Response to Referee Comment (RC1) on

Investigation of dynamical scenarios leading to particularly high impact of Aeolus on NWP forecasts

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We greatly appreciate the referee's thoughtful and valuable review. The responses to the individual comments and the corresponding changes in the manuscript are presented in the following.

General Comment:

I find this to be an excellent study of the impact of a spaceborne Doppler Wind Lidar (Aeolus) on forecast quality in a state-of-the art numerical weather prediction system. In particular I like the links to atmospheric dynamics and well-known phenomena such as El Nino/La Nina, QBO and tropical cyclone transitions into extratropical storms. For these phenomena it is demonstrated that Aeolus has a particularly significant positive impact on forecast quality. Many of the phenomena discussed in this paper were highlighted already in the preparatory work done for Aeolus by the ESA Mission Advisory team. Their foresight motivated the mission on a scientific basis, and I think the authors of the study should acknowledge this. The underlying ESA reports are available via the ESA website. I append a pdf of the paper with some detailed comments.

Specific Comments:

Comment #1 (line 21):

I think the authors should also acknowledge the foresight shown in the two ESA Mission Science reports that were published in 1999 and 2008. In particular, the potential impact of Aeolus data in the tropics and the possible impact on storm dynamics in midlatitudes were foreseen in the reports and motivated the mission. The reports can be found on the ESA website, links:
https://www.esa.int/About_Us/ESA_Publications/ESA_SP-1311_i_ADM-Aeolus_i

Response to Comment#1:

Thank you very much for this hint and the links to the relevant reference. To acknowledge the foresights about the potential impact of Aeolus observations in NWP highlighted in the ESA Mission Science reports, we have added the following statements and references to the introductory part:

Therefore, direct wind profile information from the Aeolus satellite is expected to be particularly efficient in NWP for the understanding of tropical dynamics on all length scales and the prediction of smaller-scale phenomena at higher latitudes (ESA, 2008). Furthermore, the ESA Mission Advisory team highlighted potential benefits from the Aeolus wind observations for improvements in the characterization of severe and intense storm developments and scale interaction processes associated with atmospheric wave activity (ESA, 1999, 2008, 2016).

ESA: Atmospheric dynamics mission. Mission Selection Rep., ESA SP-1233(4), 1999.

ESA: ADM-Aeolus Science Report, ESA SP-1311, 121 p., https://earth.esa.int/documents/10174/1590943/AEOL002.pdf,, 2008.

ESA: ADM-Aeolus Mission Requirements Documents, ESA EOP-SM/2047, 57 p., http://esamultimedia.esa.int/docs/EarthObservation/ ADM-Aeolus_MRD.pdf, 2016.

Comment #2 (line 88):

Reference needed

Response to Comment #2:

Unfortunately, there was a mistake in the bibliography file. That has been fixed and the associated reference is now displayed in the text:

Rhodin, A., Lange, H., Potthast, R., and Janjic-Pfander, T.: Documentation of the DWD Data Assimilation System, 2017

Comment #3 (line 174):

What is meant by "turning circle"?

Response to Comment #3:

The turning circles is defined as northernmost or southernmost latitude over which the sun is just at the zenith at the time of the solstice, thus at 23°27' north and south latitude. However, to avoid confusion, we have changed it to **Tropic of Cancer (~23°)**, as this is a more familiar term.

Comment #4 (line 261):

Please spell out RWP (Rossby Wave Packet?)

Response to Comment #4:

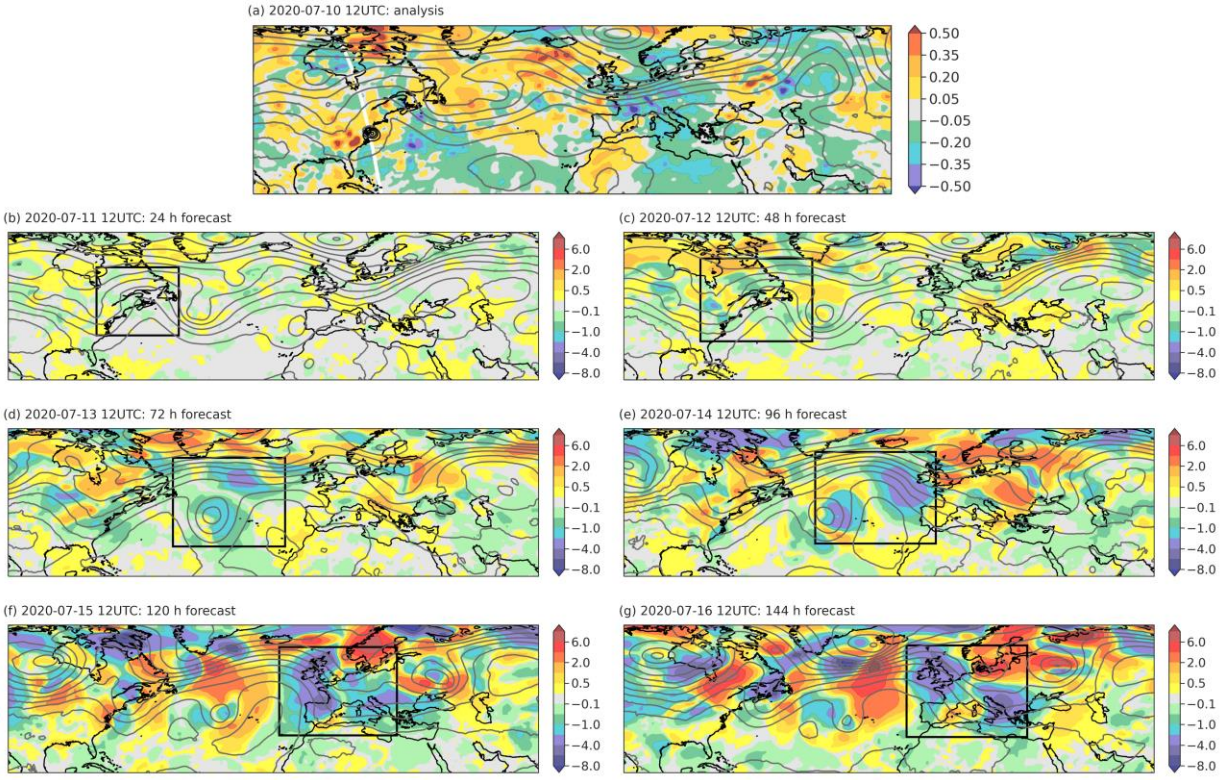
Since RWP is a fairly common abbreviation for Rossby wave packet, we prefer to use this instead of the spelled out version. We introduce the abbreviation in the introduction in line 57: "**… of tropical cyclones in association with synoptic-scale Rossby wave packets (RWPs).**"

Comment #5 (Figure 7):

It is a bit misleading to use the same colors for very different forecast difference values in the different subplots.

Response to Comment #5:

Thank you for this comment. Indeed, a uniform colorbar shows more clearly the increase in forecast differences with lead time. We have adjusted the color scale accordingly.



Comment #6 (line 312):

Forecast improvement is related to Aeolus observations in the ET Fay area rather than the event itself.

Response to Comment #6:

We agree that the formulation is misleading and revised the sentence as follows:

This spatial perspective of the individual forecast times along the wave packet further supports the assumption that the downstream forecast improvement is related to the Aeolus observations in the area of the ET of Fay and preceding nearby observations.

Comment #7 (line 320):

Why Mie rather than Rayleigh? Due to reflections from upper-level cirrus clouds?

Response to Comment #7:

Yes, we hypothesize that the impact of Aeolus around the discussed ET events is mainly due to good coverage of the upper-level divergent outflow by the Mie wind observations. To make this more clearly we slightly modified the sentence:

But it was found that the area around the upper-level divergent flow of the ET examples in Fig. 8a-c were all well-captured by the Aeolus Mie observations during the onset of the transition (not shown here). ----------

Comment #8 (line 395):

The busts are not predicted, it's rather the predictions that contain busts!

Response to Comment #8:

Thank you very much for your comment, this is an important point. We agree that the formulation was inaccurate and revised the wording as follows:

Besides the Northern Hemisphere and tropical dynamics, a better assessment of the large impacts found in the southern parts of the world would be an interesting research study, especially since the causes of forecast busts in the Northern Hemisphere are much better understood.