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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterisation of ozone deposition to a mixed oak-hornbeam forest. Flux measurements at 5 levels above and inside the canopy and their interactions with nitric oxide" *by* Angelo Finco et al.

Anonymous Referee #2

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Close examinations of the pathways controlling ozone deposition in the forest setting are important for understanding the oxidation chemistry in the forest, secondary organic aerosol formation, the boundary layer ozone budget, and, as mentioned in this manuscript, the impact of ozone on plant health. In this manuscript, the authors presented the ozone and NOx concentration gradient and flux data, and the associated meteorological parameters from the ECLAIRE campaign in 2012, as well as the initial data analyses, which would lead to a subsequent model analysis, as implied in the Introduction, that may generate model predictions of intra-canopy dynamics involving

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Discussion paper

ozone reactions with NOx and VOC. As a result of the month-long summertime observations of ozone and NOx at multiple height within and above a forest canopy at the most polluted area in Europe, this dataset provides a valuable case study of ozone dynamics and related canopy scale processes, and biosphere-atmosphere exchange. However, as specified below, major revisions are recommended.

The authors performed a fairly detailed treatment of the meteorological data to obtain the ozone fluxes at the measurement heights. Results of the fluxes at multiple elevations throughout the canopy provide information on the sources and sinks, thus the processes that affect the trace gas species in the forest. Given the data being from a month-long campaign under different meteorological conditions, the analysis could be strengthened and the conclusions may be better supported and possibly modified with the following additional considerations.

1) Above canopy influences from air transported to the surface layer above the canopy. According to the data, about 50% of the wind is from either east or west with the rest from other directions. Are there any differences in the quantities measured that coincide with the wind direction differences? Are the possible influence of the different amount of the pollutants (ozone and NOx) transported to the site considered?

2) The fluxes under the stable/unstable conditions within the canopy. If I understand it correctly, in Figure 4, y-axis is the percent of the measurement time. If so, there were times the entire canopy was either stable or unstable throughout a 24-hour period. It would be informative to separately analyze the data under these two regimes, especially when considering the within the canopy stability in the context of the enhanced ozone deposition flux at 24 m.

3) Dry and wet conditions. Apparently after the rainfall on July 6, the NO/NO2 fluxes increased dramatically. How did these changes affect the ozone deposition flux? In addition, it is known surface wetness affect ozone deposition as well. It would be instructive if the dry/wet conditions can be contrasted in the data analysis.

The data analysis results, as stated in the manuscript now, would be more convincing if the above-mentioned aspects were considered. One of the main conclusions in the manuscript is that the enhanced ozone flux at the canopy top is due to the combined NO fluxes from above the canopy and the soil emission, thus an enhanced chemical sink of ozone. However, there are other factors such as stomatal uptake and photochemical reactions involving NOx, O3 and BVOCs, both processes obviously associated with sunrise, that affect the ozone flux. The net result could well be an increased flux. Are there data available from this campaign that would help the authors address these possibilities?

It would help the readers to better understand and assess the data if the authors could present the time series plots, including error bars when appropriate, of the measurement results. It is also important to show the standard deviation (if the mean values are used) or the interquartile range (if median values are used) in the average diurnal course plots including Figure 6.

In Table 1 where it is not indicated or obvious, please list the measurements next to the instruments listed, for example, HMP45 (temperature, humidity).

I may have missed the point in Figure 8 but cannot readily see from which height are the plotted ozone mixing ratio results. Also if possible, please unify the tick location and tick labels in plots 8a and 8b.

I am not sure why the analysis of the enhanced O3 flux at 24 m is only for the morning (9:00-12:00). From the data, the enhancement, although decreasing after mid-day, lasts through 15:00. If, because of the scatter of the data, the fluxes were basically the same from 41 to 24 meters in the early afternoon, it needs to be shown and stated more clearly.

The authors used Figure 12 to explain the effect of the thermal bubbles and why the greater sensible heat flux at 32 m than at 41 m. However, the data shown are from 13:00 on July 5th. It is not clear whether this is a special case or an example of a typical situation.

The manuscript could use some help with the English language usage and organization. For example, Page 2, line 4, “Prompted by its phytotoxicity” –> Because of the phytotoxicity of ozone, . . . Page 2, line 6, “. . ., 2013), thanks also to the. . ..” may be changed to, for example: . . ., 2013). Eddy covariance measurements were made possible thanks to the . . . Page 2, line 16 – 18 and line 26-28, field campaign information was repeatedly given. Other editorial changes are not listed here since the reviewer has recommended major revisions.

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