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Root-zone water storage capacity (Sr) – the maximum water volume available for vegetation uptake – bolsters ecosystem resilience to droughts and heatwaves, influences land–atmosphere exchange, and controls runoff and groundwater recharge. In land models, Sr serves as a critical parameter to simulate water availability for vegetation and its impact on processes like transpiration and soil moisture dynamics. However, Sr is difficult to measure, especially at large spatial scales, hindering an accurate understanding of many biophysical processes, such as photosynthesis, evapotranspiration, tree mortality, and wildfire risk. Here, we present a global estimate of Sr using measurements of total water storage (TWS) anomalies from the Gravity Recovery and Climate Experiment (GRACE) and GRACE Follow-On satellite missions. We find that the median Sr value for global vegetated regions is at least 220±40 mm, which is over 50 % larger than the latest estimate derived from tracking storage change via water fluxes and 380 % larger than that calculated using a typical soil and rooting-depth parameterization. These findings reveal that plant-available water stores exceed the storage capacity of 2 m deep soil in nearly half of Earth's vegetated surface, representing a notably larger extent than previous estimates. Applying our Sr estimates in a global hydrological model improves evapotranspiration simulations compared to other Sr estimates across much of the globe, particularly during droughts, highlighting the robustness of our approach. Our study highlights the importance of continued refinement and validation of Sr estimates and provides a new observational approach for further exploring the impacts of Sr on water resource management and ecosystem sustainability.
Presentation file
zhao-meng.pdf
Meeting homepage
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