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Pan-European high-resolution groundwater recharge mapping – combining satellite data and national survey data using machine learning

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Groundwater recharge quantification is essential for sustainable groundwater resources management, but typically limited to local and regional scale estimates. A high-resolution (1 km x 1 km) dataset consisting of long-term average actual evapotranspiration, effective precipitation, a groundwater recharge coefficient, and the resulting groundwater recharge map has been created for all of Europe using a variety of pan-European datasets and seven national gridded recharge estimates. As an initial step, the approach developed for continental scale mapping consists of a merged estimate of actual evapotranspiration originating from satellite data and the vegetation controlled Budyko approach to subsequently estimate effective precipitation. Secondly, a machine learning model based on the Random Forest regressor was developed for mapping groundwater recharge coefficients, using a range of covariates related to geology, soil, topography and climate. A common feature of the approach is the validation and training against effective precipitation, recharge coefficients and groundwater recharge from seven national gridded datasets covering the UK, Ireland, Finland, Denmark, the Netherlands, France and Spain, representing a wide range of climatic and hydrogeological conditions across Europe. The groundwater recharge map provides harmonised high-resolution estimates across Europe and locally relevant estimates for areas where this information is otherwise not available, while being consistent with the existing national gridded estimates. The Pan-European groundwater recharge pattern compares well with results from the global hydrological model PCR-GLOBWB 2. At country scale, the results were compared to a German recharge map showing great similarity. The full dataset of long-term average actual evapotranspiration, effective precipitation, recharge coefficients and groundwater recharge is available through the EuroGeoSurveys' open access European Geological Data

Infrastructure (EGDI).