The JPL Tropical Cyclone Information System –

a tool for hurricane research, and model evaluation: The 11-year global database and the GRIP/HS3 interactive portals

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Motivation

In spite of recent improvements in hurricane track forecast accuracy, currently there are still many unanswered questions about the physical processes that determine hurricane genesis, and evolution.

Furthermore, a significant amount of work remains to be done in validating and improving hurricane models, developing satellite retrieval algorithms and validating the geophysical estimates from the remote-sensing observations.

None of this can be accomplished without a comprehensive set of multi-parameter observations.

To facilitate hurricane research, we developed the JPL Tropical Cyclone Information System (**TCIS**).

The JPL TCIS (http://tropicalcyclone.jpl.nasa.gov) has two main components:

i) an archival database of satellite observations (**TCIS-DA**);

ii) an interactive portal that can be run in a near-real-time mode (**TCIS-NRT**). It integrates global model forecast of geophysical variables with satellite and airborne observations from a variety of instruments and platforms.

Some outstanding questions

Why is the accuracy of hurricane intensity forecasts still lacking?

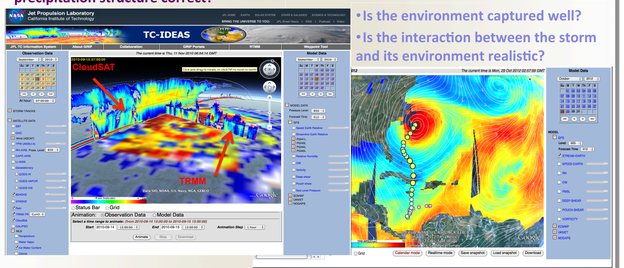
Do the models properly reflect the physical processes and their interactions?

Satellite observations (TCIS) can help through:

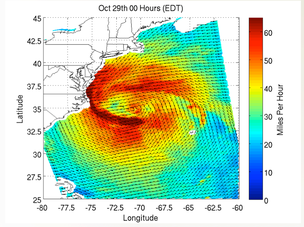
1. **Validation/improvement of hurricane models**
2. **Advanced data assimilation of satellite observations inside the hurricane core.**

Despite the significant amount of satellite observations today, they are still underutilized in hurricane research and operations, *due to complexity and volume.*

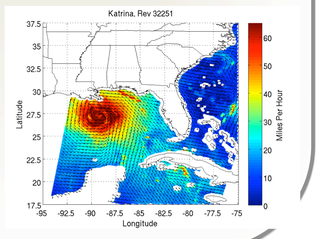
- **Is the representation of the precipitation structure correct?**
- **Is the environment captured well?**
- **Is the interaction between the storm and its environment realistic?**



- **Is the storm scale and asymmetry reflected properly?**



Hurricane Sandy
As seen by the
ISRO´s OSCAT



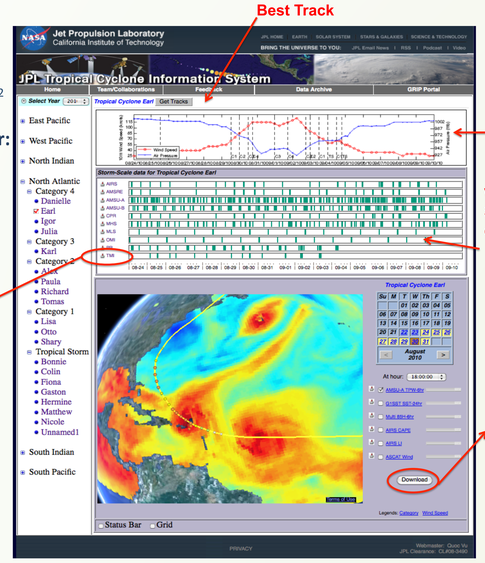
Hurricane Katrina
As seen by the
NASA´s QuikSCAT

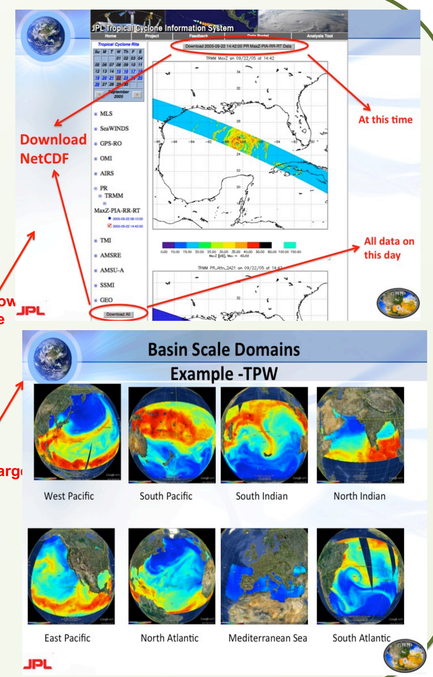
Tropical Cyclone Data Archive (TCIS-DA)

supported by NASA/HSRP-2008

- **Satellite depictions of hurricanes over the globe**
- **Multi-instrument observations pertaining to:**
  - **i) the storm structure;**
  - **ii) ii) the air-sea interactions;**
  - **iii) ii) the larger-scale environment**
- **11-year record (2000-2010)** First phase released 05/2012
- **Offers both digital data and imagery**
- **Unique source to develop robust statistics for:**
  - **hurricane research**
  - **algorithm development**

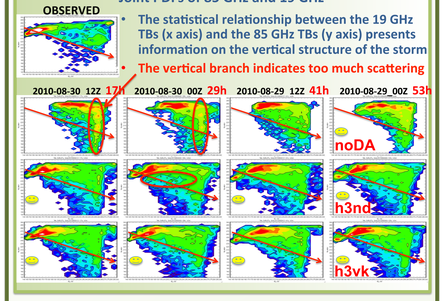
– A wide variety of data types
– Organized by year, basin, storm
  • no need to search!
– DATA and imagery
– Large-scale and storm scale
  • Large-scale (over the ocean basins; +2 days on either side)
    – SST
    – Scatterometer winds
    – TPW
    – Thermodynamic atmospheric structure from AIRS
  • Storm scale
    – Geostationary IR: GOES, MTSAT, FY2, Meteosat, MSG (HURSAT Version 5)
    – Multi-frequency brightness temperatures from TRMM-TMI, AMSR-E, SSMI, AMSU
    – full set of radar observations from TRMM-PR and CloudSAT
    – QuikSCAT surface winds
    – MLS, OMI





Research using (TCIS-DA)

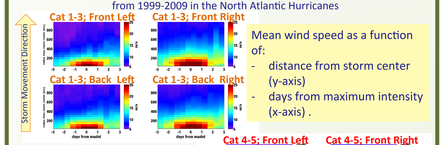
Model Evaluation - Statistical Comparison
Joint PDFs of 85 GHz and 19 GHz



- The statistical relationship between the 19 GHz TBs (x axis) and the 85 GHz TBs (y axis) presents information on the vertical structure of the storm
- The vertical branch indicates too much scattering

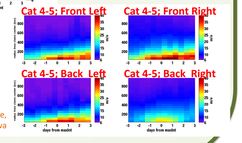
Storm Asymmetry – statistics from the observations

Azimuthal/Range Distributions of winds
from 1999-2009 in the North Atlantic Hurricanes



Mean wind speed as a function of:
- distance from storm center (y-axis)
- days from maximum intensity (x-axis) .

Cat 4 & 5 have wind fields that are less symmetric in both space and time.



A13L-357 E-poster: "Global Tropical Cyclone Winds from the QuikSCAT and OceanSAT-2 Scatterometers"
B. W. Stiles, R. Danielson, W. L. Poulsen, A. Fore, M. J. Brennan, T.-P. J. Shen, and S. Hristova-Veleva

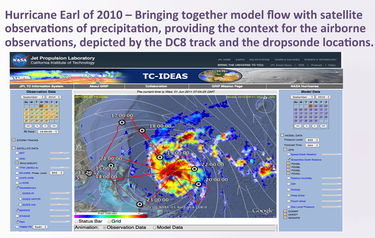
TCIS-Interactive Portals in NRT

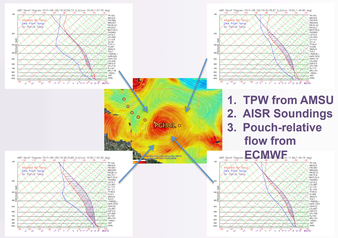
GRIP Portal – NRT in 2010, Atlantic – http://grip.jpl.nasa.gov

supported by NASA/HSRP-2008

- **Integrates model forecasts of geophysical variables with satellite and airborne observations from a variety of instruments and platforms**, providing good spatial and temporal context for the high-resolution, but limited in space and time, airborne observations.
- essential knowledge for the experiment design, flight planning, and a **very rich information source in the analysis stage of the experiment.**
- **Allows interrogation of a large number of atmospheric and ocean variables** to better understand the large-scale and storm-scale processes associated with hurricane genesis, track and intensity changes.

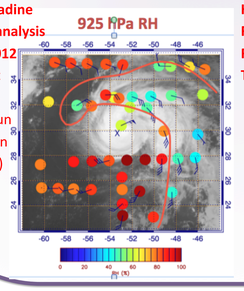
Hurricane Earl of 2010 – Bringing together model flow with satellite observations of precipitation, providing the context for the airborne observations, depicted by the DC8 track and the dropsonde locations.





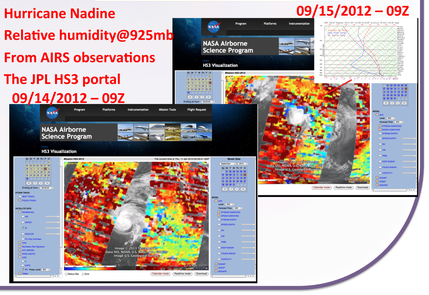
HS3 Portal – NRT in 2012, Atlantic - http://hs3.jpl.nasa.gov

Hurricane Nadine
Dropsonde analysis
09/14-15/2012
Presented at
the 67th IHC
by Scott Braun
Paul Newman
(NASA/GSFC)



Hurricane Nadine
Relative humidity@925mb
From AIRS observations
The JPL HS3 portal
09/14/2012 – 09Z

09/15/2012 – 09Z



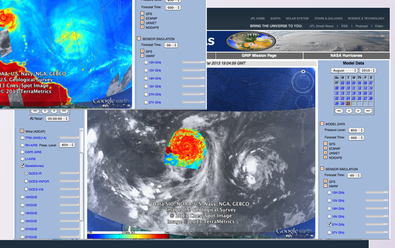
COMING UP - Fusion of Models and Observations

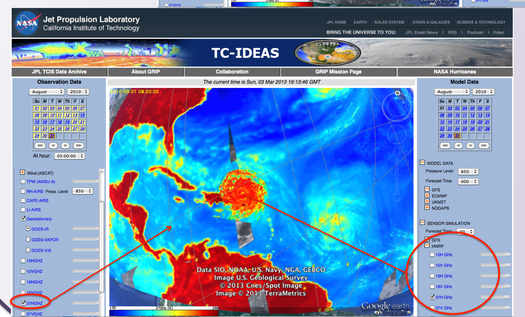
supported by NASA/ESTO/AIST-2011

- **Now:** Integrating hurricane model forecasts with satellite and airborne observations from a variety of instruments and platforms



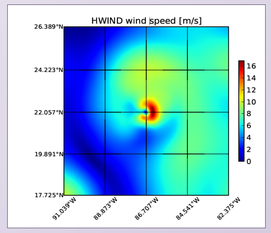
Observations
+
Synthetic Obs.

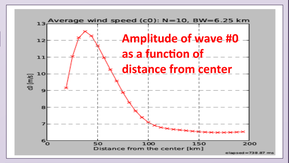


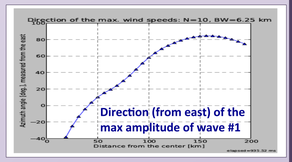


- **Next:** Analysis tools to allow interrogation of a large number of atmospheric and ocean variables
  - To evaluate and improve models
  - To better understand the large-scale and storm-scale processes and their interaction

Wave-number Analysis Tool







ARCHER (CIMSS and NRL) Automated Rotational Center Hurricane Eye Retrieval

