



Atlantic Oceanographic and Meteorological Laboratory

# Update on the Development of the Observing System Simulation Experiment (OSSE) Testbed

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## **Primary Objective**

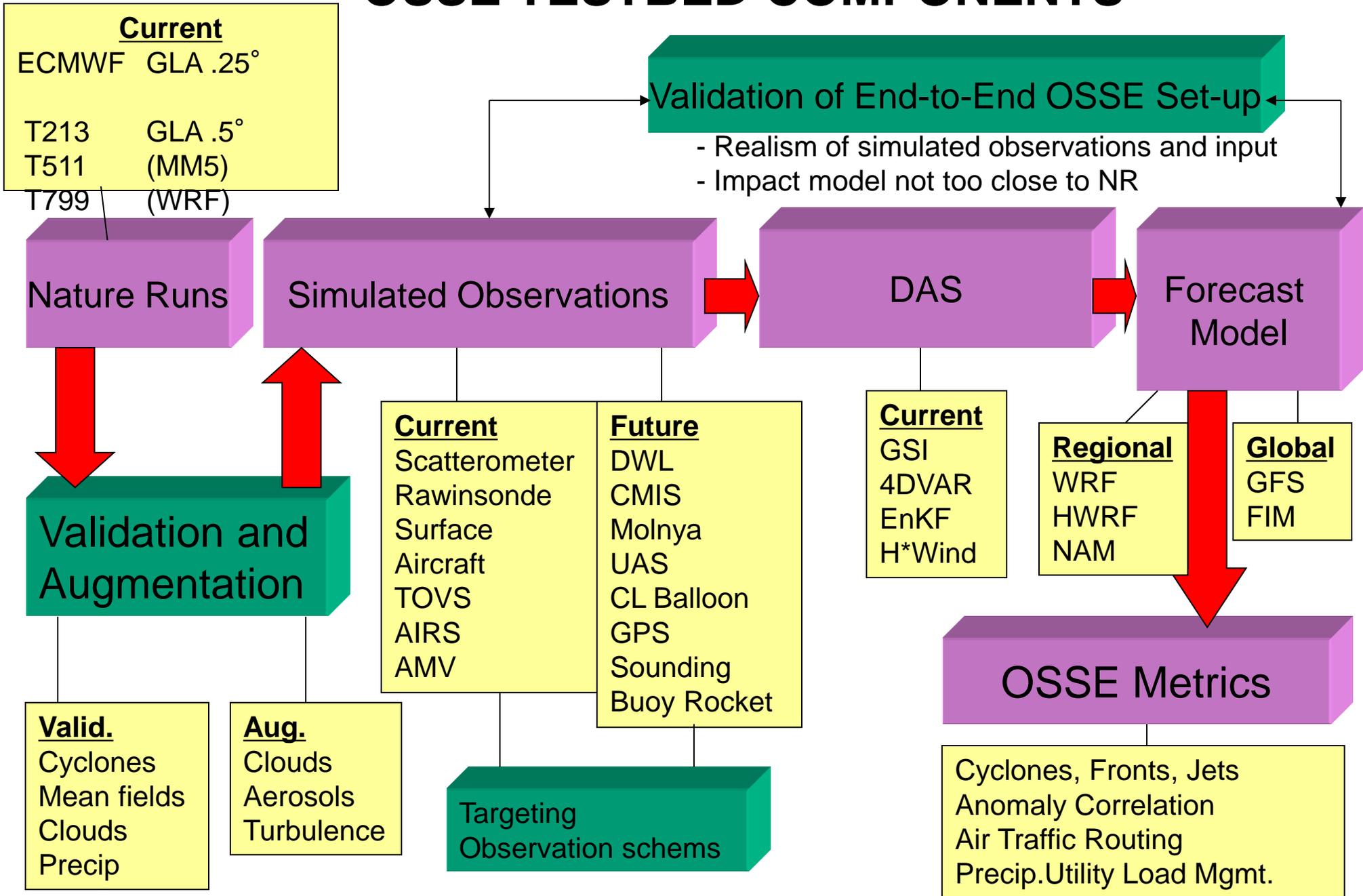
To establish a numerical test bed that would enable a hierarchy of experiments to:

- (1) determine the potential impact of proposed space-based, sub-orbital, and in situ observing systems on analyses and forecasts,
- (2) evaluate trade-offs in observing system design, and
- (3) assess proposed methodology for assimilating new observations in coordination with the Joint Center for Satellite Data Assimilation (JCSDA).

## **Sub-objectives**

- (1) To define both the advantages and limitations of a hierarchy of OSSEs that includes rapid prototyping of instrument or data assimilation concepts, as well as the more rigorous “full” OSSEs.
- (2) To generate an OSSE/OSE process that invites participation by the broad community of agency planners, research scientists and operational centers.

# OSSE TESTBED COMPONENTS



# Accomplishments

1. Provided expertise on OSSEs to NOAA, partners and academia.
2. Generated and validated regional OSSE nature runs 1km resolution. This validation required an exhaustive number of iterations of the WRF model embedded within an ECMWF global nature run and confirmed the validity (strongpoints and weaknesses) of the 1km nature run over a 13 day period. Twelve initial hurricane predictability experiments using this system were conducted. (AOML and RSMAS)
3. Completed the first phase of a global OSSE for UAS and completed a report and one refereed article from this OSSE. (ESRL, AOML and RSMAS)
4. Completed the first phase of a global OSSE for WISDOM balloons. (ESRL, AOML)
5. Conducted a global OSSE for DOD to evaluate alternatives for the DWSS early morning orbit. (JCSDA and AOML )
6. Began OSSEs to evaluate alternatives for space-based lidar winds for NASA. (AOML, SWA, BATC, JCSDA, and NASA GSFC)

## Accomplishments

7. Began OSSEs to evaluate advanced hyperspectral sounders. (AOML, NESDIS STAR, CIMSS, JCSDA, JPL, GSFC, EMC)
8. Developed the first ever rigorously validated ocean OSSE system anywhere in the world. Initial ocean OSEs and OSSEs relating to hurricane prediction have been performed. Others are continuing. . (AOML and RSMAS)
9. Conducted an OSE at the request of IOOS and the NOSC to evaluate the value of CMAN coastal buoys on hurricane surface wind analyses. . (AOML)
10. Completed 6 refereed articles in last year.
11. Presented results at AMS Annual Meeting, AGU Fall Meeting, and two SPIE Remote Sensing Conferences

## Current and future work

1. Complete the current global and regional OSSEs related to wind lidar, hyperspectral sounders, and DWSS.
2. Begin new OSSEs relating to GeoStorm, UAS, CYGNSS, other wind lidar concepts, the potential polar orbiting satellite data gap.
3. Investigate targeting observation schemes for UAS and other observing systems.
4. Expand regional OSSEs for severe local storm forecasting.
5. Begin development of next generation global OSSE system. This would replace the current NOAA joint OSSE system.

## Key Personnel and their role

Dr. R. Atlas, NOAA/AOML: Lead development of testbed, and along with a team of scientists, led by Dr. Lars Peter Riishojgaard at the JCSDA and Dr. Tomislava Vukicevic at AOML: conduct and evaluate global and mesoscale OSSEs.

Dr. Yuanfu Xie, NOAA/ESRL/GSD: Lead global OSSEs using the ESRL OSSE system and participate in regional OSSEs for UAS and HFIP.

Drs. Sharan Majumdar and David Nolan, UM/RSMAS: Generate mesoscale nature runs and participate in hurricane OSSEs.

Dr. Ross Hoffman, AER: Chair of External Advisory Group.

Dr. G.D. Emmitt, SWA: Simulation of Wind lidar and other observing systems.

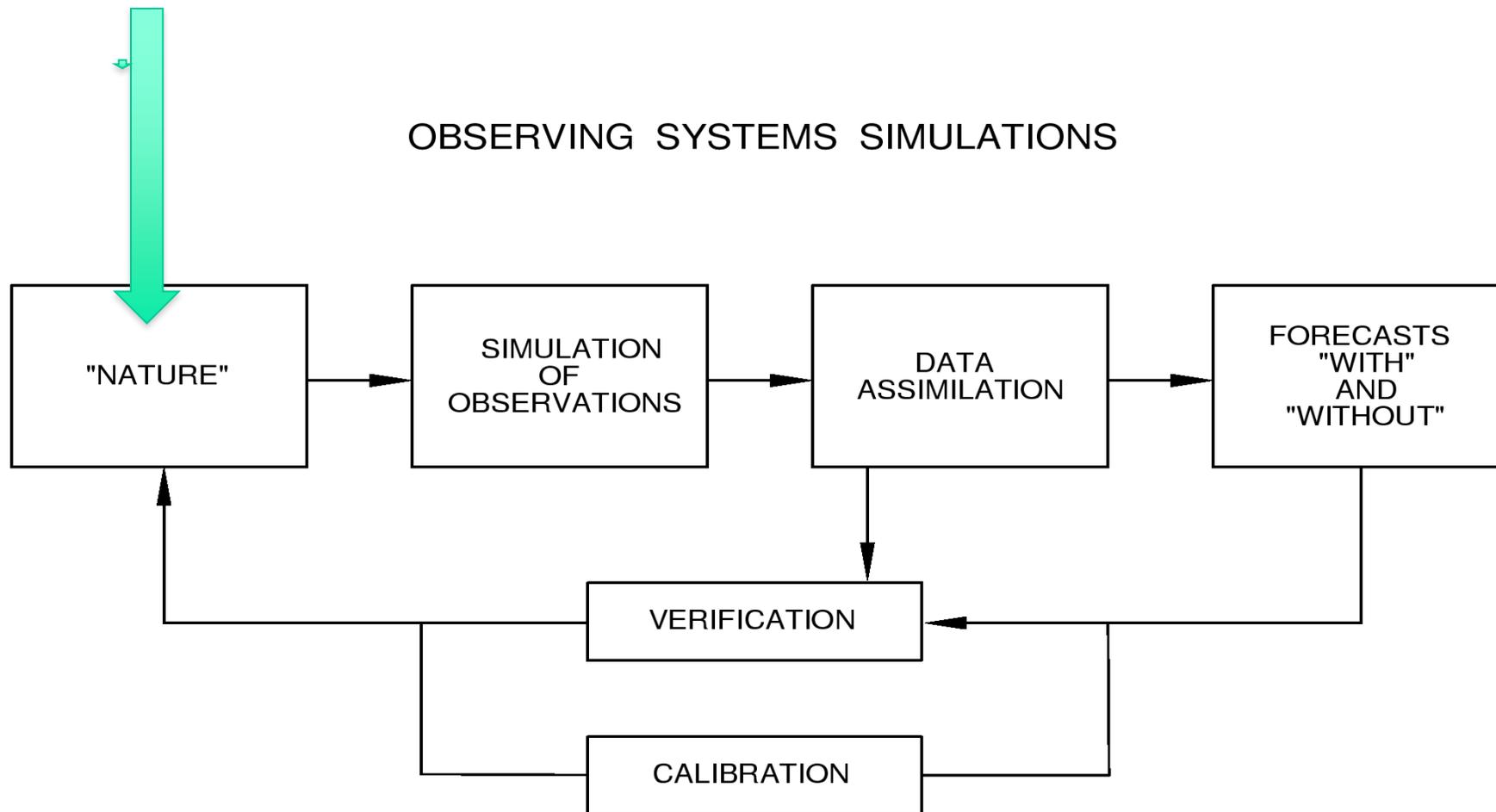
Backup slides

# Current and planned OSSEs for hurricanes

- OSSEs in support of HFIP to evaluate sampling strategies for hurricane reconnaissance, new observing systems, modeling and data assimilation and predictability.
- OSSEs to determine potential impact of UAS and to optimize sampling strategies for both UAS and hurricane reconnaissance aircraft.
- OSSEs to evaluate hyperspectral sounders
- OSSEs to evaluate alternative wind lidar technologies:  
OAWL/FI vs. 3d Winds Hybrid

# Regional OSSEs

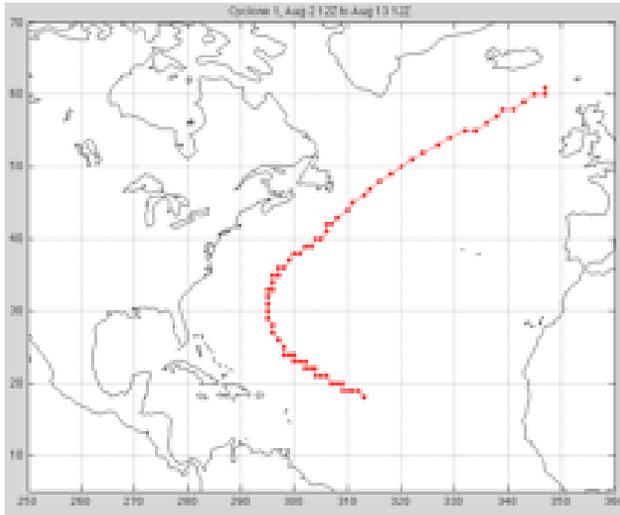
**“Regional Nature Run”**



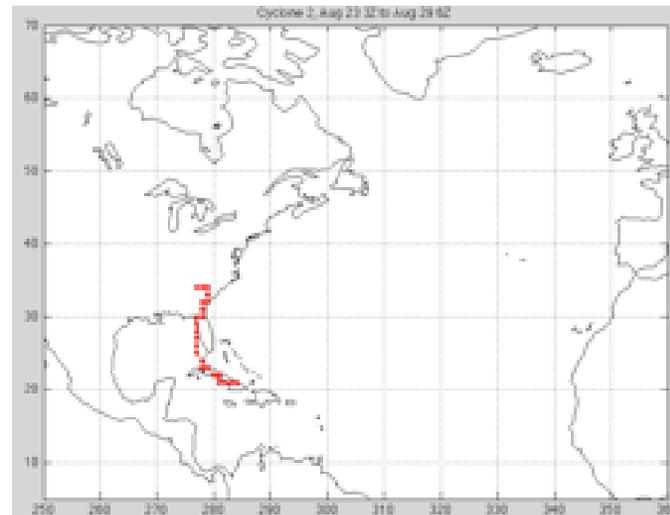
# ECMWF Nature run hurricanes

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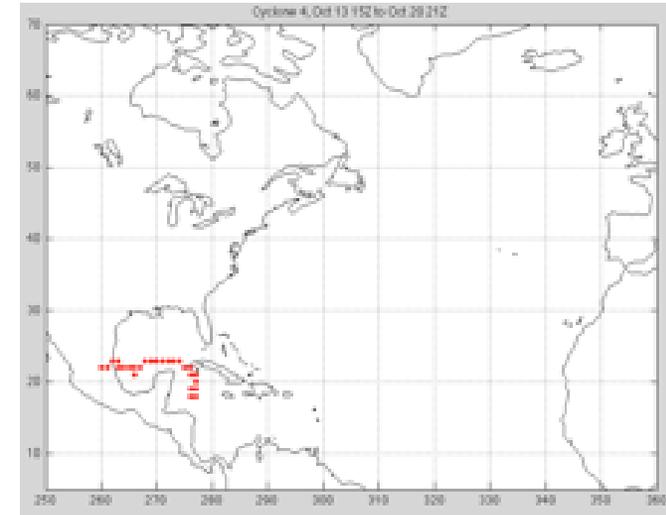
(a)



(b)

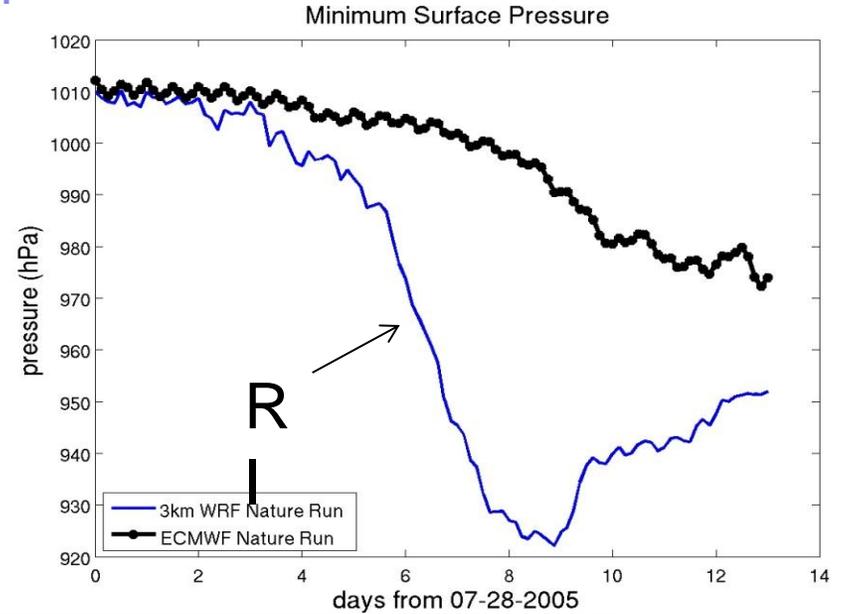
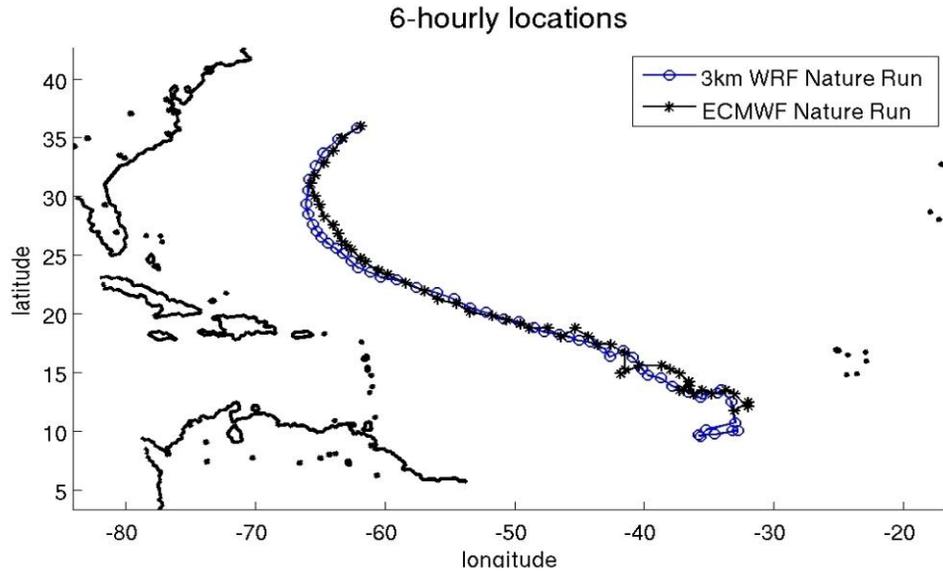


(c)

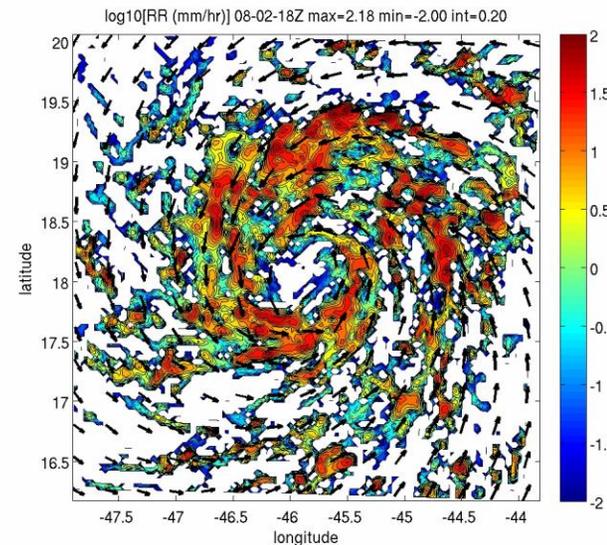
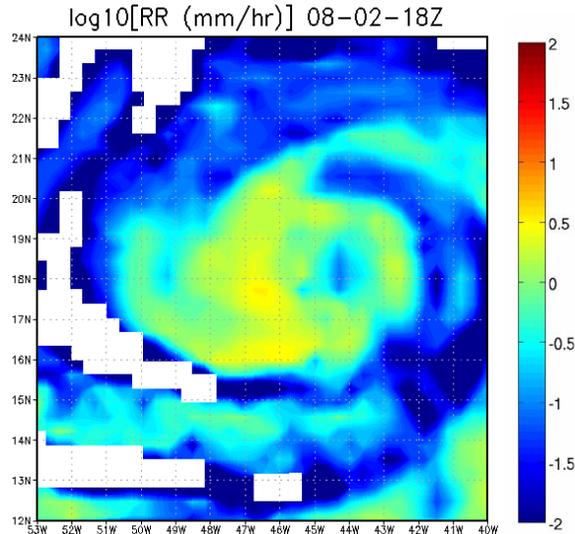


# High Resolution Hurricane Nature Run: WRF Simulation Embedded Inside the ECMWF Nature Run

60 levels; 3km resolution; double-moment microphysics; advanced radiation schemes.



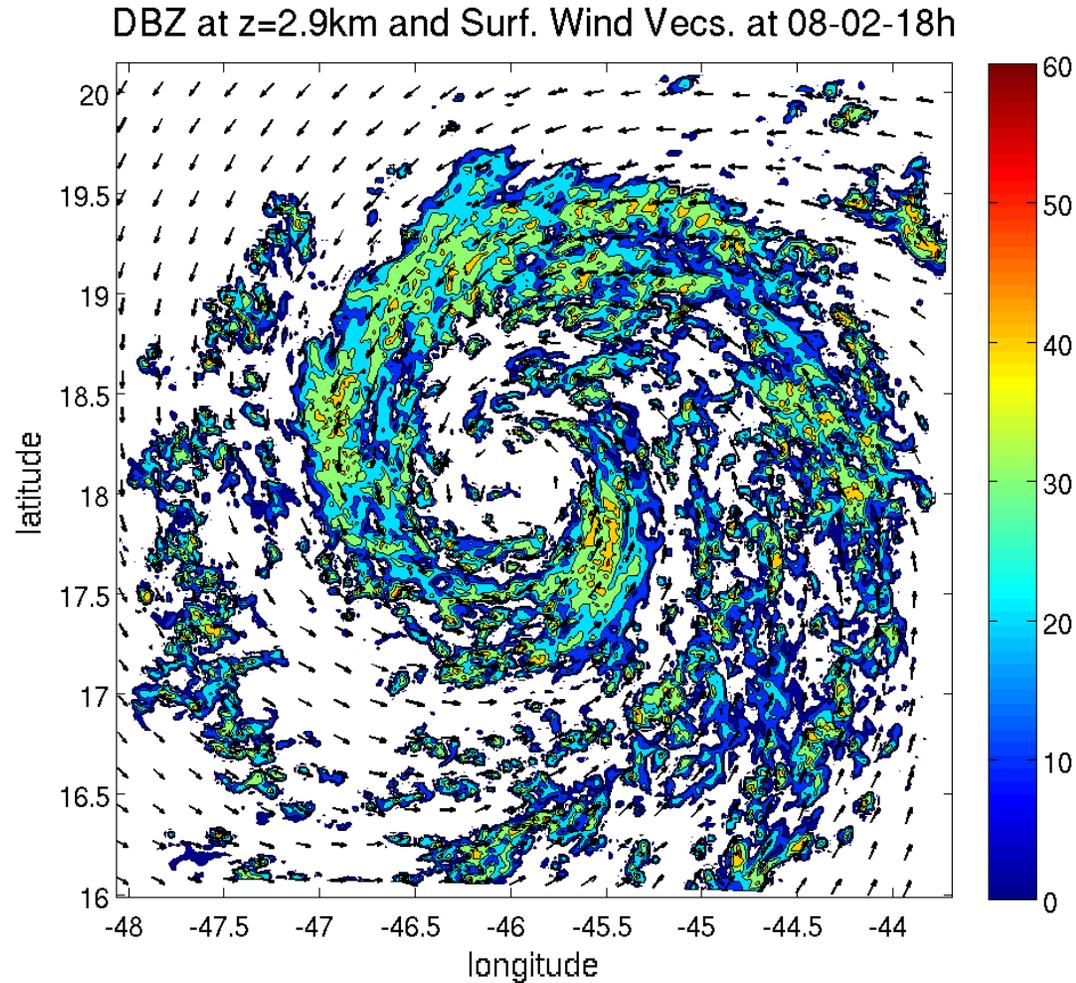
ECMWF  
T511  
Nature Run



3 km  
WRF-ARW  
Nature Run

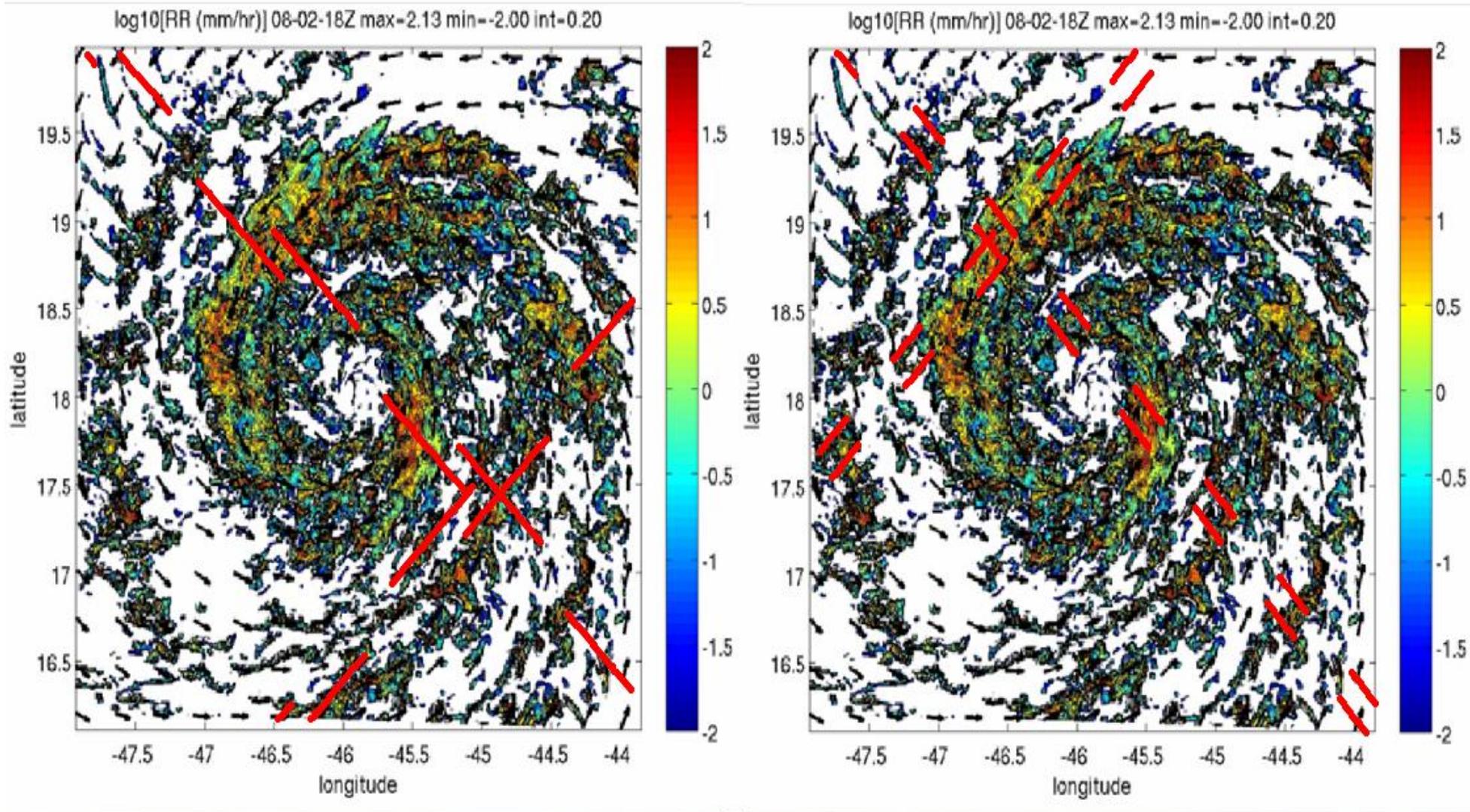
# Further improvements from 1 km resolution:

3km simulation  
nested to 1km  
for 18 hours



- More realistic distribution of precipitation
- 20 grid points between each arrow shown above

# Coverage of Coherent DWL on ISS over WRF-AFW Nature Run Hurricane \*



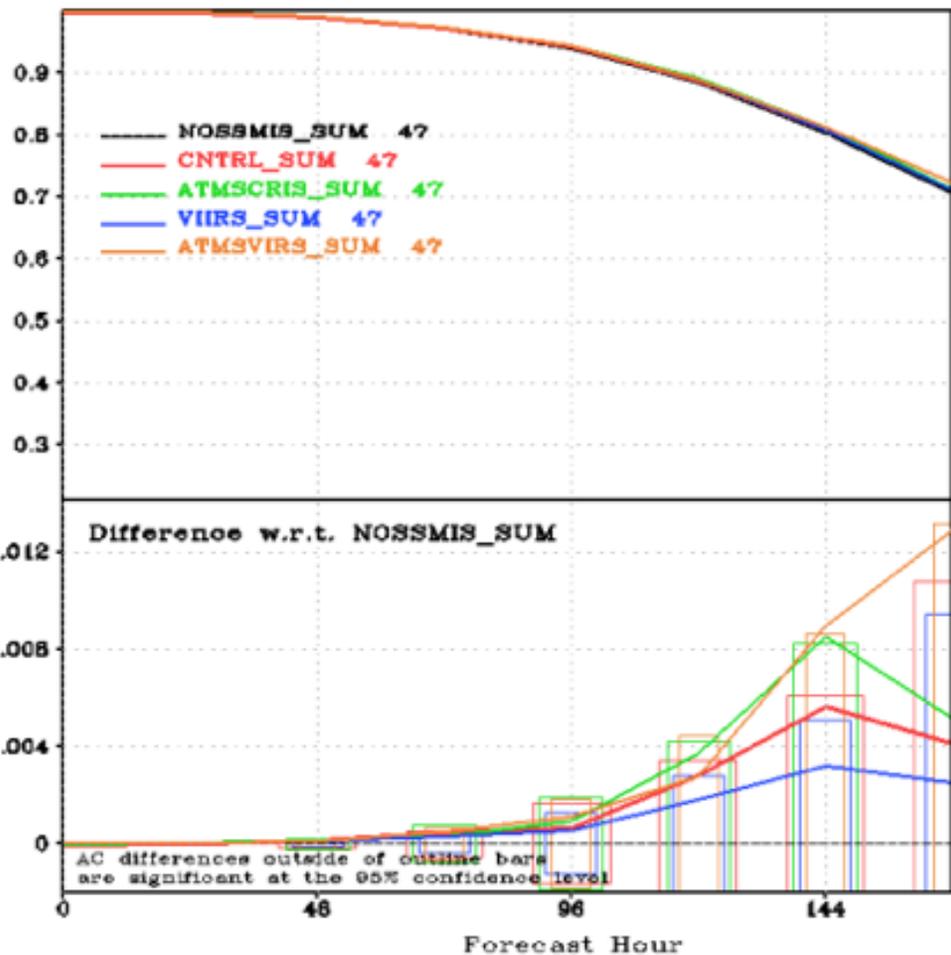
Coherent DWL at 12 sec Dwells

Coherent DWL at 4 sec Dwells

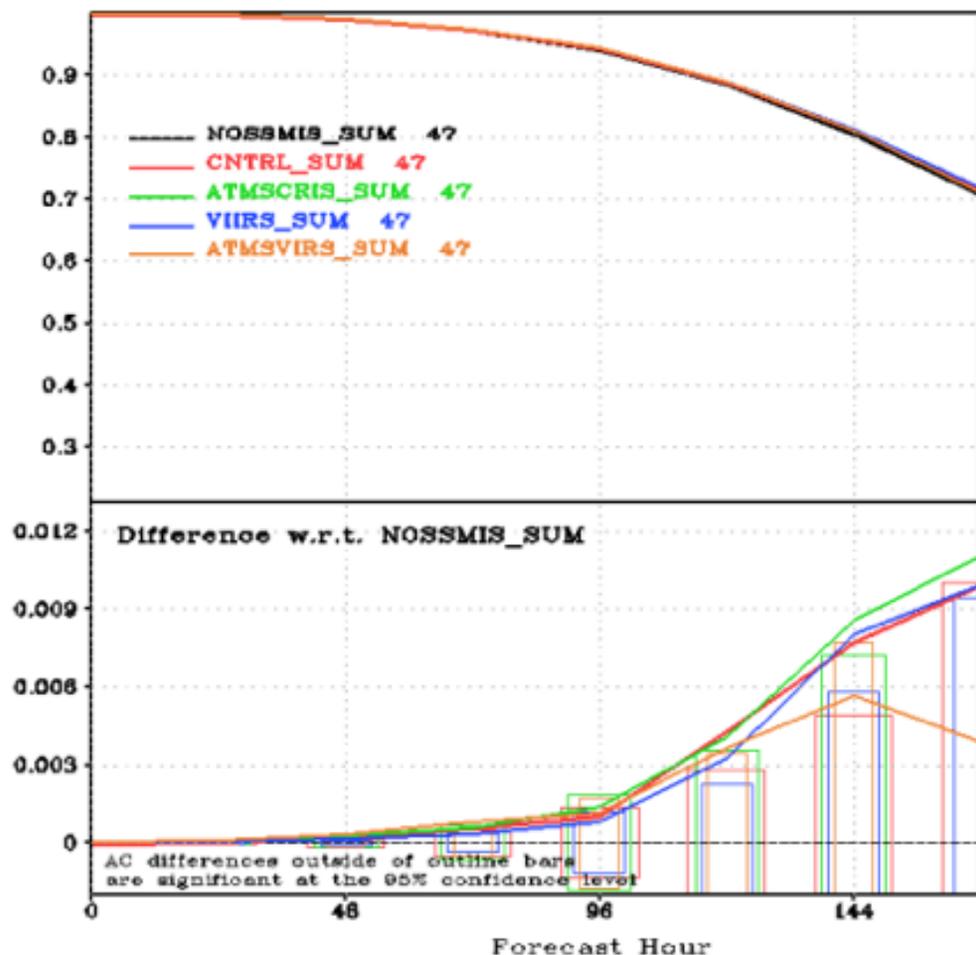
# DWSS OSSE Experiments

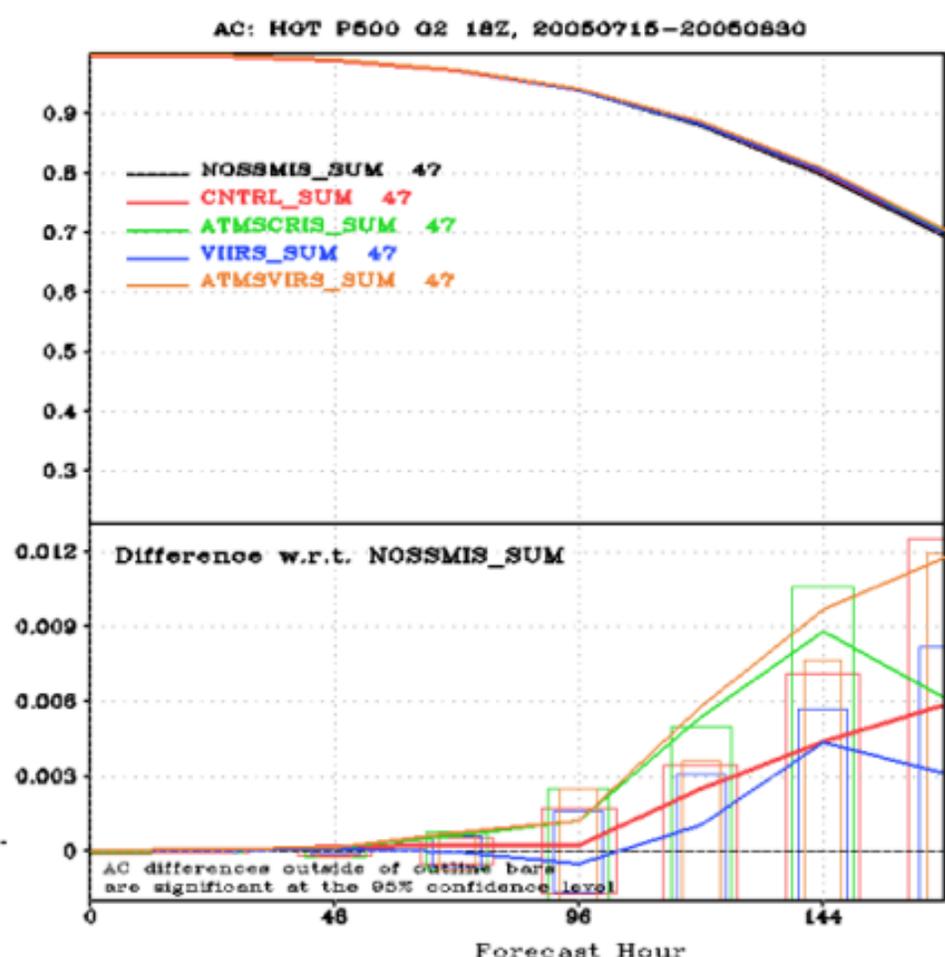
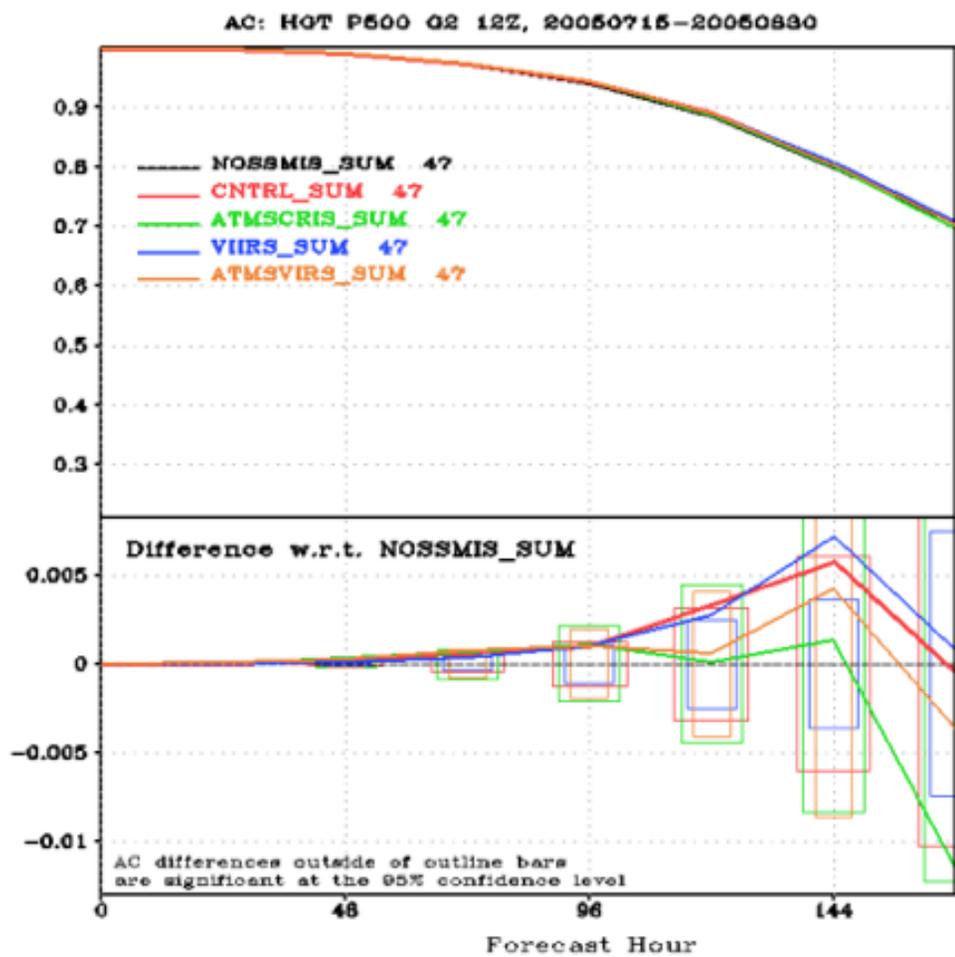
1. Control run in which all relevant observations from observing systems (conventional and space-based) are assimilated (cntrl)
2. Same as 1., but without any early morning orbit coverage (nossmis)
3. Same as 2., but with CrIS and ATMS added in the early morning orbit (atmscris)
4. Same as 2., but with VIIRS polar winds in the early morning orbit (viirs)
5. Same as 2., but with VIIRS and ATMS in the early morning orbit (atmsvirs)

AC: HOT P500 Q2 00Z, 20050715-20050830



AC: HOT P500 Q2 06Z, 20050715-20050830





*Global experiment impacts on 500 hPa pressure anomaly correlation, for forecasts valid at (above left) 00Z, (above right) 06Z, (below left) 12Z, and (below right) 18Z.*