

Referee Comments on “Measurements of the movement of the jet streams at mid-latitudes, in the Northern and Southern Hemispheres, 1979 to 2010” by R. D. Hudson, *Atmos. Chem. Phys. Discuss.*, 11, 31067-31090, 2011, [www.atmos-chem-phys-discuss.net/11/31067/2011/](http://www.atmos-chem-phys-discuss.net/11/31067/2011/) doi:10.5194/acpd-11-31067-2011.

This paper uses total column ozone data for 1979-2010 to identify “fronts” between tropical, midlatitude, and polar air and to analyze variability and changes in their position. The paper is clear, concise, and well referenced. It builds upon earlier work by the same author and extends that analysis in time and to the Southern Hemisphere.

#### General Comments (by page/line)

**1. Reality of trend.** The 10.2 degree latitude expansion of the tropical belt reported here is large in the context of the expansion computed based on other metrics, as reported in a comprehensive new study by Davis and Rosenlof (Davis, Sean M., Karen H. Rosenlof, 2012: A Multidiagnostic Intercomparison of Tropical-Width Time Series Using Reanalyses and Satellite Observations. *J. Climate*, 25, 1061–1078. doi: <http://dx.doi.org/10.1175/JCLI-D-11-00127.1> ). Therefore, it is important to ensure that this result is real and not due to data problems, and the temporal homogeneity of the ozone data is critical. The fronts (whose movement is the basis for the finding of a tropical expansion) are identified on the basis of particular threshold ozone levels (in Dobson Units), not on the basis of north-south gradients in ozone. Therefore, time-varying biases in the data, particularly when data from different satellites are merged, could strongly impact trend results. Based on the limited information presented here, I am concerned about the reality of the trends. One important step would be to clarify who made the corrections to the ozone datasets used in this study (31072/9). If that work was part of this study, more details are needed. If not, then more discussion and explanation of the literature is needed. In short, a stronger case should be made that the data are suitable for trend analysis.

**2. Details of regression analysis.** The “padding” of the seasonal terms with a dependence on the radiative forcing term in the regression analysis (31074/22) seems flawed in two respects. One is that there is already a radiative forcing term in the regression. The second is that no evidence is presented to defend the underlying assumption that somehow the seasonal variability in the ozone-derived fronts/jets is modified by time variations in radiative forcing. I’d suggest keeping seasonal periodicity and radiative forcing as independent regression variables.

**3. Interpretation of the analysis.** The discussion of the findings and figures in Section 5.1 of the paper (31075/16) is a bit problematic in several respects. (a) The main issue is that regression results are interpreted in terms of causality, with no process or modeling analysis to support such an interpretation. This can be easily remedied by changing words such as “effect”, “dependence”, “lead to”, to more neutral language, such as “is associated with”. (b) In addition, Fig. 4 does not seem to show a “distinct rise after 1992” (31075/18). To me, it looks more like a step change around that time, with little change thereafter. (c) More discussion of the large difference in the amplitude of the seasonal terms between the Northern and Southern Hemispheres (31076/2) seems needed, even if it’s only to note that seasonality in weather patterns is strong in the NH, due to greater proportion of land area. (d) Finally, the interpretation of the ozone fronts as indicators of jet stream locations is not demonstrated in this paper. If this was clearly shown before, that link should be clearly stated, along with any uncertainties in the correspondence between ozone and winds. If not, it might be better to avoid discussion of the jets and focus instead on the ozone fronts.

#### Specific Comments

31068/9 Clarify what is meant by “each of which has a distinct temperature profile”. Each front, each circulation cell, in the stratosphere or troposphere or both?

31068/14, and later 31073/27-31074/5 It's not clear whether the surface temperature is for both land and ocean or only ocean (SST).

31069/3 The distinction(s) being drawn between the subtropical and polar jets should be clarified. Is it a question of altitude, position relative to the front, something to do with the slant of the frontal zone? Also, the paper might mention that both are westerly jets.

31069/19 What is meant by "the center of the two frontal boundaries"? Is it the position midway between them?

31069/27 Consider deleting "poleward", as it presupposes a particular direction of movement.

31070/9 Clarify that Hudson et al. (2006) limited their analysis to the Northern Hemisphere. Later in the section, clarify that this study extends the analysis to the Southern Hemisphere, and fills some data gates in the earlier work.

31071/25-31072/4 Thank you for this useful discussion of the latitudinal limitation of the ozone data.

31073/11 Consider adding some discussion of Fig. 3 here, mentioning dominance of seasonal cycle, hemispheric differences, perhaps correlation between the hemispheres, ...

31074/5 I don't understand how SST data "include any change in the solar constant".

31077/3 In the discussion of changes in the areas of difference regimes, can you infer something about changes in the polar regime, based on the findings for the other two?

31078/4 Avoid using language suggesting (or declaring) causality, which has not been demonstrated.

#### Technical Corrections

31068/18 Consider changing "period of study" to 1979-2010.

31068/24 Delete "temperatures, precipitation" as these are part of weather patterns and the hydrologic cycle.

31073/24 Change "a linear regression routine" to "linear regression".

31073/27 Should "sea" be inserted before "surface temperature"?

31074/14 Specify that the zonal average wind used for the QBO index is at the equator.

31077/6 Change "above" and "below", which refer to a vertical dimension, to "equatorward" and "poleward".

31077/9 Should this be the start of a new paragraph?

31077/24 Specify the "period of study" here.

Fig. 1. The aspect ratio of this figure could be improved.

Fig. 6 caption. Are the seasonal terms "constant", or actually "periodic"?