

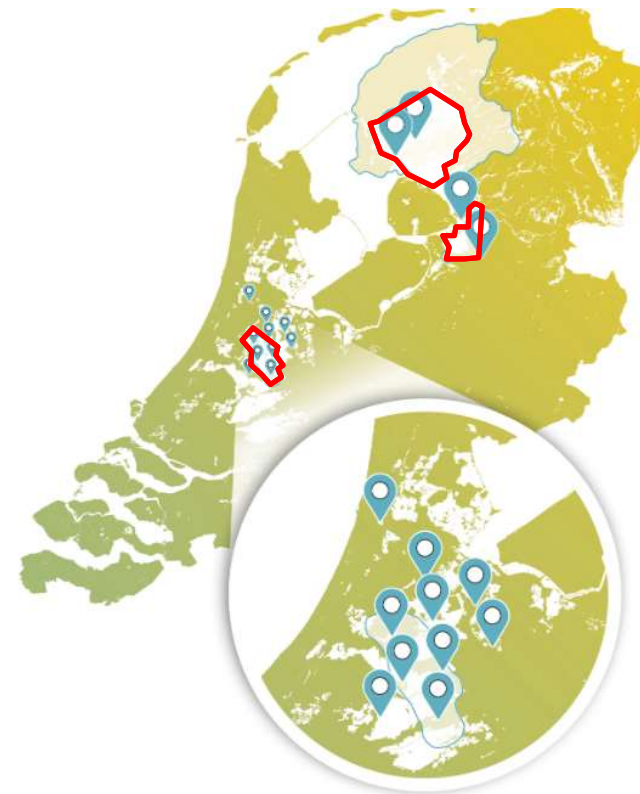
Regional CO₂ exchange from Dutch fen meadow landscapes using airborne flux observations

- Dutch fen-meadow area: 223000 ha
- Drained for agricultural use
 - intensive dairy farming
- Emissions 4.2 Mt CO₂ / yr
 - reduction target 2030: 25% / 1 Mt CO₂
- Options
 - water management
 - clay additions
 - change land use



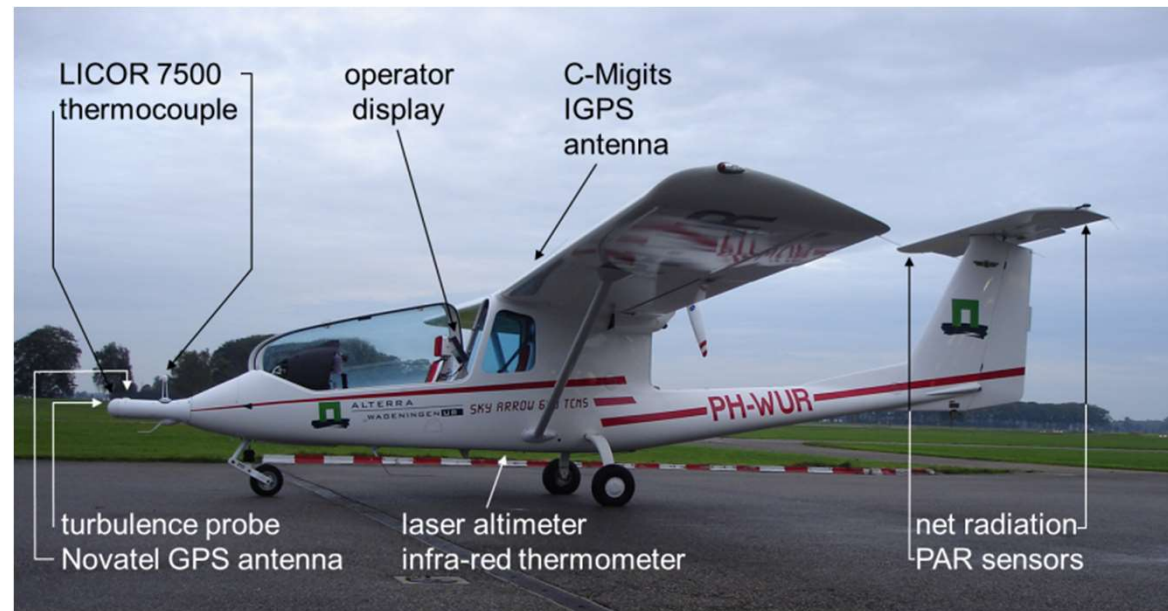
Regional CO₂ exchange from the Dutch fen meadow areas

- National research programme greenhouse gases fen meadows: NOBVeenweiden.nl
- permanent paired sites
 - reference + measure
 - chambers + EC: CO₂, CH₄, N₂O + meteo
 - soil biology / physics / chemistry
- mobile / lite sites
 - EC: CO₂, CH₄ + meteo
- aircraft EC: CO₂ (budget CH₄, N₂O)



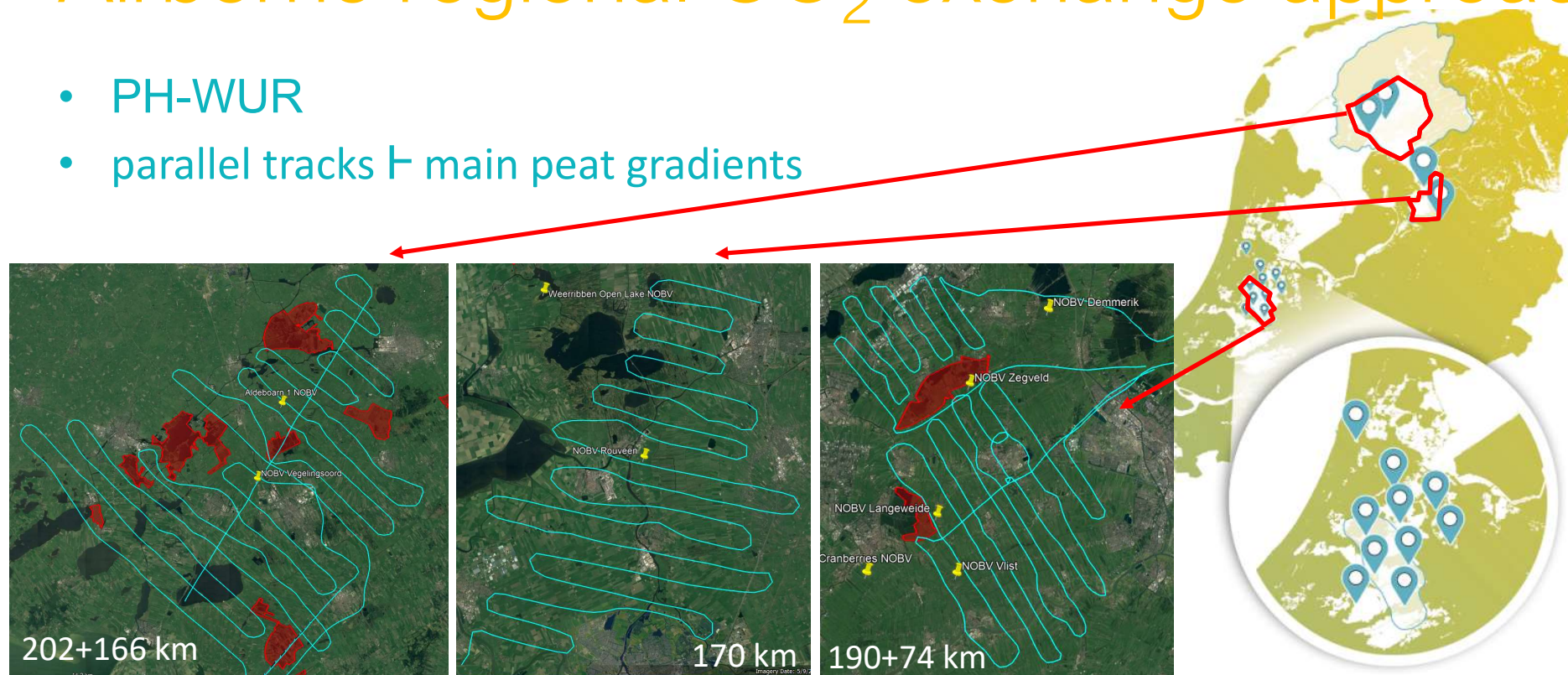
Airborne regional CO₂ exchange approach

- PH-WUR
- SkyArrow 650 TCNS ERA
- turbulent fluxes H, λE , CO₂, τ
- Q_{net} , PAR $\uparrow\downarrow$, T_{sfc}
- CH₄, N₂O (Licor 7810/15/20, Aircore)
- nominal altitude 60 m
- airspeed 100 km/hr



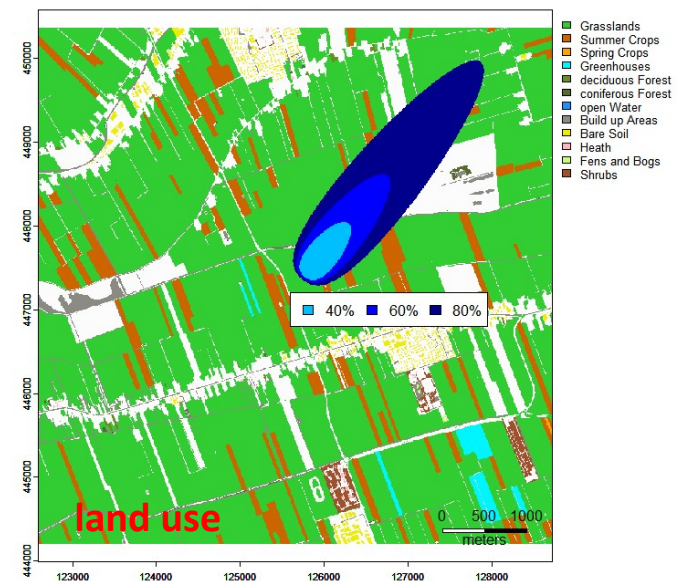
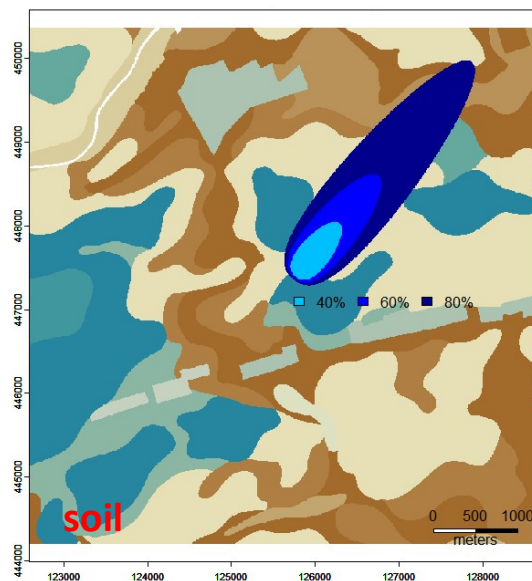
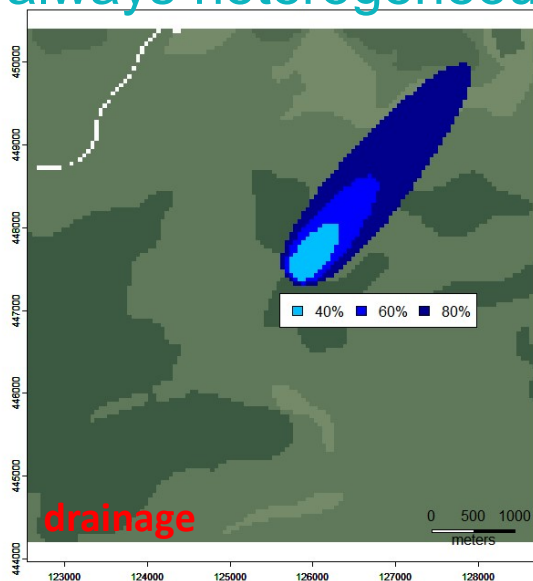
Airborne regional CO₂ exchange approach

- PH-WUR
- parallel tracks ⊥ main peat gradients



Airborne regional CO₂ exchange approach

- typical footprint aircraft: 2 – 5 km up wind, 1 - 2 km cross wind
- always heterogeneous

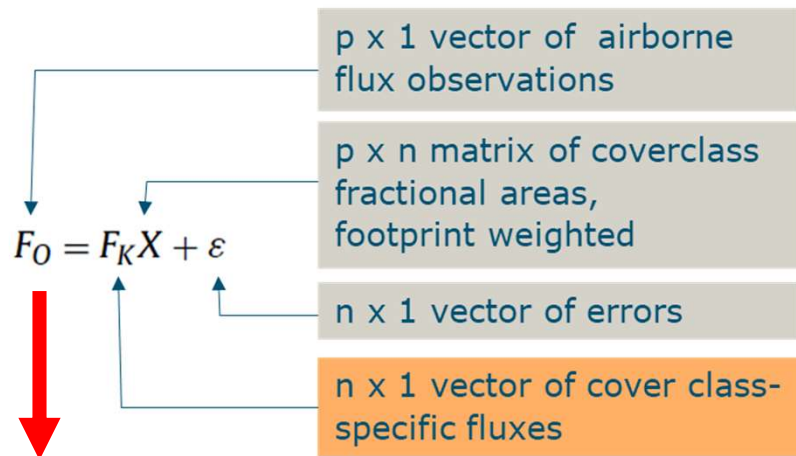


Airborne regional CO₂ exchange approach

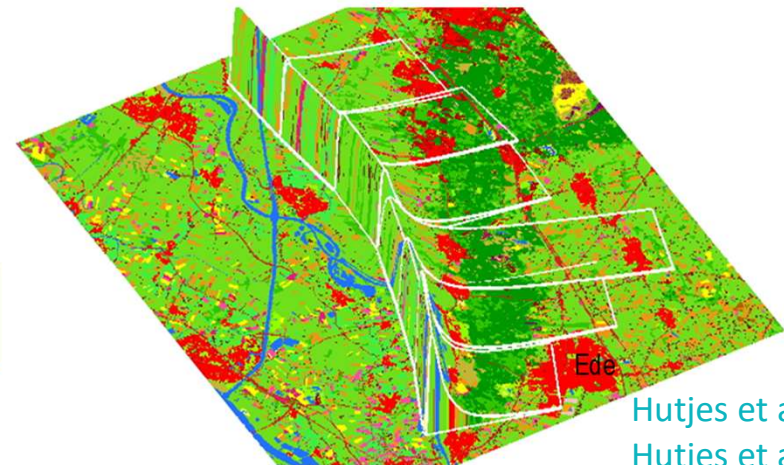
- from regional totals to distributed maps: NEE by land cover do-able
- separate NEE into GPP + Reco do-able?

$$F_{obs}(x_{obs}, y_{obs}, z_m) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} F(x, y, 0) \omega(x, y, z_m) dx dy$$

ω is footprint model (Kljun, 2004 BLM)



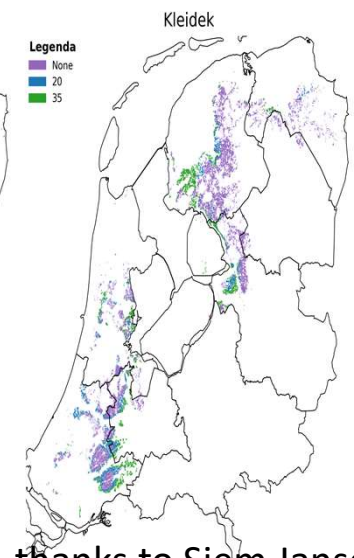
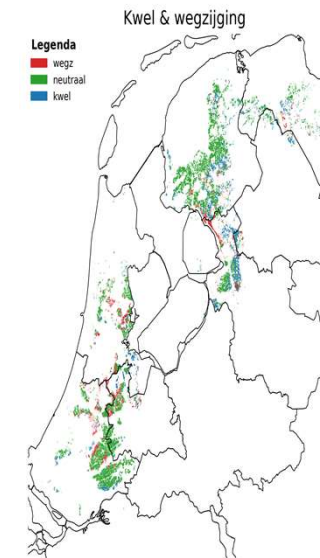
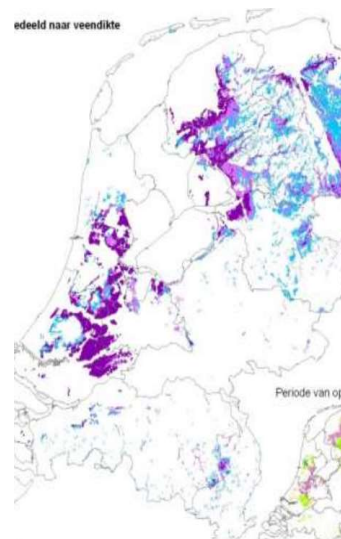
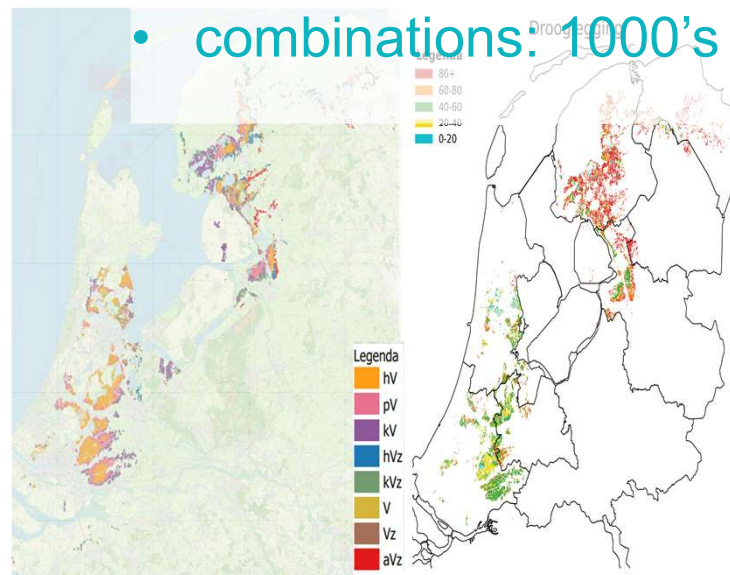
Dis-aggregate: $F_K = F_O X^{-1}$ using MLR, LSO, ML...



Hutjes et al., 2010, AFM
Hutjes et al., in prep

Potentially explanatory variables

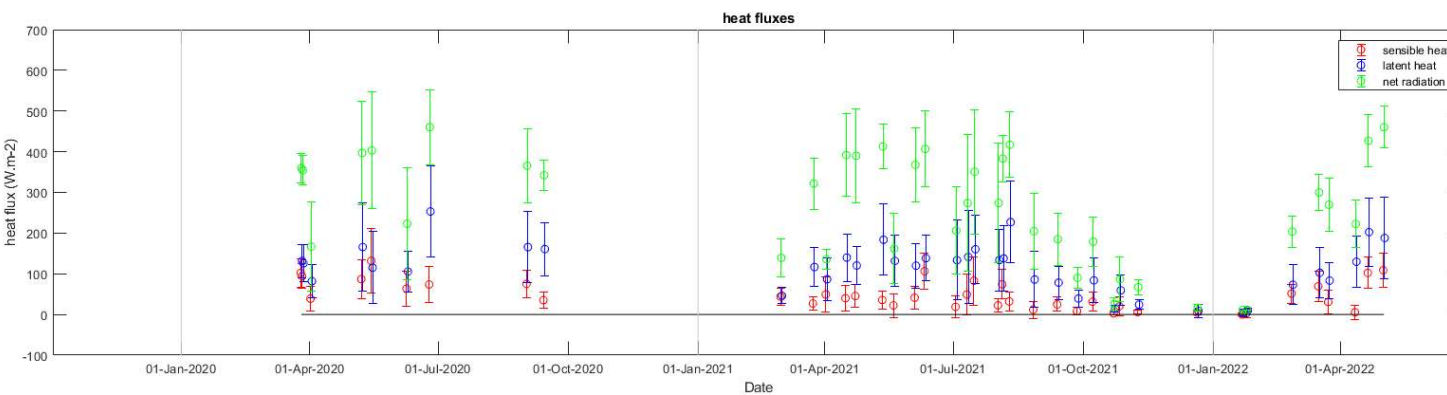
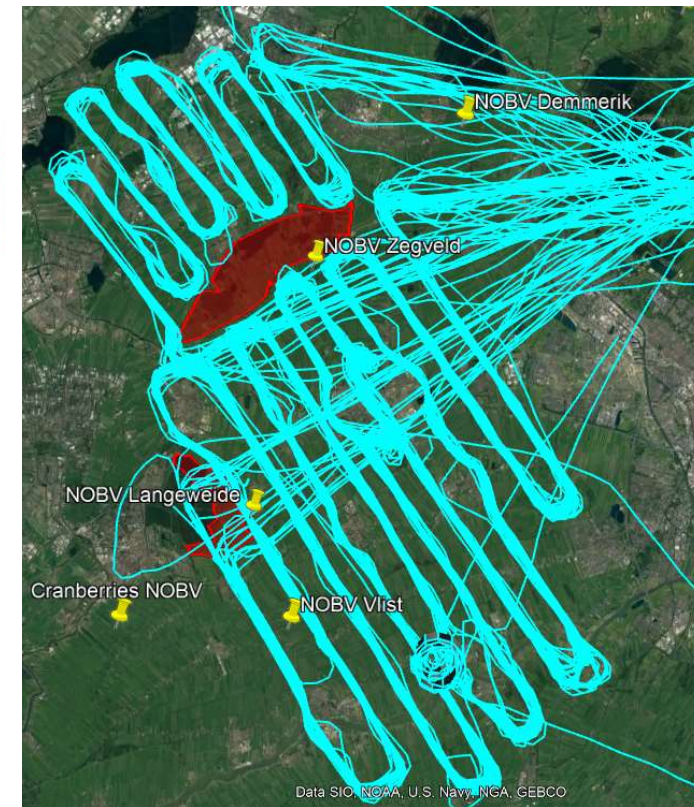
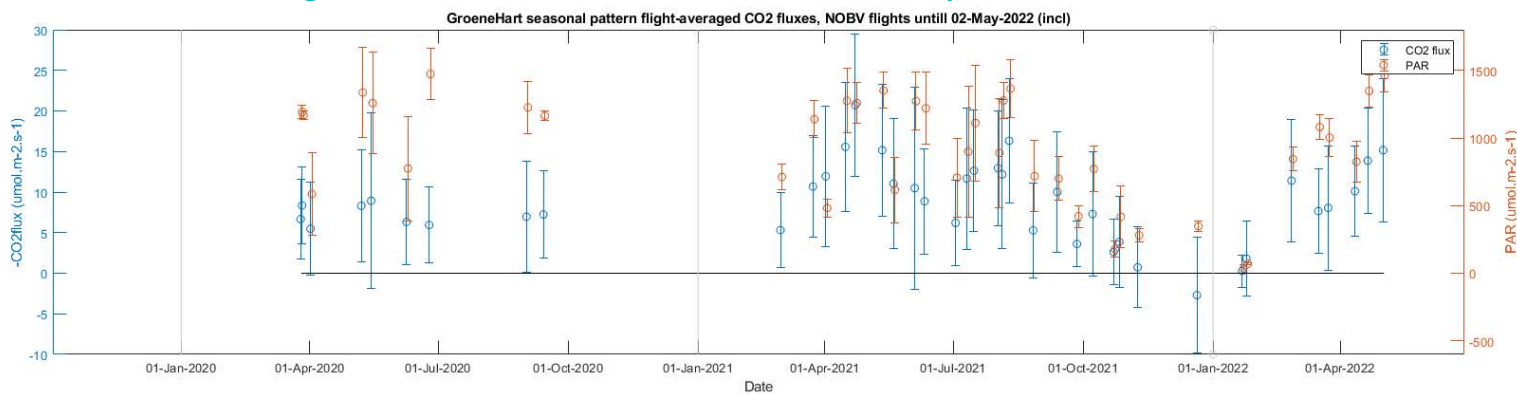
- Soil x Drainage x Land use x Peat depth x Seepage x Clay cover
- 2-10 3-5 5-12 3-cnts 3 3
- combinations: 1000's



thanks to Siem Jansen

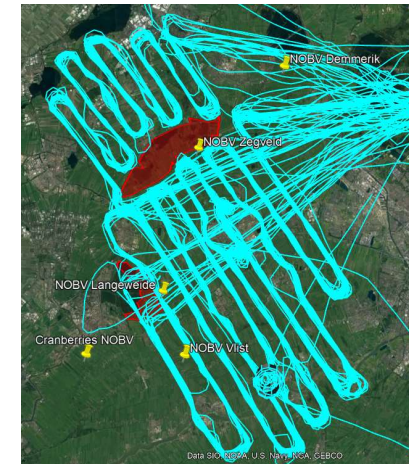
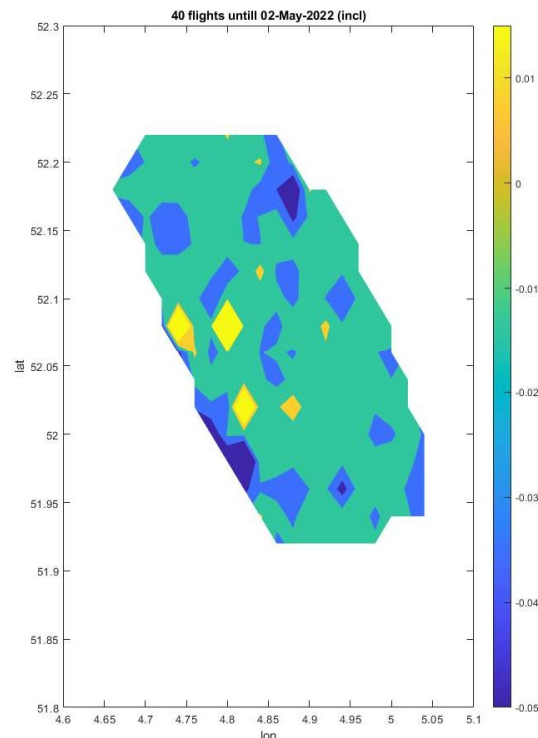
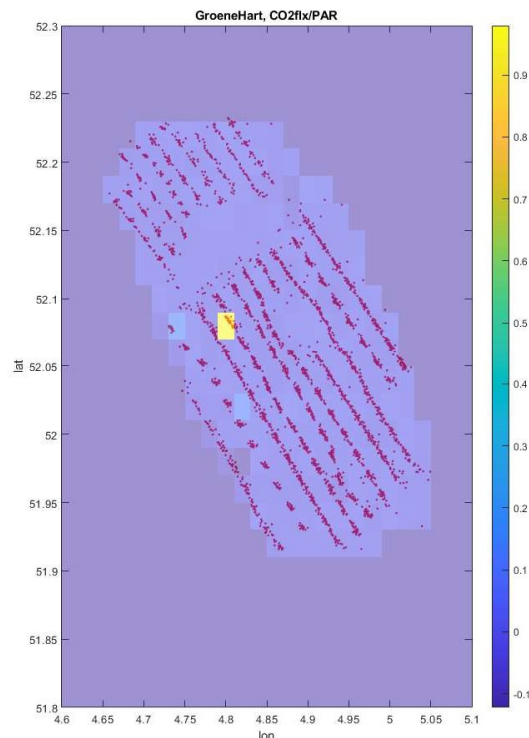
example Groene Hart

- 57 flights till date Groene Hart (2020 03 26 – 2022 05 03)



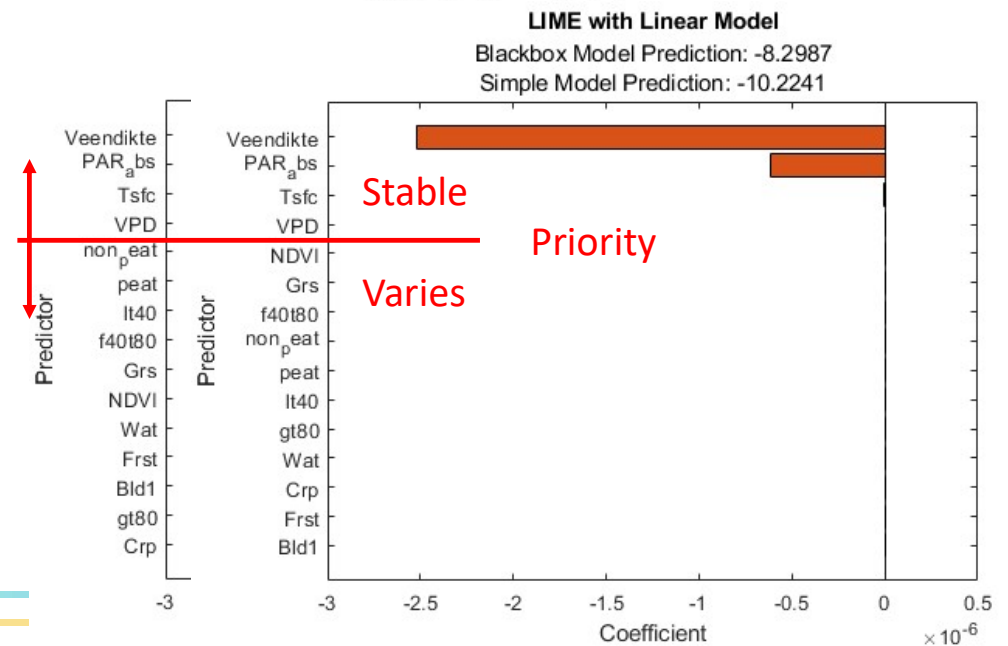
example Groene Hart

- 57 flights till date Groene Hart (2020 03 26 – 2022 05 03)
- Simple spatial interpolation PAR-normalised CO₂flux



example Groene Hart

- 57 flights till date Groene Hart (2020 03 26 – 2022 05 03)
- Spatial dis-aggregation / environmental response function by ML
- ML
 - Optimised regression ensemble
 - Meteo forcing: PAR, Tsfc, VPD
 - Peat thickness, NDVI
 - Categorical:
 - 3 drainage (<40, 40-80, >80)
 - 5 land use/cover (Grs, Crp, Wat, Bld, Frst),
 - 2 soils (peat, mineral)



Regional CO₂ exchange from the Dutch fen meadow areas: lookout

- Combine aircraft (daytime only) + tower (night time too) based data in ML
- Optimise number of explanatory variables/classes
- Optimise ML method
- Map ML results & aggregate to annual

Regional CO₂ exchange from the Dutch fen-meadow areas

- National research programme greenhouse gases fen meadows: NOBVeenweiden.nl
- EGU2022 abstracts: 7734, 7971, 9405, 9867, 12090, 12424, 12177

