MS No.: acp-2010-458 Research article

EUCAARI Special Issue

Lappalainen et al. Author Comments

Journal:	ACP
Title:	Modelling day-time concentrations of biogenic volatile organic compounds above a boreal forest canopy
Author(s):	H.K. Lappalainen et al.
MS No.:	acp-2010-458
MS Type:	Research Article
Special Issue:	European Integrated Project on Aerosol-Cloud-Climate and Air Quality Interactions (EUCAARI)

Dear Editor,

We thank the two anonymous referees for their critical comments. Based on comments we have re-written and edited the manuscript and hope it would now more clearly reflect the study aims and results.

Below are our responses to the specific suggestions and comments.

Sincerely Yours,
Hanna Lappalainen

Anonymous Referee #2
Received and published: 29 September 2010

The manuscript by Lappalainen et al. correlates measured BVOC concentrations with different driving variables, such as temperature, PAR, GPP etc. While studying the exchange and atmospheric transformations of BVOCs is an important topic, there is no clear hypothesis formulated to be tested with such a simplified correlation analysis. Consequently the main conclusion of the paper seems to be that BVOC concentrations are influenced by these different driving variables (nothing new) and that the presented simplified regression analysis can not capture most of the variability observed in this ecosystem (not surprising - see major comments below). For a high impact journal like ACP I do not think that the current manuscript presents enough novel information that warrants publication.

In particular I do not think that a correlation analysis based on BVOC concentrations can be used to infer a semi-quantitative description of BVOC emissions. This would require at least a simplified atmospheric chemistry / transport model (e.g. http://www.atmos-chem-phys-discuss.net/10/21721/2010/acpd-10-21721-2010.html). BVOC concentrations are influenced by emission, deposition and chemical transformation, which all contribute to the variability of BVOC concentrations. It is argued that "as long as atmospheric mixing is high and anthropogenic sources can be excluded, the understanding of the behavior of day-time BVOC concentrations is based on BVOC emission biology". I strongly disagree with this statement. In the surface layer the variability of short lived compounds such as monoterpenes is certainly influenced by chemical transformations in the PBL. On the other hand the variability of long-lived compounds such as methanol will certainly be influenced by advective processes, in particular in a heterogeneous landscape such as Finland, which has many lakes and different landuse types. On the timescale investigated here, frontal systems could also play an important role in influencing the variability of VOC concentrations. Thus factors controlling the

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variability of concentrations can have very different causes, which cannot be separated by the current correlation analysis.

A second possibility to draw useful conclusions on ecosystem scale emission variability would have been to perform ecosystem scale BVOC flux measurements. Then the correlational analysis using driving variables such as temperature, PAR etc. would make sense. The way the analysis is presented in the current manuscript compares apples with oranges and does not really allow gaining any new useful insights to what is already known.
Minor comments: Given the range of variance for the three different regression models it does not appear that there is any statistically significant difference between their performance (ie. 27-66% vs 29-69% vs 30-71%).

We think that simple temperature based models along with more sophisticated atmospheric chemistry models could be valuable tools for making estimates of the ambient VOC concentrations. Our study strongly based on the assumption that temperature is the main driving factor for the biogenic synthesis process (photosynthesis) and the biogenic emissions and consequently the ambient air concentrations. Thus the approach was very much source orientated. We also tested if the temperature based ,referring to photosynthetic efficiency, improved the temperature model.

In our earlier paper "Day time concentrations of Day-time concentrations of biogenic volatile organic compounds in a boreal forest canopy and their relation to environmental and biological factors" by H. K. Lappalainen et al. 2009 we show that studied compounds are intercorrelated. In this article we also evaluate in more detail how well the concentrations represented the local emissions of the forest. Based on the wind rose analysis we filtered out the possible emissions the sawmill and used also filtered data in this manuscript. We have also studied the effect of the height of atmospheric boundary layer (hours scale) on VOC concentration but did not find any correlation (not published data) during day time. In our case we lacked parallel measurements of the emissions and concentrations and we needed to use some indirect methods to maximize the link between local emissions / photosynthesis and ambient concentrations. In this task we used filtered data, specific time windows (day time data). To make the dataset representative of the postulated maximum emissions, we used day-time medians of the BVOC concentrations. The time windows specified for each season represented the time when the sun is high enough to cause atmospheric mixing. Furthermore the daytime observations presented the gas exchange from stomata to air rather than the VOC deposition to leaves, which may occur during night.

We fully agree with the referee that the unexplained the part of the variation is related to atmospheric chemistry and meteorology and we have now emphasized the aspect in more detail in the corrected manuscript.