Kartierung des September 2024 Hochwassers mittels Sentinel-1 und Sentinel-2: Warum brauchen wir dafür historische Satellitendaten?

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Earth Observation Data Centre for
Water Resources Monitoring

CEMS Global Flood Monitoring (GFM) product

- **Sentinel-1** Synthetic Aperture Radar (SAR)
  - Systematic coverage
  - Currently only one satellite
- **Fully automatic processing** of all incoming Sentinel-1 scenes within 8 hours
- **Ensemble** of 3 flood mapping algorithms
  - LIST, DLR, TU Wien
- **Context** through 11 output layers incl.
  - Flood extent
  - Likelihood
  - Exclusion mask
  - Advisory flags

→ **Advantages**
- No time is lost due to human intervention
- Discover unreported events

→ **Disadvantages**
- False alarms
- Processing overhead

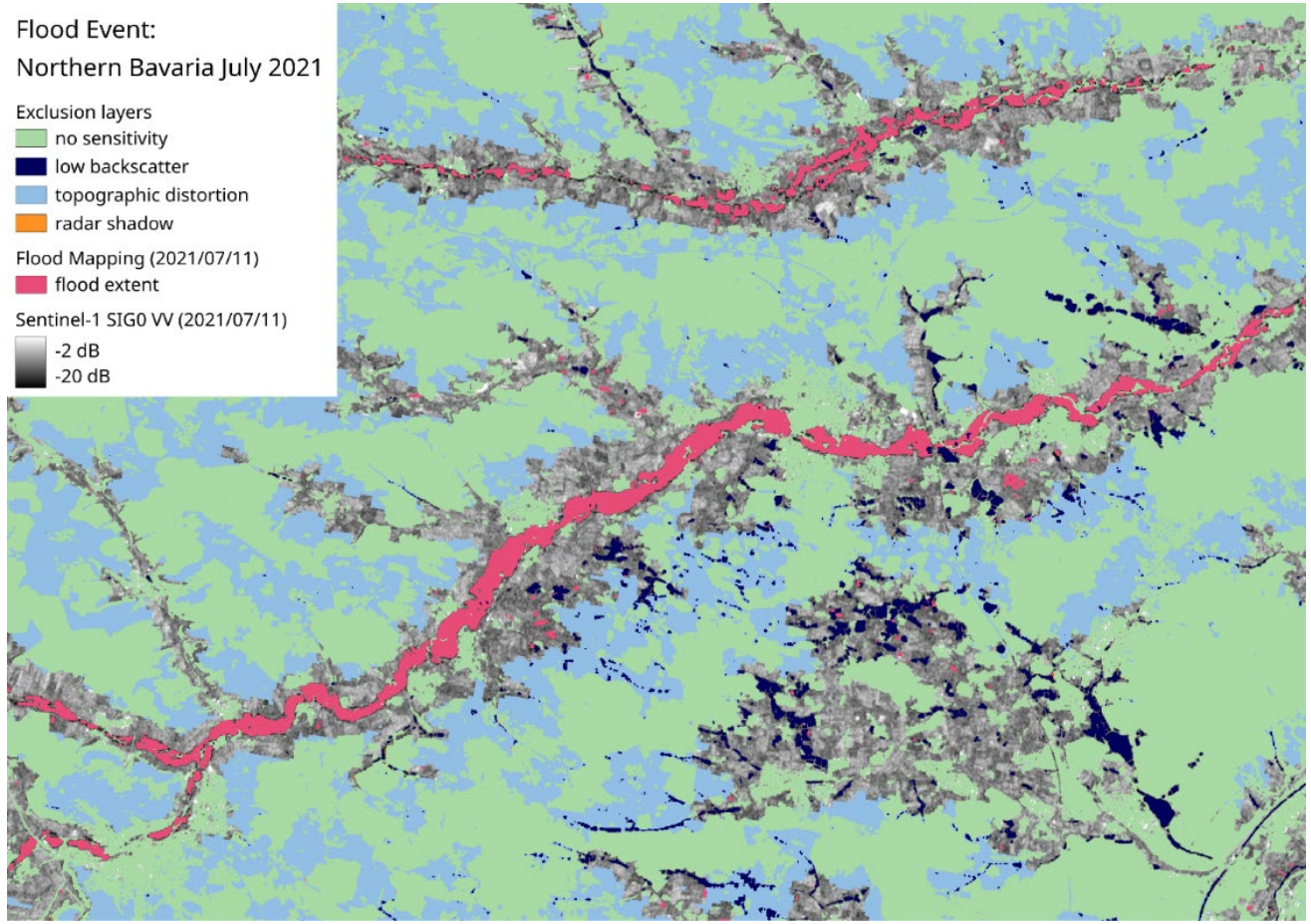
→ **Challenges**
- Accuracy
- Timeliness

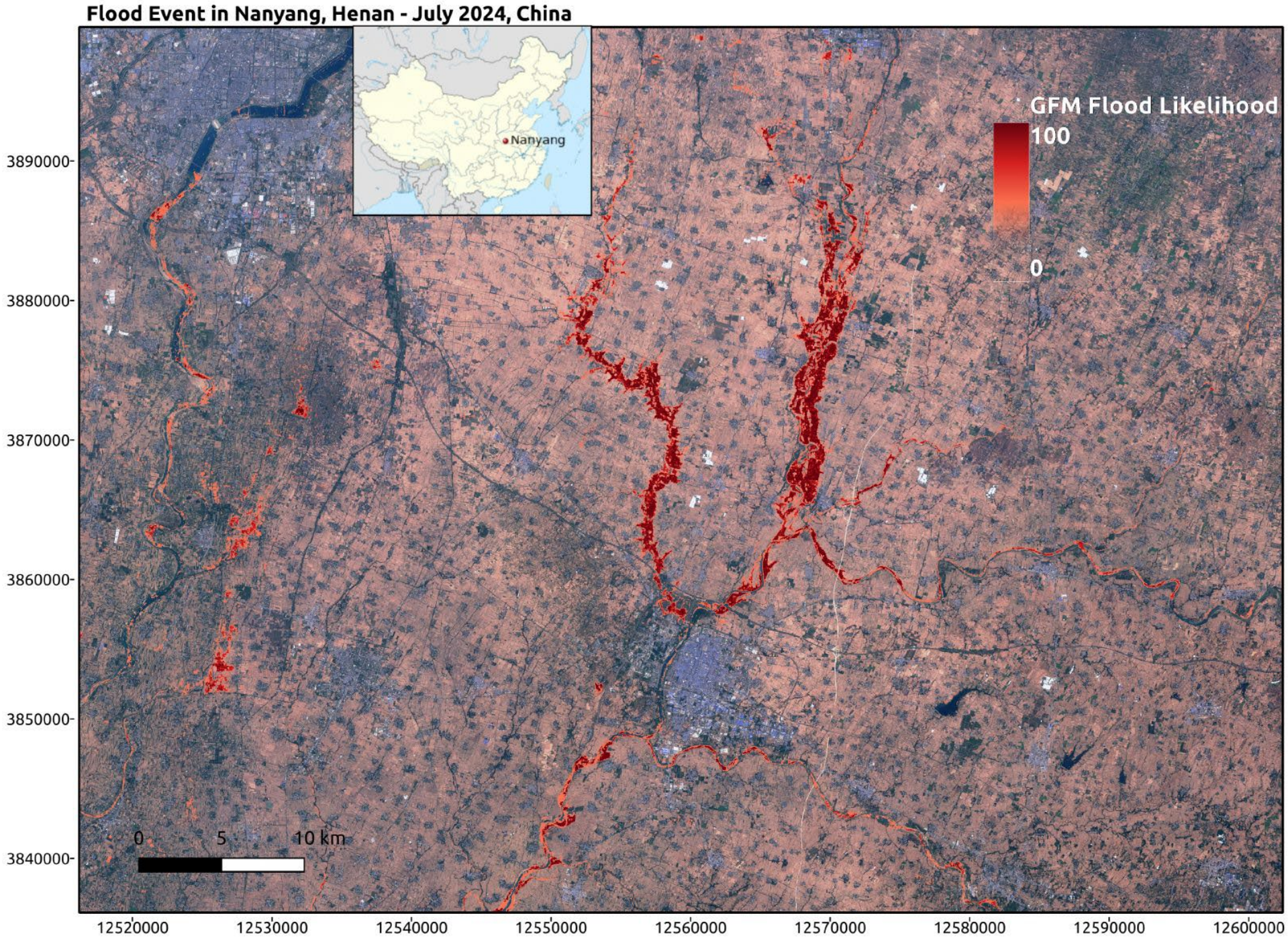
Wagner et al. (2020) Data processing architectures for monitoring floods using Sentinel-1, ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., V-3-2020, 641–648.

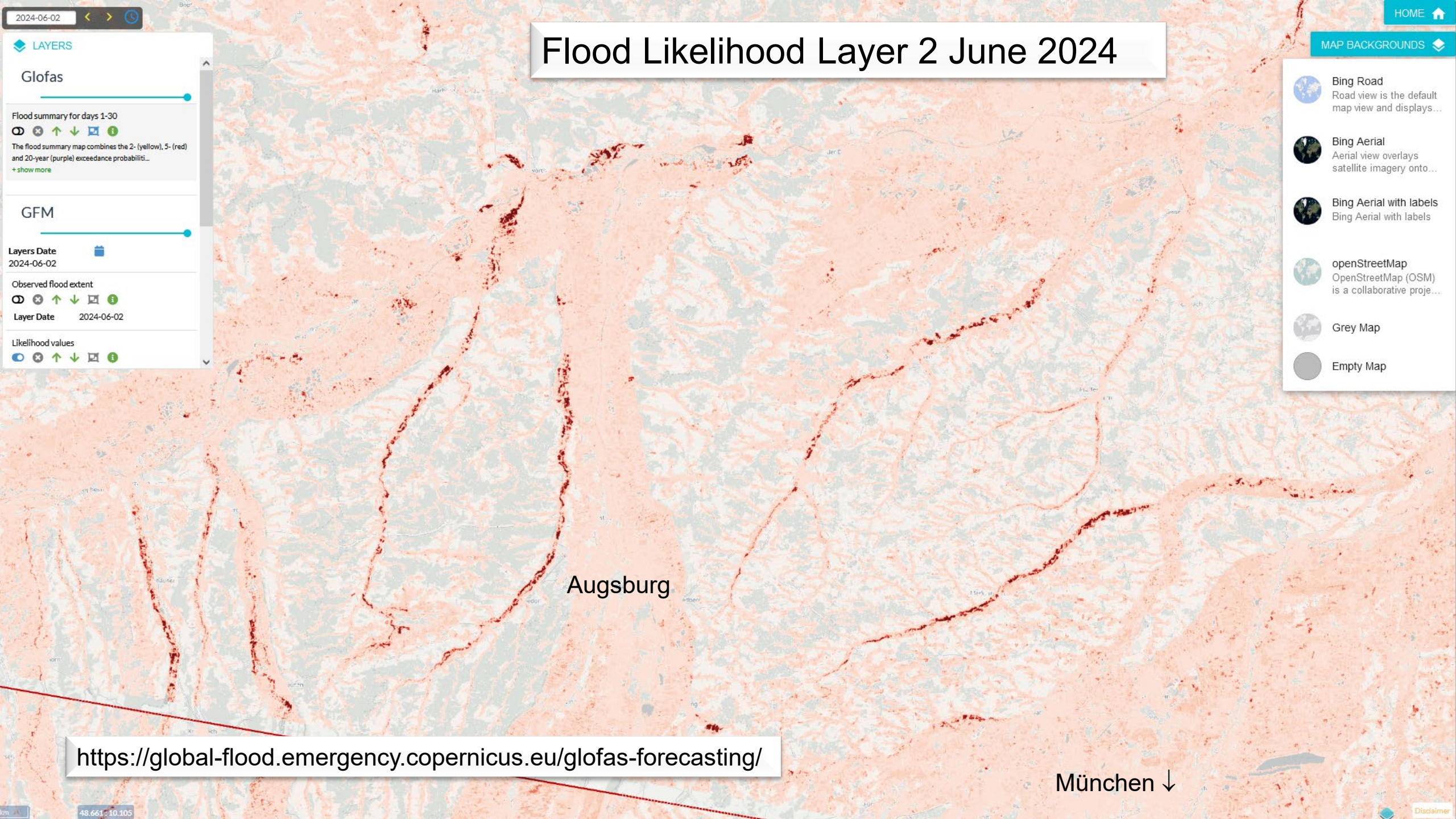
Exclusion Mask

- Masking of pixels where Sentinel-1 is unable to detect flooding
  - No sensitivity
    - forests, urban areas, …
  - Low backscatter
    - paved surfaces, sand, …
  - Topography
  - Radar shadows

- Advisory flags:
  - Mask dynamic influences
  - Low regional backscatter (snow, ice dryness)
  - Rough water surface (Wind)

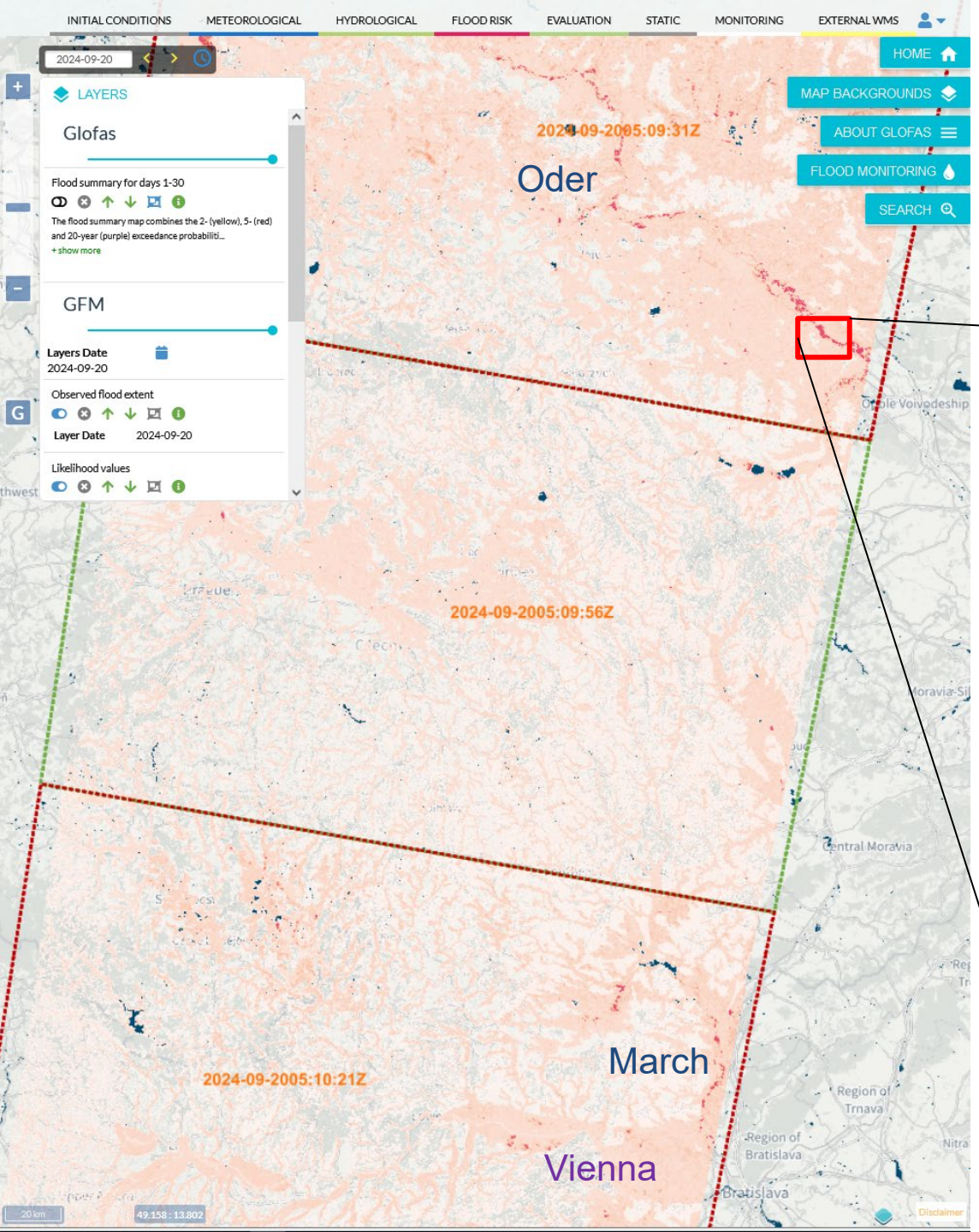


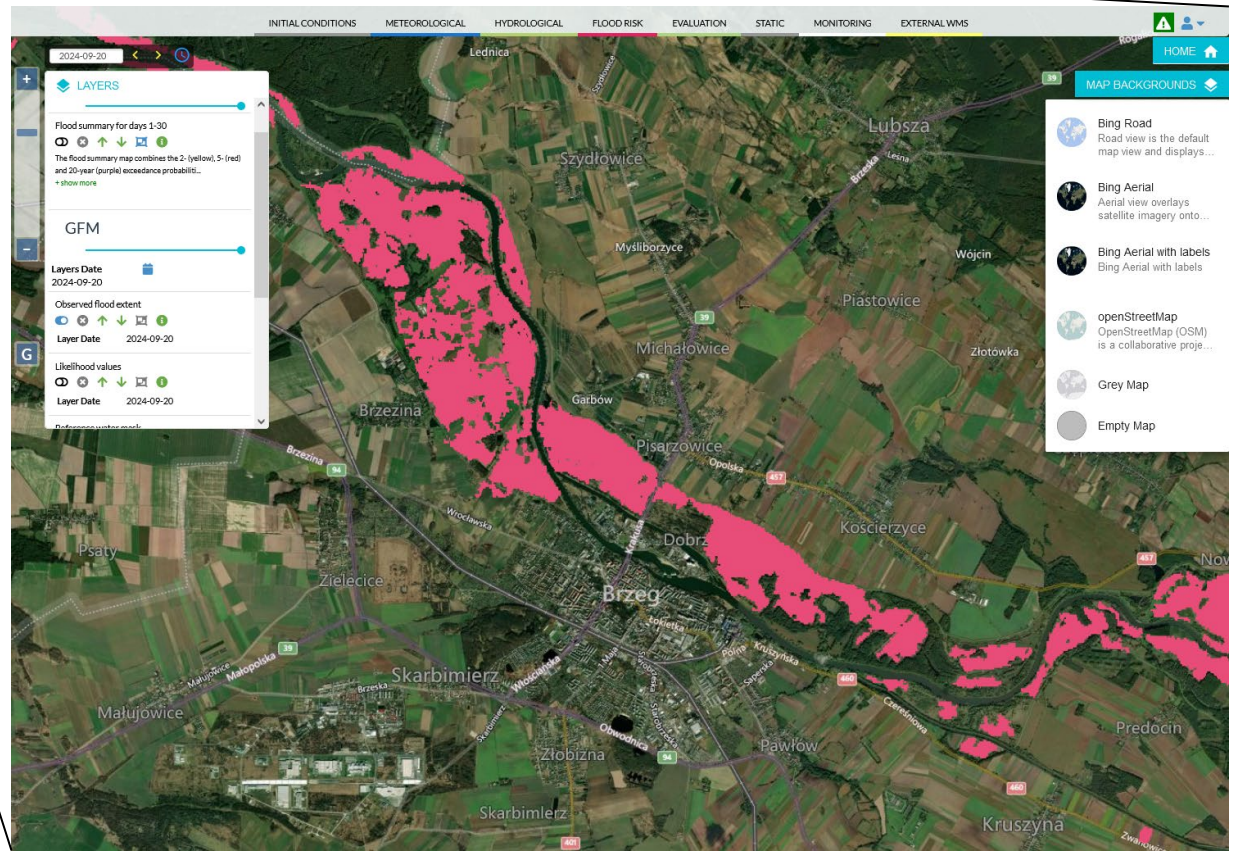

Flood Event in Nanyang, Henan - July 2024, China
Nanyang
GFM Flood Likelihood
100
0
0
5
10 km
3890000
3880000
3870000
3860000
3850000
3840000
12520000
12530000
12540000
12550000
12560000
12570000
12580000
12590000
12600000


2024-06-02
LAYERS
Glofas
Flood summary for days 1-30
The flood summary map combines the 2- (yellow), 5- (red) and 20-year (purple) exceedance probabiliti...
+ show more
GFM
Layers Date
2024-06-02
Observed flood extent
Layer Date 2024-06-02
Likelihood values
Flood Likelihood Layer 2 June 2024
HOME
MAP BACKGROUNDS
Bing Road
Road view is the default map view and displays...
Bing Aerial
Aerial view overlays satellite imagery onto...
Bing Aerial with labels
Bing Aerial with labels
openStreetMap
OpenStreetMap (OSM) is a collaborative proje...
Grey Map
Empty Map
Augsburg
https://global-flood.emergency.copernicus.eu/glofas-forecasting/
München ↓
48.661 : 10.105
Disclaimer

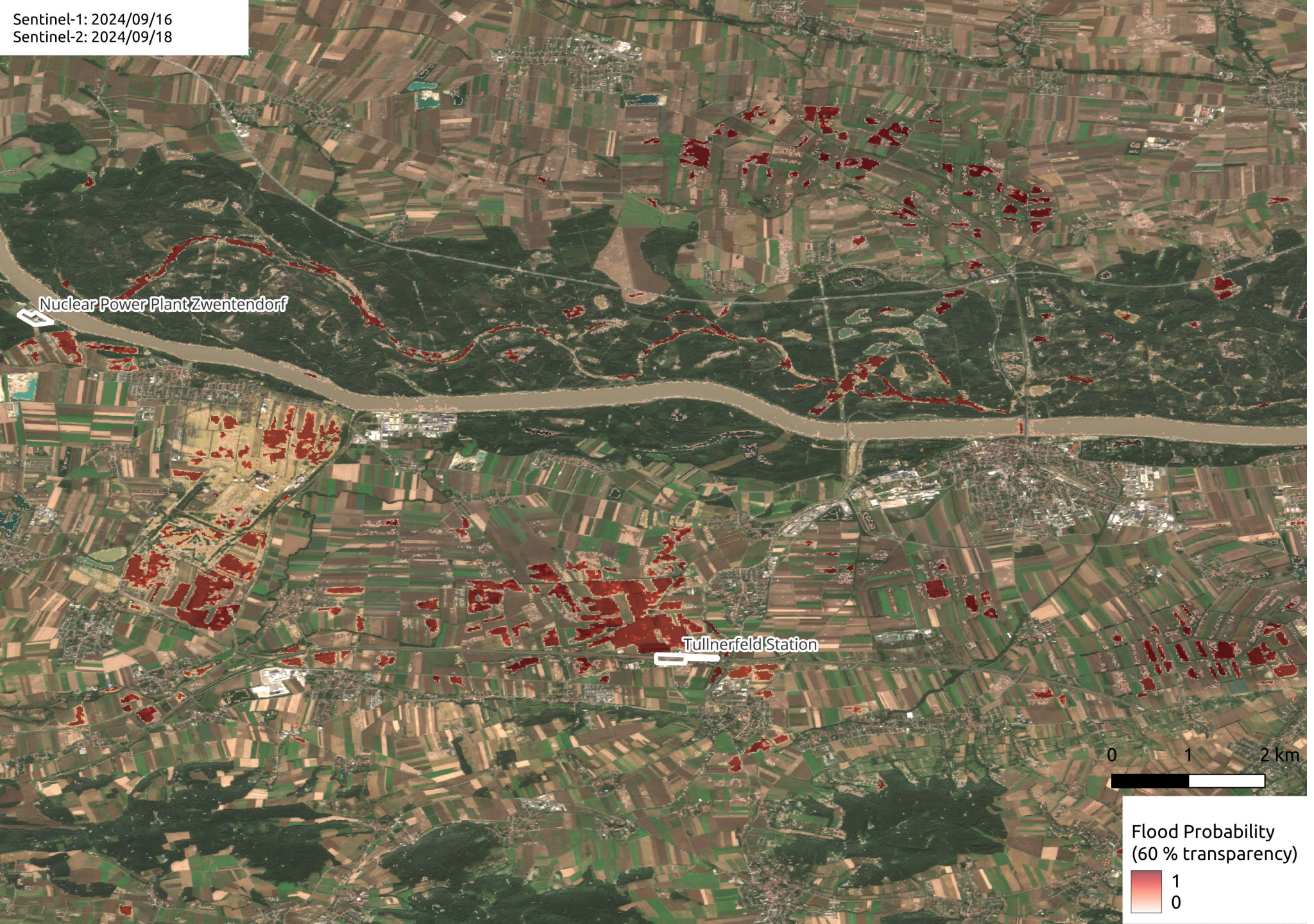
Central Europe Flood 2024

- Overview of flood situation from Austria to Czech Republic to Poland on 20th September morning





https://global-flood.emergency.copernicus.eu/glofas-forecasting/



Data analysis by Florian Roth using algorithms developed and tested in FFG funded projects: S1Floods.AT and ScaleFloods

Two day difference between Sentinel-1 and Sentinel-2 data acquisitions:

Sentinel-1: 16.9.2024
Sentinel-2: 18.9.2024

Sentinel-1 flood probability is overlain on the Sentinel-2 image.

HPTODAY COMMENTARY

Hydrology on solid grounds? Integration is key to closing knowledge gaps concerning landscape subsurface water storage dynamics

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Abstract

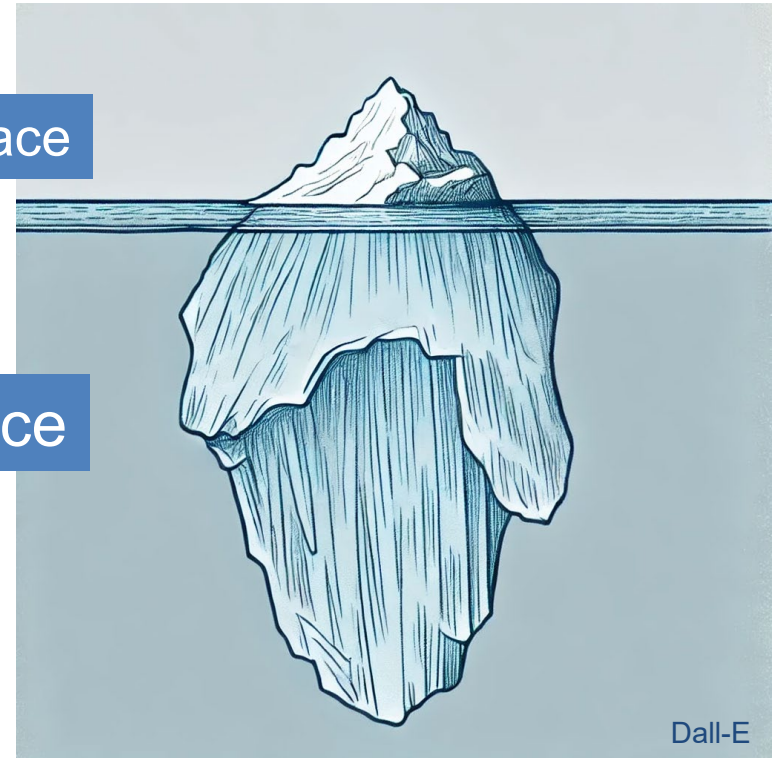
Individual approaches to observe water dynamics across our landscape, from the land surface to groundwater, are many though they individually only provide glimpses into the real world due to their specific space-time scales. Comprehensive integration across all available observations is still largely lacking, limiting both our ability to reduce scientific knowledge gaps, and to guide land and water management using the best available scientific evidence. We argue that a stronger focus on integration of observational products, while utilizing machine learning and accounting for current perceptual understanding, is urgently needed to overcome this limitation. Since Europe is warming faster than any other continent, central Europe is undergoing a dramatic hydro-climatic transition about which such integrated observations would provide timely and valuable insights. Here we present potential and gaps of current and planned observational methods. We argue that hyper-resolution (sub km) integrated estimates of landscape water dynamics are feasible, which could significantly improve our ability to simulate vadose zone and groundwater dynamics. Ultimately closing gaps in our current perception of hydrological processes in a temperate region under strong influence from climate change. We close by arguing that an interdisciplinary effort of various scientific communities is needed to enable this advancement.

KEYWORDS
subsurface water storage, observations, scales, Central Europe, critical zone, groundwater recharge

Commentary to be published in Hydrological Processes

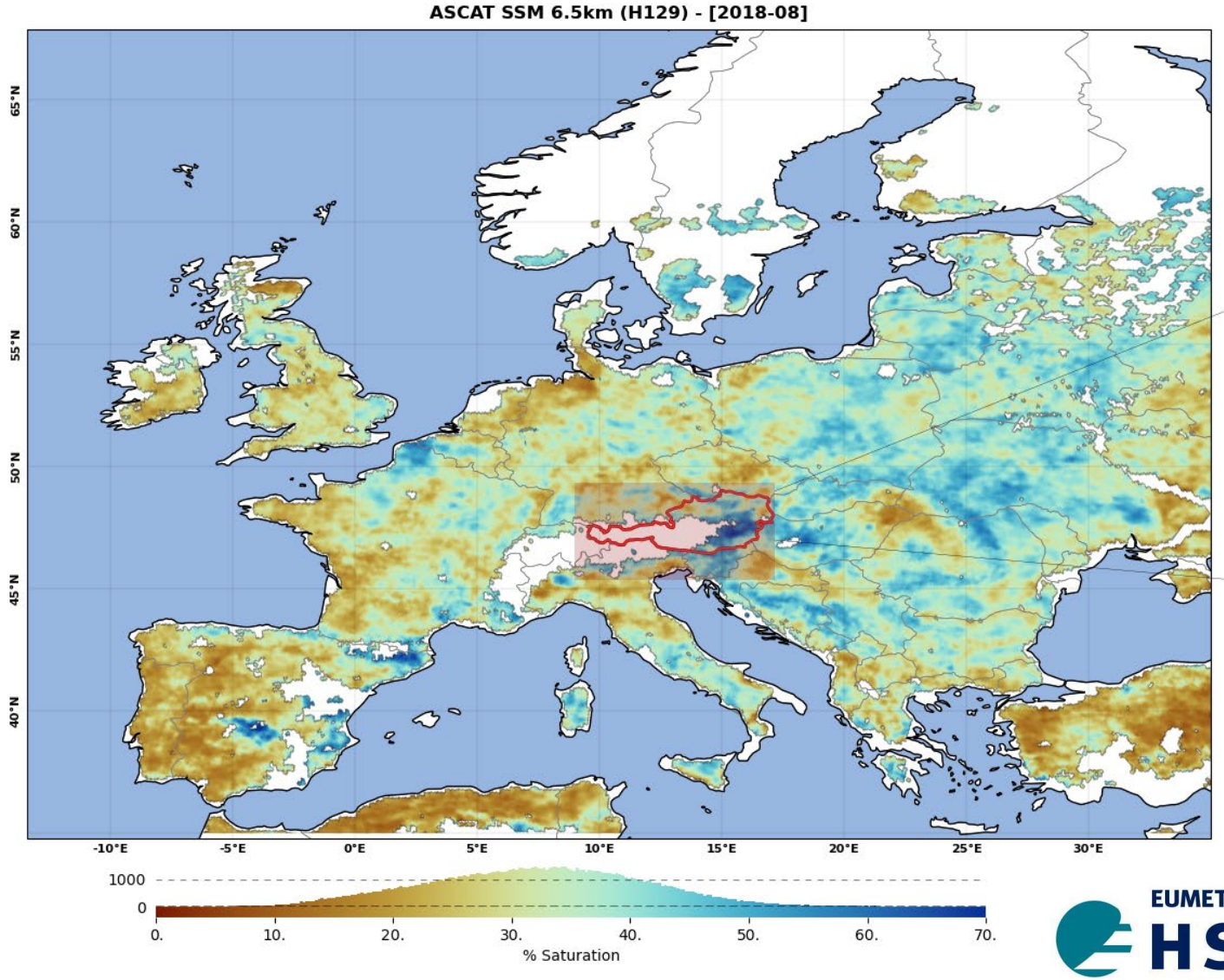
Earth Surface

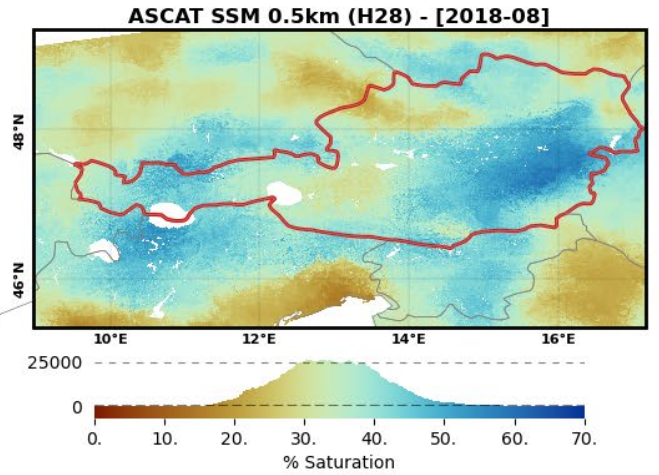
Subsurface

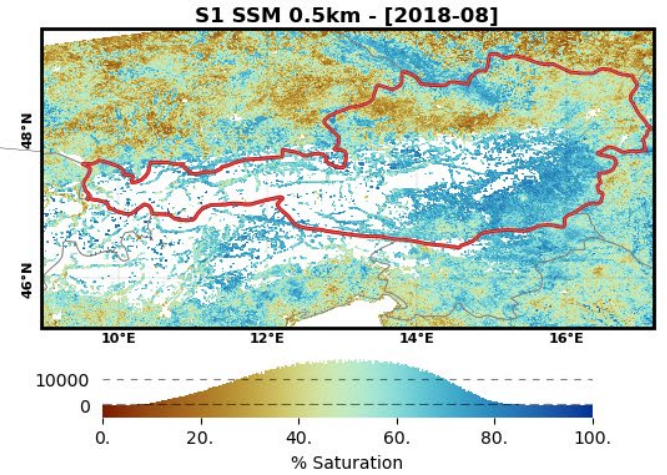


Dall-E

Dynamic Soil Moisture Monitoring with ASCAT and Sentinel-1





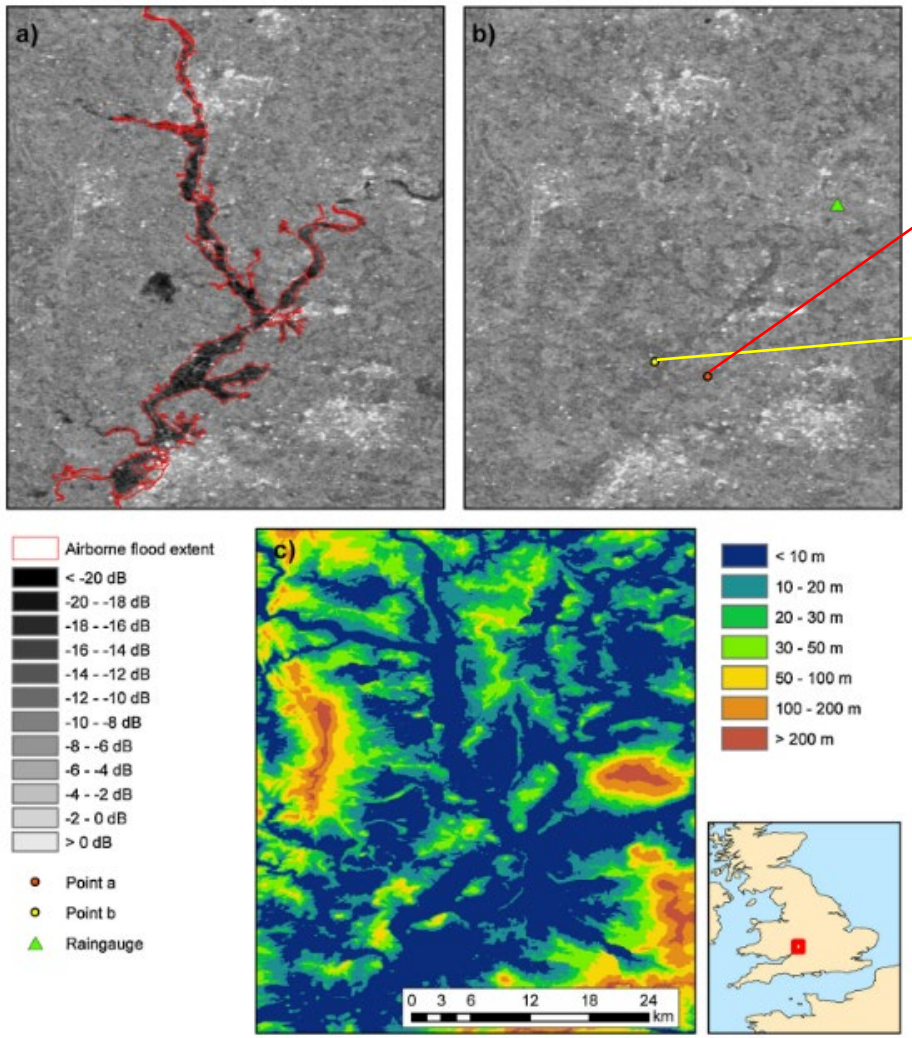


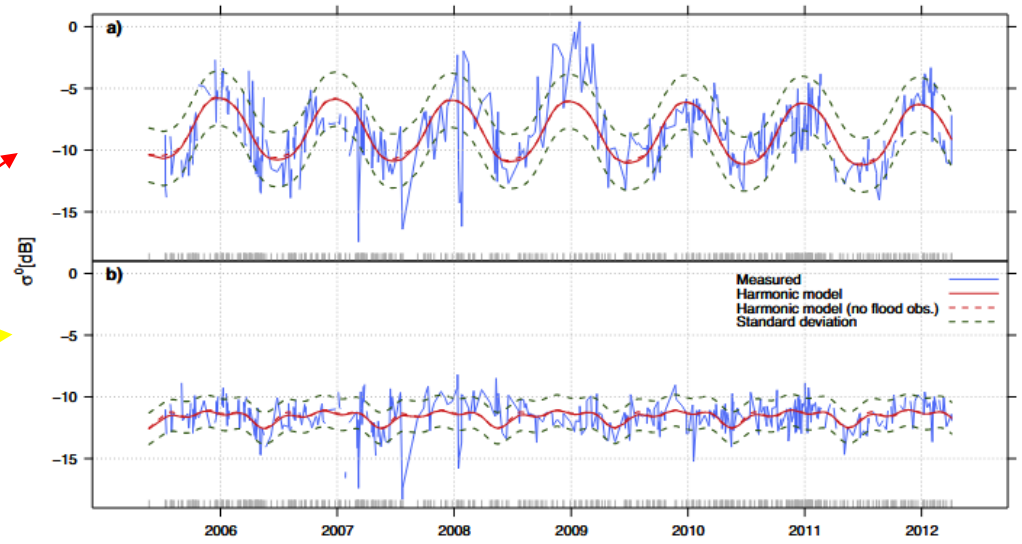
EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

GHG KIT

eodc TU WIEN GEO

TU Wien Flood Mapping Algorithm

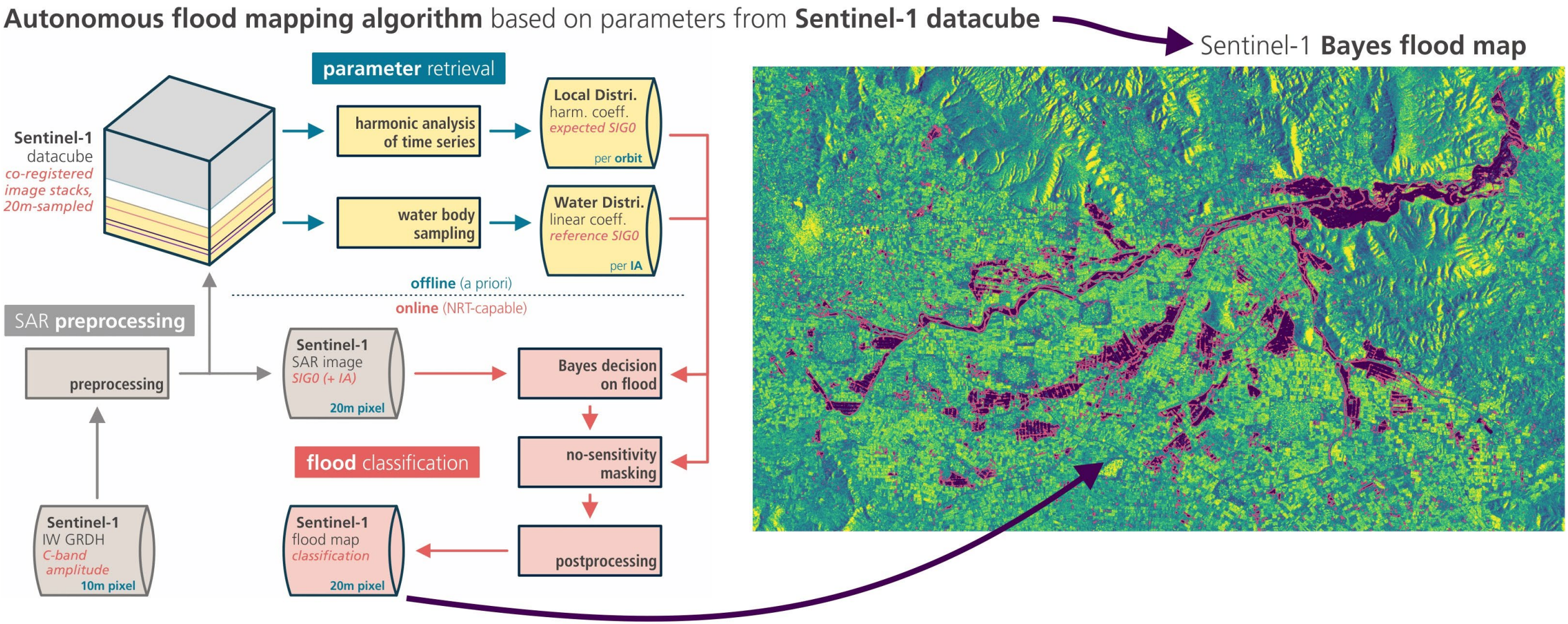




- First developed for ENVISAT ASAR Data
- Rests on the idea of detecting ‘anomalous’ behaviour in the backscatter time series
- ‘Expected’ backscatter modelled with harmonic model

Schlaffer et al. (2015) Flood detection from multi-temporal SAR data using harmonic analysis and change detection, International Journal of Applied Earth Observation and Geoinformation, 38, 15 – 24.

Datacube enabled Contextual Bayesian Classification

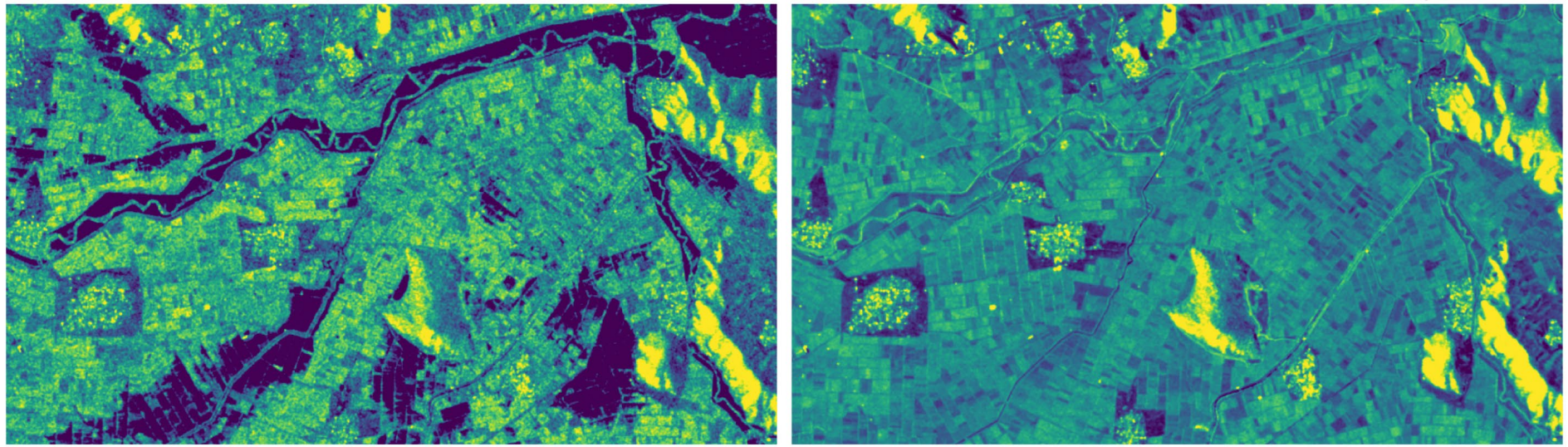


Bauer-Marschallinger et al. (2022) Satellite-based flood mapping through Bayesian inference from Sentinel-1 SAR datacube, Remote Sensing, 14, 3673, 28p.

Situation at 28 Feb 2018 | **zoom detail**

a) Sentinel-1 observation (σ^0) | Orbit A175 | at **16:31**

b) Sentinel-1 local distr. mean (μ_l) | Orbit A175 | t_{doy}= 28 Feb

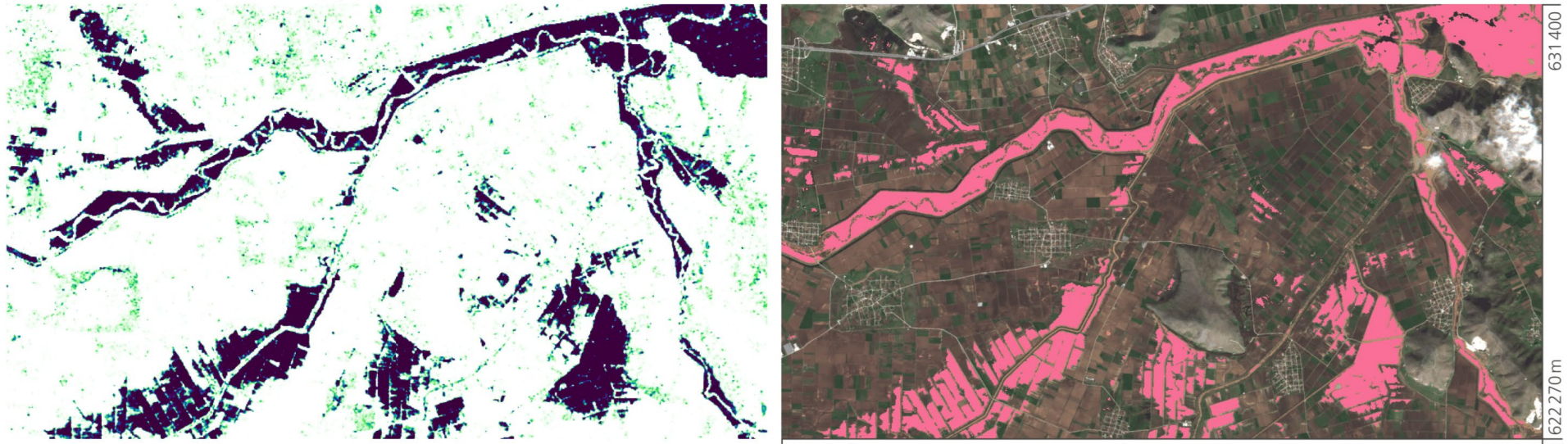


σ^0 backscatter (dB)

-15 -13 -11 -9 -7 -5

c) Sentinel-1 Bayes flood posterior probability at **16:31**

d) Sentinel-2 at **09:20** | **Flood delination** & true color image



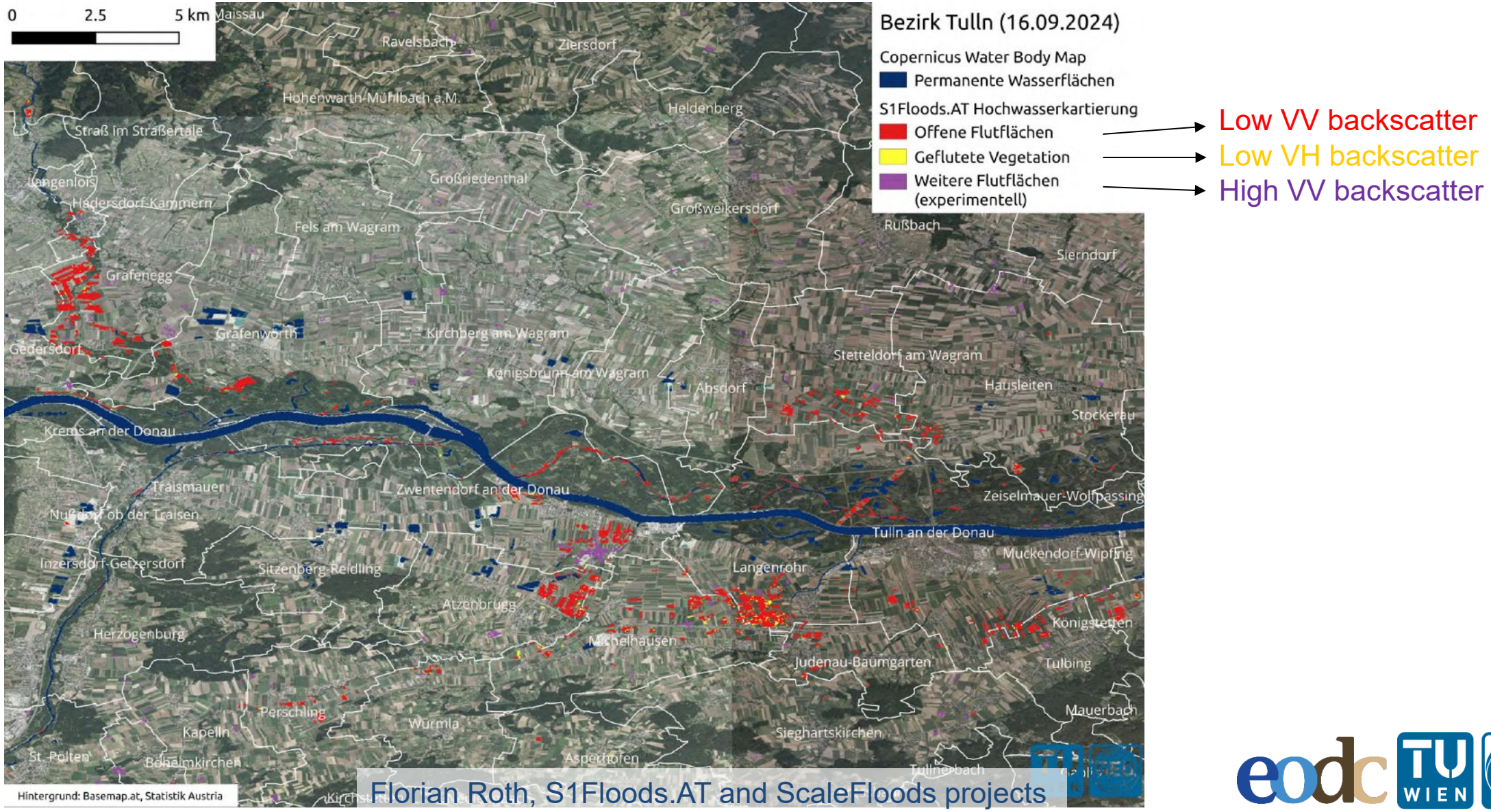
probability (%)

0 20 40 60 80 100

flood

Bauer-Marschallinger et al. (2022)

Identification of More Flooded Areas with Combination VV+VH

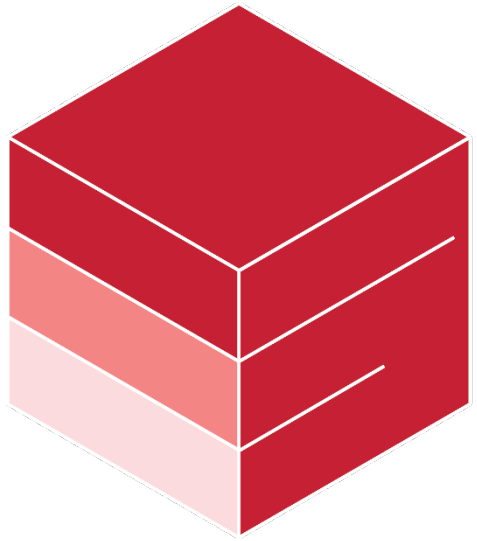


Florian Roth, S1Floods.AT and ScaleFloods projects

Requirements for Sentinel-1 Datacube

- Data are consistent and quality controlled over the complete mission lifetime
  - Online SAR data have the same standard as offline data

- Datacube needs regular updating / reprocessing
  - Deal with changes in instrument data
    - Decline in power supply
    - Space debris hitting instrument
    - Aging of material
  - Account for updates in ground processor
    - Regular software updates to deal with known issues
  - Keep the data at the latest scientific standard
    - Radiometric terrain correction



AUSTRIAN DATA CUBE

- Experts / data stewards needed to keep the data ‘alive’
  - Regular checking and updating of data needed

Conclusions

- Current Sentinel-1 coverage is not enough
  - Launch of Sentinel-1C and Sentinel-1D in the next months
  - L-Band mission: NISAR (2024) and ROSE-L (2028)

- Datacube needed for
  - Model parameterisation
  - Improved uncertainty parameterisation
  - Mapping of exclusion areas

- ACube solution needed for scientific and operational applications
  - Data stewards need to ensure fit-for-purpose quality of data
  - Avoids that work is done multiple times (but each time just a little bit different)
  - Multiple, user friendly access points

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ESA: DTE Hydrology Next | BMBWF: Cloud4GEO | Vienna Business Agency: FAIR2Earth