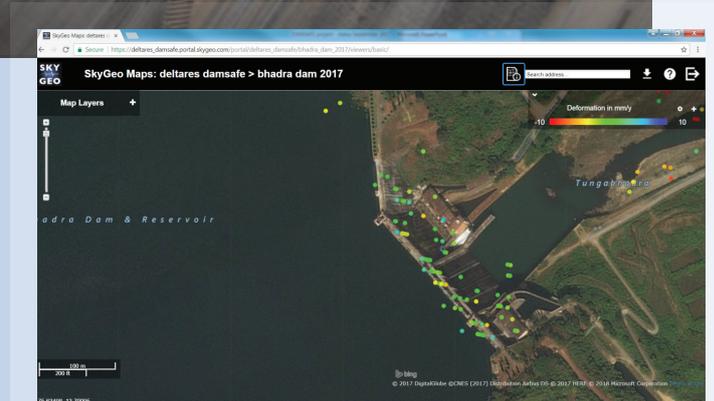


REAL-TIME DAM STABILITY MONITORING

Masonry dam, Bhadra dam-reservoir system

Demand for water is steadily increasing throughout the world. Multi-purpose water reservoirs and dams play a major role in water supplies, irrigation and flood risk management. The dams are aging, and at the same time the external conditions have also changed since they were designed, often decades or more ago. There have been transformational changes in land use, socio-economic developments and climate change.



Result of PS-InSAR satellite deformation measurements at the Bhadra masonry dam (courtesy of SkyGeo)

DAMSAFE is a pilot project to demonstrate a number of innovative technologies that contribute to the main project goal: **enhancing dam safety and water reservoir management**. The project is co-funded by the Dutch Partners for Water programme. The key end-user of the project outcome is the Karnataka Water Resources Department (KaWRD) in India, one of the major departments in the Government of Karnataka responsible for the management of 230 large dams and reservoirs. The Deltares-led DAMSAFE consortium also includes the Dutch companies SkyGeo and Royal Eijkelpomp and the Spanish company iPresas. These companies provide specialist measurement technologies. The role of Deltares is to include the measurement data in the available information using the Delft-FEWS platform and numerical modelling. The DAMSAFE project activities are:

- Online monitoring and the use of Delft-FEWS software to forecast reservoir inflow and water levels to enhance reservoir performance.
- PS-InSAR satellite measurements and the use of risk-informed safety assessment software for monitoring dam condition, resulting in the optimisation of Operation and Maintenance (OGM).
- Online monitoring and the deployment of FEWS-DAM software for the rapid assessment of dam stability in order to provide information for emergency response.

The pilot case used in the DAMSAFE project is the Bhadra dam-reservoir system. The Bhadra dam is located on the Bhadra River in the Chikkamagalore District of Karnataka State at an elevation

of 601 metres above Mean Sea Level. This is a multi-purpose dam used for the purposes of irrigation, water supplies and hydropower generation. An online monitoring system has been installed to monitor the water reservoir and identify the mechanisms that may lead to dam failure. All the measurement stations are equipped with a battery and solar panel for energy supply and a wireless connection for real-time data transmission.

Persistent Scatterer Interferometric Synthetic Aperture Radar (PS-InSAR) is a radar technique employed to generate maps of surface deformation using differences in the phases of the waves returning to the satellite. The technique is applied here to measure changes in the millimetre range in the deformation of the dam. In combination with dam safety modelling, this provides information that makes it possible to prioritise O&M efforts and detect anomalies that require in-situ inspections in the short term.

Delft-FEWS is an operational platform developed by Deltares that is being used at Bhadra to integrate data from different sources and to perform computations automatically using different numerical models, i.e. HEC-HMS, SOBEK and DAM. The platform uses HEC-HMS and SOBEK to forecast water levels in the Bhadra reservoir. DAM is used to calculate the stability of the Bhadra dam in real time for different failure mechanisms. 

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Further reading:

www.damsafe.eu