Space borne radar imagery in groundwater science

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Space borne radar (SAR) imagery can be used for numerous applications in groundwater science: delimit sedimentary units and fault systems, map land cover and spatial patterns of aquifer recharge, or to monitor ground level and its relation to aquifer hydraulic pressure, compressibility, and thickness. Until recently, these techniques were challenging to apply in Australia due to either the lack of radar imagery archives or to the difficulties in obtaining the archives when available. Since 2015, Sentinel-1 satellites are automatically acquiring images over Earth's landmass and (with constant acquisition geometry) at a 12-days frequency, unleashing an important potential for applications in Australia. In this presentation, I explain the principles of acquisition and processing of radar imagery and provide an overview of applications in Australia. I also illustrate the challenges that hydrogeologists might face while integrating this data into their work.

Radar Interferometry (InSAR) allows to derive ground level changes from radar image time-series. Over Perth basin and Murrumbidgee regions, trends in ground level changes (subsidence or uplift) are obtained from InSAR and show that significant groundwater storage changes have occurred during 2016-2019. In other areas, the interpretation of InSAR results is challenged by the important clay content in the surficial layers of soils, which induces large seasonal changes in ground level not attributable to groundwater storage. SAR imagery is also used to monitor the structural stability of vegetation during droughts, which is used to infer its reliance on groundwater [1]. Finally, SAR imagery can be combined with time-variable gravity measurements for high-resolution, volumetric mapping of groundwater depletion [2]. While such research has been carried in Central Mexico, several contributors to the gravity signal need to be removed before applying it in Australia [3].

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