

Interactive comment on “Synoptic perspectives on pollutant transport patterns observed by satellites over East Asia: Case studies with a conceptual model” by Hyun Cheol Kim et al.

Anonymous Referee #2

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General comments: As the authors have already acknowledged in the summary and conclusions section, this manuscript lacks of (if not none) quantitative analyses and provides no conclusive findings. There are a lot of jumps between reasoning steps in statements throughout the manuscript with no solid supporting evidence present. In fact, most part of the analyses are descriptive and subjective. There are many validated scientific tools out there but none of them are used here. Further, the entire manuscript is just a display of all kinds of "observations" assembled, with no scientific validation of the datasets used and no uncertainty checks on them. It is not convincing to the reviewer that the manuscript in its current shape can be an independent scientific paper. However, the datasets and the plots the manuscript collected/produced can be

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useful supporting material for advanced quantitative analyses.

Specific comments: (1) What pollutants does this manuscript study for transport patterns? Satellite images/retrievals can be useful to track certain air pollution phenomena such as sand dust storms and forest fires. The fundamental reason for that is that the origin/source of sand dust and forest fire are obvious plus there is less secondary formation involved (Duncan et al. AE 2014). However it is not appropriate that the authors borrow the same method to analyze the transport of complex anthropogenic emissions and their contributions to regional surface PM concentration, especially if secondary formation are involved. It is difficult to image that satellite images/retrievals can separate the local and transport contributions to surface PM concentration at a certain receptor location. Without such a separation, how can a transport pattern be determined? (2) What uncertainties are with the satellite data used here? Air pollution is indexed by surface concentration of air pollutants. None of the satellite image or retrievals are direct observation of surface concentration of air pollutants. Satellite retrievals contain large uncertainties due to all kinds of factors such as cloud, aerosol layer, albedo, terrain etc. The uncertainty of AOD and NO₂ column data varies at different time and location. NO₂ retrievals are also dependent on what vertical profile used. There is no uncertainty check (or at least there is no QA/QC reported in the manuscript) on the satellite data used here. For example, in Figures 3&4, MODIS AOD has large areas with data missing, but at the same time and location, GOME-2 NO₂ has complete valid data available at those areas. Why this happened considering NO₂ are more sensitive to cloud and aerosol layers? (3) What uncertainties are with the modeling results that used to produce the simulated concentration maps? There is no evaluation reported for the model produced surface concentration maps. There are PM₁₀ measurements shown in Figure 9, why don't the authors use these information to evaluate the simulations? Can the authors find more measurements such as at other locations to evaluate the simulations? The 2006 and 2007 emissions inventory are used for all the 2013-2015 simulations. How accurate the old inventory can be used to represent the more recent years without projection? Especially there was a

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2008 worldwide economic recession/decline? And plus there is an air pollution control campaign carried out in China since 2013. (4) In addition, what ratios of PM_{2.5}/PM₁₀ are observed there? This is important information for meaningful analysis. (5) Satellite images are once (or twice)-per-day snap shots. Low-pressure system or frontal passage are moving fast, it can clean up all the things within just several hours. The arrival timing of such transport carried by these systems matters. What are the exact timing of the each panel in Figures 3-8? It would be very difficult to derive useful information from daily average maps for a rapid changing process. Satellite images can be taken before or after the arrival of cold front system at certain locations (it would be very rare the images were taken exactly at the arrival time). If it was taken before, the certain locations would be still under the control of the high-pressure system and would be more impacted by the local emissions. (6) Lifetime of NO_x emissions is short. NO₂ column data are usually used to represent NO_x emissions (i.e. local emissions, not transported precursors). The association of NO₂ column and AOD data are in fact showing the local contribution of anthropogenic emissions to PM concentrations instead of that being transported downstream by fast moving low-pressure system. (7) What mechanism can bring the lifted transported pollutants down to the surface with a fast moving low-pressure system? Are there different mechanisms working for different pollutants: dust, PM₁₀, PM_{2.5} and other precursor pollutants? Column data doesn't differentiate surface density from the density above. How do the authors relate lifting transport to surface concentrations? (8) Transport patterns need to separate local contributions and those being transported, if unable to do so, how satellite images can help to identify any transport patterns? Models with appropriate tools can help, but in that case, first, modeling results of air pollutant concentrations should be extensively evaluated, inventory should be updated and modeled meteorology should be evaluated too.

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