

***Interactive comment on* “Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature)” by A. Guenther et al.**

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Received and published: 1 March 2006

The paper of Guenther et al. provides a comprehensive description of MEGAN (the Model for Emissions of Gases and Aerosols from Nature), and its application for estimating global net emissions of isoprene to the atmosphere. MEGAN calculates net emission rates as the product of the emission factor epsilon describing above canopy fluxes at standard conditions, the emission activity factor gamma that adapts to non standard conditions, and the factor rho that accounts for chemical reactions within the canopy. Foregoing modelling approaches for estimating BVOC emissions were

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all based on leaf scale emission factors - this describes both the significant merit of the new approach as well as its limitation by introducing additional complexity.

Undoubtedly, net isoprene fluxes above canopy represent the information desired by atmospheric chemistry modellers; advanced technologies based on eddy covariance for measuring these fluxes are becoming increasingly available, thus avoiding the substantial uncertainties related to the extrapolation from leaf scale emission factors to canopies and landscapes. The novel modelling approach is coming also in due time, because global datasets of drivers and constraints are becoming available with the help of more specific satellite sensors like GOME and SCIAMACHI. In addition, RS data in general undergo improved validation and integration with ground surveys.

The additional complexity linked to the new MEGAN approach is underlined by the fact that there are thousands of leaf scale emission studies available, in contrast to only some 80 studies of net canopy fluxes, which show on top of that a highly biased geographical distribution, e.g., only four studies are reported for the whole of Asia. In addition, net fluxes above canopy represent a secondary information being modified by within canopy exchanges and requiring the introduction of additional assumptions related to within canopy reactivity of the compounds emitted. Up to now we are not aware of any study that could close the canopy budget for emission of reactive BVOCs. Understanding of within canopy processes (chemical transformation and deposition of the compound emitted and of its reaction products), needs to improve before reliable generalisation of a factor ρ can be achieved.

Some specific comments: Plant functional types:  What is the reason for the typology selected with only 3 PFTs for trees? Fineleaf Deciduous contribute only 0.5% whereas broadleaf trees and shrubs represent 94% of global emissions (Table 1). It is not really transparent how the model deals with seasonality of LAI and phenology, as this group includes both deciduous and evergreen species. Why not the usual PFTs, like deciduous and evergreen woodlands? In many ecoregions and for most species, shrubby live forms develop into trees if they are allowed to;  Considering that

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broadleaved trees and shrubs represent by far the dominant isoprene emitters, and are consisted both of evergreen and deciduous species, an explanation is required how broadleaf evergreen vs. deciduous are treated with regard to LAI seasonality, and how growing season is defined.  It's not understandable on basis of the text, how shrubs are separated from trees: shrubs contribute 40% to overall emissions and cover a land area similar to the one of broadleaf trees (Table 1), but most PFT datasets in Table 2 come to a much smaller share of shrubs - there appears to be a definitional issue to be explained in the paper.

Uncertainty analysis  should be elaborated in more detail: for example, global total differences in isoprene emission are given in table 2 in the small range between minus 13% and plus 24% comparing MEGAN-P database with the other PFT databases; such numbers are not really helpful when the differences may easily be higher than factor 4 for large regions. A more in depth analysis of PFT databases on overall uncertainty would help to identify the weak spots of the driver databases available.  A similar statement can be given for LAI as the 2nd key driver (differences range globally between minus 11 and plus 29, but difer regionally by factor 3), as well as for the impact of different weather databases.  If all three key drivers cause differences in the range of factor 3, what could be the combined impact on overall uncertainty of regional emission estimates?

Conclusion: excellent review, interesting approach that will develop most likely into the new standard application for global estimates- no question the paper merits publication after some modifications. Knowing the reliability and merits of the NCAR group in foregoing modelling approaches, I am also optimistic that fully transparent model documentation will be made avialable in the future on the web and will help answering most questions. In its present version with limited documentation on the web, the model description can hardly be considered as transparent and consistent; the 70 pp. paper is almost impossible to review in a classical sense; it would require extremely careful reading and crosschecking, and many pages of questions and annotations to

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be answered.

I started such exercise, e.g., looking at consistent treatment of the temperature factor in equations and in the text - and got lost in terminologies varying between temperature of leaf, of leaf surface, of leaves in the sun and in the shadow, of ambient air, of 24 and 240 hours - surface or ambient air?. Micrometeorological parameters, radiation transfer - plenty of details - it is not always clear what is practicable and what is really used in the model. The model will mainly be used by global atmospheric chemists, some of them may easily get lost like me in an ocean of details. Offering a simplified version MEGAN-EZ will not really be helpful if one does not understand the reason for the different results he got in comparison with MEGAN standard.

All in all, I would have preferred - in order to present the approach in a more transparent way and to make the paper easier to read - to concentrate on MEGAN description in more detail, to run the model with standard and alternative driver data, to compare in more detail to previous approaches based on leaf level emission factors, to provide an integrated view on uncertainties. The chapters on MEGAN-EZ, on regional top-down constraints, on impact of earth system change, are not really needed to understand and to assess the approach, anyhow, they would deserve a more detailed presentation in separate papers.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 107, 2006.

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