Uses of Satellite Data for Improving Forecasts of Hurricane and Coastal Precipitation

Fuzhong Weng

NOAA/NESDIS/Center for Satellite Applications and Research

In Collaborations with (*Xiaolei Zou*, *Vijay Tallapragada and Andrew Collard*, *Banglin Zhang*, *Lin Lin*, *Zhengkun Qin*, *In-Hyuk Kwon and Haixia Liu*)

This project is jointly funded by GOES-Risk Reduction Program and JPSS Proving Ground Program

Satellite Data Critical for Improving Hurricane and Coastal Precipitation Forecasts

- Satellite microwave sounding data – provide hurricane thermal/moisture structure for improving intensity forecast (**SSMIS**/AMSU-A/MHS/**ATMS)**

- Satellite infrared sounding data – provide environmental thermal and moisture structure for track and precipitation forecast (HIRS/**CrIS**/AIRS/IASI)

- Ocean surface wind and temperature from satellite scatterometer and passive microwave imager – provide surface energy flux and surface vortex (ASCAT/**AMSR2)**

- GPSRO refractivity and bending angle – provide tropical cyclonegenesis information (COSMIC/GRAS)

- Geostationary sounder and imager – provide real-time monitoring and tracking of all severe weather events with a high temporal and spatial resolutions (e.g. GOES etc).

Suomi NPP TDR/SDR Algorithm Schedule

Sensor	Beta	Provisional	Validated (planned)
CrIS	May 7, 2012	January 31, 2013	2013
ATMS	February 22, 2012	January 31 2013	2013
OMPS-EV	March 12, 2012	April, 2013	2013
VIIRS	May 2, 2012	March, 2013	2013

NPP SDR Product Maturity Levels

1. **Beta**
   - Early release product.
   - Initial calibration applied.
   - Minimally validated and may still contain significant errors (rapid changes can be expected. Version changes will not be identified as errors are corrected as on-orbit baseline is not established)
   - Available to allow users to gain familiarity with data formats and parameters
   - Product is not appropriate as the basis for quantitative scientific publications studies and applications

2. **Provisional**
   - Product quality may not be optimal
   - Incremental product improvements are still occurring as calibration parameters are adjusted with sensor on-orbit characterization (versions will be tracked)
   - General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
   - Users are urged to contact NPOESS NPP Cal/Val Team representatives prior to use of the data in publications

3. **Validated/ Calibrated**
   - On-orbit sensor performance characterized and calibration parameters adjusted accordingly
   - Ready for use by the Centrals and in scientific publications
   - There may be later improved versions
   - There will be strong versioning with documentation

HWRF Model and Data Assimilation System

HWRF Model:

- 2012 NCEP-Trunk version 934
- Three telescoping domains:

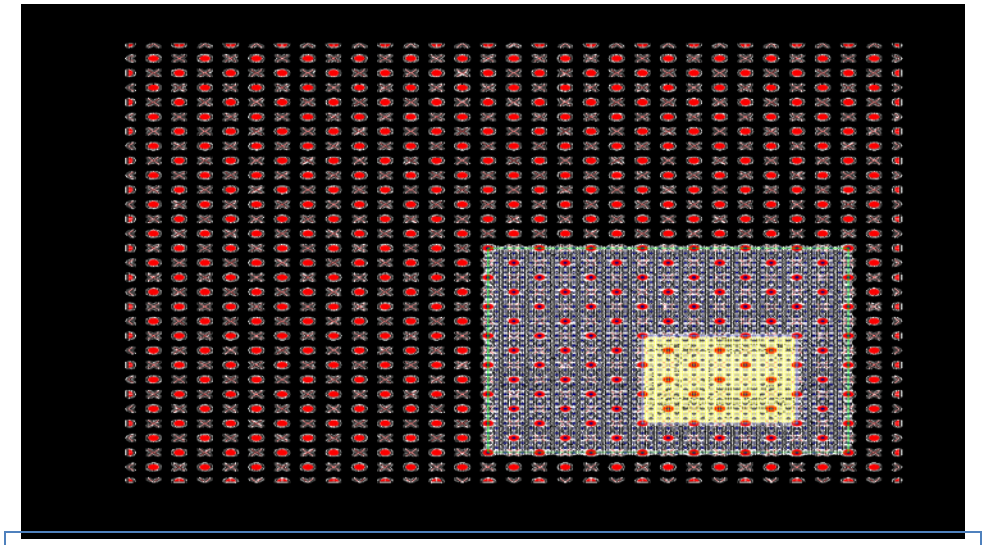
Outer domain: 27km: 75x75^o;
Inner domain: 9km ~11x10^o
Inner-most domain: 3km inner-most nest ~6x6^o

Revised Model Level and Top:

- Vertical levels: 61
- Model top: 0.5 hPa

Data Assimilation System:

- HWRF 6 hour forecasts
- GSI (3DVAR)



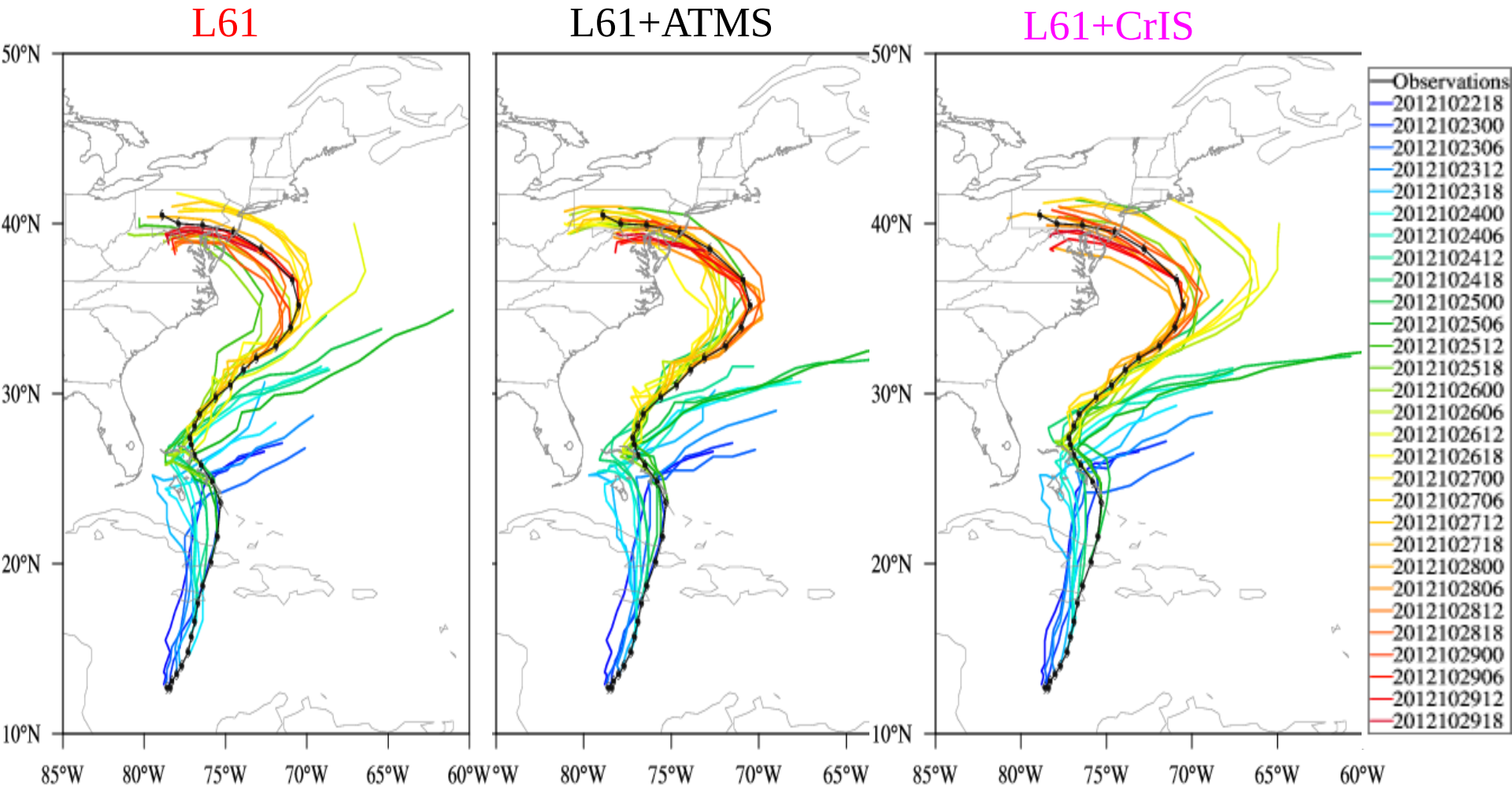
Control Run(L61):

- Conventional Data- Radiosondes, aircraft reports (AIREP/PIREP, RECCO, MDCRS-ACARS, TAMDAR, AMDAR), Surface ship and buoy observations , Surface observations over land, Pibal winds,Wind profilers, VAD wind, Dropsondes
- Satellite Instrument Data - AMSU-A (channel 5-14) , HIRS, AIRS , ASCAT, GPSRO

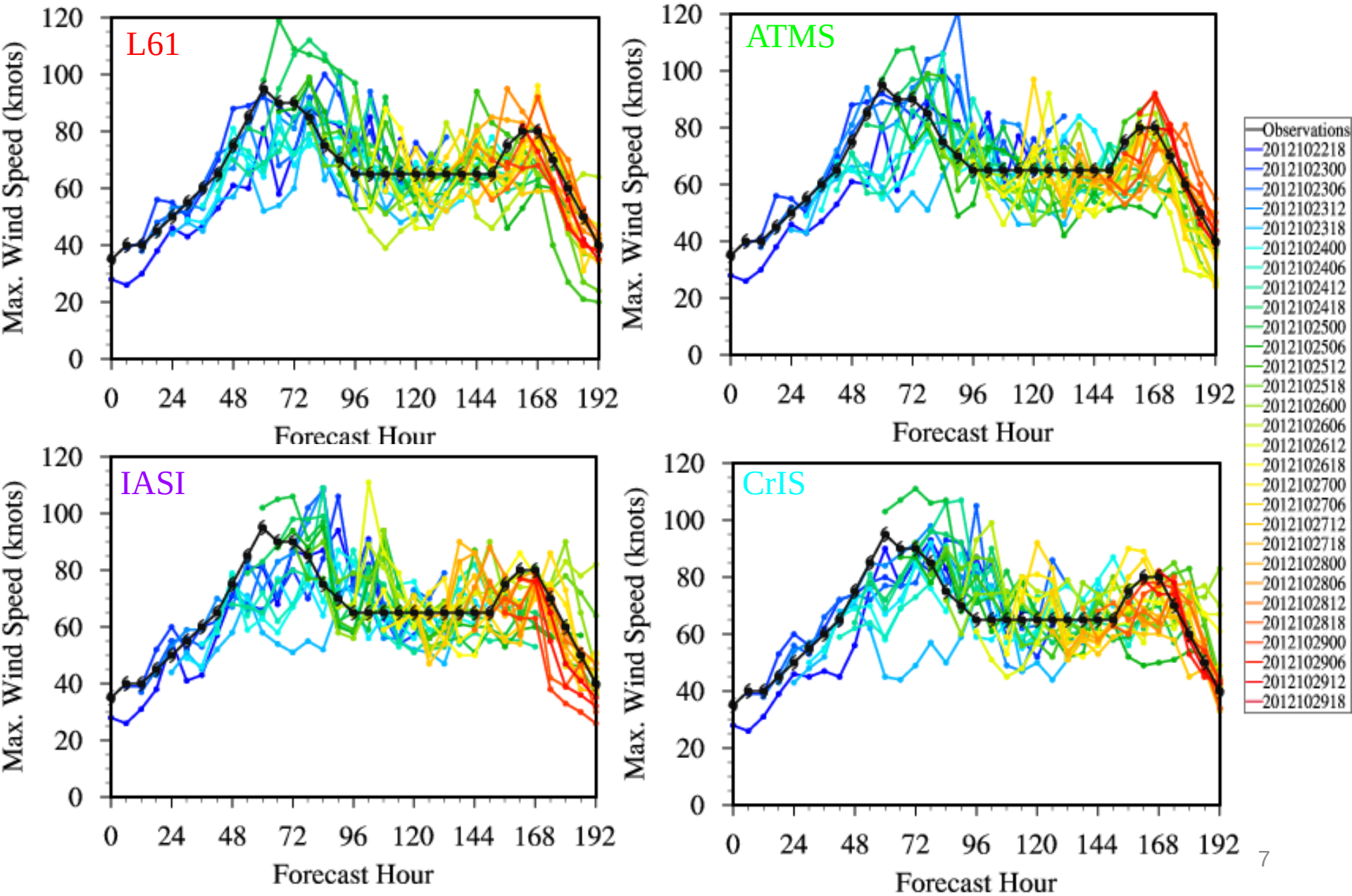
Sensitivity Runs:

- L61 + ATMS
- L61 + CRIS
- L61 + IASI

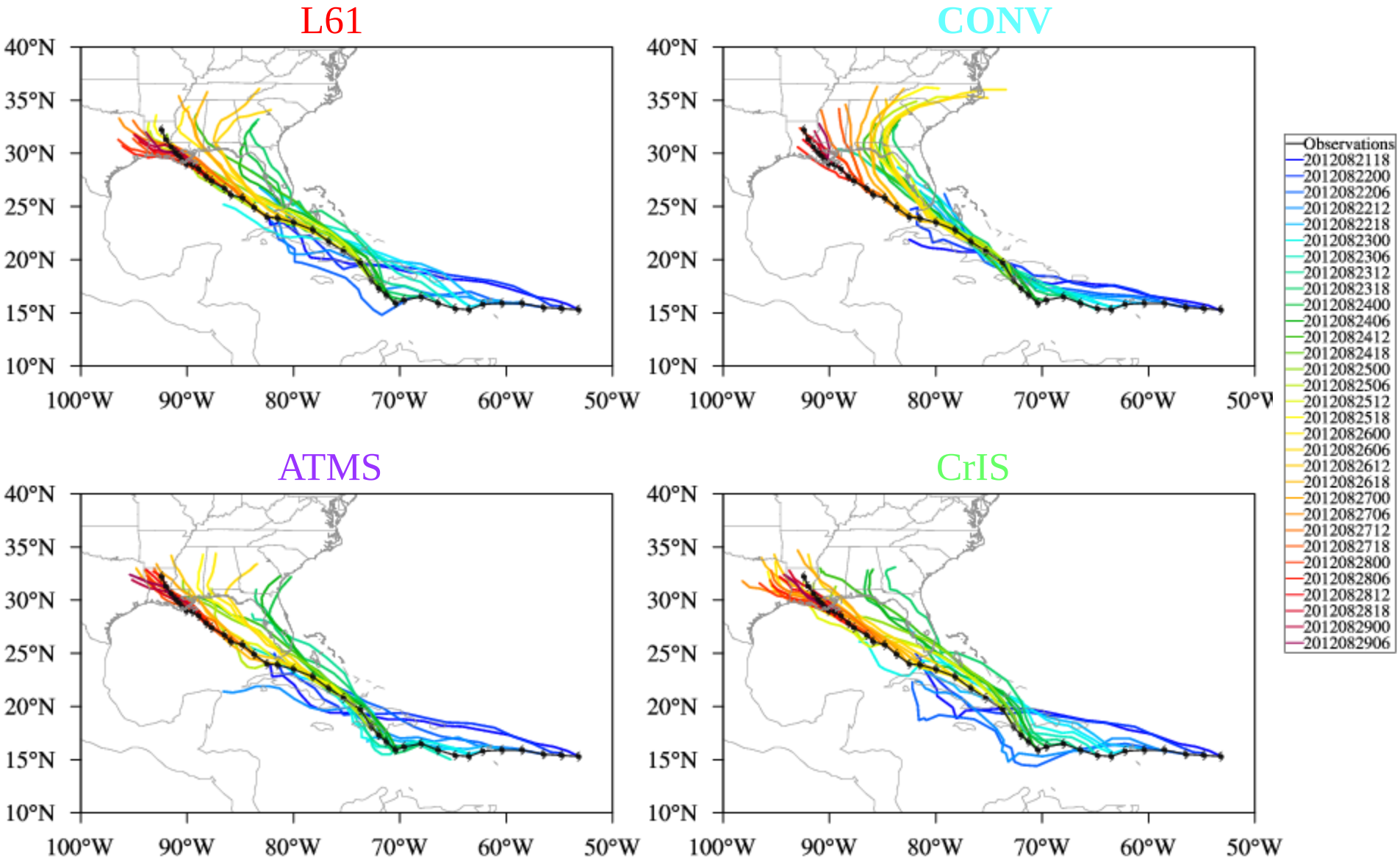
Impacts of Suomi NPP ATMS and CRIS on Hurricane Sandy's Track



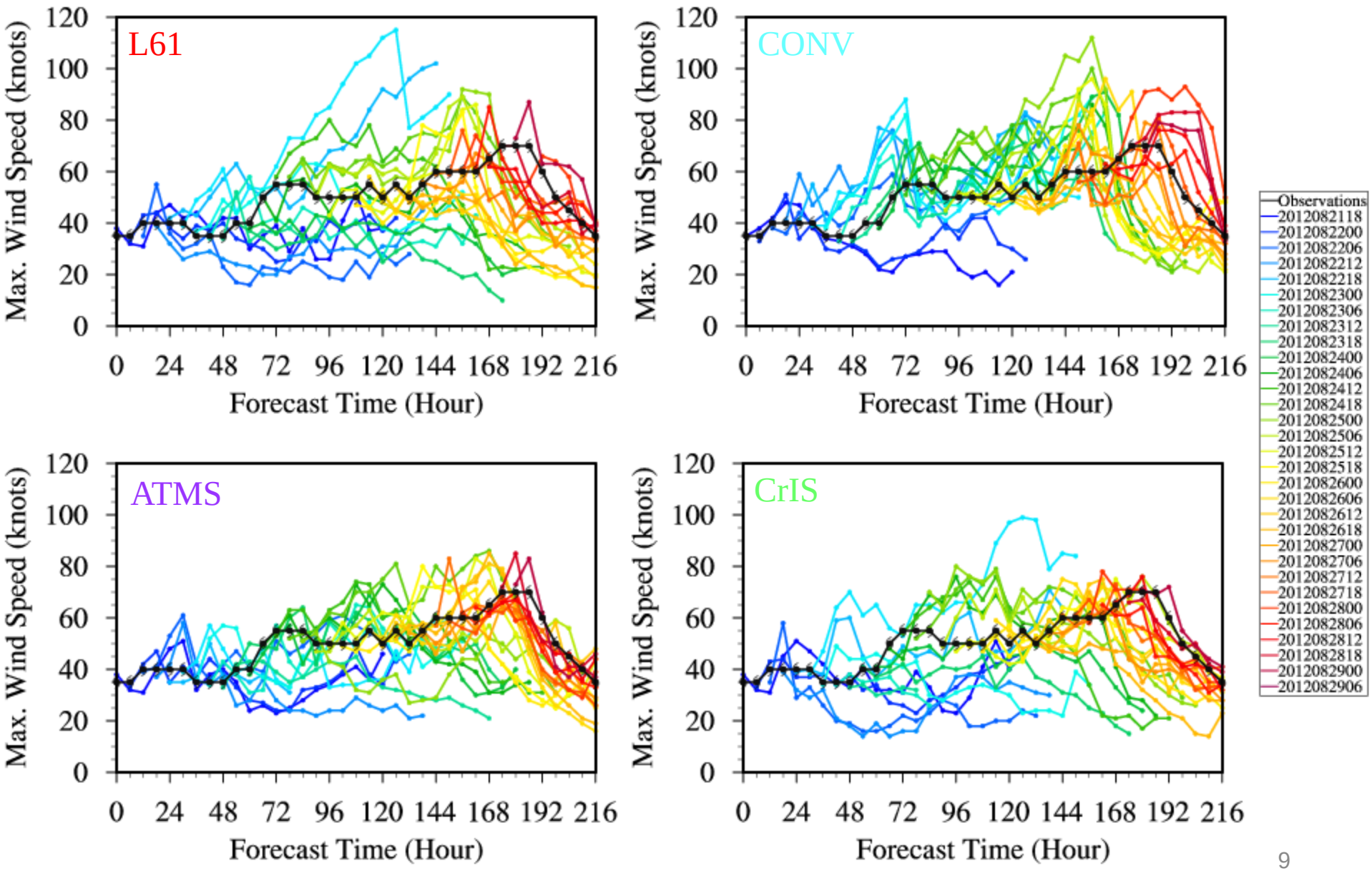
Multiple Forecasts of Max. Wind Speed (Sandy)



Impacts of Suomi NPP ATMS and CrIS on Hurricane Isaac's Track



Multiple Forecasts of Max. Wind Speed (Isaac)



Summary and Conclusions

- NOAA and METOP polar satellites provide critical information on atmospheric vertical temperature structure for hurricane monitoring and forecasts
- Suomi NPP ATMS is very unique for resolving hurricane warm core features through spatial oversampling and additional channel
- METOP unique instruments provide more information for NWP and other environmental applications
- 2012 HWRF/GSI is re-configured with more vertical layers and higher model top for direct radiance assimilation.
- Control and sensitivity experiments show NPP ATMS/CRIS improves some Sandy's track/intensity forecasts