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THE EUROPEAN UNION



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Emergency
Management

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GFM Evolution 1: The latest major release and the integration of Sentinel-1C

4th CEMS Global Flood Meeting 2025

Florian Roth (TU Wien) & the GFM consortium



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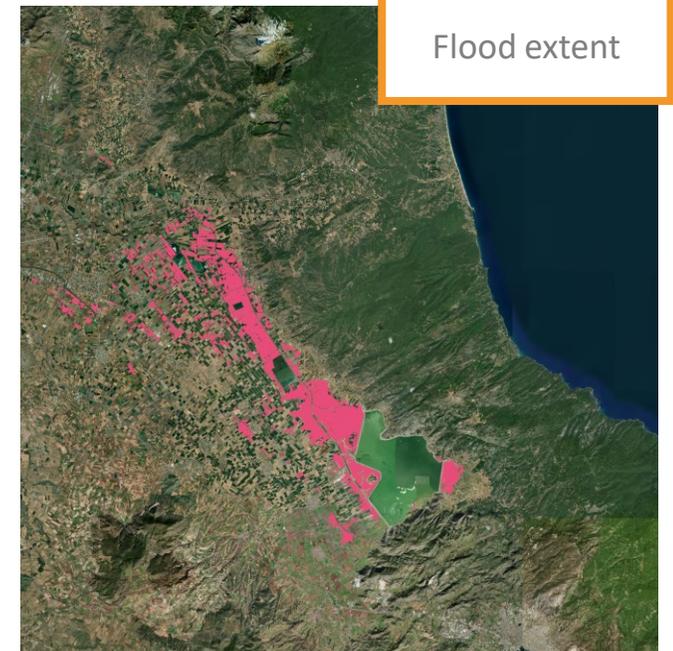
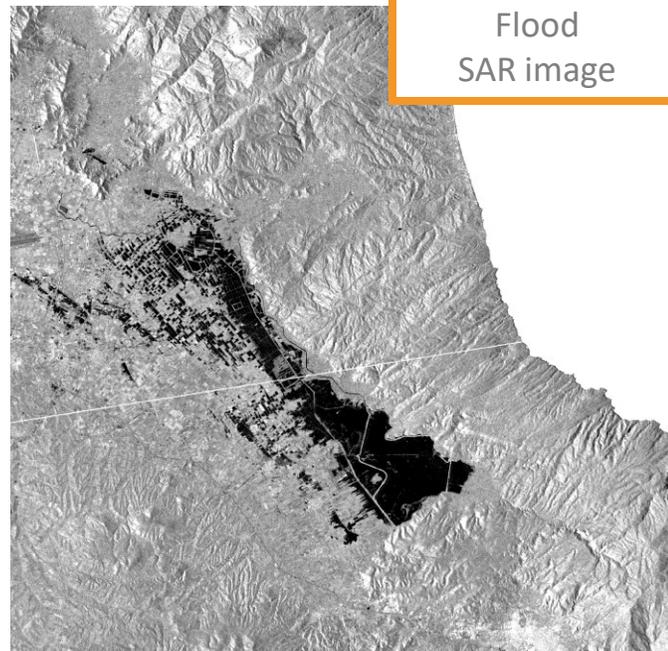
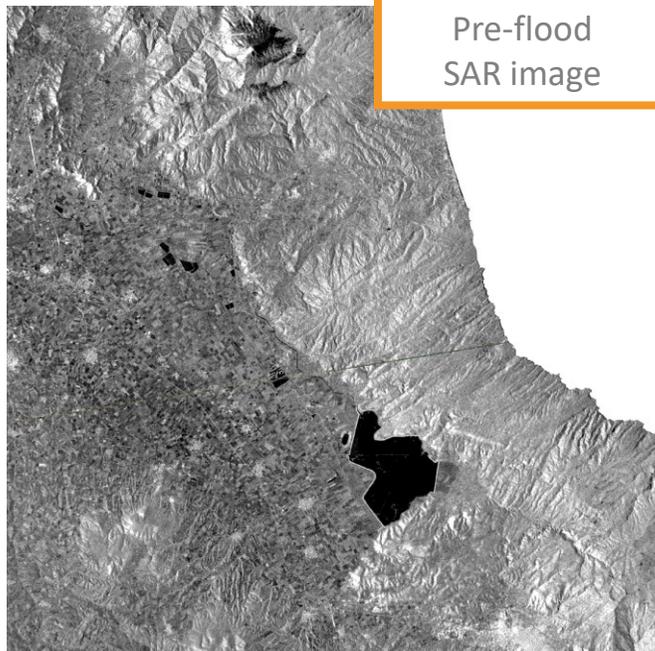
GFM v4.0





Post-processing in GFM

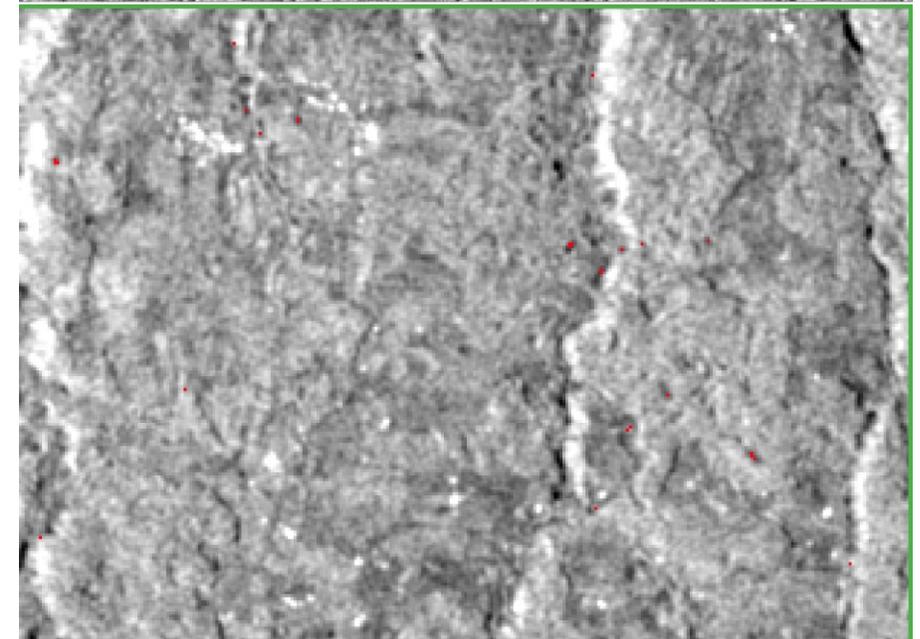
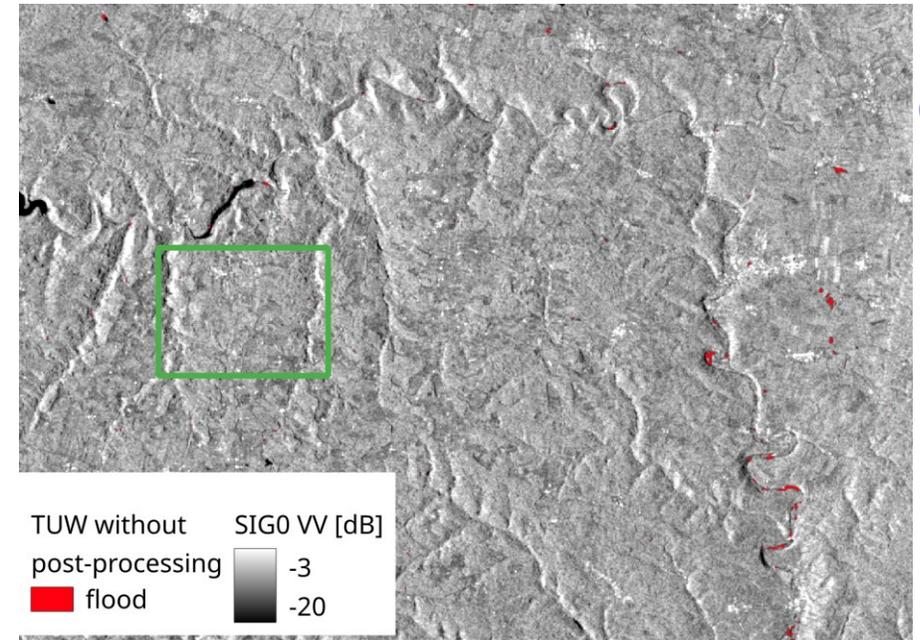
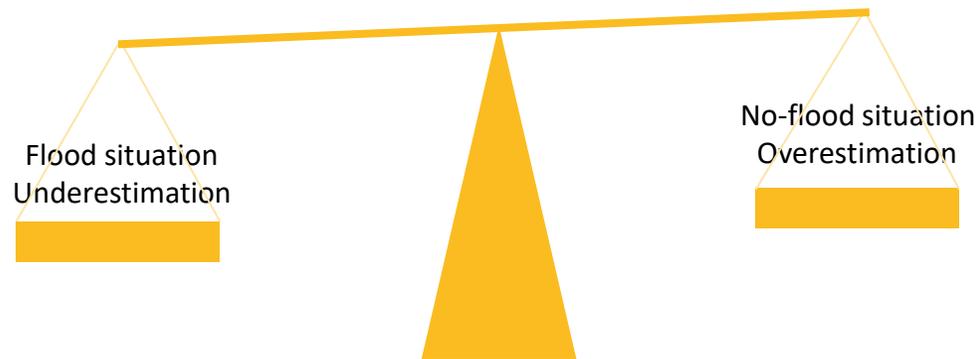
SAR-based flood mapping





Post-processing in GFM

- Removal of small misclassifications
 - SAR speckle
 - Land cover changes
- Goals
 - Improve classification accuracy
 - Preserve correct flood detections
 - Decent results in no-flood situations
- Individual and ensemble algorithms



Speckle impact for Austrian example



Updates in GFM v4.0

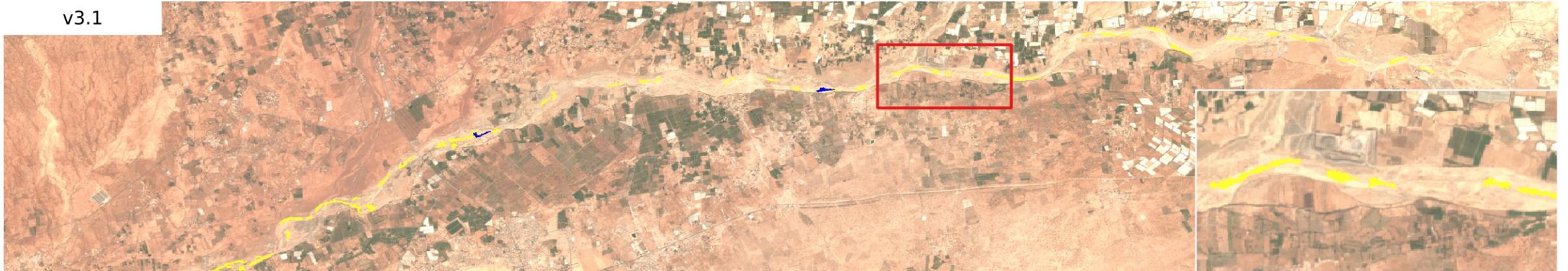
- Quality improvement of **observed flood extent** layer
 - Improved post-processing on the individual algorithm level
 - DLR: improved region growing, blob removal and fall-back thresholds
 - LIST: topography-informed object-based filtering
 - TU Wien: enhanced minimum mapping unit
 - Removed restrictive post-processing on the ensemble level



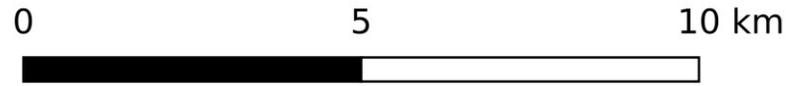
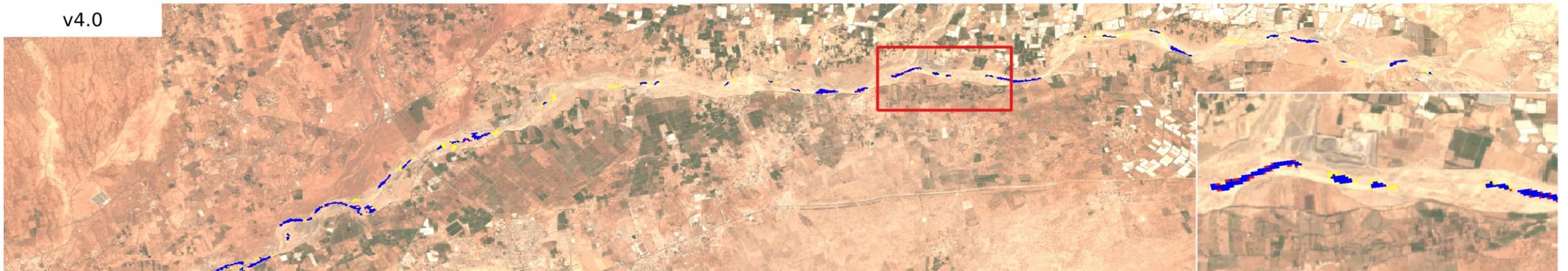
Examples

2023-Q1 Morocco

v3.1



v4.0

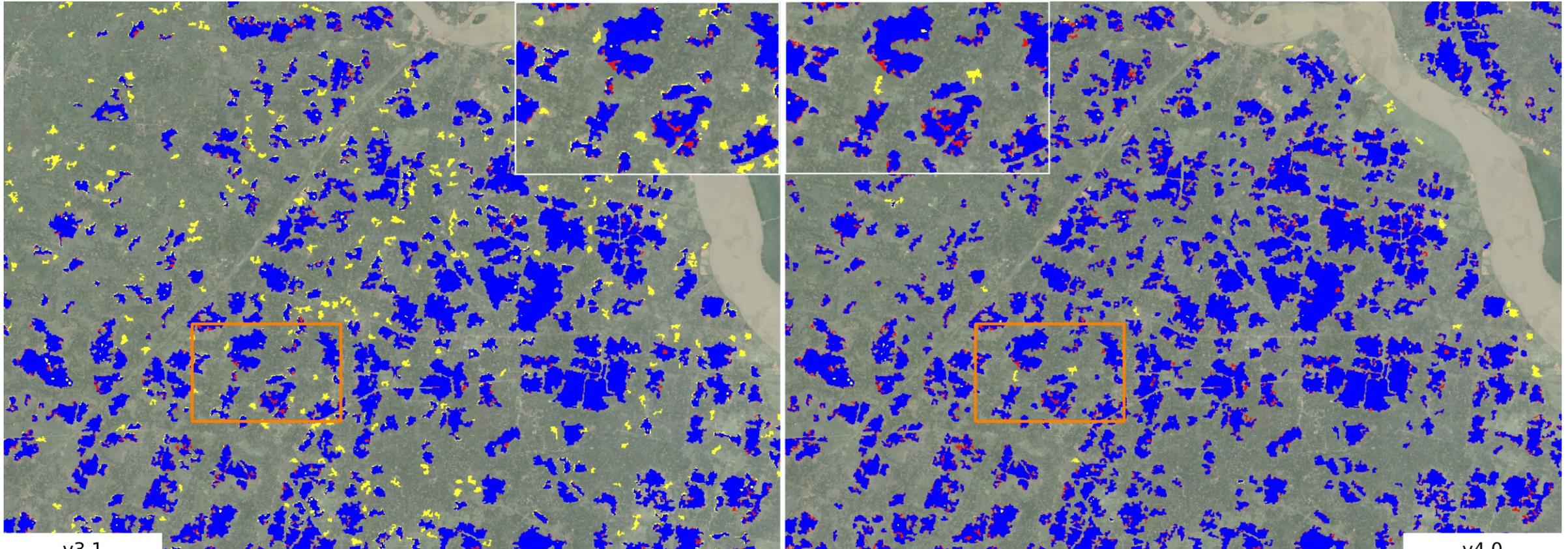


Confusion map
Yellow: underestimation
Blue: agreement
Red: overestimation



Examples

2023-Q2 India



v3.1

v4.0

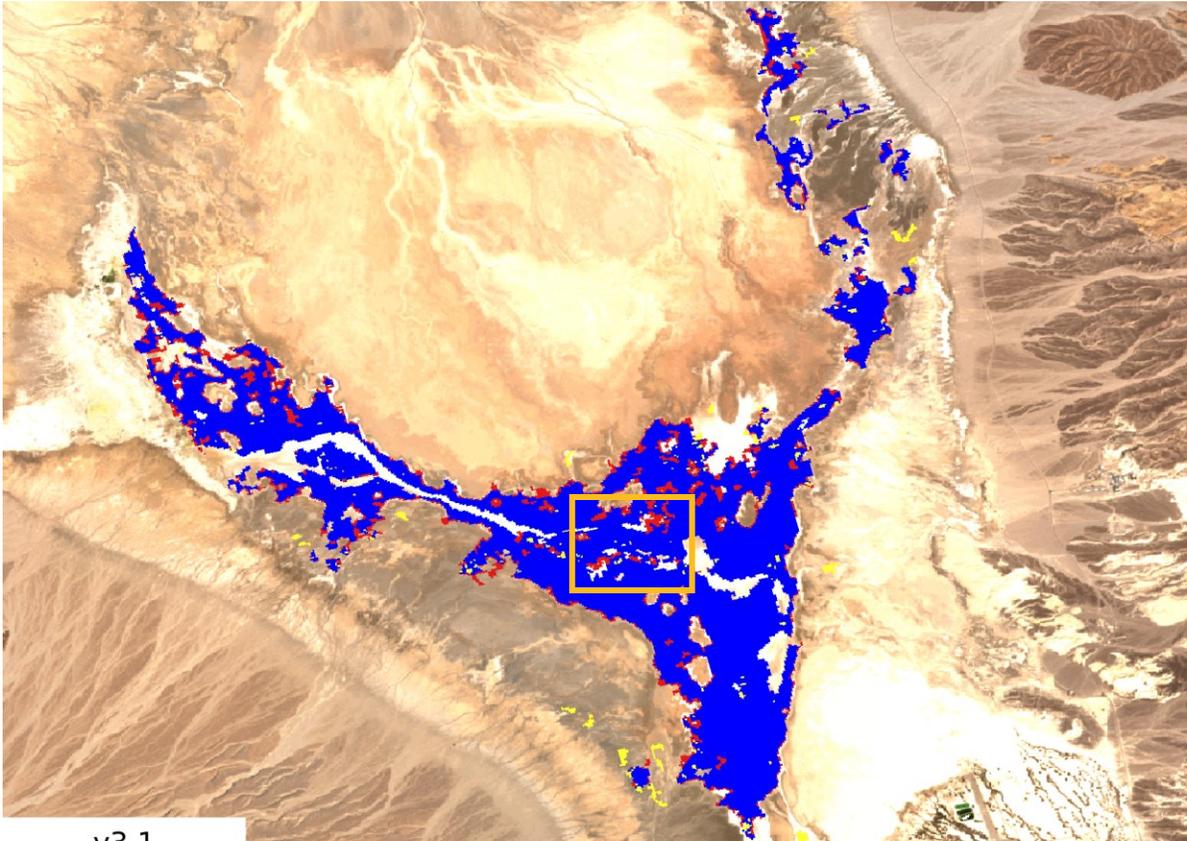


- Confusion map
- underestimation
 - agreement
 - overestimation

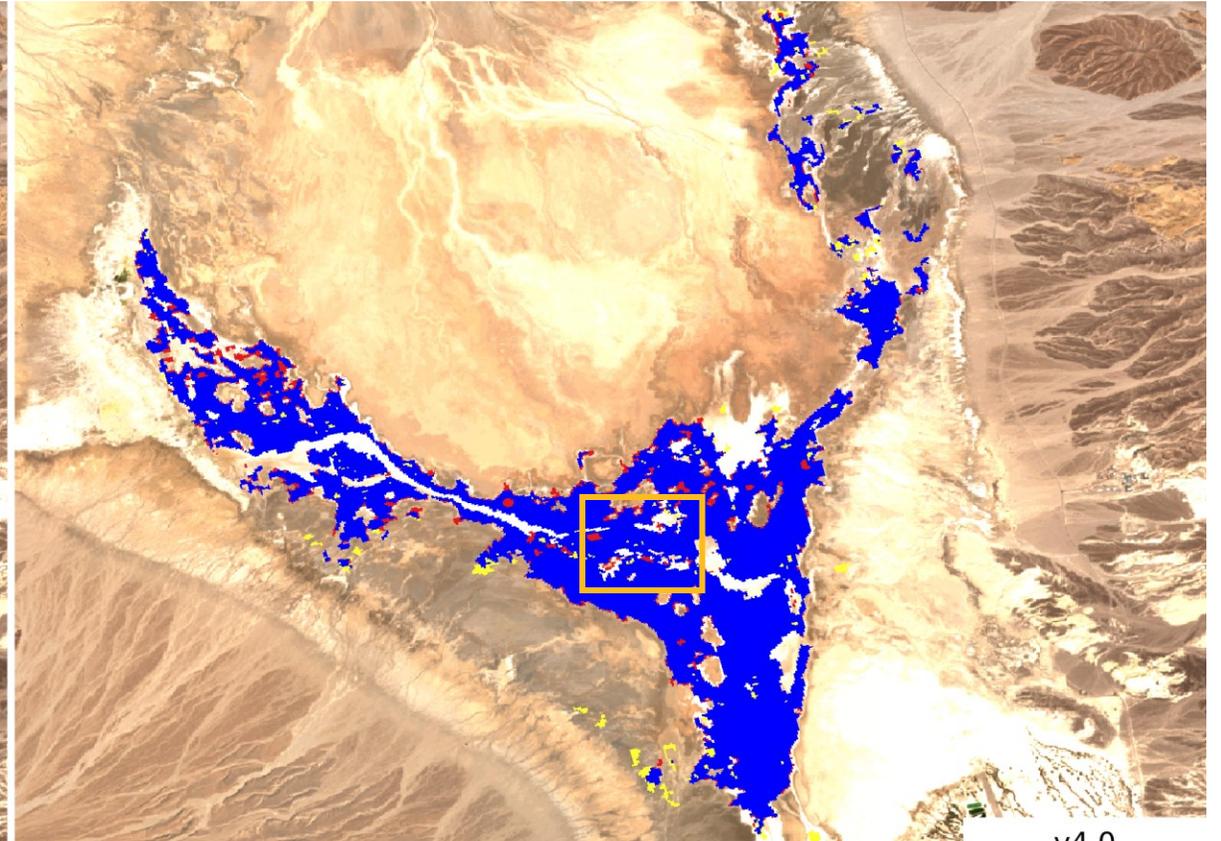


Examples

2022-Q3 USA



v3.1



v4.0

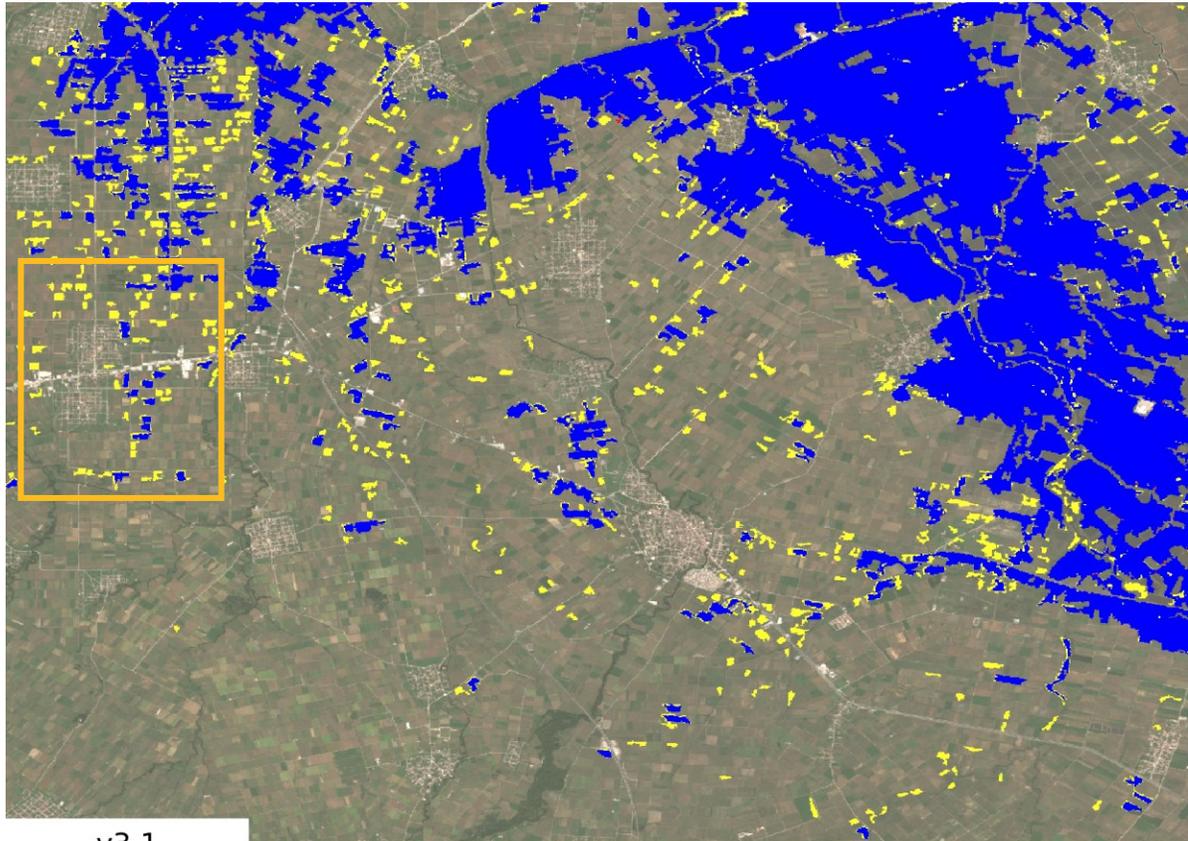


- Confusion map
- underestimation
 - agreement
 - overestimation

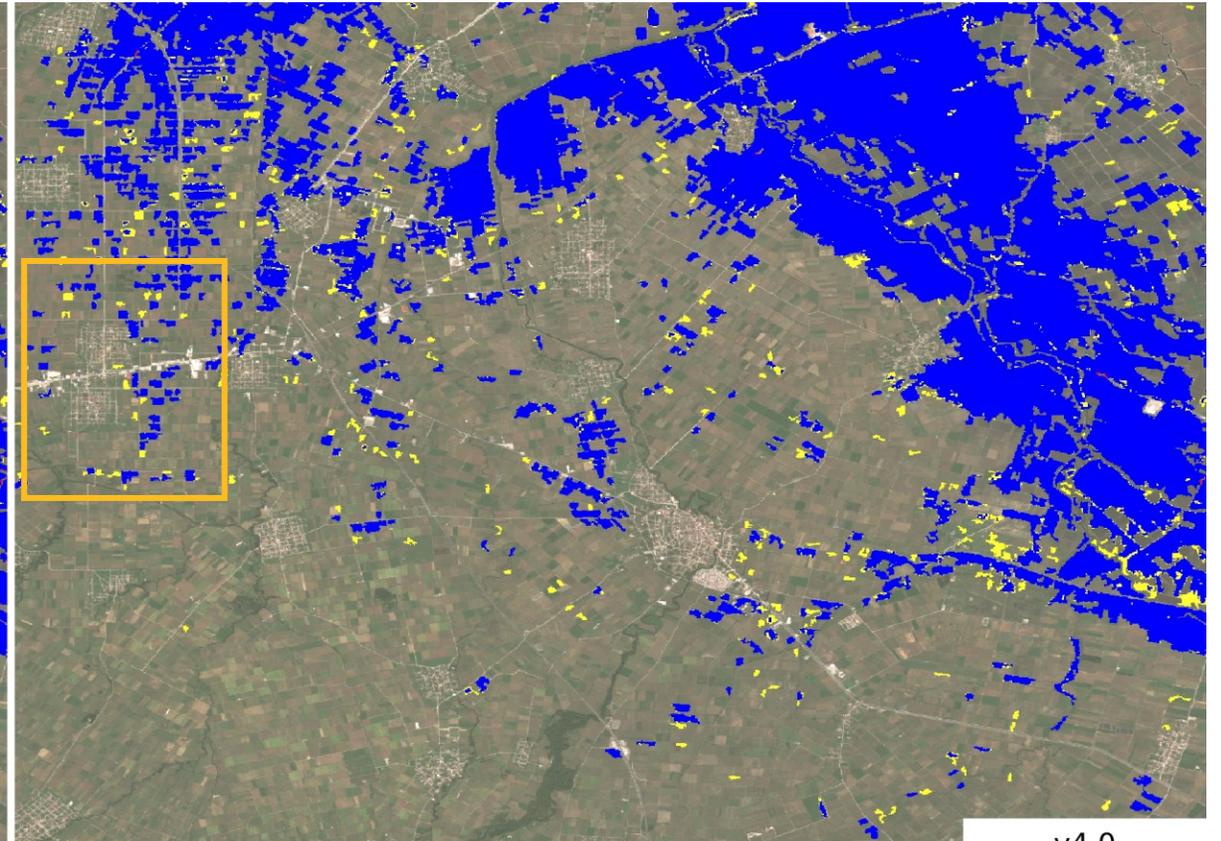


Examples

2023-Q3 Greece



v3.1



v4.0



- Confusion map
- underestimation
 - agreement
 - overestimation

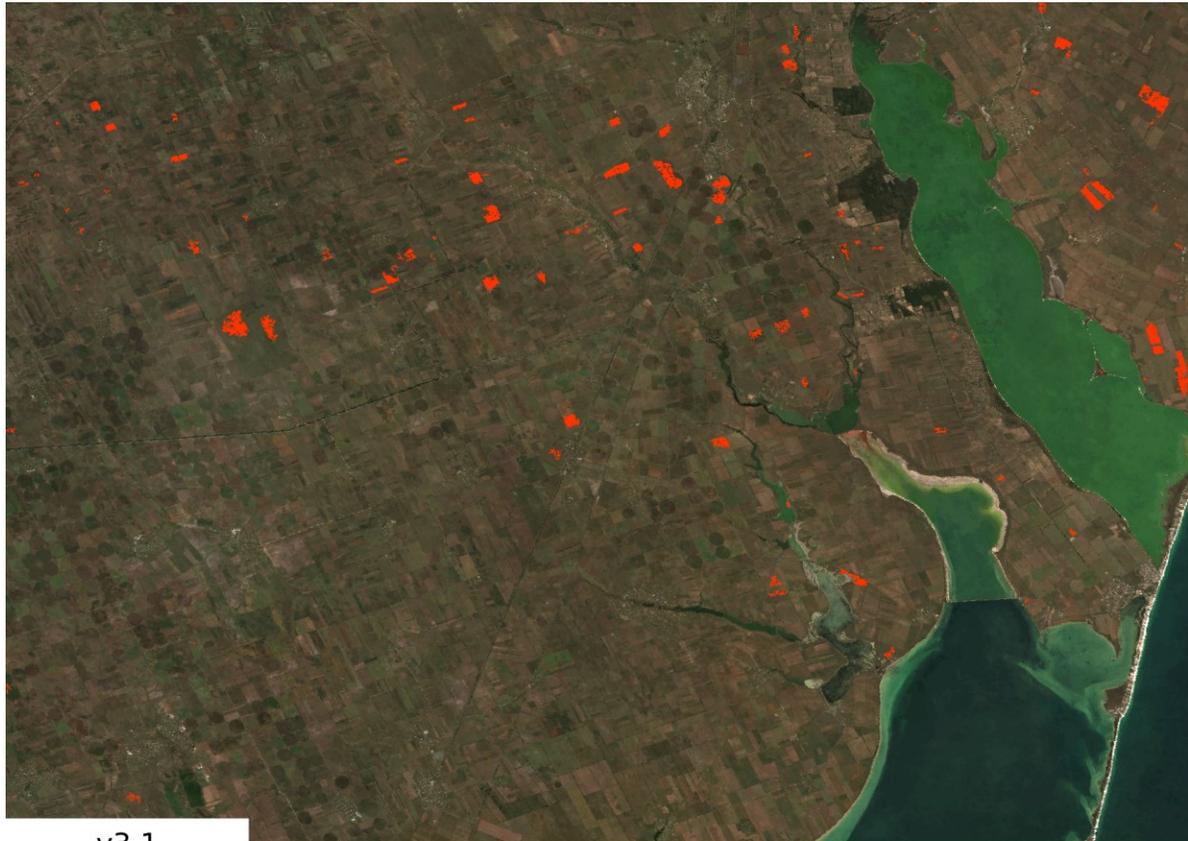


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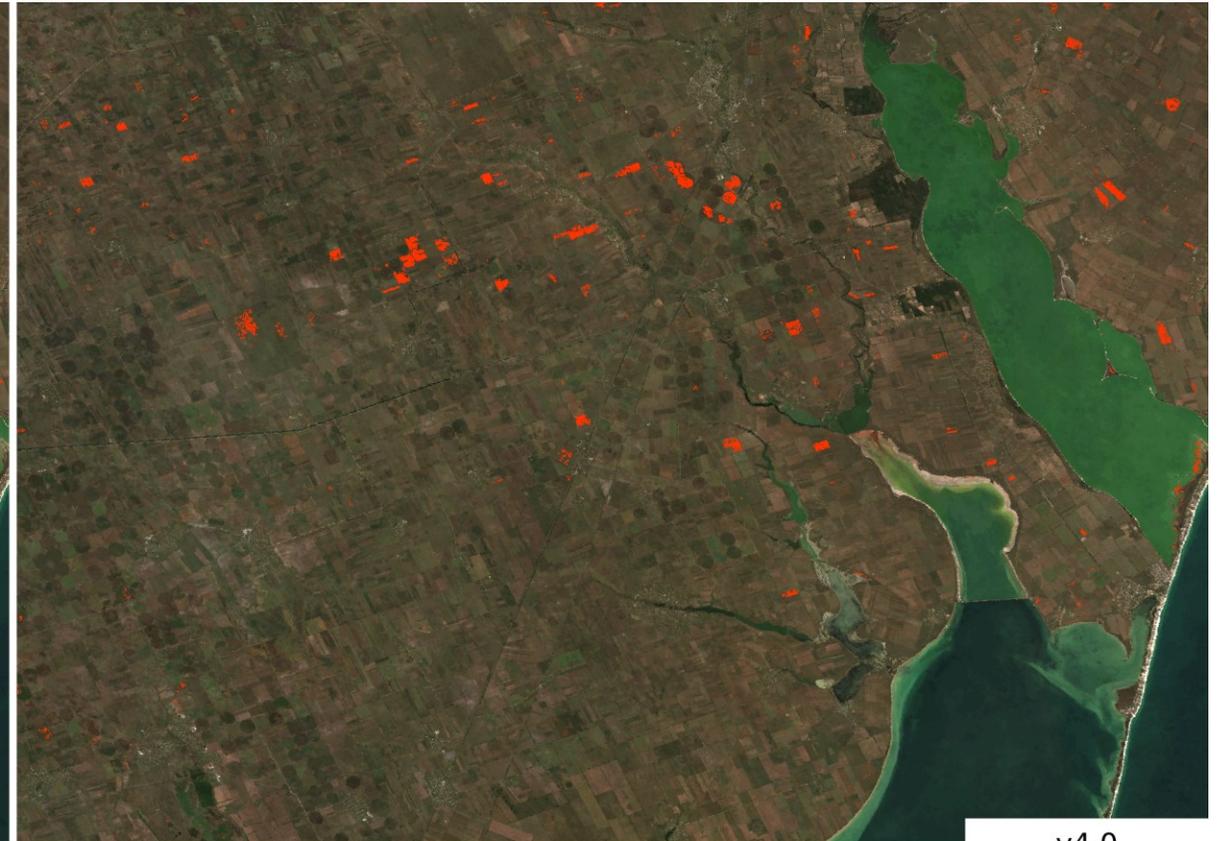


Examples

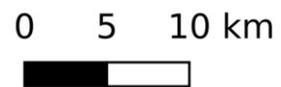
Overestimation case Ukraine



v3.1



v4.0



Ensemble flood
 overestimation



Accuracy Assessment

Approach:

- Use cases of quarterly GFM QA
- Comparison to semi-automatic reference
- Published in latest QA report

Average accuracy metrics changes:

- CSI: + 6.30
(improvements in 17 of 20 use cases)
- Bias: + 0.05
- Commission error: + 2.11
- Omission error: - 8.87

Use case	Myanmar (21.07.2021)	France (16.10.2018)	Indonesia (29.03.2023)	Italy (16.05.2023)	Venezuela (29.07.2017)	Bangladesh (10.08.2023)	Greece (07.09.2023)	Portugal (23.12.2019)	India (22.05.2020)	Dominican Republic (23.11.2023)
CSI	7.10	6.70	7.70	5.50	2.10	5.20	11.40	3.80	-0.20	12.10
Bias	0.07	0.06	-0.05	0.13	0.09	-0.05	0.04	0.10	-0.21	0.20
Commission	-3.70	-0.60	2.50	5.70	2.50	-0.60	-4.70	3.10	15.10	1.60
Omission	-7.20	-6.70	-13.00	-11.00	-5.00	-6.00	-7.80	-6.40	-17.60	-16.30

Use case	Bangladesh (18.05.2022)	Turkey (01.06.2022)	Australia - New South Wales (08.07.2022)	USA - California (05.08.2022)	Pakistan (22.08.2022)	Kenya & Ethiopia (10.10.2022)	Belize (03.11.2022)	UK - Eastern Scotland (18.11.2022)	USA - Texas (29.08.2017)	Morocco (09.01.2021)
CSI	6.70	3.00	3.20	4.10	1.00	-10.80	-2.30	5.40	10.00	44.20
Bias	-0.00	0.00	0.03	-0.05	-0.03	0.11	-0.21	-0.05	0.17	0.73
Commission	-4.80	-2.50	-4.90	-8.70	-4.30	7.00	27.80	-1.30	4.30	8.70
Omission	-3.80	-1.90	1.40	5.20	2.80	14.20	-23.60	-5.80	-13.00	-55.90



Summary & Outlook

- Impact of GFM v4.0
 - Improved accuracy in case of small-scale flood events
 - Better preservation of correctly classified flood areas
 - Remaining issues in certain land cover types and agriculture overestimation
- Planned release
 - Final tests on-going
 - Mid April 2025



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Integration of Sentinel-1C

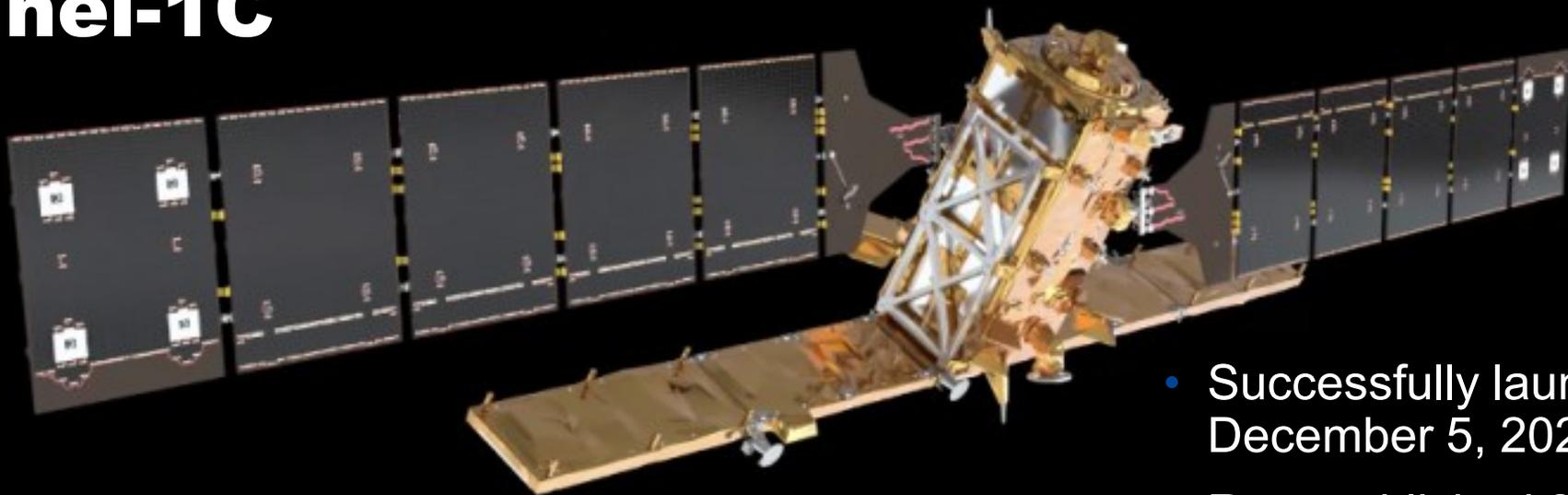




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Copernicus
Europe's eyes on Earth

Sentinel-1C



- Successfully launched: December 5, 2024
- Re-established 2 satellite mission
- Successful commissioning operations



GFM integration

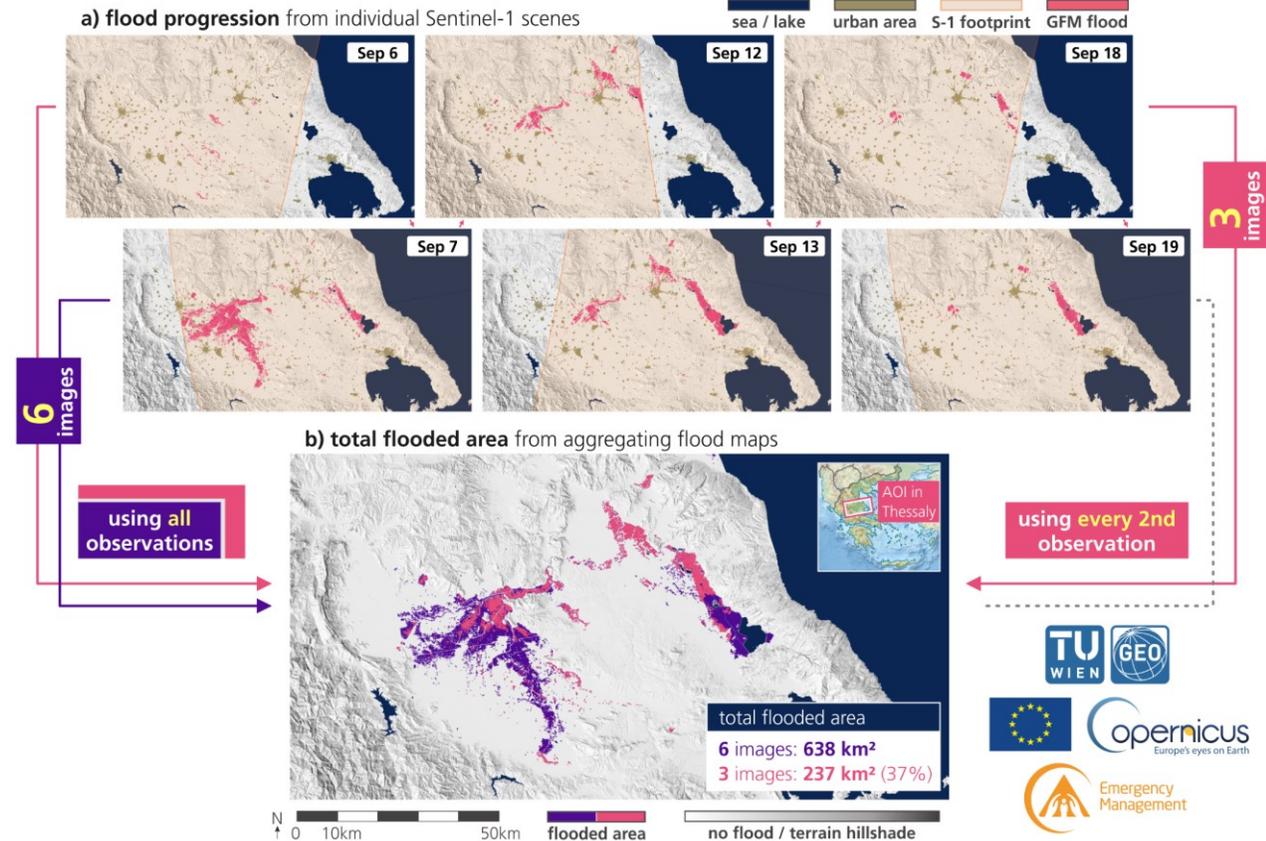
Impact of Sentinel-1C to GFM:

- Improved temporal resolution
 - Better coverage of short-term or non-European flood events
 - Better representation of the progress of an event
- Improved resilience due to second satellite

Roadmap:

- Requires major update in the pre-processing workflow
- Testing of impact of Sentinel-1C integration and software update
- Update of the GFM

Greece, Thessaly, September 2023 | Large floods after heavy rainfalls | from Sentinel-1-based Copernicus Global Flood Monitoring (GFM)



Wagner, Wolfgang, et al. "Requirements from the Copernicus soil moisture and flood monitoring services for Sentinel-1 and ROSE-L mission operations." *EUSAR 2024; 15th European Conference on Synthetic Aperture Radar*. VDE, 2024.



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Thank you Questions?

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