1) Motivation

Small Island Developing States (SIDS) have some of the highest risks to hydro-meteorological hazards worldwide, as well as impacts of future climate change. However, little research has quantified this risk for current or future scenarios due to a lack of available data at an appropriate resolution.

The newly released ~12m TanDEM-X global Digital Elevation Model (DEM) provides a renewed opportunity to assess the capacity to improve flood estimates at a finer resolution using remotely-sensed data.

2) Study area

Ba and Nadi catchments in Fiji

LiDAR data available for ‘ground truth’ comparison for the towns in both catchments.

Recent flood events

- January 2009 = 50-yr return period (RP)
- January 2012 = 50-yr RP
- March 2012 = 25-yr RP
- February 2016 (Cyclone Winston) = 200-yr RP
- April 2018 (Cyclone Josie)

3) Methods

TanDEM-X Processing

- TanDEM-X was acquired using an X-band Interferometric Synthetic Aperture Radar, measuring canopy and building tops as a Digital Surface Model (DSM). However, a Digital Terrain Model (DTM) is required for accurate flood simulation.
- A progressive morphological filtering method described in Figure 2 was created to remove artefacts from the original TanDEM-X DSM, producing TanDEM-X DTM. Figure 3 and 4 demonstrate the artefact removal.
- In comparison to the LiDAR data, TanDEM-X DTM has the lowest error.

4) Results for Ba

F1-score for inundation accuracy

- F1-score measures accuracy from 0 (no accuracy) to 1 (complete accuracy).

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F1 = \frac{2 \times (\text{Precision} \times \text{Recall})}{\text{Precision} + \text{Recall}}
\]

- The TanDEM-X models do not simulate the mangroves at the downstream boundary well, meaning MERIT has the highest F1-score.
- Without mangroves, the F1-scores for the TanDEM-X DTM are highest, followed by MERIT then TanDEM-X DSM, highlighting the importance of vegetation removal.

Vegetation pixel removal

- The TanDEM-X vegetation processing method does not completely remove large patches of dense vegetation, meaning these areas do not flood.
- Smaller artefacts are removed well.
- High pixel areas still present in the TanDEM-X DTM block key flow paths, reducing the F3-score.

5) Conclusions

- The TanDEM-X DTM and DSM shows better agreement with the LiDAR DEM in RMSE and MAE calculations than MERIT.
- However, when incorporated into LISFLOOD-FP, areas of vegetation in the TanDEM-X DSM and DTM limit floodplains. As a result, vegetation removal is a key step required for using TanDEM-X in hydrodynamic models, and the method shown in this poster is useful for removing isolated vegetation.
- To remove the larger areas of vegetation, the TanDEM-X 50m Global Forest/Non-Forest Map\(^2\), could be used in conjunction with this method and may further improve the capacity of TanDEM-X in improving flood estimates.
- Further work will conduct an identical study in the Nadi catchment to identify whether these conclusions are concurrent in another study area.

References

- UNEP, 2015. Global Forest Watch. UNEP-WCMC.