Preliminary Test of CrIS in GSI Hybrid EnKF-3DVAR System

Xiaoyan Zhang[1], James Jung[3], Andrew Collard[2], Kevin Garrett[1], and Sid Boukabara[1]

[1] NOAA/NESDIS Center for Satellite Applications and Research, [2] NOAA/NCEP Environmental Modeling Center, [3] CIMSS University of Wisconsin - Madison

Introduction

With the NPOESS Preparatory Project (NPP) successfully launched on October 28, 2011 , the Cross-track Infrared Sounder (CrIS) data became operational on April 2, 2012. CrIS data is being provided operationally to NCEP in BUFR format and in near real time via the NPOESS Data Exploitation (NDE) project since then. Before NPP launched, CrIS proxy buffer data, generated by NESDIS/STAR, was used in the NCEP global data assimilation system to ensure the system worked properly for CrIS data and was stable to run the long term cycling. This was a necessary step to ensure the assimilation of real CrIS data will work properly in this system once the data become operational.

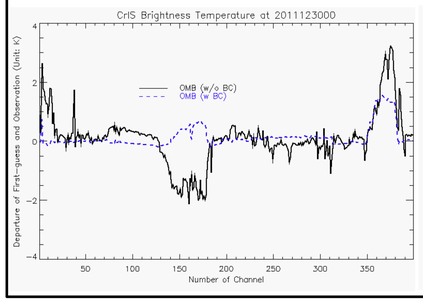
The NCEP next generation global data assimilation system, the GSI Hybrid EnKF-3DVAR, is based on the current global operational data assimilation system GSI and is combined with the ENKF features. The improvement in performance of the new GSI hybrid ENKF-3DVAR is encouraging when compared with current operational system (Derber, 2012)

Assimilation of CrIS proxy data

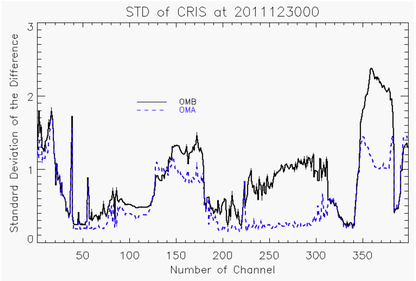
CrIS proxy data is simulated from the global model forecast by Community Radiance Transfer Model (CRTM) at NESDIS/STAR. 1-month CrIS proxy data assimilation experiment was performed with the GSI Hybrid EnKF-3DVAR system. 399 CrIS channels were selected for NWP data assimilation by Gambacorta and Barnet (2011) from the CrIS real-time proxy buffer data. We are only assimilating FOV5 initially in the GSI Hybrid system. All satellite data are thinned to 145km in the global data assimilation system. The bias correction, quality control and the observation error were examined in this experiment. The preliminary results show the system correctly converged with the CrIS proxy data assimilation. The angle dependent bias correction is also working properly for the selected channels. For comparison, the control run (CNTRL) ,assimilating all NCEP operational observations without CrIS data, has been performed by Kevin Garrett.

EnKF	80 cycled members, EnKF update, GSI for observation operators , T254L64 version of the GFS
Model	GFS T574L64
Observation	All operationally available observations (including radiances) plus CrIS proxy data
Test Period	15 December 2011– 15 January 2012 (CrIS proxy data)

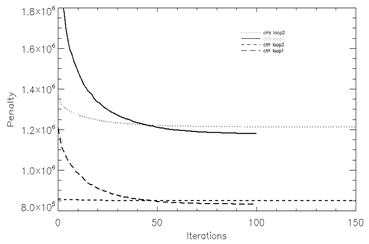
Bias Correction for 399 Channels



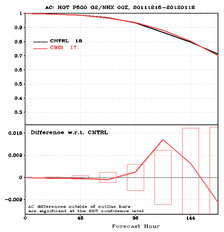
Std Dev Comparison between (O-B) and (O-A)



Cost Function w & w/o CrIS



Anomaly Correlation for days 0-7



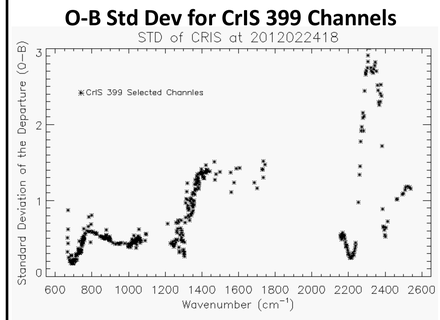
Assimilation of 'Golden Day' real CrIS data

Test Period: 00Z -18Z April 24, 2012 (NESDIS/STAR 'Golden Day' real CrIS data)

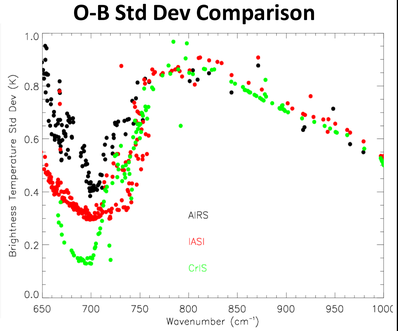
Observations: All operationally available observations plus the "Golden Day" (February 24, 2012) real CrIS data in BUFR format.

Based on the successful one month experiment with the proxy data, the 'Golden Day' real CrIS data was tested with the same experiment design as the proxy data. Similarly, all 399 channels were selected to assimilate in GSI Hybrid system. The experiment showed that most of channels in the real data have larger departures than proxy data, except for the long wave temperature channels.

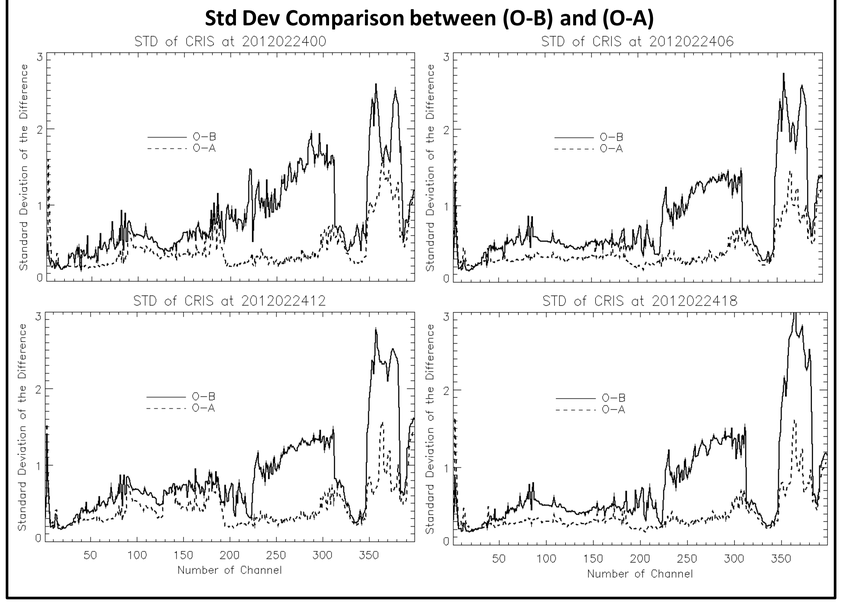
O-B Std Dev for CrIS 399 Channels



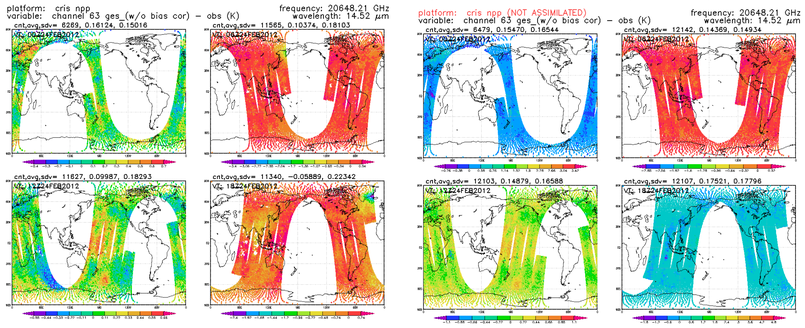
O-B Std Dev Comparison



Std Dev Comparison between (O-B) and (O-A)



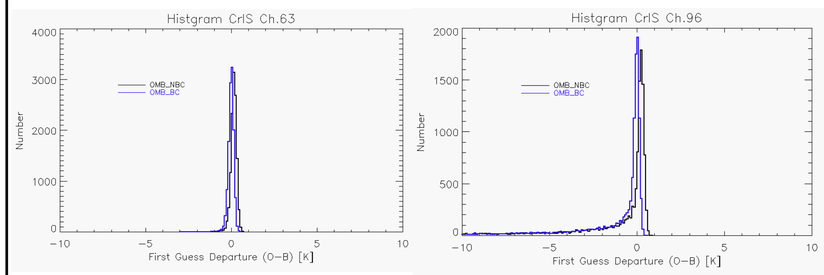
'Golden Day' NPP CrIS brightness temperature difference (OBS-BK)



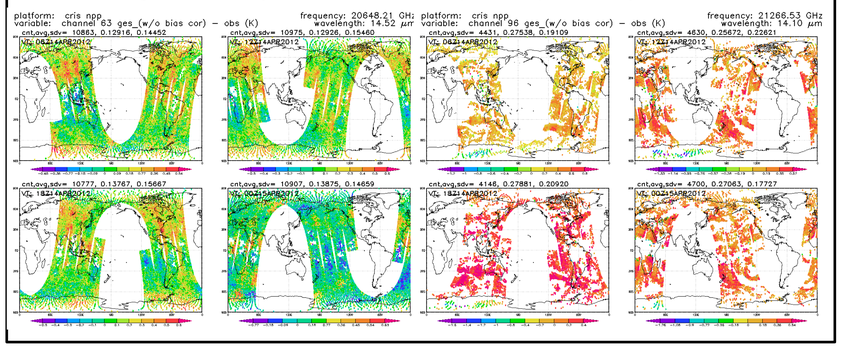
Ongoing .....Operational real CrIS data

Based on the study of the 'Golden Day' data and the CrIS proxy data, a new channel selection was made for the operational real CrIS data assimilation. We will be avoiding the short wave channels and the various trace gas channels (H_2O, CO_2, O_3, CH_4, etc.) during the bias correction spin-up.

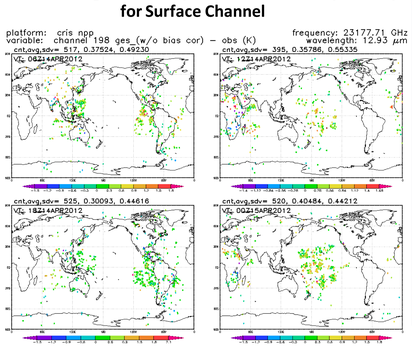
Histogram CrIS Ch.63 &96



NPP CrIS brightness temperature difference (OBS-BK) for Temperature Channels



NPP CrIS brightness temperature difference (OBS-BK) for Surface Channel



Conclusions:

✓GSI Hybrid system correctly converged with both CrIS proxy & real data assimilation;

✓The angle dependent bias correction and cloud detection procedure works correctly for CrIS

✓There is a very low noise for CrIS around 14.5 microns, high bias for five long wave channels around 15 microns and the most short wave channels; new channel selection was made to solve these issues.

Next .....

❖All the preparation work is done for the CrIS data denial experiments. The impact study with and without CrIS data will be performed after the bias correction spin-up experiment done.

Acknowledgments: Walter Wolf group for the proxy data , Chris Barnet team for the channel selection , and the CrIS SDR team for the golden day data.