

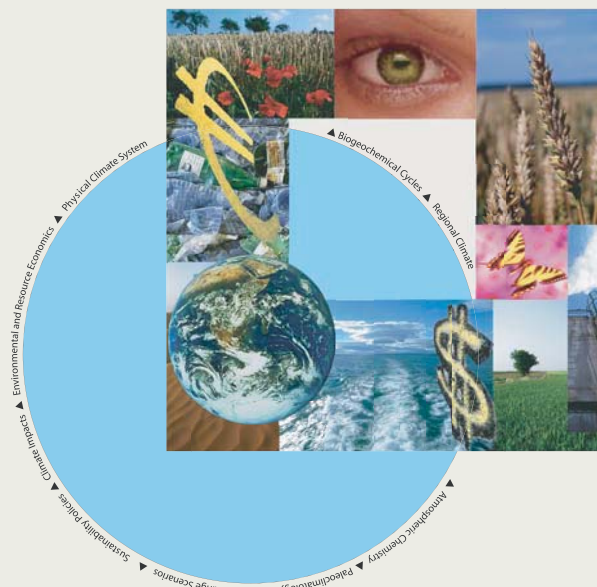


International Max Planck Research School on
EARTH SYSTEM MODELLING

Global Wildland Fire Emission Modeling
for Atmospheric Chemistry Studies

Judith Johanna Hoelzemann

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Abstract

The impact of global fire emissions on the chemical state of the atmosphere has long been recognized by the international scientific community. Specifically in the tropics, a continuous issue related to air quality are numerous deforestation fires and savanna maintenance fires that emit vast amounts of pollutants into the atmosphere. But also in extratropical regions wildland fires can lead to pollution events on the regional and inter-continental scale, as their smoke-plumes are transported over long-range distances.

Until today, climatological fire emission inventories are used in Chemistry Transport Model to provide a realistic chemical state of the atmosphere. Since emissions from fires are highly seasonal and inter-annually variable processes, information from these inventories has proved to be insufficient both for climatological studies of various years and on the short-term chemical weather scale. In the last years, satellite fire pixel products have become available, providing a more objective and complete assessment of global fire occurrences and thus, emission estimates. However, despite all progress and evidence gained with satellite retrievals that provide only the location of a fire, quantitative information on burned area and thus on aerosol and trace gas release, their dispersion and their impact, remained insufficient.

Recently, new global fire satellite products have been developed to quantify fire emissions. These products use more complex algorithms than the simpler fire pixel products and are therefore able to quantify the extension of a fire by obtaining the area burned, which is a crucial parameter in wildland fire emission modeling.

In this work, these new products have been analyzed and applied for emission calculation in order to obtain a transparent approach with reduced and assessed uncertainties. For this purpose the new Global Wildland Fire Emission Model GWEM was developed (Hoelzemann et al., 2004). Apart from area burned data, this model is based on the Lund-Potsdam-Jena Global Dynamic Vegetation Model LPJ-DGVM (Sitch et al., 2003), and landcover maps to estimate fire emissions on the global scale. GWEM has become a tool, which allows for a transparent calculation of fire emissions including seasonal and inter-annual variations, as adequate global high-resolution multiyear satellite input data for monitoring fires and landcover are becoming available. Input data and results of GWEM were carefully compared to other present inventories that are still in use within the atmospheric chemistry community and to recent publications on regional fire emission estimates. Further, emphasis was laid on the sensitivity of GWEM in relation to uncertainties in the underlying input data.

The global Chemistry Transport Model MOZART-2 was in the following used to assess the influence of the new GWEM wildland fire emissions on atmospheric chemistry. An impact study in the year 2000 was performed with the goal to assess the sensitivity of the model towards wildland fire emissions, calculated with GWEM in comparison with other, presently used, fire emission inventories. MOZART results reveal significant differences of 20-30% in background surface CO concentrations in the northern hemisphere, while fire-prone areas can differ by up to a factor of 6. Consequently, the ozone production is altered significantly over fire activity regions and outflow areas resulting in surface ozone differences of up to 30 ppbv.