ETH zürich

Food Day @ETH 2024

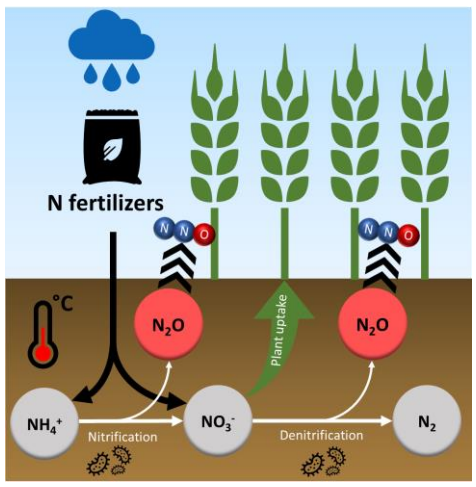
Crop growth limits N_2O losses from agricultural soils

Fabio Turco[1], Lorenz Allemann[1], Frank Liebisch[2], Nina Buchmann[1]

[1]Grassland Sciences Group, ETH Zurich, [2]Water Protection and Substance Flows, Agroscope Zürich

Why?

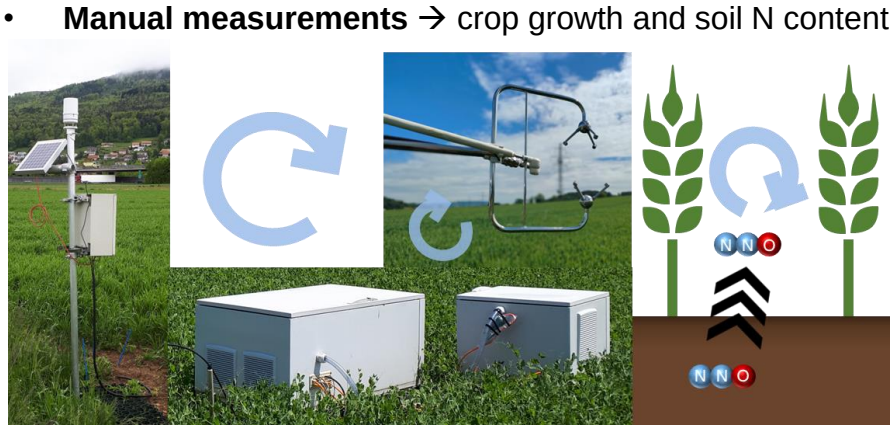
- **Nitrous oxide** (N_2O) is the third most important **greenhouse gas**.
- ~**70%** of anthropogenic N_2O emissions are attributed to **agriculture** due to the use of nitrogen (N) fertilizers.
- Limited understanding of NO_2 drivers in croplands
- **What can farmers do to reduce the NO_2 footprint of crop production?**



How?

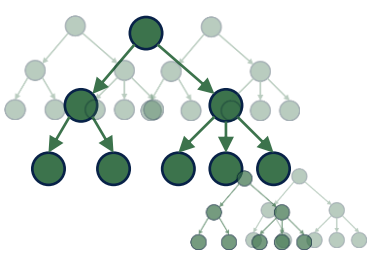
Data collection:

- **Eddy covariance** station → N_2O, CO_2, H_2O and CH_4 fluxes
- **Meteo station** → >30 environmental variables
- **Manual measurements** → crop growth and soil N content



Statistical analysis:

- **Random forest**
  supervised machine learning
- **SHAP** (Shapely Additive exPlanations)
  explanation of machine learning model predictions



Results!

- **CO_2 flux** (Net Ecosystem Exchange, NEE) ranked as the **2nd most important driver** after N fertilization [Fig. 1]
- **Increased CO_2 uptake limits N_2O emissions** [Fig. 2]

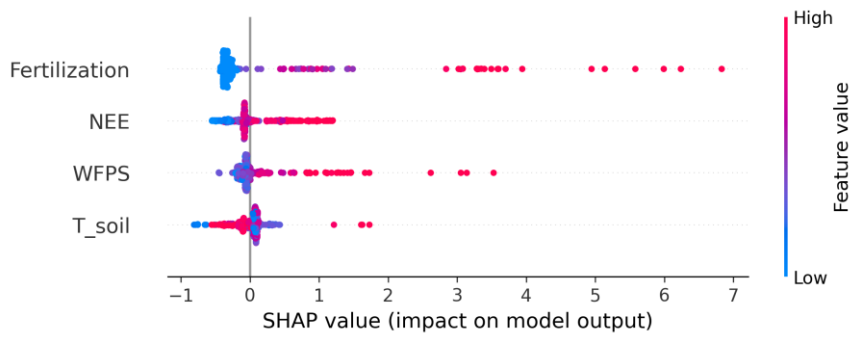


Fig. 1. Features ranked by their importance in the model. The x-axis shows SHAP values: positive values indicate that the feature increases N_2O emissions, while negative values suggest a decrease. The color gradient represents the feature values.

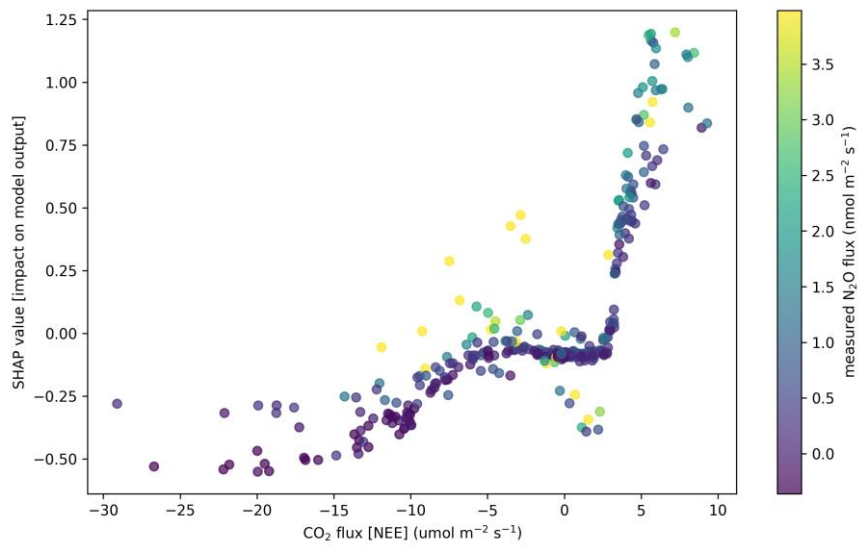
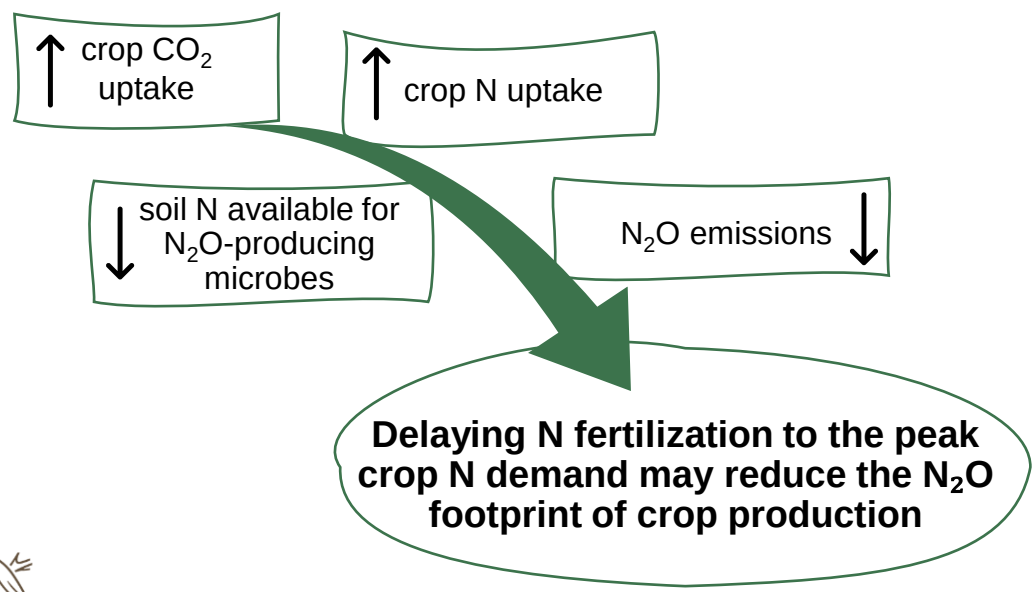


Fig. 2. SHAP dependence plot showing the impact of CO_2 flux (negative values indicate uptake) on N_2O emissions. The x-axis represents the CO_2 flux, and the y-axis shows the SHAP value of the CO_2 flux. The color gradient reflects the measured N_2O flux.

Discussion and conclusions



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