

GOODIE



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

Updates from the second year of activities

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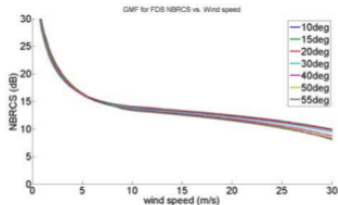
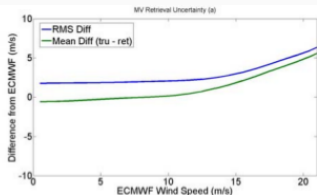
- Introduction
- Motivation
- Results
- Preliminary conclusions

Introduction

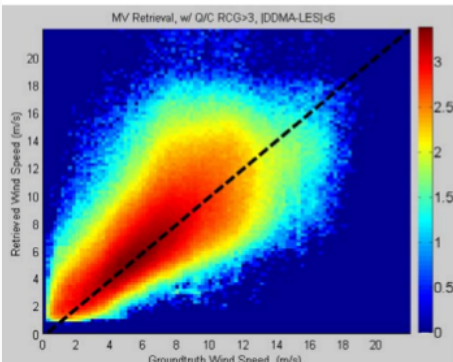
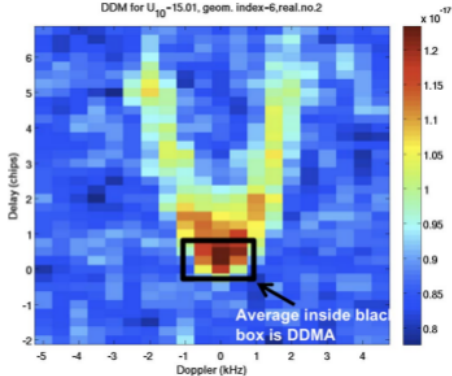


- QC of TDS-1/CYGNSS DDMs
- Development of Observation Operator
- Impact Evaluation of GNSS-R derived winds on WF

State of the art of GNSS-R derived winds [3] [1]



DDM for $U_{10} = 15.01$, geom. index = 6, real.no.2



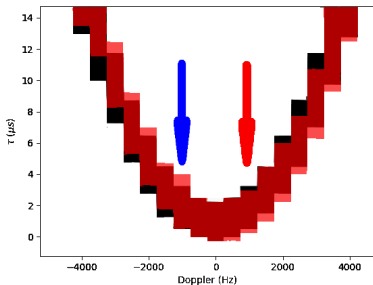
Motivation

- GNSS-R derived winds still have low impact on WF.

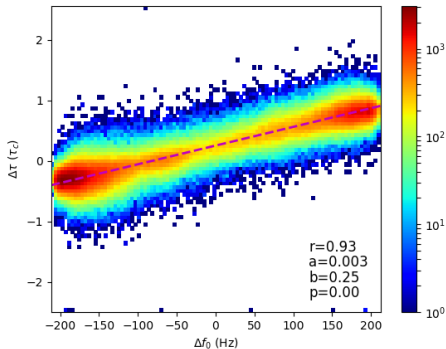
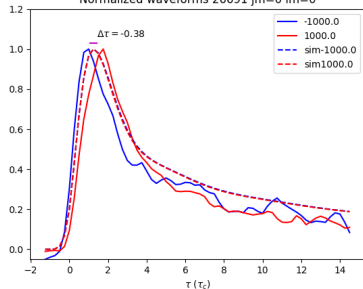
Causes:

- calibration and inter/calibration issues
 - lack of information from peripheral DDM
- Solution:
- Understand/Solve calibration/intercalibration issues
 - apply **multi-look** approaches

Aims of this presentation



Normalized waveforms 26691 jm=0 im=0



$r=0.93$
 $a=0.003$
 $b=0.25$
 $p=0.00$

- $\Delta\tau$ are correlated with Δf_D [2]
- Aims:
 - Demonstration
 - Impact on DDM observables

Methodology & Results

Demonstration of the distorting mechanism

- **Methodology:** Compress CYGNSS Raw IF data by varying f_D^{SP}
 - $Y(t_0, \tau, f) = \int_0^{T_i} u(t_0 + t + \tau) a(t_0 + t) e^{j2\pi f^* t} dt$
- **Dataset:**
 - 60 s track CYGNSS Raw IF (Intermediate Frequency)
 - Harvey 25-08-2017 14:17 ($|\Delta f_D| \approx 150\text{Hz}$)
 - Irma 08-09-2017 23:17 ($|\Delta f_D| \approx 10\text{Hz}$)

Distortions on CYGNSS data I

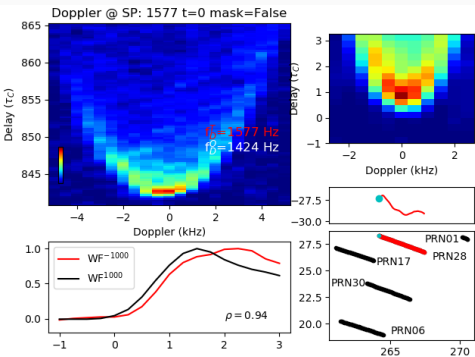


Figure 1: Harvey. $\Delta f_D = -153$ Hz

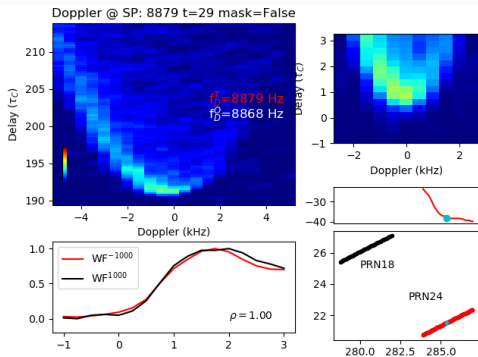
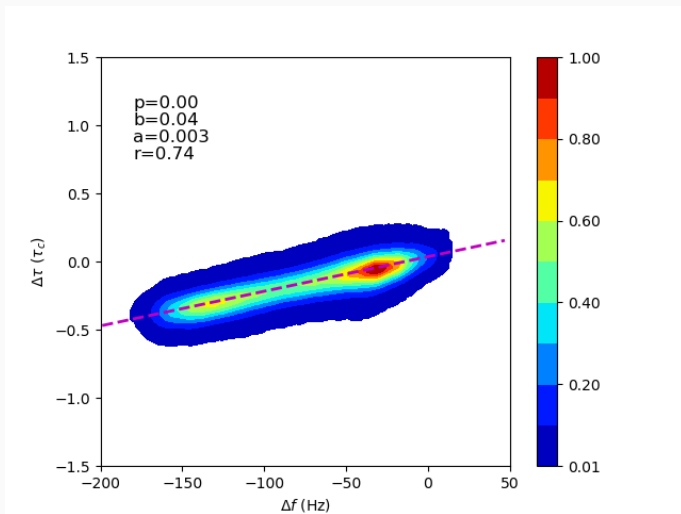
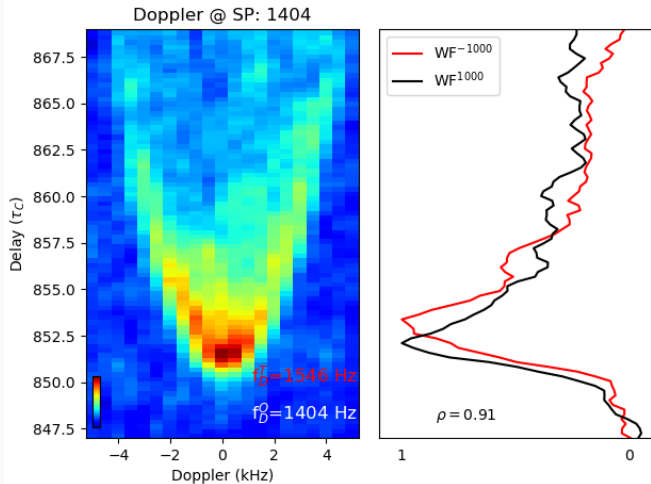


Figure 2: Irma. $\Delta f_D = -11$ Hz

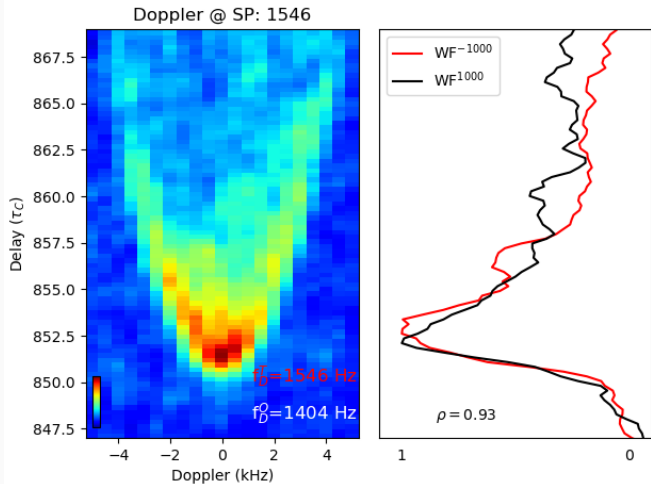
Distortions on CYGNSS data II



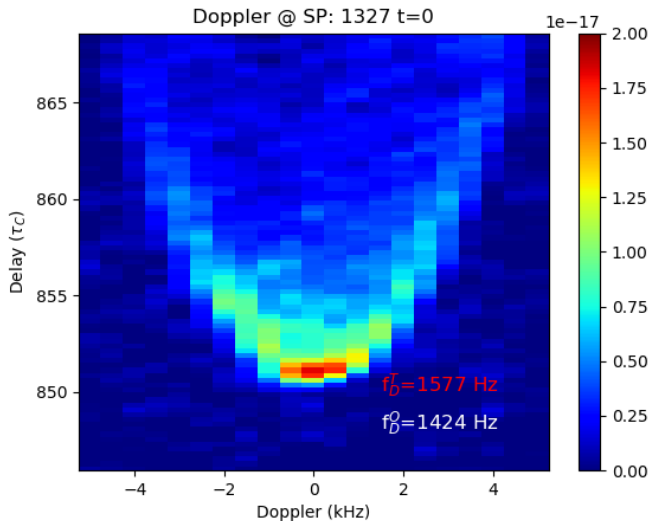
Re-compression or raw echo with f_D^O



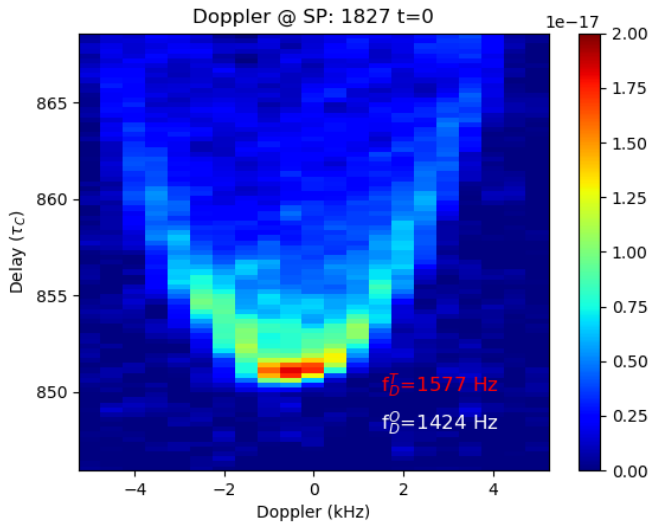
Re-compression or raw echo with f_D^T



Doppler periodicity



Doppler periodicity

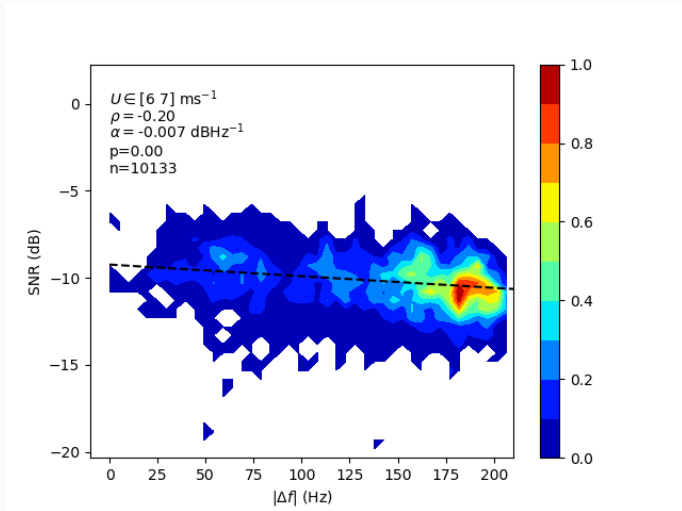




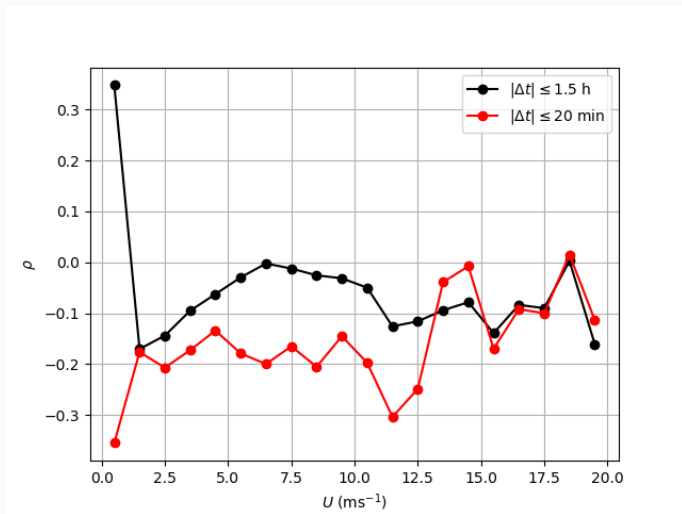
- DDM distortions are caused by SP inaccuracies
- The correlation integral may give rise to **sampling issues**

- **Methodology:**
 - Binning SNR for wind speed (1 ms^{-1})
 - Analyzing the trend of DDM peak data w.r.t. $|\Delta f_D|$
- **Dataset:** TDS-1 DDMs collocated with ASCAT/RSCAT wind field
 - $|\Delta t| \leq 20'$, $D \leq 25 \text{ km}$ [2]
 - Period: June 2015 - April 2016

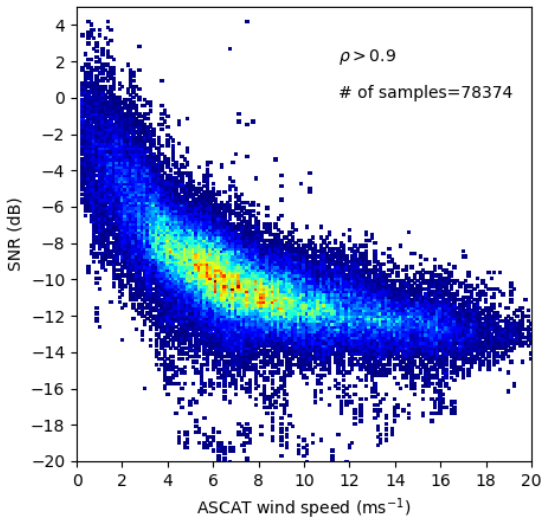
Impact on TDS-1 SNR^{PEAK}



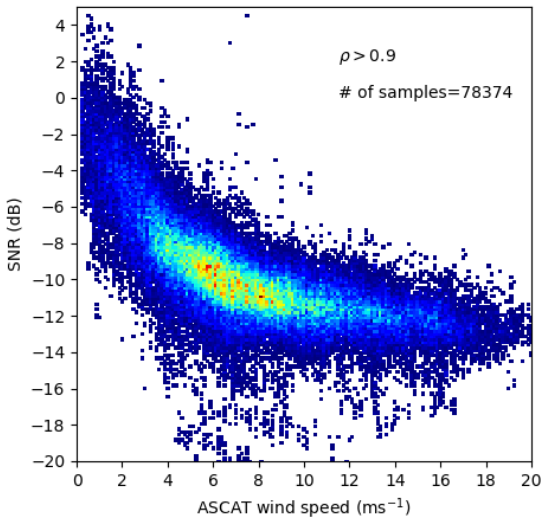
Effects of sampling criteria



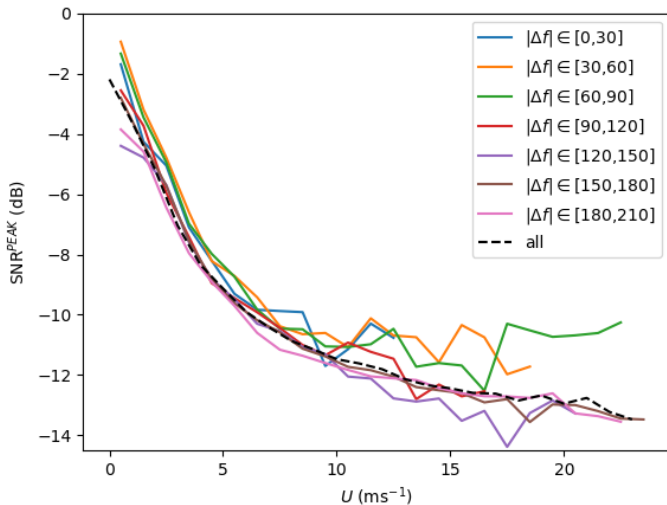
Effects on scatter: before correction



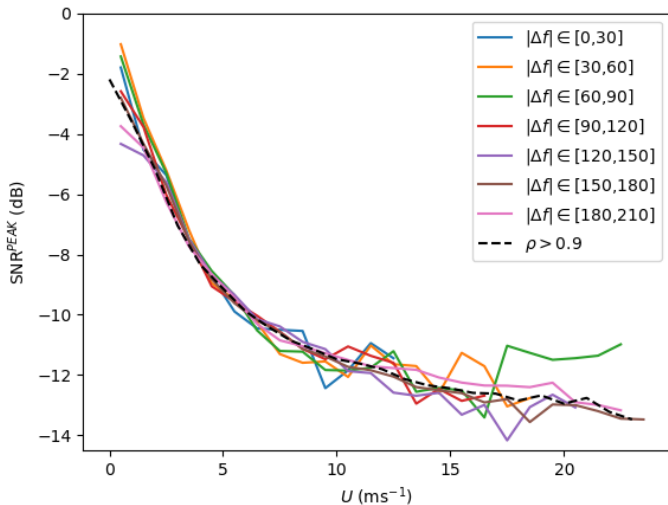
Effects on scatter: after correction



SNR^{PEAK} vs U



After correction



Second point conclusions


- sensitivity is higher than 0.005 dB/Hz, ≈ 1 dB for $|\Delta f_D| = 200$ Hz
- $\Delta f_D = \pm 200$ Hz is the most likelihood shift (TDS-1)
- This dataset is **not appropriate** for $|\Delta f_D|$ correction because of non-uniform data distribution
- temporal collocation constraint is important for such sensitivity

Conclusions


- SP inaccuracies cause DDM shape asymmetries
- TDS-1 observables are affected by SP inaccuracies

Future work

- Impact of SP inaccuracies on CYGNSS observables
- Modeling/correction of such distortions
- Implementation of stare-processing
- Visit of Dr. Feixiong Huang, Purdue University:
 - Impact of SP inaccuracies on EKF
 - Optimal choice of HS points for EKF

-  M. P. Clarizia, C. S. Ruf, P. Jales, and C. Gommenginger.
Spaceborne gnss-r minimum variance wind speed estimator.

IEEE Transactions on Geoscience and Remote Sensing,
52(11):6829–6843, Nov 2014.

-  G. Grieco, A. Stoffelen, M. Portabella, M. B. Rivas,
W. Lin, and F. Fabra.

Quality control of delay-doppler maps for stare processing.

IEEE Transactions on Geoscience and Remote Sensing,
pages 1–11, 2018.



C. S. Ruf, S. Gleason, and D. S. McKague.

Assessment of cygnss wind speed retrieval uncertainty.

IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 12(1):87–97, Jan 2019.