

## ***Interactive comment on “Hemispheric transport and influence of meteorology on global aerosol climatology” by T. L. Zhao et al.***

**Anonymous Referee #1**

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This paper describes the year to year and seasonal variations in the hemispheric transport of aerosol and the role of meteorological processes in driving this variability. It provides useful insight into the modes of variability in hemispheric transport and relates these to large scale features of the global circulation and to climate oscillations such as that of ENSO. It identifies three meteorological factors controlling interannual variability, and quantifies the variability in aerosol loading over large continental-scale regions. The paper is certainly interesting and worthy of publication in ACP, but there are a number of important weaknesses that need to be addressed before publication.

### General Comments

In some parts of the paper there is insufficient quantification. The coefficient of variation of the anthropogenic loading is quantified in Fig 8 and in the conclusions, but

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there are other places where a similarly simple quantification would make the results clearer. How does the regional net flux vary from year to year? How does this flux (or loading) over the 10-year period compare between regions, and does it correlate with the ENSO index? How much do the wet and dry deposition fluxes actually vary, and how significant is this difference? Only the relative effects are currently described in the paper. At a more fundamental level, the paper also fails to quantify the overall importance of hemispheric transport for aerosols. While this has been described elsewhere, a brief sentence or two quantifying its importance would provide a clearer context for the reader.

The paper would benefit from some discussion of the uncertainties involved, particularly regarding possible biases associated with the location of sources within particular regions. Are the same features seen for different aerosol types with different sources and lifetimes, or are the results presented here dominated by a single type of aerosol?

It would be useful to include a brief discussion of the role of the NAO in the variability in mid-latitude/Arctic transport.

The English in the paper is generally reasonable, but there are quite a number of places where the grammar remains awkward, and these issues needed to be resolved before publication, ideally through editing by a native speaker.

Bracketed or slashed alternatives are used in a number of places (e.g., abstract lines 21-22). These break up the flow of the text and make interpretation of the meaning more difficult for the reader, and therefore they should be avoided entirely. Please rewrite these sentences replacing the alternatives or rephrase in full. For an entertaining explanation of this, see the article by Alan Robock in EOS, Vol 91, No.49, Nov 9, 2010. (Other cases in the text: p.10192 l.24-26; p.10200 l.16; p.10202 l.14-20)

Please try to reduce the number of acronyms, as unfamiliar acronyms can significantly hinder comprehension. The acronym "HAT" does not seem necessary here, as it can be replaced with "aerosol transport" (or "hemispheric aerosol transport" if needed) in

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most places.

#### Specific Comments

Abstract I.14-15: "HTAP regions" are not defined here. This could be rephrased as main northern hemisphere source regions, or alternatively the regions should be identified.

10189, I.10: How do the natural emissions vary? The meteorological variation in emissions is an important component of the interannual variability, and it would therefore be useful to quantify this briefly here.

How do the patterns described in section 3.2 and Figs 3-6 vary between years?

10193, I.1-3: You should relate these changes to the migration of the ITCZ.

The discussion in Section 4.2 would benefit from some tightening, and from further quantification, particularly for the deposition section where a table of deposition fluxes and variability could be provided for each region for wet and dry removal.

Section 4.3 presents an interesting and useful analysis. It would be helpful if the anomaly distributions presented in Fig 11 could be supplemented by a simple quantification of the overall impact of ENSO: do you see net regional changes in fluxes (if so, how much?) or just changes in inflow/outflow location within the region?

It would be valuable to include a final line in Table 2 that gives the coefficient of variation for the net flux out of each region.

Fig 2 would be clearer if the lines used 4 colors (one for each region) and two line styles (one for W, one for E). Currently NAW and EUE are difficult to distinguish.

Figs 3-6 currently contain both shading and contours, and the winter shading is much easier to interpret than the summer contours. The figures would be clearer if the summer fluxes were plotted separately (i.e., 4 panels for each figure rather than the current 2) so that winter and summer fluxes can be compared side by side. All panels in a

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single figure should use the same color scale so that they can be directly compared with each other. The figures would also be clearer if the vertical scale was presented in km rather than m.

Fig 8: remove "changes of" in the caption.

Fig 11: The panels contain too much detail and the resulting figure is difficult to interpret. Please consider plotting fewer streamlines and reducing the line thickness so that the underlying shading can be seen.

#### Technical corrections

10183, I.5: add Northern Hemisphere and remove the acronym NH.

10185, I.1: "Only 1 yr" -> "A single year"

10189, I.13: form -> from

10191, I.14: built

10197, I.2: Sect 4. -> the next section.

10203, I.4: financial

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 10181, 2012.

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