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

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My attention has been drawn to some comments in this paper about the EMEP MSC-W model (Simpson et al., 2012) and its treatment of soil water (SW) effects on ozone uptake. These comments might mislead some readers, so I would just like to clarify.

Firstly, the naming convention around EMEP and DO3SE is confusing. The DO3SE model itself is a stand-alone ozone deposition code available from the Stockholm Environment Institute at York (www.sei-international.org/do3se). The EMEP model is a 3-dimensional atmospheric chemical transport model. The deposition frameworks of the EMEP and DO3SE (then unnamed) models were developed jointly as a cooperation between several groups (EMEP, SEI-Y, FMI, University of Bradford, UK, see

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Emberson et al., 2000a,b) in the late 1990s. Although still similar in terms of equations and parameterizsations, the EMEP and DO3SE models are very different and independent. Loosely stated though, one can say that EMEP uses the Jarvis-like stomatal conductance (gst) methods from DO3SE.

On lines 67-69 Anav et al state that 'this original formulation of the DO3SE model presented a main limitation ... ; for both forest and crops the model did not take into account the limitation due to soil water content. Lines 103-105 also suggest that SW was not accounted for in DO3SE and EMEP until the 2012 papers of Bueker et al, 2012 (DO3SE) and Simpson et al. (2012).

These comments are simply not true (as we have noted to the first author and this group before). Soil water effects have been included in the EMEP model since the 'DO3SE-like' deposition scheme was developed in the late 1990s (Emberson et al., 2000a,b). Simpson et al. (2001) and Simpson et al (2003) showed the dramatic effects that SW could have on estimated deposition velocities for a site in Portugal. Tuovinen et al (2004) also illustrated the importance of SW (using fSMD, for soil-moisture deficit) against the other Jarvis-like factors for a Portuguese meadow. These early studies showed that SW had very significant effects on modelled deposition parameters, especially in southern Europe.

Of course, estimation of SW (ether as soil moisture deficit, SMD, or soil water pressure, SWP) is extremely uncertain. Further, as noted by Tuovinen et al (2009), stomatal conductance (gst) ...

.. "is thought to be driven by SWP rather than SMD. The relationship between these two variables is both non-linear and sensitive to assumptions on soil characteristics (e.g. Jones, 1992), and even moderate uncertainties in SMD can lead to very large (orders of magnitude) uncertainties in SWP. As a result of such difficulties, a method to estimate soil water stress and its influence on gst has not, as yet, been agreed upon for EMEP or UNECE mapping purposes. However, it is clear that the influence of soil water status on stomatal O3 flux needs to be considered in both local- and large-scale risk assessments, and especially for the Mediterranean region where soil water deficits are the norm rather than the exception. During dry summers, which may become more frequent in the future, severe drought may be experienced across the continent (Granier et al., 2007). Thus further development of methods needs to be prioritised as a matter of some urgency to ensure that flux-based risk assessments can be performed reliably at the European scale."

Thus, as these papers make clear, we have been well aware of the importance of SW effects since DO3SE-type modelling was introduced in EMEP, but we have been well aware of the considerable difficulties of both predicting and evaluating SW impacts. We have encouraged development and testing of new methods over this time period, as evidenced by the study of Bueker et al (2012).

Line 75 suggests that the role of SW has 'often been neglected in risk assessment', but this is also misleading. The main risk assessments in Europe in the context of ozone-damage are probably those of the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation, icpvegetation.ceh.ac.uk/). EMEP model results have been used extensively within ICP Vegetation, and the main focus has been to show the potential for ozone damage to well-watered sensitive vegetation. This focus is partly in recognition of the difficulties asociated with SW impacts, but also because maps of ozone-risk were indeed intended to show areas of worst-case risk. Such risk areas are valid for irrigated vegetation, or for vegetation which accesses ground-water rather than relying on precipitation - a common adaptation in dry areas.

Thus, in summary, the EMEP model (and DO3SE, they are not the same) has been capable of calculating and using SW data since the late 1990s, but we, and indeed all scientists in this field, need to be wary of relying on very uncertain predictions of SW effects when it comes to providing policy-relevant modelling results. This is clearly an important research area, and clearly a topic needing careful investigation.

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