Geophysical Research Abstracts
Vol. 15, EGU2013-8298, 2013
EGU General Assembly 2013

Olive Tree Branches Burning: A major pollution source in the Mediterranean

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Olive tree branches burning is a common agricultural waste management practice after the annual pruning of olive trees from November to February. Almost 1 billion (90%) of the olive trees in our planet are located around the Mediterranean, so the corresponding emissions of olive tree branches burning can be a significant source of fine aerosols during the cold months.

Organic aerosol produced during the burning of olive tree branches (otBB-OA) was characterized with both direct source-sampling (using a mobile smog chamber) and ambient measurements during the burning season in the area of Patras, Greece.

The aerosol emitted consists of organics, black carbon (BC), potassium, chloride, nitrate and sulfate. In addition to NO_x, O_3, CO and CO_2, Volatile Organic Compounds (VOCs) such as methanol, acetonitrile, benzene and toluene were also produced. The Aerosol Mass Spectrometry (AMS) mass spectrum of otBB-OA is characterized by the $m/z's$27, 29, 39, 41, 43, 44, 55, 57, 67, 69 and 91 and changes as the emissions react with OH and O_3. Fourier Transform Infrared Spectroscopy (FTIR) analysis showed that otBB-OA was composed of 48% alkane groups, 27% organic hydroxyl groups, 11% carboxylic acid groups, 11% primary amine groups and 4% carbonyl groups. The oxygen to carbon (O:C) ratio is 0.29±0.04. The otBB-OA AMS mass spectrum differs from the other published biomass burning spectra. The m/z60, used as levoglucosan tracer, is lower than in most biomass burning sources. This is confirmed by Gas Chromatography Mass Spectroscopy (GC-MS) analysis on filters where the levoglucosan to OC mass ratio was between 0.034 and 0.043, close to the lower limit of the reported values for most fuel types. This may lead to an underestimation of the otBB-OA contribution in Southern Europe if levoglucosan is being used as a wood burning tracer.

During the olive tree branches burning season, 20 days of ambient measurements were performed. Applying positive matrix factorization (PMF) to the ambient organic data 3 factors could be identified: OOA (oxygenated organic aerosol), HOA (hydrocarbon-like organic aerosol) and otBB-OA. The chamber organic AMS spectrum resembles the ambient mass spectrum during olive tree branches burning events. We estimated an otBB-OA emission factor of 3.45±0.2 g kg^{-1}. Assuming that half of the olive trees branches are burned 2,300 tons of otBB-OA are emitted in Greece each winter. This is one of the most important fine aerosol emission sources during the winter months in the Mediterranean countries in which this activity is prevalent.