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Lake Mead and Hoover Dam monitoring in Nevada and Arizona states, USA using InSAR

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Man-made reservoirs and lakes are key elements in the terrestrial water system. The increased concern about the impact of anthropogenic interventions on and the dynamics of these water resources has given rise to various approaches for representing human-water interactions in land surface models. Synthetic aperture radar interferometry (InSAR) has become a powerful geodetic tool for this purpose, by evidencing changes of ground and water surfaces across time and space. In this research, the Lake Mead and associated Hoover Dam are studied using Small Baseline Subset (SBAS) technique. Lake Mead is the largest reservoir in the United States, in terms of water capacity, supplies water and hydropower for millions of people in Las Vegas, Los Angeles and southwestern part of the USA. In recent years, rising temperature, increasing evaporation and decreasing precipitation have decreased water levels substantially, and probably modified its surrounding groundwater and surface as well.

This study aims to identify a hydrology-induced ground deformation around the lake Mead and a probable Hoover dam movement displacement. For the reservoir, we used the SBAS technique using 138 SAR data, including ERS1/2, Envisat, ALOS PALSAR and Sentinel-1, covering a time-spam between 1995 and 2019. For the analysis on the dam, we used the SBAS technique from 2014 to 2019 with descending and ascending modes of Sentinel-1A/B imageries. We found two main deformation patterns around the lake associated with the water level changes. Firstly, ERS and Sentinel-1 data evidenced a ground deformation that manifested itself as as a subsidence pattern in 1995 that has gradually changed into an uplift up to 2019. Secondly, the correlation trend between the deformation and water level changes has changed from negative to positive, with a transition point around March 2008. A possible interpretation for this is that the ground has initially reacted to the water fluctuations in the reservoir before March 2008 but after no longer plays a dominant role in the deformation occurring around the lake. The findings will help us to have a better understanding over the changes happened around the lake due to the water level changes and provide the valuable information for more effective management and maintenance of hydraulic structures and facilities near by the lake and water control in the future.