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# Towards a better understanding of isoprene emissions and chemistry above tropical forests with the TM5 model

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Isoprene emissions from vegetation are a major driver for the formation of organic aerosols and tropospheric ozone. These emissions are very sensitive to changes in land cover use and changes in climate. Satellite instruments take daily measurements of formaldehyde (HCHO) and glyoxal (CHO-CHO) concentrations with global coverage. Because both species are produced during isoprene oxidation, these measurements provide a unique perspective on how to assess isoprene emissions, and their dependencies on environmental variables such as temperature and moisture. However, in order to invert the HCHO and CHO-CHO observations into their isoprene emission sources, we need a better understanding of the a priori isoprene emissions and the isoprene oxidation chemistry.

To investigate these, we have simulated isoprene and HCHO concentrations using the global 3-D chemistry transport model TM5 with a focus on the densely vegetated region of West Africa. We have applied two different isoprene emission models, the 12-year climatology from the ORganizing Carbon and Hydrology In Dynamic EcosystEms (ORCHIDEE) model with a diurnal cycle, and the Model of Emissions of Gases and Aerosols from Nature (MEGAN). The corresponding yearly isoprene emissions are 473 Tg C and 540 Tg C respectively, where the isoprene emissions in MEGAN were reduced by approximately 30% by taking soil moisture availability into account.

We evaluated the isoprene chemistry in TM5 using aircraft observations from the African Monsoon Multidisciplinary Analysis (AMMA) campaign, which took place over West Africa during June, July and August 2006. During this campaign the Facility for Airborne Atmospheric Measurements (FAAM) BAe-146 measured isoprene, HCHO and OH. Using these measurements, we find that TM5, for both emission models, overestimates both isoprene and HCHO by a factor 3, and underestimates OH by a factor 3. Taking the HCHO measurements made on board the DLR (Deutsches Zentrum für Luft- und Raumfahrt) F-20, TM5 overestimates HCHO by a factor 2.

In line with previous studies we find that the TM5 model, as many other models, simulates insufficient OH over tropical forests, which results in too high isoprene concentrations, and an erroneous yield of HCHO from isoprene that would strongly bias the inversion. We are therefore implementing a number of recently proposed isoprene oxidation schemes to replace the standard TM5 CBM-IV isoprene + OH reaction. Preliminary results indicate that the epoxide-formation scheme proposed by Paulot et al. [2009] does not resolve discrepancies between the simulations and observations. We will discuss the success of the Leuven Isoprene Mechanism (LIM0) by Peeters et al. [2009], and the general implications of our findings for providing constraints on isoprene emissions in low-$NO_x$ regions.