Quantification of Flood Impact on Human Settlement Using Sentinel-1 And Google Earth Engine: A Case Study of 2019 Flood in North East Thailand

Gautam Dadhich and Hiroyuki Miyazaki
Asian Institute of Technology, Thailand
Contact: <st120591@ait.asia> Web: <https://www.ait.ac.th/>

(1) Introduction: Floods affects society and environment by causing loss of human life and damage to property and infrastructure. To respond opportunely to hydrometeorological hazards, it is necessary to assess, rapidly and accurately, damage to the affected area. This work shows advances in the field of flood damage assessment to estimate affected population with radar images. This study proposes a framework which can be applied for urban flood damage assessment and estimation of the number of people affected by flood.

(2) Method: Synthetic Aperture Radar (SAR) earth observation product from Sentinel-1 is used to prepare a flood inundation map. The 2018 JRC Global Surface Water dataset of 30 m resolution (Pakel et al., 2016) is used to mask out all areas covered by water for more than 12 months per year i.e. permanent water. Flooded pixels are separated from non-flooded ones using Kittler and Illingworth (KI) threshold method. The parametric Kittler and Illingworth minimum error thresholding approach (Kittler and Illingworth, 1986) is then employed to derive local threshold values using a cost function which is based on the statistical parameterization of the sub-histograms of all selected tiles as bi-modal Gaussian mixture distributions. GHS BUILT-UP Sentinel-1 GRID (Corbane et al., 2019) of 20 m resolution was used to estimate affected people and validated by Facebooks research's High-Resolution Settlement Layer (HRSL) data (30 m resolution).

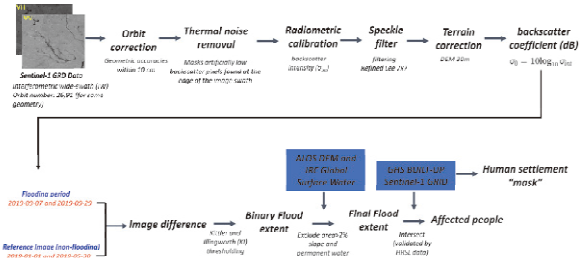

Figure 1: Methodology for flood affected settlement mapping

(3) Result: The results of flood extant map were assessed by calculating confusion matrix. The overall accuracy of the classified flood extant map was found to be 93.57% with a kappa coefficient of 0.86. The user accuracy was 94.55 for non-flooded class and 98.46 for flooded class. The producer's accuracy was 98.74 for non-flooded class and 94.78 for flooded class. High classification accuracy demonstrates the potential of the Kittler and Illingworth (KI) threshold method for classifying the flooded and non-flooded pixels. Figure 2 shows the spatial distribution of flood extant overlaid on human settlement. Our results show that sentinel-1 data and sentinel-1 based population data product can be effectively used for estimation of number of people affected by flood disaster.

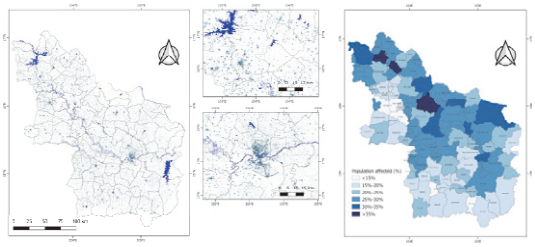

Figure 2: Flood extant map of Sept. 2019 flood in NE Thailand

(4) Data:

- 2018 JRC Global Surface Water dataset of 30 m resolution (30 m)
- Sentinel-1 GRD Data (IW)
- GHS BUILT-UP Sentinel-1 GRID (20 m)
- High-Resolution Settlement Layer (HRSL) (30 m)

(5) Reference:

Corbane, C., Pesaresi, M., Kemper, T., Politis, P., Florczyk, A. J., Syrris, V., ... & Soille, P. (2019). Automated global delineation of human settlements from 40 years of Landsat satellite data archives. Big Earth Data, 3(2), 140-169.

Kittler, J., & Illingworth, J. (1986). Minimum error thresholding. Pattern recognition, 19(1), 41-47.

Pekel, J. F., Cottam, A., Gorelick, N., & Belward, A. S. (2016). High-resolution mapping of global surface water and its long-term changes. Nature, 540(7633), 418-422.

High-Resolution Settlement Layer (HRSL) data: https://ciesin.columbia.edu/data/hrsl/