Review of the paper „A statistically optimal Analysis of systematic differences between Aeolus HLOS winds an NOAA's Global Forecast model"

The paper describes a bias correction method, based on the on observation minus background statistics and relative error variances between the model background and Aeolus wind data. The paper showed that the first reprocessed HLOS winds (B10) used in this study still have large remaining mean differences compared to the FV3GFS model background. These biases vary with latitude, height, orbit phase and HLOS wind speed. To correct these biases a total least square (TLS) regression method was used. Here the authors assumed a linear dependency of the bias with wind speed. The TLS method was calculate for each orbital phase, vertical layer and 10-degree latitude band over a period of 7 days. Separated for both, Mie and Raleigh channels. The necessary error variances were estimated using the Hollingsworth-Lonnberg method, which is based on obs minus background statistics. In a comparison to the normal linear regression methods the strength of the TLS method was shown.

In the following, I have only some small suggestions for some minor revisions

Lines 62-70. First, you said that NWP models have large uncertainties in regions where conventional observations are missing. Do you mean analysis uncertainties or forecast uncertainties? Also with observations, the models tend to evolve towards their own climatology over long forecast lead times because the forecast errors become much larger than the analysis errors. Can you clarifiy these sentences a little, and can you you taken into account the different use of satellite radiances between the different centers which can explain a lot of the differences you mentioned in data sparse regions.

It is also not clear to me which backround you use in Fig. 1 and further. In a 4d-VAR or 4D-ENVAR the background is a time series of forecasts over the used assimilation window. Which forecast lead time do you use ?

Line 78-81: I think that the use of ECMWF model fileds to crrect the M1 temperature bias can be neglected. Also to derive other observations like AMVs different model fields are used but their impact can be neglected almost all the time

Line 96: Innovation of Aeolus minus model is a double meaning since innovation means per definition obs minus background. Let the "Innovation of" away

Line 99: You certainly mean Section 2 instead of section 0

Line 119-124: Here you describe the quality control steps recommended by ESA and ECMWF. Do you use additional quality control steps like background check or variational quality control check etc. ?

Line 166 – 182: You assume that the Aeolus bias depends linearly on the Aeolus wind speed. Do you have any prove of this assumption. The bias can also have a non-linear part and if so do you have any idea how large the non-linear part can be.

Chapter 3: To show, that the innovations depend on Aeolus wind speed you can include a picture where on the y-axes you display the innovations and on the x-axes you display the Aeolus wind speed.

Chapter 3.1: In Fig. 9 and including text you describe the success of using the TLS method to reduce the speed dependent bias. Can you explain the high peak of your data count at zero wind speed? It seems the you bias correction enhance the negative bias for large positive wind speeds in case of Rayleigh winds. Can you explain that.

Chapter 3,2; In Figure 11 there are also larger biases visible in the Mie descending orbit for small wind speeds in the tropics. Can you explan that ?

Section 4: In Fig. 12 we see, that the differences between the TLS method and the different OLS regressions are relatively large although the same linear model and assumptions are used. Can you explain this ? You said that using OLS statistics underestimates the biases. How can I see that? What is the truth ?

At the end I think it would be a nice thing to show some assimilation and forecast results using your TLC method in comparison to not using your bias correction. At least some results from your assimilation cycle.