Geophysical Research Abstracts
Vol. 12, EGU2010-13305, 2010
EGU General Assembly 2010

Of trees and clouds: can the biosphere influence the climate system through aerosols?

Declan O'Donnell (1) and Johann Feichter (2)

(1) ETHZ, Institute for Atmospheric and Climate Science, Zürich, Switzerland (declan.odonnell@env.ethz.ch), (2) Max Planck Institute for Meteorology, Hamburg, Germany

Of the many ways in which the biosphere interacts with the atmosphere, one that has been little studied is how the biosphere can influence the properties of clouds. Such influence arises from the emission of both primary biological particles and of trace gases, such as dimethyl sulphide and volatile organic compounds (VOC). Estimates of the emission of biogenic VOC (BVOC) indicate a flux to the atmosphere of the order of several hundred teragrams per year. Results of laboratory studies of the aerosol yield from certain such BVOC (coupled with field measurements that indicate that laboratory conditions may well underestimate the ultimate aerosol yield) lead to the conclusion that BVOC are a major source of tropospheric aerosol. Studies of emissions from different plant species indicate that tropical forests are the most powerful emitters of BVOC. Strong photochemistry and powerful vertical transport in the tropics is likely to yield large amounts of aerosol, of which much may be entrained into the free troposphere, and thereby carried far from the source region.
In this study, we concentrate on the possible influence of aerosol derived from BVOC (biogenic secondary organic aerosols, BSOA) on clouds.
We deploy the global aerosol-climate model ECHAM5-HAM in the study. The model calculates BVOC emission and BSOA formation online, and is furthermore size-resolved, and therefore able to explicitly calculate the effect of BSOA on the particle size distribution. Initial model results indicate that the overall sign of the climate feedback operated by the effect of the biosphere on clouds is positive, reducing the aerosol indirect effect. The effect arises mainly by shifting the particle size distribution towards larger particles, thereby mitigating the anthropogenic cloud albedo effect, which has the opposite effect on the particle size distribution. Repeating these simulations in the absence of anthropogenic aerosols leads to a much weaker BSOA influence. In these latter simulations, cloud properties are properties differ significantly, particularly in terms of the cloud droplet number concentration (CDNC), which remains low over both ocean and continents, and at all latitudes. Thus the feedback appears to be significant only when the CDNC is large. This leads to the conclusion that the effect of BSOA on clouds is not intrinsic to the natural climate system and in fact constitutes an anthropogenic forcing. These results may point out one factor that can cause models to overestimate (when compared with observationally-constrained estimates) aerosol indirect forcing.