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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Transpacific transport of Benzo[a]pyrene emitted from Asia: importance of warm conveyor belt and interannual variations" *by* Y. Zhang et al.

Anonymous Referee #1

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General comments: The topic of PAH behavior in the environment is an important, underresearched one, particularly with respect to global-scale modeling. Transpacific transport of a number of contaminants, including CO and Hg, as the authors state, is a growing concern, and model and measurement studies are much needed to better understand and quantify pollutant transport pathways from rapidly-developing economies in Asia with increasing pollutant emissions.

Unfortunately, this paper is not yet in a form which is able to credibly address these critical questions. My main concern is that the validation and comparisons shown do not seem to support the conclusions drawn. In a modeling study of these compounds

I do not expect model-measurement comparisons to be as clear as they are for well-studied compounds like CO. Correspondingly, however, authors should be cognizant that limited reproducibility of observations dramatically limits the type of conclusions that can be drawn from this data. I would suggest that the authors might think more critically about scientific questions they can answer using their modeling framework – potentially, more detailed studies of the Asian environment, as the model performs quite well there. In addition, the 1948-2007 comparison seems premature and not based on any data.

I also have several specific comments on the model and paper in general:

p 18982 line 18-20: unique chemical and physical properties of PAHs – what are these and have they been included in the model? I'm not sure how these pathways wouldn't be applicable if PAHs have the necessary atmospheric lifetime to travel. Overall lifetime seems to be the critical variable here, not properties (which of course may influence the lifetime. . .)

p 18983: line 10-11: BaP was chosen as representative. However, in Fig 1, BaP is compared with total PAHs. This seems inconsistent. Also, in emissions description, it seems as if full PAH emission was used. Were the BaP physical properties used for total PAHs here? PAHs behave very differently in the atmosphere from each other, and I'm not sure the single-compound approach is warranted. At a minimum, this should be clarified and described.

Section 2.1. model description: has this model ever been successfully used for diagnosing trans-pacific transport? If so, citations would be useful. If not, then this is potentially a very difficult problem to start out with for PAHs (can it reproduce CO events, for example, at the relevant sites in North America?) Some intuition about how the model behaves might be helpful to determine whether the poor performance in North America is due to the underlying meteorology or the PAH parameterization.

p 18984 lines 6-10: dry and wet deposition are critical processes influencing lifetime

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and need to be discussed in much more detail. Why is wet deposition proportional to precipitation intensity? Does this make sense for PAHs? What parameters are used to quantify solubility?

p 18984 line 16-17: does deep ocean exchange influence trans-Pacific transport? These seem to be processes that are important on much longer timescales than are considered in this paper.

p 18984 lines 20ff: How important is transport in soil? Especially in a paper that deals with trans-Pacific transport. Is this a substantial influence on the PAH cycle? (on the relevant timescales)?

p 18986 line 3-13: What is used for the surface area of aerosol in the model? All aerosol? Size distribution? Composition? Where is it from? Also, how is OH radical quantified? Daily? Diurnal variation? Monthly mean? This needs to be quoted. Some discussion about the lifetimes relative to these processes would be useful. Also, do surface-adsorbed aerosols react? What about absorption?

Section 2.4 – comparison with observations – this needs to be the focus of the paper. It seems as if the model does well at near-source comparisons (but not local source comparisons), but performance rapidly degrades with long-range transport. This is simply unacceptable in a paper that deals with long-range transport. Also, some comparisons of mean concentrations are necessary – what about the ratio of mean concentrations at long-distance and at source regions? It seems as if there might be a bias, which would indicate a problem with the lifetime of PAH in the model, which is critical for long-range transport as discussed above. Perhaps some other analyses of data vs model could illuminate this issue of lifetime.

3.1 Annual Mean transport: what sort of conclusions are drawn here with PAH that are different from any other tracer (like CO)? I'm not convinced that this is unique to PAH.

The conclusions on episodic transport, source contributions, and pathways are unfor-

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tunately not supported by the model validation.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 18979, 2011.