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Source apportionment of PM2.5 organic aerosol over Europe: primary/ secondary, natural/ anthropogenic, fossil/biogenic origin

A. Gelencsér (1), B. May (2), D. Simpson (3), A. Sánchez-Ochoa (4), A. Kasper-Giebl (4), H. Puxbaum (4), C. Pio (5), and **M. Legrand** (6)

(1) Air Chemistry Group of the Hungarian Academy of Sciences, Pannon University, Veszprém, Hungary, (2) Insitute for Environmental Physics, University of Heidelberg, Germany, (3) EMEP MSC-W, Norwegian Meteorological Institute, Oslo, Norway, (4) Institute for Chemical Technologies and Analytics, Vienna University of Technology, Austria, (5) Departamento de Ambiente e Ordenamento, Universidade de Aveiro, Portugal, (6) Laboratoire de Glaciologie et Géophysique de l'Environnement - CNRS, St Martin d'Hères, France

Atmospheric aerosol was continuously sampled for 2 years at 6 sites along a west-east transect extending from Azores to Hungary. Aerosols were analyzed for ^{210}Pb, inorganic ions, EC and OC, WSOC, macromolecular (humic-like) organic substances, C_2-C_5 diacids, cellulose, levoglucosan, and ^{14}C. It is shown that, except at Azores where inorganic dominates, similar amounts of organic and inorganic matter are found in the non-urban European atmosphere, at the surface as well as in the free troposphere. This extensive data set also permits characterization of OC aerosol with regard to water solubility, showing that most (50-80%) of OC is water-soluble.

Based on this comprehensive dataset source apportionment of aerosol is attempted by combining ^{14}C data with OC, EC, levoglucosan and cellulose. Source types are lumped into primary emissions from fossil fuel combustion and biomass burning, bioaerosol, and secondary organic aerosol from precursors emitted by fossil and non-fossil sources. It is found that while fossil-related sources dominate EC throughout the year at all sites, the sources of OC are primarily biogenic and markedly different between summer and winter. In winter biomass burning primary emission is the main source. In summer secondary organic aerosol (SOA) from non-fossil sources becomes predominant (70 % of total carbon). An uncertainty analysis was done showing that the main conclusions from this study are robust.