Estimating Sea Surface Local Wind Variability from ASCAT-derived information

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Outlines

1.Motivation

2.Data and method

3.Results

4.Conclusions

1. Motivation

- Local variability of sea surface wind has a significant impact on the mesoscale air-sea interactions and wind-induced oceanic response.

- *Lin et al.* (TGRS, 2015) show that the ASCAT wind quality seems to be mainly associated with large (sub-WVC) wind variability, i.e., wind variability within a wind vector cell (WVC) may be characterized using the quality indicators of ASCAT, such as the inversion residual (MLE) and the singularity exponent (SE).

- Once the above inference is validated, one can develop a new useful NRT variable – wind variability, using the ASCAT wind data.

2. Data and Method

1) "True" local wind variability is estimated from the 10-min buoy wind series within a certain temporal window, following the Taylor Hypothesis [*Lin et al., 2015*]

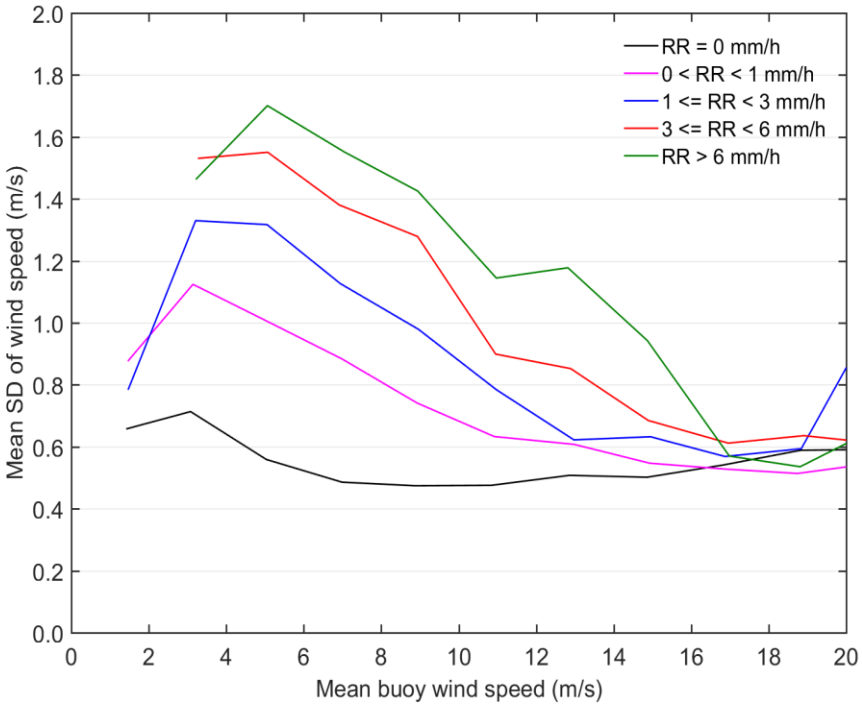
$$SD = \sqrt{\frac{1}{M-1}\sum_{i=1}^{M}\left(x_i - \bar{x}\right)^2} \qquad SD_{\text{vector}} = \sqrt{SD_u^2 + SD_v^2}$$

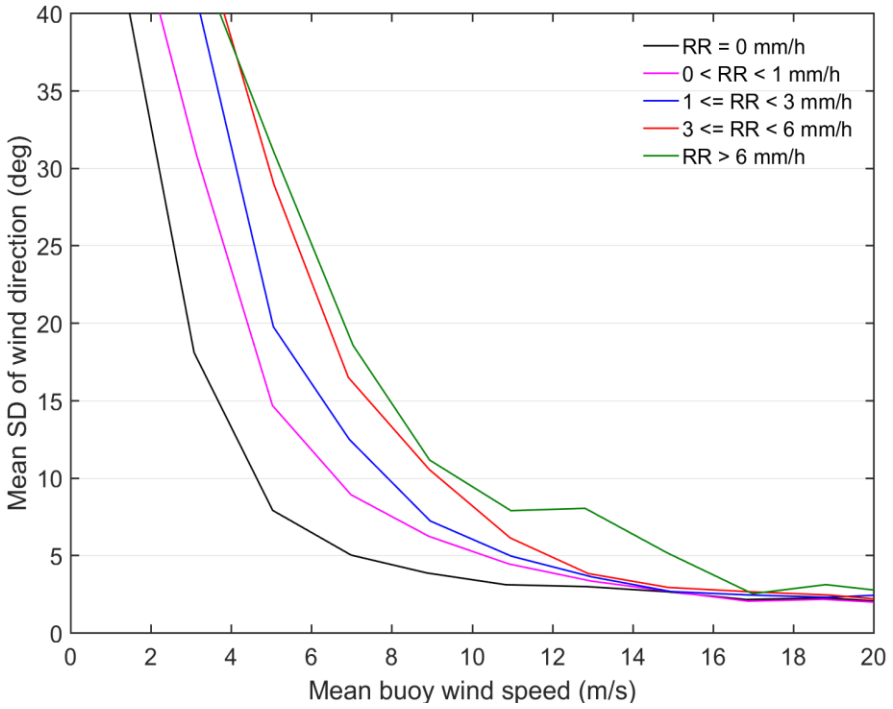
2) The wind variability as a function of wind speed is studied under different rain conditions, based on the collocated buoy-GMI rain data.

3) The correlation between wind variability and ASCAT quality indicators (MLE & SE) is evaluated using the collocated buoy-ASCAT data.

$$\text{MLE} = \frac{1}{3}\sum_{i=1}^{3}\left(z_{\text{m}i} - z_{\text{s}i}\right)^2 \qquad \text{SE(x)} \sim \frac{\log\left|\nabla s\right|(\text{x})}{\log r}$$

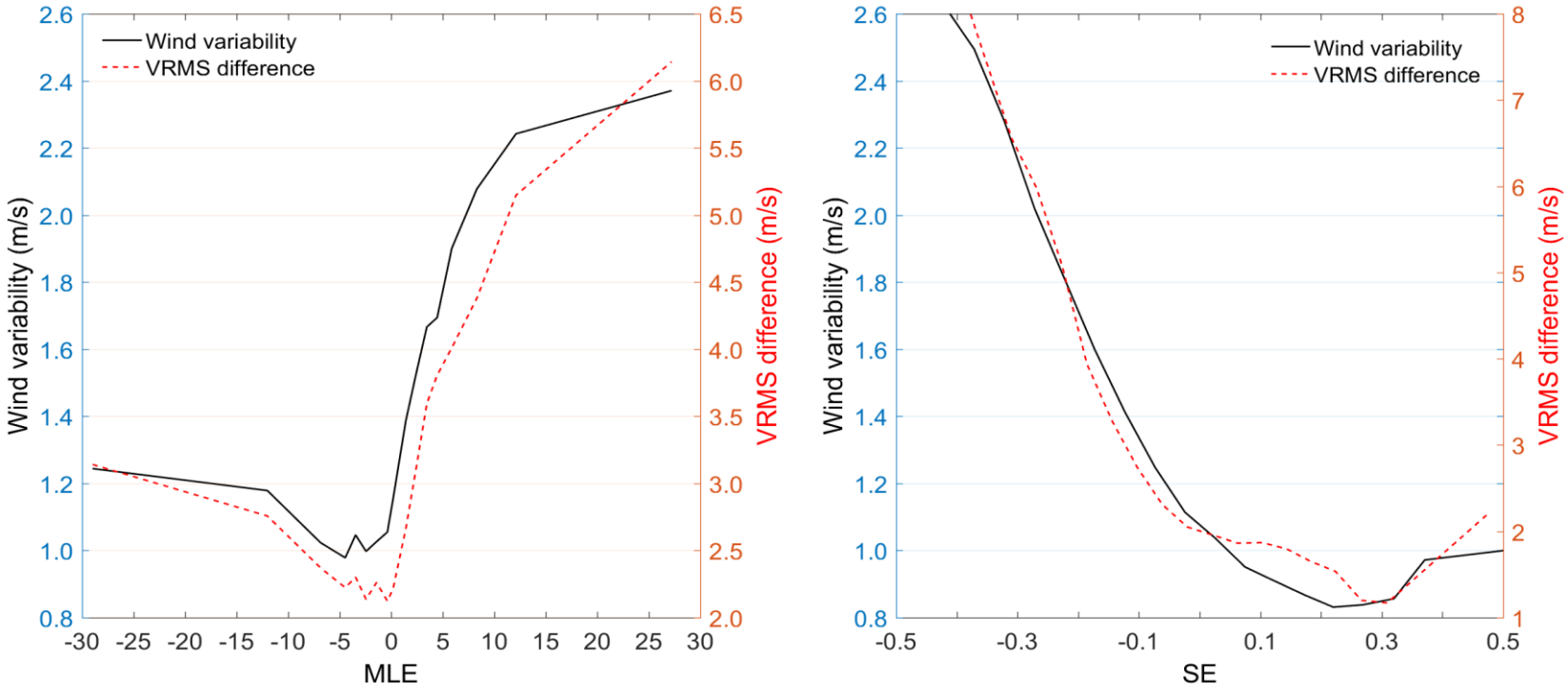
3. Results





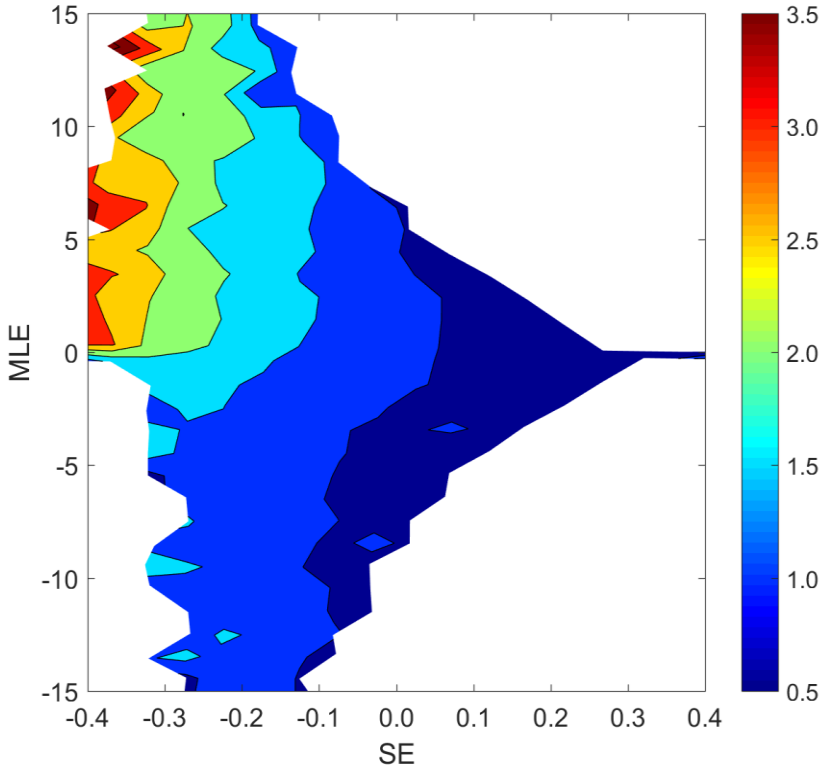
The mean wind speed (left) and direction (right) variability as a function of wind speed under different rain conditions (see the legends)

3. Results

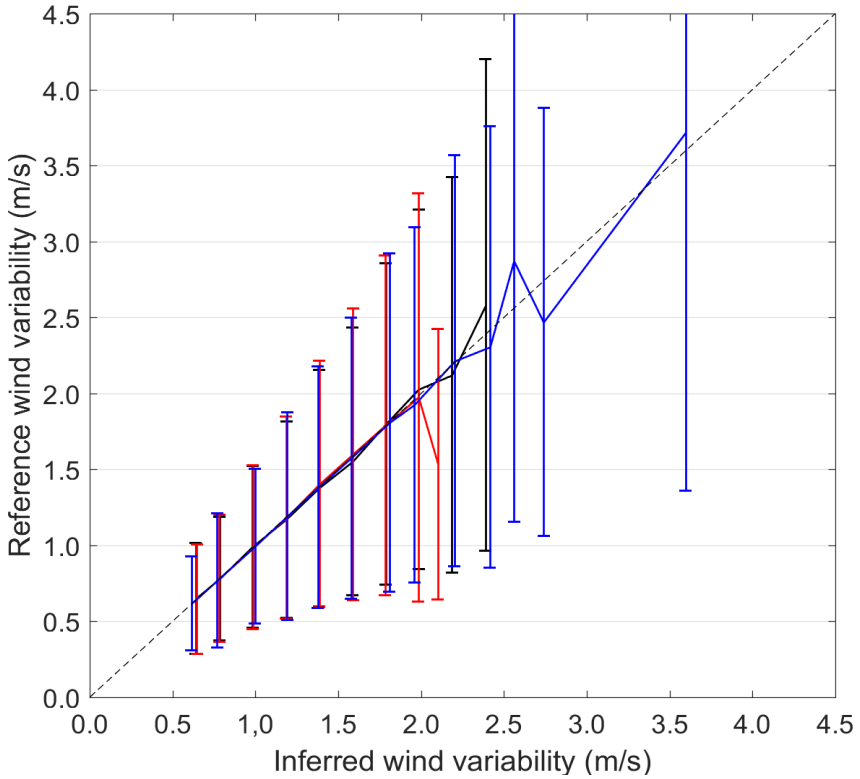


The vector variability (black curves) and VRMS difference between ASCAT and Buoy winds (red curves) as a function of MLE (left) and SE (right)

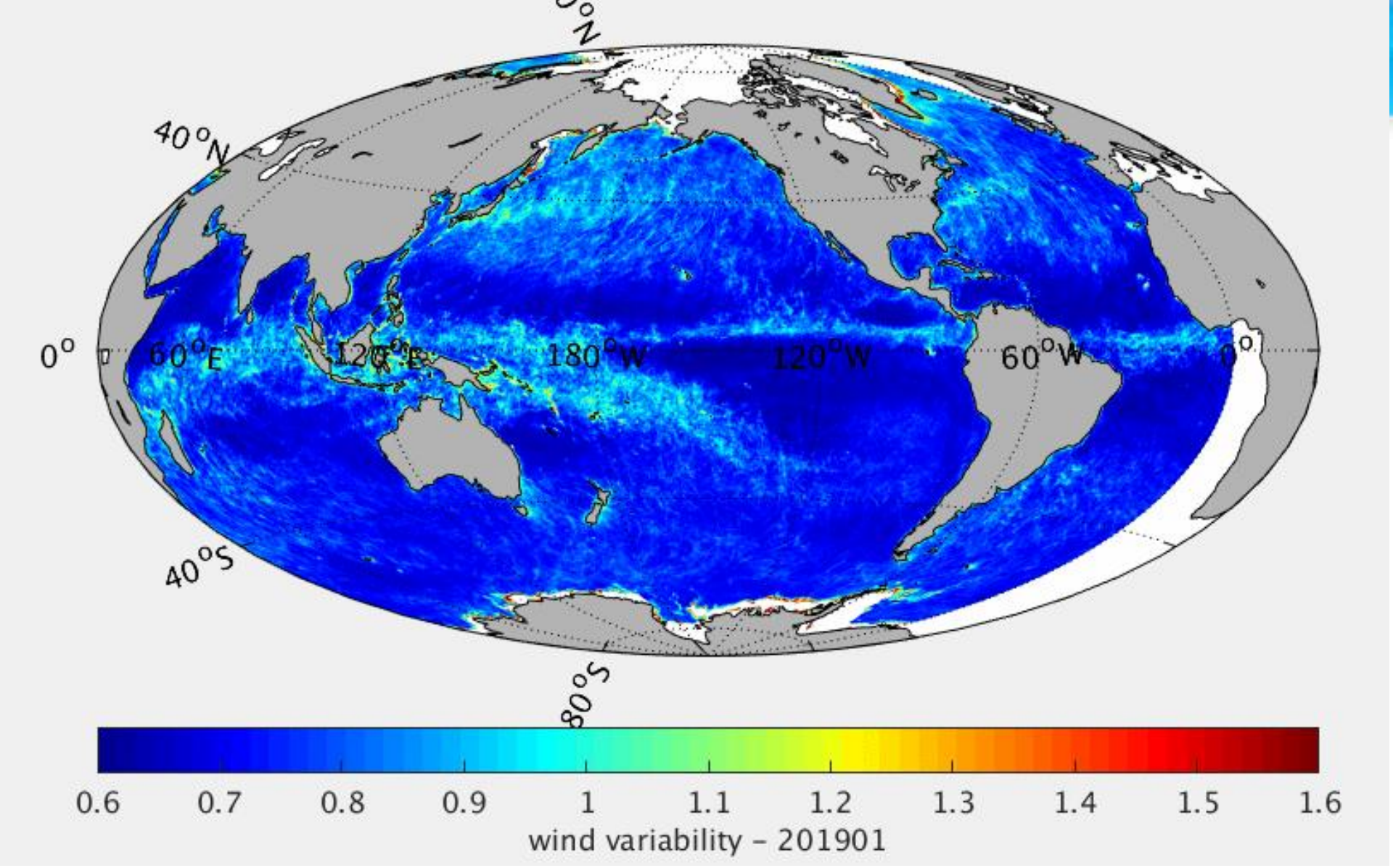
3. Results



The vector variability (colorbar) versus ASCAT MLE and SE. Blank area is due to the lack of data.



1. Estimate the wind variability a function of SE/MLE (2012-2019)
2. Define the wind variability using SE/MLE; (2010-2011)
3. Evaluate the wind variability from the collocated buoy winds; (2010-2011)
4. Compare 2 and 3.



Monthly variability derived from ASCAT (Year 2019, Movie)

4. Conclusions

- ASCAT MLE and SE are indeed good & complementary indicators of wind variability
- Although the ASCAT wind quality is strongly correlated with sub-cell wind variability, note that ASCAT winds are proven to be of fair quality at high wind variability conditions
- A new sub-cell wind variability parameter can be easily incorporated in the ASCAT wind product
- This parameter is particularly relevant for, e.g., nowcasting purposes, since it clearly depicts areas of wind disturbances
- It can also be used to filter out small-scale wind information which is potentially detrimental in global NWP data assimilation