



Trends in Extremes

The literature has very different trends in extremes derived from altimeters compared to those from radiometers and scatterometers. This study examines the impact of sampling and shows that the differences in sampling have large implications on uncertainty in trends

- Trends in the mean winds are 'relatively easy' to determine from scatterometer observations
- However, trends in higher percentiles are quite challenging
- We sample the ECMEF's ERA-Int winds to test the importance of sampling
- For three types of sampling during the QuikSCAT period
 - QuikSCAT sampling
 - Altimeter Sampling
 - SSMI (multiple satellites sampling)
- Examined the mean, 90th percentile, and 99th percentile wind speeds
- Restricted to times within 1.5 hours of the ERA-Int winds
- To reduce inconsistencies with sampling of Diurnal winds
- Observations are synthetic (matching ERA-Int) to reflect purely sampling related problems (not observational error)

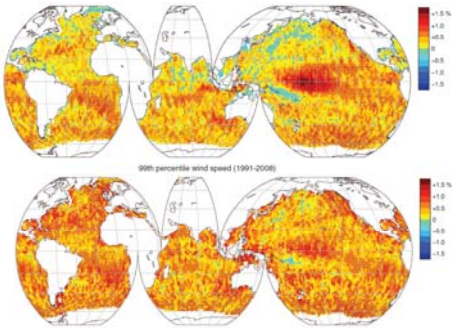


Fig. 1: Trends in the mean (top) and 99th percentile (bottom) for 1985 to 2008 (Young et al., 2011, Science). The points that are statistically significant according to the seasonal Kendall test are shown with dots.

Altimetric Trends in Wind Speed

The visibility of the sampling pattern is concerning. That suggests that sampling is an issue that needs to be carefully considered. The background below reviews calibration issues, whereas the right hand side of this poster focuses purely on sampling.

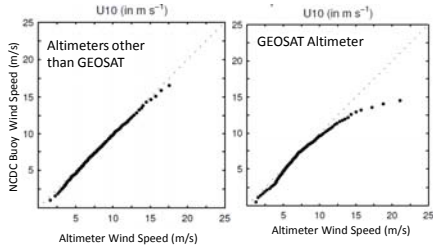


Fig. 2: Comparison of wind speeds at each percentile determined from collocated buoy and altimeter observations. Graphics from Young et al., (2011, Science). Each dot represent one percentile.

Altimeter Accuracy and Impact on trends

- The calibration of altimeter winds is quite good except for the GEOSAT altimeter
- GEOSAT data are at the beginning of the time series, which could lead to an overestimate of trends for extreme winds
- The accuracy of the median is good even for GEOSAT, therefore, problems with the trend in median values are unlikely to be associated with GEOSAT calibration (see Fig. 5) to see that there are quite substantial problems.
- This suggests that sampling issues are the greatest problem, particularly for extremes (Figs. 6 and 7).

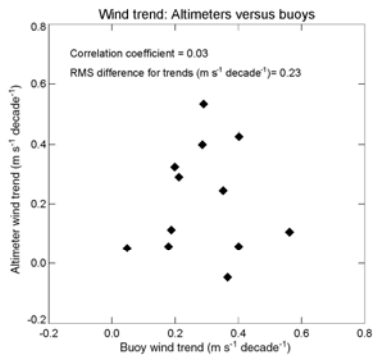


Fig. 3: Comparison of wind speed trends at several collocated buoy and altimeter observations. Most correlations are low, but that might not mean statistically insignificant. Graphics from Wentz et al. (2012, Science).

Conclusions

- The sampling from the SSM/I constellation is excellent!
- QuikSCAT-like sampling is also good, but clearly not ideal for the most extreme conditions.
- Sampling from a pair of high precision altimeters is insufficient to examine the median conditions, and cannot be used to assess trends in the mean or extreme wind speeds

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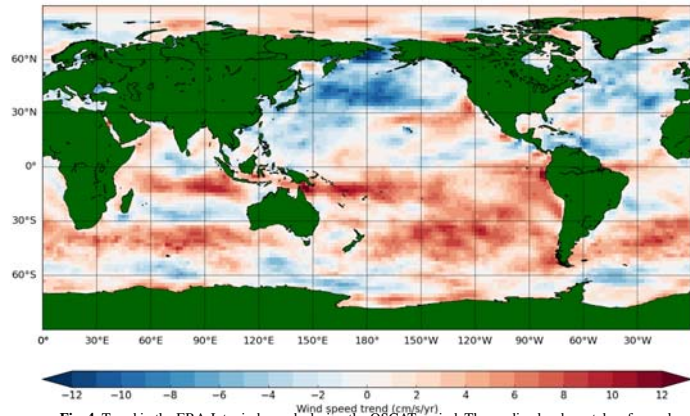


Fig. 4: Trend in the ERA-Int wind speeds during the QSCAT period. The median has been taken for each month, and the trend is computer over a continuous nine year period to avoid a spurious trend due to chaning seasons.

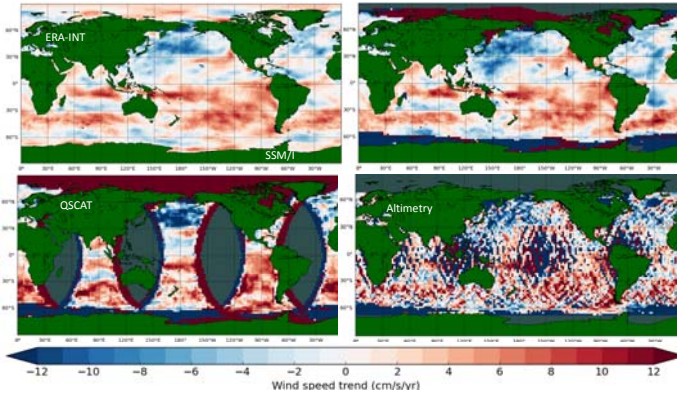


Fig. 5: The trends in the ERA-Int (upper left) are similar to that in Fig. 5, except that this is the trend in the median. The trends of the ERA-Int, sub-sampled by the SSM/I observational pater (upper right) are similar. The trends sub-sampled by QSCAT (lower left) are similar (slightly more extreme) where there are sufficient observations at close to the times of the 6 hourly ERA-Int data. The trends from ERA-Int sub-sampled with the high precision altimeters is very noising in comparison.

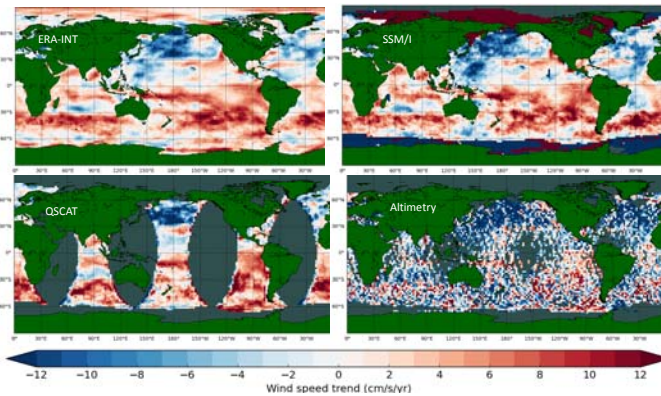


Fig. 6: As for Fig. 5, except for monthly 90th percentiles.

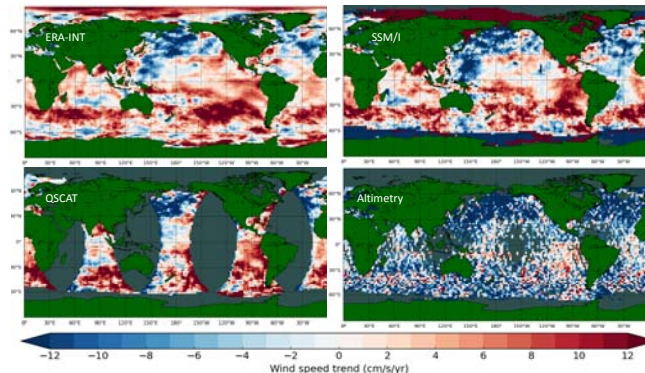


Fig. 7: As for Fig. 5, except for monthly 99th percentiles.