Observing System Simulation Experiments (OSSEs) for Tropical Cyclones

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1. Purposes of OSSEs

Observational network design

Assess impact of assimilating data from future platforms

- Future satellites or other platforms not yet built
- Different orbital configurations
- Design and configuration trade-offs of a given platform
- "Optimal mix" of different instruments
- Identify state variables, accuracy, and spatial/temporal/spectral density and resolution of data needed to significantly impact NWP
- Ask similar questions with new airborne, ground based, crowd sourced, or other sensors

Assess impact of assimilating data from existing platforms

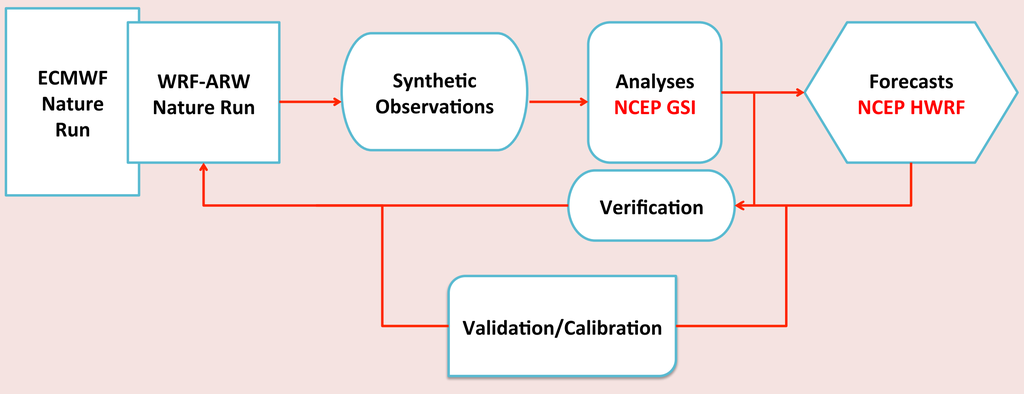
- Selective thinning and targeting of satellite radiances
- Aircraft flight tracks
- Optimization of characteristics of Doppler radars
- Optimal mix of existing observations

Other Applications

- **Developing and testing new data assimilation schemes**
- **Predictability and sensitivity studies in a controlled environment**
- **Assessing strengths and weaknesses of verification methods**
- **Extensions: Oceans; Chemistry; Climate; Coupled Systems**
- **New Ideas: Socio-Economic OSSEs**

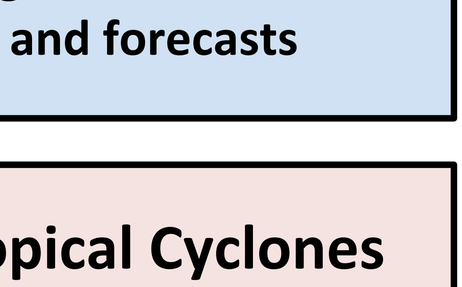
This poster: impact of assimilating future satellite data on tropical cyclone analyses and forecasts

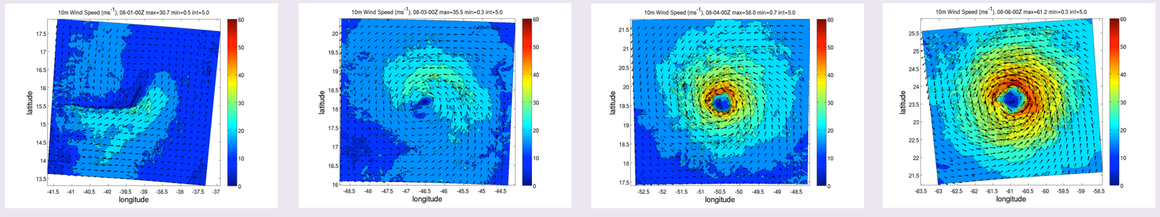
2. OSSE Framework for Tropical Cyclones



3. Hurricane Nature Run

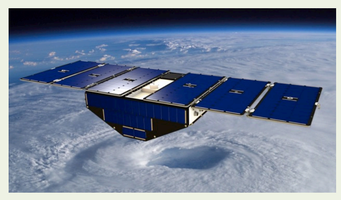
13-day WRF-ARW simulation, 27/9/3/1 km grids
Fields stored every 6 min
"Perfect" observations directly extract data from Nature Run at observation locations
"Realistic" observations use observation simulator to sample observations and prescribe errors





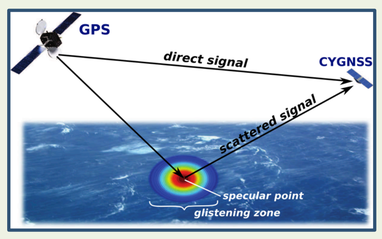
Nolan, D. S., R. Atlas, K. T. Bhatia, and L. R. Bucci (2013), Development and validation of a hurricane nature run using the joint OSSE nature run and the WRF model, *J. Adv. Model. Earth Syst.*, **5**, 382–405.

4. CYclone Global Navigation Satellite System (CYGNSS)

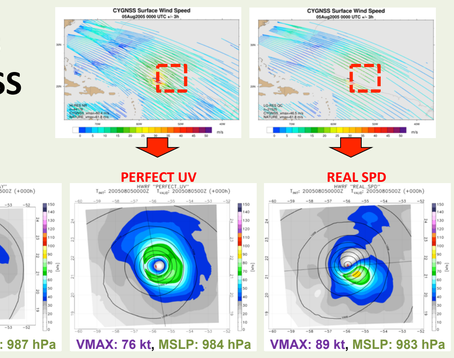


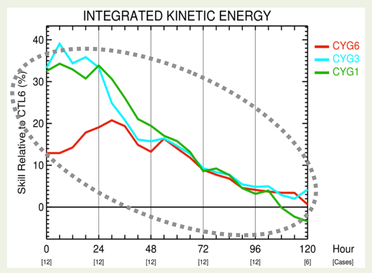
Capable of retrieving a large range of surface wind speed data in all precipitating conditions, with frequent revisit times

Receives GPS L-band signals at 19-cm wavelength
Low-Earth orbit covers 35S-35N. 25-km spatial resolution
Wind speed dynamic range 0-70 m/s
Median / mean revisit time is 2.8 h / 7.2 h

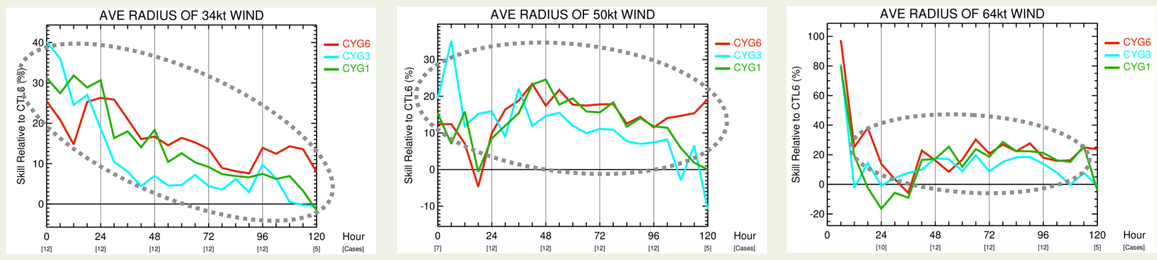


Improved TC analysis structure with CYGNSS



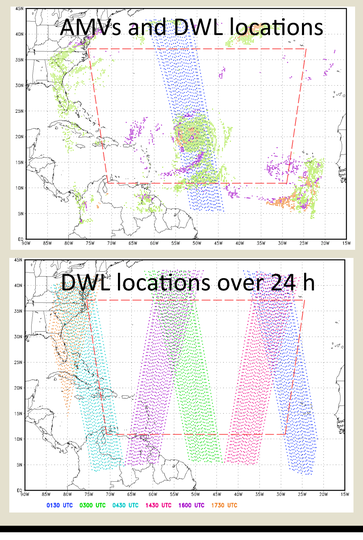


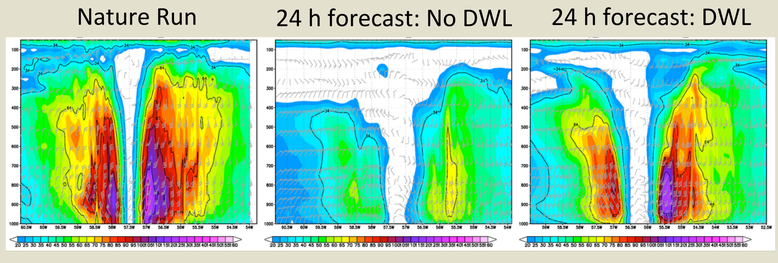
Analyses & forecasts of all critical radii improved with CYGNSS data at assimilation frequencies of 1 h, 3 h and 6 h.



Ruf, C. et al. (2016), New Ocean Winds Satellite Mission to Probe Hurricanes and Tropical Convection, *Bull. Amer. Meteor. Soc.*, **97**, 385-395.

5. Spaceborne Doppler Wind Lidar

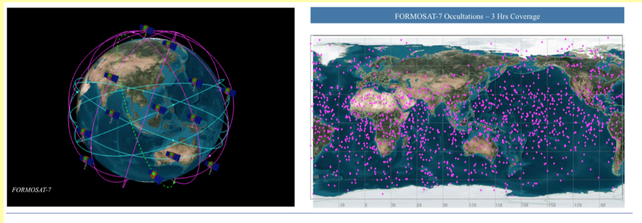


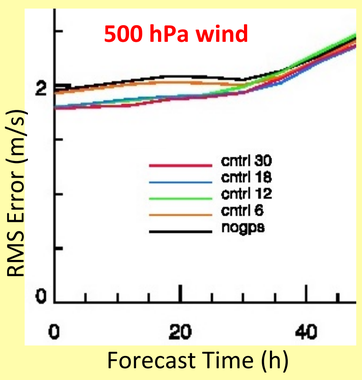


Preliminary results exhibit potential for "perfect" DWL data to improve forecasts

Extend to more realistic configurations with errors

6. GPS Radio Occultation (FORMOSAT-7 / COSMIC-2)





7. Future Work

Synergistic utilization of observations; Hyperspectral Sensors; Geostationary Microwave Sensors; New Nature Runs; New Assimilation & Forecast Models

Hoffman, R. N. and R. Atlas (2016), Future Observing System Simulation *Experiments, Bull. Amer. Meteor. Soc.*, In Press.