On the use of CYGNSS to observe convectively driven near-surface winds in tropical precipitation systems

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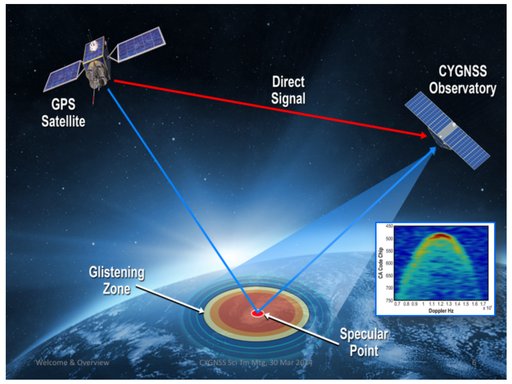
1. Introduction



What is CYGNSS?

The Cyclone Global Navigation Satellite System (CYGNSS) is a NASA Earth Venture Mission project aimed at improving near-surface wind observations within tropical cyclones.

It consists of 8 microsats launching October 2016, and will leverage GPS reflectometry to retrieve near-surface wind speeds.

Advantages over traditional scatterometers:
1. Little to no rain impacts
2. Rapid revisit time

That's great, but tropical cyclones only occur a small percentage of the time! What else can CYGNSS help with?

This study leverages the CYGNSS End-To-End Simulator (E2ES) to investigate how CYGNSS maps convectively driven winds in large tropical precipitation systems in the Indian Ocean.

The E2ES takes input from any gridded, geolocated, and temporally varying near-surface wind dataset and simulates what the CYGNSS constellation would observe.

Key Issues to Explore:
1. CYGNSS provides data in the form of individual "tracks" of specular points
2. Noise/uncertainty in retrieval increases as a function of wind speed

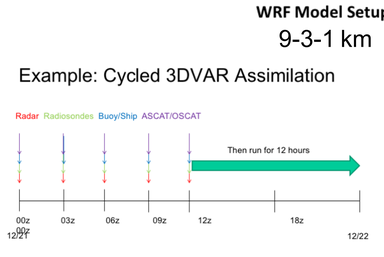
2. WRF Simulations from DYNAMO Campaign

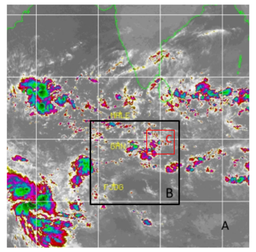
First, we examined how CYGNSS would observe convection associated with multiple MJO onsets during the DYNAMO field campaign. Assimilation of the DYNAMO observations into WRF was performed, and the E2ES was applied to the resultant wind fields.

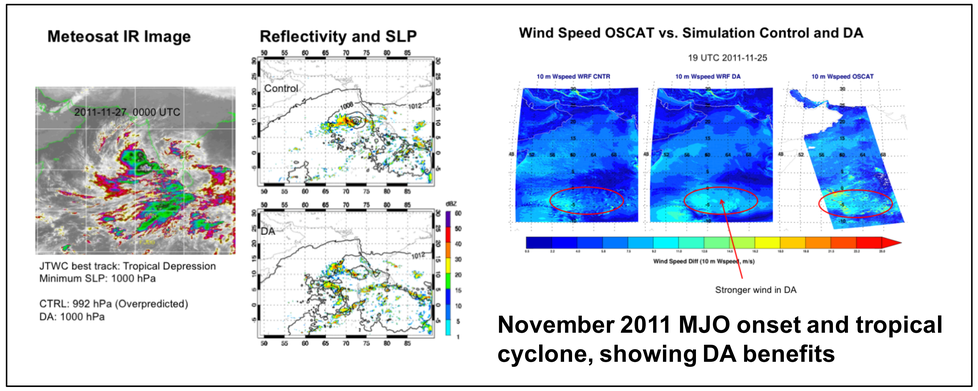
- Data assimilation was found to significantly improve forecasts relative to the control.
- Track-based view provides unique spatiotemporal "cross-sections" through gust fronts and other convectively driven wind features.
- Uncertainties in CYGNSS retrievals benefit from filtering.

WRF Model Setup
9-3-1 km

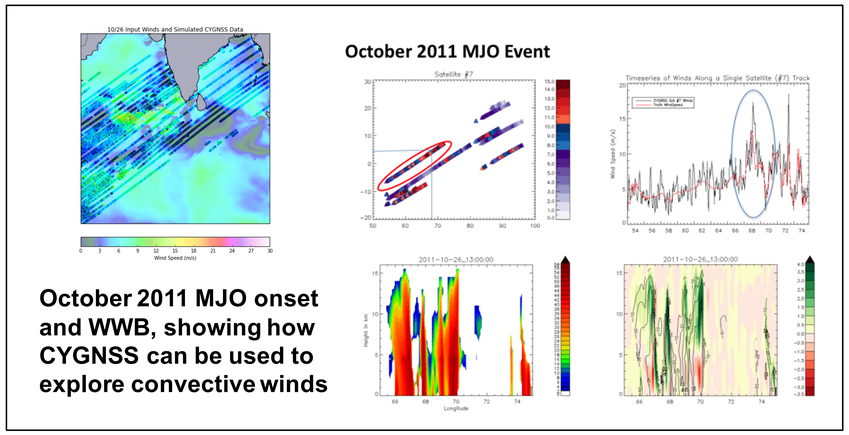
Example: Cycled 3DVAR Assimilation



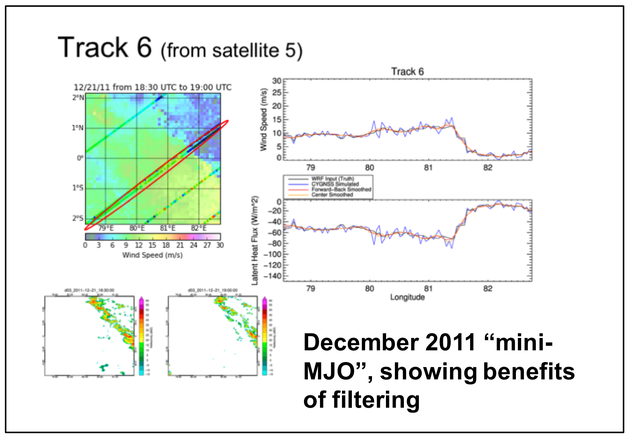




November 2011 MJO onset and tropical cyclone, showing DA benefits



October 2011 MJO onset and WWB, showing how CYGNSS can be used to explore convective winds

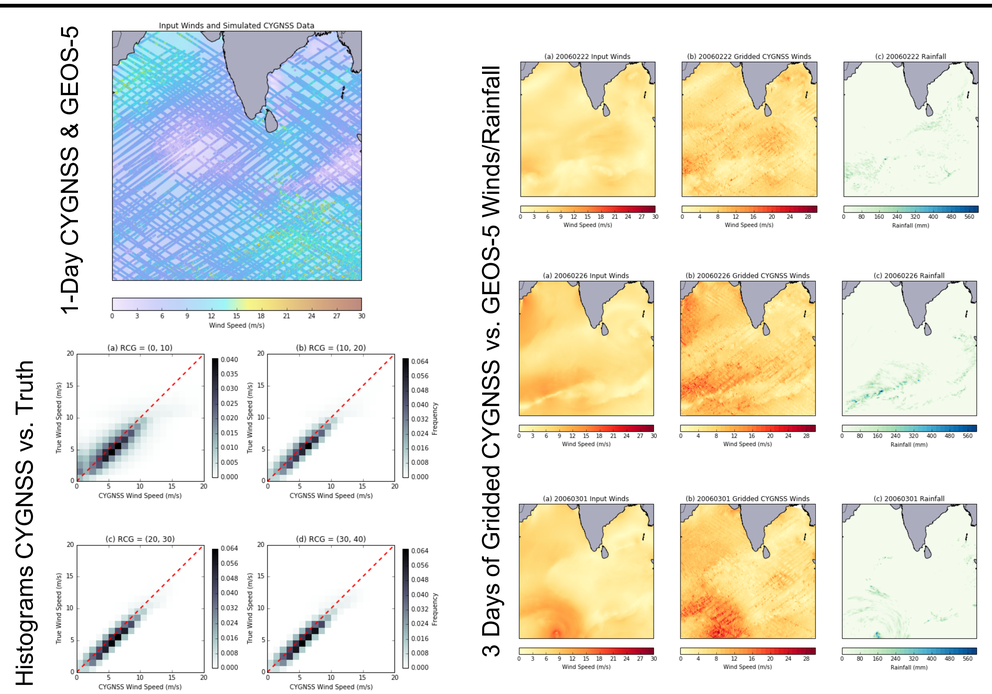


December 2011 "mini-MJO", showing benefits of filtering

3. GEOS-5 Nature Run

The GEOS-5 Nature Run provides approximately two years of global analyses at ~7-km and 30-min resolution.

- Python toolkit produces E2ES-ready output from any arbitrary time period and spatial domain.
- Gridded daily CYGNSS maps reproduce essential character of convective signal, but also demonstrate effects of noise and sampling.
- Filtering (including range-corrected gain) and smoothing suggested, but Level 3 gridded products show promise for convective studies



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