Assessment of Altimeter, Scatterometer and Model High Surface Wind Speeds

Int. W/S Measuring High Wind Speeds over the Ocean, 15-17 November 2016.

Saleh Abdalla & Giovanna De Chiara

ECMWF, Shinfield Park, RG2 9AX, UK

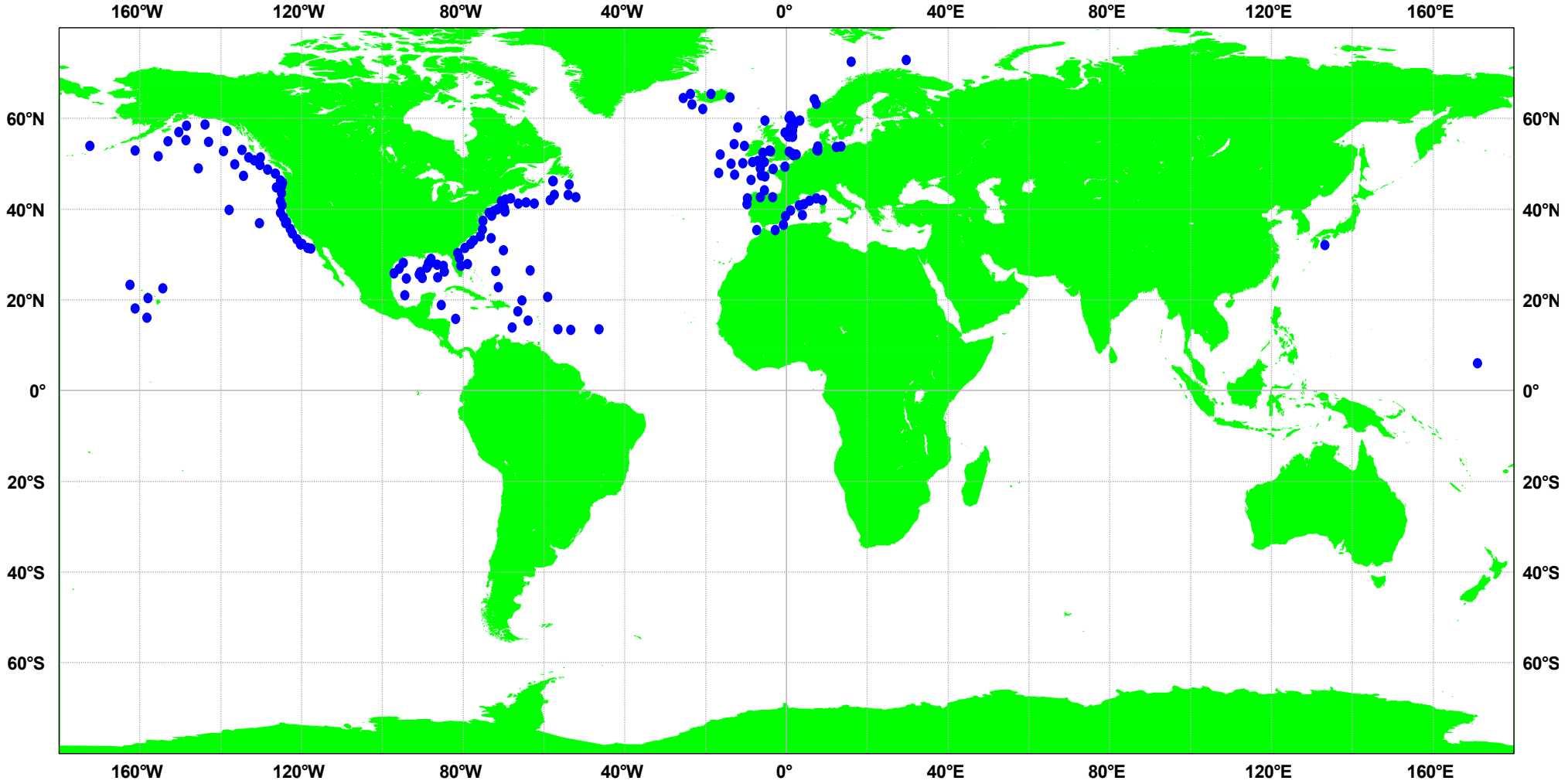
Saleh.Abdalla (AT) ECMWF.INT & Giovanna.DeChiara (AT) ECMWF.INT

ECMWF

Introduction

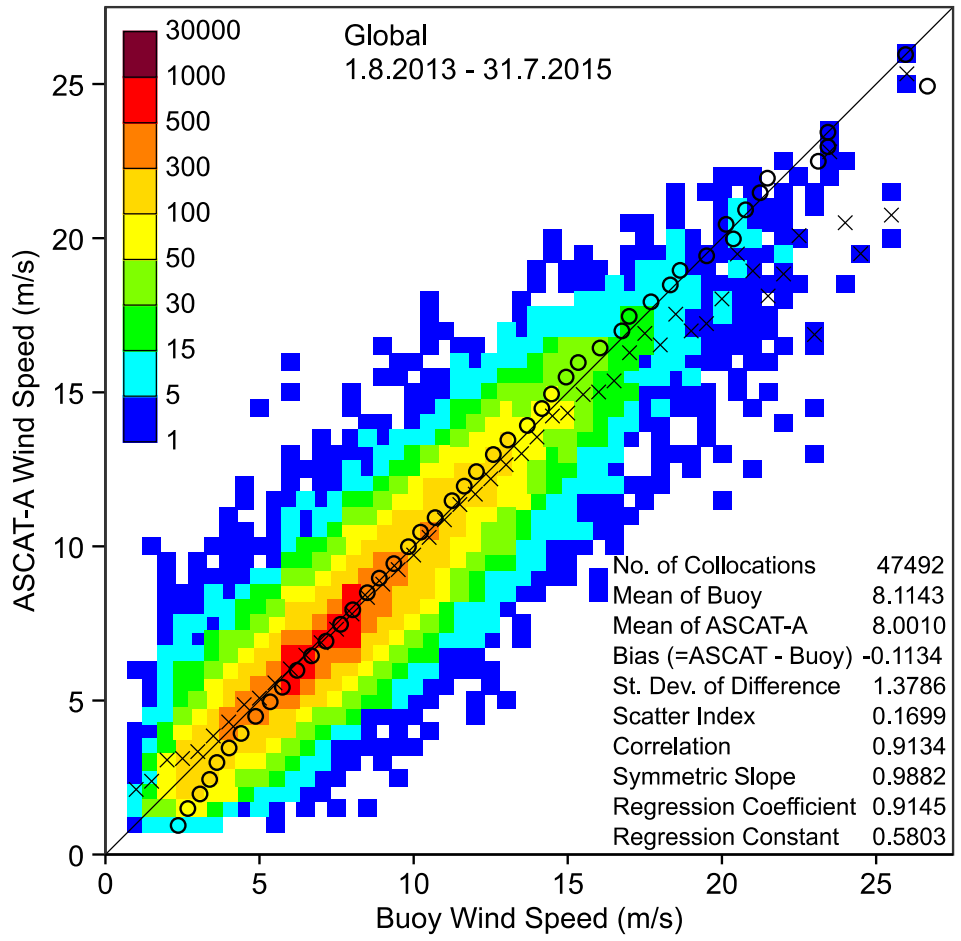
- Dilemma:
  - Satellite measurements (of wide range of geophysical quantities) rely on models for algorithm development and cal/val activities.
  - Models make use of satellite measurements for data assimilation and/or verification.
- Scarce in-situ observations are often considered as the proper reference for algorithm development, cal/val and/or verification; but
  - limited coverage (spatial and temporal).
  - they have their own issues ➔ not the ground truth.
  - marine measuring systems operate in very harsh conditions.
- Measurement systems and models are usually tuned for low to moderate wind speeds. Usually there is not enough data to tune them at high wind speed regime.
- Here is only a trial to assess high wind speed measurements from altimeters and scatterometers from statistical point of view.

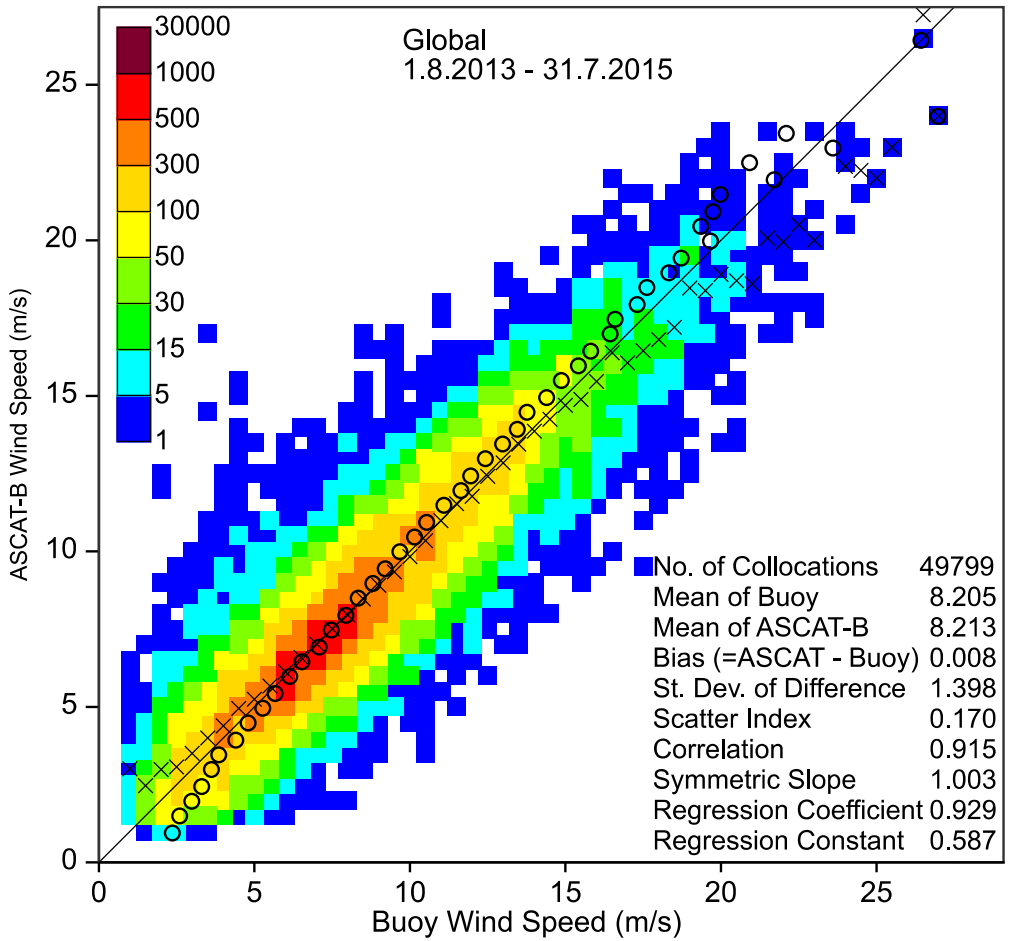
Typical locations of the in-situ (buoy/platform) stations (TAO/TRITON array not included)



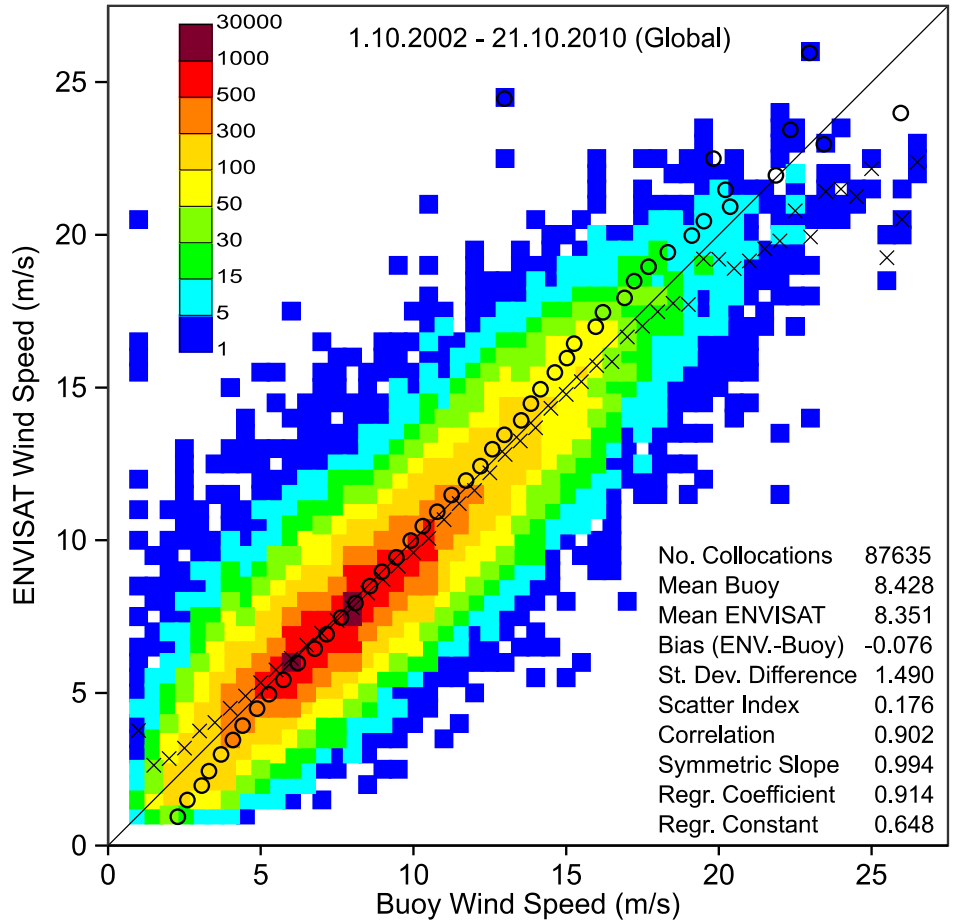
ECMWF

Wind speed comparison between ASCAT-A/B and the buoys

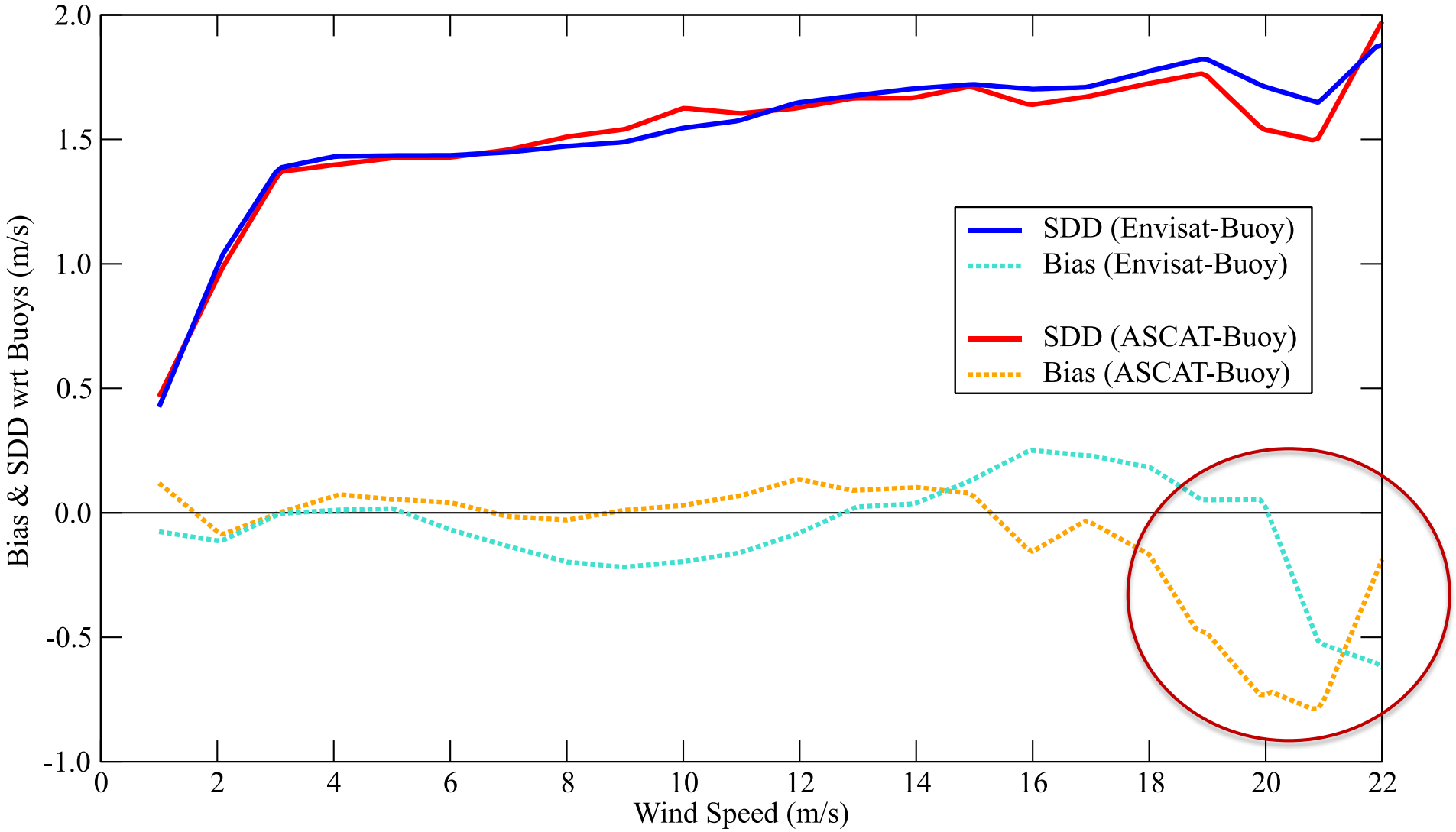




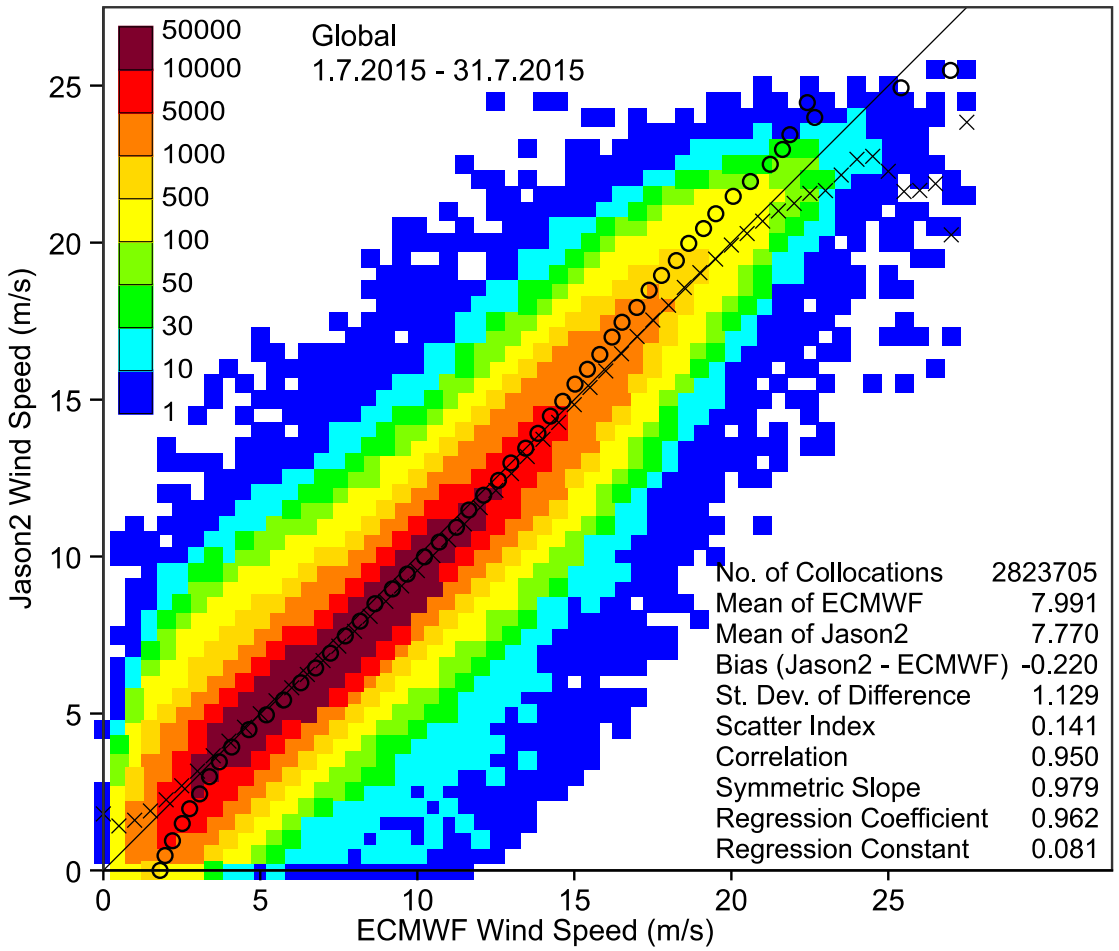
Wind speed comparison between ENVISAT and the buoys



Bias & SDD with respect to buoys



Wind speed comparison between Jason-2 and ECMWF model



TRUTH?

Unknown!

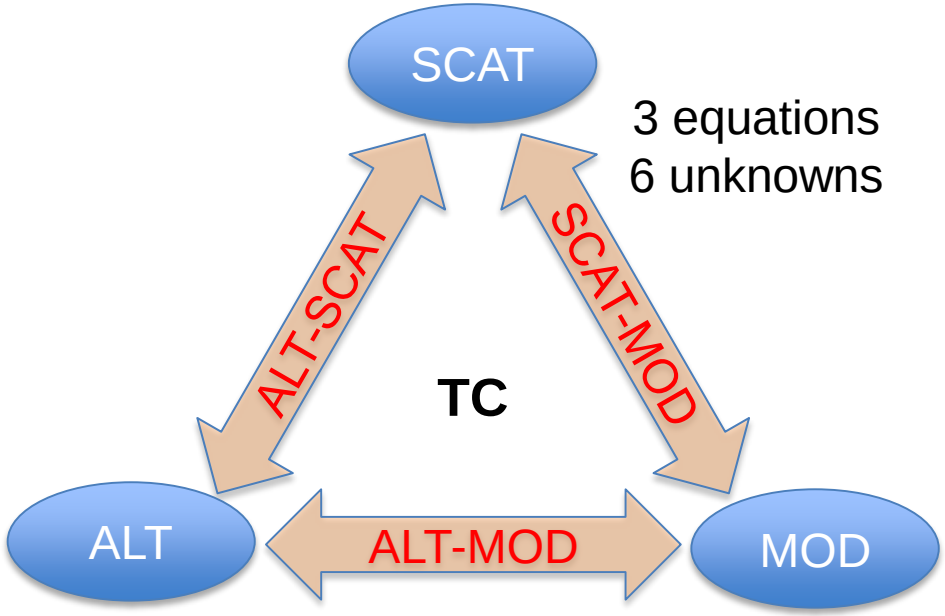
Triple Collocation Technique

Great!

But it makes several assumptions which are *sometimes* violated easily!

Altimeter – Model – Scatterometer Collocations

- Altimeter: Jason-2.
- Model: ECMWF IFS
- Scatterometer: ASCAT-B (A provides same results).

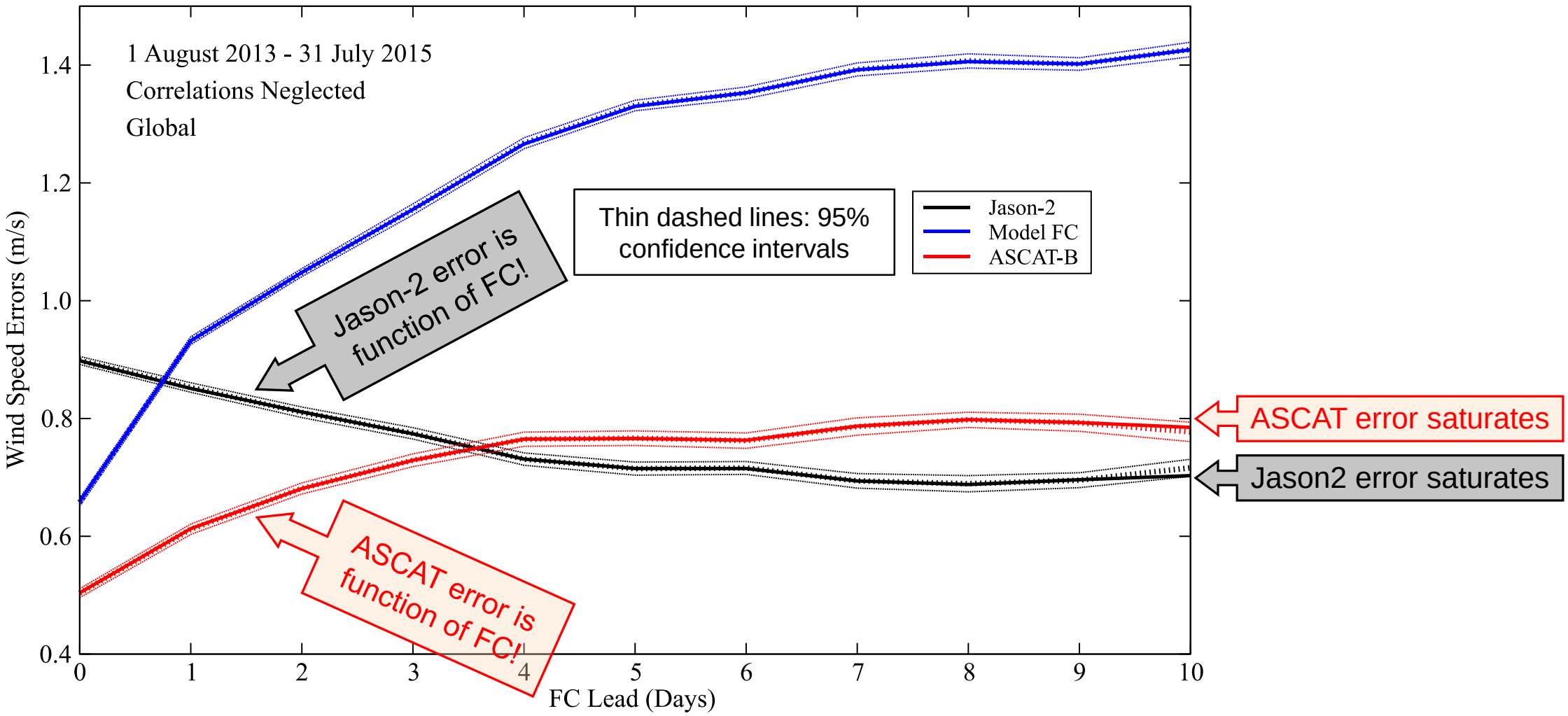


- Period: 1 August 2013 – 31 July 2015 (2 years).
- Only assimilated ASCAT data (good quality).

- Comparable scales by averaging altimeter data ➔ 70~100 km.

- Triple collocation (TC) assumes no (or known) correlation among data sets.
- The model assimilates ASCAT data ➔ correlations! (violation to the assumptions).

Errors estimated by ignoring the correlations



Altimeter – Model – Scatterometer Collocations (cont'd)

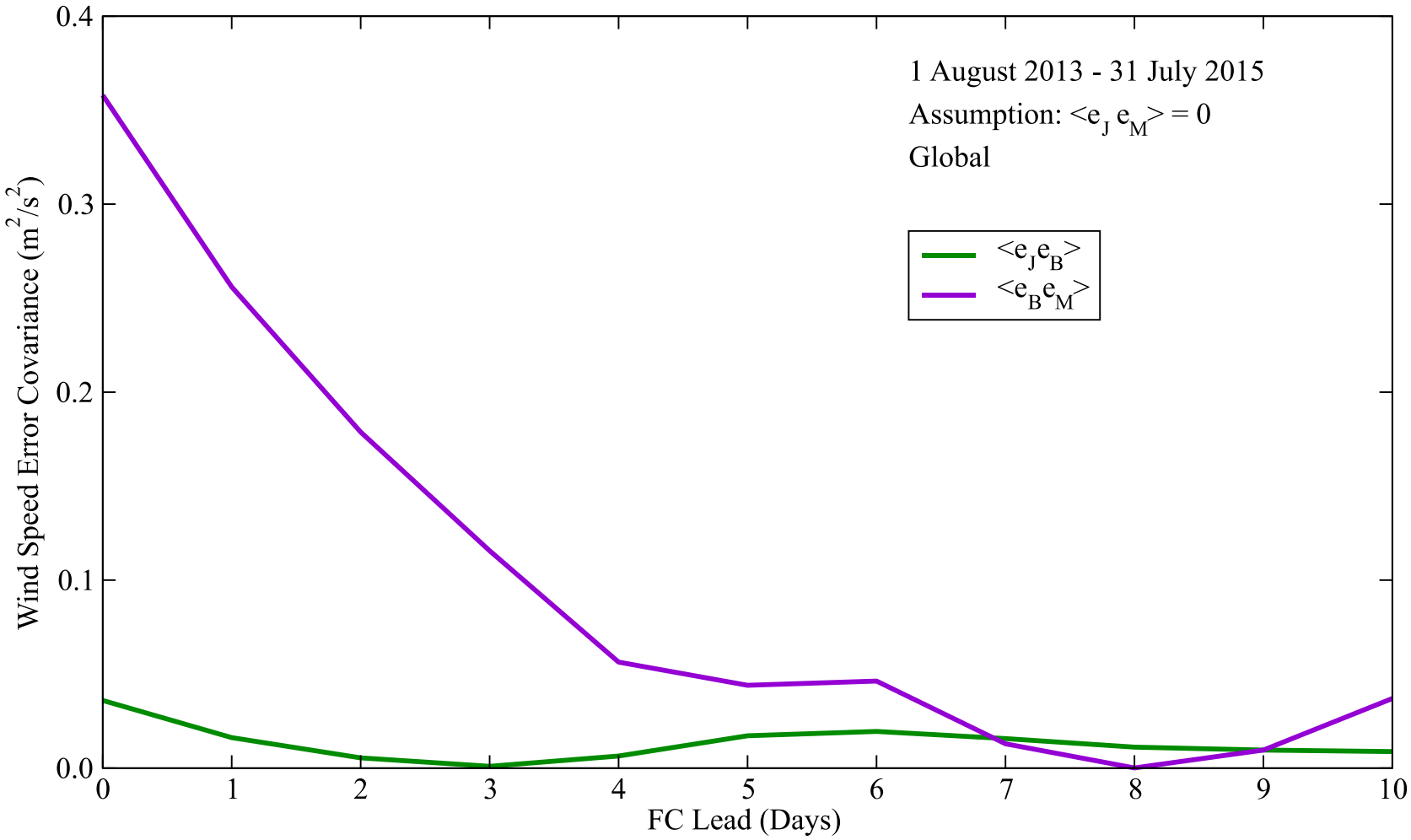
- Model error increases with increasing the FC lead time ➔ OK.
- Altimeter and scatterometer errors should not depend on FC lead time.

- The model assimilates ASCAT data ➔ correlations (which were ignored).

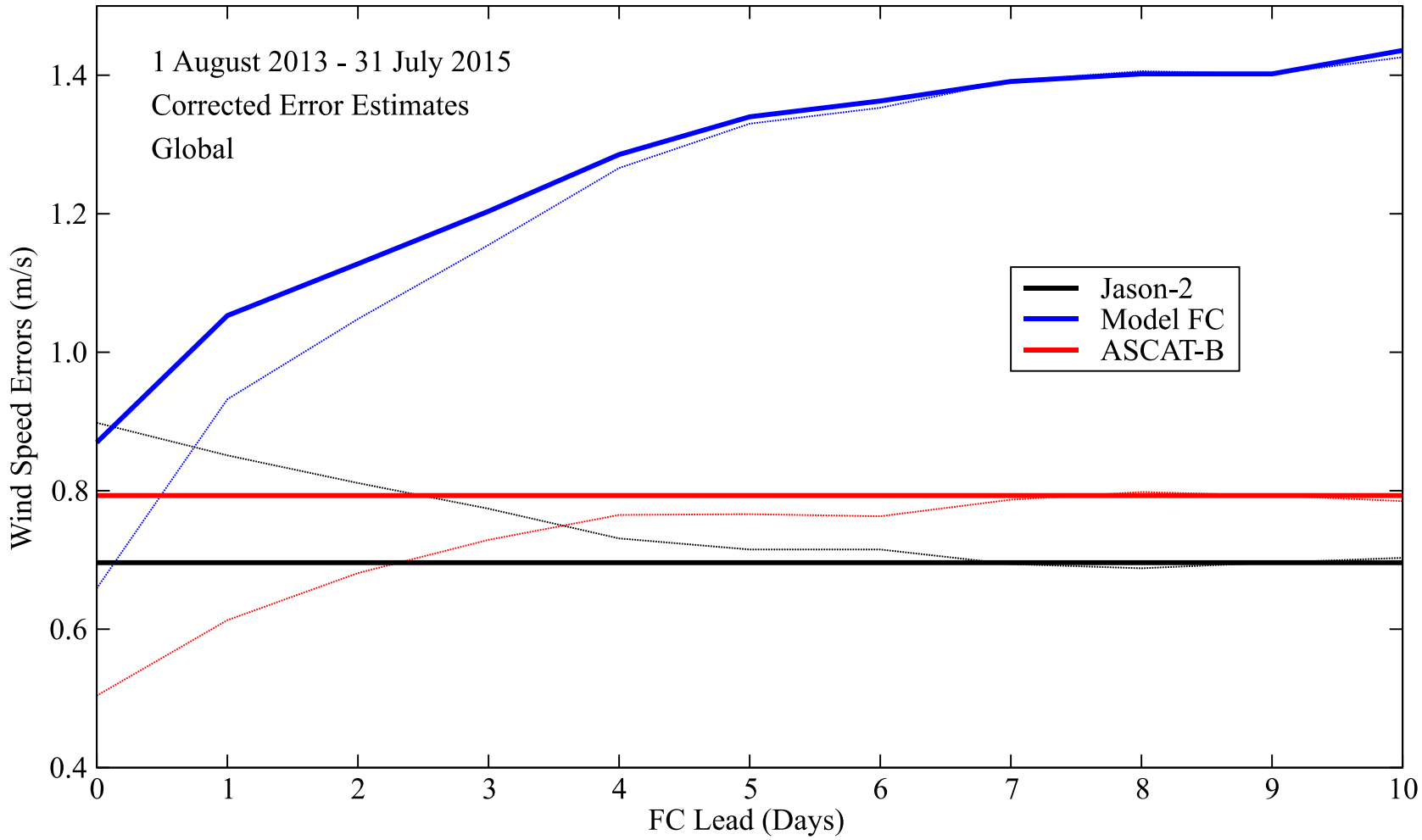
- Altimeter and scatterometer errors asymptote at long lead times (> ~7 days).
- Correlations between ASCAT and the model almost vanish.

- We can estimate the correlations (2 out of 3 only) and correct the error estimates.

Estimation of correlations (covariances)



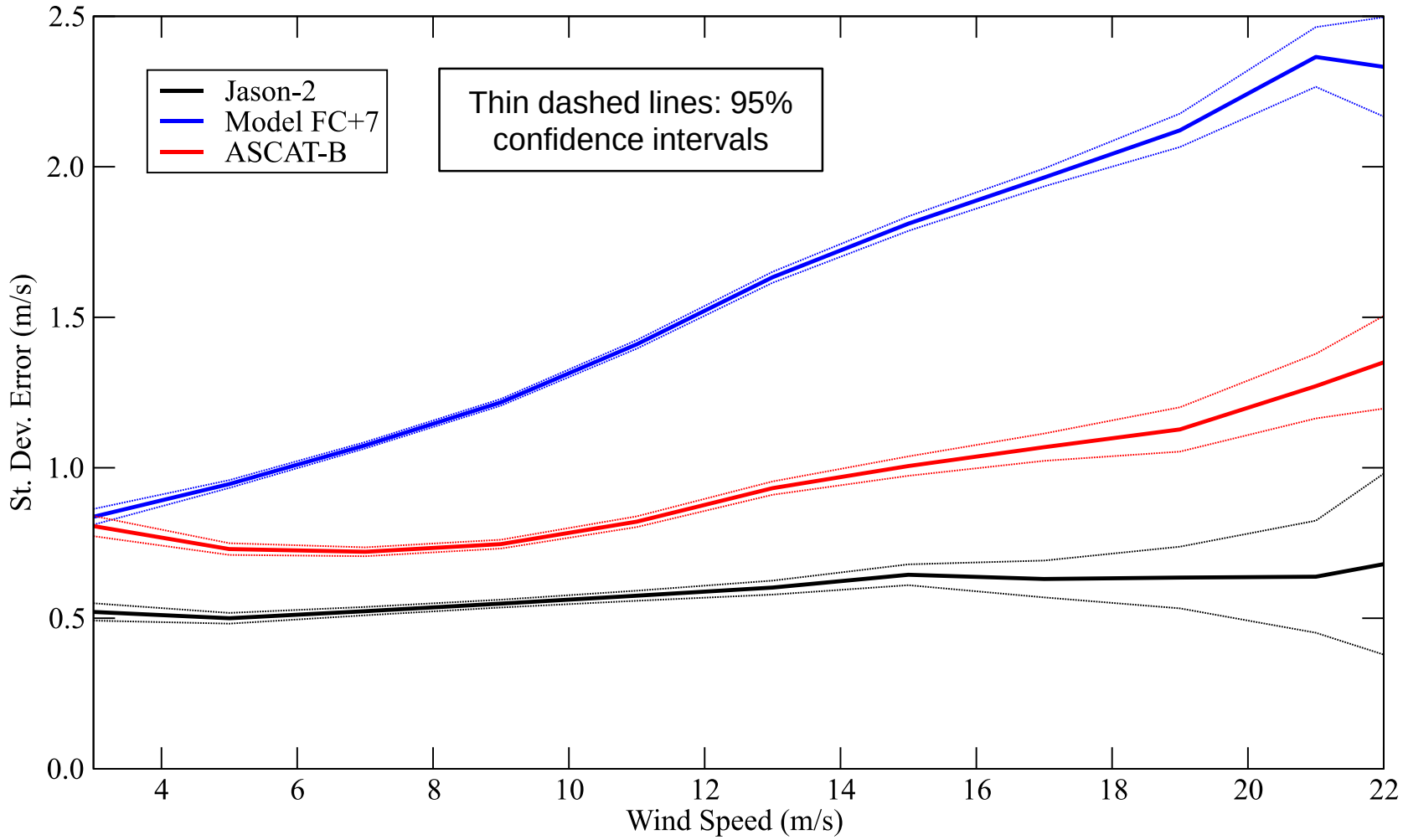
Errors corrected for correlations



What about high winds?

- Over two years collocations between ASCAT-A/B and Jason-2 resulted in very limited (less than 100) collocations with high winds (> 25 m/s) to provide reliable results.
- Triple collocation technique is used to estimate errors for (overlapping) bands of wind speeds.
- Jason-2 and ASCAT-B errors are rather constant for the range of wind speeds below ~22 m/s.
- The model error at 7-day lead time is a rather linear function of wind speed.

Change of error w.r.t. wind speed

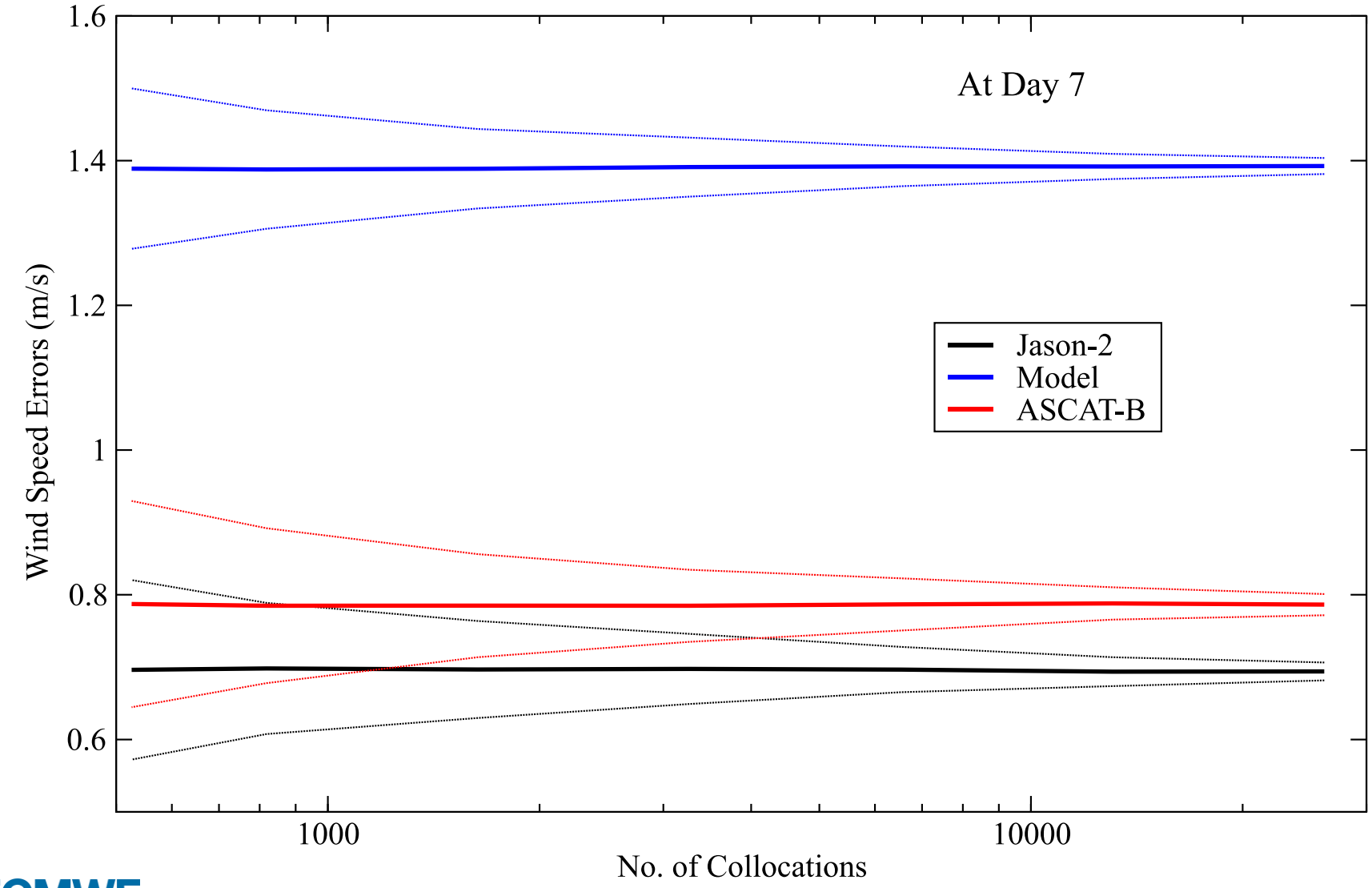


Concluding Remarks

- Wind speeds from altimeters and scatterometers have low errors for scales in the order of 100 km. Those errors are weak functions of wind speed.
- The error in the model analysis is comparable with altimeters and scatterometers.
- Some error correlations can be estimated by using model forecasts at 7-day lead time or beyond.
- There is a considerable correlation between the model and scatterometer data which cannot be ignored when using triple collocation.
- Error estimation at higher winds needs larger sample (covering more than 2 years).

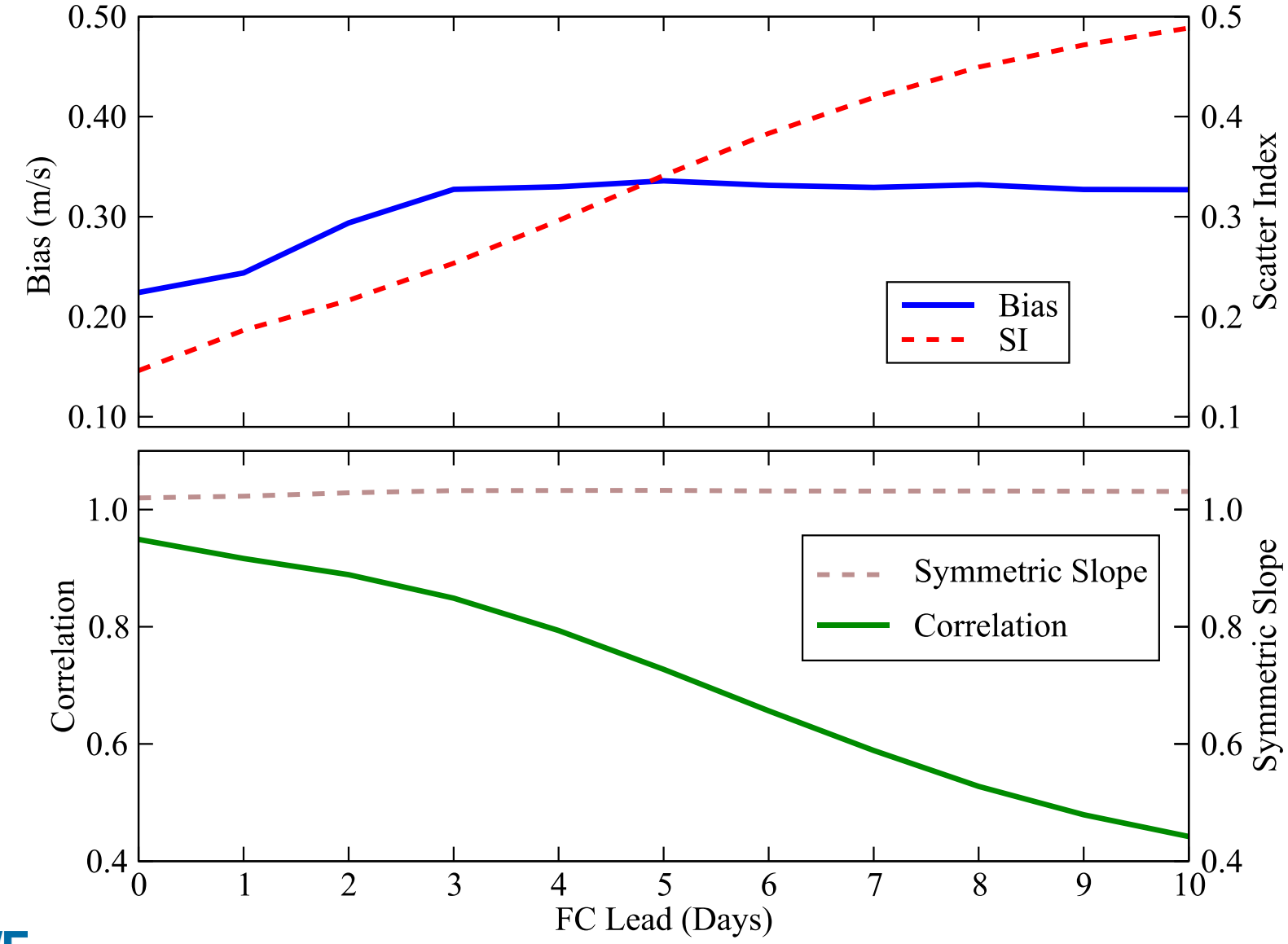
Thank you.

Impact of sample size on the results



ECMWF

Model forecast skill



ECMWF

Example on inconsistencies among missions: Altimeter mean Sigma_0 & mean wind speed