

# Current status and future developments of the Global Flood Monitoring product

EODC Forum 2022

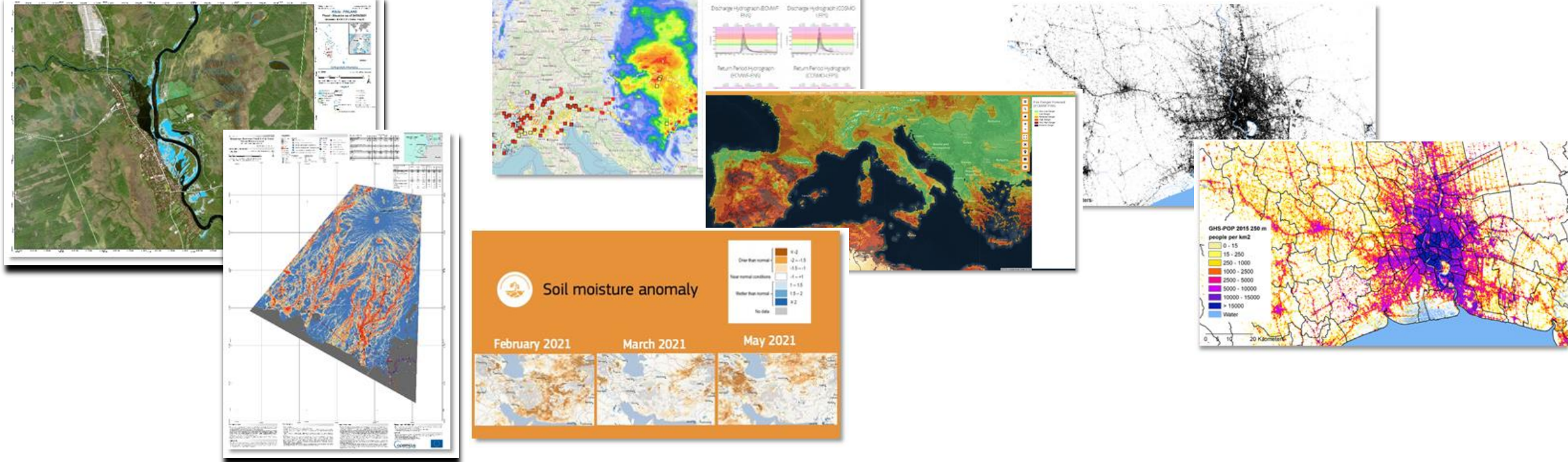
Peter Salamon, Joint Research Center, European  
Commission & GFM consortium



## COPERNICUS EMERGENCY MANAGEMENT SERVICE



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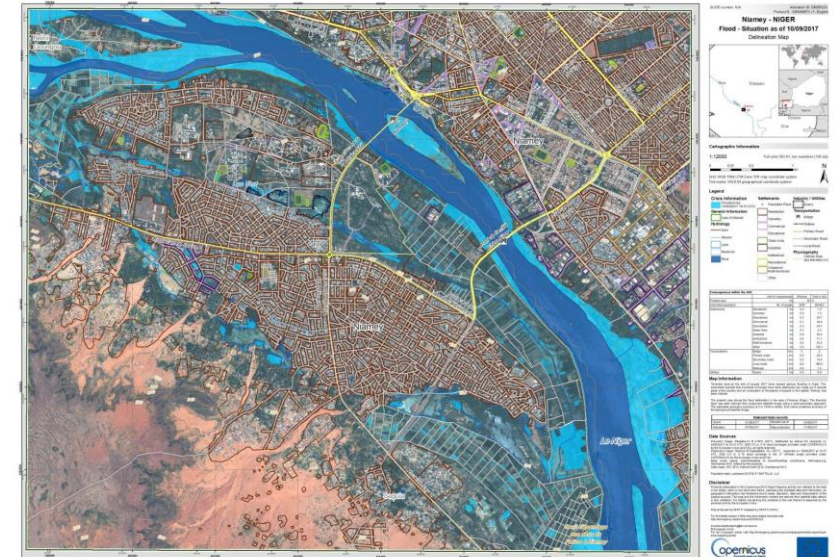
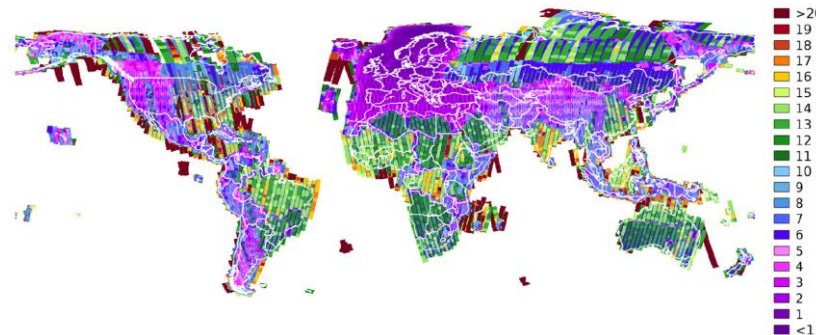
- Operational since 2012
- Managed by the Joint Research Center of the European Commission
- Supports all phases of the disaster risk management cycle

## Technological developments:

- Sentinel-1 A/B enabling **systematic**, high-frequency radar observations at global scale
- Automated SAR-based flood retrieval algorithms have reached **high technical readiness levels**
- **Fast & easy access to imagery**
- **Fast (pre-)processing of data** via cloud-based platforms
- Successful launch of large scale applications enabling a fully automated SAR-based monitoring of water bodies

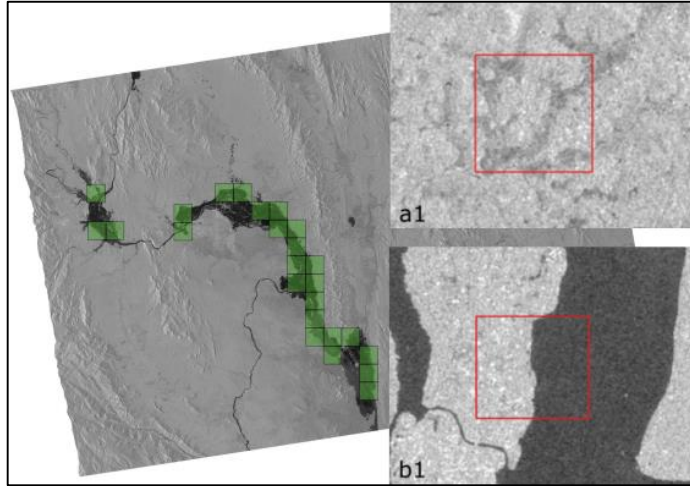
## Current limitations of CEMS:

- No constant automatic monitoring
- Requires user activation
- Activation requests often arrive late (missing flood peak)
- Currently not possible to map all floods (resource limitations)



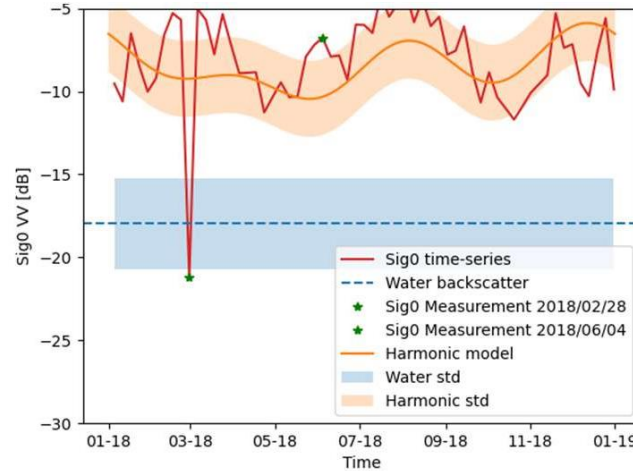
# Combining different strategies to increase robustness

DLR



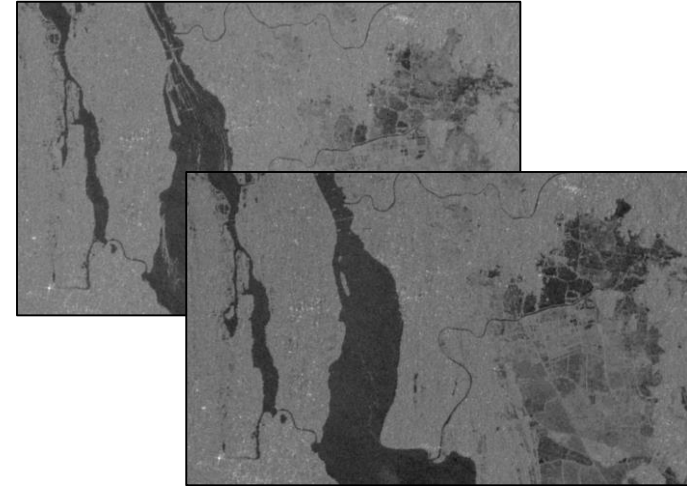
- Hierarchical tile-based thresholding
- Post classification and likelihood estimation through fuzzy logic-based refinement

TUW



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

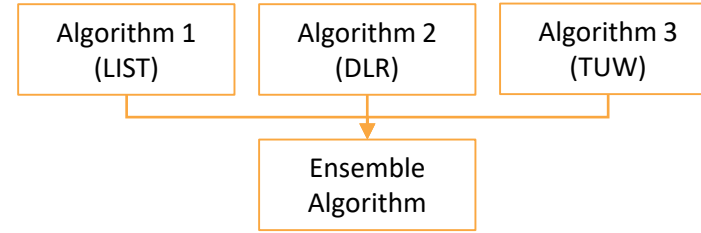
LIST



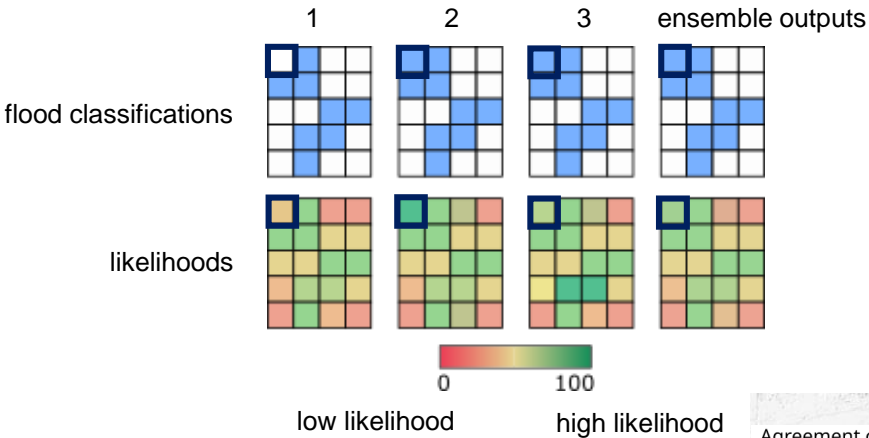
- Change detection
- Flood as deviating water surface
- Likelihood through probability

# Flood Ensemble

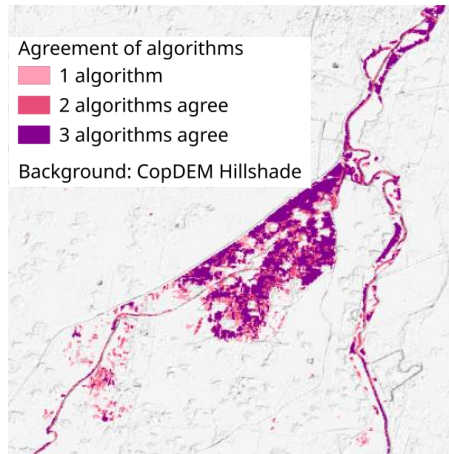
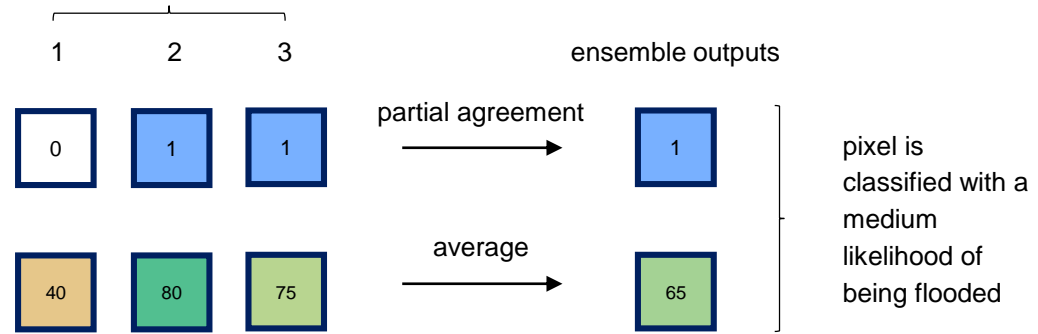
- Combining flood and likelihood results of all three flood algorithms
- Majority vote decides if a pixel is marked as flood or non-flood
- Final likelihood layer is the arithmetic mean of all likelihoods



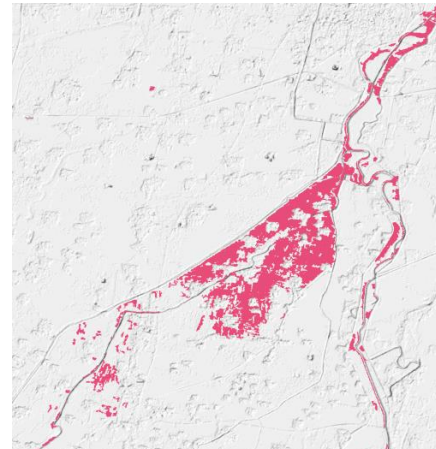
inputs generated from algorithms



example of values from three algorithms over same pixel location in SAR scene

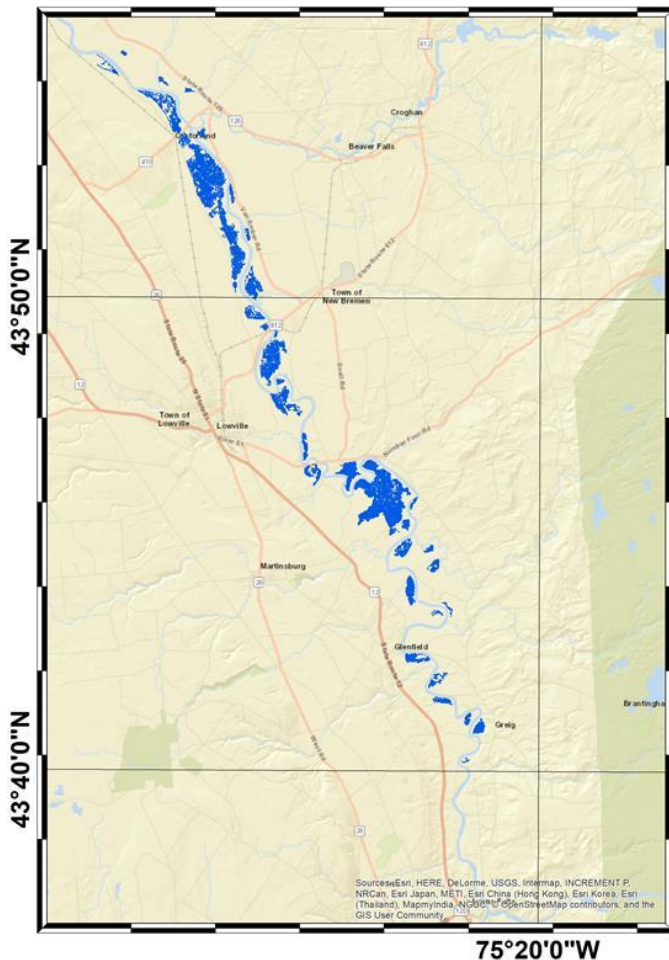


Ensemble



**Flooding near Guantao, China**  
Sentinel-1 scene from 14.10.21

## (Preliminary) Quality Assessment

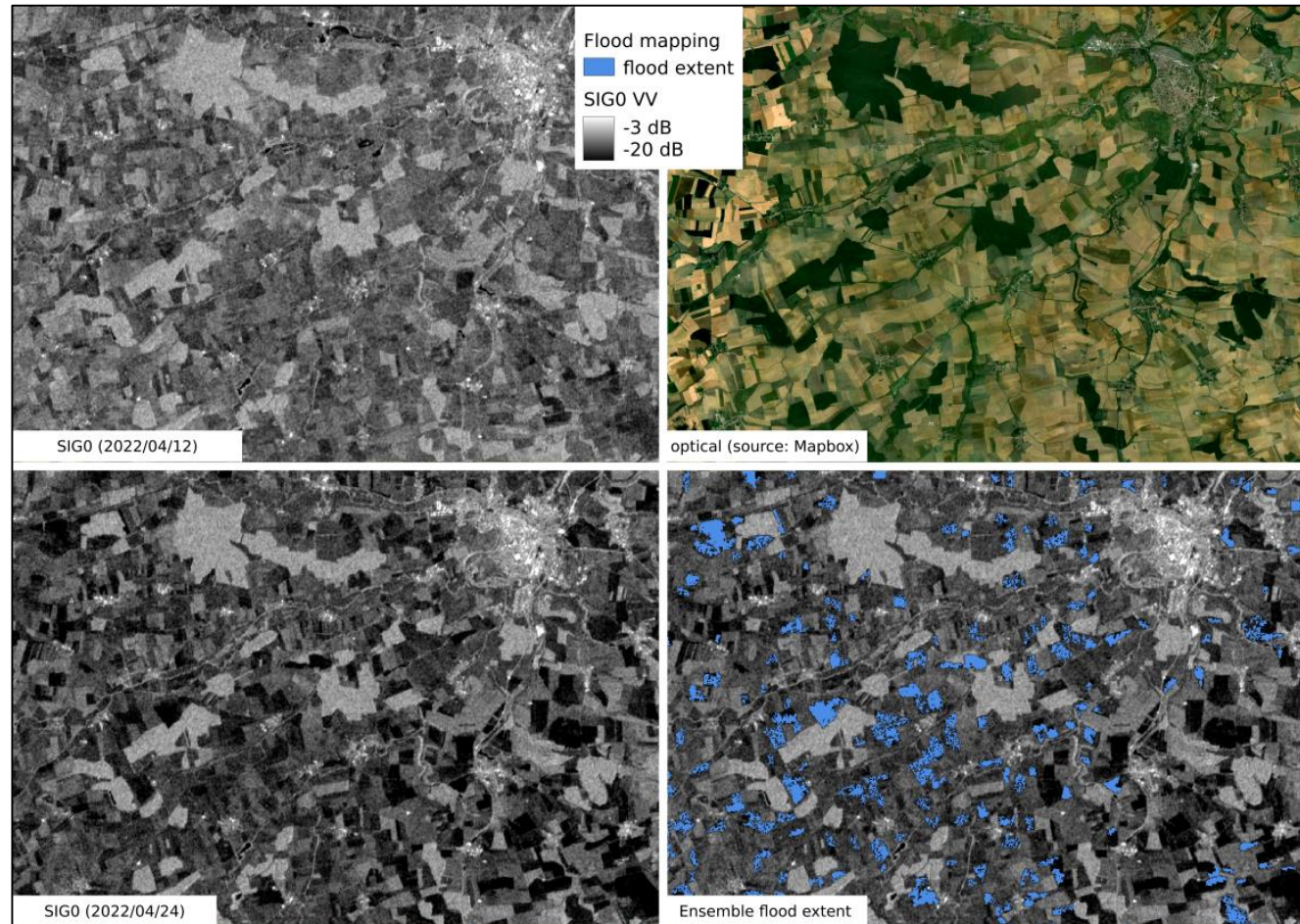


Title	Observed Flood Extent (averaged values)
Critical Success Index	83.76 %
Bias	0.92
Overall accuracy	99.0 %
Omission errors (no flood / flood)	0.23 % / 12.5 %
Commission errors (no flood / flood)	0.87 % / 4.87 %

- use-case based approach
- Compared with higher-quality (manual plus auxiliary data) methodology
- Future developments:
  - Increase number of use-cases
  - Stratified sampling

# Uncertainties & Limitations

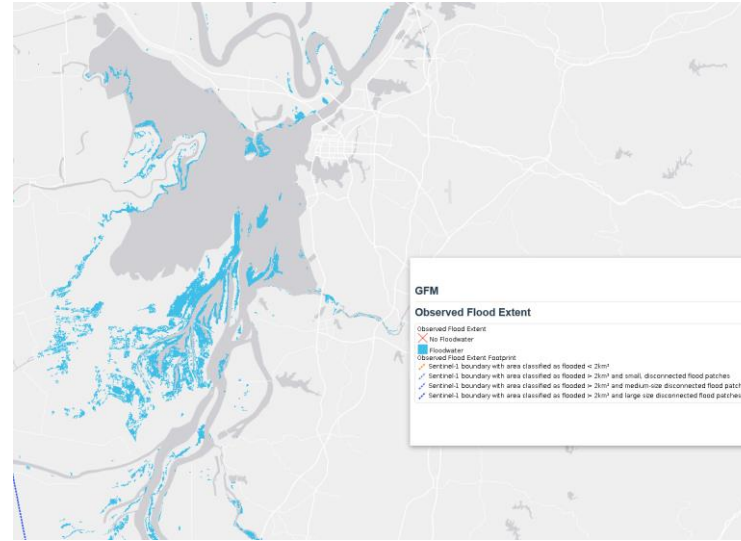
- Ensemble flood output is a complex scientific data product supported by several novel data layers
- Not all detection errors can be captured
  - Wet snow
  - Frozen soils
  - Agriculture
- Interpret flood pixels using available information
  - Likelihood Layer
  - Exclusion Mask
  - Reference Water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



# Product Output Layers: Water observations

## S-1 observed flood extent

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



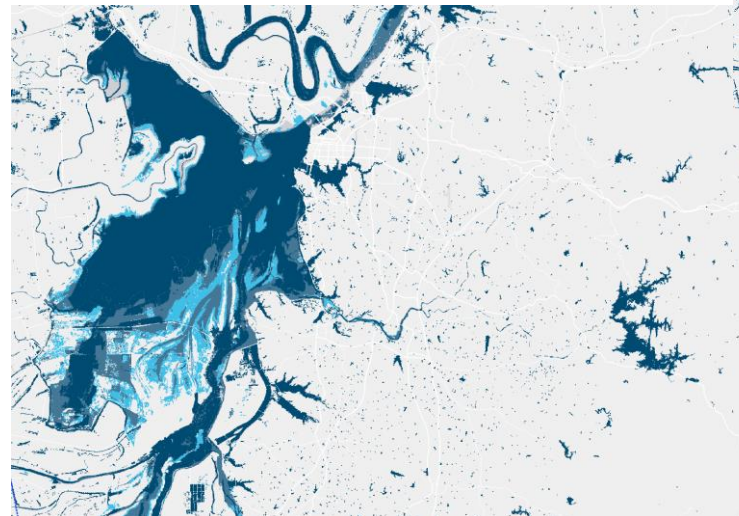
## S-1 reference water mask

- 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





## Product Output Layers: Contextual Information

### Exclusion mask

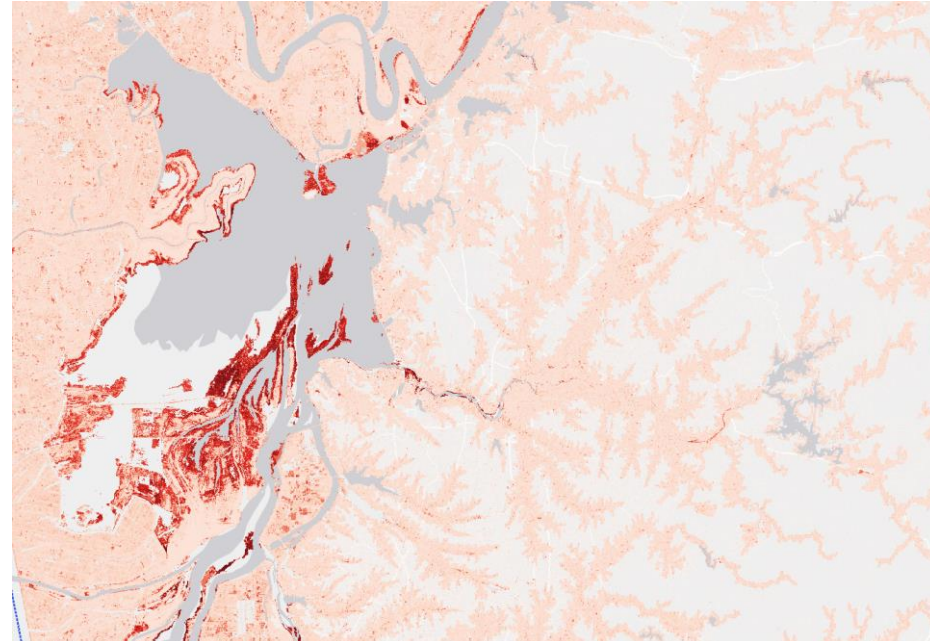
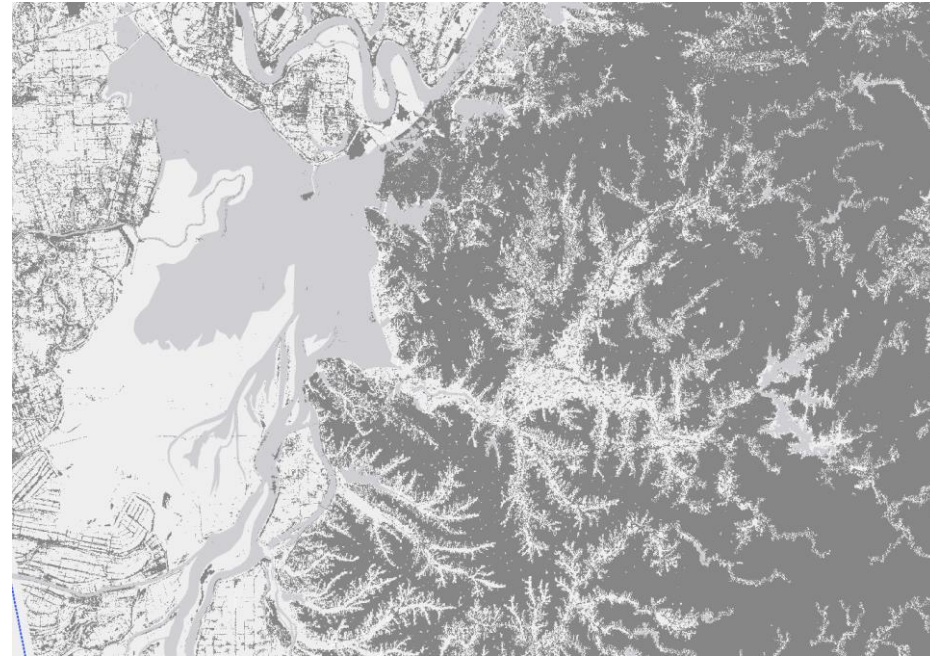
- Exclusion mask where S1 flood delineation is hampered

### Likelihood values

- Likelihood of flood classification

### Advisory flags

- Advisory flags indicating challenging classification circumstances (wind, snow/ice, dryness)



# Product Output Layers: Contextual Information II

## Affected landcover/population

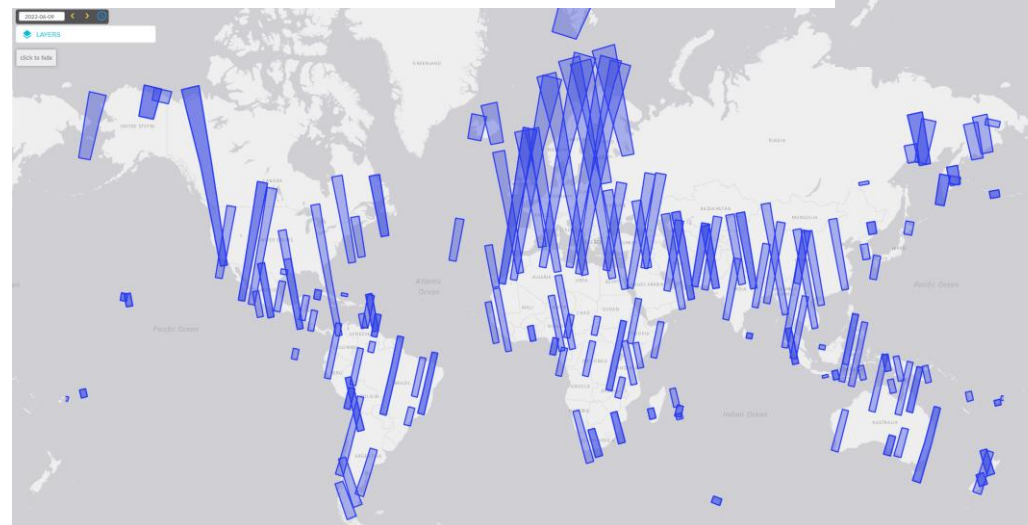
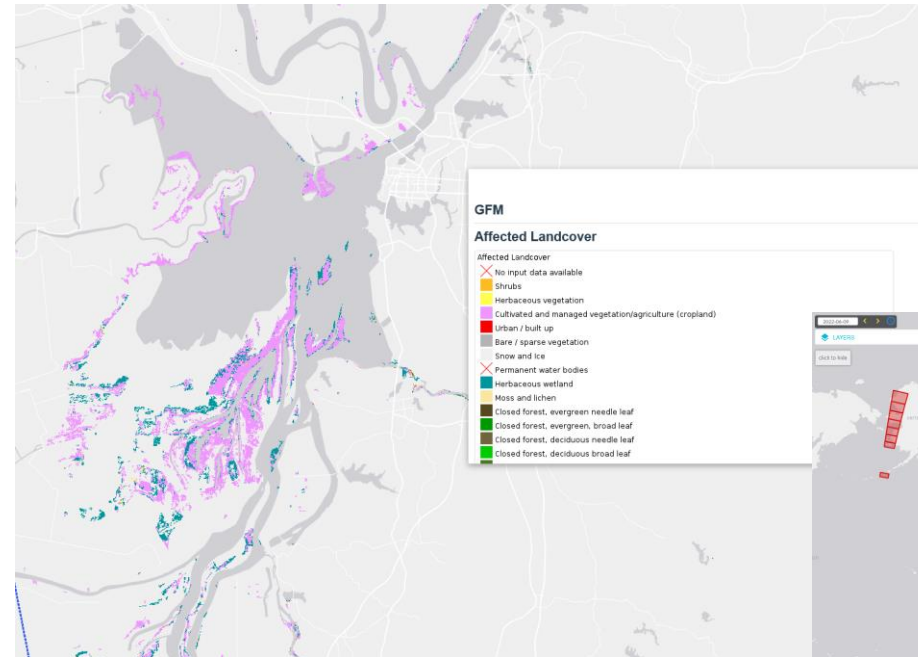
- GHSL and GlobCover/CORINE

## Sentinel 1 Footprint

- S1 footprint boundary for specific day

## Sentinel 1 Schedule

- S1 overflight boundaries for the next 3 days



# Data Access and User Manual

## For Product Visualization

<https://www.globalfloods.eu/>

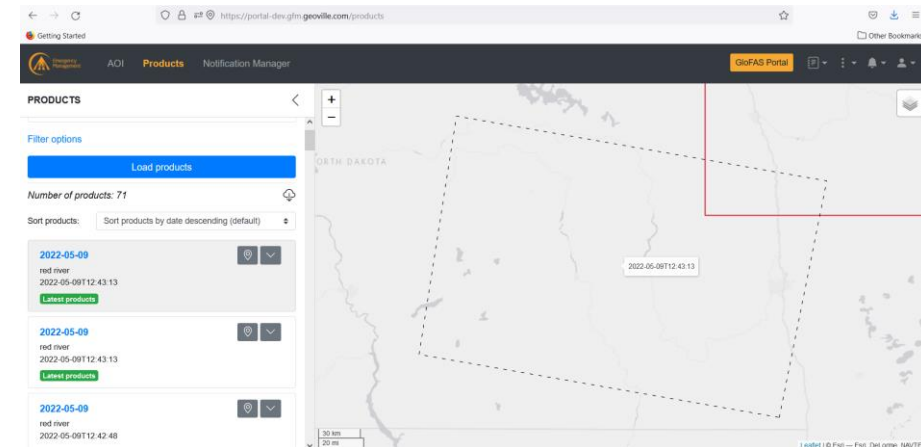
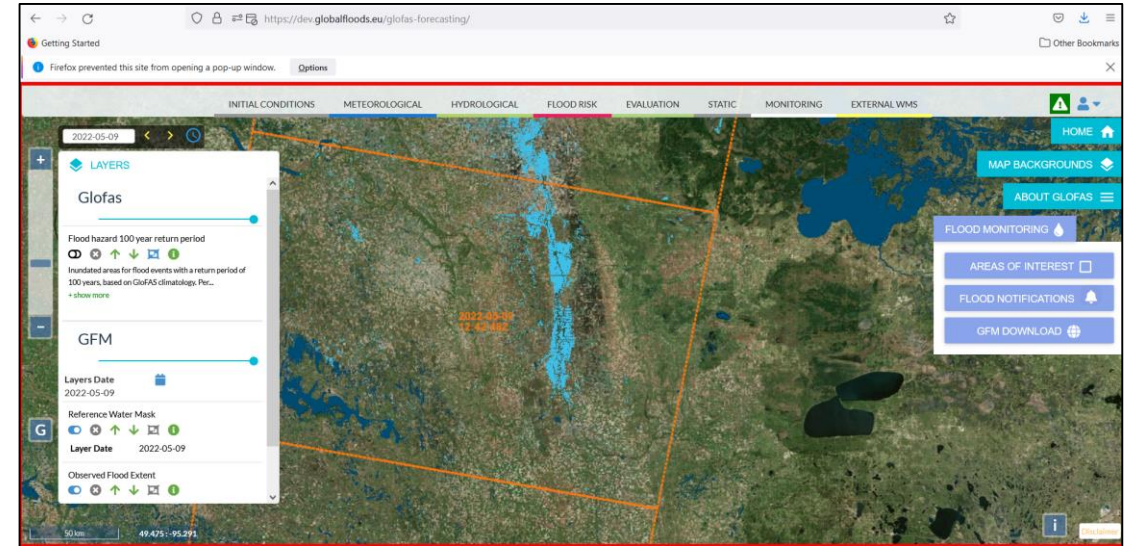
## For Product Download and configuration log in at

<https://gfm.portal.geoville.com/>

One login for all components and functionalities  
(synchronised in the backends)

## Product user manual & Product definition document

<https://extwiki.eodc.eu/en/GFM>



## Future evolutions

### Short term (July/August 2022)

- Updated permanent/seasonal reference water mask (based on data from 2020/2021)
- Updated exclusion mask (improved HAND index, low coverage tiles, ....)
- Bugfixes and minor updates to ensemble algorithms

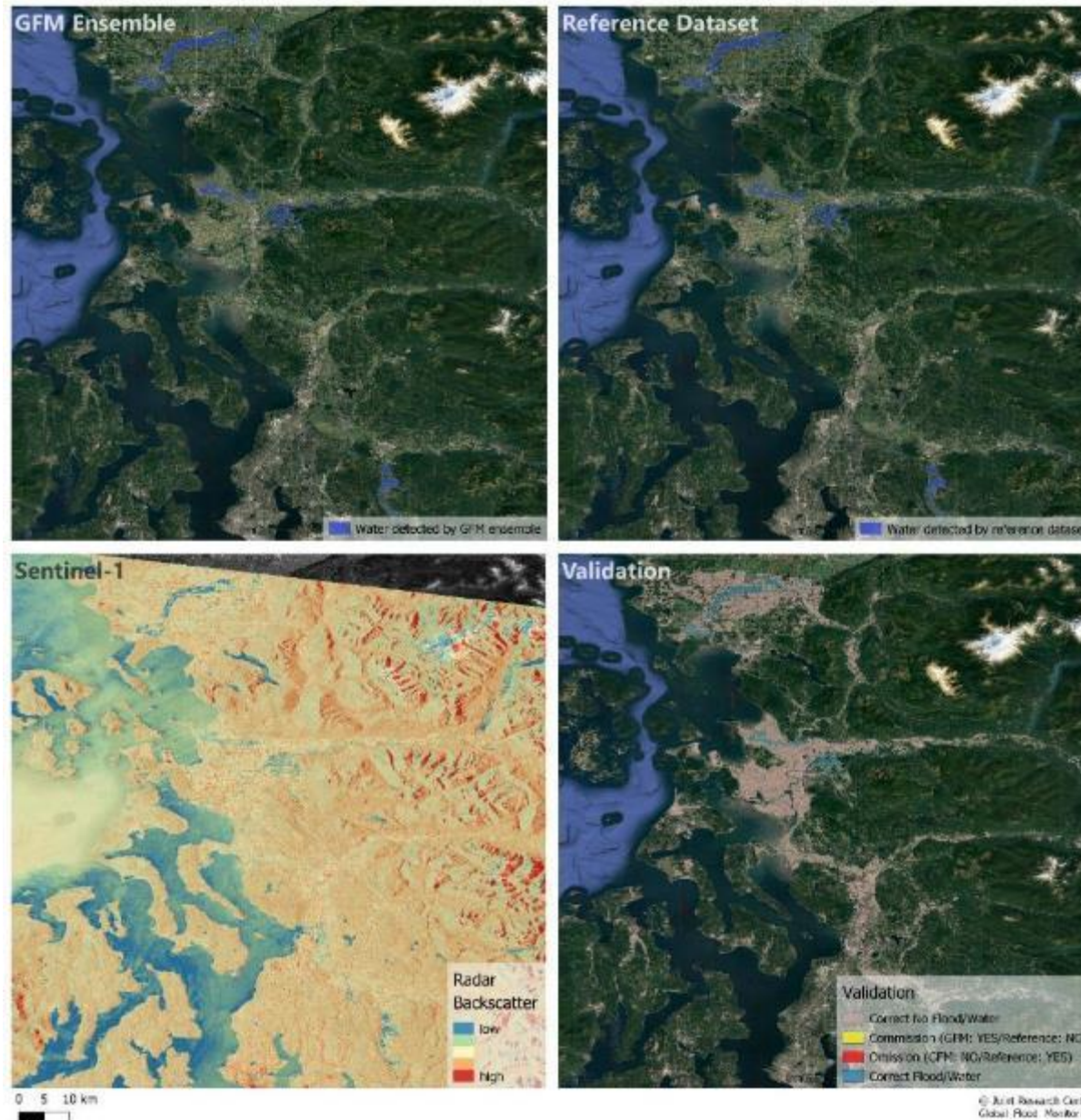
### Mid-term

- Global Flood Archive
- Increased number of use case and stratified sampling for QA

### Long-term

- Updated permanent/seasonal reference water mask (based on data from 2017-2021)
- Algorithm improvements to address overdetection
- Integration of Sentinel 1C

## Washington State, USA



# STAY CONNECTED

EVENTS, ONLINE, and MAP VIEWERS



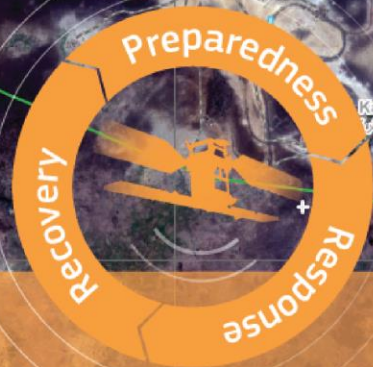
@CopernicusEMS



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Rapid  
Mapping



Risk & Recovery  
Mapping



Floods



Fires



Droughts



Population



Built-up  
areas



PROGRAMME OF THE  
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