10 years of QuikSCAT: Evaluation and Comparisons with In-Situ & Model Data

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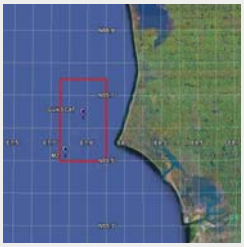
Introduction

QuikSCAT has been providing valuable information concerning the wind over the world's oceans for more than 10 years. Backscattered radiation from the sea surface was measured and transformed into wind speed and direction information. Data from QuikSCAT have been implemented in numerical weather prediction, ocean and atmospheric modelling. The long data set can also provide a source for assessment of the wind regime. The coarse resolution (25x25 km) along with the special characteristics of coastal areas does not allow proper coverage of many closed and semi-closed areas, especially of complex coastal morphology. The aim of this study is to implement the long data set from QuikSCAT to derive characteristics of general climatology in the North Sea and the Baltic. In order to evaluate the quality of the results, comparisons with in-situ measurements from a meteorological mast located 14 km offshore from the west coast of Denmark have been performed. Finally, 10 years of WRF re-analyses data, available at Risø-DTU, have been implemented to evaluate the performance of the model as opposed to the satellite measurements.

Data & Methods

Data:

* 10 years of QuikSCAT observations (obtained from RSS)
* 10 years of WRF model re-analyses
* 4 years of meteorological mast measurements (Horns Rev Offshore Wind Farm, Denmark)



Methods:

1. WRF resolution: 15 km
   - WRF data re-gridded
   - Select point closest to QuikSCAT's pixel centre
2. Met.Mast data: averaged (1hr), stability corrected
   - Available wind direction measurements at 28 m
   - Available wind speed measurements at 15 m
   - Estimate U_* from measurements

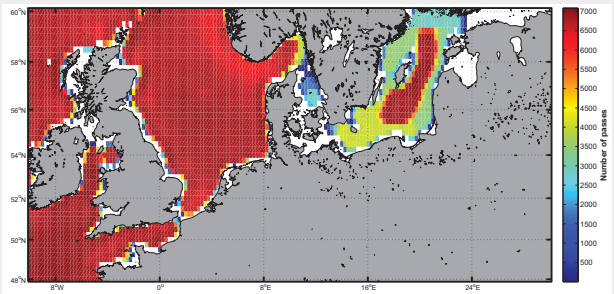
$$U_{15} = \frac{U_*}{\kappa}[ln(\frac{z}{z_0}) - \Psi_{M_{15}}(\frac{z}{L})] \quad (1)$$

   - Estimate U_{10} for neutral conditions

$$U_{10} = \frac{U_*}{\kappa}[ln(\frac{z}{z_0})] \quad (2)$$

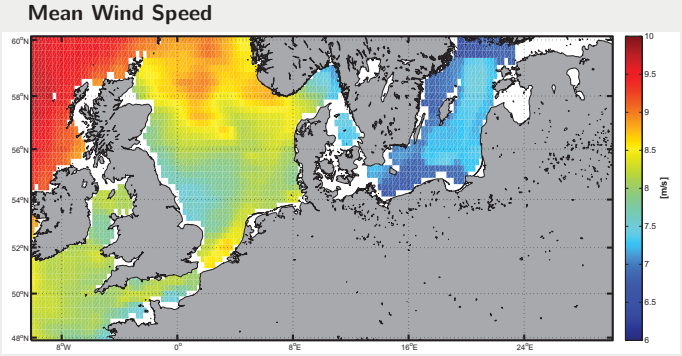
Data Availability

* Period: 01/08/1999 - 31/10/2009 (3745 days)
* Days with available data: 3733
* Two passes/day → potentially 7466 passes
* Maximum available passes: 7085



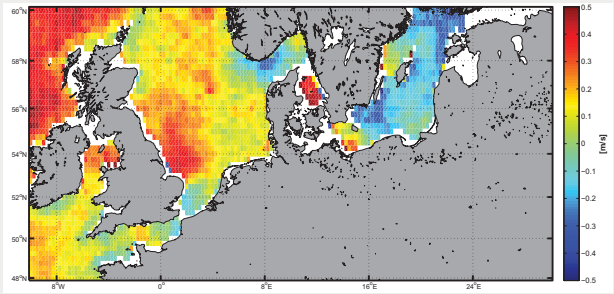
General Climatological Features I

Mean Wind Speed

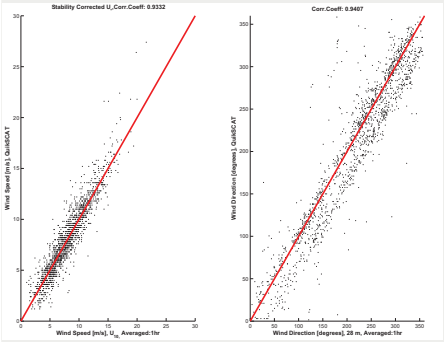


General Climatological Features II

Mean Wind Speed Difference: Morning - Afternoon



Comparisons with In-Situ Data



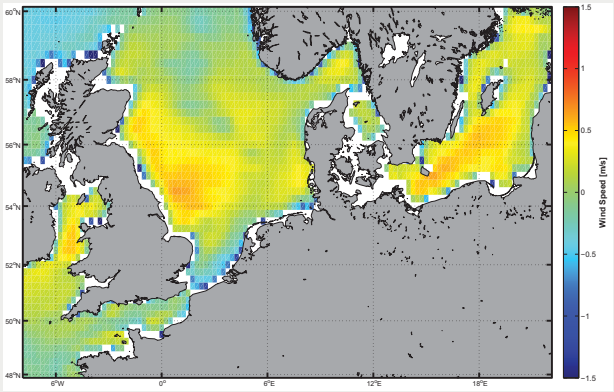
Met.Mast - QuikSCAT

Speed [m/s]	
Mean Bias	-0.05
St.D.	1.26
R^2	0.8709

Direction [deg]	
Mean Bias	8.35
St.D.	30.52
R^2	0.8850

Comparisons with WRF Model Re-analyses Data

Mean Wind Speed Difference: WRF-QuikSCAT



Mean Bias: 0.05 [m/s] St.D.: 0.3 [m/s]

Conclusions

* Different profile and stability methods of estimating U_{10} from met. mast measurements yield not very different results
* Correlation with QuikSCAT is best when stability corrections are included only in U_*
* Significant differences in the mean wind speed between the North Sea and the Baltic
* The two daily passes are not sufficient to resolve diurnal variability but Morning minus Afternoon Wind Speeds indicate consistent patterns in certain areas that could be subjected to land or sea breezes
* Good correlation between met. mast & QuikSCAT, in both speed and direction
* WRF shows consistently underestimated winds in some coastal areas
* Generally, WRF overestimates wind speeds in most parts of North Sea and Baltic but not in the Atlantic
* Mean bias for WRF-QuikSCAT winds: 0.05 m/s
* Correlation between met.mast & WRF (R^2=0.5955 for speed, R^2=0.842 for direction) significantly worse than for met. mast & QuikSCAT