Comparing InSAR, microwave, and optical measurements of soil moisture in hyper-arid regions

Paula Bürgi, Rowena Lohman

Quantifying the spatial and temporal changes in soil moisture in hyper-arid regions is crucial to our understanding of the climate and geomorphology of these regions. However, monitoring soil moisture in hyper-arid regions, such as the Atacama and Arabian Deserts, is difficult because they are often remote and sparsely populated. Here, we assess a novel technique to calculate soil moisture using InSAR (Interferometric Synthetic Aperture Radar) coherence. We compare InSAR-derived soil moisture metrics to other remote sensing techniques derived using optical data from the Sentinel and Landsat satellites, passive microwave data from SMAP (Soil Moisture Active Passive) and SMOS (Soil Moisture Ocean Salinity) satellites, and other remotely sensed soil moisture datasets such as ASCAT (Advanced SCATterometer) and CyGNSS (Cyclone Global Navigation Satellite System). InSAR-derived measurements of soil moisture are higher resolution (~30 m) compared to passively-sensed measurements of soil moisture (~10-36 km), and we find that they are significantly more sensitive to soil moisture changes than optical data. We also find that InSAR coherence also records the decay in soil moisture after a rain event, which we did not find in other datasets. The applicability of this novel technique is currently limited to hyper-arid regions that have recently experienced rain events. Future work exploring the applicability of this technique in vegetated regions could allow for it to be applied more broadly.