Summary of Session #2 Advanced Instrument

June 10-11, 2008

Session Chair: Chris Barnet

Summary of Presentations in Session #2: Advanced Instruments

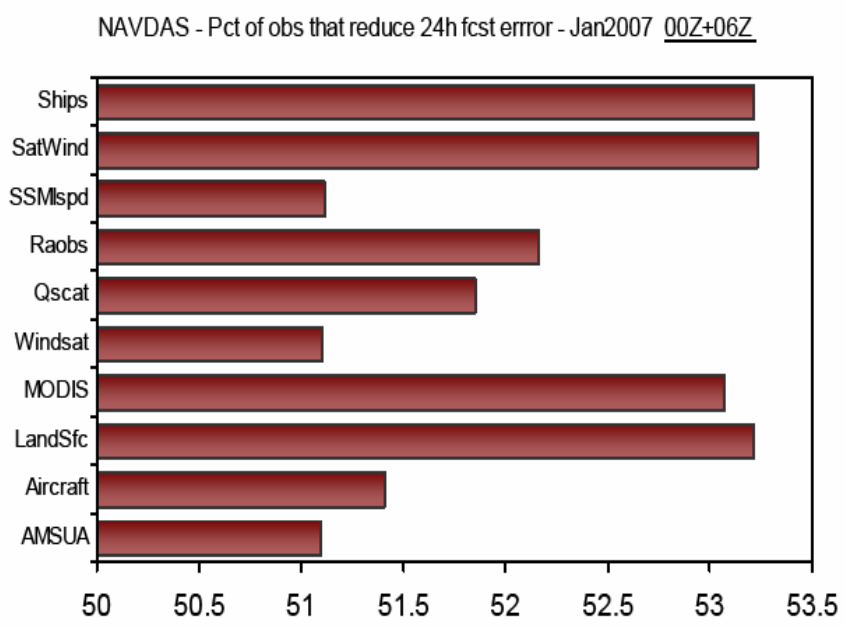
#	Presenter	Title
01	Craig Bishop (for Rolf Langland)	Satellite Channel Selection with Data Assimilation Adjoint
02	Jim Jung	Assimilation of IASI data in GFS
03	Lidia Cucurull	GPS Radio Occultation data assimilation: progress report
04	Li Bi	A two-season impact study of ASCAT surface wind retrievals in the NCEP Global Data Assimilation System
05	Zhanqing Li	Evaluating the NCEP Global Forecast System Cloud Vertical Structure against MODIS, CloudSat/Calipso Retrievals
06	Mike Richman	Thinning WindSat Data Using Support Vector Regression
07	Craig Bishop (for Steve Swadley)	JCSDA Unified PreProcessor for SSMIS
08	Banghua Yan	SSMIS Data Assimilation in GFS
09	Chris Barnet	AIRS, IASI, CrIS Advanced Processing for Data Assimilation
10	Lars Peter Riishojgaard	Observing System Experiments for MODIS winds in the Joint Center for Satellite Data Assimilation

01: Satellite Channel Selection with Data Assimilation Adjoint

Rolf Langland, Nancy Baker, Benjamin Ruston Naval Research Laboratory, Monterey, CA

William Bell UK Met Office, Exeter, UK

- Adjoint tools to predict the error reduction due to every observation assimilated have been developed. These tools are useful for
  - observation quality monitoring
  - channel selection and other forms of observation thinning.
- **On-line Observation Impact monitor**
  - **www.nrlmry.navy.mil/ob_sens**



Assimilating the global set of observations improves the analysis and forecast, even though 40-50% of observation data are non-beneficial in any selected assimilation

02: Initial IASI Radiance Assimilation Experiments

PIs and Co-PIs: Steve Ackerman, James Jung, Li Bi, Todd Schaack

NWP Center Collaborators:John Derber, Russ Treadon, Paul van Delst, Dennis Keyser, Tom King, Walter Wolf, Chris Barnet

Accomplishments

BUFR issues resolved

CRTM modifications incorporated

GSI source code modifications completed

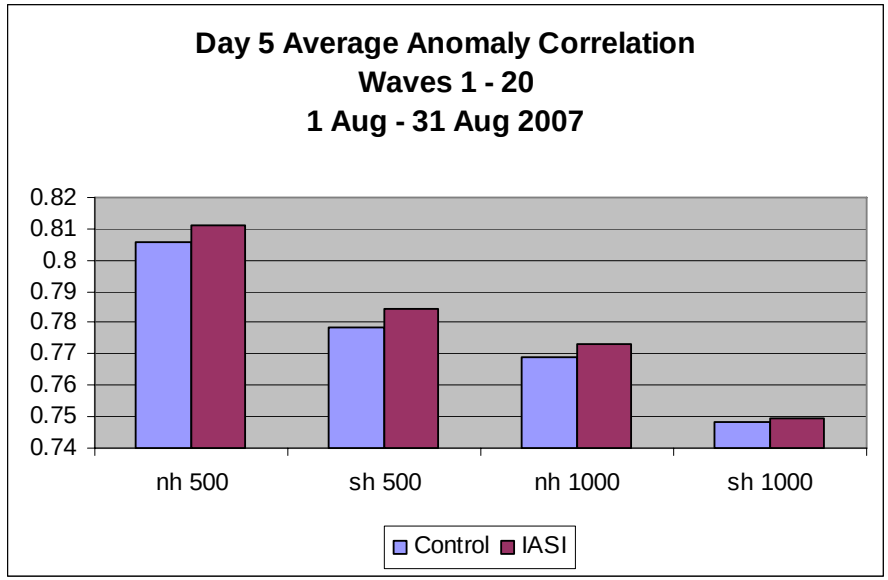
Two season assimilation impact study completed with longwave channels

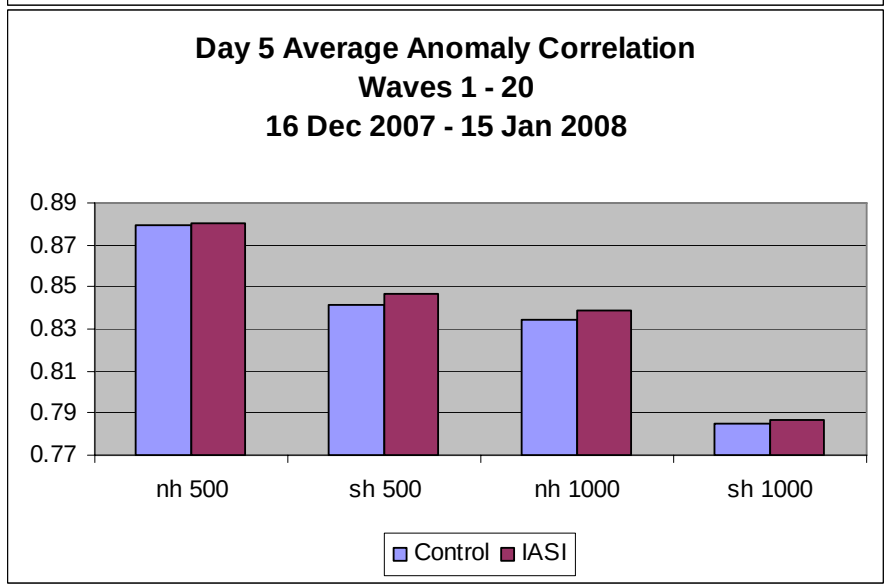
Source code transferred to NCEP. should be operational by early FY09

Future Plan

Improve use of longwave channels

Investigate use of water vapor channels





03: GPS RO DA

PI: Lidia Cucurull, NOAA (IPA)

Accomplishments

- Monitor transition of COSMIC data into operations.
- Improve diagnostic files for GPS RO in the GSI code.
- Generalize the GPS RO code in GSI to use any vertical coordinate system.
- Analysis of more impact studies with COSMIC for different areas and periods. (The use of COSMIC improves model skill).
- Improve assimilation of GPS RO over areas of complex topography.
- Testing, evaluation and feed-back to UCAR on stratospheric bug-fixed profiles. (UCAR improved the quality of the profiles in the stratosphere in November 2007).
- Correct weights associated to the vertical levels surrounding a GPS RO observation in GSI.
- Transition of (GFZ) CHAMP & GRACE-A data into the operational tanks.

Accomplishments (on the side)

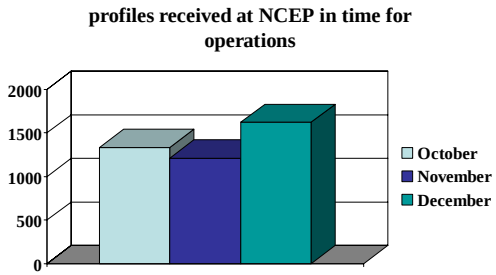
- Evaluation & assimilation of GPS RO data into the new reanalysis system (CFSRR project; NCEP/EMC).
- Assess the use of COSMIC data to retrieve PBL heights for assimilation into the real-time mesoscale analysis system (RTMA). [Co-I in a NASA-funded Homeland Security project (within the Air Quality Group at NCEP/EMC)].
- POC within NOAA/NESDIS to use GPS RO derived products of temperature and water vapor to validate other satellite instrument data and to extend the NOAA/NESDIS 1dvar capability to include GPS RO.
- Evaluation of the requirements needed to add the GPS RO capability to conduct OSSEs within the international Joint OSSE project (PI for CEOS Category 1 action WE-07-1_3).
- Provide guidance to the Navy in their COSMIC assimilation efforts.
- POC at NESDIS/OSD & NWS (and EMP) for user requirements for GPS RO data.
- Involved in evaluation/planning for a possible GPS RO follow-on mission.

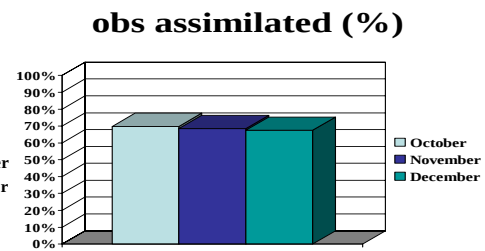
Current and Future Plan

- Update quality control checks & observation error characteristics for GPS RO data within GSI/GFS.
- Improve (refractivity) forward operator for GPS RO data in the GSI.
- Evaluation, testing, tuning and (likely) assimilation of GPS RO from (GFZ) CHAMP & GRACE-A (in pre-operational mode) and MetOp/A GRAS (when available). [Possible availability of SAC-C data in real-time as well. Negotiations are underway].
- Develop the necessary code infrastructure to monitor the GPS RO statistics and transition to operations.
- Assimilation of COSMIC observations (and other GPS RO missions) into the regional model (NAM).
- Improve the performance of the assimilation of observations of bending angle (switch to bending angle in operations? Global and/or regional systems?).
- Explore more complex forward operators to take into account horizontal gradients of refractivity (2D forward operators).

- We assimilate rising and setting occultations, there is no black-listing of the low-level observations (provided they pass the quality control checks), and we do not assimilate observations above 30 km (due to model limitations).
- In an occultation, the drift of the tangent point is considered.

The plot shows COSMIC data available and assimilated in operations for October, November and December 2007.





The remaining ~20% received, but not assimilated, is due to:

- Preliminary quality control checks (bad data/format)
- Gross error check
- Statistics quality control check (obs too different from the model-obs statistics)

04: ASCAT assimilation and forecast impact in the NCEP GDAS

PIs and Co-PIs: Steve Ackerman, Li Bi, James Jung

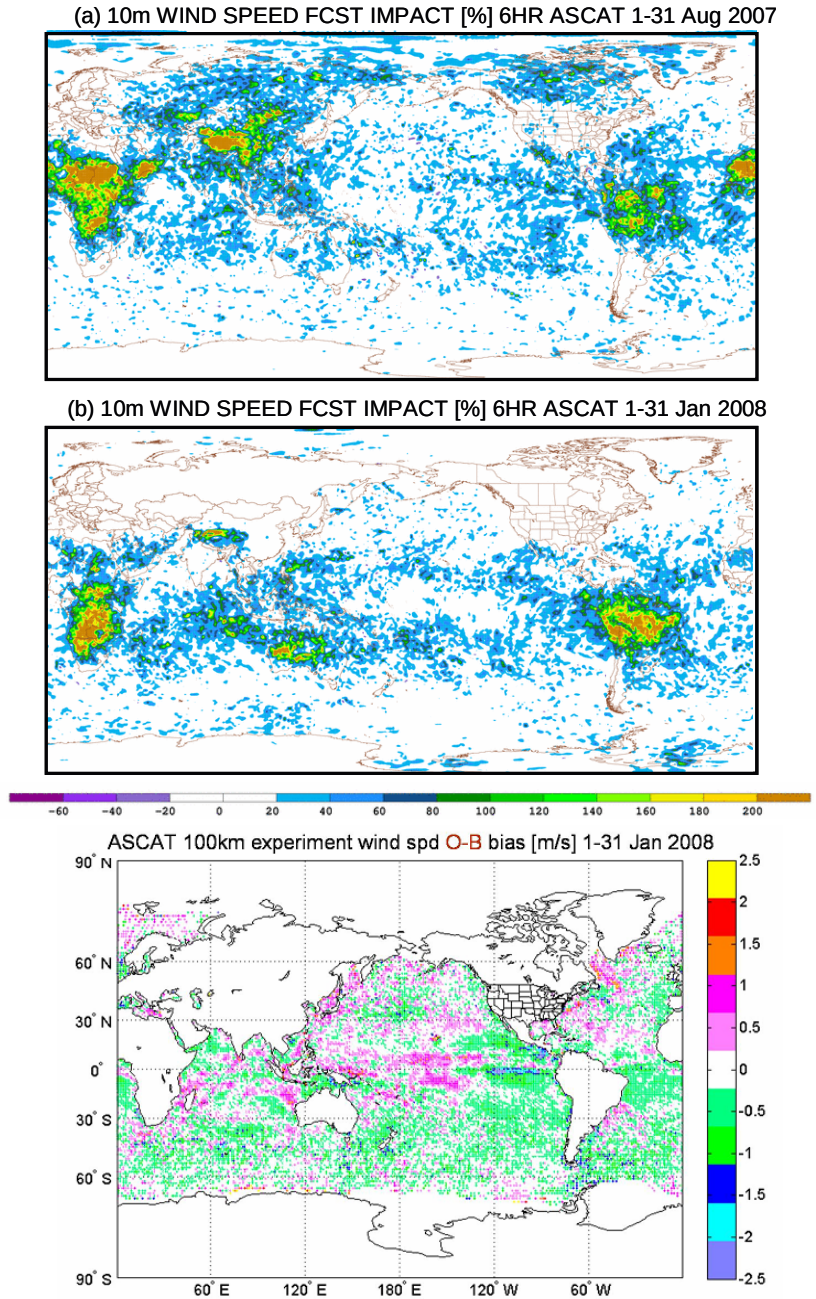
NWP Center Collaborators: John Derber, Russ Treadon, Dennis Keyser, Zorana Jelenak, Paul Chang

Accomplishments

- **Developed quality control and assimilation procedures for the ASCAT retrievals**
- **Evaluated ASCAT diagnostic stats for the two-season experiments.**
- **Evaluated GFS forecast impacts of ASCAT retrievals thinned to 100km with positive results**
- **Provided source code to NCEP, should be operational early FY2009**

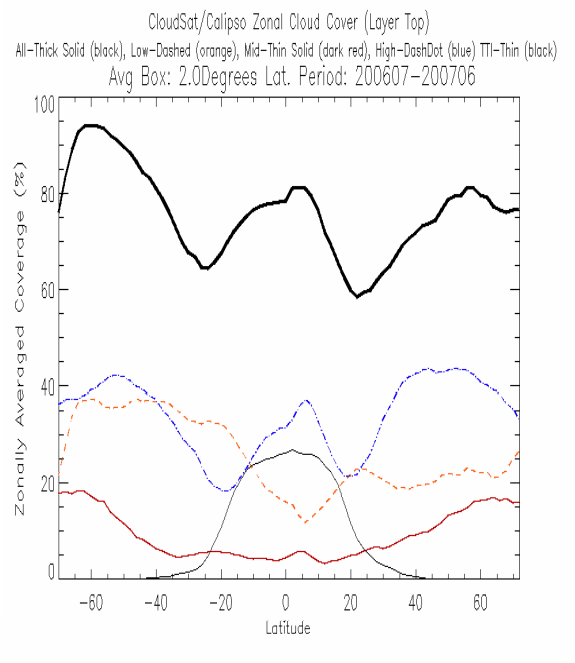
Future Plans

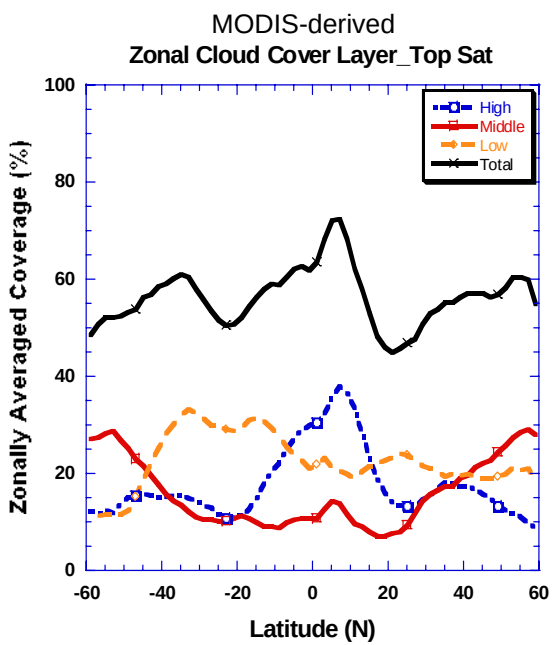
- **Continue working on the quality control procedures.**
- **Develop and test new thinning techniques (adapt thinning algorithm of Leslie et al. , different grid resolution)**

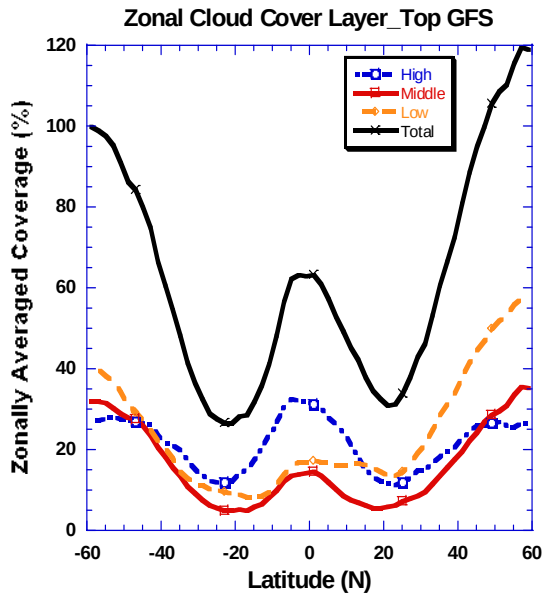


05: Evaluating the NCEP Global Forecast System Cloud Vertical Structure against MODIS, CloudSat/Calipso Retrieval

- The spatial patterns and latitudinal variation of cloud from all three sources (NCEP-GFS, MODIS, C/C) bear great resemblance
- Large discrepancies exist among all three products
- In general, the GFS modeled clouds are more similar to the MODIS retrieved clouds than to C/C clouds
  - The GFS model tends to generate less high clouds, more middle clouds and less low clouds than C/C clouds
  - The GFS produces far less cirrus cloud in the tropics
  - The GFS clouds are generally too thin by about 50%
- Many regional features are yet to be explored, *e.g.* too much cloud over deserts, too little over cold oceans.







06: Thinning WindSat Data Using Support Vector Regression

PIs and Co-PIs: Mike Richman and Lance Leslie

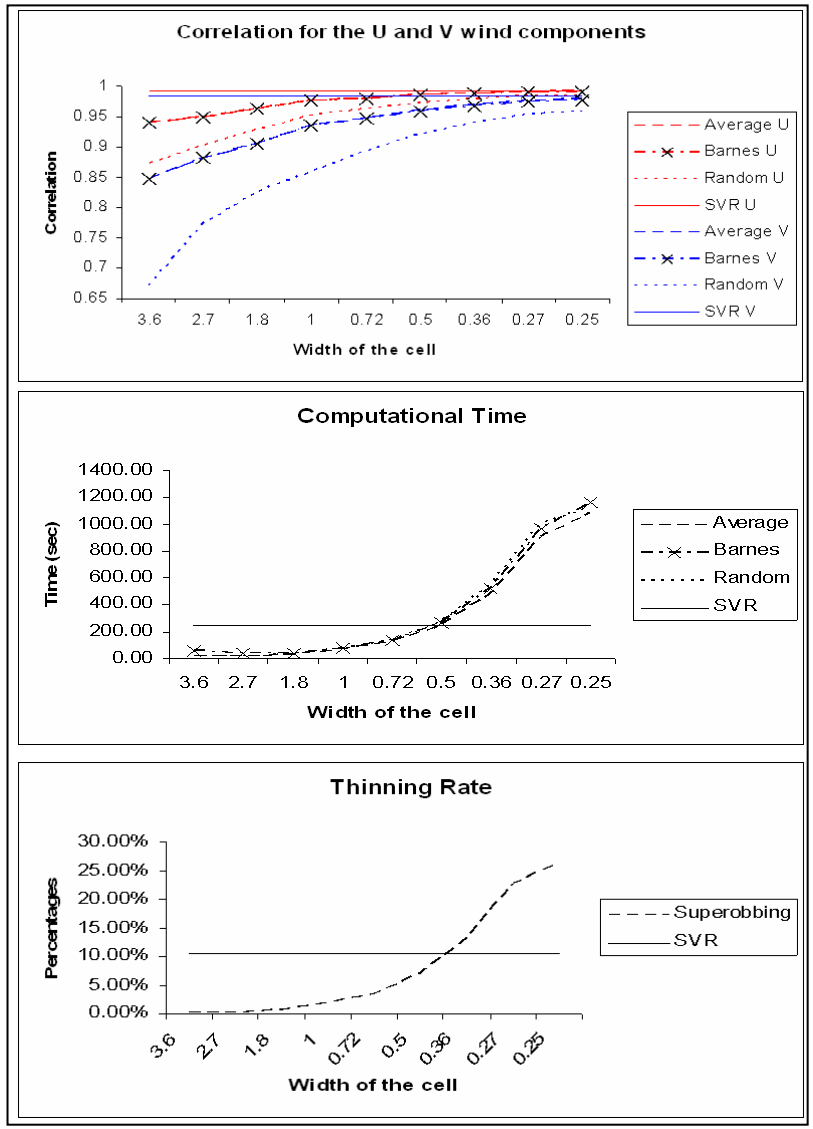
NWP Center Collaborators: JCSDA

Accomplishments

- **Only 10.4% of the data were needed to reconstruct the wind field with high accuracy (correlation coefficients are > .99 for the u- and the v-components)**
- **To obtain the same accuracy as SVR, the thinning rate of the other superobbing methods was 26.3% and the computation time was over four times that of SVR.**

Future Plan

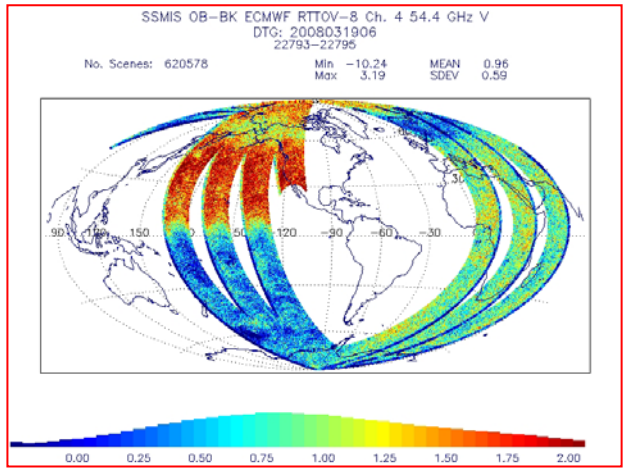
Thinned data will be assimilated and their impact on model forecasts assessed in collaboration with Dr. John LeMarshall and scientists at the University of Wisconsin.



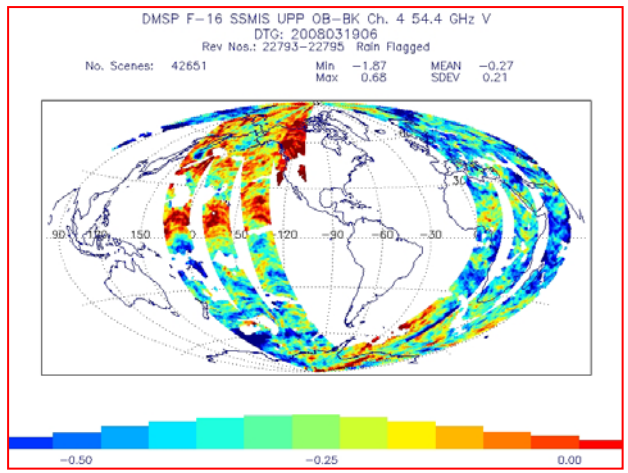
07: JCSDA Unified PreProcessor for SSMIS

- SSMIS Unified Post-Processor is now producing radiances suitable for assimilation in NWP models.
  - Modest improvements have been obtained.
  - Large challenges associated with poorly shrouded instrument have been strongly mitigated by producing accurate models of unshrouded instrument.
- Importance of Zeeman and Doppler corrections for 60.7927 GHz channels

Un-corrected O-B



UPP-V2 Corrected O-B



08: F16 SSMIS Data Assimilation Impact Study for NCEP Global Forecast Model

PI : Fuzhong Weng

Co-PI: Banghua Yan

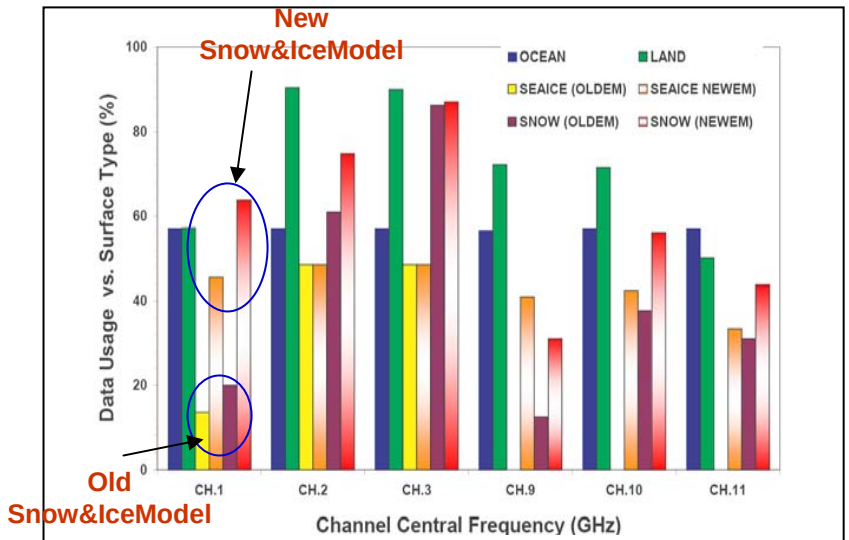
NWP Center Collaborators: John Derber

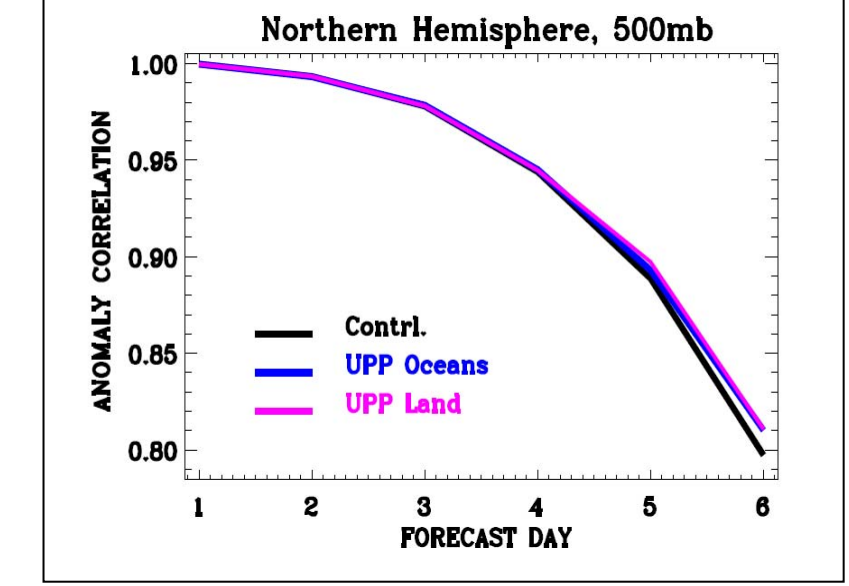
Accomplishments

- **Δ Bias/anomaly of F16 SSMIS data quality is assessed and corrected**
- **Δ An improved snow and ice emissivity is applied to SSMIS, which results in more QC-passed data**
- **Δ A positive or neutral assimilation impact of F16 SSMIS is observed**

Future Plan

- **Δ Assimilation impact of F16 SSMIS data is further investigated**
- **Δ F16 SSMIS UPP data is implemented to NCEP operational forecast model**

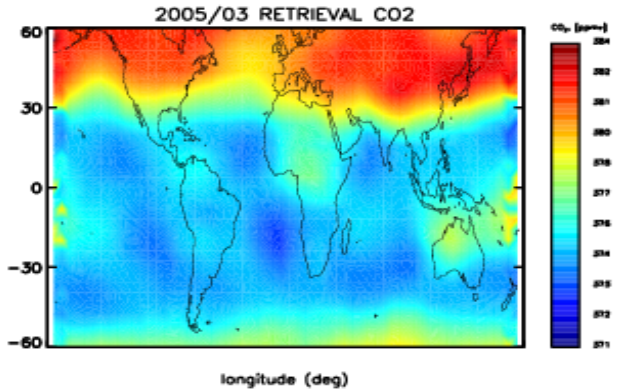


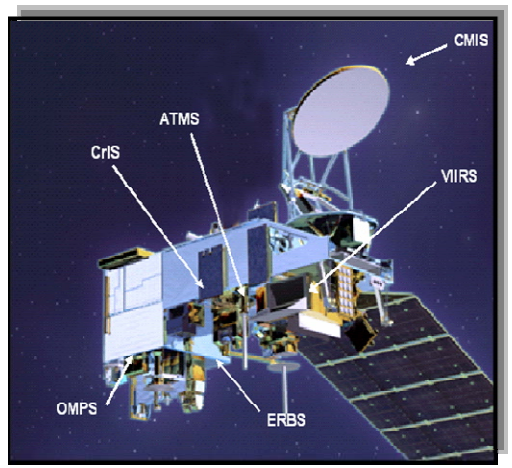


09: AIRS, IASI, CrIS Advanced Processing for Data Assimilation

- Provide Near-Real Time (NRT) tailored products.
  - Spatial and spectral subsets of radiances – various flavors.
  - Merged instrument products (*e.g.*, MODIS/AIRS, AVHRR/IASI)
- Produce research products for weather & climate.
  - Principal components, reconstructed radiance, noise characterization.
  - Cloud cleared radiances
  - Geophysical products (with averaging functions and covariance matrices).
    - T(p), q(p), spectral emissivity, cloud top pressure
    - OLR, Convective parameters (CAPE, LI, etc.)
    - O3(p), CO(p), HNO3
    - CH4 and CO2 background.
- Can help with preparations for NPP and NPOESS CrIS and instrument characterization and monitoring.
  - BUFR formats for D.A.
  - Pre-launch simulated data provided in D.A. formats.
  - Apodization of CrIS radiances.
  - Channel selection.
  - First light analysis of instrument performance and issues.

AIRS CO2 Product for March 2005





10: Observing System Experiments for MODIS winds in the Joint Center for Satellite Data Assimilation

- Example of MODIS Winds
  - Original study had positive impact.
  - Neutral impact in current NCEP operational system
    - Changes in system include new analysis, increased horizontal resolution, addition of AIRS.
  - UKMET and GMAO still show positive impact.
- Positive impacts of observing systems are NOT automatically carried forward in time
  - Resolution changes
  - GOS changes
  - Data assimilation algorithm/model changes
- Observing system monitoring and tuning is (or should be) an ongoing effort
  - This is currently not the case for JCSDA

Today's Breakout Session

- Topics for Group Discussions
  - Overall strategy for scientific development in each of the priority areas - show how the present work fits into the strategy and indicate broad milestones (*e.g.* operational implementations) toward executing the strategy.
- What progress on the proposed work has been made over the performance period?
  - list milestones or significant accomplishments
- Is the scientific direction and progress:
  - consistent with and relevant to JCSDA priorities?
  - producing code capable of being integrated into JCSDA supported systems?
  - note when code will be transferred to the JCSDA
  - likely to lead to a positive impact of forecast skill or other tangible positive impact on JCSDA systems?
- What next?
  - plans for future direction of group effort
  - unfunded areas of high priority that need JCSDA attention?