Integrating UAV-borne remote sensing with Traditional Field Surveys to Study Soil Respiration in a Peatland Landscape of the Belgian High Fens

Yanfei Li[1], François Jonard[2], Maud Henrion[1], Kristof Van Oost[1]

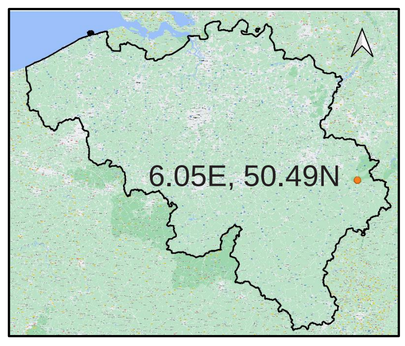
[1] Earth and Life Institute, UCLouvain, Belgium [2] Department of Geography, University of Liège, Belgium

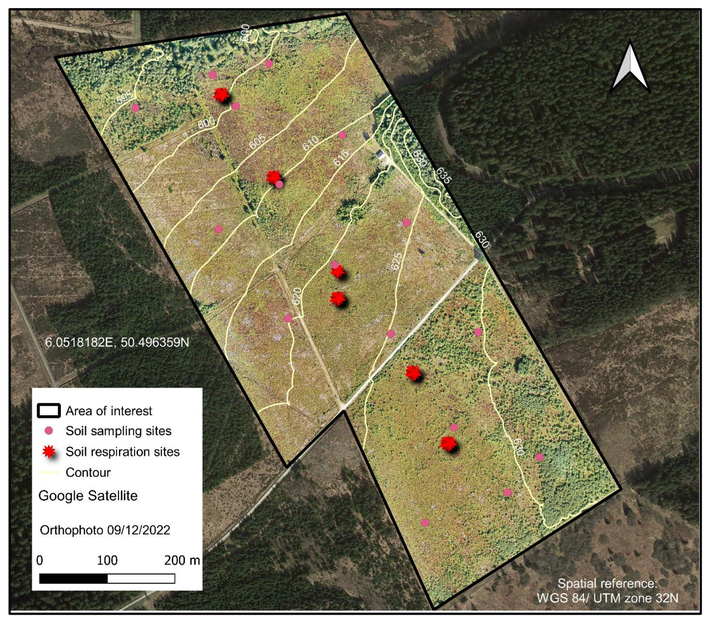
INTRODUCTION

- Peatlands are known to store a large amount of carbon stock.
- Soil CO_2 respiration in peatlands exhibits great spatial-temporal variability even on a fine scale.
- Challenges characterizing the interactions between soil respiration and environmental factors using in-situ measurements.
- The integration of Unmanned aerial vehicles (UAVs) with traditional field surveys is still in its early stages.

STUDY SITE

- A peatland landscape located in Belgian High Fens.
- Steep topographic gradient.

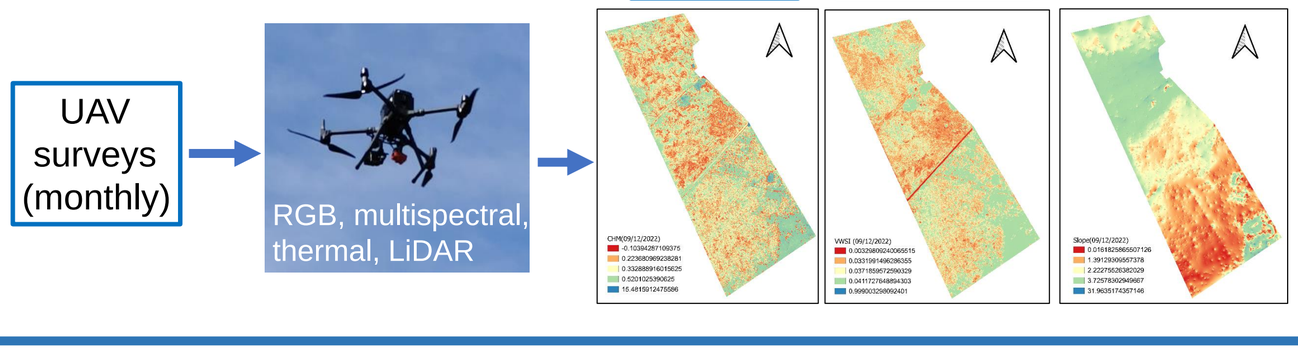




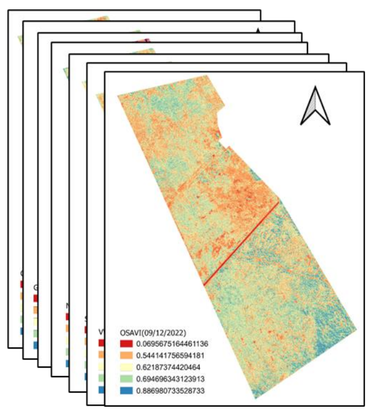
RESEARCH QUESTIONS

- Q1: what controls the nature and the strength of the link between soil respiration and environmental factors at the scale of the landscape?
- Q2: how can UAV-borne RS, when combined with traditional point measurements, assist in characterizing the spatial & temporal dynamics of the controlling factors?
- Q3: do hot-spots & hot-moments have a disproportional influence on the landscape-integrated flux?

WORKFLOW

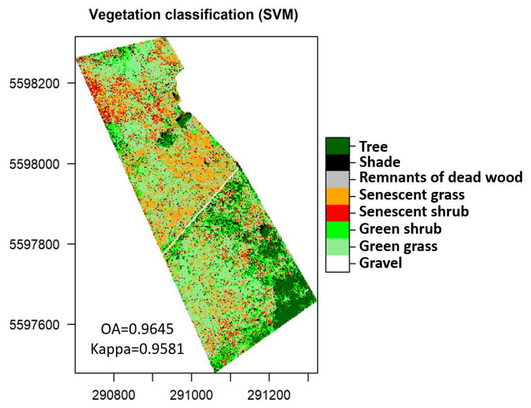


Preliminary results 1: Vegetation and soil properties



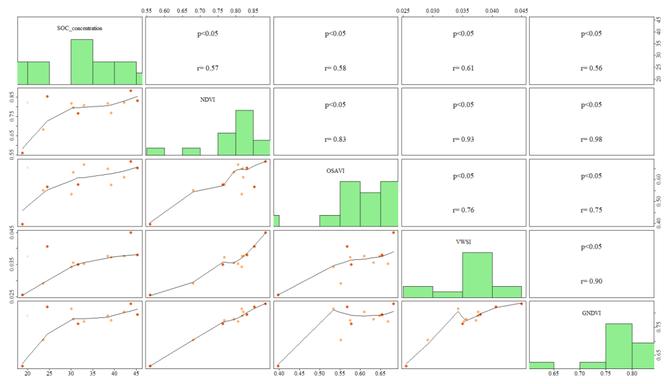
Input: 26 layers

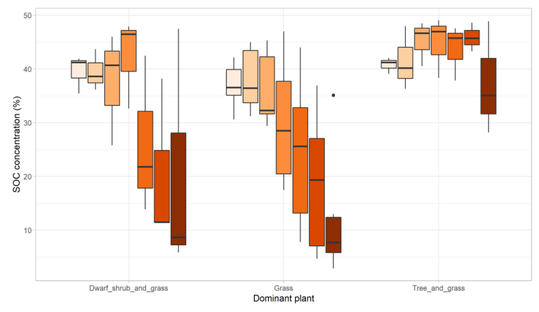
Machine learning

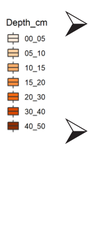


Conclusion:

- UAV-borne multi-sensor data input can achieve detailed and accurate vegetation classification.

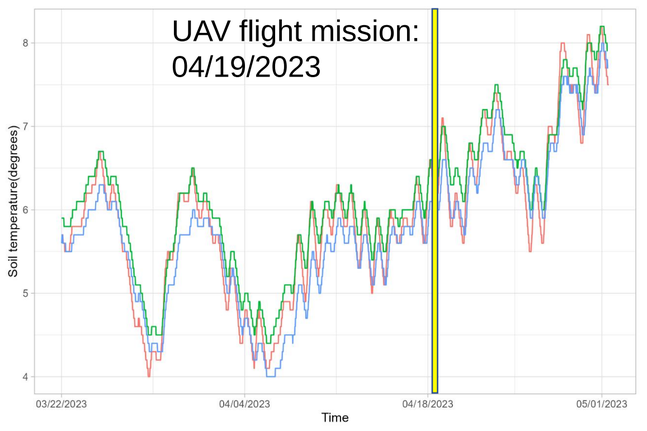


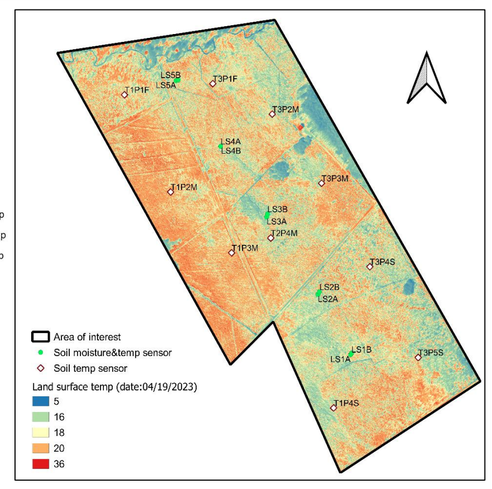




- SOC is related to vegetation indices (e.g., NDVI, GNDVI, VWSI, OSAVI).
- Variations in the distribution of SOC depth among different plant covers.

Preliminary results 2: Soil temperature and surface temperature





Conclusion:

- Soil temperature exhibits lower spatial heterogeneity compared to surface temperature.
- The correlation between soil temperature and land surface temperature suggests the possibility of spatial prediction using surface temperature.

Preliminary results 3: Soil respiration spatial-temporal dynamics

- In-situ CO_2 gas analyzer system (Biweekly: Licor8100, Daily: eosFD)

Early findings

- Spatial variability along the hillslope.
- Higher CO_2 flux is observed in May compared with February.
- Positively related to soil temperature and negatively related to moisture.