Sentinel-1 for High-Resolution monitoring of vegetation Dynamics

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Objectives

Develop and use a novel high-resolution global vegetation optical depth dataset based on ESA's Sentinel-1 satellite to improve our understanding of the local impacts of water availability on vegetation using novel machine learning approaches.

1. establish quantitative relationships between Sentinel-1 backscatter and ratios thereof and MetOp ASCAT VOD.
2. develop a high-resolution 1 km VOD product sensitive to changes in water content of the above ground biomass.
3. evaluate using different ESA and non-ESA EO datasets, among which are CGLS LAI and ESA's Earth Explorer SMOS VOD.
4. quantify the effect of water availability on vegetation dynamics for different land cover types at the local scale.

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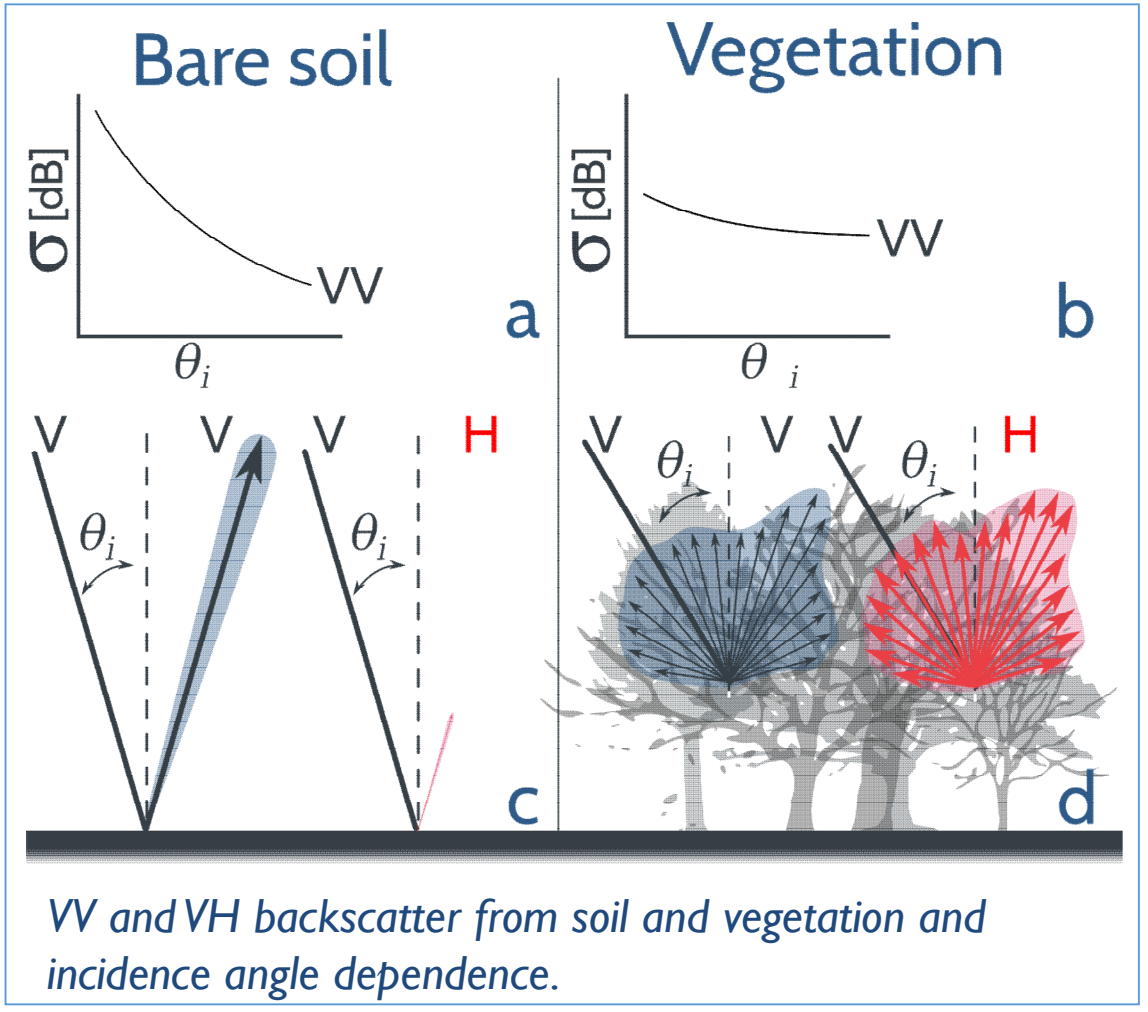
VOD from cross-polarized backscatter

VOD from Metop ASCAT

- Based on relation between incidence angle and backscatter:
  - Change in slope and curvature when vegetation changes due to the character of volume scattering

Cross Ratio - ratio between VH and VV backscatter

- Based on sensitivity of VH to volume scattering:
  - VH backscatter increases stronger with volume scattering than co-polarized backscatter.

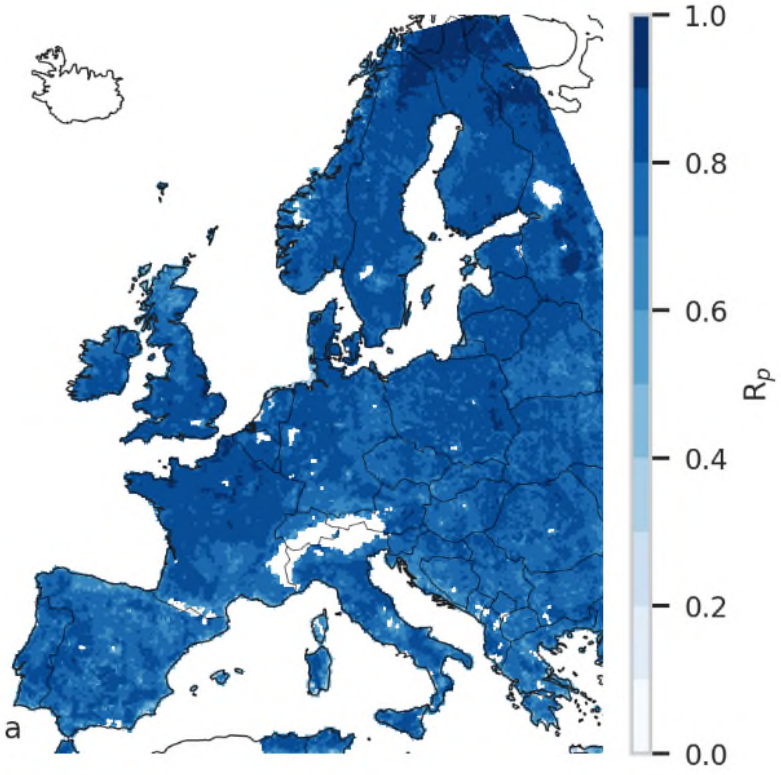


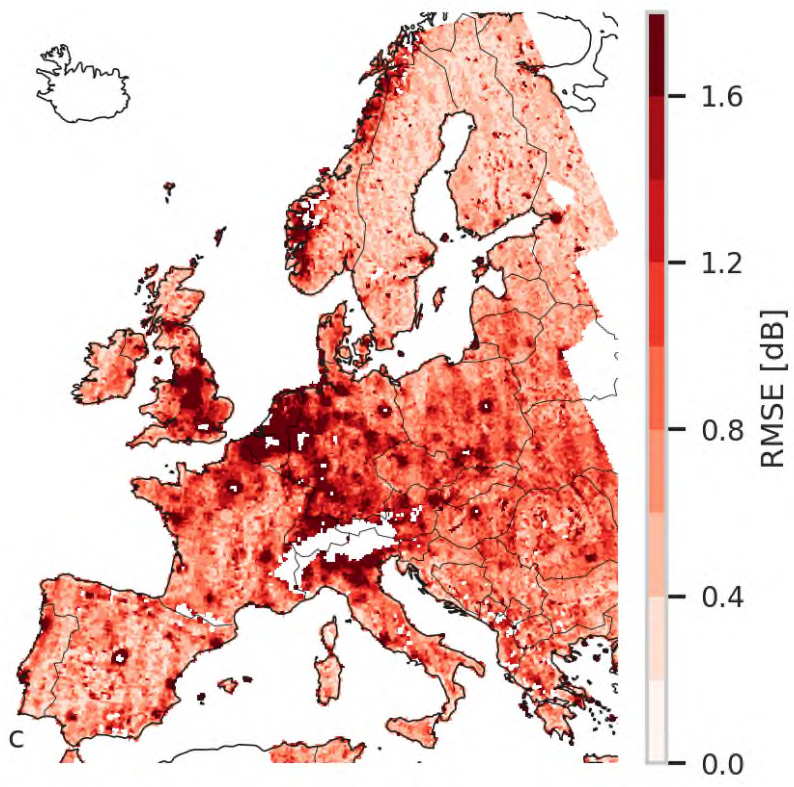
VV and VH backscatter from soil and vegetation and incidence angle dependence.

Synergies VV backscatter

Temporal dynamics and RMSE between VV backscatter from

- Sentinel-1 (resampled to 12.5km)
- Metop ASCAT (12.5km sampling)

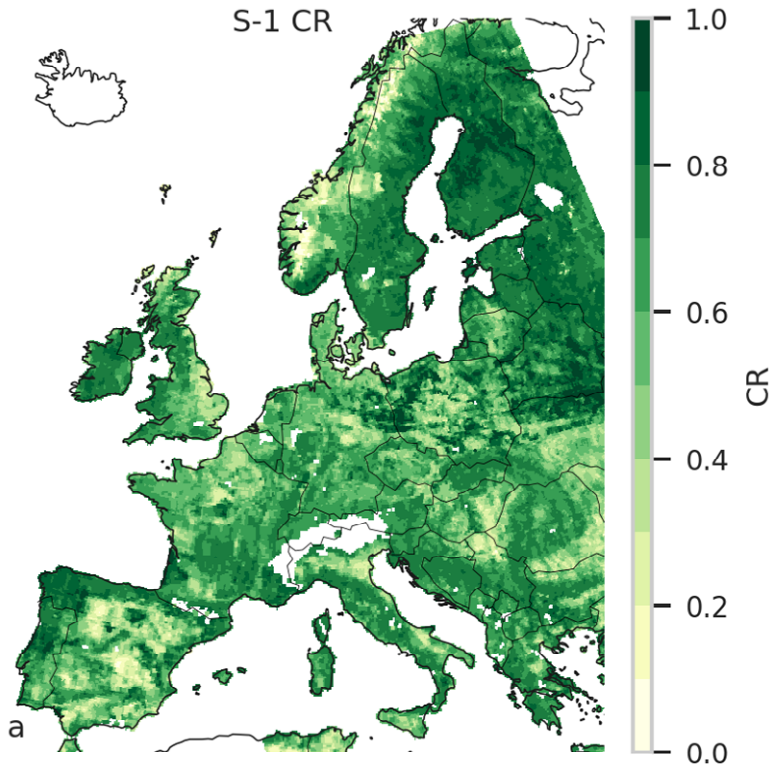


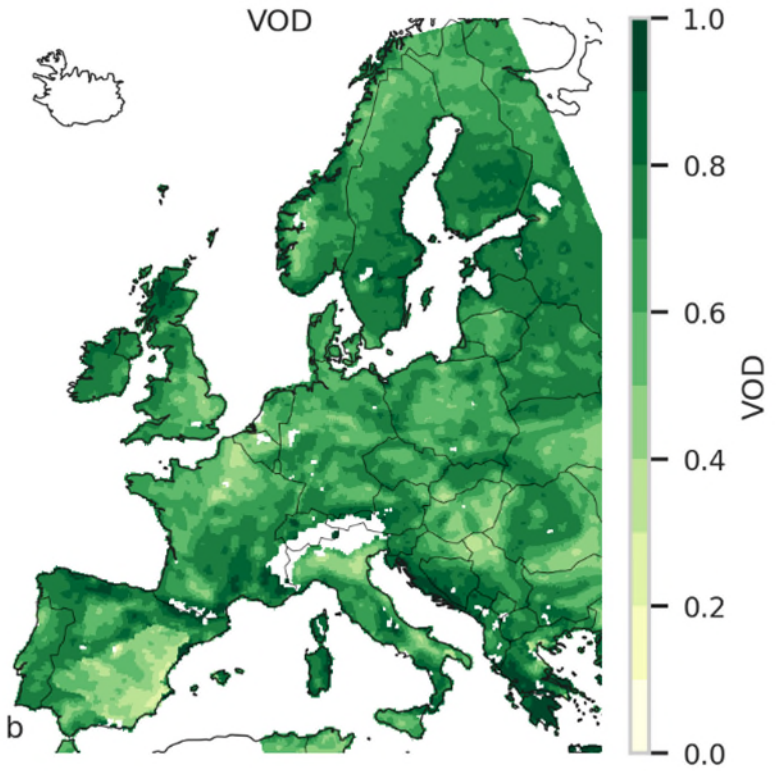


Synergies S-1 CR and ASCAT VOD

Mean (scaled)

- Sentinel-1 (resampled to 12.5km)
- Metop ASCAT (12.5km sampling)

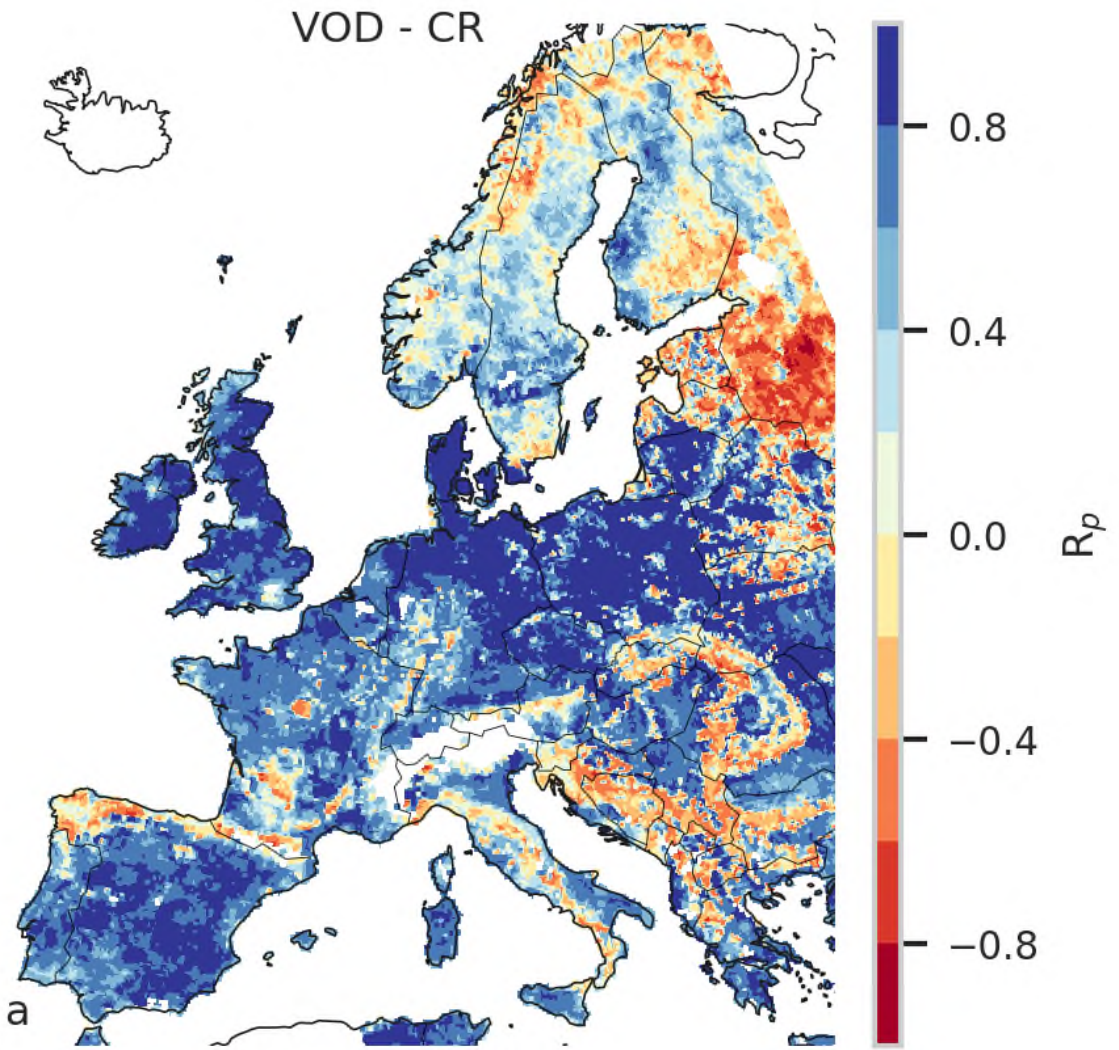




Synergies S-1 CR and ASCAT VOD

Temporal dynamics between S-1 CR and ASCAT VOD:

- High correspondence croplands and grasslands
- Negative correlation forests



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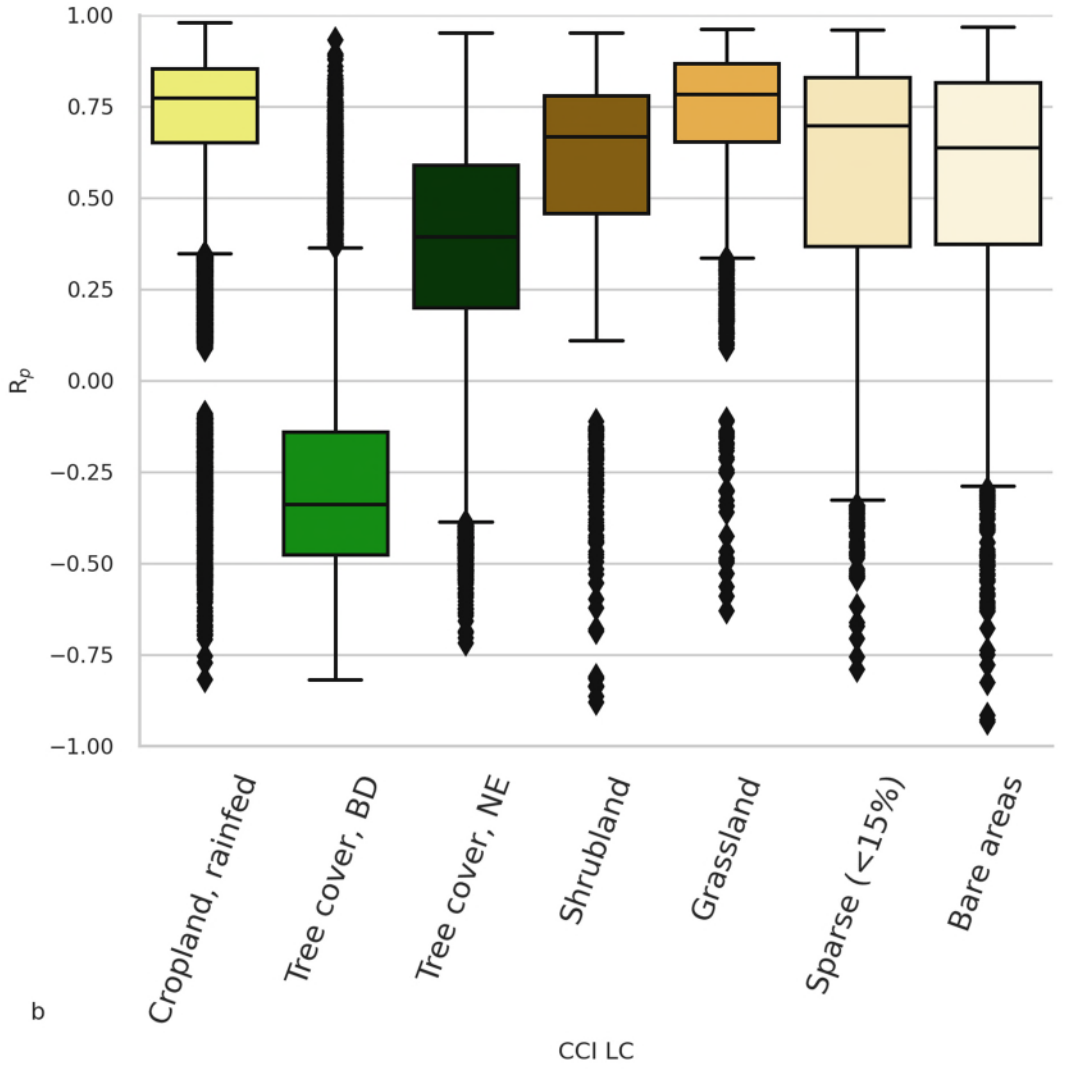
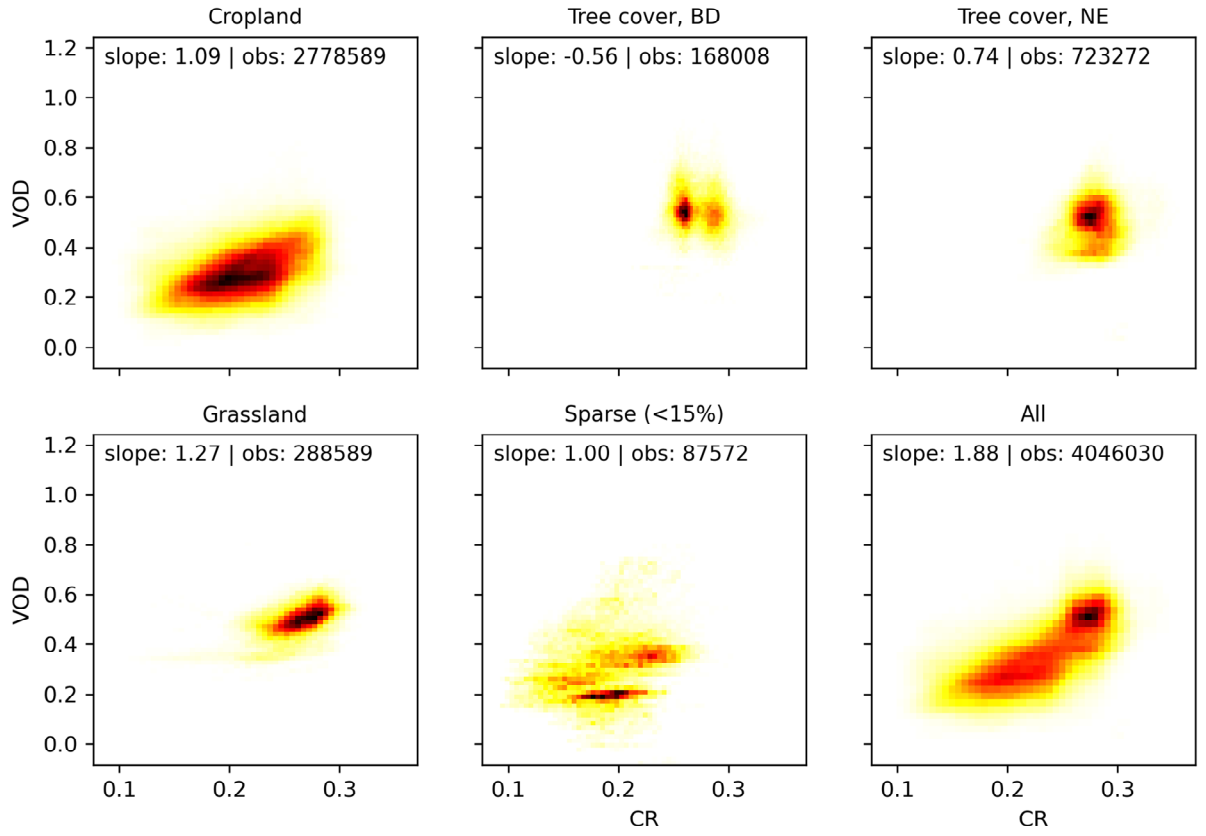


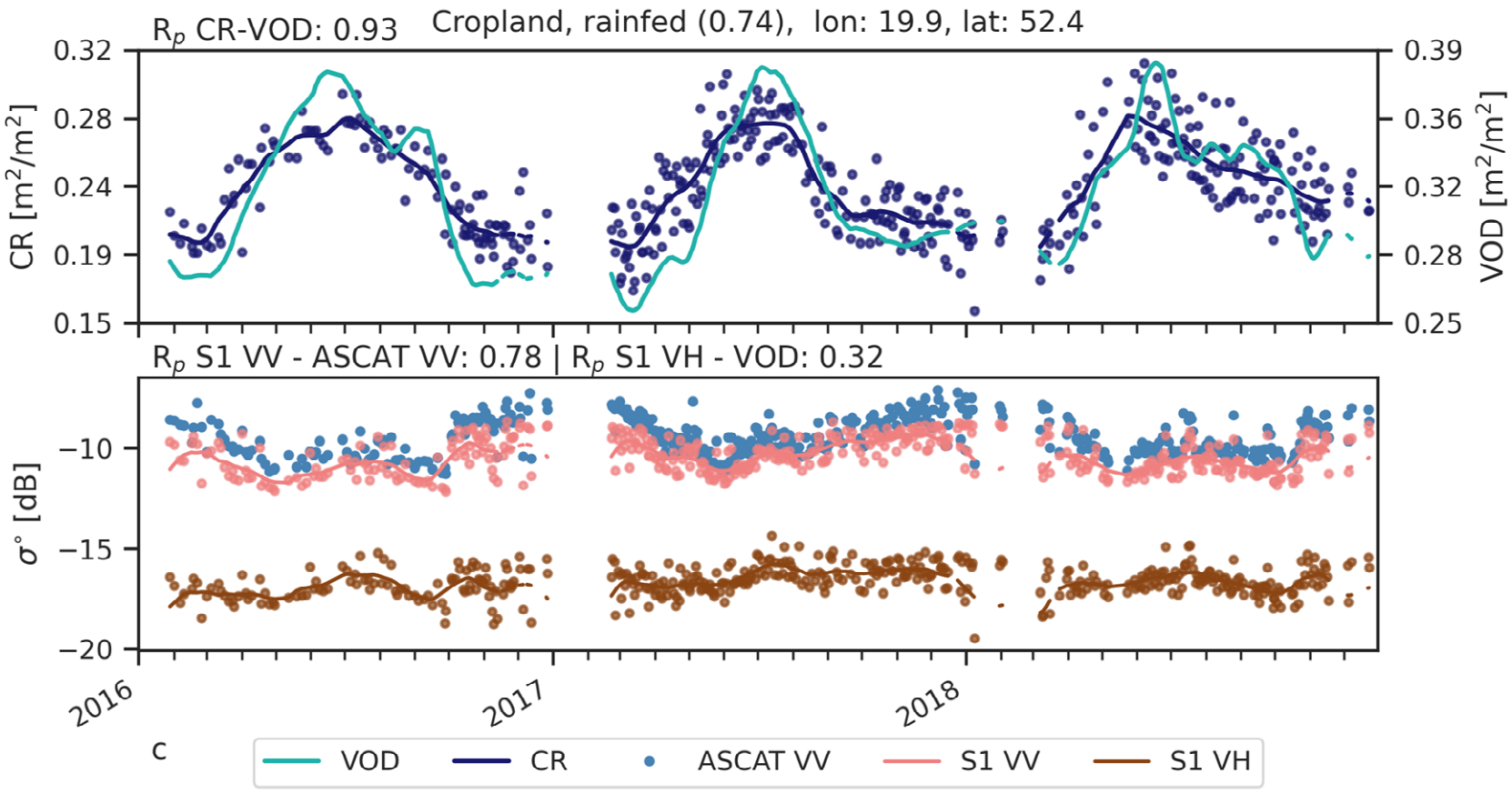
Synergies S-1 CR and ASCAT VOD

Temporal dynamics between S-1 CR and ASCAT VOD:

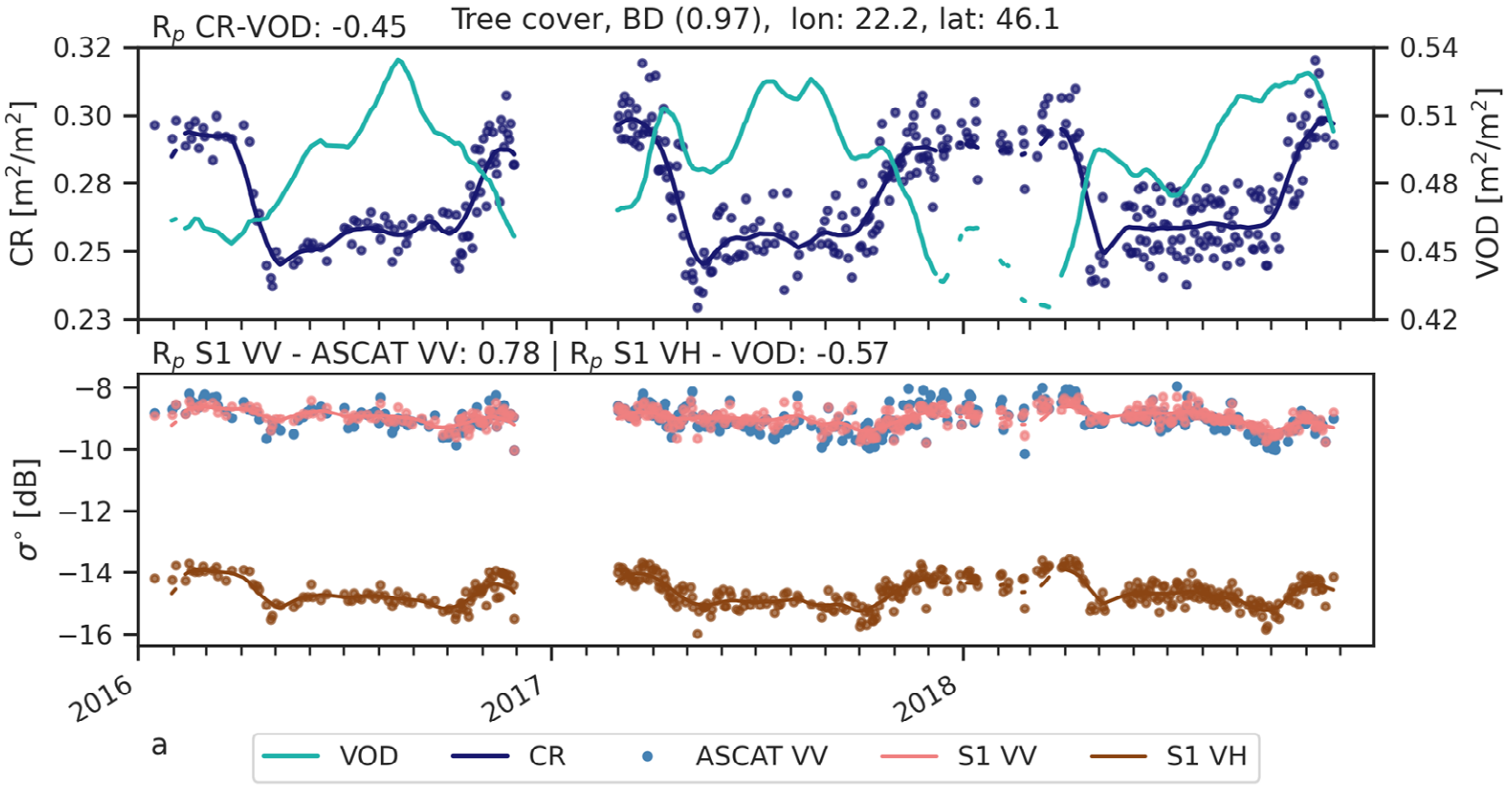
- Not linear when merging all land cover types



Temporal dynamics - cropland



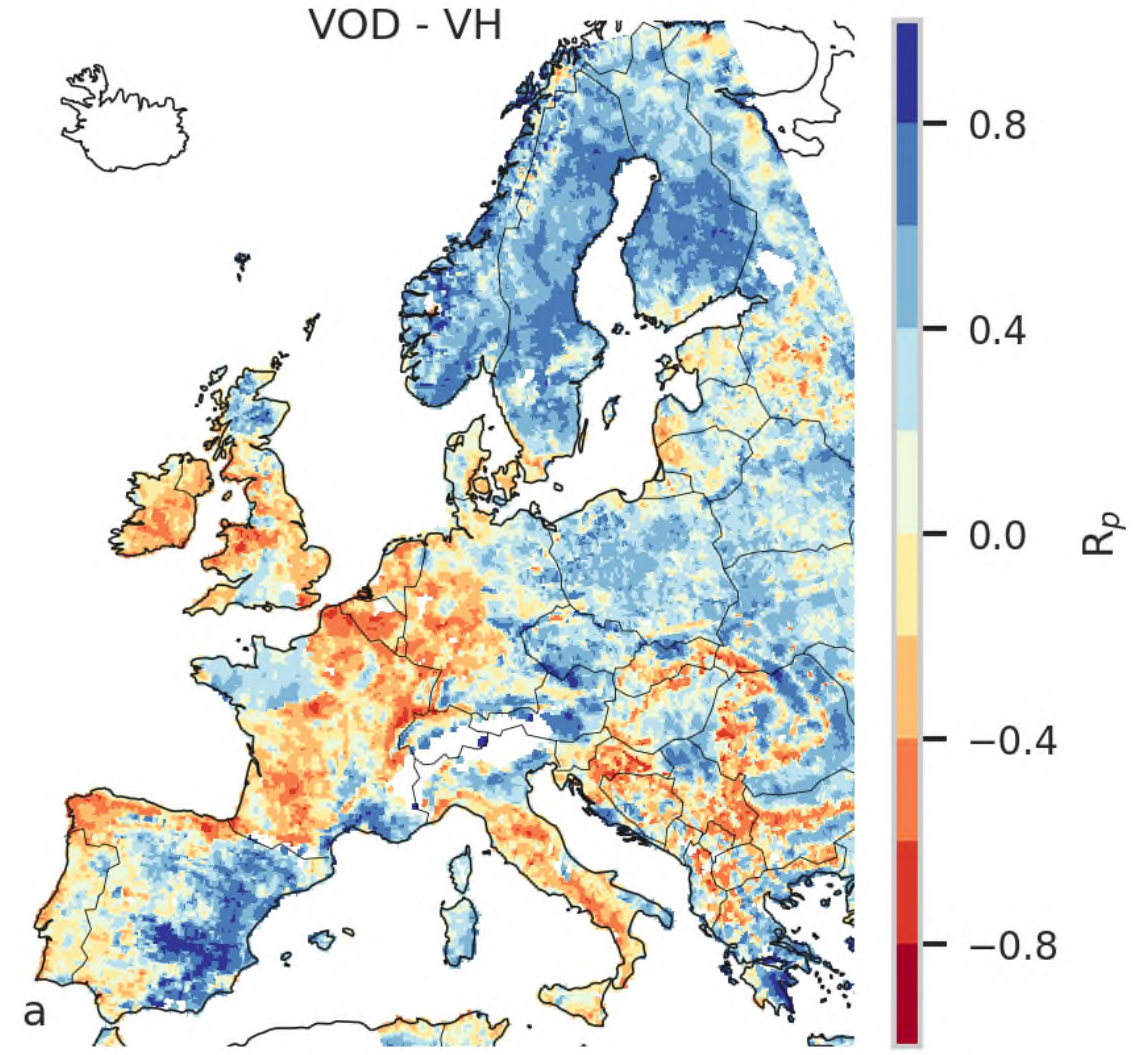
Temporal dynamics – forest BD



Synergies S-1 VH and ASCAT VOD

Temporal dynamics between S-1 VH and ASCAT VOD:

- Negative effect croplands and grasslands
- Slightly higher correlation forests



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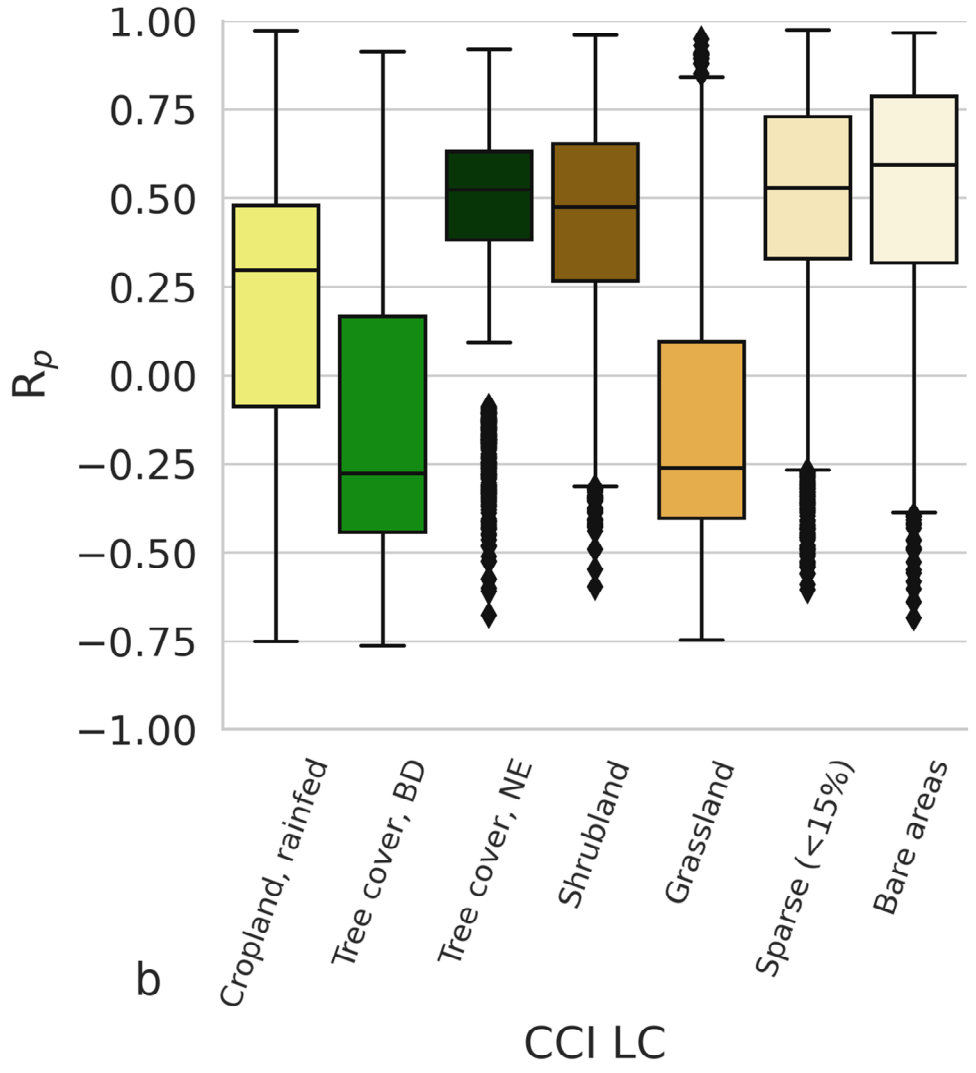
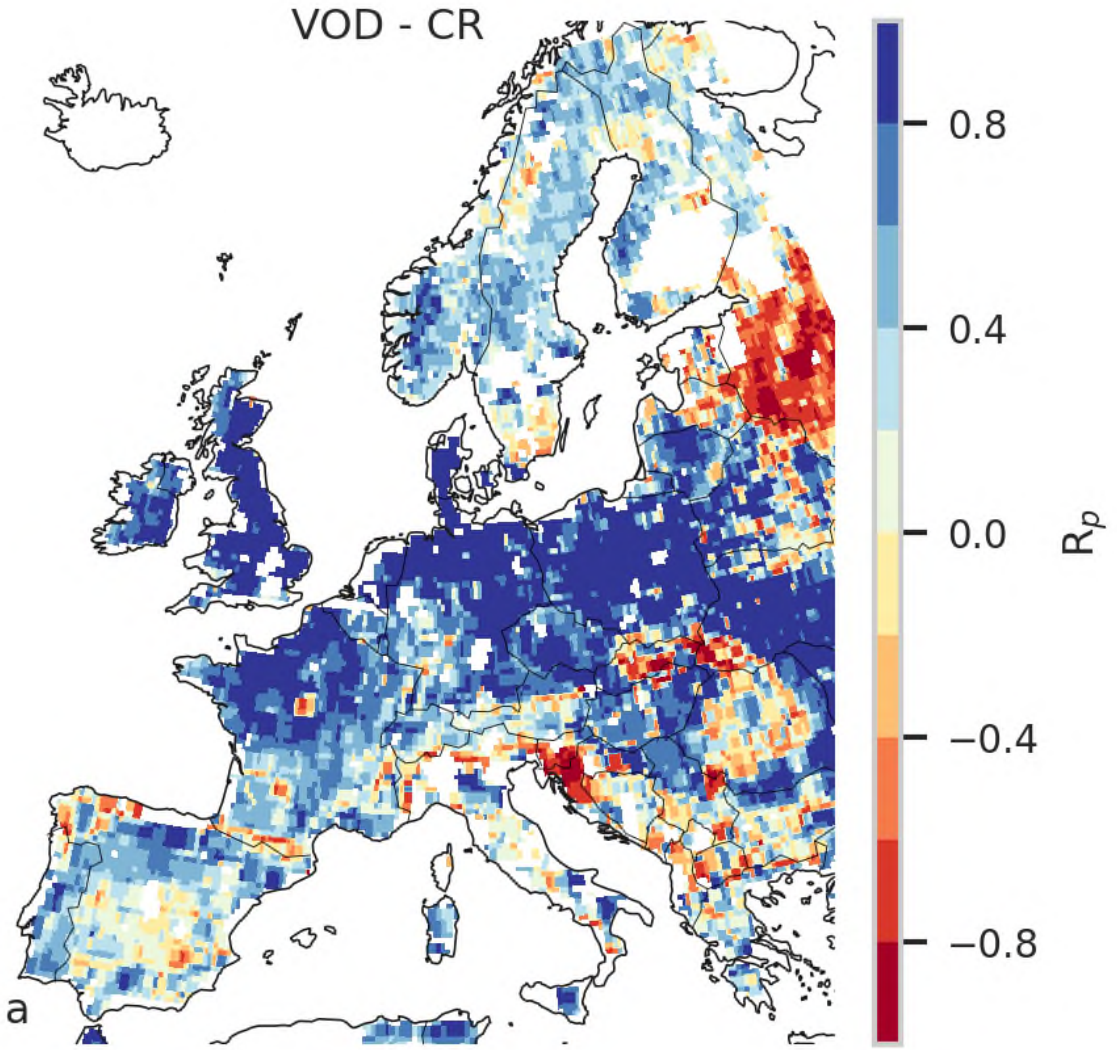


Synergies S-1 CR and VODCA

Temporal dynamics between S-1 CR and VODCA:

- Same patterns as for ASCAT VOD
- Subsurface scattering in dry regions



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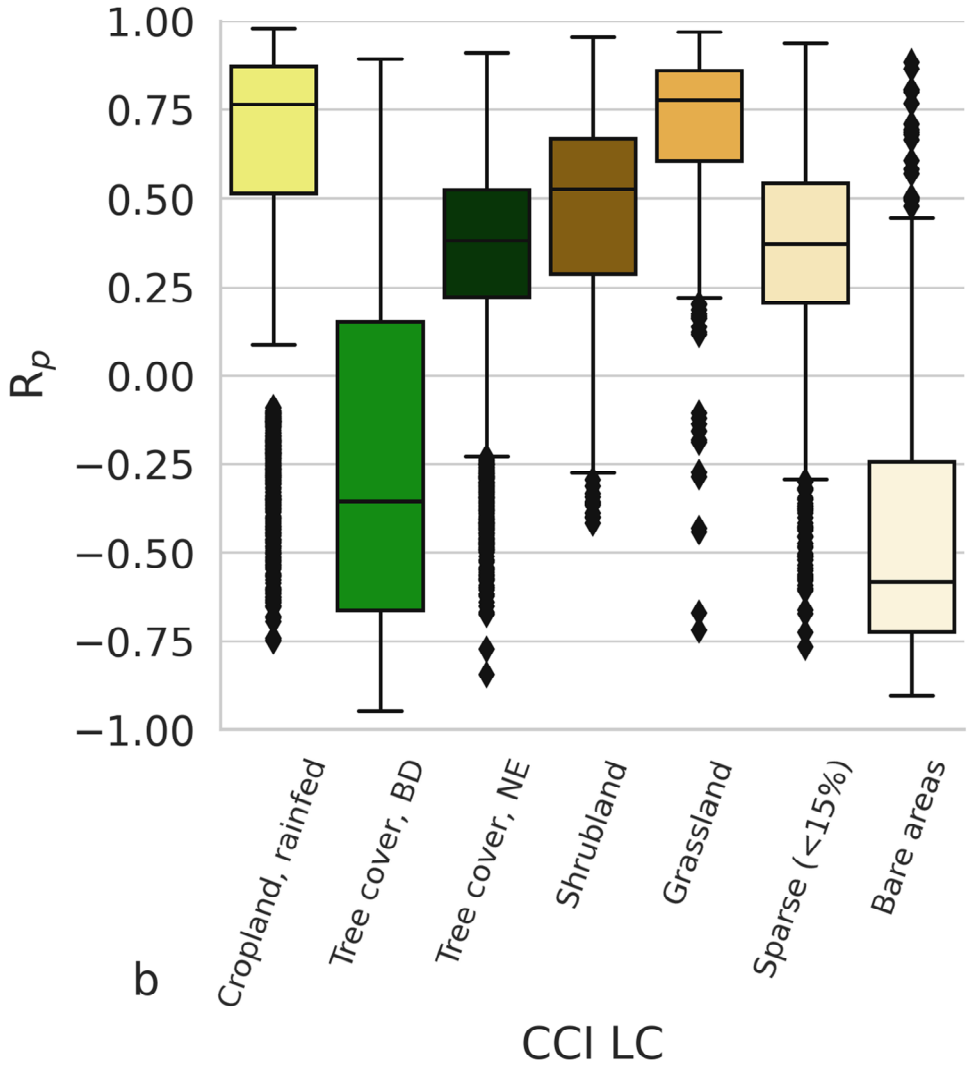
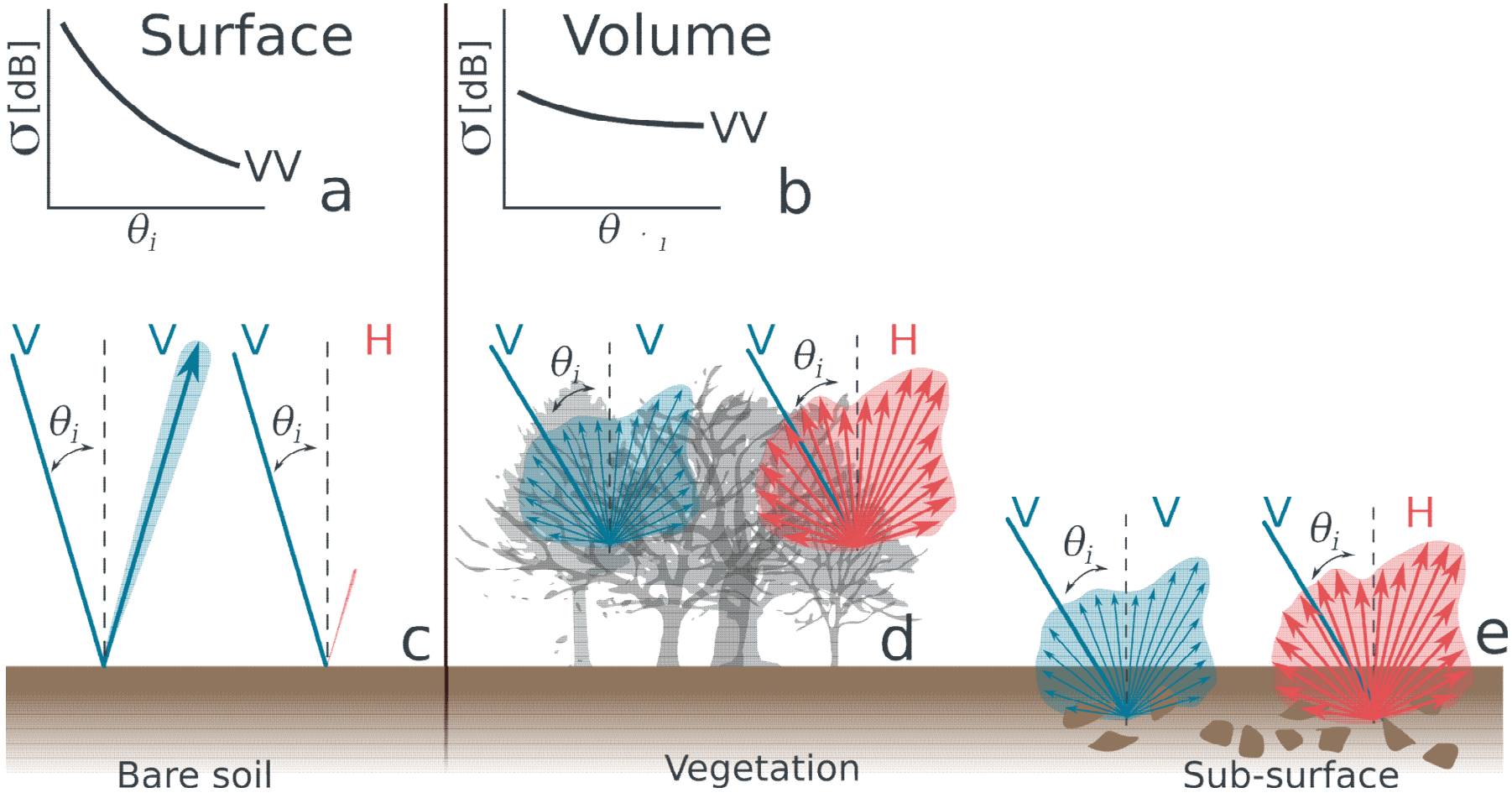
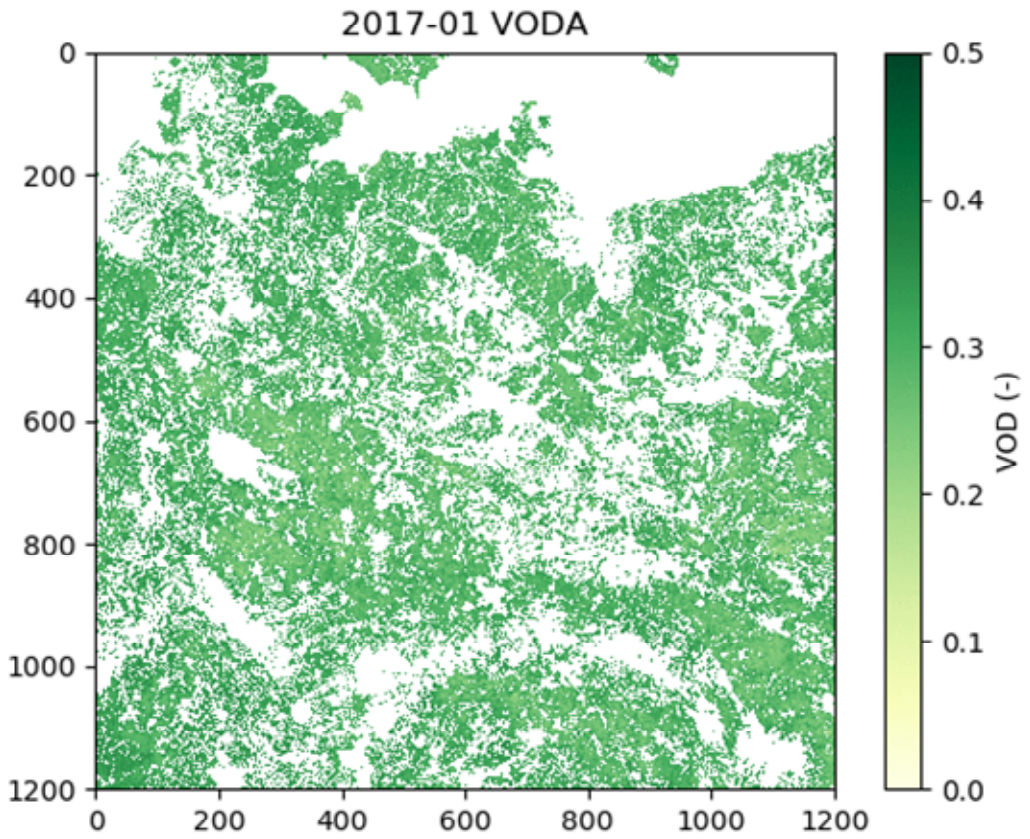


Subsurface scattering



Conclusions

- High temporal correlation between CR and VOD over most vegetation types
  - VOD could be easily calculated over croplands and grasslands
- Forests are a challenge
  - VH performs better over forests
- Not a linear relationship when merging all land cover classes
- CR and ASCAT VOD are sensitive to subsurface scattering



Outlook

Way forward for the last year:

- Different model per land cover type or use land cover information in RF
- Analyze droughts in 2018 and 2020