Environmental controls of biogenic volatile organic compound emissions from a grazed grassland in Dorinne, Belgium

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Background & Objectives

- VOCS have an important role in atmospheric chemistry
- Few BVOC studies on grassland, none on grazed grassland so far
- Poor understanding of the influence of (a)biotic stress on emissions
- Methanol represents around 75% of the VOCs carbon cumulated flux of grasslands

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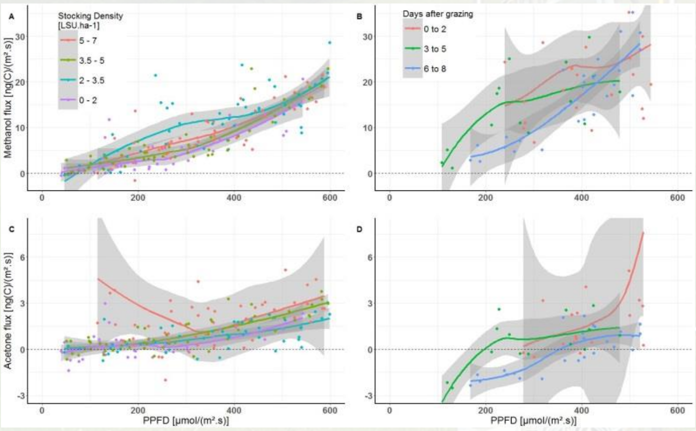
- Evaluate the impact of the grazing stress on BVOC emissions
- Evaluate the capacity of MEGAN v2.1 to model the methanol exchange

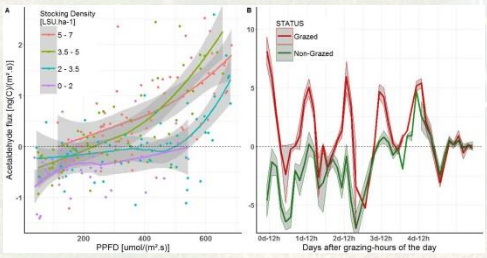
Results: Impact of grazing

BVOC presented: Methanol (most emitted VOC) and Acetone and Acetaldehyde (VOCs most impacted by grazing)



(a) Daily response to radiation (main driver) of EC methanol flux for different stocking density classes and (b) Daily response to radiation of EC chambers methanol flux for different days after grazing event, (c) and (d) same but for acetone in stead of methanol

- EC methanol flux not impacted by difference in stocking density but chambers methanol flux higher after grazing event especially at lower radiation
- EC acetone flux more impacted by the stocking density (very erratic data at high stoking density) and chambers acetone flux higher after grazing event (switch from deposition to emission depends on PPFD and grazing)



(a) Daily response to radiation (main driver) of EC acetaldehyde flux for different stocking density class and (b) acetaldehyde chambers fluxes for the 5 days just after grazing events in red (average for the 3 campaigns and 3 chambers) and non-grazed control in green

- Clear impact of stocking density and days after grazing event on the EC and chamber fluxes
- Clear switch from deposition to emission depending mainly on grazing and PPFD

Conclusions & Perspectives

- Grazing induces higher emissions of methanol, acetaldehyde and acetone but it is only detectable when measuring specifically with chambers for methanol → The EC data will be analyzed more finely using footprint function and the accurate grazing during the previous days by means of GPS and activity monitoring devices for cows.
- LDF is equal to 1 (no light independent fraction) and past temperature and radiation do not seem to have an effect on the methanol flux (data not shown)
- Yage can be modeled as a linear function of time during the growing season of an intensively grazed grassland

Material & Methods

- <u>Site characteristics:</u>

Intensively grazed grassland (Average of 3.7 $LSU.ha^{-1}$ during the grazing season) located in Dorinne, Belgium (Condroz region). Mean annual air temperature of 10°C
66% graminaceous (mainly Perennial Ryegrass) and 16% legumes (mainly White Clover)

- <u>Measurement campaign:</u>

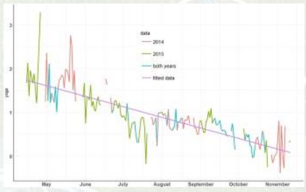
Eddy covariance: May to November in 2014 and April to October in 2015 (with gaps)
Chambers: three two-week campaigns from August to September 2016

- <u>Instrumentation:</u>

CO_2, H_2O concentration measured using a Infrared gas analyzer
6 BVOC concentration (M33,M45,M59,M61,M73,M83) measured using a conventional high sensitivity proton-transfer-reaction mass spectrometer (HS-PTR-QMS)
meteorology, stocking density and biomass above ground (grass height) measurements
Eddy covariance : Methanol flux obtained per disjunct eddy covariance by mass scanning
Chambers : Methanol flux obtained with three non-grazed and three fully grazed automated dynamic flow-through chambers

Results: MEGAN v2.1 model for Methanol

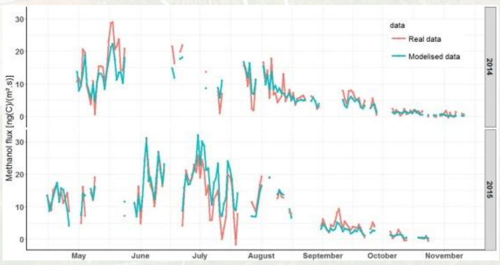
<u>First step</u>: use established parameters (Stavrakou 2011) and determine epsilon and light dependent fraction (LDF) by using least square estimate to all of the data
→ ϵ=480 ug. $m^{-2}.h^{-1}$ (Stavrakou 400) and LDF=1 (Stavrakou 0.8) [half hourly data: R^2=0.66, daily mean data: R^2=0.64]
<u>Second step</u>: Divide daily mean of methanol data by the daily mean of modeled data to determine γage
$[\gamma_{age} = \frac{F\_M33_{real}}{F\_M33_{model1}}]$



Yage evolution throughout the two growing seasons (lots of gaps during the two growing seasons)

- Yage linearly modeled to the day of the year [R^2=0.61]

<u>Third step</u>: $F\_M33_{model2} = F\_M33_{model1} * \gamma_{age}$
[hourly data: R^2=0.74, daily data: R^2=0.83]



Daily evolution throughout the two growing seasons of the modeled data and the real data

- Good fit between the modeled and real data
- Deposition not taking into account in the model (problems in July 2015)

Acknowledgement

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