The impact of satellite-derived temperature profiles on simulating and understanding tropical cyclone genesis

Zhaoxia Pu and Hailing Zhang, *Department of Atmospheric Sciences, University of Utah*
Sid Boukabara, *Joint Center for Satellite Data Assimilation*
(Contact: Zhaoxia.Pu@utah.edu)

Background

- Forecasting tropical cyclone (TC) genesis is a challenging problem in numerical weather prediction, partly because mechanisms that control the TC genesis is not well understood.

Objective

- Examining the impact of satellite-derived temperature profiles (e.g., these from AIRS) on the prediction of tropical cyclone genesis.
- Understanding the role of upper atmospheric warming in TC genesis.

Data, model and data assimilation system

- AIRS derived atmospheric temperature profiles.
- Weather Research and Forecasting (WRF) model; 36/12km horizontal resolution.
- The Gridpoint Statistical Interpolation (GSI) data assimilation system.

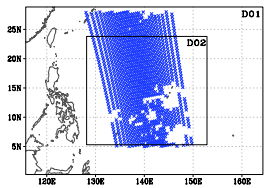
Case

- Typhoon Nuri (2008) over western Pacific Ocean.
- Observed cyclone genesis time: 18 UTC 16 Aug 2008
- Simulation period: 0000 UTC 16 – 0000 UTC 18 Aug 2008
- AIRS data assimilation: 0400 UTC 16 Aug 2008.

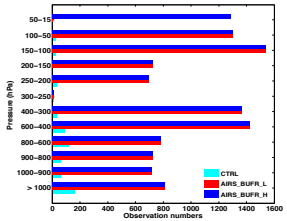
Experimental Configurations

EXP	Model top	Data Assimilated
NODA	50hPa	None (cold start from NCEP FNL)
CTRL	50hPa	NCEP BUFR
AIRS_BUFR_L	50hPa	AIRS temperature profiles NCEP BUFR
AIRS_BUFR_H	15hPa	AIRS temperature profiles NCEP BUFR

Model domain and data coverage

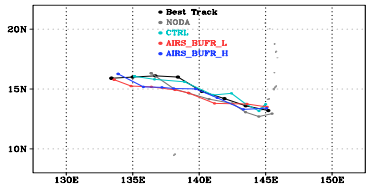


Number of observations in data assimilation experiments

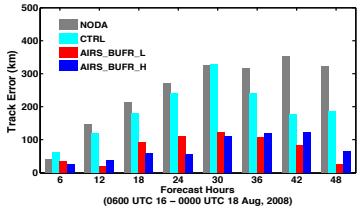


Results: Positive data impact on TC genesis prediction and the role of upper level warming

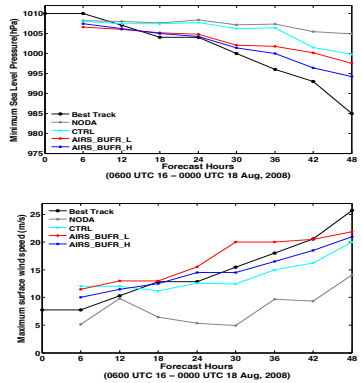
Track



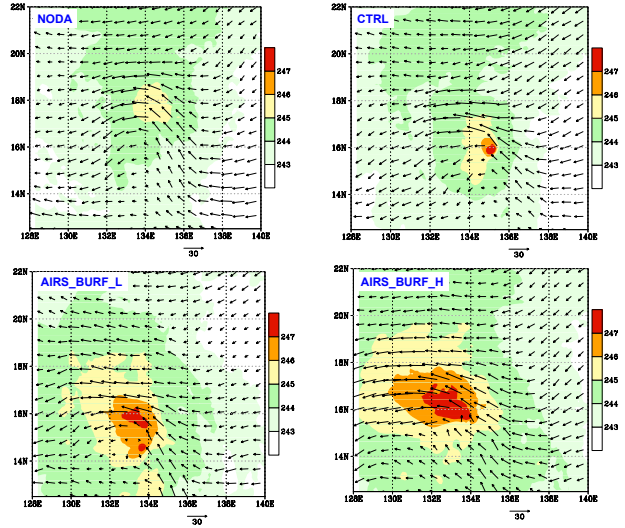
Track error



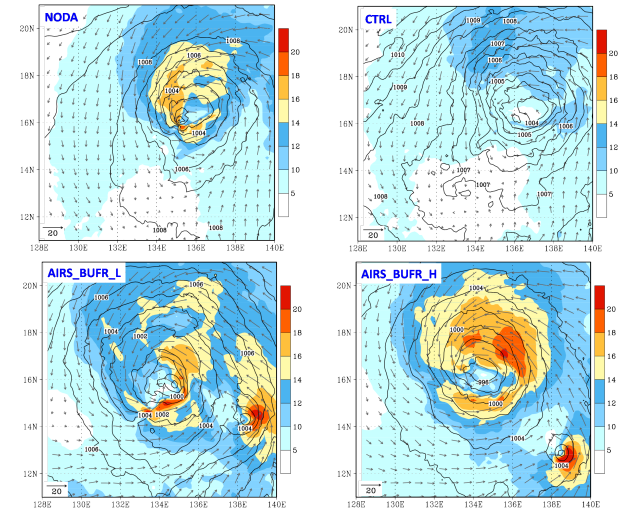
Intensity (SLP_{min} and V_{max})



Temperature (shaded) and wind vectors at 300 hPa at 00 UTC 18 Aug 2008 (48 h forecast)



SLP(contours) and surface wind speed at 00 UTC 18 Aug 2008 (48 h forecast)



Major findings

- Assimilation of AIRS derived temperature profiles results in more accurate prediction of Nuri's genesis. Without the AIRS data assimilation, the model fails predicting Nuri's genesis.
- Results imply that the upper level warming contributes to Nuri's genesis. Assimilation of AIRS data enhances the representation of upper level warming in the WRF model.
- Increasing altitude of the model top allows more data to be assimilated into the model, thus resulting in positive impacts on the simulation.

Future work

- Examining the impact of new NPP satellite temperature and moisture profiles with more cases.