Are BVOC exchanges in agricultural ecosystems overestimated?

Insights from fluxes measured in a maize field over a whole growing season

Aurélie Bachy, Marc Aubinet, Niels Schoon, Crist Amelynck, Bernard Bodson, Christine Moureaux, and Bernard Heinesch

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Why studying BVOC?

Biogenic Volatile Organic Compounds

Main source: terrestrial ecosystems (plants)

Implications:
- Methane lifetime
- SOA formation
- Tropospheric ozone

Sources: Google image and Vielsalm Terrestrial Observatory (forest)
Why studying maize?

- Second most important worldwide crop...

  - ... but little information for BVOC exchanges
    (Graus et al., 2013; Das et al., 2003)
Study goals

• **Which BVOC** are exchanged by a maize field?

• Are BVOC exchanges **important** regarding:
  – Other maize studies?
  – Other crop studies?

• **Do BVOC flux values** used by up-scaling **models** match values measured on the maize field?
The Lonzée Terrestrial Observatory (LTO)
- Agricultural field with conventional cropping system
- Size: 10 ha in 2012
- CO$_2$ fluxes since 2004 - ICOS candidate site
Experimental set-up

Ecosystem-scale – DEC-MS technique

Sonic anemometer

Micro-meteorological station

PTR-MS

Source: LTO site
Measurement campaign

- Silage maize (European varieties)
- 11 BVOC compounds
- 1 flux per ½ h during 185 days

Start: 17 May 2012

I Bare soil
II Leaf unfolding
III Stem elongation
IV Inflorescence kernel forming
IV Kernel maturation

Source: LTO site
Source: LTO site (phenological camera)
BVOC composition

Source: LTO site

I Bare soil

II Leaf unfolding

III Stem elongation

IV Inflorescence kernel forming

IV Kernel maturation

Source: LTO site (phenological camera)
Comparison with other maize studies

Source: LTO site

Similar T, PPFD and phenological stages

- Methanol
- ACD
- Acetone
- Acetic acid
- MVK + MACR
- MT

This study
Graus et al., 2013

Das et al., 2003
Comparison with other crop studies

Sources:
A Copeland et al., 2012
B Custer et al., 2007
C Bamberger et al., 2010
D Ruuskanen et al., 2011
E Schade et al., 2004

Agricultural BVOC fluxes studies in Europe
Standard emission factors

<table>
<thead>
<tr>
<th>Substances</th>
<th>ORCHIDEE $[\text{mg} g_{DW}^{-1} h^{-1}]$</th>
<th>MEGAN v 2.1 $[\text{mg} m^{-2} h^{-1}]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoprene</td>
<td>0.06</td>
<td>8</td>
</tr>
<tr>
<td>Monoterpenes</td>
<td>0.03</td>
<td>231</td>
</tr>
<tr>
<td>Methanol</td>
<td>1.64</td>
<td>500/800</td>
</tr>
</tbody>
</table>

Sources: Lathière et al., 2006 for ORCHIDEE and Guenther et al., 2012; Stavrakou et al., 2011 for MEGAN
Take home messages

• Qualitatively, BVOC exchange similar to other crop and grasses

• Soil was a major actor in BVOC exchanges

• Quantitatively:
  – Much lower than other maize studies
  – Lower than other European crops

• Methanol and isoprene SEF much lower than those currently used by models
Interested?

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Research article

**Are BVOC exchanges in agricultural ecosystems overestimated? Insights from fluxes measured in a maize field over a whole growing season**

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Abstract. Although maize is the second most important crop worldwide, and the most important C4 crop, no study on biogenic volatile organic compounds (BVOCs) has yet been conducted on this crop at ecosystem scale and over a whole growing season. This has led to large uncertainties in crop BVOC emission estimates. This paper seeks to fill this gap by presenting, for the first time, BVOC fluxes measured in a maize field at ecosystem scale (using the disjoint eddy covariance by mass scanning technique) over a whole growing season in Belgium. The maize field emitted mainly methanol, although exchanges were bi-directional. The second most exchanged compund was acetaldehyde and the third 2-methylbutanol.

Bachy et al., 2016 - DOI 10.5194/acp-2015-1034
On the road...

Source: LTO site