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A model to assess the emission of individual isoprenoids emitted from Italian ecosystems

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The aim of this work was to develop a GIS-based model to estimate the emissions from the Italian forest ecosystems. The model was aimed at generating a species-specific emission inventory for isoprene and individual monoterpenes that could have been validated with experimental data collected in selected sites of the CARBOITALY network. The model was develop for the year 2006. At a resolution of 1 km2 with a daily time resolution.
By using the emission rates of individual components obtained through several laboratory and field experiments carried out on different vegetation species of the Mediterranean basin, maps of individual isoprenoids were generated for the Italian ecosystems.
The spatial distribution and fractional contents of vegetation species present in the Italian forest ecosystems was obtained by combining the CORINE IV land cover map with National Forest Inventory based on ground observations performed at local levels by individual Italian regions (22) in which the country is divided.
In general, basal emission rates for individual isoprenoids was reported by Steinbrecher et al. 1997 and Karl et al. 2009 were used. In this case, classes were further subdivided into T and L+T emitters as functions of the active pool. In many instances, however they were revised based on the results obtained in our Institute through determinations performed at leaf, branch (cuvette method) or ecosystem level (REA and the gradient method). In the latter case, studies performed in Italy and/or Mediterranean countries were used.
An empirical light extinction function as a function of the canopy type and structure was introduced. The algorithms proposed by (Guenther et al. 1993) were used, but, they were often adapted to fit with the experimental observations made in the Mediterranean Areas. They were corrected for a seasonality factor (Steinbrecher et al. 2009) taking into account a time lag in leaf sprouting due to the plant elevation. A simple parameterization with LAI was introduced to account for the amount of monoterpene biomass from the litter of stands composed by plants equipped with storage organs. Daily data of incident PAR and leaf temperature obtained from high resolved satellite observation were provided by the partners of the CARBOITALY Project. They were available for the entire year 2006. They were disaggregated into proper day-night cycles.
Emission values predicted by the model are in perfect agreement with those that were measured by different micrometeorological techniques in Castelporzioano (Ciccioli et al, J Chromatogr., 2003) and in the Collelongo site (Ciccioli et al. unpublished).
The good correlation between modeled and measured values emphasizes the fact that accurate predictions can be obtained if validated emission factors for individual VOC are used in the model. The almost equivalent potential emission of isoprene and monoterpenes reported in a previous work was confirmed, although lower values of total biogenic emissions were found for both classes of hydrocarbons.
Data from individual monoterpenes indicates also that highly reactive cis- and b-ocimenes are also quite abundant in many Italian forest ecosystems, including those dominated by coniferous trees, such as Pinus pinaster and sylvestris. This may lead to rather low dominance of pinene generated particles in the air.
The high spatial and temporal resolution, combined with the species-specific emission output makes our model particularly suitable for ozono and SOA prediction with both Eulerian and Lagrangian photochemical models, at the scale at which ozono pollution develops in Italy.