The SPoRT Center – Infusing NASA Technology Into NWS WFOs

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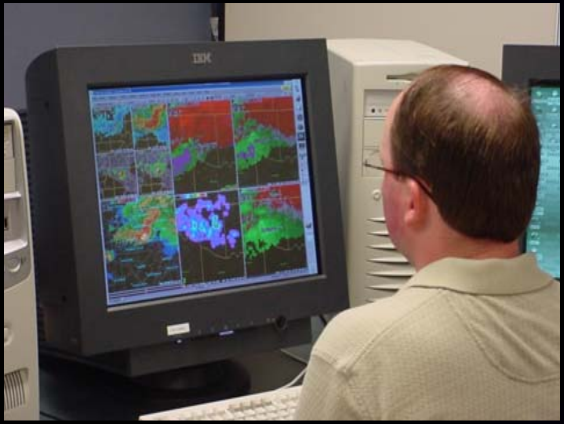
Earth Science Office

__Mission of the SPoRT Center:__ Apply NASA measurement systems and unique Earth science research to improve the accuracy of short-term (0-24 hr) weather prediction at __the regional and local scale__



__http://weather.msfc.nasa.gov/sport__

SPoRT – Short-term Prediction and Research Transition

Players and Partners

Core NASA capability – main focus on short-term weather forecast improvement on a regional and local scale -- complementary to JCSDA

- **conduct focused research**
- **evaluate in “testbed” mode**
- **transition priority products**

Players	**External Partners**
SR NWS forecast offices	NWS (Southern Region, HQs)
Universities (UW, UW, UAH, USF, FIT, FSU)	NESDIS (STAR, NDE)
ENSCO	JCSDA, JPL, GSFC (GMAO)

External advisory committee to help guide work

Interactions with WFOs

Keys to success

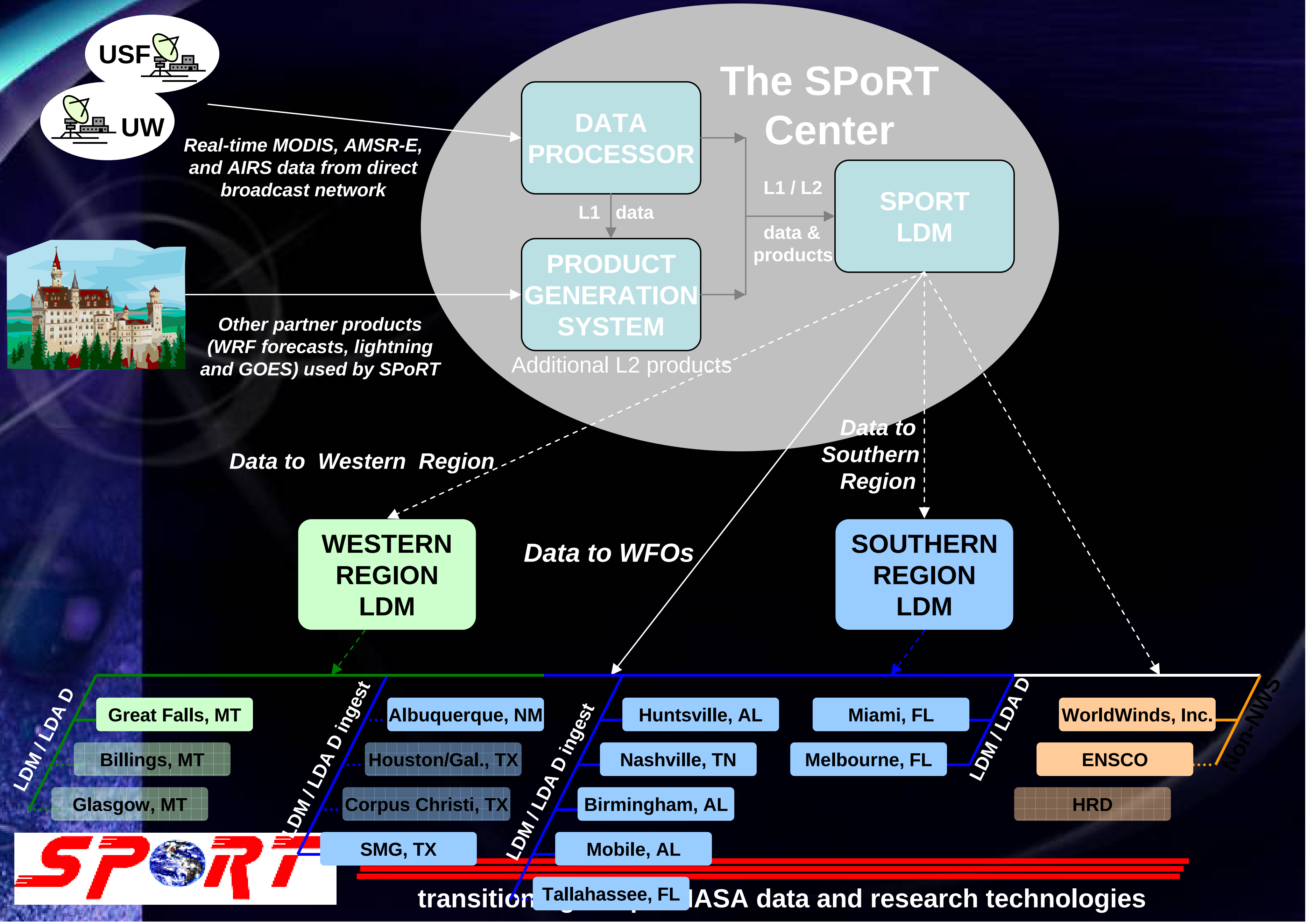
Link data / products to forecast problems
Integrate capabilities into AWIPS
Provide training / forecaster interaction & feedback

NWS Southern Region -- forecast problems

- timing and location of thunderstorms
- severe weather warnings
- diagnostic analysis of current conditions (esp. at night)
- morning minimum temperatures (and its local variations)
- fog and low cloud detection
- coastal weather processes (sea breeze convection / temperatures)
- off-shore precipitation processes

Science Mission Directorate
National Aeronautics and Space Administration

Data Dissemination Via LDM


USF
UW
Real-time MODIS, AMSR-E, and AIRS data from direct broadcast network
Other partner products (WRF forecasts, lightning and GOES) used by SPoRT
The SPoRT Center
DATA PROCESSOR
L1 data
PRODUCT GENERATION SYSTEM
Additional L2 products
L1 / L2 data & products
SPORT LDM
Data to Western Region
Data to Southern Region
Data to WFOs
WESTERN REGION LDM
SOUTHERN REGION LDM
LDM / LDAD
LDM / LDAD ingest
LDM / LDAD ingest
LDM / LDAD
Non-NWS
Great Falls, MT
Billings, MT
Glasgow, MT
Albuquerque, NM
Houston/Gal., TX
Corpus Christi, TX
SMG, TX
Huntsville, AL
Nashville, TN
Birmingham, AL
Mobile, AL
Tallahassee, FL
Miami, FL
Melbourne, FL
WorldWinds, Inc.
ENSCO
HRD
SPoRT

transitio ASA data and research technologies

Unique NASA Data to Operations

MODIS high resolution visible/infrared imagery – derived products

- 4 times / day – full resolution, channels simulating NPOESS and GOES-R capabilities
- TPW, LST/SST, cloud (masks/height) and fog products, composite imagery (smoke/haze, vegetation patterns, tornado damage tracks, & snow cover)

AMSR-E products

- rain rate, convective fraction – off-shore precipitation mapping
- snow water equivalent

Lightning Mapping Array (LMA) flash densities

- Increased lead time for severe weather warnings, reduction in FAR

AIRS temperature and moisture profiles (spring 2008)

All products in Advanced Weather Information Processing System (AWIPS)

Unique Model Data to Operations

Demonstrated value of regional modeling products to WFOs

Conducted study with HUN WFO on value of WRF (0-24h) to forecast process

- Initialized with MODIS 1km composite SSTs since Fall 2005
- Impact of high resolution local models
- benchmarked performance in several WFOs – positive impact of QPF as supplemental product

Disseminating WRF 4km product produced in conjunction with NSSL to selected WFOs

- Working towards inclusion of GSFC LIS for surface variables

Collaborative local WRF forecasting with MIA WFO (2km, with MODIS SSTs)

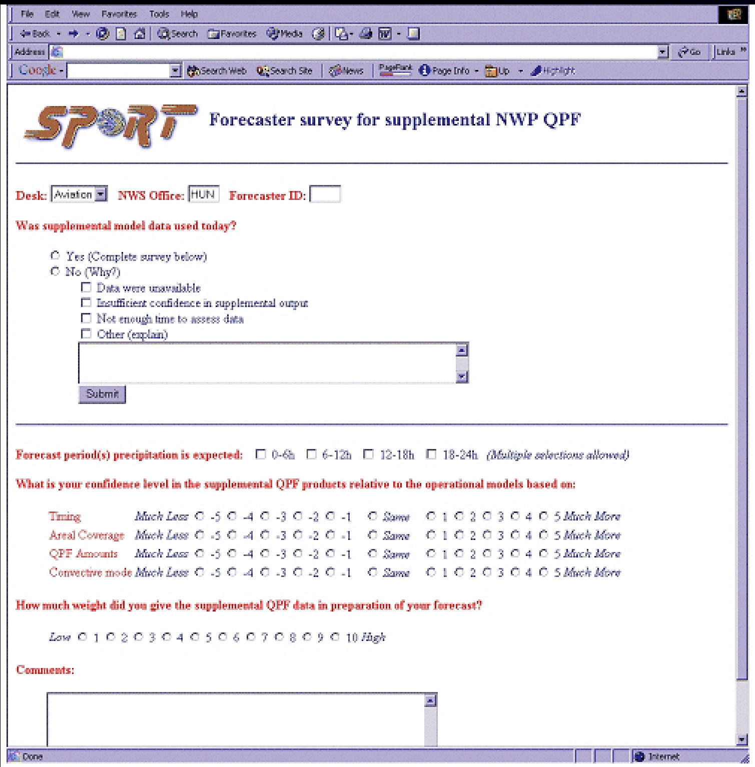
Assessments and Product Surveys

Just don't throw data / products over the fence to end user!

- match need (problem) to data/products (solution)
- involve end users in the entire process
- provide various types of training
- assess utility and success

User surveys

- when and how used
- value added to the decision process
- web-based
- quick and easy to fill out
- response stored in database for assessment


File
Edit
View
Favorites
Tools
Help
Back
Search
Favorites
Media
Address
Go
Links
Google
Search Web
Search Site
News
PageRank
Page Info
Up
Highlight
Submit
Done
Internet

Forecaster survey for supplemental NWP QPF

Desk: Aviation **NWS Office:** HUN **Forecaster ID:**

Was supplemental model data used today?

○ Yes (Complete survey below)
○ No (Why?)
  ☐ Data were unavailable
  ☐ Insufficient confidence in supplemental output
  ☐ Not enough time to assess data
  ☐ Other (explain)

Forecast period(s) precipitation is expected: ☐ 0-6h ☐ 6-12h ☐ 12-18h ☐ 18-24h *(Multiple selections allowed)*

What is your confidence level in the supplemental QPF products relative to the operational models based on:

Timing	*Much Less*	○ -5	○ -4	○ -3	○ -2	○ -1	○ *Same*	○ 1	○ 2	○ 3	○ 4	○ 5	*Much More*
Areal Coverage	*Much Less*	○ -5	○ -4	○ -3	○ -2	○ -1	○ *Same*	○ 1	○ 2	○ 3	○ 4	○ 5	*Much More*
QPF Amounts	*Much Less*	○ -5	○ -4	○ -3	○ -2	○ -1	○ *Same*	○ 1	○ 2	○ 3	○ 4	○ 5	*Much More*
Convective mode	*Much Less*	○ -5	○ -4	○ -3	○ -2	○ -1	○ *Same*	○ 1	○ 2	○ 3	○ 4	○ 5	*Much More*

How much weight did you give the supplemental QPF data in preparation of your forecast?

Low ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 *High*

Comments:

Figure 1. Survey completed by NWS Duty Forecasters to evaluate supplemental numerical QPF products

Testbeds

- Physical entity or “virtual” environment
- Simulate operational constraints
- Focus on “low hanging” fruit – early success stories
- Build a working relationship with end user
    - all levels in organization
    - involve end user in testbed activities (personnel exchange)
    - training
    - continued involvement post-transition
- Preliminary performance assessment

Programmatic Accomplishments

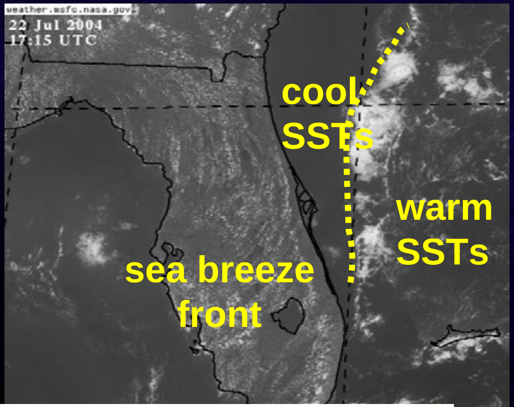
- Established a working paradigm for transition of research capabilities to operations – a foot bridge over the “valley of death”
- Regularly improve weather diagnostic and forecast capabilities at the WFO level
- Developed user advocacy for new products, many of which will become future NOAA operational capabilities
- Trained forecasters on use of new technologies
- Developed, tested and transitioned various tools to collaborative organizations for application to their transition activities
- Broadened partnerships to extend capabilities to new satellites and next generation weather display systems

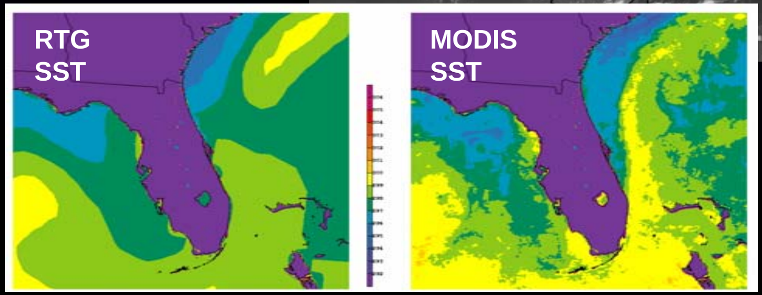
Background Charts – Application Examples

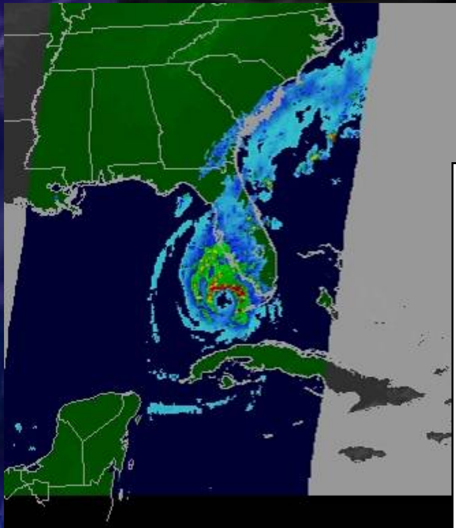
- Coastal applications
- MODIS data high resolution data and fog product
- AMSR-E for tropical storm / precipitation monitoring
- LMA
- Convective initiation products
- AIRS profiles
- AIRS data assimilation

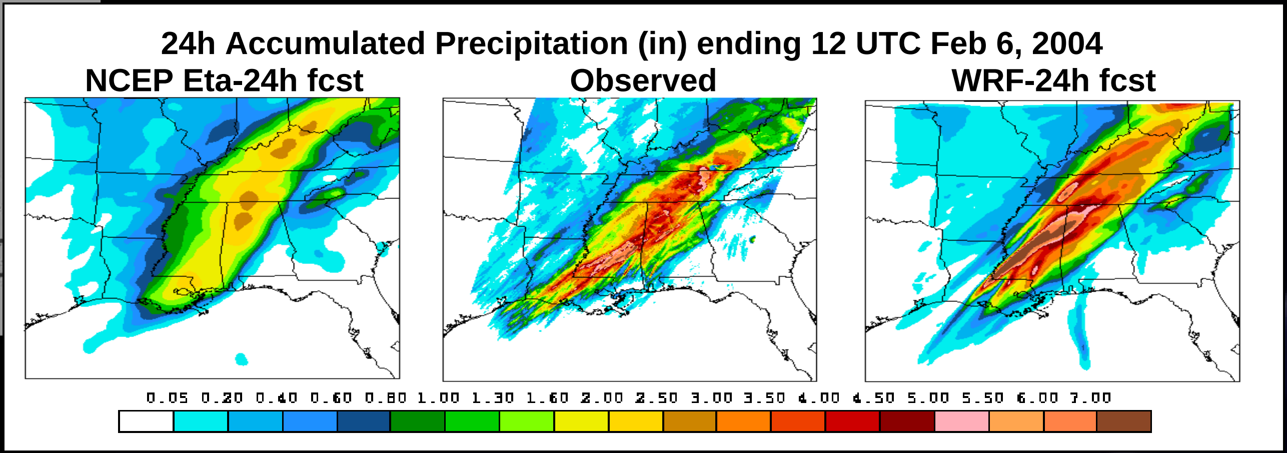
Coastal Applications

- Real-time MODIS and AMSR-E products (SSTs, chlorophyll, rain rates, wind spd)
- High resolution WRF forecasts (2-4km, 0-36h)


weather.msfc.nasa.gov
22 Jul 2004
17:15 UTC
cool SSTs
warm SSTs
sea breeze front


RTG SST
MODIS SST

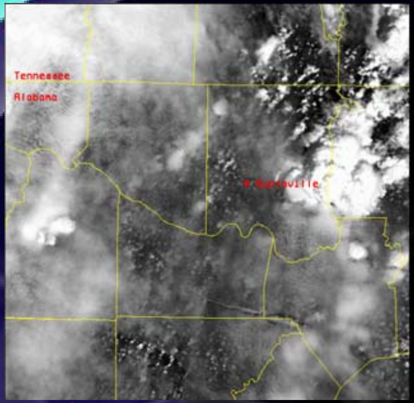



24h Accumulated Precipitation (in) ending 12 UTC Feb 6, 2004

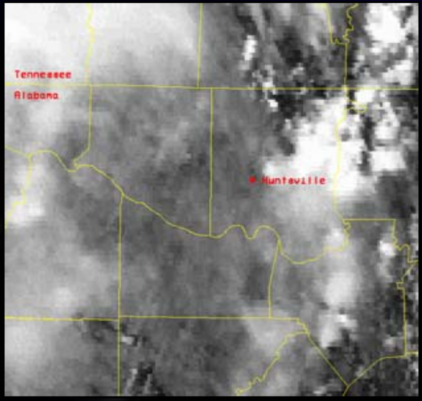
NCEP Eta-24h fcst
Observed
WRF-24h fcst
0.05 0.20 0.40 0.60 0.80 1.00 1.30 1.60 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 7.00

High-resolution MODIS Data and Products

MODIS 250m Visible

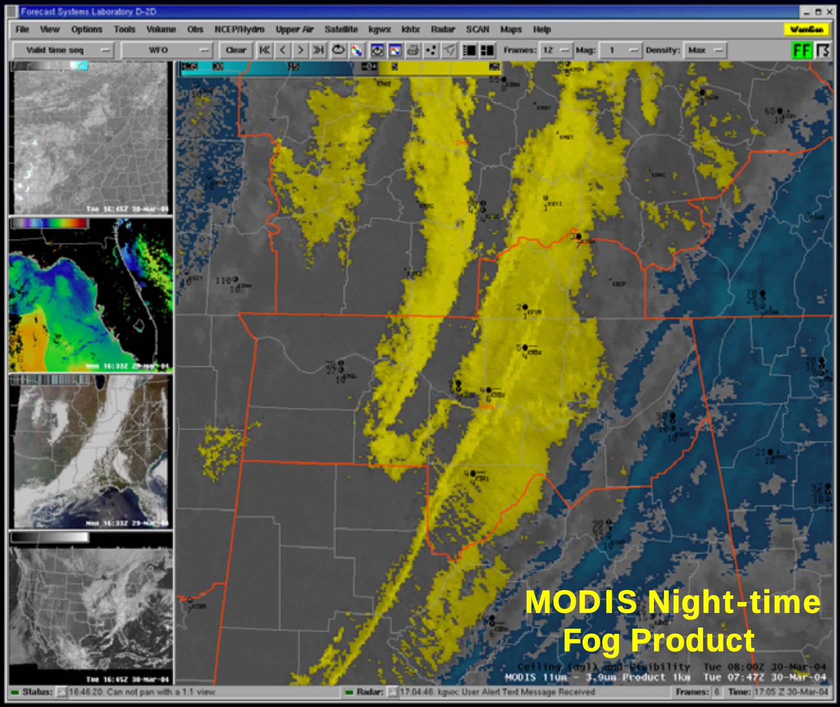

Tennessee
Alabama
Huntsville

GOES 1 km Visible


Tennessee
Alabama
Huntsville

↑ The 250m resolution visible bands provides cloud features undetected with GOES.

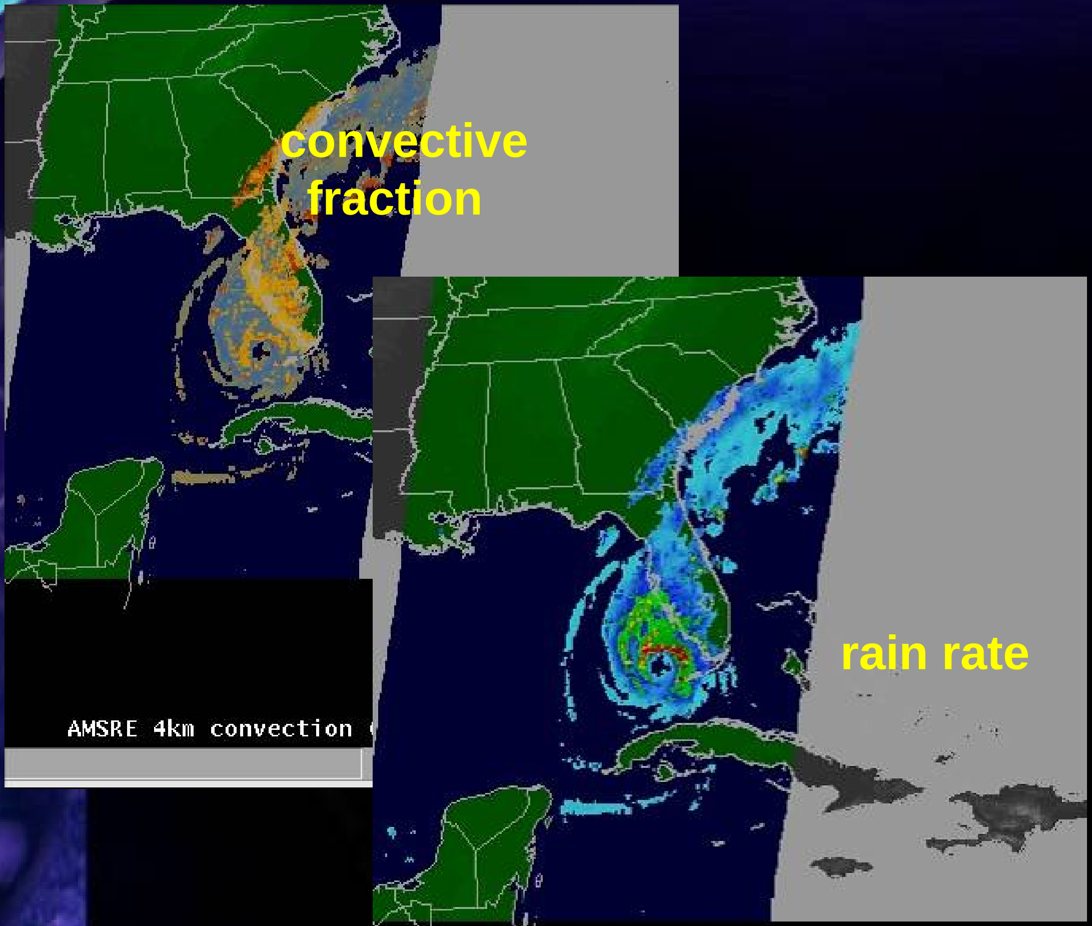
→


Forecast Systems Laboratory D-2D
File View Options Tools Volume Obs NCEP/Hydro Upper Air Satellite kgwx khtx Radar SCAN Maps Help
Valid time seq
WFO
Clear
Frames: 12
Mag: 1
Density: Max
Tue 16:45Z 30-Mar-04
MODIS Night-time
Fog Product
Ceiling (agl) and Visibility Tue 08:00Z 30-Mar-04
MODIS 11um - 3.9um Product 1km Tue 07:47Z 30-Mar-04

Status: 16:46:20: Can not pan with a 1:1 view.
Radar: 17:04:46: kgwx: User Alert Text Message Received
Frames: 6 Time: 17:05 Z 30-Mar-04

High resolution thermal channels allow for night time fog and low clouds detection which limits surface visibility. ↑

Precipitation Detection with AMSR-E

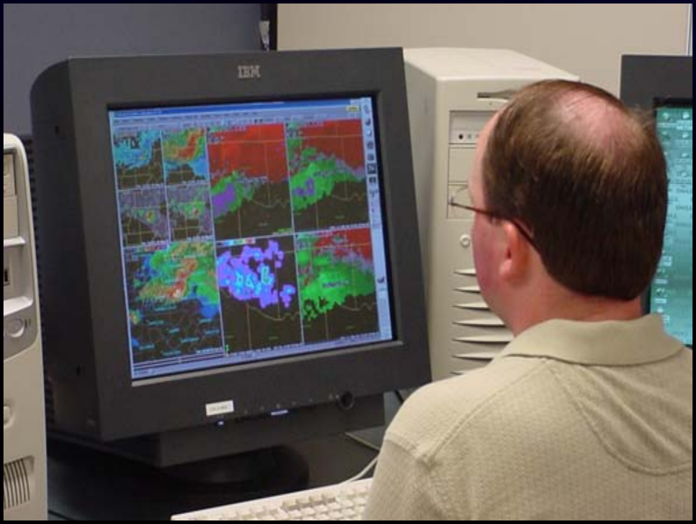


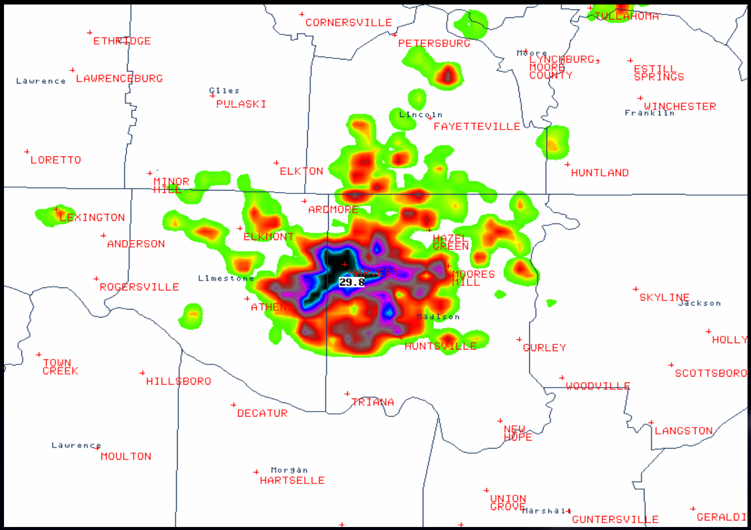
- *"…in high wind events tipping buckets don't always give you the true sense of how much is really raining."*
- *"…MODIS data we have found to be very useful in giving us a better sense of how extensive the cloud cover is at night, detecting low level clouds which is critical for aviation forecasting operations …detecting cloud streets and subtle convergent lines during day time with the high res visible"*

Pablo Santos, SOO

Total Lightning Impacts Decision Making….

- **Has directly contributed to several correct severe warning decisions at HUN and BMX**
  - ***"…the LMA density map gives you a great overall view of where storms with intensifying updrafts are located. So it gives you a good map of where to concentrate attention."***
  - ***"I believe the flash density rates were the primary factor in holding off on a warning."***
- **Used in Warning Event Simulator (WES) for office training**



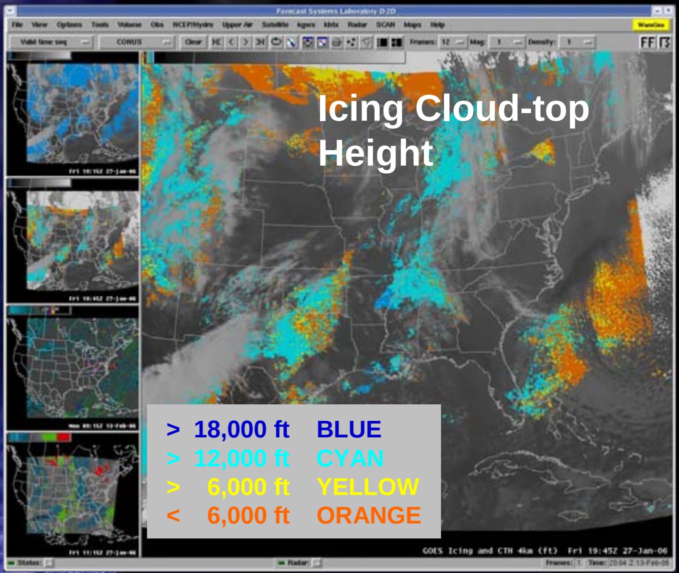

CORNERSVILLE
TULLAHOMA
ETHRIDGE
PETERSBURG
Moore
LYNCHBURG, MOORE COUNTY
ESTILL SPRINGS
Lawrence
LAWRENCEBURG
Giles
PULASKI
WINCHESTER
Franklin
Lincoln
FAYETTEVILLE
LORETTO
ELKTON
HUNTLAND
MINOR HILL
LEXINGTON
ARDMORE
ANDERSON
ELKMONT
HAZEL GREEN
HARVEST
29.8
MOORES MILL
ROGERSVILLE
Limestone
ATHENS
SKYLINE
Jackson
Madison
HOLLY
HUNTSVILLE
GURLEY
TOWN CREEK
SCOTTSBORO
HILLSBORO
WOODVILLE
TRIANA
DECATUR
NEW HOPE
LANGSTON
Lawrence
MOULTON
Morgan
HARTSELLE
UNION GROVE
Marshall
GUNTERSVILLE
GERALDI

Other Products

Nowcasting Products

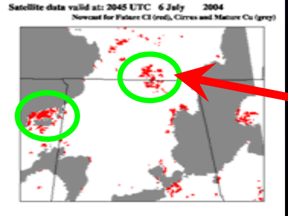
- Convective initiation products for thunderstorm development
- Flash density of total lightning (LMA) – relation to severe weather

Unique GOES aviation products in advance of AWIPS Builds


Forecast Systems Laboratory D-2D
File View Options Tools Volume Obs NCEP/Hydro Upper Air Satellite Ingest Klds Radar SCAN Maps Help
CONUS
Frames: 12
GOES Icing and CTH 4km (ft) Fri 19:45Z 27-Jan-06

Icing Cloud-top Height

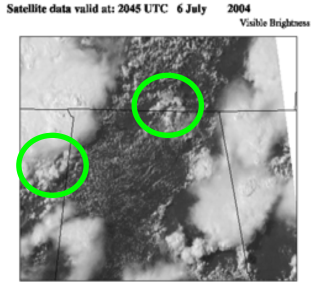
> 18,000 ft BLUE
> 12,000 ft CYAN
> 6,000 ft YELLOW
< 6,000 ft ORANGE


Satellite data valid at: 2045 UTC 6 July 2004
Nowcast for Future CI (red), Cirrus and Mature Cu (grey)

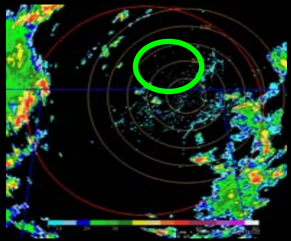
6 July 2004

CI Nowcast Pixels

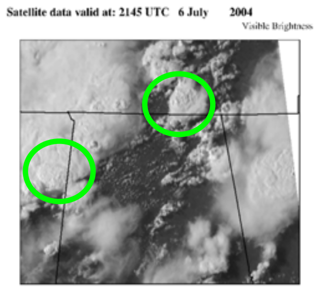
Grey=Mature Cumuli


Satellite data valid at: 2045 UTC 6 July 2004
Visible Brightness

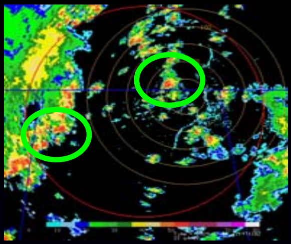
NOWCAST



2047 UTC


Satellite data valid at: 2145 UTC 6 July 2004
Visible Brightness

VALID TIME

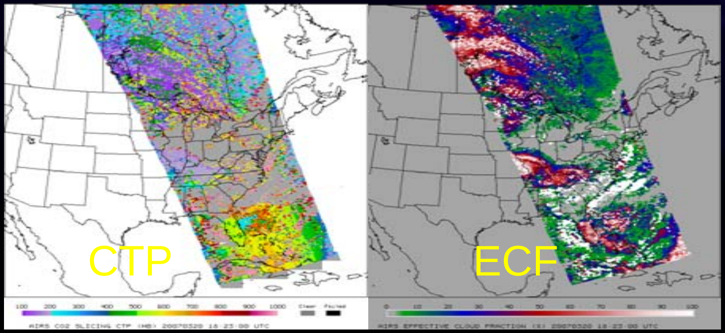


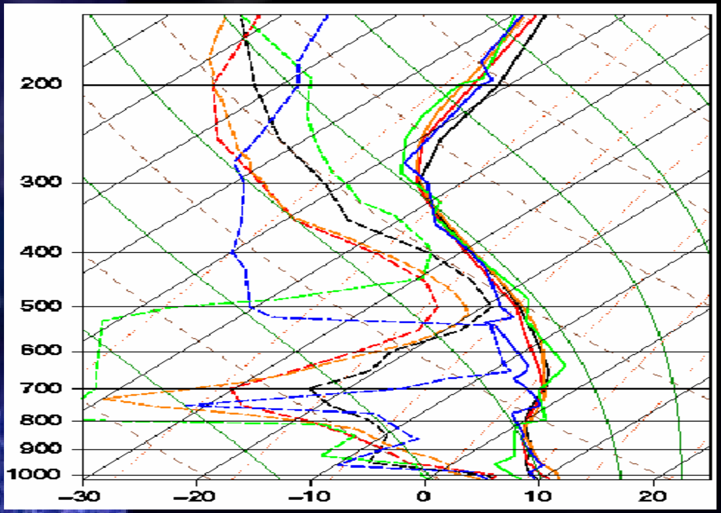
2147 UTC

Near-term -- AIRS Products to WFOs

- **ingest *real-time* AIRS imagery from UW direct broadcast**
- **derivation of imagery products, profiles from AIRS science team**

http://weather.msfc.nasa.gov/sport "AIRS Imagery and Products"





Longer-term:

o suite of AIRS products and multi-pass composites (based on collaborations with other product developers)

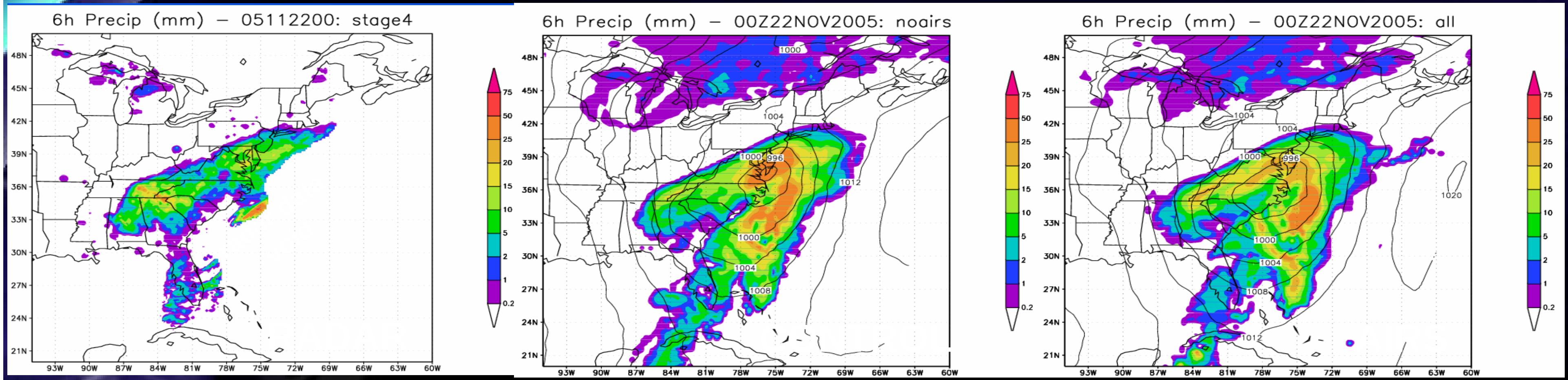
- **3D structure of moisture**
- **atmospheric stability**
- **fill time and space void in conventional observations**

Science Mission Directorate

National Aeronautics and Space Administration

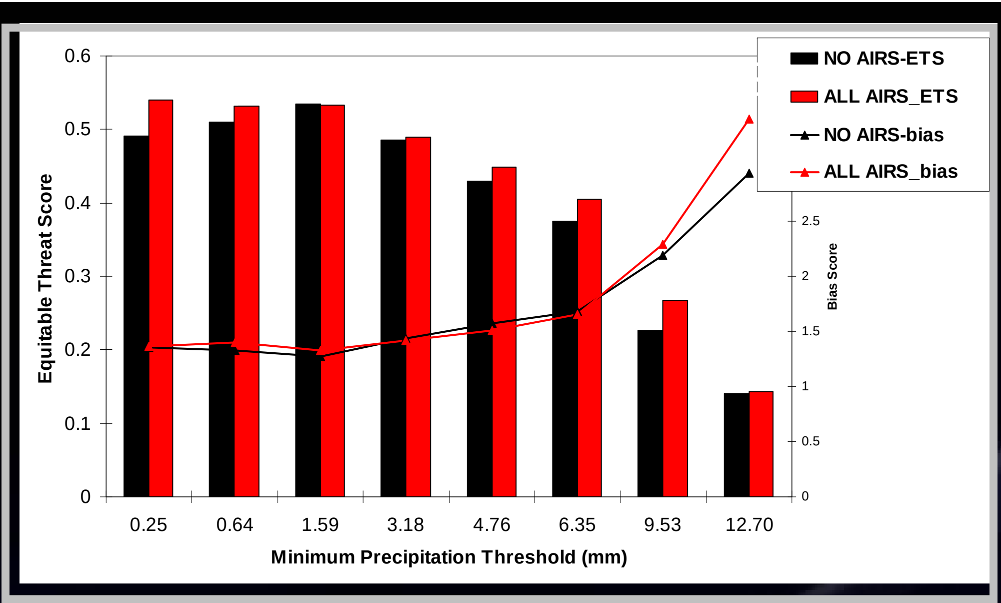
Future Products

41h Forecast — Cumulative Precipitation -- Valid at 0000 UTC 22 Nov 2005


6h Precip (mm) – 05112200: stage4
6h Precip (mm) – 00Z22NOV2005: noairs
6h Precip (mm) – 00Z22NOV2005: all
48N
45N
42N
39N
36N
33N
30N
27N
24N
21N
93W
90W
87W
84W
81W
78W
75W
72W
69W
66W
63W
60W
75
50
25
20
15
10
5
2
1
0.2
1000
1004
1008
1012
1020
996

Profiles Improve Forecast

- Assimilation of AIRS T(p) and q(p) improves initial model conditions and leads to improved short-term weather forecasts
- AIRS provides better forecast of precipitation intensity
- Near real-time demonstration to validate case study results



SPORT

transitioning unique NASA data and research technologies