Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 5, 1891-1904, 2005
www.atmos-chem-phys.net/5/1891/2005/

Naturally driven variability in the global secondary organic aerosol over a decade

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Abstract. In order to investigate the variability of the secondary organic aerosol (SOA) distributions and budget and provide a measure for the robustness of the conclusions on human induced changes of SOA, a global 3-dimensional chemistry transport model describing both the gas and the particulate phase chemistry of the troposphere has been applied. The response of the global budget of SOA to temperature and moisture changes as well as to biogenic emission changes over a decade (1984-1993) has been evaluated. The considered emissions of biogenic non-methane volatile organic compounds (VOC) are driven by temperature, light and vegetation. They vary between 756 and 810 Tg Cy^{-1} and are therefore about 5.5 times higher than the anthropogenic VOC emissions. All secondary aerosols (sulphuric, nitrates and organics) are computed on-line together with the aerosol associated water. Over the studied decade, the computed natural variations (8%) in the chemical SOA production from biogenic VOC oxidation equal the chemical SOA production from anthropogenic VOC oxidation. Maximum values are calculated for 1990 (warmer and drier) and minimum values for 1986 (colder and wetter). The SOA computed variability results from a 7% increase in biogenic VOC emissions from 1986 to 1990 combined with 8.5% and 6% increases in the wet and dry deposition of SOA and leads to about 11.5% increase in the SOA burden of biogenic origin. The present study also demonstrates the importance of the hydrological cycle in determining the built up and fate of SOA in the atmosphere. It also reveals the existence of significant positive and negative feedback mechanisms in the atmosphere responsible for the non linear relationship between emissions of biogenic VOC and SOA burden.

Final Revised Paper (PDF, 1898 KB) Discussion Paper (ACPD)

Citation: Tsigaridis, K., Lathière, J., Kanakidou, M., and Hauglustaine, D. A.: Naturally driven variability in the global secondary organic aerosol over a decade, Atmos. Chem. Phys., 5, 1891-1904, 2005. Bibtex EndNote Reference Manager