# Internationally Collaborative Joint OSSEs Progress At NOAA

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OSSE:Observing Systems Simulation Experiments
http://www.emc.ncep.noaa.gov/research/JointOSSEs/

# Full OSSEs

***There are many types of simulation experiments. Sometimes, we have to call our OSSE a 'Full OSSE' to avoid confusion.***

➢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.

## Advantages

➢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

## OSSE Calibration

Calibration of OSSEs verifies the simulated data impact by comparing it to real data impact. In order to conduct an OSSE calibration, the data impact of existing instruments has to be compared to their impact in the OSSE.

**Existing Data assimilation system and verification method are used for Full OSSEs. This will help development of DAS and verification tools.**

## International Joint OSSE capability

- Full OSSEs are expensive
  - Sharing one Nature Run and simulated observation saves costs
  - Sharing diverse resources
- OSSE-based decisions have international stakeholders
  - Decisions on major space systems have important scientific, technical, financial and political ramifications
  - Community ownership and oversight of OSSE capability is important for maintaining credibility
- Independent but related data assimilation systems allow us to test the robustness of answers

# Joint OSSE Nature Run by ECMWF

Based on discussion with JCSDA, NCEP, GMAO, GLA, SIVO, SWA, NESDIS, ESRL, and ECMWF

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

**ECMWF Nature run used at NOAA**
**Spectral resolution : T511**
**13 month long. Starting May1st,2005**
**Vertical levels: L91, 3 hourly dump**
**Daily SST and ICE: provided by NCEP**
**Model: Version cy31r1**

**Simulated radiance data,**

with and without MASK in BUFR format for entire Nature run period

Type of radiance data and location used for reanalysis from May 2005-May2006

Simulated using CRTM1.2.2
No observational error added

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

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

Ellen Salmon Ellen.M.Salmon@NASA.gov
Bill McHale wmchale@nccs.nasa.gov

**NCAR**
**Currently saved in HPSS**
**Data ID:** ds621.0
Contact:
Chi-Fan Shih chifan@ucar.edu
Steven Worley worley@ucar.edu

**Archived in the MARS system at ECMWF**
Accessed by external users. Currently available internally as expver=etwu

**Conventional data**
Entire Nature run Period
Restricted data removed
Cloud track wind is based on real observation location
No observational error added

***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***

# OSSE to evaluate Impact of GWOS DWL
# GWOS: Global Wind Observing Sounder

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

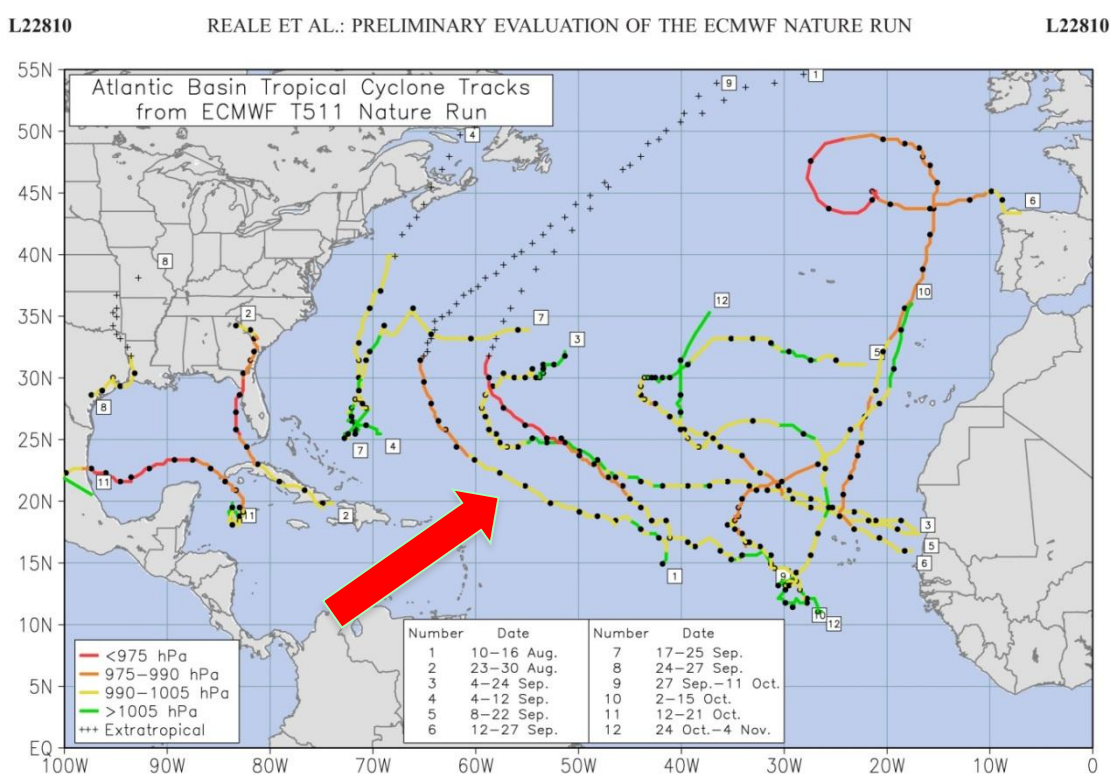
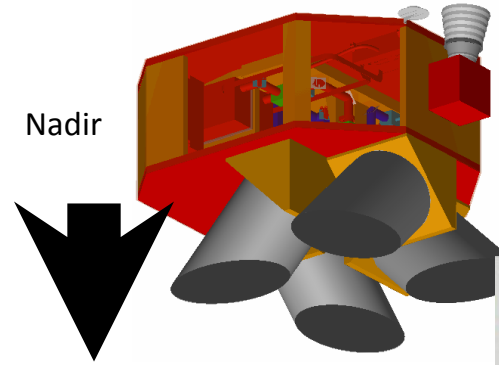


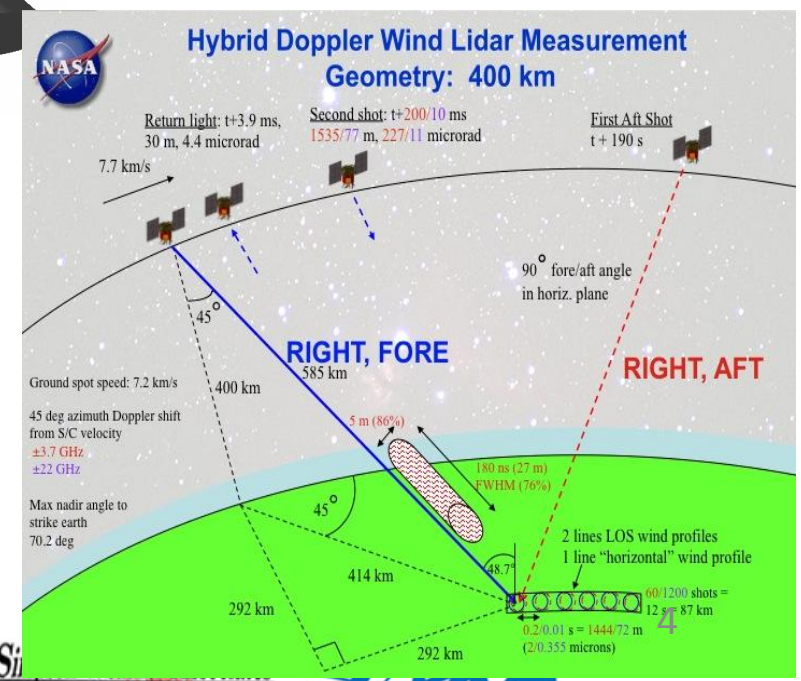

**Figure 3.** Atlantic TCs in the NR 'hurricane season.' Different colors show center pressure in the full resolution surface fields. Crosses indicate extratropical storms defined when the 200 hPa minus 850 hPa shear exceeds 10 $ms^{-1}$. Tracks are from original full-resolution T511 surface fields.

Simulated observation
Control data: Observation type and distribution used by reanalysis for 2005.
Observational error is not added to the control data but calibration was performed to demonstrate the impact of observational error in control data.

DWL data: GWOS concept DWL simulated by Simpson weather associates.




- 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.




NCEP THORPEX A World Weather Research Programme NASA KNMI Joint OSSEs NESDIS ENVIRONMENTAL CONSULTANTS

# Calibration experiments and DWL OSSE at JCSDA

Calibration and initial evaluation of DWL impact were conducted for the period 1st Jyly-15 August.

No observational were added to simulated control data.

Calibration experiments showed reasonable agreement in data impact of RAOB wind in real and simulated impact. (Fig.1 and Fig.2)

Fig.3 shows GWOS DWL may have more than RAOB wind.

**Related presentations and a poster**

Thursday, 26 January 2012: 1:45 PM
**Impact of Different Wind Lidar Configurations on NCEP Forecast Skill**
Room 340 and 341 (New Orleans Convention Center )
Zaizhong Ma et al.

Tuesday, 24 January 2012: 11:30 AM
**Observing System Simulation Experiments in the Joint Center for Satellite Data Assimilation**
Room 256 (New Orleans Convention Center )
**Lars Peter Riishojgaard et al.**

Wednesday, 25 January 2012
**Joint OSSEs at NOAA, Evaluation of DWL, JPSS, and DWSS**
Hall E (New Orleans Convention Center )
**Michiko Masutani** et al

NOUV: NO RAOB wind, NONW: No wind data
DWL: CTL + GWOS type DWL

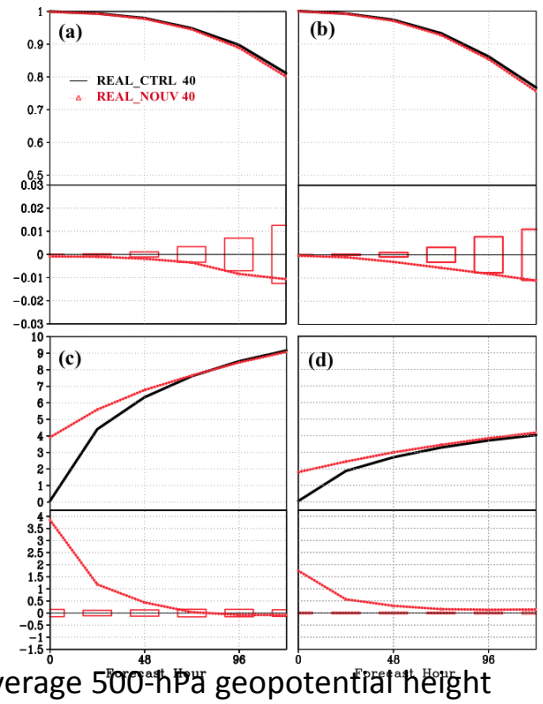



Fig.1Average 500-hPa geopotential height anomaly correlation as a function of forecast range for the Northern (a) and Southern (b) Hemisphere. Tropical wind vector RMS errors (m/s) at 200 hPa (c) and 850 hPa (d) as a function of forecast range. CTRL shown in black, NOUV in red. **All observations used were real.** Lower plot of each panel shows difference between NOUV and CRTL with, error bars indicating differences that are significant at the 95% confidence level.

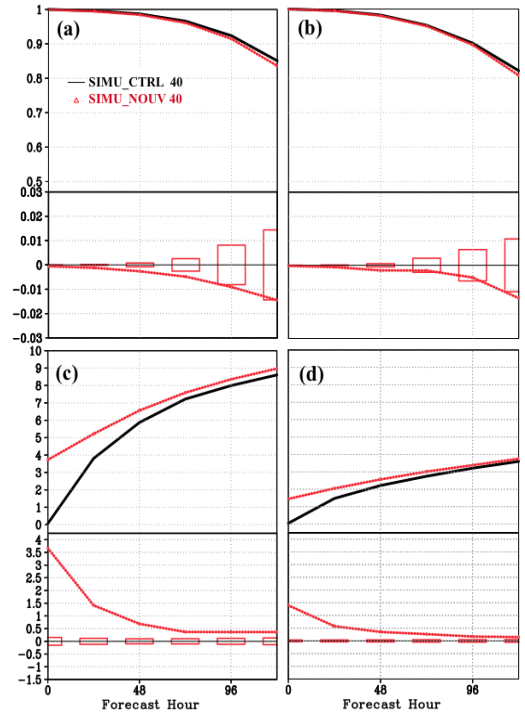



Fig. 2: As Figure 1, except that all observations were simulated based on T511NR.

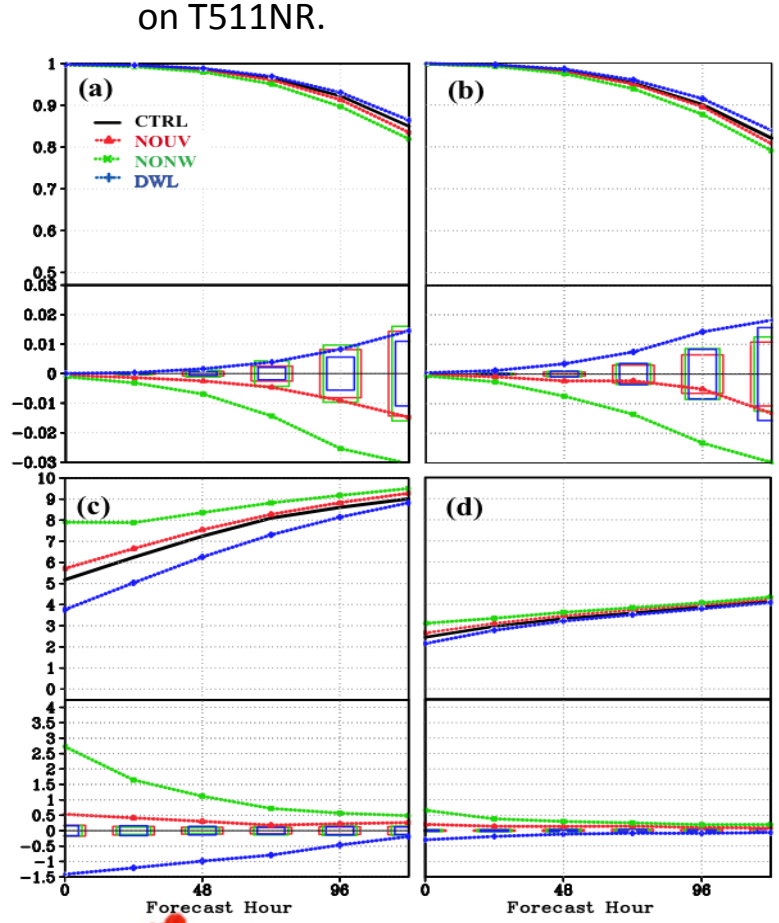
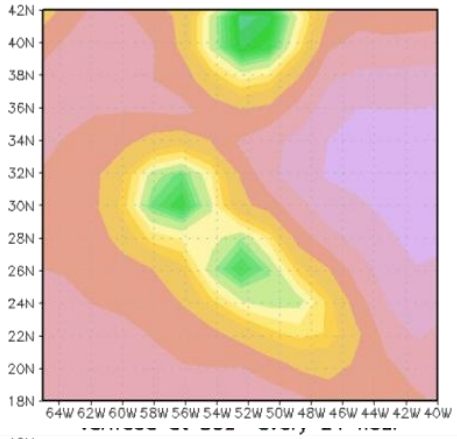
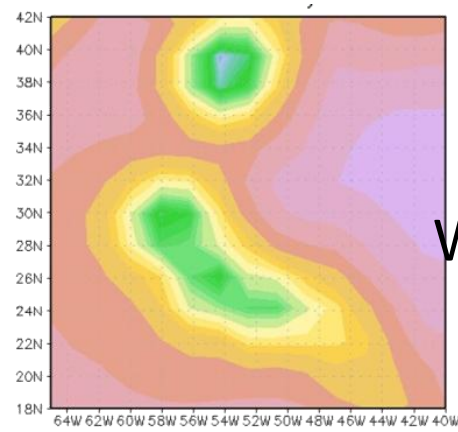



**Fig. 3:** Average 500-hPa geopotential height anomaly correlation as a function of forecast range in the Northern (a) and Southern (b) Hemisphere. Tropical wind vector RMS errors (m/s) as a function of forecast range at 200 hPa (c) and 850 hPa (d). CTRL in black, NOUV in red, NONW in green, and DWL in blue. Lower plot of each panel shows differences between CTRL and the perturbation experiments (NOUV, NONW or DWL); error bars indicate differences significant at the 95% confidence level. All forecasts were verified against T511NR.

T126

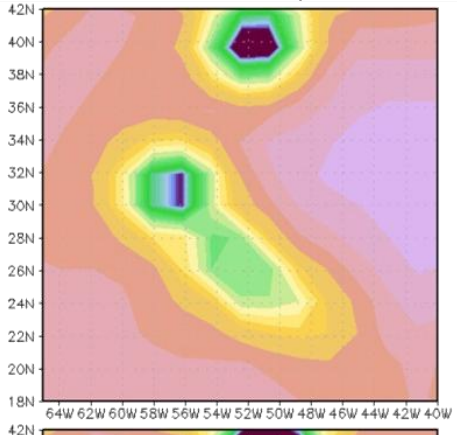


Minimum Mean Sea level Pressure
The verification period:
Sep28-Oct13, 2005
in 72 hour forecast
Evaluated at 00Z only

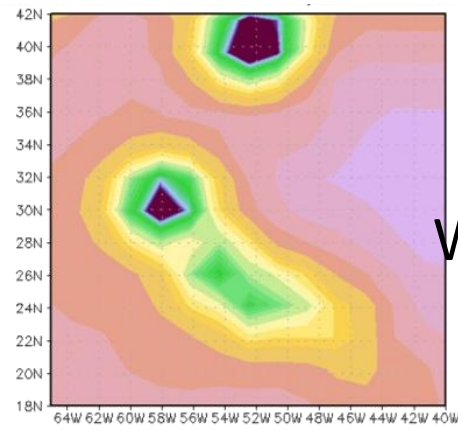


T126
With DWL

T170

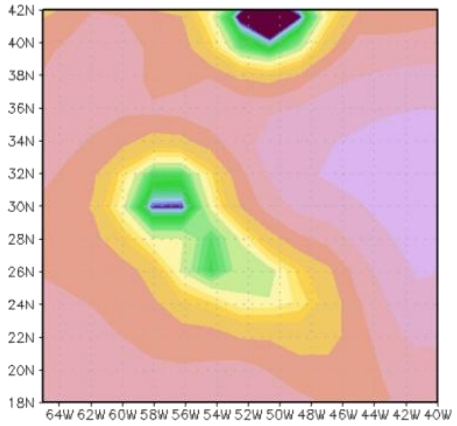


This display indicates the hurricane track and intensity

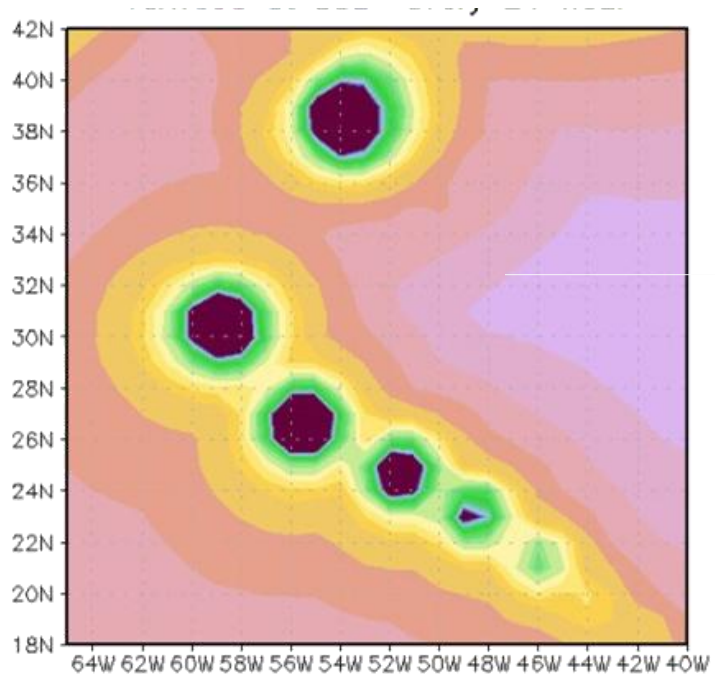


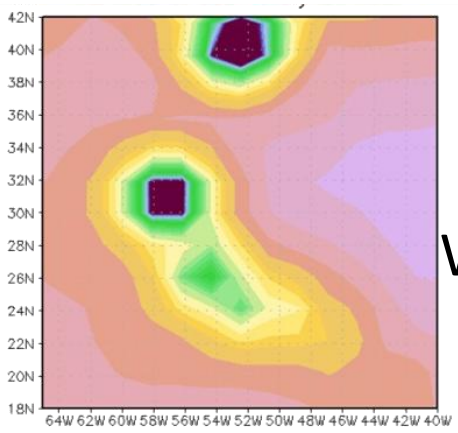
T170
With DWL

T254



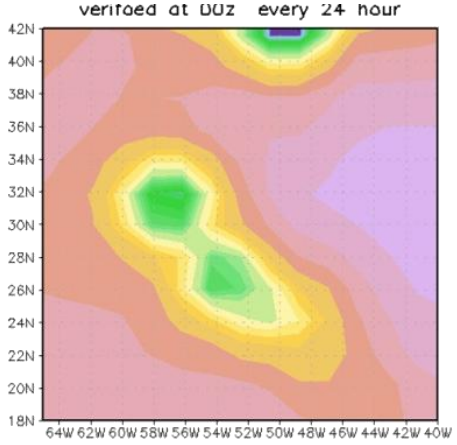
Nature run
Truth

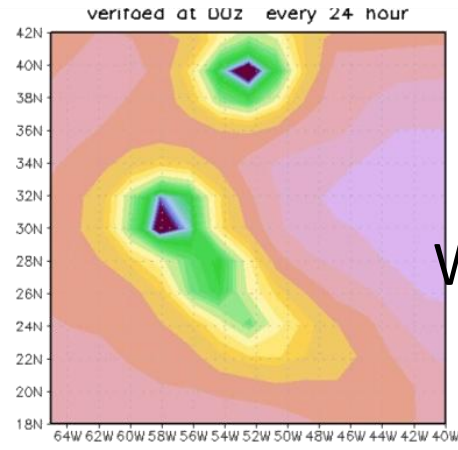




T254
WithDWL

T382

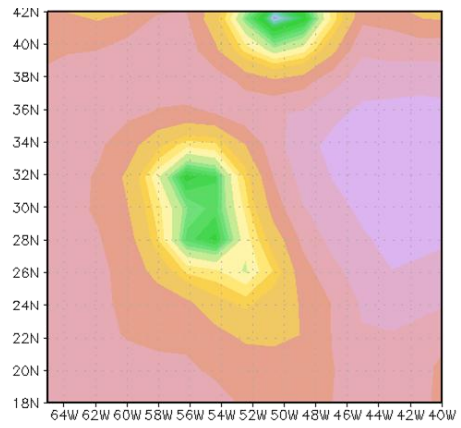




T382
With DWL

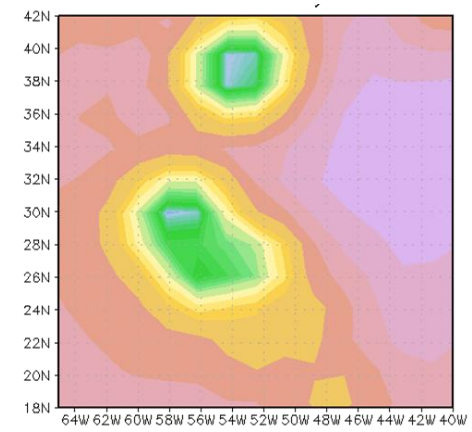
# Evaluation of observational error in radiance

T170 with large obs error in radiance



Add DWL

T170 with large obs error in radiance
DWL added



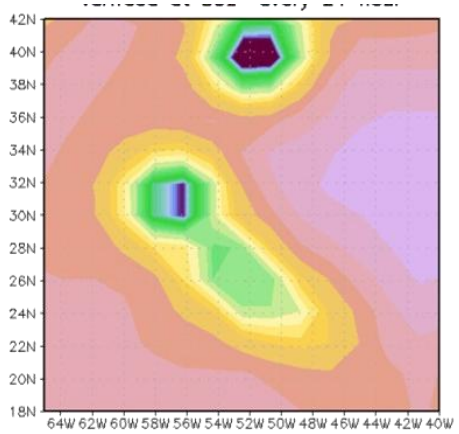
Improve radiance data

Minimum Mean Sea level Pressure
The verification period Sep28-Oct13, 2005
72 hour forecast evaluated at 00Z only

Improve radiance data

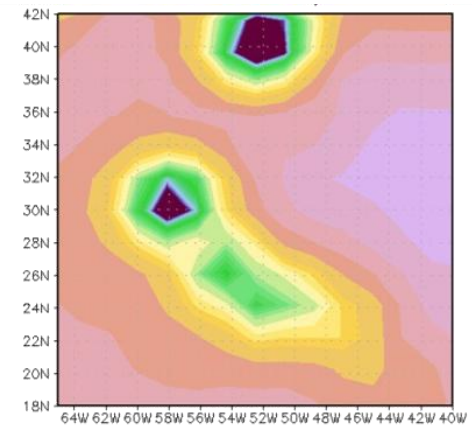
Better radiance data help track and intensity forecast. DWL also will improve intensity forecast s even with perfect radiance data.

T170 No obs error in radiance



Add DWL

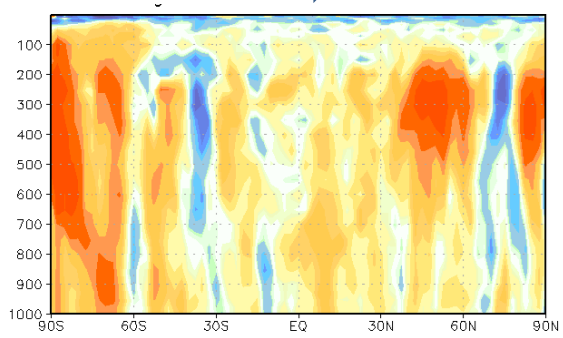
T170 no obs error in radiance
DWL added



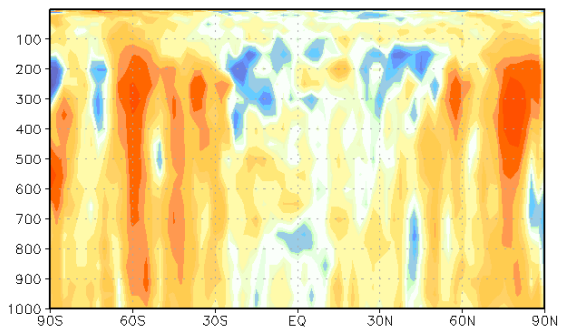
# Impact of resolution vs. GWOS DWL

Improvement by
Increasing resolution

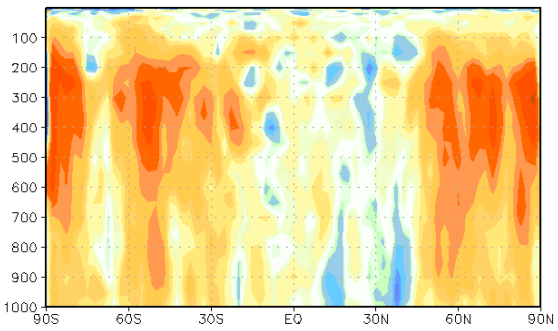
T126 ➡ T170



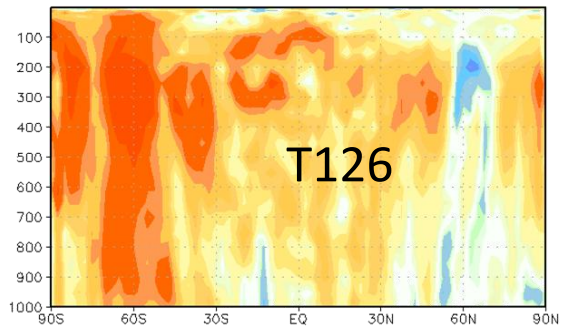

T170 ➡ T254

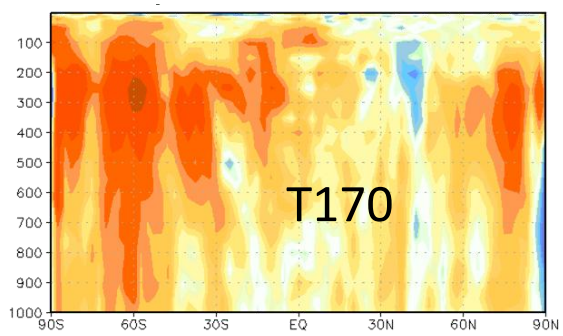


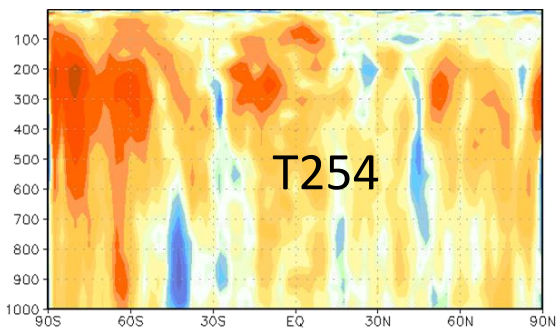

T254 ➡ T382

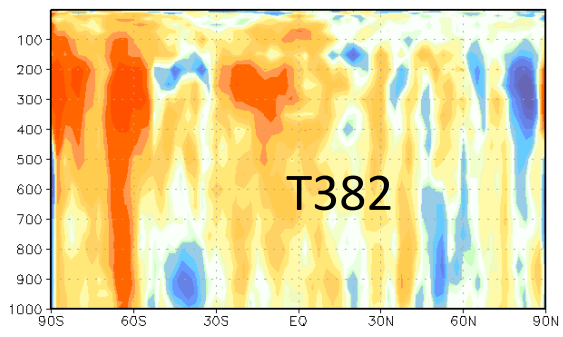



Improvement by
Adding GWOS DWL



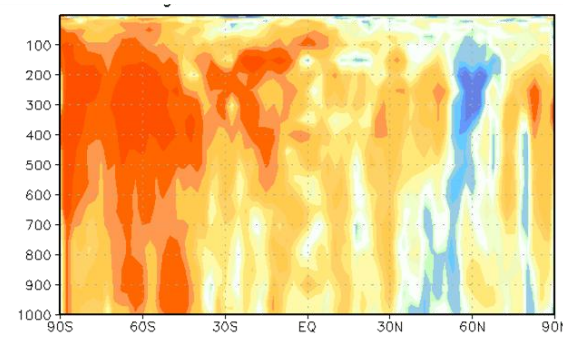



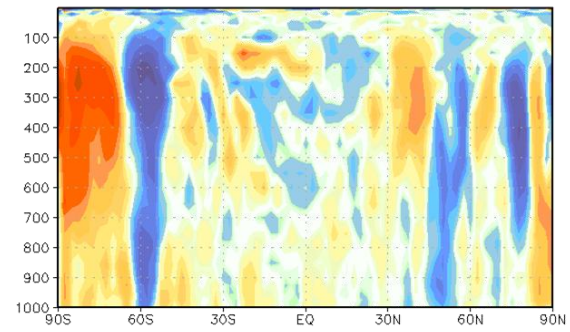




The verification period
Sep28-Oct13, 2005
in 72 hour forecast
Evaluated at 00Z only

Improvement by adding GWOS DWL
to radiance data with large obs error




Improvement by removing obs error of radiance data. Blue indicate positive impact of random error.




**More verification planned.**

Add forecast from 12z. Try DWL with other configuration.
Produce hurricane track diagnostics.

# Summary and discussion

OSSE with control observation without observational error is useful to provide initial outlook of the data impact in large scale. Adding random error can have a positive impact.

DWL improves both intensity and location of a hurricane at all resolution eve with perfect control observation.

Adding DWL is more effective than increasing model resolution in Spring Hemisphere.

In Northern hemisphere, increasing model resolution will be more effective in large scale forecast. Improvement due to adding DWL is mainly over hurricane.

At least T170 resolution is required to utilize DWL data for hurricane forecast . Impact of DWL is larger in T254 than in T170 model forecast but reduced in T382 model forecast with T511 Nature run.

# Future Plans

Add various observational errors to control observations and study data sensitivity to the data impact .

More OSSEs to study detailed evaluation of configurations of DWL planned by NASA and compared with ESA DWL.

Prepare control data for OSSE period with 2011-2012 template.

Conduct OSSE to evaluate JPSS and DWSS.


## Acknowledgement

The nature runs for Joint OSSEs were produced by Dr. Erik Andersson of ECMWF. We appreciate GMAO to providing initial satellite data for calibration at ESRL. GMAO also provided code to add random error to simulated data.