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From satellite-based global flood mapping to local end-user support

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Floods affect more people every year than any other disaster, yet the historic data required to improve models to accurately predict flood exposure and adequately prepare for these events is lacking. With support from Google Earth Outreach and in collaboration with the Dartmouth Flood Observatory, Cloud To Street mapped 3,044 large flood events between 2000-2018 at 250-m resolution. Of these, 896 events were mapped with sufficient quality according to our evaluation metrics (average accuracy of 83%) in 105 countries worldwide, totaling 3.6 million km^2 of flooded area and 318 million people exposed to inundation.

The importance of such global data lies in the enhanced understanding of historic flood exposure, assessing flood models for their accuracy, gleaning new insights about social vulnerability to floods, and improving future flood risk prediction. Yet on a more tangible level, satellite-based flood maps directly enable the improvement and effective implementation of local flood forecast models, and the development of novel flood monitoring tools to support regional government bodies. In collaboration with the World Bank and The Eastern Nile Technical Regional Office (ENTRO), Cloud To Street developed a Flood Risk Dashboard (http://nile-flood-database.appspot.com/). The dashboard, iteratively designed with the end-user, shows a history of floodable areas with estimated recurrence intervals, exposed land uses and population, precipitation hyetographs, and flood footprints. Mapping all extreme flooding in the watershed since 1984 reveals that at least 140,000 km^2 and over one million people have been exposed to floods since 2000. Some local and regional flood trends are apparent, as dam and levee infrastructure appear to have changed hydrologic patterns in the basin. Additionally, the 17 individual flood events from 1988-2017 that ENTRO requested covered over 26,000 km^2 of land exposed and over 300,000 people to flooding.

Cloud To Street also compared the current ENTRO flood forecasting model, GFT (GIS Flood tool), to 10 observed flood event maps in the Gambella Basin. We found the GFT model is able to capture some of the flood events along the Baro river and existing water reservoirs. However, GFT was significantly overpredicting flooded areas, in combination with false positives and low "hit rates" compared to inundated areas revealed in satellite images. The poor GFT model performance is partly caused by a lack of observation data to calibrate the model, and the flatness of the region. In addition, we found evidence of flood "striping" believed to be due to use of a low quality SRTM DEM. Therefore we recommend ENTRO to begin using MERIT, Multi-Error-Removed Improved-Terrain, which is open access for government use. The methods developed in this assessment can be replicated and used to calibrate and benchmark ENTRO progress as Hec-HMS and Hec-RAS models are developed for Gambella and other regions.

In short, the development of online tools in close collaboration with stakeholders allows them to identify flood prone communities, enhance regional collaboration, evaluate currently-used flood models, and improve national capacity in the mitigation, preparedness, and response to floods.