K&C Phase 4 – Status report

Inundated mapping during flood events on Dec 23, 2016 in Bima city, West Nusa Tenggara, Indonesia

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Background

- The flood hit Bima city, West Nusa Tenggara occured on Wednesday, Dec 21, 2016 and again on Friday, Dec 23, 2016
- This event caused inundated areas of six districts and damages of more than 16,000 houses, 27 school infrastructures and 4 hospitals (National Agency for Disaster Management (BNPB)).

Project outline and objectives

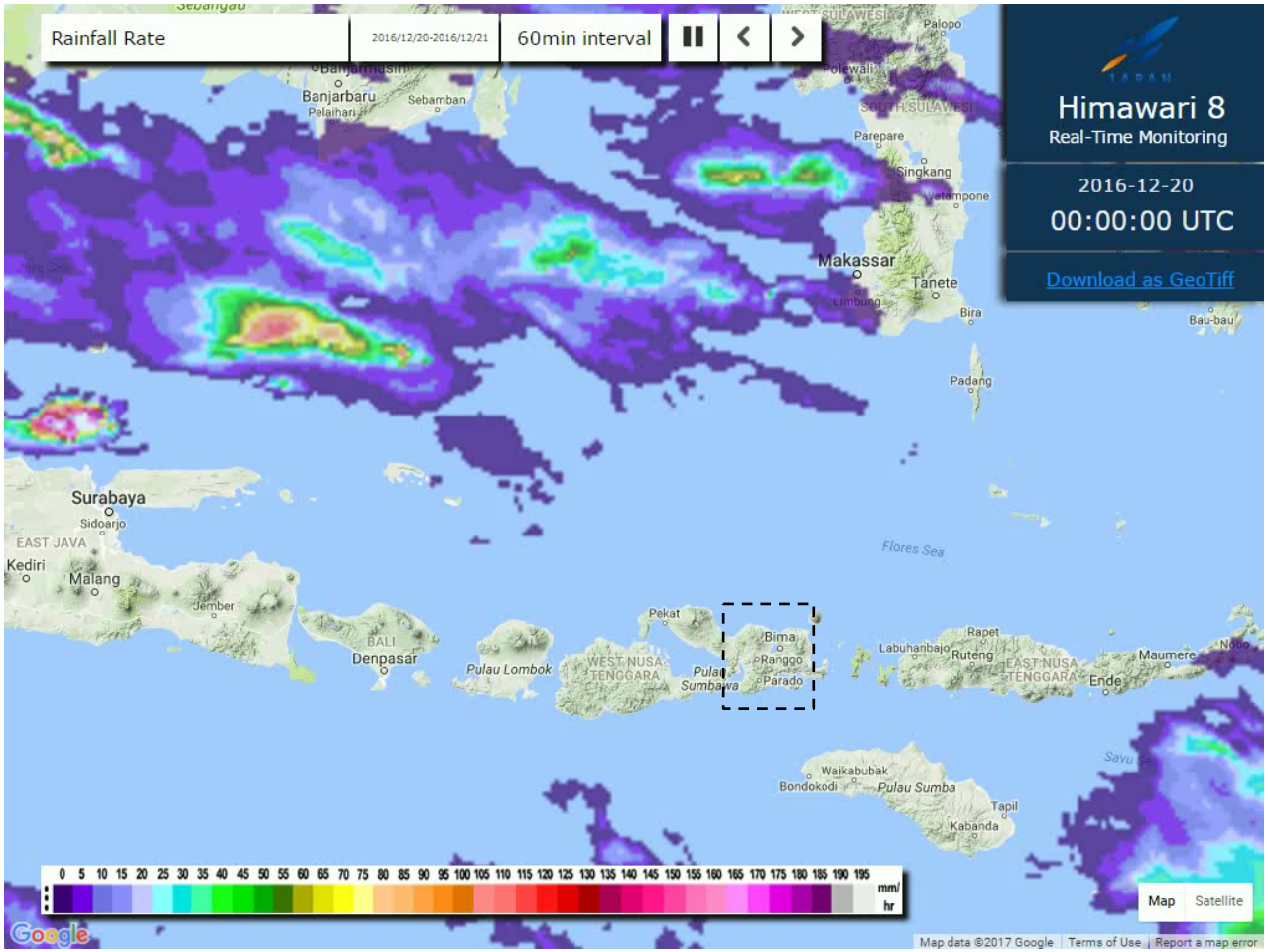
- to map inundated areas of flood event as rapid mapping steps of disaster mitigation effort
- to identify the cause of the flooding

Study Area

Indonesia Map

Bima City,
West Nusa Tenggara,
Indonesia

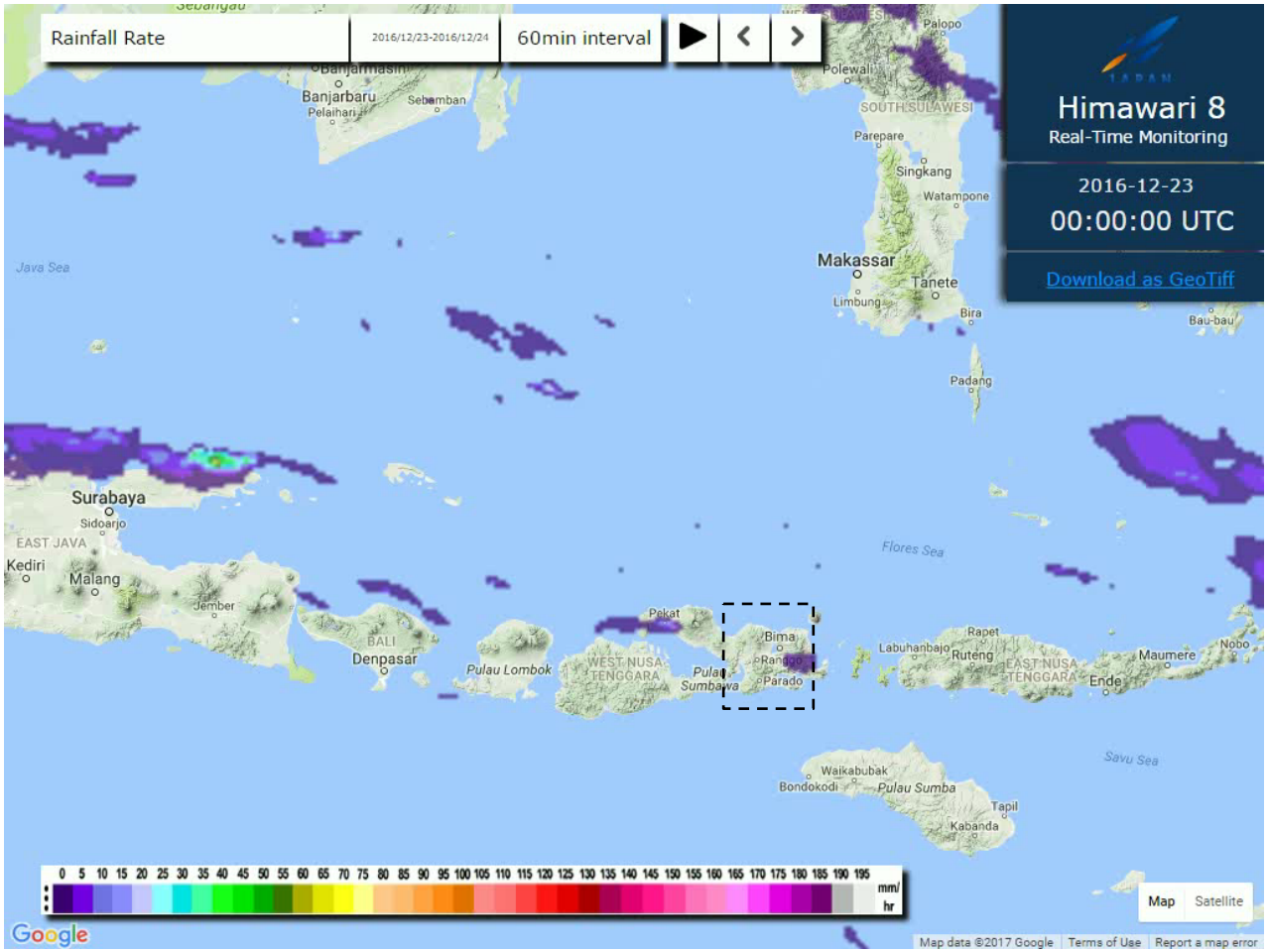
1. Flood event : Rainfall condition from 20-21.12.2016



- Effect of Tropical Cyclone Yvette
- Himawari-8 Data Rainfall rate of **165 mm/hr** on 21 Dec 2016 at 03.00 UTC

Source :http://modis-catalog.lapan.go.id/dev/himawari-8/

2. Flood event : Rainfall Condition from 23-24.12.2016

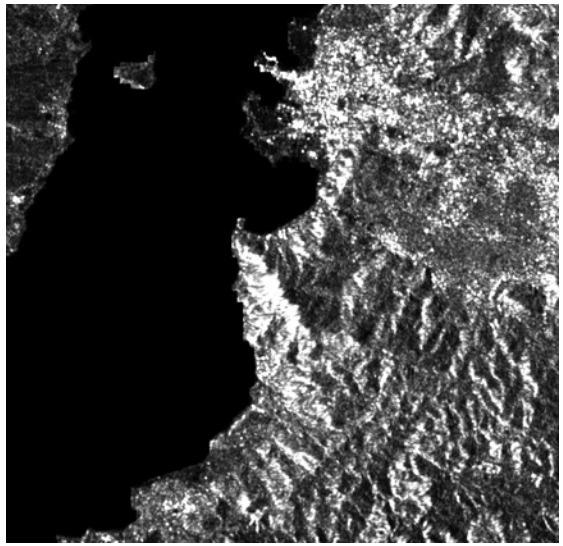


- Himawari-8 Data Rainfall rate of **165 mm/hr** on 23 Dec 2016 at 04.00 UTC
- and **195 mm/hr** on 23 Dec 2016 at 20.00 UTC

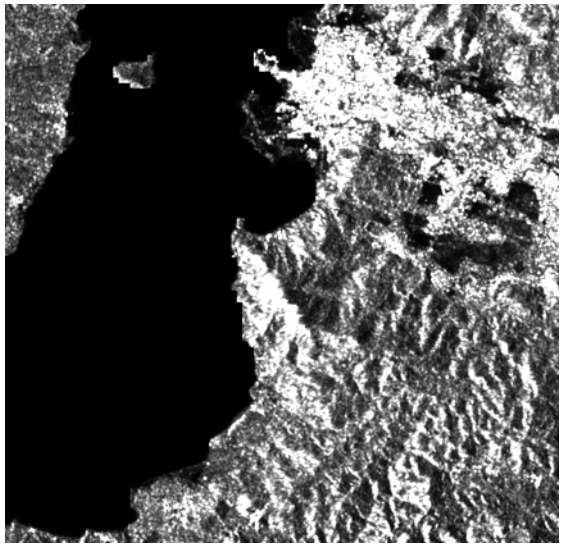
Source :http://modis-catalog.lapan.go.id/dev/himawari-8/

Data

Sentinel 1A, GRD, Mode IW, VV Polarization, Res. 10 m



05.11.2016
before flood

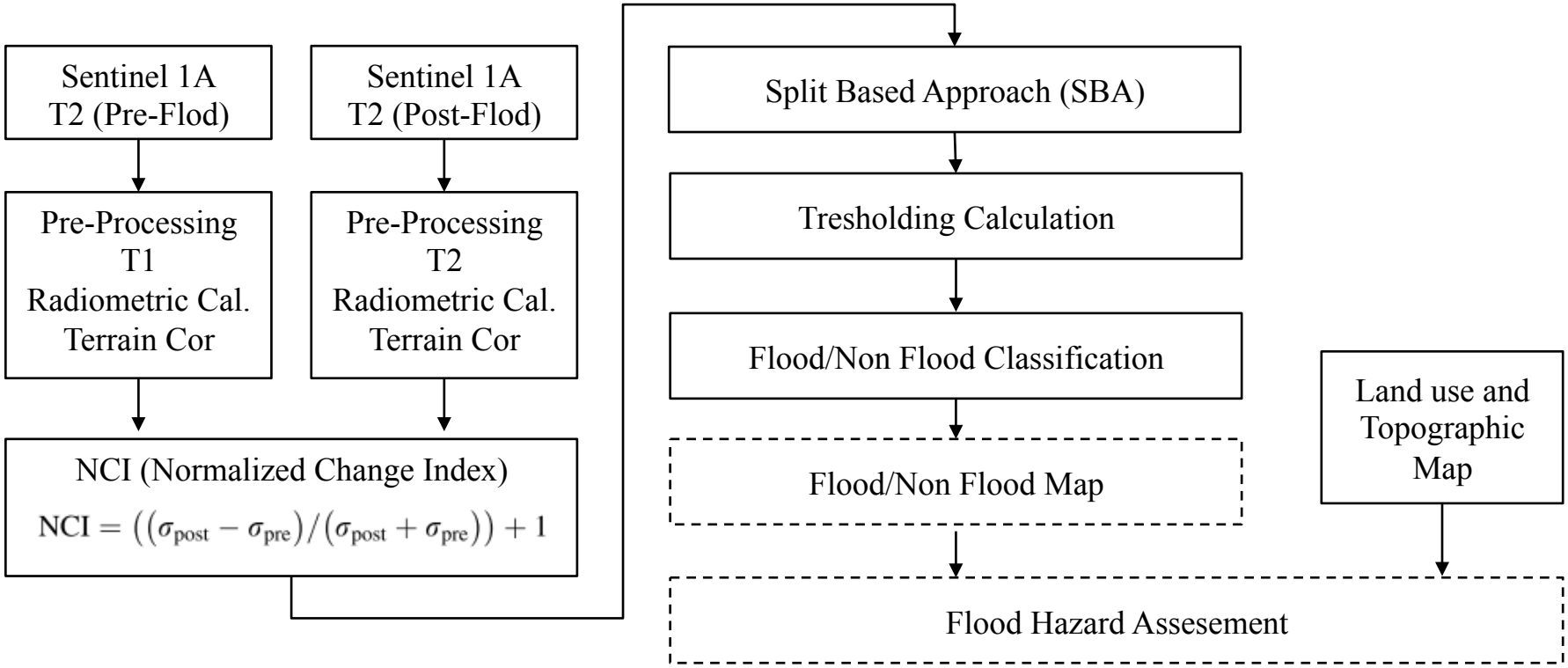


23.12.2016
after flood

Image of the flood compared to a reference image

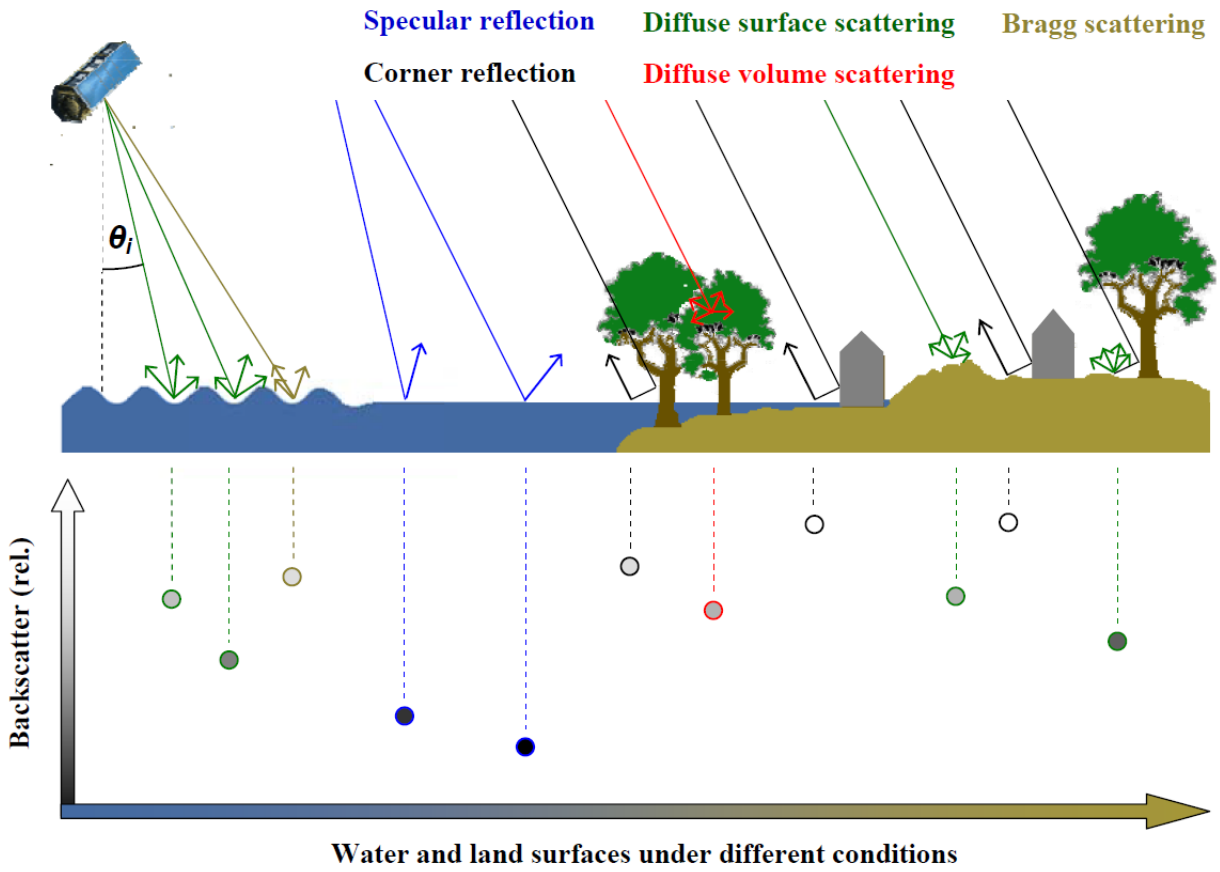
- **Both images need to have been acquired from the same sensor geometry!**

Methodology
to generate flood mapping



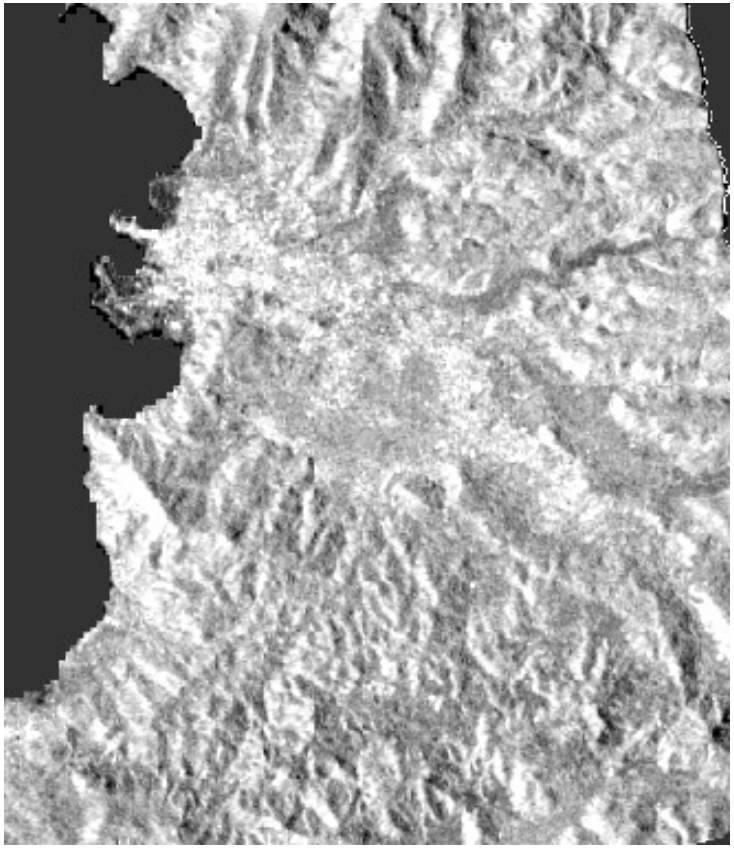
Yulianto, F., Sofan, P., Zubaidah, A., Sukowati, K. A. D., Pasaribu, J. M., & Khomarudin, M. R. (2015). Detecting areas affected by flood using multi-temporal ALOS PALSAR remotely sensed data in Karawang, West Java, Indonesia. *Natural Hazards*, *77*(2), 959–985. http://doi.org/10.1007/s11069-015-1633-x

Scattering mechanisms of water and land surfaces under different conditions as well as specular and diffuse components of surface scattered radiation as a function of incidence angle and surface roughness.

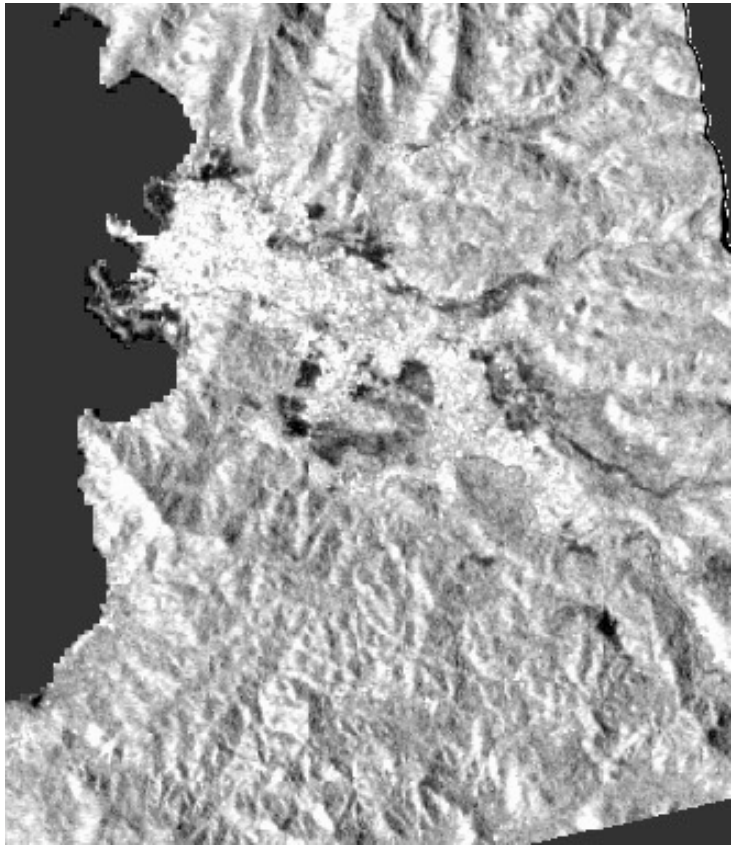


Martinis2010

Radiometric Calibration



05.11.2016
before flood



23.12.2016
after flood

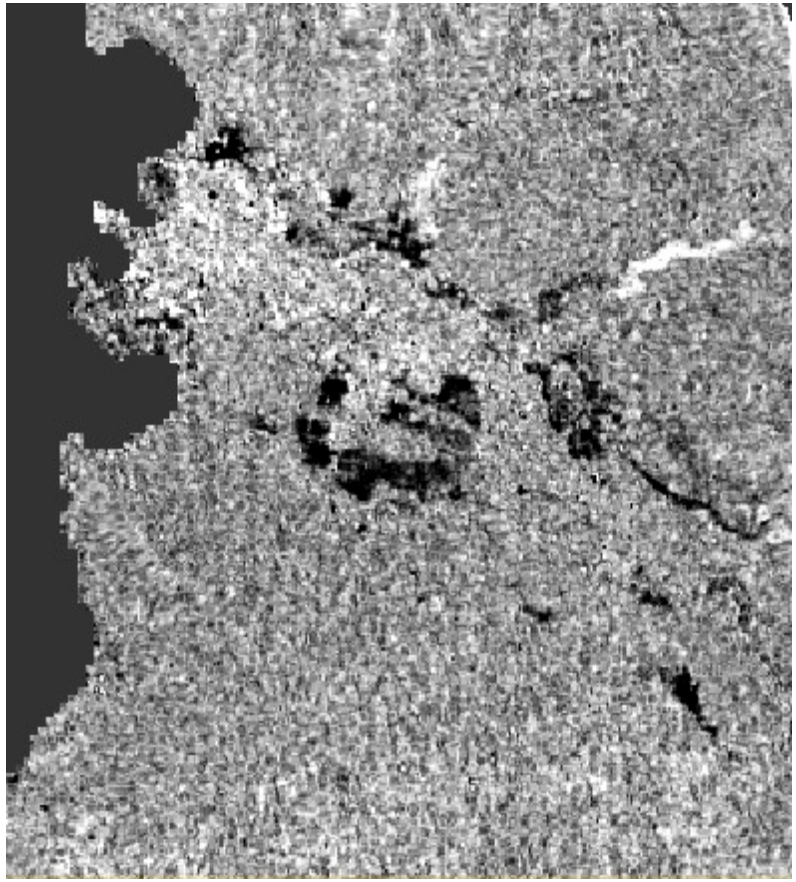
Normalized Change Index and Thresholding of Water Scatter

$$NCI = \left((\sigma_{post} - \sigma_{pre})/(\sigma_{post} + \sigma_{pre})\right) + 1$$ (Martinis2010, Yulianto2015)

- Compare of Post and Pre-Sigma Naughts
- NCI has a float data range from [0,…, 2], with values that are equal to 1 (one) showing the unchanged areas. NCI are transformed to 8-bit integers with a possible gray-level range [0, …, 255]

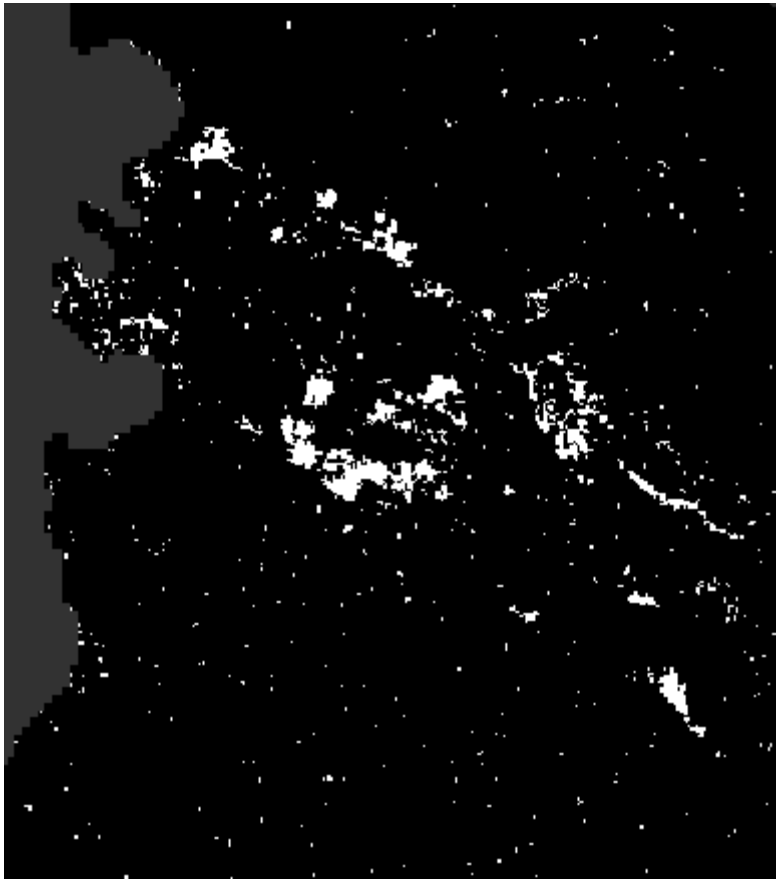
- Split Based Approach and Threshold Calculation (Kittler and Illingworth (KI) algorithm)
  - ➪ Threshold value for Water < 67 – 75 (Mean : 70,6)

Results of NCI and threshold of water scatter



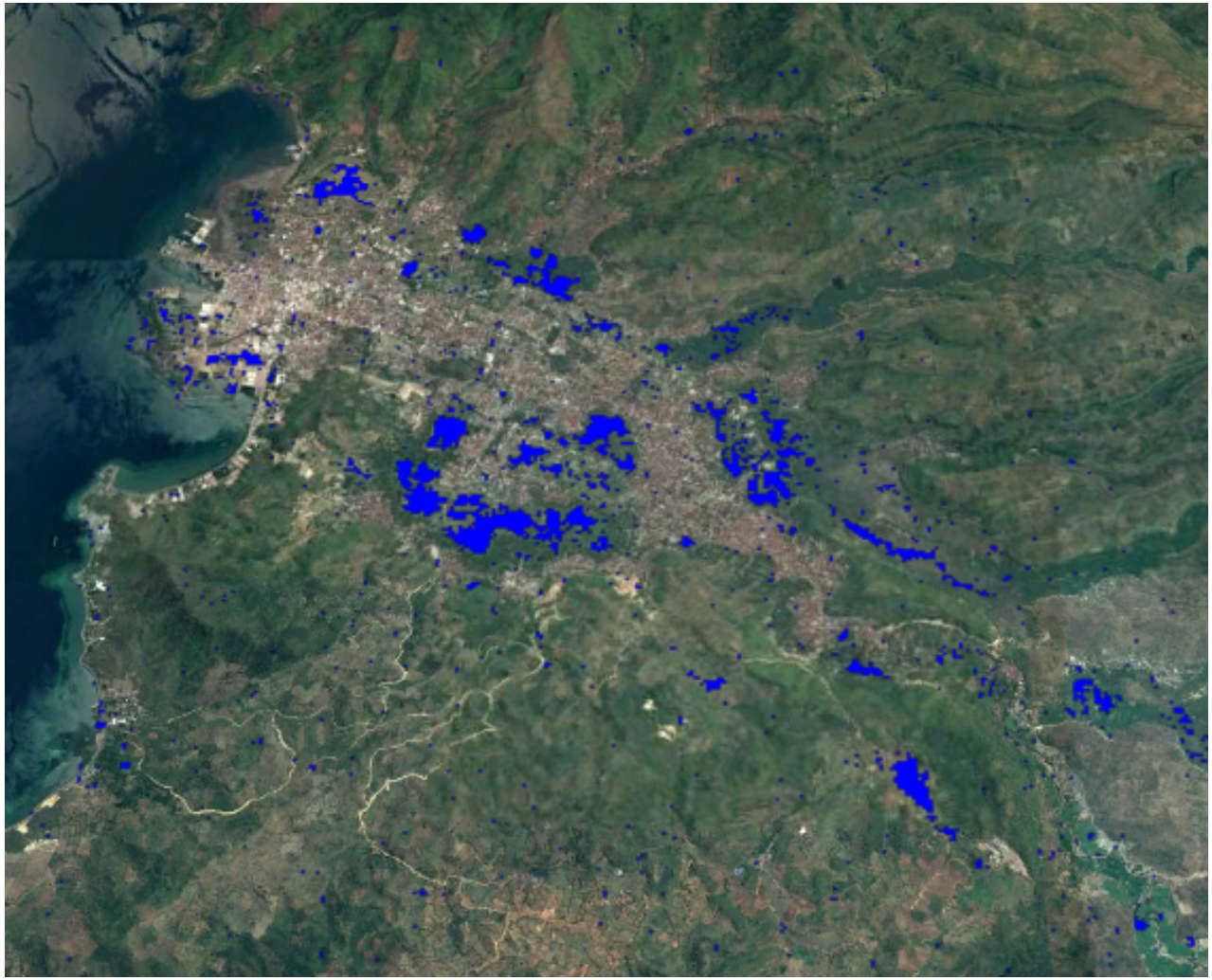
NCI grey level (0-255)

$$\mathrm{NCI} = \left((\sigma_{\mathrm{post}} - \sigma_{\mathrm{pre}})/(\sigma_{\mathrm{post}} + \sigma_{\mathrm{pre}})\right) + 1$$



Threshold of Water Scatter
<70.6

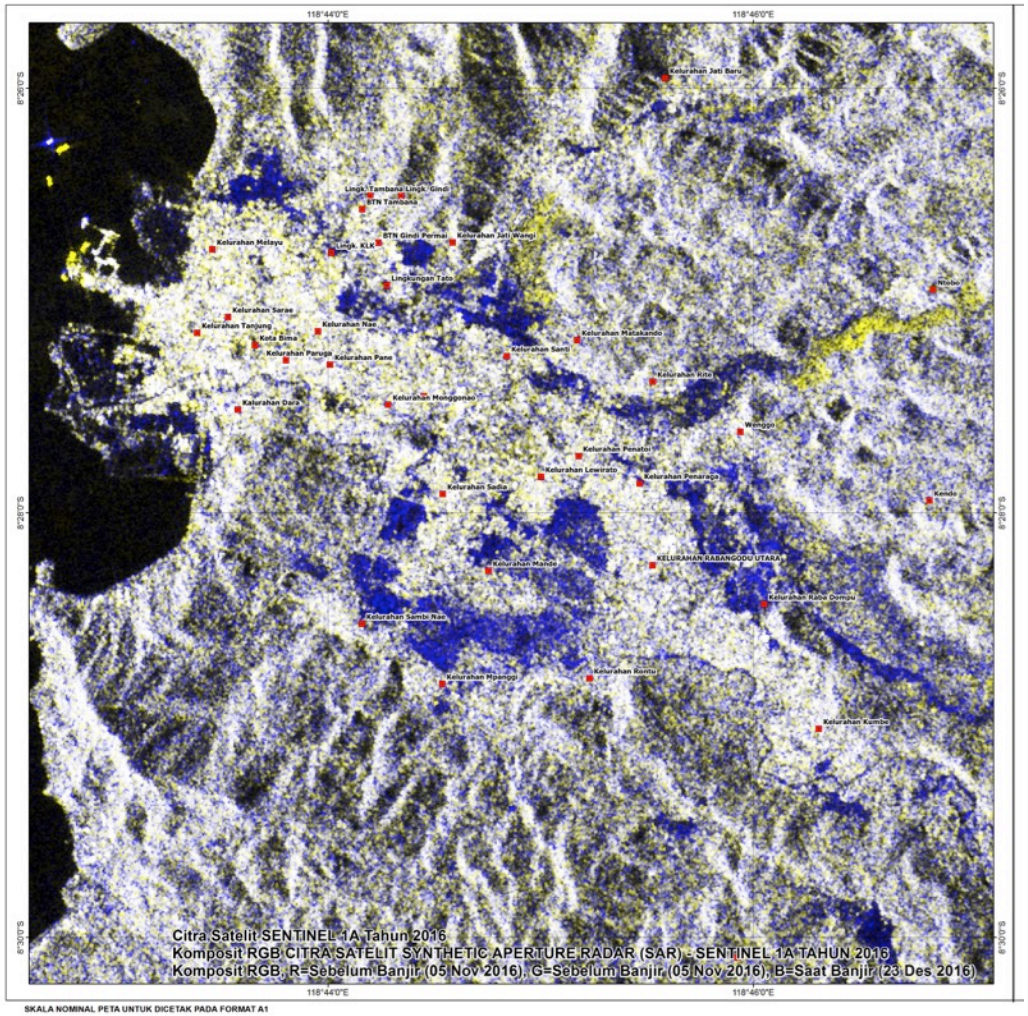
Inundated Area Mapping



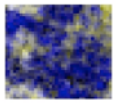
Blue : Indundated area

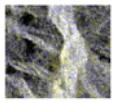
RGB Composite

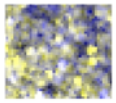
R:05 Nop 2016 G:05 Nop 2016 B:23 Dec 2016



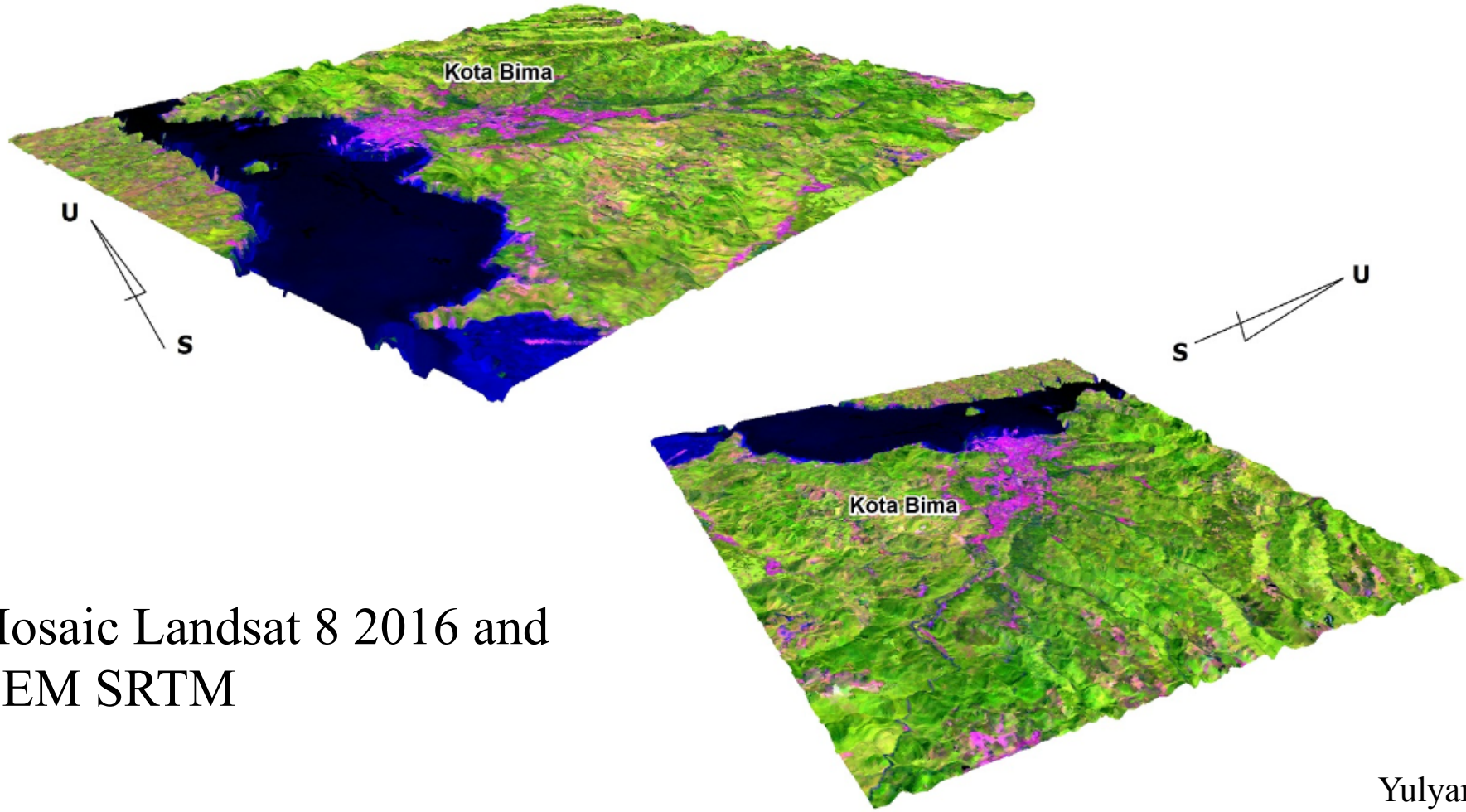
Legend :


areas affected by flood


areas not affected by floods


settlements affected by floods

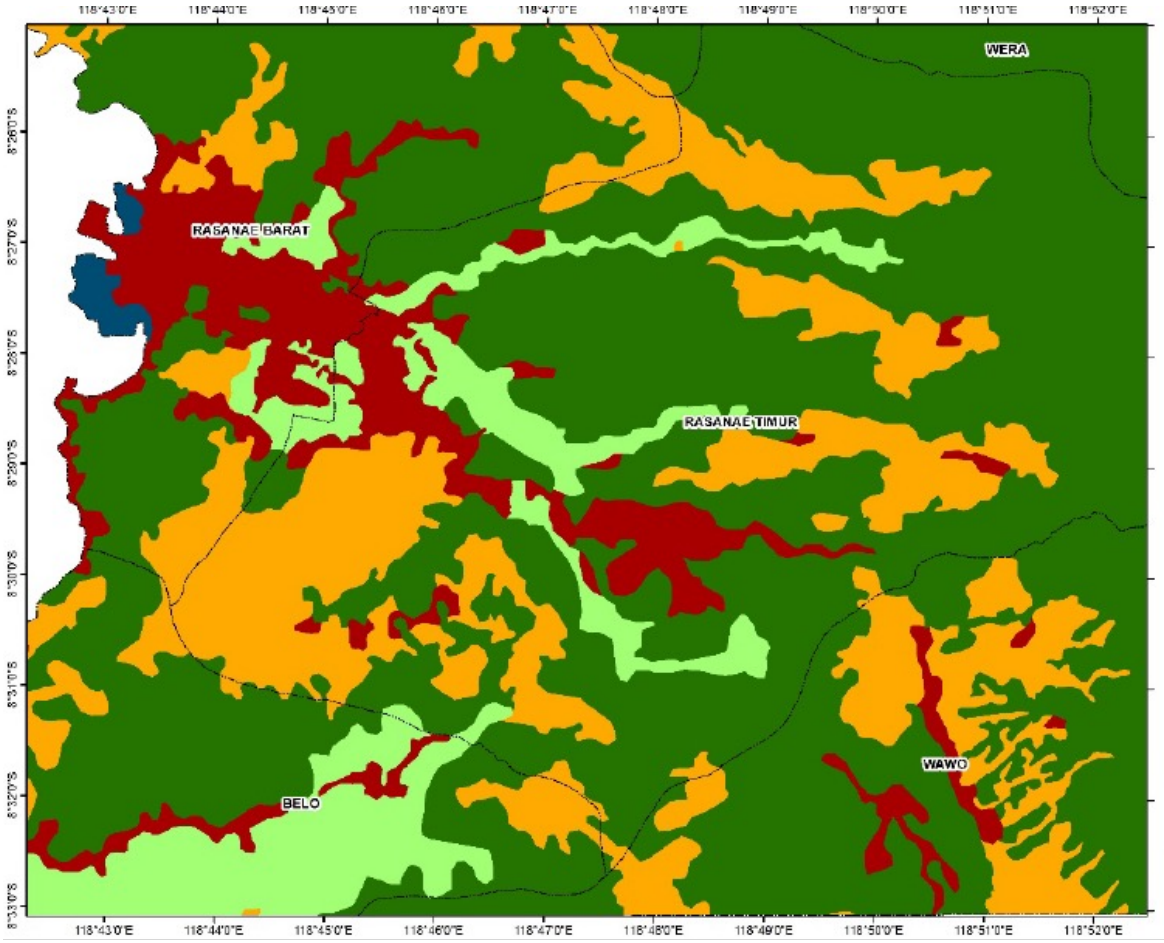
Identifying of Flooding cause
Topographic information of Bima City in 3D



Mosaic Landsat 8 2016 and
DEM SRTM

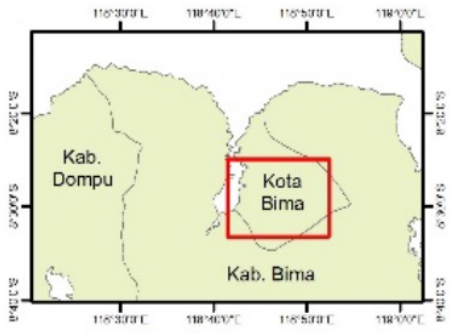
Yulyanto, et all

Land Cover Change in Bima City



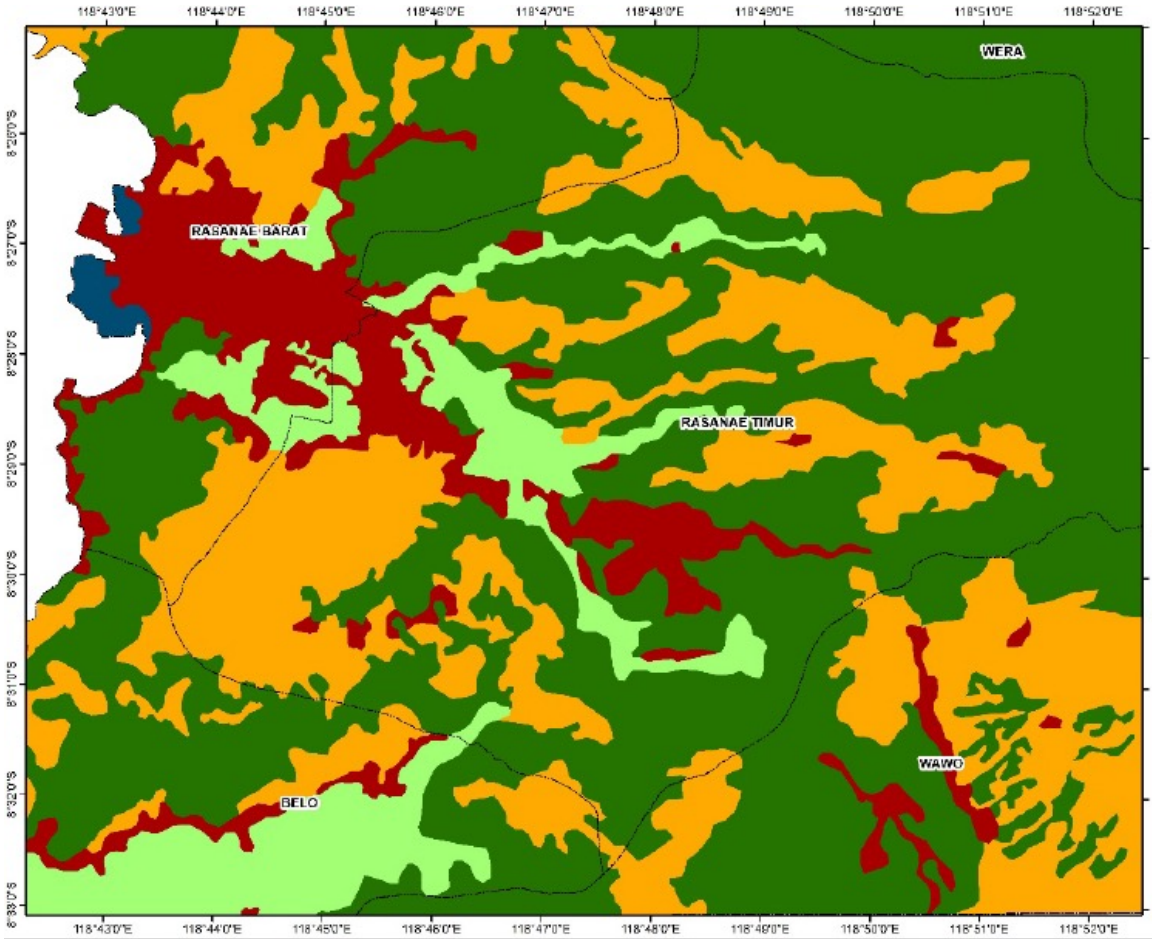
Landsat-8 Data
- 8 Sep 2015

- Forest
- Wet agricultural land
- Dry agricultural land
- Seatlement
- Fishpond



Trisakti, et all

Land Cover Change in Bima City

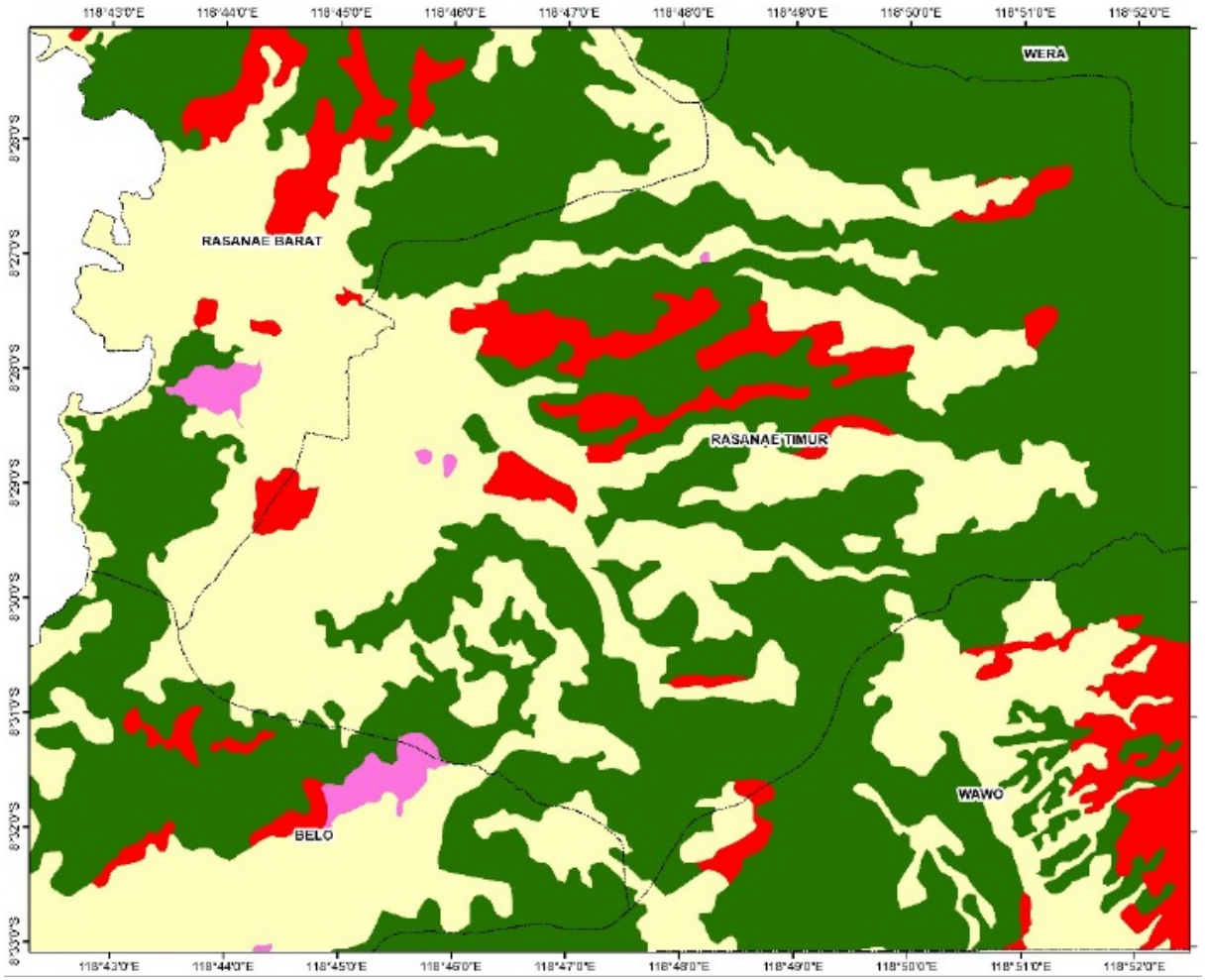


Landsat-8 Data
- 10 Sep 2016

- Forest
- Wet agricultural land
- Dry agricultural land
- Seatlement
- Fishpond

Trisakti, et all

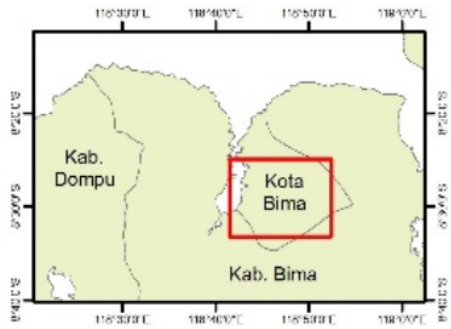
Land Cover Change for Forest and Non-Forest



Landsat-8 Data
- 8 Sep 2015
- 10 Sep 2016

Legend :

- changes in forest area
- changes in non-forest area
- not change in forest area
- not change in non forest area



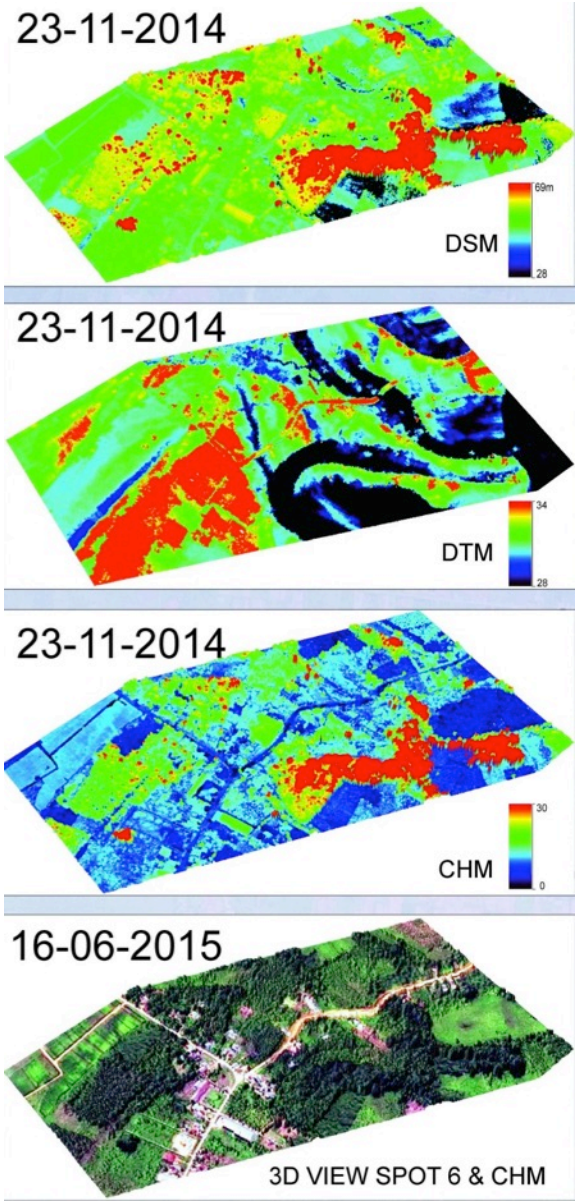
Trisakti, et all

Conclusion

- In this research, multi-temporal Sentinel-1 and Landsat-8 remotely sensed data with a medium-size resolution have been used to detect areas affected by floods in the research area.
- Application of change detection has been successfully carried out using a calculation the threshold value based on Split based approach. It is able to classify the areas affected by floods, in the class of ‘‘flood’’ and ‘‘non-flood,’’
- Some limitations: Some of the areas with the local flood conditions and the distribution of flood in relatively small area are still difficult to detect.
- Field surveys was not done, so the validation of method in Study area is not performed,

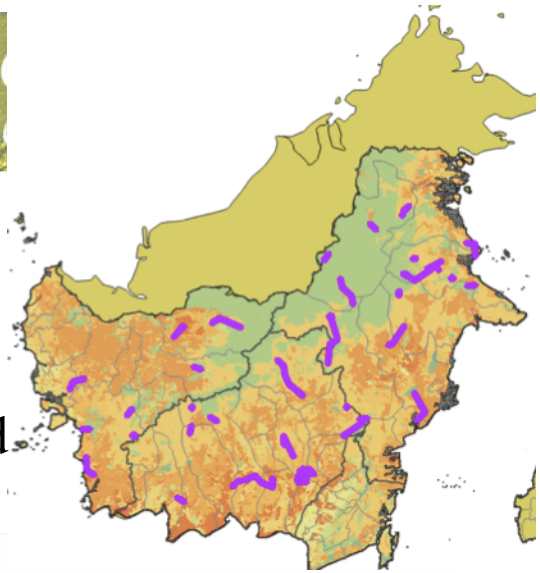
Future Activites

- **identify the cause of the flooding from forest destruction around the study area using SAR Data**
- **Limitation of Sentinel 1 Data**
  - ➪ **provide only 1 data with VV Polarization data after disaster (Date 23. Dec 2016)**
- the use of SAR polarimety data and detail is recommended for the next future research == >**The next task to use ALOS PALSAR2 for this project**



Lidar Data Processing

Data of LiDAR 104.000 ha (Collaboration with AGS, funded by NASA)



Canopy Height Model (CHM)

Benda, Putussibau
West Bornea

Katmoko, et all

THANK YOU

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