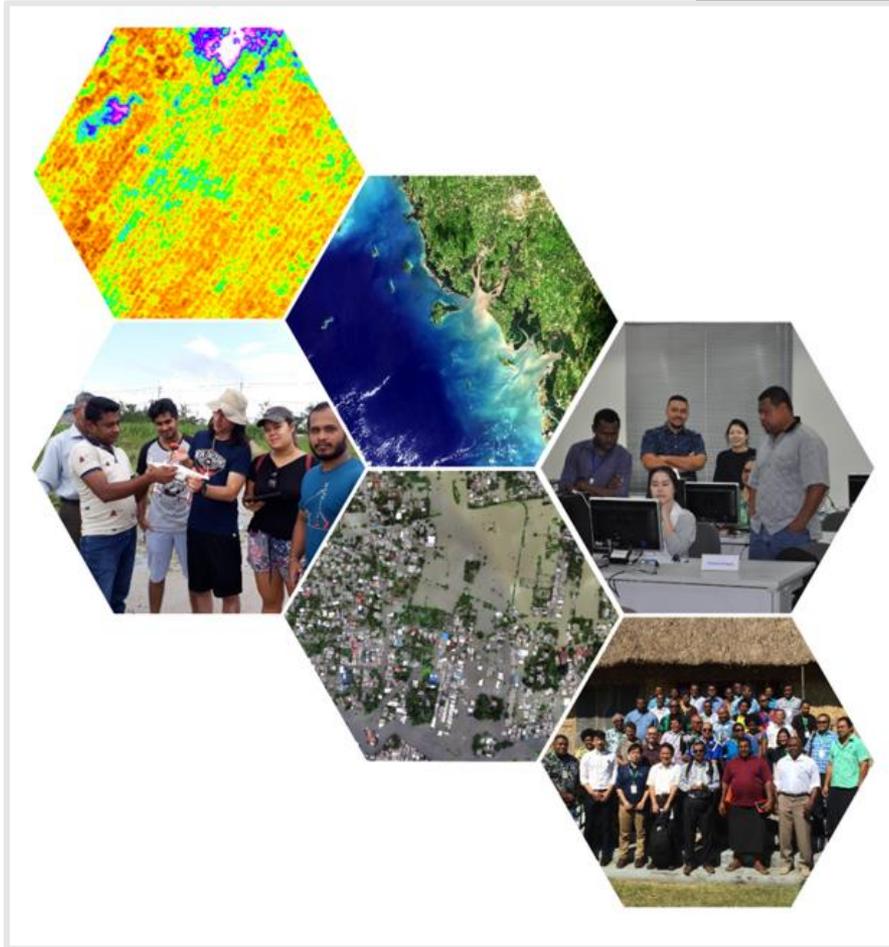


Urban Flood Mapping Using SAR Data and Validation Insights from Recent Floods in Southern Thailand

Syams Nashrullah
syams@ait.asia

10th JPTM Sentinel Asia, 10-12 February 2026,
Dubai, the United Arab Emirates



Flood and Urban Flooding

Basic definition

...a temporary condition in which normally dry land areas are partially or completely inundated,

...occurs due to the overflow of inland/tidal waters or excessive surface runoff from rivers, streams, lakes, canals, or the ocean.

Urban flooding

- Often caused by the failure of urban drainage system and rapid, unplanned expansion into hazard zones
- Occurs in densely populated areas characterized by impervious surfaces like building and roads.
- Floodwaters develop relative slowly and inundation can remain for several days.



Flooding in Jakarta, Indonesia (Jakarta Post, March 2025)

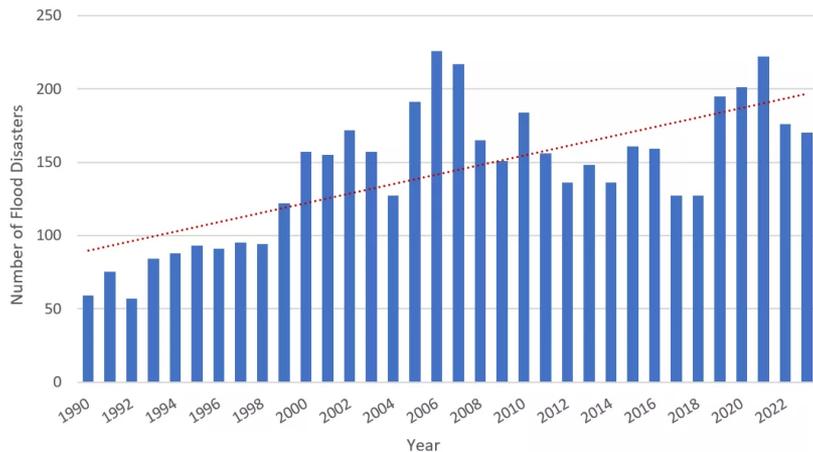


Flooding at the Ratchada-Lat Phrao intersection, Bangkok, Thailand (Bangkok Post, May 19, 2022)

Flood and Urban Flooding

Disaster trends and its economic impact

Flood Disasters Worldwide, 1990-2023



Source: www.statista.com/statistics/1339730/number-of-flood-disasters-worldwide/

Source: NESDIS NOAA, 2024

- Increasing frequency of global flood disasters
- Emergency observations far exceeding other disasters
- In the Asia-Pacific region, flooding is the costliest disaster (\$1.02 Trillion out of \$3.11 Trillion of total economic damage)

Source: Sentinel Asia Annual Report 2024

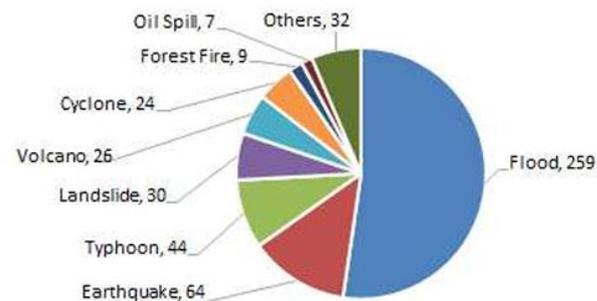
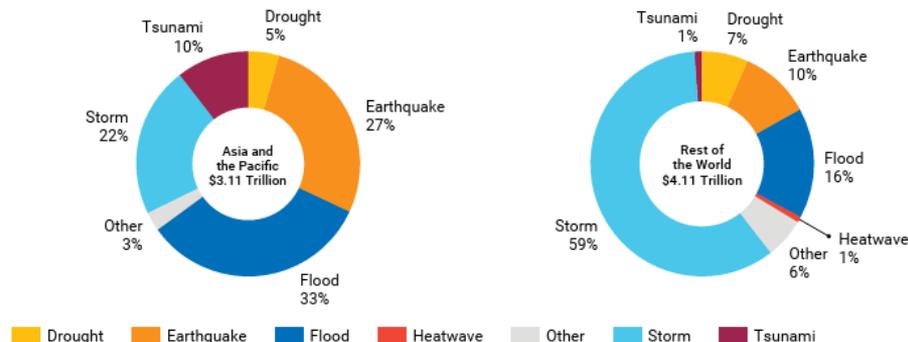


Figure 6: Breakdown of Emergency Observations by Disaster (2007–2024)

*Activations (N=495)

Source: Asia-Pacific Disaster Report 2025 (UN-ESCAP)

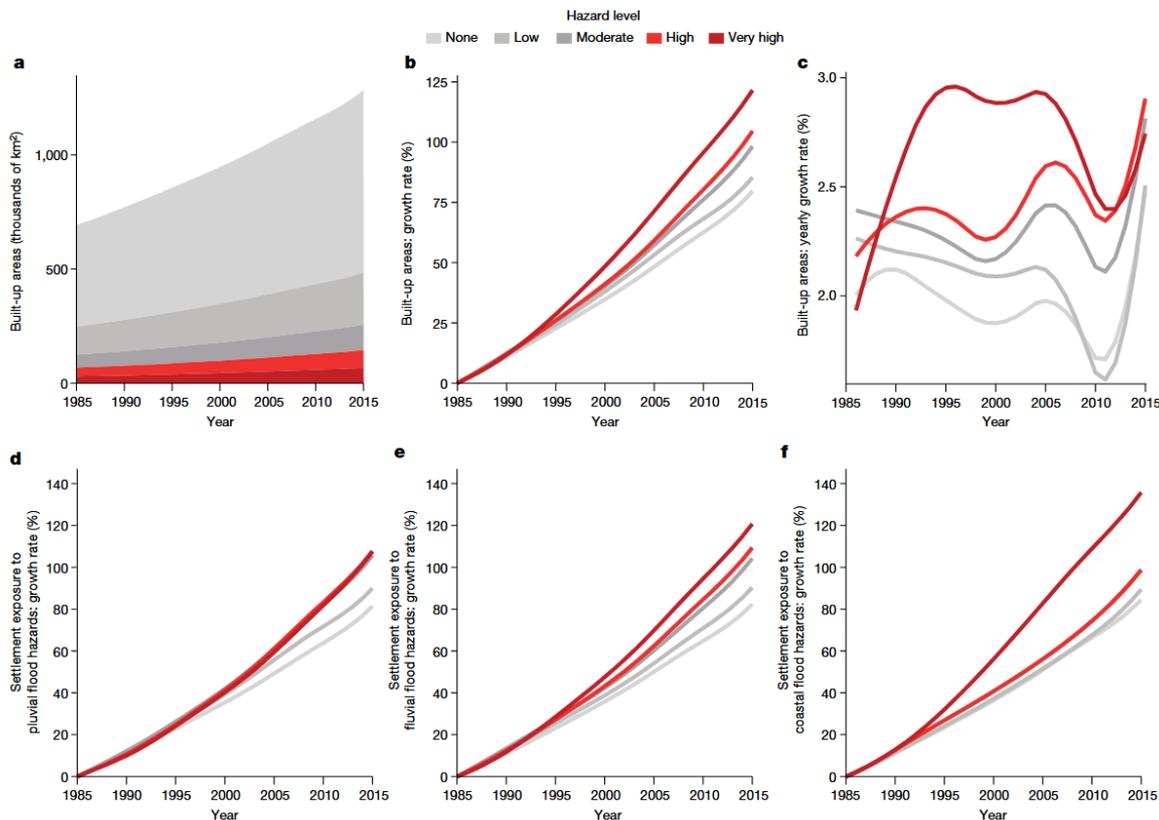
FIGURE 1-3 Economic damage from disasters in the Asia-Pacific region and the rest of the world, 1970–2024



Source: ESCAP calculations based on EM-DAT. Accessed on 9 September 2025.
Note: Economic losses adjusted with 2024 as the base year.

Flood and Urban Flooding

Rapid urban growth in flood zones since 1985



- Human settlements expanded globally by 84.5% between 1985 and 2015
- Global settlement growth is fastest where hazards are highest

Hazard classes are defined on the basis of the estimated inundation depth during a 1-in-100-year flood: none (flood depths of 0 cm), low (up to 15 cm), moderate (between 15 and 50 cm), high (between 50 and 150 cm) and very high (over 150 cm).

Remote Sensing for Flood Mapping

Historic milestones in satellite remote sensing of floods

Breakthrough/Milestone event	Satellite/Sensor	Year ^a	Progress enabled	Barrier lifted
MS1: The first flood map	Landsat-1	1973	Flood mapping from space demonstrated	Beyond small scale mapping
MS2: Seeing through clouds	SIR-B	1984	All-weather, day and night capability demonstrated	Restricted to good weather and sunlight
MS3: Disaster Charter Sentinel Asia	Interagency satellite tasking	2000 2008	State-of-the-art international collaboration enabling free multi-mission satellite tasking	Difficulty in satellite tasking during disasters
MS4: Global mapping potential	MODIS Terra/Aqua	2003	Sub-daily revisit time	Capturing a much larger number of flood events
MS5: Copernicus programme	Sentinel-1	2014	Open-access operational satellite data	Beyond free opportunistic SAR satellite data
MS6: WorldFloods	Wild Ride	2019	Machine learning-based flood mapping onboard optical satellite	Latency in flood map delivery

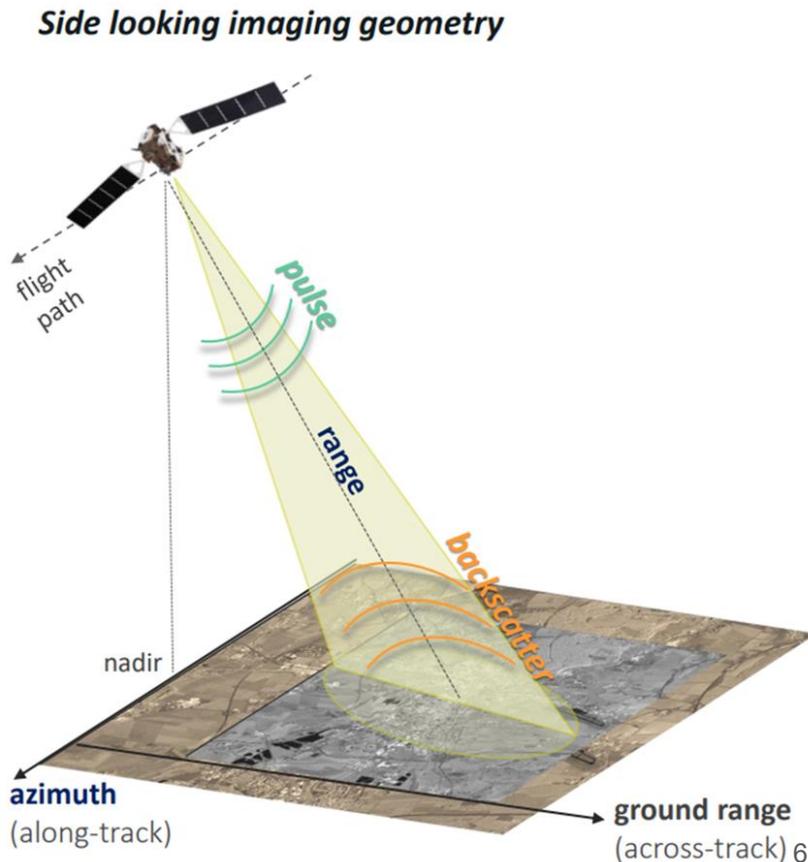
^aDenotes year of flood-relevant breakthrough, not year of launch of satellite or sensor.

Flood Mapping using SAR Data

Why Synthetic Aperture Radar (SAR)

SAR advantages over optical remote sensing:

- Active sensor, day-night capability
- All-weather, cloud penetration
- Strong sensitivity to water surfaces
- Rapid and timely monitoring
- Wide area coverage
- Consistent and quantitative data
- Cost effectiveness

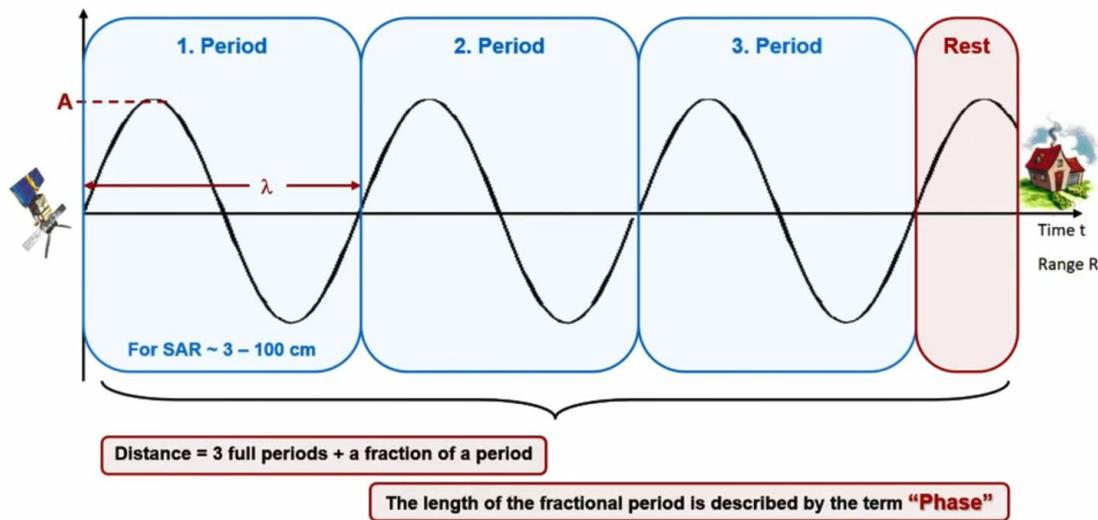


Source: I-E. Kalavrezou et al., 2023

Flood Mapping using SAR Data

Understanding SAR Amplitude (Intensity) and Phase

A radar sensor transmits electromagnetic waves in the microwave radar spectrum



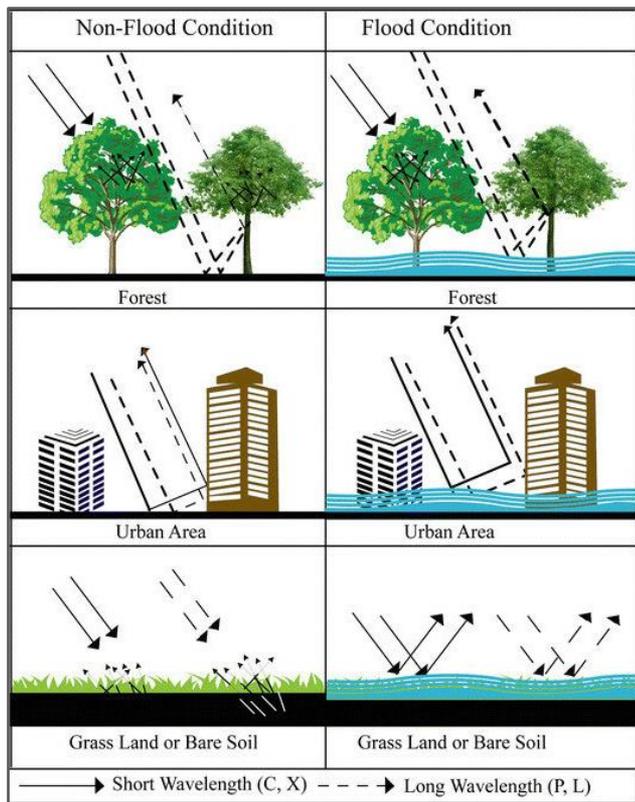
Records backscattered energy as a complex signal containing both **intensity** (amplitude) and **phase** information

- **Intensity (amplitude)**: the strength of the return signal
- **Phase**: the fractional part of the last radar wave's cycle

Source: F. Meyer, University of Alaska Fairbanks

Flood Mapping using SAR Data

SAR Backscatter and Scattering Mechanism



Specular Reflection (Calm floodwater or paved roads):

- Smooth surfaces reflect signal away from the sensor.
- Appears dark/black in the image.

Rough Surface Scattering (Soil, grass, disturbed water):

- Uneven surfaces scatter signal in many directions.
- Returns moderate energy; appears grey.

Volume Scattering (Vegetation, forest canopies):

- Signal bounces multiple times within canopies.
- Appears bright and textured.

Double-Bounce (Flooded urban/forest):

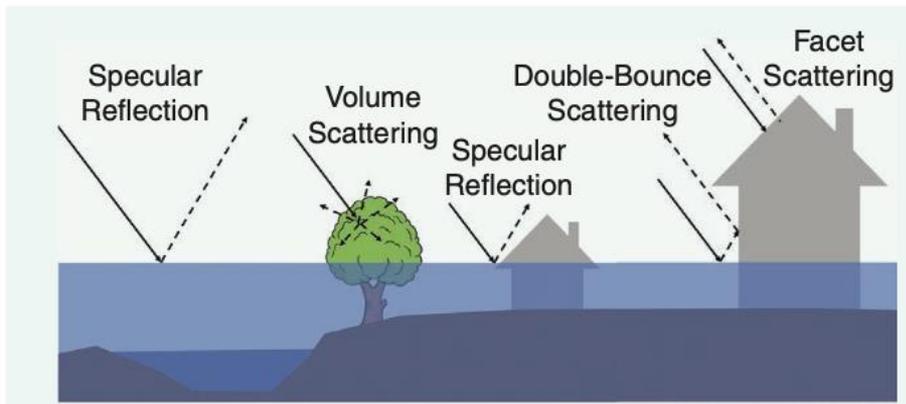
- Signal hits horizontal water, then a vertical object, and returns directly to the sensor.
- Creates an exceptionally bright (hotspot) return.

Urban Flood Mapping

Defining "Urban Flooding" in SAR research

1. Buildings surrounded by floodwater
 - Water encircles structures
 - Complex scattering (double-bounce)

2. Flooded streets and public areas
 - Similar to flooding in open rural area
 - Specular reflection, rough-surface scatt.



Source: J. Zhao et al., 2025

Challenges:

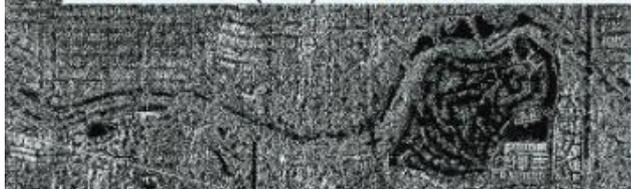
- Sensor-related (wavelength, polarization, incidence angle, spatial resolution)
- Radar geometry-related (shadows, layover)
- Environment-related (building density, height, orientation, surrounding vegetation, water depth)

SAR Characteristics in Urban Floods

Wavelength

...determines the signal's ability to penetrate atmospheric obstacles and surface vegetation to reach floodwater.

TerraSAR-X (HH)- 20170901 - Houston



X-band (~3.1 cm) | TerraSAR-X

- High-resolution mapping, good for narrow streets.
- Sensitive to atmospheric disturbance.
- Very limited vegetation penetration.

Sentinel-1 (VV)- 20170830 - Houston



C-band (~5.6 cm) | Sentinel-1

- Global operational mapping, open access
- Better atmospheric resilience than X-band.
- Limited under dense urban trees.

ALOS-2 (HH)- 20170829 - Houston



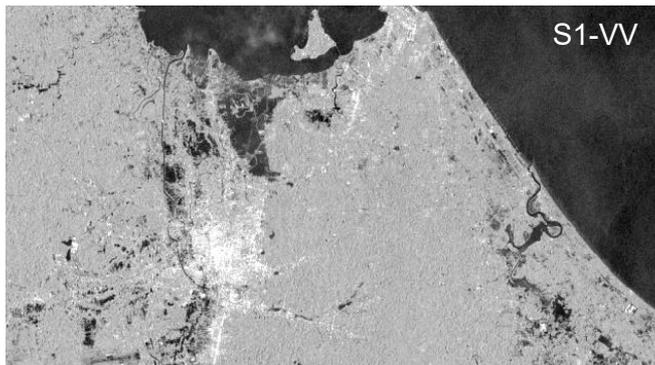
L-band (~23.6 cm) | ALOS-2

- Detecting floodwater beneath urban vegetation.
- Strong double-bounce returns from submerged trunks/walls.
- Coarser spatial resolution.

SAR Characteristics in Urban Floods

Polarization

...refers to the orientation of the electric field of the radar wave



Co-Polarization (HH or VV):

- Strong double-bounce (floodwater and building façades).
- VV: highly sensitive to vertical building façades; better for flooded urban areas.
- HH: less sensitive to "noise" from wind-induced waves; preferred for open water areas.

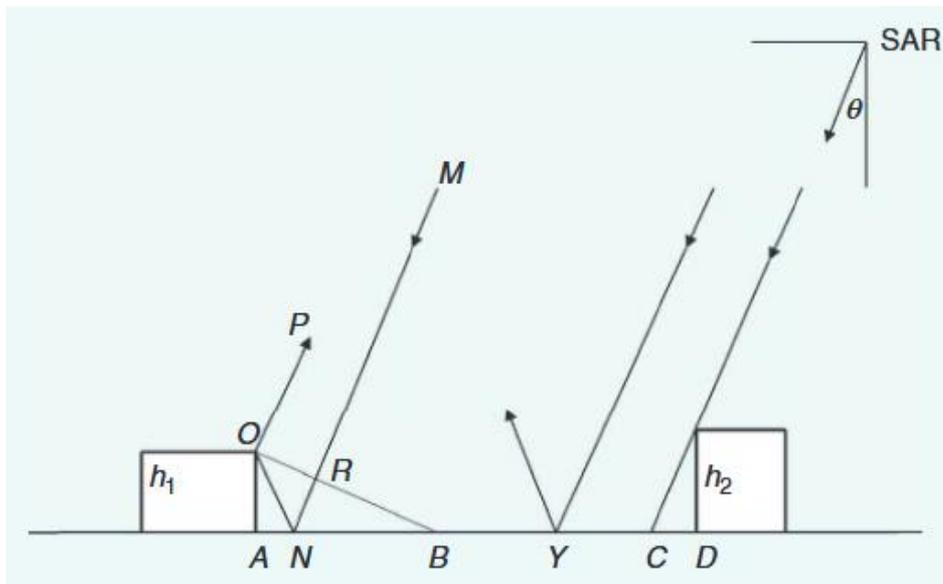
Cross-Polarization (VH or HV):

- Sensitive to vegetation/volume scattering.
- Ineffective for capturing the double-bounce effect

SAR Characteristics in Urban Floods

Radar geometry

...because SAR is a side-looking sensor, the presence of tall, vertical structures in cities creates geometric distortions.



(AB) Layover and (CD) shadow regions in a (AD) flooded street between adjacent buildings of height h_1 and h_2 (θ = incidence angle)

Source: J. Zhao et al., 2025

Shadows: "Blind Spots"

- Tall buildings block the radar signal.
- Appear dark, similar to open water.
- Causing false flood detection and missed flood areas.

Layover:

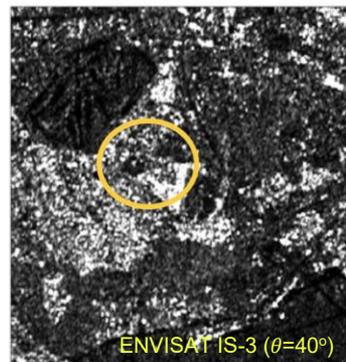
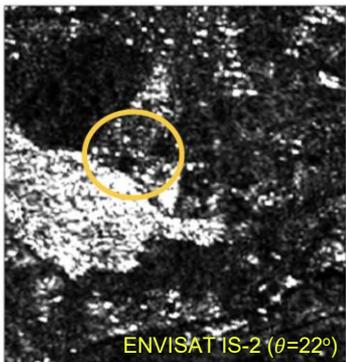
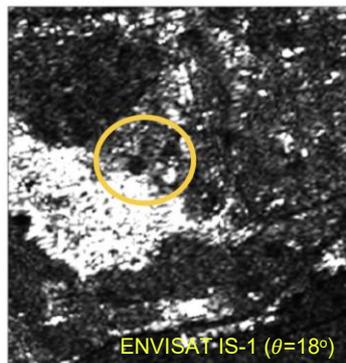
- Building tops detected before the base.
- Roof and walls overlap the ground signal.
- Ground pixels shifted toward the sensor; flooded streets may be hidden.

SAR Characteristics in Urban Floods

Incidence angle

...refers to the angle between the radar beam and the line perpendicular to the Earth's surface.

...this angle determines the visibility of ground features between tall structures.



Large Incidence Angles ($\sim 45^\circ - 70^\circ$):

- Strong land–water contrast in the open area.
- Increase radar shadows \rightarrow missed street flooding.

Small Incidence Angles ($\sim 8^\circ - 25^\circ$):

- Land–water separation is more difficult.
- Fewer shadowed areas.
- Stronger layover effects.

SAR Characteristics in Urban Floods

InSAR Phase and Coherence

...phase captures subtle geometric changes between the sensor and stable targets.

...coherence measures the pixel-wise correlation between two SAR images

Phase

- Very sensitive to geometry, not brightness.
- Stable in dense urban areas.
- Detects small flood-induced changes over stable "persistent scatterers" (like buildings).

Coherence

- Building = stable targets, high and consistent coherence over time.
- Flooding → rapid coherence loss
- Typical threshold: coherence drops by more than 0.3 compared to pre-event levels

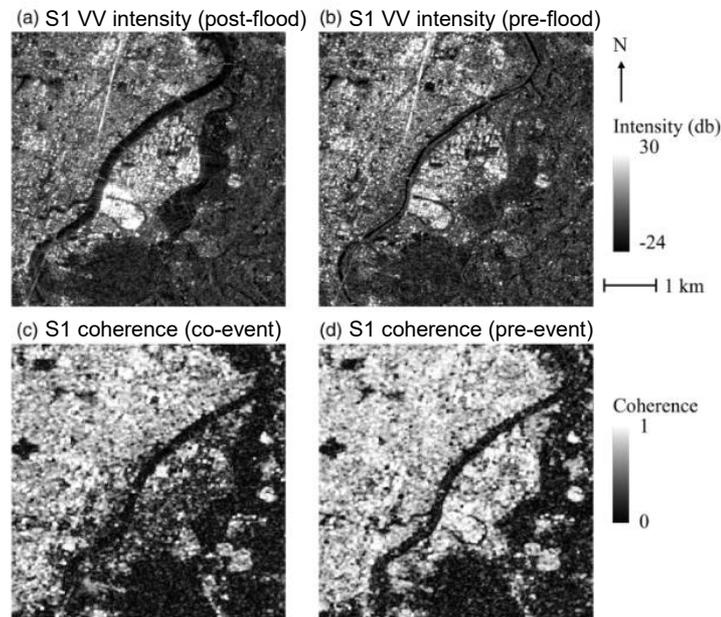


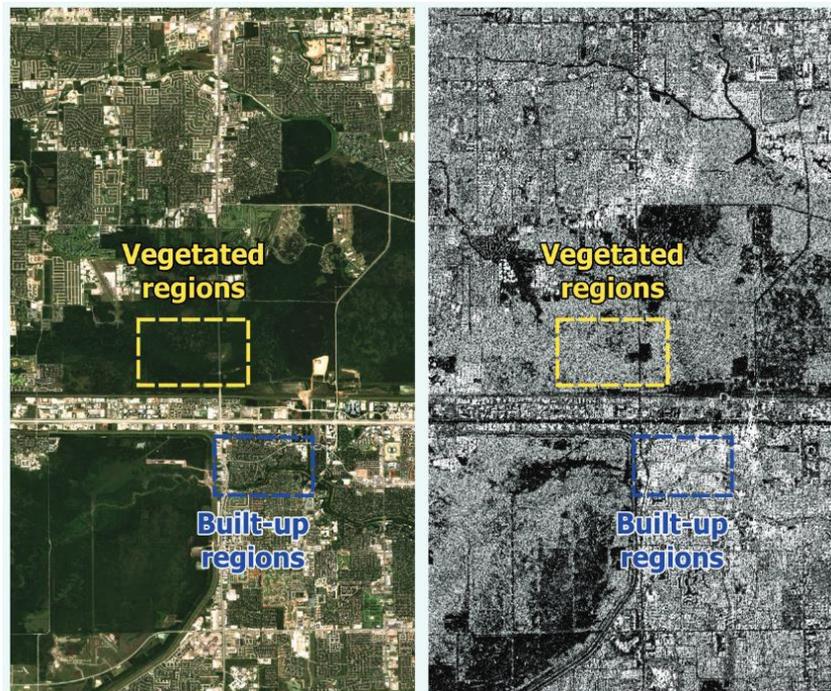
Fig. 5 (a) S-1 VV intensity image for October 12, 2019 (post-flood). (b) S-1 VV intensity image for October 6, 2019 (pre-flood). (c) Coherence image for co-event image pair October 12, 2019, and October 6, 2019. (d) Coherence image for pre-event image pair October 6, 2019, and September 24, 2019.

Source: D.C. Mason et al., 2025

SAR Characteristics in Urban Floods

Complex environment

...urban environment is a heterogeneous landscape; multiple physical factors interact with the radar signal.



Source: J. Zhao et al., 2025

Building Density and Height

- Urban canyons: shadows & layover.
- Multiple reflections → mixed signals.

Building Orientation

- Double-bounce depends on façade alignment.
- Small orientation changes → large signal drop

Surrounding Vegetation

- Volume scattering masks double-bounce.
- Coherence loss ≠ flooding

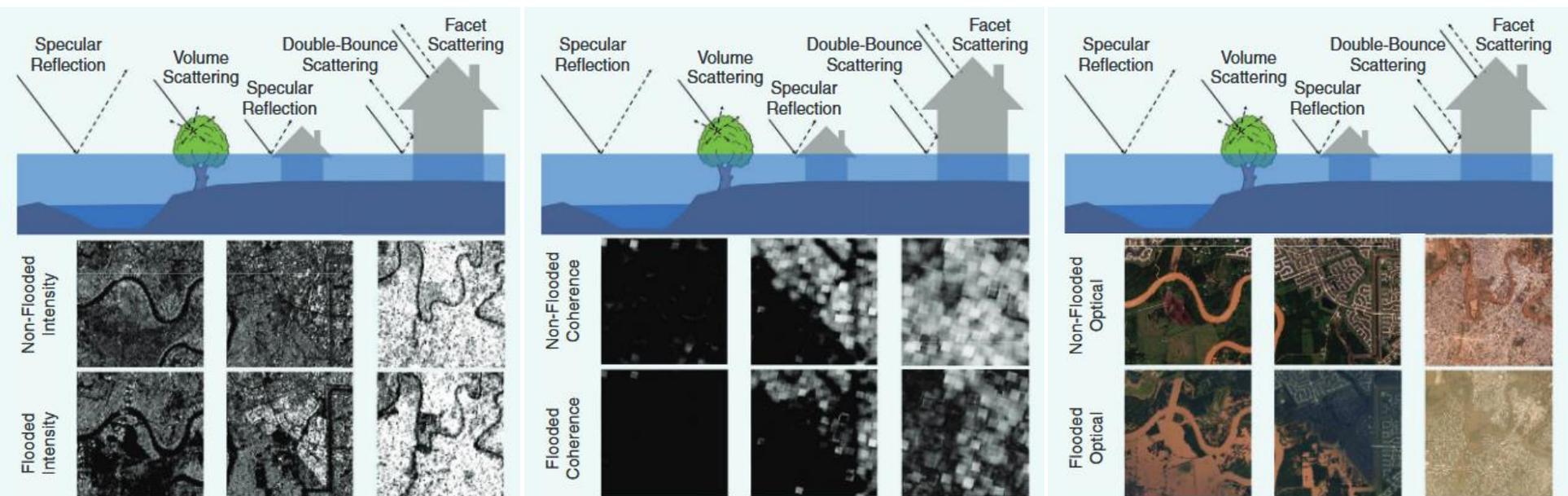
Water Depth and Submergence

- Partial submergence → stronger returns.
- Full submergence → smooth water → specular reflection

SAR Characteristics in Urban Floods

More on scattering mechanisms

...scattering mechanisms in flooded urban areas and examples of floods in different scenarios.



Mapping Approaches & Methodologies

SAR-based urban flood mapping

...various approaches range from visual interpretation to fully automated learning-based methods (J. Zhao et al., 2025):

VISUAL INSPECTION

RULE-BASED APPROACHES

- Fuzzy-logic-based methods.
- Region growing-based methods.
- Decision tree-based approaches
- Thresholding

ELECTROMAGNETIC MODEL-BASED APPROACHES

MACHINE LEARNING METHODS

- Bayesian inference-based approaches.
- Machine learning classifiers
- Deep learning

Mapping Approaches & Methodologies

Visual Inspection

...the direct qualitative method, relying on the human ability to interpret complex color patterns in SAR composites.

Method: RGB Coherence Composites

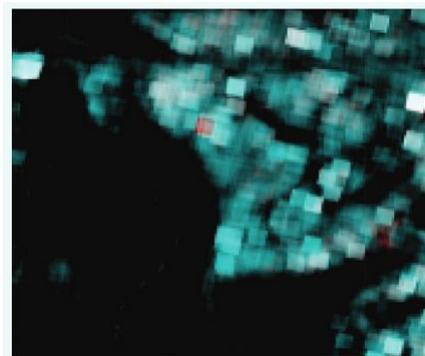
- Multi-temporal coherence visualization.
- Highlights loss of surface stability.
- Flooded urban areas → cyan / light blue.

Advantages

- Fast, intuitive interpretation.
- No complex processing required.
- Useful for rapid response

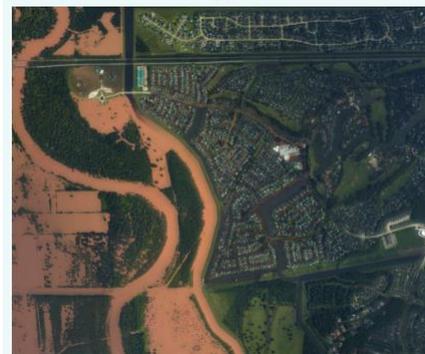
Limitation

- Qualitative, not automated.
- Analyst-dependent interpretation



(a)

(a) RGB composition of pre- and co-event InSAR coherence image in the Houston areas (R = co-event image, G = B = pre-event image).



(b)

(b) optical image acquired after the flood event provided by NOAA.

Source: J. Zhao et al., 2025

Mapping Approaches & Methodologies

Thresholding

...the most widely used quantitative method, relying on a "cutoff" value to extract flooded pixels from the background.

Method:

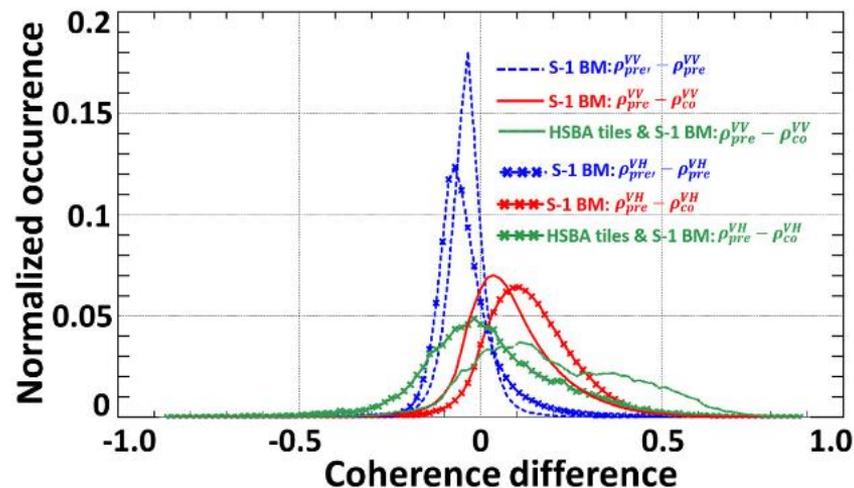
- Three-way thresholding strategy:
 - Intensity decrease (specular reflection)
 - Intensity increase (double-bounce)
 - Coherence drop-off
- Threshold value: analyzing the histogram of the backscatter or coherence change.

Advantages

- Fast & simple, no training data.

Limitation

- Thresholds are site-specific.
- Coherence threshold sensitive to temporal baseline.
- Manual tuning is often required.



Distributions of the InSAR coherence difference

- ρ_{pre} : Coherence between two images acquired before the flood.
- ρ_{co} : Coherence between pre-flood and post-flood image.

Mapping Approaches & Methodologies

Fuzzy-Logic-based methods

...flooding is represented as a degree of membership, not a binary state.

Method

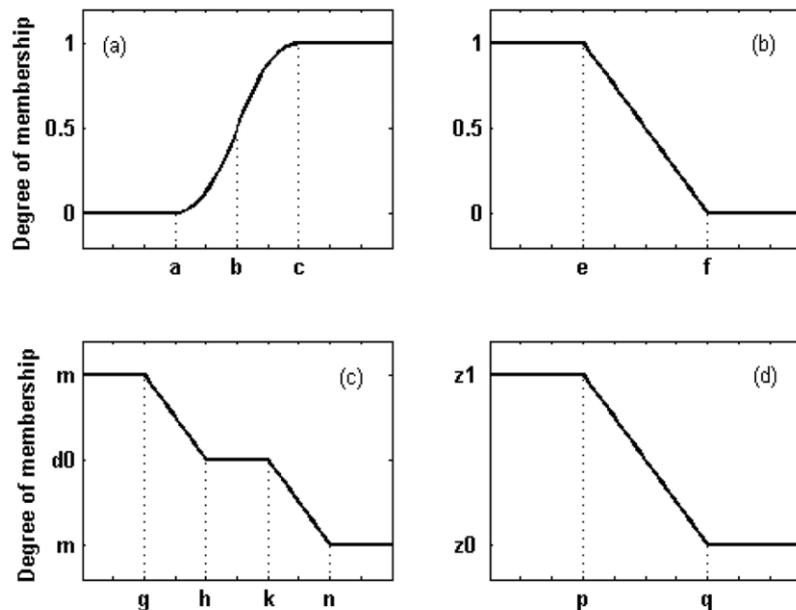
- Combines SAR backscatter with auxiliary data such as land cover maps, topography, etc.
- Manages the dual nature of urban flooding (ambiguous urban signals)
- Expert knowledge to define fuzzy sets and thresholds

Advantages

- Integrates multiple variables.
- Reduces misclassification in complex cities.

Limitation

- Rule- and site-dependent → limited scalability.



Membership functions that translate raw data (like dB values or meters) into fuzzy degrees of truth.

Mapping Approaches & Methodologies

Region-Growing-based methods

...flood extent is expanded from reliable 'seed' pixels based on similarity rules.

Method

- Start from initial flood seeds (manual or set rules).
- Iteratively grow to neighboring pixels with a predefined criterion.
- Common inputs: radar intensity, coherence, elevation, and optional multi-criteria rules.

Advantages

- Spatial continuity and cohesive flood patches.
- Effective with high-resolution SAR.

Limitation

- Sensitive to seed quality.
- Computationally demanding.

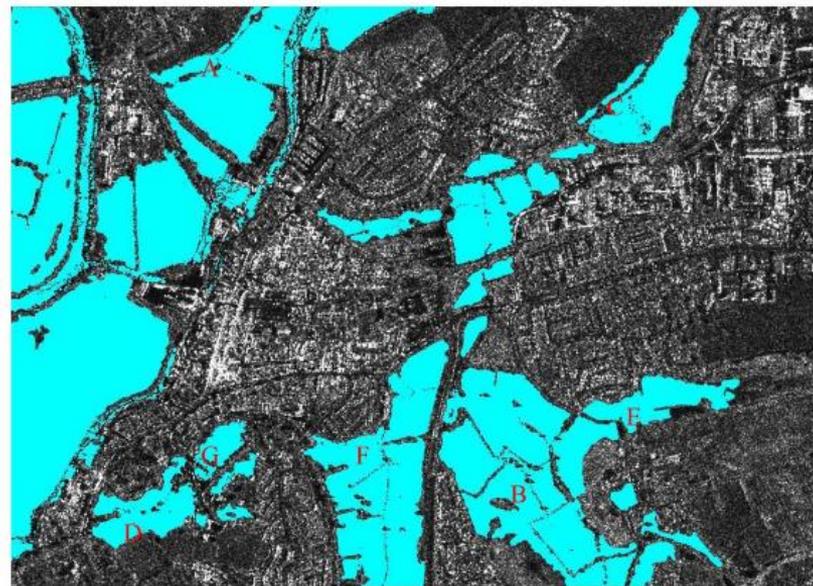


Fig. 9. TerraSAR-X image of Tewkesbury with (blue) flood extent predicted by the snake superimposed (shadow/layover regions masked out) (A – G = positions of snake nodes selected for interpolation).

Mapping Approaches & Methodologies

Decision-Tree-based approaches

...pixels are classified as flooded or non-flooded through a sequence of simple binary splits.

Method

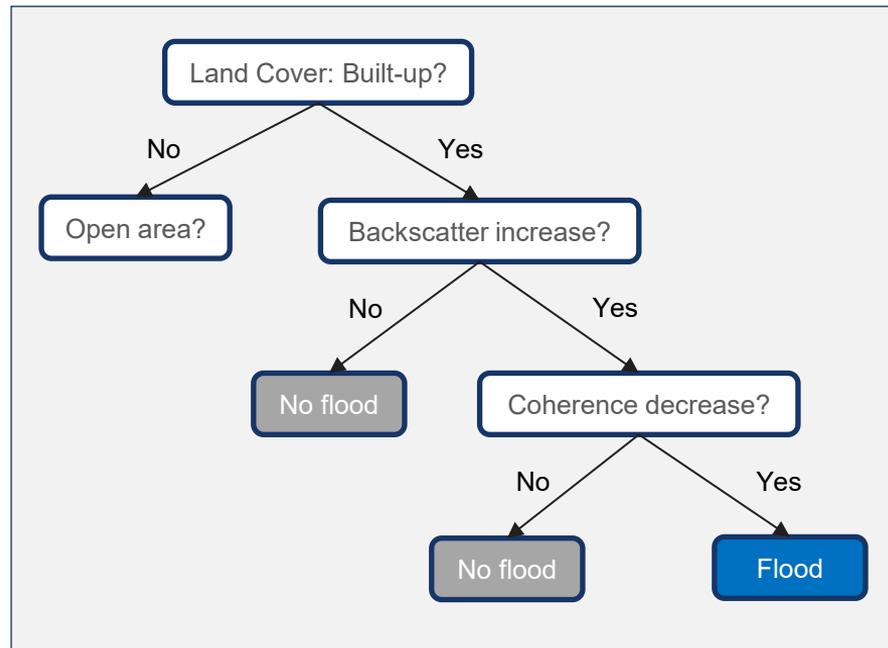
- Hierarchical if-then rules.
- Binary splits on key variables.
- Transparent, explainable logic.
- Input: radar backscatter, coherence, land cover or built-up mask, elevation, or HAND index.

Advantages

- Easy to interpret, fast, and scalable.
- Integrates multiple data sources.

Limitation

- Sensitive to threshold choice.
- Often site-specific.
- Risk of overfitting with deep trees.



A simplified decision tree for detecting urban flood

Mapping Approaches & Methodologies

Machine Learning Classifiers

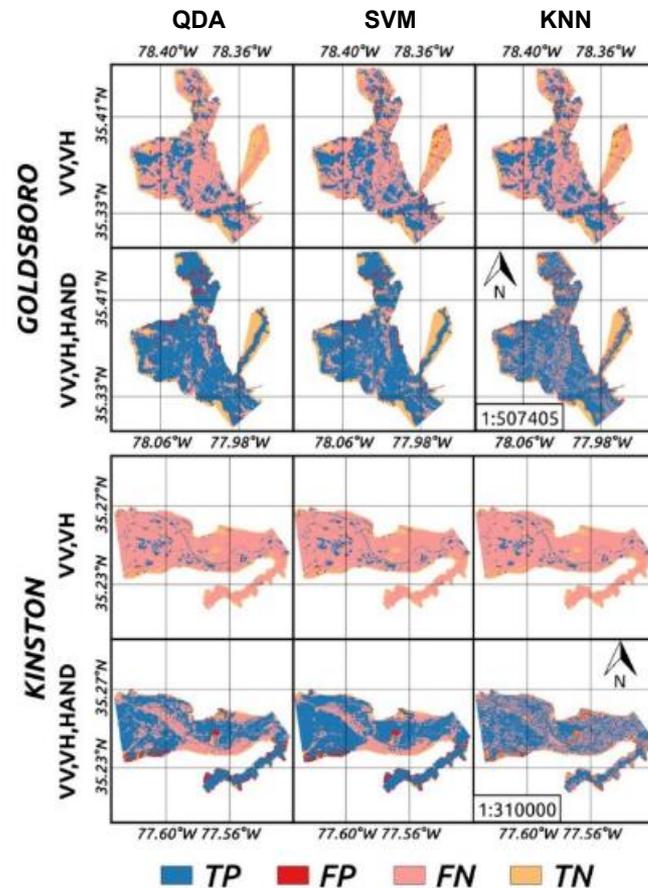
...automated learning of non-linear flood patterns from multi-source SAR features.

Method

- Multi-source feature fusion: intensity, coherence, geomorphic variables (HAND, DEM, land use).
- Supervised classification: train using labeled samples.
- Non-linear decision boundaries.

Common Classifiers

- *Ensemble (RF)*: robust to noise; effective for multimodal SAR–terrain features.
- *Geometric (SVM/KNN)*: efficient for small datasets; SVM models non-linear boundaries, KNN uses feature similarity.
- *Discriminant (QDA)*: fast parametric classification, often trained using pre-flood water/land statistics.



Mapping Approaches & Methodologies

Deep Learning

...utilizing multi-layered neural networks to automatically extract high-level spatial and temporal features from complex SAR datasets.

Method

- End-to-end feature learning
- Multi-temporal & multi-source SAR inputs
- Self-learning via pseudo-labeling

Advanced Architectures

- *Urban-aware U-Net (attention)*
- *Active self-learning CNNs*
- *Unsupervised GANs (OOD detection)*

Challenges

- Annotation cost
- Cross-city generalization

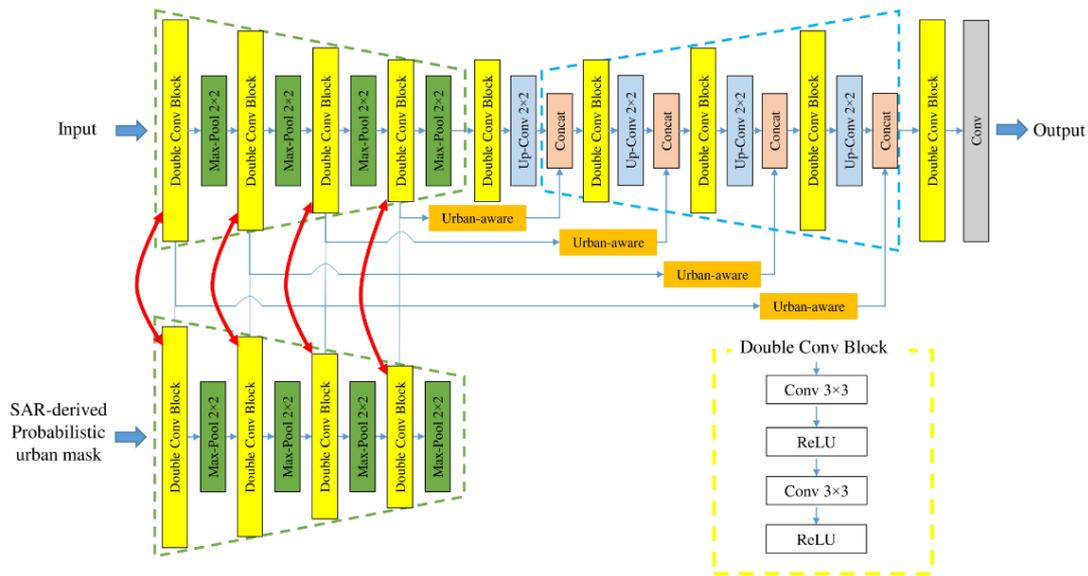


Fig. 3. Proposed urban-aware U-Net architecture: the block in orange represents the urban-aware module.

Flooding in Southern Thailand

Overview of the disaster

In November 2025, Southern Thailand experienced one of the worst monsoon-driven flooding events in recent history.

- Affected provinces (12): Songkhla, Nakhon Si Thammarat, Phatthalung, Pattani, Narathiwat, Trang, Satun, Surat Thani, Yala, Chumphon, Krabi, and Prachuap Khiri Khan.
- Duration: Nov 17 – Dec 4, 2025
- Estimated impact:
 - 700,000 to 1.2 million households affected (reaching over 3.2 million people) (DDPM)
 - 145 flood-related fatalities (EFCOC)
 - Cost of damages: \$15.7 million USD (MoF)



*Flooding in Hat Yai, Thailand
(The Nation, Nov 2025)*

Flooding in Southern Thailand

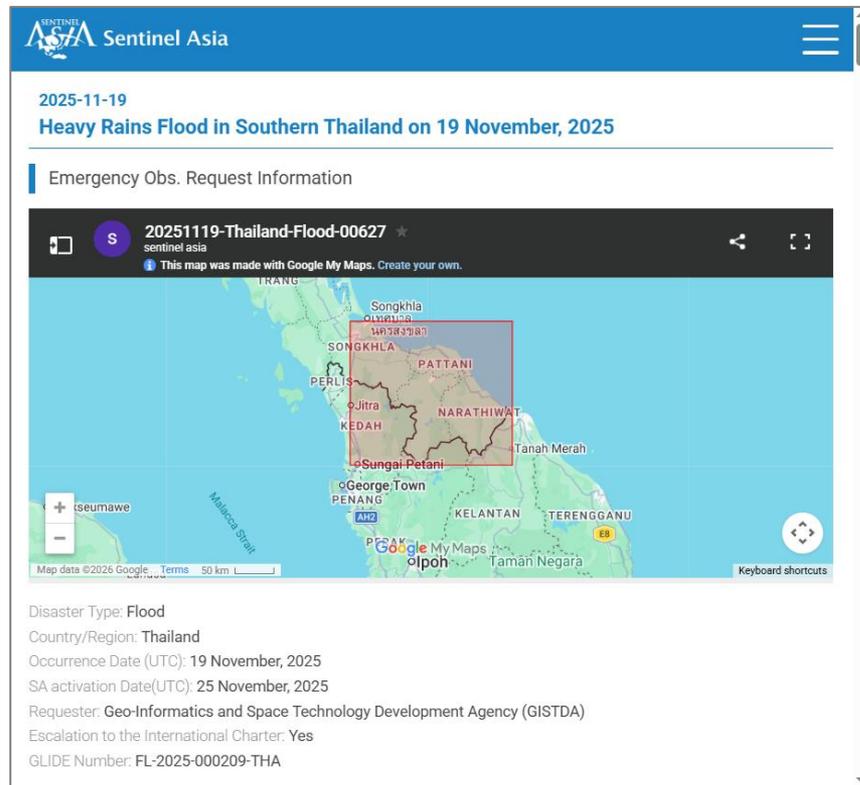
Sentinel Asia and International Disaster Charter activation

Sentinel Asia activation: Nov 25, 2025

- Requester: GISTDA
- Satellite data provided: ALOS-2 (JAXA), KazEOSat-1 (KGS), FORMOSAT-5 (TASA), EOS-04 (ISRO).

IDC activation: Nov 25, 2025

- Satellite data provided: Pleiades-1 (CNES), GF-3 (CNSA), SAOCOM-1A (CONAE), TANDEM-X (DLR), CBERS-4A (INPE), EOS-04 (ISRO), CAS500-1, KOMPSAT-3A, KOMPSAT-5 (KARI), RESURS-P (ROSCOSMOS), GEOEYE-1 (USGS).

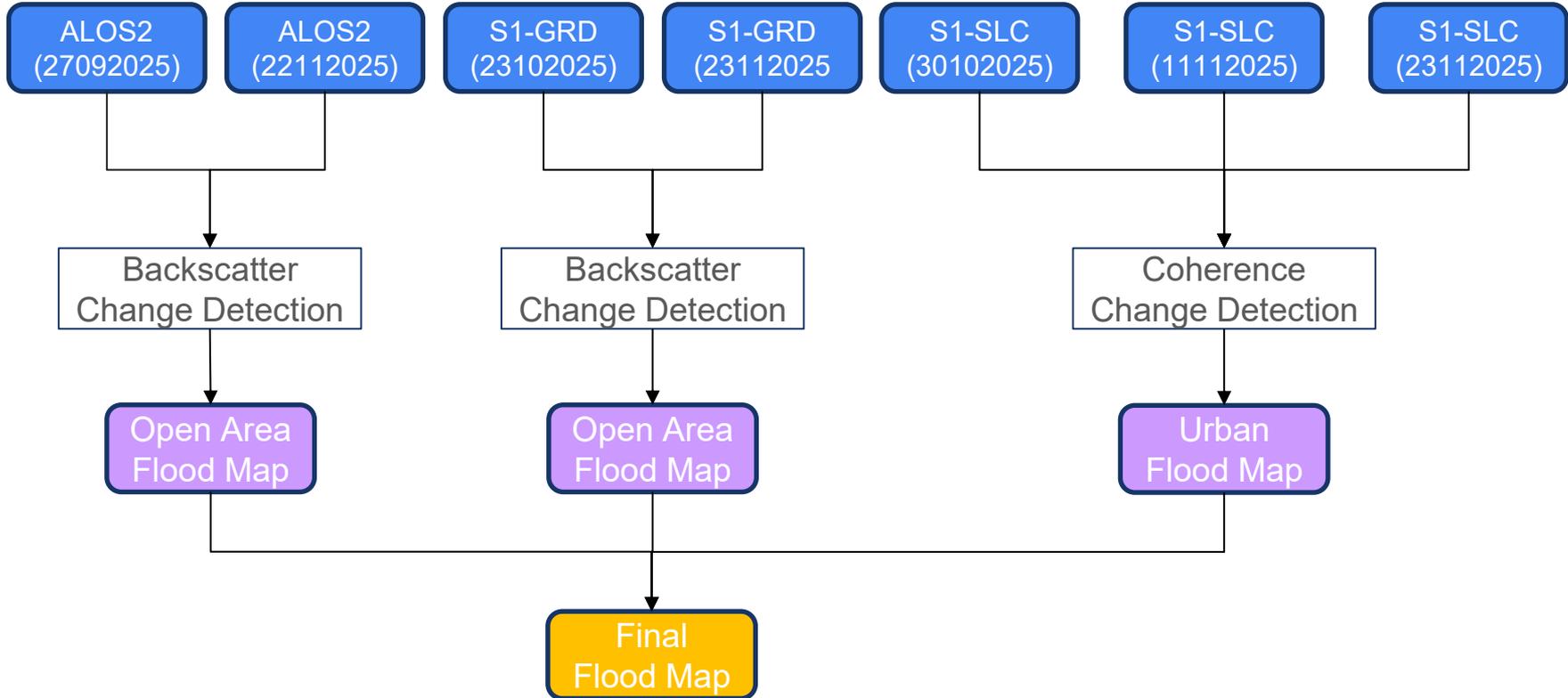


The screenshot shows a web interface for Sentinel Asia. At the top, it says "Sentinel Asia" and "2025-11-19 Heavy Rains Flood in Southern Thailand on 19 November, 2025". Below this is a section for "Emergency Obs. Request Information". The main part of the page is a map of Southern Thailand, with a red box highlighting the flood-affected area. The map includes labels for provinces like Songkhla, Pattani, Narathiwat, Kelantan, and Terengganu, as well as cities like Songkhla, Jitra, and George Town. A scale bar at the bottom of the map indicates 50 km. Below the map, there is a metadata section with the following details:

- Disaster Type: Flood
- Country/Region: Thailand
- Occurrence Date (UTC): 19 November, 2025
- SA activation Date(UTC): 25 November, 2025
- Requester: Geo-Informatics and Space Technology Development Agency (GISTDA)
- Escalation to the International Charter: Yes
- GLIDE Number: FL-2025-000209-THA

Flooding in Southern Thailand

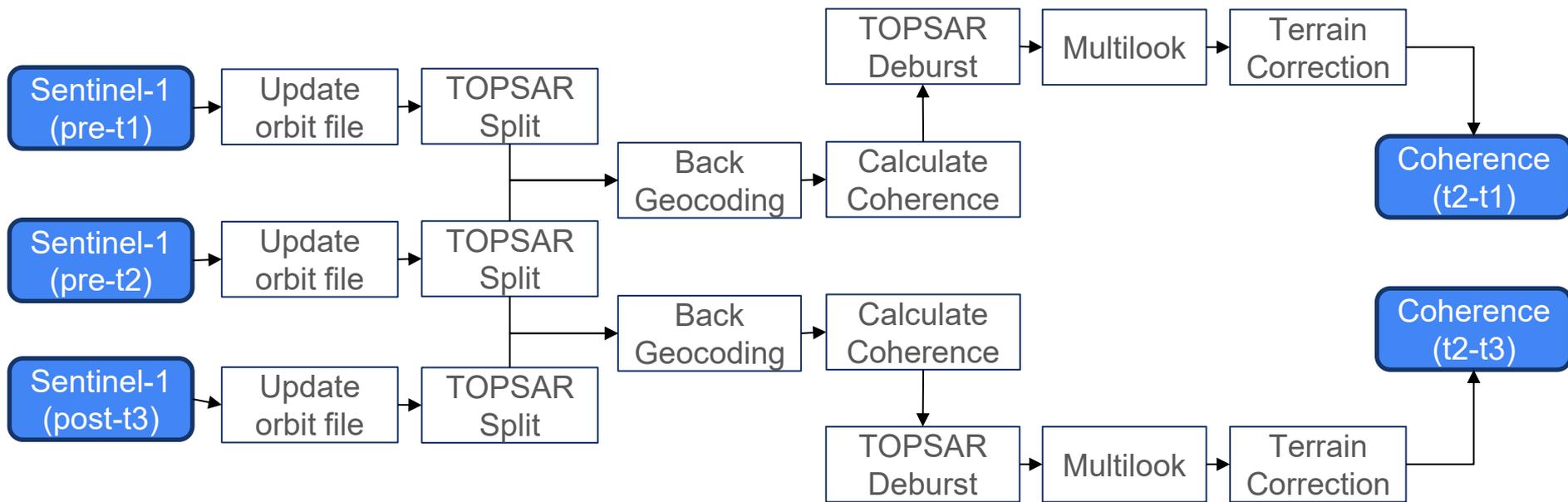
Flood mapping approach



Flooding in Southern Thailand

Urban flood mapping

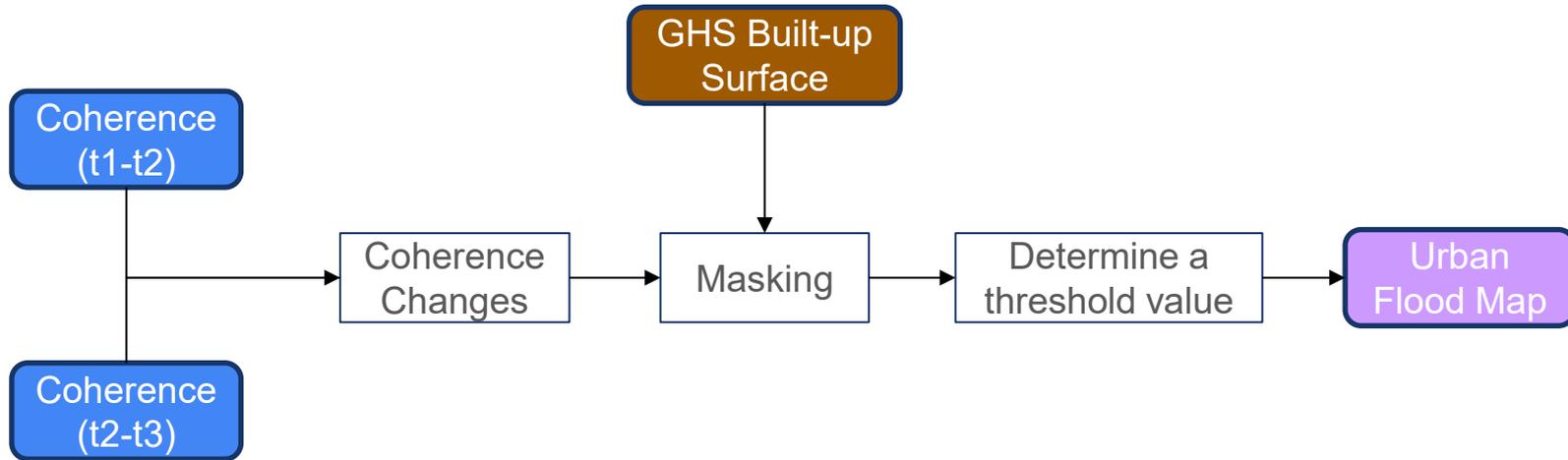
Processing using SNAP



Flooding in Southern Thailand

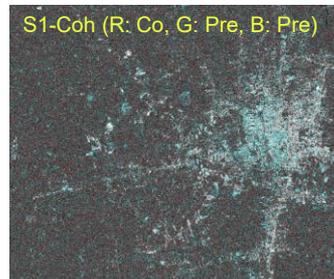
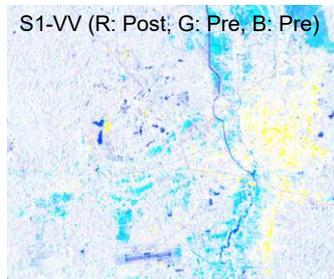
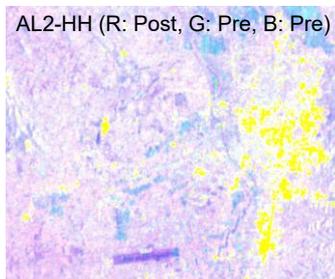
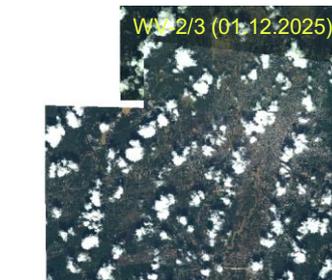
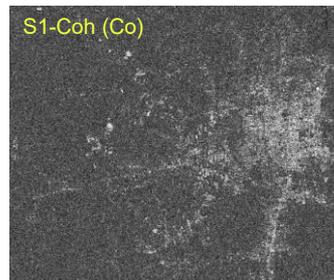
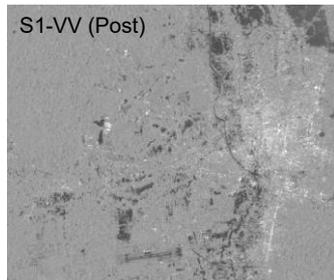
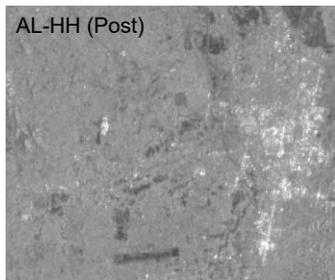
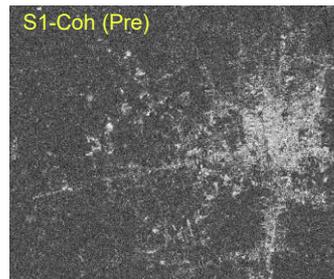
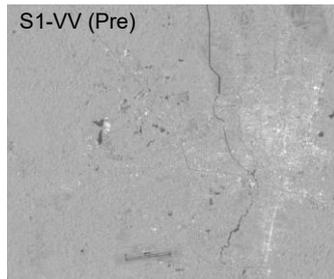
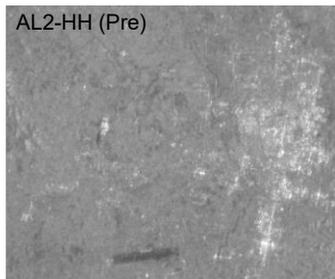
Urban flood mapping

Processing using Google Earth Engine (GEE)



Flooding in Southern Thailand

Visual Inspection



Urban flooding:

- Intensity \uparrow
- Coherence \downarrow

Open area flooding:

- Intensity \downarrow

Flooding in Southern Thailand

AIT Value-Added Products



This map shows the detected flood water areas in Songkhla and Phatthalung provinces, Thailand, on November 19, 2025, caused by heavy rains.

3 NUMBER OF DEATHS

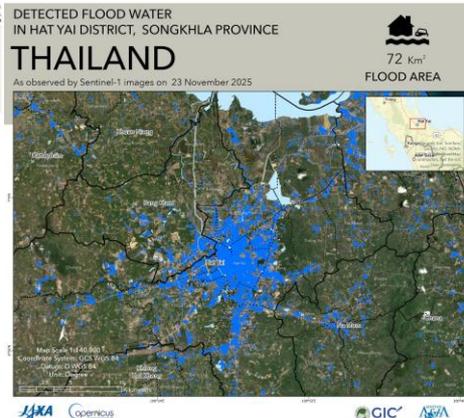
702,954 AFFECTED PEOPLE

Legend:

- Detected Flood Water
- Province Boundary
- District Boundary
- Waterbody
- Waterway
- Road

Map Scale: 1:700,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

Disclaimer: The accuracy of this product is not validated.



This map shows the detected flood water areas in Hat Yai district, Songkhla province, Thailand, on November 19, 2025, caused by heavy rains.

110 NUMBER OF DEATHS

Legend:

- Detected Flood Water
- District Boundary
- Sub-district Boundary
- Waterbody
- Waterway
- Road

Map Scale: 1:400,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

Disclaimer: The accuracy of this product is not validated.



This map shows the detected damaged areas in Chana district, Songkhla province, Thailand, on November 19, 2025, caused by heavy rains.

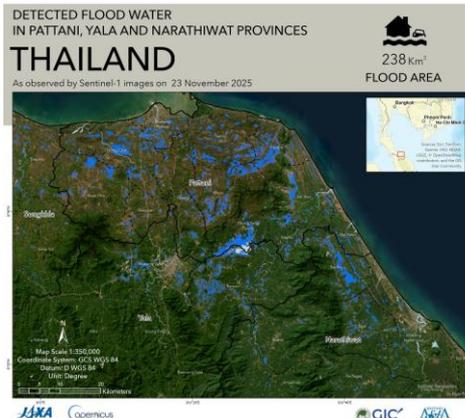
FLOOD

Legend:

- District Boundary
- Sub-district Boundary

Map Scale: 1:25,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

Disclaimer: The accuracy of this product is not validated.



This map shows the detected flood water areas in Pattani, Yala, and Narathiwat provinces, Thailand, on November 19, 2025, caused by heavy rains.

239,895 AFFECTED HOUSEHOLDS

Legend:

- Detected Flood Water
- Province Boundary
- District Boundary
- Waterbody
- Waterway
- Road

Map Scale: 1:350,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

Disclaimer: The accuracy of this product is not validated.



This map shows the detected flood water areas in Nakhon Si Thammarat, Songkhla, and Phatthalung provinces, Thailand, on November 22, 2025, caused by heavy rains.

817,410 AFFECTED HOUSEHOLDS

Legend:

- Detected Flood Water
- Province Boundary
- District Boundary
- Waterbody
- Waterway
- Road

Map Scale: 1:900,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

Disclaimer: The accuracy of this product is not validated.



This map shows the detected damaged areas in Bang Klam and Hat Yai districts, Songkhla province, Thailand, on November 19, 2025, caused by heavy rains.

FLOOD

Legend:

- District Boundary
- Sub-district Boundary

Map Scale: 1:45,000
Coordinate System: GCS WGS 84
Projection: UTM
Unit: Degree

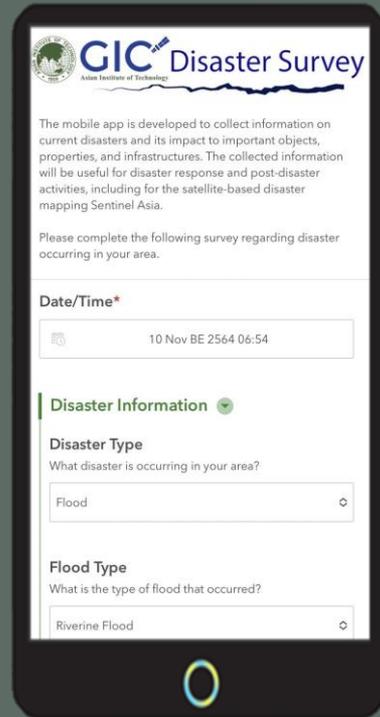
Disclaimer: The accuracy of this product is not validated.

Flooding in Southern Thailand

Field Survey in Songkhla Province: December 9 to 11, 2025



Disaster Survey
Mobile Application



GIC Disaster Survey
Asian Institute of Technology

The mobile app is developed to collect information on current disasters and its impact to important objects, properties, and infrastructures. The collected information will be useful for disaster response and post-disaster activities, including for the satellite-based disaster mapping Sentinel Asia.

Please complete the following survey regarding disaster occurring in your area.

Date/Time*
10 Nov BE 2564 06:54

Disaster Information

Disaster Type
What disaster is occurring in your area?
Flood

Flood Type
What is the type of flood that occurred?
Riverine Flood



Aerial Survey Using Drones



SONGKHLA

FIELD SURVEY

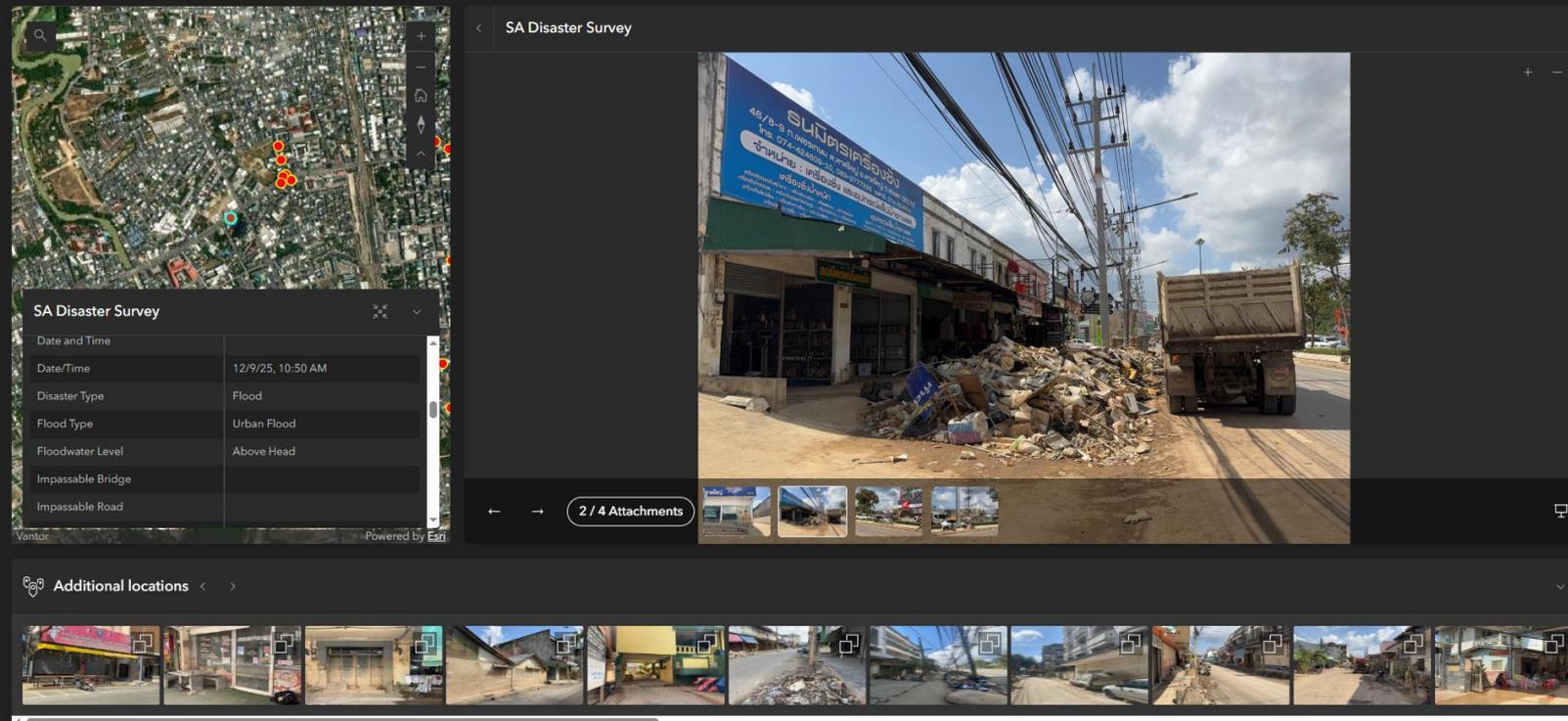


Flooding in Southern Thailand

Field Survey: Web GIS dashboard

<https://gicait.maps.arcgis.com/apps/instant/attachmentviewer/index.html?appid=4b1b9a997b4d4951959e3ca431c8f78f>

Field survey in Songkhla, Thailand



The screenshot displays a Web GIS dashboard interface. On the left, a satellite map shows the location of the survey in Songkhla, Thailand, with several red circular markers indicating survey points. Below the map is a data table titled 'SA Disaster Survey' with the following information:

SA Disaster Survey	
Date and Time	
Date/Time	12/9/25, 10:50 AM
Disaster Type	Flood
Flood Type	Urban Flood
Floodwater Level	Above Head
Impassable Bridge	
Impassable Road	

Below the table, there is a section for 'Additional locations' and a gallery of 2/4 attachments. The main attachment is a large photo showing a street scene with a large pile of debris (cardboard boxes, plastic) on the sidewalk, a truck parked nearby, and a blue sign for 'Sunrise' (สุริยะ) in Thai. The sign includes the address '46/8-9 ถนนสุริยะ ตำบลบ้านกล้วย อำเภอเมืองสงขลา จังหวัดสงขลา' and contact information for 'สุริยะก่อสร้าง' (Sunrise Construction).

- 233 ground validation points.
- Collected across 4 districts: Hat Yai, Chana, Mueang Songkhla, and Singhanakhon.

Flooding in Southern Thailand

Field Survey in Hat Yai and Mueang Songkhla districts



Flood Type
Urban Flood

Floodwater Level
Above Head

Damage Information

Damage Object
Building

Building Type
Commercial

Construction Material
Concrete

Hat Yai district



Flood Type
Urban Flood

Floodwater Level
Chest

Damage Information

Damage Object
Building

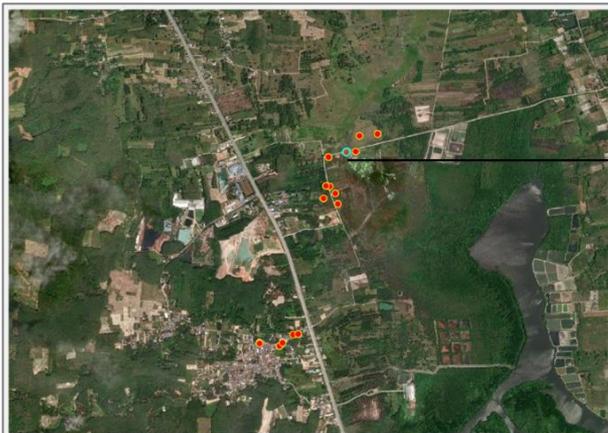
Building Type
Residential

Construction Material
Bricks

Mueang Songkhla district

Flooding in Southern Thailand

Field Survey in Chana and Singhanakhon districts



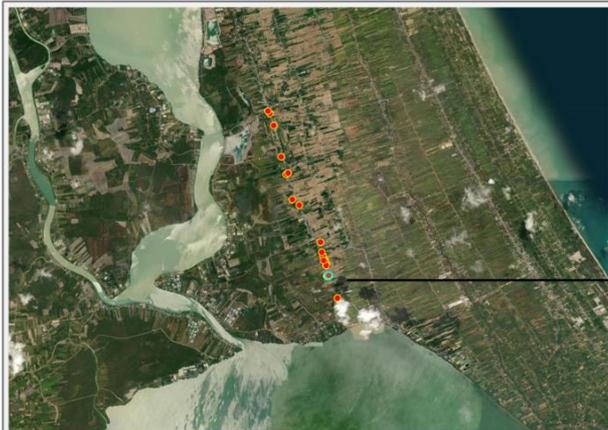
Damage Object

Agriculture

Crop Type

Rice

Chana district



Damage Object

Agriculture

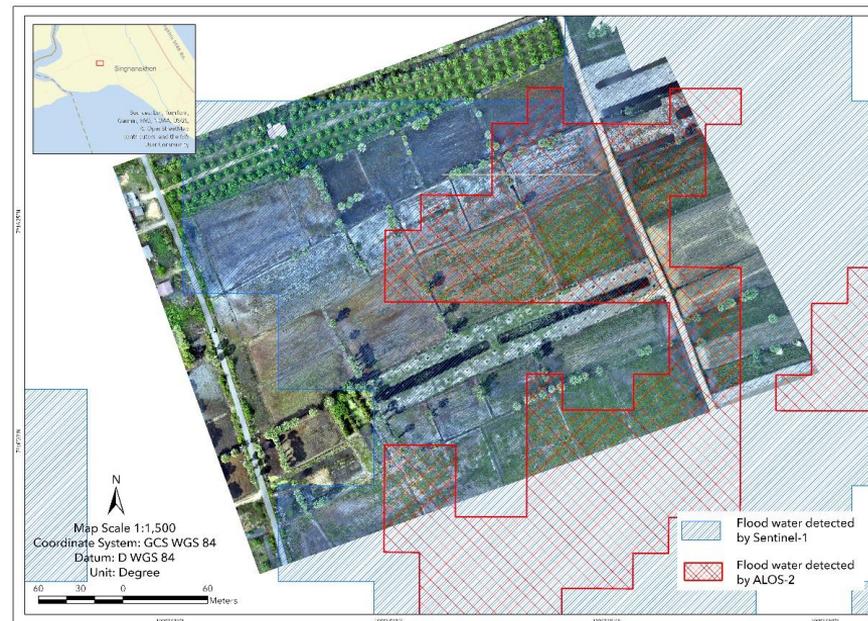
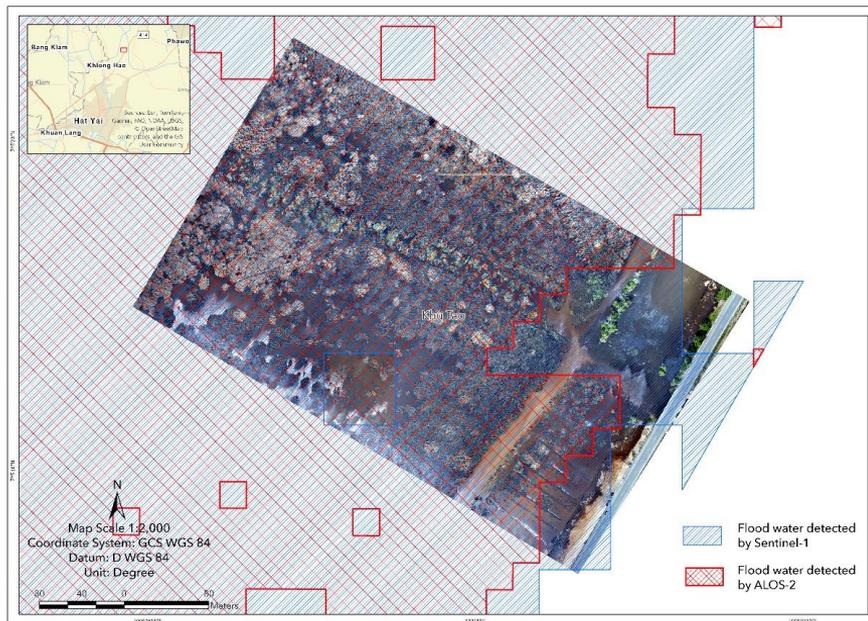
Crop Type

Rice

Singhanakhon district

Flooding in Southern Thailand

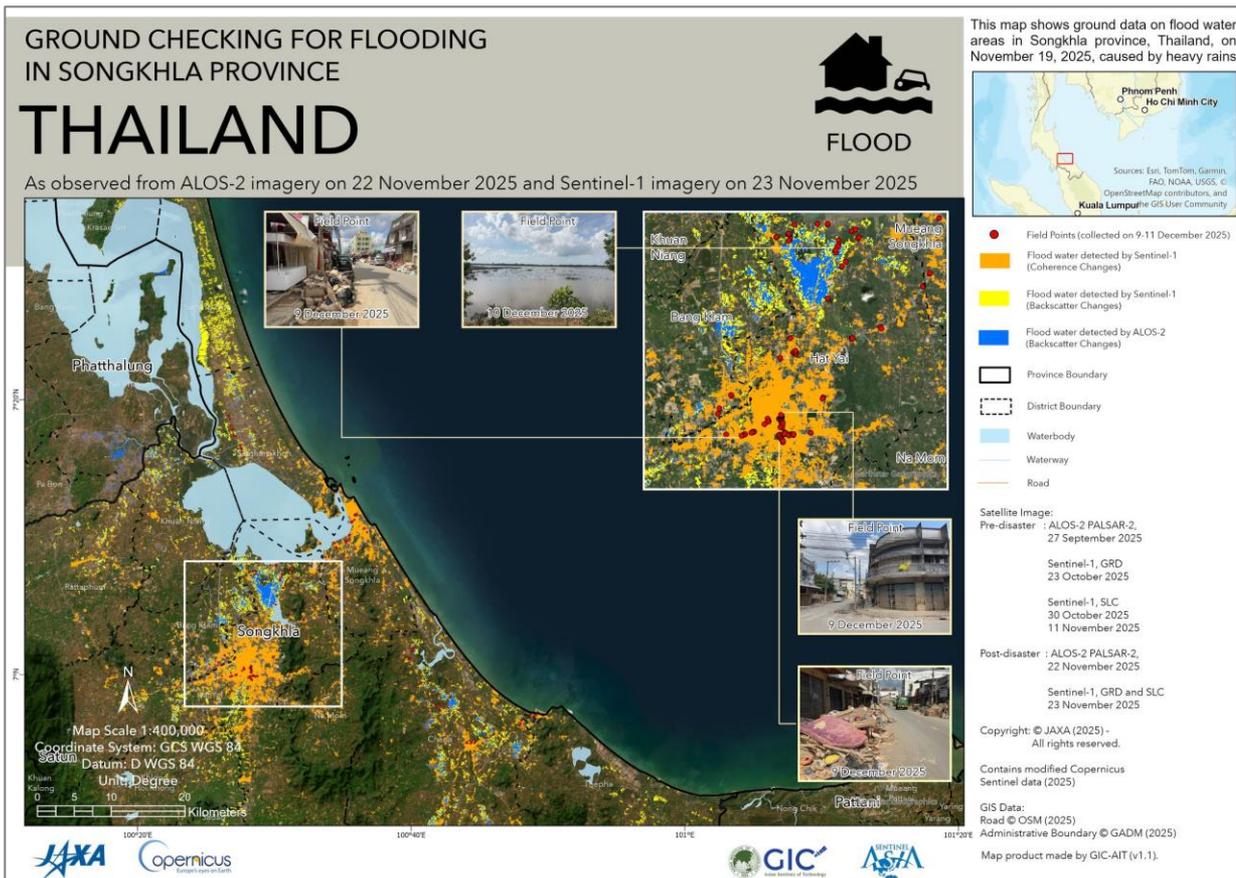
Drone survey



- Comparison between the satellite-detected flood extents and high-resolution drone imagery.
- Drone flights were deployed primarily over agricultural areas to capture detail where accessibility was limited.
- Additional points for validation.

Flooding in Southern Thailand

Comparing flood map products with validation points



Flooding in Southern Thailand

Comparing flood map products with validation points



● Flooding

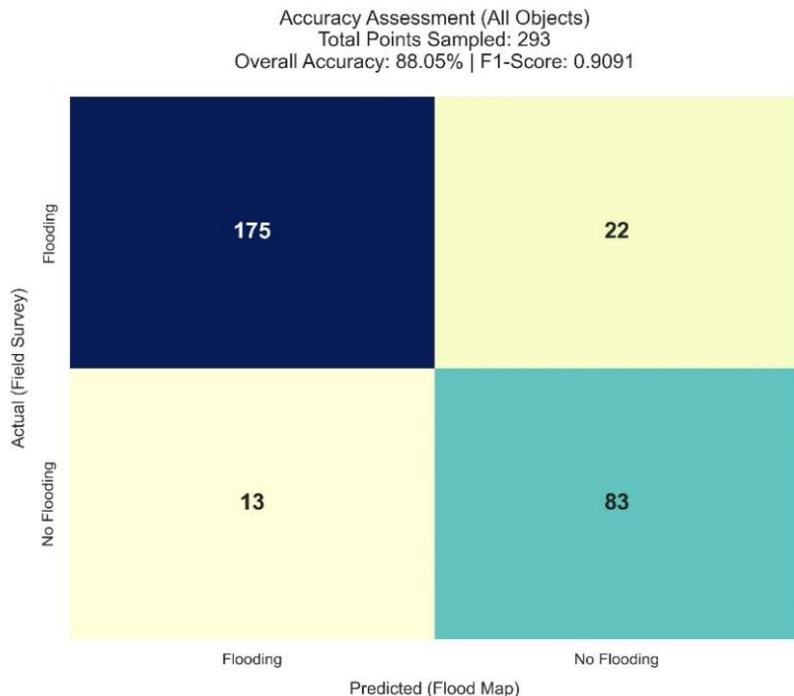
● No flooding

▨ Flood area by GIC-AIT

Flooding in Southern Thailand

Validation Results

...validation was conducted using 233 photo-survey points, combined with 60 additional points derived from drone imagery and VHR optical data, resulting in a total of **293 validation points**.



The validation confirms that coherence-based methods significantly improve urban flood detection compared to backscatter alone.

	precision	recall	f1-score	support
Flooding	0.93	0.89	0.91	197
No Flooding	0.79	0.86	0.83	96

Flooding in Southern Thailand

Validation Results

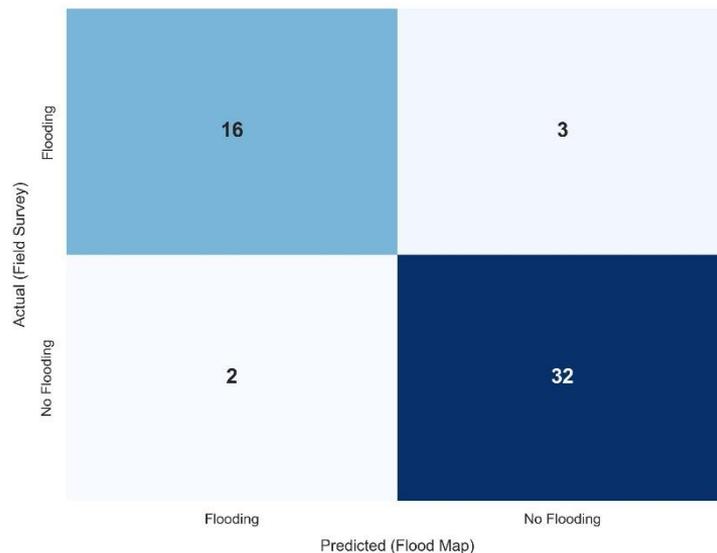
...targeted accuracy assessment was conducted specifically for urban environments and agricultural areas.

Accuracy Assessment (Urban)
 Total Points Sampled: 177
 Overall Accuracy: 85.88% | F1-Score: 0.9191



	precision	recall	f1-score	support
Flooding	0.93	0.90	0.92	157
No Flooding	0.40	0.50	0.44	20

Accuracy Assessment (Agricultural)
 Total Points Sampled: 53
 Overall Accuracy: 90.57% | F1-Score: 0.8649



	precision	recall	f1-score	support
Flooding	0.89	0.84	0.86	19
No Flooding	0.91	0.94	0.93	34

Concluding Remarks

- Urban flood mapping using SAR remains challenging due to complex scattering, radar geometry, and heterogeneous urban environments.
- The integration of **multi-temporal SAR backscatter and coherence change**, combined with urban masks, proved effective for detecting urban flooding during the Southern Thailand event.
- **Ground truth information is critical** for improving analysis quality and validation reliability; participants and partner agencies are encouraged to **share and contribute ground-based observations** to strengthen future flood mapping efforts.
- Results from the Southern Thailand case demonstrate the operational value of SAR-based urban flood mapping for rapid disaster response.
- Future work should focus on cross-city generalization, integration of auxiliary datasets, automation, and scalable validation frameworks.

THANK YOU

Geoinformatics Center, Asian Institute of Technology

