Comparison of seasonal evapotranspiration of temperate coniferous forests with Copernicus Sentinel-1 time series

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Motivation

- **Evapotranspiration** is one of the key metrics for **under-standing vegetation dynamics** and changes in an ecosystem
- Correlation analyses of evapotranspiration using SAR remote sensing data exist on a smaller scale [1]
- Our goal is to establish a broader understanding on the **influences of evapotranspiration** on the signal of **Sentinel-1 C-Band SAR** for managed temperate **coniferous forests**.

Study Site & Data

Tab. 1. Available Sentinel-1 datasets

Data set	Flight direction	Relative orbit	Inc. angle	Number of acquisitions	Timespan of acquisition
1	Descending	168	38.9	256	07/14/2016 - 12/14/2020
2	Ascending	44	36.5	246	07/05/2016 - 12/17/2020
3	Ascending	117	44.7	234	07/17/2016 - 12/16/2020

- Co- and cross-polarized Copernicus **Sentinel-1 Time Series**
- Data of **four weather stations** with daily temporal resolution
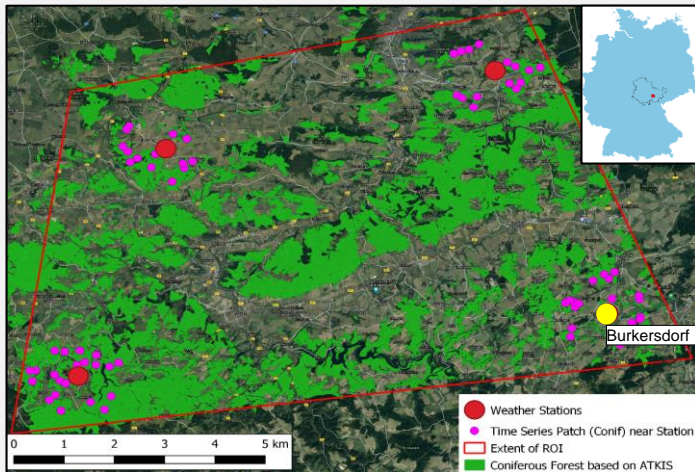

Fig. 1. Study site located in Thuringia, central Germany and comprises of mostly temperate coniferous forests, agriculture and small urban settlements
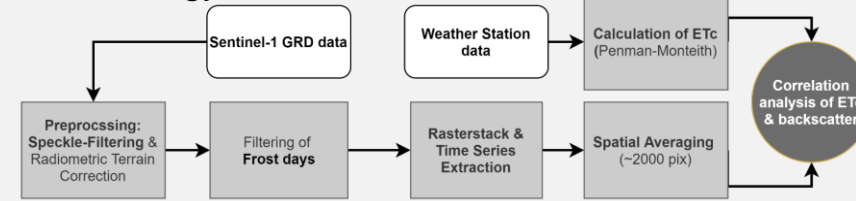
Methodology

Fig. 2. Processing Workflow of SAR data.

First Results (Station Burkersdorf)
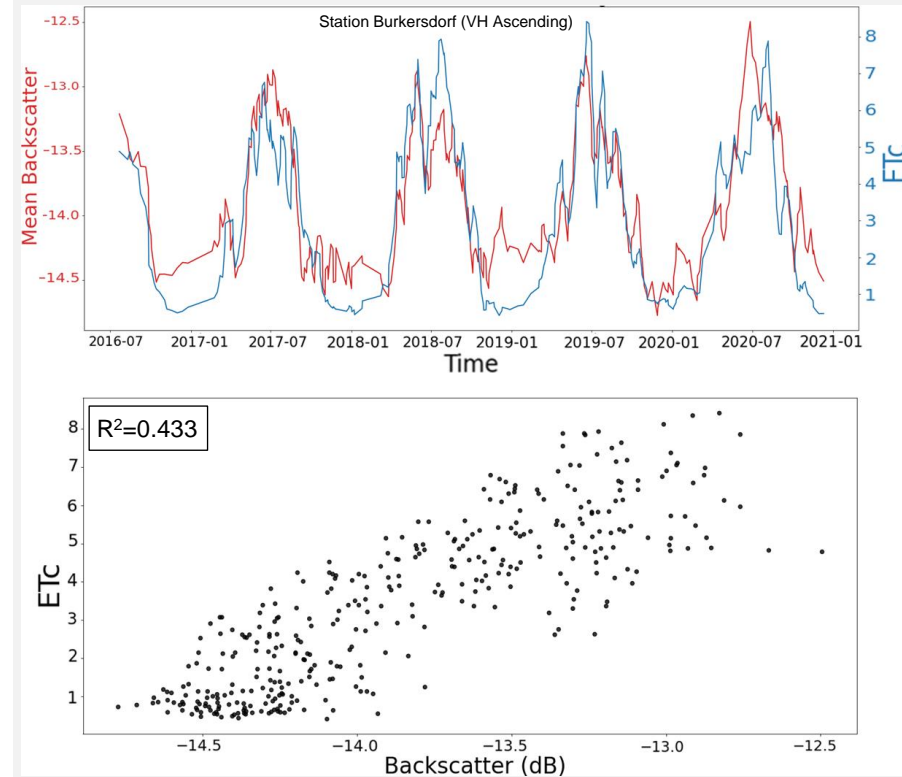

$R^2 = 0.433$

Fig. 3. Time Series of ETc (blue) and backscatter (red) at the top and scatterplot of ETc and backscatter (bottom) for one station (Burkersdorf) and VV/Ascending without frost days

Results

- **Substantial seasonal variability** in both SAR data and evapotranspiration [2]
  - Yearly variation of 1.5 dB in backscatter
- **Correlation between Evapotranspiration and SAR backscatter** values over temperate coniferous forests.
  - Similar results for all stations
- Removal of data points with daily average **temperature below freezing brings improvement** of agreement of evapotranspiration time series and SAR backscatter time series.

Conclusion

- **Strong influence of temperature** on the evapotranspiration → also visible in the SAR signal
- Very long and dense time series allow high temporal accuracy
  - Signal seasonal variations higher than relative radiometric accuracy
- Important analysis to **differentiate and characterize external influences** on the SAR C-band signal

Outlook

- Further analyses planned regarding other influential factors such as VPD, wind or soil moisture
- More in-depth analysis of statistical metrics is currently underway

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