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Cloud-based Near Real Time Probabilistic Flood Mapping with Synthetic Aperture Radar Intensity data

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1. INTRODUCTION

Floods are one of the most common yet most destructive natural hazards around the world. It is estimated that around half of deaths caused by natural hazards can be attributed to floods alone [1]. Floods can also be devastating in economic terms: in 2018 alone, the worldwide economic loss due to floods reached up to 82 billion US dollars [2]. In Taiwan, which is vulnerable to flooding induced by typhoons and storms during plum rain season, the flood-related average annual economic loss between 1980s and 2000s was 5.5 billion New Taiwanese dollars [3].

2. OBJECTIVES

To derive a new SAR intensity-based index for rapid and accurate Flood Proxy Mapping (FPM) with cloud-based implementation for seamless deployment and production.

3. METHODS

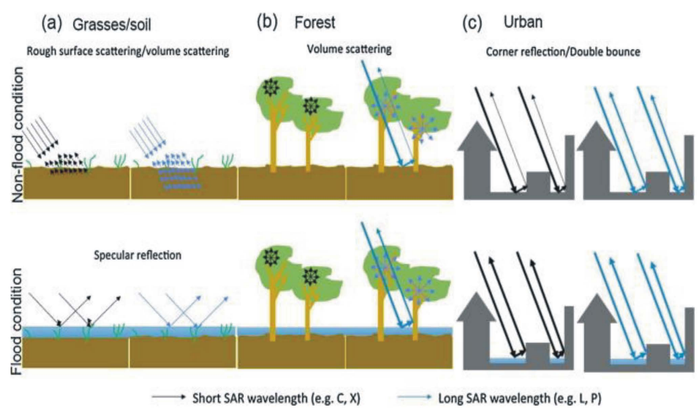


Figure 1. Changes in the scattering of SAR signal due to flooding [4]

Normalized Difference Scattering Index and Bayesian Approach

$$NDSI = \frac{\sigma_f^o - \sigma_r^o}{\sigma_f^o + \sigma_r^o}$$

where,

σ_r^o = Reference image backscatter value

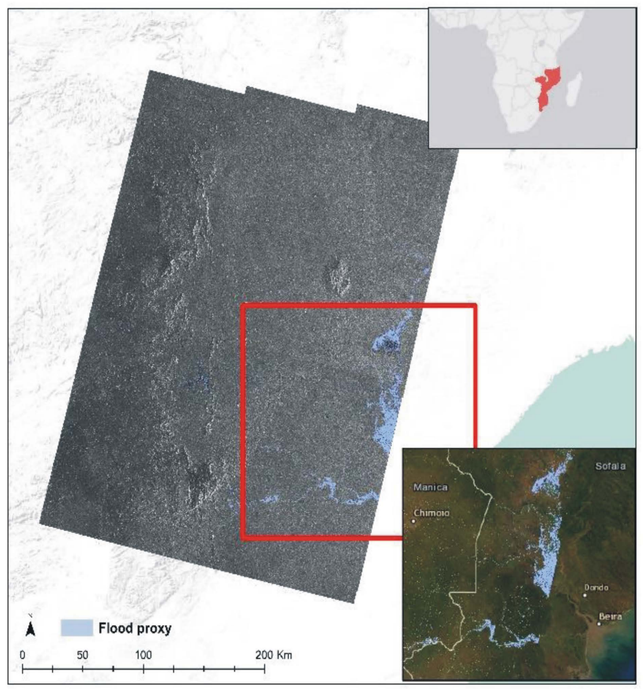
σ_f^o = Flood image backscatter value

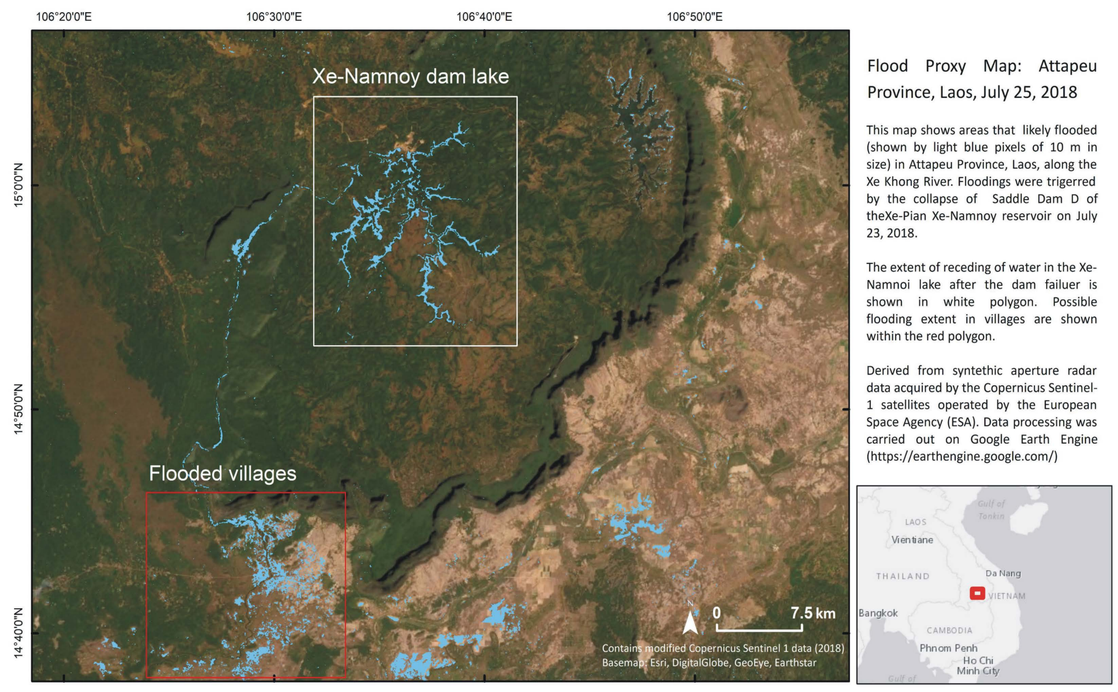
$$p(F|S_{NDSI_F}) = \frac{p(S_{NDSI_F}|F)p(F)}{p(S_{NDSI_F}|F)p(F) + p(S_{NDSI_F}|\bar{F})p(\bar{F})}$$

4. RESULTS

The proposed methodology was tested using the floods in Sofala province, Mozambique, caused by cyclone Idai on March 14–19 of 2019. Results show that thresholding of the NDSI Vertical Transmit-Horizontal Receive (VH) can produce results with Overall Accuracy above 90%, and Kappa higher than 0.6.

Considerable performance improvements were obtained by our thresholding method over the entropy of NDSI, yielding results with Kappa of 0.70–0.77.





Flood Proxy Map: Attapeu Province, Laos, July 25, 2018

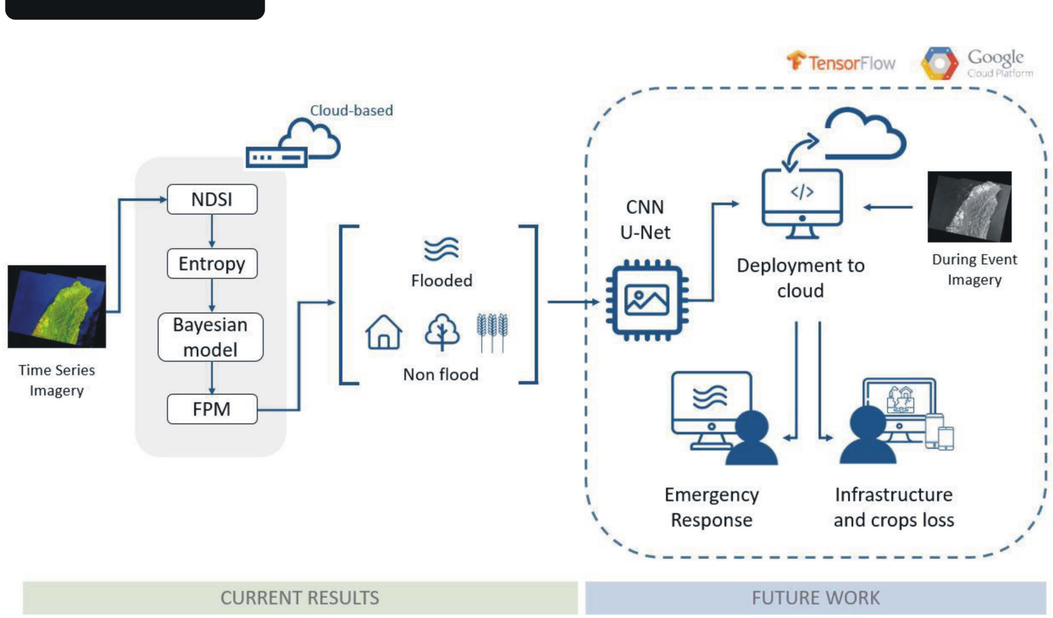
This map shows areas that likely flooded (shown by light blue pixels of 10 m in size) in Attapeu Province, Laos, along the Xe Khong River. Floodings were trigerred by the collapse of Saddle Dam D of theXe-Pian Xe-Namnoy reservoir on July 23, 2018.

The extent of receding of water in the Xe-Namnoi lake after the dam failuer is shown in white polygon. Possible flooding extent in villages are shown within the red polygon.

Derived from syntethic aperture radar data acquired by the Copernicus Sentinel-1 satellites operated by the European Space Agency (ESA). Data processing was carried out on Google Earth Engine (https://earthengine.google.com/)

Figure 2. Flood Proxy Map for Mozambique. Event triggered by Cyclone Idai, March 2019

5. FUTURE WORK



6. Publications

Chiang, S.-H., & Ulloa, N.I.. Mapping and Tracking Forest Burnt Areas in the Indio Maiz Biological Reserve Using Sentinel-3 SLSTR and VIIRS-DNB Imagery. Sensors, 19(24), 5423. (2019) SCI Journal (Engineering, Electrical & Electronic)

Ulloa, N.I., Chiang, S.-H., & Yun, S.-H. Flood Proxy Mapping with Normalized Difference Sigma-Naught Index and Shannon’ s Entropy. Remote Sensing, 12(9), 1384. (2020) SCI Journal (Remote Sensing)

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