

Sentinel-2-based fractional cover time series reveal drought impacts on Central European grasslands

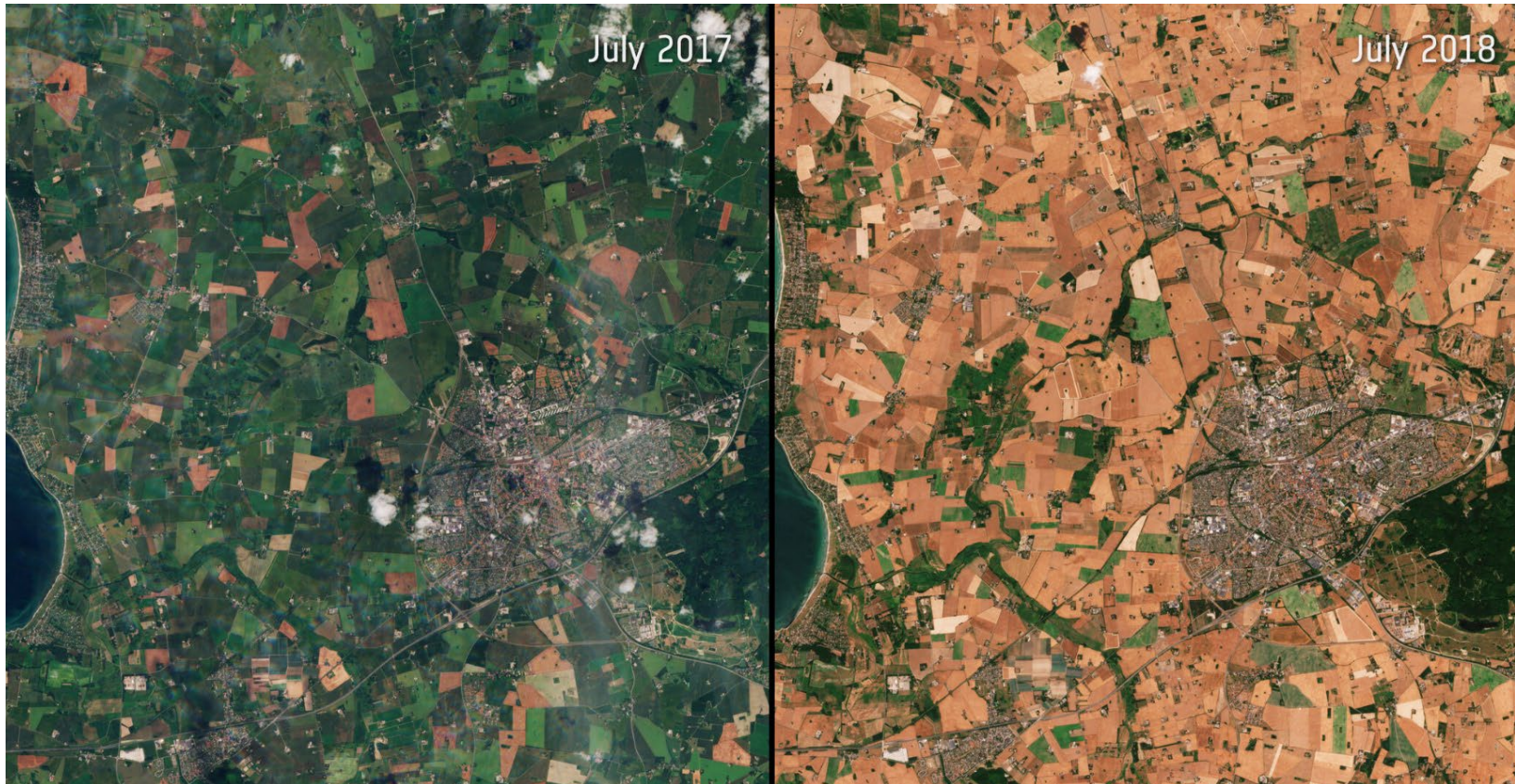
Katja Kowalski
Akpona Okujeni
Patrick Hostert

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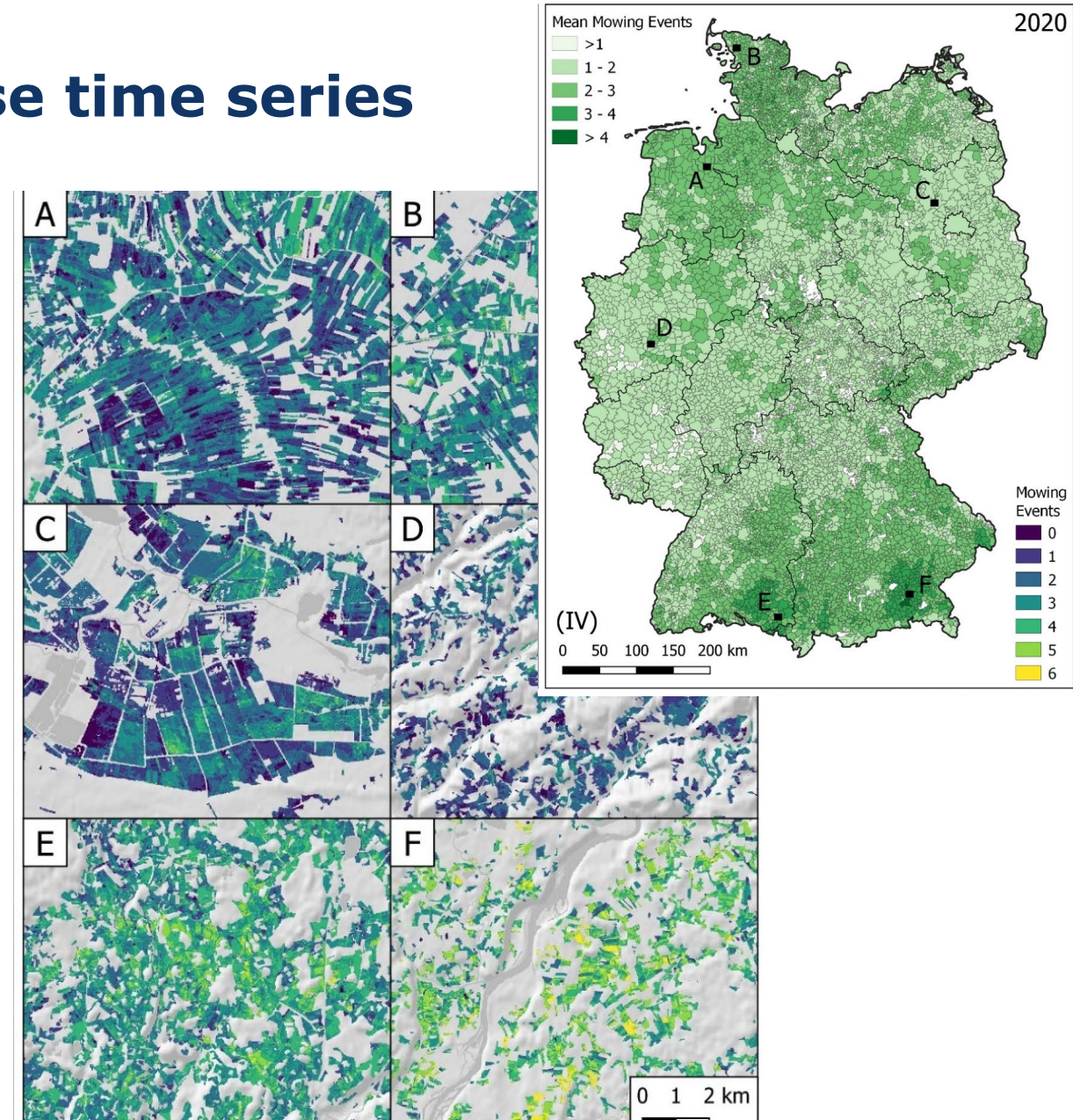
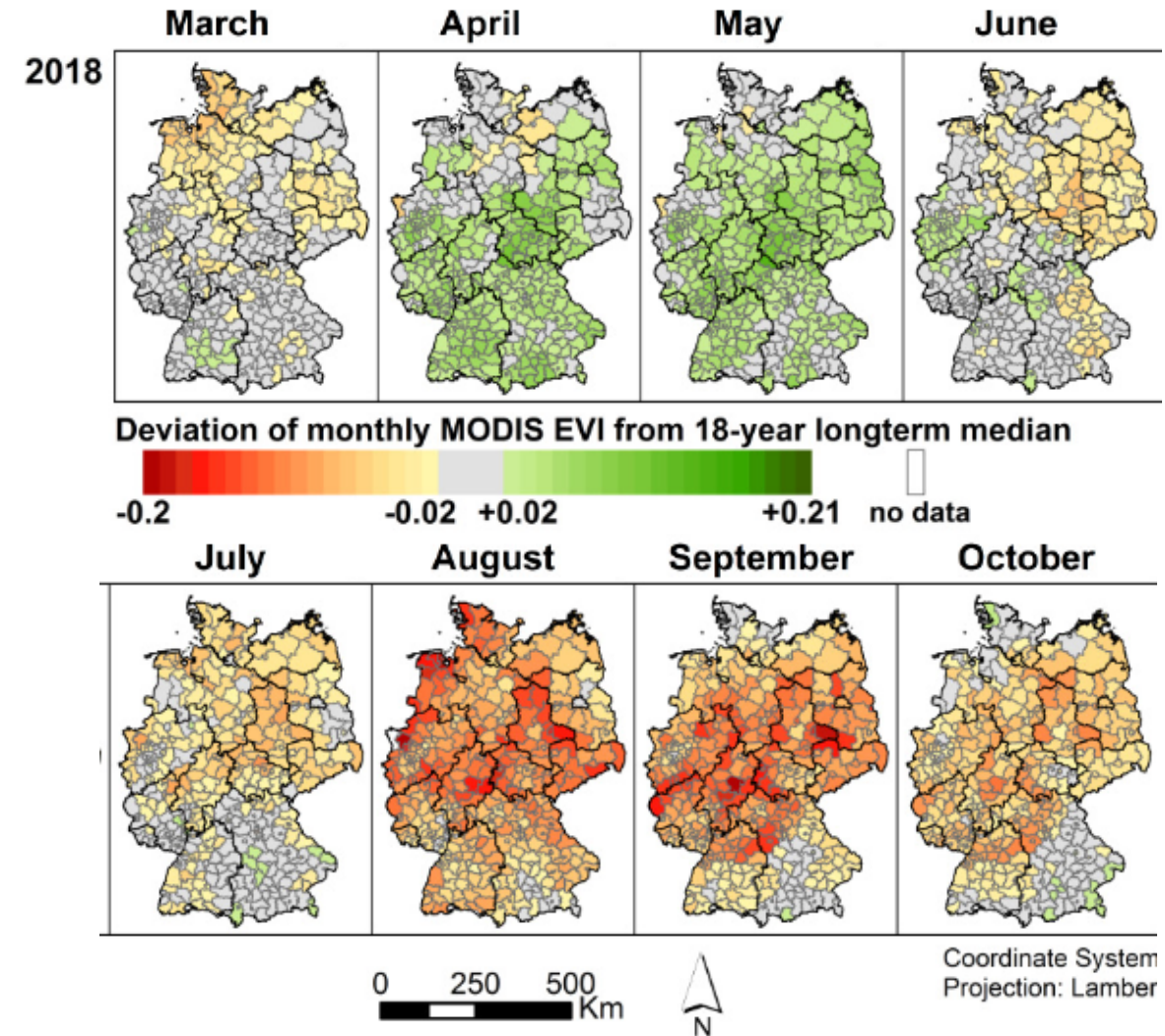
Grasslands in Central Europe

- Widespread drought impacts on grasslands in recent years
(Buras et al. 2020, Reiner mann et al. 2019)



Denmark captured by Sentinel-2 (image by ESA)

Grassland monitoring using dense time series



Grassland monitoring with fractional cover

- Fractional cover of
 - PV (green veg.)
 - NPV (dry, dead veg.)
 - soil

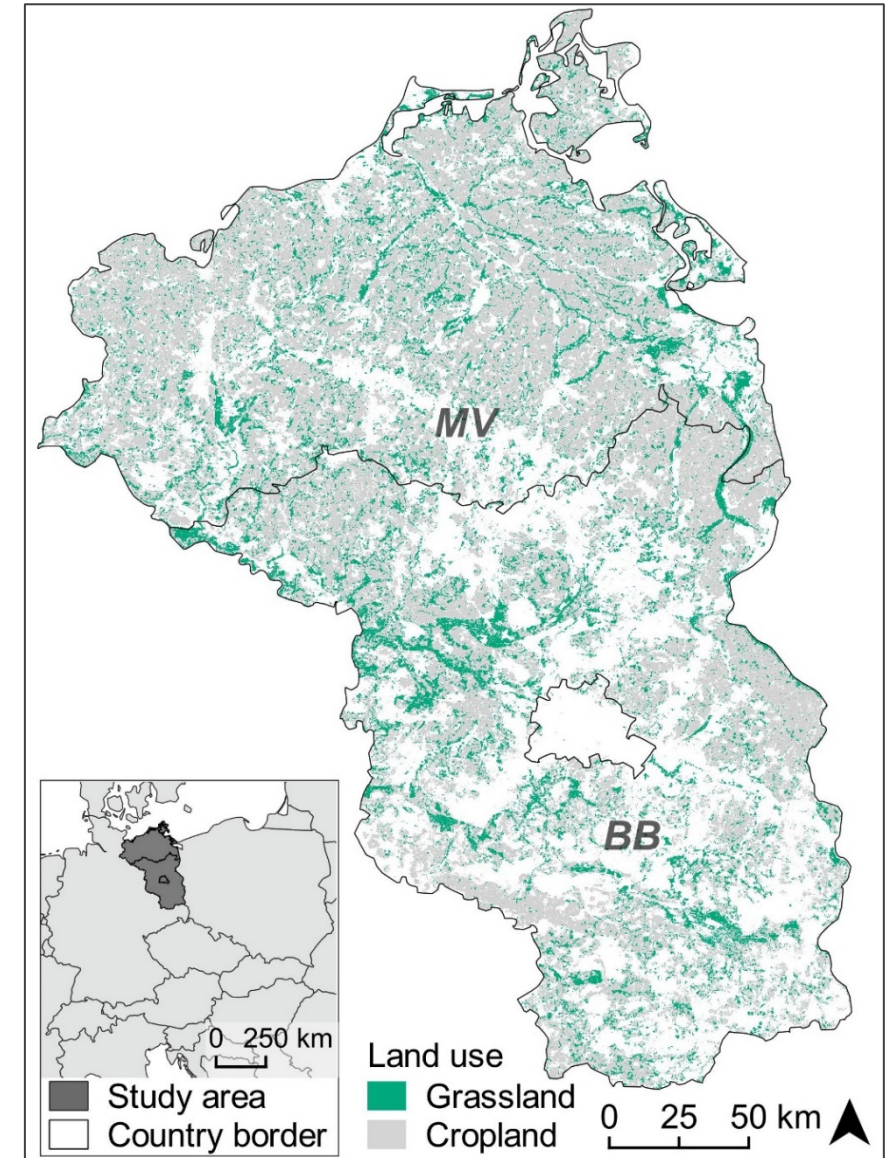


as universal framework for grassland mapping and monitoring
(e.g. Guerschman et al. 2009, Numata et al. 2007, Lewińska et al. 2020)

- Grassland monitoring benefits from NPV estimates during dry periods
- Combination with intra-annual time series

Research questions

- I. How well do fractional cover time series reveal drought effects between years?
- II. How did drought effects on grasslands vary spatially in 2018 and 2019?

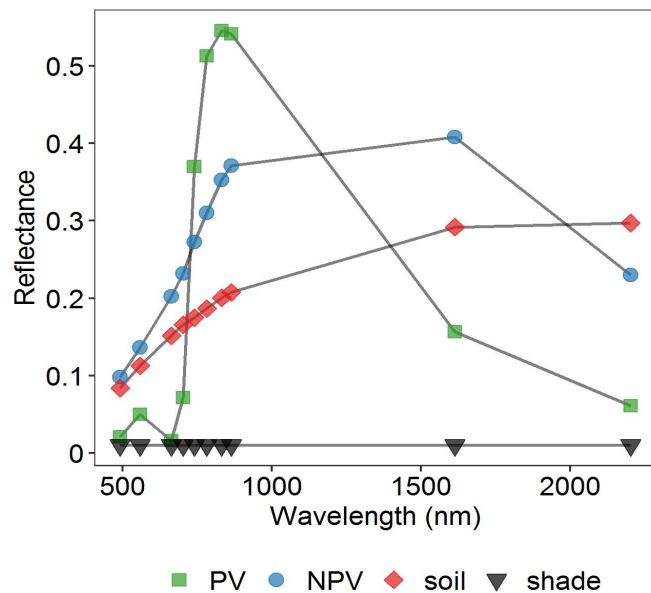


Methods – Estimating fractional cover

Sentinel-2 data 2017-2019

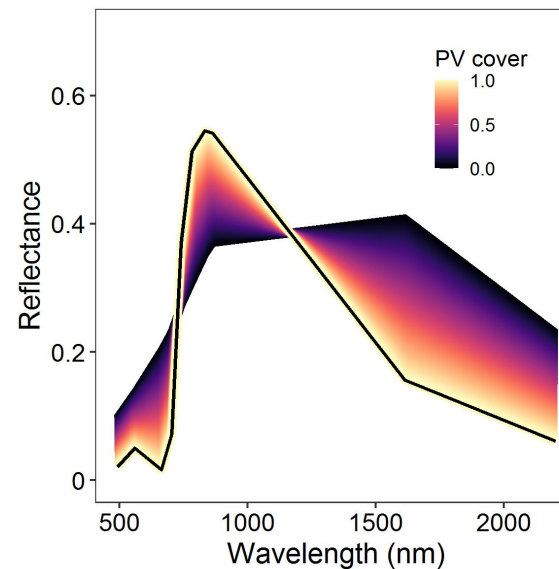
- Preprocessing: FORCE (Frantz 2019)

Spectral library

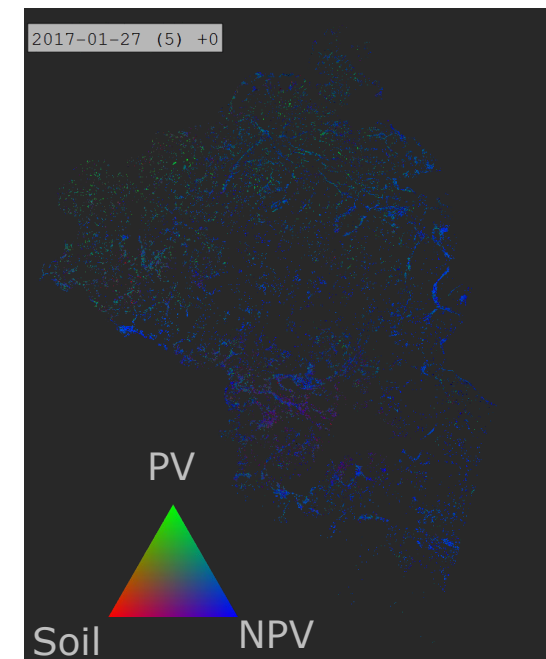


Training data

Linear synthetic mixtures
(0-100%)



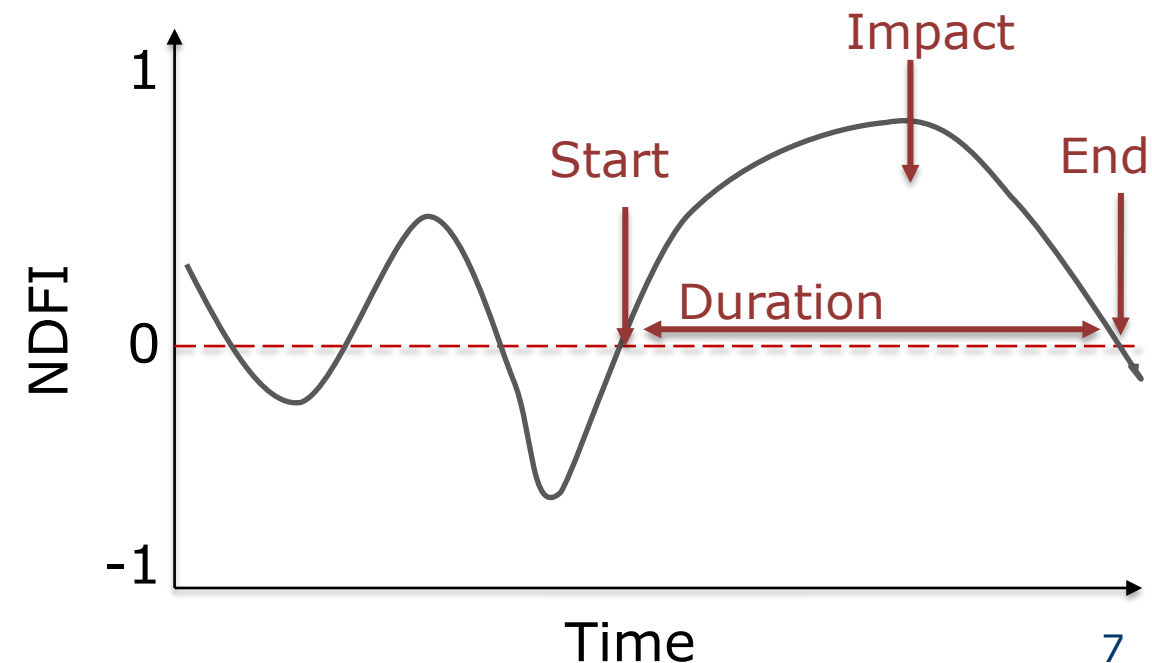
Fractional cover time series



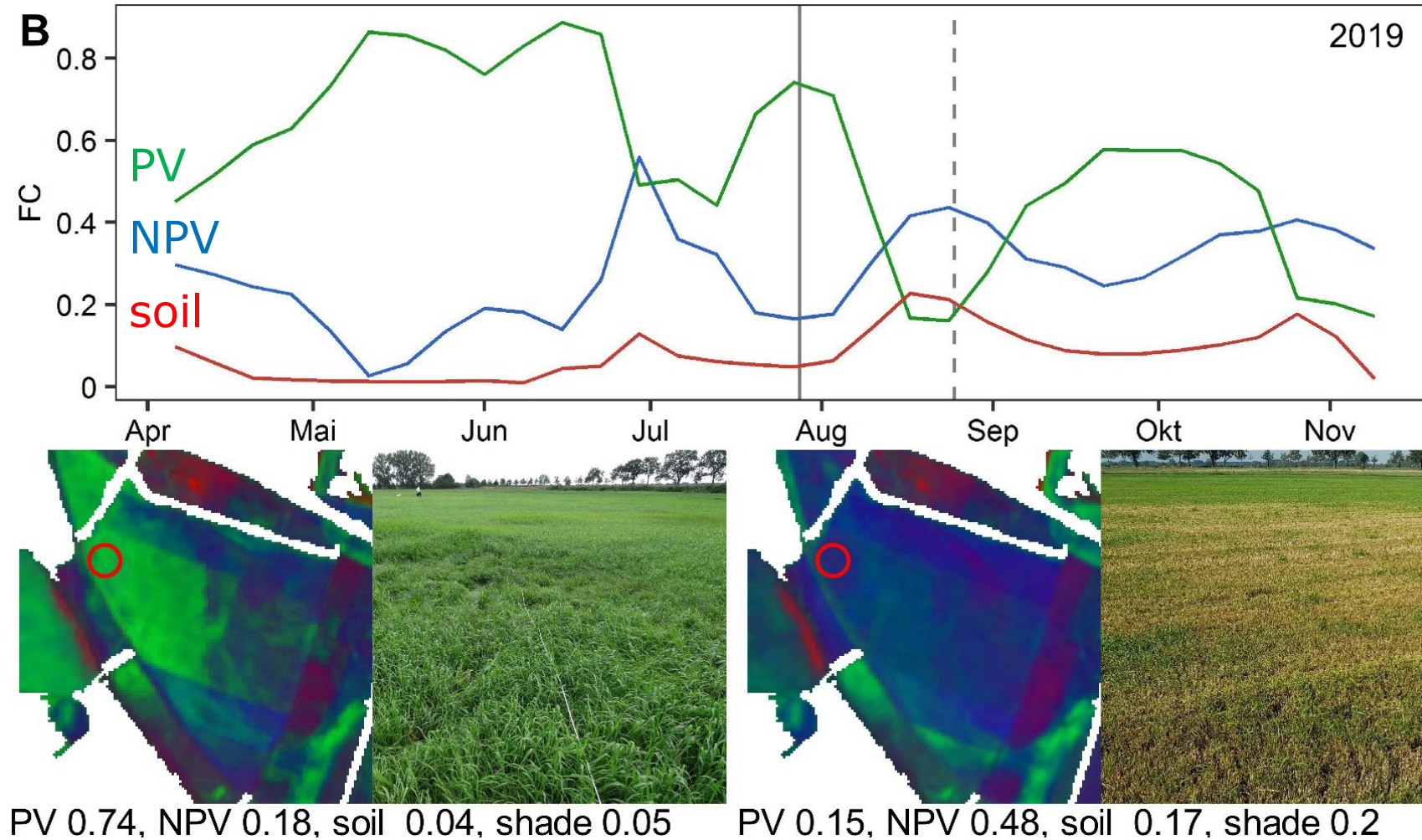
Methods – NDFI time series and metrics

- Fractional cover index (Souza et al. 2005)
- Comparison to common drought indices (SPEI03, SMI)
- Time series metrics (Duration/Onset/Impact/End)
- Soil types based on BUEK200

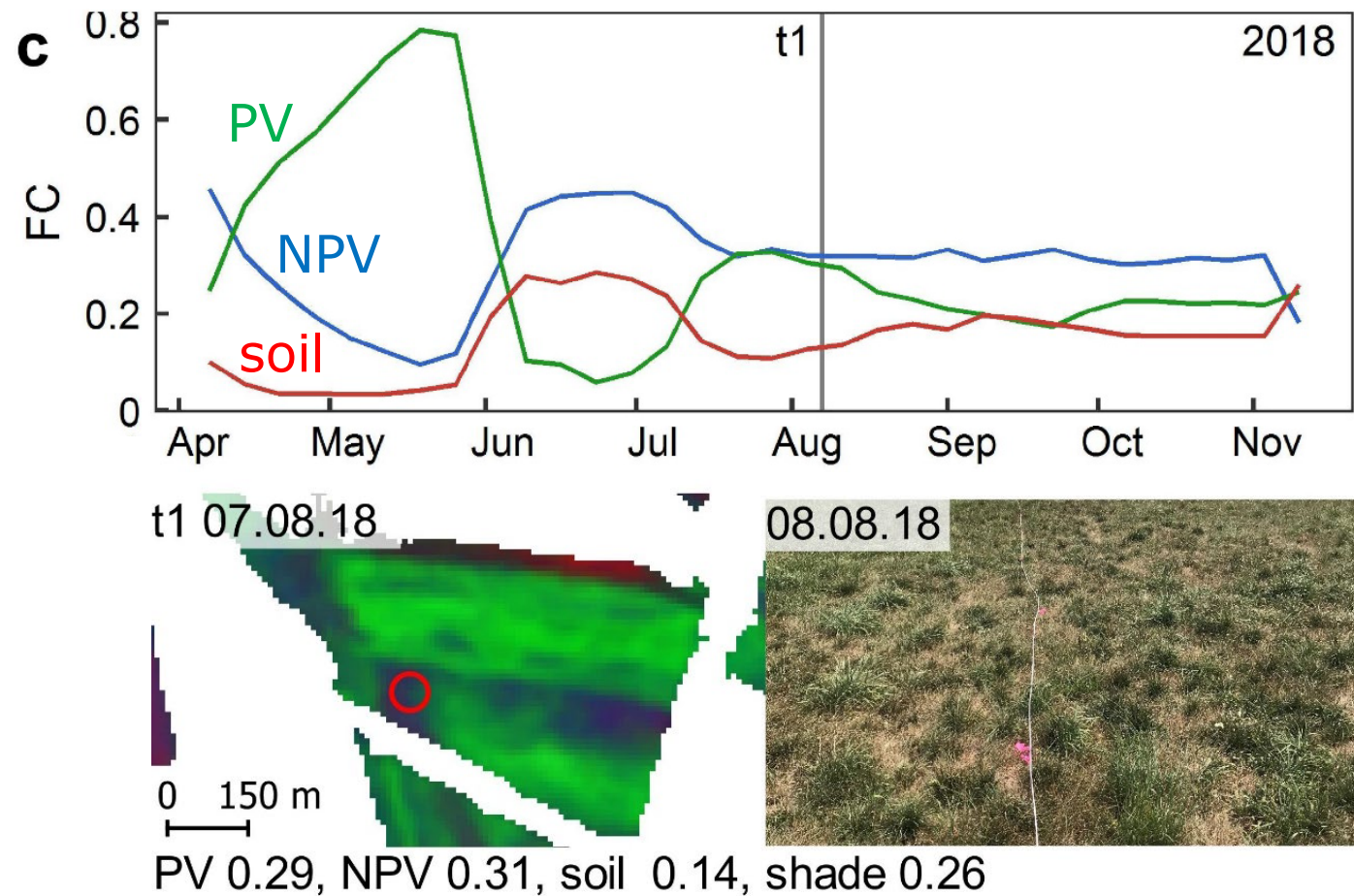
$$NDFI = \frac{((f_{NPV} - f_{i_{NPVbase}}) + f_{soil}) - f_{PV}}{(f_{NPV} - f_{i_{NPVbase}}) + f_{PV} + f_{soil}}$$



Results – time series of PV, NPV, and soil

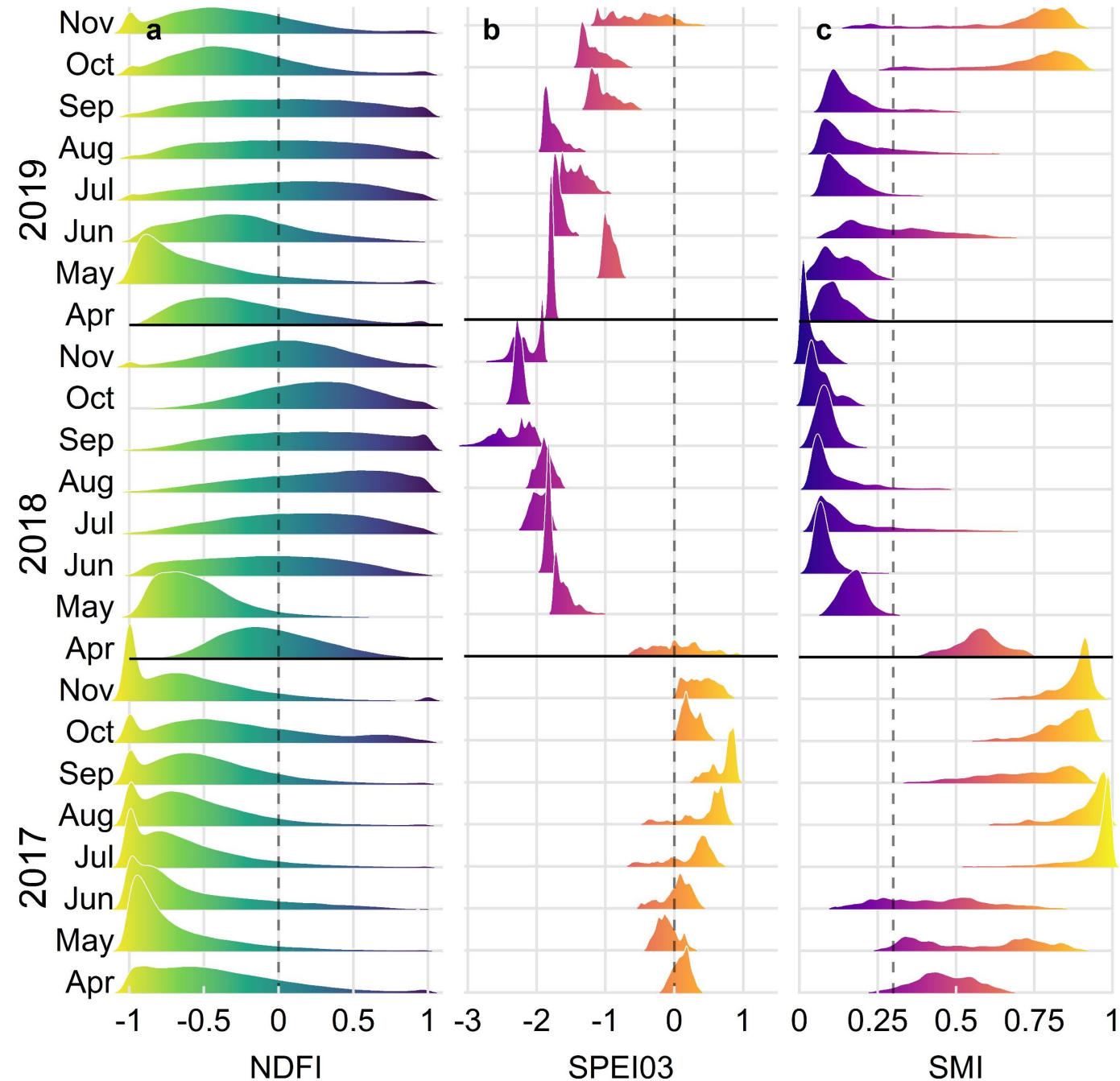


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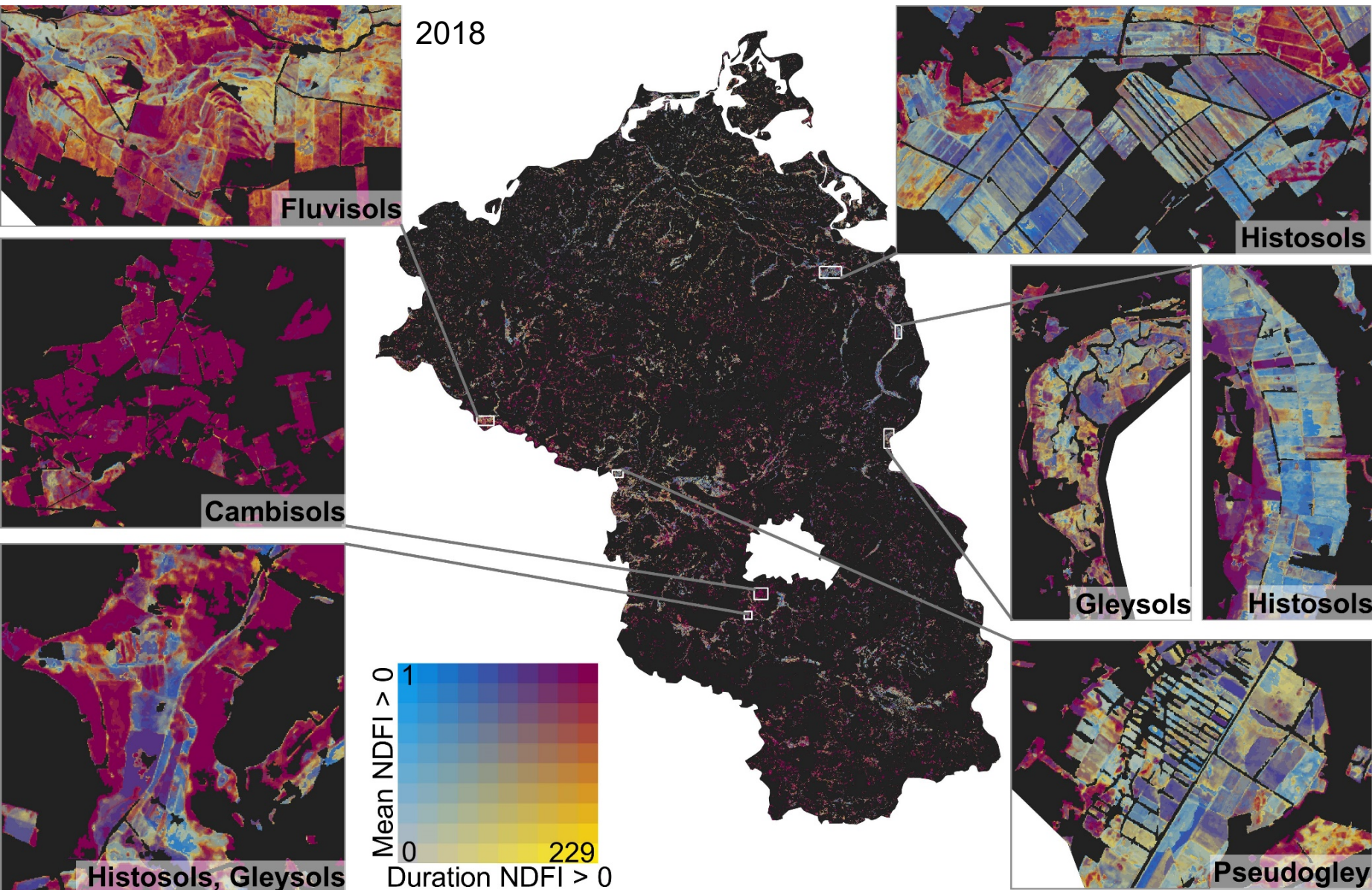


Results – seasonal drought effects

- Severe drought in 2018 and 2019 corroborated by all indices
- Grassland vegetation responds with time lag of 1-2 months
- Higher spatial variability of NDFI compared to meteorological indices



Results – drought impacts on different soil types



- Seasonal indicator for grassland response to drought stress
- Duration and intensity of drought impact varies locally
- Related to: soil type, ground water level, management

Conclusion

- NDFI time series tracked seasonal drought effects in line with meteorological drought indices
- S-2 mandatory to capture drought effects related to local management and soil types
- Severe drought impacts on least productive soil types indicate need for adaptation under changing climate

Thank you for your attention!