Preliminary inter-comparison of hurricane hunter and buoy wind observations under high wind conditions, using collocations with ASCAT

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1. C-band High and Extreme-force Speeds (CHEFS) project
2. ASCAT and buoy wind comparison
3. Hurricane hunter wind data analysis
4. ASCAT and Stepped Frequency Microwave Radiometer (SFMR) preliminary wind comparison
**VH GMF:** The understanding of the future C-band VH information contribution to high and extreme wind retrievals from C-band scatterometer missions;

**Spatial scaling** of extremes: The definition of spatial scaling issues and related consequences for product sample resolutions and validation approaches;

**Understanding** of extremes: To further understanding of satellite remote sensing of high and extreme wind conditions over the ocean

To consolidate an extreme wind reference
Data collection

- Period: **2007-2018**
- Moored buoy GTS U10N (NDBC, TAO/TRITON, PIRATA, RAMA, etc.)
- NOAA P-3 flight campaigns (summer & winter)
  - Stepped Frequency Microwave Radiometer (SFMR)
  - Dropsonde
- Best Track data
- ASCAT-A reprocessed U10N
- ERA5 & ECMWF OPS U10N
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12.5 km ASCAT QC-accepted wind speed versus buoy wind speed

ASCAT 12.5-km winds slightly low w.r.t. buoy winds above 15 m/s (regardless of anemometer height) – Similar results for 25 km ASCAT winds
ASCAT/Buoy comparison - different wind variability conditions

- **ASCAT 12.5-km winds slightly low w.r.t. buoy winds**
- **Standard deviation increases as the wind variability condition increases**
Outline

1. C-band High and Extreme-force Speeds (CHEFS) project
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Dropsonde WL150 Algorithm

- WL150 wind is a altitude weighted average of the lowest 150m wind measurements available between 10m and 350m

\[ u_{L150} = \frac{\sum_{i=1}^{n} u_i w_i}{h_n - h_1} \]

\[ v_{L150} = \frac{\sum_{i=1}^{n} v_i w_i}{h_n - h_1} \]

\[ WL150 = \sqrt{u_{L150}^2 + v_{L150}^2} \]

\[ u_{10} = 0.85u_{L150} + 0.89 \]

\[ v_{10} = 0.85v_{L150} + 0.89 \]

\[ U_{10-WL150} = \sqrt{u_{10}^2 + v_{10}^2} \]
• Increasing mean bias from 3.17 m/s (nominal altitudes) to 5.35 m/s (highest altitudes).
• Slightly increase of the standard deviation and scaling with height.
• The layer width has an impact on WL wind computation;

• The sonde WL wind/SFMR mean bias and RMSE decrease when using smaller layers;

• The 0.85 correction used to convert the sonde WL150 into U10 should be revised when having layer smaller than 150 m.
Sonde U10_WL150 w.r.t. SFMR averaging

Slightly decrease of the standard deviation
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Interpolation of Best track position to ASCAT pass time (BT points every 6h)

Is Best track accurate enough for ASCAT storm center estimation?
Storm-motion relative conversion: The BT vector around the time of the SFMR eye-wall observations (15% of maximum wind observations) is used.

Time difference ASCAT storm center / SFMR mean operational time: $\sim 1.30 \, \text{h}$

SFMR sees a stronger storm than ASCAT (?)
Test case: ERIKA 2015

Time difference ASCAT storm center / SFMR mean operational time: \(~45 \text{ min}\)
Test case: JULIO 2014

Time difference ASCAT storm center / SFMR mean operational time: \(\sim 15 \text{ min}\)

- **BT/ASCAT Center**
- **BT position at operational SFMR mean time**
- **SFMR position at the time of ASCAT storm center**

Image description:
- Time difference: ASCAT Center / Oper. SFMR mean time = 870 sec
ASCAT compared to closest SFMR for different $\Delta T$

ASCAT compared to 12.5km averaged SFMR for different $\Delta T$

Period: 2009-2016
Conclusions

- ASCAT wind products in good agreement with collocated buoy winds up to 25 m/s; slight underestimation of ASCAT w.r.t. buoy for winds above 15 m/s;

- Triple collocation analysis shows no significant degradation of buoy winds up to 25 m/s;

- SFMR & dropsonde comparisons at different spatial/temporal integrations show in general good agreement;

- Special attention is required at near eyewall collocations (most extreme winds & gradients);

- Dropsonde WL150 – the layer width and mean altitude do matter. The 0.85 correction factor (to estimate the 10m winds) applies for the lowest 150m layer; alternative correction factors are required for other layers.

- Significant best track position errors
  - Alternatives: use of SFMR data to estimate the storm track; this will only work though when coincident (in time) SFMR-ASCAT overpasses; more accurate estimation of storm center using ASCAT data.

- Substantial underestimation of ASCAT winds > 15 m/s w.r.t. SFMR;

- ASCAT & SFMR however very well correlate (0.93) for high winds;

- Discrepancy between buoy & SFMR high-wind scaling. Which one should we trust?
Two new positions issued at the Barcelona Expert Centre (ICM-CSIC):

- Remote sensing
- Data assimilation into regional NWP

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SFMR/ASCAT Comparison: Storm motion relative conversion

- Only **one best track vector** (*) is used for SFMR storm-relative conversion;

- The vector used is the one around the **time of the SFMR eye-wall observations** (15% of maximum wind observations – operational SFMR altitude).
SFMR/Sonde statistics: Rain Effects

- Slight overestimation of SFMR w.r.t. dropsonde at high wind speeds, when high rain rate events occur

- A new reprocessed SFMR dataset will be analyzed (Sapp et al., 2019)
Artifacts when using different BT vector
Using the dropsonde launch time:
Associating to the dropsonde surface winds the SFMR value at the dropsonde launch time

The dropsonde displacement is generally with the same radial distance with respect to the center.

We assume that the dropsonde and the SFMR at the launch time are observing the same wind.

[Uhlhorn et al., 2007 and Klotz et al., 2014]
SFMR/Sonde collocation method (2/2)

Using Sonde launch time saved in the raw data

Comparison between:
D20110825_232236_PQC.nc
D20110825_232236_RAW.nc

We did not use
D20110825_232236_PRAW.nc

Sonde data – PQC.nc file
Sonde Data – RAW file
(not PRAW)
WL25 w.r.t. WL150: new correction factor

- WL25 gets lower winds w.r.t. WL150
- WL25 might be more noisy than WL150 as it is derived by measurements closer to the surface
- New correction needs to be applied to estimate U10 from WL25
A correction has been defined and applied.