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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Jet characterization in the upper troposphere/lower stratosphere (UTLS): applications to climatology and transport studies" *by* G. L. Manney et al.

Anonymous Referee #2

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Review of Manney et al:

The paper by Manney et al., introduces jet based coordinates to map comprehensive satellite observations of particularly UTLS data and segregating tropospheric and stratospheric data. The jets are identified by basically the wind speed and spatial separation (in the case of multiple jets) at a given longitude refining and modifying previous algorithms from other authors. Meteorological and observational data are then displayed in their relative distances to the locations, where jet streams are identified. The jet based coordinates are directly compared with equivalent latitude data and both coordinates are used to map satellite observations of ozone.

The authors demonstrate that jet based coordinates provide a powerful tool to map instantaneous as well as climatological observations and map collocated regions of strong gradients of PV and tracer (ozone, CO, CH_4) across the jet. They conclude, that jet based coordinates provide a more detailed view on the relation of gradients of e.g. PV and ozone and that equivalent latitude (EqL) coordinates tend to wash out this signature.
The paper is of high value and importance for the scientific community. It is very well written, methods are sound and the results are presented in a clear and concise way.
The paper is very convincing, but the only point I found a bit misleading is the interpretation of the equivalent latitude to jet based coordinate comparison. Therefore I clearly recommend the paper for publication after the following considerations have been addressed.

Main point: I would appreciate a consideration of the pros and cons of both methods on p.1868, l.11, since it is implied that jet based coordinates are superior over EqL representations. This clearly holds for jet-based processes, but not necessarily for a complete tracer climatology including non-jet longitudes. The jet-based aspect should be stronger emphasized in the conclusions along with the constraints and limitations.

The comparison of the PV and ozone contours of Figure 11 (center) and Figure 10 (top) illustrates, that the EqL-Theta view does not obscure tracer structures. It expands the sharp PV- and ozone gradients at the STJ. This is comparable to e.g. vertical ozone profiles, which are displayed as a function of Theta instead of altitude, which stretches the stratospheric part of the profile depending on the vertical Theta-gradient. The same holds here for horizontal gradients of PV (or EqL, ozone, CO) in the horizontal direction at the jet using EqL-coordinates. Therefore the gradients in Figure 7 are much less pronounced in EqL coordinates.
Second - as stated by the authors - the jet coordinates are only defined where a jet is

identified. EqL contains all longitudes, which put constraints on the direct comparison and interpretation of the relation between both quantities.
The weaker appearance of gradients is therefore the result of two things: Expanding a sharp PV (EqL) gradient at the jets and remapping of data filtered by different conditions.

The fact that Figure 10(top) and Figure 11(middle) both show ozone-following PV contours, illustrates correspondence in both coordinate systems. Fig. 10(top) and 11(middle), however, also illustrates the complementary information of both coordinates: The jet based coordinates show the relation to jet, the EqL coordinates demonstrate that a strong diabatic component leads to the high ozone tongues up to 300 ppbv below the tropopause and in vicinity of the jet. Note that this feature is much more prominent in the EqL representation, however the link to jet itself is better to see in jet-based coordinates. As such I don't see any coordinate superior over the other, both together provide a very powerful combination. Both remove to some extent undulations of the tropopause, but address different questions: Which role play the jets (and only the jets)? Where is PV conservation violated?

Minor: p.1838, l.23: The subvortex jet as part of the polar night jet: Maybe it would be good to emphasize here that the 'subvortex jet' is meant to be different from the upper tropospheric polar jet.

p.1854, l.14 ff (Fig.5): The Figure shows two local maxima of Equivalent latitude on a given Theta level (e.g. Fig.5, upper right, 420-440K). This is strange, since EqL on an isentrope should be continuously increasing from low to high Eql. Clearly this must be the result of the jet based remapping, but does a bimodal isentropic equivalent latitude distribution make sense? What is the physical background, when airmasses are normalized to jet altitudes in the vertical direction, when they are several thousands of kilometers away from the jet? Note that transport within the stratosphere is quasi isentropic, thus sloped downward towards the poles.

p.1855, l.22: The fact that the polar (subtropical) jet is washed out relative to the subtropical (polar) jet is explained by temporal non-coincidence. However, the latitudinal distance relative to each other at any given longitude is completely ignored, but seems to be the driving agent (see Fig. 1/2)

p.1856, l.25-29: Is it possible to plot ozone in the same coordinates? This would nicely illustrate the relationship between EqL and negative PV-gradients above the winter STJ.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1835, 2011.