Joint OSSEs at NOAA, Calibration Evaluation of DWL, JPSS, and DWSS

Michiko Masutani[1,2,#], Lars Peter Riishojgaard [2,$], Jack S. Woollen[1,+], Zaizhong Ma[2,$], Tong Zhu[3,@], Dave Emmitt[5], Sid Wood[5], Steve Greco[5], Haibing Sun[3,%], Fuzhong Weng [3]
David Groff[1.+], Mike Lueken[1,+], Yuanfu Xie[4]

[1]NOAA/National Centers for Environmental Prediction (NCEP)
[2]Joint Center for Satellite and Data Assimilation (JCSDA)
[3]NOAA/ NESDIS/STAR,
[4]NOAA/Earth System Research Laboratory (ESRL)
[5]Simpson Weather Associates
Wyle Information Systems, McLean, VA,
+IM Systems Group)IMSG), MD
$Earth System Science Interdisciplinary Center, Univ. of Maryland, College Park,,
@Cooperative Institute for Research in the Atmosphere (CIRA)/CSU, CO
%Perot System Government Services, Virginia

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

NCEP THORPEX NASA KNMI Joint OSSEs ESDIS Simpson Weather Associates UCAR JAXA

Joint OSSE Nature Run by ECMWF

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

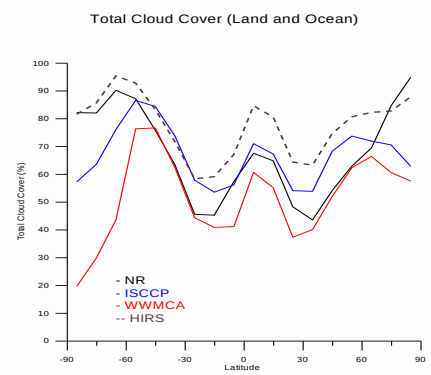
ECMWF Nature run used at NOAA
Spectral resolution : T511
13 month long. Starting May 1st,2005
Vertical levels: L91, 3 hourly dump
Daily SST and ICE: provided by NCEP
Model: Version cy31r1

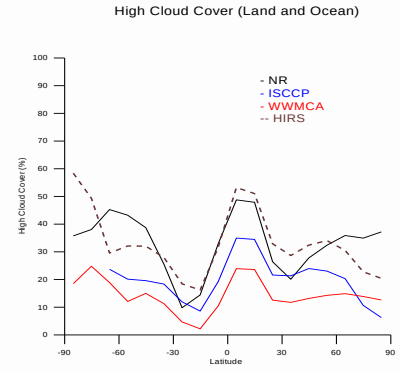
Supplemental in 1degx1deg

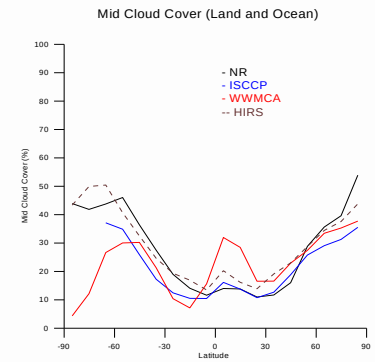
Pressure level data: 31 levels,
Potential temperature level data:
315,330,350,370,530K
Selected surface data for T511 NR:

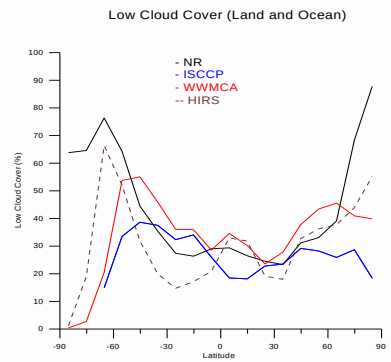
Andersson, Erik and Michiko Masutani 2010: Collaboration on Observing System Simulation Experiments (Joint OSSE), ECMWF News Letter No. 123, Spring 2010, 14-16.

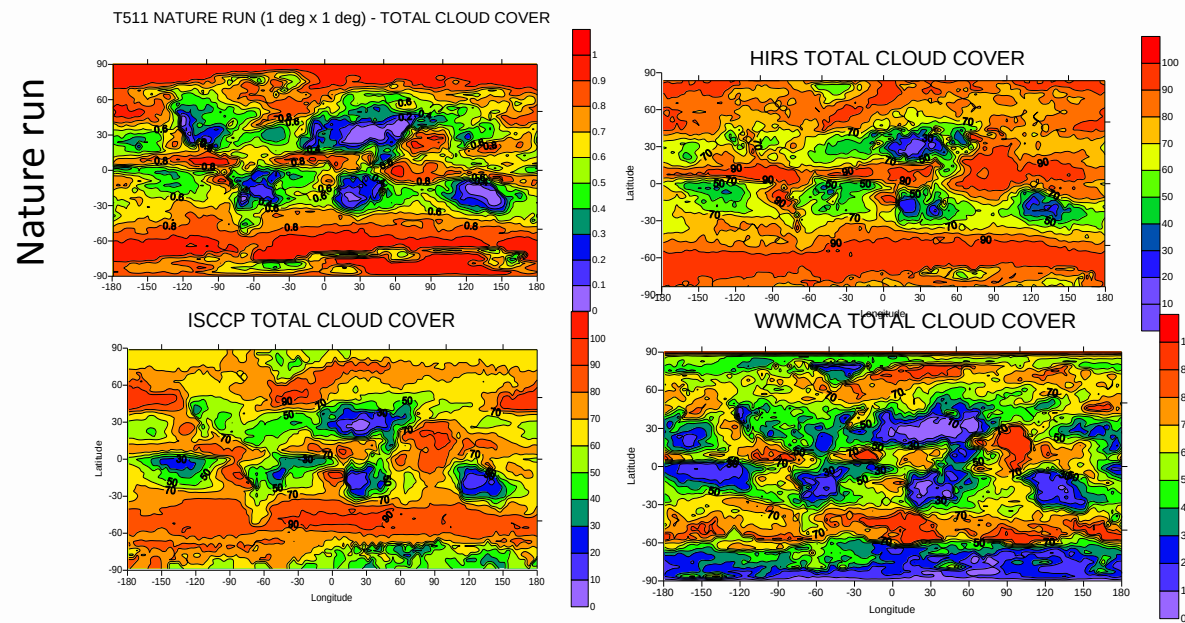
Evaluation of Nature Run cloud
Steve Greco (SWA)











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
- Entire Nature run Period -

Michiko Masutani and Jack Woollen (NOAA/NCEP/EMC)

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
http://dss.ucar.edu/datasets/ds621.0/matrix.html
Contact:
Chi-Fan Shih chifan@ucar.edu
Steven Worley worley@ucar.edu

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

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

Data posted at Joint OSSE Home page http://www.emc.ncep.noaa.gov/research/JointOSSEs/

[Simulation of TC vital]
TC vital was simulated using software originally written by Tim Marchock and currently developed by Guan Ping Lou of NCEP.

Software used for simulations are all posted.
CRTM used for simulation. CRTM1.2.2
(Different from the version posted at JCSDA website)

Conventional data posted at NASA/NCCS

Restricted data removed

NCCS Portal - JOSSE http://portal.nccs.nasa.gov/josse/index.pl

GODDARD SPACE FLIGHT CENTER

+ NASA Homepage
+ NASA Center for Climate Simulation

NCCS Data Portal - Joint OSSE

This U.S. Government resource is for authorized use only. If not authorized to access this resource, disconnect now. Unauthorized use of, or access to, this resource may subject you to disciplinary action or criminal prosecution. By accessing and using this resource, you are consenting to monitoring, keystroke recording, or auditing.

Joint OSSE Data Usage and Credit

This data must not be used for commercial purposes and redistribution rights are not given. Originating institutes must be given credit in any publications in which this data is used.

If you are interested in using the data or need assistance please contact the originating institute.

For more information about Joint OSSE and the data sets, please visit the Joint OSSE website.

Dataset	Originating Institute	Contact
NCEP Obs	NOAA/NCEP	Michiko Masutani (Michiko.Masutani@noaa.gov)
NCEP-NESDIS	NOAA/NCEP NOAA/NESDIS	Michiko Masutani (Michiko.Masutani@noaa.gov)
NCEP_prebufr	NOAA/NCEP	Michiko Masutani (Michiko.Masutani@noaa.gov)

Path: /josse

File/Directory	Size	
NCEP-NESDIS	8.0K	go to dir
NCEP_Obs	8.0K	go to dir
NCEP_prebufr	8.0K	go to dir

USA.gov + Privacy Policy and Important Notices

Curator: Bill McHale
NASA Official: Phil Webster
Last Updated: 04/2/2007

Path: /josse/NCEP_prepbufr

File/Directory	Size	
README	144	View/Download
real.v1110	8.0K	go to dir
simulated.v1110	8.0K	go to dir

Real

Path: /josse/NCEP_prepbufr/real.v1110

File/Directory	Size	
200505	8.0K	go to dir
200506	8.0K	go to dir
200507	8.0K	go to dir
200508	8.0K	go to dir
200509	8.0K	go to dir
200510	8.0K	go to dir
200511	8.0K	go to dir
200512	8.0K	go to dir
200601	8.0K	go to dir
200602	8.0K	go to dir
200603	8.0K	go to dir
200604	8.0K	go to dir
200605	8.0K	go to dir

File/Directory	Size	
REAL_prepbufr_2005070100.gz	12M	View/Download
REAL_prepbufr_2005070106.gz	9.6M	View/Download
REAL_prepbufr_2005070112.gz	12M	View/Download
REAL_prepbufr_2005070118.gz	11M	View/Download
REAL_prepbufr_2005070200.gz	11M	View/Download
REAL_prepbufr_2005070206.gz	9.1M	View/Download
REAL_prepbufr_2005070212.gz	11M	View/Download
REAL_prepbufr_2005070218.gz	11M	View/Download
REAL_prepbufr_2005070300.gz	9.9M	View/Download
REAL_prepbufr_2005070306.gz	8.2M	View/Download
REAL_prepbufr_2005070312.gz	11M	View/Download
REAL_prepbufr_2005070318.gz	9.8M	View/Download
REAL_prepbufr_2005070400.gz	9.8M	View/Download
REAL_prepbufr_2005070406.gz	8.2M	View/Download
REAL_prepbufr_2005070412.gz	9.8M	View/Download
REAL_prepbufr_2005070418.gz	9.9M	View/Download
REAL_prepbufr_2005070500.gz	11M	View/Download
REAL_prepbufr_2005070506.gz	8.7M	View/Download

Simulated

Path: /josse/NCEP_prepbufr

File/Directory	Size	
200505	8.0K	go to dir
200506	8.0K	go to dir
200507	8.0K	go to dir
200508	8.0K	go to dir
200509	8.0K	go to dir
200510	8.0K	go to dir
200511	8.0K	go to dir
200512	8.0K	go to dir
200601	8.0K	go to dir
200602	8.0K	go to dir
200603	8.0K	go to dir
200604	8.0K	go to dir
200605	8.0K	go to dir

File/Directory	Size	
OSSE_prepbufr_2005070100.gz	5.5M	View/Download
OSSE_prepbufr_2005070106.gz	5.0M	View/Download
OSSE_prepbufr_2005070112.gz	5.8M	View/Download
OSSE_prepbufr_2005070118.gz	5.2M	View/Download
OSSE_prepbufr_2005070200.gz	5.1M	View/Download
OSSE_prepbufr_2005070206.gz	4.7M	View/Download
OSSE_prepbufr_2005070212.gz	5.5M	View/Download
OSSE_prepbufr_2005070218.gz	5.1M	View/Download
OSSE_prepbufr_2005070300.gz	4.9M	View/Download
OSSE_prepbufr_2005070306.gz	4.2M	View/Download
OSSE_prepbufr_2005070312.gz	5.0M	View/Download
OSSE_prepbufr_2005070318.gz	5.0M	View/Download
OSSE_prepbufr_2005070400.gz	4.9M	View/Download
OSSE_prepbufr_2005070406.gz	4.2M	View/Download
OSSE_prepbufr_2005070412.gz	4.9M	View/Download
OSSE_prepbufr_2005070418.gz	5.0M	View/Download
OSSE_prepbufr_2005070500.gz	5.0M	View/Download
OSSE_prepbufr_2005070506.gz	4.5M	View/Download
OSSE_prepbufr_2005070512.gz	5.5M	View/Download
OSSE_prepbufr_2005070518.gz	5.0M	View/Download
OSSE_prepbufr_2005070600.gz	5.6M	View/Download
OSSE_prepbufr_2005070606.gz	5.0M	View/Download
OSSE_prepbufr_2005070612.gz	5.5M	View/Download
OSSE_prepbufr_2005070618.gz	4.9M	View/Download
OSSE_prepbufr_2005070700.gz	5.4M	View/Download
OSSE_prepbufr_2005070706.gz	4.8M	View/Download
OSSE_prepbufr_2005070712.gz	5.9M	View/Download
OSSE_prepbufr_2005070718.gz	5.1M	View/Download
OSSE_prepbufr_2005070800.gz	5.5M	View/Download

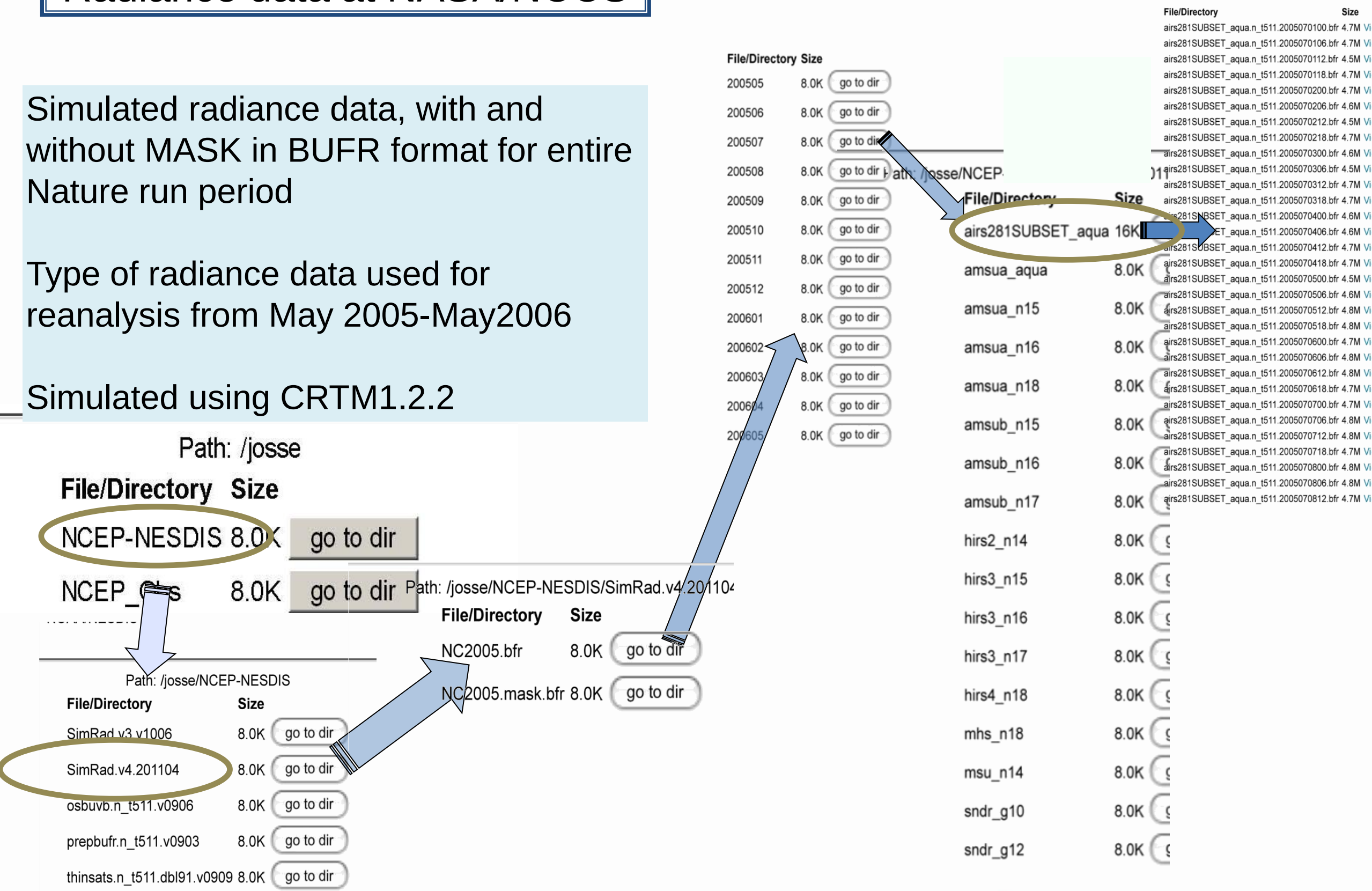
NCEP THORPEX A World Weather Research Programme NASA KNMI Joint OSSE Simpson Weather Associates ENVIRONMENTAL CONSULTANTS

Radiance data at NASA/NCCS

Simulated radiance data, with and without MASK in BUFR format for entire Nature run period

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

Simulated using CRTM1.2.2

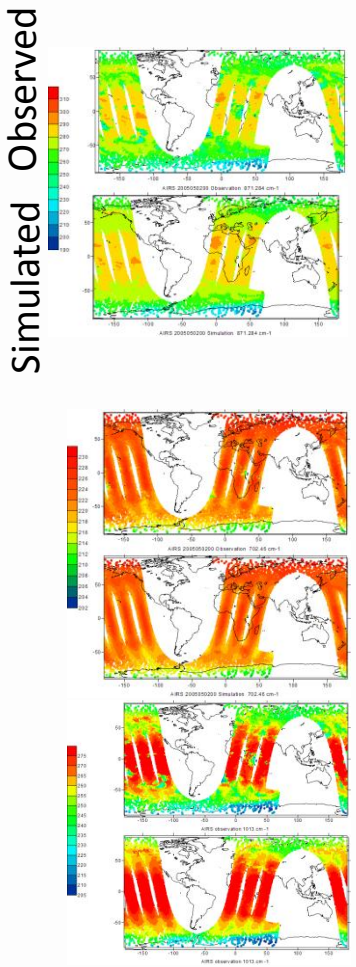


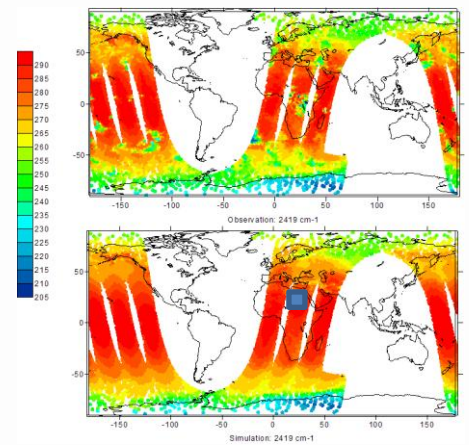
Evaluation of simulated AIRS and IASI at the 1st step (12hr fcst) of the Nature Run simulated with 2009 template

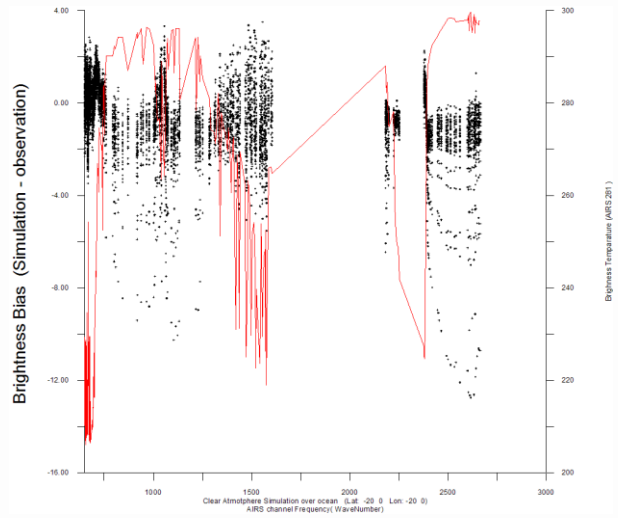
Haibing Sun (NESDIS)

AIRS

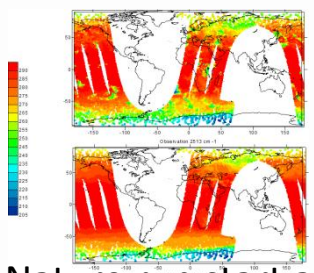
Simulated Observed

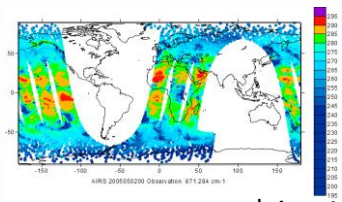






Cloud Mask Not used



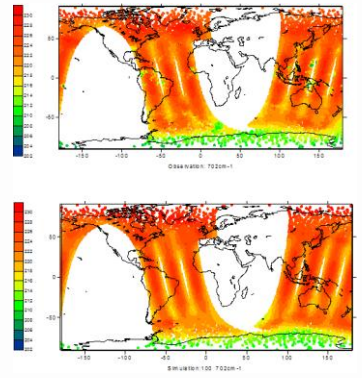


The Nature run start at May 1st 12z. At 00z May 2nd (12hr forecast), the Nature Run fields are still very close to real atmosphere and simulated radiance can be compared with real observations.

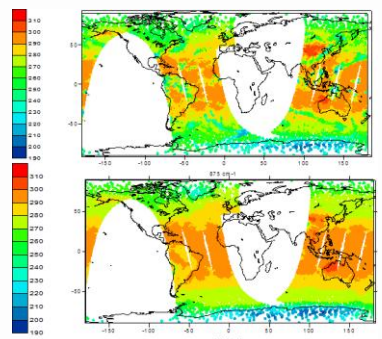
IASI

IASI simulation Evaluation at CO_2 Absorption Band

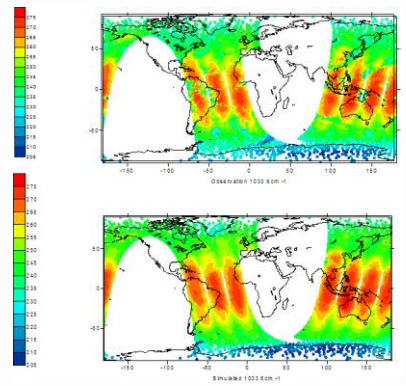
Simulated Observed



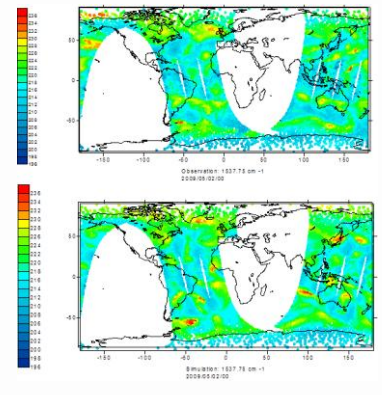
IASI simulation Evalutaion at Windows channel



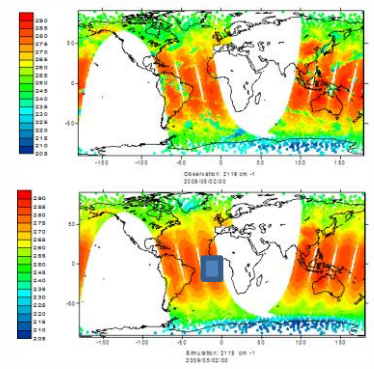
IASI simulation Evaluation at O_3 Absorb band



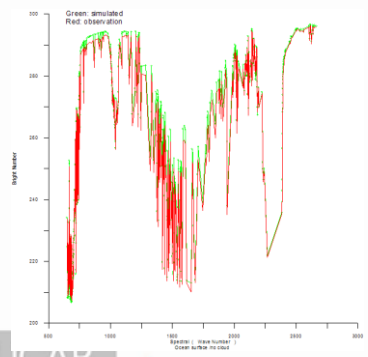
IASI simulation Evalation at $H0_2$ Absorption Band



IASI simulation Evaluation at Windows channel

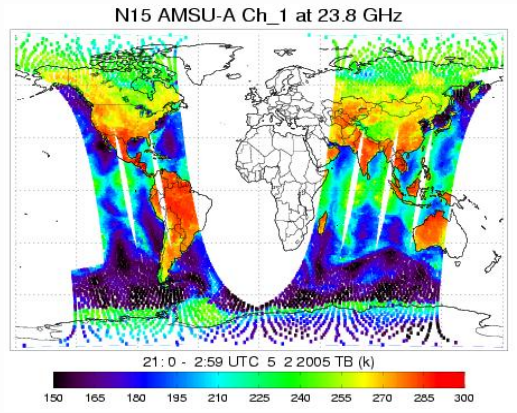


IASI Simulation over ocean(Clear atmosphere)



Evaluation of simulated GOES and AMSUA at the 1st step (12hr fcst) of the Nature Run simulated with 2005 template

Tong Zhu (NESDIS)



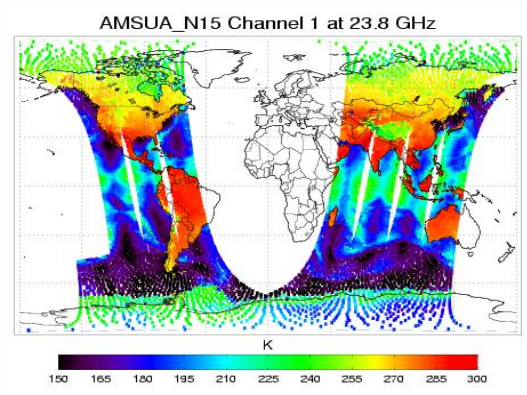


Fig. 1 NOAA -15 AMSU-A Channel 1 brightness temperature at GSI analysis time 0000 UTC May 2, 2005, time window 6 hours from (left) observation, (right)) CRTM simulation with NR atmospheric profiles.

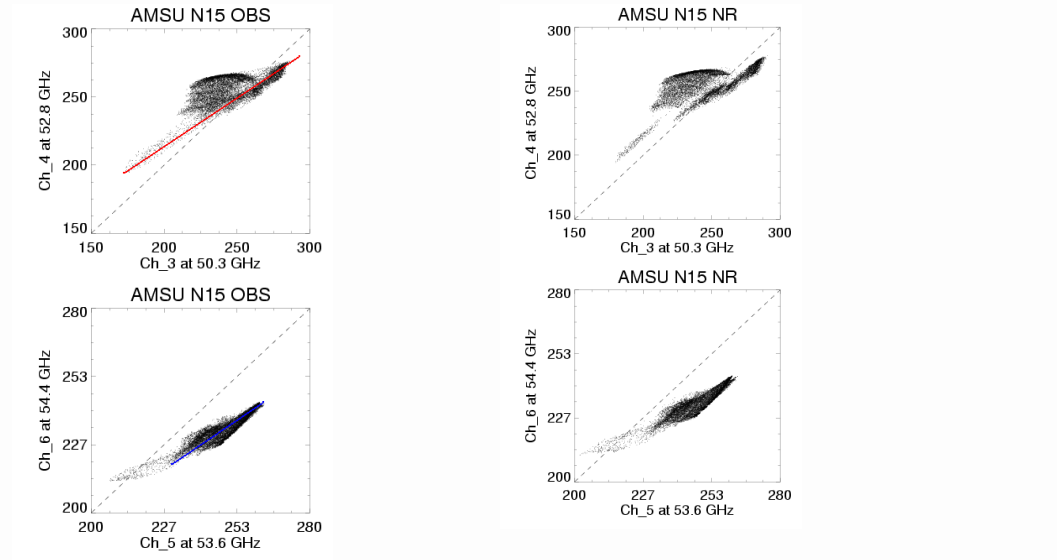
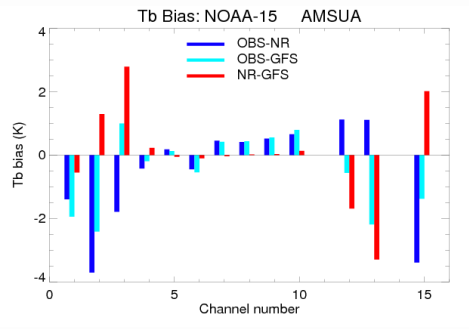


Fig. 3 Scatter plots of the inter-channel relation between brightness temperatures of (a) channel-3 and channel-4 from observation, (b) channel-3 and channel-4 from NR simulation, (c) channel-6 and channel-7 from observation, and (d) channel-6 and channel-7 from NR simulation at 0000 UTC May 2, 2011.



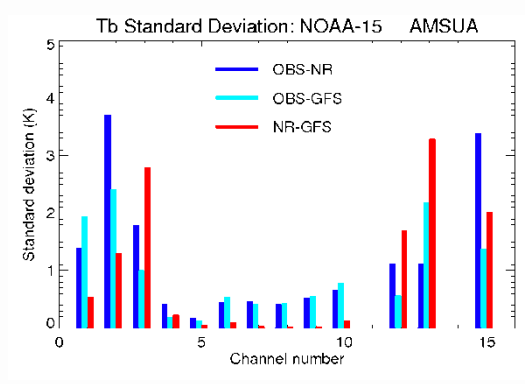


Fig. 2 Comparisons of (a) biases and (b) standard deviations (STD) of NOAA-15 AMSU-A brightness temperatures of observation-minus-simulation(NR), observation-minus-background(GSI), and simulation(NR)-minus-background(GSI) at 0000 UTC May 2, 2011.

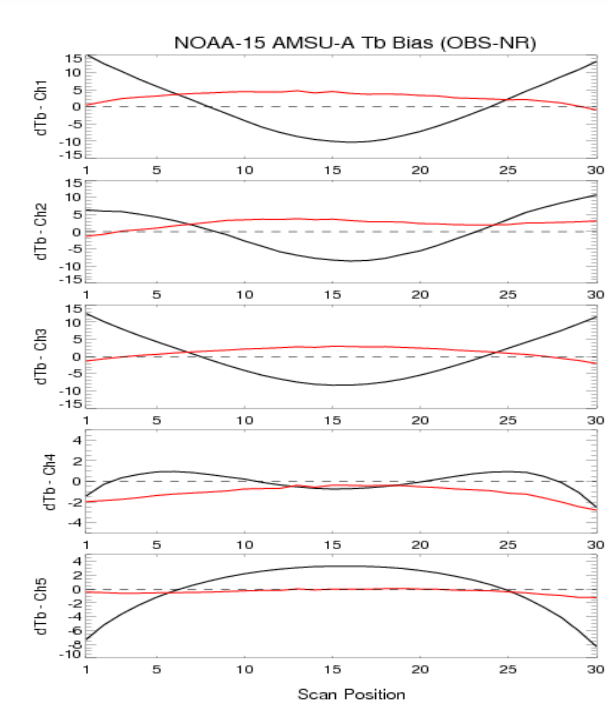


Fig. 4 Monthly mean scan angular dependent biases of observed and simulated brightness temperature for May 2005 at AMSU-A (a) Ch1 23.8 GHz, (b) Ch2 31.4 GHz, (c) Ch3 50.3 GHz, (d) Ch4 52.8 GHz and (e) Ch5 53.6 GHz. Solid black line is the observed angular dependent bias, $dT(obs)=T_{obs}(30scan)-T_{obs}(mean)$; and the red line is different between observed and simulated angular dependent bias, dT(obs) – dT(sim).

Calibration experiments and Initial results of DWL OSSE at JCSDA

Assimilation codes for DWL were developed and improved and merged to NCEP GSI trunk.

Simulation of control observation without observational error have been completed and made available to scientific community.

Calibration experiments showed reasonable agreement in large scale data impact of RAOB wind in real and simulated impact.

Initial evaluation of DWL impact were conducted for the period 1st July-15 August. Hurricane case study conducted. Significant improvement in intensity forecast is demonstrated.

OSSE with control observation without observational error is useful to provide initial outlook of the data impact in large scale. Some time random error has positive impact.

Future Plans

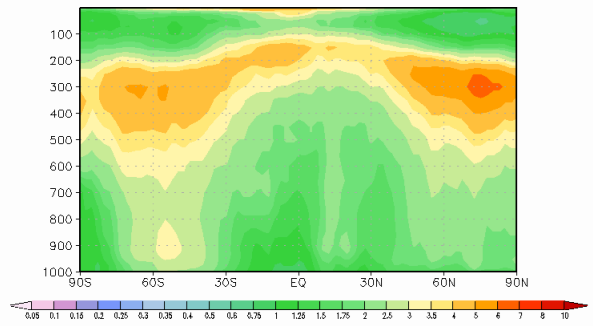
Add various observational errors to control observations and study data sensitivity to the data impact .

More OSSEs to study detail evaluation configuration of DWL planed by NASA and compared with ESA DWL.

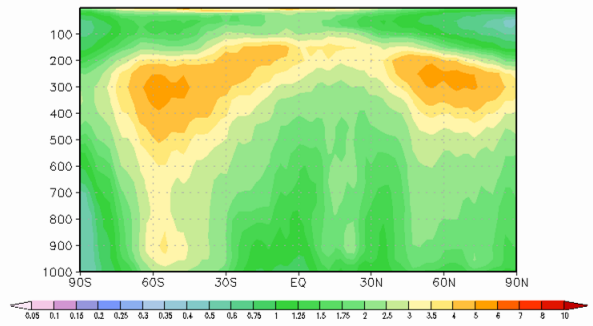
OSSE calibration test

RMSE difference between Control and Control without RAOB wind.
RMSE(NOUV,CTL) for REAL and Simulated.
24 hourly time averaged between July 7 and August 15, 2005

REAL



Simulated

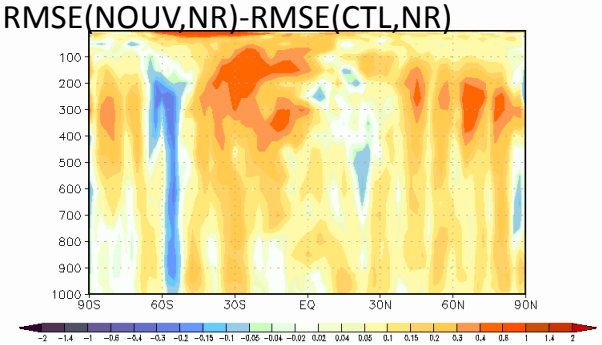


DATA impact test

Data impact measured as Reduction of RMSE from NR
24 hourly time averaged between July 7 and August 15, 2005

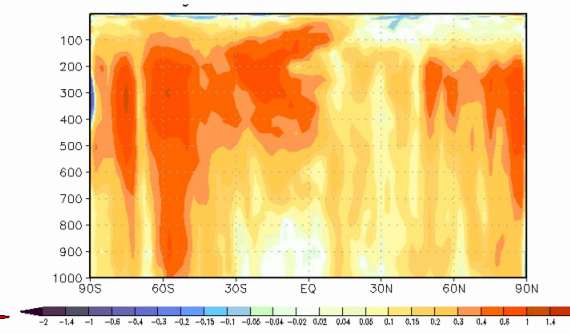
RAOB wind

RMSE(NOUV,NR)-RMSE(CTL,NR)



GWOS DWL

RMSE(CTL,NR)-RMSE(DWL4,NR)



CTL: All data used for operation. NOUV: CTL without RAOB wind
DWL4: CTL amd 4 look GWOS DWL, NR: T511 Nature Run (truth)

Related presentations and a poster

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.**

Thursday, 26 January 2012 **Internationally Collaborative Joint OSSEs - Progress At NOAA in** Hall E (New Orleans Convention Center), **Michiko Masutani**, EMC,

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

NCEP THORPEX A World Weather Research Programme NASA KNMI Joint OSSEs ESDIS Simpson Weather Associates ENVIRONMENTAL CONSULTANTS UCAR JAXA

Progress and Plans for OSSE to evaluate JPSS and DWSS

Back Ground

In 2010 NPOESS project was transferred into JPSS and DWSS

JPSS(Joint Polar Satellite System)
Civilian Program by NOAA and NASA
PM orbit for NPOESS
VIIRS, CrIS, ATMS, OMPS, CERES and others

DWSS (Defence Weather Satellite Systems)
Early AM orbit
VIIRS, SEM-N, MIS and others

(Mid Morning Orbit is covered by EUMETSAT)

Acknowledgement

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

OSSE Plans and Progress

Initial period July 2011

Simulate existing operational satellite observation and conventional data using July 2011 template (Progress at NCEP)

Development of CRTM and data assimilation system for JPSS. (Ready to be evaluated.)

Simulation of ATMS. (Completed by NESDIS)

Simulate observation from JPSS instrument.

Simulation of DWSS instrument.

OSSE calibration with 2011 observing system.

Conduct OSSE to evaluate JPSS and DWSS.