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Optimizing operational water management with soil moisture data from Sentinel-1 satellites

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In the Netherlands, regional water authorities are responsible for management and maintenance of regional water bodies. Due to socio-economic developments (e.g. agricultural intensification and on-going urbanisation) and an increase in climate variability, the pressure on these water bodies is growing. Optimization of water availability by taking into account the needs of different users, both in wet and dry periods, is crucial for sustainable developments. To support timely and well-directed operational water management, accurate information on the current state of the system as well as reliable models to evaluate water management optimization measures are essential. Previous studies showed that the use of remote sensing data (for example soil moisture data) in water management offers many opportunities (e.g. Wanders et al. (2014)). However, these data are not yet used in operational applications at a large scale. The Sentinel-1 satellites programme offers high spatiotemporal resolution soil moisture data (1 image per 6 days with a spatial resolution of 10 by 10 m) that are freely available. In this study, these data will be used to improve the Netherlands Hydrological Instrument (NHI). The NHI consists of coupled models for the unsaturated zone (MetaSWAP), groundwater (iMODFLOW) and surface water (Mozart and DM). The NHI is used for scenario analyses and operational water management in the Netherlands (De Lange et al., 2014). Due to the lack of soil moisture data, the unsaturated zone model is not yet thoroughly validated and its output is not used by regional water authorities for decision-making. Therefore, the newly acquired remotely sensed soil moisture data will be used to improve the skill of the MetaSWAP-model and the NHI as whole.

The research will focus among other things on the calibration of soil parameters by comparing model output (MetaSWAP) with the remotely sensed soil moisture data. Eventually, we want to apply data-assimilation to improve operational water management in cooperation with users. As a first step, the current simulation of soil moisture processes within the NHI will be reviewed. We want to present the findings of this assessment as well as the research methodology.

This PhD-research is part of the Optimizing Water Availability with Sentinel-1 Satellites (OWAS1S)-project in which two other PhD-students are participating. They are focussing on the translation of raw Sentinel-1 satellite data to surface soil moisture data and the application of the remotely sensed soil moisture data on crop water availability and trafficability on field scale.

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