Extreme Winds from the Ku-band and C-band Wind Scatterometers

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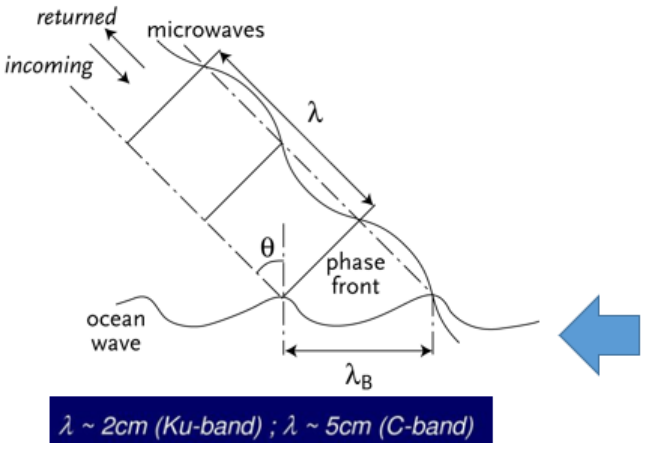
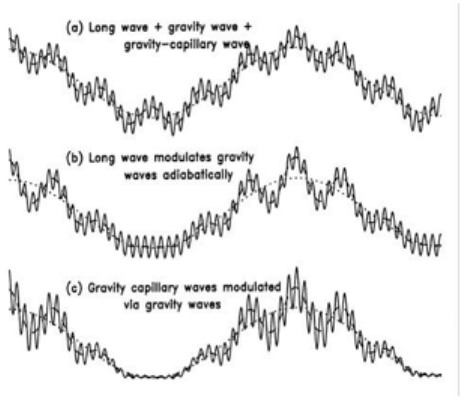




(A. Stoffelen, 1998)

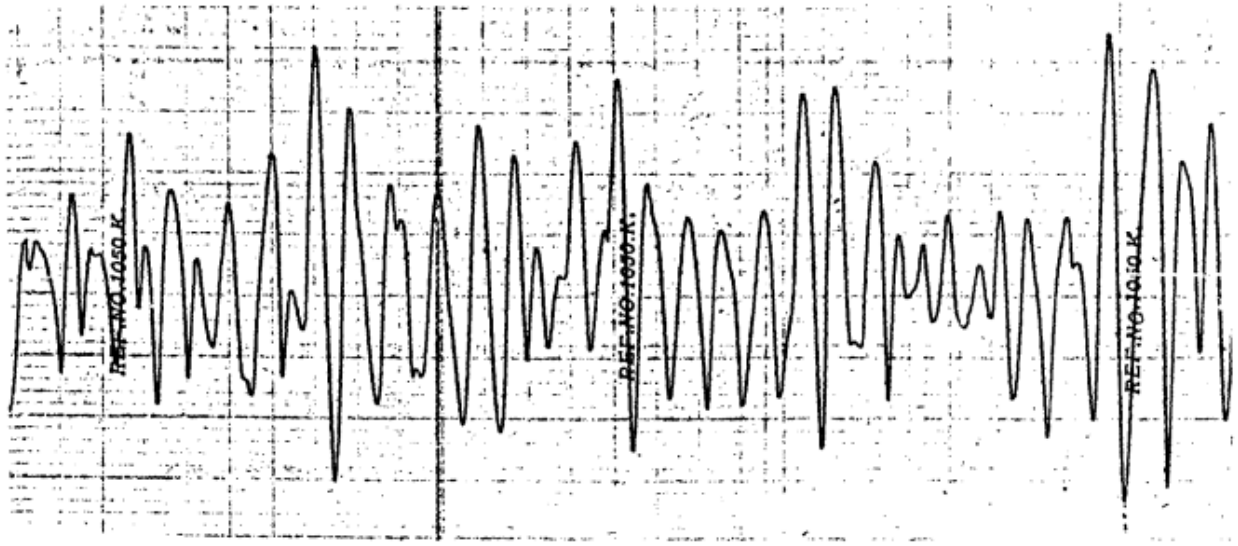
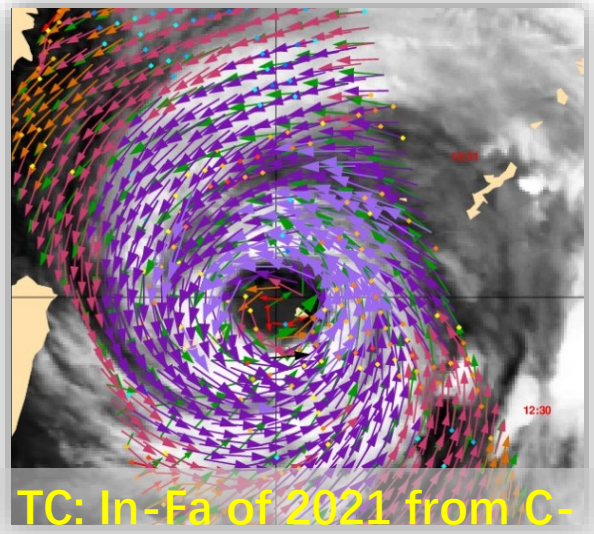


Figure 4.1 – Portion of time history of wave profile in very severe sea state in North Atlantic measured by a weather ship.

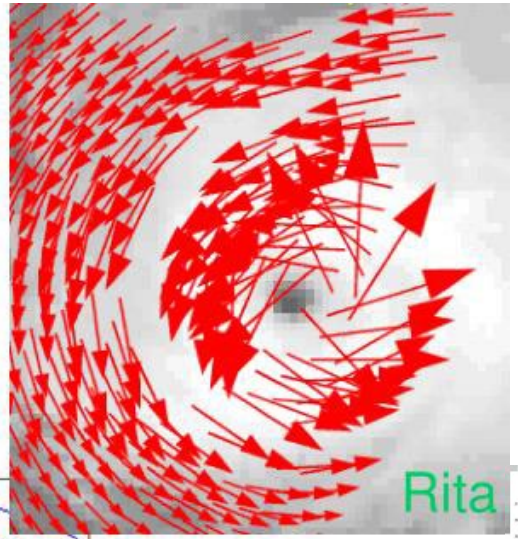
(M. Ochi, 2013)

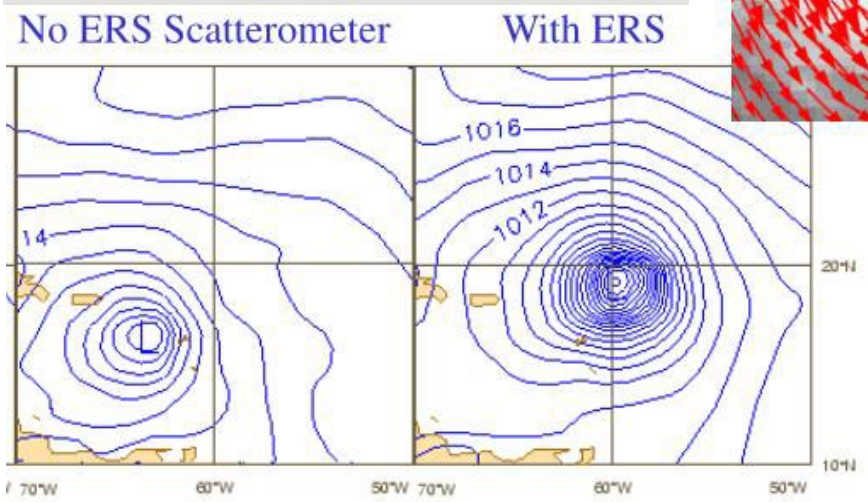
Contents

Background



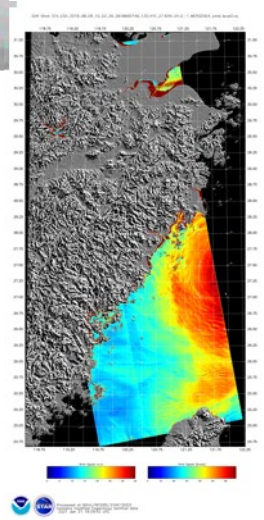
TC: In-Fa of 2021 from C-band (KNMI)

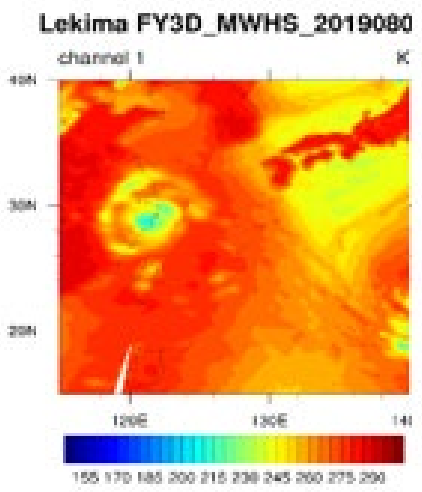


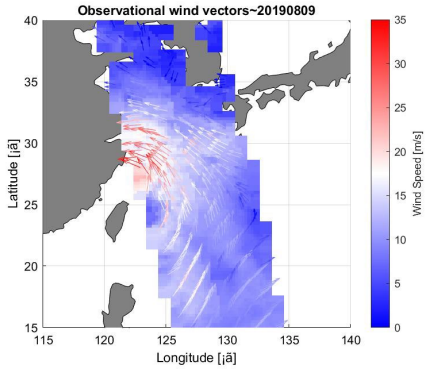


(Isaksen & Stoffelen, 2000)

- Scatterometer Tropical Cyclone (TC) winds provide good information for NWP
- TCs are complex, multi-source information are important for improving scatterometer high winds





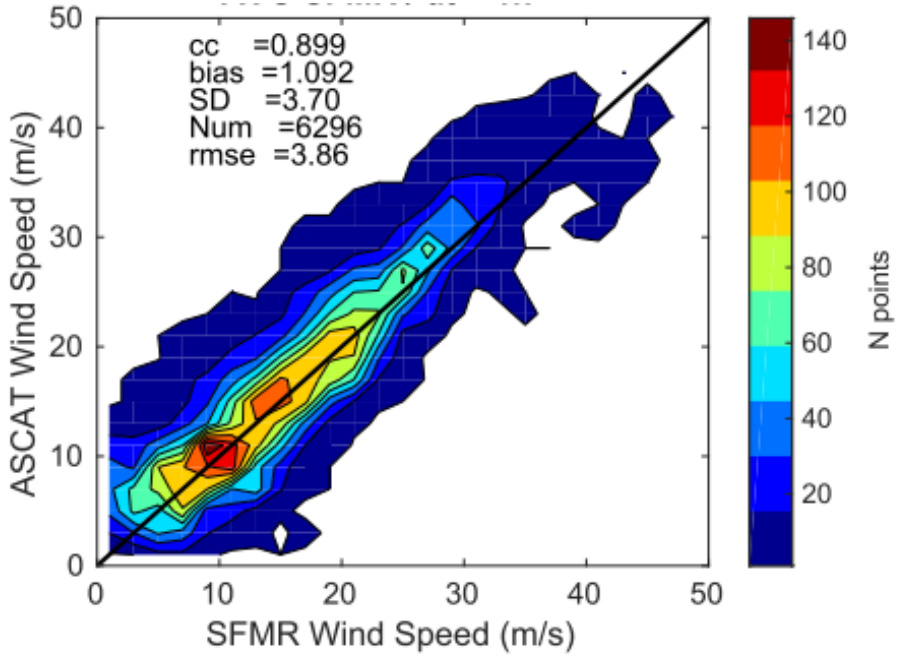


Lekima of 2019 (0809) from VH SAR, 89GHz passive and Ku-band.(NOAA,CMA and NSSC)

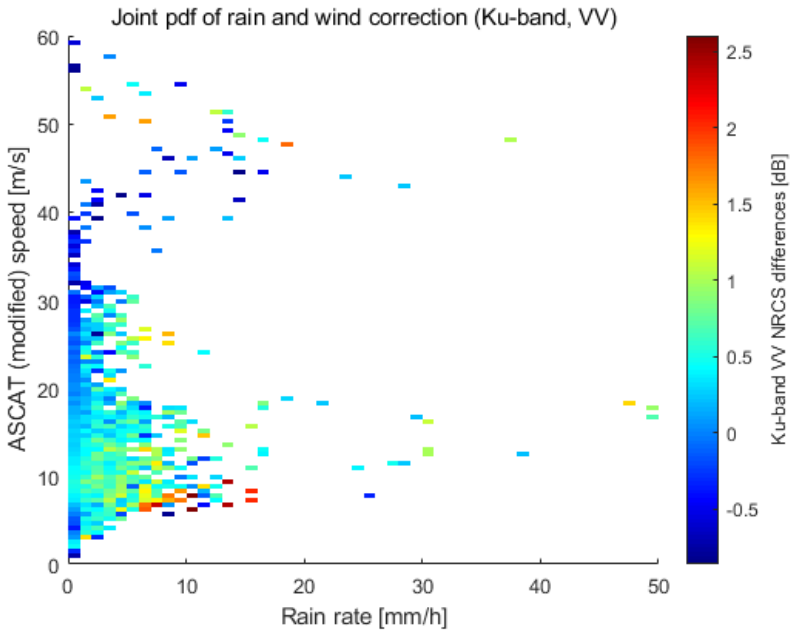
The development of the scatterometer high wind

C-band scatterometer data sets are adjusted against the airborne radiometer SFMR using a well-explored methodology, in the equation for wind speed larger than 12 m/s:

$$U_{10s}^{*}=0.0095\,U_{10s}^{2}+1.52\,U_{10s}-7.6$$



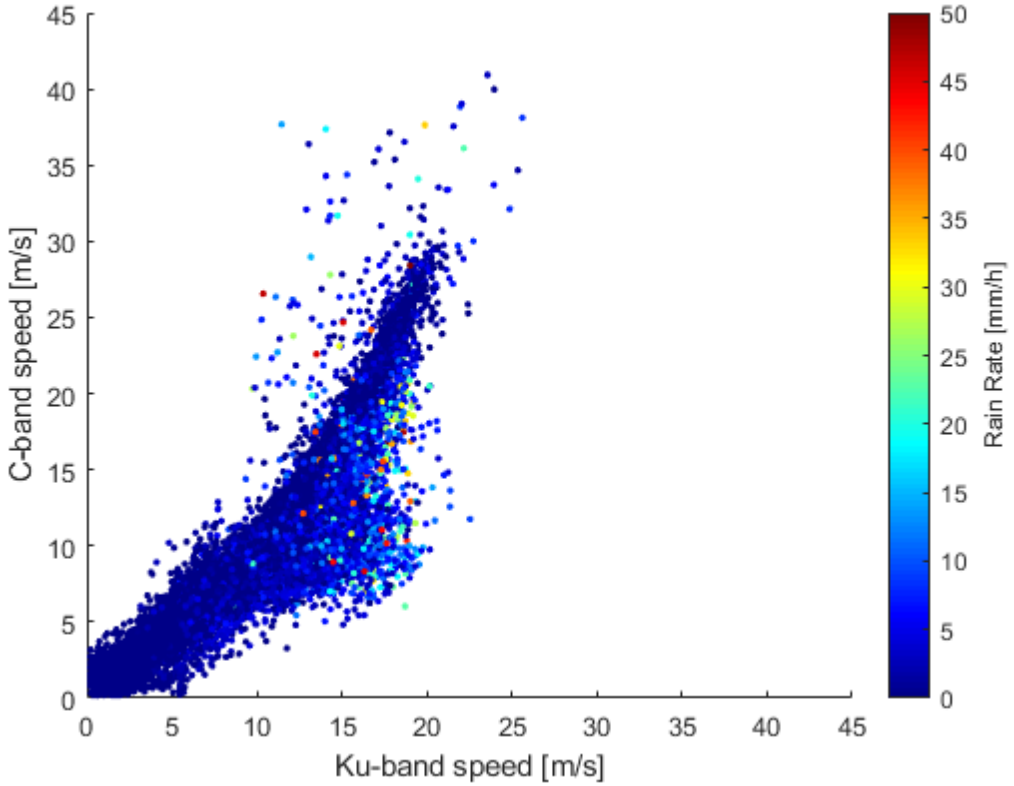
(F. Polverari, et al., 2021)



Differences of NRCS obtained from Ku-band NRCS mean in a WVC from wind products simulated NRCS and the measured NRCS.

- Scatterometers are capable for high winds
- Deviation of Ku band winds is due to rain

The development of the scatterometer high wind



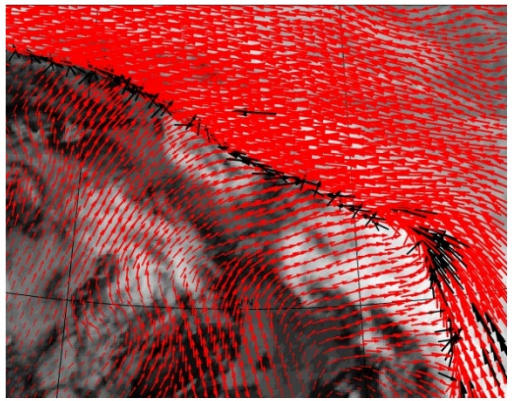
Ku band product wind v.s C band adjusted wind

Ku high wind sketch:

① Rain QC

② High wind reference

③ High wind adjusting , GMF adjusting for Ku band



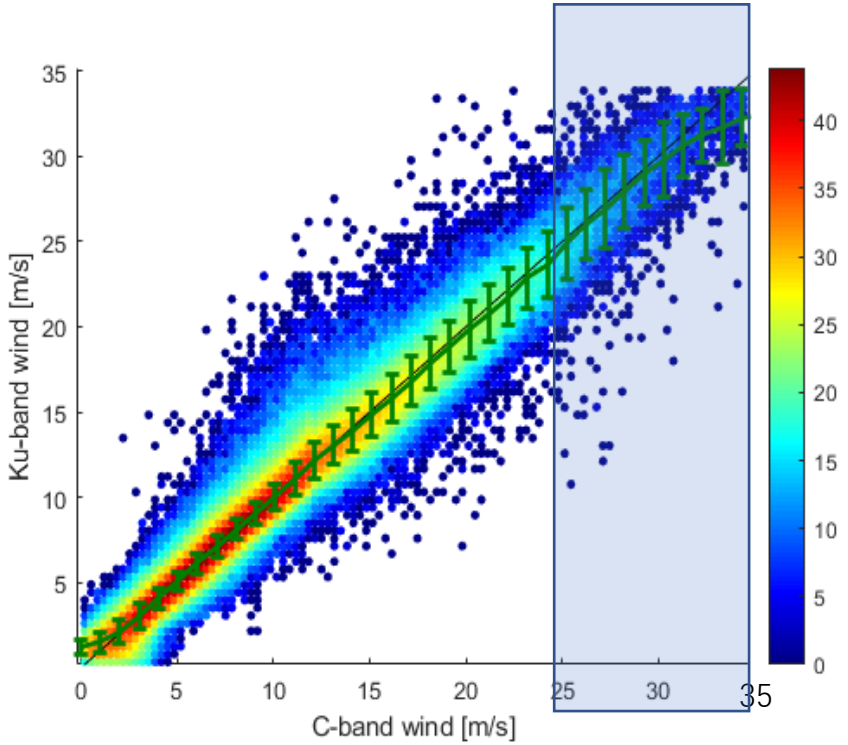
- Improved rain QC in 2020 and 2021
- For model establishment, strict QC in MLE is applied

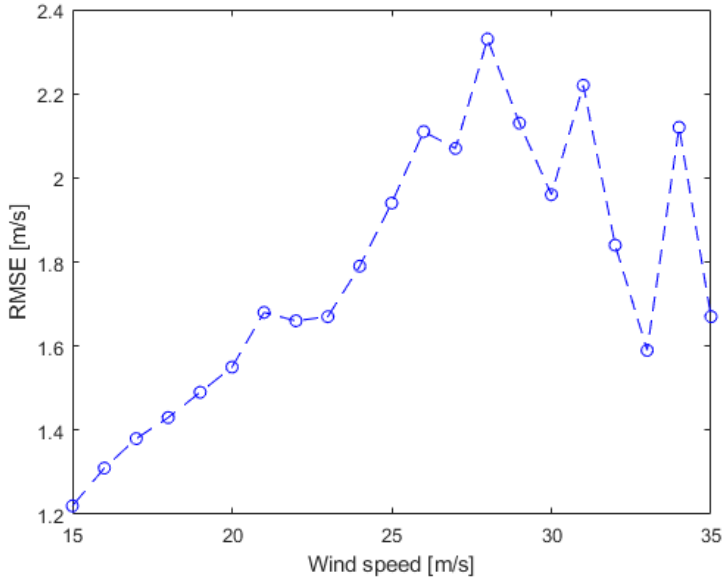
Results from C-band scatterometer references

- Rain affected Wind Vector Cells excluded by Quality Control (QC) flag.
- Ku-band adjusting model obtained from collocated C-band WVCs (ASCAT-A, ASCAT-B and OSCAT-2):

$$U_{10s}^{*}=-2.421*10^{-5}*U_{10s}^{5}+0.001122*U_{10s}^{4}-0.015*U_{10s}^{3}+0.07096U_{10s}^{2}+0.8604U_{10s}+0.1767$$

Results (validation set, in OSCAT-2)

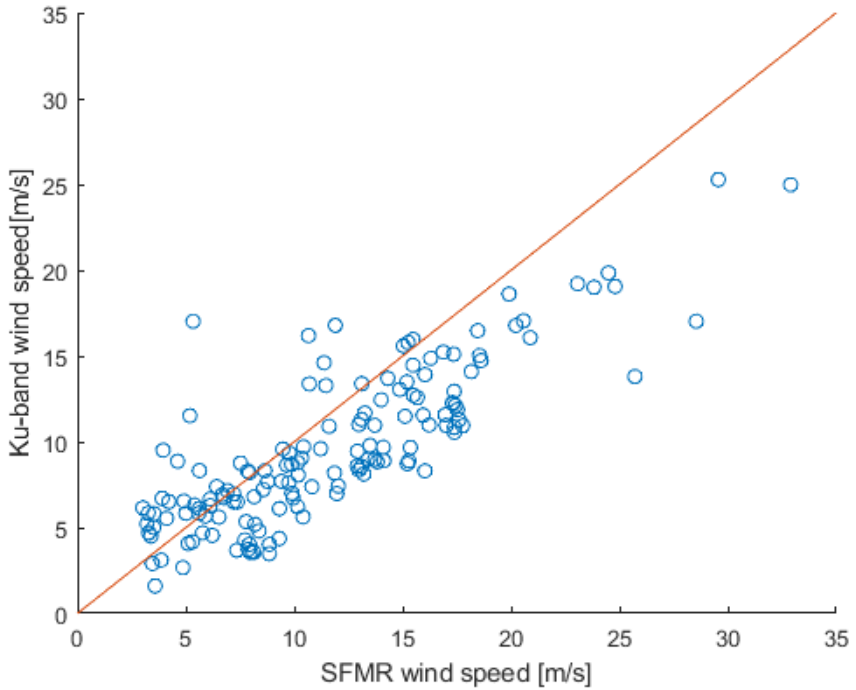




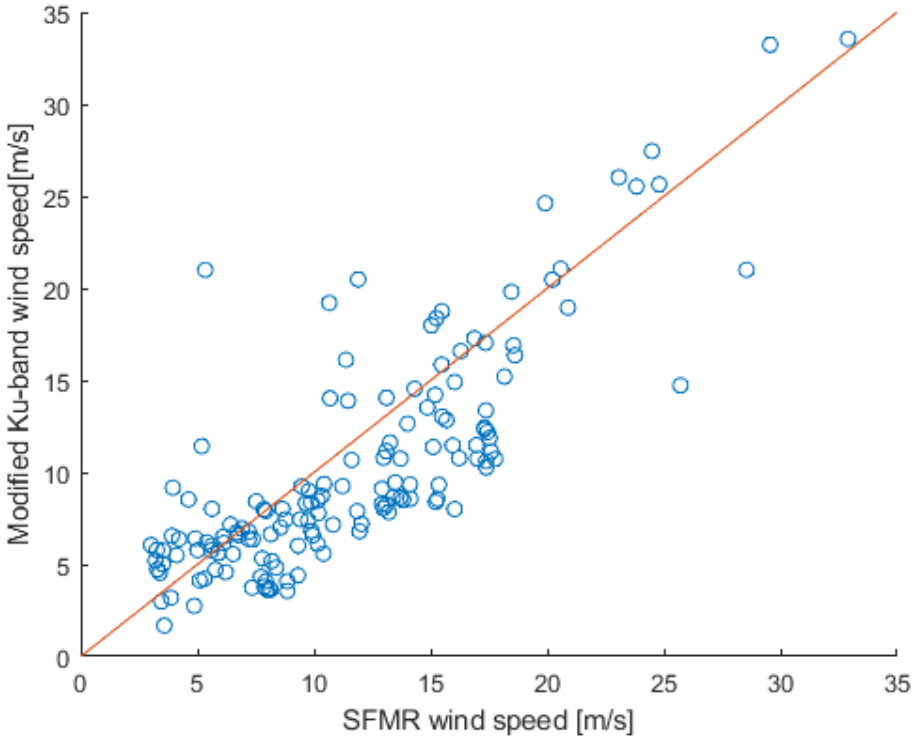
RMSE v.s. speed,
Fluctuations due to differences in sample amounts

Results from C-band scatterometer references

- HY-2B HSCAT validation, Not applied in model derivation;
- Collocated with SFMR;
- Begin assimilation experiments in research aspect



SFMR v.s. Ku band product speed



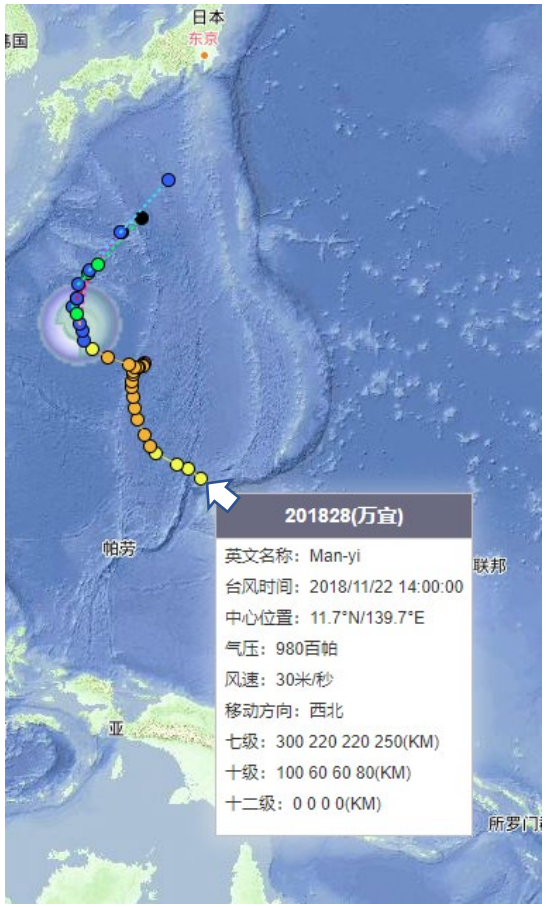
SFMR v.s. adjusted Ku band speed

(X. Xu, A. Stoffelen, W. Ni, M. Portabella and A. Rabaneda 2023)

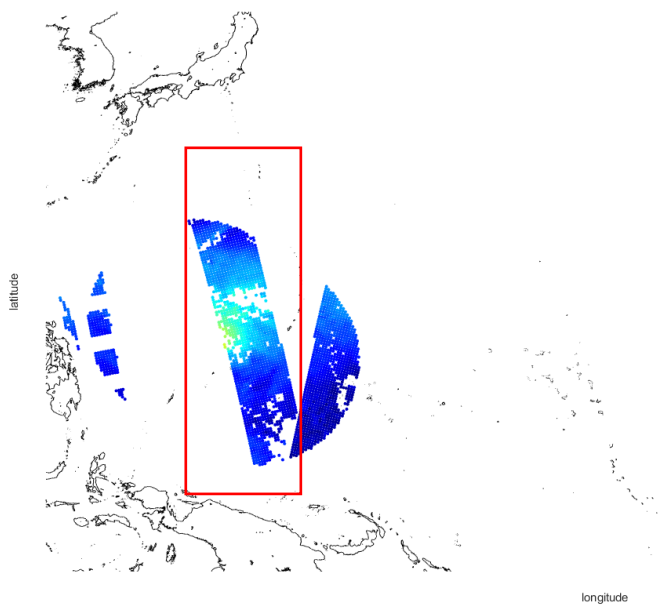
Results from C-band scatterometer references

-Case example from TC Man-yi

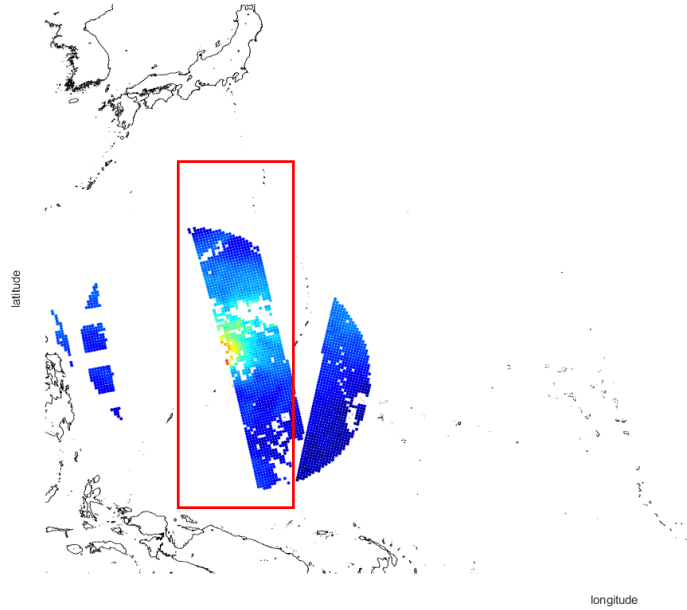
Existing wind speed is underestimated, established model improves this with more details in eye wall regions, and better consistency with best track information from CMA



CMA best track informaton



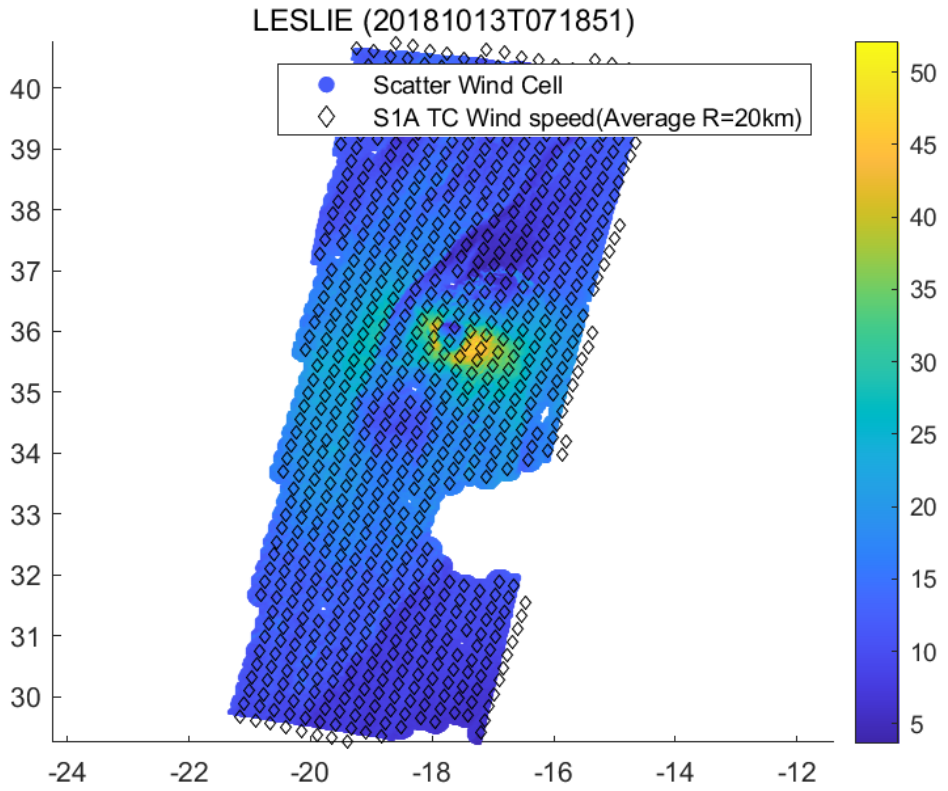
Ku-band product wind



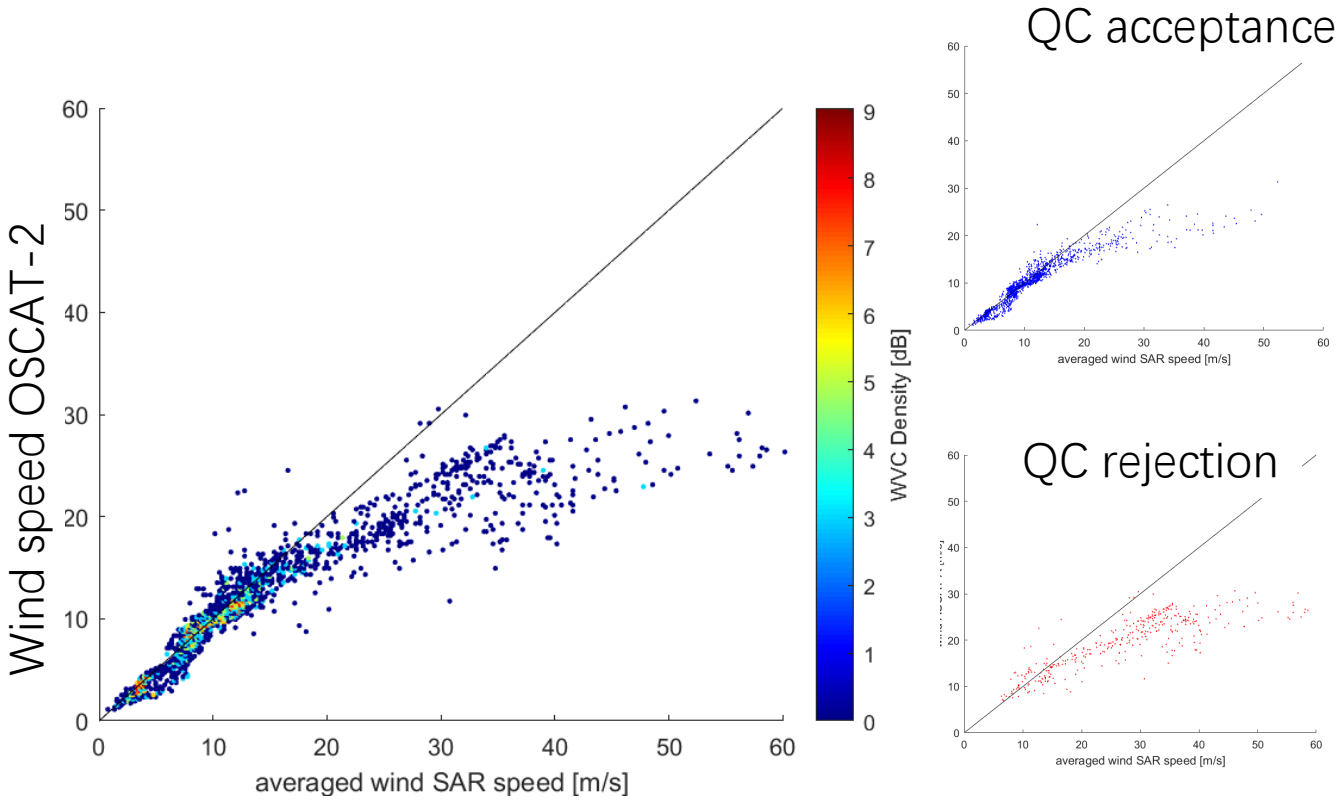
Adjusted wind

OSCAT-2 Ku band wind

Results from C-band SAR references

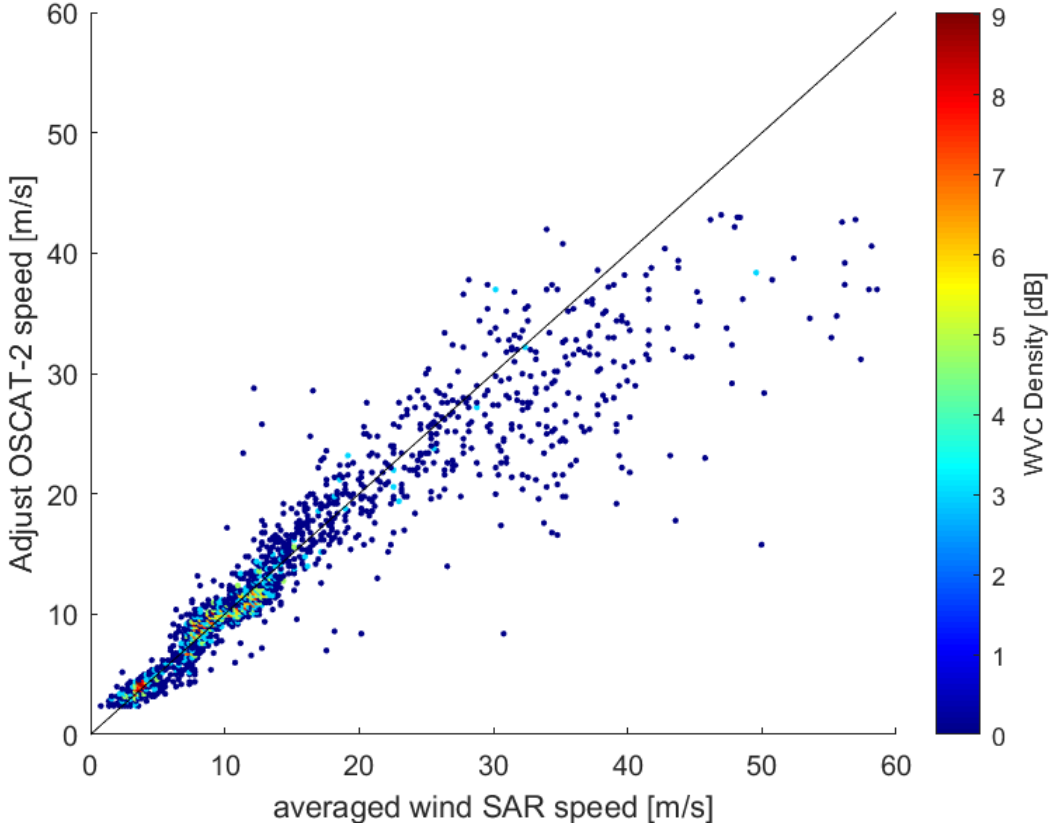


Example of SAR (Sentinel-1A) collocated with scatterometer（TC LESLIE，2018）



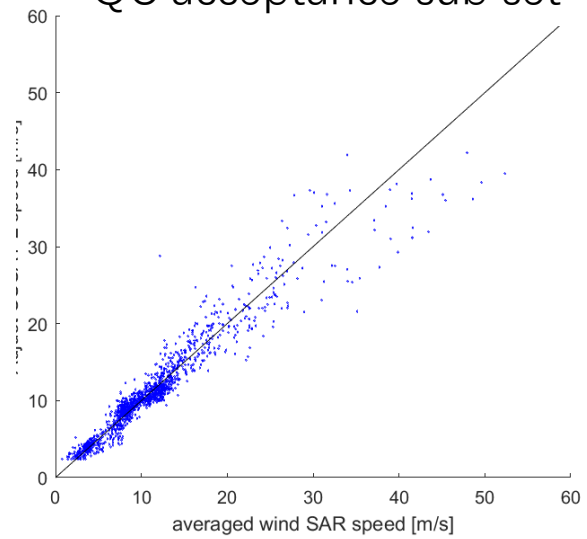
SAR (Sentinel-1A) collocated with OSCAT-2 winds（2016-10~2019-01，filtered by collocating with ASCAT-A）

Results from C-band SAR references

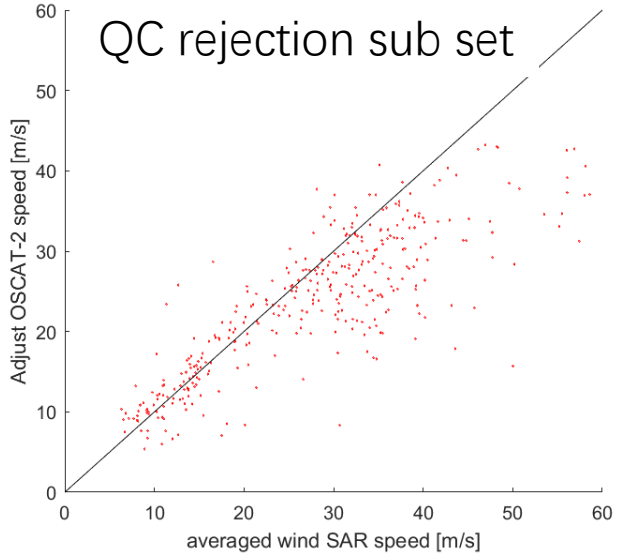


Established adjusting model

QC acceptance sub set

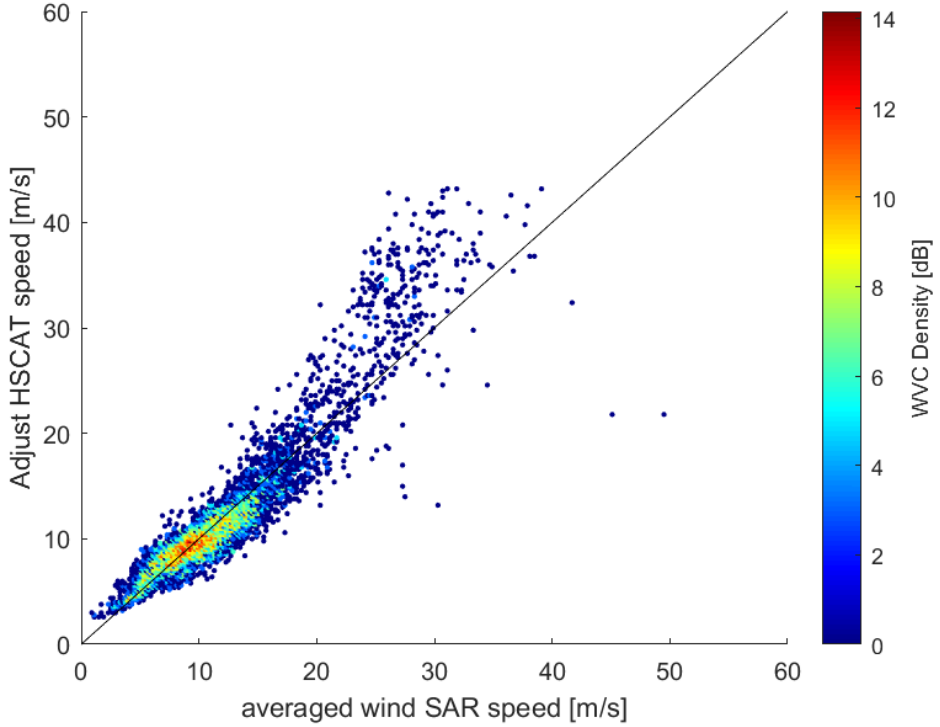


QC rejection sub set



Results from C-band SAR references

HY-2B validation (2019, global TC)



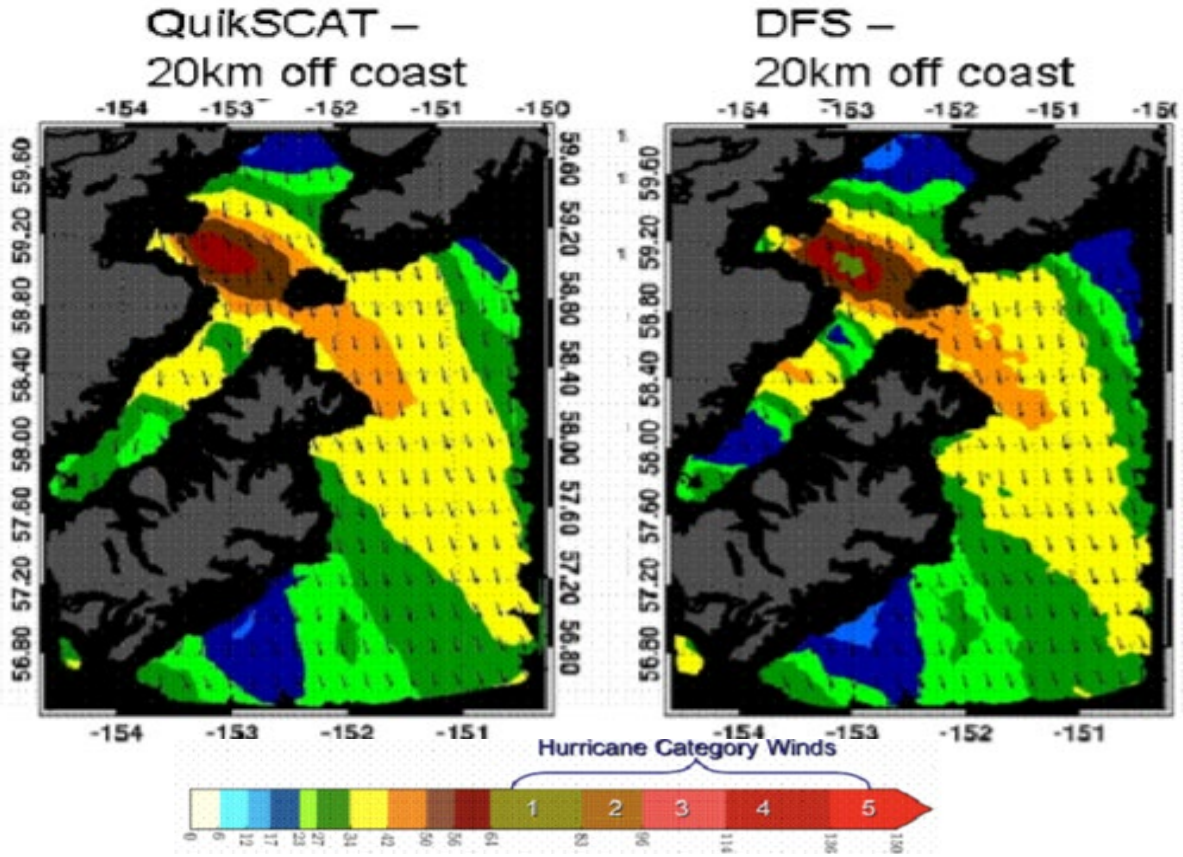
Improvement required by:

- Considering smaller scale features in SAR observations and that effects on scatterometer winds
- Increasing data samples

Conclusions

- Scatterometers are capable for high winds
- Deviation of Ku band winds is due to rain
- Ku-band results from adjusted C-band scatterometer references resolve up to 35 m/s;
- Ku-band results from C-band SAR high wind references aiming at speeds more than 45m/s, is still under-development.

Discussions



Near shore TC simulation with QuickSCAT and Dual-frequency observations（NOAA）

Further steps:

- Improve the Ku-band GMF model
- Optimization in combined obserations of both C and Ku band, research on Wind-rad of FY-3E
- Validation in applications

Key references:

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- X. Xu, A. Stoffelen, W. Ni, M. Portabella and A. Rabaneda, "*Extreme Winds from Ku-Band and C-Band Wind Scatterometers,"* IGARSS 2023 - 2023 IEEE International Geoscience and Remote Sensing Symposium, Pasadena, CA, USA, 2023, pp. 4064-4067, doi: 10.1109/IGARSS52108.2023.10281803.

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Thanks!

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