

Interactive comment on “A global perspective on atmospheric blocking using GPS radio occultation – one decade of observations” by Lukas Brunner and Andrea K. Steiner
Anonymous Referee #2

We thank the reviewer for the positive assessment and helpful comments. Please find our responses to the comments highlighted in bold below.

General comments

The paper "A global perspective on atmospheric blocking using GPS radio occultation – one decade of observations" by Brunner and Steiner analyses 10 years of blocking events as detected in GPS Radio Occultation (RO) data. Climatologies of blocking events as detected in RO data and in reanalysis data are studied: frequency as function of longitude and hemisphere, time evolution of blocking, and seasonal characteristics. The impacts of blocking on vertically resolved atmospheric temperature and specific humidity are investigated.

This paper presents an interesting application that utilizes the high vertical resolution of RO measurements - which is a unique feature of RO amongst satellite observation techniques. Global statistical studies of blocking have up to now been using models or reanalyses. Here, it is quite convincingly shown by Brunner and Steiner that RO data can be used as a fully observation-based alternative to the models.

The study seems to be an extension of a previous study by Brunner et al. [Atmos. Chem. Phys, 2016] in which the fundamental blocking detection technique is developed. The new study provides a 10-year climatological view, based on the previously developed techniques.

It is a well-written, clear, and concise report of the work undertaken. It is an interesting example of RO data contributing within a rather mature field of meteorology and atmospheric sciences. And, as also pointed out in the paper, it is a field that recently gained renewed attention due to its coupling to extreme weather, heat waves, etc. It also seems that the potential shortcomings of the RO method for this particular application (mostly due to a low horizontal resolution due to under-sampling) are pointed out and at least partly explained. The paper is well suited for publication in AMT.

Specific comments - only minor

Abstract, line 11: "equator-ward" should be "equatorward". Search for these, there are several of them in the text. Also "pole-ward" which should be "poleward".

We replaced “equator-ward” by “equatorward” and “pole-ward” by “poleward” throughout the manuscript.

Abstract, line 12: "anti-cyclonic" should be "anticyclonic". Search for this throughout the text.

We replaced “anti-cyclonic” by “anticyclonic” throughout the manuscript.

Section 2.1: Which RO missions are included in the analysis? I don't find that information in this section. Perhaps it is found in one of the references.

Information on which missions are specifically included, is found in the references cited in Table 1 for each reanalysis, respectively. For ERA-Interim, data from CHAMP, FORMOSAT-3/COSMIC, GRACE, MetOp, and TerraSAR-X are included (Poli et al. 2010, Table 1; Dee, 2016). For JRA-55, data from CHAMP, SAC-C, FORMOSAT-3/COSMIC, GRACE, MetOp, TerraSAR-X, and C/NOFS are included (Kobayashi et al. 2015, Appendix A). For MERRA-2, data from CHAMP, FORMOSAT-3/COSMIC, MetOp, GRACE, SAC-C, and TerraSAR-X are

included (see McCarty et al. 2016, Section 2.3.2).

We added the following information at the end of Sect. 2.2:

“All three reanalyses assimilate RO data. ERA-Interim includes measurements from CHAMP, COSMIC, GRACE, MetOp, and TerraSAR-X (Poli et al., 2010; Dee, 2016), MERRA-2 additionally includes SAC-C (McCarty et al., 2016), and JRA-55 all the former plus C/NOFS (Kobayashi et al., 2015).”

Section 4.1: A specific day and grid cell is defined as either blocked (if certain conditions described in Section 3.1 are met) or not blocked. If I understand it right, Figure 1 shows the overall frequency of blocking (i.e, Nblocked/Ntotal) for the whole 10-year period. What does "annual" blocking frequency mean in this context? I assume it means that data from all seasons are included, but to me "annual" indicates that data are separated into years.

As the reviewer correctly assumes “annual” indicates that all seasons are included. This is consistent with the wording of the IPCC 2013 report (AR5; Box.14.2, Figure 1) where the phrase “Annual mean blocking frequency” is used to indicate that all seasons are included.

To make this clear, we now refer to “annual mean blocking frequency” in the caption of Fig.1 and in the related manuscript text in Sect. 4.1.

Section 4.1, line 29: what does "one-dimensional" blocking frequency mean?

We thank the reviewer for raising this question. The definition of one-dimensional blocking frequencies was indeed not included in the methods section.

In the revised version we state the definition of “one-dimensional” blocking in Sect. 3.1, last but one paragraph:

“Reducing the longitude-latitude view, one-dimensional blocking frequencies consider a given longitude in the northern or southern hemisphere as blocked if at least one latitude is blocked.”

References, line 19, Brunner and Steiner: "amtospheric" should be "atmospheric"

We corrected it.

Additional references:

Dee, D., Fasullo, J., Shea, D., Walsh, J., and National Center for Atmospheric Research Staff: The Climate Data Guide: Atmospheric Reanalysis: Overview & Comparison Tables, <https://climatedataguide.ucar.edu/climate-data/atmospheric-reanalysis-overview-comparison-tables>, accessed November 15th, 2017, 2016.