# BVOC emission simulation for the Vienna region during an extreme heat event

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## *Introduction:*

Biogenic volatile organic compounds (BVOC) are emitted by trees. In the presence of NOx they can help to produce tropospheric ozone. During heat waves this can cause a critical additional stress for human wellbeing, especially in areas exhibiting high NOx concentrations. Heat wave intensity and frequency is expected to increase.

The most frequently occurring BVOC is isoprene. Main factors contributing to the magnitude of emission are next to the light dependent fraction of the vegetation the leaf area index (LAI) at the specific location and soil moisture (Fig. 1).

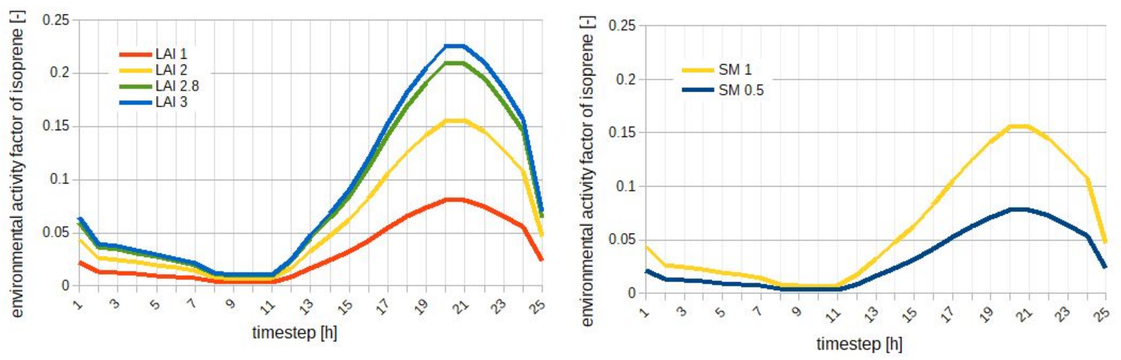


*Figure 1: Environmental activity factor [-] of isoprene for one day (30.5.2019 12 UTC – 31.5.2019 11UIC) dependence on different factors. Left: leaf area index (LAI) sensitivity for saturated soils (soil moisture activity factor = 1),*
*Right: soil moisture activity factor (SM) sensitivity for LAI=2.*

## *Method*

To estimate the potential threat, we simulate BVOC emissions over the Vienna region during an extreme heat wave using the Model of Emissions of Gases and Aerosols from Nature (MEGAN) (Guenther et al. 2012) in its latest version 3. We adapted the model to directly ingest the files used and produced by the land surface model SURFEX8.1 (Surface Externalisée, in French) (Boone et al. 2017) and its preprocessors. In this poster we present our methodology and first results showing the spatial distribution and time series of selected BVOCs.

*Heat Wave*
The chosen heat wave covers 5 days during August 2015, with an average daily 2 m air temperature of 36.3 °C, and represents a significant event with a 15 year return period (of the period 1988-2017).

*Preprocessing of input data*
The LAI and soil parameters field capacity and wilting point are taken from the physiographic fields derived from ECOCLIMAP, soil moisture and temperature from the prognostic SURFEX output fields calculated for urban and non-urban areas, the 2 m air temperature from the diagnostic output fields of SURFEX.

*Calculation of intermediate results*
The meteorological forcing is used to create daily meteorology parameters and together with LAI maps run the canopy meteorology module. Further we use the soil emission activity module to calculate a soil temperature and soil moisture dependent isoprene soil emission activity factor.
Using these datasets the emission activity factors are calculated.

*Lumping and calculation of BVOC emissions*
Finally, the emission activity factors are converted from 20 to 201 species and lumped according to the RACM2 mechanism in order to obtain BVOC emission.

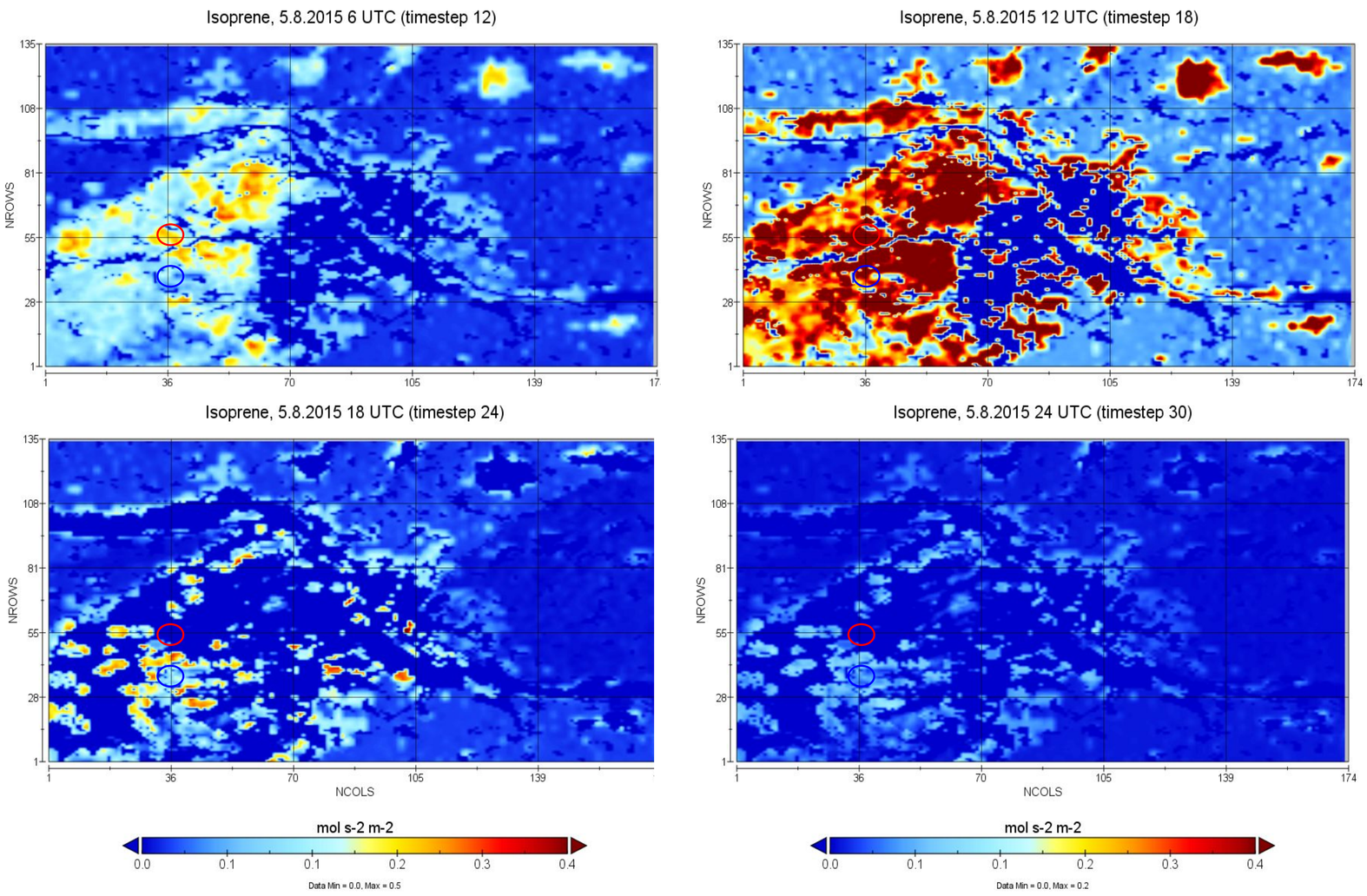


*Figure 2: First isoprene emission results for the beginning of the chosen heat wave episode in the Vienna region, which show the spatial distribution of emissions, which are mainly in the forested regions west of the city. The circles mark the positions, of the timeline graphs shown in Figure 3. The red circles mark an area of vegetation cover "mountain coniferous forest" (ECOCLIMAP Cover 210), the blue circles mark an area of "temperate complex cultivation pattern" (ECOCLIMAP Cover 189).*

## *First results and outlook*

First results, show the strong dependence of isoprene emissions on incoming photosynthetically active radiation and LAI as well as soil moisture (Figure 1). In the course of the heat wave isoprene emissions decline (Figure 2+3), which correlates with the decline in soil water availability and consequent decreased stomatal opening.

Further the isoprene emissions wiill be compared with EMEP simulation results. Next the monoterpene emissions, which are expected to be significant due to the abundance of *Fagus sylvatica* west of Vienna, are analyzed.

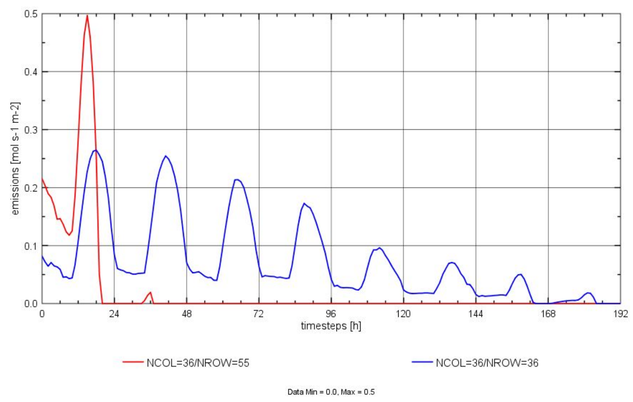


*Figure 3: Emission of isoprene during the chosen heat wave for two different locations (see circles in Figure 2) in the forested regions west of the city Vienna ("Wienerwald") who show distinct differences in temporal evolution.*

## *References*

Boone, A., Samuelsson, P., Gollvik, S., Napoly, A., Jarlan, L., Brun, E., & Decharme, B. (2017). The interactions between soil–biosphere–atmosphere land surface model with a multi-energy balance (ISBA-MEB) option in SURFEXv8 – Part 1: Model description. Geoscientific Model Development, 10(2), 843–872. https://doi.org/10.5194/gmd-10-843-2017

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