FOREST FIRES AND AGRICULTURAL BURNING: EMISSIONS AND EFFECTS

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Wildfires are predicted to increase with global climate change, resulting in longer fire seasons and larger areas burned. On the other hand, the use of fire to reduce or dispose of vegetative debris is a worldwide and long-standing practice, since it is a quick and inexpensive way to manage the large amounts of residues. However, the smoke from both sources affects human health, worsens air quality, and can trigger severe regional haze events. At both national and international levels, there is an increasing focus on the establishment of emission inventories and regulations of regional carbon emissions to the atmosphere. From the standpoint of atmospherically-based carbon monitoring programs, fires are challenging because they tend to be extremely variable in both space and time, they are expected to increase in number and severity, and because emission estimates depend on biofuel characteristics and combustion phase. In addition to high spatial and temporal variations in fuel loadings and lack of observational data, one of the most influential and variable parameters is the emission factor. Emission factors (EFs) of selected species for major biomes have been reviewed and summarized by Akagi et al. (2011). However, due to the variability and complexity of the burning conditions and limited on-site experiments, EFs for many biofuels are still uncertain. In addition, EFs measured in the laboratory may substantially differ from those obtained in the field.

With the aim of quantifying and characterizing the emissions of trace gases and aerosol particles from representative wildfires and open agricultural burning events, the University of Aveiro has developed techniques to sample the smoke plumes under real conditions and to perform the detailed characterization of both the gas and particulate phases. The new datasets include carbon oxides, organic and inorganic volatile compounds, and a vast array of particulate constituents, including organic and elemental carbon (OC and EC), water soluble ions, metals and hundreds of individual organic compounds. The particulate matter samples were also tested for ecotoxicity by the *Vibrio fischeri* bioluminescence inhibition bioassay. Based on the 50%-effective concentration (EC50), Toxic Units (TU) were calculated. The TU values indicated that most samples presented significant acute toxicity. The comprehensive databases may be useful for numerical models to evaluate the impact of wildfires in the Mediterranean region, which is particularly uncover by this type of studies. This research may also contribute to improve source apportionment models allowing to estimate the input of wildfires to the atmospheric levels at specific monitoring sites. The results consolidate previous argumentations that smouldering emissions make a significant contribution to the total emissions, and therefore cannot be neglected. The smoke plume is mainly composed of fine particles containing carcinogenic (e.g. polycyclic aromatic hydrocarbons) and compounds that cause oxidative stress (e.g. phenolics). Thus, populations regularly exposed to fire smoke are at high health risk. Smoke particles are carbonaceous in nature with a clear dominance of OC and much higher OC/EC values than those reported in the literature for other sources. Since EC plays a key role in radiative forcing and considering the discrepancies between the various studies, the magnitude of the emission factor for EC remains uncertain and deserves further investigation.

Acknowledgements: The experimental work supported by the project "Chemical and toxicological SOurce PROfiling of particulate matter in urban air (SOPRO)", POCI-01-0145-FEDER-029574, funded by FEDER, through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI), and by national funds (OE), through FCT/MCTES.

Reference: Akagi et al., 2011. Atmos. Chem. Phys. 11, 4039-4072.