First Look at NOAA CyGNSS winds in the Tropical Cyclone Environment

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Motivation

brief description of currently used GMF and ‘track-wise’ wind retrieval method

Wind retrieval performance for 2017/2018 hurricane seasons against
  – Hurricane Weather Research and Forecasting Model (HWRF)
  – Stepped Frequency Microwave Radiometer (SFMR)

A look at a few case studies

Summary and Observations
Motivation

1. Dependence on significant wave height first noticed with TDS data\(^1\)
2. Calibration issues

current NOAA Level 2 GMF using v2.1 from May 2017-July 15th 2018

\[ \sigma^o(u_{10}, H_s, \Theta_i) \]

\[ \sigma^o({u_{10}, H_s} | \Theta_i \sim 17.7^\circ) \]

\[ \sigma^o({u_{10}, H_s} | \Theta_i \sim 32.5^\circ) \]

\[ \sigma^o({u_{10}, H_s} | \Theta_i \sim 47.3^\circ) \]
Comparison with HWRF
All basins (2018)
All PRNs included
NOAA 2018

all FM | All blocks | Time period: Jul 1–Oct 31 2018 | NOAA L2 dataset
How about retrievals from block IIIF?
NOAA 2017 – BLOCK IIF excluded

all FMs | IIF excluded | Time period: Jul 1–Oct 31 2017 | NOAA L2 dataset
Comparison with SFMR
Hurricane Season Years 2017 and 2018
UMICH 2017
all FMs | All blocks | Time period: Jul 1–Oct 31 2017 | UMICH L2 dataset
Selected Tropical Cyclone case studies
IRMA CASE 1

NOAA

IRMA type: HU 2017/09/04–23:03:07 utc
MAX SFMR WIND: 121.5 knots @ 20170904–2328

UMICH

storm speed: ~22.2 km/hr

<15mn
15–45mn
>45mn

34kt wind radii
50kt wind radii
64kt wind radii

CVG (knots)

HWWF (knots)
IRMA CASE 2

IRMA type: HU 2017/09/06–22:51:50 UTC

NOAA

UMICH

CVG [knots]

CVG [knots]

15–45mn

>45mn

Storm speed: 25.6 km/h

MAX SFMR WIND: 149.4 knots @ 20170907–0003

<15mn

<15mn

15–45mn

15–45mn

>45mn

>45mn

34 kt wind radii

34 kt wind radii

64 kt wind radii

64 kt wind radii

CVG [knots]

CVG [knots]

H WRF [knots]

H WRF [knots]
Summary

- Trackwise w.r algorithm
  - implements a $\sigma^0$ bias removal on a track-by-track basis
  - makes use of a GMF dependent on incidence angle, wind speed and significant waveheight
- improves performance in Tropical Cyclone environment
- Storm structure is more apparent on a case by case basis
- Performance is similar regardless of GPS block type

Future work

- Refine GMF
- Improve the gridding algorithm
- Improve aspects of the track-wise bias removal
- Test it with upcoming CyGNSS v3.0 L1 data
- Compare with winds from other scatterometers/radiometer instruments
C'è una speranza, dopo tutto!
Additional slides
Bin averaged $\sigma_0$ vs incidence angle separated by antenna and observatory

ALL PRNs except block IIF—6≤u10≤6.5m/s—time period: May–Dec 2017

v2.0

v2.1 beta

sand035

sand036

v2.1

3D altitude dependent LUT for scattering area

NF correction to both NBRCS and LES

3D altitude+NF corr.

This might be the cause of the L2 performance degradation previously noted.
D/A conversion from Rx power cal. was removed