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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Current estimates of biogenic emissions from Eucalypts uncertain for Southeast Australia" *by* K. M. Emmerson et al.

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Thanks to reviewer #2 for your comments. Reviewer #2 touches on a couple of items I have thought a great deal about; choice of chemistry scheme and the boundary layer height in the model.

Detailed comments: P 2 L 26: The effect of soil moisture on plant emissions seems to be an unknown which could potentially have considerable influence on predictions. Even if the model would include it - how good is the soil moisture in the model?

There are two issues here: the soil moisture code within MEGAN and the soil moisture parameter which enters the CTM from the meteorological component (CCAM). This particular version of MEGAN v2.1 returns a value of 1 for Gamma(soil), thus the soil moisture does not influence the BVOC emission. Soil moisture within CCAM comes

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from CABLE, the outputs of which could be coupled to MEGAN in future, subject to aligning soil types and textures. Soil moisture at 1cm, 16cm and 44cm are used. CABLE soil moisture within the ACCESS GCM has been assessed by comparison with 19 other models in the CMIP5 evaluation and found to lie at the median of the model ensemble mean (personal communication, Ian Watterson, CSIRO). The CABLE terrestrial water cycle has been evaluated in the global soil wetness project GSWP-2 and found to compare well with evapotranspiration and runoff measurements (Zhang et al., 2013).

The following text has been added at page 4 line 14.

"...CABLE to provide information of surface roughness, soil moisture and leaf area index (LAI, based on MODIS data). The soil moisture parameter has been evaluated indirectly within the Global Soil Wetness Project, by comparing model evapotranspiration and runoff to measurements (Zhang et al., 2013). Whilst CABLE performed well, soil moisture remains a source of uncertainty."

text added at page 4 line 37: "Note that soil moisture is used elsewhere in the CTM to calculate the dust emission flux, and could be coupled with MEGAN in the future".

p 4 l 18: CB05 is almost 10 years old now, and our knowledge on isoprene chemistry has improved considerably - IEPOX formation, ISOPOOH and the associated OH recycling directly impact the influence of isoprene on O3, and hence your evaluation. Can you assess how well CB05 performs compared to other mechanisms with a more updated isoprene chemistry? At least mention this potential source of error.

I have compared CB05's predecessor, CBIV to another five mechanisms, one of which was the Master Chemical Mechanism, and am aware of the differences the choice of mechanism can make to secondary species such as O3 (Emmerson and Evans, 2009). More recently Knote et al (2015) compared a couple of variants of the CB05 mechanism to other schemes containing improved isoprene oxidation schemes. The choice of mechanism resulted in differences in ozone and isoprene concentrations,

particularly in biogenic regions. However, neither the Knote nor Emmerson papers went so far as to compare with measurements nor make an assessment of which scheme was 'best'. I am looking into adapting the most recent version of MOZART into the CSIRO CTM as I would like to calculate MVK and MACR separately, and consider the more recent research into isoprene oxidation pathways particularly the isoprene nitrates.

I will add the following text to page 4 line 21. "The CB05 mechanism treats the production of a lumped isoprene oxidation product only, simplifying the chemistry. More recent schemes consider explicit oxidation products which can affect the production of ozone and nitrate species. The CB05 mechanism and its predecessor CBIV, have been compared with other schemes in Emmerson and Evans (2009) and Knote et al. (2015), but not against measurements. Choice of chemistry scheme can introduce uncertainty, which could be explored in future work".

p 8 l 19: Do you have any evaluation of the boundary layer height performance of the modeling system? The modelled concentrations are highly sensitive to this parameter, and especially its dynamic behavior (i.e. the collapse at dusk) can easily be wrong in the model.

We do not have any measurements of boundary layer height for these field campaigns. We included the ratios of isoprene and the isoprene products at figure 9 with the observations as this exercise removes the dilution effects, and still compared well.

However, we have looked at vertical potential temperature profiles from aircraft taking off from Sydney airport (AMDAR data) as a proxy to compare the model with. The modelled and observed potential temperature profiles compare reasonably well. However, the aircraft take off towards the sea and there is significant horizontal transport of the plane between the readings. The boundary layer can be inferred from these plots by eye, but we found this too subjective. We could also infer the dilution of the atmosphere by inserting a radon source to the model and comparing with radon measurements for

SPS1, SPS2 and MUMBA. This is something I intend to do in future.

The following text has been added to the supplementary section, page 3 line 14.

"There are no direct measurements of boundary layer height for these field campaigns. The model boundary layer height has been compared with vertical potential temperature profiles from aircraft taking off from Sydney airport (AMDAR, http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/AMDAR_System.html). From a small sample, the overall profiles compare reasonably well (not shown). However, the aircraft generally take off towards the sea and there is significant horizontal displacement of the plane between the potential temperature readings. We assess that horizontal gradients in temperature and boundary layer height in this coastal region considerably confuse the issue of resolving the boundary layer depth at Westmead, a site 33 km inland. Thus at this stage boundary layer height verification is not possible."

Figures: Is it possible that the figures are copy-pasted from Excel or similar? Please improve their quality (spurious frames around them, resolution) to publication standards.

Agreed, I will work on improving the resolution of the images.

References

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