N_2O eddy covariance fluxes: From field measurements to flux analysis

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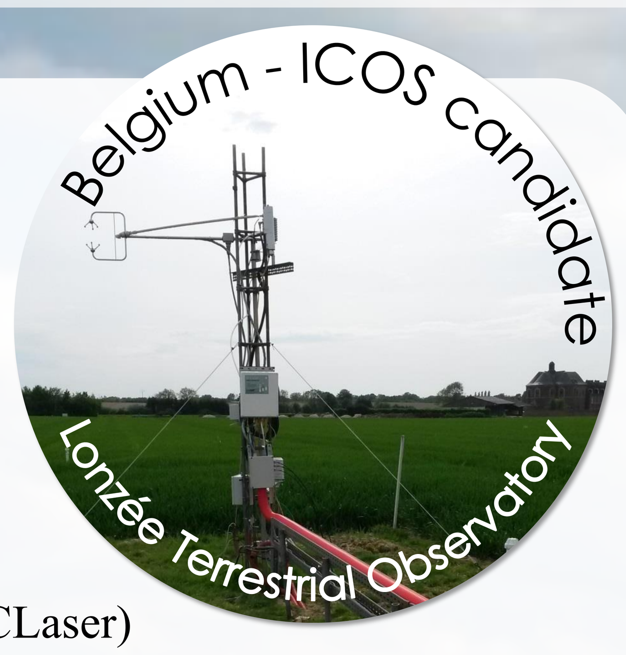
1. Methodology



Experimental set up

Ecosystem :

- Production crop - sugar beet (2016)

Measurements :

- Wind velocity (Gill HS-50)
- N_2O mixing ratio (Aerodyne Research Inc. QCLaser)
- Meteorological and soil conditions (half-hourly monitoring)

Data treatment

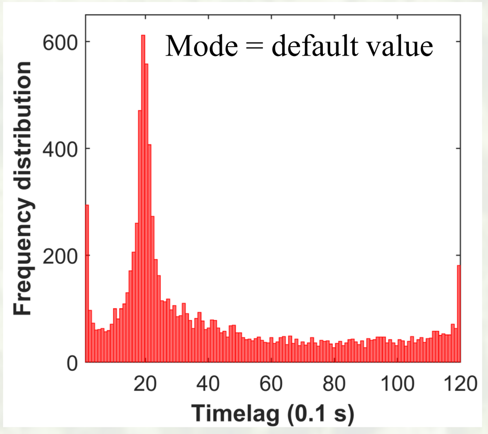
➢ **Use of EddyPro® Software (LI-COR) to process data**

➢ **Time series quality was assessed following Vickers & Mahrt, 1997**

⇨ The test for skewness and kurtosis was discarded due to excessive flagging of N_2O time series.

➢ **Timelag correction was based on covariance maximum with a default value**

⇨ The automatic procedure of timelag optimization implemented by EddyPro® gave unrealistic results and was thus discarded.



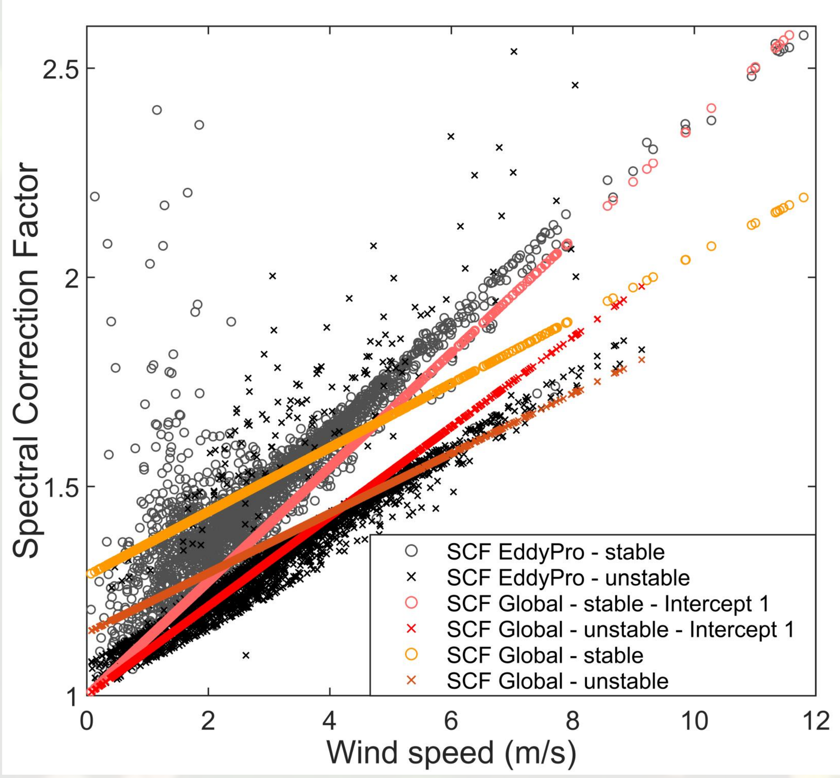
Spectral corrections

➢ **Comparison of two methods for spectral correction factors (SCF)**

⇨ **EddyPro approach :** *Fratini et al. (2012)* for tube attenuation and *Horst & Lenschow (2009)* for sensor separation → $SCF_{EddyPro} = SCF_{FR12} \times SCF_{H\&L09}$

⇨ **Global approach :** one transfer function (adapted Lorentzian) based on ensemble cospectra of N_2O and sensible heat → SCF_{Global}

Based on high quality (co)spectra in the dataset, the step of *Fratini et al. (2012)* and the global approach perform **a linear regression between SCF and wind speed**. This regression is then applied to half-hours of poorer quality.



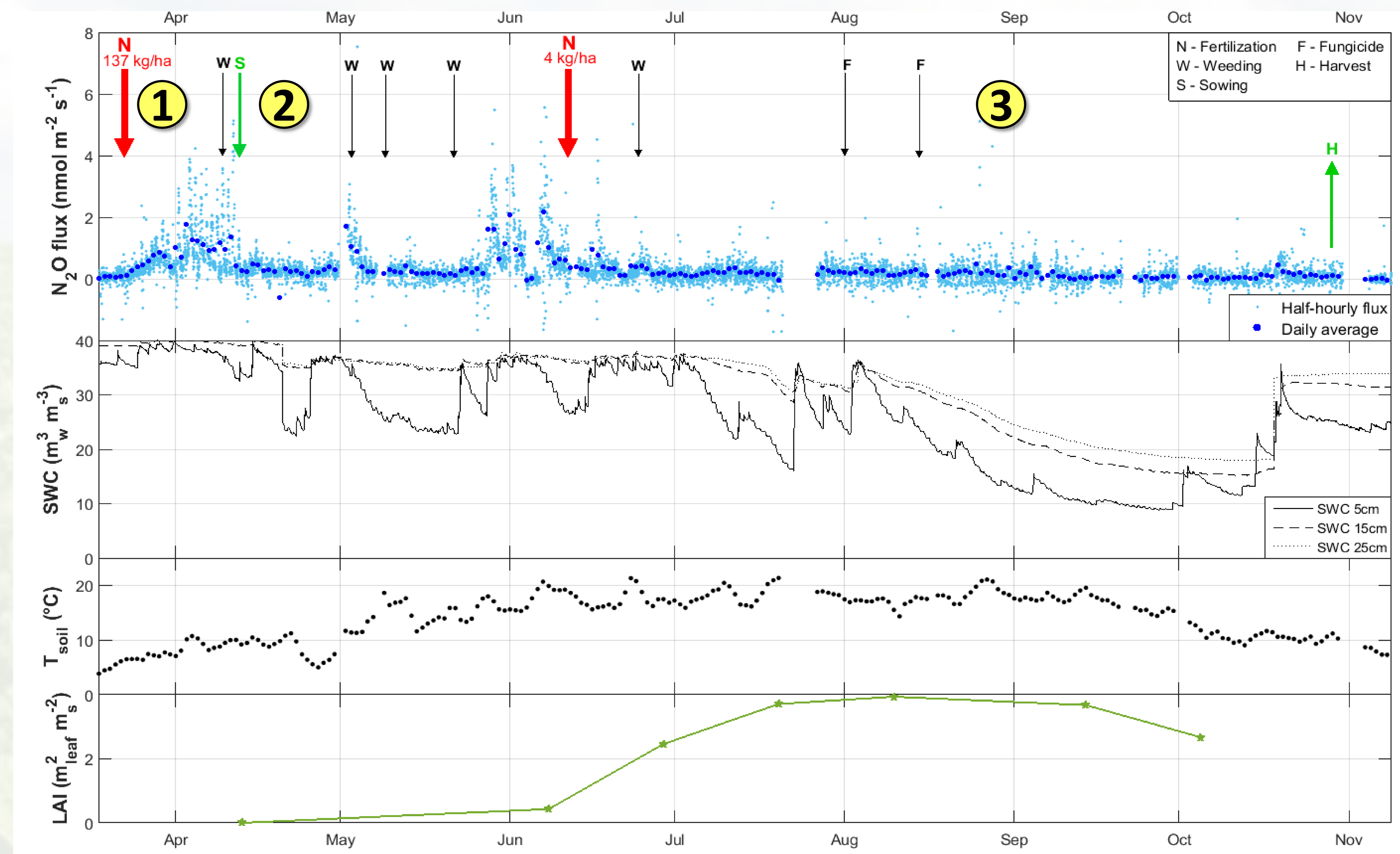
➢ **A 6% difference in cumulated corrected fluxes between methods** was found.

➢ **Higher differences** between methods were observed **for stable conditions at low wind speed**, which was attributed to $SCF_{H\&L09}$

➢ The **global approach** gave **different SCF, depending on whether the intercept was set to 1 or not** (7% difference in cumulated corrected fluxes).

2. Flux analysis

Influence of farming practices and weather



➢ **Cumulated emissions from fertilization to harvest : 5800 µmol N_2O m^{-2} (to be refined)**

⇨ This represents a **1.2% loss of N inputs** via N_2O emissions, which is in agreement with IPCC 2006 estimates of emission factor for managed soils.

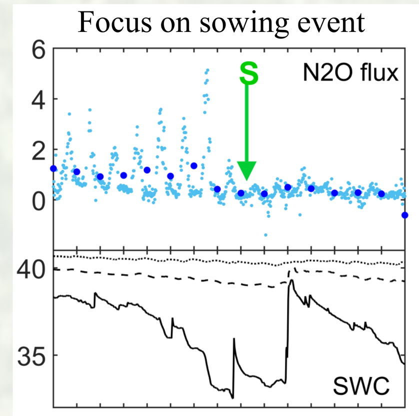
⇨ When converted to CO_2-eq, it corresponds to about **20% of the mean annual GHG budget** of the experimental site.

➢ **Precipitation (and consequently SWC in the top soil) and some farming practices were the main drivers, with the specific following observations :**

① **Triggered by mineral fertilization and rainfall, an emission burst occurred (30% of total N_2O emissions)**

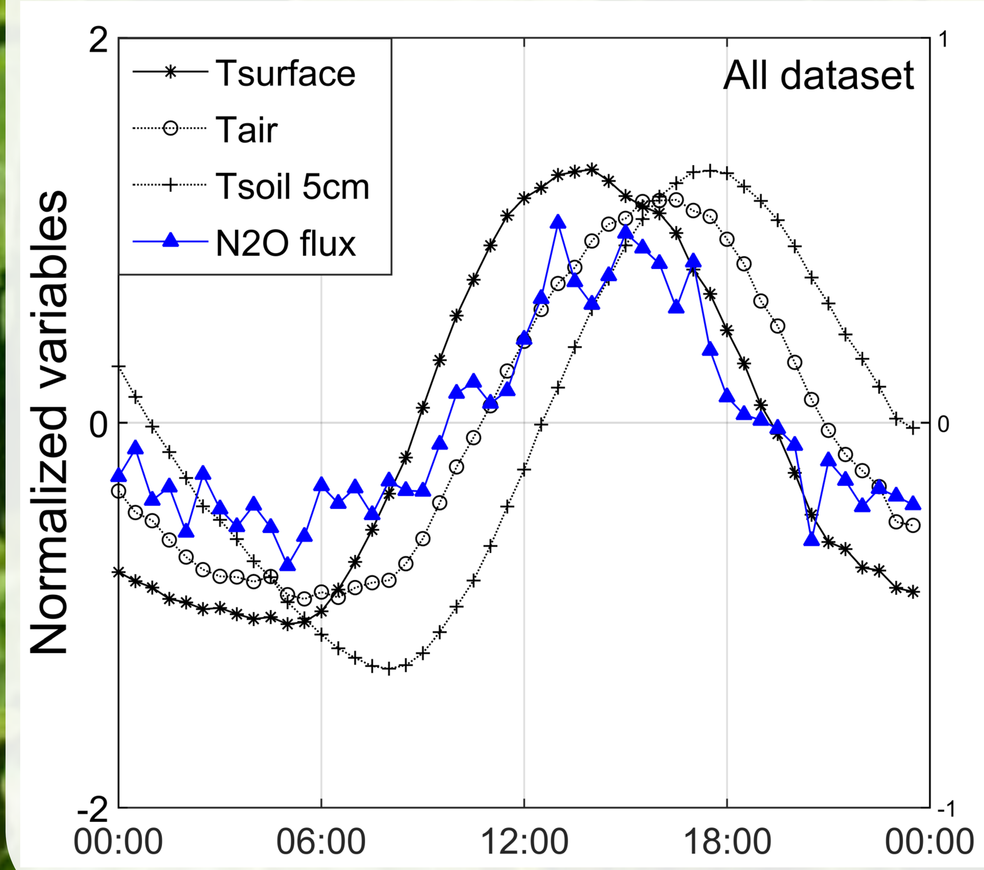
② **The emission burst was inhibited after sowing**

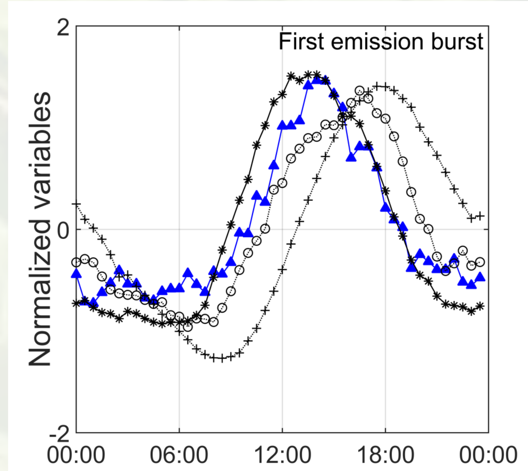
⇨ This suggests that the preparation of seedbed, by disturbing the top soil layer, relocated active micro-organisms at a greater depth which decreased N_2O production

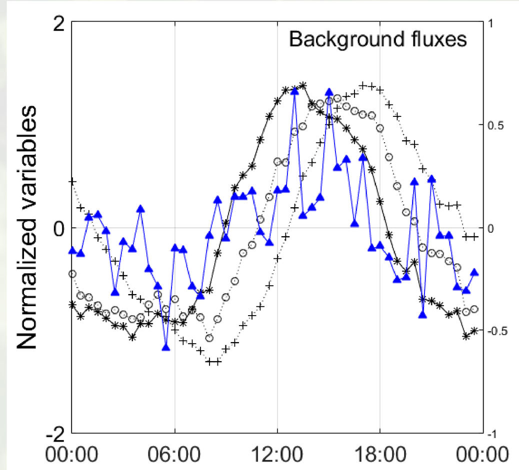


③ **When vegetation development begins, no more important peaks are observed.**

Daily variability of N_2O fluxes







➢ **Cyclic variations of N_2O fluxes are observed at a daily scale.**

➢ **These oscillations are more in phase with the surface temperature (Tsurface) than with the soil and air temperatures (Tsoil and Tair).**

3. Take-home message

☞ **Cumulated N_2O emissions reached 5800 µmol m^{-2}, corresponding to 20% of mean annual GHG budget**

☞ **30% of N_2O was emitted between the first fertilization and sowing**

☞ **No emission burst was observed after crop development**

☞ **Emission peaks interrupted at sowing**

☞ **Flux oscillations in phase with surface temperature**

} **Emission processes are concentrated in the soil surface layer**

☞ **Spectral correction methods should be further investigated**

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