Combined Sentinel-1 and Sentinel-2 data to map semi-natural grassland quantity and quality

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Introduction

Questions

- Does combining **Sentinel-1 and Sentinel-2** data improve the mapping of semi-natural **grassland** forage **quantity** and **quality**?
- Can an **optimised** subset of the **predictor dataset** increase the **random forest regression** model performance?

Data & Methods

- Grafenwöhr **military training area** (GTA) in Bavaria, Germany (Fig. 1), extensively grazed by wild red deer (*Cervus elaphus*).
- About 85% are part of the **Natura 2000** network.
- Grassland samples (*n* = 120) were collected between 2015 and 2017 (Fig. 2).
- Corresponding Sentinel-1 (*n* = 16) and Sentinel-2 (*n* = 8) images were acquired and pre-processed using SNAP.

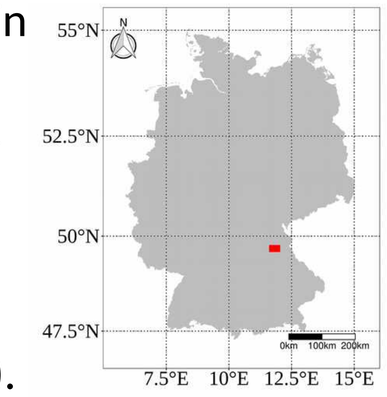

Fig. 1: Location of the GTA in Germany

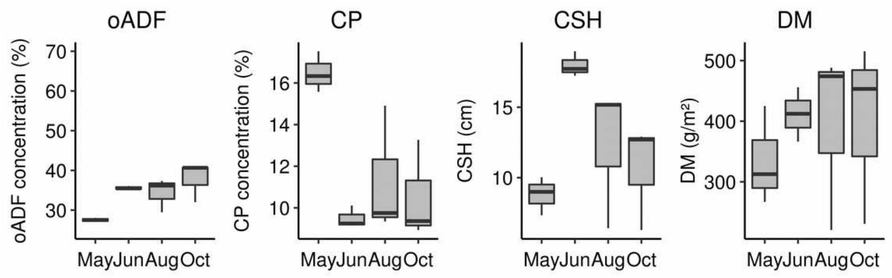

Fig. 2: oADF = organic acid detergent fibre concentration, CP = crude protein concentration, CSH = compressed sward height, DM = standing biomass dry weight.

Results & Discussion

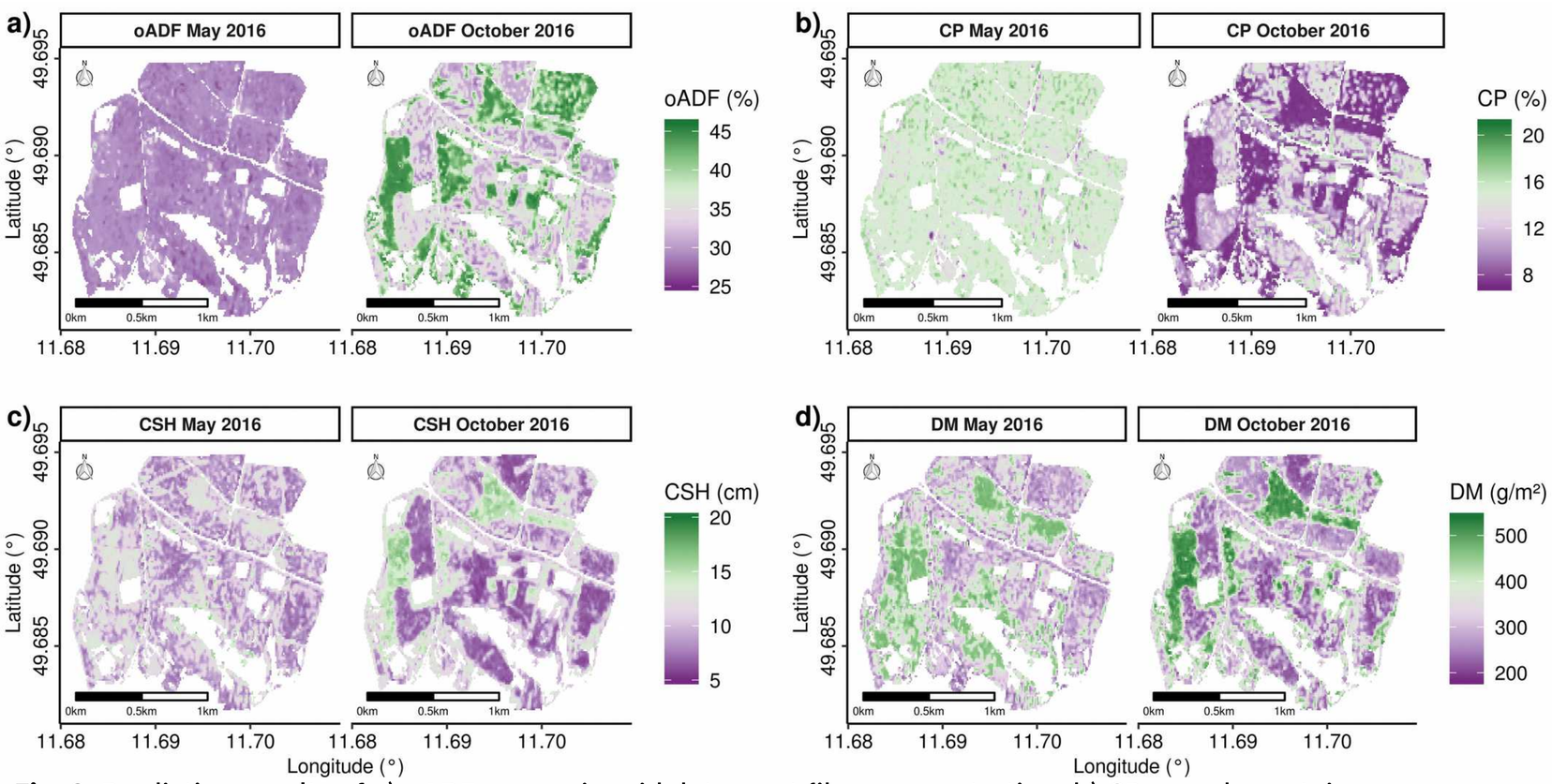

Fig. 3: Prediction results of a) oADF = organic acid detergent fibre concentration, b) CP = crude protein concentration, c) CSH = compressed sward height, d) DM = standing biomass dry weight. For illustration purposes, the results are presented for a spatial subset of the study site.

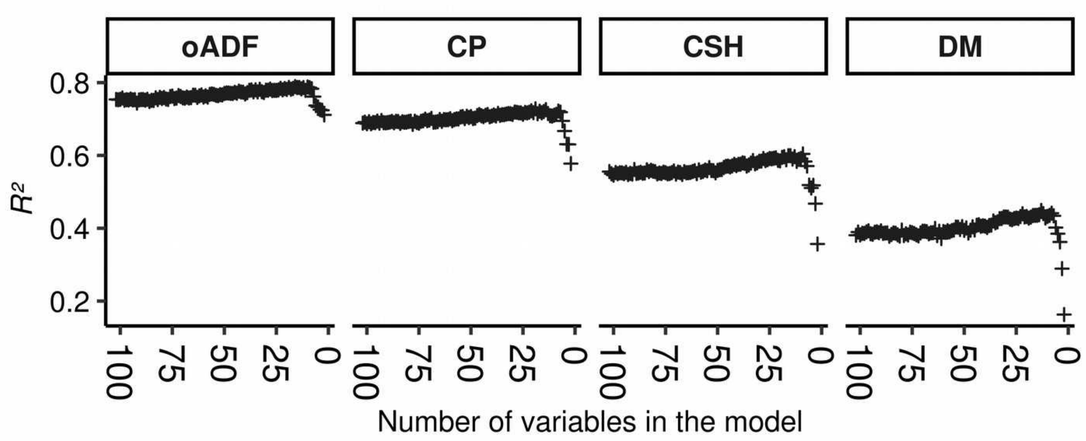

Fig. 4: Changes in R^2 depending on the number of predictor variables remaining in the random forest regression model as variables were iteratively removed from the combined Sentinel-1 and Sentinel-2 predictor dataset. See Fig. 3 for abbreviations.

- The predictor dataset was optimised using permutation-based variable importance, **maximising the predictive power** of the random forest regression models (Fig. 4). See Fig. 3 for the respective prediction results.
- High R^2 values were obtained for the grassland quality indicators **oADF (R^2 = 0.79, RMSE = 2.29%)** and **CP (R^2 = 0.72, RMSE = 1.70%)** using 15 and eight predictor variables, respectively.
- Lower R^2 values were achieved for the quantity indicators **CSH (R^2 = 0.60, RMSE = 2.77 cm)** and **DM (R^2 = 0.45, RMSE = 90.84 g/m²)**.
- The model performance for oADF, CP and CSH was only **marginally increased** by adding **Sentinel-1** data.

Conclusion

- Optical **Sentinel-2** data might be sufficient to **accurately predict** indicators of **forage quality**, and to some extent also quantity, in semi-natural grasslands.
- The optimised subset of predictor variables **increased the predictive power** of the respective model.

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