Near real time high resolution mapping of flood extent in west African sites

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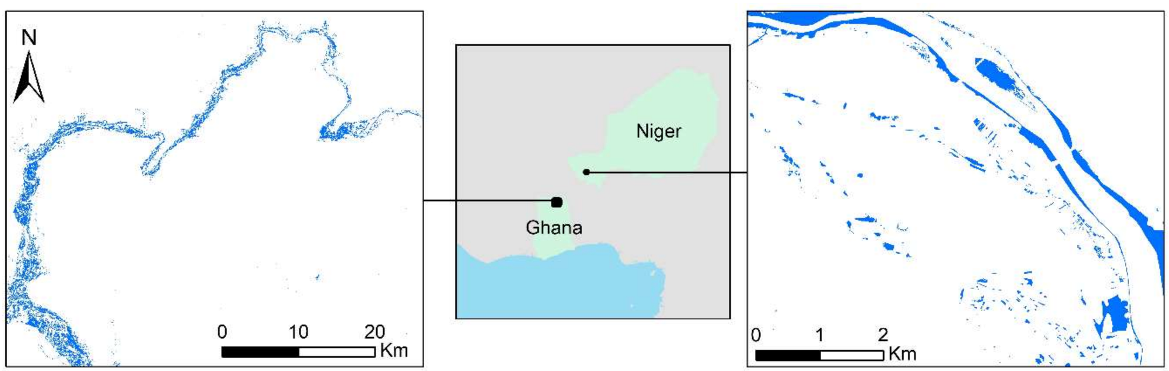

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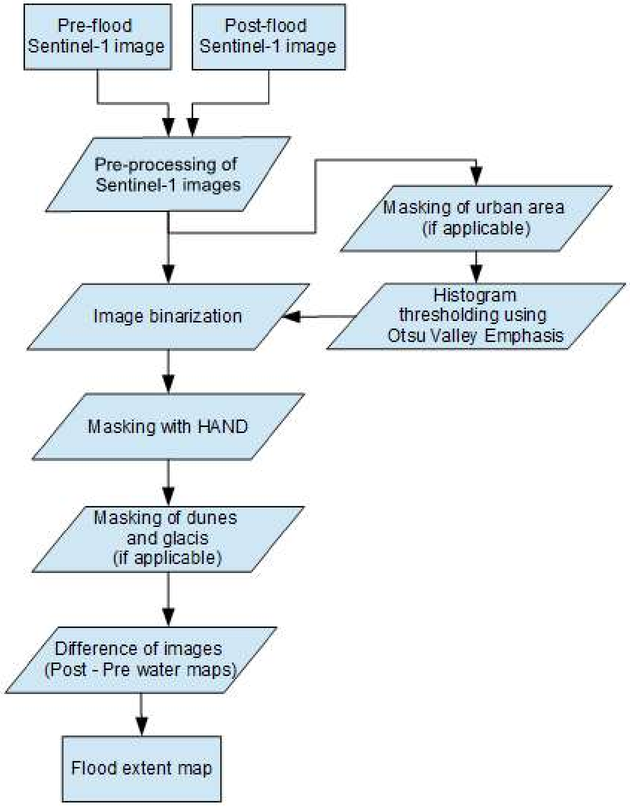
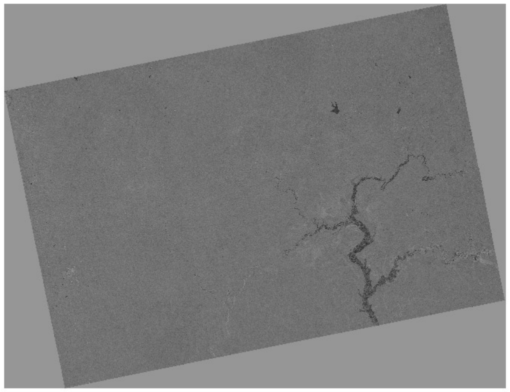
Methodology

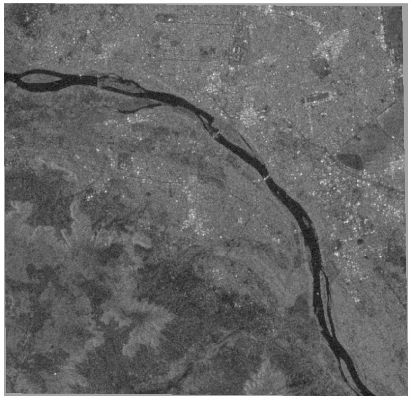
Flow chart of the approach for mapping floods at high resolution using Sentinel-1 images in West-Africa



Data:

- Sentinel-1 satellite images prior, during and after the flood event (GRD, IW, VV polarization)
- LULC map
- Height Above Nearest Drainage map (HAND)





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Case studies

<u>Flood event in Niger:</u>

Location: around Niamey

Period: 31/8/2017

Cause: heavy rain

Extent: 353ha [(1)]

Damage: houses destroyed, roads cut [(1)]

Land cover in the flooded area: Urban, bare land, rocks, dunes, glacis, cropland [(2)]

<u>Flood event in Ghana:</u>

Location: Upper east region

Period: 25/8/2018

Frequency: annual

Cause: releases of the Bagre dam in Burkina Faso and long-term rainfall

Damage: deaths, people displaced, ~11,960ha of farmland affected [(3)], infrastructure destroyed

Land cover in the flooded area: Agricultural land, riparian vegetation, bare surface [(4)]

(1) Copernicus EMS https://emergency.copernicus.eu/mapping/list-of-components/EMSR235.
(2) Observatoire du Sahara et du Sahel, Atlas des cartes d'occupation des sols, Niger, 2015. http://www.oss-online.org/rep-sahel.
(3) National Disaster Management Organisation (NADMO) https://www.nadmo.gov.gh.
(4) Nsor, Collins & Ashiagbor, George & Danquah, Emmanuel. (2019). Quantifying Recent Floodplain Vegetation Change along the White Volta River in the Northern Region of Ghana.

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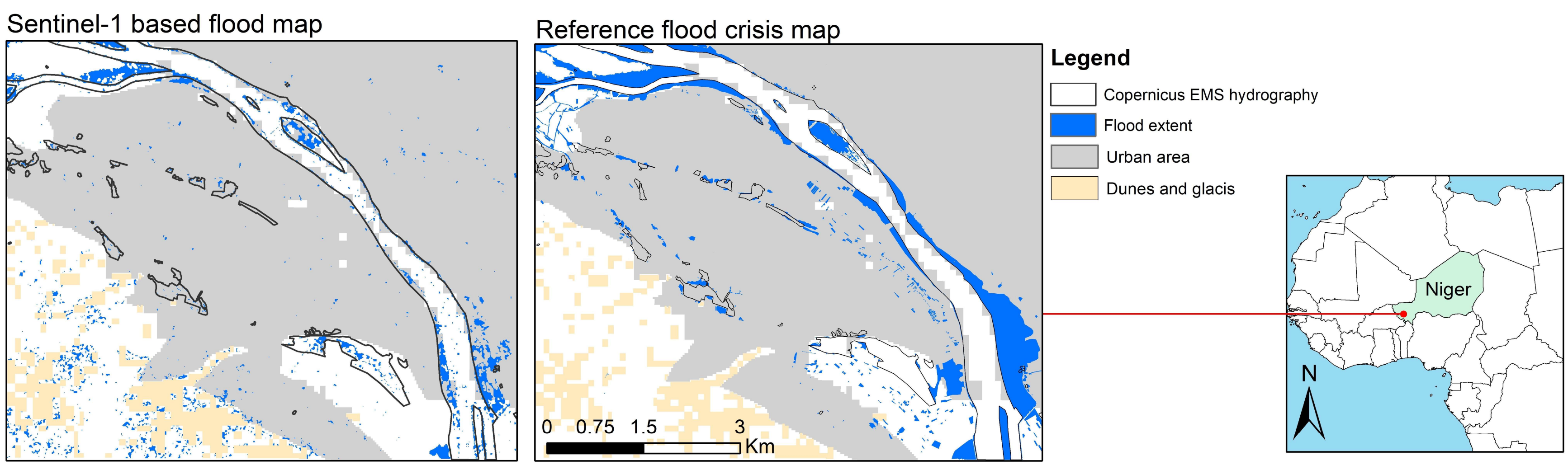
Flood mapping in Niger

Flood event: Niamey, Niger (Sep 2017)



- Reference data from Copernicus Emergency Management System (EMS) derived from Pleiades-1A and GeoEye.

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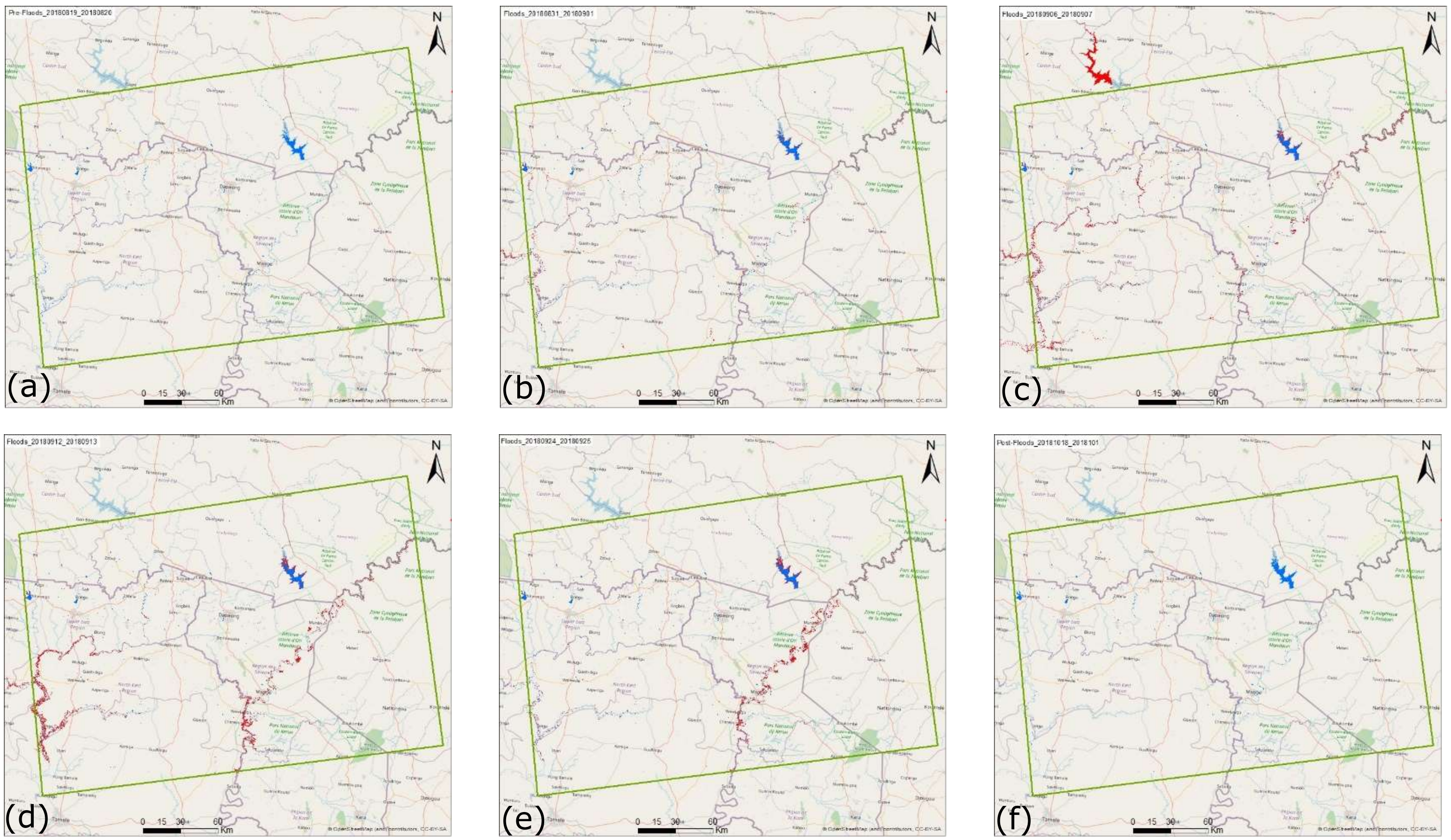
Flood monitoring in Ghana

Flood event: Upper East region, Ghana (Aug - Sep 2018)



(a) 19-20/8/2019
(b) 31/8-1/9/2019
(c) 6-7/9/2019
(d) 12-13/9/2019
(e) 24-25/9/2019
(f) 18-19/10/2019

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Results assessment

- Quantitative assessment of the flood maps in Niamey based on Copernicus EMS data.
- River Niger well detected in all S1 images. Major flood spots detected along riverbanks.
- Presence of extended urban area and dunes is challenging. Method was tested with two pre-flood dates. Masking of dunes and glacis required to limit false alarms together with HAND information.
- Similar overall accuracy of 0.92 independently of the S1 pre-flood image used.
- Comparison to Sentinel-2 based results using MNDWI index (similar OA, higher recall, lower true negative rate). S2-based flood maps are difficult to produce on a systematic basis due to cloud cover during the flood period. Lower resolution of 20m.
- Several missed detections mainly with S1 but some detection failures are common with S2.
- False alarms with both S1 and S2 data. S2 overestimating the flood extent area.
- Some errors due to the long gap between the two VHR reference images (May to Sept).

- Flood maps in Ghana were validated by a local expert. Possibility to monitor the flood extent with multiple S1 SAR images.

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Conclusion

- S1-based flood maps were produced at 10m resolution in two study sites in Niger and Ghana (riverine flood events).
- Using free and frequently available data major flood spots could be detected.
- Possibility to rapidly map and monitor floods in NRT.
- Synergies with the Mifmass project and GMES & Africa (Database of flood events).

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