Observing System Simulation Experiment at the Joint Center for Satellite Data Assimilation

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IMSystem Group, Rockville, MD
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Concept of OSSE and International Joint OSSE

- A Nature Run (NR, proxy true atmosphere) is produced from a free forecast run using the highest resolution operational model which is significantly different from the NWP model used in Data Assimilation Systems.
- Calibrations is performed to provide quantitative data impact assessment.
- . Without calibration quantitative evaluation of data impact is not possible.

- Data impact on analysis and forecast will be evaluated.
- A Full OSSE can provide detailed quantitative evaluations of the configuration of observing systems.
- A Full OSSE can use an existing operational system and help the development of an operational system

Note: This data must not be used for commercial purposes and re-distribution rights are not given. User lists are maintained by Michiko Masutani and ECMWF

Simulated observation for Control experiments posted from NASA/NCCS portal and NCAR
Michiko Masutani and Jack Woollen (NOAA/NCEP/EMC)
Initial condition for NCEP GSI is also available

Joint OSSE Nature Run by ECMWF

ECMWF Nature run used at NOAA
Spectral resolution : T511
13 month long. Starting May 1st,2005
Vertical levels: L91, 3 hourly dump

Andersson, Erik and Michiko Masutani 2010: Collaboration on Observing System Simulation Experiments (Joint OSSE), ECMWF News Letter No. 123, Spring 2010, 14-16.

Data distribution
NASA/NCCS
http://portal.nccs.nasa.gov/osse/index.pl
ID and Password required

http://portal.nccs.nasa.gov/josse/index.pl

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Bill McHale wmchale@nccs.nasa.gov

NCAR
Currently saved in HPSS Data ID: ds621.0
http://dss.ucar.edu/datasets/ds621.0/matrix.html
Contact:
Chi-Fan Shih chifan@ucar.edu Steven Worley worley@ucar.edu

Joint OSSEs and JCSDA OSSE Conducted and in Progress

OSSEs at JCSDA and collaborators

Evaluation of Infrared sounders on the geostationary Hyperspectral Environmental Suite (HES) including GIFTS
JCSDA, SSEC-Univ. Wisc, AOML

Evaluation of Future configuration of GNSS-RO
JCSDA, ESRL

Evaluation of OAWL and WISCCR DWL
JCSDA,AOML,SWA,Ball,EMC,NESDIS

Evaluation of DWSS and JPSS
JCSDA,EMC,NESDIS,AOML,DOD

Simulation of DWL planned from NASA (GWOS, ISS)
Simpson Weather Assocuates

Simulation and assimilation of Cloud Motion Vector, ASCAT
Simpson Weather Associates, JCSDA

Evaluation of Wind Lidar (GWOS, ISS) impact and configuration experiments for NASA
JCSDA, SWA, NCEP/EMC

Evaluation of Impact of GWOS on monsoon,
Indian Institute of Tropical Meteorology

Other OSSEs

PREMIER InfraRed and MicroWave
Limb Sounder measurements by ESA/ESTEC
Environment of Canada

Polar Communications and Weather mission (PCW)
Environment of Canada

ADM-Aeolus and follow up mission
KNMI, NASA/GSFC/GMAO

Studies of Observational errors
NASA/GSFC/GMAO

Regional OSSE to Evaluate DWL data on Hurricane forecast,
Univ Utah

Rigional OSSE on severe storm,
Mississippi State University

Global OSSE forUnmanned Aircraft System
NOAA/AOML, NOAA/ESRL

Evaluation of Hybrid Data assimilation system
NOAA/EMC, UMD

Global OSSE for WISDOM balloons
NOAA/ESRL, NOAA/AOML

Evaluation of RAOB over India
National Centre for Medium Range Weather Forecasting (NCMRWF)

Highlight from JCSDA OSSE

OSSE to evaluate the third polar orbits(DWSS)

S. Casey, L. –P. Riishojgaard, M. Masutani, J. Woollen, T. Zhu, R. Atlas

Following the cancellation of the NPOESS program in February 2010, US plans for sounding coverage in the early morning orbit (~5:30 AM ECT) were put on hold indefinitely. How might the lack of early morning sounding coverage affect medium-range weather forecasts? Which of three suggested replacement satellites would have the greatest forecast impact?

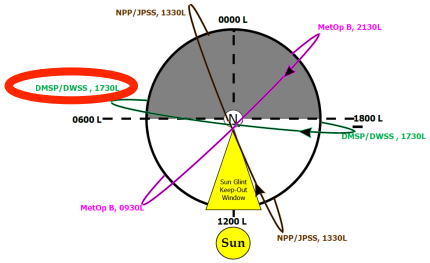


Image Courtesy F. Weng

Three polar orbits? Or two?

How might the lack of early morning sounding coverage affect medium-range weather forecasts?

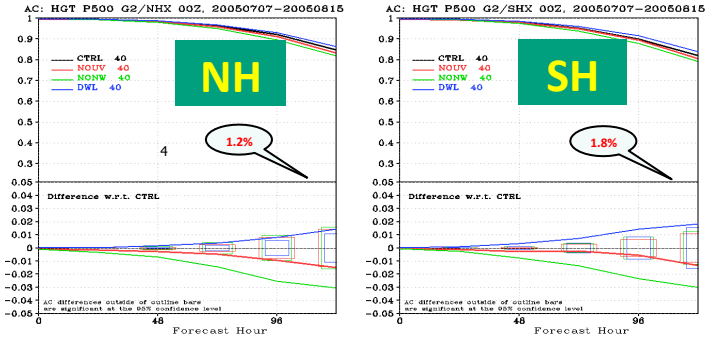
Which of three suggested replacement satellites would have the greatest forecast impact?

Initial outlook of the results

- Current OSSE work demonstrates the impacts of a meteorological satellite in the early-morning orbit

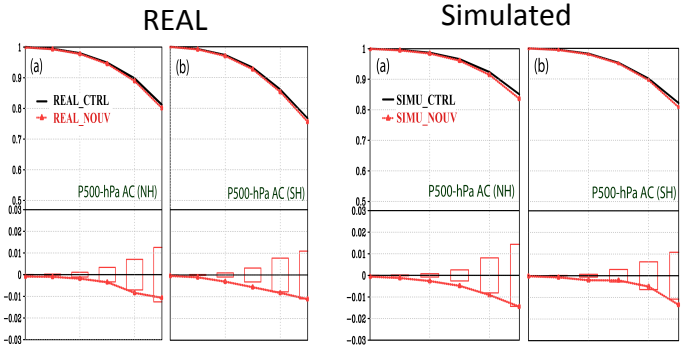
Impact of DWL with four telescope (GWOS)

Zaizhong Ma, L. –P. Riishojgaard, M. Masutani, J. Woollen, G. D. Emmitt



Calibration Experiments

Compare impact of removal of RAOB wind in real and simulated experiments



Data impact and model resolution

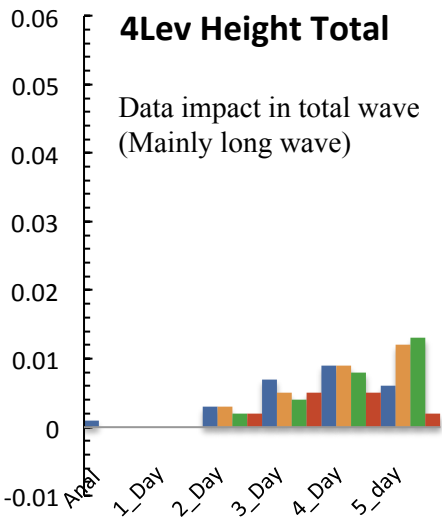
OSSE to evaluate four telescope to measure wind vectors (GWOS)
The coherent subsystem provides very accurate (< 1.5m/s) observations when sufficient aerosols (and clouds) exist.
The direct detection (molecular) subsystem provides observations meeting the threshold requirements above 2km, clouds permitting.

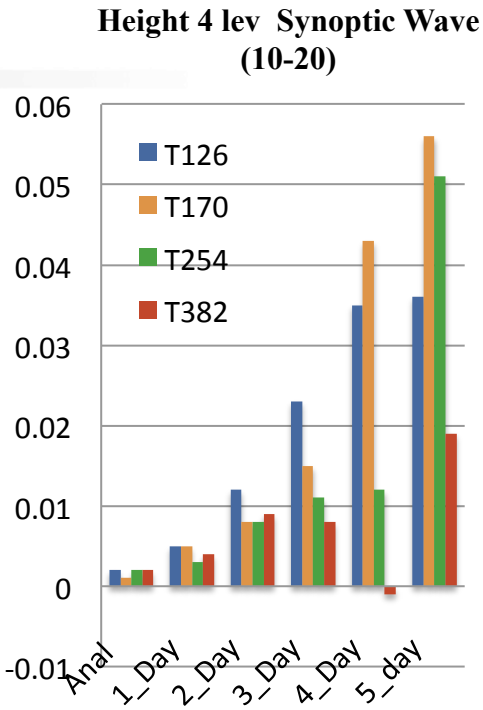
Riishojgaard, L. P., Z. Ma, M. Masutani, J. S. Woollen, G. D. Emmitt, S. A. Wood, and S. Greco 2012: "Observation System Simulation Experiments for a Global Wind Observing Sounder," *Geophys. Res. Lett.*, **39,** L17805, doi: 10.1029/2012GL051814.

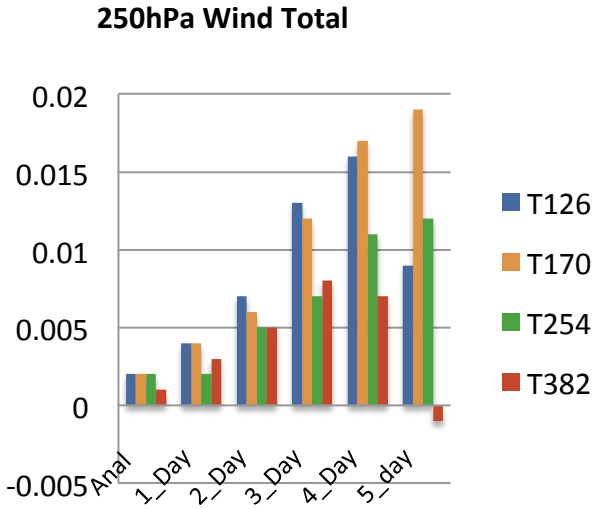
Case Study to compare impact of DWL with model resolution

Atlantic Hurricane in the nature run for the analysis period of 9/25-10/10

AC difference in AC, with and without GWOS







- At least T170 resolution is required to utilize DWL data for hurricane case. Impact of DWL is larger in T254 than in T170 model forecast. T382 model for OSSE with T511 Nature run may not be the best.
- Increasing resolution and adding DWL are equally important to improve large scale forecast skill.
- DWL data is more effective in improving forecast for small scale event.
- OSSE with control observation without observational error is useful to provide initial outlook of data impact a new type of observation.
- Further experiments with observational error is required.

Impact in short wave is much stronger than that in large scale wave. Impact in wind is stronger than that in height.in fact the impact on V only is even stronger

T511 Nature run may not be sufficient to evaluate Data assimilation system with even T382 resolution.

NEW Nature run

ECMWF Nature Run

(The Primary Nature run used at JCSDA)

ECMWF IFS T1279 91 Level
March 1st, 2005- April 30th, 2006
3 hourly write up
1 hourly write up for selected period
Selection will be based on evaluation of 3 hourly data

Sample data
Operational forecast archive from 00Z October 27,2012
(Sample data will be used for code development and verification of simulated observations.

The Nature run will be maintained by JCSDA .

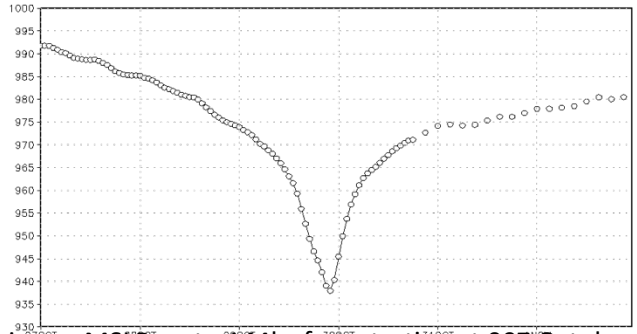
GOES-5 Nature Run

GOCART model

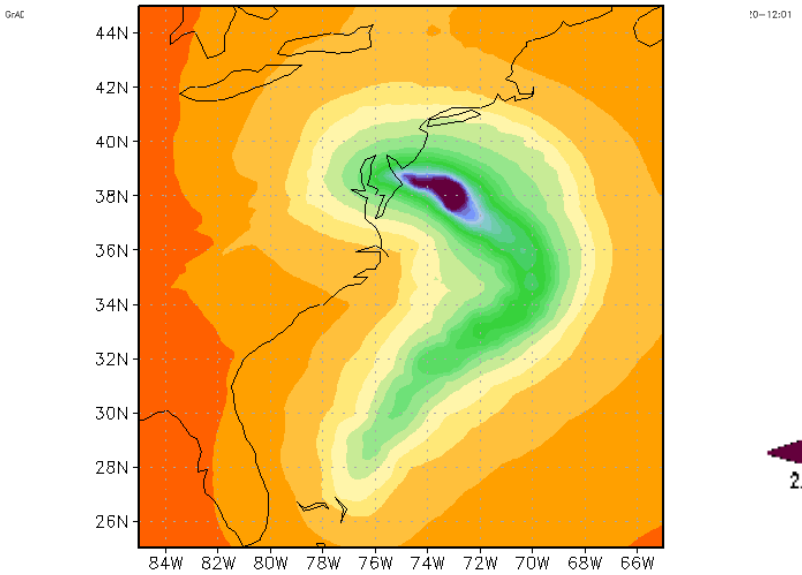
Global, 7 km
15 ? aerosol, parameterized Chemistry
~ 2 years ***simulation***
May 2005 – May 2007
Aerosol, full chemistry
~ 1 month (TBD)
3km for selected 2month period (?)
Gradsdod

Hurricane Sandy in sample data for T1279 NR Hourly diagnostics in model resoljution

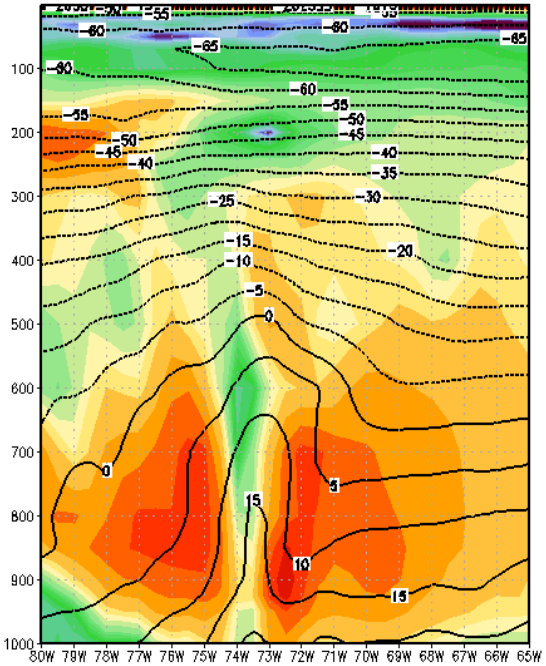
MSLP at 73.1W 38.2N

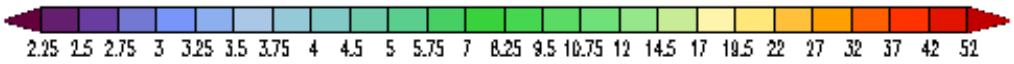


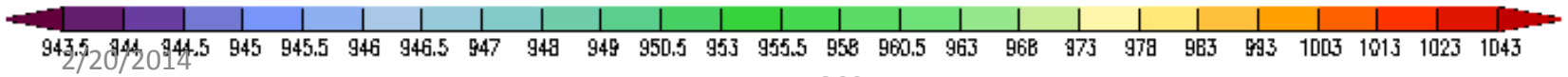
Minimum MSLP upto 144hr fcst starting at 00Z October 27th, 2012
Hourly archive up to 90 hour fcst, 90hr-144 hr, 3 hourly archive



Wind speed and Temperature
23Z October 29th, 2012 at 38.165 N
72 hr Fcst from 00Z October 27th, 2012



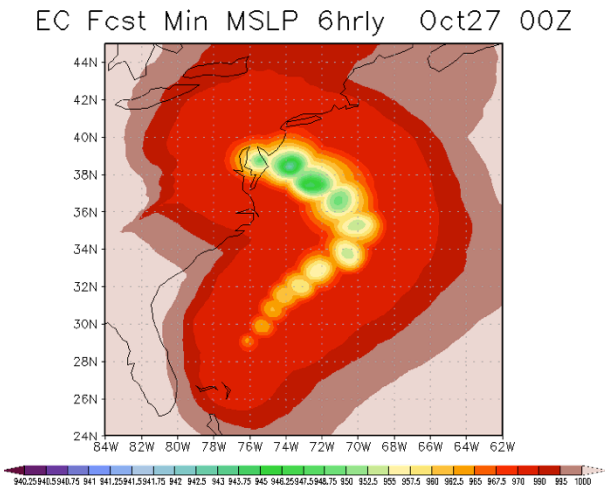




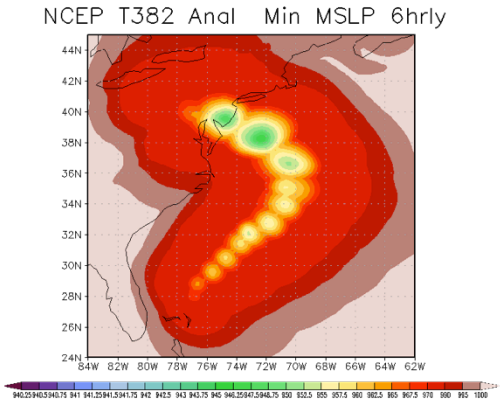
6 hourly Validation of simulated observation OSSE system using sample Nature Run

Minimum Mean sea level pressure between 00Z Oct 27 and 00Z Nov 2nd
6 hourly sampling on 1degx1deg grid point

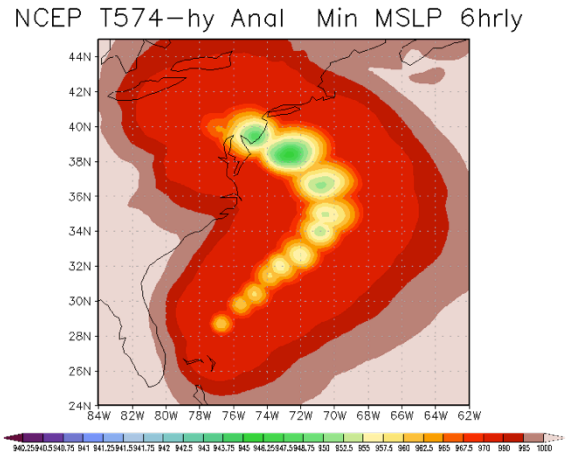
Sample data for T1279 NR Forecast from 00Z Oct 27th



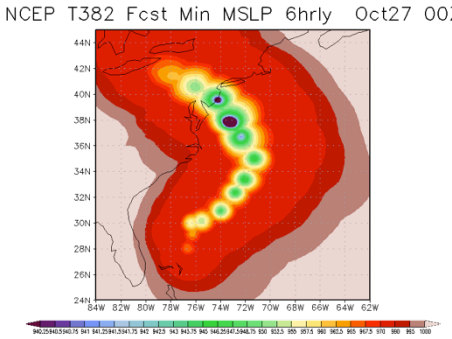
T574 NCEP analysis



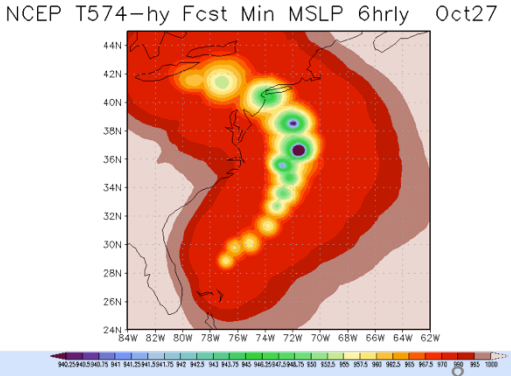
T574 Hy NCEP analysis



T574 NCEP GFS forecast from 00Z Oct 27th



T574-Hybrid NCEP GFS forecast from 00Z Oct 27th

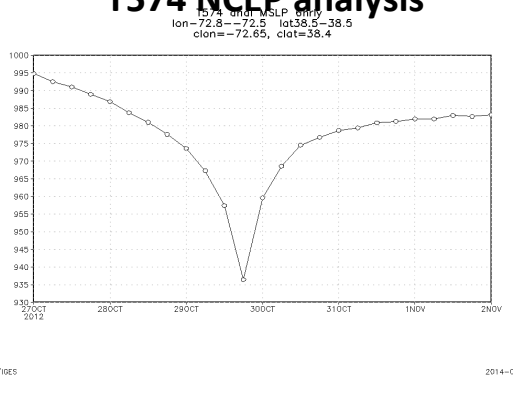


6 hourly Validation of simulated observation OSSE system using sample Nature Run

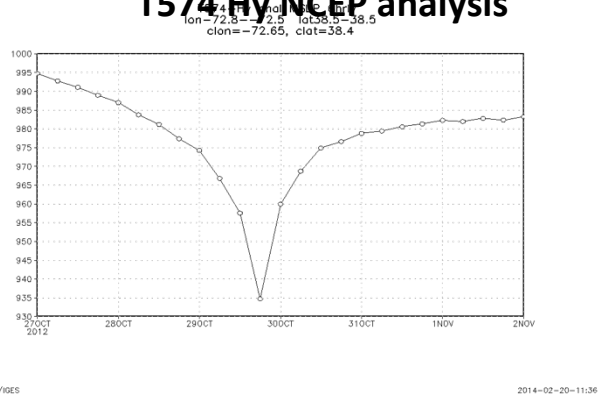
MSLP at center
6 hourly sampling

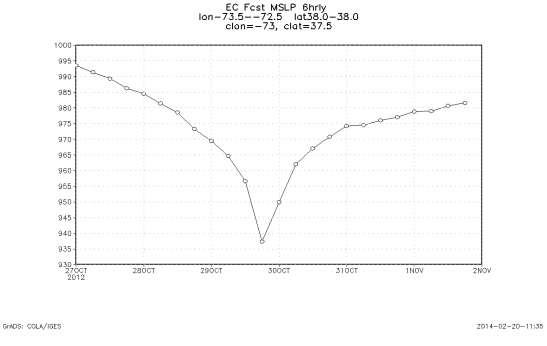
Sample data for T1279 NR
Forecast from 00Z Oct 27th

T574 NCEP analysis

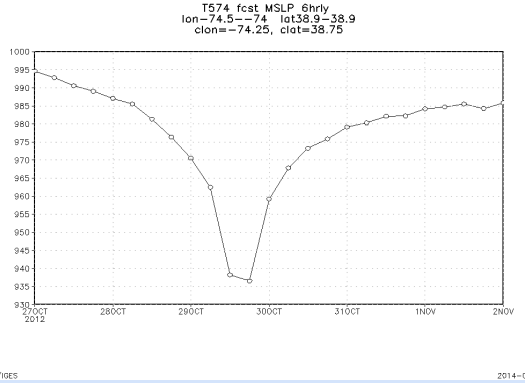


T574 Hy NCEP analysis

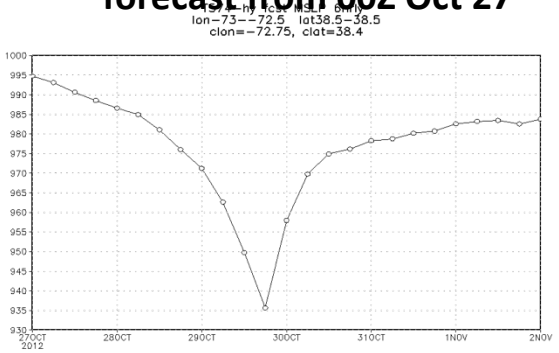




T574 NCEP GFS
forecast from 00Z Oct 27th



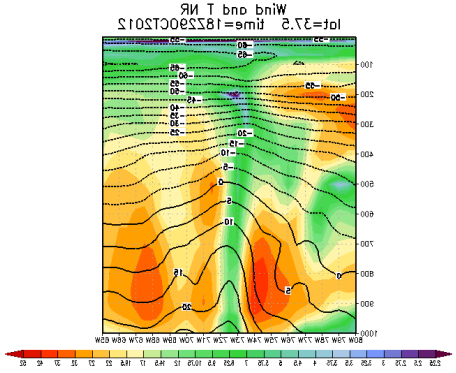
T574-Hybrid NCEP GFS
forecast from 00Z Oct 27th



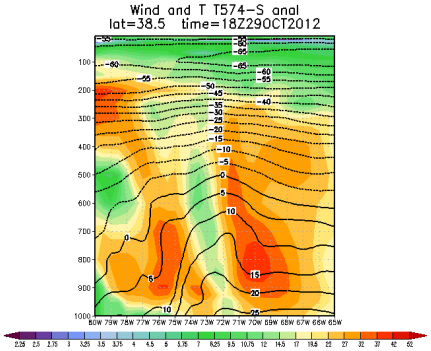
6 hourly Validation of simulated observation OSSE system using sample Nature Run

Wind and temperature near center

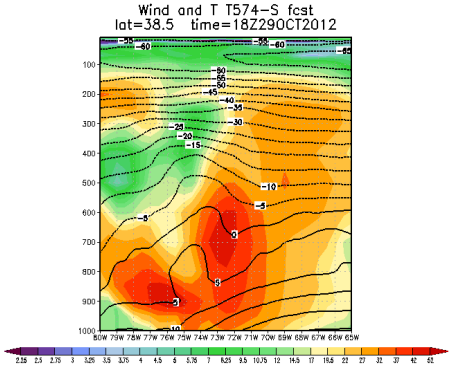
Sample data for T1279 NR Forecast from 00Z Oct 27th



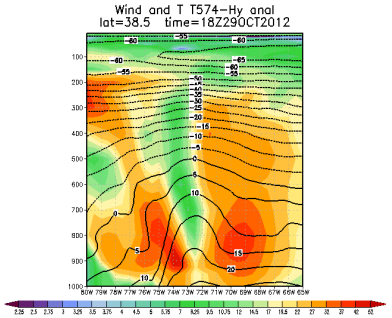
T574 NCEP analysis



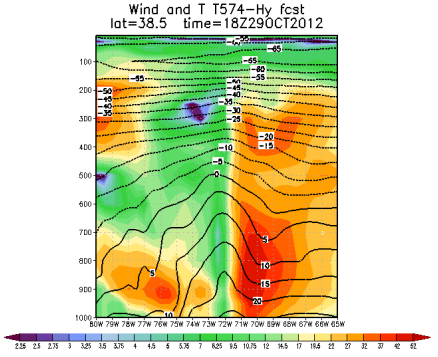
T574 NCEP GFS forecast from 00Z Oct 27th



T574 Hy NCEP analysis



T574-Hybrid NCEP GFS forecast from 00Z Oct 27th



OSSE at JCSDA

Related presentation in this meeting

◆Conduct OSSE to Evaluate of Infrared sounders on the geostationary Hyper-spectral Environmental Suite (HES). Add various observational errors to control observations and study data sensitivity to the data impact. Use template from real observation.

Sean Casey: Impact assesments of adding Errors to Simulated Radiance data in Observing System Simulation Experiments. JCSDA Symposium poster session 800.

◆Further OSSE to evaluate Optical Autocovariance Wind Lidar (OAWL) developed by Ball Aerospace and the Winds from International Space Station for Climate Research (WISSCR)

Zaizhong Ma et al: Observing System Simulation Experiments for Space-based Doppler wind Lidar Observations, JCSDA Symposium poster session 779

Development in OSSE system at JCSDA

- Add bias and random error
- Upgrade simulation of radiance
- Acquire T1279 NR from ECMWF
- Acquire 7km resolution NR from NASA/GMAO
- Upgrade OSSE system to current operational data assimilation and beyond.
- Conduct OSSE for geostationary Hyper-spectral Environmental Suite
- Conduct OSSE for future GNSS-RO