

## **Review of “NH<sub>3</sub> Spatio-temporal variability over Paris, Mexico and Toronto and its link to PM<sub>2.5</sub> during pollution events”**

### **Summary**

This paper analyses 10 years of IASI NH<sub>3</sub> data over three large domains, each of which encompasses a major metropolitan area (Paris, Toronto and Mexico City). The ten year average and seasonal means of the NH<sub>3</sub> total columns from the IASI instruments deployed on Metop-A and Metop-B are presented and the relationships between NH<sub>3</sub> amounts and temperature and precipitation are evaluated; the authors find a strong correlation between temperature and NH<sub>3</sub> amounts in the Paris and Toronto domains, but only a weak one in the Mexico City domain. This analysis is extended to sub-domain scales, focusing on a number of previously identified source regions, and expanded to include the effect of relative humidity. Many of the smaller domains show an interesting local maxima in the NH<sub>3</sub> vs temperature plot that coincides with fertilization activities.

The impact of wind direction on air quality is also examined, using back-trajectories from HYSPLIT and a cluster analysis, along with in situ PM<sub>2.5</sub> data from local networks. The PM<sub>2.5</sub> data is also used in conjunction with the NH<sub>3</sub> columns to identify and count pollution events; wind roses are then constructed to determine the wind patterns on days with high pollution; interestingly PM<sub>2.5</sub> and NH<sub>3</sub> are not always high on the same days. Finally IASI NH<sub>3</sub> and the local PM<sub>2.5</sub> data are compared against GEOS-Chem output for one month. This last analysis is interesting but too limited to provide really useful information on GEOS-Chem performance.

The paper is well laid out and clearly written. The plots are of high quality and in general easily understood, though a few require more detailed captions, described below. It requires only some minor edits and clarifications to be acceptable for publication. Overall, a good illustration of how to apply a number of different techniques and data sources to the problem of understanding the drivers of pollution events.

### **Technical comments**

Section 3.1: How are the IASI averaged and what is the grid resolution? How are the boxes for each source region defined?

Figure 3: Please comment on the high NH<sub>3</sub> values over the Arctic.

Lines 266-274: Is each back-trajectory associated with the 50 km NH<sub>3</sub> mean for that day? Could the authors please briefly describe the clustering approach? Are the NH<sub>3</sub> means clustered according to the corresponding back-trajectories?

Line 289: Which sources have increased near Toronto?

Line 303: What are the criteria used for defining a pollution event?

Line 313: It would be useful to add the spring plot here

Line 319: What does the radial distance in the wind roses in Figure 7 indicate?

Line 350: Please state the coincidence criteria.

Lines 360-364: I don't agree that the GEOS-Chem and IASI are in good agreement; the authors should state that the two datasets capture some of the same pollution events.

Figure S4: Are the bins for the RH plot also specified by temperature? This does not seem right.

### **Minor edits**

Lines 32-33: ... in Paris and Mexico **City**;

Line 65: However, NH<sub>3</sub> concentrations are increasing in many countries: France, Canada and Mexico reported increases of .....

Line 67: ... are composed **of** ...

Line 72: ...nitrate formed **from** ...

Line 127: ... are located **within** a 50-km

Line 134: ... the same **month**

Line 150: **Note** that

Line 153: ... daily 24-**hour** back-trajectories ...

Line 156: Finally, all back-trajectories are combined .... (not sure here what the authors mean to say)

Line 182: ... practices (**which are dominant** over Europe and North America)

Lines 205: ... **in this region closer to the Equator**

Line 220: ...(with **small contributions** from industries)

Line 255: ...nitrogen fertilizers **to**

Line 267: concentrations. **In order to** analyze ...

Line 280: ... associated with the **highest** ...

Line 281: ...on average, are **originating** ...

Line 322: ... concentrations are **observed**

Line 352: ...numbers of **coincident** observations

Line 403: ...sources **are**

Line 440: ... surrounding regions:

**Line 441: ...These lead**

Line 444: ... and Mexico **pollution is transported along the northeast-southwest line,**

Line 458: ... **launched** in