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| **Analysing sensitivity of Sentinel-1 SAR data to phenological and moisture dynamics in Central European Forests in a coupled modelling approach** |
| Changes in plant phenology, such as earlier leaf unfolding and delayed autumn senescence, can impact the water cycle resulting in limited availability of moisture during summer. In combination with higher temperatures, droughts increase forest fire danger in Central European forests. Due to the sensitivity of radar data to both, structural and dielectric properties of the scattering materials, microwave remote sensing offers potential to analyse phenology and vegetation water dynamics. Microwave data, e.g. Sentinel-1 SAR data, is widely used for retrieval of soil moisture, biophysical variables and more recently for live fuel moisture content (LFMC) in Mediterranean and Western US ecosystems. However, it is still unclear to which extent Sentinel-1 is sensitive to moisture content within temperate forests.  To address this, we couple a semi-empirical backscattering model (Water Cloud Model, Attema & Ulaby (1978)) with a dielectric mixing model (de Jong et al. (2002)) including in-situ measurements of LFMC and rainfall interception calculated from precipitation and throughfall based on the simple model by Rutter et al. (1971). In addition, information on soil moisture and vegetation structure (i.e. leaf area index, LAI) are incorporated into the model.  The model’s calibration and inversion are tested at four sites in both evergreen needleleaf forest (ENF, spruce stand) and deciduous broadleaf forest (DBF, beech stand) using meteorological and ground data. Information on LAI and soil moisture allows applying the model spatially to a larger area. The calibrated model further allows to analyse individual effects of both vegetation descriptors, LAI and LFMC, by removing either structural or moisture related changes in the seasonal pattern of the Sentinel-1 signal. Understanding how these factors influence backscatter could improve accuracy and applicability of microwave remote sensing in assessing plant phenology and fire danger. Combining the advantages of a data and physical driven model enables the approach to being scaled to larger areas of similar vegetation even without the availability of in-situ measurements.  Attema, E. P. W., & Ulaby, F. T. (1978). Vegetation Modeled as a Water Cloud. *Radio Science*, *13*(2), 357–364. <https://doi.org/10.1029/RS013i002p00357>  de Jong, J. J. M., Klaassen, W., & Kuiper, P. J. C. (2002). Monitoring of rain water storage in forests with satellite radar. *IEEE Transactions on Geoscience and Remote Sensing*, *40*(2), 338–347. <https://doi.org/10.1109/36.992793>  Rutter, A. J., Kershaw, K. A., Robins, P. C., & Morton, A. J. (1971). A predictive model of rainfall interception in forests, 1. Derivation of the model from observations in a plantation  Corsican pine. *Agricultural Meteorology*, *9*, 367–384. <https://doi.org/10.1016/0002-1571(71)90034-3> |

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