

Interactive comment on “Typical meteorological conditions associated with extreme nitrogen dioxide (NO₂) pollution events over Scandinavia” by Manu Anna Thomas and Abhay Devasthale

Anonymous Referee #2

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In their manuscript “Typical meteorological conditions associated with extreme nitrogen dioxide (NO₂) pollution events over Scandinavia“, Thomas and Devasthale report on a study evaluating the meteorological conditions under which the highest tropospheric NO₂ columns are observed in OMI data over Scandinavia. Their results show, that such events are linked to situations in which transport from the polluted regions in Europe towards Scandinavia occurs, that such events are mostly observed in winter and spring and that they persist for several days.

The topic of the study (impact of meteorology and long-range transport on pollution) is interesting and fits well into ACP. The paper is also well written, clearly structured and to the point. I have however several concerns with respect to the relevance and

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also the methodology of the study which need to be addressed before the paper can be considered for publication.

General points

- Probably the most important point is that I'm not sure what the relevance of the results presented in this manuscript really is. It is not surprising that pollution transport from Germany and the Benelux countries impacts on Southern Scandinavian air quality. As there is no attempt made to quantify the impact in absolute or relative terms, the study does little more than confirming what one would have guessed anyways. I think it would be good to try to become more quantitative in the sense of how many days are affected, what are the mean and maximum anomalies, and what is the relation to pollution from local sources.
- A second very important point is the use of OMI satellite data without separating cloud free and cloudy situations. While the argument for this approach is clear as many transport events are associated to clouds, such data cannot be easily interpreted as for cloudy conditions, the assumptions made in the retrieval become very important for the results. In the current manuscript, this point is not addressed at all and I think the authors need to investigate differences between cloudy and clear sky averages in order to better understand the impact of clouds on the satellite data. They also need to discuss uncertainties linked to the satellite retrievals.
- The tacit assumption made in this study is that NO₂ observed from satellite (partly above clouds) is indicative of enhanced NO₂ levels on the ground. I'm not convinced that this is always the case during transport events and it would be good to support the timing and location of their extreme NO₂ events by at least some surface observations showing that in deed air quality on the ground was also poor during the satellite observed pollution events.

- Definition of extreme cases is another critical aspect and I think that given the large seasonality of NO₂, monthly thresholds would be better than seasonal thresholds. I'm also a bit confused by the relevance of Figure 2b) showing the number of extreme events per month – isn't the number of extreme events per season constant the ways the authors define their thresholds, and therefore the distribution over months just reflecting the seasonality of NO₂?
- Considering Figure 3, I'm wondering why the situations with higher NO₂ over Southern Scandinavia appear to also have higher than normal NO₂ over the supposed source regions. Does this mean that under these conditions, pollution is accumulating in general? If this would be simple transport from Central Europe to Scandinavia, I would expect to see less NO₂ in the source region or what am I missing here?

Minor points

- Line 40: Add soil emissions
- Line 47: Does NO₂ really affect psychological health?
- Figure 3: Are these total or tropospheric columns?
- Figure 6: Not sure what is “the same as in Fig. 5” here
- Figure 7 a / b are difficult to read (too many lines)
- While the article is overall well written, there are many places in which I would add / remove articles. I therefore recommend another round of proof reading to fix these and other small English problems.