Application of Joint Polar Satellite System (JPSS) Imagers and Sounders to Tropical Cyclone Track and Intensity Forecasting

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Project Goals

- ATMS/CrIS and VIIRS will provide valuable new data for tropical cyclone analysis and forecasting
- Project includes 3 applications
  - Improved center finding
  - Wind Structure Estimation
  - Application of ATMS/CrIS temperature moisture soundings to intensity forecasting

Center Finding

- Center location is starting point for operational hurricane forecasts
- Combine VIIRS "snapshots" with geostationary data
- ATMS/CrIS retrievals provide warm core
  - Hydrostatic integration gives pressure field
- Combine all available data in automatic image processing algorithm to estimate low-level circulation center
- NPP data collection under way

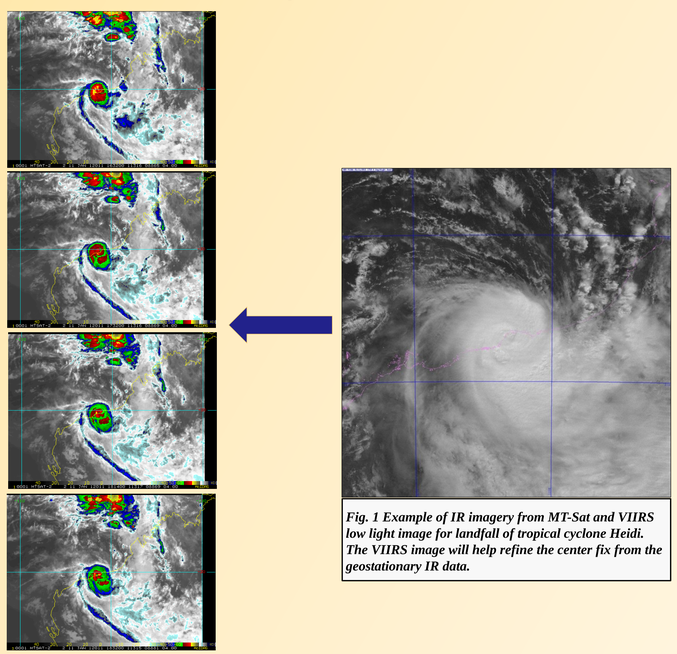

Fig. 1 Example of IR imagery from MT-Sat and VIIRS low light image for landfall of tropical cyclone Heidi. The VIIRS image will help refine the center fix from the geostationary IR data.

Wind Structure Estimation

- Adapt operational AMSU algorithms to ATMS/CrIS
- Estimate max wind, radii of 34, 50, 64 kt winds

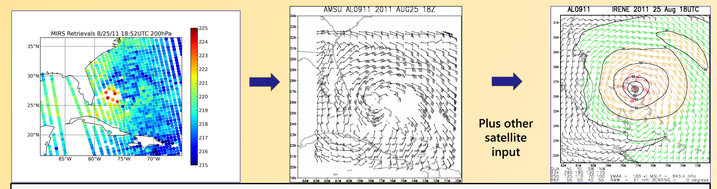

Fig. 2 Schematic representation of how microwave temperature retrievals (left) can be used with the hydrostatic and nonlinear balance equations to estimate winds (middle) which can be combined with other satellite data to give a wind analysis (left).

Intensity Forecasting

- Statistical-Dynamical intensity models most accurate in past few years (LGEM in Fig. 3)
  - LGEM requires T, q soundings in storm environment
  - Used for CAPE (with entrainment) and maximum potential intensity (MPI) estimation
- Replace GFS model soundings with ATMS/CrIS at t=0
- Test impact on Logistic Growth Equation Model (LGEM)

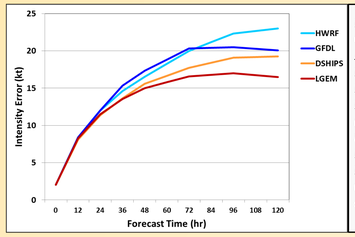

Fig. 3 Operational Atlantic Hurricane Intensity Model Errors (2007-2011). Statistical Dynamical LGEM was the most accurate.

Preliminary Tests

- Use MIRS AMSU retrievals
- Hurricane Irene (2011) cases with NOAA G-IV Jet soundings for ground truth (Fig. 4)
- Compare CAPE and MPI from NOAA Jet and MIRS (Fig. 5 and 6)
- Preliminary results encouraging but bias corrections needed in low level temperature fields for CAPE calculation
- Coordination with MIRS developers to improve retrievals

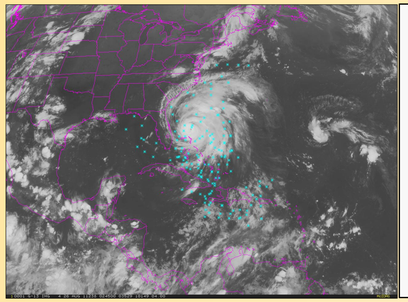

Fig. 4 Location of NOAA Jet Soundings with MIRS retrievals for the 8 flights into Irene. Dates and times of each flight are shown in Table 1 (below).

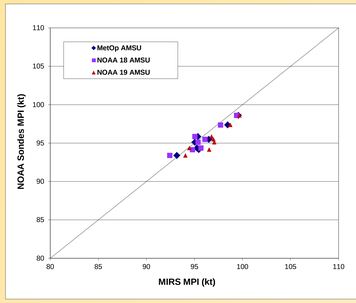

Fig. 5 Scatter plot of maximum potential intensity estimated from MIRS and NOAA Jet Soundings.

Table 1. Dates and times of Jet Soundings.

Mission	Date
M1	Aug 22 1830z – Aug 23 1100z
M2	Aug 23 1830z – Aug 24 0100z
M3	Aug 24 0630z – Aug 24 1400z
M4	Aug 24 1800z – Aug 25 0130z
M5	Aug 25 0600z – Aug 25 1300z
M6	Aug 25 1800z – Aug 26 0130z
M7	Aug 26 0600z – Aug 26 1300z
M8	Aug 26 1800z – Aug 27 0100z

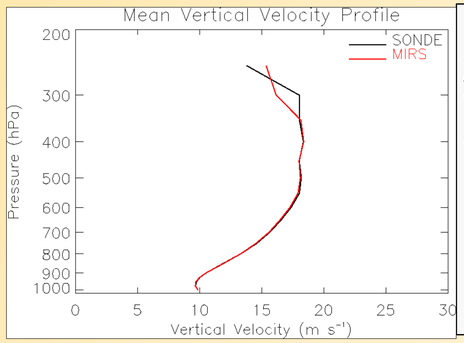

Fig. 6 Vertical velocity profiles from MIIRS and NOAA Jet Soundings.

User Feedback and Future Plans

- Begin ATMS/CrIS collection during 2012 hurricane season
- Obtain 2012 VIIRS TC cases with aircraft ground truth
- Develop center fixing algorithm with NPP sample
- Test LGEM model with MIRS input
- Demonstrate capabilities at NHC in the Satellite Proving Ground