

Interactive comment on “Sensitivity of stomatal conductance to soil moisture: implications for tropospheric ozone” by Alessandro Anav et al.

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Response to RC1:

We would like to thank the reviewer for the time taken to read and comment on this manuscript. The comments have been very helpful to improve the manuscript. We will follow your suggestions in addressing these changes in the revised version. Please find below our responses to the reviewer's comments.

RC1

This paper describes an analysis of the seasonal effects of soil drying on ozone stomatal deposition and surface ozone concentrations. The analysis utilizes the CHIMERE chemical transport model coupled with WRF, DOS3E, and the NOAA soil models. Re-

C1

sults show large changes in ozone deposition and surface ozone concentrations in Mediterranean climates in Europe. My main concern is the lack of discussion. The Results section is thin and should be supplemented with quantitative information not readily derived from the maps, for example, differences resulting from the different soil moisture scenarios. Critically missing is a Discussion section, or a combined Results and Discussion, describing the reasoning, importance, and context of the results. For example, the discussion of the change in model performance is just a few sentences long and is entirely descriptive.

RC1

Minor comments: The manuscript should be edited for grammar and flow. There are numerous grammatical errors.

AC1

We have corrected a few typo and grammar errors in the revised manuscript.

RC1

Figure 1: Increase the font size. The titles should be changed to be more easily understood. The color bars should be labeled.

AC1

We increased the font size in Figure 1 and labeled the colorbar.

RC1

Can you add measured data to Figure 1? I understand that soil moisture measurements are made at different soil depths than the depths where the simulations are done, but they should still agree qualitatively with the gradients.

AC1

We fully agree that observed soil moisture data would help to understand whether the

C2

model reasonably reproduces the soil water; unfortunately, over the selected sites, soil water measurement are too shallow or layers do not coincide making thus the vertical interpolation and subsequent comparison very uncertain and confusing (see for instance figure 1 at the end of the document).

RC1

I find the model and measured precipitation correspondence difficult to discern. To my eye, it is easier to distinguish when the model and measurements do not agree. Is there some other way to represent the data? In the text, you state that the measurements are "well reproduced," but on what timescale? Weekly? Seasonally? They do not appear to coincide day-to-day.

AC1

We agree that the comparison of hourly data might be confusing and not easy to read, but we also believe that only showing high frequency data allows to fully understand how the water is distributed between the different soil layers as well as evaluate the offset between rainfall events and soil water. Nevertheless, in figure 2 at the end of this document we present a more readable comparison between the simulated precipitation and the observations over the four analyzed sites. Finally, we make more clear in the revised version that rainfall events refer to the validation of hourly data.

RC1

Is there another variable that can be added to the precipitation panels that makes it visually clear why precipitation does not coincide with soil moisture seasonally?

AC1

Surely, evapotranspiration (or latent heat), runoff and snow cover would help to clarify the water dynamic into the soil; however we believe this analysis is out of the scope of this paper. In fact, the main aim here is to assess changes in atmospheric chemistry when different assumptions of water uptake by roots are used.

C3

RC1

Lines 342–346: The annual change across Europe is not a very interesting statistic. I recommend highlighting certain regions, especially the portion of Europe with a Mediterranean climate. Second, does the variability in deposition change, rather than just the mean?

AC1

We fully agree the paper would benefit from the inclusion of a regional-based analysis; for this reason we aggregated seasonal data over climatic region derived from EEA dataset (<http://discomap.eea.europa.eu/Services.aspx?agsID=9&fID=5477>). This analysis allows to easily understand how mean and variability (i.e standard deviation) change between different simulations/regions/seasons. We will add figure 3 of this document in the revised paper.

RC1

Figure 2: The color scale saturates over large regions of southern Europe. I'm curious to know how large the observed percent change was.

AC1

The figure has been changes as suggested; please see the revised manuscript for further details.

RC1

There is little to no discussion of whether ozone deposition and ozone concentration differences were observed between soil moisture schemes. These differences, if they exist, are not apparent to me from Figures 2 and 3. Results and discussion to this point should be added.

AC1

C4

Indeed, this discussion is shown in Figure 4 (and relative text in the paper); following also the next comment, we have broadened this discussion in the revised version of the manuscript.

RC1

I find Figure 4 and the small portion accompanying text to be unconvincing and not useful. I recommend removing this piece of the analysis.

AC1

We believe this figure is very useful for two reasons: 1) it clearly allows to quantify, in absolute units (i.e. not a percentage), the resulting changes in O₃ concentration because of the different assumption in water uptake in the rooting zone, and 2) it shows how a process occurring within the soil affects also the concentration of gas in the upper troposphere (up to 650 hPa). According also to previous comment from reviewer, we decided to broaden this discussion in the revised paper.

RC1

The text concerning changes to ozone measurements and model agreement should be clarified and expanded. It isn't clear to me what the authors are communicating.

AC1

We have broadened this discussion in section 4 of the revised manuscript.

RC1

Can the authors quantitatively contextualize the change in ozone concentration results in terms of the attainment of European ozone standards?

AC1

We thank the reviewer for this suggestion; we have added in the revised document a new figure showing the percentage of change in the European standards used to pro-

C5

tect vegetation and human health from ozone (i.e. AOT40 and SOMO35, respectively). Results are very interesting as we find a relevant percentage of change, reaching even the 100% in some points. More details can be found in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-1057>, 2017.

C6

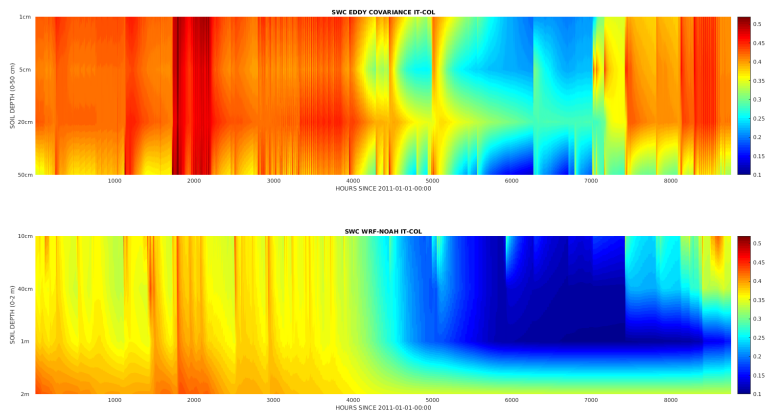


Fig. 1.

C7

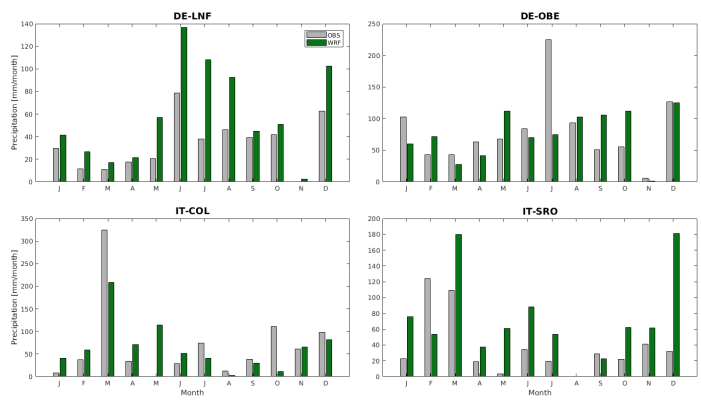


Fig. 2.

C8

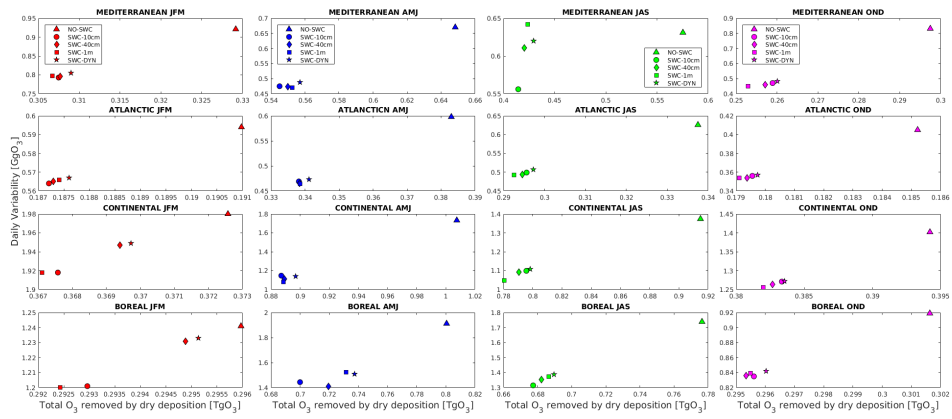


Fig. 3.