Estimation of the water balance and water yield in the Lagan River catchment, Sweden, using the Australian Water Resources Assessment Landscape Model

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Abstract: Water scarcity is one of the leading global crises. Although Sweden has limited experience in this regard, the severe drought that hit Europe in 2018 has led to an increased interest in understanding water balance, prompting researchers to explore new approaches to measuring it. As of today, the water balance in Sweden is measured using two separate flow models: S-HYPE for surface water and SGU-HYPE for groundwater. While both models can be considered useful tools in assessing water availability, the inability to set up a full-scale water balance makes it difficult to accurately evaluate the water balance within a said catchment, let alone determining the actual water storage of individual waterbodies.

This study aims to assess to what extent the Australian Water Resources Assessment Landscape Model (AWRA-L) can be used to estimate the water balance of Swedish catchments. For this study, the Lagan River catchment, a 6445 km^2 large catchment in the southwestern part of Sweden, was chosen as the study area. Spatial data was mapped using open-source data provided by national authorities and agencies. This includes among others; surface water drainage density, depth of the unconfined aquifer, long term mean daily potential evaporation, clay fraction, and specific leaf area. The data was interpolated using QGIS and divided into 325 individual hydrological response units (HRU) within the catchment. Temporal data obtained from the Swedish Meteorological and Hydrological Institute (SMHI) including wind speed, temperature, precipitation, and downward (incoming) solar radiation was collected from a total of 33 weather stations within, or in close connection, to the catchment area over a five-year period (2018–2022). The temporal data was later plotted on a catchment level using kriging interpolations, from which a mean value was calculated for each individual HRU.

The result from the initial calculations suggests that the water balance and water yield of the Lagan River catchment to a great extent could be estimated using the AWRA-L model. This is further supported by the ability to utilize existing open-source data with limited data cleaning, which also suggests that the model could be applied on a national level. However, local conditions in Sweden, with long periods of snow and ice coverage, suggests that further research is needed to account for the delay in storage and changes to the albedo. In addition, high presence of boreal forests and high levels of dissolved organic carbon in the surface water affects the water quality. By applying the AWRA-L model to conditions outside of Australia, this study could provide researchers and developers with additional means of validation. In addition, this study highlights some areas of further interest including the importance of accounting for snow and ice, as well as different forest conditions.

Keywords: *Water balance, hydrological modelling, water resources management, model validation*