Produced for “Observing and Modelling Surface Water in a Changing World”
ITC Quartile 3 2022 - 2023

What is HYDRAFloods?

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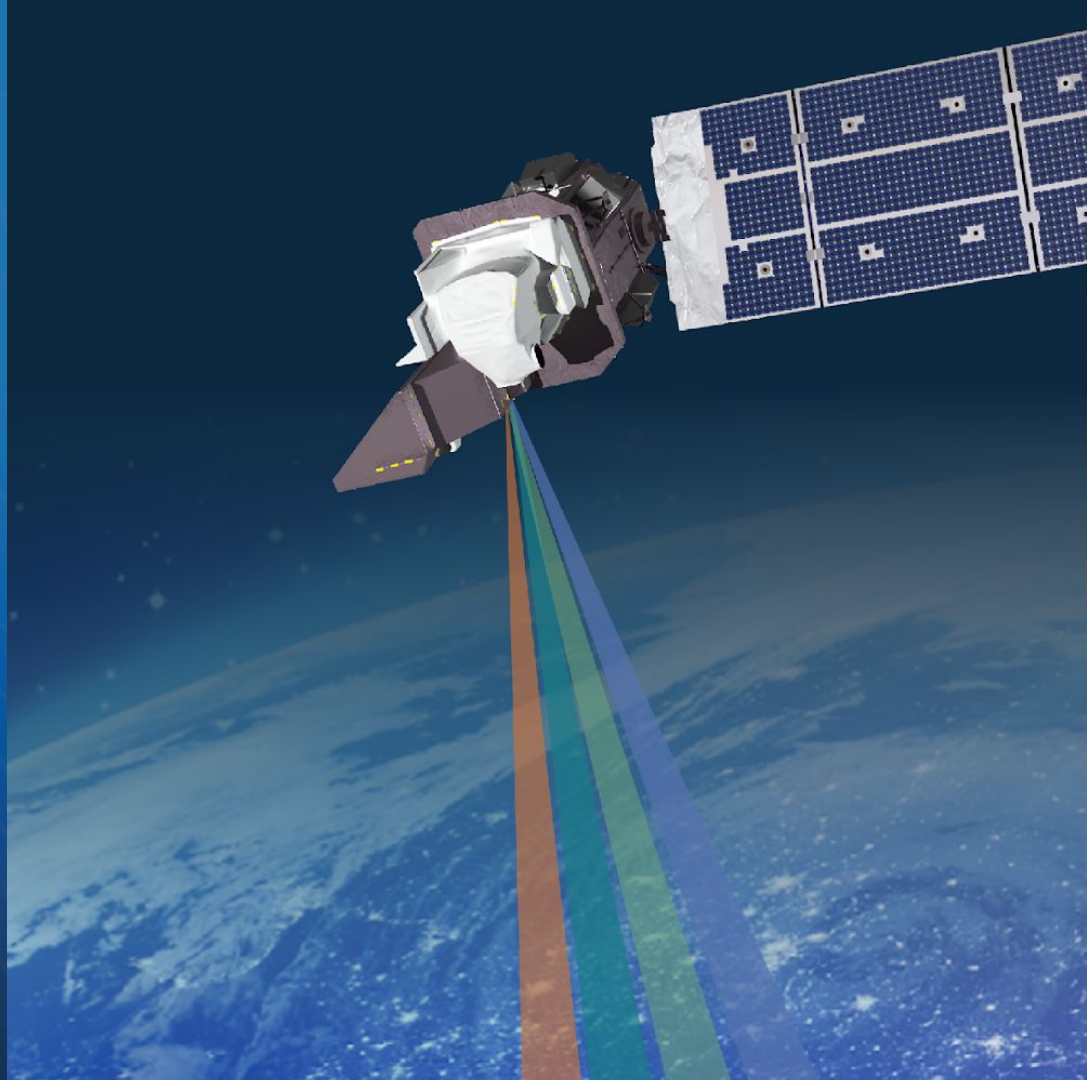
SERVIR

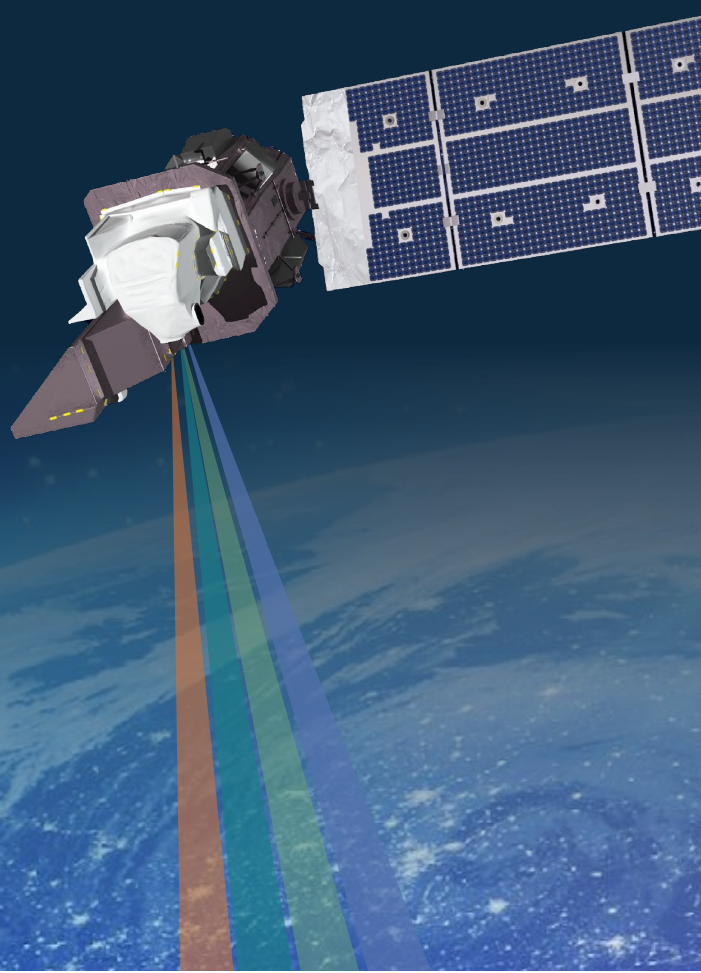
What is SERVIR?



CONNECTING
SPACE TO **VILLAGE**

SERVIR is a joint initiative of NASA, USAID, and leading geospatial organizations in Asia, Africa, and Latin America that partners with countries and organizations to address challenges in climate change, food security, water and related disasters, land use, and air quality.

Using satellite data and geospatial technology, SERVIR co-develops innovative solutions through a network of regional hubs to improve resilience and sustainable resource management at local, national and regional scales.



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Who Is SERVIR?

SERVIR

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- Poverty reduction & resilience
- Data-dependent issues in data-scarce places
- International field presence

NASA

- 30+ Earth observing satellite missions, free & open data
- Major research portfolio
- Societal benefit from space

Private sector collaborators:

Google · mapbox · developmentSEED · planet. · esri · aws · MAXAR TECHNOLOGIES

USG collaborators: NOAA · USGS science for a changing world · USFS · DOS

Intergovernmental, NGO collaborators:

Food and Agriculture Organization of the United Nations · WFP World Food Programme · MERCY CORPS

Regional Hub Host Institutions:

ALLIANCE (Bioversity International · CIAT) · ICRISAT International Crops Research Institute for the Semi-Arid Tropics · RCMRD · ICIMOD · adpc

Research collaborators: 20+ US universities & research centers through the SERVIR Applied Sciences Team; ITC, in-region university networks

ITC UNIVERSITY OF TWENTE.

Hub Consortium Members:

Deltares · SEI Stockholm Environment Institute · Spatial Informatics Group · Conservación Amazónica ACCA · imaflora · eco ciencia · CILSS · AFRIGIST · CERSGIS · CSE Centre de Suivi Ecologique · AIMS · ISESTEL · Columbia University · University of Florida 1853

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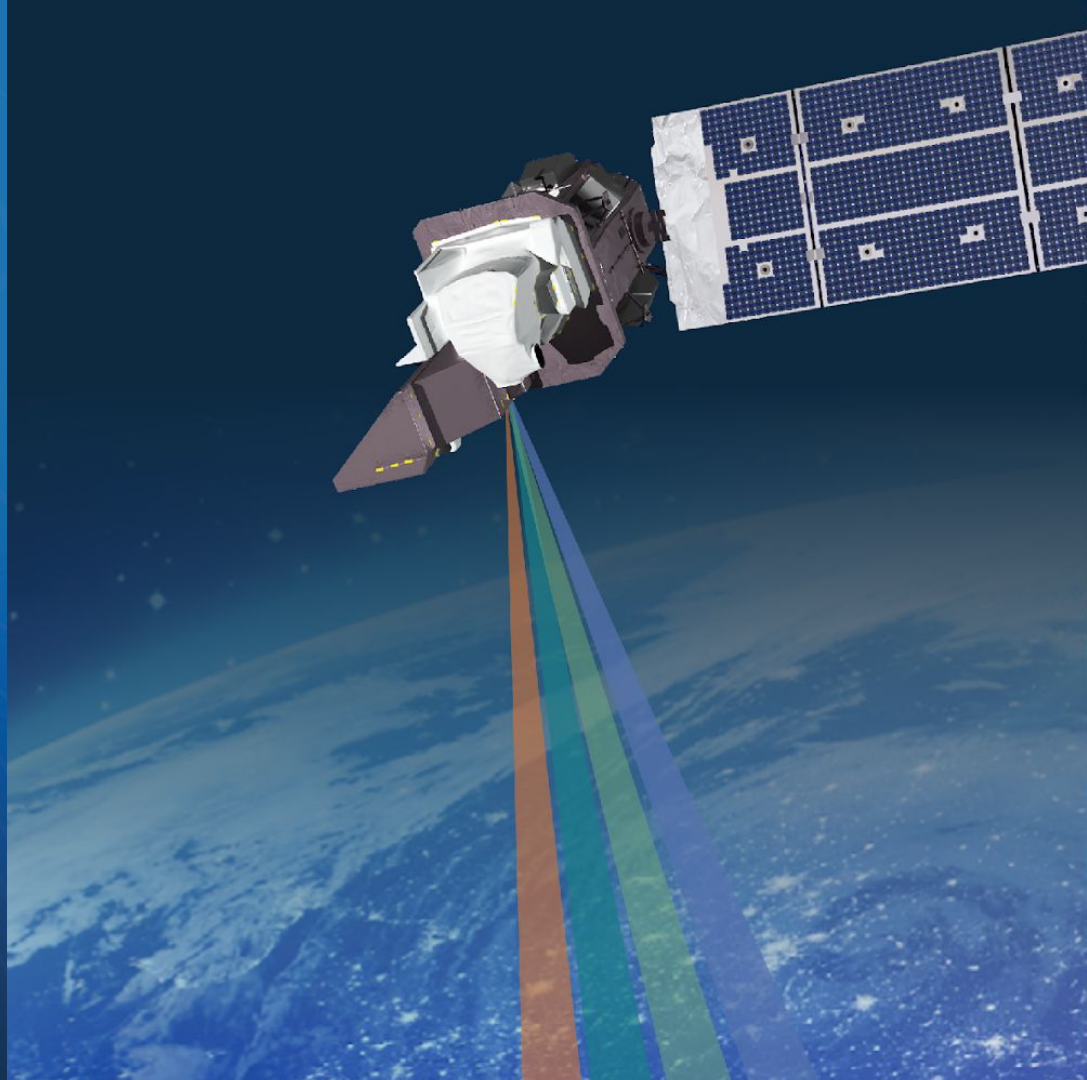
Surface Water Mapping



Optical Water Mapping

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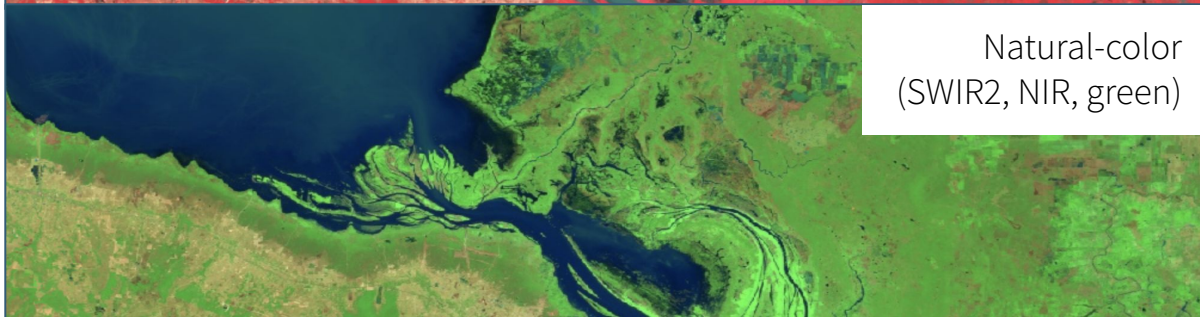
Band Combinations

True-color
(red, green, blue)

False-color
(NIR, red, green)



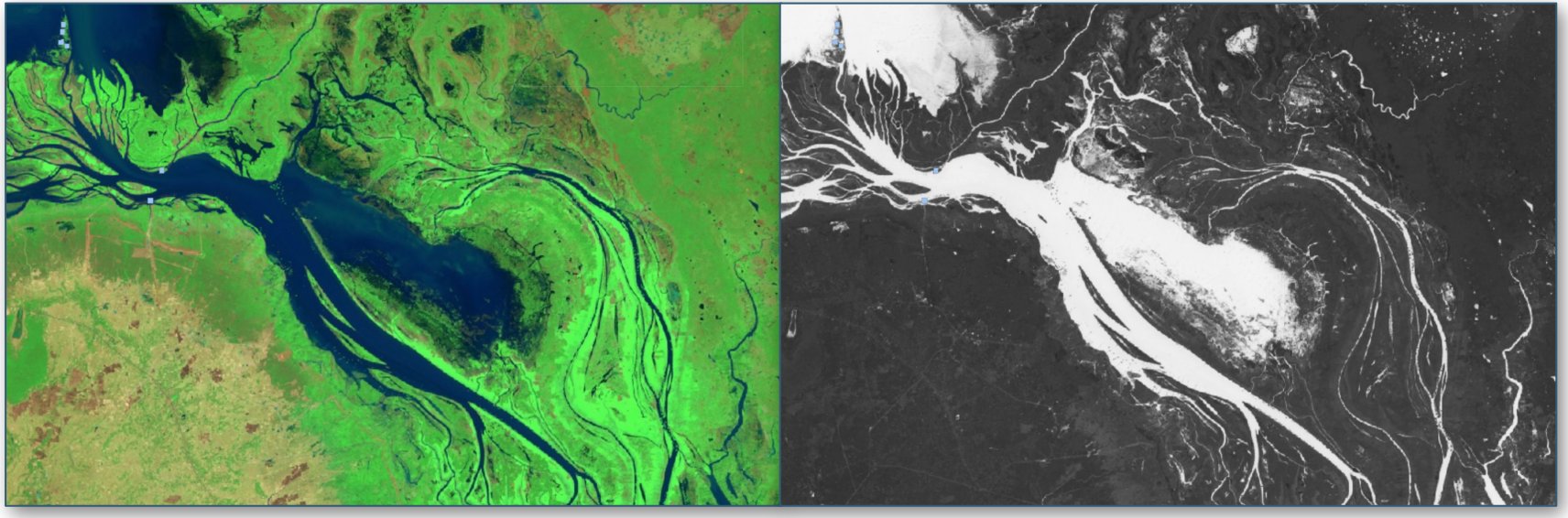
Natural-color
(SWIR2, NIR, green)

Slide Credit: Kel Markert

Water Indices

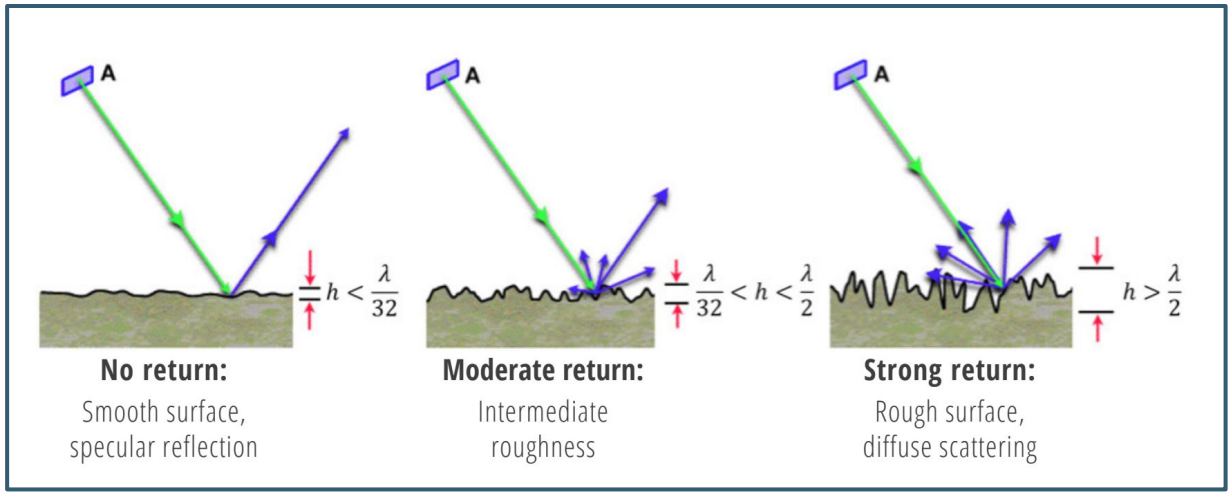
- Transform multispectral imagery to highlight water
- Rely heavily on shortwave infrared

$$MNDWI: \frac{(green - swir1)}{(green + swir1)}$$



SAR Water Mapping

- Synthetic Aperture Radar (SAR) is a type of active remote sensing that is available in all weather conditions
- SAR measures the amount of energy returned to the sensor (backscatter)
  - Water – Low intensity due to specular reflection
  - Land – High intensity due to scattering by vegetation



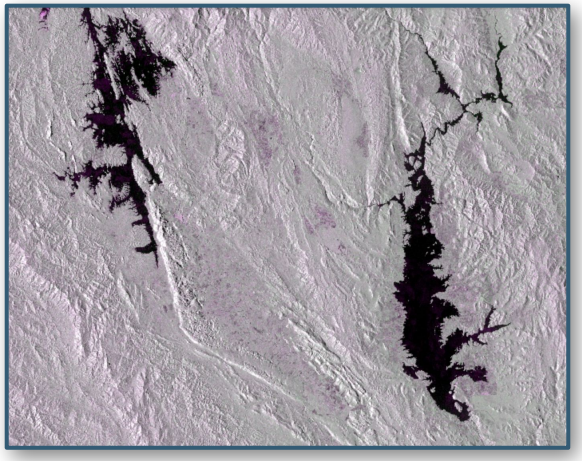
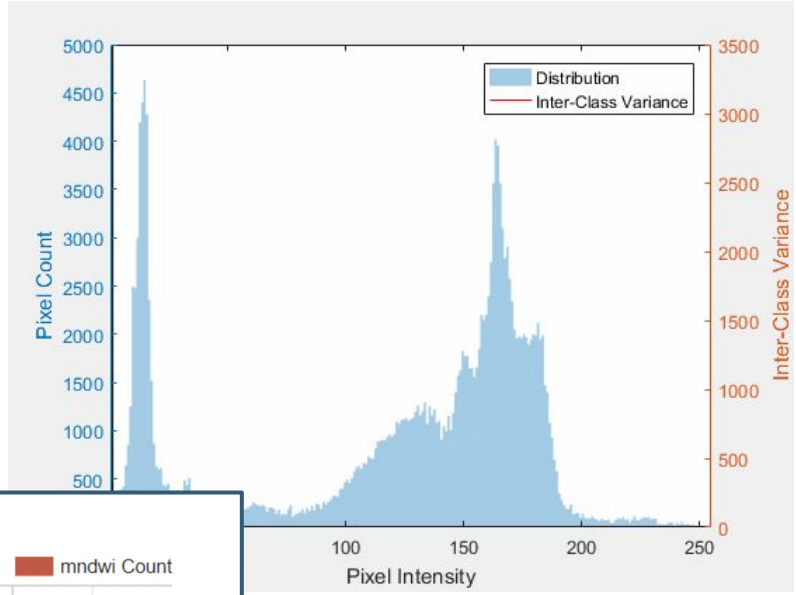
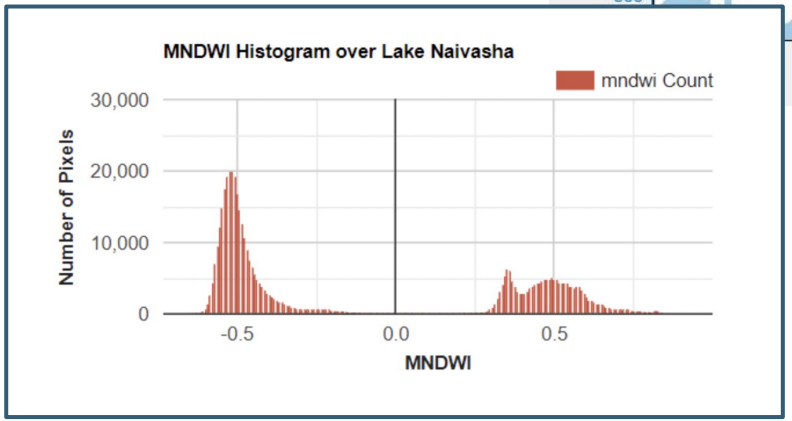


Image Credit: SERVIR SAR Handbook

Thresholding Algorithms

- Automated Histogram-based thresholding approach
- Maximized inter-class variance between two classes
- **Assumes there are only two classes**, a background and a foreground





Otsu's Method

Compute Index

$$I = \frac{\rho_{green} - \rho_{swir1}}{\rho_{green} + \rho_{swir1}}$$

Detect Edges

$$C = Canny(I, \sigma, th)$$

Buffer

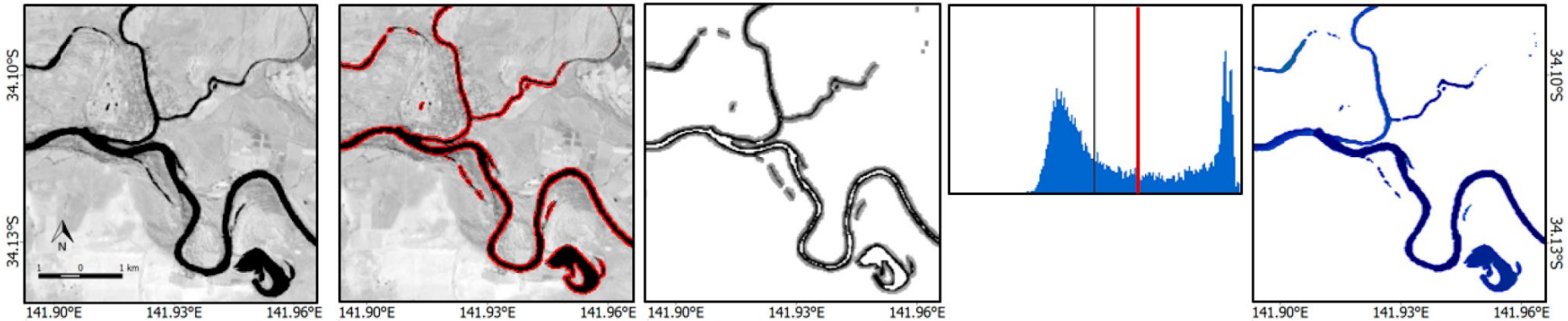
$$I_c = \{I | I \in C \oplus S\}$$

Find Threshold

$$T = Otsu(I_c)$$

Threshold

$$Water = \{I | I < T\}$$



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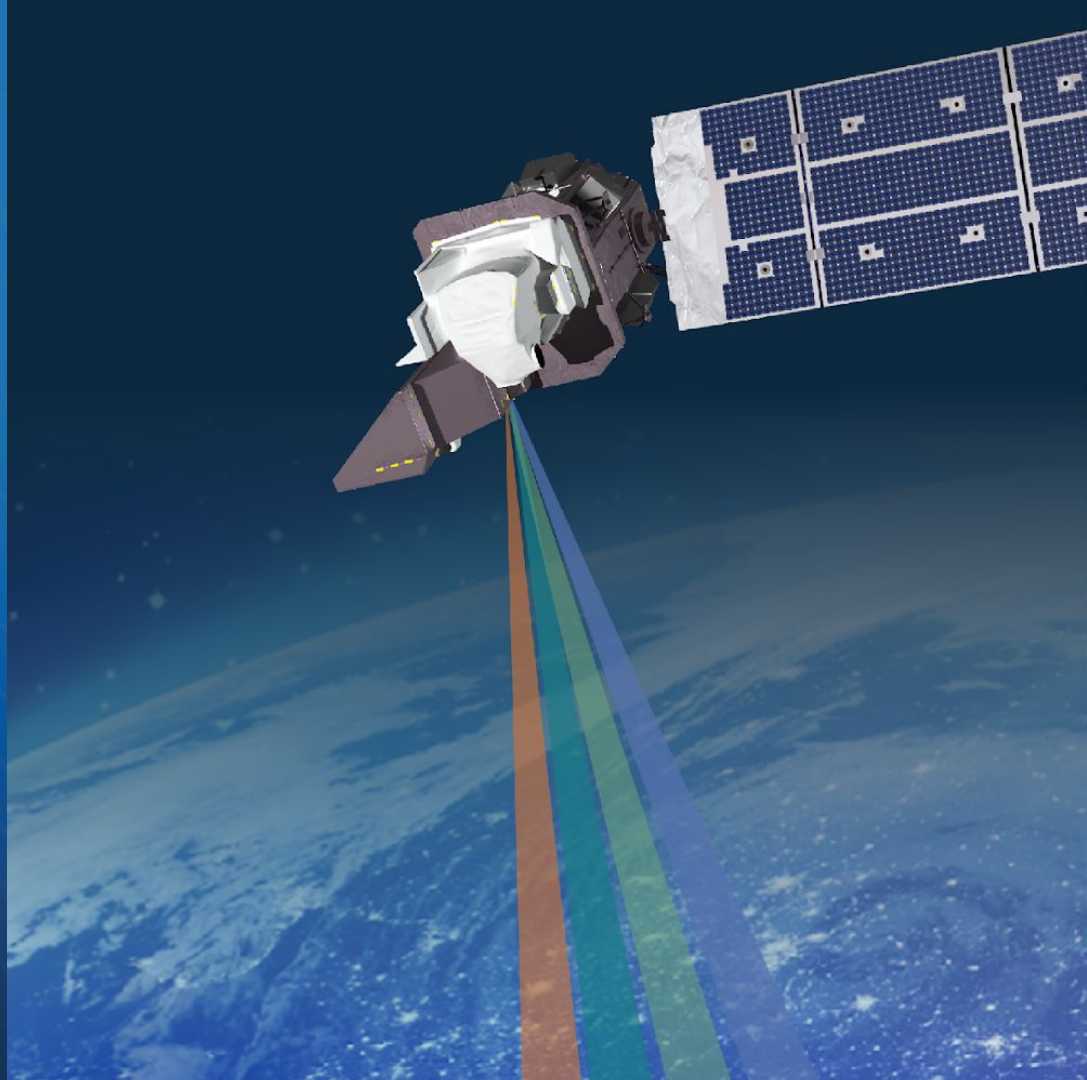
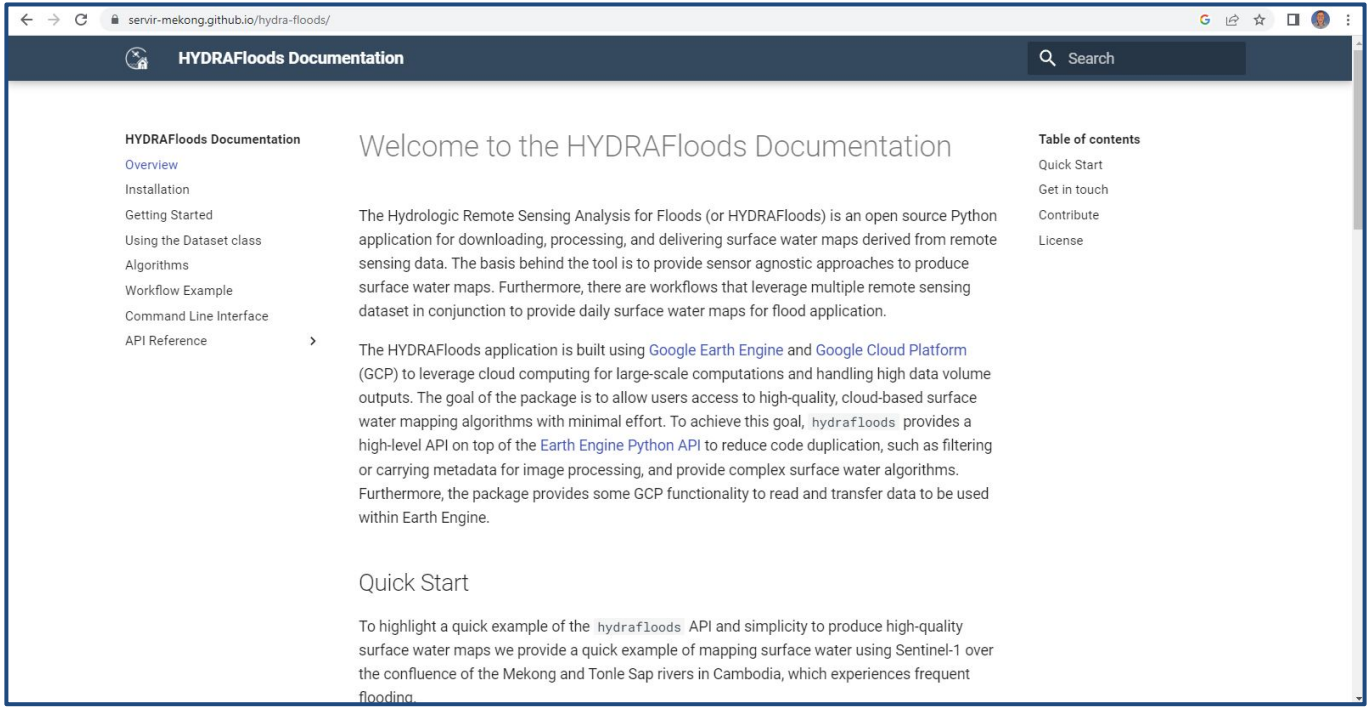
HYDRAFloods



HYDRAFloods Background

HYDRAFloods is …

- Open Source
- Documented
- Cloud-Based
- Customizable
- Used in the Real World!



HYDRAFloods Workflow

Pre-processing

Sentinel 1 Image Collection

Where is your study area? When is your study period?

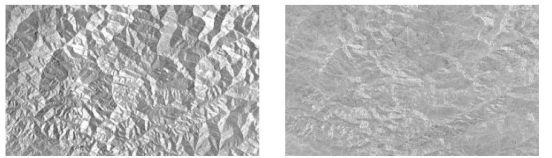
Spatial & temporal filtering

Apply pseudo-terrain correction

Helps to reduce terrain effects being detected as water.

Original Sentinel 1 Image

Corrected Sentinel 1 Image



All SAR imagery must be corrected to reduce speckle (noise).

Apply speckle filter

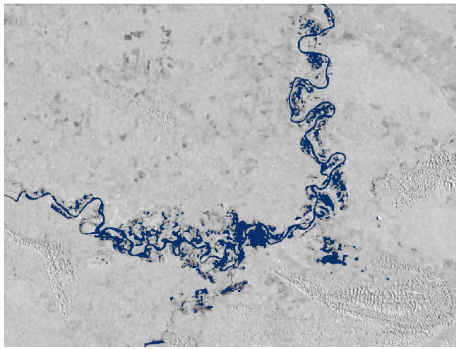
Apply elevation mask

We can set an elevation cut-off so that we don't look for water higher than a certain height above the nearest drainage.

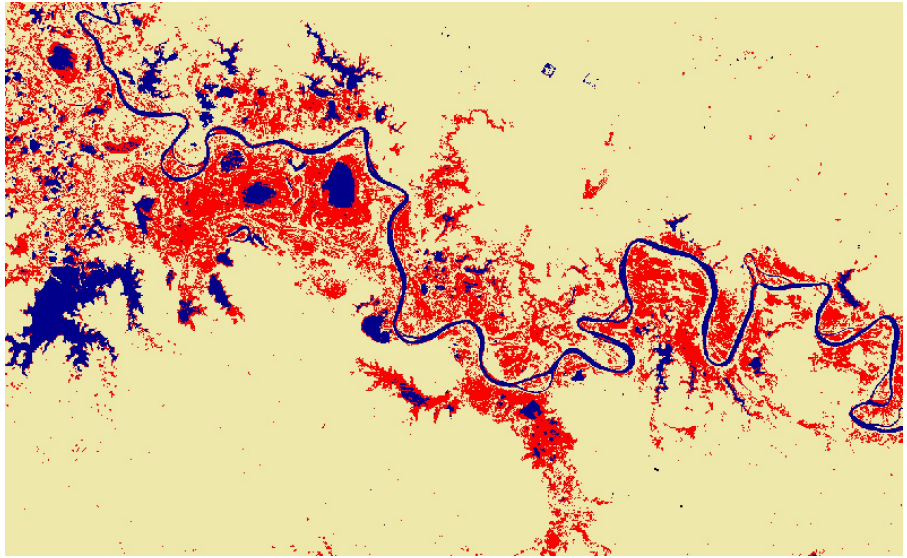
Water Detection

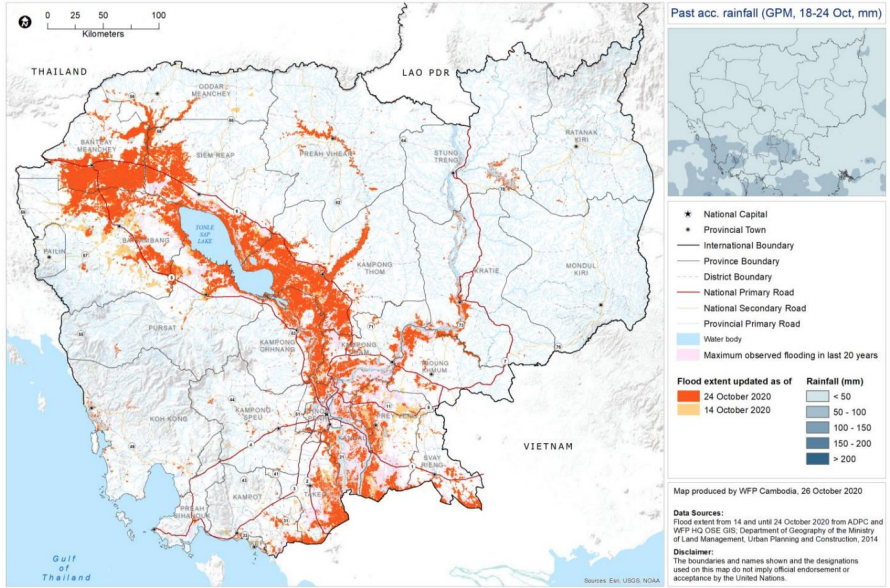
Output is a binary image with two classes: water and non-water

Image Thresholding

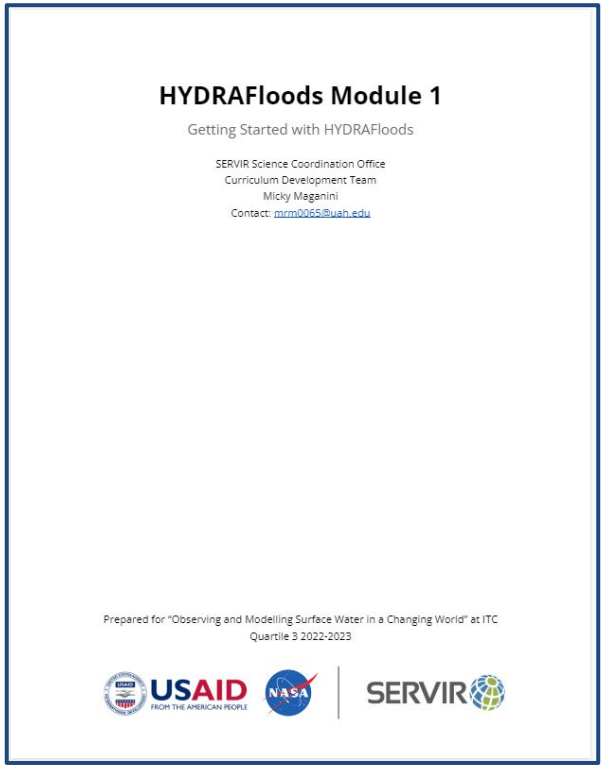


HYDRAFloods Use Cases





HYDRAFloods Materials



HYDRAFloods Module 1

Getting Started with HYDRAFloods

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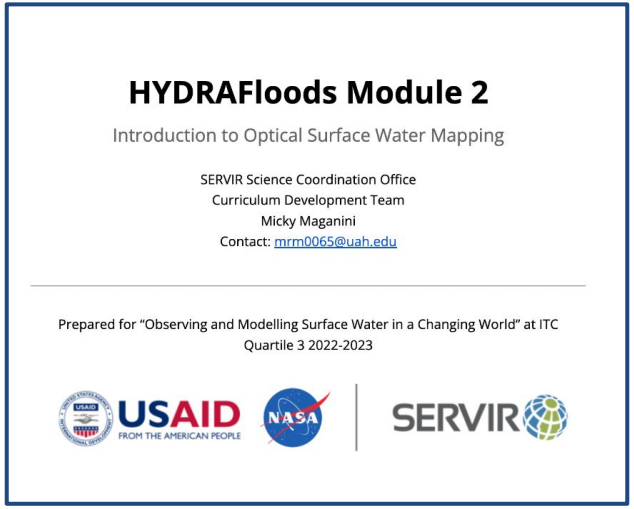

HYDRAFloods Module 2

Introduction to Optical Surface Water Mapping

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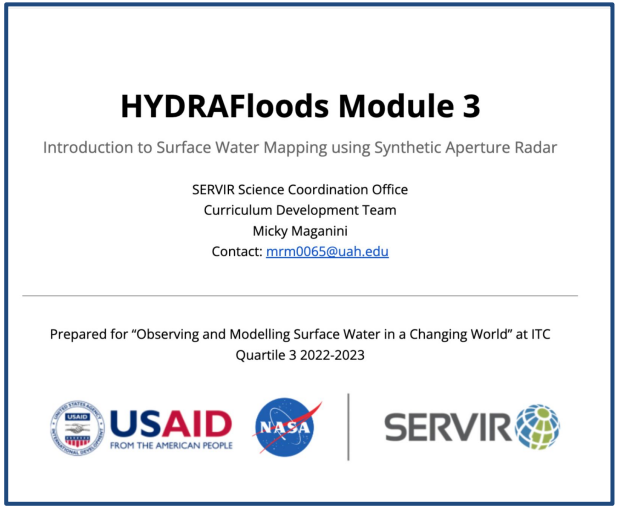

HYDRAFloods Module 3

Introduction to Surface Water Mapping using Synthetic Aperture Radar

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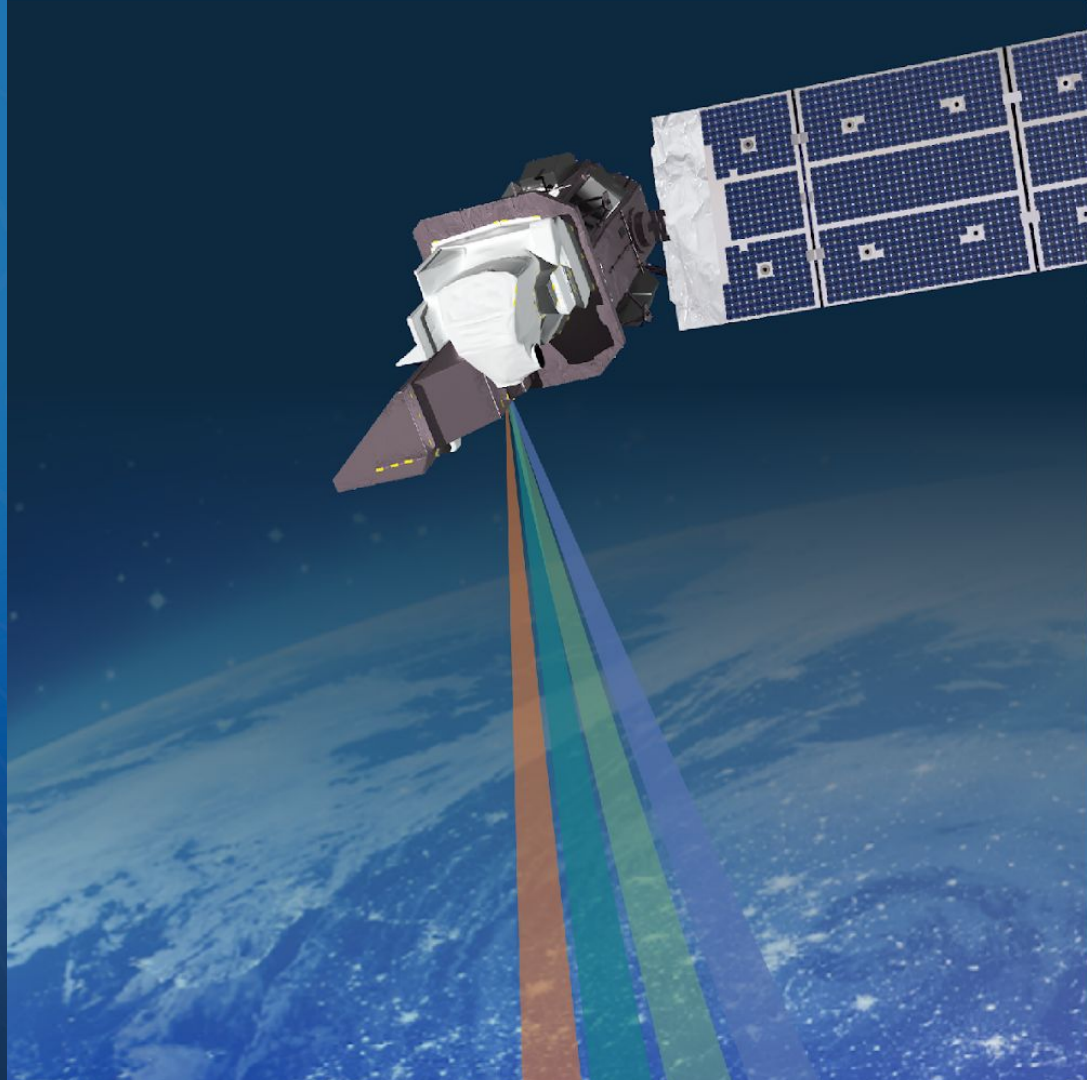
Live Demonstration



Acknowledgements

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Sources:

SERVIR Application Management System – HYDRAFloods Entry: https://sams.servirglobal.net/detail/19

HYDRAFloods Documentation: https://servir-mekong.github.io/hydra-floods/

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