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ACROSS: A future project to improve understanding of the impacts of anthropogenic-biogenic interactions on air quality using many observational platforms

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Historically, air pollution research has focused either on processes in remote locations or on the air quality of urban environments. With urban plumes extending over hundreds of kilometers, urban emissions and reaction products mix with rural/semi-rural environment biogenic emissions adding to the complexity of the chemistry. Indeed, the proximity of cites to areas of strong biogenic emissions is not unusual. Many major cities at mid-latitudes are surrounded by forested areas (e.g. Paris, Berlin, New York, Tokyo, Seoul, Toronto, Sydney).
Important differences in the chemistry of mixed anthropogenic/biogenic air masses have been reported, although historically the focus has been on ozone production. Urban air masses are generally characterized by high NO_x levels and by volatile organic compounds (VOCs) from fossil fuels and industrial processes. Air of biogenic origin generally has lower NO_x levels and contains VOCs that are usually unsaturated, including isoprene (C5H8), monoterpenes (C10H16), sesquiterpenes (C15H24), and/or oxygenated (e.g. 2-methyl-3-buten-2-ol aka MBO). These organic compounds are generally more reactive toward oxidation than those of anthropogenic origin. Mixed air masses can have oxidant production rates and yields of secondary organic aerosols significantly different from anthropogenic or biogenic ones. Several factors explain this particular behavior, among others: (i) different oxidation mechanisms for biogenic VOCs at higher levels of NO_x (e.g. leading to formation of organic nitrates and reduced formation of organic hydroperoxides), (ii) rates of oxidant production are affected by changes in the production of photolabile compounds (e.g. formaldehyde, nitrous acid), (iii) enhanced nighttime oxidation chemistry initiated by nitrate radicals, (iv) higher ozone levels enhancing the rate of ozone-biogenic alkene reactions and increasing radical production from ozone photolysis. The effects of higher ozone levels typically maximize as urban ozone peaks some 50 to 100 km downwind of the urban area, although the location and timing can vary depending on the nature of the emissions and the meteorological conditions. Recent studies conducted in megacities such as Paris, Mexico City, Los Angeles, and Chinese megacities have led to significant advances in our understanding of chemical evolution in urban plumes. However, significant scientific questions remain on how such mixed anthropogenic/biogenic air masses modify the composition of urban plumes and hence their impacts.
The ACROSS (Atmospheric ChemistRy Of the Suburban foreSt) is a framework for investigation of the atmospheric chemistry of mixed urban/biogenic air masses. The research is conducted primarily through a comprehensive, multi-platform field campaign in which observations will be made to address key scientific questions, but also includes related laboratory and modeling activities. This presentation will outline the timeline and plans for the ACROSS field campaign including the expected platforms to be used (including aircraft), infrastructure to be developed, and scientific questions to be addressed. Development of partnerships with researchers throughout Europe and beyond who are interested in ACROSS will be discussed and encouraged.