

Interactive comments on “Comparisons of ground-based tropospheric NO₂ MAX-DOAS measurements to satellite observations with the aid of an air quality model over Thessaloniki area, Greece” by Theano Drosoglou.

Referee:

In this manuscript, the authors report on a comparison of ground based tropospheric NO₂ MAX-DOAS measurements to satellite observations with the benefit of an air quality model. The main point is the spatial resolutions between different instruments, for this purpose, different satellite data and model data were used.

I am going to comment only the author's responses.

I recommend the publication after at least these two revisions:

In this paper, we need some clarifications, at every point, if you want to compare the three selected areas with satellite data, you should add meaning of the time shift, for example Page 1, line 20; here it is important to know the time of the campaign SC area!!

The wind data during the campaign should be shown.

1. The main point in this study is the adjustment factors, which are not clear, how they are determined, please clarify this point, maybe by an example. Maybe by a rescaling of satellite data is this study easier to explain.

The additional explanation to this point is acceptable but it could be declared better.

2. Few satellite data and many different models are used but we cannot find any map or plot from these data. Please try to visualize, what you use. I expect maps from all applied models and satellites (examples) in this study.

Figures 5 and 6 are the answer to this question. From these figures, we can see the gradients from the satellites so that the selected areas have low NO₂ values.

Actually, the figure 6 must be in the same frame as figures 5. The model data are used for the calculations of adjustment factors, it is interesting to see, if there is a strong or weak agreement between model and satellite data, this agreement should be done rough only from the maps.

3. The three measurement areas (fig. 1) are more complex because of the sea, how is this problem (sea land) in the model considered? This makes the selected albedo also complex.

Here, it was an easy answer, no, they did not.

4. The selected areas overlap each other, how is this problem considered?

Here it was the same answer, no. I think, at this point and last one, the authors neglect many important modeling points but I can understand that it is complicated and need the related knowledge.

5. The campaigns have different time periods, to compare these data-sets, we need the same time period. Maybe an additional fit for the overlapping time!

I think, the authors did not understand, how important the consistency of the data is. That is clear that you cannot repeat a campaign but this misunderstanding is represented in correlations and comparisons and consequently in the interpretations.

6. Please clarify the wind directions for the period of the campaigns.

Please add plots and data with references.

7. The map of satellite can show the variability of NO_x and corresponding the emissions, this means, if the applied OMI data shows really the emitted from this area or not.

From the satellite maps, we can see that the selected areas have low values, for the transport by wind, we need the related wind.

8. The comparison of the NO₂ tropospheric from different sites (UC, RC and SC) is less relevant because the data are from different time periods, for such comparison, you need the same time period.

9. The adjustment factors are more depend on the model data than OMI data; this rescaling can be used but it is somehow banal. Without any adjustment factors, the results can be seen from fig. 4, what I expect for OMI reconstructed.

Please see the answer number 1.

10. Generally, you can compare every ground based with every satellite with different time periods but in this case, you can not compare the results together.

Your measurements show few gradients but you speculate here that you do not have many gradients from satellite.

11. P4, l16: direct sun light, we have only scattered sun light, but if we look directly in the sun (still scattered), the measured spectra have structures, which should be removed from the analysis.

That is ok.

12. P5,I5: albedo: 0.1. The three different areas (UC, SC and RC) have definitely different albedos.

Albedo does not affect directly the NO₂ VCDs, if you expect first to see different VCDs then adopt different albedos, you are wrong. You have different surfaces. That is clear that you will get different albedos but I understand that it is difficult for you.

13. Fig. 5 down: Some pixels are missing after averaging!

The answer is OK.

14. Fig. 7: It is not clear to me, if you used all data from different campaigns with different time periods or not, if yes, they are not comparable in such form. You need a significant criteria, namely the same time period.

I think, we discussed at different points about this issue, I do not want to repeat.

15. Fig. 9: You cannot compare the slopes from different time periods specially with seasonal difference!

These three correlations in a figure is an obvious sign that the areas will be compared together.

By such a time shift of ground based measurements, it does not make much sense, the shape and the gradients of OMI is more and less the same for all three areas, now, it is important, at which time period, you did the measurements, for example SC area, that means, if the data are close to the background, the correlation is better. For this reason, you should remove these correlations or add enough clarification.