Effective and innovative Big Data processing and analysis is becoming increasingly important for risk assessment in data-scarce locations, particularly when defining and scaling up the present human and economic value of assets and when characterizing the natural hazards to which they may be exposed. This is driven primarily by dramatic increases in the volume and spatial/temporal resolution of remotely-sensed datasets and by social media sourced derivatives. Here, we present a few examples from Uttarakhand.

In January 2019, with financial support from the World Bank, the Uttarakhand State Government engaged a team of experts from DHI Water & Environment (S) Pte. Ltd, the Asian Institute of Technology (AIT) and the Evaluación de Riesgos Naturales (ERN), to complete a disaster risk assessment of the entire state and quantify, for the first time, the threat from natural hazards and the exposure of communities and critical infrastructure.

It was found that buildings are one of the major elements-at-risk. To overcome a gap of accurate information on the location of buildings, all building clusters and individual (distinctly standalone) buildings, in Uttarakhand, were digitized from high-resolution satellite images covering the whole state (an area of 53,483 km2). Considering the large number of buildings in Uttarakhand, the whole state was divided into 60,000 grids that were each randomly assigned to a data entry operator for digitizing using an application. Figure 1 depicts the workflow of the tool, developed for rapid and collaborative efforts, that captures the building clusters for the entire state.
To be able to model the potential building losses, the team defined a set of typical building types (with consideration to varying vulnerability to hazards), and then estimated the proportion of each type in every settlement across the state. This was achieved by using a variety of Big Datasets and remotely-sensed data, such as topography and night-time light. These datasets were fed into a machine learning algorithm and then trained and validated using the results of detailed field surveys in representative villages and towns.

Big Data also proved useful in modelling the spatial distribution of tourists and tourism activity around the state, which is significant, both in terms of its economic value but also because tourists are often a highly exposed subset of the human population with limited risk knowledge of the place they are visiting. Zones of high tourism activity were defined based on hundreds of thousands of anonymized spatial points, drawn from tourism booking and the review of websites listing hotels, restaurants and attractions, as well as photos posted on social media. Geolocating and characterizing these photos revealed popular hotspots, including informal infrastructures, such as tea-houses at highway viewpoints (Figure 2).

Another example shows how space data helps improve hazard forecasting and modelling. To be reliable, flood hazard models require high resolution and consistent weather datasets. Despite considerable efforts in modernizing its weather station networks, some parts of India do not currently possess adequate information from ground monitoring alone. In Uttarakhand, the team applied local weather data enhancement using alternative data sources, including satellite-based rainfall products (specifically, GPM and CHIRPS), together with other weather variables from the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA-Interim climate models to produce final flood hazard and risk maps. In Uttarakhand, the team of experts statistically downscaled an ensemble of 14 climate projections to evaluate the impacts of climate change on local floods.
The multi-hazard risk maps developed for Uttarakhand are now being fed into a decision support system (DSS) for better disaster management in the state. The DSS integrates both baseline and real-time data to support the emergency operation centre at the state-level. For example, during the rainy season, the DSS will select the closest hazard and risk map in the at-risk areas and enable the authorities to plan the response activities for an effective management of the disaster.

**Figure 2. Example of geotagged photos indicating hotspots and density of tourism activity during the tourist season around Rishikesh and Haridwar, Uttarakhand**

![Image of geotagged photos indicating hotspots and density of tourism activity around Rishikesh and Haridwar, Uttarakhand.](image)

**Source:** Geoinformatics Center, AIT.

**Disclaimer:** The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Links: [http://geoinfo.ait.ac.th/](http://geoinfo.ait.ac.th/)

Additional details and more practices like this can be found in *Geospatial Practices for Sustainable Development in Asia and the Pacific 2020: A Compendium*.