Karlsruhe Institute of Technology

Helmholtz Research School on Mechanisms and Interactions of Climate Change in Mountain Regions

BVOC fluxes from a bioenergy maize plantation

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Background

- BVOC emissions strongly depend on plant species, temperature (+), radiation (+), and CO_2 (-)
- Emissions affect CH_4 life time, formation of SOA and O_3
- Thus, analyzing environmental impacts of bioenergy maize cultivation requires a quantification of BVOC emissions – which has hardly be done yet
- The project Volatile Organic Carbon Emisson (VOCE) investigates BVOC, CO_2, and CH_4 fluxes from 3 bioenergy plant species throughout the growth period applying a new big chamber methodology (see Fig. 1)
- Project partner: Leibnitz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V.

Objectives

Which BVOC compounds are substantially emitted and how do they evolve during the growth season with changing weather?

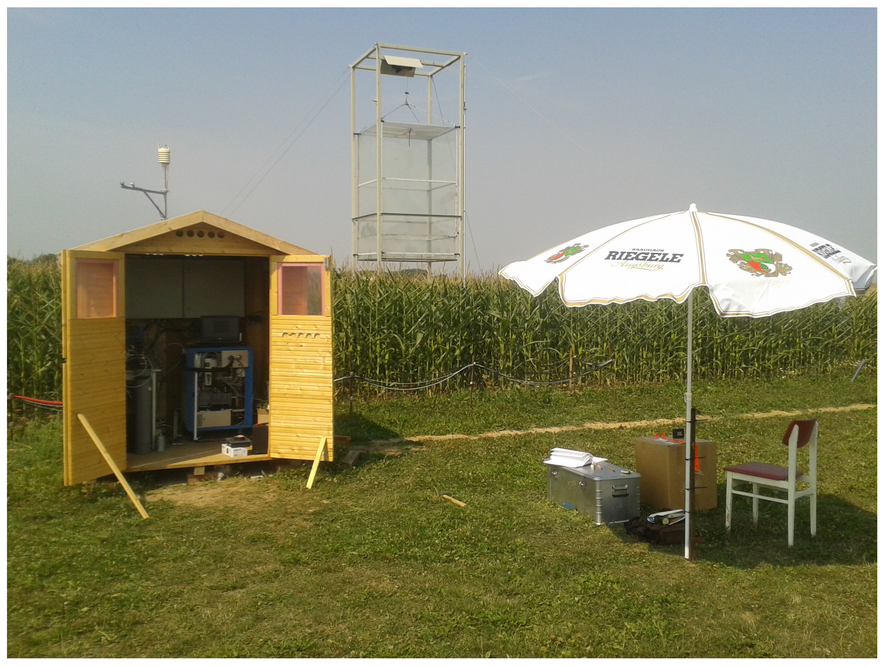

Fig. 1: Maize field with hut including the observation devices (PTR-MS, LGR-GGA) and one of the two automatic chambers in open position at the field experiment site in Dedelow, Brandenburg, Germany, 11th August 2015.

Methodology

- Field experiment at CarboZALF site in Dedelow, Brandenburg, Northeastern Germany (ZALF e.V., Müncheberg)
- Sort of maize (*Zea mays):* Zoey from Advanta Seeds DMCC
- We measured 18 BVOCs (PTR-MS, GC-MS), CO_2, CH_4, H_2O concentrations and meteorological parameters
- Two transparent automatic closed chambers (1.5 m * 1.5 m * 2.5 m, polycarbonate)
- Each chamber is closed for 12 min h-1
- BVOC fluxes are calculated as significant slopes of linear regression (see Fig. 2) from each closed chamber period

Results

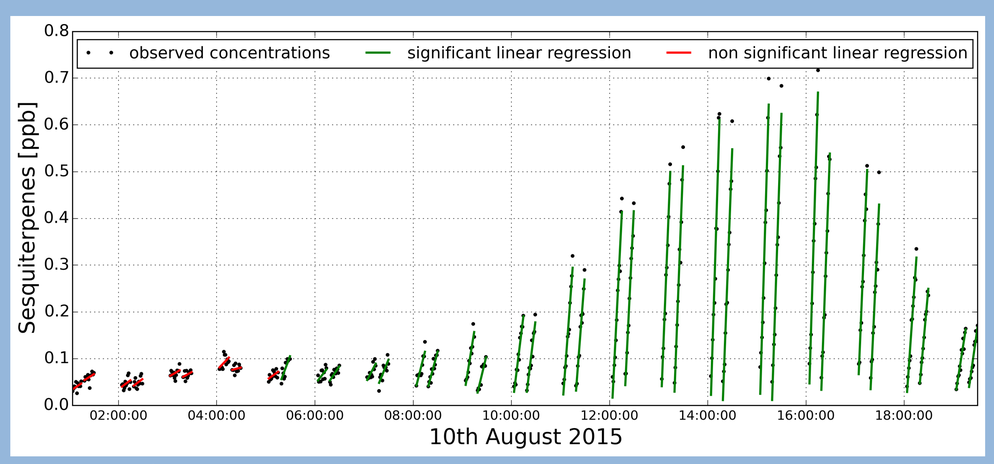

Fig. 2: Example of sesquiterpene concentrations during one day of measurement. Concentration increase in the headspace of the transparent automatic chamber, V = 5.625 m³ (see Fig. 1) originate from 21 maize plants at the 10th August 2015 in Dedelow (black dots). Significant (p-Value < 0.05, green lines) and non significant linear regressions (red lines) fitting to the observations were calculated to derive canopy emission rates (see Figs. 3 and 4).

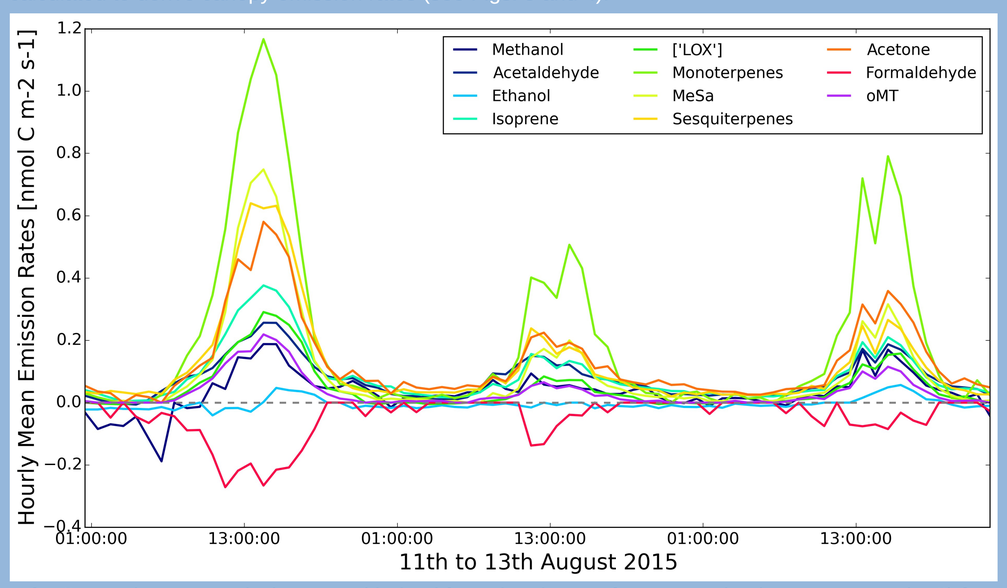

Fig. 3: Hourly mean emission rates (derived from the slopes of concentration increase, see Fig. 2) for three days in August 2015 based on carbon atoms and m² leaf area

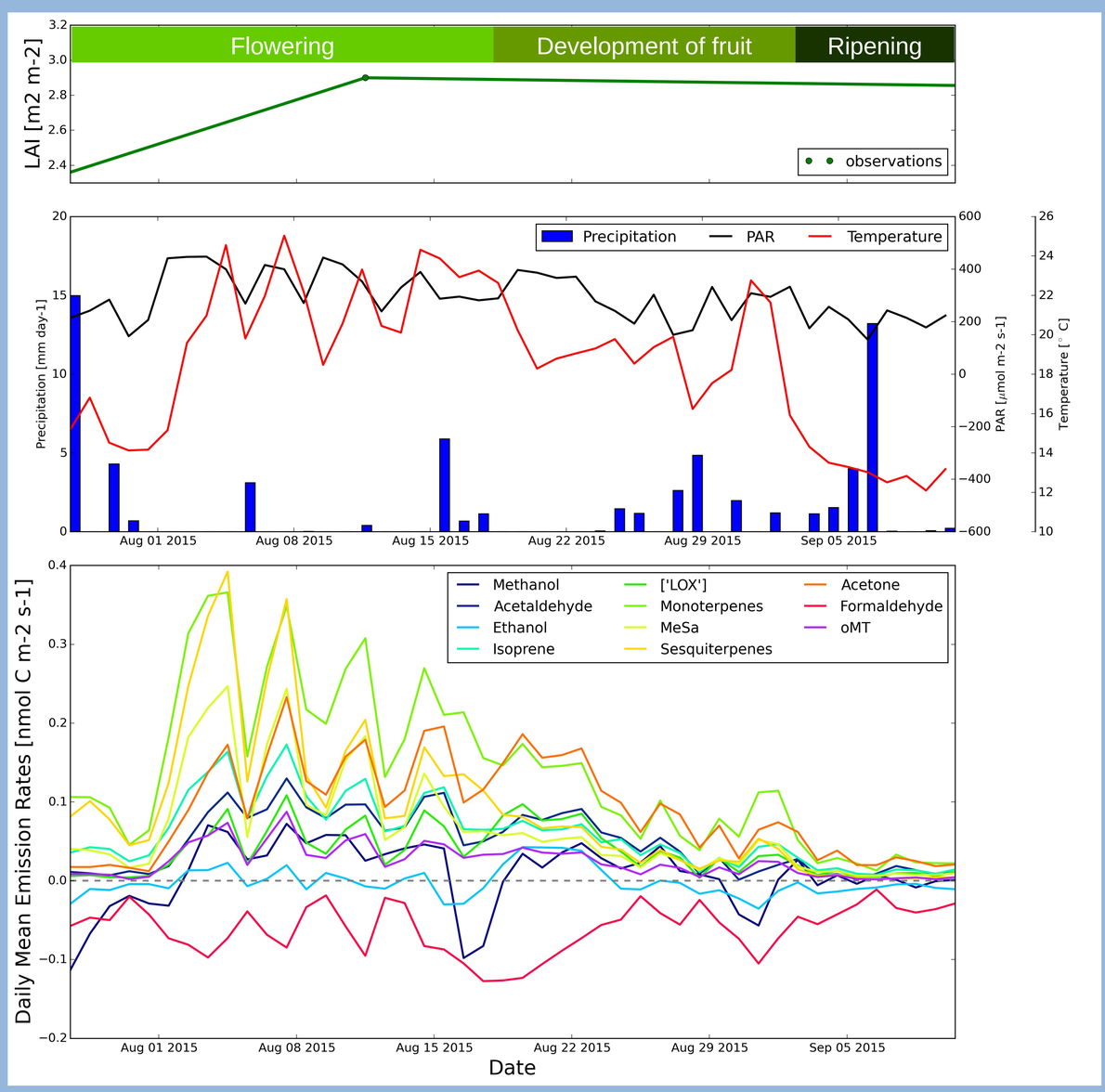

Fig. 4: *Top*: observed (green dot) and linear interpolated (green line) LAI,annotated phenological states – *Middle*: daily mean temperature (red), PAR (black), and daily summed precipitation (blue) – *Bottom:* daily mean emission rates for the most relevant compounds (positive and negative values represent emission and deposition, respectively).

Highlights and conclusion from first results

- Significant amount BVOC emissions, particularly of monoterpenes, sesquiterpenes, and acetone – deposition of formaldehyde
- Changes of BVOC emission profiles and rates reflect both, the phenological state of the plant and meteorological conditions → further investigation needed to distinguish between both
- Mean fraction of BVOC emission in NEE 0.07 % (daily mean maximum 0.24 %)