Copernicus Emergency Management Service

Products Outline

Global Flood Monitoring Webinar 2022

Presented by Christian Krullikowski, German Aerospace Center (DLR)

28 04 2022

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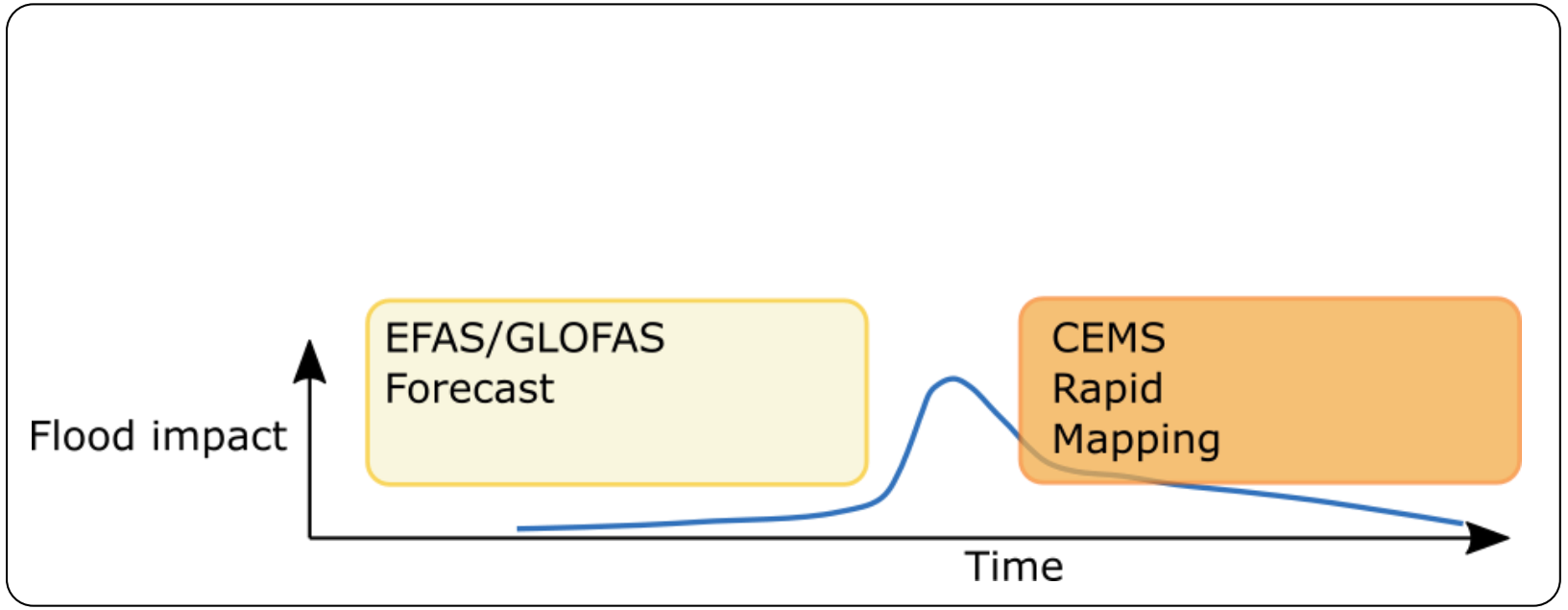
Motivation

Emergency Management

Identify Event

Order Image

Map Flood

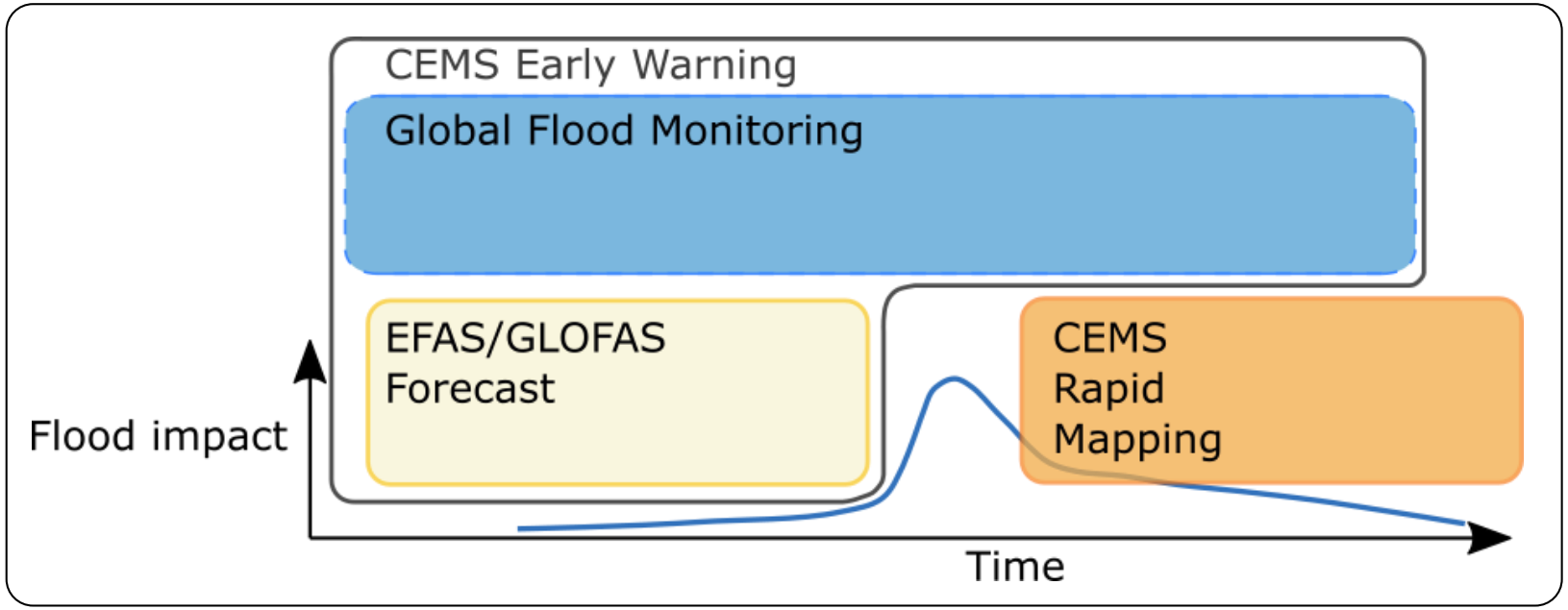


- Focus on the flood events

- Time consuming
- Limited resources

Motivation

Emergency Management



- Time saving
- Discover unreported events

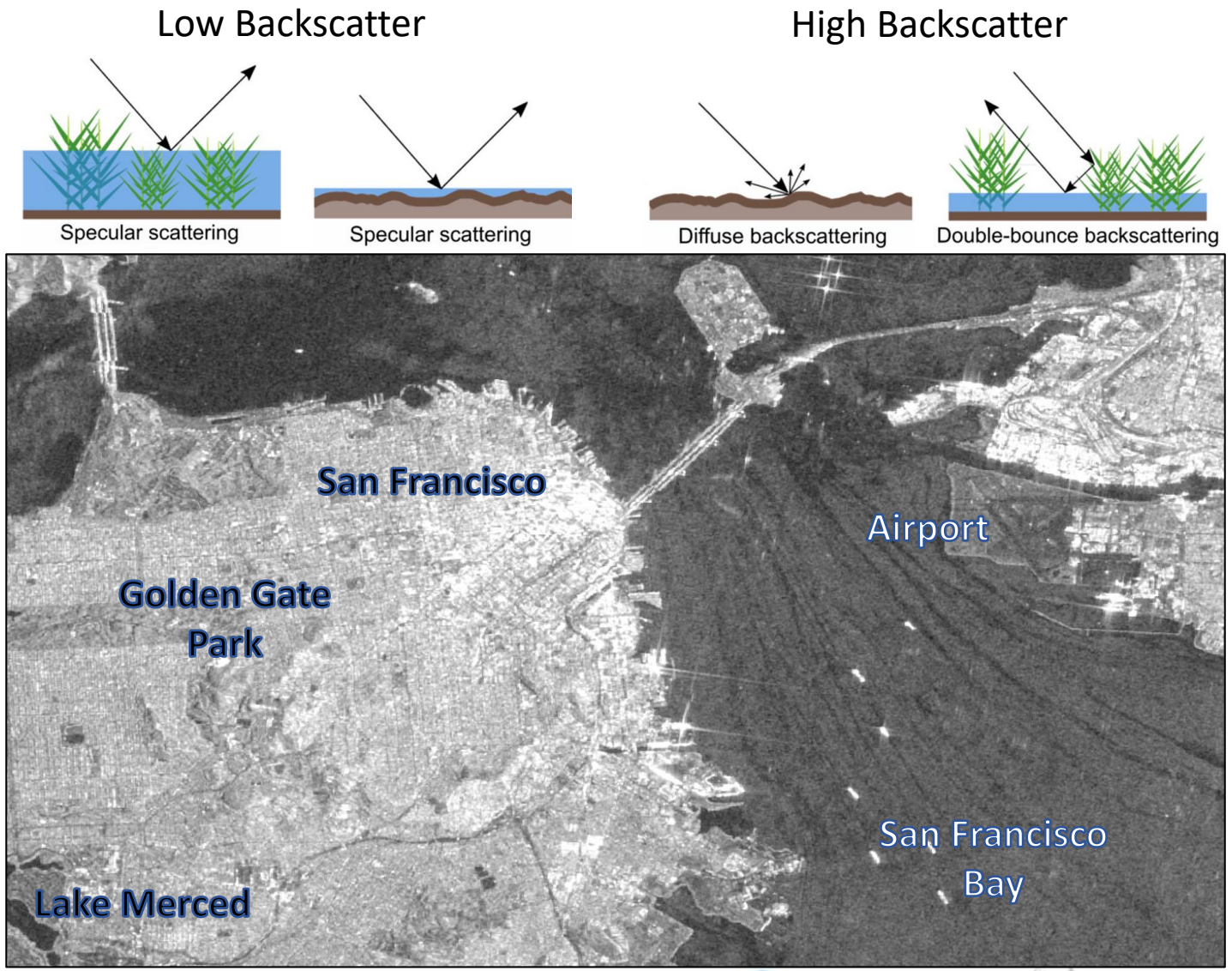
- False alarms

- Accuracy

Sentinel-1 & water detection

Emergency Management

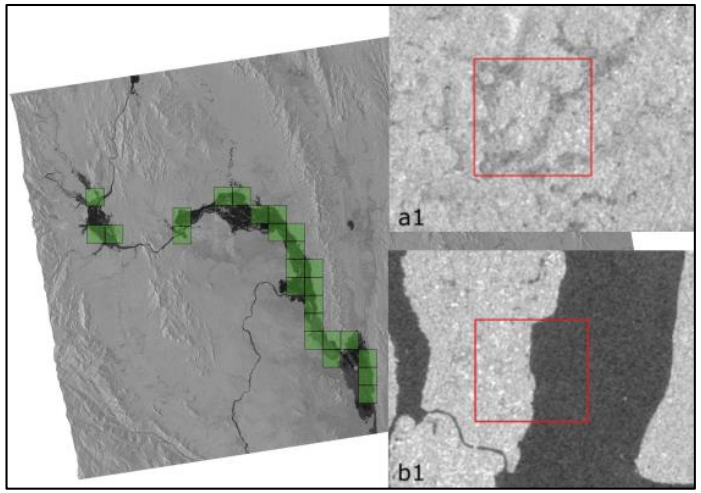
- Specular scattering over calm water bodies
- Water look-alikes
  - Tarmacs
  - Dry soil
  - Wet snow
  - Agricultural fields
- Rough water surfaces disturb specular scattering
- Double-bounce backscattering in urban areas
- Diffuse backscatter over dense vegeation



Combining different strategies to increase robustness

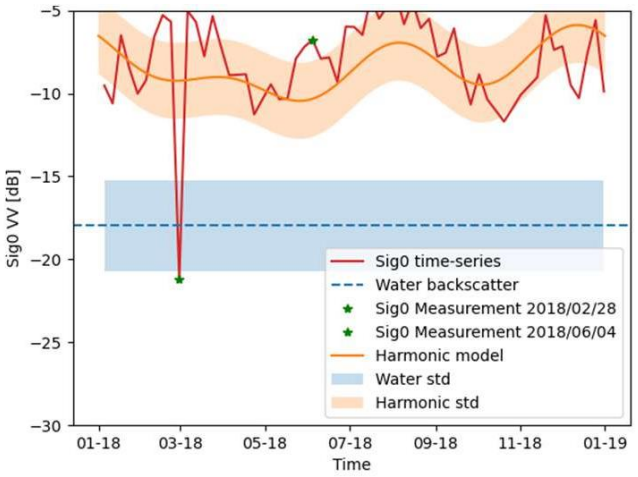
Emergency Management

DLR



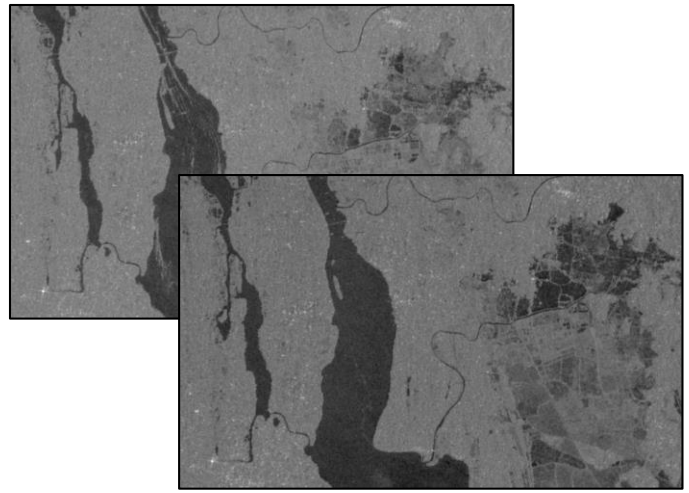
- Hierarchical tile-based thresholding
- Post classification and likelihood estimation through fuzzy logic-based refinement

TUW



- Per-pixel time series analysis
- Flood as deviation from harmonic model
- Likelihood through probability of opposing class

LIST



- Change detection
- Flood as deviating water surface
- Likelihood through probability

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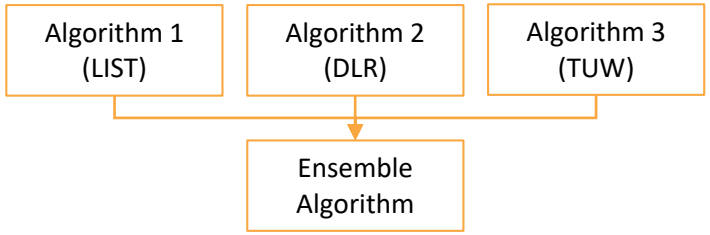
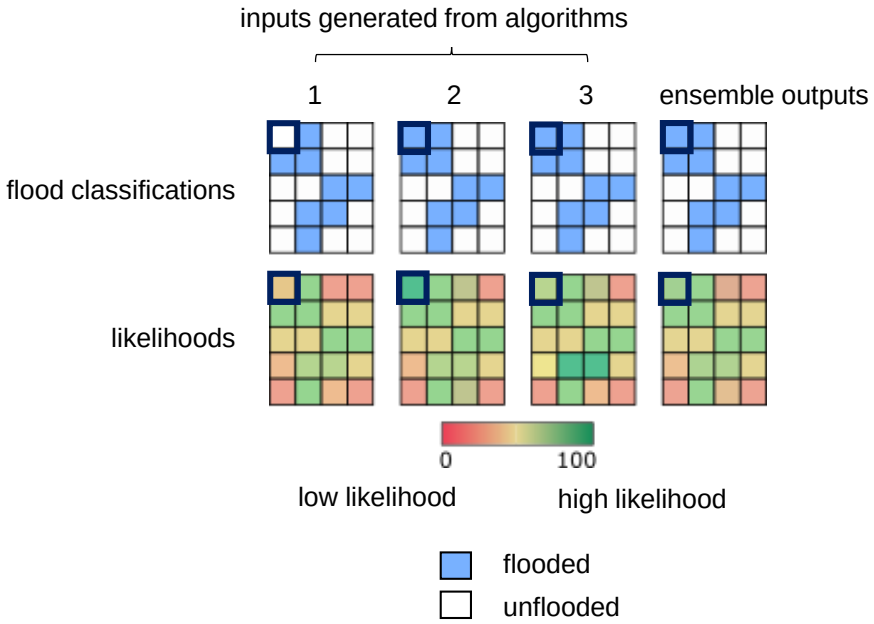
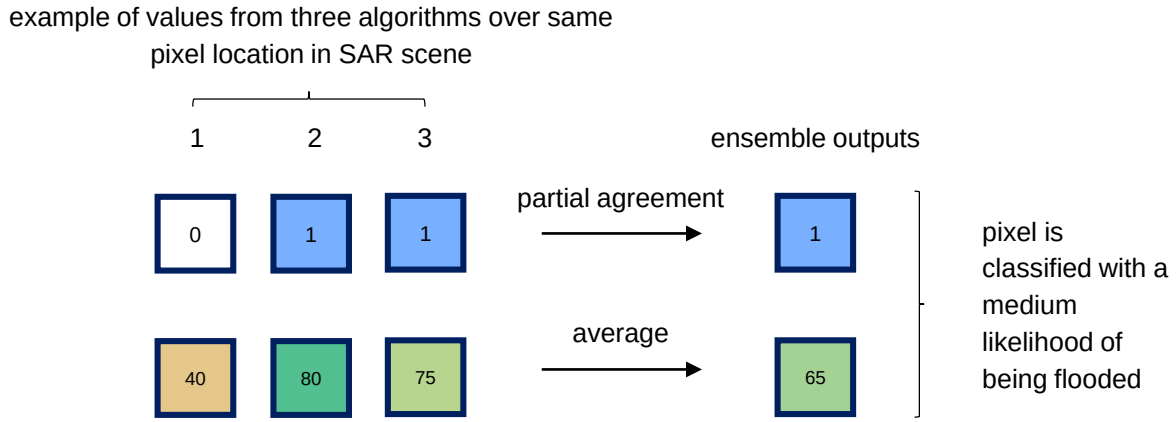
Flood Ensemble

- Combining flood and likelihood results of all three flood algorithms
- Majority vote decides if a pixel is marked as flood or non-flood
- Final likelihood layer is the arithmetic mean of all likelihoods







Ensemble Flood Results

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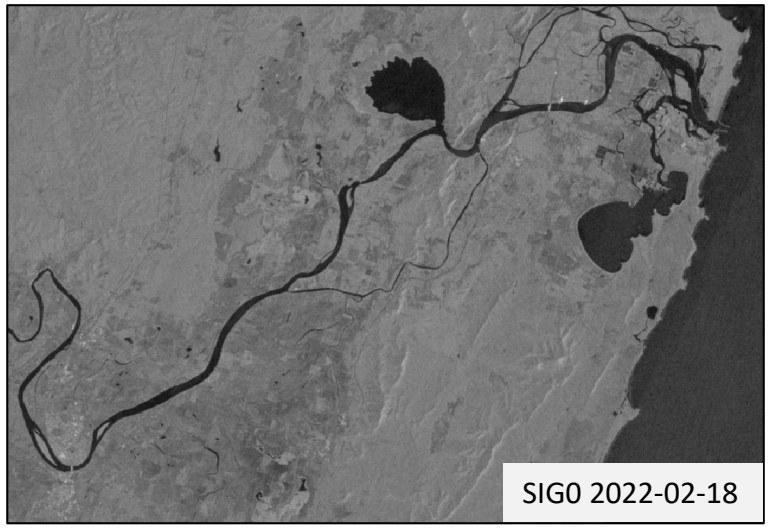

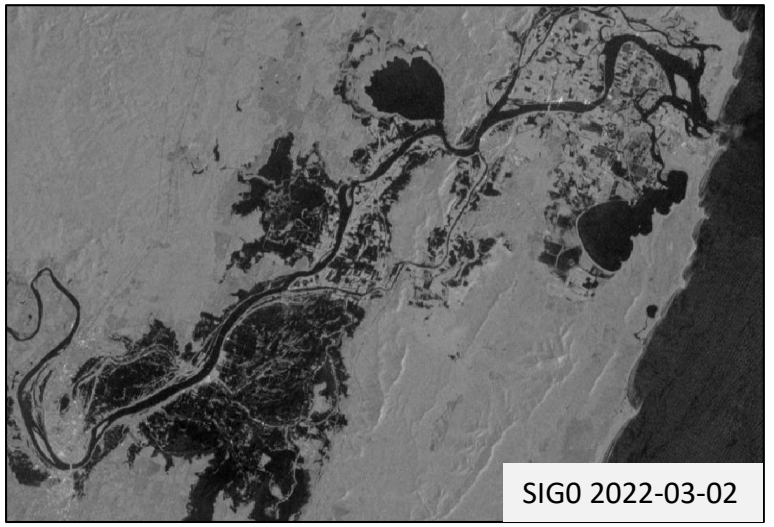

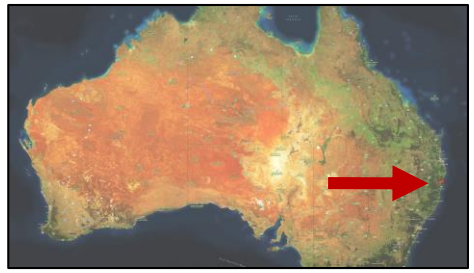

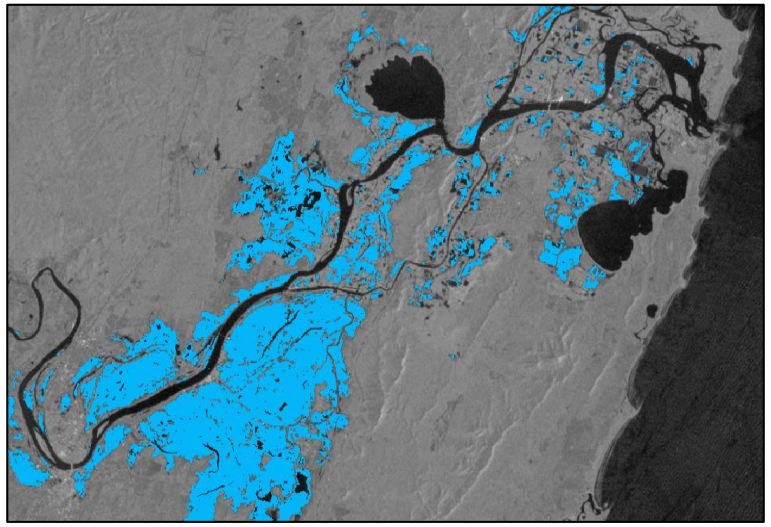

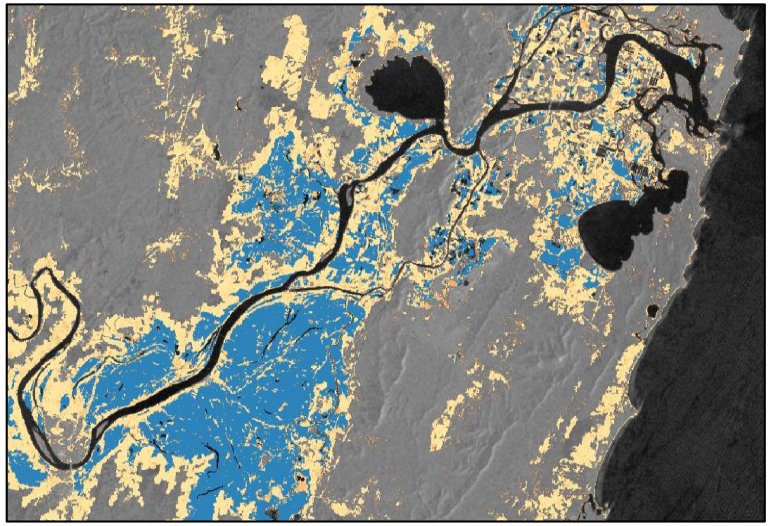

Ensemble flood

Flood

Ensemble likelihood

Certainly flood

Certainly non-flood

10 km

https://emergency.copernicus.eu/

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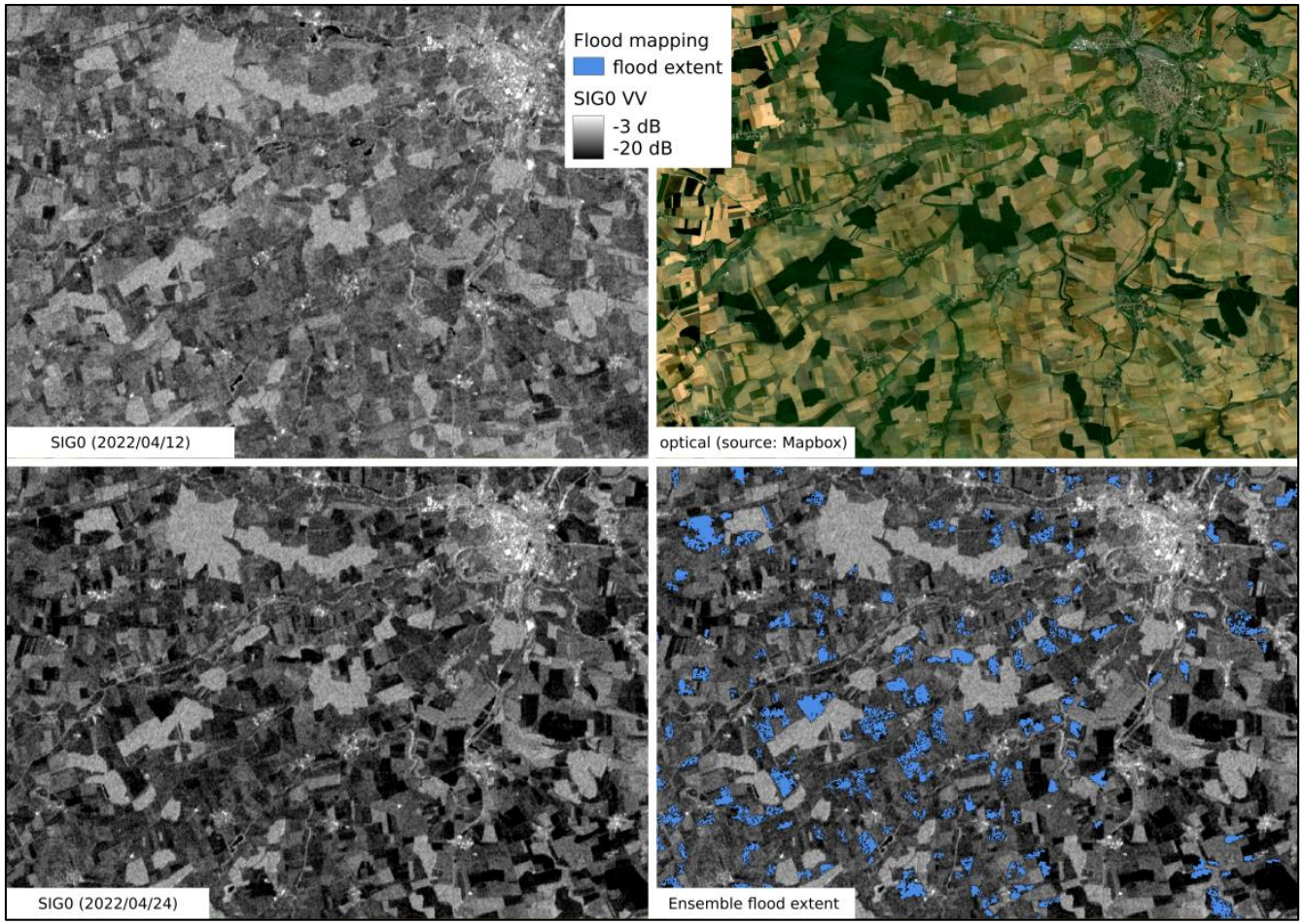
Uncertainties & Limitations

Emergency Management

- Ensemble flood output is a complex scientific data product supported by several novel data layers
- Not all detection errors can be captured
  - Wet snow
  - Frozen soils
  - Agriculture
- Interpret flood pixels using available information
  - Likelihood Layer
  - Exclusion Mask
  - Reference Water
  - Advisory Flags
  - Environmental factors
  - Use local knowledge



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Product Output Layers: Water observations

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S-1 observed flood extent

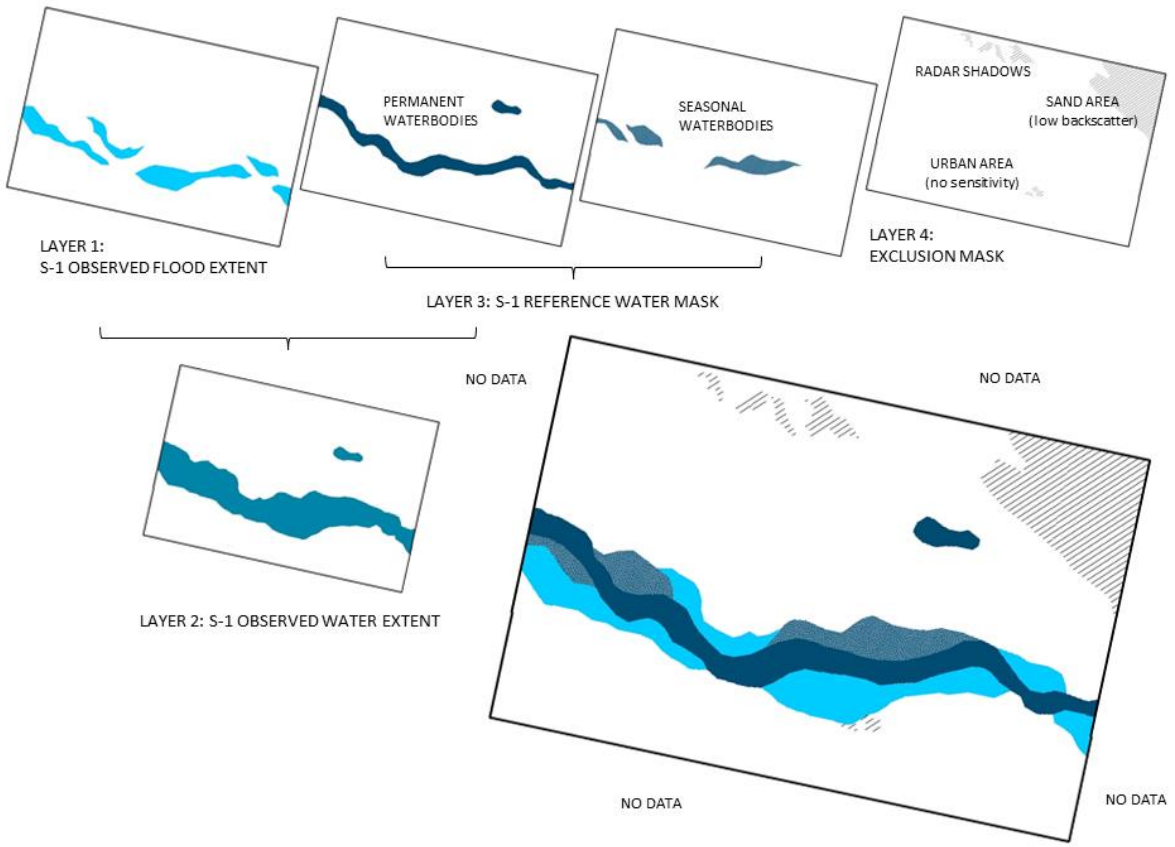
- Ensemble flood extent through flood algorithms by DLR, LIST & TUW

S-1 reference water mask

- Based on water algorithms of DLR & LIST
- Permanent & seasonal water

S-1 observed water extent

- Open water extent as combination of flood extent and reference water



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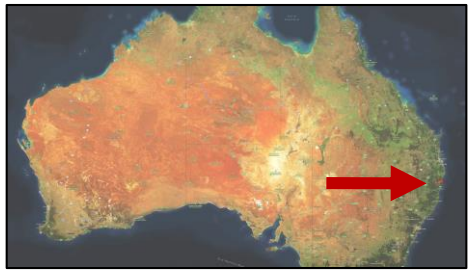
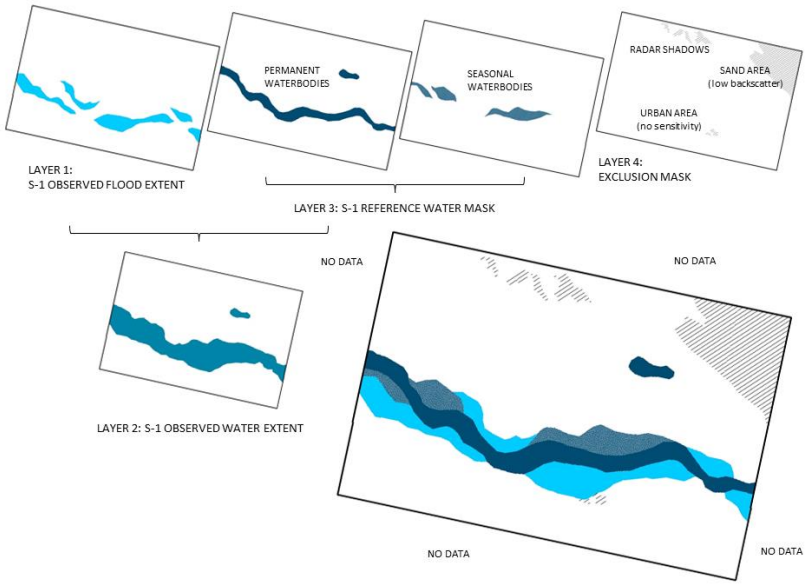
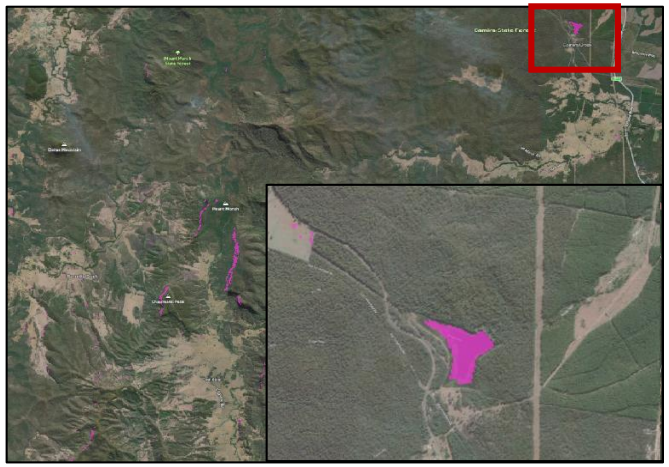
Product Exclusion Mask



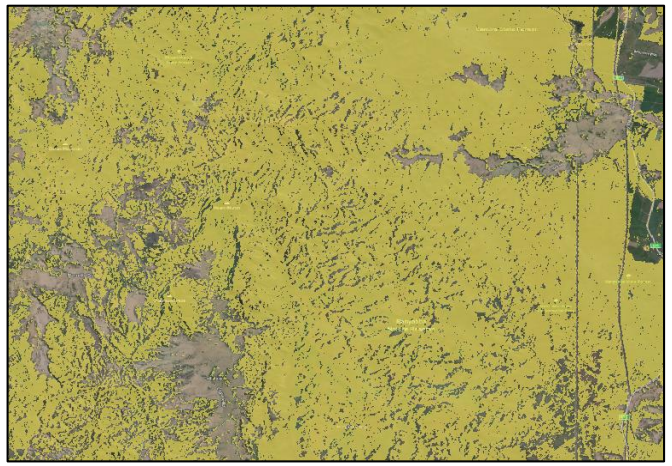


10 km

Radar shadow



Permanent low backscatter



No sensitivity

HAND

Product Output Layers: Contextual Information

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Exclusion mask

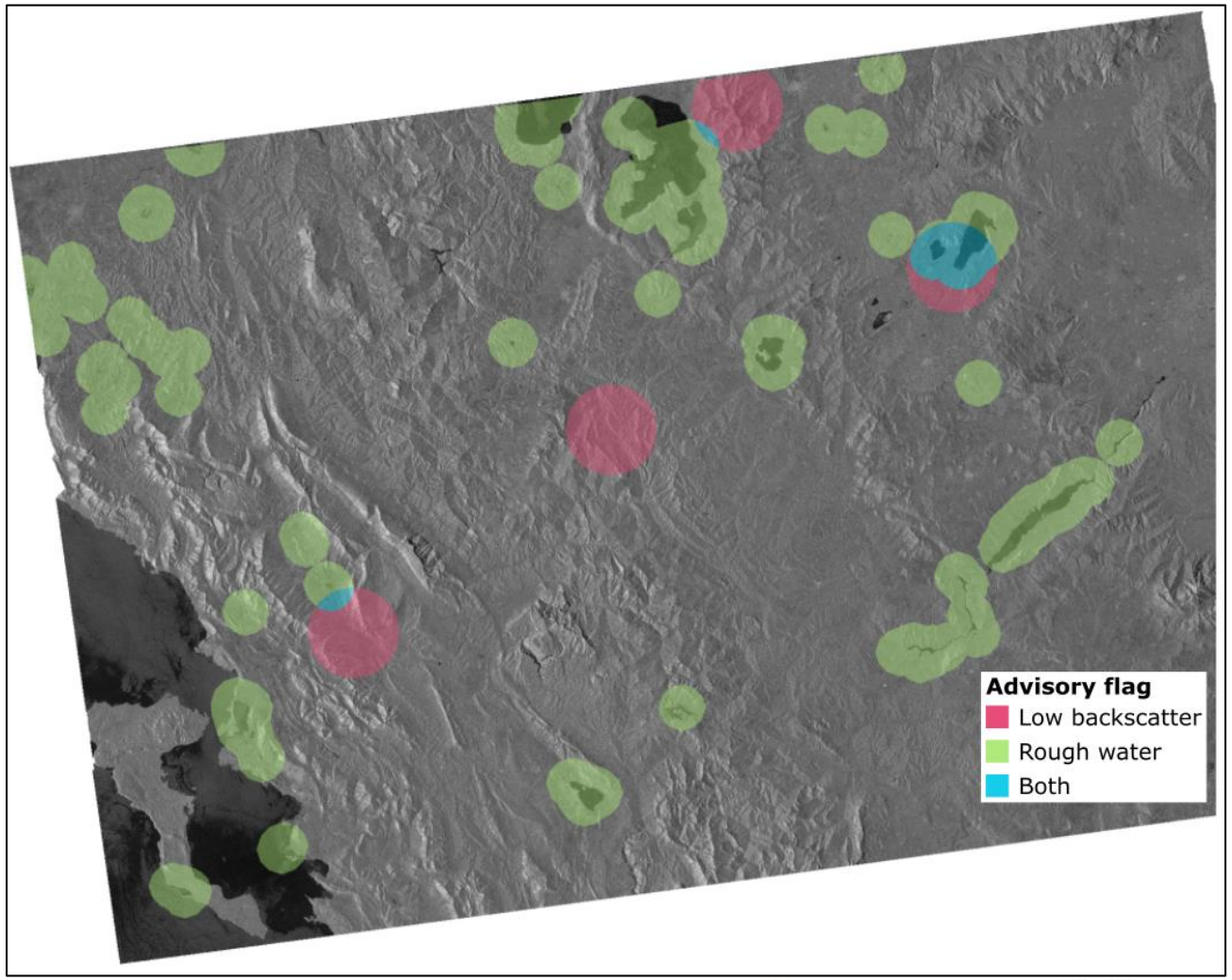
- Exclusion mask where S1 flood delineation is hampered

Likelihood values

- Likelihood values accounting for classification confidence

Advisory flags

- Advisory flags indicating challenging classification circumstances



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Final Results

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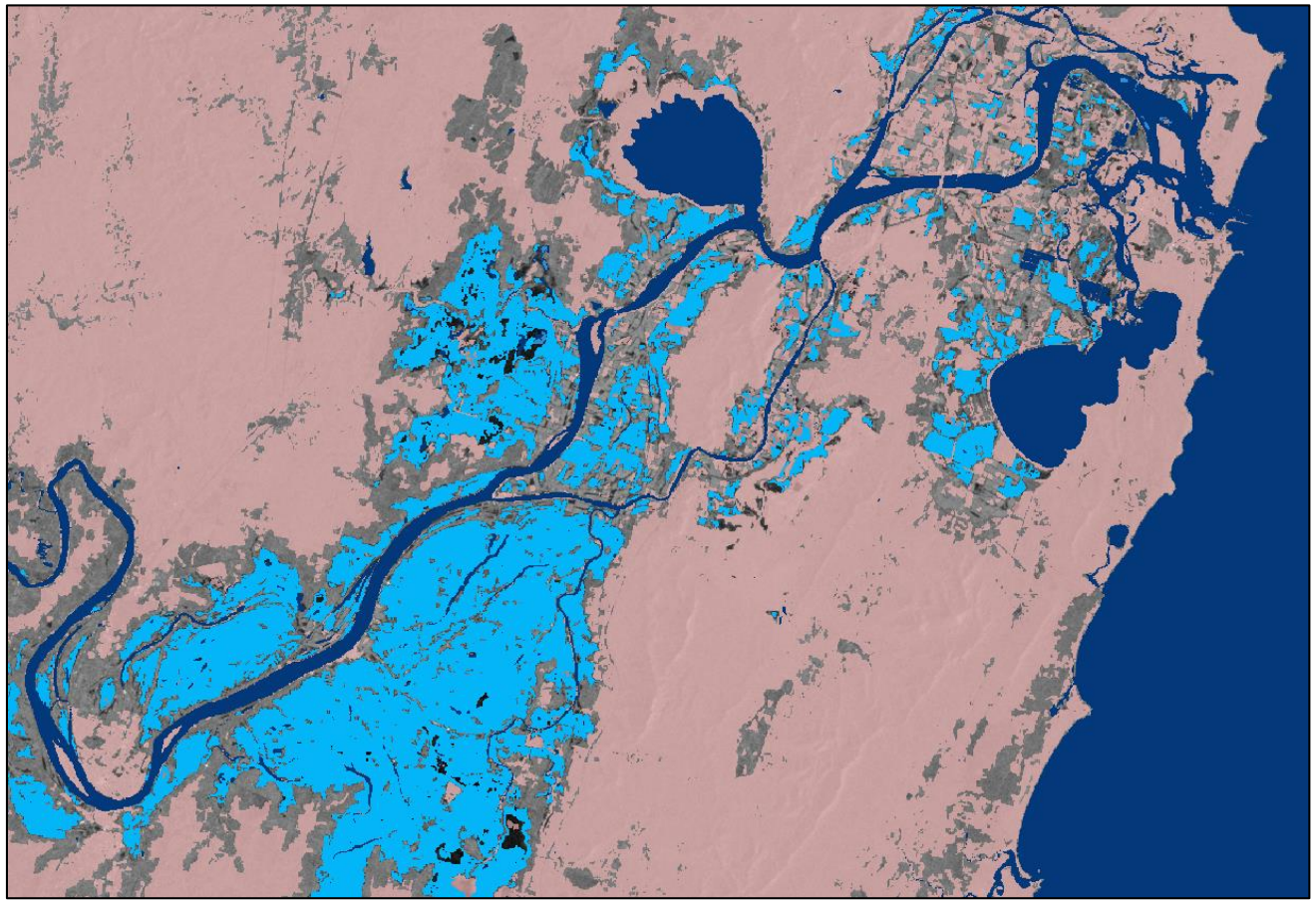
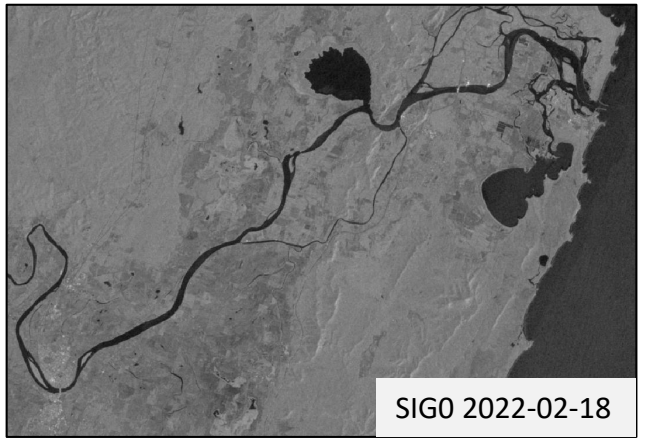
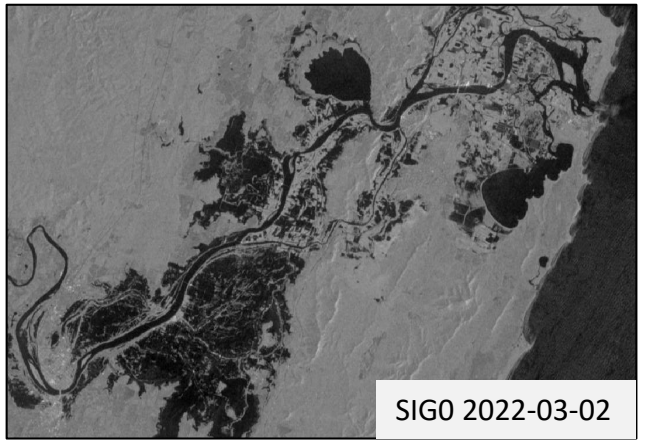
- Majority of exclusion from HAND







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For more insights, please see the GFM Wiki
https://extwiki.eodc.eu/en/GFM/PDD

Thank you for your attention!

Annex: Flood Ensemble Split Decisions

- One algorithm might produce no-data pixels
- Split decisions resolved through likelihood analysis