

Interactive comment on “Springtime variability of lower tropospheric ozone over Eastern Asia: contributions of cyclonic activity and pollution as observed from space with IASI” by G. Dufour et al.

Anonymous Referee #1

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General comments:

This paper presents a good exercise with IASI observations to investigate variability of tropospheric ozone in East Asia and its meteorological factors associated with synoptic-scale transport. The authors focused on May 2008 and described a couple of episodes as seen in day-to-day variations. Although I still wonder why the authors only focused on May 2008 and did not mention any cases in the other periods of time, I appreciate the authors' challenge to look at lower tropospheric ozone from space. Generally the analysis presented is sound, and the manuscript is well structured. I have two major scientific comments that the authors should consider before publica-

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tion to improve the paper - not major but moderate. I also found some sentences that need clarification and improvement in English.

Specific comments:

1. Validation of IASI against ozonesonde

Ozonesonde at Tateno (Tsukuba) are launched in the early afternoon (specifically 14:30LT). Tsukuba site is located in sub-urban area (approx. 50 km away from Tokyo), and there are typically diurnal variations observed, with a maximum in the early afternoon and a minimum during the night due to photochemical build-up and titration by NO, respectively. This means that ozone data by sondes is recorded when lower trop. ozone (say, boundary layer ozone) is at the maximum during the day, resulting in overestimates by sondes versus other methods like UV absorption at the surface sites, when we simply compare daily or monthly means. I think this would be the main cause for the difference between sonde and IASI at Tateno/Tsukuba. I am not familiar with other sites including Beijing, Hong Kong, Naha, and Sapporo, but if the sondes are launched in sub-urban area, we can expect the same bias. In fact, as the authors noted at the footnote of in Table 1, most sonde observations are made in the early afternoon, hence they had to relax time-matching criteria from 6 hr to 24 hr. This can allow the authors to increase the number of matched (concomitant) data, but this does not necessarily contribute to statistical robustness nor improve the validation of IASI against sondes, due to differences in local-time sampling between satellite and sondes, along with substantial diurnal variations at Tsukuba. I would suggest the authors to stick to narrow time band, say 6 hr (by the way, is this +/- 6 hours, correct?) for the sites where diurnal cycles are presumably negligible (say, Naha, Sapporo). This might result in a number that is different from currently estimated (-2DU, -9%) for lower trop. ozone in East Asia.

Also, please specify if "correction factor" is used for ozonesonde in this comparison, and mention the database used here (WOUDC?).

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In spite of higher sensitivity of IASI to ozone in the upper atmosphere, the biases for UTLS and STRATO are larger than for LT and TROPO, while correlation coefficients are excellent (0.95). What is the explanation of this?

2. O₃-CO correlation as seen with IASI

In Abstract, the authors mention that they found significant correlation between lower tropospheric ozone and carbon monoxide, especially over North China Plain (NCP), and this O₃-CO correlation indicates that the photochemical production of ozone from primary pollutants emitted over such large polluted regions. Later in Page 9217, they mention that the correlation (coefficient?) is 0.6 over NCP for one specific day, 5 May 2008 (Later in Page 9224, the correlation is said as 0.62). The fact that the authors found correlation is good, but more important factor is the slope of O₃/CO – i.e., relative enhancement of O₃ to CO, as this ratio can suggest the degree of photochemical O₃ production per precursor emitted in a given season of the year. For example, in East Asia, Tanimoto et al. (2008) paper (Tanimoto et al., Diagnosing recent CO emissions and ozone evolution in East Asia using coordinated surface observations, adjoint inverse modeling, and MOPITT satellite data, *Atmos. Chem. Phys.*, 8, 3867-3880, 2008) showed that the O₃/CO ratios can vary from 0 to 0.3 as a result of photochemical evolution of the air masses transported from Asian continent. It would be interesting to describe how IASI can see the O₃/CO ratios over NCP (and downwind area) and quantitatively discuss the O₃/CO ratios in comparison to those in previous papers.

3. Some other relevant work

P9297, LL27: Wang et al. 2009 paper does not really examine Asian monsoon effect on trop. ozone seasonality, but rather look at long-term trend. Please check. Other relevant references that are missing but dealing with monsoon effect on ozone seasonality (with a focus on spring) in East Asia is: Tanimoto et al. (2005), Significant latitudinal gradient in the surface ozone spring maximum over East Asia, *Geophys. Res. Lett.*, 32, L21805, doi:10.1029/2005GL023514.

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There is also a paper looking at synoptic-scale transport of air pollutants in East Asia, that the authors might be interested in and add values when discussed in the paper. Miyazaki et al. (2003), Synoptic-scale transport of reactive nitrogen over the western Pacific in spring, *J. Geophys. Res.*, 108(D20), 8788, doi:10.1029/2002JD003248.

Technical comments:

Title: "contributions" of cyclonic activity and pollution. I found it a bit unfitted to what is discussed in the paper, since "cyclonic activity" is a meteorological factor and "pollution" is a (sort of) source. Perhaps the "role" is better? Or do the authors mean "cyclonic activity on pollution transport"? Anyway it needs to be modified to be clearer.

Figure 1 can be omitted since it is not very important and there are as many as 15 figures.

There are many English errors that make readers confused. For example:

P9206, L5: In addition to be an → to being an ...

P9207, L17: Since the past decades → During the last decades

P9214, L7: "relative information" meant "related information"?

Abstract: "maximum of sensitivity" can be "maximum sensitivity", "North East" would be "Northeast", "UTLS" needs explanation at the first appearance.

The authors use both "Eastern" Asia and "East" Asia. Is this meant to be different from each other? Otherwise, please use East Asia, which is more common.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 15, 9203, 2015.

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