

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 #1

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This paper presents an interesting analysis of the relationship between air pollution transport and synoptic weather in East Asia based on weather maps, PM measurements and regional chemical transport modelling. The overall topic of this paper fits to the scope of this journal. However, I think that in the current version the weather typing method was not so objective, and the numerical simulation needs to be improved and validated. Moreover, the discussion part was mainly descriptions on pollution episodes and its associated synoptic weather condition based on horizontal patterns. More quantitative results and in-depth analysis are needed to improve the scientific significance of this work. The paper would benefit from improvements along several main lines, which should amount to major revision.

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Specific comments:

Conceptual classification of pollutant transport patterns in the work is too subjective. Numerical classification or other objective method is more applicable, especially in terms of pollution forecast.

As presented in Section 2, surface weather maps was utilized to determine regional pollutant transport patterns in the present work. However, long-range transport might be more related to 850-hPa and 700-hPa maps, especially for Asian Dust. Please justify why this work used surface maps.

WRF-CMAQ modelling: As described in the Section 3.3, the model was driven by NCEP GFS forecasts data. Here, reanalysis data like FNL with observation assimilation will improve the model performance in meteorology reproduction, and also transport of air pollutants. The authors mentioned that the model performance was presented in Kim et al. (2016). However, the modelling time period, meteorological input data and emission inventories used in the present work were all different from those in Kim et al. (2016). Thus, the model evaluation for this simulation (both meteorological parameters and pollutant concentrations) should be conducted and discussed in the manuscript. Observations at 105 surface monitoring sites (Section 4.4) can be used to validate the modelling results.

In Section 4, the authors only gave general pictures of horizontal distributions of surface pressure and satellite retrievals using combined plots. It makes no sense to repeatedly show the combined plots throughout the article (Figure 3-8). For the same reason, it's unnecessary to include too much introduction on the geo-referencing method in the manuscript. This section can be substantially improved by more in-depth analysis based on modelling results. Discussion on vertical structure/atmospheric stratification and its impacts on pollutant transport and dispersion will make more sense.

Warm conveyor belts (WCBs), which are associated with cyclones, are crucial in the long-range transport of air pollutants over East Asia. However, in this work, there is

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no discussion on WCBs. To clarify the relation between synoptic weather and pollutant transport, more focus should be paid on WCBs.

Most part of Section 4 is descriptive, lacking of quantitative analysis and constructive conclusions. The study period is less than two years, leading to the fact that the discussions are more like descriptions on pollution episodes, which has been addressed in detail by many existing studies. In addition, many conclusions need more support, for instance, the authors concluded that the PM pollution on December 30–31 was caused by anthropogenic emissions and Asian Dust transport without enough evidences. Checking the dust emission rate in the model and observed PM_{2.5}/PM₁₀ ratio can provide more useful information and supportive evidences. Besides, it should be noted that some pollution cases cannot be totally attributed to the transport. Some kinds of synoptic weather pattern might give rise to specific meteorological conditions (strong radiation, high air temperature, less precipitation and stable boundary layer) that favor the formation of secondary pollutions (NO₂ and PM) or the accumulation of locally-emitted pollutants. The aforementioned uncertainties should be discussed and clarified here. It is actually insignificant to describe the individual pollution episode and its transport pathway in this work. Long-term dataset and statistical analysis could further strengthen the quantitative conclusions and improve the scientific importance.

Technical Corrections: Page 5, Line 23: NIER and KMA need to be specified when they are presented for the first time.

Page 6, Line 4-6: surface PM₁₀ concentrations and KMA weather map are introduced twice in Section 3.1 and 3.2. Section 3.1 is too short to be a section, and the descriptions on graphical technique are redundant.

The quality of figures was too bad. The contour labels and legends in figures are not clear enough.

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