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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Representation of the Tropical Stratospheric Zonal Wind in Global Atmospheric Reanalyses" *by* Y. Kawatani et al.

A. Hertzog

albert.hertzog@lmd.polytechnique.fr

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In this detailed study, *Kawatani et al.* (2016, hereinafter referred to as K16) present an intercomparison of monthly-mean zonal winds in the tropics in recent reanalyses. While focusing on monthly means is fully justified when tropical large-scale circulations (like the Quasi-Biennial Oscillation or quasi-stationnary planetary waves) are addressed, I would like to emphazise that such a time average ignores a significant fraction of the wind variability in the tropical lower stratosphere. Indeed, propagating dis-

turbances associated with planetary waves trapped in the equatorial wave guide (e.g., Kelvin and Rossby-gravity waves) are essentially discounted in K16, even though reanalyses in principle have sufficient horizontal and temporal resolution to resolve most of these waves. It might thus be appropriate that K16 briefly discuss the implications of such time averaging on their results. Two references are provided hereinunder to that purpose, and also to bring up some elements on reanalysis agreement vs accuracy.

1. K16 show that the agreement between reanalyses in monthly-mean zonal winds has continuously improved since 1979. The standard deviation (SD) among reanalyses reaches zonal-mean values of ~ 1 m s^{-1} at 70 hPa in the last decade they studied (2001-2011), and never exceeds 1.8 m s^{-1} locally (their Figures 14 and 15). Despite the difficulties of constraining the tropical-stratosphere dynamics in atmospheric models with observations (which are recalled by K16), these SDs are quite impressive, as they are less than the assumed uncertainty associated with radiosonde winds in most models during the assimilation process. Yet, such good agreement likely does not apply to instantaneous reanalyses (i.e., without monthly average): *Baker et al.* (2014) (their Figure 2) have for instance shown that, in 2010, the zonal-mean SD between ECMWF operational analyses and NCEP GFS in zonal winds at 300 hPa is typically 3 m s^{-1}, and can reach values over 5 m s^{-1} over the eastern Pacific and Indian Oceans, i.e. at least three times the values reported in K16: according to K16, the SD at 300 hPa should be less than in the lower stratosphere (their Figure 1 and 13).

2. Away from regions with assimilated observations, an agreement between reanalyses does not necessarily mean an equivalent agreement with observations, even in the most recent decade. For instance, *Podglajen et al.* (2014, hereinafter referred to as P14), who compared reanalyzed winds with independent in-situ observations performed along long-duration balloon flights in 2010, have reported occurrences where ECMWF operational analysis, ERA-interim and MERRA products all agree, while the balloon observations depart from them (see

their Figure 4). These events, which are associated with equatorial waves, induce discrepancies between reanalyses and observations that can reach values as large as 10 m s^{-1} and last for weeks. They once again tend to occur over areas with (very) few radiosounding stations: the Eastern Pacific and Indian Ocean. In these areas, observational increments are very low (about 1 m s^{-1} or less, see Figure 11 in P14), and the model dynamics is essentially running freely in the lower stratosphere.

It may therefore be worthwhile to warn the readers that they should not over-interpret encouraging figures regarding the improved agreement between reanalyses reported in K16.

I finally note that the lower agreement between reanalyses during QBO shear phases reported in K16 likely has a counterpart in the agreement between reanalyses and observations, as discussed in P14. Shear layers indeed tend to reduce the vertical wavelengths of waves that propagate in the shear direction while they increase the associated horizontal-wind disturbances. The reduced wavelength means that the model resolution may become insufficient to properly resolve the wave disturbances, even though the wave signal is present in the assimilated observations (see for instance Figure 9 in P14).

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