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Effect of VOC emissions from vegetation on urban air quality during hot periods

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Programs to plant millions of trees in cities around the world aim at the reduction of summer temperatures, increase of carbon storage, storm water control, and recreational space, as well as at poverty alleviation. These urban greening programs, however, do not take into account how closely human and natural systems are coupled in urban areas. Compared with the surroundings of cities, elevated temperatures together with high anthropogenic emissions of air and water pollutants are quite typical in urban systems. Urban and sub-urban vegetation respond to changes in meteorology and air quality and can react to pollutants. Neglecting this coupling may lead to unforeseen negative effects on air quality resulting from urban greening programs. The potential of emissions of volatile organic compounds (VOC) from vegetation combined with anthropogenic emissions of air pollutants to produce ozone has long been recognized. This ozone formation potential increases under rising temperatures.
Here we investigate how emissions of VOC from urban vegetation affect corresponding ground-level ozone and PM10 concentrations in summer and especially during heat wave periods. We use the Weather Research and Forecasting Model with coupled atmospheric chemistry (WRF-CHEM) to quantify these feedbacks in the Berlin-Brandenburg region, Germany during the two summers of 2006 (heat wave) and 2014 (reference period). VOC emissions from vegetation are calculated by MEGAN 2.0 coupled online with WRF-CHEM. Our preliminary results indicate that the contribution of VOCs from vegetation to ozone formation may increase by more than twofold during heat wave periods. We highlight the importance of the vegetation for urban areas in the context of a changing climate and discuss potential tradeoffs of urban greening programs.