Seminari IRSA

Venerdì 8 Novembre 2024 ore 11:30

Monitoring Groundwater Resources from Space: Compounding Anthropogenic and Climate Impacts on Water Quantity

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As the largest source of non-frozen freshwater, groundwater is an essential component in the water resource management equation. However, across the globe, groundwater supplies are being exploited due to reoccurring droughts, increasing aridity, and increasing freshwater demand. Because groundwater is “hidden” beneath the surface, monitoring volumetric changes in storage is challenging. Space-based geodetic measurements of Earth’s time-variable gravity as well as deformation of Earth’s surface offer a means of measuring these changes. The Gravity Recovery and Climate Experiment (GRACE) satellites and the second-generation Follow-On mission (GRACE-FO) observe small changes in Earth’s gravity field that, after correcting for other geophysical phenomenon, can be used to detect water storage changes with unprecedented accuracy. In addition to gravitational change, water and groundwater storage changes induce displacements of the Earth’s surface that are measurable using Global Navigation Satellite System (GNSS) station displacements and multi-temporal interferometric synthetic aperture radar (InSAR). In this talk, I will describe novel methods to combine these measurement systems with in-situ observations of groundwater level to track time-variable changes in water and groundwater quantity through two case studies. The first, in the Central Valley of California, where decades of groundwater overdraft accelerated by intense, multi-year droughts threaten the future of groundwater supplies. In the second, I will provide nearly two decades of groundwater storage trends across the Po Plain, Italy. I will show that in both places, utilizing these space-based detection methods allow us to better understand aquifer dynamics, help illuminate the underlying drivers of change, and improve monitoring of hazards related to groundwater overdraft such as aquifer system compaction and land subsidence, providing essential contextual information for future water management and drought resiliency planning.

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