Hydro-Climate Projects:

"Improving Precipitation Forecast"

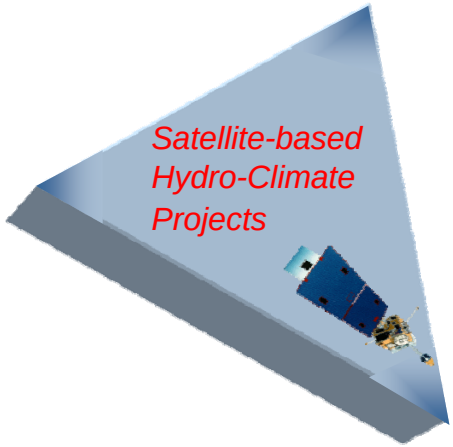
(NOAA-NWS, NESDID, MDL, OAR & CIMMS)

- *Satellite-based Precipitation Nowcasting Capability for New York City Metropolitan Area;*
- *Exploring the Relationships between Aerosols (urbanization) & Hydrological Variables.*

"Precipitation Estimation"

(NOAA-NWS & -NESDIS)

- *Development of MW based Multi-Spectral Remotely Sensed Detecting & Classifying Light, Moderate & Heavy Snowfall;*
- *Development of a Multi-Spectral MW based Snowfall Rate Estimation;*
- *Development of a Satellite-based Rainfall Retrieval Algorithm using Multi-Sensor IR & Lightning Data;*
- *Multi-Sensor Precipitation Estimation (QPE) over radar Gap Areas.*

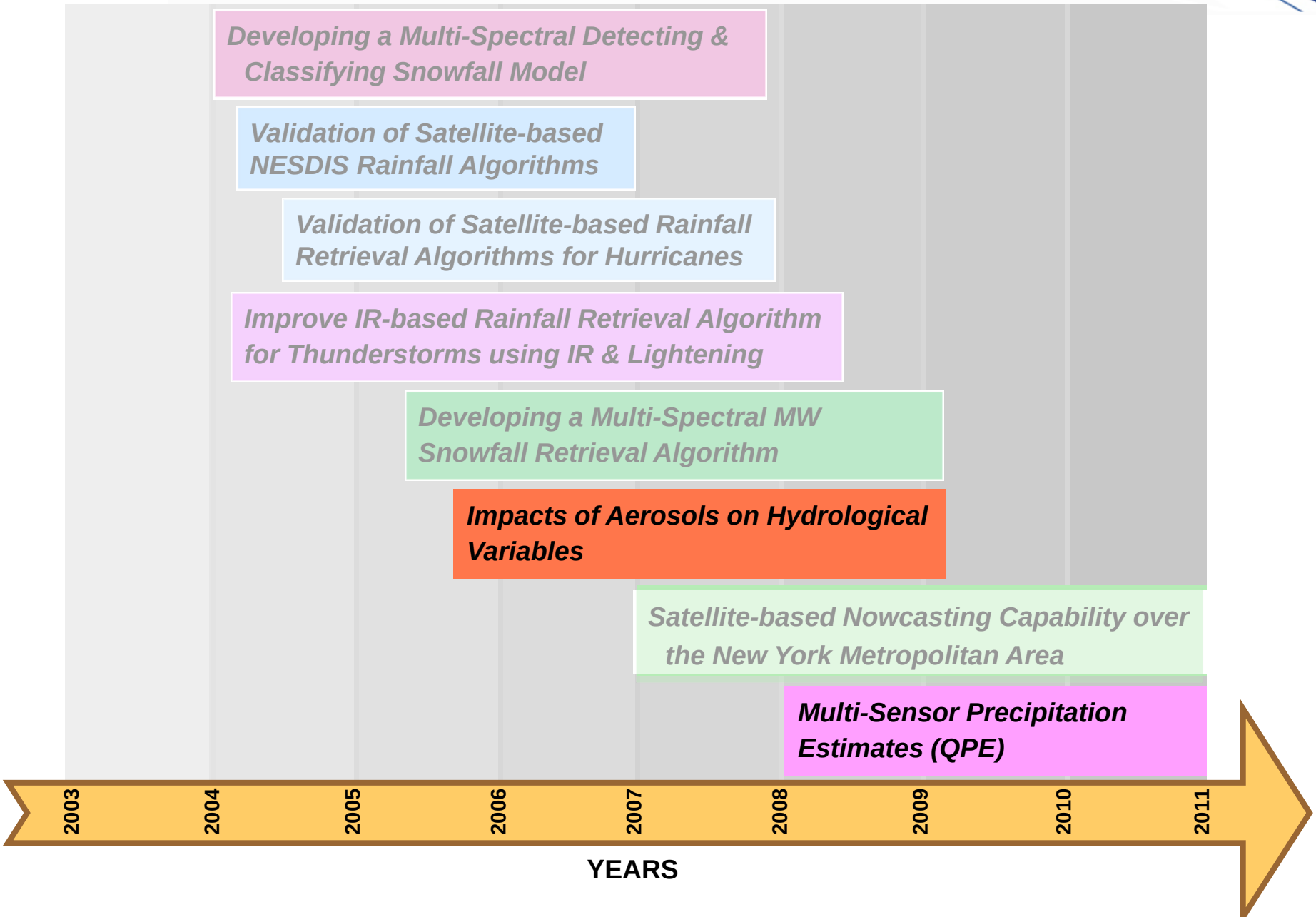


"Validation of Rainfall Products"

(NOAA-NWS & -NESDIS)

- *Validation of Satellite-based NESDIS Rainfall Algorithms;*
- *Validation of Satellite-based Rainfall Retrieval Algorithms for Hurricanes.*

Time-Line of Hydro-Climate Projects

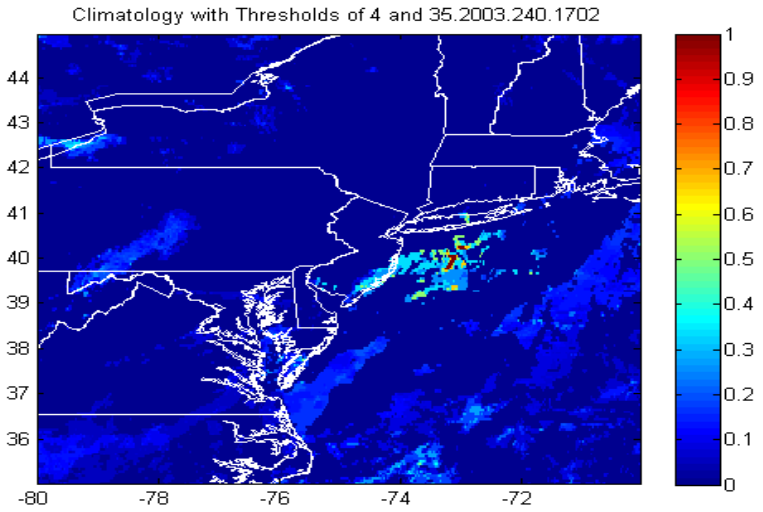


CREST Hydro-Climate Participants

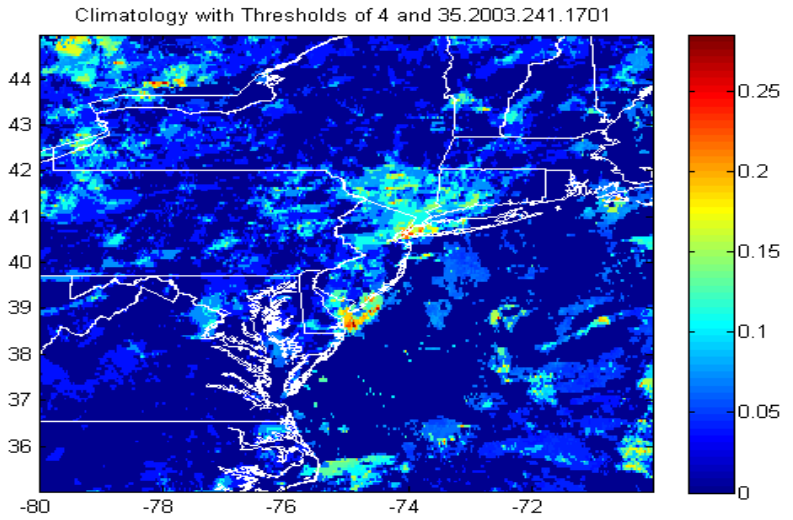
NOAA-CREST Scientists:	***Shayesteh E. Mahani***	***CCNY- CUNY***
	Reza Khanbilvardi	***CCNY- CUNY***
	Arnold Gruber	***CCNY-CUNY***
	Brian Vant Hull	***CCNY-CUNY***
	Nazario Ramirez	***UPRM***
NOAA Collaborators:	***Ralph Ferraro***	***NESDIS***
	Bob Kuligowski	***NESDIS***
	Pedro Restrepo	***NWS***
	Mamoudou Ba	***MDL***
	Robert Rabin	***OAR***
	Cezar Kongoli	***NESDIS***
	Stephan Smith	***MDL***
	David Kitzmiller	***NWS***

Urbanization and Clouds

Student: Heather Glickman, PhD

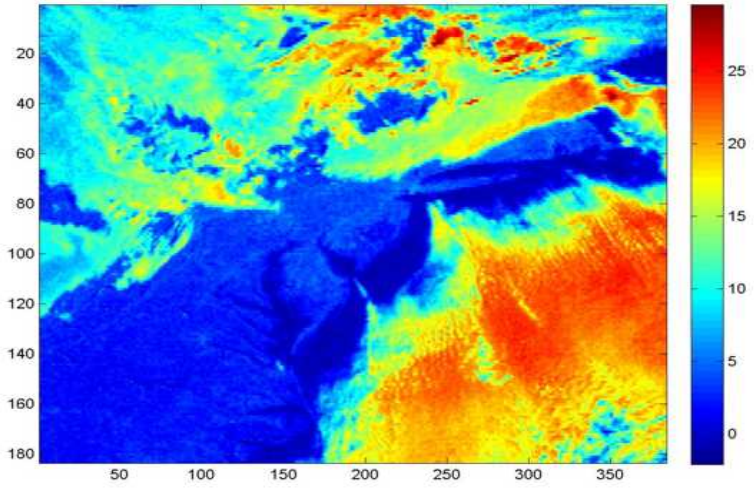


2003 Dry Moderate



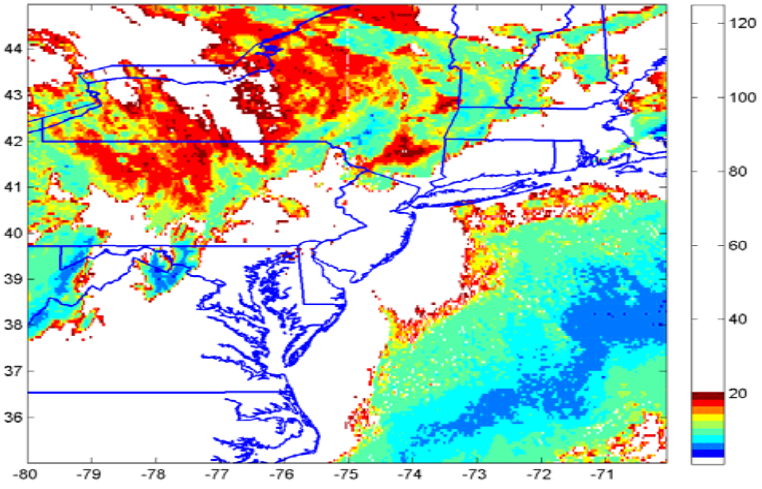
2003 Moist Tropical

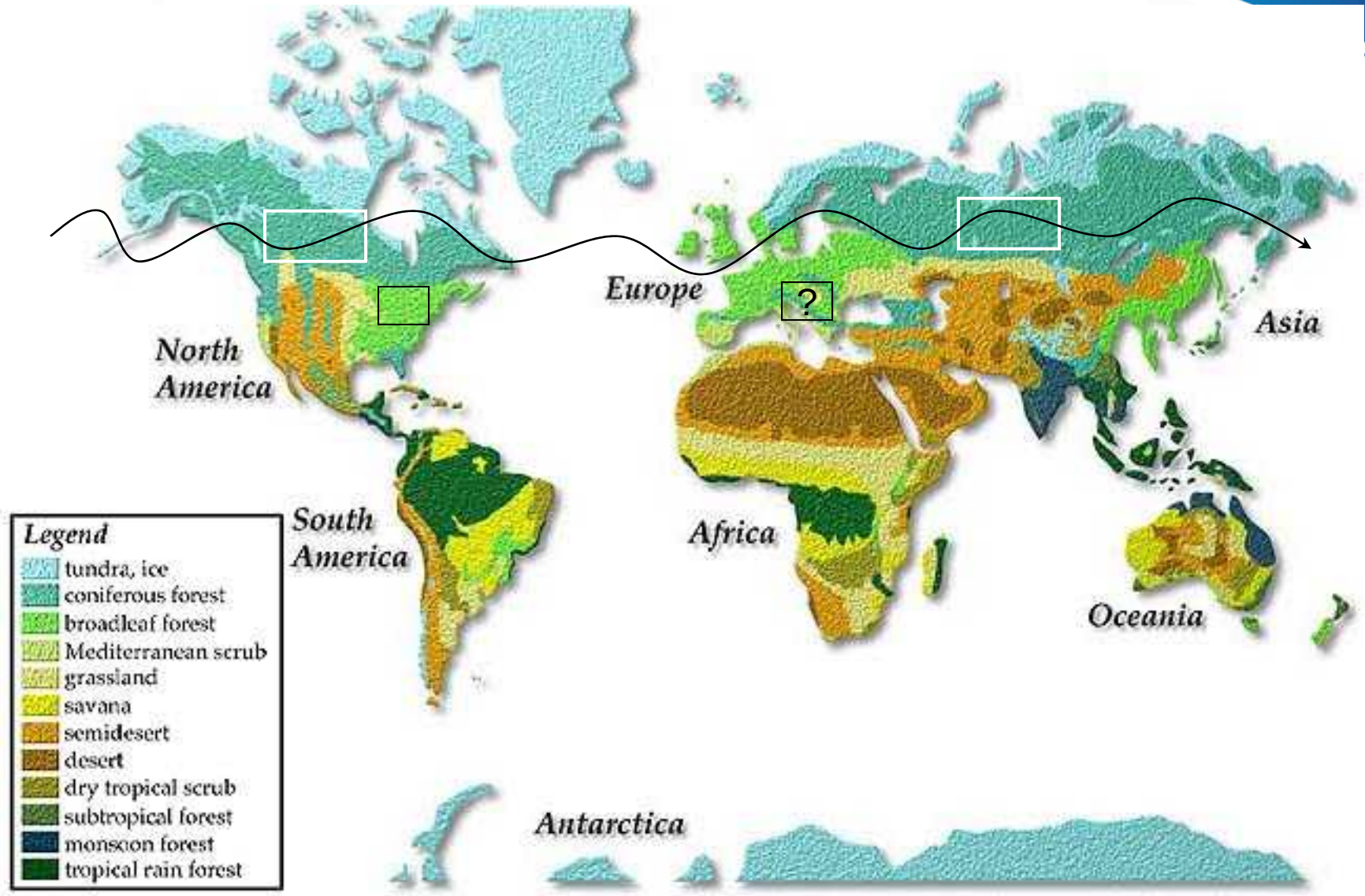
GOES Channel 2-4 particle Size Differences, Jan. 11, 2004



Estimating particle size

Liquid particle radius, Jan. 11, 2004



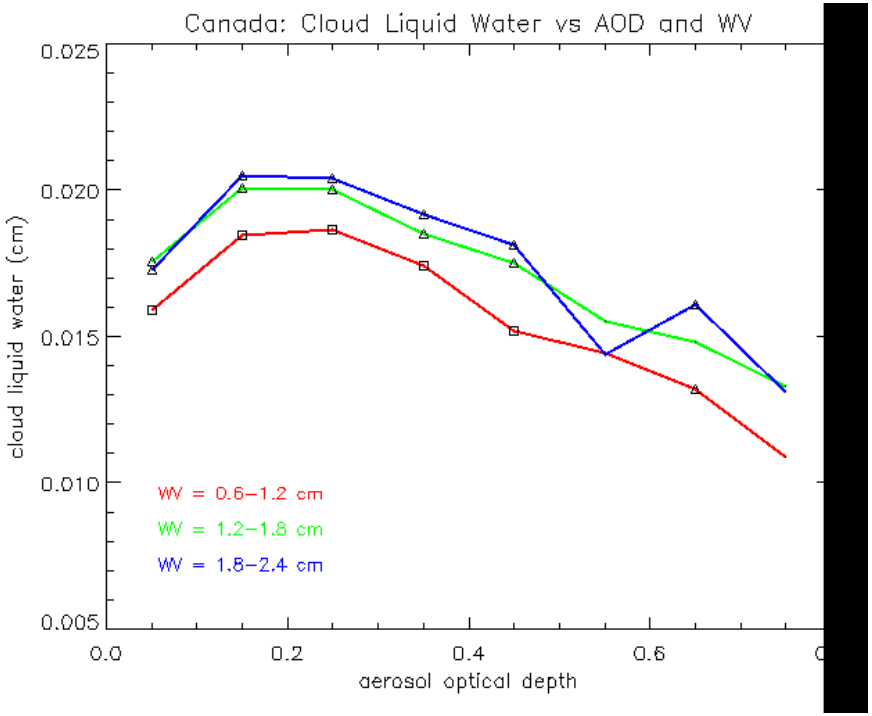


Siberian and Canadian areas are chosen so that the scattering angles and surface cover are the same, so biases will be the same. New areas in USA and Europe are under investigation so radar may be used.

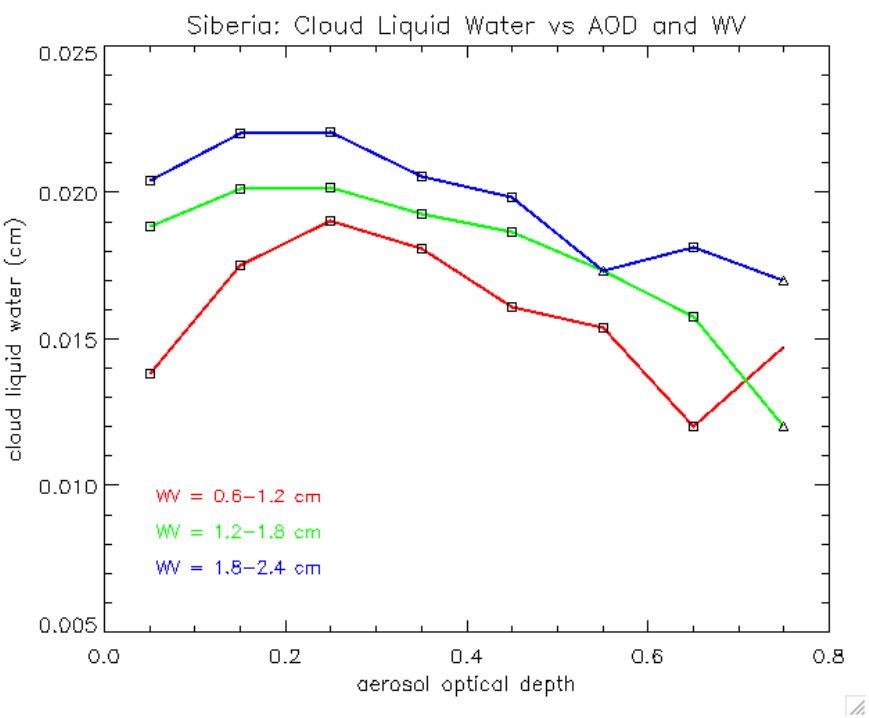
Average Cumulus Cloud Liquid Water as a function of total column Water Vapor and AOD

(summers of 2002-2005)

Canada



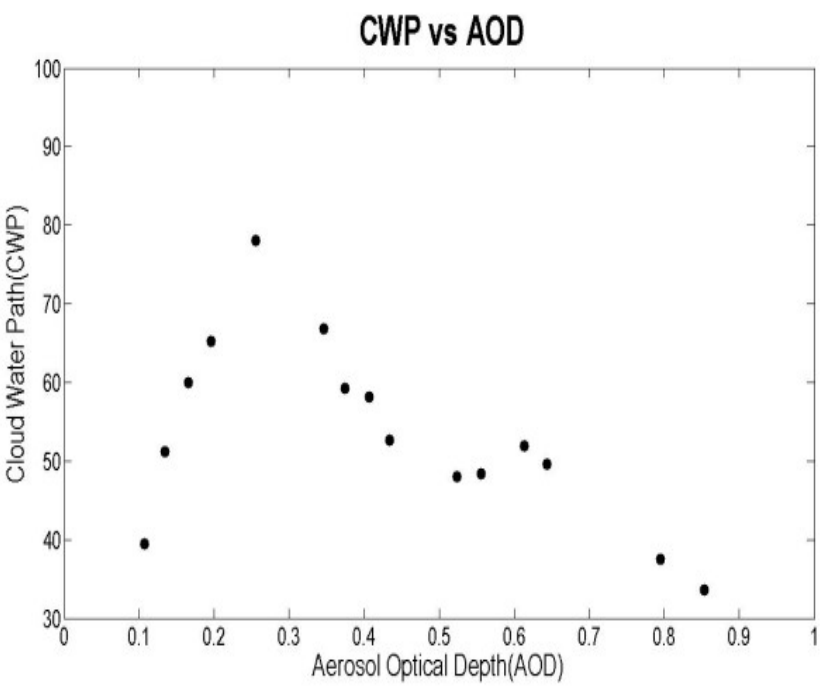
Siberia



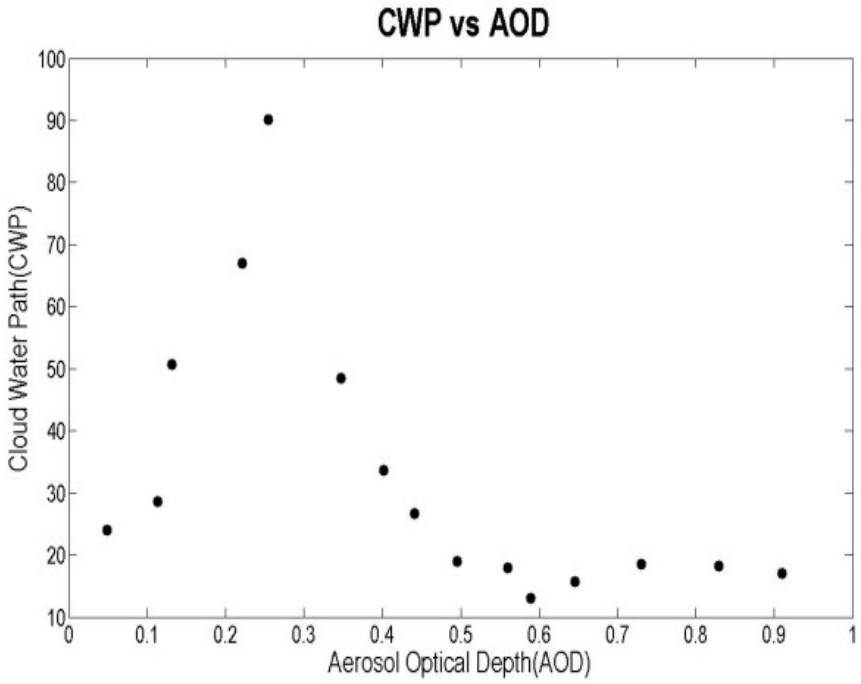
- Initial increase of cloud liquid water with AOD probably indicates precipitation washing out aerosol.
- The decrease of liquid water with higher AOD suggests either atmospheric stabilization or evaporation from smaller droplets.

Eastern Seaboard: All Data and Precipitation Free

(student research)



Full Data Set



Precipitation Free Set

The occurrence of a peak with and without precipitation indicates that the aerosol is affecting the clouds and not the reverse.

Multi-sources Precipitation Estimation

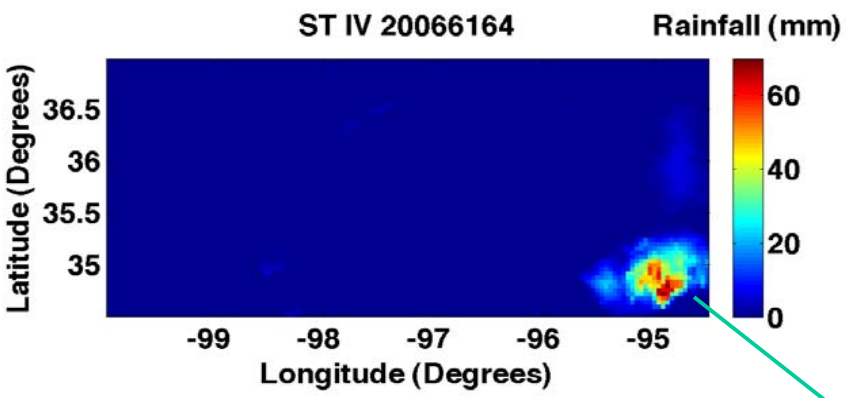
Student: Kibre Tesfagiorgis, PhD

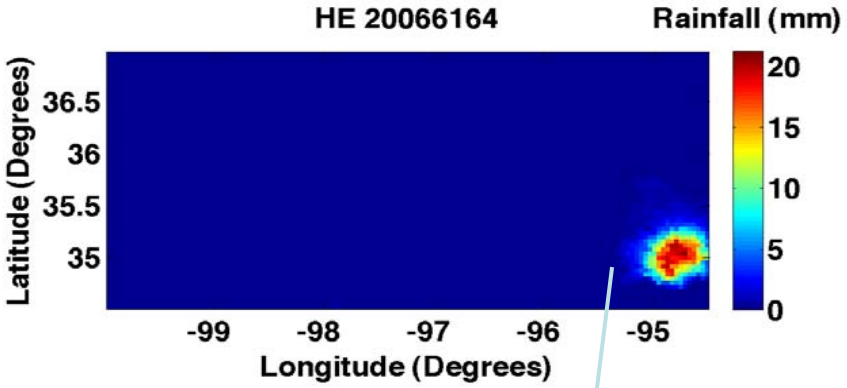
NESDIS Satellite IR-based Hydro-Estimator & NEXRAD Stage-IV at Hourly 4km x 4km

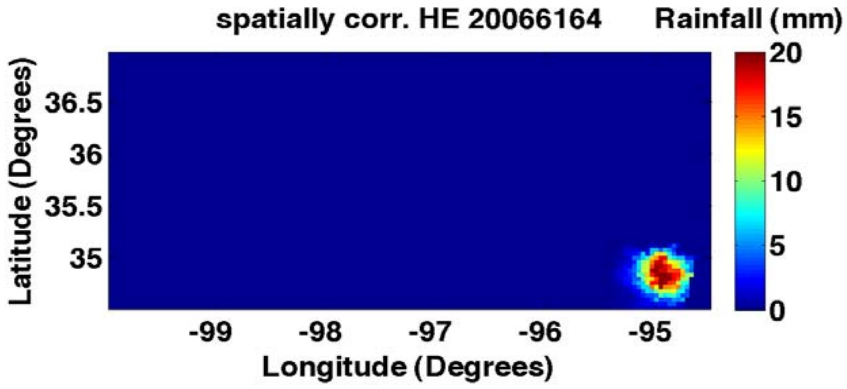
Procedures:

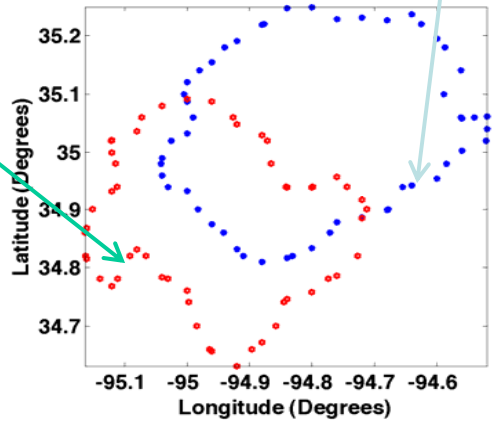
1) Spatial Error Correction

Apply Method of Least Squares (Brogan 1985): the method of Hills Climb to cluster Rainy pixels because the corresponding clusters are to pick up.









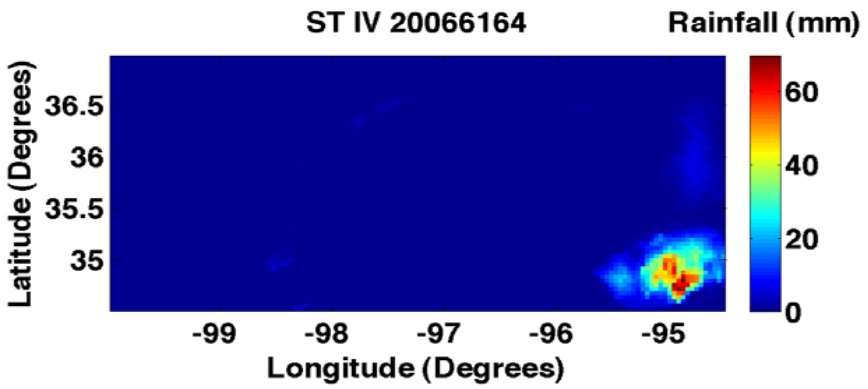
Multi-sources Precipitation Estimation (Cont.)

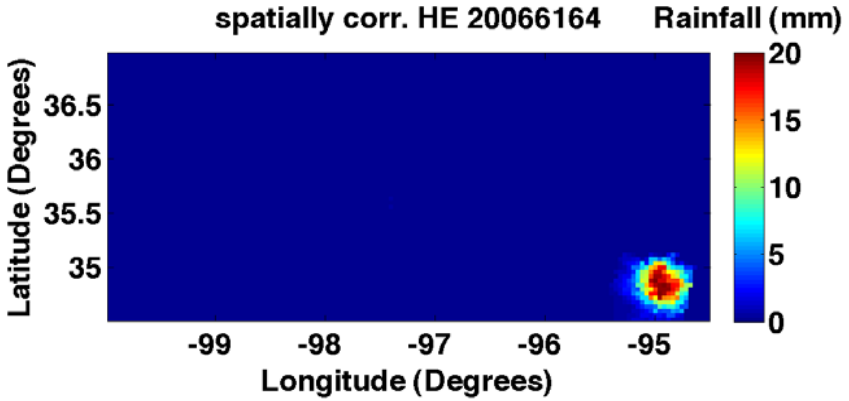
2) Bias Correction

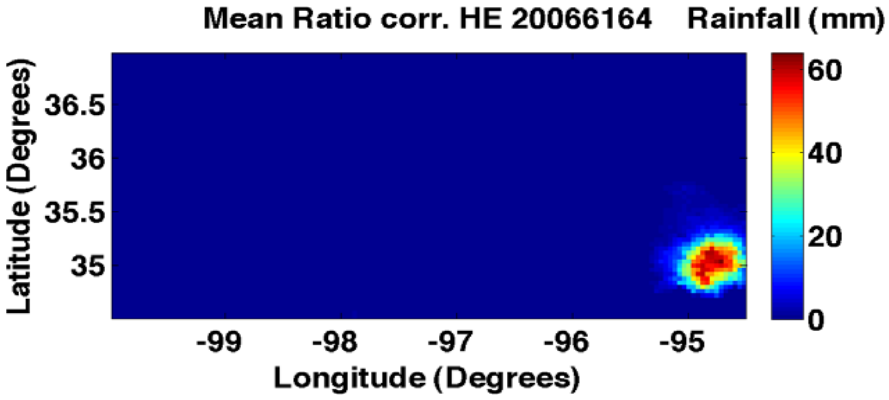
Helps for precipitation Intensity & frequency corrections

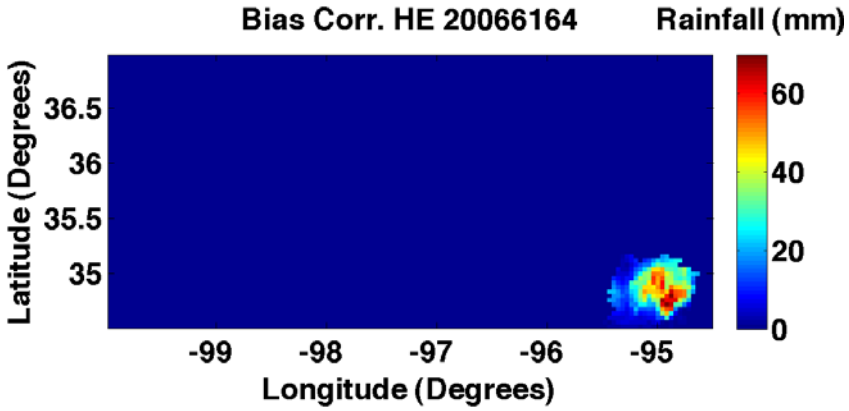
Methods of bias corrections: 1. Ratios of Mean, Median, Maximum;

2. Bias ratio field using Inverse Distance method









Method 2 provides a more radar like output both spatially and intensity wise.

3) Merge Rain gauge with Combined Radar & Satellite Rainfall Estimates

Improvements of the Hydro-Estimator

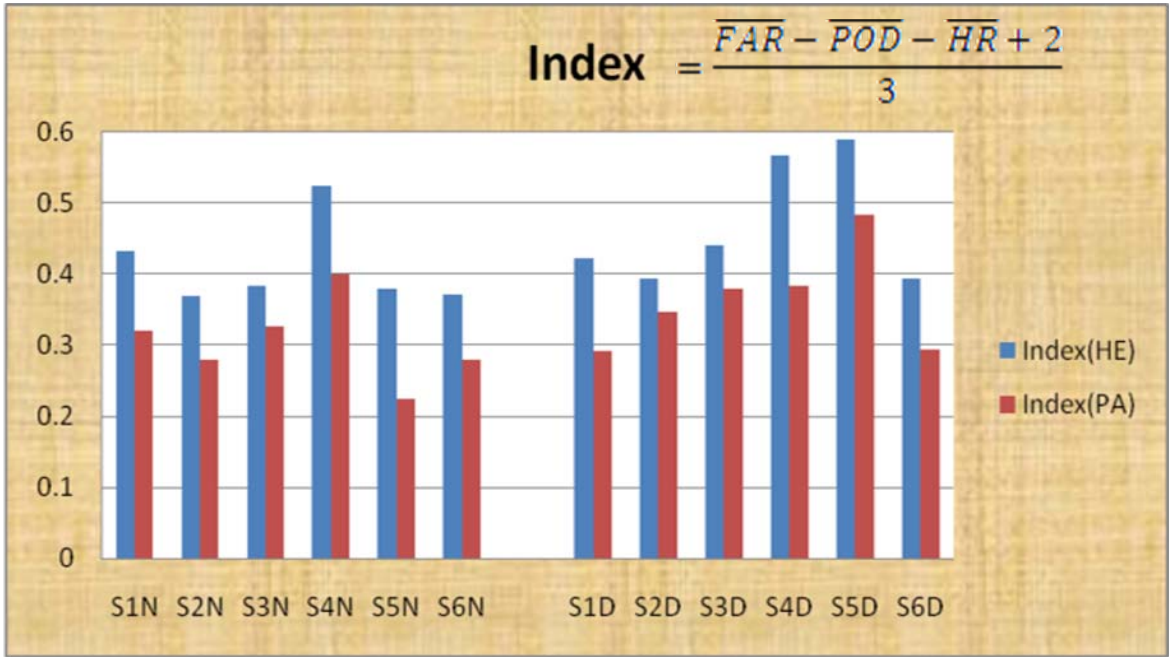
Dr. Nazario D. Ramirez , students: Melvin Cardona[1], Arnaldo Garcia[1], Pablo Mejia[1] and Joan Castro[2]

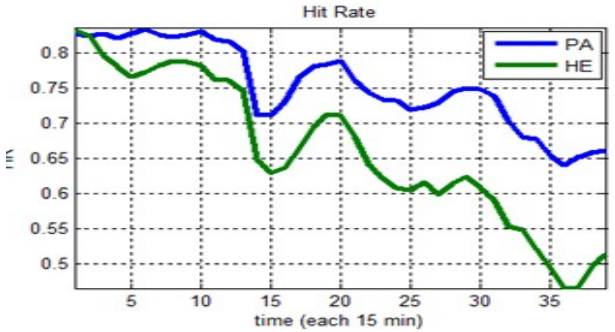
[1]NOAA funding , and [2]External funding

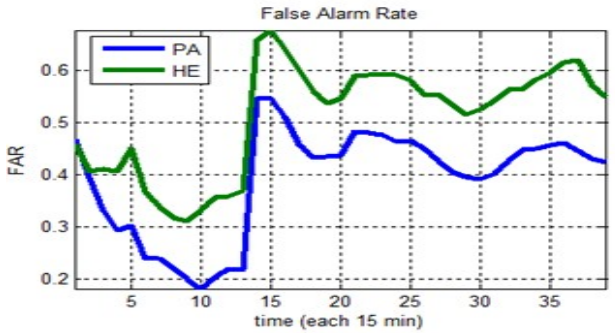
A new algorithm is been developed to detect rainy cloud pixels using visible and infrared GOES data. This algorithm improves the performance of the Hydro-Estimator.

The plots show the preliminary comparison between the Hydro-Estimator and new algorithm.

Minimizing the index number implies minimizing the average false alarm rate (FAR), maximizing the average of probability of detection (POD), and maximizing the average hit rate (HR). **PA=UPRM algorithm, HE=Hydro-Estimator**







April 17, 2003

Results from six storms, left side nighttimes, and right side daytimes

Land Group: Soil - Snow - Vegetation

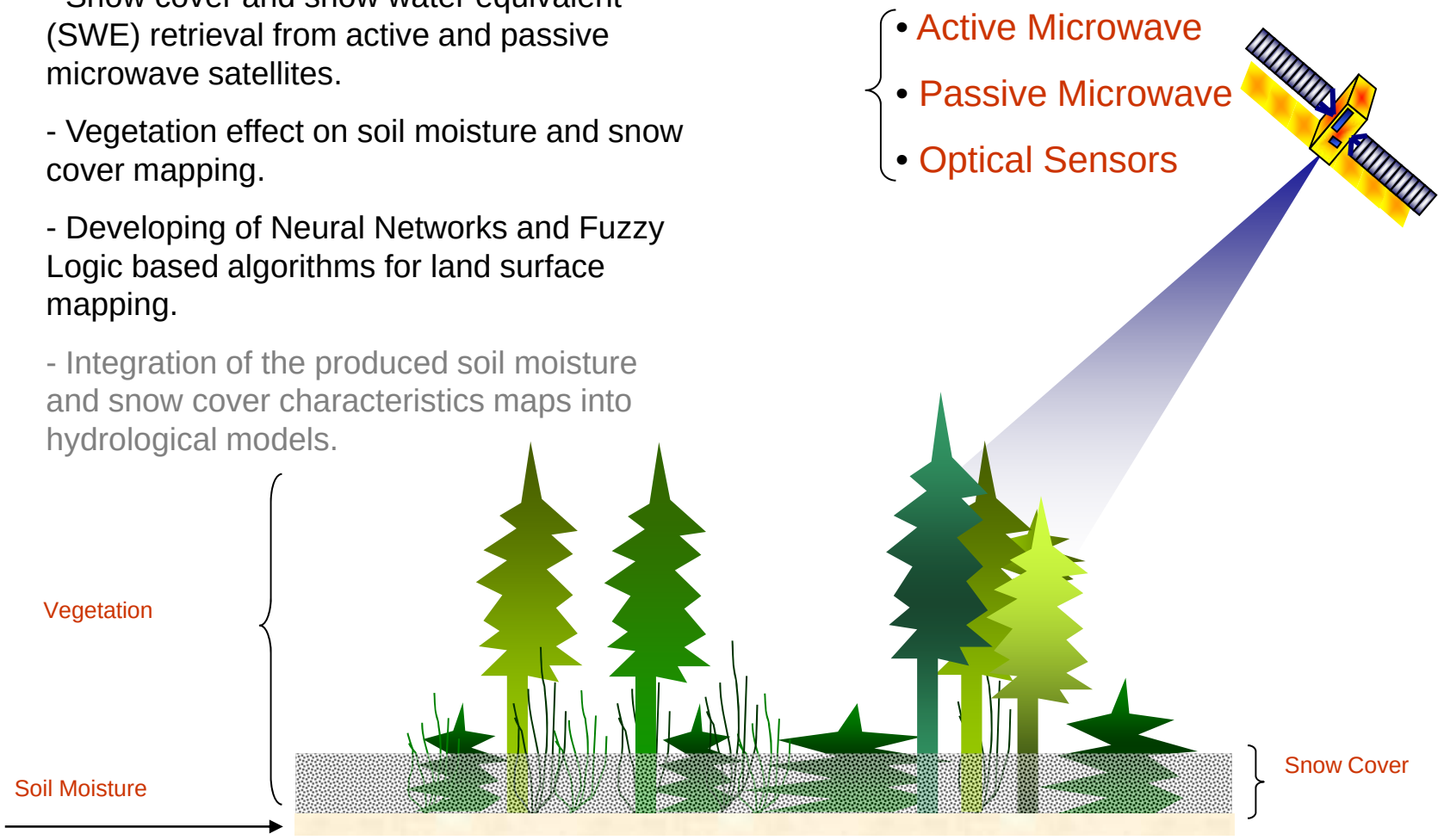
Projects:

- Snow cover and snow water equivalent (SWE) retrieval from active and passive microwave satellites.

- Vegetation effect on soil moisture and snow cover mapping.

- Developing of Neural Networks and Fuzzy Logic based algorithms for land surface mapping.

- Integration of the produced soil moisture and snow cover characteristics maps into hydrological models.



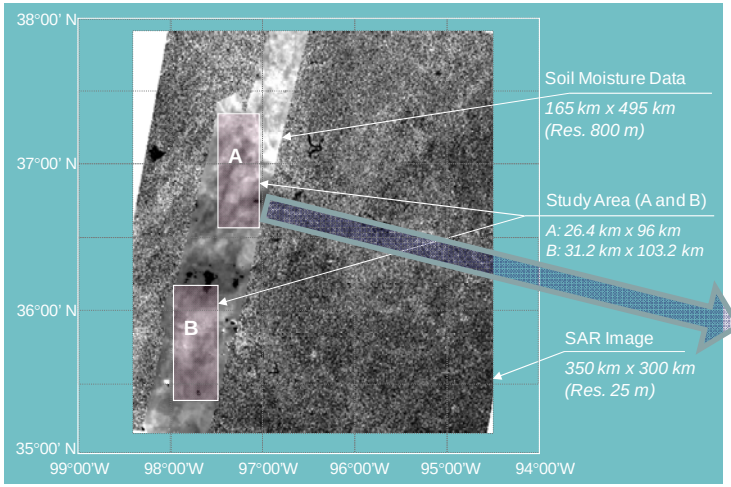
CREST Land Participants

NOAA-CREST Scientists:	***Marouane Temimi***	***CCNY- CUNY***
	Bill Rossow	***CCNY- CUNY***
	Reza Khanbilvardi	***CCNY-CUNY***
	Naira Chaouch	***CCNY-CUNY***
	Lenny Roytman	***CCNY-CUNY***
	Tarendra Lakhankar	***CCNY-CUNY***
	Amir Azar	***CCNY-CUNY***
	Marco Tedesco	***CCNY-CUNY***
	Eric Harmeson	***UPRM***
NOAA Collaborators:	***Al Powell***	***NESDIS/***
	Peter Romanov	***NESDIS***
	Fuzhong Weng	***NESDIS***
	Sid Boukabara	***STAR***
	Jerry Zhan	***STAR***
	Felix Kogan	***STAR***
	Mitch Goldberg	***NESDIS***

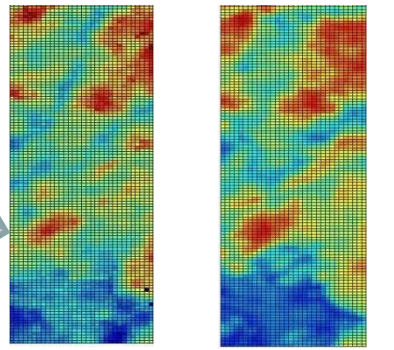
Soil Moisture Research

- Evaluate Flash flood guidance system using SMAP In-situ test-bed data for future satellite (SMAP) mission using Hydrology Laboratory-Research Distributed Hydrologic Model HL-RDHM.
- Calibration and validation of radiative transfer model for soil moisture retrieval at low frequency (1.4 GHz) using better vegetation component.
- Neural network and fuzzy logic modeling for soil moisture retrieval.
- Evaluate the impact of land cover heterogeneity on soil moisture retrieval.
- Evaluate the vegetation impact on soil moisture retrieval for different land cover type.

Neural network and fuzzy logic modeling for soil moisture retrieval



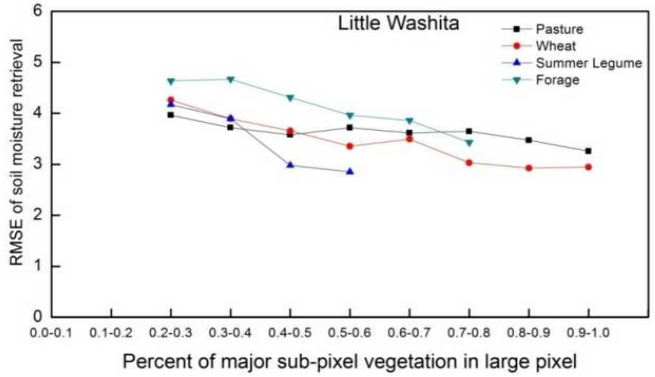
Lakhankar et al (2009 a)



Truth SM

Simulated SM

Impact of land cover heterogeneity on soil moisture retrieval



Lakhankar et al (2009 b)

NOAA-CREST Microwave Radiometers

L-Band Radiometer

- Frequency: 1.40 to 1.55 GHz (**SMAP** mission Frequency)
- Dual polarization (H, V)
- Antenna system: 1.5 x 0.7 meters
- Manufacturer: Radiometrics Corporation, Boulder CO.

High frequency Radiometers

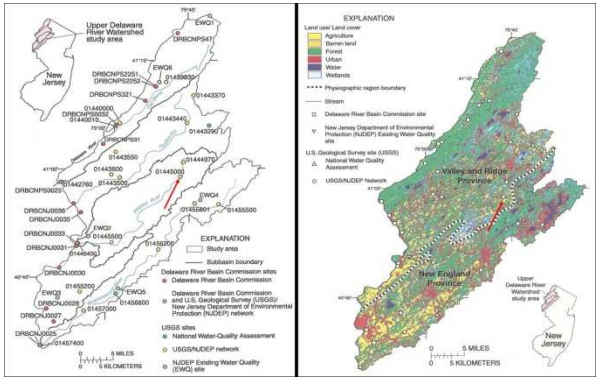
- 37 GHz radiometer
- 89 GHz radiometer
- Dual polarization (H, V)

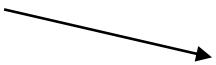
Research Objectives:

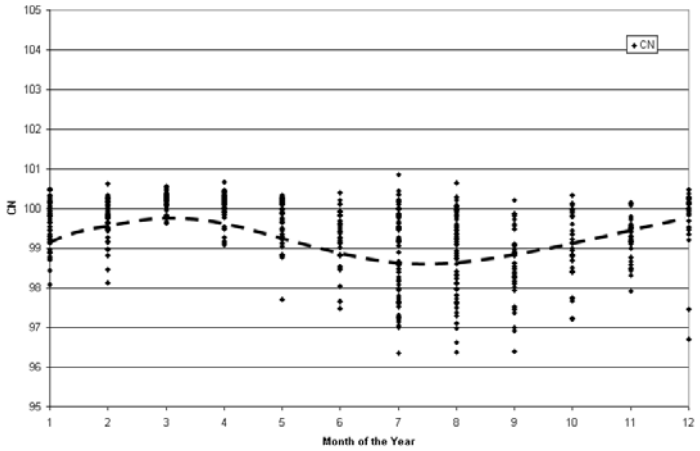
- L-band radiometer will be used for calibration and validation of radiative transfer algorithm for NASA's SMAP mission.
- Study the land emissivity variation under a controlled environment (roughness and vegetation).
- Temporal (crop cycle of 4 month) monitoring of brightness temperature for complete growth cycle of crop (Wheat, Corn, Soybean, etc).
- Brightness temperature variation with respect to measured soil moisture and NDVI will be analyzed to develop (or strengthen) vegetation component of radiative transfer model.
- Investigate the impact of inter rainfall time interval on the retrieval of soil moisture particularly over vegetated areas.

Soil moisture retrieval and hydrological modeling

Analysis of an Adaptive NRCS Curve Number



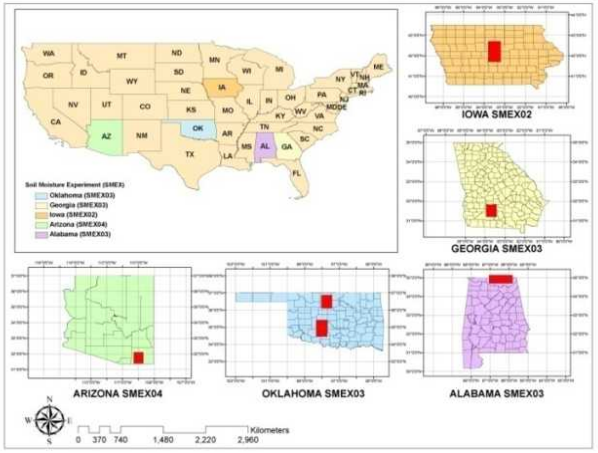




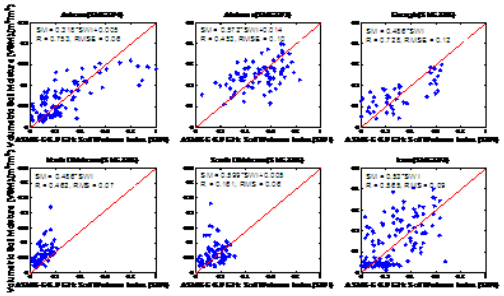
LULC influences CN and is closely related to its changeable behavior. SM affects the CN values and also contribute to its variation due to the amount of water infiltrated. LULC and SM, therefore, are key factors for understanding CN 's behavior.

Intraseasonal variation of the CN over a selected watershed in NJ. MOPEX data has been used. discharge and precipitation observations since 1927

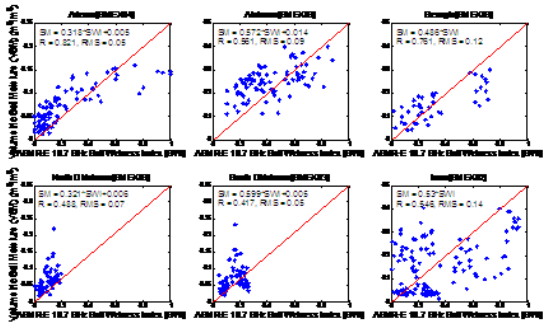
Qualitative vs quantitative estimate of soil moisture



Soil moisture experiment (SMEX) campaigns



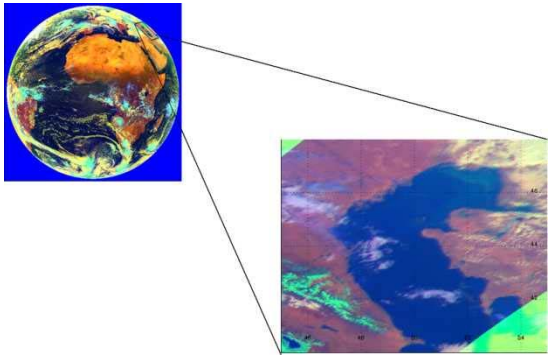
Regression analysis between soil wetness indexes [T_B (H) 6.9 GHz] using the end members derived at local and In-situ soil moisture observed



Regression analysis between soil wetness indexes [T_B (H) 10.7 GHz] using the end members derived at local and In-situ soil moisture observed

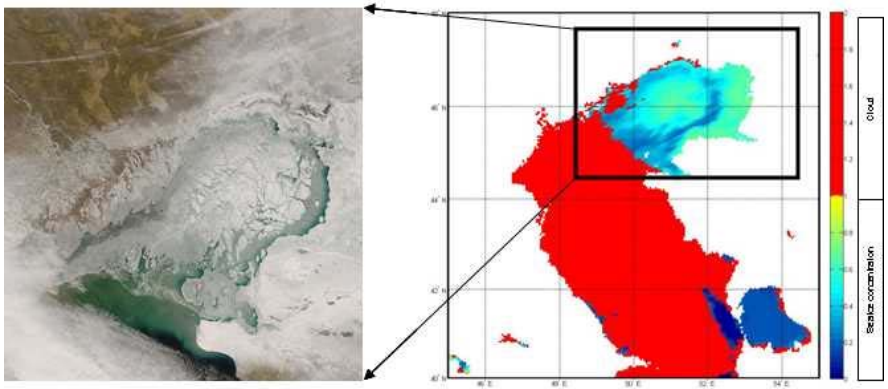
Sea ice monitoring over the Caspian Sea using geostationary satellite data

Students: Rouzbeh Nazary (PhD) & Kim Smith



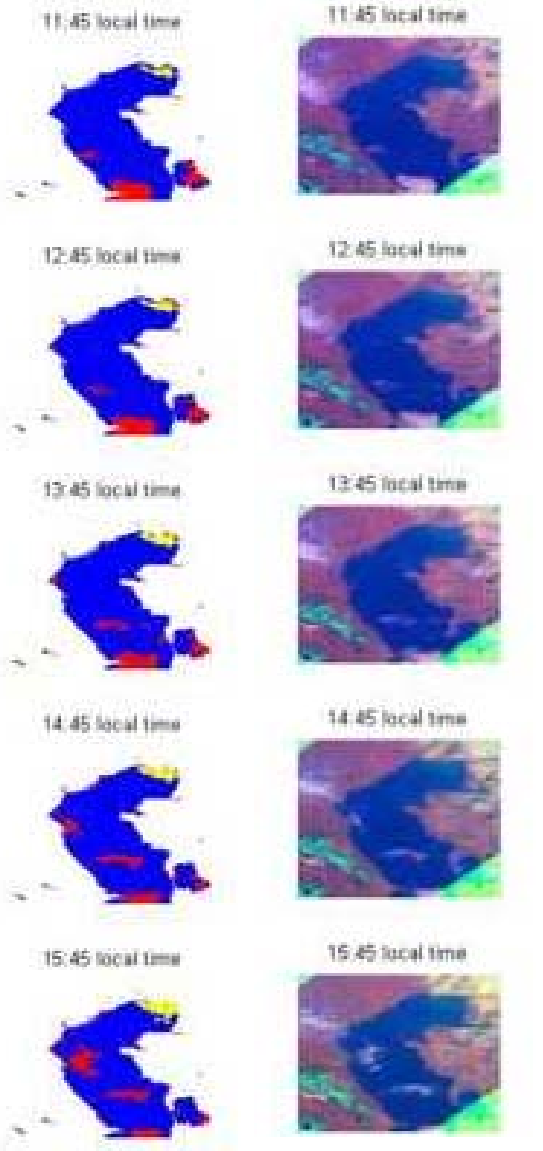
MSG SEVIRI full disk false color composited image and the portion of the image over Caspian Sea reprojected to latitude-longitude grid on 23 January 2007 at 10:15 AM UTC.

The average percentage of cloud reduction because of the daily compositing ranged from 22% to 25%. Daily maps of ice distribution and concentration with minimal cloud coverage were produced.



SEVIRI-based sea ice map over the northern part of the Caspian Sea on 28 February 2007 at 11h15 AM UTC (right) and the MODIS true-colour image for the same day (left)

The obtained correlation coefficients with IMS charts for 2007 and 2008 were 0.92 and 0.83 respectively. The technique has been proposed as one of candidate ice mapping techniques for the future GOES-R ABI instrument.



Instantaneous ice maps (left column) and original MSG SEVIRI images on 23 January 2007. False color images in the right column are constructed with Ch.3 reflectance (red), HRV reflectance (green) and inverted infrared brightness temperature (blue)

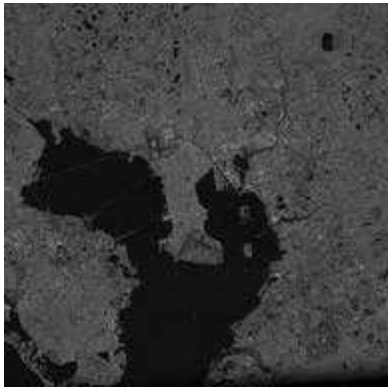
TEMIMI, M., ROMANOV, P., GHEDIRA, H., KHANBILVARDI, R. & SMITH, K. (2009) Sea ice monitoring over the Caspian Sea using geostationary satellite data. *International Journal of Remote Sensing,* Accepted.

ESTABLISHING THE APPLICATION OF HIGH RESOLUTION SATELLITE IMAGERY TO IMPROVE COASTAL AND ESTUARINE FLOOD MONITORING

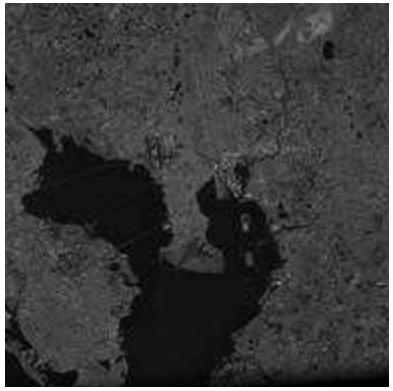
Hurricane Charley 2004 track and hurricane eye location on the 08/14/2004

Example of inland flooded area in red

Use of Radarsat 1 images

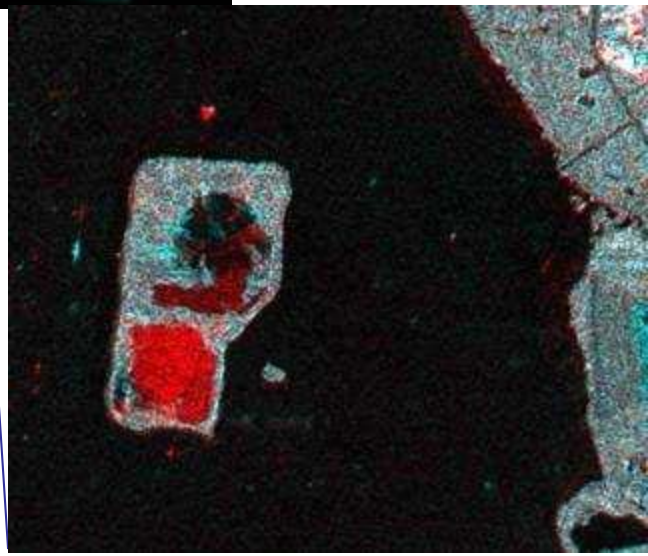


8/15/2004 (right after hurricane Charley 2004)



11/14/2005 (low tide conditions)

Additional flooded area (in red) can be seen inland and along the coast



Towards a better global retrieval of microwave land surface emissivity

Students: Hamidreza Norouzi (PhD)

Model

$$emisP = \frac{TbP - Tatm\_up - Tatm\_down \times e^{-\tau(0,H)/\mu}}{e^{-\tau(0,H)/\mu} \times (Tsurf - Tatm\_down)}$$

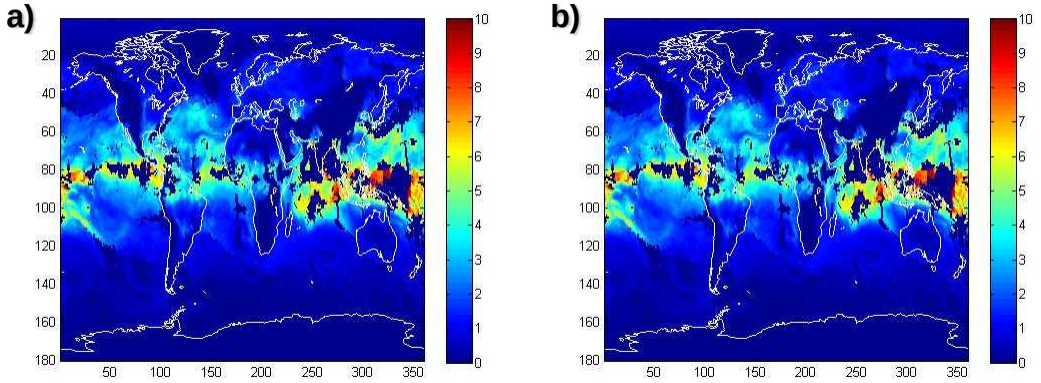
Where

$$Tatm\_down = \int_0^H T(z)\alpha(z)e^{-\tau(0,z)/\mu}dz$$

and

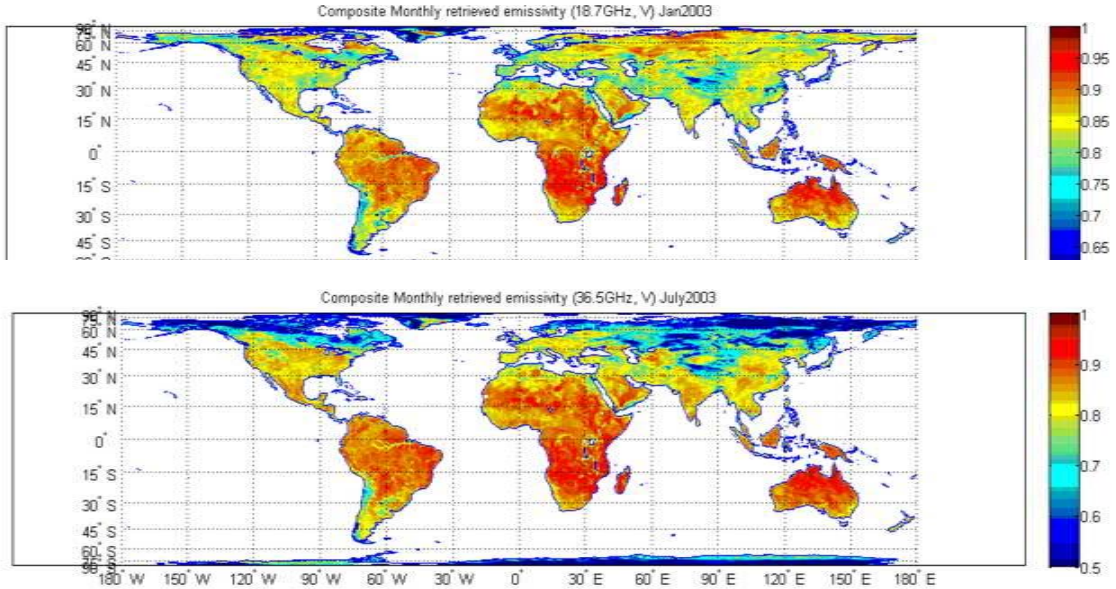
$$Tatm\_up = \int_0^H T(z)\alpha(z)e^{-\tau(z,H)/\mu}dz.$$

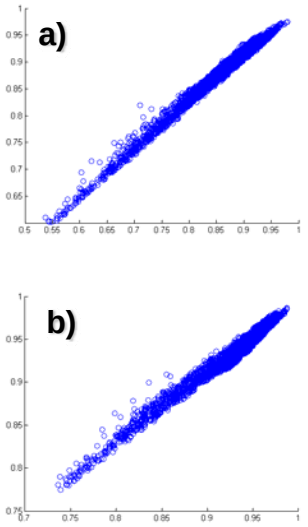
Atmospheric correction according to Liebe's model



Upwelling (a) and downwelling (b) brightness temperature as an atmospheric contribution to the satellite observation on July 14th 2003 at 37 GHz

Products

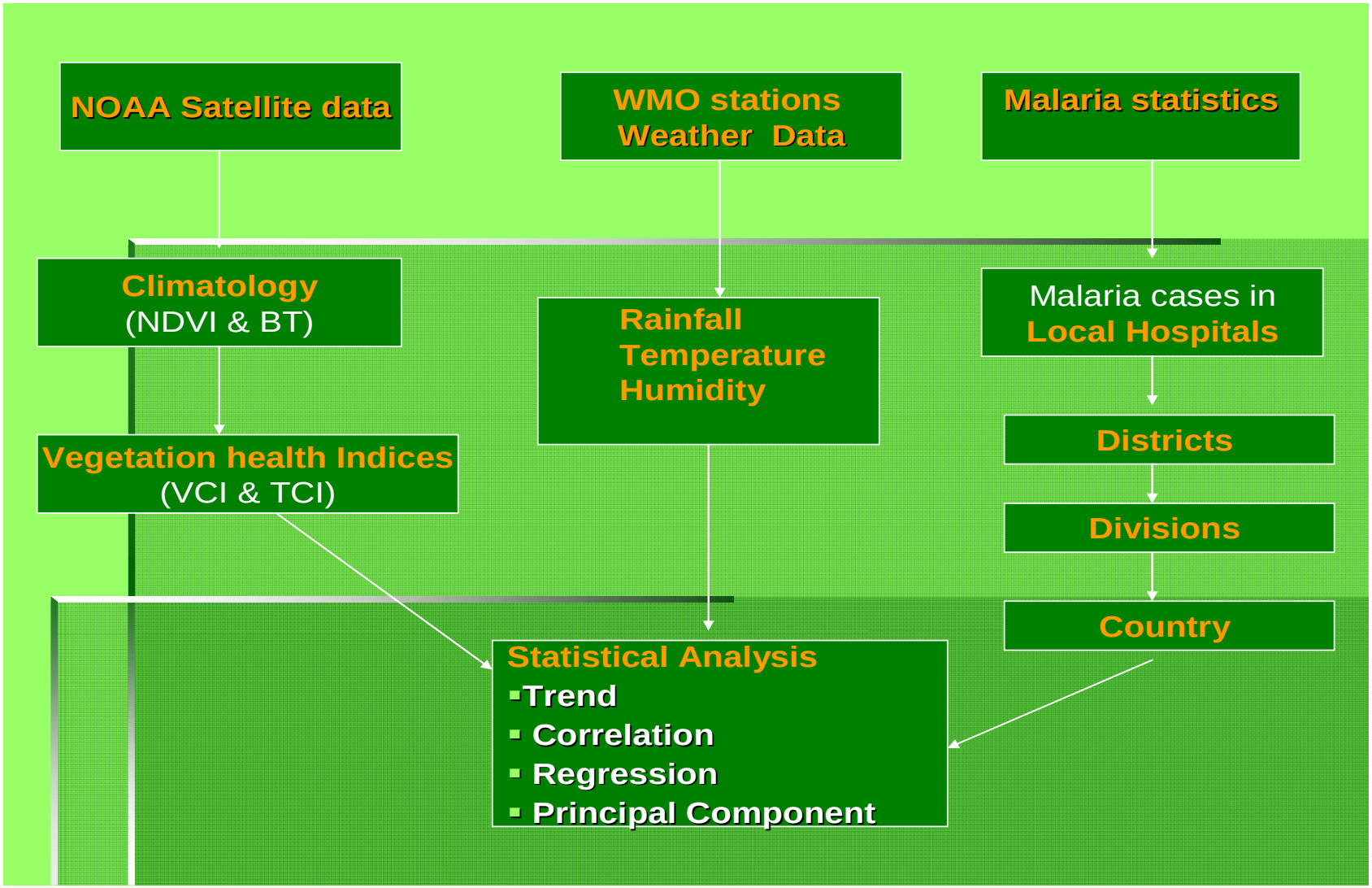




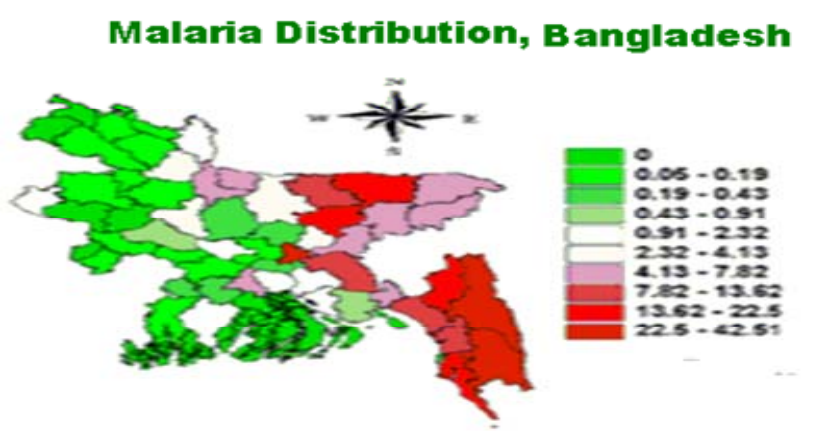
Comparing 19 GHz in a) and 37 GHz in b) V and H polarization emissivities

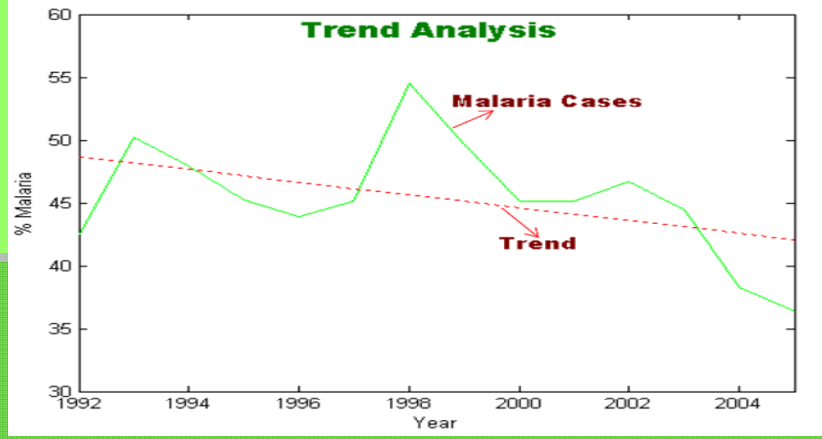
Application of NOAA POES AVHRR- based vegetation health indices for early warning and monitoring of malaria

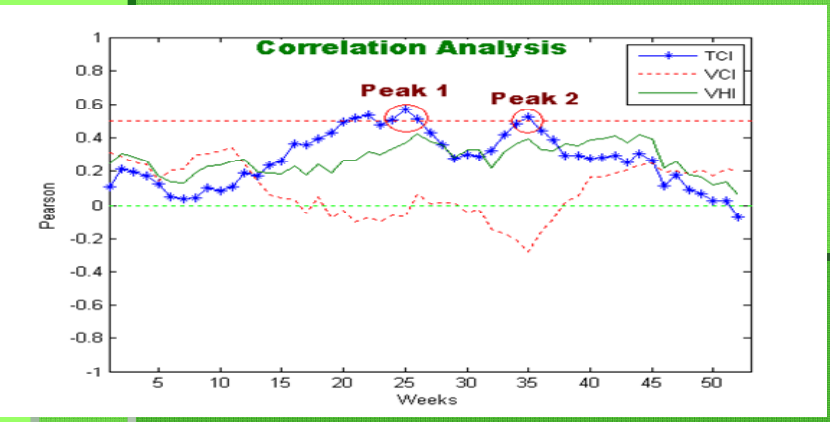
Students: Mohammad Nizamuddin & Clement Savadogo (PhD)

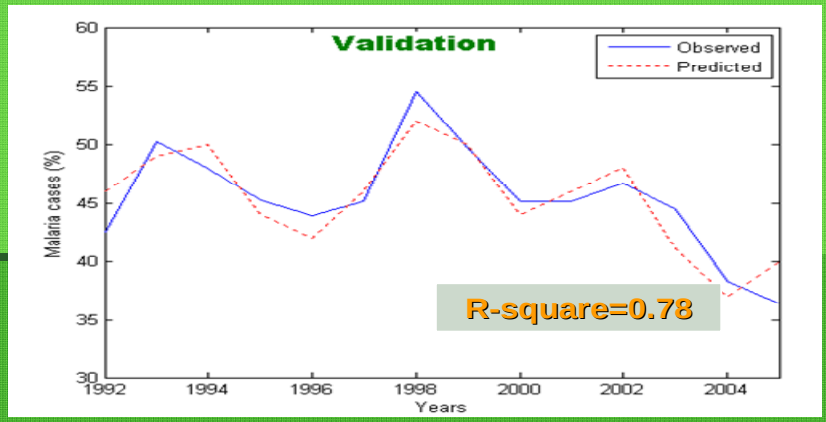


Analysis & Results









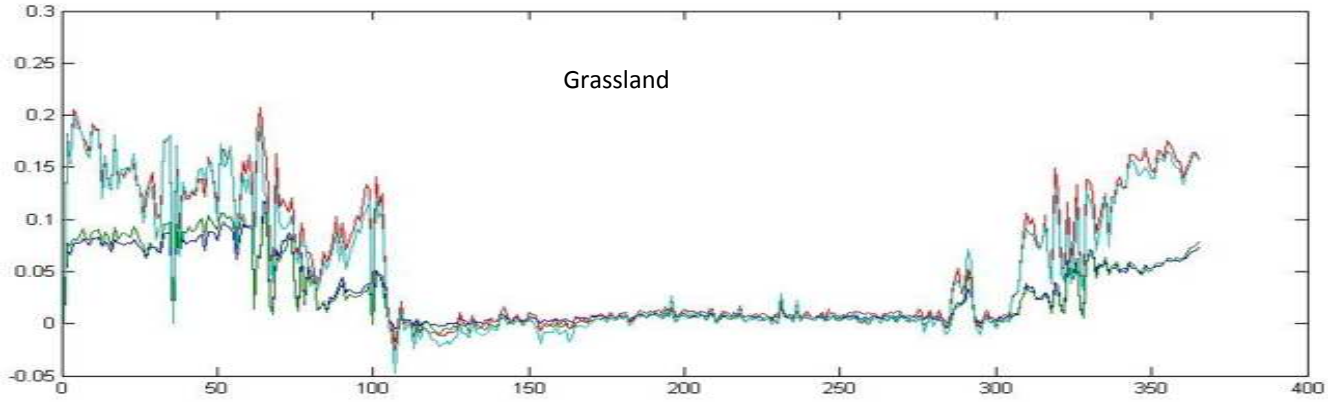
Malaria early warnings can be generated 6-8 weeks in advance of the epidemics

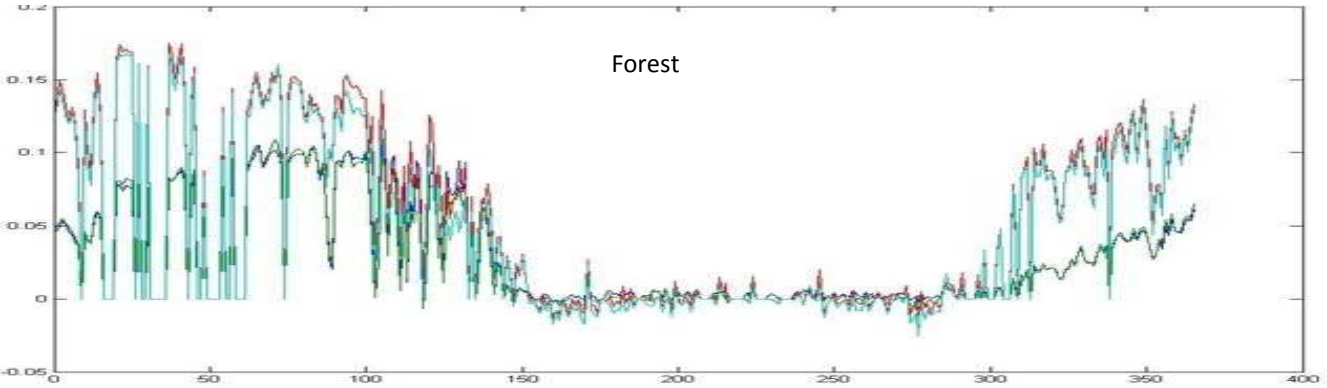
Our latest joint project is NASA-NOAA-UN-CREST
Flood-Air Borne Diseases Namibia WebSensor Pilot Project

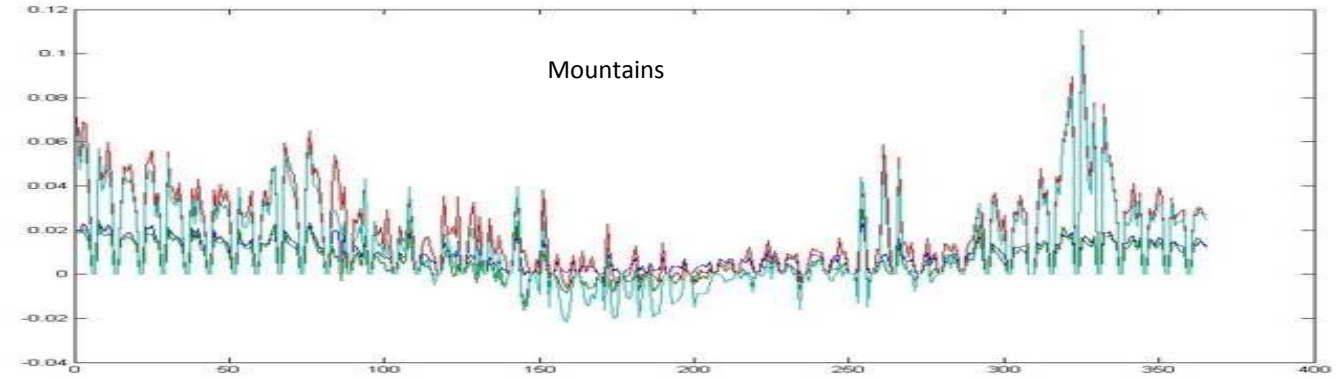
Snow Characteristics /Flash Flood Guidance (FFG) System

Ground-based radiometers

Emissivity Ratios and Snow







- **Normalized Emissivity Ratios:**

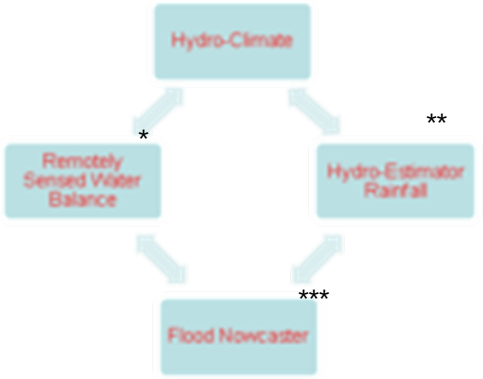
- (19v-37v)/(19v+37v)
- (19h-37h)/(19h+37h)
- (85v-37v)/(85v+37v)
- (85h-37h)/(85+37h)

- The emissivity ratios are highly sensitive to snow cover

Development of a NowCast Flood Forecast System for Western PR

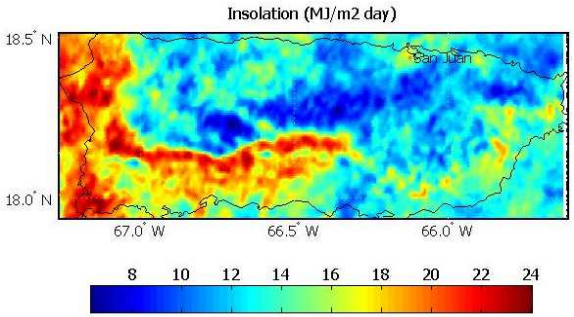
Recent efforts have focused on the development of a subwatershed hydrologic model within the western PR study basin. An up-scaling procedure is being applied to refine the calibration of the basin-scale model.

A 1-km resolution GOES product has been developed for PR to estimate ground-based solar radiation and evapotranspiration. An algorithm is being developed to perform a pixel-by-pixel daily water balance. The algorithm will provide soil moisture content which is needed as input to the flood Nowcast model.

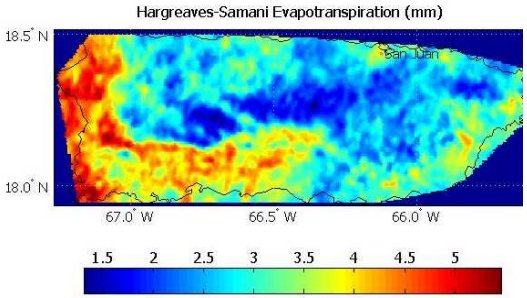


Students:
* Sionel Arocho
**Melvin Cardona
*** Alejandra Rojas (external funds)

Daily estimated solar radiation



Daily reference evapotranspiration in PR



Estimated cumulative seasonal water consumptive use for five different crops at seven locations in PR

	Seasonal Evapotranspiration (mm)						
Crop	Isabela	Maricoa	Guilarte	Fortuna	Combate	Mayaguez	Bosque
Tomato	217	207	198	263	283	232	291
Sweet Corn	228	219	208	277	297	243	305
Squash	200	191	183	242	259	212	267
Lettuce	206	198	189	251	268	219	276
Sweet Pepper	210	201	192	255	273	223	280

Min

Max

Comparison of measured and estimated solar radation at Juana Diaz, PR