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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comment on "Observation and modelling of HO<sub>x<> radicals in a boreal forest" by Hens et al. (2014)" *by* D. Mogensen and M. Boy

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Firstly, we thank both the anonymous referee and the editor for taking the time to read and provide useful comments on this comment paper. We aim to respond the comments below.

"While I agree with authors that there can be large vertical varibility on OH reactivity in forests, such variability may have been investigated in several studies, at least to some extent."

As also mentioned in the comment paper, we acknowledge there have been investiga-

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tions prior to the publication of Mogensen et al., 2011 that have addressed part of the vertical OH reactivity. However, our point is that Mogensen et al., 2011 was the first paper to model the "total" vertical OH reactivity, and not only the reactivity attributed to a small selection of measured compounds.

"1. As far as I know, measurements of OH reactivity have been conducted at three heights at Blodgett Forest Station in 2007 and 2009. Many other VOC measurements were also conducted at the same time. A paper by Wolfe et al. (2011) has done quite a bit modeling on comparing vertical profiles of VOCs with their model. Presumably OH reactivity was also compared in that study."

Yes, it is correct that Mao et al., 2012 measured the reactivity of OH at several heights, however, this paper was published after Mogensen et al., 2011. Further, Wolfe et al., 2011 provide modelled vertical profiles of several organic as well as inorganic compounds. The OH reactivity at 10 m is calculated, however, no vertical profile is provided.

"2. Another measurement on OH reactivity at three different heights has been recently been published by Hansen et al. (2014).

3. Besides Wolfe et al. (2011), I also noticed another paper on 1-D modeling in forests by Pratt et al. (2012)."

Both papers were published after Mogensen et al., 2011.

Comment 1-3: We suggest to make an addition to the paper along the lines of: "Upon publication of Mogensen et al., 2011 has followed several measurement and modelling papers investigating the vertical dimension of the OH reactivity (e.g. Mao et al., 2012, Hansen et al., 2014, Pratt et al., 2012)".

"4. I should also point out, that there have been measurements on vertical profiles of isoprene, monoterpenes and sesquiterpenes in forests, for example by Kim et al. (2009) and many others. There are also some modeling studies on the resulting chem-

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istry at different heights (Fuentes et al., 2007). It seems pretty straightforward to infer the vertical profiles of OH reactivity from these studies, if one assumes that NMHCs are the dominant component of OH reactivity."

This task might seem quite straightforward, however, it was not done.

Thornton: *"The comment should address additional previous studies of OH reactivity in forested regions, as pointed out by referee 1."*

The comment paper do mention previous studies (Stroud et al., 2005 and Mao et al., 2009). The references mentioned by the reviewer are all published after Mogensen et al., 2011.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 853, 2015.

List of changes

*) We mentioned that before publication of Mogensen et al. (2011) the OH reactivity had once been measured at more than one height simultaneously at one site, but that this data was published later (Mao et al., 2012).

*) We added references to other modelling and measurement works published after Mogensen et al. (2012).

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Comment on "Observation and modelling of HO_x radicals in a boreal forest" by Hens et al. (2014)

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1 Correction on reference

Though as a researcher one is always happy when peers find ones work useful and accordingly cite it, it is unfortunate when the respective paper is cited incorrectly. Hens et al. (2014) write “Studies on oxidation processes in monoterpene–dominated environments are rare. Direct OH reactivity measurements in a boreal forest, conducted by Sinha et al. (2008), and a box model study investigating the OH reactivity budget (Mogensen et al., 2011) revealed a significant fraction of “unknown OH reactivity”.” Firstly, the reference of Sinha et al. (2008) must be an error, since that refers to a publication about the method development of the Comparative Reactivity Method (CRM) together with first field tests conducted in the tropical rainforest of Suriname and the urban atmosphere of Mainz, but not in a boreal forest. We assume that Hens et al. (2014) instead are thinking of the paper by Sinha et al. (2010). Further, it is correct that Mogensen et al. (2011) found a large fraction of unaccounted OH reactivity, however they did not reach that conclusion using a box model. Instead they presented the first model study of the total OH reactivity in a boreal forest using a one dimensional column model with near-explicit chemistry (Boy et al., 2011; Mogensen et al., 2011). There exist earlier publications where the OH reactivity has been addressed using a 1-D model; e.g. the OH loss has been simulated with respect to certain primary emitted organic compounds (e.g., Stroud et al., 2005).

By including the dimension of the entire column of the boundary layer, we are capable of providing valuable information. E.g., as shown in Mogensen et al. (2011), the reactivity of OH has a distinct vertical profile, which is obviously not captured by a box model. Due to practical limitations, one can only measure the reactivity of OH (and other parameters of any other compound) at one or a few points in space. To our knowledge, at the time of publication of Mogensen et al. (2011), there existed no publications describing that the OH reactivity had ~~never~~ been measured at more than one height simultaneously at one site. ~~An~~ Mao et al. (2012) had conducted such experiments in 2009, however, the manuscript appeared later than Mogensen et al. (2011) . Another exception is the aircraft measurements conducted by Mao et al. (2009), how-

ever those measurements did not capture the lowest part of the boundary layer. Mogensen et al. (2011) therefore gave the first hints about how the space dependent canopy emission and boundary layer meteorology could affect the reactivity in a boreal forest. Hereby we got the first glimpse of how the reactivity of OH could look outside of that one measured height. Upon publication of Mogensen et al. (2011) has followed several measurement and modelling papers investigating the vertical dimension of the OH reactivity (e.g., Mao et al., 2012; Pratt et al., 2012; Hansen et al., 2014) .

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