has supported 282 students of whom 189 have graduated. Several of these students have entered into MS or PhD programs at CREST and/or other universities or taken professional jobs. Three of these students – Martin Yapur (2002), Michael Edwards (2003) and Marco Vargas (2006) have joined the NOAA workforce. Ms. Leona Charles, who defended her PhD in January 2008, joined Northrop Grumman (NG) as a Space Systems Engineer. Mr. Ankur Agarwala, UG; Moran Dagan UG (EESE) also joined NG in summer 2009 with Nikisa Jordon to be the fourth CREST student to join Northrop Grumman in January 2010.

**Outreach:** A number of K-12 educational and outreach initiatives in collaboration with junior high schools, as well as summer internship and NOSB (National Ocean Science Bowl) with New York City high schools continues to grow at CREST premises. **New**

**Educational Programs:** A significant number of existing courses have been modified to incorporate NOAA-related sciences in the curriculum. In spring 2006, The City College of CUNY has introduced a new multidisciplinary Engineering and Science program leading to a Bachelors degree in Engineering or Science and received over 59 applications in Spring 2010, which includes 42 males and 17 females. At HU, the Space Earth and Atmospheric Sciences (SEAS) minor was introduced in January 2003 with 18 graduates applied so far. This has resulted into a new Department of Atmospheric and Planetary Sciences at HU. The CREST education and outreach plans are detailed in subsequent section of the report. In addition, CUNY is looking to expand it's educational activities through a proposed IGERT Proposal. **Multidisciplinary Graduate Research Training in Sustainable Urban Coastal Systems.**

CCNY is also in the process of proposing a new professional Master of Science degree in Earth Systems and Environmental Engineering (ESEE) that will integrate several traditional science and engineering disciplines, with the overall goal of training students to solve contemporary environmental problems and address the emerging needs of today's global society. A diverse group of administrators and faculty members from The City College of New York's School of Engineering and Division of Science has come together to develop this new interdisciplinary Science Master's Program (SMP). In addition to blending historically distinct fields in Science, Technology, Engineering and Mathematics, (STEM) the ESEE degree program will offer a variety of perspectives from the social sciences, economics, law, policy and management to enhance our students' understanding of the complex relationship between humans and our Earth environment.

The objectives of the new master's programs are in line with City College's mission, which emphasizes access to excellence in undergraduate and graduate education and research. Requiring demonstrated potential for admission and a high level of accomplishment for graduation, the College seeks to provide a diverse student body with exceptional opportunities to participate in creative intellectual pursuits, led by a faculty committed to the advancement of knowledge and the guidance of students in the attainment of rigorous academic goals.

#### **Leverage Funds:**



CREST has received a significant amount of leveraged funding during the reporting period (see **Appendix 1**).

**Performance Metrics for the reporting period (September 1, 2009- February 28, 2010)**

No. of Students trained in NOAA Sciences	No. of Students graduated in NOAA Sciences	No. of Collaborative Projects	No. of Peer Reviewed Papers/Seminars	Leverage Funding (Reporting Period)
12 funded & 1 Non-Funded (during the reporting period) <b>93* (Total)</b>	9 funded & 2 Non-Funded (during the reporting period) <b>189 (Total)</b>	Projects- 18 Tasks - 74	15 published & 30 ref. proc. (more details in <b>Appendix 3</b> )	<b>\$21,037,019.56</b> <b>(\$3,388,824.86)</b>
*Includes the 6 CREST-SHIP students from summer 2009.				

**1. Status of goals/objectives accomplished as defined in the Center's proposal.**

**CREST overall objectives are:**

1. Build institutional capacity and conduct cutting edge research in Remote Sensing science and technology in line with NOAA's Mission Goals, and in support of NOAA line offices
2. Recruit, mentor, and train graduate students in science, engineering, and technology areas of relevance to NOAA, with a special emphasis on traditionally underrepresented groups, to provide a diverse future workforce for NOAA, NOAA contractors and other related federal, state, and industrial stakeholders.
3. Develop a pipeline of students from high school through college level to increase the number of students pursuing graduate studies in NOAA related science, engineering, and technology areas by introducing education and outreach programs at CREST institutions and communities that they serve.

**Research & Publications:**

CREST faculty/research scientists have been interacting with NOAA Scientists from various line offices and facilities viz., NESDIS, NWS, NOS, ARL, ETL, AOML, on three research clusters viz. Remote Sensing Applications to Climate and Air Quality; Marine and Coastal Remote Sensing; and Remote Sensing Applications in Water Resources and Hydrology. Majority of the projects have one or more CREST graduate and/or undergraduate students and a NOAA collaborator. **Appendix 2** highlights all the projects and tasks for this reporting period. CREST faculties and students attended several conferences and symposiums during the reporting period. Fifteen peer-reviewed research papers have been published during the reporting period (with an additional 2 leverage publication) & 30 refereed proceedings (with 26 additional leverage ref. proc.) have been presented in various conferences. Eight papers



are *in press* & 6 *under review*. A detailed list of peer-reviewed publication is presented in **Appendix 3**. The research details are presented in subsequent sections of the report.

### **Students' Recruitment Training and Mentoring:**

The NOAA sponsored CREST program, in its second year of its second five-year funding cycle, has significantly enhanced the student's recruitment and training program at CUNY and all partner institutions. There is a substantial increase in the graduate and undergraduate students, some of them continuing with CREST. So far, 189 students have graduated, who were actively involved in NOAA-CREST related research. One of the goals of this program is to obtain a strong pool of research students both directly supported by CREST (and are members of traditionally underrepresented groups) as well as leveraged from other sources to train them in NOAA-related sciences and through specialized courses that are developed keeping in view with CREST and NOAA's Strategic Missions. The students, thus trained, have brighter career options to join agencies like NOAA, NASA, and industry like Raytheon and Northrop Grumman. CREST anticipates recruiting more students in its graduate and undergraduate programs in 2010-11.

2. **Status of benchmarks due during the performance period. The center should specify any anticipated delays, difficulties/problems that may impede timely completion of projects or activities.**

Most of the tasks related to research, students and finances during the performance period have been accomplished with no delays. All the CREST and NOAA research collaborations have been further strengthened and enhanced. Several Seminars have been conducted during the reporting period September 1, 2009 to February 28, 2010 (**Appendix 4**). A number of proposals have been submitted for external funding. There has been a significant amount of leveraging funds during the reporting period (**Appendix 1**).

3. **Status of special award conditions (if applicable) due during the performance period.**

All general special award tasks conditions are on schedule.

4. **Identification of all cooperative research activities undertaken during the award period; this must include names of both NOAA and academic (faculty and student) individuals. In addition, provide the duration and status of the collaborative research activity.**

## **Thrust 1: Remote Sensing Application in Climate & Air Quality**

### **Thrust 1a: Climate Applications and Remote Sensing**

#### ***Project 1: Middle Atmospheric Remote Sensing***

- **Relevance to NOAA's mission and the strategic plan**

The research under this thrust supports the NOAA strategic plans to: "*Provide Critical*

*Support for NOAA's Mission*" and "*Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond*". Performance objectives: Increase quantity, quality, and accuracy of satellite data that are processed and distributed within targeted time. Mission Support Strategies: Provide applied research to ensure the quality, reliability, and accuracy of current and future satellite products and services to support the Mission Goals.

The AIM-PMC Analysis research projects specifically pursue answers to questions that are related to this strategic initiative such as "How is stratospheric ozone changing as the abundance of ozone-destroying chemicals decreases?".

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

This research supports the NOAA-NESDIS "Satellite Services" program which is executed to meet the NOAA's Strategic Goal to: "Provide Critical Support for NOAA's Mission". The knowledge gained from our research ensures continuing improvements in the quality of satellite observations and the accuracy of satellite data and derived products. Our research also supports the NOAA-NESDIS "Climate Observations and Analysis" program, which is executed to meet the NOAA's Strategic Goal to: "Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond".

- **Staff** : Drs. Pat McCormick, Bill Smith, & James Russell, John Anderson; Robert Loughman, Stanislav Kireev, Hovakim Nazaryan, Mike Hill, and Dr. John McNabb
- **Students PhD** – Chris Spells; Charles Anthony Hill (Tasks 2 & 3)
- **Students MS** – Sydney Paul; Carl Arrington, Jason Bernier, Chris Queen (Task 2)
- **Students Undergraduate** - John Jones
- **NOAA Collaborators (with Affiliations)** –Lawrence Flynn (NOAA/NESDIS); Dr. I. Petropavlovskikh, NOAA/CIRES; Karen Rosenlof NOAA/ESRL and Sam Oltmans of NOAA/ESRL
- **Other Collaborators (with Affiliations)** – Paul Menzel, University of Wisconsin, Madison; D. Rault and D. Flittner (NASA Langley Research Center, Climate Science Branch), G. Taha, J. Li and G. Jaross (Science Systems and Applications, Inc., (SSAI) Lanham, MD); James M. Russell, Center for Atmospheric Sciences (CAS)/Department of Atmospheric and Planetary Sciences (DAPS) ; Larry Gordley (GATS inc), Mark Hervig (GATS inc), Scott Baily (Virginia Tech); William Rossow, Distinguished Professor; James Russell III, Hampton University.
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

The Ozone Mapper Profiler Suite (OMPS) Limb Profiler (LP) instrument is scheduled to play a key role in future ozone profile monitoring as part of the National Polar-orbiting Operational Environmental Satellite System (NPOESS). However, the algorithms required to process the data measured by this instrument are not yet in place, putting the future of the OMPS instrument in peril. An urgent need exists to implement an ozone profile retrieval algorithm that exploits the capabilities of the OMPS LP instrument, and the current research will provide support for this effort. The algorithms developed under this program may be integrated into the main OMPS data processing stream (under the control of IPO). If not,

they will definitely be used in the NPOESS Data Exploitation (NDE) program (under the control of NOAA) to glean further information from the NPOESS measurements. Working on the operational validation of the ozone data obtained from the NOAA-16, NOAA-17, and NOAA-18 SBUV/2 instruments.

- **Status of the project with respect to the goals/objectives and benchmarks previously identified**

Research is Ongoing under all tasks. Research is Ongoing. Results are published in four articles in refereed journals (Journal of Geophysical Research). New results are being regularly presented at various scientific conferences and workshops (most recently the NOAA EPP Fifth Educational and Science Forum, Washington, D.C., November 2009).

#### **Task (1) SBUV/2 validation, calibration and trends**

- **Validate the ozone retrievals obtained by the SBUV/2 experiment. (Hovakim Nazaryan)**

The SBUV/2 instruments from the NOAA-16, NOAA-17, NOAA-18, and NOAA-19 satellites continue to provide valuable information on ozone abundance and distribution. The study of consistency among the data sets of various instruments is vital in developing confidence in those data records and in determining their value in trend analyses. In order to establish the validity of the ozone data records, one needs to show that different measurement techniques based on various physical principles give similar ozone estimates. We continue the validation of the ozone products obtained by the NOAA's SBUV/2 and NASA's OMI experiments. We employ advanced statistical techniques to validate the SBUV/2 version 8 data sets and to compare with SAGE II, HALOE, and OMI retrievals. NOAA-16 and NOAA-11 SBUV/2 ozone data records have been studied and published the SBUV/2, HALOE, and SAGE II ozone profiles comparison results in the Journal of Geophysical Research. The team is also working on the operational validation of the NOAA-16, NOAA-17, NOAA-18, and NOAA-19 SBUV/2 ozone retrievals. **Reason for continuing in Year 4:** This work is of continued interest for the scientific community and for our NOAA collaborators. Ozone data validation is essential for ozone trend analysis (Task (1) for year 4).

- **Study the performance of those instruments and investigate their calibration issues. (Hovakim Nazaryan)**

The team continues to investigate the performance of the SBUV/2 instruments. The topic of time dependence of the bias statistic between the NOAA-11, NOAA-16, NOAA-17, NOAA-18 SBUV/2, and OMI measurements is particularly important for estimating long-term changes of the ozone abundance in the atmosphere and employing the SBUV/2 and OMI data sets for the trend analysis. The investigation of the drift in the differences between these experiments is essential for assessing possible uncertainties of ozone trend estimates that may have been caused by experimental effects or changing calibration uncertainties. We have examined the time dependence of the differences between the HALOE (v19) and SAGE II ozone retrievals and the SBUV/2 data from NOAA-11 and NOAA-16. We published our results in the Journal of Geophysical Research. The studies of the time dependence of

differences between the OMI retrievals and the NOAA-17 continues, and NOAA-18 SBUV/2 data sets. **Reason for continuing in Year 4:** This work is of continued interest for the scientific community and for our NOAA collaborators and we continue the investigation of the calibration issues of the SBUV/2 instruments. The analysis of the performance of the SBUV/2 instruments is essential for ozone trend analysis (Task (1) for year 4).

- **Continued Trend analysis of the ozone retrievals obtained by the NOAA-9, NOAA-11, NOAA-16, NOAA-17, and NOAA-18 SBUV/2 experiments. (Hovakim Nazaryan)**

Ozone is an important atmospheric constituent that shields the Earth's surface from harmful ultraviolet radiation and also plays a critical role in radiation forcing, thus affecting climate change. Valuable information about the global distribution, long-term changes and trends of atmospheric ozone is provided by space-based instruments. A scientifically robust understanding of the change in data and variations in measured species requires the analysis and modeling of accurate and consistent long-term observations of data distribution. Accurate statistical techniques have been applied to do trend analysis of the ozone profiles obtained by the SBUV/2, SAGE II, and HALOE instruments and compared those results. Particularly we have calculated the ozone trends from the SAGE II v6.2 and NOAA-11 SBUV/2 v8 data sets and assessed their relative accuracy. The ozone trend differences between SBUV/2 and HALOE has also been studied. The results on ozone trend estimates obtained from the SBUV/2, SAGE II and HALOE data sets have been published in refereed journals (Journal of Geophysical Research).

#### **Task (2) Polar Mesospheric Cloud (PMC) and Polar Stratospheric Clouds (PSC) and polar vortex studies (Bill Rossow)**

**Activity:** Comparison of Calipso with a revised version of the ISCCP cloud detection in the polar regions is nearing completion. A proposal to analyze and combine satellite datasets of upper tropospheric water vapor and cirrus has been approved by NOAA.

**Status:** One paper is in preparation.

**Future:** Studies of tropical cirrus and their large-scale interaction with upper troposphere and lower stratosphere water vapor will continue.

#### **Task (2) Polar Mesospheric Cloud (PMC) and Polar Stratospheric Clouds (PSC) and polar vortex studies (James Russell et al)**

- Update analysis with AIM and CALIPSO measurements.

Research is ongoing as numerous discoveries are being made (see updated publications list) on cloud formation. As stated in previous reports, the Aeronomy of Ice in the Mesosphere (AIM) is the first satellite mission dedicated to the study of noctilucent or "night-shining" clouds (NLCs) also called Polar Mesospheric clouds (PMCs). The mission is performing exceptionally well as it is now providing global-scale view's of the clouds with an unprecedented resolution of 5 km by 5 km and has just covered most of the 2010, Southern Hemisphere season.

#### **Task (2) Polar Mesospheric Cloud (PMC) and Polar Stratospheric Clouds (PSC) and**

**polar vortex studies (Mike Hill)**

- Update analysis with AIM and CALIPSO measurements.

Observations from the CALIOP lidar on CALIPSO are being used to investigate the seasonal and spatial distributions, average temperatures, and measurement frequencies of PSCs for the 2006-2009 polar winter seasons. PSCs are categorized by their microphysical composition (nitric acid crystals, supercooled liquid droplets, or water ice) based on backscatter and polarization data from the 532 nm wavelength lidar channel. Weekly statistics are collected by cloud type for each season. Results show higher frequencies of nitric acid PSCs at warmer temperatures than water ice PSCs occurring in both hemispheres throughout their respective winter seasons. Water ice PSCs are observed infrequently in the Arctic region and most frequently in austral winter over the Antarctic Peninsula. In the Arctic winter, nitric acid PSCs are observed mostly over northern Scandinavia and Siberia. The 2007 Antarctic winter season experienced a substantial increase in PSC NAT volumes and a disturbed vortex in late July, which correlated with higher observed PSC frequencies and a shift in their horizontal distribution away from the Antarctic Peninsula. Some results were presented at the 2009 NOAA EPP conference at Howard University in November. Version 3.0 of the CALIPSO lidar data will be incorporated into the project when it becomes available.

**Task (4) Upper Atmosphere trend improvements**

- Test proxy on SBUV ozone data in upper stratosphere (John Anderson)

The team is now analyzing the HCl measurements from the upcoming HALOE 4<sup>th</sup> public release.

**Task (5) Limb scattering retrieval improvements and application (Robert Loughman)**

- Address Outstanding Issues for the LS retrieval problem (inhomogeneous scenes) Address outstanding issues for the LS retrieval problem (inhomogeneous scenes, problems specific to the OMPS Limb Profiler instrument, etc.), and begin to study OMPS data as it becomes available.

The Ozone Mapper Profiler Suite (OMPS) Limb Profiler (LP) instrument will play a key role in future ozone profile monitoring as part of the National Polar-orbiting Operational Environmental Satellite System (NPOESS). NOAA CREST research has helped refine the OMPS LP ozone profile retrieval algorithms, building on validation studies of the SAGE (Stratospheric Aerosol and Gas Experiment) III limb scattering measurements. The algorithm improvements developed during the SAGE III validation studies have now been applied to the OMPS LP retrieval algorithms, and ongoing research uses proxy data developed from the OSIRIS (Optical Spectrograph and Infrared Imaging System) and SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric CHartography) limb scattering measurements to further refine the OMPS LP algorithms. The launch of the NPP satellite been delayed to Spring 2011, so real OMPS data is not yet available. However, the ozone and aerosol retrieval algorithms are in good enough shape to integrate them into an end-to-end instrument model package and simulate processing actual OMPS data. Recent research has focused on increasing the realism of these end-to-end



processing tests (by introducing better representation of the OMPS LP instrument characteristics, better representation of bad/missing data, etc.).

#### **Task (6) Brewer/Umkehr algorithm development, data validation and analysis (Smith and Kireev)**

- Development of an ozone retrieval algorithm from the measurements of IR-emitted radiation.

SBUV/Brewer/Umkehr cross-validation is critical for both long-term ozone trend analysis and to control the instrument performances as well. During the performance period, efforts were spent to develop an ozone retrieval algorithm from infra-red spectral measurements and to study the possibility of combining ozone profiles obtained from UV-observations (SBUV/Brewer/Umkehr measurements) with ozone data obtained in the IR-region (IASI and NAST-I observations). This will lead to a more consistent ozone data sets and a better understanding of the retrieval accuracy. Study of the IR-sensitivity to the ozone profile (weighting functions, averaging kernel, and the error analysis) is presently under investigation.

#### **Task (7) Trace Gas and aerosol climatologies and analysis using multiple RS techniques including CALIPSO and A-Train Data**

- Development of cirrus cloud climatology. (Hovakim Nazaryan, M. Patrick McCormick)

Cirrus clouds play a significant role in the energy budget of the earth-atmosphere system by their effects on the transfer of radiant energy through the atmosphere. They are one of the most important and yet uncertain components in weather and climate studies. Thus, a thorough description of global cloudiness and its associated properties is essential. The presence or absence of cloudiness in remotely sensed data must be accurately determined in order to retrieve properly many atmospheric and surface parameters. In order to place the relevance and importance of cirrus composition, structure, and radiative properties into a global perspective, statistical distributions of fundamental cirrus cloud properties are required. Operational remote sensing from satellites provides a means to achieve a global and temporal characterization of cirrus clouds. We study the CALIPSO cirrus clouds occurrence frequency, optical thickness, and geometrical thickness as a function of time, latitude, and altitude. In particular, the latitude-longitude and vertical distributions of cirrus clouds are being examined, including their seasonal behavior. Results of this study are published in the Journal of Geophysical Research, and presented at the NOAA EPP Fifth Educational and Science Forum, 24th ILRC and various other seminars (89<sup>th</sup> AMS meeting, 2009 CALIPSO/CloudSat Science Workshop, etc.).

- **(New) Global OZone Chemistry And Related trace gas Data records for the Stratosphere (GOZCARDS) project**

John Anderson is currently involved in a leveraged project with researchers from the Jet Propulsion Laboratory (JPL), University of Maryland at College Park, and Georgia Tech University. The goals of Global OZone Chemistry And Related trace gas Data records for the Stratosphere (GOZCARDS) project is to provide a commonly-formatted Earth

System Data Record (ESDR) for stratospheric composition, of high relevance to the issue of ozone decline and recovery. During the past 6 months, merging techniques were extensively investigated for water vapor and hydrogen fluoride. Work on methane and nitric oxide has begun

- **Stratospheric Processes and their Role in Climate (SPARC) Water Vapor ASsesment (WAVAS) II**

John Anderson is also involved in a leveraged project with NOAA/ESRL and international researchers in the Stratospheric Processes and their Role in Climate (SPARC) WATER Vapor ASsesment (WAVAS) II. He attended the first meeting in Bologna, Italy, in September 2008, and a second meeting in Toronto, Canada, in March 2009. Work has begun on assessing the new HALOE water vapor data product.

### **New: Tropical cyclone studies with A-Train and GOES data**

Christopher Spells is working on collocating FORMOSAT data with data from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and data taken onboard the NOAA ship Ronald H. Brown during Aerosol and Ocean Science Expeditions (AEROSE) III and V. Christopher is using a suite of data collected onboard the Ronald H. Brown to characterize the physical, chemical, and biological aspects of aerosols, originating from Western Africa, as they are transported across the Atlantic Ocean. Collocating data from the FORMOSAT and CALIPSO satellites will allow Christopher to better characterize temperature, humidity, and location of the Saharan Air Layer (SAL). Christopher has also worked on creating back trajectories for the AEROSE V research cruise which occurred from 11 July 2009 to 5 August 2009.

### **Project 2: Analysis of Global Observations**

- **Relevance to NOAA's mission and the strategic plan**

Development of global data products from satellite observations feeds directly into almost all NOAA mission goals; in particular, the analysis being conducted is comprehensive in its goal to obtain a multi-decadal description of the weather-scale variability of the global energy and water exchanges that comprise Earth's energy and water cycle. Specific datasets being worked on during this reporting period include: clouds and radiation, precipitation and flooding.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

Development of global data products from satellite observations feeds directly into almost all NOAA mission goals; in particular, the analysis being conducted is comprehensive in its goal to obtain a multi-decadal description of the weather-scale variability of the global energy and water exchanges that comprise Earth's energy and water cycle. Specific diagnostics being worked on during this reporting period include: dynamic evolution of convective systems and development of indicators and behavior of severe weather systems.



- **Staff** - Bill Rossow; Research Associates: Dr. Deniz Gencaga, Ms. Violeta Golea, Dr. Ademe Mekonnen, Dr. Fabrice Papa, Ms. Cindy Pearl, Dr. Eric Tromeur, Ms. Alison Walker.,
- **Students PhD**; Marzieh Azarderakhsh and Narges Shahroudi (Civil Engineering, City College of New York)
- **Students MS:**
- **Students Undergraduate** -Charles Sosa
- **NOAA Collaborators (with Affiliations)** – Drs. John Bates; Ken Knapp; and Lei Shi, (NCDC)

**Other Collaborators (with Affiliations)** – Dr. Mike Bauer, Columbia University at NASA GISS; Dr. Anthony Del Genio, NASA GISS; Mr. Joe Ferrier, NASA GISS; Dr. Kevin Knuth, SUNY Albany; Dr. Zengzhao Luo, CCNY; Dr. Luiz A.T. Machado, CPTEC, INPE (Brazil); Dr. Catherine Prigent, Paris Observatory (France); Dr. David Randall, Colorado State University; Dr. Anastasia Romanou, Columbia University at NASA GISS; Dr. Graeme Stephens, Colorado State University; Dr. Claudia Stubenrauch, LMD (France); Dr. George Tselioudis, Columbia University at NASA GISS; Dr. Duane Waliser, JPL; Dr. Yuanchong Zhang, Columbia University at NASA GISS.

- **Operational Impact (Has Research been /or planned to be transitioned to operation)**  
Planning is underway to transition the International Satellite Cloud Climatology Project (ISCCP) to NOAA Climate Data Record operations at NCDC.
- **Status** – All tasks ongoing

### **Task (1) Comparison and Evaluation of Global Products**

**Activity:** The global inundation data record has been extended by four more years. Comparisons with results based on AMSR measurements have begun. A study is underway to force a hydrological model of the Amazon basin with more input observations, based on satellites, than are usually used.

**Status:** Two papers are in preparation. An international evaluation of radiative flux products is nearing completion.

**Future:** The cloud particle size climatology will be analyzed, together with observations of water vapor, cloud water amount and precipitation, to elucidate how clouds regulate the atmospheric water cycle. A specific evaluation of possible artifacts in the ISCCP cloud products will also be completed.

### **Task (2) Development of Non-linear analysis approaches to elucidate the nonlinear, multi-variate relations that describe the behavior of a very complex system like the climate**

**Activity:** The tropical “cluster analysis” of joint histograms of cloud properties has been used to study the interaction of deep convection with African waves. A complete analysis of the annual variations of tropical convection, with a focus on the ITCZ and monsoons, has begun. A newly developed non-linear analysis procedure that uses the dataset entropy to evaluate causal relationships is now being applied to the MJO case study. The cyclone

tracking analysis of midlatitude cyclones is being used to characterize the variations of clouds and diabatic heating of the atmosphere associated with these storms.

**Status:** One paper was published and three papers are in preparation.

**Future:** The tropical convection studies will be extended using the TRMM and CloudSat datasets to determine variations of cloud system vertical structure.

### **Task (3) Global Energy/Water Cycle Study through complementary approaches**

**Activity:** Development of the advanced non-linear analysis technique is being wrapped up. Another study using a variety of clustering techniques is underway looking at the 66 year history of global surface pressures from the NCEP reanalysis.

**Status:** One paper is in preparation.

**Future:** Application of the advanced non-linear analysis technique to the global energetics results will be done.

### **Project 3: Hyper spectral Remote Sensing Algorithm Development, Application, and Validation**

- **Relevance to NOAA's mission and the strategic plan**

1. To improve forecasting of weather and air quality, and to better understand climate variability and climate change to enhance society's ability to plan and respond
2. To provide critical support for NOAA's weather, climate, and air quality mission.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

NOAA/NESDIS/ Office of Research and Applications: to conduct research on the use of satellite data for monitoring meteorological and climatological environmental characteristics

- **Staff** – Prof. W.L. Smith and Stanislav Kireev, Hampton University (HU)/Atmospheric Planetary Sciences (APS)/Center for Atmospheric Sciences (CAS)/Cooperative Remote Sensing Science and Technology Center (CREST)
- **Students PhD**
- **Students MS** – Melissa Yesalusky
- **Students Undergraduate**
- **NOAA Collaborators (with Affiliations)** - Dr. M. Goldberg, (NOAA/NESDIS); Dr. E. Maturi (NOAA/NESDIS)
- **Other Collaborators (with Affiliations)** - D. Zhou (NASA/LaRC), Dr. X. Liu (NASA/LaRC) and H-L. Huang (UW/CIMSS)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)** Research is planned to be incorporated into operational algorithms. The developed algorithms also provide validation of current operational algorithms.
- **Status:** On Schedule.

**Task (3) Conduct case study analyses in which the meteorological results, obtained from the application of the hyperspectral profile retrieval algorithm to METOP IASI data, , are compared with results produced by operational satellite data centers (i.e., EUMETSAT and NESDIS).**

**Adapt the retrieval software so that it can be applied to the NPP Crosstrack Infrared and Microwave Measurement System (CrIMMS).**

**Demonstrate the utility of the CrIMMS research algorithm using results produced from its application after the NPP satellite is in orbit.**

The goal of the Project is to develop a methodology and associated algorithms to incorporate Polar satellite Hyper-spectral Sounder (PHS) data into processing of the Advanced Baseline Imager (ABI) data in order to achieve the important mesoscale sounding objectives of the GOES program. The team is developing the concept for combining the high horizontal and temporal resolution radiance data to be observed by the GOES-R/S ABI with the high vertical resolution sounding radiance data to be obtained by the PHS (MetOp IASI and NPP/NPOESS CrIS). It will provide with the extended capability to measure the time varying atmospheric thermodynamic structure with the higher accuracy that leads to better forecasting of such hazardous atmospheric phenomena as intense convection and associated severe thunderstorms and tornados.

During the performance period, the processing of cloudy observations has been incorporated into retrieval algorithms to enhance the performance. A dual-regression scheme is being proposed to retrieve the cloud altitude. Regression predicting matrixes for atmospheric state retrievals depend on cloud altitude and are trained for “clear sky” and “cloudy sky” conditions separately. At the first step, the cloud altitude is retrieved with linear regression, and then the atmospheric state vector is retrieved (temperature and humidity profiles plus surface temperature) under “clear sky” and “cloudy sky” conditions. During the second step, the cloud altitude is associated with the height where “clear sky”-retrieved temperature is regularly less (colder) than “cloudy sky”-retrieved temperature. Simulations have shown that the accuracy of cloud altitude retrieval is about 1 km in 0-10 km altitude range for cloud fraction 35% and more in the field of view. The developed algorithm to be applied for the real NAST-I data obtained during JAIVEx validation campaign.

#### ***Project 4: Data Compression Algorithms***

- **Relevance to NOAA’s mission and the strategic plan**

NOAA is required to distribute its GOES satellite Earth science data at relatively low cost to users throughout the U.S. and to foreign nations of the Earth view from geostationary orbit. The NOAA’s commitment to maximizing its earth science data distribution at low cost by GOES satellites is consistent with U.S. commitments to the Earth Observation Summit and to the Global Earth Observing System of Systems (GEOSS).

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**
- **Staff** - Irina Gladkova & Michael Grossberg, Computer Science, CUNY
- **Students PhD**
- **Students MS** Paul Alabi (leveraged), George Bonev (Leveraged)
- **Students Undergraduate** –Fazlul Shariar, Tence George and Malka Rabinowitz (funded).

- **NOAA Collaborators (with Affiliations):** Roger Heyman (NOAA/STAR/OSD) and Tim Schmit (NOAA/NESDIS/STAR)
- **Other Collaborators (with Affiliations)**
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

### **Task 6: Optimize compression algorithms between performances for speed:**

#### **Task1: Optimized Compression Algorithm For Speed**

In previous compression work the team used nearest neighbor searches to implement non-parametric prediction. As background to the current work, it has been noted that the relationship between the prediction algorithm model and prediction is that the prediction algorithm is chosen and tuned to model the redundancy in the data. This redundancy is expressed in terms of the algorithm allowing us to use a portion of the data to predict another portion. To maintain lossless compression we store the residual error between predicted and true value. If the prediction is effective the residual error essentially be mean zero noise with standard deviation close to zero.

While non-parametric prediction has provides better prediction, which means better compression performance, it is quite computationally expensive. As per our milestone we have investigated the speed versus the compression performance. Rather than perform an expensive search, the team has approximated the search results as a function and tested the results. For instance a single multilinear transformation was tried and compared this with the present search results. Although this was much faster, it was determined that the compression performance was poor. A more flexible result was obtained by breaking the image into disjoint tiles and obtaining transformations for each tile separately. Depending on the size of the window that was used for prediction and the tile, more comparable results could be achieved that was obtained with search but much faster.

#### **New Task: Quantitative Image Restoration for risk reduction**

In prior periods the team accomplished tasks relating to error mitigation associated with sending compressed NOAA data across noisy channels. It was suggested that these methods could be adapted to estimate missing pixel values in satellite images, due to malfunctioning detectors. Al Powell of NOAA-STAR, indicated that this was of great potential use at NOAA for risk reduction. Based on feed back from NOAA the team then demonstrated how their compression to restoration by targeting a restoration of the damaged 1.6 micron channel of MODIS Aqua. The current method was evaluated by artificially damaging the corresponding channel in Terra. In this way the restored results were compared with the actual values. The present work, method, evaluation and results were presented in paper “Quantitative Image Restoration” that will be presented at Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery Conference of the SPIE.

#### **\* Subtask: Restoration of an Aqua Granule for Cloud Mask and Snow Products**

A fully restored 1.6 micron channel of MODIS Terra was produced that could be used to

evaluate potential improvement of cloud mask and snow products.

## Thrust 1b: Troposphere Air Quality (TRAQ)

- **Relevance to NOAA’s mission and the strategic plan**

TRAQ research at CREST focuses on atmospheric remote sensing and air quality monitoring and lies at the intersection of two NOAA mission goals: **Climate Mission Goal:** *Understanding climate variability and change to enhance society’s ability to plan and respond*, and **Weather and Water Mission Goal:** *Serve society’s needs for weather and water information*. In the troposphere, radiatively important trace constituents that impact climate forcings (e.g. aerosols or ozone, etc.) also have a direct impact on air quality and human health as well. TRAQ has focused on monitoring and studying *regional* and *urban* air quality in eastern United States and, in the longer term, the impact of Air Quality on the regional and global climate.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**
- NOAA NESDIS MISSION: *“To transfer satellite observations of the land, atmosphere, ocean, and climate from scientific research and development into routine operations, and to offer state-of-the-art data, products and services to decision-makers.”*

TRAQ is well aligned with a number of NOAA line offices, including NESDIS, NWS, and OAR. TRAQ activities are in line with NESDIS’s **Weather Water Science, Technology, and Infusion Program** through algorithm refinement for current satellite instruments (e.g. GOES imager and MODIS aerosol over land products) and algorithm development for future instruments (e.g. VIIRS, CALIPSO, APS, GOES-R imager). This also includes multisensor data fusion from spaceborne and ground-based platforms. Our focus on refining satellite products on a regional scale and integrating these products with CREST ground measurements in the North-east US region ultimately enable tools for NESDIS’s **Regional Decision Support Program**. In monitoring aerosols, TRAQ has also worked closely or collaborated with OAR labs (e.g. ESRL).

### Project 1: Satellite Algorithm Development and Validation

- **Staff:** CCNY: Prof Barry Gross, Fred Moshary, Bomidi Madhalvan - UMBC: Prof Ray Hoff, Hampton U: Prof. Pat McCormick, Dr. Jia Su UPRM Hamed Parsiani
- **Students PhD:** CCNY: Ana Picon, Eduardo Hernandez, Yuzhe He\*, Alexandra Tsekeri\*, UMBC: Nikisa Jordan Hampton Jasper Lewis, Robert B. Lee and Kevin Leavor
- **Students MS:** UPRM
- **Students Undergraduate:** CCNY Gary Bouton, Crae Sosa UPRM Amilcar Gonzalez-Alvarez
- **NOAA Collaborators:** Shobha Kondragunta, Chuanyu Xu, Istvan Laszlo (NESDIS),
- **Other Collaborators:** Yujie Wang, Alexi Lyuptysin, Rob Levy (NASA GSFC)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**
- Regional AOD product was demonstrated in urban areas of Mexico City and New York

- City. Plans to use 5 additional cities
- The research conducted in this project will ultimately be transitioned into the current GASP product
- Contribution to CALIPSO quid-pro-quo validation effort
- Leveraged project (Zhang/Kondragunta; IDEA) is operational

### **Task (1) Analysis & Refinement of regional MODIS AOD by tuning vis-mir correlations using Hyperion and ground-based data**

**Status:** On time

**CCNY:** To assess the importance of high resolution surface VIS-SWIR ratios, retrievals from Landsat 7 was used to assess the need for using regional surface resolutions. In this way, the team was able to assess the feasibility of surface models to retrieve aerosols at high resolution < 300 meters from the 30 meter LANDSAT data. In particular, using high resolution data, AOD was retrieved for nearby urban-vegetation pairs which can then be compared both to AERONET as well as consistency with each other since it is expected AOD to be uniform for sub-km scales. It was found that only if the VS-MIR spectral ratios coefficients are taken to be 0.69 (660/2130) and .42 (470/2130) for the urban regions do the AOD retrievals agree with those obtained over vegetation as well as good agreement with AERONET. Using the operational algorithm results in very large discontinuities in the AOD between neighboring pixels. An example for a high AOD case is given in the table below.

Table 1. Evaluation of Landsat retrieval using regional surface models.

Days of observation	Locations	URBAN AOD $\pm$ sd			VEGETATION AOD $\pm$ sd
		C660_urb=0.69	C660_urb=0.8	C660_urb=0.5	C660_veg=0.5
August 14, 2002	Site 1	1.019 $\pm$ 0.163	1.896 $\pm$ 0.248	0.674 $\pm$ 0.214	0.997 $\pm$ 0.057
	Site 2	1.062 $\pm$ 0.100	1.852 $\pm$ 0.121	0.767 $\pm$ 0.122	1.0 $\pm$ 0.051
High AOD	Site 3	1.008 $\pm$ 0.417	2.214 $\pm$ 0.848	0.514 $\pm$ 0.343	1.116 $\pm$ 0.117

### **Task (3) Intercomparison of MODIS and GASP Derived BRDF**

**CCNY:** Comparisons have been made to the BRDF from GASP based on their 2<sup>nd</sup> minimum mosaic and compared to MODIS retrievals of surface reflectance. Since the MODIS retrievals are at different observation geometries, we instead use the BRDF functional based on LSQ fit to the Ross-Li kernels of MODIS and which is then evaluated at the observation geometry of GASP. While this procedure is not expected to be very accurate in urban settings, we expect that for dark areas including water bodies, reasonable correlations should occur. Furthermore, regional trained data has been used in combination of AERONET and MODIS (The AERONET-based Surface Reflectance Validation Network) or ASRVN product from NASA GSFC to improve the MODIS retrievals in the comparison. The results are shown for the NYC region below.



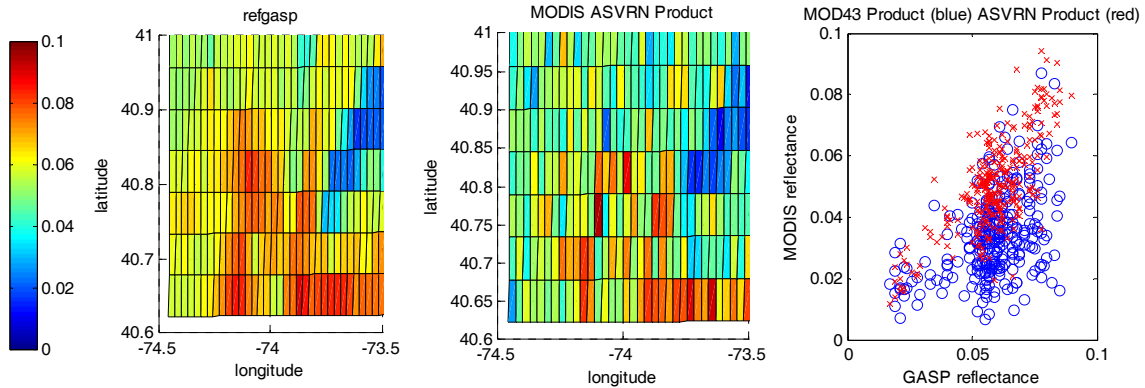


Fig. 1. a) GASP Reflection image b) MODIS ASVRN retrieval product c) Regression analysis: blue=MOD43, red=ASVRN

In figure 1, we plot geospatially resolved reflection from GASP (a) and MODIS band 3 (b) based on the ASVRN product that constructs the surface based on atmospheric correction from AERONET. Quite good agreement has been noted in low reflection areas and decent correlation even in urban regions. Regression analysis of the image is given in (c). It is also noted that if the MOD43 product is used without AERONET based correction, the surface reflection is significantly underestimated with low correlation. The atmosphere correction within the ASVRN product

### Task (6) MODIS/GASP Aerosol Optical Depth Fusion

The main effort during this period was to be able to reproduce the operational GASP datasets before ingesting MODIS aerosol (and surface) information. In particular, excellent agreement was obtained between the current processing and GASP. In judging the sensitivity of using the continental aerosol model against the AERONET derived MODIS aerosol model for CCNY, based on calculations using the 6SV radiative transfer code, it was found that differences appearing in the TOA reflectance are not significant for AOD values  $< .6$  and surface reflectance is below 0.2. For the NYC area, surface reflections on the visible channel are less than .2 indicating that the continental background aerosol seems to be suitable for reasonable surface albedo for the CCNY site.

### Task (8) CALIPSO Quid-Pro Quo Validation

**Status:** On going

**CCNY** At present, we have 31 complete matchups. Unfortunately, direct validation of Calipso products have been hampered by NASA not releasing the level 2 lidar backscatter or extinction products. The main effort is to validate layer (level 3 products) with particular emphasis on PBL layer and is discussed in Project 2.

**HU:** The 48-inch lidar system has performed under a continuous schedule of aerosol, water vapor, and/or temperature measurements throughout the past period. Improvements have been made to the beam direction system to limit the amount of noise present at all altitudes and increase the overall detection range. Measurements include aerosol extinction coefficients using elastic backscatter at 1064 nm, 532 nm, and 355 nm wavelengths; water vapor using vibrational Raman scattering from the 355 nm wavelength into 386 nm (Nitrogen) and 407 nm (water vapor); and temperature using rotational Raman scattering from 355 nm into 353.6 nm and 354.2 nm. Aerosol measurements are typically compared with coincident CALIPSO overpasses, while temperature measurements are compared to the



Wallops Island, VA balloon soundings and AIRS and FORMOSAT-3 measurements when available. Water vapor measurements are similarly compared to Wallops Island balloon soundings, FORMOSAT-3, and Driver, VA's integrated water vapor GPS measurements.

### **Project 2: Ground Based Remote Sensing Network**

- **Staff:** CCNY-Faculty Fred Moshary, Barry Gross, Sam Ahmed, Dr. Yonghua Wu UPR-Faculty Hamed Parsiani UMBC Prof. Ray Hoff, Ruben Delgado Hampton Prof. Pat McCormick, Dr. Jia Su.
- **Students PhD CCNY:** Lina Cordera, Miguel Bustamante Hampton Robert B. Lee and Kevin Leavor
- **Students MS: CCNY** Alex Tejada, **UPRM:** Allen Lizarraga.

**Students Undergraduate:** CUNY: Gary Bouton UPRM Amilcar Gonzalez, Adriana Melendez.

- **NOAA Collaborators:** Shobha Kondragunta (NESDIS), Michael Hardesty (ESRL), Jeff McQueen (NWS).
- **Other Collaborators** Mikael Alexandrov and Brian Cairns (NASA GISS).
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**
  - CCNY MFRSR retrievals are available at [earth.engr.cuny.cuny.edu/noaa/wc/Shadowband/](http://earth.engr.cuny.cuny.edu/noaa/wc/Shadowband/)
  - CCNY Lidar data is archived at [earth.engr.cuny.cuny.edu/noaa/wc/Lidar](http://earth.engr.cuny.cuny.edu/noaa/wc/Lidar)
  - UMBC is the leading the management activities of the new World Meteorological Organization Global Atmosphere Watch Atmospheric Lidar Network (GALION). Over this performance period, we continued to take data on the GALION schedule. CREST Lidar Network listserver was created ([cln@lists.umbc.edu](mailto:cln@lists.umbc.edu)). CLN researchers have been added to listserve to allow prompt and immediate communication between CREST institutions prior and during air quality events. This remote sensing effort will aid in the determination and impact of regional and long-range transport of pollutants into the eastern US states and Caribbean. Guidelines/instructions were provided to CLN in how to create on-line operation calendar for visualization and dissemination of lidar images.

### **Task (2)Shadow band Network Implementation, Operation, and Data Analysis**

#### **Status: Ongoing**

CCNY-The MFRSR Data is being collected locally at each site. Data during this time period has now been made is available as MFRSR Raw ASCII as well as NETCDF files (.ndf) These Raw or processed files using the NASA-GISS algorithm can be downloaded from: [sky.cuny.cuny.edu/wc/map\\_Shadowband.html](http://sky.cuny.cuny.edu/wc/map_Shadowband.html) by clicking the appropriate link of choice. The team is currently working on a new interactive web browser to display AOD products processed by NASA-GISS algorithm. The first interactive web browser should be ready by June of 2010 and also pull down operational MODIS and GOES aerosol products.

In analyzing the data, it was felt the need to first assess performance in retrieving both fine and coarse mode AOD's based on simultaneous matchups with AERONET. In particular, based on matchups made at CCNY, a good agreement was found for the fine mode with deviations below .02 although a bias of .02 is also observed. The coarse mode has little bias but obviously greater errors (~.05) due to the restrictions on the wavelengths of the MFRSR.

Current effort is being made to use the combined diffuse and direct measurements to

obtain estimates of the aerosol single scattering albedo. Preliminary sensitivity studies show that with proper accounting for the geometry of the shadow which would misinterpret diffuse light as direct light, SSA can be obtained for  $AOD < .3$ .

#### **Task (4) UPRM Lidar Refinement & Expanded Capability**

##### **Status: Ongoing**

Currently the UPRM Lidar operates as an elastic backscatter system, emitting and receiving wavelengths of 355, 532, and 1064 for aerosol characterization. A two-phase Lidar system expansion is proposed which involves the implementation of the RAMAN channels of 387, 407, and 607 nm for water vapor mixing ratio acquisition, which allows for relative humidity calculation. All the corresponding optics have been purchased from Barr Associates and, with the exception of the 355 nm dichroic filter, all have been shipped. Remaining to be purchased: 3 transient recorders and 3 photomultiplier tubes to allow for simultaneous operation of inelastic and elastic Lidar functions.

#### **Task 9 CREST Lidar Network Observation-PBL Dynamics**

##### **Status (ongoing)**

**CCNY:** There is interest in seeing if meteorologically derived mixing layer heights are realistically connected to the top of the aerosol layer. This is crucial if satellite AOD can be combined with MET model predictions of PBL layer height to improve PM<sub>2.5</sub> forecasting. To study this, we first obtained 31-day coincident lidar observations with the CALIPSO passing over the NYC area. The CALIPSO-derived PBL comparison tops (using the wavelet analysis on CALIPSO level-1B (stage-3) attenuated backscatter profiles as in section 4) with colocated radiosonde measurements. Comparisons show quite good agreement in absolute terms as well as a correlation coefficient of 0.73. In measuring the mixing layer height, the potential temperature gradient method was used and it was found to be more robust than the Richardson # approach. Therefore, using MET PBL data together with AOD retrievals offers the possibility of improving PM<sub>2.5</sub> observations from space. Current efforts include replacing the radiosonde MET data with NAM based models accessed within HYSPLIT.

**UMBC:** Lidar operations were carried out to support CLN. UMBC lidar activities were carried out within the WMO-GALION framework, with at least of a minimum of 2 days of operations (Monday and Thursday), weather permitting. UMBC's operation calendar and images for the elastic 355 nm and 532 nm, LEOSPHERE and Elastic Lidar Facility (ELF), respectively can be found at [alg.umbc.edu/UMAP](http://alg.umbc.edu/UMAP).

UMBC lidars supported the joint NOAA/ARL and NCEP ad hoc field study in the Baltimore-Washington metro area. This campaign, carried out during September 14-22, 2009, developed a meteorological database to investigate the evolution and spatial variability of the urban atmospheric boundary layer height. At the same time allowed comparison of boundary layer height detection from various instrumentation platforms and forecasting models, as shown in Figure 2. Lidar measurements helped to identify problems with the automatic PBLH calculation in the Real-Time Mesoscale Analysis (RTMA), used by plume dispersion modelers.

UMBC's lidar measurements and satellite analysis aided Maryland Department of the Environment, North Carolina Department of the Environment and Natural Resources, and

Pennsylvania Department of Environmental Protection in their justification of the “Exclusion of Air Quality Exceedances (8-hour ozone and 24-hour PM<sub>2.5</sub>) due to Exceptional Events: North Carolina Fires on June 14, 2008” to the Environmental Protection Agency. Lidar measurements showed that during the early morning hours a nocturnal low level jet had formed and transported smoke from North Carolina to Pennsylvania.

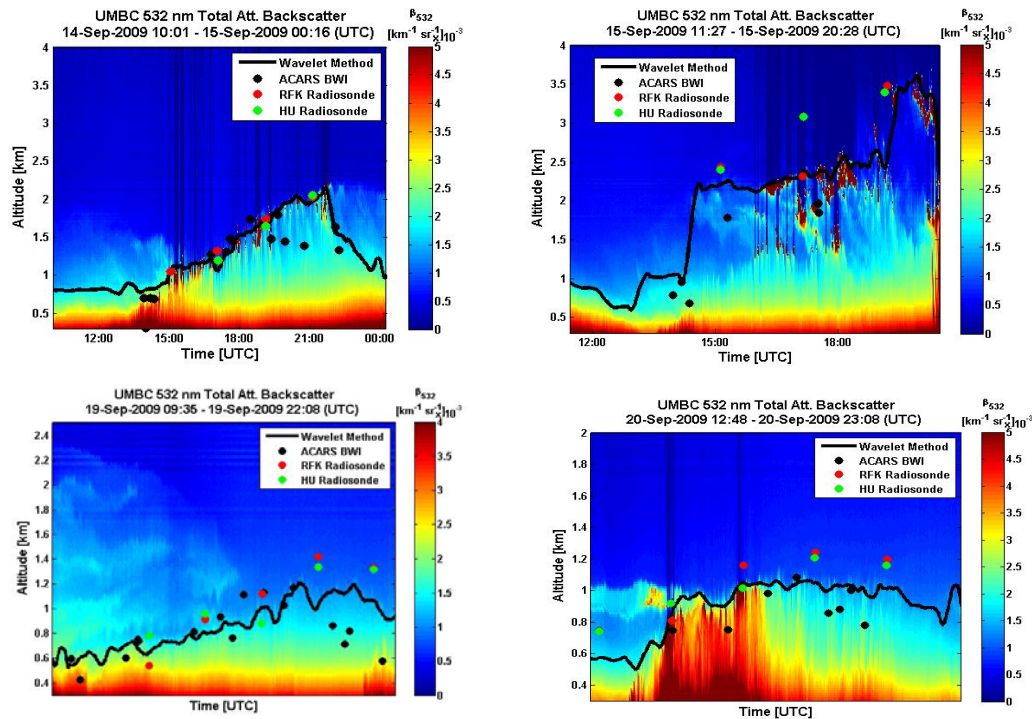


Figure 2. Comparison of UMBC Elastic Lidar (ELF) estimates of PBLH (km, black line) to BWI Aircraft-ACARS (black dots), NOAA/ARL radiosonde launches at RFK Stadium (red) and NCAS/Howard University (green) in Washington DC, on Sept. 14, 15, 19, 20 2009. ELF total attenuated backscatter (color shaded) also depicted.

**HU:** The lidar measurements provide detailed descriptions of atmospheric conditions over the Hampton area. The aerosol measurements also provide an indicator of air quality, particle type, and potentially origin, while temperature and water vapor measurements play important roles in understanding atmospheric meteorological conditions and convective systems such as the Planetary Boundary Layer (PBL). Most recently, measurements of lengths greater than 24 hours have been performed to gain a greater understanding of the variability of aerosols due to anthropogenic factors such as their work and travel schedules.

**UPRM CCNY** provided and helped to install the dichroic and narrowband interference filters for the 387 nm channel to be able to view 355, 387, and 532 nm channels simultaneously while the UPRM optics are still unavailable.

## Task (10) Data Collection and Analysis

**Hampton U-** Ongoing: In order to facilitate data availability, work has begun centralizing HU lidar data in order to automate the processing of raw information into higher level products. These products are then made available through web interface to network members.

As a supplemental project to lidar measurements, an automated system to track and catalogue volcanic-aerosol-emissions has been developed. The system watches the weekly Smithsonian Institute's Global Volcanism Program Common Alert Protocol (CAP) feed. These updates are freely available from <http://www.volcano.si.edu/reports/usgs/>. The system maps all volcanoes active in the past week, from which satellite overpasses and trajectory models can be used to determine quantities such as injection heights, composition, lifetimes, and plume position.

#### UPRM-

The UPRM aerosol characterization algorithm has been expanded to include water vapor mixing ratio calculations to quickly be able to process data once the hardware expansion is completed. The radiosonde calibration technique devised by D. Vladutescu et al. was implemented.

$$Q_{H_2O}(z) = C * (P_{407nm}/P_{387nm}) \quad \text{Eq. 1}$$

Here  $Q_{H_2O}(z)$  is the water vapor mixing ratio profile. C is the calibration constant obtained by taking the average of the water vapor mixing ratio for a reference altitude interval of high intensity from radiosonde measurements of the site.  $P_{407nm}$  and  $P_{387nm}$  are the Raman Lidar obtained water vapor and nitrogen power signals respectively. Fig. 1 in Appendix A shows the water vapor mixing ratio results using radiosonde calibration. City College of New York Raman Lidar data is used for processing.

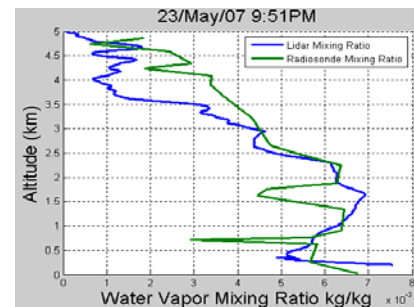


Fig. 1 Water Vapor Mixing Ratio compared to radiosonde launched at 8:00 PM using CCNY

### *Project 3: Ground Based In-Situ Measurements, Sampling, and Speciation*

- **Staff:** CCNY Profs Jeff Steiner, Urs Jans, Drs. A Katz, Diomaris Padilla, **UPR-RP** Olga Mayol
  - **Students PhD UPR-RP** Hector Rivera\*
  - **Students MS CCNY** Ryan Huthinson
  - **Students Undergraduate: CCNY,** Vismit Patel\*, Souradji Idrissou\*, Adjiwano Gbagba\*, A. Atia **UPR-RP** Arelis Rivera
  - **NOAA Collaborators** Istvan Laslo (NESDIS), John A. Ogren, Patrick Sheridan, Elisabeth Andrews, (ESRL), Israel Matos (NOAA NWS San Juan)
- Other Collaborators** Paul Menzel (University of Wisconsin), Brent Holben (NASA GSFC)
- **Operational Impact (has research been /or planned to be transitioned to operation)**

#### **Task (4) Implement Sampling and Speciation Protocols**

**Status:** Ongoing

**CCNY:** Ongoing research is continuing to identify sourcing for NYC particulates using a

combined SEM/EDS method for aerosol chemistry and erecting relationships with the aerosol optical depth products, such as the MODIS 550 nm AOD product. Validation is based in part on correlations erected with well-documented sourcing events and the creation of new methods for the deconvolution of specific chemical signals. Recent advances include the purchase of a Coupled Plasma Emission (Thermo X-Series 2 ICP-MS) scheduled for operation in several months. The purchase of a Microwave Digestion Unit (purchase complete, Sept., 2010) and the addition of the ICP-MS makes semi-automated detection of an extensive range of trace elements (to at least ppb) feasible for the speciation research. This new equipment will be joined in approximately June, 2010 by a new focusing X'Pert PRO MRD diffractometer for micro-structural determinations. This will essentially complete the acquisition of the necessary instrumentation for aerosol speciation that now includes the E-BAM, polycarbonate impactor, new Zeiss Field Emission SEM/EDS, new PanAlytical x-ray diffractometer, Thermo-Fisher Atomic absorption spectrometer, and both organic geochemical and calorimetry capability.

**A. Biomass Burning.** The fractional model outlined in the previous Report has been submitted to the journal - Atmospheric Environment for publication. The operational-related effort on extending the results to a viable methodology for monitoring biomass burning in the infrared is continuing.

**B. Monitoring of NYC Aerosol.** A cadre of students collected daily samples of aerosols for the period June-present impacted on 0.2 micron polycarbonate; the students also collected silica ribbons from the CCNY E-BAM. Target dates were selected for SEM/EDS analysis by examining the 550 nm Aerosol Optical Depth from MODIS to identify pollution plumes, and analyzing wind trajectories using NOAA HYSPLIT. Over 10000 data points were recovered that are now being analyzed for specific speciation patterns. A new SEM/EDS procedure was enacted that for the first time allowed the aerosols to be categorized on the basis of morphology. The distribution of NYC PM<sub>2.5</sub> aerosols for June 17, 2009 is in fig. 2. It shows that the aerosols for this date are distributed along a continuum comprising shape, aspect and continuum components showing that for this date the smaller perimeter fraction were distributed relatively equally in shape vs aspect ratio. The various links between morphological parameters and pollutant composition will be evaluated. Certain distributions show anomalous characteristics. A representative pollutant particle for the given low-perimeter distribution is in Fig. 2, an element analysis is in Table 1.

### **C. African Dust Component**

Dust transported across oceans continues to be of concern from the standpoint of both organic and inorganic chemicals and through transport of bio-agents. Research ongoing that attempts to understand the interactions between dust and microbes has been expanded to include work with Vernon Morris, Howard University who has supplied NOAA student, Adam Atia with samples on silver impactors. These are being examined for speciation and minor element contaminants using the new field emission SEM with the EDAX x-ray dispersive analyzer.

## **Task (5) Comparison Studies of data from multiple in-situ instruments**



**Status:** Ongoing

**UPR-RP** The instruments that measure the physical and optical properties of aerosols at the ground level in CSJ are deployed and continuously measuring. Some of the instruments (e.g., sunphotometer) have presented some problems and therefore were sent for repairing. Students were successfully trained on how to access, use, edit, and correct the data generated by these instruments, and also on how to sample using filters for subsequent chemical characterization. For this purpose, Dr. E. Andrews (NOAA ESRL), visited and trained the PhD student (H. Rivera) and the field technician in aspects related to the CSJ data and to the station. Results (e.g., AOT values, size distributions, absorption, scattering, angstrom coefficient, single scattering albedo, submicron scattering fraction, submicron absorption fraction) clearly show the impact of marine aerosols, African dust, and volcanic ash from the Soufriere Hills in the island of Montserrat, on the aerosols' physical and optical properties in the Caribbean region. These results have been presented at several local workshops and national and international conferences (e.g., AGU annual meetings, IGAC meeting). The objectives for years 1, 2, and 3 have been successfully achieved, several students and personnel are now trained, a manuscript is in preparation and will be submitted in the next months, measurements of the aerosols' physical and optical properties are being accompanied by the sampling of aerosol particles for chemical characterization, and comparisons between CSJ and other stations around the world have already started. These activities will allow us to improve our understanding of the aerosol physical and optical properties of regions under the influence of different air masses, and therefore, will help the team in reducing the uncertainties regarding the magnitude of the aerosol radiative forcing.

#### ***Project 4: Air Pollution Modeling and Model Validation***

- **Staff:** CCNY: Prof Barry Gross, Jorge Gonzalez, NYCCT Viviana Vladutescu
  - **Students PhD** CCNY Lina Cordera
  - **Students MS** Daniel Comarazamy, Alex Miranda
  - **Students Undergraduate:**
  - **NOAA Collaborators** Shobha Kondragunta (NESDIS)
  - **Other Collaborators** Jia-Yeong Ku (NYS DEC), F. Binkowski (NCAT)
- Operational Impact (Has Research been /or planned to be transitioned to operation)**

#### **Task (2) CMAQ Aerosol PM Component Validation**

**Status:** Ongoing

In this period, the consistency of the CMAQ model over the NYC area in predicting PM<sub>2.5</sub> mass as well as the vertical structure of the mixing layer has been explored. To begin, the CMAQ particle mass predictions was compared to the TEOM measurements. In doing this comparison, 4 cases were considered - a) Water soluble mass made up of ammonium, sulphates and nitrates b) Organic Matter c) Elemental Carbon d) All other inorganics (i.e total mass) . This was done for 22 days in the summer and fall of 2005 where simultaneous lidar measurements were made to assure clear sky conditions.

It was first observed that column averaging improves significantly the correlation but at the expense of predicting the magnitude of the PM<sub>2.5</sub> mass. At the same time, the magnitude of PM<sub>2.5</sub> mass predictions (as defined by the regression slope) are best at the surface when only the soluble component is used. This can be interpreted that near the surface, the coarse modes which aggregate near the surface greatly amplify the total mass

and thus it is reasonable that the near surface CMAQ prediction of PM<sub>2.5</sub> is best when only the soluble mass is counted since the extensive coarse mode aerosols are not included in the TEOM measurements.

### *Project 5: Health Impacts*

- **Staff: Lehman College:** Prof. Juliana Maantay  
**Students PhD Lehman College** Andrew Maroko, Rachael Weiss\*, Keith Miyake\*, Lauren Mei Turbin\*  
**Students MS:** Kristen Grady\*
- **Students Undergraduate Lehman College:** Brian Morgan\*
- **NOAA Collaborators:** Ralph Ferraro and Bruce Ramsay (NESDIS)
- **Other Collaborators** Hal Strelnick (Montefiore Medical Center/Albert Einstein College of Medicine), Peter Arno (New York College of Medicine), Gretchen Culp (New York City Department of Health), Nancy Sohler (City College of New York, Sophie Davis School of Biomedical Education), South Bronx Environmental Justice Partnership; New York State Department of Health
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

### **Task (3) Air Dispersion/GIS Model Integration**

**Status:**Ongoing

In order to get more definitive conclusions on the association between air pollution and asthma hospitalization rates, other pollution sources, including mobile sources, TRI facilities, and other stationary point sources are included in the model. Most of the spatial and attribute data necessary for this task has been collected. The limited access highway and major truck routes have been mapped for the entire city, and will be utilized for both proximity analysis and land use regression models. Hospitalization data on additional air pollution-related diseases has also been obtained, so that in addition to respiratory outcomes, the team will also be able to correlate cardiovascular disease with air pollution. All NEI facilities (National Emissions Inventory) have now been mapped for the entire city and we are conducting air dispersion modeling for these major stationary point sources, expanding the modeling to cover all the five boroughs. For the mobile sources, sampled vehicle counts and speed are used as inputs for a Gaussian dispersion model to estimate mobile source pollution concentrations for inclusion in the health outcome models. The team is proceeding with integrating the environmental models with the GISc, and are creating statistical surfaces of several of the pollutants that have been modeled. Analyses will include proximity models, land use regression models, and utilization of air dispersion model outputs as inputs to the health outcome models using OLS regression, spatial autoregressive models, and geographically weighted regression. Completing the analysis as indicated on the milestone chart is on track.

## **Thrust 2: Remote Sensing of Coastal Waters**

### *Project 1: Evolution of measurement approaches for coastal water bio-optical properties*

- **Relevance to NOAA's mission and the strategic plan**  
The work in this thrust area is in line with NOAA goals to conserve, protect, manage, and restore living marine resources and coastal and ocean resources is critical to the health of



the U.S. economy, and to Restore, and Manage the Use of Coastal and Ocean Resources Through an Ecosystem Approach to Management. The work is also in keeping with NOAA strategies that address end-to-end processes that cover monitoring and observing the land, sea, atmosphere, and space to create an observational and data collection network that tracks Earth's changing systems, and assess and predict the changes of natural systems and provide information about the future.

- **Relevance to NOAA Line Office (i.e., National Weather Service (NWS), National Ocean Service (NOS)) strategic plan.**

The work falls within NOAA-NESDIS mandates through National Oceanographic Data Center (NODC) and National Coastal Data Development Center (NCDDC) to manage uses of ecosystems by applying scientifically sound observations, assessments, and research findings and supports the NOAA-NESDIS algorithm development strategy for improved coastal water retrieval; and within NOAA-NOS mandates to perform coastal monitoring and observations through measurements of physical, chemical, biological and meteorological phenomena affecting the marine environment.

- **Ongoing, New or Revised?** If this is a revised project, please describe revisions and the impact - ongoing

- **Staff** - Profs. S. Ahmed, A. Gilerson, B. Gross, F. Moshary, Dr. J. Zhou (CCNY)
- **Students PhD** R. Amin, S. Hlaing\*, I. Ioannou\* - CCNY
- **Students MS** W. Zheng, M. Tang - CCNY
- **Students Undergraduate**, R. Singh, J. Kuang\* - CCNY
- **NOAA Collaborators (with Affiliations)** Dr. P. DiGiacomo, Dr. M. Wang, STAR, Dr. R. Stumph, NOAA's National Centers for Coastal Ocean Science (NCCOS).
- **Other Collaborators (with Affiliations)** Dr. J. Chowdhary – Columbia University, NASA GISS, Dr. A. Gitelson – University of Nebraska-Lincoln, NE, Dr. R. Arnone, Dr. A. Weidemann, Naval Research Laboratory, Stennis Space Center.

- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

These results will be used in the analysis of the applicability of the ocean color satellite sensors' bidirectional reflectance distribution function (BRDF) algorithms for coastal waters. The data from the newly developed coastal observatory will be used in the calibration and validation of the current and future Ocean Color satellites including NPOESS project, calibration of the hyperspectral sensors like Hyperspectral Imager for Coastal Observations (HICO) recently installed on the International Space Station. Chl algorithms based on red-NIR bands can efficiently improve Chl estimations in coastal waters.

- **Status of the project with respect to the goals/objectives and benchmarks previously identified** – on schedule

\* - Leveraging funding

**Tasks (For year IV as per the Milestone Chart)** (provide a brief narrative on each task with reasons if any for the delay)

### New development

With the support from CCNY, grants from ONR and NOAA the ocean group of CCNY established in October 2009 a Coastal Observatory in Long Island Sound (LISCO) for the calibration and validation of the current and future Ocean Color satellites as well as for time series monitoring of coastal waters in LIS. SeaPRISM multispectral instrument (CIMEL Electronics, Paris, France, the main instrument for this project supported by NASA as a part of AERONET and AERONET– Ocean Color) and a set of 3 hyperspectral radiometers HyperSAS were installed on the tower 12 m above water. The data from the SeaPRISM are transmitted to NASA and displayed on the NASA-AERONET website. HyperSAS data are transmitted to the CCNY server. Photos of the instruments on the tower and the tower on the platform are shown in Fig. 1. The data from the instruments will be used in the further data analysis and algorithm development.



Fig 1 SeaPRISM and HyperSAS on the tower

### Task (1) Modification of the diffuse transmission to account for directional effects

Previously simulated with Hydrolight radiative transfer program synthetic datasets of above and below water reflectances for very wide range of parameters in coastal waters including chlorophyll concentrations  $[Chl] = 1 - 100 \text{ mg/m}^3$ , absorptions of CDOM at 400 nm  $a_y(400) = 0 - 5 \text{ m}^{-1}$ , concentrations of mineral particles  $C_{min} = 0 - 100 \text{ mg/m}^3$  and very fine spectral resolution of 1nm for the visible and NIR spectral range had data for the incident angle of  $30^\circ$  and vertical viewing. These dataset were expanded to the full range of viewing angles ( $0-90^\circ$ ) and azimuth angles ( $0-180^\circ$ ). Both synthetic data and simulated from field measurements are further used to account for the dependence of bidirectional reflectance distribution function (BRDF) on the viewing and azimuth

angles, possible retrieval of chlorophyll fluorescence magnitude, estimation of accuracies of simulations and measurements. LISCO data has also great potential for the evaluation of BRDF effects in coastal waters.

### Task (2) Intercomparison of the simulated data, results of laboratory and field tests for the improvement of measurement and retrieval approaches

Recent advances in the development of the atmospheric correction models made the retrieval of surface reflectance spectra of coastal waters from the top of atmosphere signals more accurate and inspired the further development of the coastal retrieval algorithms. This includes algorithms employing the red and NIR bands which are less sensitive to the absorption of the colored dissolved organic matter (CDOM) and scattering of mineral particles than traditional blue-green ratio algorithms. Such algorithms using comprehensive synthetic datasets of reflectance spectra and inherent optical properties (IOP) has been tested related to various water parameters mentioned in the previous task. The choice of the specific phytoplankton absorption for further analysis was rectified by the comparison of simulated data and field data from Nebraska lakes (A. Gitelson) with the measurements included water sampling for Chl and mineral concentrations as well as measurements of water optical characteristics (absorption and attenuation) and reflectance spectra.

It was shown that 2-band Red-NIR algorithm  $Rrs(708)/Rrs(665)$ , which uses MERIS bands, provides a good estimation of chlorophyll concentration for  $[Chl] > 5 \text{ mg/m}^3$  with a weak dependency on variation in CDOM concentrations. We have not found the advantage of the 3-band algorithm over 2-band algorithm. While obvious sensitivity to mineral concentration was observed for 2-band algorithm it can be partially pared by the addition of  $(1 + 25 * Rrs(665))$  term to the numerator.

On the other hand simulations using the same datasets showed that blue-green ratio algorithms which are efficient for the open ocean can lead to the errors of 100-300% in the coastal waters.

### *Project 2: Field measurements in coastal waters for algorithm testing /development and satellite validation*

- **Ongoing, New or Revised?** If this is a revised project, please describe revisions and the impact - ongoing
- **Staff** Profs. S. Ahmed, A. Gilerson, B. Gross, F. Moshary, Drs. J. Zhou (CUNY), Prof. F. Gilbes (UPRM)
- **Students PhD** R. Amin, S. Hlaing\*, I. Ioannou\* (CCNY)  
M. Rosado\* (UPRM)
- **Students MS** W. Zheng, M. Tang (CCNY), V. Rodriguez, N. Hernández\*, UPRM-Department of Geology
- **Students Undergraduate** R. Singh, J. Kuang\* (CCNY)
- **NOAA Collaborators (with Affiliations)** Dr. P. DiGiacomo, Dr. M. Wang, STAR, Dr. R. Stumpf, NOAA's National Centers for Coastal Ocean Science (NCCOS), Joaquin Trinanes, Acting NOAA Coast Watch Operations Manager for the Caribbean Regional Node.
- **Other Collaborators (with Affiliations)** Dr. A. Gitelson – University Nebraska-Lincoln, NE, Dr. R. Arnone, Naval Research Laboratory, Head of Ocean Science Branch, Dr. M. Twardowski, VP, WET Labs, Inc., Drs. R. Zimmerman, V. Hill, ODU, Dr. M. Twardowski, WET Labs, Inc., Dr. J. Trinanes, Acting NOAA Coast Watch Operations Manager for the Caribbean Regional Node, Dr. Eric Harmsen (UPRM-Department of Agricultural Engineering), Dr. C. Ramos-Scharrón (Department of Geosciences, Colorado State University) and Dr. R. Armstrong (UPRM-Department of Marine Sciences)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**  
The on-going project aims to develop the appropriate techniques to use ocean color sensors to monitor the conditions of coastal environments. Estimates of Chlorophyll and Suspended Sediments from space can be used as proxy for the quality of coastal waters. Continuous monitoring of such parameters with satellite sensors will help to better understand and manage our coastal environments.
- **Status of the project with respect to the goals/objectives and benchmarks previously identified** – on schedule

\* - Leveraging funding

**Tasks (For year IV as per the Milestone Chart)** (provide a brief narrative on each task with reasons if any for the delay)

**Task (1) Perform field measurements in Long Island waters, and opportunistically at other sites on the East coast and Puerto Rico in coordination with satellite over flights and atmospheric aerosol parameters measurements. IOP and radiance underwater measurements for retrieval of particle size distributions, refractive indices and possibly species composition. Tests to be carried out for a variety of seasonal and weather conditions to develop understanding of related impacts. Compare to satellite water leaving products and atmosphere retrievals. Intercomparison of the below/above water signals with aircraft and satellite data as available. Make opportunistic measurements of HABs if they occur.**

CCNY 2009 field campaign included comprehensive set of measurements: reflectances above and below water, depth profiles of total attenuation and absorption as well as absorption of CDOM, particulate backscattering, temperature, salinity, chlorophyll and CDOM fluorescence. This year new instrument LISST-100X (Sequoia Scientific) measuring particle size distributions was added to the profiling package. The whole set was complemented by water sampling with the further filtering and extraction procedures and measurements of chlorophyll concentrations, concentrations of organic and inorganic particles. Main focus of the campaigns is the combination of these measurements with the data from our newly developed sensor to measure angular distributions of reflectances and water polarization characteristics. This work was performed in waters with various mineral concentrations (New York Harbor, Hudson River, NY – June-July 2009), in moderate coastal waters during the cruise on R/V Paumanok, Stony Brook University (NY-NJ waters, July 2009) together with WET Labs group (VP M. Twardowski). Measurements at multiple stations from clear waters offshore (30 miles from the coast) to turbid waters of Chesapeake Bay were conducted on R/V Fay Slover, stationed at NOAA facility, Norfolk, VA together with Old Dominion University for the validation of CALIPSO satellite mission (August 2009). The measured data are being processed and compared with the simulation models. Data are added to our field database for various water environments which is used for the algorithm development and validation.

First comparisons of the data from SeaPRISM on the LISCO platform and MODIS Aqua are shown in Fig. 2 for 2 atmospheric correction models NIR and SWIR. Satellite data are processed with new NASA aerosol tables and NIR atmospheric correction works better than SWIR. Work is on the way for the development of the software and comparison models for LISCO data which can be used further in calibration/validation.

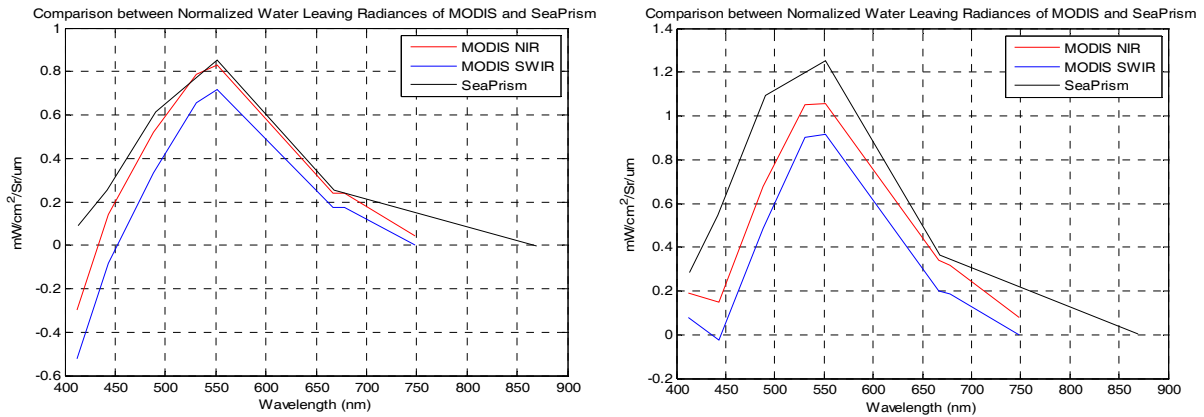


Fig. 2 Comparison of SeaPRISM (LISCO) and MODIS normalized water leaving radiances for Nov 3, 2009 (left) and Dec 18, 2009 (right) with NIR and SWIR atmospheric correction models.

### Task (2) Joint CCNY-UPRM campaigns

This campaign is currently in planning stage for the second part of 2010, beginning of 2011.

### Project 3: Improvement/Development of algorithms for remote sensing of coastal waters

- **Ongoing, New or Revised?** If this is a revised project, please describe revisions and the impact
- **Staff** Profs. S. Ahmed, A. Gilerson, B. Gross, F. Moshary, Dr. J. Zhou (CUNY), Prof. F. Gilbes (UPRM)
- **Students PhD** R. Amin, S. Hlaing\*, I. Ioannou\* (CCNY), R. Lopez (UPRM)
- **Students MS** W. Zheng (CCNY), V. Rodriguez, UPRM-Department of Geology
- **Students Undergraduate** R. Singh(CCNY), J. Martinez\*, A. Cruz\* (UPRM)
- **NOAA Collaborators (with Affiliations)** Dr. P. DiGiacomo, Dr. M. Wang, STAR, Dr. R. Stumpf, National Centers for Coastal Ocean Science (NCCOS), J. Trinanes, Acting NOAA CoastWatch Operations Manager for the Caribbean Regional Node.
- **Other Collaborators (with Affiliations)** Dr. A. Gitelson – University Nebraska-Lincoln, NE, Dr. R. Arnone, Naval Research Laboratory, Head of Ocean Science Branch, Dr. J. Trinanes, Acting NOAA CoastWatch Operations Manager for the Caribbean Regional Node, Dr. Eric Harmsen (UPRM-Department of Agricultural Engineering), Dr. Carlos Ramos-Scharrón (Department of Geosciences, Colorado State University) and Dr. R. Armstrong (UPRM-Department of Marine Sciences)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

Algorithm for HAB detection can be used as one of the tools for the detection of *Karenia Brevis* blooms.

**Status of the project with respect to the goals/objectives and benchmarks previously identified** – on schedule

\* Leveraging funding

**Tasks (For year IV as per the Milestone Chart)** (provide a brief narrative on each task with reasons if any for the delay)

**Task (5) Examine and analyze trends and data need to define baselines for HAB detection and prediction**

**Novel Optical Techniques for Detecting and Classifying Toxic Dinoflagellate *Karenia brevis* Blooms Using Satellite Imagery**

This material was partially shown in the previous report ahead of schedule. A detection technique for blooms with low backscatter characteristics has been proposed, which is named as the Red Band Difference (RBD) technique, coupled with a selective *K. brevis* bloom classification technique, which is named the *K. brevis* Bloom Index (KBBI). The proposed techniques take advantage of the fact that because of lower backscatter characteristics in *K. brevis* blooms, the red peak in the reflectance signal is dominated chlorophyll fluorescence rather elastic scattering. The proposed techniques are applied to the detection and classification of *K. brevis* blooms from Moderate Resolution Imaging Spectroradiometer (MODIS) ocean color measurements off the Gulf of Mexico. To assess the efficacy of the techniques for detection and classification, simulations, including chlorophyll fluorescence based on *K. brevis* blooms and non-*K. brevis* blooms conditions were performed.

These simulations show that effective bloom detection from satellite measurements requires a threshold of  $RBD > 0.15 \text{ W/m}^2/\mu\text{m/sr}$ , corresponding to about  $5 \text{ mg/m}^3$  of chlorophyll. While blooms are still detected at lower concentration for lower RBD thresholds, false alarms also increase. The KBBI classification technique is found most effective for thresholds of  $RBD > 0.15 \text{ W/m}^2/\mu\text{m/sr}$  and  $KBBI > 0.3 * RBD$ . The techniques were applied and shown to be effective for well documented blooms of *K. brevis* in the Gulf of Mexico and compared to other detection techniques, including FLH approaches, and impacts of different atmospheric corrections examined.

**Task (6) Assess/compare different algorithms to obtain water leaving radiances both in NE and PR; Assess improvement over SeaDAS.**

New development of the LISCO platform opens multiple opportunities for the evaluation of different atmospheric correction approaches. This includes more detailed understanding of aerosol properties in the area of the platform, which can be derived from SeaPRISM observations, comparison of the satellite and SeaPRISM – HyperSAS data for the same pixel with different atmospheric correction models, correlation between SeaPRISM data at the LISCO site and similar data from CIMEL AERONET instrument at the CCNY site. All these activities will follow but they require first to make the site fully operational and to establish proper quality metrics for the LISCO data. This work is currently on the way.

**Task (7) Analysis of optical field measurement together with Chl, TSS concentrations.**

This task is now interconnected with the Task 2 of the Project 1. Main results were reported



there.

### **Task (9) Development of GIS database for land sea interactions in Mayaguez Bay**

The Revised Universal Soil Loss Equation (RUSLE) was applied to Mayaguez Bay watershed by defining raster layers (pixel size = 10 m) of associated factors in a GIS based model. Spatially variable soil erosion rates and sediment yields estimations, from 2001 to 2005, were estimated for this basin. Validation results indicated that the equation published by Boyce (1975) to calculate Sediment Delivery Ratios (SDR) responded to conditions of the area, while the other two equations evaluated for the same purposes (Vanoni, 1975 and USDA, 1972) tended to overestimate this parameter. Sediment yield estimations generated for year 2004 for Rosario river sub-watershed (32,365 Mg/yr) were highly comparable to field measurements at USGS gauge station (33,622 Mg/yr) showing the great potential of the developed model. MODIS data for twenty dates of 2004 were used to generate suspended sediment load products corresponding to northern and southern parts of the bay. Results of the northern area showed a fairly good relationship ( $R^2=0.71$ ) with Añasco river discharge measurements, but additional values of high river discharge are required to strengthen this association. This work is part of Vilmaliz Rodriguez master thesis.

## **Thrust 3: Precipitation and Water Resources**

### **Thrust 3a: Hydro-Climate**

#### ***Project 1: Develop and Improve Satellite-based Precipitation Retrieval Algorithms.***

- **Relevance to NOAA's mission and the strategic plan**

Remote sensing for water and weather and for improvement of precipitation and flashflood estimating, forecasting/nowcasting, and warning. Investigate strengths and weaknesses of the NOAA's operational Hydro-Estimator rainfall algorithm, help to guide the development of the GOES-R era algorithm, sustain healthy coastal areas, and improve weather forecasting and warnings. Sustain healthy coastal areas, improve flood forecasting and warnings, improve the reliability, lead-time, and understanding of flooding to improve prediction.

The work in this thrust area contributes directly to NOAA's goals of supporting activities directed toward helping to sustain healthy coastal areas, improving weather forecasting and warnings, provide improved environmental forecasts/analyses, and to prepare for future NOAA operational environmental satellite missions. This project will contribute to improving the reliability, lead-time, and understanding of weather and water information and services that predict changes in environmental conditions; expand and enhance advanced technology monitoring and observing systems to provide accurate, up-to-date information. This study will provide information related to the strengths and weaknesses of the three rainfall algorithms (HE, SCaMPR, PERSIAN), and will help to guide the development of the GOES-R era algorithm. It also relates to remote sensing of water and weather for the improvement of precipitation and flashflood estimating, forecasting/nowcasting, and warning.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**



The work relates directly to the NWS. This project supports the following goals of NOAA and its Line Office by expanding sources of reliable observational data, continued integration of environmental sciences, providing data to satisfy the increased demand for NWS warnings and response, will produce advances in science and technology, will expand climate information, and will provide more explicit and more useful measures of forecast certainty. The projects are being conducted in collaboration with NOAA NWS, NESDIS/Cooperative Institute for Climate Studies (CICS) and National Severe Storm Laboratory (NSSL).

- **Staff:** Drs. Shayesteh Mahani and Reza Khanbilvardi, CUNY; Drs. Arnold Gruber (Visiting Research Faculty), and Yajaira Mejia, Post Doctoral Researcher.
- **Students PhD** - Cecilia Hernández-Aldarondo, Nasim Nourozi, Heather Glickman, and Kibrewossen Tesfagiorgis\* from CUNY
- **Students MS**
- **Undergraduate Students**
- **NOAA Collaborators (with Affiliations)** - Ralph Ferraro, Robert Kuligowski, Cezar Kangoli, Mamoudou Ba & Stephan Smith from NESDIS/CICS, David Kitzmiller from NWS/HL, and Robert Rabin from NSSL/OAR
- **Other Collaborators (with Affiliations)** - Brian Vant Hull, Post Doctorate, ISET/CUNY.
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**
  - The “Nowcasting, RDT, Algorithm” is operational in house (CCNY), but there are no immediate plans to transition to NWS operations until further testing and development is completed.
  - The “Snowfall Detection Algorithm using Multi Spectral AMSU Observations” has been planned to be transitioned to operation at NWS
- **Status** – on Schedule

### **Task 1: Develop Multi-Spectral Microwave Snowfall Detection Model**

The two snowfall detection networks of NN1 and NN3 based on ANN, which has been developed at CREST, were tested for different study cases using data from AMSU NOAA 15 and 18. The difference between NN1 and NN3 are: 1) the number of snowy and no-snowy pixels are 141 and 309 in NN1 and 136 and 314 in NN3 respectively; 2) time lag for NN1 is 30 minutes as for NN3 is 90 minutes. Following tables give comparison between two networks of NN1 and NN3 for two storms of January 24, 2008, at 18:31UTC and 21:37 UTC from NOAA-18 and -15, respectively, and February 3-6, 2008 from NOAA-15. The results shown in the table (Appendix-3) are better than the ones obtained in the last report. The accuracy in detecting snowfall pixels has improved by 30 %. NN1 system tends to classify the non-snowfall pixels as snowfall. On the other hand, the NN3 system shows an improvement of 7 % in detecting the snowfall pixels in comparison with the results shown in the last report. The conclusions are: the neural network system does not detect snowfall and non-snowfall areas accurately when surface temperature is above 0°C and the most of the pixels are classified as snowfall pixels.

### **Task 2: Develop Multi-Spectral Precipitation (Snowfall) Retrieval Algorithm**

In the last six months, the snowfall-rate retrieval algorithm ANN configuration was selected, and consisted of a combination of 150 and 183±7–GHz frequencies from AMSU-B, which was the model that exhibited a better relationship between the observations and

estimates in terms of precipitation amounts as well as storm coverage. As previously stated, this retrieval algorithm aimed to use as input only combinations of AMSU-B frequencies, however the addition of more data to the model was tested. For these tests, data and products from AMSU-A, GOES, RUC, SNODAS, IMS, and combination of them were used as additional input to the model; for approximately 350 variables. The preliminary results show that data from AMSU-A, RUC, SNODAS, and GOES are best suited to be used as additional input to the model. Specifically, from AMSU-A: surface temperature, channels 4, 5, 7, and 8 (52.8, 53.6, 54.9, 55.5 GHz, respectively); from RUC: u wind at 850mb, BLI (Best lifted index) to 500 hPa, and v wind at 925mb; from SNODAS: snow depth from the previous date; and from GOES, channel 6 (13.3  $\mu\text{m}$ ). In terms of storm pattern, AMSU-A channels near 50 GHz perform better than the other combinations. Also, a new study area in northeast was selected in addition to the Midwest US area, to observe patterns in the selected model, and as a validation site. Ongoing tasks consist on model improvements by testing different storm cases, to select a final model.

### **Task 3: Improve Satellite-based Rainfall Products over the Radar Gap Area by merging with NEXRAD**

This is an ongoing project that has been funded by NWS for the last two years, with the objective generating more accurate precipitation over radar gap areas using multi-source rainfall satellite, radar, and ground-based gauge rainfall estimates. Enhance of the bias correction technique for improving satellite based rainfall estimates and the merging algorithm for generating rainfall estimates over radar gap areas using multi-sources data is continuing to be investigated. As cited in the previous report, the satellite-based NESDIS precipitation product from Hydro-Estimator (HE) has been corrected for biases with respect to radar rainfall (RR) products. A noble technique of generating ensemble biased fields using Cholesky decomposition has been implemented for bias correction and compared with using the ratio of means, medians, and maximum values between HE and RR that were tried before. The results of this comparison are satisfactory. In the last six months, adjustment of the spatial discrepancies between the satellite and radar rainfall estimations was investigated in addition to implementing the ensembled bias correction techniques. The application of linear registration technique between the satellite and radar rainfall estimates has provided a good results interim of quantifying the spatial error and improving the satellite rainfall estimates (figure in Appendix-3). This work was presented at annual EPP forum and received constructive ideas. And for many, the project was a valid approach to solve the long lived satellite rainfall estimation uncertainties.

### **Task (4): Improve the Nowcasting Algorithm based on Satellite Observations and Analysis the Nowcast output**

RDT was compared to the SatCast Algorithm, which attempts to estimate convective initiation by multispectral indicators on a pixel basis. The results show that when RDT and SatCast detection overlaps, RDT does a better job of detecting thunderstorms throughout it's lifecycle, but 80% of pixels that SatCast indicates will be convective fall outside the RDT contours, in highly textured clouds. This suggests that SatCast detects convective initiation before RDT does. Work is being pursued to see if setting RDT to detect smaller cloud towers will improve the detection of convective initiation. Lifecycle studies of RDT will be used to extrapolate cell growth into the future. Cloud towers with similar lifetimes were binned and averaged to produce averaged lifecycle of cell area and temperature difference

between base and top (tower height), as shown in the figures in the Appendix-3. Though the fits to averaged cloud cells look robust, statistical tests are planned to see if this type of curve fitting is applicable to individual cells. The WDSS-II tracking algorithm known as segmotion is being applied to produce complete cloud lifecycle averages, including precipitation and lightning. The lifecycles will be binned by environmental variables derived from numerical weather models: wind shear, stability indices, and total precipitable water. At this point code has been written to extract the averaged lifecycles from the Segmotion output.

#### **Task (5): Validate the Enhanced Nowcasting Algorithm for other Areas**

POD and FAR of RDT was tested in Oklahoma using lightning as validation. The results were similar to New York study area. Due to a stolen computer the results cannot be shown.

#### **Task (6): Improve Precipitation Estimates using Interaction between UHI/Aerosols and Climate Changes**

During the past 6-months, in addition to continuing running climatology with different thresholds for more study cases, investigating the influence of urbanization on cloud top particle size has initiated. For this study, winter study cases in 2004 have been selected to understand the impacts of cold air outbreaks that make offshore winds form clouds downwind over the ocean. The difference between GOES channels 2, shortwave infrared 3.9  $\mu\text{m}$ , and channel 4, at 10.7  $\mu\text{m}$  have been used. Water clouds reflect much more than ice clouds on 3.9 microns data and smaller water droplets reflect more than larger ones. HYSPLIT model was used for trajectory analyses, following images, for New York City that compared with two control regions. The figure (left) in the Appendix-3 shows the difference between GOES channels 2 and 4 of offshore winds, in which a pattern apparently with larger particle size can be seen coming from the NYC metropolitan region. This pattern is very strong on some days, for instance: the 16<sup>th</sup> and the 23<sup>rd</sup> of January 2004. And, the right image (Appendix-3), demonstrates liquid particle radius for estimating particle size.

#### **Project 2: Validate Existing Precipitation Retrieval Algorithms**

- **Staff** -Nazario Ramírez, Eric Harmsen, and Ramón Vasquez (UPRM) and Ismail Yucel (HU)
- **Students PhD:**
- **Students MS** - *Cordona*, Department of Electrical and Computer Engineering
- **Students Undergraduate** - *Pablo Mejias* from the Department of Civil Engineering; *Arnaldo J. Garcia*, Department of Industrial Engineering
- **NOAA Collaborators (with Affiliations)** Dr. Robert Kuligowski, Center for Satellite Applications and Research (STAR/NESDIS/NOAA), Israel Matos at National Weather Service, San Juan, Puerto Rico
- **Other Collaborators (with Affiliations)** – Daniel Lindsey from Cooperative the Institute for Research in the Atmosphere (CIRA) at Colorado State University; Sandra Cruz-Pol, Department of CEE, University of Puerto Rico; David Gochis (NCAR/RAP)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

- **Status of the project with respect to the goals/objectives and benchmarks previously identified**

The HE algorithm with and without a topographic correction method was evaluated using the data obtained from the North American Monsoon Experiment (*NAME*) *Event Rain Gauge Network (NERN)* (*NAME/NERN*) rain event network over the complex topography of northern Mexico during the 2002 and 2003 summer monsoon periods. A manuscript from this work is now under review. Findings from this study showed that the topographic correction method needs to be modified because the HE products had elevation biases in that there is underestimation for light rains toward high elevation and overestimation toward lower elevations for heavy rains. Based on these findings, the work began on developing a new orographic correction method to be used in SCaMPR algorithm for GOES-10 data. This study is granted by NOAA for a period of July 01, 2009 to June 30, 2010. Data acquisition from SCaMPR and raingage network for calibration method was completed during this period.

### **Task 2: Develop a Validation Algorithm**

A validation algorithm has been developed and the corresponding computer program was written in Matlab. This program has been tested under different rainfall events with the purpose of measuring robustness of the validation algorithm. Specially, during this semester the validation computer activities were intensified and the computer code was tested over different rainfall events in Puerto Rico. As a result of this validation task some computational improvements were accomplished. During this reporting period we also developed a procedure to convert a simple Matlab computer code into an executable program, and to be able to run the computer code without the support of Matlab library.

### **Task 3: Improve NESDIS Rainfall Algorithm**

#### **3.1. Improvement of Hydro-Estimator (HE):**

During the previous report a new rainfall detection algorithm has been developed that can improve the performance of the Hydro-Estimator algorithm over Puerto Rico. The new rainfall detection algorithm is called the projection algorithm (PA), and requires radar data to be initialized; and during this research period an algorithm was developed with the purpose of identifying an analog storm, which will be used to initialize the PA to perform rainfall detection. The analog storm (AS) algorithm starts by organizing the cloud radiative data. The radiative information includes visible and infrared bands from GOES 12. The radar data are used only for characterizing the clouds of archived storms. The application process of the PA algorithm consists of selecting a pixel (from a current storm) to be classified as a pixel of one of the archive storms. Thus, a pixel from the current storm is used to create a third vector, which will be projected onto the rain and no rain vectors of the archived storms. The magnitude of the projection angles of radiative variables will be used to classify the pixel from the current storm into one of the archived storms. This process is repeated over and over until the entire groups of pixels from the current storm are classified as one of the archived storm. The PA initialized with the analog storm was implemented over several rainfall events that have occurred over Puerto Rico and the performance was compared with the Hydro-Estimator algorithm. Preliminary results show that the PA initialized with an

analog storm improves the performances of the Hydro-Estimator, over the studied area. A larger sample should be studied in order to confirm this preliminary conclusion.

### *3.2. Improvement of SCaMPR:*

The WDSS-II tracking algorithm known as segmotion can be used to calculate cooling rates on a pixel resolution for input into the SCAMPR rainfall estimation algorithm. A code package has been written that produces these cooling rates automatically, and has been delivered to NESDIS for testing with the SCAMPR algorithm. The goal of this project is to identify a pattern between the coldest GOES IR pixels and heaviest radar rain rates through the life cycle of the storm in order to eliminate the errors caused by horizontal displacement between cold cloud tops and surface rainfall observed by the radar. Several convective storms in New York metropolitan area were selected to study the relationship between coldest IR pixels and radar rainfall. The emphasis was to select the storms with single tower. GOES IR brightness temperatures and radar rainfall rates were collected for the selected storms and have been statically analyzed in order to identify a pattern for the displacements of the satellite cold pixels and radar heavy rainfall rates.

### **Task 4: Validate NESDIS-SCaMPR Model over the US and Puerto Rico**

For the calibration work of the SCaMPR algorithm, a database needed for rain-rate estimates and predictors are created as follows:

- All available event data from NERN rain gauges over the northern Mexico from July through September for 2002, 2003, and 2004 are prepared in hourly time interval and their quality control check is performed.
- Hourly SCaMPR rainfall accumulations and 1-km topography data are obtained from NESDIS/STAR.
- NWP modeling data include temperature, wind speeds (u and v), specific humidity, potential temperature, equivalent potential temperature at 700 mb, the first model level above the surface, and integrated moisture convergence and divergence between 700 mb and first model levels are obtained from NESDIS/STAR in 6 hr time intervals. Wind speeds at 700 mb and the first model level will be used to calculate the vertical updraft speeds. The other NWP data such as temperature, humidity and convergence values will be used to enhance the orographic correction method.

The topography correction algorithm, based on the original code that the Hydro Estimator (HE) algorithm, uses updated and modified artificial wind speeds and real topography as inputs. Subsequent calibration work for the orographic adjustment for the rain rate algorithm has just started.

### *Project 3: Flood Forecasting using Satellite-based Rainfall Estimates*

- **Staff** – Drs. Shayesteh Mahani; Reza Khanbilvardi and Bill Rossow from CUNY; and Eric Harmsen from UPRM
- **Students PhD** - Alejandra Rojas\*, Department of Civil Engineering, UPRM
- **Students MS** - Alexander Recaman\*, Department of Agronomy, UPRM
- **Students Undergraduate**



- **NOAA Collaborators (with Affiliations)**Dr. Pedro Restrepo, Office of Hydrologic Development, OHD/NWS/NOAA; John R. Mecikalski; Israel Motos, NWS-San Juan Office
- **Other Collaborators (with Affiliations)** - Dr. Baxter Vieux, Department of Civil Engineering, University of Oklahoma; Sandra Cruz Pol, University of Puerto Rico, Department of Electrical and Computer Engineering
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**
- **Status –The work on this project is progressing but since there are no NOAA-CREST funds to cover this project, progress is slower than originally anticipated.**

### **Task 1: Modify a Hydrological Model by coupling with a Satellite-based Rainfall Retrieval Algorithm**

Little progress has been made on this task because the Hydro Estimator is not capable yet of providing reliable rainfall estimates within the study area. Therefore, our efforts have focused on improving the rainfall algorithm (See Project 2, Task 3 above). The development of the NowCast Flood Alarm System will follow the flowchart shown in Figure-1 in Appendix-3. A new graduate student (Ph.D., Civil Engineering, funded by NSF-CASA project) recently started to working on the project. Her responsibility is to develop the NowCast flood alarm system. As part of the validation of the improved GOES rainfall estimation methodology, we will be utilizing rainfall data from the Collaborative Adaptive Sensing of the Atmosphere (CASA) radar network, with spatial resolution that is on the order of tens of meters, recently installed on the UPRM Campus. The first step will be calibration of the CASA radar in Puerto Rico. To accomplish the calibration we are utilizing the NOAA-CREST 28-rain gauge network installed east of the UPRM Campus (Figure-3 in Appendix-3). The rain gauge network is located within a single GOES pixel (4 km x 4 km) area. Collaboration with the CASA project was initiated during the reporting period. Calibration of the CASA radar is expected to be completed within three months.

### **Task 2: Develop hydrologic model (Vflo) for the Mayagüez Bay drainage basin**

In the previous report the calibration of the basin-scale model was described. As a part of this research a calibration up-scaling procedure is being developed to improve the basin-scale model, based on the analysis of a high resolution sub-watershed-scale model. The sub-watershed or Testbed Sub-watershed (TBSW) is shown in Figure-3 of task-1, Appendix-3. Rain gauge network statistics were calculated at 1 hour, daily and monthly temporal resolution and compared with MPE pixels. Discrete variables were evaluated with contingency tables, evaluating the accuracy of the rainfall detection in terms of hit rate “H”, probability of detection “POD”, false-alarm rate “FAR” and discrete bias “DB”. The mean field bias (*Bias*) is used to remove systematic error from radar estimates and used to correct the radar quantifications in the hydrologic simulation. The indicators to evaluate the accuracy of MPE rainfall estimations over the HE pixel at different temporal scales are the root mean square error (*RMSE*) and normalized bias (*NBIAS*). The results of those evaluations are founded in Rojas et al, 2009. Appendix-3 includes more results of this task.

**New Tasks (NOT in the milestones)** (provide a brief narrative and justify the deviation)

### **Task 4: Estimate and validate Evapotranspiration to improve flood nowcasting**



In the previous report we described the development of an evapotranspiration (ET) remote sensing product for PR (1-km resolution). This product will be used to develop a daily water budget for the purpose of initializing the soil moisture in the flood NowCast algorithm. Our collaborator at the University of Alabama-Huntsville (John Mecikalski) visited PR in January for the purpose of planning the direction of research related to the ET product and to discuss future publications and proposals. As a result of our consultation we have proceed to expand the solar insolation product (required for estimating ET) to the area covered in the Figure in Appendix-3. Because of the relatively large area covered, the spatial resolution was reduced to 2-km. The new coverage extends from the U.S. Virgin Islands to the western tip of Cuba. It should be noted that the new grid includes Haiti. It is hoped that the hydrologic products that result from this work will assist Haiti in their redevelopment. We will continue to produce the 1-km products for Puerto Rico.

### **Task 5: Develop a new Hydrological Model by combining analysis of precipitation, inundation extent and water level from Satellites:**

**Activity:** The combined analysis of precipitation, inundation extent and water level from satellites is being used to force a hydrological model in a different way than usual.

**Status:** One paper has been published and one paper is in preparation.

**Future:** The more detailed case studies for the Amazon and Congo river basins will be performed. A similar approach will be tested in snow-covered regimes by combining measures of snow water amount, spring thaw and flood extent and estimates of discharge.

### ***NEW Project: Analyzing satellite and in situ data to study tropical convection and hurricanes***

- **Relevance to NOAA's mission and the strategic plan**

Dr. Luo's research in tropical clouds and convection will improve our ability to better parameterize these important processes in global climate models, which will in turn help the prediction of future climate changes.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

Dr. Luo's research, especially the study of hurricane intensity from space-borne sensors, will help develop alternative hurricane intensity estimation technique, which will improve hurricane forecasting and save lives and property.

- **Ongoing, New or Revised Ongoing**

- **Staff**

Dr. Johnny Luo and Dr. Reginald Blake (faculty Members)

Dr. Gary Liu (postdoc)

**Students PhD:** Hanii Takahashi (**Leveraged**)

**Students MS:** Cheila Benavides (funded), James Rios (funded)

- **Students Undergraduate**

Cadecia Josephs, Renee Jarvis, Nipun Aggarwal, Jeyavinoth Jeyaratnam (**Leveraged Students**)

- **NOAA Collaborators (with Affiliations)**

- **Other Collaborators (with Affiliations)**

Dieter Kley (Research Centre Juelich GmbH, Germany),

Xianglei Huang (U. Michigan), William Rossow (CCNY & NASA/GISS); Graeme Stephens (CSU & NOAA CIRA), W.-K. Tao (NASA/GSFC); Richard Johnson (Colorado State University)

### **Task #1: Testing a new hurricane technique using satellite data**

Dr. Luo started a pioneering study aiming at finding satellite application of Prof. Kerry Emanuel's hurricane intensity theory (see NASA News Release on this study: [http://www.nasa.gov/mission\\_pages/cloudsat/news/cloudsat-20071101.html](http://www.nasa.gov/mission_pages/cloudsat/news/cloudsat-20071101.html) and publication which is downloadable from (bad link removed)). CloudSat data were used at first attempt. Since the summer of 2008, a new collaboration with NASA/JPL MISR team (contact: Dr. David Diner) has started that uses MISR data. New results with MISR also proved promising. Upon the invitation of MISR PI Dr. Diner, Dr. Luo presented these results at the upcoming MISR symposium in December 2008. Eventually, this new technique will be considered for NOAA operational satellites.

### **Task #2: Use of NASA A-Train to study tropical convection**

The objective is to characterize tropical convection from a new perspective (e.g., internal vertical structure) using CloudSat, MODIS and other members of the A-Train and to make connection to model simulations. Two recent publications along this line by Dr. Luo can be found at (bad link removed) and (bad link removed).

### **Task #3: Use of aircraft measurements for studying upper-tropospheric humidity and for calibrating NOAA operational satellites**

This is an ongoing NSF-funded project carried over from CSU (which will end this year). The goal is to analyze 10-years of upper-tropospheric humidity (UTH) measurements made onboard commercial aircraft for better understanding processes controlling UTH distribution and variations. A number of publications can be found at Dr. Luo's website: (bad link removed). Starting from recently, this high-accuracy in situ data have been used to inter-calibrate the water vapor channel across NOAA and DMSP satellites (e.g., HIRS, SSM/T2, AMSU-B).

## **Thrust 3: Precipitation and Water Resources**

### **Thrust 3b: Land Hydrology**

- **Relevance to NOAA's mission and the strategic plan**

Managing environmental resources to meet nation's economical, social, and environmental needs is among the missions of NOAA. Snow as the most important source of fresh water in regional scale and an influential factor in earth's energy balance, in global scale, is very important of NOAA's goal in managing nation and earth resources.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

All or parts of each project directly support the goals and objectives of the following NOAA line offices: NESDIS, NCEP, NWS, NOHRSC, and OAR.

Improvement of snow retrieval algorithms is among the major concerns of National Weather service due to the fact that snow melt and water equivalent are critical for flood forecast and water resource managements.

- **Staff** – Dr. Reza Khanbilvardi; and Dr. Amir Eshraghi (Post Doctorate)
- **Students PhD**
- **Students MS**
- **Students Undergraduate -**
- **NOAA Collaborators (with Affiliations)** Al Powell, NOAA/NESDIS/STAR, Peter Romanov.
- **Other Collaborators (with Affiliations)** – Chris Derksen (Environment Canada)
- **Status** – on schedule
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

***NEW Project: Estimation of snow grain size and snow characteristics: variations and distribution using microwave data***

- Analysis of snowpack properties (Grain size, SWE, Temperature) profile and its effects on snow emissivity
- Analysis of emissivity data
- Analysis of snow profile
- Identification of the dominant snow layers affecting scattering
- Preparation for ground based field measurement of microwaves and snow parameters for the winter season

**Progress:** Based on our investigation, the sole way to understand the nature of snowpack is to observe its behavior and evolution throughout the whole season. Seasonal pattern of snow fall, snow metamorphism, thaw and refreeze, and finally snow melt significantly affects microwave signals. The results confirmed that over the shallow snow, it is observed that in 85GHz the emissivity data perform significantly better than TB data. The high error in the results from brightness temperatures is associated from atmospheric effect in 85GHz. The comparison in potential of Brightness Temperature and Emissivity data shows that the grain size derived from emissivity data indicates emissivities at high frequency (85 GHz) and brightness temperature at low frequencies (37 GHz) are very sensitive to the presence of snow on the ground for very low snow depth. In addition, in our previous research, the snow layers in the snowpack profile were analyzed and the effect of different layers and their properties (snow depth, grain size, density, and temperature) on microwave scattering were measured. To account for the vegetation changes winter NDVI data was used. The results revealed that the bottom layers of snow are the source of majority of the changes on the microwaves measured by the satellites. Unlike the satellite microwave data that have large foot-prints ( $> 30\text{km}^2$ ), the ground-based radiometer measures microwave signals in small

area ( $<3\text{m}^2$ ) in which the snow characteristics (depth, density, SWE, and grain size) can be measured and observed with high accuracy. These coordinated measurements of microwaves and snow parameters will provide the essential dataset for investigating the effect of individual parameters on snowpack. Considering the necessity of the ground-based radiometer for continuing the cutting edge research on snow, Snow Research Group of CREST initiated a campaign to acquire the most advanced ground-based microwave radiometers to escalate our level of understanding of snowpack.

### *Project 2: Reducing the negative effect of vegetation cover on soil moisture retrieval from microwave satellite data (Future SMOS Satellite)*

#### **Relevance to NOAA's mission and the strategic plan**

The main objective of this project is to develop a tool to quantify the effect of soil moisture on land surface emissivity under different vegetation cover types. The proposed tool would improve the accuracy of soil moisture retrieval from actual passive microwave sensors and eventually from the future combined Active/Passive microwave missions (the European SMOS and NASA/SMAP). This research addresses two of the six Joint Center for Satellite Data Assimilation (JCSDA) priority areas by improving our understanding of land surface emissivity and reflectivity over different land cover conditions and types and by assessing their effects on improving soil moisture retrieval from passive microwave sensors. These priority areas are: (1) improvement of the land surface data assimilation, and (2) contribute to the development of SfcOptics component of Community Radiative Transfer Model CRTM.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

This project builds upon previous research related to soil moisture mapping carried out by the PI and the Co-PIs in collaboration with NOAA-NESDIS Scientists. This research will also extend NOAA-CREST expertise on algorithm development for land cover mapping using a combination of expert systems (neural networks & fuzzy logic) and statistical approaches.

The final product of this proposed research will improve the soil moisture inputs to numerical weather prediction (NWP) and hydrological models through an innovative spatial data assimilation framework. Ingesting the satellite-based soil moisture into NWP distributed hydrology model, and integrating the model results into a widely used flood hazard mapping tool would add scientific and operational value to the remote sensing data in distributed hydrology, flood forecasting accuracy and flash flood warning capabilities. It will also provide NOAA/NWS with enhanced modeling capabilities to complement their lumped operational models.

**Staff** – Drs. Marouane Temimi; and Reza Khanbilvardi.

- **Students PhD** – Hamid Reza Norouzi
- **Students MS**
- **Students Undergraduate**
- **NOAA Collaborators (with Affiliations)** : Dr Sid Boukabara (NOAA-NESDIS), Dr Fuzhon Weng (NOAA-NESDIS)
- **Other Collaborators (with Affiliations):** Bill Rossow (CREST)
- **Operational Impact (Has Research been /or planned to be transitioned to operation)**

- **Status of the project with respect to the goals/objectives and benchmarks previously identified**

**Task (4) Investigating the difference in amplitude and phase between thermal and passive microwave brightness temperature**  
**- assess the impact of topography and atmosphere on the retrieval of land emissivity**

In the recent few months, we particularly focused on the use of low frequencies i.e. 6.9 and 10.7 GHz. In the previous step, preliminary results have been developed showing obtained emissivity maps at different frequencies. Also, it has been noticed that a fraction of almost 5 % of the obtained emissivity is over 1. This finding has been investigated in the last few months. The change of the source of the used LST product from MODIS to ISSCP did not alleviate the problem. The overestimation of the emissivity values over certain pixels seems to be caused by a difference in phase and amplitude between land skin temperature and passive microwave data. This difference can be explained by the difference in penetration depth of the infrared wavelength from which LST has been derived and passive microwave frequencies.

**Project 3 Evaluation of Vegetation Products over Geostationary and Polar platforms**

**Task : Inter-Calibration and Scaling-Up Algorithm for SEVIRI and NOAA-18 data**

- **Relevance to NOAA Line Office:** National Oceanic and Atmospheric Administration  
National Environmental Satellite, Data, and Information Service
- **Supervising PI : Prof. Roytman**
- **Students PhD: Clement S.**
- **NOAA Collaborators :** Dr. Felix Kogan, STAR, NOAA.
- **Status of the project with respect to the goals/objectives and benchmarks previously identified**
  - Geographic location Selection:* 13 study sites (within MSG SEVIRI footprint) were chosen from a variety of vegetation types in Africa and Europe (Figure 1).
  - Transform Data to allow comparisons:* At each stage in this process, the best estimate of the channel radiance should be produced, together with an estimate of its uncertainty. In this process Spectral Matching, Spatial Matching and Temporal Matching criteria will be followed.
  - Filtering:* Uniformity Test will be performed to reduce uncertainty in the comparison due to spatial/temporal mismatches. Outlier Rejection will be tested to prevent anomalous observations having undue influence on the results, “outliers” may be identified and rejected on a statistical basis.

*d) Statistical Analysis:*

*Interpolation:* The NOAA-18 climatology data will be overlaid onto SEVIRI data according to the tie point selection by visual interpretation and the resampling

procedure of AVHRR data by bilinear interpolation.

***NEW Project: To develop soil moisture retrieval algorithms using active and passive microwave remote sensing***

- **Relevance to NOAA's mission and the strategic plan**

The main objective of this project is to develop soil moisture retrieval algorithms using active and passive microwave remote sensing. The algorithm will be used for future SMAP mission for real time estimation of soil moisture. The benefits of accurate soil moisture retrieval are: (1) Economical and water conservation benefits through precision farming via rational irrigation scheduling based on soil moisture information (Save ~200 million dollars annual in 2 states of Great Plains: as per NOAA's 5 year plan); (2) Flood forecasting and risk assessment can be advanced up before disaster due accurate information on runoff and infiltration.

- **Relevance to NOAA Line Office (i.e., National Weather Service, National Ocean Service) strategic plan.**

- **Supervising PI or Co-Is** (only faculty member(s) at your institution): Reza Khanbilvardi, Tarendra Lakhankar

- **Students MS:** Dugwon Seo

- **NOAA Collaborators (with Affiliations)** : Dr. Xiwu Zhan, Physical Scientist, NOAA NESDIS Center for Satellite Applications and Research

- **Other Collaborators (with Affiliations):** Dr. Andy Jones, Cooperative Institute for Research in Atmosphere (CIRA); Dr. Rick Lawford, Center for Earth Observation Science (CEOS), CANADA

- **Operational Impact (Has Research been /or planned to be transitioned to operation)** Once the soil moisture retrieval model fully developed, validated and tested, it will available to NOAA and other research communities to retrieve soil moisture from future SMAP mission.

**Task (1) Compared different passive microwave models (equations) derived by several authors.**

**Task (2) Analyzed inner variable derivation and compare the differences.**

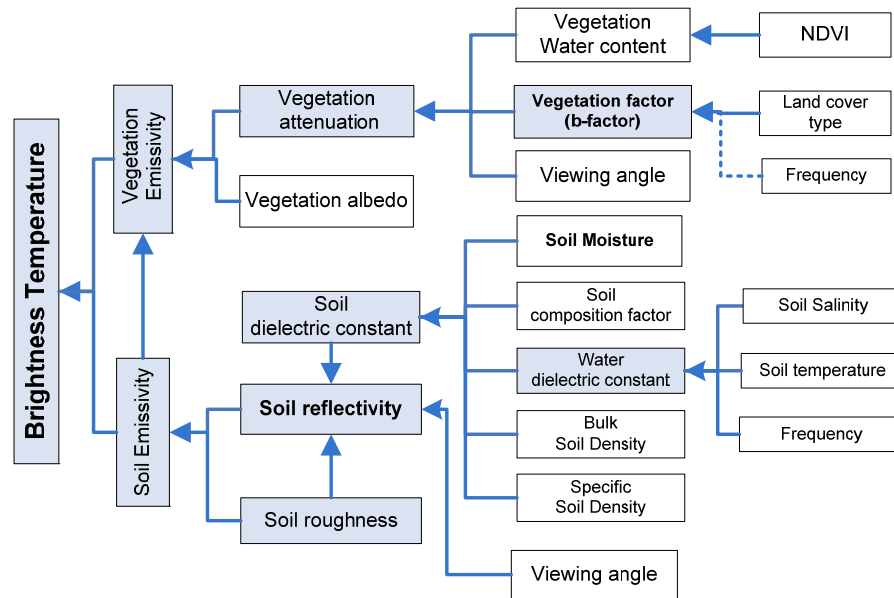
Considering the effect of the  $b$  factor to the soil moisture retrieval, the sensitivity analysis is carried out for the microwave emission model (Figure 1). The sensitivities of three different variables are computed as comparing to the soil moisture relatively. The  $b$  factor showed the highest sensitivity for wet soil and when the vegetation water content is above  $1 \text{ kg/m}^2$ . The vegetation water content is little less sensitive than the  $b$  factor in these conditions with base values. The surface roughness and temperature has moderate to low sensitivity relatively. Yet, it is observed that the efficiency of each variable varies with different soil and vegetation conditions. Therefore, the weight of the  $b$  factor should be the same ranking as the vegetation water content in the microwave emission model for the soil moisture retrieval.

The evaluation of the  $b$  factor in this study obtains a better understanding of the microwave emission model for the soil moisture and will contribute the improvement of the future satellite, SMAP (Soil Moisture Active Passive), which utilizes a unique active and passive L-



band microwave concept to measure the microwave emission and backscatter simultaneously.

**Figure 1.** Flow chart of the microwave emission model for soil moisture retrieval



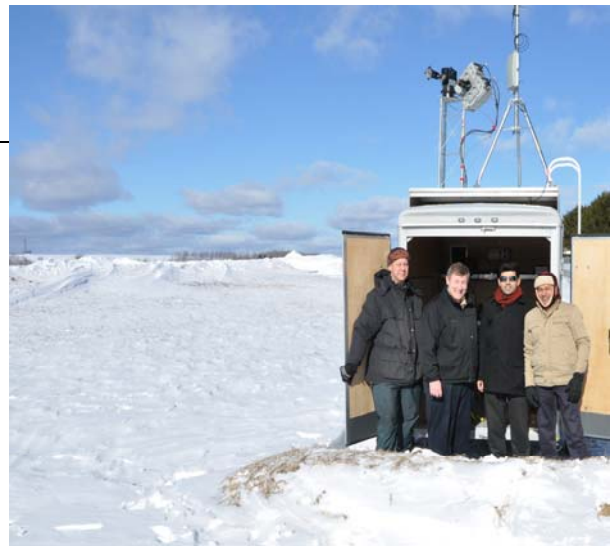
## NEW TASKS:

### **Task #1:** NOAA-CREST Multi-Frequency Microwave Radiometer for Snow Cover Measurement

**CREST Research Team:** Dr. Reza Khanbilvardi, Tarendra Lakhankar, Amir Azar, Civil Engineering Dept. CCNY

Snowmelt floods which break out in spring often bring enormous social and economic loss. Therefore accurate information of snow characteristics is required to increase the accuracy of hydrological forecasts. Microwave remote sensing has advantages over optical or infrared spectrum due to its capability to penetrate clouds, offers a great potential to measure the snow characteristics. NOAA-Cooperative Remote Sensing Science and Technology Center (NOAA-CREST) setup microwave radiometers to measure snow characteristics such as snow depth, and snow water equivalent at National Weather Service campus at Caribou ME. These radiometers will be operating at 37 and 89 GHz frequency, which coincides with Special Sensor Microwave Imager (SSM/I) frequency. The time series of microwave brightness temperature of snow-covered ground from an extensive in-situ data set collected during through the winter season will be used for develop new algorithm and validation of previously developed algorithm for snow cover and snow water equivalent estimation. The study will be conducted throughout the snow season to measure the snow depth, density, grains size, and snow water equivalent.

NOAA-CREST researchers Drs. Amir Azar and Tarendra Lakhankar installed the Radiometer on site on 8-9th February 2010. Hendricus Lulofs (meteorologist-in-charge), Mark Turner (data acquisition program manager), and William Desjardins (Technician) from National Weather Service, Caribou ME helped to setup the radiometer and promised to provide in-situ snow measurements. The wireless internet access was facilitates the trailer through local internet service provider. The radiometer site having wireless internet access, and the data is collecting in real time at the CCNY server through internet. In the future, it will be available through NOAA-CREST website.



2: Radiometer with NWS and CREST Scientists (Left to Right) Mark Turner (data acquisition program manager), Hendricus Lulofs (meteorologist-in-charge, NWS Caribou), Amir Azar and Tarendra Lakhankar (NOAA-CREST).

## **Task #2: Spatio-temporal variability of supraglacial lakes from ASTER and LANDSAT data**

CREST Staff: Marco Tedesco

CREST Students: Gina Stuvoll, Undergraduate student

NOAA Collaborators: Don Cline, NWS, NOAA.

Extensive decreases in glaciers and ice caps are contributing to sea level rise and melting of the Greenland ice sheet, especially on the western coast, has accelerated in recent years. Among the most important issues that need to be addressed there is the role of the so-called ‘supraglacial lakes’ over the Greenland ice sheet. When snow and ice melt, liquid water flows along the ice sheet. Some of it accumulates in large ponds or lakes. Little is known about these lakes and Gina has been supporting the study of these lakes by using visible and near-infrared satellite data. These lakes are important: evidence suggests that the drainage mechanism for some lakes may involve subsurface features, called ‘*moulins*’ and drainage via these channels has been observed, eventually down to the glacier bottom. This effect might be responsible for the acceleration of the ice sheet; The dark color of the lakes also reduces the ice sheet albedo (e.g., the ratio between outgoing and incoming solar radiation), thus increasing the amount of solar energy absorbed by the ice sheet installing the so-called positive feedback mechanism: the more melting produces more liquid water which in turn decreases the albedo which further increases the absorbed solar radiation thus inducing more melting, and so on. Important questions like ‘*is the number of lakes going to increase with increasing surface temperature or is it the volume or their surface going to change ?*’ or ‘*what is the relationship between the volume of liquid water accumulated in the lakes and the amount of water that reaches the ice-bedrock interface?*’ are some of the unanswered ones so far. Gina has been supporting to partially answer to these questions by means of high-resolution satellite visible and near-infrared (NIR) images (ASTER and LANDSAT). She has been working on the estimates of lake area and depth over selected regions of Greenland and she has been starting working on another fundamental aspect connected to supraglacial lakes and ice surface processes, such as cryoconite.

**Task #3:** Simulated interactions between soil moisture and climate using the GISS Model E GCM. Currently modeling the impacts of irrigation on regional climate under different greenhouse gas levels; comparing with satellite precipitation and cloudiness products; and developing application to drought forecasting (with Alma Reynoso-Cabral, CREST REU student; collaborators: Benjamin Cook and Michael Puma (NASA-GISS); Ajay Jha (Colorado State)).

**Task #4:** Began comparison of thermal and microwave soil moisture products over the Midwest, with the goal of producing a combined soil moisture product that combines the high spatial resolution of thermal methods with the robustness under cloud cover of microwave methods (with Zulamet Vega, CREST master's student; collaborators: Marouane Temimi (CREST/CCNY), Martha Anderson (USDA)).

**Task #5:** Studied the impact of warming on peak flow timing and magnitude for streams in the northeast US using stream gauge and meteorological records. Found a clear relationship, which varies by elevation (and hence mean winter temperatures and snowpack accumulation), between spring temperature and peak flow. Journal article in preparation (with CREST student J. Jimenez-Vargas).

**5. Report on the administrative and research meeting conducted in support of activities under this award. Summary minutes may be included as attachments.**

**CREST-NOAA/NESDIS/STAR Annual Technical Meeting, December 7-8, 2009**

On December 7-8, 2009, seventy scientists from NESDIS/STAR and affiliated universities of NOAA-CREST Cooperative Science Center attended the 2nd Annual Technical Meeting held at NOAA in Silver Spring, MD . The two-day meeting highlighted the significant accomplishments and partnerships that expanded over the years between CREST and NESDIS/STAR since the first Annual CREST-STAR technical meeting held in Camp Spring, MD, from February 24-25, 2003.

The morning plenary session of the first day began with the welcome remarks from Ms. Mary Kicza, NOAA Assistant Administrator for Satellite and Information Services, followed by overview presentations on NOAA/NESDIS/ STAR' s 20 year outlook and the current state of CREST research, education and capacity building. CREST thematic area and NESDIS/STAR research overview presentations were given during the afternoon of the first day of the meeting. The presentations comprised the CREST related research clusters/themes as aligned with NOAA's current missions and goals including: Climate and Air Quality; Coastal Remote Sensing; Land/Terrestrial Precipitation, Soil Moisture & Water Resources; Severe Weather and Hazards; and Education; Outreach and Professional Development. The day concluded with a group dinner in a local restaurant. The second day began with several break-out sessions by thematic area to discuss the expansion of research and educational collaboration between NOAA/NESDIS/STAR and CREST.

All groups reconvened after the lunch to share the results of these breakout session and discuss and develop a comprehensive action item for sustainable partnership between NOAA

and CREST for the next decade. For more information and the presentations please visit: <http://www.star.nesdis.noaa.gov/star/meetingCN2009program.php>

**CREST Internal Executive Committee teleconference calls** are held every 2<sup>nd</sup> Thursday of the month at 10:00 AM. The teleconference call essentially encompasses but not limited to agenda items viz., subcontracts; budget tracking; expenditure invoices; students' tracker database; newsletters-news items; conferences participation; performance reports; publications; and other routine events within CREST. The committee comprise of Center Director, Campus PIs from each institution (City University of New York, Hampton; University of Maryland, Baltimore County; University of Puerto Rico, Mayaguez; Bowie State University). Regular research meetings are conducted in CREST and its partners to monitor the research progress of their students.

**New partnership developed between NOAA-CREST and National Weather Services Eastern Regional Office, Bohemia, New York.**

A new partnership has been developed between NWS/WFO, New York and CREST in 2009. Reggina Cabrera, Chief of the Hydrologic Services Division in NWS Eastern Region attended the first meeting on March 30, 2009, held in the City College, NY. A second meeting was held on April 28th with Donald Cline of NOAA/NWS and Reggina Cabrera. As a follow-up a larger group of NOAA/NWS experts were invited on December 10, 2009, to finalize the collaborative research between CREST and NWS/ER. During these deliberations several NWS related issues including soil moisture satellite based products in the development of NWS Flash Flood Guidance (FFG) and the monitoring of draught and reservoir management were discussed. Ms. Cabrera has also stressed the importance of using satellite based products to mitigate coastal and urban flooding hazards by closely working with NWS experts at different River Forecast Centers and Weather Forecast Offices. A project proposal on "River ice monitoring in the Susquehanna River" has been submitted by CREST for possible funding support from NWS/WFO/NY, that demonstrate the beginning of this collaboration.

**Meetings attended by CREST Researchers:**

**William Rossow** attended the following meetings during the reporting period:

- 08-09 SEP09: KISS (Cal Tech) Feedback Workshop, Pasadena, CA, USA
- 10-11 SEP09: NOAA EPP Meeting, Silver Spring, MD, USA
- 16-18 SEP09: GEWEX Radiation Panel Working Group on Data Management and Analysis Meeting, College Park, MD, USA
- 12-16 OCT09: GEWEX Radiation Panel Meeting, Rostock, Germany
- 12-14 NOV09: NOAA EPP Forum, Washington, DC, USA
- ---17 NOV09: GEO Plenary, Washington, DC, USA
- 02-03 DEC09: NASA Energy and Water Study Team Meeting, College Park, MD, USA
- 07-08 DEC09: CREST Technical Meeting, Silver Spring, MD, USA
- 22-23 FEB10: NASA Calibration Team Meeting, Hampton, VA, USA
- 24-25 FEB10: Invited Seminar at U Michigan, Ann Arbor, MI, USA

Maraoune Temimi attended SMAP Canada workshop held in Montreal Canada from 6-7 October 2009.

Dr Temimi recently visited North East River Forecast Center in Tauten MA. During the two day visit to the center Dr Temimi has exchanged ideas and expertise with NOAA NWS scientists. A joint research plan is the process of being established.

Dr. Maroune Temimi, Alex Gilerson, Brian Vant Hull, Hangson Tang visited NWS Weather Forecast Office in Mount Holly, PA on February 1, 2010. They were received by the meteorologist-in-chief. A joint research project on the mapping of coastal floods is being defined to be conducted in collaboration with the NWS Weather Forecast Office.

Hamidreza Nourouzi (PhD candidate); attended the AGU Fall meeting in San Francisco CA from 14-19 December 2009.

Johnny Luo attended the following meeting:

- visited the University of Michigan, Nov. 12-13, 2009: Upon invitation of Prof. X. L. Huang of U. Michigan, Dr. Luo visited AOS department of Umich and gave a seminar. This visit was sponsored by a NASA MAP project in which Dr. Luo is a Co-I (Dr. Huang is PI).
- AGU 2009 Annual meeting, Dec. 15-18, at San Francisco and presented a poster.

Ruben Delgado attended the 1<sup>st</sup> District of Columbia-American Meteorological Society Chapter Meeting, February 2010.

Ruben Delgado and Raymond Hoff attended the 5<sup>th</sup> Lidar Workshop in Latin America, Buenos Aires, Argentina, November 2009.

UPRM NOAA-CREST Technical meeting Jan 28, 2010 in Stefani-230. All of the CREST professors and students attended and each CREST student gave his/her research presentation –See the APPENDIX-5.

Gina attended the Fall AGU meeting , on December 2009, in San Francisco where she presented a poster where she is first author.

## **6. Status of recruitment (both staff and post doctorates).**

### **At the City College of New York\*:**

Dr. Lakshmi Madhavan Momidi joined CREST in fall 2009 as Post Doctoral Scientist.

## **7. Status of Faculty/NOAA staff exchange**

None during the reporting period

## **Section II: Education & Outreach Efforts**

### **1. How many students and faculty were recruited to participate in academic programs, training, workshops, conferences or seminars?**



### **Recruitment, Education and Outreach:** **Outreach Programs (K-12)**

- **CREST High School summer and outreach**

Not Applicable during reporting period. See previous semi-annual reports for details.

- **Summer Science Enrichment, HU, Student Enrollment 25**

We are sorting through the 30+ applications for our upcoming summer REU program.

- **Teacher Workshops at Hampton University - Teachers Enrollments 10**

Not applicable during this reporting period. See previous semi-annual reports for details.

- **CREST-HU Graduate Student middle school visit**

Ciara Brown and Sydney Paul visited Lafayette Winona middle school in Norfolk, VA, on Monday, February 15, 2010. They participated in a Science Exposition coordinated by the chair of the school's science department, Mrs. Blackwell. They presented and discussed the field of Atmospheric Science with 12 classes of children (grades 6-8). They also described their CREST related research, what they study and where they attend graduate school (Hampton University). They answered numerous questions from the interested middle-school students and performed small simulations (experiments) of natural phenomena such as tornados, tsunamis, greenhouse gases and clouds. The kids really enjoyed it! Ciara and Sydney were excellent role models to these young middle-school students.



In 2006 the interdisciplinary undergraduate Earth System Science and Environmental Engineering (ESE) program was established at CCNY. The success of the program has contributed to increases in student enrollment.

Figure 1 shows the total number of students in the ESE Program since its inception in 2006. During the Spring 2010 semester, the ESE Program saw an increase in student enrollment to 59 students, which includes 42 males and 17 females.

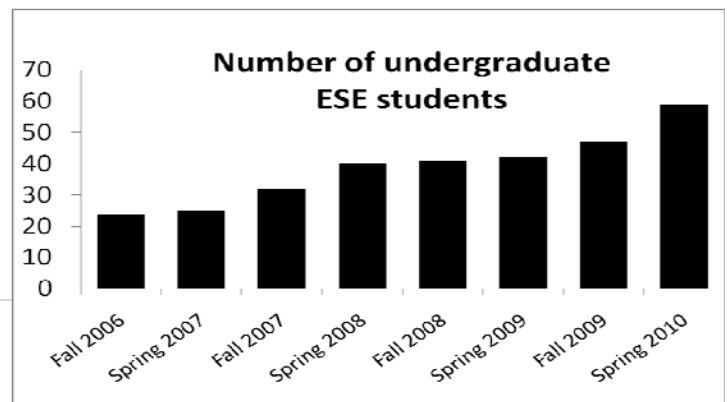


Figure 1. Student Enrollment in the ESE



## Graduation Rates

Spring 2009 – 3 students graduated with a BE degree in ESE

Summer 2009 – 4 students graduated with a BE degree in ESE

Winter 2010 - 1 student graduated with a BE in ESE

### *ESE graduates went on to the follow professional positions:*

- ✓ Environmental Engineer - Bahamas
- ✓ Environmental Engineer – NYC Department of Environmental Protection
- ✓ Management Associate – Con Edison
- ✓ Engineer - Northrop Grumman
- ✓ Engineer – Con Edison
- ✓ Senior Pollution Control and Prevention Coordinator - Anguilla
- ✓ Environmental Engineer – NYC Department of Transportation
- ✓ Environmental Engineering Intern – NYC Department of Design and Construction

The ESE program also prepares students for graduate studies as evidenced by ESE student enrollment in the following graduate programs:

- ✓ MIT – MS in Civil and Environmental Engineering
- ✓ Columbia University – MS in Earth and Environmental Engineering
- ✓ CCNY – MS in Civil Engineering
- ✓ Baruch College – MBA in Statistics

More details on the ESE program is shown in Appendix 5.

- **HU SEAS Minor, HU (enrollment 4-5)**

Currently, there are 2 SEAS minor students in the program.

## Graduate Education & Outreach

### Seminars and Workshops All Campuses – 25/year

- **21 Seminars conducted during this reporting period (see Appendix 4)**
- CREST Graduate Student Researchers - 20/year
  - Currently, CREST has 59 graduate (41 funded and 18 leveraged) students that are involved in CREST related research.
  - Miguel Bustamante and Eduardo Hernandez, CREST PhD students graduated in February 2010. Shuki Chaw and Ruhul Amin graduated in September 2009. Ruhul is working as Post Doctoral Scientist at NAVY Research LABS in Stennis)
  - Charles Hill and Jasper Lewis are scheduled to defend their Ph.D. dissertation's on March 29, 2010.
  - Robert Loughman visited James Madison University (Physics Department) on January 14, 2010, and Towson University (Physics, Astronomy and Geosciences Department) on February 19, 2010 to recruit prospective graduate students.

- Dr. Nikisa S. Jordan, 2009 UMBC NOAA CREST alumni, joined Northrop Grumman in January 2010.
- Debra Wicks Kollinge, an atmospheric physics graduate student, joined the UMBC CREST program.
- CREST New Faculty Recruitment - 1/year

Karen Block was recruited during the reporting period, as Assistant Professor, Earth and Atmospheric Science (EAS) Department, CCNY.

### **Recruitment and Outreach activities:**

#### ***University of Puerto Rico 21<sup>st</sup> Annual Job fair October 2<sup>nd</sup>, 2009, Mayaguez, Puerto Rico***

One of the most attended, CREST gathered information on 142 students. Most of these students are from engineering fields and are very interested in graduate studies. In the past two years, a total of five students have been recruited by CREST and are now part of the center as Master students. One student, Javier Jimenez, completed his Masters degree in December 2009. From this 21<sup>st</sup> annual job fair, five students are in the process of applying for Masters Degrees for fall 2010. Due to this excellent response, CREST is looking forward to participating in future UPRM job fairs.

#### **NOAA/EPP and NOAA/Corps Participated in the CCNY Career Fair, The City College of New York, October 7, 2009**

On October 7, 2009, CCNY's office of recruitment, placement and external relations in coordination with NOAA/CREST organized an information session for NOAA/EPP and NOAA Corps to educate and inform the CCNY students on various educational internships and career opportunities available at NOAA. More than 50 undergraduate and graduates attended the session. Most students returned back to the NOAA/EPP and NOAA/Corp career fair booth on October 8th held in the Great Hall, City College of New York.

#### **5th annual NOAA Educational Partnership Program Education and Science Forum, Howard University, November 12-14, 2009.**

Thirteen CREST faculty/staff and 32 students attended the Forum presented results from the City University of New York, Hampton University in Virginia, University of Maryland at Baltimore County, and the University of Puerto Rico at Mayaguez. Three of the sessions were chaired by CREST members, and two served as judges for student presentations. City College distinguished professor William Rossow and distinguished scientist Charles Vorosmarty provided keynote addresses for the sessions they chaired while Shakila Merchant presented and summarized the educational activities at CREST. At the forum, the bulk of the presentations were by students, with 19 CREST students giving oral presentations and 15 displaying posters. Among the oral presentations, Ana Picon won first place in the Remote Sensing and Satellite session and Heather Glickman was awarded 3rd place in the Climate in Air Quality and Global Change session. Among the poster sessions, Cheila Benavides was awarded first place and Christopher Spells received 3rd place in the Climate, Air Quality, and Global Change category, while James Rios received second place and Kevin Leavor and

Ciara Brown tied for 3rd place in the Remote Sensing and Satellites category. For some CREST students this was their first time presenting work outside their own institution and they found this experience very rewarding and educational.

**2. Enter data in the EPP provided Student Tracker Database for each student receiving direct support through this award. Please do not provide student data in any other format other than what is provided in the Student Tracker Database.**

Not applicable for this reporting period.

**3. What outreach activities (i.e., workshops, conferences, seminars) have the Center coordinated as part of the project? Report on any local, regional or national media that were involved on this activity. Specify all participants including students, faculty, partner organizations or institutions. Also, please provide copies of the news articles, press clippings and releases, pictures, etc. in the appendices. This information is particularly useful for the NOAA EPP/MSI web site, annual report, brochures and other outreach materials.**

CREST Lidar Network listserver was created ([cln@lists.umbc.edu](mailto:cln@lists.umbc.edu)). Electronic mail distribution list will allow for immediate communication between CREST institutions prior and during air quality events aiding in the determination and impact of regional and long-range transport of pollutants into the eastern US states and Caribbean. UMBC CREST lidar activities were carried out within the WMO-GALION framework. Timeseries and calendar of lidar measurements can be found at [alg.umbc.edu/UMAP](http://alg.umbc.edu/UMAP).

UMBC participated in a NOAA /NCEP and ARL field experiment with the Howard University/NCAS facility, from September 14-22, 2009 to provide direct planetary boundary layer height (PBLH) measurements. Lidar measurements helped to identify problems with the automatic PBLH calculation in the Real-Time Mesoscale Analysis (RTMA), used by plume dispersion modelers.

### **CREST in International Partnership with CaribEST in Dominican Republic- 31 August-2 September 2009**

A three day kick-off meeting on international partnership sponsored by the members of Caribbean Environmental Science & Technology Enterprise (CaribEST) was held during August 31 to September 2, 2009 at Santo Domingo, Dominican Republic. CaribEST is a program under the CUNY Cross-Roads Initiative at the City College of NY. The goal of the meeting was to set the stage for the planning of the CaribEST initiative and its activities by (1) Introducing partners to each other; (2) Discussing areas of mutual interest with possibility of collaboration; and (3) Plan a scientific conference in near future. Dr. Charles Vorosmarty Director of CUNY Cross Road Initiative at CCNY and CREST Distinguished Scientist is leading this activity to involve other Caribbean Nations in research and education of the water resources sciences.

### **Bronx High School of Science Ocean Science Bowl Team (2009-2010) – NOAA CREST**

continues to sponsor the BHSS Ocean Science Bowl Team. This year, the New York Regional NOSB Bay Scallop Bowl was held at Stony Brook University by the Marine Science Research Center on March 6, 2010. BHSS was a finalist among the sixteen participating schools from New York State. Each of the members of the BHSS team won a cash prize of \$750 for their strong performance. The members of the BHSS Team were Captain Ho Chit Siu, Senior Xiang Zhang, Junior Kezi Cheng, Sophomore Matias Tong, and alternate Diptesh Tailor. Backup team members Senior Joanna Kim, Junior Ariam and Junior Carissa Ho also attended the New York Regional NOSB Bay Scallop Bowl to cheer on the starting team. This year's team was new and inexperienced with the exception of Senior Captain Ho Chit Siu. The team is coached by Jerry Eng, a math teacher and Coordinator of Student Affairs at BHSS. Mitchell Fox who started the BHSS Oceanography team serves as a special consultant and technical advisor to the BHSS team. Dr. Reid Strieby, from the Bronx Community College and a CREST Faculty is the overall coordinator for BHSS-NOSB

### **Section III: Success Stories**

#### **1. What specific contributions has the project made to the Center, NOAA and partners?**

CREST and its partner institutions could integrate more cohesively with NESDIS. This program has also helped in developing extensive collaborations with other line offices viz. NWS; NOS; ETL. Regular seminars by NOAA scientists at CREST have helped the faculties and students to have in-depth interactions and thus strengthen the collaborations between NOAA scientists and CREST researchers. Several algorithms have been developed and or validated in Land and Hydrology research thrust that have resulted in several MS and PhD thesis dissertations. Attempts are underway to collaborate with Joint Center for Satellite Data Assimilation (JCSDA) and Air Resources Laboratory (ARL) labs as suggested by NOAA Scientific Advisory Committee members.

CREST has been benefited by Bowie State University efforts in development and deployment of conferencing, seminar, distance and online learning technologies. The NOAA CREST Live and archived seminar products enable a widely dispersed audience to "sit in" on NOAA CREST activities across all sites. Web-casts have been made live from both CCNY and UPRM in the past, and are archived at BSU for anytime/anywhere access.

**NOAA GEONETCast** - GEONETCast has been established as a way to aggregate environmental satellite data products and provide them to participants through digital satellite broadcast services (satellite dishes) rather than broadband Internet and the WorldWideWeb. As residents of sophisticated metropolitan areas with almost universal access to the 'Web, we fail to realize how many people fail to have similar access. GEONETCast uses 'satellite TV', a much more ubiquitous technology, to reach those who may not have access to the Internet. NOAA participates with European (Eumestat) and the Chinese Meteorological Administration to broadcast environmental data with similar technologies.

BSU has linked with NOAA GEONETCast to bring CREST as a whole to participate. BSU has procured a satellite receiving dish which will be installed in early March to capture

GEONETCast data broadcasts. Thanks to NOAA GEONETCast and UCAR funding, we will have an operational receiving station, both for BSU and University of Puerto Rico, Mayaguez (to serve as a Caribbean GEONETCast gateway) and a Kencast receiving server to capture and stage GEONETCast data products to the Web. We will be focussing on outreach with NOAA GEONETCast and hope to also have specially-created CREST data products from our own CCNY receiving station to stage to GEONETCast.

Installation of the BSU GEONETCast station will be fully documented to share with other NOAA GEONETCast users, and we have acquired a small 'toolkit' to share with others doing installations. The tool kit has cable termination supplies and an 'antenna signal finding' meter to help with installation. BSU has already received the antenna and are waiting for favorable weather conditions for outdoor installation of the 2.4 m parabolic dish. BSU CREST students will participate in the install. Once operational the GEONETCast will be installed at University of Puerto Rico Mayaguez. (More BSU related Outreach activities are reported in Appendix 5)

**2. How many students participated in Center projects or activities?**

Currently 92 (BS=27; MS=26; PhD=33 and HS = 6) students are participating in the center projects and/or activities. The students attended conferences including AMS, AGU, SPIE during the reporting period. Many students involved in Coastal studies also participate in field trips for water quality studies. 189 students trained in NOAA related sciences have graduated so far.

**3. What specific benefits were accrued to students, faculty members and the institution(s) by participating in the program?**

Students at CREST come from multi-disciplinary backgrounds and diversity. They get excellent opportunities to do research in CREST and NOAA related Sciences. Students also benefit through financial aids; in terms of tuitions, fellowship; stipend or internship; they also utilize the facilities at CREST that would not have strengthened or existed without the CREST program. CREST students also have access to the NOAA and NESDIS data and programs. Students and faculties have excellent opportunities to present their research works through participation in various conferences/workshops/seminars (AMS; AGU; IEEE; SPIE, Amer. Geog Assoc. etc).

They also increase their collaboration and scientific interactions with NOAA scientists by visiting NOAA labs and attending NOAA-CREST seminars. The list of seminars that were featured during the reporting period is documented in **Appendix 4**. (See CREST new website for more details on seminars and other CREST activities). CREST faculty members get the opportunity to work in collaboration with NOAA scientists and learn more about NOAA instruments and products. It provides another great source of knowledge and exchange of experience.

**4. To what extent has, the project or activities enhanced and improved outreach, education, training and NOAA related research at the institution(s)?**

**CREST's Satellite Earth Observation Center at the City College of New York**

As a result of very significant cost sharing by CCNY, an expanded satellite receiving station has finally been installed. It went operational in December 2007. Data types received and processed are from X-band transmitting polar orbiters (MODIS), and L-band data from geostationary (GEOS) satellites. MODIS products include cloud mask and cloud properties; aerosol concentration and optical properties; vegetation and land surface cover, surface temperature over oceans and land, ocean color, concentration of chlorophyll-a, among others. GEOS products include images of the Earth's surface and cloud cover derived from radiation samples of the Earth and its atmosphere. The system has been updated to allow real time access to AMSR-E crucial to the NOWCASTING efforts and will be further supported by leveraged microwave radiometers.

**5. Did students participate in site visits to NOAA laboratories and/or facilities?**

None during this reporting period.

**6. In what specific NOAA activity (e.g., NOAA research cruises) were students involved?**

None during this reporting period.

**7. What is the significance, and impact, of the research/demonstration activity to NOAA, Center and the local community?**

The distance/online learning technological developments supported by NOAA CREST through the local BSU PI, have served as a catalyst and model to campus-wide growth in capability. The growth has led to a broad interest and adoption of online/distance courses and outreach that will eventually benefit the community.

- The Weather station at CREST-CUNY, operational since December 2003, continues to provide real-time data on various parameters for NY City, research groups and other agencies.
- The new Satellite Data Acquisition Unit is operational now and receiving and archiving the data. The system essentially is a **2.4m Dual X/L-Band Satellite Acquisition System**, with capabilities to download data from various satellites (Terra; Aqua; OceanSat-1) and sensors (MODIS; AIRS; AMSU; AMSR-E; Ocean Color Monitor) from X-band. The Satellites on L-Band include; NOAA Polar Orbiters; FY-ID and Orbview-2 and sensors are; (AVHRR; DCS; ATOV; TOV; SeaWIFS; MVSIR). , which would serve as a very useful data resource for research community across the NE region.

**CREST LIDAR NETWORK— URPM Lidar Lab Inaugurated on September 15, 2009**

The NOAA-CREST partner institution at the Department of Electrical and Computer Engineering of the University of Puerto Rico at Mayaguez (UPRM) inaugurated its LIDAR (Light Detection and Ranging) laboratory on September 15, 2009, at the hands of Dr. Jorge Ivan Velez Arocho, the UPRM Chancellor. The LIDAR technology, which operates at three wavelengths is the first of its kind in the Caribbean region and is an important tool to study the



atmospheric particles known as aerosols using remote sensing methods. The three ultraviolet, visible, and infrared wavelengths permit acquisition of atmospheric data related to the climate change. “These particles which we call aerosols affect the weather conditions, and causes asthma are also responsible for global warming problems”, explained Dr. Hamed Parsiani, Director of the LIDAR laboratory and Professor of Electrical and Computer Engineering.

“The atmospheric data will be interpreted by the researchers and subsequently will appear in the Laboratory’s web page, which could be used by scientists and public community including medical doctors; urban planners for proper urban development, and decision-makers to develop important strategies that will affect the air quality in Puerto Rico” said the Vice Chancellor Dr. Arocho. The equipment valued at \$250,000 was mostly supported by NOAA-CREST, with additional support from NASA-EpSCOR and UPRM. As a part of the CREST Lidar Network (CLN), the UPRM lidar will operate in collaboration with other CREST partners—City University of New York, Hampton University and the University of Maryland, Baltimore County.

**Section IV: Grant Award Amendment Revisions to Task**

If applicable, the Center should report on revisions to tasks described in the grant award amendment. In addition, the description of the task revisions should include the impact of the revision on the grant award.

**AnaN/A**

Appendix 1  
Leverage Funds

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
<b>THRUST I: Atmosphere</b>						
Bronx CREED		Juliana Maantay John Anderson, Hampton/CREST &	21,250.00	85,000.00	Sep-07	9/1/2009
GoZCARDS	NASA-JPL	Lucien Froidevaux Irina Gladkova, Michael Grossberg	10,000.00	20,000	Sep-09	9/1/2010
Lossless Compression Algorithm for the GOES-R series Multi-spectral Advanced Baseline Imager- (ABI)	NOAA-NESDIS	(Data Compression Group) Irina Gladkova, Michael Grossberg	0	230,000.00	2/1/2008	2/1/2009
Algorithm for Quantitative Image restoration and Graphite Alogorithm Development Tool	NOAA_NESDIS	(Data Compression Group) Irina Gladkova and Michael Grossberg	40,000	80,000.00	9/21/2009	9/21/2010
Remote sensing Earth Science Sensor Data “Lossless” Compression Algorithm for the GOES-R	NOAA/NESDIS/OSD	(Tech Monitor – Roger Heymann)	0	220,000.00	2008	7/1/1905
Mid Infrared Technologies for Health and Environment, (MIRTHE)	NSF Engineering Research Center	Fred Moshary, CCNY	143,000	1,430,000.00	May-06	4/1/2011
Year 1 of “Three Dimensional Air Quality System (3D-AQS)	NASA Cooperative Agreement (NN-H- 04-Z-YO-010-C).	Ray Hoff, UMBC	0	1,113,740.00	2006	6/29/1905

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Profiling Air Quality over Baltimore	NASA NNX08AO93G/PS42 32 Maryland	Ray Hoff, UMBC	229,227.28	458,454.56	2009	7/2/1905
Measurements of Nocturnal Jets with UMBC ELF Lidar	Department of the Environment U00R6200819	Ruben Delgado, UMBC	15000	30000	2009	7/2/1905
Optimal blending of EOS observations, Goddard cumulus ensemble model, and MERRA reanalysis: towards a better database for testing cloud parameterization	NASA-ROSES 2008	Huang, X. L. (PI), Z. Luo (Co-I), W.-K. Tao (Co-I), D. Posselt (Co- I),	17,350	104,100	2009	7/4/1905
On the maintenance and use of A-Train simulators to evaluate the cloudiness and precipitation parameterization of global models	NASA-ROSES 2008	Stephens, G. L. (PI), Z. Luo (Co-I), K. Suzuki (Co-I),	9,058	54,353	2009	7/4/1905
Towards Assimilation of Satellite Data in Modeling Water Vapor Fluxes over Land	NASA/NEWS	Alan Lipton, SER (PI); William Rossow (Co- I)	24,824	148,945.00	2009	7/4/1905

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Multi-Variate Analyses of Cloud-Climate Feedbacks: Observations Compared to Climate Model Behavior	NASA	William B. Rossow, CCNY	126,417	758,504.00	2007	7/2/1905
Combining CloudSat, Calipso and A-Train Cloud Observations with ISCCP and Meteorological Data to understand the relation between cloud 3D-Structure and General Circulation of the Atmosphere.	NASA	William B. Rossow	161,560	969,365.00	2007	7/2/1905
Global Cloud Process Studies in the context of Decadal Climate Variability: Enhancement and Continuation of Data Analysis for the International Satellite Cloud Climatology Project (ISCCP)	NASA	William B. Rossow	102,997	1,209,972.00	2008	7/5/1905
Combining CloudSat, Calipso and A-Train Cloud Observations with ISCCP and Meteorological Data to Understand the Relation between Cloud 3D-Structure and the General Circulation of the Atmosphere	NASA	William B. Rossow	161,561	969,365.00	2006	7/1/1905
Extending the Cloud and Radiation Climate Record: Climate Calibration of the ISCCP/SRB Narrowband Imagers from 1983 to 2005	NASA	Laura Hinkel man, NASA Langley & Bill Rossow	5,000	30,000.00	2006	7/1/1905





Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Understanding Impacts of climate Change on Energy Infrastructure in Urbanized Coastal Area	NSF	Jorge Gonzalez	60998	121,996.00	8/1/2009	7/31/2010
Quantitative Image Restoration	NOAA/Contract	Irina Gladkova	41,000	82,000.00	Aug-09	7/1/2010
<b>THRUST II: Coastal Water Remote Sensing</b>						
Exploring Techniques for Improving Retrievals of Bio-Optical Properties of Coastal Waters	Office of Naval Research Stennis Space Center	Samir Ahmed	16,667	1,000,000.00	2007	7/2/1905
Biological Response to the Dynamic Spectral-Polarized Underwater Light Field"	Office of Naval Research, DOD MURI program	Samir Ahmed	103192.5	619,155	2009	7/4/1905
Development of the New Integrated Coastal Observation Platform in the Long Island Sound, NY with the Extensive Capabilities	NOAA/NA09NES42 80024	Samir Ahmed, Alex Gilerson	25,000	50,000.00	2009	7/2/1905
Monitoring Nutrients Content in the San Juan Bay Estuary using Hyperspectral Remote Sensing	Resources and Puerto Rico Water Environmental Research Institute	Fernandez Gilbes	0	5,000.00	2007	6/30/1905
Developing a protocol to use Exploring Techniques for Improving Retrievals of Bio-Optical Properties of Coastal Waters	Puerto Rico Sea	Fernandez Gilbes	0	50,000.00	2007	6/30/1905
Retrievals of Bio-Optical Properties of Coastal Waters	ONR	Samir Ahmed	150,000.00	900,000.00	1/1/2009	12/1/2012

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/Group	6 Month Period	Total Dollars to date	Start Date	End Date
Biological Response to the Dynamic Spectral-Polarized Underwater Light Field	ONR/DOD MURI Prog, Un of TX	Samir Ahmed	103,192.50	619,155.00	1/1/2009	12/1/2012
NOAA Interdisciplinary Scientific Environmental Technology (ISET) Cooperative Research Education Center	NCAT	Samir Ahmed	68,743.75	549,950.00	9/1/2006	8/31/2010
Exploring Techniques for Improving Retrievals of Bio-Optical Properties of Coastal Waters	ONR w/ NRL, Stennis Space Center	Samir Ahmed	175,000.00	700,000.00	1/1/2007	12/1/2009
<b>THRUST III: Land &amp; Hydrology</b>						
Develop Snow Prediction Algorithm from Satellite Data	NOAA/Contract/DG 133EO7CQ0077	Amir Azhar, Reza Khanbilvardi	25,000	50,000.00	Sep-09	8/1/2010
Improve the Nowcasting Algorithm based on Satellite Observations	NOAA-GOES-R3	Shayesteh Mahani, Reza Khanbilvardi, Robert Rabin, Mamoudou Ba, Bob Kuligowski, Stephen Smith, & Arnold Gruber	66,500	133,000	Sep-09	8/1/2010
Development of an Advanced Technique for Mapping & Monitoring sea & Lake Ice for the Future GOES-R ABI	NOAA/NA09NES440	Marouane Temimi; Reza Khanbilvardi	62,500	125,000.00	Aug-09	7/1/2010

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Environmental Entrepreneurship Program –Green Roofing Project	NOAA/EPP	Reggie Blake	49931.4	499,314.00	3/1/2005	2/28/2010
Surveying Supraglacial Lakes in West Greenland: Understanding and Documenting Climate Change	WORLD/Private Indu	Marco Tedesco	7685	15,370.00	4/1/2009	3/31/2010
Inter-Calibration & Scaling-up Algorithm for SEVIRI... (CREST)	NOAA/NA09NES44 00014	Lennoïd Roytman; Reza Khanbilvardi	62,500	125,000.00	Jul-09	7/1/2010
Collaborative Adaptive Sensing of the Atmosphere Puerto Rico Student Testbed	NSF	Sandra Cruz PI, Eric Harmsen Col UPRM/CREST	0	3,000	10/1/2007	7/30/2008
Research Experiences for Undergraduates (REU)	NSF	Sandra Cruz PoI/UPRM/NSF CASA Project	2500	5,000	6/1/2009	7/31/2010
Predicting Climate Variability and its Impact on Water Resources in the Caribbean Region	NASA	Eric Harmsen	1250	5,000	4/1/2007	4/1/2009
NSF-CASA Project	NSF	Eric Harmsen	3,000	6,000.00	2007	6/30/1905
Rapid Detection of Soils and Drinking Water Sources impacted by salt water flooding	NASA-GSFC	Eric Harmsen and Leonid Roytman	0	20,000.00	2008	7/1/1905

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
NSF-CASA Project	NSF	Nazario Ramirez	0	6,000.00	2007	6/30/1905
Multi-Sensor QPE	NOAA/NWS	Reza Khanbilvardi and Shayesteh Mahani	0	50,000.00	2008	7/1/1905
Transitioning GOES-Based Nowcasting Capability into the GOES-R Era	NOAA-GOES R3	Shayesteh Mahani	0.00	150,000.00	Jan-08	12/1/2008
GOES Satellite Stations for Urban Nowcasting and Snow Grain Size	NOAA/NESDIS	Reza Khanbilvardi	0	185,000.00	Oct-06	9/30/2008
Improve the Nowcasting Algorithm based on Satellite Observations	NOAA-GOES-R3	Shayestah Mahani, Reza Khanbilvardi, Robert Rabin, Mamoudou Ba, Bob Kuligowski, Stephen Smith & Arnold Gruber	0.00	128,000.00	Sep-08	8/1/2009
Multi-Sensor Rainfall Estimation over Radar Gap Areas	NWS	Shayestah Mahani & Reza Khanbilvardi	44,000.00	80,000	Jan-09	12/1/2009
Developing Hydrologic Model	NSF-CASA	Ph.D. Student: Alejandra Ross	1500	3000		
Calibrating Hydrologic Model	NASA IDEAS	M.S. Student: Alexander Racaman	0	5000	N/A	N/A

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Ice Monitoring in the Susquehennna River using Satellite Imagery	NOAA	Maraune Temimi	50,000.00	100,000.00	2/1/2010	1/1/2011
Coastal Flood Monitoring using active Microwave data	NASA	Maraune Temimi	18,750.00	75,000.00	10/1/2009	9/1/2011
Toward Assimilation of Satellite Data in Modeling Water Vapor Fluxes over Land	NASA, NEWS	Alan Lipton, AER and William Rossow	18618.125	148,945.00	2008	7/4/1905
Mesoscale Organization of Precipitation Convection and Large-Scale Convective Coherence in the Tropics: Modeling, Analysis and Prediction	NASA MAP	Mitchell Monecrieff , NCAR and William Rossow	38,333.33	230,000.00	2009	7/4/1905
WaterNet: The NASA Water Cycle Solutions Network	NASA	Charles Vorosmarty	1041862.5	2,083,725.00	7/1/2008	9/30/2009
Annual Colloquium & Early Career Exchange Program (CREST)	NOAA/NA09NES44 00012	Shakila Merchant; Reza Khanbilvardi	18500	37,000.00	Jun-09	7/1/2010
Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
On the Maintenance and Use of A-Train Simulators to Evaluate the Cloudiness and Precipitation Parameterizations of Global Models	NASA	Luo Zhengzhao	2,942.17	17,653.00	5/5/2009	5/4/2012

Establishing the application of satellite imagery to improve coastal and estuarine Models	NASA	Reza Khanbilvardi	30,601.25	122,405.00	9/15/2009	9/14/2011
Development and Application of Diagnostic Analysis tools for investigation differences between observed and model cloud behavior	Colorado State University	William Rossow	6,000	60,000.00	7/1/2006	6/30/2011
NEWS Science Integration Team	NASA	William Rossow	19,698.38	157,587.00	7/23/2007	7/22/2011
Improving Surface Mass Balance Estimation of the Greenland Ice Sheet Through Assimilation of Multi-Senso Satellite Products and Ground Measurements	NSF	Marco Tedesco	95,405.00	572,430.00	9/1/2009	8/31/2012
Estimation of Melt Onset and Refreezing Dates From Passive Microwave Observations by Means of a Dynamic Diurnal Amplitude Impact of Climate Change and Variability on the Nation's Water Quality and Ecosystem State	NASA	Marco Tedesco	21,000.00	42,000.00	8/17/2009	8/16/2010
	EPA	Charles Vorosmarty	46,412.00	278,472.00	10/1/2009	9/30/2012
CREST: Transitioning GOES-Based Nowcasting Capability into the GOES-R Era	NOAA	Shayesteh Mahani	33,250.00	133,000.00	9/21/2008	9/20/2010
CREST: Satellite Earth Science Sensor Compression and Product Algorithm Research	NOAA	Reza M. Khanbilvardi	25,000.00	50,000.00	9/21/2009	2/20/2010



Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
Optimal Blending of EOS Observations, Goddard Cumulus Ensemble model and MERRA Reanalysis: Towards a Better Test- bed Database	MICHIGAN TECH UNIV	Luo Zhengzhao	22,500.00	45,000.00	5/5/2009	5/4/2010
Nonlinear and Threshold Responses to Environmental Stresses Inland-River Networks at Regional to Continental Scales	MARINE BIOLOGICAL LAB	Charles Vorosmarty	33,750.00	135,000.00	9/1/2008	8/31/2010
CREST: Satellite Earth Science Sensor - Task VII	NOAA	Reza Khanbilvardi	41,000.00	82,000.00	9/21/2009	9/20/2010
Toward Assimilation of Satellite Data in Modeling Water Vapor Fluxes over land	A AND E RESEARCH INC	William Rossow	2,735.63	21,885.00	11/1/2009	5/11/2013
River Ice Monitoring Over the Susquehana River Basin Using Remote Sensing Data	NOAA	Reza Khanbilvardi	52,500.00	105,000.00	1/1/2010	8/31/2011
CloudSat and Calipso Science Team and Modeling/Analysis of A-Train Related Data	NASA	William Rossow	21,759.88	174,079.00	8/15/2007	8/14/2011

Title	Funding Agency	PI/Co- PI/Recipient/Group	Six Month Award	Total Award	Proposal Submission Date	Status
Observing Systems Network to Support and Enhance Calibration/Validation of Ocean/Atmosphere	NIST	Samir Ahmed		0.00	7/13/2009	Pending

Title	Funding Agency	PI/Co-PI/Recipient/Group	Six Month Award	Total Award	Proposal Submission Date	Status
Characterizing Strong Storm Dynamics by Analysis of Cloudsat-Calipso Observations Combined With Other Satellite Data Products	NASA	William Rossow		0.00	7/22/2009	Pending
Tropical Convective Processes: New Insights From Satellite/Modelling Perspective and Framework for Evaluating Cumulus Parameterization	NASA	Zhengzhao Luo		0.00	7/23/2009	Pending
Role of Colloids on the Fate and Transport of Manure-borne Steroid Hormones and Veterinary Medicines in the Environment	CAMILLE & HENRY DREYFUS	Pengfei Zhang		0.00	8/10/2009	Pending
Toward a Better Understanding of Deep Convective Processes and Connection to Atmospheric Energetic Using DOE ARM Climate	DOE	Zhengzhao Luo		0.00	8/31/2009	Pending
On The Control of Surface Boiling as Alternative to Effective High Heat Flx	NSF	Jorge Gonzalez		0.00	9/17/2009	Pending
Integrating Land-to-Ocean Flux Dynamics: A Focus on Global Change in the Coastal Oceans	NASA	Charlie Vorosmarty		0.00	9/18/2009	Pending
Development of a Snowmelt Flood Nowcast Alarm System (FNAS) Over the US Great Plains	NSF	Shayesteh Mahani		0.00	12/6/2009	Pending
Sediment Transport in Highly Unsteady and Non-Newtonian Flows Induced by Dam Failure	NSF	Hansong Tang		0.00	12/7/2009	Pending

Collaborative Research: OPERA: The Search Collaboratory	NSF	Charles Vorosmarty	0.00	12/10/2009	Pending
IGWCO Planning Meeting and Water Resource Assessment and Applications Workshop	EPA	Charles Vorosmarty	0.00	1/11/2010	Pending
Collaborative Research: Spatio-Temporal Characterization of Optical, biological and Chemical Properties of Cryoconite Systems	NSF	Marco Tedesco	0.00	1/13/2010	Pending
An Environmentally Sensitive and Renewable Energy (ESRE) Curriculum for Engineers	NSF	Jorge Gonzalez	0.00	1/20/2010	Pending
Crest Support to the NESDIS Cooperative Research Exchange Program	U OF MARYLAND	Reza Khanbilvardi	0.00	1/29/2010	Pending
Development of Validation tools and Proxy Data for Goes-R ABL Air Quality proving Ground for the Northeast (NY Metro Region)	NOAA	Barry Gross	0.00	2/5/2010	Pending
BRIGE: Investigation of Rheology and Wall Slip Behavior of Activated Sludge	NSF	Hansong Tang	0.00	2/25/2010	Pending
Prototype Development of a Microwave Radiometer Simulator for Land Surface and Precipitation Characterization	PRINCETON UNIV	William Rossow	0.00	1/10/2028	Pending
Consequences of Global Change for Water Quality	EPA(STAR)	Charles Vorosmarty	N/A	N/A	N/A
Collaborative Research: AON RIMS: An Integrated Hydrographic Monitoring Systems and Supporting Framework for the Arctic Observing Network	NSF/ARC	Charles Vorosmarty	760,677.00	N/A	pending

Project Title	Sponsoring Agency	PI/Co-PI/Recipient/ Group	6 Month Period	Total Dollars to date	Start Date	End Date
A Test Bed to Develop the GEOSS Global Water Cycle Observing Nowcast System and its Linkages with the GEOSS Sustainable Agriculture and Global carbon Observation System Applications	NASA	Charles Vorosmarty	NOI		7/15/2008	pending
GEOSS Sustainable Agriculture and Global carbon Observation System Applications Automated Framework for the Operation	.	.		0		0
GEOSS Global Terrestrial Water Observing System	NASA	Charles Vorosmarty	NA		6/30/2008	Pending
<b>TOTAL</b>				4,138,751.86	20,997,019.56	
<b>TOTAL (6 months reporting period)</b>				3,378,074.86		
<b>TOTAL PENDING</b>				760,677.00		

Appendix 2  
**Research Tracker**

Reporting Period September 1, 2009 to February 28, 2010

Projects	Task (with each Projects)	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>Thrust: Remote Sensing Application in Climate &amp; Air Quality</b>					
<b>Thrust 1a: Climate Applications and Remote Sensing</b>					
<b>Project 1: Middle Atmospheric Remote Sensing</b>	<p><b>Task (1) SBUV/2 validation, calibration and trends (Nazaryan)</b></p> <ul style="list-style-type: none"> <li>• Validate the ozone retrievals obtained by the SBUV/2 experiment.</li> <li>• Study the performance of those instruments and investigate their calibration issues.</li> <li>• Continued Trend analysis of the ozone retrievals obtained by the NOAA-9, NOAA-11, NOAA-16, NOAA-17, and NOAA-18 SBUV/2 experiments.</li> <li>• Development of cirrus cloud climatology.</li> </ul> <p><b>Task (2) Polar Mesospheric Cloud (PMC) and Polar Stratospheric Clouds (PSC) and polar vortex studies (Russell + Hill)</b></p> <ul style="list-style-type: none"> <li>• Update Analysis with AIM</li> </ul>	<p><u>Hampton:</u> Pat McCormick, Bill Smith, &amp; James Russell, John Anderson; Robert Loughman, Stanislav Kireev, Hovakim Nazaryan, Mike Hill</p>	<p>Lawrence Flynn (NOAA/NESDIS) for Tasks 4, 5 &amp; 7; and Dr. I. Petropavlovskikh, NOAA/CIRES for Task 6.</p>	<p>Paul Menzel, University of Wisconsin, Madison; D. Rault and D. Flittner (NASA Langley Research Center, Climate Science Branch), G. Taha, J. Li and G. Jaross (Science Systems and Applications, Inc., (SSAI) Lanham, MD); K. Bush (Science Systems and Applications, Inc., Hampton, VA); James M. Russell, Center for Atmospheric Sciences (CAS)/Department of Atmospheric and Planetary Sciences (DAPS) ; Larry Gordley (GATS inc), Mark Hervig (GATS inc), Scott Baily (Virginia Tech); William Rossow, Distinguished Professor, CUNY</p>	<p><b>PhD HU</b> Chris Spells (Tasks 4 &amp; 7); Charles Anthony Hill (Tasks 2 &amp; 3) <b>MS /HU–</b> Kaba Bah* (non-funded – Task 7) ; Sydney Paul (Task 1); Carl Arrington, Jason Bernier, Chris Queen (Task 2)</p>

\* Leveraged Students



Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
	<p>and CALIPSO measurements</p> <p><b>Task (4) Upper Atmosphere Trend Improvements (Anderson)</b></p> <ul style="list-style-type: none"> <li>Investigate HALOE HCl time-series as a proxy for Cl in ozone regression models</li> <li>SPARC WAVAS II (NEW)</li> <li>GozCARDS (New)</li> <li>Tropical Cyclone Analysis</li> </ul> <p><b>Task (5) Limb Scattering Retrieval Improvements and Applications (Loughman)</b></p> <ul style="list-style-type: none"> <li>Address outstanding issues for the LS retrieval problem (inhomogeneous scenes, problems specific to the OMPS Limb Profiler instrument, etc.), and begin to study OMPS data as it becomes available</li> </ul> <p><b>Task (6) Brewer/Umkher Algorithm Development, Data Validation and Analysis</b></p> <ul style="list-style-type: none"> <li>Continuous Validation and Inter-Comparison of Dobson and Brewer Ozone Datasets with SBUV and other available measurements</li> </ul> <p><b>Task (7) Trace Gas and Aerosol Climatologies and Analysis using Multiple RS techniques including CALIPSO and A-Train Data (Nazayran/McCormick)</b></p>			<p>Karen Rosenl of NOAA/ESRL and Sam Oltmans of NOAA/ESRL</p>	

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
	<ul style="list-style-type: none"> <li>Development of Cirrus Cloud Climatology</li> </ul>				
<b>Project 2: Analysis of Global Observations</b>	<p>Task (1) Comparison and Evaluation of Global Products</p> <p>Task (2) Development of Non-linear analysis approaches to elucidate the nonlinear, multi-variate relations that describe the behavior of a very complex system like the climate</p> <p>Task (3) Global Energy/Water Cycle Study through Complementary Approaches</p>	<p>Bill Rossow, Distinguished Professor,  <u>Research Associates:</u>            Dr. Elies Campmany, Dr. Deniz Gencaga, Ms. Violeta Golea, Dr. Ademe Mekonnen, Dr. Fabrice Papa, Ms. Cindy Pearl, Dr. Eric Tromeur, Ms. Alison Walker,</p>	<p>Drs. John Bates; Ken Knapp; Ana Pinheiro and Lei Shi, (NCDC); Dr. Graeme Stephens, Director of NOAA CIRA at Colorado State University; Dr. Steve Miller, Deputy Director of NOAA CIRA at Colorado State University</p>	<p>Dr. Mike Bauer, Columbia University at NASA GISS; Dr. Anthony Del Genio, NASA GISS; Mr. Joe Ferrier, NASA GISS; Dr. Kevin Knuth, SUNY Albany; Dr. Luiz A.T. Machado, CPTEC, INPE (Brazil); Dr. Catherine Prigent, Paris Observatory (France); Dr. David Randall, Colorado State University; Dr. Anastasia Romanou, Columbia University at NASA GISS; Dr. Graeme Stephens, Colorado State University; Dr. Claudia Stubenrauch, LMD (France); Dr. George Tselioudis, Columbia University at NASA GISS; Dr. Duane Waliser, JPL; Dr. Yuanchong Zhang, Columbia University at NASA GISS</p>	<p><b>PhD:</b>            Marzieh Azarderakhsh  <b>UG-CUNY</b>            Charles Sosa;</p>

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<p><b>Project 3: Hyper spectral Remote Sensing Algorithm Development, Application, and Validation</b></p>	<p>Task (3) Conduct case study analyses in which the meteorological results, obtained from the application of the hyperspectral profile retrieval algorithm to METOP IASI data, , are compared with results produced by operational satellite data centers (i.e., EUMETSAT and NESDIS). Adapt the retrieval software so that it can be applied to the NPP Crosstrack Infrared and Microwave Measurement System (CrIMMS). Demonstrate the utility of the CrIMMS research algorithm using results produced from its application after the NPP satellite is in orbit.</p>	<p>Prof. W.L. Smith and Stanislav Kireev, Hampton University</p>	<p>Dr. M. Goldberg, E. Maturi (NOAA/NESDIS)</p>	<p>D. Zhou (NASA/LaRC), and H-L. Huang (UW/CIMSS)</p>	<p><b>MS – HU</b> Melissa Yesalusky</p>
<p><b>Project 4: Data Compression Algorithms</b></p>	<p>Task (4) Develop Application-Centric Notion of Near-Lossless Compression Task (5) Coupling Compression and Error-Correction Methods.</p>	<p>Irina Gladkova &amp; Michael Grossberg, Computer Science; Leonid Roytman, Electrical Engineering &amp; Srikanth Gottipati (Post Doctorate Scientist)</p>	<p>Roger Heymann (OSD), Tim Schmit (STAR), Walter Wolf (NESDIS)</p>	<p>Paul Menzel (CIMSS, University of Wisconsin, Madison)</p>	<p><b>UG:</b> Paul Alabi (non-funded), Peter Alabi (non-funded), Tence George and Malka Rabinowitz (funded).</p>

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
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**Thrust 1b: Troposphere Air Quality (TRAQ)**

<p><b>Project 1: Satellite Algorithm Development and Validation</b></p>	<p>Task (1) Analysis &amp; Refinement of regional MODIS AOD by tuning vis-mir correlations using Hyperion and ground-based data.            Task (2) Inter comparison of Directional Surface Albedos MODIS-MISR.            Task (3) Inter comparison of MODIS and GASP Derived BRDF.            Task (6) MODIS/GASP Aerosol Optical Depth.            Task (7) Improved CALIPSO Retrievals using Path Reflectance Constraints            Task (8) CALIPSO Quid-Pro Quo Validation</p>	<p><b>CCNY:</b> Prof Barry Gross, Stanley Gedzelman, Fred Moshary, Dr. Matthias Jerg, Yonghua Wu-  <b>UMBC:</b> Prof Ray Hoff <b>Hampton U:</b> Prof. Pat McCormick, Dr. Jia Su <b>UPRM</b> Hamed Parsiani</p>	<p>Shobha Kondragunta, Chuanyu Xu, Istvan Laszlo (NESDIS), R. Michael Hardesty (ESRL)</p>	<p>Rob Levy (NASA GSFC), Allan Huang, Steve Ackerman, Tony Wimmers (CIMSS), Jill Engel-Cox (Battelle), Ana Prados, Hai Zhang (JCET), Mike Woodman (MDE)</p>	<p><b>P PhD:</b>  <b>CCNY:</b>Ana Picon, Eduardo Hernandez, Min Min Oo*, Yuzhe He*, Alexandra Tsekeri- <b>UMBC:</b> Nikisa Jordan, <b>Hampton</b> Jasper Lewis, Robert B. Lee and Kevin Leavor  <b>Students MS:</b>  <b>UMBC:</b> Kamonayi Mubenga,  <b>UPRM</b> Javier Mendez  <b>Students Undergraduate:</b>  <b>UPRM</b> Dolly Hernandez</p>
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Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>Project 2: Ground Based Remote Sensing Network</b>	Task (1) Shadow band Network Implementation and Quality Assurance Task (2) Shadow Band Network Operation and Analysis Task (3) UPRM Lidar Implementation and Refinement Task (5) Data Collection and Analysis Task (6) Hampton Lidar Implementation and Refinement Task (10) CREST Lidar Network Observation-PBL Dynamics	<b>CCNY-Faculty</b> Fred Moshary, Barry Gross, Sam Ahmed, Dr. Yonghua Wu, Ben Herman <b>NYCCT</b> Prof Reginald Blake & Viviana Vladutescu <b>UPR-Faculty</b> Hamed Parsiani, Olga Mayol, <b>UMBC</b> Prof. Ray Hoff, Ruben Delgado <b>Hampton</b> Prof. Pat McCormick, Dr. Jia Su	Shobha Kondragunta and Matthew Seybold (NESDIS), Michael Hardesty, John A. Ogren, and Patrick Sheridan (ESRL), Israel Matos ( NWS)	Mikael Alexandrov and Brian Cairns (NASA GISS), Rich Ferrare (NASA LARC), Steve Ackerman Tony Wimmers (CIMSS), David Whiteman and Brent Holben (NASA GSFC), Kevin McCann, and Meloe Kacenenbogen (JCET), Belay Demoz (Howard University), Michael Woodman (Maryland Department of the Environment), , (Howard University), David Whiteman (NASA-GSFC)	<b>PhD CCNY:</b> Lina Cordera, Miguel Bustamante, Shukie Chaw, <b>UMBC</b> Nikisa S. Jordan <b>Hampton</b> Robert B. Lee and Kevin Leavor <b>MS UPR</b> Javier Mendez <b>Undergraduate:</b> <b>CUNY:</b> Alex Tejada, Emanuel. Hereira, B. Perez, Stacia Green <b>UPRM</b> Mariano Marte

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>Project 3: Ground Based In-Situ Measurements, Sampling, and Speciation</b>	Task (4) Implement Sampling and Speciation Protocols Task (5) Comparison Studies of Data from Multiple in-situ Instruments	<b>CCNY</b> Prof. Barry Gross, Fred Moshary, Jeff Steiner, Urs Jans, <b>UPR-RP</b> Olga Mayol	Shobha Kondragunta, Istvan Laslo (NESDIS), Paul Menzel (NESDIS and University of Wisconsin), John A. Ogren, Patrick Sheridan (ESRL), Israel Matos (NOAA NWS San Juan)	Pat Lavin and David Wheeler (NYS DEC), Prof. N. Eby (U Massachusetts)	<b>PhD CCNY:</b> Diomaris Padilla <b>MS CCNY</b> Stacy St. John <b>UG: CCNY,</b> Daniel Gratkowski*, Theresa Carranza* <b>UPR-RP</b> Carlos Reyes De Jongh
<b>Project 4: Air Pollution Modeling and Model Validation</b>	Task (1) CMAQ Aerosol PM Validation	Barry Gross, & Jorge Gonzalez, CUNY	Shobha Kondragunta, NOAA/NESDIS/STAR	Jia-Yeong Ku, Chris Hogrefe, Gopal Sistla (NYS DEC), Craig A. Tepley (Arecibo Observatory), Robert Bornstein (San Jose State U)	<b>PhD CCNY</b> Lena Cordera, Chuen Mei Gan* <b>MS</b> Daniel Comarazamy, Alex Miranda
<b>Project 5: Health Impacts</b>	Task (1) Air Dispersion Model Examination and Selection Task (2) Adapt Air Dispersion Model for the Region; Task (3) Air Dispersion/GIS Model Integration.	Juliana Maantay	Ralph Ferraro and Bruce Ramsay (NESDIS)	Hal Strelnick (Montefiore Medical Center/Albert Einstein College of Medicine), Peter Arno (New York College of Medicine), Gretchen Culp (New York City	<b>PhD:</b> Andrew Maroko <b>MS:</b> Rosa Perez, Kristen Grady* <b>UG</b> Brian Morgan*,



Projects	Task (with each Projects)	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
				Department of Health), Nancy Sohler (City College of New York, Sophie Davis School of Biomedical Education), South Bronx Environmental Justice Partnership; New York State Department of Health	
<b>Thrust 2: Remote Sensing of Coastal Waters</b>					
<b>Project 1: Evolution of measurement approaches for coastal water bio-optical properties</b>	Task (2) Assessment of the angular properties of the underwater light fields for different turbid coastal conditions and atmospheres. Task (3) Extension of Studies to Retrieval Approaches in Shallow Waters	Profs. S. Ahmed, B. Gross and F. Moshary, Drs. A. Gilerson and J. Zhou (CUNY), Prof. F. Gilbes (UPRM) and Drs. Alex Gilerson and Jing Zhou (Post Doctorates)	Dr. M. Wang, STAR, Dr. R. Stumph, NOAA's National Centers for Coastal Ocean Science (NCCOS)	Dr. J. Chowdhary – Columbia University, NASA GISS, Prof. J. Schalles – Creighton University, NE, Dr. D. Gray, Naval Research Laboratory.	<b>PhD</b> -R. Amin, S. Hlaing*, A. Tonizzo*, I. Ioannou* - CCNY <b>MS</b> - W. Zheng, K. Zhao - CCNY <b>UG</b> - L. Delacruz, S. Elzeftawy*, R. Singh* - CCNY
<b>Project 2: Field measurements in coastal waters for algorithm testing/development and satellite validation</b>	Task (2) Perform field measurements in Long Island waters, and opportunistically at other sites on the East coast and Puerto Rico in coordination with satellite over flights and atmospheric aerosol parameters measurements. IOP and radiance	Profs. S. Ahmed, B. Gross, F. Moshary, Drs. A. Gilerson, J. Zhou (CUNY), Prof. F. Gilbes (UPRM)	Dr. M. Wang, STAR, Dr. R. Stumpf, NOAA's National Centers for Coastal Ocean Science (NCCOS), Joaquin Trinanes, Acting NOAA CoastWatch	Dr. J. Chowdhary – Columbia University, NASA GISS, Prof. J. Schalles – Creighton University, NE, Dr. R. Arnone, Naval Research Laboratory, Head of Ocean	<b>PhD:</b> R. Amin, S. Hlaing*, N. Steiner*, I. Ioannou* – (CCNY) P. Reyes, R. Lopez (UPRM) <b>MS:</b> V.

Projects	Task (with each Projects)	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
	<p>underwater measurements for retrieval of particle size distributions, refractive indices and possibly species composition. Tests to be carried out for a variety of seasonal and weather conditions to develop understanding of related impacts. Compare to satellite water leaving products and atmosphere retrievals.</p> <p>Intercomparison of the below/above water signals with aircraft and satellite data as available.</p> <p>Make opportunistic measurements of HABs if they occur.</p>		<p>Operations Manager for the Caribbean Regional Node.</p>	<p>Science Branch, Dr. M. Twardowski, WET Labs, Inc., Dr. Eric Harmsen (UPRM-Department of Agricultural Engineering), Dr. C. Ramos-Scharrón (Department of Geosciences, Colorado State University), and Dr. L. Pérez-Alegría (UPRM-Department of Agricultural Engineering) and Dr. R. Armstrong (UPRM-Department of Marine Sciences)</p>	<p>Rodriguez, UPRM- Department of Geology  <b>UG:</b> L. Delacruz , S. Elzeftawy*, R. Singh*, N. Hernández* (UPRM- Department of Geology)</p>

Projects	Task (with each Projects)	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<p><b>Project 3: Improvement/Development of algorithms for remote sensing of coastal waters</b></p>	<p>Task (2) Examine different atmospheric correction schemes for coastal waters including both longer wavelengths methods, and combining NIR channels with VIS measurements in the blue to isolate absorbing contributions and iterative schemes for next generation sensors such as GOES-R  Task (4) Comparison of Hyperspectral and FLH Retrieval Approaches, Development of Band Selection Criteria for Future Satellite Missions  Task (3) Analysis of optical field measurement together with Chl, TSS concentrations  Task (8) Evolution and tuning of algorithm for Chl retrieval in PR coastal waters  Task (9) Development of GIS database for land sea interactions in Mayaguez Bay</p>	<p>Profs. S. Ahmed, B. Gross, F. Moshary, Drs. A. Gilerson, J. Zhou (CUNY), Prof. F. Gilbes (UPRM)</p>	<p>Dr. M. Wang, STAR, Dr. R. Stumpf, National Centers for Coastal Ocean Science (NCCOS), J. Trinanes, Acting NOAA CoastWatch Operations Manager for the Caribbean Regional Node.</p>	<p>Prof. J. Schalles – Creighton University, NE, Dr. R. Arnone, Naval Research Laboratory, Head of Ocean Science Branch, Dr. Eric Harmsen (UPRM-Department of Agricultural Engineering), Dr. Carlos Ramos-Scharrón (Department of Geosciences, Colorado State University), and Dr. Luis Pérez-Alegría (UPRM-Department of Agricultural Engineering), Dr. R. Miller (National Aeronautics &amp; Space Administration), and Dr. R. Armstrong (UPRM-Department of Marine Sciences)</p>	<p><b>PhD:</b> R. Amin, S. Hlaing*, I. Ioannou* (CCNY), R. Lopez (UPRM)  <b>MS:</b> W. Zheng (CCNY), V. Rodriguez, UPRM-Department of Geology  <b>UG:</b> L. Delacruz, S. Elzeftawy*, R. Singh*, J. Martinez*, A. Cruz* (UPRM)</p>

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
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**Thrust: Precipitation and Water Resources**  
**Thrust 3a: Hydro-Climate**

<p><b>Project 1: Develop and Improve Satellite-based Precipitation Retrieval Algorithms.</b></p>	<p>Task (1): Develop Multi-Spectral Microwave Snowfall Retrieval Model  Task (3): Develop Multi-Spectral Microwave &amp; IR Precipitation (Snowfall/Rainfall) Retrieval Algorithm; Task (6) Improve Satellite-based Rainfall Products over the Radar Gap Area by merging with NEXRAD  Task (8) Improve Precipitation Estimates using UHI &amp; Climate Changes</p>	<p>Drs. Shayesteh Mahani and Reza Khanbilvardi, CUNY; Drs. Arnold Gruber (Visiting Research Faculty), and Yajaira Mejia, Post Doctoral Researcher.</p>	<p>Ralph Ferraro, Robert Kuligowski, Cezar Kangoli, Mamoudou Ba &amp; Stephan Smith from NESDIS/CICS, David Kitzmiller from NWS/HL, and Robert Rabin from NSSL/OAR</p>	<p>Brian Vant Hull, Post Doctorate,</p>	<p>Cecilia Hernández-Aldarondo, Nasim Nourozi, Bernard Mhando, Heather Glickman, and Kibrewossen Tesfagiorgis* from CUNY</p>
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Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>Project 2: Validate Existing Precipitation Retrieval Algorithms</b>	<p>Task (1): Validate IR- and MW-based Rainfall Retrieval (NESDIS-HE, &amp; GMSRA, TRMM, CMORPH, and PERSIANN) for (Hurricanes) (Mahani &amp; Khanbilvardi)</p> <p>Task (2): Validate NESDIS Rainfall Algorithms for different Sites and Seasons. (Ismail Yucel)</p> <p>Task (3) Validate NESDIS HE &amp; GMSRA Rainfall Algorithms for Puerto Rico.</p> <p>Task (4) Develop a Validation Algorithm</p> <p>Task (5) Improve NESDIS Rainfall Algorithm</p> <p>Task (6) Validate NESDIS-SCaMPR Model over the US and Puerto Rico</p>	Drs. S. Mahani and R. Khanbilvardi (CUNY); Ismail Yucel (HU); Eric Harmsen, Nazario Ramirez, Ramon Vasquez from UPRM.	Dr. Robert Kuligowski, Center for Satellite Applications and Research (STAR/NESDIS/NOA A), Israel Matos at National Weather Service, San Juan, Puerto Rico	Daniel Lindsey from Cooperative the Institute for Research in the Atmosphere (CIRA) at Colorado State University; Sandra Cruz-Pol, Department of CEE, University of Puerto Rico; Mark Jury, Department of Physics, UPRM; David Gochis (NCAR/RAP)	<b>MS</b> - Cordona, Department of Electrical and Computer Engineering <b>UG-</b> Edvier Cabassa, Department of Electrical and Computer Engineering; Pablo Mejias from the Department of Civil Engineering; Arnaldo J. Garcia, Department of Industrial Engineering
<b>Project 3: Flood Forecasting using Satellite-based Rainfall Estimates</b>	<p>Task (1) Modify a Hydrological Model by coupling with a Satellite-based Rainfall Retrieval Algorithm.</p> <p>Task (2) Develop Hydrologic Model (Vflo) for the Mayaguez Bay Drainage Basin.</p> <p>Task (3) Develop Algorithms for Hydrologic Model to Assimilate the Real-time Satellite QPE</p>	Drs. Shayesteh Mahani; Reza Khanbilvardi and Bill Rossow from CUNY; and Eric Harmsen from UPRM	Dr. Pedro Restrepo, Office of Hydrologic Development, OHD/NWS/NOAA; John R. Mecikalski; Israel Motos, NWS-San Juan Office	Dr. Baxter Vieux, Department of Civil Engineering, University of Oklahoma	<b>PhD</b> - Alejandra Rojas*, Department of Civil Engineering, UPRM <b>MS</b> - Alexander Recaman*,

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
	<p><b>Task not in the Milestone Chart:</b>  <u>Task:</u> Estimate and validate Evapotranspiration to improve flood nowcasting</p>	Johnny Luo; Reginald Blake			Department of Agronomy, UPRM
<p><b>Project NOT in the milestone chart</b>  <b>Project: Analyzing satellite and in situ data to study tropical convection and hurricanes</b></p>	<p>Task (1): Testing a new hurricane technique using satellite data  Task (2): Use of Cloud Sat to study tropical convection  Task (3): Use of aircraft measurements for studying upper-tropospheric humidity</p>	<p>Dr. Johnny Luo and Dr. Reginald Blake (faculty Members)  Dr. Gary Liu (postdoc)</p>		<p>Kerry Emanuel (MIT), Dieter Kley (Research Centre Juelich GmbH, Germany), Larry Di Girolamo (UIUC), David Diner (NASA/JPL), Xianglei Huang (U. Michigan), Richard Johnson (Colorado State U.), Steve Klein (DOE/LLNL), Tristan L'Ecuyer (Colorado State U.), William Rossow (CCNY &amp; NASA/GISS) ; Graeme Stephens</p>	<p><b>MS:</b> Cheila Benavides, James Rios and Mya Mya Teiktin  <b>UG:</b> Cadeicia Josephs, Renee Jarvis, Nipun Aggarwal, Jeyavinoth Jeyaratnam (Non-Funded)</p>



Projects	Task (with each Projects)	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
				(CSU & NOAA CIRA), Hui Su (NASA/JPL), W.-K. Tao (NASA/GSFC)	
<b>Thrust 3b: Land Hydrology:</b>					
<b>Project 1: Assessing the effect of changes in vegetation cover on snow pack dynamics</b>	Task (1) Investigating the potential of combining optical data from GOES and AVHRR sensors with passive microwave to improve the accuracy and the resolution of satellite-based snow maps. <b>Not in the Milestone Chart:</b> <b>Task:</b> Evaluation of capability of ISCCP emissivity data in estimating snowpack properties (Grain size, SWE, temperature) <b>Task:</b> Analysis of snowpack properties profile and its effects on snow emissivity	Reza Khanbilvardi, Amir Eshraghi	Al Powel, STAR/NESDIS		<b>MS - CUNY</b> Narges Shahroudi, and Dugwan Seo (MS Students)
<b>Project 2: Reducing the negative effect of vegetation cover on soil moisture retrieval from microwave satellite data (Future SMOS Satellite)</b>	Task (4) Assimilate the derived soil moisture maps into existing hydrological models	Marouane Temimi; Hosni Ghedira and Reza Khanbilvardi.	Dr Sid Boukabara (NOAA-NESDIS), Dr Fuzhon Weng (NOAA-NESDIS)	Bill Rossow	<b>PhD – CUNY</b> Hamid Reza Norouzi

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>Project 3: Evaluation of Vegetation Products over Geostationary and Polar platforms (COMPLETED)</b>	<p>Task (1) Collection of AVHRR data of the selected study areas from NOAA-NESDIS data center</p> <p>Task (2) Collection of MSG SEVIRI data over Europe and Africa for the spring, summer and fall season of 2006 over the Northern Hemisphere</p> <p>Task (3) Developing an image compositing algorithm to produce daily NDVI maps with reduced cloud contamination.</p> <p>Task (4) Assessment of the efficiency of cloud clear products and NDVI retrieval algorithms.</p> <p>Task (5) Evaluation of the correspondence of MSG NDVI to NOAA AVHRR-based and MODIS-based vegetation indices.</p> <p>Task (6) Evaluation of the seasonal change of NDVI and of the consistency its intra-seasonal variations.</p>	Reza Khanbilvardi, Reggie Blake	Dr. Peter Romanov, NESDIS/NOAA		<u>UG CUNY</u> : Jiang Hong Li
<b>Projects NOT in the Milestone Chart To develop soil</b>	Task (1) Compared different passive microwave models (equations) derived by several	Tarendra Lakhankar – Post Doctoral Scientist; Reza Khanbilvardi			

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
<b>moisture retrieval algorithms using active and passive microwave remote sensing</b>	authors. Task (2) Analyzed inner variable derivation and compare the differences.				
<b>Project: To develop global-scale water resources indicators.</b>	Task (1) Analyzed the global precipitation, discharge, population data Task (2) Developed the shell and Matlab scripts to derive indicators.	Tarendra Lakhankar & Charles Vorosmarty			
<b>Project: Interactions between soil moisture and climate simulated using the GISS Model E and evaluated with satellite-based precipitation time series, with application to drought forecasting</b>  <b>Project: Changing seasonality of streamflow and snowmelt in the Northeast US from ground-based and satellite</b>		Nir Krakauer		Benjamin Cook (Lamont-Doherty Earth Observatory) and Michael Puma (NASA-GISS))	PhD: Che Ngufor MS: Javier Jiménez-Vargas

Projects	Task (with each Projects	CREST Researchers	NOAA Collaborators	Other Collaborators	CREST Students
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measurements					
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Total Projects: 18 Total Tasks: 74 NOAA Collaborators: 40					
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Appendix 3  
Publications

**Peer Reviewed Journal Publication**

1. Oo, M. M.; Jerg, M.; Hernandez, E.; Picon, A.; Gross, B. M.; Moshary, F.; Ahmed, S. A.; , "Improved MODIS Aerosol Retrieval Using Modified VIS/SWIR Surface Albedo Ratio Over Urban Scenes," /*Geoscience and Remote Sensing, IEEE Transactions* **48** .983-1000 (2010)
2. Zhang, H., Hoff, R.M., Engel-Cox, J.A. 2009: The relation between Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth and PM<sub>2.5</sub> over the United States: a geographical comparison by EPA regions, *J.Air & Waste Manage. Assoc.* **59**, 11, 1358 -1369.
3. Jia Su, M. Patrick McCormick, Zhaoyan Liu, Kevin H. Leavor, Robert B. Lee III, Jasper Lewis, and Michael T. Hill, Obtaining Ground-based Lidar Geometrical Form Factor Using Coincident Spaceborne Lidar Measurements, *APPLIED OPTICS*, Vol.49,(2010).
4. Alimova, Alexandra, Katz, A., Steiner, Nicholas, Rudolph, Elizabeth, Hui, Wei, Alfano, R., Steiner, Jeffrey C., and Gottlieb, Paul, *Bacteria-Clay Interaction: Structural changes in smectite induced during biofilm formation*, *Clays and Clay Minerals*, Vol. 57, No. 2, 205–212, 2009
5. Maantay, J. A., **Maroko, A.R.**, 2009. Asthma and air pollution in the Bronx: Using the Cadastral-based Expert Dasymetric System (CEDS) to improve population mapping and understanding the spatiality of disease in urban areas. *Journal of Urban Health (Bulletin of the New York Academy of Medicine)*, 86(3): 353-354.
6. Zhang, H., Hoff, R.M., Engel-Cox, J.A. 2009: The relation between Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth and PM<sub>2.5</sub> over the United States: a geographical comparison by EPA regions, *J.Air & Waste Manage. Assoc.* **59**, 11, 1358 -1369.
7. R. Delgado, M. S. Kacenenelbogen, A. Roche-Lima, P. Sawamura, M. H. Tabacniks, J. Vanderlei Martins, and R. M. Hoff; "Identification of Urban Aerosols during Wintertime Pollution Event in Baltimore", In Proceedings of the 8<sup>th</sup> International Symposium on Tropospheric Profiling: Integration of Needs, Technologies and Applications (ISTP 2009), ISBN 978-90-6960-233-2, 18-23 October 2009, Delft, The Netherlands, 2009.
8. Lakhankar T., Jones A.S., Combs C.L., Sengupta M., Vonder Haar T.H., and R. Khanbilvardi (2010) "Analysis of Large Scale Spatial Variability of Soil Moisture Using a Geostatistical Method. *Sensors*, Vol. 10(1), pages 913-932.
9. Lakhankar T., Krakauer N.Y., R Khanbilvardi (2009), Applications of microwave remote sensing of soil moisture for agricultural applications, *International Journal of Terraspace Science and Engineering*, Vol. 2(1), pages 81-91.



10. Dugwon Seo, T. Lakhankar, and R. Khanbilvardi (2010) A Parameterization of Soil Moisture Retrieval using Passive Microwave Data: A Case Study for SMAP Mission, Submitted to *Remote Sensing*.
11. Marouane Temimi, Peter Romanov, Hosni Ghedira, Reza Khanbilvardi and Kim Smith. An automated approach for determining sea-ice concentration for the future GOES-R ABI sensor. International Journal of remote Sensing. (Accepted, 2009)
12. Temimi, M., R. Leconte, F. Brissette, N. Chaouch. A Combination of Remote Sensing Data and Topographic Attributes for Spatial and Temporal Control of the Soil Wetness over the Mackenzie River Basin. Journal of Hydrology (Accepted, 2009).
13. Jia Su, M. Patrick McCormick, Zhaoyan Liu, Kevin H. Leavor, Robert B. Lee III, Jasper Lewis, and Michael T. Hill, Obtaining Ground-based Lidar Geometrical Form Factor Using Coincident Spaceborne Lidar Measurements, APPLIED OPTICS, Vol.49,(2010).
14. K. Yilmaz, I. Yucel, et al, 2009, New Approaches to Hydrological Prediction in Data-sparse Regions, IAHS Publication 333, ISSN 0144-7815.
15. Ramírez-Beltran, N.D, Kuligowski, R.J., Castro, J.M., Cardona-Soto, M, Vasquez, R. (2009). A Projection Algorithm for Satellite Rainfall Detection. *WSEAS Transaction on Systems*. Issue 6, Vol 8, pp 763-772.

#### Under Review/Press:

1. R. Delgado, M. Weldegaber, M. Seybold, M. Woodman, B. Demoz, K. McCann, and R. M. Hoff; Elastic Lidar Measurements Of Summer Nocturnal Low Level Jet Events over Baltimore, Maryland”, *Atmos. Chem. Phys. Disc.*, **submitted**, 2010.
2. DeSouza-Machado, S. G., L. L. Strow, B. Imbiriba, K. McCann, R. M. Hoff, S. E. Hannon, J. V. Martins, D. Tanré, J.L. Deuzé, F. Ducos, O. Torres, 2010. Using infrared radiances to study dust: A comparison of optical depths and heights derived for a North African dust storm using collocated A-Train and surface observations , *J. Geophys. Res.* (**Accepted**)
3. Winker, D. M., J. Pelon, J. A. Coakley, Jr., S. A. Ackerman, R. J. Charlson, P. R. Colarco, P. Flamant, Q. Fu, R. Hoff, C. Kittaka, T. L. Kubar, H. LeTreut, M. P. McCormick, G. Megie, L. Poole, K. Powell, C. Trepte, M. A. Vaughan, B. A. Wielicki, 2010. The Calipso Mission: A Global 3D View Of Aerosols And Clouds, *Bull. Am. Met. Soc.* (**submitted**)

4. M. H. Weldegaber, M. H., B. B. Demoz, L. C. Sparling, R. Hoff and S. Chiao, 2010. Observational Analysis of Moisture Evolution and Variability in the Boundary Layer during the Dryline on 22 May 2002, *Meteor. Atmos. Phys.* (**submitted**)
5. Weber, S. A., J. A. Engel-Cox, R. M. Hoff, A. Prados, H. Zhang, 2010. An improved method for estimating surface fine particle concentrations using seasonally-adjusted MODIS, MISR, and GASP aerosol optical depth values, *J. Air & Waste Manage. Assoc.* (**accepted**).
6. Irina Gladkova, Michael Grossberg, **Fazlul Shahriar**, Quantitative Image Restoration, (accepted, to appear in Proceedings of the SPIE, Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery)
7. Yucel, I. R. Kuligowski, Gochis, D., 2009: Evaluating the Hydro-Estimator Satellite Rainfall Algorithm over a Mountainous Region, *International Journal of Remote Sensing*, (**Accepted**).
8. Bay, E., I. Yucel, T. Kovacs, P. McCormick, 2009: Effects of Implementing Satellite Observed Aerosols into a Mesoscale Atmosphere Model, *International Journal of Remote Sensing*, (**Accepted**).
9. Tromeur, E., and W.B. Rossow, 2010: Interaction of tropical deep convection with the large-scale circulation in the Madden-Julian oscillation. *J. Climate*, (**in press**).
10. Papa, F., C. Prigent, W.B. Rossow and E. Matthews, 2010: Interannual variability of surface water extent at global scale, 1993-2004. *J. Geophys. Res.*, (**in press**).
11. Zhang, Y-C., W.B. Rossow, C.N. Long and E.G. Dutton, 2010: Exploiting diurnal variations to evaluate the ISCCP-FD flux calculations and Radiative-Flux-Analysis-Processed Surface Observations from BSRN, ARM and SURFRAD. *J. Geophys. Res.*, (**in press**).
12. Teixeira, J., S. Cardoso, M. Bonazzola, J. Cole, A. Del Genio, C. DeMott, C. Franklin, C. Hannay, C. Jakob, Y. Jiao, J. Karlsson, H. Kitagawa, M. Koehler, A. Kuwano-Yoshida, C. LeDrian, A. Lock, M.J. Miller, P. Marquet, J. Martins, C.R. Mechoso, E.V. Meijgaard, I. Meinke, P.M.A. Miranda, D. Mironov, R. Neggers, H.L. Pan, D.A. Randall, P.J. Rasch, B. Rockel, W.B. Rossow, B. Ritter, A.P. Siebesma, P. Soares, F.J. Turk, P. Vaillancourt, A. Von Engel, M. Zhao, 2010: Tropical and sub-tropical cloud transitions in weather and climate prediction models: The GCSS/WGNE Pacific Cross-section Intercomparison. *J. Climate*, (**in revision**).
13. Tselioudis, G., and W.B. Rossow, 2010: Time scales of variability of the tropical atmosphere derived from cloud-defined weather states. *J. Climate*, (**submitted**).
14. Papa, F., F. Durand, A. Rahman, S. Bala and W.B. Rossow, 2010: Estimation of Ganges-Brahmaputra river discharge, 1993-2008, from multiple satellite altimeters. *J. Geophys.*

Res., (submitted).

### In Preparation:

1. J. Compton, R. Delgado, N. S. Jordan, R. M. Hoff; “An Approach to Retrieve Planetary Boundary Layer Heights from a Ground Based LIDAR”, *Remote Sensing of the Environment*, **in preparation**, 2010
2. D. Wicks Kollonige, W. W. McMillan, L. Sparling, S. Trahan, and S. Strahan. Observations of Stratosphere-Troposphere Exchange with A-Train Satellites: A Case Study during INTEX-B. *Atmos. Chem. Phys. Disc*, **in preparation**, 2010.
3. Rivera, H., C. J. Reyes De Jongh, C. Villanueva, J. A. Ogren, P. Sheridan, E. Andrews, **O. L. Mayol-Bracero\***, Physical and Radiative Properties of Aerosol Particles in the Caribbean: Influence of African Dust and Volcanic Ash from the Soufriere Hills, in revision (**to be submitted** to the *Journal of Geophysical Research, Atmospheres*), 2010.

### Conference Presentations and Proceedings:

1. Min Oo, Matthias Jerg, Ana J. Picon, Eduardo Hernandez, Barry Gross, Fred Moshary, and Samir Ahmed Development of urban surface models for improved aerosol retrieval Proc. SPIE, Vol. 7456, 74560B (2009)
2. Ana J. Picon “Improved aerosol retrieval from MODIS over urban areas with regional tuning of surface models” 5<sup>th</sup> NOAA EPP Education and Science Forum, Washington, D.C., November 2009.
3. Eduardo Hernandez, Modification of Urban Surface Reflection Models with MODIS-AERONET Observations and Validation with High Resolution LANDSAT and HYPERION Imagery, 5<sup>th</sup> NOAA EPP Education and Science Forum, Washington, D.C., November 2009.
4. Hoff, R. M., 2009 "Observing at the Mesoscale: What Role Can the EPP Cooperative Centers Play in Answering Questions Asked by the National Academy", Paper 6A.6, 5<sup>th</sup> NOAA EPP Education and Science Forum, Washington, D.C., November 2009.
5. Hoff, R. M., S. A. Christopher, F. Moshary, S. Kondragunta, and B. Pierce, 2009. An Air Quality Proving Ground for GOES-R, Paper 3A.2, 5<sup>th</sup> NOAA EPP Education and Science Forum, Washington, D.C., November 2009.
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  11. **Gbagba, Adjiwanou**, Steiner, J. C., **Patel, Vismet, Connor, Dallen, Idrissou, Souradji** , SEM/EDS Characterization of New York city Aerosol Speciation, Queenborough AMP Conference, 2010.
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30. R. Amin, S. A. Ahmed, A. Gilerson, J. Zhou, B. Gross, F. Moshary, “Extension of the Red Band Difference (RBD) Technique for Low Backscattering Algal Bloom Detection”. AGU Ocean Sciences, Portland, Oregon, February 2010

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1. M. M. Oo, B. Gross, M. Jerg “Measurement of Aerosol Properties over Urban Environments from Satellite Remote Sensing”, Book Chapter “Advances of Environmental Remote Sensing to Monitor Global Changes “EDITOR: Ni-Bin Chang Taylor & Francis Group /CRC Press (in preparation July 2010)
2. Maantay, J.A., **Maroko, A.**, and Culp, G., Using Geographic Information Science to Estimate Vulnerable Urban Populations for Flood Hazard and Risk Assessment in New York City, in Showalter, P., and Lu, Y. eds., *Geotechnical Contributions to Urban Hazard and Disaster Analysis*, Chapter 5, pp. 71-97, 2009, Springer-Verlag.
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16. R. Delgado, M. Weldegaber, M. Seybold, M. Woodman, B. Demoz, K. McCann, R. M. Hoff; Elastic Lidar Measurements Of Summer Nocturnal Low Level Jet Events over Baltimore, Maryland, Center for Aerosol Research (AEROCENTER), NASA-Goddard Space Flight Center, Greenbelt, Maryland, January 2010.



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18. Sydney D. Paul, Hovakim Nazaryan, and M. Patrick McCormick (2009), Investigation of Cirrus Clouds Using the CALIPSO lidar data, Presented at the NOAA EPP Fifth Educational and Science Forum, Washington, D.C., November 12 – 14, 2009.
19. S. Ahmed "Recent Advances by CCNY in Bio-optical Retrievals and Cal/Val in Coastal Waters". NOAA EPP Symposium, Washington, DC, November 2009
20. R. Amin, J. Zhou, A. Gilerson, B. Gross, F. Moshary, and S. Ahmed "Hunting Poisonous Planktons from Space". NOAA EPP Symposium, Washington, DC, November 2009
21. W. Zheng "Inversion of Remote Sensing Reflectance by Modeling the Spectral Beam Attenuation in Northeast Coast Area". NOAA EPP Symposium, Washington, DC, November 2009

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#### Peer Review:

1. Baker, D.N., J.P. McCollough, R.L. McPherron, S.M. Ryan, J.C. Westfall, J.M. Russell, and S.M. Bailey, AIM Receiver/Communication Lock Analysis: When Bad Space Weather is Good, *Space Weather*, Vol. 6, Issue 4, pp. 25-30, 2009.
2. Gordley, Larry L. , John Burton, Benjamin T. Marshall, Martin McHugh, Lance Deaver, Joel Nelsen, James M. Russell, and Scott Bailey, High Precision Refraction Measurements by Solar Imaging during Occultation: Results from SOFIE., Larry Gordley, John Burton, Benjamin T. Marshall, Martin McHugh, Lance Deaver, Joel Nelsen, James M. Russell, and Scott Bailey, *App.Optics* Vol. 48, Iss. 25, pp. 4814–4825, 2009.

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10. C.M. Wrasse, J. Fehine, H. Takahashi, C.M. Denardini, J. Wickert, M.G. Mlynczak, J.M. Russell and C.L. Barbosa, Temperature comparison between CHAMP radio occultation and TIMED/SABER measurements in the lower stratosphere, *Advances in Space Research*, **in press**.
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2. Green, M., R. M. Hoff, S. A. Christopher, F. Moshary, S. Kondragunta, R. B. Pierce, An Air Quality Proving Ground (AQPG) for GOES-R, GOES User Conference, Madison, WI, November 3-5, 2009.
3. R. C. Wilson, R. Delgado, W. W. McMillan, R. M. Hoff; Atmospheric Remote Sensing at UMBC: A PBL Study, 1<sup>st</sup> District of Columbia-American Meteorological Society Chapter Meeting, Howard University, Washington DC, February 2010.
4. J. T. McQueen, Y. Zhu, C. M. Tassone, M. Tsidulko, S. Liu, L. Cucurull, G. DiMego, S. Lu, M. B. Ek, W. Pendergrass, E. J. Welton, E. L. Joseph, M. Hicks, R. M. Hoff; An Overview of the NOAA/NWS/NCEP Real-Time Mesoscale Analysis (RTMA) System with Extensions for the Atmospheric Boundary Layer, 16<sup>th</sup> Conference on Air Pollution Meteorology, 90<sup>th</sup> American Meteorology Society Meeting, Atlanta, Georgia, January

2010.

5. J. S. Friedman, J. Fentzke, R. Delgado, S. Raizada, Q. Zhou, C. A. Tepley; Observations of Sporadic Metal Atom, Ion and Electron Layers in the MLT above Arecibo, American Geophysical Union 2009 Fall Meeting, San Francisco, California, December 2009.
6. M. Kacenelenbogen, J. Redemann, P. Russell, A. Kaduwela, C. Cai, Jose-Luis Jimenez, M. Cubison, R. Delgado, R. M. Hoff; Combination of Spaceborne Sensor(s) and 3-D aerosol models to Assess Global Daily Near-surface Air Quality, American Geophysical Union 2009 Fall Meeting, San Francisco, California, December 2009.
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8. R.M. Hoff and G. Pappalardo; The Global Atmosphere Watch (GAW) aerosol lidar network (GALION), 5<sup>th</sup> Lidar Workshop in Latin America, Buenos Aires, Argentina, November 2009.
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10. Hervig, M E, L L Gordley, M Rapp, S Kirkwood, J M Russell, S M Bailey, SA33B-01 Relationships between PMC and PMSE from SOFIE and radar observations in both hemispheres (*Invited*) 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
11. Randall, C E, L Harvey, S Benze, K Hoppel, D E Siskind, J D Lumpe, S Bailey, J M Russell, A W Merkel, SA33B-05 AIM/CIPS Measurements of PMCs in relation to Temperature and Water Vapor 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
12. Karlsson, B, H Körnich, C E Randall, S Benze, M J Mills, L Harvey, D R Marsh, A W Merkel, S Bailey, J M Russell, E Becker, S Lossow, D E Siskind, SA41A-1584 *POSTER* Inter-hemispheric coupling in PMC observations and in models 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
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14. Lumpe, J D, S M Bailey, J N Carstens, K Nielsen, G E Thomas, J Gumbel, C E Randall, B Templeman, D Cilke, J M Russell, D W Rusch, SA41A-1587 *POSTER* Retrieval of

- PMC Properties From CIPS: Algorithm Description, Error Analysis and Cloud Detection Sensitivity 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
15. Bailey, S M, C E Randall, J D Lumpe, M E Hervig, J N Carstens, L L Gordley, J M Russell, SA41A-1589 *POSTER* Nadir and Limb Viewing Observations of Polar Mesospheric Clouds from the Aeronomy of Ice in the Mesosphere (AIM) Explorer 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
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  17. Zhao, Y, M J Taylor, P Pautet, C E Randall, S M Bailey, J M Russell, SA41A-1592 *POSTER* Investigating monochromatic wave events in the summer polar mesosphere 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
  18. Benze, S, G E Thomas, M T DeLand, S M Bailey, J M Russell, SA41A-1593 *POSTER* AIM CIPS Observations of the Last Five PMC Seasons using an SBUV-type analysis 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
  19. Gordley, L L, M E Hervig, J M Russell, S Bailey, B T Marshall, J C Burton, M J McHugh, L E Deaver, G Paxton, R E Thompson, SA41A-1595 *POSTER* Results from the SOFIE instrument on AIM 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
  20. Mast, J C, M Mlynczak, F Martin-Torres, A K Smith, D R Marsh, J Yee, B T Marshall, J M Russell, A33D-0279 *POSTER* Atomic Oxygen, Atomic Hydrogen, and Chemical Energy Deposition Rates Derived from SABER Measured Hydroxyl Airglow in the Mesosphere Region 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
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  22. Yee, J, X Zhu, J M Russell, M Mlynczak, SA44A-06 The Accuracy of Ozone Concentration Derived from the 1.27 mm Dayglow Emission in the Mesosphere and Lower Thermosphere 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
  23. Hunt, L A, M G Mlynczak, C J Mertens, B T Marshall, M Lopez-Puertas, P P Wintersteiner, J R Winick, R H Picard, J M Russell, SA51A-1204 *POSTER* SABER Mesosphere Radiative Cooling Results from Solar Max to Solar Min 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
  24. Nair, H, J Yee, J M Russell, M G Mlynczak, J C Mast, W R Skinner, SA51A-1206

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25. Pound, A E, B T Svedin, N M Erni, D J Baker, G A Ware, M G Mlynczak, J M Russell, SA51A-1207 *POSTER* Mesospheric OH Airglow Zonal Trends and Periodicities Observed from SABER 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009
26. Peng, T, J L Gardner, M Lopez-Puertas, B Funke, M G Mlynczak, J M Russell, S M Miller, R D Sharma, J R Winick, SA51A-1211 *POSTER* Nitric Oxide Emissions in the Thermosphere during the January 2005 Solar Storm 09' AGU Fall Meeting, San Francisco, CA, Dec. 14-18, 2009.

Appendix 4  
Seminars &  
Presentations

**List of Seminars (September 1, 2009 to February, 2010)**

1. On **February 18, 2010**, between 3:00 to 4:30 pm, in the Steinman Hall, T-512, Dr. Ademe Mekonnen, spoke on “The relationship between convective activity and easterly waves”.
2. On Wednesday, **February 3, 2010**, between 12-1 pm in Phenix 119 at HU. Dr. Ping-Ping Rong, Department of Atmospheric and Planetary Science, spoke on “Application of SABER/TIMED and AIM data in several recent research topics”.
3. On Wednesday **January 20, 2010**, between 11-12pm, in Phenix 119 at HU, Dr. Robert Loughman, Department of Atmospheric and Planetary Science, spoke on “The Stratosphere: We Don’t Live In It, But We Must Live With It”.
4. On Wednesday **December 16, 2009**, between 11:00am -1:00pm in the Steinman Hall, T-105, at the City College of New York, Dr. Zoltan Vekerdy, Professor of “The International Institute for Geo-information and earth Observation” ITC, The Netherlands, spoke on “Space technology to support the poor”.
5. On **December 3, 2009**, between 3:00 to 4:30 pm in the Steinman Hall T-512, Dr. Ann Fridlind of NASA-GISS spoke on, “Estimated sensitivity of radiative impacts of broken low clouds to uncertainties in aerosol parameter retrievals”.
6. On Wednesday, **December 2, 2009**, between 12-1 pm in Phenix 119 at HU, Dr. Stanislav Kireev, Department of Atmospheric and Planetary Science, spoke on “Atmospheric Sounding from Hyperspectral Radiances – A Case Study”.
7. On Tuesday **November 24, 2009**, between 12:00-1:00pm in the Steinman Hall, T-105, at the City College of New York, Dr. Kyle McDonald of the Water and Carbon Cycles group, Jet population Laboratory, California Institute of Technology Pasadena, California, spoke on “Connecting Terrestrial Water, Carbon and Energy Cycles through Microwave Remote Sensing”.
8. On Monday **November 23, 2009**, between 12:00-1:00pm in the Steinman Hall, T-105, at the City College of New York, Dr. Jules S. Jaffe from Marine Physical Lab., Scripps Inst. of Oceanography, spoke on “Microbes to Manatees: Sizing organisms that live In the sea using optical and acoustical diffraction tomography”.
9. On **November 19, 2009**, between 3:00 to 4:30 pm, at GISS conference room on 3rd floor, Dr. Andy Ackerman of NASA-GISS, spoke on, “Cloud droplet size dispersion in shallow convection”.
10. On Wednesday, **November 18, 2009**, between 12-1 pm in Phenix 119 at HU. Mr. Yongxiao Jian, Department of Atmospheric and Planetary Science graduate student,



spoke on “Retrieval of temperature and water vapor profiles from ground ultraspectral-resolution radiance measurements”.

11. On Tuesday **November 17, 2009**, between 12-1 pm in the Steinman Hall, T-105, at the City College of New York, Dr. Jeffrey C. Luvall of the NASA Marshall Space Flight Center, Huntsville, Alabama, spoke on “Integration of Dust Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health”.
12. On Wednesday, **November 11, 2009**, between 12-1 pm in Phenix 119 at HU,
13. Dr. Zhong Cheng, Department of Atmospheric and Planetary Science, spoke on “Combining OMI and CALIPSO Measurements for Aerosol Retrieval”.
14. On Wednesday, **October 28, 2009**, between 12-1 pm in Phenix 119 at HU, Dr. Bill Smith, Distinguished Professor in the Department of Atmospheric and Planetary Science, spoke on “The Use of Hyperspectral Sounding Radiances for Climate Analyses – Experience with AIRS”.
15. On Tuesday **October 27, 2009**, between 12-1 pm in the Steinman Hall, Exhibit Conference room, at the City College of New York, Dr. Mahta Moghaddam from the University of Michigan of the Electrical Engineering and Computer Science department, spoke on “Subsurface Sensing: Recent Advances in Instrumentation and Analysis Techniques”.
16. On Wednesday, **October 14, 2009**, between 12-1 pm in Phenix 119 at HU, Dr. Hiren Jethva, Post Doctoral Fellow in the Department of Atmospheric and Planetary Science, gave a seminar entitled “Near-UV Remote Sensing of Spectral Aerosol Absorption using OMI Measurements”.
17. On **October. 22, 2009**, between 3:00 to 4:30 pm, in the Steinman Hall, T-512, Dr. Bill Rossow of NOAA-CREST, City College of New York, spoke on, Tropical Weather State Transition Probabilities.
18. On Wednesday, **September 30, 2009**, between 12-1 pm in Phenix 119 at HU. Dr. Bill Paterson, Department of Atmospheric and Planetary Science Chairman, spoke “Europa's Space Environment”.
19. On Thursday **September 24, 2009**, between 5:00-6:00pm in the Steinman Hall, 424 - GIS Lab, at the City College of New York, Dr. Peter C. Fusaro, Chairman & Founder, Global change Associates, spoke on “Transitioning to a low-carbon economy”.
20. On **September 24, 2009**, between 3:00 to 4:30 pm; at GISS (3rd floor), Dr. Johnny Luo, of City College of New York, spoke on, The use of active and passive remote sensors to estimate convective buoyancy and entrainment rate. The speaker is working on a new paper.
21. On Monday **September 21, 2009**, between 12:00-1:00pm in the Steinman Hall, T-105, at the City College of New York, Dr. Ehrhard Raschke of the Hamburg University,

Germany, spoke on “50 Years of Satellite Data for Earth Radiation Budget: Explorer VII to CERES”.

# Appendix 6

# Acronyms

## Acronyms used in Report

Advanced Baseline Imager (ABI)  
Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E)  
Advanced Microwave Sounding Unit (AMSU)  
Aeronomy of Ice in the Mesosphere Experiment (AIM)  
Aerosol Optical Depth, (AOD)  
Aerosol Size Distribution (ASD),  
Aerosol and Ocean Science Expedition (AEROSE)  
Air Resources Laboratory (ARL)  
Air Quality Index (AQI)  
American Geophysical Union (AGU)  
Atmospheric Environmental Research (AER)  
Atomic Absorption Spectroscopy (AAS)  
Atmospheric Infrared Sounder (AIRS)  
American Meteorological Society (AMS)  
American Meteorological Society/Environmental Protection Agency Regulatory Model – (AERMOD)  
Artificial Neural Network (ANN)  
Atlantic Oceanographic and Meteorological Laboratory (AOML)  
Atmospheric Planetary Sciences (APS)  
Advanced Very High Resolution Radiometer (AVHRR)  
Bidirectional Reflectance Distribution Function (BRDF)  
Bronx High School of Science (BHSS)  
Cadastral-based Expert Dasymetric System (CEDS)  
Center for Multiscale Modeling of Atmospheric Processes (CMMAP)  
Cloud-to-Ground Lightning (CGL)  
Compact Aircraft Lidar (CAL)  
Charge-Coupled Device (CCD)  
Chlorophyll (ChL)  
Colored Dissolved Organic Matter (CDOM)  
Comprehensive Large Array-data Stewardship System (CLASS)  
Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP)  
Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO)  
Cold Land Experiment (CLPX)  
Community Radiative Transfer Model (CRTM)  
Community Multiscale Air Quality (CMAQ)  
Condensation Particle Counter (CPC)  
Consultative Committee for Space Data Systems (CCSDS)  
Cooperative Institute for Climate Studies (CICS)  
Cooperative Institute for Meteorological Satellite Studies (CIMSS)  
Cape San Juan (CSJ)  
Coarse Mass (CM)  
CREST Lidar Network (CLN)  
Cross-track Infrared Sounder (CrIS)

Crosstrack Infrared and Microwave Measurement System (CrIMMS)  
Defense Meteorological Satellite Program (DMSP)  
Elemental Carbon (EC)  
Empirical Orthogonal Functions (EOF)  
Earth System Research Laboratory (ESRL)  
Environmental and Earth System Engineering/Science (EESA)  
Earth System Data Record (ESDR)  
Fluorescence Line Height (FLH)  
Forecast and Tracking the evolution of Cloud Clusters (FORTRACC)  
Free Soil (FS)  
Goddard Institute of Space Science (GISS)  
Global Atmosphere Watch Atmospheric Lidar Network (GALION)  
GOES Aerosol and Smoke Product (GASP)  
Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS)  
Global Circulation Models (GCM)  
Global Earth Observing System of Systems (GEOSS).  
Geo-Orbiting Environmental Satellite “R” (GOES-R)  
Global Ozone Monitoring Experiment (GOME)  
Global Ozone Chemistry and Related trace gas Data records for the Stratosphere (GOZCARDS)  
Harmful Algal Blooms (HAB’s)  
Halogen Occultation Experiment (HALOE)  
High Spectral Resolution Lidar (HSRL)  
High-resolution Infrared Radiation Sounder (HIRS)  
HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT)  
Hydrogen Chloride (HCl)  
Hydro Estimator (HE)  
High-spectral Environmental Satellite (HES)  
Industrial Source Complex Short Term (ISC-ST)  
Infrared Atmospheric Sounding Interferometer (IASI)  
Inherent Optical Properties (IOP)  
Integrated Program Office (IPO)  
International Laser Radar Conference (ILRC)  
International Satellite Cloud Climatology Project (ISCCP)  
Inter-tropical Convergence Zones (ITCZ)  
Jet Propulsion Laboratory (JPL),  
Joint AIRS IASI Validation Experiment (JAIVEX)  
Joint Center for Satellite Data Assimilation (JCSDA)  
Journal of Geophysical Research (JGR)  
K.brevis Bloom Index (KBBI)  
Kilometer (km)  
Line By Line Radiative Transfer Model (LBLRTM)  
Light Detection and Ranging (LIDAR)  
Lidar In-space Technology Experiment (LITE)  
Limb Profiler (LP)

Long Island Sound Coastal Observatory (LISCO)  
Look Up Tables (LUT's)  
Madden-Julian oscillation (MJO)  
Masters in Geographic Information Science (MGISc)  
Man computer Interactive Data Access System (McIDAS)  
Mesoscale Meteorological Model Version 5.(MM5)  
Meteorological Operational satellite (MetOp)  
Meteosat Second Generation (MSG)  
Microwave Limb Sounder (MLS)  
Mid-InfraRed technologies for Health and the Environment (MIRTHE)  
Multi-angle Imaging SpectroRadiometer (MISR)  
MODIS Reprojection Tool (MRT)  
MODerate Image Spectrometer (MODIS)  
Modified Vegetation Index (MVI)  
Multifilter Rotating Shadowband Radiometer (MFRSR).  
Multi-sensor Precipitation Estimation (MPE)  
Nanometer (nm)  
National Aeronautics and Space Administration (NASA)  
National Aeronautics and Space Administration/Langley Research Center (NASA/LaRC)  
National Center for Atmospheric Research (NCAR)  
National Climate Data Center (NCDC)  
National Emissions Inventory (NEI)  
National Environmental Satellite, Data, and Information Service (NESDIS)  
National Lightning Detection Networks (NLDN)  
National Oceanic and Atmospheric Administration (NOAA)  
National Oceanographic Data Center (NODC)  
National Operational Hydrologic Remote Sensing Center (NOHRSC)  
National Polar-orbiting Operational Environmental Satellite System (NPOESS)  
National Polar-orbiting Operational Environmental Satellite System (NPOESS) Atmospheric Sounding Testbed (NAST)  
National Severe Storm Laboratory (NSSL)  
National Snow and Ice Data Center (NSIDC)  
National Weather Service (NWS)  
National Weather Services/Hydrological Laboratory (NWS/HL)  
Navy Aerosol Analysis and Prediction System (NAAPS)  
Next Generation Radar (NEXRAD)  
Neural Network System 3 (NN3).  
North American Monsoon Experiment (NAME)  
Noctulucent Cloud (NLC)  
Nocturnal Low Level Jets (NLLJ)  
Navy's Operational Global Atmospheric Prediction System (NOGAPS)  
Northrup Grumann (NG)  
New York State Department of Environmental Conservation (NYSDEC)  
NPOESS Preparatory Project (NPP)  
NPOESS Data Exploitation (NDE)

NOAA's National Severe Storms Laboratory (NSSL)  
Office of Systems Development (OSD)/National Environmental Satellite Data and Information Service (NESDIS)  
Ozone Monitoring Instrument (OMI)  
Office of Naval Research (ONR)  
Optical Properties of Aerosols and Clouds (OPAC)  
Optical Spectrograph and Infrared Imaging System (OSIRIS)  
Ozone Operational Algorithm Team (O3OAT)  
Ozone Mapper Profiler Suite (OMPS)  
Optimal Spectral Sampling (OSS)  
Particle Soot Absorption Photometer (PSAP)  
Particulate Matter 2.5 microns (PM 2.5).  
Precipitation Estimation from Remote Sensed Information using Artificial Neural Network (PERSIANN)  
Principal Components Analysis (PCA)  
Polar Hyperspectral Sounder (PHS)  
Polar Mesospheric Clouds (PMC)  
Polar Stratospheric Cloud (PSC)  
Photochemical Steady State (PSS)  
Problem Based Learning (PBL)  
Probability Density Functions (PDFs)  
Radiative Transfer Model (RTM)  
Rapidly Developing Thunderstorms (RDT)  
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Red Band Difference (RBD)  
Regional Atmospheric Modeling System (RAMS)  
Regional East Atmospheric Lidar Mesonet (REALM)  
Research Experiences for Undergraduates (REU)  
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CHartographY (SCIAMACHY)  
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Science Systems and Applications, Inc., (SSAI)  
Space Earth and Atmospheric Sciences (SEAS)  
Self-Calibrating Multivariate Precipitation Retrieval (SCaMPR)  
Single Scattering Albedo (SSA),  
Spinning Enhanced Visible and Infrared Imager (SEVIRI)



Snow Water Equivalent (SWE)  
Short Wave Infrared (SWIR)  
Solar Backscatter Ultraviolet (SBUV)  
Source Impact Index (SII)  
Stratospheric Processes and their Role in Climate (SPARC)  
Special Sensor Microwave/Imager (SSM/I)  
Science, Technology, Engineering and Math (STEM)  
Stratospheric Aerosol and Gas Experiment (SAGE)  
Short Wave Infrared (SWIR)  
Tapered Element Oscillating Microbalance (TEOM)  
TestBed Sub Watershed (TBSW)  
The North American Monsoon Experiment (*NAME*) *Event Rain Gauge Network (NERN)*  
Top of Atmosphere (TOA)  
Total Suspended Sediments (TSS)  
Tropical Rainfall Measuring Mission (TRMM)  
University of Maryland Baltimore County (UMBC)  
University of Wisconsin/Cooperative Institute for Meteorological Satellite Studies (UW/CIMSS)  
Upper-Tropospheric Humidity (UTH)  
Vegetation Index (VI)  
Visible Infrared Imaging Radiometer Suite (VIIRS)  
Visible – Mid Infrared (VIS-MIR)  
Weather Research and Forecasting Model (WRF)  
X-Ray Diffraction (XRD)  
X-Ray Fluorescence (XRF)  
Solar Occultation for Ice Experiment (SOFIE)  
University of Maryland Baltimore County (UMBC)  
World Meteorological Organization Global Atmosphere Watch Atmospheric Lidar Network (WMO-GALION)  
WATER Vapor ASsesment (WAVAS)  
Weather Research and Forecasting Model (WRF)

# Appendix 7

# Figures

**APPENDIX-3; Hydro-Climate Projects:**

**Project 1: Develop and Improve Satellite-based Precipitation Retrieval Algorithms.**

**Task 1: Develop Multi-Spectral Microwave Snowfall Detection Model**

Table: Accuracy at different thresholds

<i>NN1 Networks</i>					<i>NN3 Networks</i>				
	Threshold #					Threshold #			
	10	15	20	25		10	15	20	25
	Accuracy (%)					Accuracy (%)			
<b>P-P</b>	96.67	90.00	53.33	30.00	66.67	46.67	30.00	20.00	
<b>P-NP</b>	3.33	10.00	46.67	70.00	66.67	46.67	30.00	20.00	
<b>NP-P</b>	98.56	96.80	91.02	74.51	33.33	53.33	70.00	80.00	
<b>NP-NP</b>	1.44	3.20	8.98	25.49	87.62	59.96	39.11	30.03	

Above table gives average of the modified NN1 and NN3 networks outputs for two snow storms. Comparison between these and previous results show improvement about 7% on NN3 and 30% of NN1 outputs.

**Task 3: Improve Satellite-based Rainfall Products over the Radar Gap Area by merging with NEXRAD**

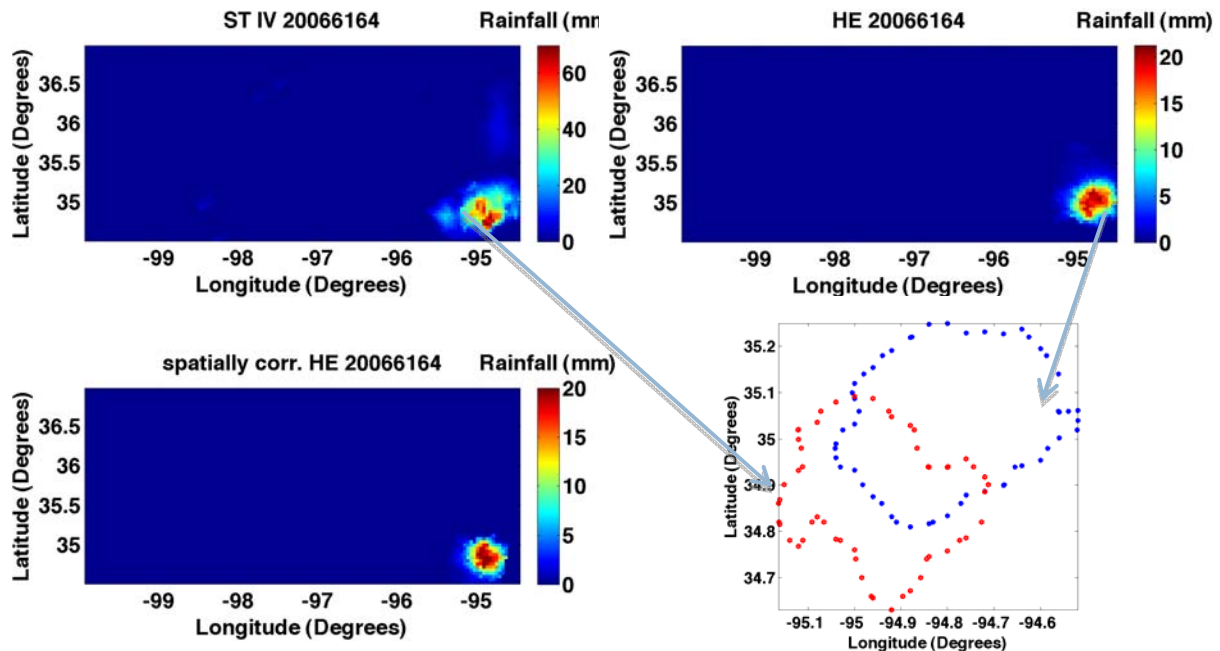


Figure: Comparison of the spatial corrected (bottom left) of Hydro-Estimator HE output (top right) with NEXRAD Stage-IV (top left) using the proposed bias correction technique after adjusting spatial displacements.

**Task (4): Improve the Nowcasting Algorithm based on Satellite Observations and Analysis the Nowcast output**

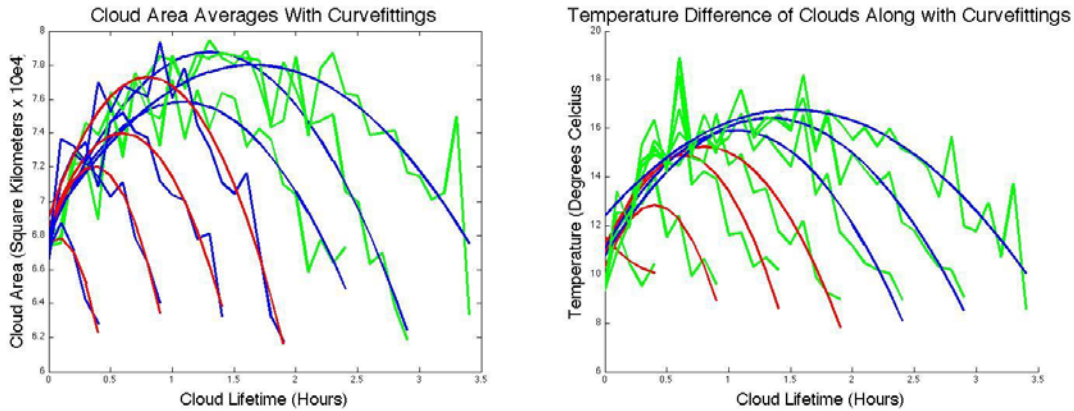


Figure: Cloud area (left) and temperature differences between cloud base and top (right) with respect to cloud life time.

**Task (6): Improve Precipitation Estimates using Interaction between UHI/Aerosols and Climate Changes**

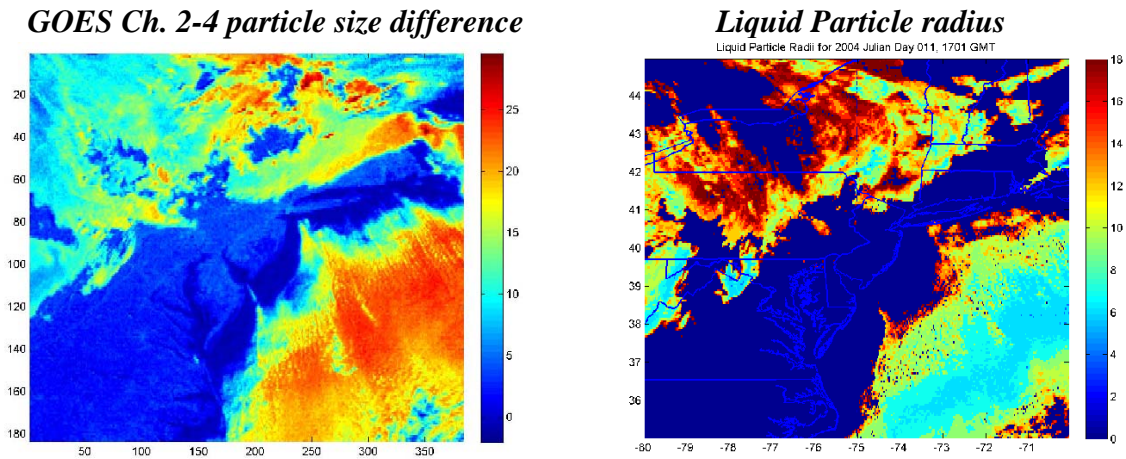


Figure: GOES Channel 2-4 particle Size Differences (left) and liquid particle radius (right), for winter case, on January 11, 2004.

**Project 3: Flood Forecasting using Satellite-based Rainfall Estimates**

**Task 1: Modify a Hydrological Model by coupling with a Satellite-based Rainfall Retrieval Algorithm**

Little progress has been made on this task because the Hydro Estimator is not capable yet of providing reliable rainfall estimates within the study area. Therefore, our efforts have focused on improving the rainfall algorithm (See Project 2, Task 3 above). The development of the NowCast Flood Alarm System will follow the following flowchart:

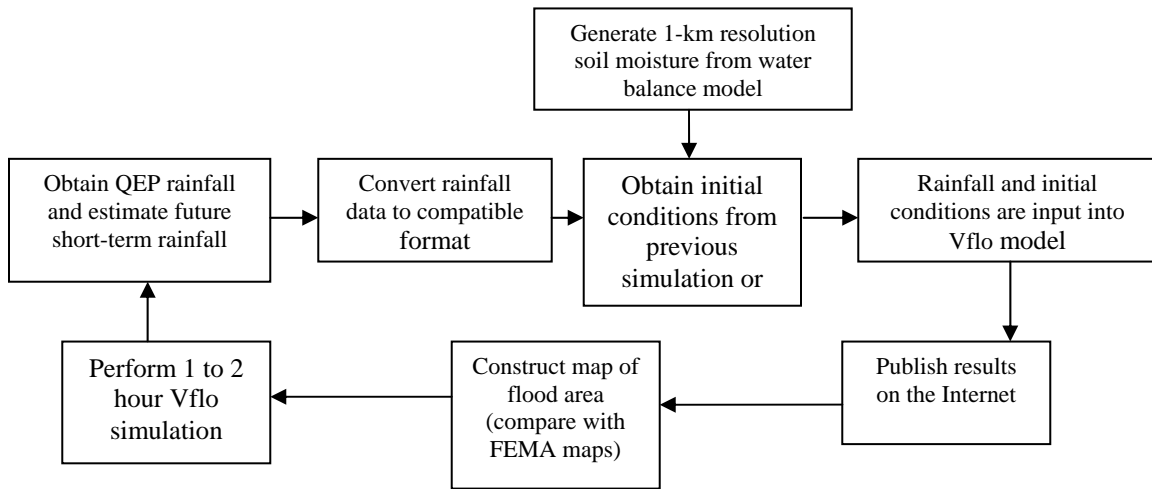


Figure 1: Flowchart illustrating the solution process for the NowCast Flood Alarm System.

The CASA radar has the following characteristics: Frequency = 9.41 GHz, Peak Power = 4 kW, Operational Range = 15 km, HPBW= 3.8°, Antenna Speed = 24 RPM, Antenna Gain =32.4dB, Single Polarization (H). Following Figures show a comparison of the CASA and Colorado State University-CHILL (dual-polarized S-band) National Weather Radar (reflection).

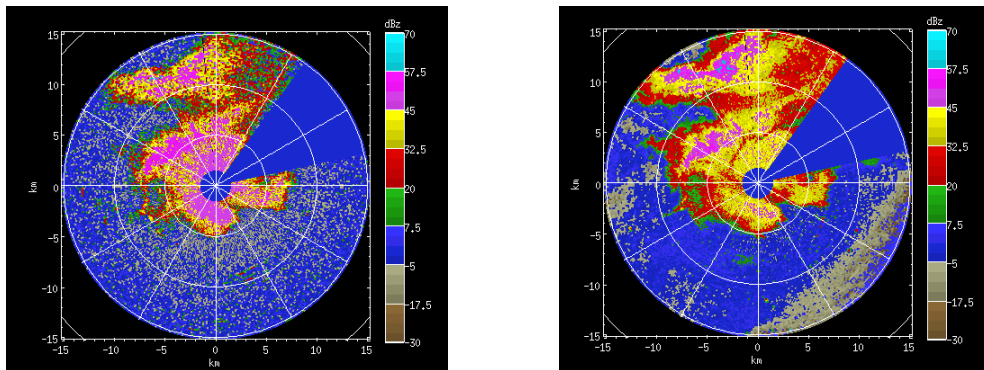
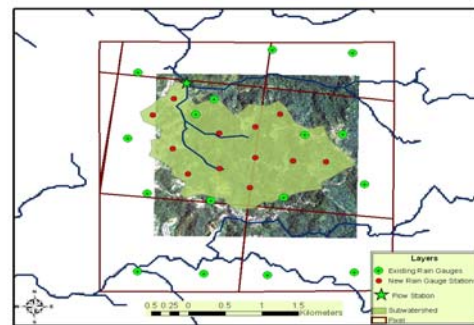


Figure 2: Comparison of the CASA and Colorado State University-CHILL (dual-polarized S-band) National Weather Radar reflection.

Figure 3: TestBed SubWatershed (TBSW) located within the Mayaguez Bay drainage basin. The 3.55 km<sup>2</sup> area TBSW is instrumented with 28 rain gauges and stage elevation gauge at the subwatershed outlet.



## Task 2: Develop hydrologic model (Vflo) for the Mayagüez Bay drainage basin

### Test Bed Sub-Watershed Model – Progress Report

The flow is calculated in each grid and is accumulated downstream and routed in the river cells as far as the outlet. The flow stage can be obtained by using Manning equation in each river cell, with an adequate cross section it is possible to predict flooding in vulnerable areas. To evaluate the predictability limits in the hydrologic simulation and study the interrelation between rainfall scales and terrain scales, a rain gauge network (28 tipping buckets rain gauges) was installed in a small highland area in western Puerto Rico. The rain gauge network is located within a single GOES HE pixel (4 km), Figure-3 of the task-1, and 64% of the rain gauges are within a test-bed sub-watershed (TBSW). The rain gauge network will provide a high resolution rainfall data set (temporally and spatially) to evaluate the CASA radars, calculate the NEXRAD products and the improved Hydro Estimator uncertainty under their typical resolution (Harmsen et al., 2008), and understand the hydrologic response and predictability limits due to rainfall and topographic resolution using a distributed hydrologic model.

In this study we are using a numerical hydrologic distributed model *Vflo* (Vieux and Associates, Inc., 2004) to simulate the hydrologic response in the TBSW. Rainfall data sources will include a high density rain gauge network, an improved version of the Hydro-Estimator, the CASA radars, and the Multisensor precipitation estimation product (MPE). Most of the parameters data for the distributed model was prepared in ArcGIS using a digital elevation model (DEM) with 10 meter resolution (projection NAD 83 State plane Puerto Rico and Virgin Island), land use and SSURGO soil maps. Overland slope, flow direction, flow accumulation and stream locations were determined using the Arc Hydro Tools extension used commonly in water resources.

The net grid cell flow direction is based on the eight surrounding flow directions, depending on the terrain slope, after which, the interconnected cells are counted and accumulated to produce the flow accumulation map, defining the creeks and rivers or stream network (stream map). Finally, the specified number of cells that determine the streams are interconnected with the digital elevation model (DEM) cells and basin size and desired calculation precision. The generated river network was utilized to define the channel cells in *Vflo*; channel side slopes were assumed to be 1:1, channel width is set to 5 meters and bed channel slopes were measured in the field and assigned by segments. A hydraulic model (HECRAS) was created with GeoRAS and terrain survey to calibrate the rating curve of the TBSW creek. Flow stage measurements have been taken since October 2007.

The abstractions in the distributed model are calculated with the Green Ampt equation where the principal parameters are: saturated hydraulic conductivity calculated using the percents of clay and sand, and bulk density of each soil in the Rosetta Lite version 1.1 (Schaap, 2001); effective porosity, soil depth and wetting point. The dominant soil is Consumo soil making up 59.85 % of the area. This soil is a clay texture and hydrologic group B enhancing the infiltration in the zone (Table 1). The predominant land use is forest low density with a 39.36 % and brush rangeland with 38.17 % area and 14.51 % of urban land use (Table 2).

The rain gauge network data were interpolated using the Inverse Distance weighted method at 100 meters resolution and were incorporated into the Vflo model at 10 meters resolution and calibrated with measured flow data. Once the calculated and measured values are close, an up-scaling procedure will be developed for the larger basin.

The up-scaling experiment (Figure A1) consists in increasing the grid size to produce incrementally coarser resolution maps of each parameter and terrain inputs to be evaluated by an ensemble approach and the generalized likelihood uncertainty estimation (GLUE) methodology. The time required to run the model in real-time operation mode is critical. Therefore, the grid size should be optimized (time), produce accurate results and know the probability distribution function associated with each scale. An ensemble forecasting will be generated for each terrain and parameters including the high resolution model. Each initial condition (DEM resolution) is modeled with all possible map sets producing a deterministic forecast called “ensemble member” using Vflo model. A forecast ensemble provides the capability to estimate the forecast probability distribution function (pdf).

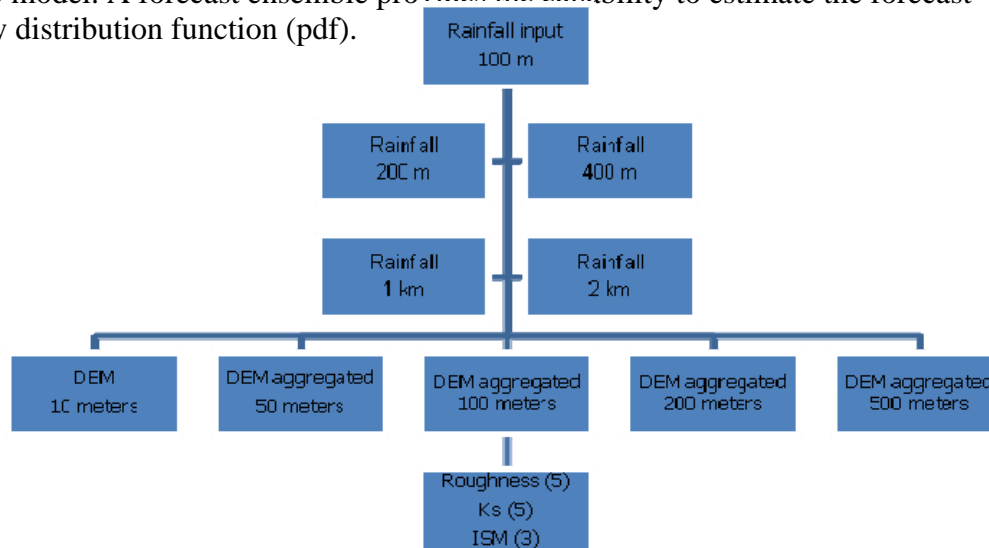


Figure A1. Up-scaling Scheme.

Table 1. Soils type classification (SSURGO) in the TBSW with the hydrologic group and infiltration parameters

Soil Name	Texture	Hydrologic Group	Area (percent)	Wetting Front (cm)	K sat (cm/hr)	Depth (cm)	Effective Porosity
Consumo	Clay	B	59.85	31.63	1.273	300	0.415
Daguey	Clay	C	15.11	31.63	1.266	300	0.451
Humatas	Clay	C	25.03	31.63	1.736	300	0.454
Serpentinite	Rock Serpentine	D	0.01	3.00	5.7	300	0.26
Toa	Silty Clay Loam	B	0.01	27.30	0.294	300	0.377



Table 2. Land use classification in the TBSW, Manning' n, Evapotranspiration “crop” coefficient  $K_c$ , area and percent area for each land use.

Land use Classification	n Manning	$K_c$	Area (m <sup>2</sup> )	Area Percent
Forest low density	0.1500	1.100	1399376	39.36
Shrub and brush rangeland	0.1300	1.000	1357012	38.17
Urban or built-up land	0.0150	0.300	515711	14.51
Forest high density	0.1500	1.200	208260	5.86
Baren land	0.0150	0.300	37800	1.06
Transition area	0.0500	0.300	21600	0.61
Transportation, communication	0.0150	0.300	8341	0.23
Streams and canals	0.0300	1.050	4500	0.13
Gravel pit	0.0150	0.100	1800	0.05
Native pastures	0.0450	0.850	900	0.03

#### Task 4: Estimate and validate Evapotranspiration to improve flood nowcasting

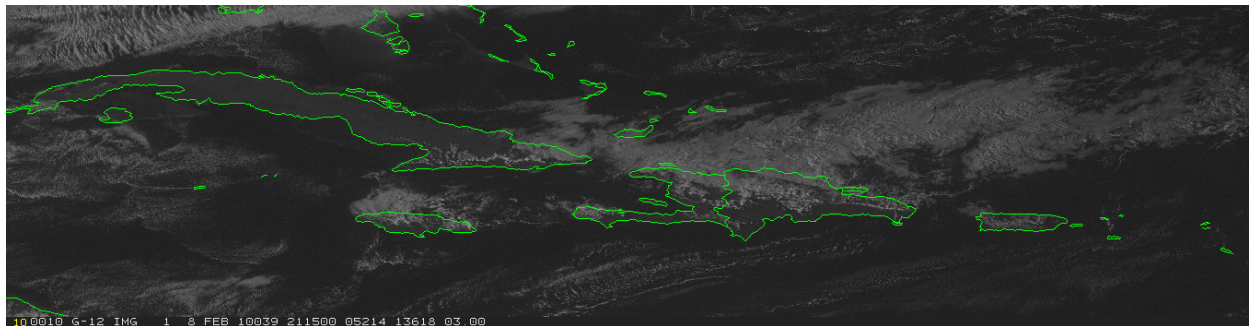


Figure: Expanded area of coverage of solar insolation and evapotranspiration remote sensing products.



**CREST NEWSLETTER**  
**December Issue**

# CREST Semi-Annual Digest

A Publication of Cooperative Remote Sensing Science and Technology (CREST) Center

Volume 7 Issue 1 & 2

Combined Edition 2009



*Dr. Reza Khanbilvardi*

## *Director's Message...*

The year 2009 was quite busy for the CREST family members—who performed admirably to remain at the pinnacle of success in both education and research. I congratulate the entire CREST family for their constant support and dedication.

Twenty six students graduated in 2009. Min Min Oo; Nikisa Jordan; Ruhul Amin and Mohammad Nizamuddin defended their PhD dissertations. Min and Ruhul joined as post doctoral scientists at CIMSS in Wisconsin and Naval Research Lab, respectively, and Nikisa Jordan is yet another CREST/UMBC student to join Northrop Grumman (in 2010), after Leona Charles (2008) and Ankur Agarwala (2009). Ms. Claudette Ojo, a CREST/Hampton graduate was selected as NOAA-EPP Graduate Sciences Program Scholar and is currently pursuing her MS degree at Columbia University, NY.

Several events occurred at NOAA-CREST including an on-site evaluation in March; CREST Day in April; the CREST Annual Advisory Board meeting in May; and the sixth NESDIS/STAR/CoRP Annual Symposium hosted by CREST in August. CREST also participated in the fifth Annual NOAA-EPP Science & Education forum hosted by NCAS at Howard University, Washington, D.C., in November and we productively signed off the year 2009 with the joint CREST-STAR technical meeting held in NOAA, Silver Spring in December 2009. This year-ending event rather marked the beginning of the next decadal science and education vision that CREST will share with NESDIS/STAR to fortify the existing 9-years of partnership with NOAA/NESDIS.

As CREST director, I had the honor and the opportunity to attend the GEO VI Plenary Summit in November and the NOAA Stakeholder meeting in December that was hosted, chaired and convened by NOAA Administrator Dr. Jane Lubchencho. The main goal of the stakeholder's meeting was to reorient the NOAA mission, vision and goals.

Climate Change has no doubt become the “buzz word” of this era and is indeed the major environmental concern of our time. With the 2009 UN Climate Change Conference COP 15 held in Copenhagen, Denmark and COP 16 to be held in Mexico City, Mexico in 2010, Climate Change has certainly reinforced a global consciousness with the drafting of the “Copenhagen Accord” ratified by more than 180 countries. NOAA will play a major supporting role and explore the United States' efforts both domestically and internationally to research, understand and provide tools to respond to the impacts of a changing climate with NOAA-CREST acting as a strong science and education partner to NOAA in this crucial national and international effort.

CREST is in the process of drafting a white paper that highlights CREST's 5- and 10-years strategic planning to align with NOAA's new missions and five science priorities: Satellite Services; Climate Services; Healthy Coastal Zones; Improved Weather Forecasts and Adaption to Climate Change. NOAA-CREST is committed to its partnership with NOAA in charting and addressing these priorities.

*- Reza Khanbilvardi, PhD, P.E.  
Director, NOAA-CREST*

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## NOAA-CREST Site Evaluation Meeting, New York, March 11-13, 2009

Early in the third year of the five-year grant award, all five Educational Partnership Program Cooperative Science Centers (CSC) were evaluated in 2009 by a five-member team of external evaluators. CREST's evaluation occurred from March 11-13, 2009.

The evaluation process consisted of a formal review of the CSCs education, scientific and administrative components. The team was selected by NOAA EPP to conduct the CSC evaluation at the site of the lead CSC institution. The evaluation process encompassed three phases – (1) Phase I: Pre-site evaluation; (2) Phase II: On site evaluation; and (3) Phase III: Post-site evaluation. Prior to the on-site evaluation, a detailed briefing report including the standard evaluation questions was submitted by CREST to the NOAA/EPP.

CREST evaluation team was: Dr. Connie Della-Piana, (Chair); Dr. Walter Robinson, (Co-Chair); Dr. Franco Einaudi; Steven Goodman; and Steve Drescher. NOAA observers included Dr. Alfred Powell, Dr. Wolfgang P. Menzel, Ms. Jacqueline Rousseau and Dr. Priti Brahma.

The three-day on-site evaluation kicked-off at 9:45 AM on March 11, 2009 in the Exhibit Room of Steinman Hall, the City College of New York, with welcoming and opening remarks by CCNY President, Dr. Gregory Williams, and CUNY Vice Chancellor for Research, Dr. Gillian Small, followed by the introduction of the site evaluation team members and the NOAA observers. This was followed by the CREST overview presentation by Dr. Reza Khanbilvardi, CREST Director.

Infrastructure for Research & Education and (2) CREST Management and Administration and an extensive student poster session were the main highlights for the remainder of day one and all of day two. The Evaluation Team conducted two closed-door meetings, one with CREST senior faculty members & select post doctoral scientists and the other with select CREST research students. Day three began with two parallel sessions where part of the members initiated a closed-door session at City College while another part of the Evaluation Team visited the RFCUNY site in downtown NYC. The two groups reconvened at 10:30 AM to continue the closed-door session.



CREST Lab/Facility tours

The On-Site Evaluation concluded at 3:30 PM on March 13, 2009, soon after the evaluation team chair, Dr. Connie Della-Piana provided preliminary feedback from the draft Evaluation Recommendation Report to the CREST Executive Committee & University Administrators.

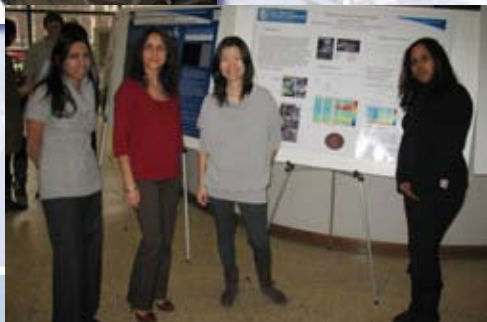
The final Evaluation Findings and Recommendations was provided to CREST on November 29, 2009 with the rating of Excellent with recommendations. The general report stated - "The Evaluation Team found "High positive energy" by all CREST participants; "Extremely supportive environment" for CREST administrators, faculty, and students; and the addition of new industrial partner (Northrop Grumman) as a strength".

CREST has demonstrated significant accomplishments in the areas of science, curriculum development, outreach, and staff development. The Team has noted that CREST has seen tremendous growth in both science & education over the past several years and commends CREST for its exemplary performance. CREST has added new capability (water) and increased recognition by increased publications. CCNY, as the lead institution and administrative center, has developed a positive relationship with its administration.

Extensive presentations by several CREST members under two broad categories (1) Institutional Capabilities &



CREST presentation- Exhibit Room



Students Poster Session



## ***8th Annual CREST External Advisory & Scientific Board Meeting, May 7-8, 2009***

The Eighth Annual CREST External Advisory & Scientific Board Meeting was held at CREST/UMBC, MD, from May 7-8, 2009. The one and a half day meeting kicked-off at 9:00AM on May 7th



with introductory remarks by Dr. Reza Khanbilvardi. The CREST/UMBC campus PI, Dr. Ray Hoff, welcomed and introduced Dr. Jim Gerhart, Director of USGS office collocated at UMBC. Dr. Connie K. Della-Piana, of NSF and the CREST Site Evaluation Chairperson presented the CREST Evaluation Findings report resulting from the on-site CREST Evaluation by a 5-member team from March 11-13, 2009.

Dr. John Bates, Chairperson of CREST Advisory Board, presented the 2008 Action Items, followed by a CREST overview presentation by Dr. Reza Khanbilvardi; Research Overview by Dr. Ray Hoff and Education & Outreach Overview by Dr. Fred Moshary. CREST Students: Jasper Lewis, HU; Mariano Martes, UPRM; Nikisa Jordan, UMBC; Cecelia Hernandez, and Ruhul Amin, CUNY, also presented their research work. The first day ended with the UMBC campus and CREST/UMBC lab tour. The Advisory Board submitted the 2009 recommendations to CREST. The responses to the action items and the 2009 report will be made available to the Advisory Board one-month prior to the 2010 Annual Meeting to be held in NY.

## ***CREST participated in the 89th AMS Annual Meeting, Phoenix, Arizona, January 10-15, 2009***



The American Meteorological Society's 89th Annual Meeting was held January 10-15, 2009, at the Phoenix Convention Center in Phoenix, AZ. More than 2,500 of the world's leading atmospheric scientists gathered to discuss a broad range of weather and climate related issues. The meeting theme was "Urban Weather and Climate: Now and the Future". Most of the subjects discussed in this conference are directly related to NOAA goals & mission that made this conference very informative & interesting for the CREST faculty & students. Several CREST members presented their research and CREST also co-shared an exhibitor booth with NOAA Center of Atmospheric Science (NCAS).

## ***The Annual College Wide Career Fair, The City College of New York, March 5, 2009***

The CCNY career fair is held twice a year and attracts over 150 employers, and 1,600 students. This is an important event for graduating students to learn more about available job and graduate school opportunities. It provides wider visibility to CREST to interact with prospective students interested in pursuing higher studies in STEM related areas. Fifty prospective candidates visited the CREST booth this year.



## ***Pre-College Engineering Day (PCED), The City College of New York, March 20, 2009***

This is an open house activity for HS students and is organized by the Society of Hispanic Professionals Engineers (SHPE) at the City College of New York in March each year. The main objective is to showcase the institutional facilities at the school and provide information on the existing undergraduate programs at the Grove School of Engineering. About 300 HS students from various schools around NYC metro region including Randolph HS school, Gregorio Luperon HS for Science and Math attended this event. The event serves as a good recruitment and pipeline effort from high school to college.



## NOAA-CREST Day at the City College, April 22, 2009



The 8th Annual NOAA-CREST Day was held on April 22, 2009, at the City College of New York. This is one of the major recruitment events at CREST targeted towards STEM related high school and undergraduate students to learn about internships and career opportunities available through NOAA-CREST. There were many booths providing information on opportunities including CREST and other research programs,

STEM, Honors College, Earth & Environmental Science and Engineering (ESEE) for the students. The day started with opening remarks from Dr. Reza Khanbilvardi and a welcoming address from the Dean of Science, Daniel Lemons and Dean of the Grove School of Engineering, Joe Barba.

Later in the day, five CREST Students made presentations on their research experience at CREST. Zulamet Vega, student president of the newly formed CREST Students' Association (CSA) presented on CSA activities. Originally from University of Puerto Rico, Mayaguez, Zulamet joined CREST and CCNY in January 2009 and soon took the initiative to start the student club for the benefit of all incoming and continuing students. The other exciting part of the day was the raffle drawings where iPods and cameras were given to the lucky winners. The day ended with a lunch session where all

the students had an opportunity to network. In addition there were optional lab tours—the most popular of which was the Science on Sphere—Magic Planet, displayed in the main lobby of the Steinman Hall. Students were amazed by its unique method of displaying data making easy to visualize events like Climate Change, Global Warming, Green House Gases (GHGs), and Carbon Cycle.



## 7th Graders from Columbia Secondary School Visited NOAA-CREST on June 5, 2009

Twenty-nine 7th graders from the Columbia Secondary School with their science teachers, Carla Cota and Dan Novak, visited CREST in Summer 2009. Every year, the school offers a specialized course in June. This year, the students focused on nature in the city, showcasing New York City as one of America's greenest cities, yet most of its inhabitants aren't aware of it. And so, their objective in visiting CREST was to learn more about environmental science, especially, how remote sensing sci-



ence can be applied to understanding the earth and its processes. They learned about Tropospheric Remote Sensing Air Quality monitoring (TRAQ). In addition, they visited the satellite receiving station and the optical remote sensing laboratory. CREST graduate students presented their research projects. The middle schoolers also had the opportunity to see the Magic Planet where Dr. Vant-Hull explained climate variables and demonstrated the physical properties of aerosols using a hands-on approach. Students were awed as captured in one student's comments, "science is awesome".

## Weather Bug Donated to MS 394 as Part of the SciencePlay Project, Summer 2009

On September 16, the "Secrets of Science" was revealed at the opening of the Science Playground Flagship at the Mary McLeod Bethune Academy (M.S. 394) in Brooklyn. On this newly built playground, students will explore the hidden mysteries of physics and weather while enjoying unstructured free play and group activities. This forward-thinking landscape fills a once barren asphalt lot with athletic facilities, brightly painted educational surfaces, meeting areas, and specially selected play equipment. M.S. 394, a K-8 public school in Crown Heights, was designated as one of 290 schools to participate in "Schoolyards to Playgrounds," a project of Mayor Bloomberg's PlaNYC initiative. As a part of the greater plan to create a

greener city by 2030, Schoolyards to Playgrounds helps achieve the City's goal to create open space within easy reach of every New Yorker.

PlayLab is collaborating with organizations city-wide to develop some of these playgrounds with a focus on science. For the Science Playground Flagship at M.S. 394, NOAA-CREST donated a Weather Bug weather station through its CREST-REU NSF grant, that students can use to track and broadcast live meteorological readings as part of a national reporting system. NOAA-CREST is further supporting the school through science education outreach and enrichment, targeted to students in the sixth through eighth grades.



Before the Science PlayLab



After the Science PlayLab



## *CREST shows excellence at the fifth NOAA/EPP Education and Science Forum, hosted by NCAS, Howard University—By Brian Vant Hull*



November 12-14, 2009.

Thirteen faculty/staff attended and 32 students presented results from the City University of New York, Hampton University in Virginia, University of Maryland at Baltimore County, and the University of Puerto Rico at Mayaguez. Three of the sessions were chaired by CREST members, and two served as judges for student presentations. City College distinguished professor William Rossow and distinguished scientist Charles Vorosmarty provided keynote addresses for the sessions they chaired while Shakila Merchant presented and summarized the educational activities at CREST.

A gray, misty Washington, DC, did not deter a sizable fraction of the NOAA-CREST family from attending the 5th annual NOAA Educational Partnership Program Education and Science Forum that convened at Howard University from

At the forum, the bulk of the presentations were by students, with 19 CREST students giving oral presentations and 15 displaying posters. Among the oral presentations, Ana Picon won first place in the Remote Sensing and Satellite session and Heather Glickman was awarded 3rd place in the Climate, Air Quality and Global Change session. Among the poster sessions, Cheila Benavides was awarded first place and Christopher Spells received 3rd place in the Climate, Air Quality, and Global Change category, while James Rios received second place and Kevin Leavor and Ciara Brown tied for 3rd place in the Remote Sensing and Satellites category. Congratulations to these students!

For some CREST students this was their first time presenting work outside their own institution and they found this experience very rewarding and educational.



Winners of oral and poster sessions

## *CREST member attended the NASA Earth System Science Symposium, at the National Academy of Science, Washington, DC, June 22-24, 2009*



CREST Researcher Prof. Nir Krakauer (Civil Engineering, CCNY) attended a symposium held from June 22-24 at the National Acad-

emy of Sciences in Washington, DC, commemorating the 20th anniversary of earth system science becoming a NASA priority under the Global Change Research Program.

The 1990s and 2000s have seen NASA launch many earth-observing satellites and support research intended to better understand our planet; assess; and respond to environmental threats. Speak-

ers and attendees included past and current NASA administrators and program officials who saw the satellites of the Earth Observing System through development, launch, and operation, as well as scientists at the forefront of US global change research.

A recurrent theme was the threat to the legacy left by the great achievements of the last 20 years due to the lack of replacements satellites. These satellites now currently make valuable measurements from orbit. Funding these satellite programs listed by the National Research Council's decadal survey Earth Science and Applications from Space (2007) is necessary to keep up with the

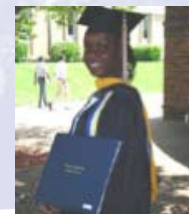
many stresses on the earth system. It was emphasized that those working in earth science need to do a better job of showing politicians and the public the importance of satellites for many of the capabilities we now take for granted, from monitoring forest fires to good hurricane forecasts to GPS.

Through its development and promulgation of new applications of satellite imagery to meet human needs and through its training and outreach activities, CREST plays an integral part in developing public appreciation for the importance of a strong earth observing program and in building the required technical capabilities to continue it.

### *CREST/Hampton student Claudette Ojo Awarded NOAA/EPP Graduate Scholarship*

Ms. Claudette Ojo, a CREST-HU undergraduate scholar, graduated Magna Cum Laude with a B.S. in Business Management at Hampton University, with a minor in Space, Earth, and Atmospheric Science. She was selected for the NOAA EPP Graduate Sciences Program with a position in the OAR

Office of Policy, Planning and Evaluation in Silver Springs, MD. Ms. Ojo began her graduate studies in the Climate and Society Program at Columbia University in New York, NY, in fall 2009.



## *NESDIS-CI and CREST Director-Administrators Meeting, CIRA, Fort Collins, June 16-17, 2009*

A meeting of the National Environmental Satellite, Data, and Information Service (NESDIS) Cooperative Institutes (CI's) and CREST directors and administrators was held at the Cooperative Institute for Research in the Atmosphere (CIRA), Fort Collins, CO, to discuss topics of mutual interest to the CIs and NOAA. Representatives

from each of the NESDIS CIs; CREST; and the staff from NOAA/NESDIS and the NOAA Grants Management Division attended the two-day meeting. The meeting consisted of briefings on guid-

ance and policy updates that directly impact the research and administrative process of each CIs and CREST. The meeting concluded with a list of action items from both NOAA and the CI's.



NESDIS-CI Directors-Administrators group shot at CIRA

## *CREST Students participated in AEROSE V Atlantic Mission on NOAA Ship R.H. Brown*

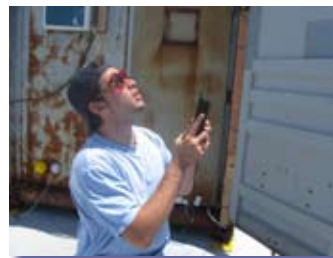


This summer, CREST-HU Ph.D. student Christopher Spells and CREST/REU students Adam Atia and Ibrahim Siddo participated in the Aerosol Ocean and Science Expedition (AEROSE) 2009 research mission, aboard the NOAA research vessel Ronald H. Brown.

AEROSE, which is a series of trans-Atlantic research missions, organized by NOAA-Center for Atmospheric Sciences (NCAS), seeks to obtain a compilation of measurements to study the physical and chemical evolution of aerosols originating on the African continent, especially dust and smoke aerosols, during trans-Atlantic transport.

AEROSE 2009, took place during peak months of dust outflows from Africa, and embarked from Barbados on July 11 2009, and disembarked in Miami, FL, on August 10, 2009.

During this research mission, the students had the opportunity to glean information on possible influences of Saharan dust on tropical storm development and intensity. Chris' responsibilities on-board the Ronald H. Brown were to collect aerosol samples, Particulate Matter (PM) 2.5  $\mu\text{m}$  and PM 10  $\mu\text{m}$ , launching radiosondes and ozonesondes, and making aerosol and ozone sun-photometer measurements, in addition to providing daily weather briefings to the research crew. Adam and Ibrahim primarily took measurements of



aerosol mass densities in different size fractions using QCM instruments. They learned the measurement techniques for using the Microtops Sun Photometer to obtain the aerosol optical thickness in the atmosphere. They

also assisted with radiosonde launches and ozonesonde launches.

All three students found this to be a very enriching experience. As Adam writes "I realized that being just an engineer is not the only goal that I intend on pursuing in future. I would like to participate in more scientific

research expeditions and continue to work out in the field. Also, I would like to improve on my data analysis and programming skills. I want to be a scientist as well as an engineer—which was not the case before this cruise".



## *CREST Doctoral Student Kibrewossen featured in the College Preview Magazine*



Kibrewossen Tesfagiorgis, a CREST doctoral Student at City College of New York was featured in the College PreView (ISSN 1049-9946). College PreView is a College Magazine oriented towards students who are in the process of attending college/universities to pursue their careers in the fields of Environmental Sciences, Engineering & Technology.



## *New York City to Monitor Air Quality-CREST Researcher to Lead this Effort*



In an article published by the Daily News on January 2009, a new approach was introduced to track air quality at the street level in neighborhoods in all the five boroughs.

the most detailed research of how air quality varies throughout the city. "I can't wait to have that data," says Dr. Juliana Maantay, a CREST Faculty at Lehman College, who led a 2007 study that showed the link between acute asthma and living in high traffic areas of the Bronx.

Her studies revealed the places in the Bronx where children were hospitalized for asthma attacks and further linked the cases of asthma in children who lived in close vicinity of

major roadways. But, as in similar studies, her assumptions were based on computer models rather than measurements of actual air quality. "These fine-grain air-quality measurements will make the linkages all the more compelling," Maantay said. Dr. Maantay theorizes that heart disease is also linked to bad air quality.

After gathering the research data, Dr. Maantay and her research team will issue periodic reports with further details.

The NYC Community Survey will gather

## *NOAA/EPP and NOAA/Corps Participated in the CCNY Career Fair, The City College of New York, October 7, 2009*



On October 7, 2009, CCNY's office of recruitment, placement and external relations in coordination with NOAA-CREST organized an information session for NOAA/EPP and NOAA Corps to educate and inform the CCNY students on various educational internships and career opportunities available at NOAA. More than 50 undergraduate and graduates attended the session. Most students returned back to the NOAA/EPP and NOAA/Corp career

fair booth on October 8th held in the Great Hall, City College of New York.



## *CREST in International Partnership with CaribEST in Dominican Republic*



A three day kick-off meeting on international partnership sponsored by the members of Caribbean Environmental Science & Technology Enterprise (CaribEST) was held during August 31 to September 2, 2009 at Santo Domingo, Dominican Republic. CaribEST is a program under the CUNY Cross-Roads Initiative at the City College of NY.

The goal of the meeting was to set the stage for the planning of the CaribEST initiative and its activities by (1) Introducing partners to each other; (2) Discussing areas of mutual interest with possibility of collaboration; and (3) Plan a scientific conference in near future. Dr. Charles Vorosmarty Director of CUNY Cross Road Initiative at CCNY and CREST Distinguished Scientist is leading this activity to involve other Caribbean Nations in research and education of the water resources sciences.

## *CREST Faculty Members Attended WSEAS Conference in China, May 2009*



Drs. Hamed Parsiani, Eric Harmsen and Dr. Nazario Ramirez, CREST members at UPRM, attended the World Scientific Engineering Academy and Society (WSEAS)/Instrumentation, Measurement, Circuits and Systems (IMCAS) conference in Hangzhu, China in May 2009. Dr. Parsiani was invited as a plenary

speaker; together they presented five papers on the atmospheric remote sensing, hydro-climate, and coastal remote sensing research work being conducted at UPRM.

These papers were published in the WSEAS-2009 proceedings. The UPRM group visited two uni-

versities of Zhejiang University of Technology (ZUT) in the city of Hangzhu, and Shanghai Institute of Technology (SIT) in the city of Shanghai, where they made presentations and discussed possible international collaboration between the two organizations.

## ***CREST LIDAR NETWORK— URPM Lidar Lab Inaugurated on September 15, 2009***



The NOAA-CREST partner institution at the Department of Electrical and Computer Engineering of the University of Puerto Rico at Mayagüez (UPRM) inaugurated its LIDAR (Light Detection and Ranging) laboratory on September 15, 2009, at the hands of Dr. Jorge Iván Velez Arocho, the UPRM Chancellor.

The LIDAR technology, which operates at three wavelengths is the first of its kind in the Caribbean region and is an important tool to study the atmospheric particles known as aerosols using remote sensing methods. The three ultraviolet, visible, and infrared wavelengths permit acquisition of atmospheric data related to the climate change. “These particles which we call aerosols affect the weather conditions, and causes asthma are also responsible for global warming problems”, explained Dr. Hamed Parsiani, Director

of the LIDAR laboratory and Professor of Electrical and Computer Engineering.

“The atmospheric data will be interpreted by the researchers and subsequently will appear in the Laboratory’s web page, which could be used by scientists and public community including medical doctors; urban planners for proper urban development, and decision-makers to develop important strategies that will affect the air quality in Puerto Rico” said the Vice Chancellor Dr. Arocho. The equipment valued at \$250,000 was mostly supported by NOAA-CREST, with additional support from NASA-EpSCOR and UPRM. As a part of the CREST Lidar Network (CLN), the UPRM lidar will operate in collaboration with other CREST partners—City University of New York, Hampton University and the University of Maryland, Baltimore County.



## ***Dr. Lakshmi Madhavan Bomidi Joined CREST/CUNY Team As Post Doctoral Fellow in 2009***



Dr. Lakshmi Madhavan Bomidi joined NOAA CREST in fall 2009 as a Post Doctoral Research Fellow under the mentorship of Professor Barry Gross of the Electrical Engineering Department.

He received his PhD degree from Andhra University, Visakhapatnam, India in June 2008 under the supervision of Prof. K.

Niranjan. His thesis work was entitled “Aerosol Physico chemical characterization during Indian summer monsoon – Implications to

Radiative Forcing” and required a combination of aerosol in-situ and remote sensing measurements including radiometer and MPL together with radiative transfer simulations to measure heat flux gradients. His current work is on “Development of aerosol retrieval algorithms for Landsat and GOES sensors with particular emphasis on accounting for urban surface contamination”.

He is also working on the improvement of data processing of the Multifilter Shadowband Radiometer (MFRSR) to retrieve Single Scatter Albedo for absorbing aerosols to improve the validation capabilities of the MFRSR Network.

## ***Dr. Karin Block Joins NOAA-CREST Family as Assistant Professor***



Dr. Karin Block joined the faculty of the City College of New York’s Department of Earth and Atmospheric Sciences as Assistant Professor in the Fall of 2009.

Dr. Block has been a member of the CCNY remote sensing research group since 1998 as a second degree student supported by the NASA-PAIR program and a Sloan Scholar.

She received her Ph.D. from The CUNY Graduate Center program in Earth and Environmental Sciences in 2006.

Prior to her current appointment Dr. Block served as Postdoctoral Research Scientist and later Associate Research Scientist with the Geoinformatics for Geochemistry group at Columbia University’s

Lamont-Doherty Earth Observatory (LDEO).

Her current work spans a number of disciplines in geochemistry from high temperature studies of basalt petrology to experimental investigation into the modification of mineral structures during bio-film production.

Dr. Block is currently developing new techniques to examine linkages between geochemical cycles and ecosystems in response to the active volcanism of the Soufriere Hills volcano on the island of Montserrat. Dr. Block continues to collaborate with LDEO in developing solid earth geochemistry databases for research and education applications, in integration of geoinformatics resources in the classroom, and in the development of standards for sound archiving and dissemination of geochemical data.



## *CREST-NOAA/NESDIS/STAR Annual Technical Meeting, December 7-8, 2009*

### **Decadal Environmental Remote Sensing Science & Technology: NESDIS & CREST Visions**



On December 7-8, 2009, seventy scientists from NESDIS/STAR and affiliated universities of NOAA-CREST Cooperative Science Center attended the 2nd Annual Technical Meeting held at NOAA in Silver Spring, MD. The two-day meeting highlighted the significant accomplishments and partnerships that expanded over the years between CREST and NESDIS/STAR since the first Annual CREST-STAR technical meeting held in Camp Spring, MD, from February 24-25, 2003.

The morning plenary session of the first day began with the welcome remarks from Ms. Mary Kicza, NOAA Assistant Administrator for Satellite and Information Services, followed by overview presentations on NOAA/NESDIS/STAR's 20 year outlook and the current state of CREST research, education and capacity building. CREST thematic area and NESDIS/STAR research overview presentations were given during the afternoon of the first day of the meeting.

The presentations comprised the CREST related research clusters/themes as aligned with NOAA's current missions and goals including: Climate and Air Quality; Coastal Remote Sensing; Land/Terrestrial Precipitation, Soil Moisture & Water Resources; Severe Weather and Hazards; and Education; Outreach and Professional Development.

The day concluded with a group dinner in a local restaurant.

The second day began with several break-out sessions by thematic area to discuss the expansion of research and educational collaboration between NOAA/NESDIS/STAR and CREST. All groups reconvened after the lunch to share the results of these breakout session and discuss and develop a comprehensive action item for sustainable partnership between NOAA and CREST for the next decade.

The overarching goals and objectives of the meeting were —(1) discuss and expand the long existing partnership between NOAA/NESDIS/STAR and CREST; (2) review NESDIS' science & education goals and outlook; (3) review CREST program and its accomplishments; (4) leverage/ explore new opportunities (research; education & outreach and professional development); (5) expand existing NESDIS/STAR-CREST collaborations; (6) increase CREST students' mentoring by NOAA/NESDIS/STAR scientists; (7) enhance/explore NOAA/NESDIS Scientists visits/ exchange to CREST; and (8) increase opportunities for joint seminars/webinars; shortcourse teaching/training.

For more information and the presentations please visit: <http://www.star.nesdis.noaa.gov/star/meetingCN2009program.php>

### *New partnership developed between NOAA-CREST and National Weather Services Eastern Regional Office, Bohemia, New York.*

A new partnership has been developed between NWS/WFO, New York and CREST in 2009. Reggina Cabrera, Chief of the Hydrologic Services Division in NWS Eastern Region attended the first meeting on March 30, 2009, held in the City College, NY.



A second meeting was held on April 28th with Donald Cline of NOAA/NWS and Reggina Cabrera. As a follow-up a larger group of NOAA/NWS experts were invited on December 10, 2009, to finalize the collaborative research between CREST and NWS/ER.

During these deliberations several NWS related issues including soil moisture satellite based products in the development of NWS Flash Flood Guidance (FFG) and the monitoring of draught and reservoir management were discussed. Ms. Cabrera has also stressed the importance of using satellite based products to mitigate coastal and urban flooding hazards by closely working with NWS experts at different River Forecast Centers and Weather Forecast Offices.

A project proposal on "River ice monitoring in the Susquehanna River" has been submitted by CREST for possible funding support from NWS/WFO/NY, that demonstrate the beginning of this collaboration.



## *Development of New Coastal Optical Algorithms to Detect Harmful Algal Blooms Using Ocean Color Remote Sensing - Graduate Student—Ruhul Amin*



Dr. Ruhul Amin defended his thesis in September 2009 from the Electrical Engineering Department of the City College of New York, under the guidance of Prof. Samir Ahmed. He

has been a CREST student since fall 2005 studying optical properties of oceanic and coastal waters.

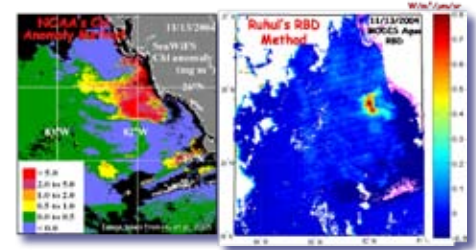
Ruhul was a visiting researcher to the Naval Research Laboratory (NRL) Stennis Space Center (SSC) in Mississippi from October 2008 to May 2009, to conduct joint research on ocean optics and ocean color remote sensing in collaboration with Dr. Richard Gould, head of Ocean Optics Section and Dr. Bob Arnone, head of the Ocean Science Branch. Ruhul also conducted research on several topics including developing, validating, and evaluating new coastal optical algorithms to detect harmful algal blooms

using ocean color remote sensing, with applications for MODIS and MERIS sensors. He also participated on a field trip as part of the NRL 6.1 project “Determining all intrinsic optical properties of coastal waters with an off-nadir airborne hyperspectral sensor.” During this two weeks field exercise he performed laboratory analyses at the “SEA LAB” on Dauphin Island, AL to determine absorption spectra of particulate and dissolved matter in the optically complex coastal waters of Mobile Bay.

Ruhul has expertise in developing satellite ocean color algorithms to (1) detect and trace toxic algal blooms, (2) analyze reflectance and optical data from coastal waters, and (3) for atmospheric correction techniques. He has developed three new optical algorithms: Red Band Difference (RBD), Extreme Bloom Index (EBI), and Karenia brevis Bloom Index (KBBI) to detect and classify various toxic plankton blooms from

space. His EBI and RBD techniques are currently being tested at the NRL Stennis Space Center in Mississippi.

Ruhul received his bachelor degree in computer engineering (with top rank) in May 2005 from City College and entered the PhD program in the fall of same year. He is a Life Member of Tau Beta Pi engineering honor society, Eta Kappa Nu electrical and



computer engineering honor society and Golden Key International Honor Society. He is currently working as a Post Doctoral Scientist at NRA/SSC.

## *CREST-CUNY Graduate Min Min Oo Joins Cooperative Institute for Meteorological Satellite Studies (CIMSS)*



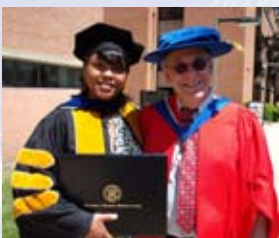
Dr. Min Min Oo received his PhD degree in electrical engineering from the Graduate Center of the CUNY in 2009 under the supervision of Professor Barry Gross. His PhD work was on “Improved MODIS aerosol retrieval using modified VIS/SWIR ratios”. As a CREST graduate he was involved in several research projects organized by NOAA-CREST program.

He is currently working as a research associate at SSEC (Space Sci-

ence & Engineering Center) at the University of Wisconsin-Madison. He collaborates with Professor Steve Ackerman, Dr. Robert Holz and Dr. Liam Gumley on the Atmospheric PEATE (Product Evaluation and Analysis Tools Elements) project.

His work include (1) evaluating NGST (Northrop Grumman Space Technology) Cloud and Aerosol retrieval algorithms using MODIS as proxy data for VIIRS/ CrIS, (2) comparing passive MODIS cloud/aerosol products with active sensor products from CALIPSO and (3) implementing cloud/aerosol radiative transfer into the PEATE Processing system.

## *CREST-UMBC Alumna Nikisa Jordan Joins Northrop Grumman*



Dr. Nikisa Jordan graduated on May 20, 2009 from UMBC, in Marine, Estuarine and Environmental Science Area with Specialization in Atmospheric Remote Sensing.

As a part of her doctoral research, Dr. Jordan verified the height of the lower

layer of the Earth’s atmosphere using satellite remote sensing and for the first time, compared those results to one of the largest computer models of the atmosphere, the Goddard GEOS-5 model.

Dr. Jordan is completing publication of those results while has a postdoctoral fellow in the Joint Center for Earth Systems Technology. She will join Northrop Grumman as Systems Engineering III on January 25, 2010.



## *Research Experiences for Undergraduate (REU) - A Perfect Bridge to NOAA-CREST Graduate Program - By Ryan Jaipaul, REU Student*



Research Experiences for Undergraduates (REU) aims to expose undergraduate students to research incorporated within a Science, Technology, Engineering and Mathematics (STEM) discipline. REU students are given the opportunity to conduct research with faculty mentors and graduate students from NOAA-CREST.

The REU experience cultivates interest and involvement in satellite and ground-based remote sensing research, while building an enthusiastic community of scholars willing to take the initiative to pursue masters and doctoral degrees. REU can therefore be thought of as “a perfect bridge” to the NOAA-CREST graduate program. Along with most of my REU colleagues, this is my first year participating in the REU program.

Before diving straight into research, the first two weeks of the program was an orientation period which included numerous

lectures and activities aimed at informing us about various areas of remote sensing research conducted by NOAA-CREST faculty and scientists.

Each of the REU students chose a research area that they felt most intrigued by. For example, Gina Israel chose to study sea ice because she is a motivated environmentalist and wanted to learn more about the specifics of the natural habitat of polar bears. Gilbert Fahnbulleh chose to research soil moisture in African regions because he remembered the personal turmoil that droughts have caused while he was growing up in Sierra Leone. Ibrahim Siddo and Adam Atia were always intrigued by the high seas so they teamed up with Dr. Vernon Morris from Howard University and sailed along a pre-determined course over the Atlantic Ocean to track the path of Saharan dust aerosols.

Our REU experiences thus far have inspired my REU colleagues and I to expand our ho-

rizons and find a niche in the research community that will take us far and beyond the undergraduate level.

These experiences have undoubtedly enhanced our communication abilities by our participation in oral and poster sessions as well as written journal reports. We have participated in oral and/or poster sessions at the Summer Research Symposium at CCNY; the Sixth Annual NOAA/NESDIS/STAR/CoRP Science Symposium at CCNY; the LSAMP Conference at the University of Texas, Austin; and the NOAA Fifth Education and Science Forum at Howard University. During summer 2009, we also had an opportunity to network with other students by joining the CREST picnic at River Bank State Park; a trip to the American Museum of Natural History and a weather camp at the Brookhaven National Laboratory.

These experiences have given us the unique opportunity to share our research results, network with others from within the science community and develop meaningful professional relationships.

The REU experience is indeed “a perfect bridge” to the NOAA-CREST graduate program because it has given us a taste of research along with supportive faculty and student mentors who provide the inspiration and encouragement needed to achieve higher degrees and professional career.

## *CREST Students Association established at the City College of New York*

*By—Zulamet Martinez Vega and Vanessa Clarke*

With strong encouragement and support from the CREST Director, the enthusiastic CREST graduate and undergraduate students created student association and registered the student club with City College of New York. The club has its mission to **develop and evolve as Leaders in the field of Science & Technology** and a slogan—**Analyzing + Creating = Achieving a Rising Future**.



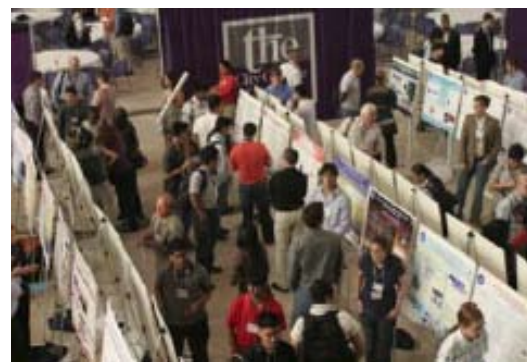
The students have their own executive board members and focus on three themes (1) Educational (students technical seminars; Workshops to encourage peer mentoring and support. Museum Trips to engage students in science inquiry) (2) Social Activities (Picnics, dinners, parties that include games, volunteer work – Visit a High School and conduct science workshops) and (3) Networking (create own Website; Facebook; twitter to connect with all other peers and fellow CREST students).



## *Summer Research Symposium, The City College of New York, August 4, 2009*

A one day Summer Research Symposium was organized on August 4, to mark the end of the 8-week CREST Summer High School Internship (SHIP) program. More than 100 students from various HS in NY metro region attended the event.

The event was organized by different programs: NOAA CREST; NOAA-ISET; the NASA GISS Summer Program; NSF MIRTHE (Princeton, Rice, UMBC, JHU, Texas AM, CCNY); CRESTREU and the CCNY-STEM program. Series of talks were given by motivated faculty and student speakers and student poster session showcased their summer research work. Dr. Reza Khanbilvardi spoke about NOAA-CREST and strongly motivated the students to follow science and engineering related careers.



## *NOAA-CREST's First Weather Camp, July 2009*



The 2009 weather camp, primarily funded and supported by CREST, was organized this summer from July 20-31. Nine high school students attended, two undergraduates assisted the Camp Director Dr. Brian Vant Hull; Outdoor Facilitator Mr. Mike Balk; and National Weather Service Collaborators - Jeff Tongue, Nancy Furbush. The first week was day camp which was held on the City College campus.

Wildwood State Park, camping in tents while cooking and socializing around the campfire. Each morning was spent at the NWS office learning about their work from various speakers, while the afternoons were spent in field studies.

Guest Presenters during the event were: William Rossow and Mark Arend, NOAA-CREST; Bob Rabin, National Severe Storm Laboratory; Leonard Druyan, NASA GISS/Columbia University; Regina Cabrera, Chief, NWS/Eastern Region, Bohemia, NY; Eric Blake, National Hurricane Center (video conference); Undergraduate Camp Counselors: Janelle Lawrence, Alma Reynosa Campers were; Wellesley Ellis; Jeremy Weinberg; Noelle Singh; Jaynelle Baird; Jennifer Couch; Alexandra Laurentieva; Damani Guthrie; Koren Clapperton; Lawrence Lo.

Basic concepts of meteorology were explored in a hands-on classroom environment. During the second week, the camp moved to the vicinity of the National Weather Service' Weather Forecast Office (WFO) in Upton, Long Island, NY . Camp nights were spent in the

## *Sixth Annual CoRP Symposium hosted by NOAA-CREST, August 18-19, 2009, The City College of NY*



CREST hosted the sixth annual CoRP Symposium on August 18-19, in the City College of NY. The theme for the Symposium was "Extracting the Maximum Information from Remote Sensing Observations".

Day one ended with a banquet/reception in the North Academic Center, CCNY. Poster presentations were held in the morning of day two, followed by more oral research presentations in the afternoon.



This symposium gives the NESDIS CIs and CREST researchers particularly graduate students and post doctoral scientists, an opportunity to share their research activities in various thematic areas aligned with NOAA goals and mission. Seventy participants from various CIs and CREST center and its partner universities attended the symposium.

The symposium kicked-off on August 18 with opening remarks and presentations by NOAA representatives followed by individual research presentations by CI and CREST researchers.

The event concluded with award ceremony for the best student poster/ oral presentations. Ms. Cristal Sampson, UG CREST/REU; Dugwon Seo, MS, CREST and Alejandra Rojas, UG, CREST/UPRM won the first, second and third prize respectively for best poster presentations; while Mr. Daniel Comarazamy, PhD/CREST/CUNY; Chian Yi-Liu, PhD/CIMSS; and Ruhul Amin, PhD/CREST/CUNY received first, second and third prize respectively in oral category.

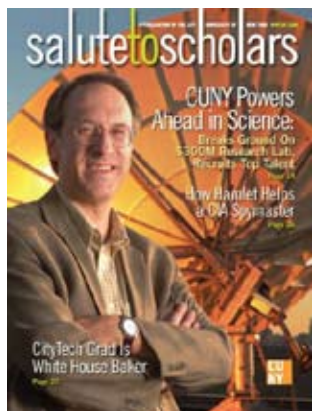


## Dr. Charles Vörösmarty in the Spotlight....

Dr. Charlie Vörösmarty, Distinguished Scientist of CREST and Director of CUNY Cross-Roads Initiative was a featured speaker for the March 2nd 2009 session of "Serving Science," (The CUNY Science Café), at the Kouzan Restaurant, 685 Amsterdam Avenue.

Science cafes provide forums in casual settings where established researchers discuss provocative topics in terms easily understood by a large cross-section of the general public.

Five years ago, in order to renew



the University's commitment to creating a first-class research environment to educate the next generation of scientists and engineers and to attract and retain research faculty of national prominence, CUNY Chancellor Matthew Goldstein initiated the "Decade of Science," a neat rubric that encapsulated an ambitious plan to attract nationally recognized scientists in emerging disciplines.

Dr. Vörösmarty's presentation focused on

"Water in the Line of Fire: Origins and solutions to the global water crisis." See <http://web.cuny.edu/research/Serving-Science-CUNY-Science-Cafe.html> for the "Serving Science" Calendar and future presentations.

Dr. Vörösmarty was also honored at the CUNY Presenters for Research Showcase event held at Albany, New York on April 29, 2009. CUNY Vice Chancellor for research, Dr. Gillian Small provided a brief overview on the ongoing initiatives encapsulated under the umbrella of the "Decade of Science".

## Ray Hoff Attended the Annual Conference of the Air and Waste Management Association (AWMA) in June 2009, Detroit, Michigan



Dr. Raymond Hoff, Professor of Physics at the University of Maryland, Baltimore County, and NOAA-CREST Distinguished Senior Scientist, delivered the Critical Review for the Annual Conference and Exhibition of the Air and Waste Management Association (AWMA) in June 2009 in Detroit, Michigan.

Dr. Hoff's Review has also been published as an article in the Association's Journal. The review is titled "Remote Sensing of Particulate Pollution from Space: Have We Reached the Promised Land?", and focuses on needs for improved, long-term remote sensing in-

formation on particulate pollution, which is a growing health problem worldwide. While existing capabilities are reviewed and ongoing research questions in the retrieval of particulate concentrations from remotely sensed aerosol optical depth are treated, it is concluded that the relevant satellite programs have suffered from not being made a government priority and not being clear part of the mission of any one agency.

Dr. Hoff suggests that a consistent government policy that assigns responsibilities for meeting specific air quality monitoring needs to individual agencies, along with adequate funding for monitoring programs, is necessary if remote sensing of air quality is to become an integral part of protecting human and planetary health.

## CREST Seminars and Research Publications

During 2009, CREST hosted 30 seminars under its monthly seminar series, on various research areas from Vegetation structure to the ecology of streams and rivers; mostly relevant to Remote Sensing Science.

Some of the prominent speakers were Dr. Kyle C. McDonald of Jet Propulsion Laboratory; Dr. Jules S. Jaffe, Marine Physical Lab., Scripps Inst. of Oceanography; Dr. Jeffrey C. Luvall, NASA Marshall Space Flight Center, Huntsville, Alabama; Dr. Mahta Moghaddam, Electrical Engineering and Computer Science, the University of Michigan; Dr. Guido D. Salvucci Dept. of Earth Sciences, Boston University; Dr. Sid Boukabara of Senior Scientist, NOAA/NESDIS/STAR.

Forty four papers were published in peer reviewed journals by CREST researchers including students; with 15 in press and an additional 26 under review. Sixty six papers were presented during 2009 at various conferences including AMS, AGU, IEEE, SPIE.





## ***Workshop on Community Hydrologic Modeling Platform (CHyMP): Blueprint for a CHyMP***

NOAA-CREST will play a significant role in developing the next generation of water cycle models, particularly in the areas of specialized high-performance computing, remote sensing of water fluxes and storage, interaction of water with ecology and land use, and urban hydrology.

NOAA-CREST scientists Nir Krakauer (Assistant Professor in CCNY's Civil Engineering Department) and Balazs Fekete

(CUNY Water Initiative Program Director) attended a Community Hydrologic Modeling Platform development workshop held at the University of Memphis' FedEx Institute of Technology on March 31- April 1.

The goal of the workshop was to scope needs and prospects for an open-source, collaborative model of surface water and groundwater that could be applied to better understand water resources related prob-

lems at small watersheds, large basins, nationally, or globally. Users of such a model would include university researchers, government agencies such as NOAA, NASA, EPA, and USGS, and private-sector consulting hydrologists.

## ***NOAA - CREST Participates in the World Science Festival Street Fair, Washington Square Park, NYC, June 14, 2009***

With an attendance of more than 100,000 people, participation in the World Science Festival Street Fair was arguably one of the most important outreach event for NOAA-CREST, in which, the unknowing yet eagerly curious general public was interactively engaged.

Four hands-on experiments, designed to entertain and inspire both children and adults, were continuously being stewarded by a fifteen member team of NOAA-CREST students, researchers and faculty.



Attendees were able to experience the Coriolis Effect and make their own personal cloud appear in a bottle and visualize what it is that makes the wind blow.

The NOAA-CREST scientists and engineers had prepared eye-catching posters that facilitated their explanations of the physical phenomena displayed in these K-12 popular science activities.

A NOAA-CREST publicity video ran continuously to complement a series of displayed posters that showcased much of the research conducted by NOAA-CREST researchers. The event was extremely successful and the organizers of the event are excited to invite us back in 2010.

## ***CREST Members Invited to Attend the GEO VI Plenary Summit , November 17-18, 2009, Washington, D.C.***

Dr. Reza Khanbilvardi was invited by NOAA/EPP to participate in the Group on Earth Observations (GEO) Plenary VI held in Washington, DC, on November 17-18. The Global Earth Observation System of Systems (GEOSS) will make available access to an unprecedented amount of environmental information, integrated into new data products benefiting societies and economies worldwide to yield a broad range of societal benefits.

United States at the First Earth Observation Summit in Washington in July 2003. GEO was formally established at the Third Earth Observation Summit in February 2005 to carry out a 10-Year Implementation Plan for the Global Earth Observation System of Systems (GEOSS), with the purpose of achieving comprehensive, coordinated, and sustained observations of the Earth System.

The GEO process was initiated by the

The 2010 GEO Ministerial will provide the 5-year review of progress towards GEOSS

implementation. The GEO Plenary is the main body of designated representatives of the 80 Members (79 governments plus the European Commission) and 56 Participating Organizations of the intergovernmental GEO.

The GEO Plenary meets at least once annually, and is co-chaired by the United States, China, the European Commission, and South Africa. The GEO Plenary is accountable to ministerial-level meetings which meet approximately every three years.



## New Additions to the CREST Family

CREST has been productive in 2009 not only in professional growth but also family growth. Five babies were born during the year and one student tied the nuptial knots.

Ryan Nourozi was born to Hamidreza Nourozi and Marzieh, PhD students at CUNY on June 24, 2009; while Digna Martinez a graduate student at CREST/CUNY had her baby-boy Emmanuel on August 8,

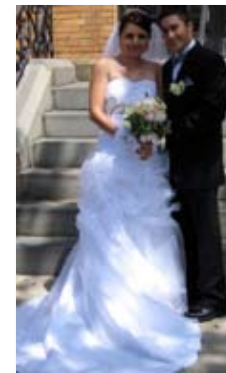
2009. Dugwon Seo who graduated as MS student and currently doing PhD also graduated to become a mother to a baby-boy Jaden Pedro on September 9, 2009, while Erika Garofalo, a master student at CUNY had her baby-girl Angelina on October 13, 2009.

It was a pretty successful and busy year for our Nikisa Jordan who defended her thesis in Summer 2009;

got married to Michael George on June 13, 2009; and gave birth to a baby girl Nailah George on October 9, 2009. This new mom is set for a new career path starting January 25, 2010 as she joins Northrop Grumman as System Engineer III—Kudos Nikisa! Lina Cordero, a doctoral student at CREST/CUNY got married to Jorge Vladimir Sanchez on August 8, 2009.



Hamidreza and Marzieh with Ryan



Bride Lina and Groom Jorge



Nikisa's Nailah



Erika with Angelina



Dugwon's baby boy Jaden



Emmanuel (right) with his brother Ricardo



## CREST Summer Picnic, September 2009



To end the warm weather and welcome a new term at CCNY, a outdoor picnic was organized by CREST Students Association on the afternoon of Sept 25 along the beautiful Riverbank State Park. Many faculty and students attended the picnic and enjoyed the fun and good delicacies – mostly ethnic food, cheeses, tasty spreads etc. In addition, the students also organized some fun team-based games like three-legged races; quiz games. The competition was fierce but fun and it was a good time by all. CREST family indeed exemplifies “unity in diversity”



## CREST Holiday Party, December 11, 2009



CREST Santa—Barry Gross!!

After a year of hard work and productivity, it always has been a tradition at CREST to thank and express its gratitude to all its family members and friends.

On December 11, 2009 one such party was organized by the CREST Students Association in the Great Hall, the City College of New York. Many CCNY; CUNY and Research Foundation of CUNY members joined the party to rejoice the year-long hard work and the holiday spirits. The CREST students and several other members and guests displayed high zeal and spirits with some foot tapping music—while they all relished the delicious dainties and together marked a happy ending to a successful 2009!.



In the News... All About CREST Family



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# NOAA · CREST

CREST, a multi-institutional center funded by National Oceanic and Atmospheric Administration (NOAA) is led by The City University of New York (CUNY), including The City College (the headquarter), Lehman College, the CUNY Graduate Center, Bronx Community College and New York City College of Technology, in collaboration with four partner institutions.



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