Interactive comment on “Spatiotemporal variations of air pollutants (O_3, NO_2, SO_2, CO, PM_{10}, and VOCs) with land-use types” by J.-M. Yoo et al.

Anonymous Referee #3

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This manuscript provided an interesting study about the long-term air pollutant levels in South Korea. The authors innovatively investigated the spatiotemporal distribution of pollutants base on land-use types. The topic is applicable for Atmospheric Chemistry and Physics; however several concerns have been identified. Major revisions as indicated in the comments and remarks below are needed before consideration of publication in ACP.

Generally, the current manuscript is not well organized and not concisely written, which makes it hard to read. For instance, in section 2 'Data and Method', the authors referred to Figures 7 and 8 (Page 16994) and discussed the land-use types (Page 16996). These explanation and discussion related to results should not be included in section 2. Lots of sentences in the current manuscript are not concise, for example, in Page 16999 Line 17-18), I don't think the authors need to list all the air pollutants investigated in Flemming et al. and Meng et al. Examples of not concise writing include: in Page 17009 Line 14, listing the unit of NO2 is not necessary; explanation about the instruments in section 2 is good but it contains too many details. There are so many places are redundant or repeat presenting same information. Especially in the conclusion part (section 8), the authors just list all the results discussed in previous chapters. It lacks emphasizing the major significance of this paper and does not discuss the possible uncertainty/error introduced in this analysis. In summary, careful revision of the manuscript is suggested to make it more concise and focused on the scientific contribution of this study.

The authors used two spatial resolutions of grids, 0.1 D and 0.25 D. However, after reading section 2, I still do not understand how these 283 site data are averaged into the 0.25 and 0.1 degree grids. Do the grids cover the whole South Korea and data are grouped into each grid? I also find one grid could be attributed to multiple land-use type, e.g. in Figure 5 areas near Seoul have been attributed to R, C, and I. How the data are processed? Also for readers who are not familiar with South Korea, it is hard to tell if the grids are urban, suburban, or rural, as well as the locations of major cities such as Seoul, Daegu, and Busan. Therefore, one map showing the raw AVHRR or MODIS land-use data and locations of the major cities is suggested. Another question is, after using 0.25 and 0.1 gridded data, what conclusion the author achieved? What are the pros/cons for each method? I found the current manuscript used both of them simultaneous and discuss the difference, but have any conclusions have been drawn? Overall, since the land-use types gridded are so important, I suggest the author add a separate section discussing this important part.

Data presented in this study are very comprehensive, and show the regional nature and trends of air pollution in South Korea. However, the current manuscript doesn’t discuss the possible influence from the changing world in the past decade. For instance, can the change of Asian summer monsoon influence the summertime ozone
pollution? How are the effects of land-use change on air pollution? Has any member
from monitoring sites, 0.1 or 0.25 grids been influenced by the recent expanded urban-
ization? For instance, how the Seoul or SMA expanded in the past decade, did the
land-use types of sites in or near SMA change from G to R/C? The revised manuscript
should take them into account and discuss their potential impacts.

Detailed Remarks/Suggestions for Revision

Page 16988 Line 14: As discussed above, details such as ‘for NOx’ are not necessary.
Using ‘Kim et al. 2011’ is suggested. Also ‘Wang et al. 2013’ does not discuss the
transport of air pollutants from China, please consider using the following two papers
as references:

Li C., N. A. Krotkov, R. R. Dickerson, Z.Q. Li, K. Yang, and M. Chin: Transport and
Evolution of a Pollution Plume from Northern China: A Satellite-Based Case Study, J.

He H., C. Li, C. Loughner, Z. Li, N. A. Krotkov, R. R. Dickerson: SO2 over Central
China: Measurements, numerical simulations, and the tropospheric sulfur budget, J.

Page 16994 Line 19: Why Figure 7 & 8 were introduced before Figure 2-6? This section
should only describe the dataset and method used in this study, so I don’t think Figures
that are discussed later should be mentioned here.

Page 16992 Line 10-12: As discussed in the general comments, please provide de-
tailed information about how to create these grids.

Page 17000 Line 3: As discussed above, please provide a map of South Korea showing
the major cities. Line 23-30: It is hard for me to comprehend the Table 6 and 7. For
instance, in line 24, it states ‘Table 6 shows the magnitude order . . .’. What is the
definition of ‘magnitude order’? Also I didn’t see any information about the order. Does
Table 6 accidently have the content of Table 7? Please re-write these sentences. Line
C5154

18: The production of O3 is through ‘photochemical reactions’

Page 17003: Line 9-10: The high concentrations of NO2 could also be caused by shal-
low PBL and slow photolysis rate. Line 20-22: Due to faster photochemical reactions
in summer, the atmospheric lifetimes of SO2 and NO2 are substantially shorter. So if
the transport from China dominates, it could be as important as summer Asian mon-
soon. Further discussion is suggested here. Line 26-27: As discussed in the general
comments, this sentence described the different characteristics of 0.1 and 0.25 degree
grids. It should be emphasized in the conclusion part.

Page 17008 Line 23-26: It is hard to comprehend, especially ‘Seoul was defined as
part of the SMA’ while you have 3 regions with/without the capital city. I found Figure
9b has this information, so it should be mentioned here.

Page 17010: Line 2-3: The ‘residence’ areas should also be close to main and sec-
ondary roads. Why all the regions next to roads are attributed to ‘commerce’ in this
study? Line 20: Same questions as above, ‘residence’ areas should have lots of traffic
emissions, so how can all the areas close to roads are grouped to ‘commerce’. I am
confused, and further explanation/discussion is expected.

Page 17012 Line 25-25: What could be the cause? Any possible explanation? Is
Seokmo downwind of major sources? A map showing these monitoring sites as well
as major cities is suggested.

Page 17016 Line 4-7: The authors cited the studies in South California to discuss the
‘VOCs-limiting’ photochemistry intensively in this manuscript. Based on VOCs concen-
trations presented in Figure 10 (VOCs in G is much lower than VOCs in R/I/C), VOC
measurements only focus on the traces of anthropogenic VOC emissions such as ben-
ze, and toluene. However, at least in the G areas biogenic VOCs emissions such as
isoprene could dominate. Are there any measurements or previous studies confirming
that the anthropogenic VOCs suppress the influences from biogenic sources in South
Korea as the study in Southern California of late 1990’s? i.e., do South Korea and
South California have the similar ozone photochemistry.

Page 17017 Line 15: The current conclusion part only re-listed all the results, and some of the materials are redundant. Rewriting (focusing on the scientific contribution of this study) is suggested. Also adding discussion of the possible uncertainty of this analysis is necessary.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 16985, 2015.