

Interactive comment on “Inter-annual variation of aerosol pollution in East Asia and its relation with strong/weak East Asian winter monsoon” by Min Xie et al.

Anonymous Referee #3

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In this paper, the authors examined the interannual variability of aerosols over East Asia, using MODIS AOD data, and NCEP reanalysis, in relationship to the strength of the East Asian Winter Monsoon (EAWM). They concluded that a recent long-term weakening of the EAWM contributed to increased aerosol in the central and southwestern China, Yangtze River Delta, Beijing-Tianjin-Hebei (BTH) and Szechuan Basin (SCB), and decreased aerosol in southern China. They also conducted numerical experiments using RegCCMS model to simulate strong and weak EAWM from 2000-2013, under conditions of prescribed aerosol emission for all years, to corroborate with their observational results. However, I don't see much similarity between the observed (Fig. 8) and the simulated (Fig. 12) AOD. Overall, this study does not add much new insight,

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but more confusion to previous studies on similar topics. I recommend a rejection of the paper in its current form. However, given that the subject matter is important, and the combined approach of observation analysis and modeling is valid, I encourage a re-submission, with major revision and additional analysis, along the following lines:

1. The use 500 hPA geopotential height variation over a small region in the subtropics an mid-latitudes to define EAWM index in Eq (1) maybe problematic. This index tends to give too much weight to the mid-latitude, and less to the tropical influence on the EAWM. In this paper, the authors emphasized the increased (decreased) in low-level meridional winds during strong (weak) monsoon over East Asia, in affecting the aerosol transport and distribution. The changes in meridional winds between strong and weak EAWM as defined by the authors EAWM index, is mainly confined to the eastern part of midlatitude East Asia, with little signal, such as cold air outbreak during strong EAWM, over tropical East Asia. The EAWM is a large-scale phenomenon, covering much larger area than the domain used in the present analysis. A better index should include the magnitude of the slp of the Siberian High, contrasting with the low slp over the North Pacific, and the Maritime Continent (see for example, Wang and Chen 2013, and others). Such an EAWM index will give a much sharper contrast between the anomalous northerly/southerly flow over the entire East Asia region. Using different indices is also likely to change the years of strong and weak EAWM years used in their subsequent analysis. The authors need to consider more carefully the proper choice of the EAWM index used for their analysis, including evaluating how the use of different EAWM indices may affect their results.

2. The short-term MODIS AOD data record (2000-2013) and therefore limited samples of strong (2 years), and weak (4 years) of EAWM are not likely to yield robust results. The only strong signal is found over the Szechuan Basin. This may be due to one year of very strong signal of one sign over the region, dominating the sample. What is the level of statistical confidence of the observed AOD differences in different regions? Statistical confidence should also be computed for the modeling results.

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3. The authors discussed aerosol transport as the only factor (besides emission) that can affect AOD distribution. A strong vs. weak EAWM is likely to be associated with changes in atmospheric conditions such as stability, relative humidity, rainfall and aerosol residence time, etc., in affecting AOD. New insight may be gained by examining changes in some of these factors in affecting AOD between strong and weak EAWM.

4. The paper needs better organization and more careful English editing. Section 2.3 on RegCCM should be put in Section 4, before the discussion of the model results. The word “prove” is improperly used in many places and should be avoided, since the results do not really prove anything. At best they “show” or “suggest” certain lines of reasoning. Please make sure all figures are properly labeled. In some, e.g. Fig. 8, 9, 12, the labels are missing or obscured, and the wind vectors, e.g. Fig. 10, are masked by the dark coloring.

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