Monitoring stability of embankment dams in response to 2019 Iran Flood event

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In April 2019, large parts of Khuzestan province in Iran were affected by intense record rainfall in the Zagros mountains. Persian Gulf catchment received approximately 30% of its long-term average rainfall over the course of a few days. Karkheh and Dez, two of the major rivers in this catchment, overflowed their banks. As several dams, including Karkheh, with the country's largest capacity, reached their limits, the water had to be released from the reservoirs, which resulted in flooding downstream of the dams. Several cities and more than 200 villages were flooded, and many people had to be evacuated. Many of the dams affected by the 2019 flood were embankment dams, previously reported to exhibit post-construction settlements, at places reaching 13 cm/yr. Therefore, during and after the flood, significant concerns were raised about their health and stability.

In this study, we use Sentinel-1 InSAR to monitor embankment dams' response in Khuzestan to the 2019 flood event. We process the full archive of Sentinel-1 using the Small Baseline Subset approach and estimate the time series of displacement for three different embankment dams in Khuzestan province. The first two studied dams are Karkheh and Gotvand, which have the country's largest capacities and became operational in 2001 and 2012, respectively. The third studied dam is the Masjed-Soleyman dam, previously reported to sustain a high displacement rate since its operation in 2002.

The Sentinel-1 InSAR displacement results indicate that all observed dams exhibit long-term post-construction settlement before the flood, with rates varies from approximately 1 cm/yr for the Karkheh dam to 5 cm/yr for Gotvand dam and 8 cm/yr for Masjed-Soleyman dam. The time series of displacement for Karkheh and Gotvand dams show gentle changes of displacement in response to the increase in water level following the flood. However, for the Masjed-Soleyman dam, the movement accelerates sharply after the flood with more than 2 cm of displacement on the crest in only two months. For the Masjed-Soleyman dam experiencing the most severe effect of the flood, we also analyzed high-resolution data from TerraSAR-X and COSMO-SkyMed. The results provide a detailed picture of the displacement pattern over the crest and the dam's body before and after the flood.