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Global Snow Water Equivalent for continuous groundwater monitoring from space: uncertainties, evaluation, and application

Miriam Kosmale, Kari Luojus, Jaakko Ikonen, and Pinja Venäläinen

Finnish Meteorological Institute, FMI, Arctic Space Centre, Helsinki, Finland (miriam.kosmale@fmi.fi)

Sufficient groundwater resources are unarguably essential for human populations all over the world. With a contribution of over 30% to freshwater reserves in the global hydrological cycle, it is important to increase the capacity of the currently sparse groundwater monitoring network. Spatially and temporally continuous monitoring of groundwater as an Essential Climate Variable (ECV) can be realized with remote sensing techniques. Within the “Global Gravity-Based Groundwater Product” G3P-project (www.g3p.eu), gravimetric satellite missions GRACE and GRACE-FO are applied for global groundwater monitoring. Groundwater derived from gravimetric measurements require detailed knowledge of all continental water compartments, which are contributing to the total water storage variations.

Within the G3P project the Finnish Meteorological Institute is producing a global gap-filled Snow Water Equivalent (SWE) product that describes the snow compartment for global groundwater estimation. The product complements remote sensing-based information with model-based data for regions where remote sensing can't observe SWE on global scale.

The production of SWE from long-term satellite observations covering the full GRACE and GRACE-FO mission period from 2002 to 2021 are investigated. The Finnish Meteorological Institute efforts within the Copernicus Land monitoring service and ESA frameworks ensure operational Near-Real-Time information on SWE for the Northern hemisphere. Microwave and optical remote sensing sensor techniques are the basis for the SWE monitoring services. Validation with in-situ reference data is important in understanding product accuracy. Pixel-level uncertainties provided with the snow product support efforts on groundwater estimation. Model- and remote sensing-based SWE are evaluated on various regional scales. As part of the new Gravity-Based Groundwater Product G3P, global Snow Water Equivalent products will be presented and discussed.