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**CYGNSS Mission Update** 

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For more information: http://cygnss-michigan.org



## **CYGNSS Objectives and Mission Design**

- CYGNSS Objectives
  - Measure ocean surface wind speed in all precipitating conditions, including those experienced in the tropical cyclone (TC) eyewall
  - Measure ocean surface wind speed in the TC inner core with sufficient frequency to resolve genesis and rapid intensification

#### CYGNSS Mission Design

 Eight satellites in low earth orbit at 35° inclination, each carrying a modified GPS receiver capable of bistatic scatterometer measurements of GPS signals reflected by the ocean surface









 Scattering cross-section image measured by UK-DMC-1 spaceborne mission with variable time lag correlator and variable frequency Doppler filter







# Spaceborne Empirical Demonstration of Ocean Wind Speed Retrievals by GNSS-R

GNSS-R instrument (early version of CYGNSS science payload) deployed on UK-DMC-1 mission, launch 2003







# **UK-DMC Wind Sensing Results**

- Using 22 measurements from the UK-DMC, the near surface wind speed was estimated with an uncertainty of 1.65 m/s RMS relative to NDBC ground truth winds
- Spaceborne measurements available only at low and medium wind speeds
- Higher wind speed matchups with dropsondes and SFMR (up to 65 m/s) available for airborne P-3 flights



*ref.* Clarizia *et al.* (2014), "Spaceborne GNSS-R Minimum Variance Wind Speed Estimator," IEEE Trans Geosci. Remote Sens., doi: 10.1109/TGRS.2014.2303831.





### **CYGNSS Spatial Sampling**









# **CYGNSS Temporal Sampling**

- Temporal sampling is not deterministic due to asynchronous CYGNSS and GPS orbits
- Model revisit time as a random variable with empirical probability density function derived from Monte Carlo simulations
- Revisit time PDF shown at right
- Median revisit time = 2.8 hr
- Mean revisit time = 5.9 hr





### Nature Run Life Cycle Track, Min. Pressure, Peak wind speed



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. Earth. Model. Syst.*, **5**, 1-24.





## **CYGNSS Sampling of Nature Run**







## True vs. Retrieved Winds for Storm Center Transects







#### CYGNSS Peak Hold Wind Retrieval for Full 13 Day Nature Run







#### **Project Schedule**

Date	Milestone
Dec 2012	Project start
Jun 2013	System Requirements Defined
Jan 2014	Overall System Design Completed
Jan 2015	Detailed Design Completed
Mar 2015 – Jun 2016	Build, Assemble & Test the Spacecraft
Jul-Aug 2016	Integrate Spacecraft and Launch Vehicle
Oct 2016	LAUNCH
Oct 2016 – Mar 2017	Spacecraft commissioning, Science payload and algorithm calibration and validation
Oct 2016 – Sep 2018	On-orbit Mission Lifetime
After Sep 2018	Extended mission





## **CYGNSS Posters & Datasets**

- IOVWST Meeting Posters
  - Wind Speed Retrieval Algorithm (Maria Paola Clarizia *et al.*)
  - Tropical Cyclones Cal/Val Simulations (Faozi Said *et al.*)
- Datasets
  - Level 1 Scattering Cross Section DDM
  - Level 2 Wind Speed
  - Level 2 Mean Square Slope
  - To be measured "24/7" throughout mission life (including low wind conditions and over land) and made available via PO.DAAC

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