Justyna
?liwi?ska-Bronowicz
Centrum Bada? Kosmicznych Polskiej Akademii Nauk (CBK PAN)
Tatiana Solovey, Polish Geological Institute – National Research Institute
Rafa? Janica, Polish Geological Institute – National Research Institute
Agnieszka Brzezi?ska, Polish Geological Institute – National Research Institute
Anna Stradczuk, Polish Geological Institute – National Research Institute
Oral
Our study introduces an improved methodology for assessing groundwater storage (GWS) dynamics by integrating downscaled Gravity Recovery and Climate Experiment (GRACE) and GRACE Follow-On (GRACE-FO) data with outputs from the Global Land Data Assimilation System (GLDAS) in the transboundary Bug River Basin (BRB). The approach incorporates three main innovations that enhance satellite-based GWS estimation. First, we employed the Random Forest (RF) algorithm to downscale GRACE-derived terrestrial water storage (TWS) to a 0.1°×0.1° resolution, using precipitation, evapotranspiration, river runoff, and soil moisture as predictors. Second, we developed a novel cumulative component for the GLDAS-based TWS change indicator, representing the vadose zone water equivalent, which depends on groundwater level (GWL) depth. This modification accounts for hydrodynamic conditions by extending the accumulation period as GWL depth increases, thereby reducing phase shifts and temporal lags relative to in-situ GWS observations, a limitation in previous studies. Third, satellite-derived GWS estimates were calibrated using in-situ groundwater measurements combined with RF and kriging techniques. This calibration markedly improved agreement between satellite and ground-based GWS data (correlations ranging from 0.66 to 0.95), enhancing the reliability of groundwater monitoring. The results indicate that seasonal variability and amplitude of GWS are strongly influenced by lithology of vadose zone and GWL depth. Despite an overall decline in total TWS, groundwater resources in the BRB remain relatively stable, highlighting the system's resilience to climatic variability. The proposed framework enables improved monitoring and forecasting of groundwater in transboundary catchments and facilitates the reconstruction of continuous GWS changes over time and space, which is particularly valuable for regions with sparse in-situ observation networks.
Presentation file
sliwinska-bronowicz_justyna.pdf
Meeting homepage
GRACE-FO 2025 Science Team Meeting
Download to PDF