https://doi.org/10.5194/egusphere-egu2020-7660

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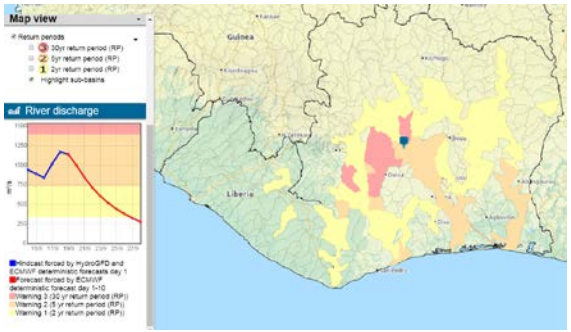
FANFAR: Reinforced cooperation to provide operational flood forecasting and alerts in West Africa



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SMHI CILSS isardSAT TERRAQUE eawag aquatic research NIGERIA HYDROLOGICAL SERVICES AGENCY (NIHSA) FEDERAL MINISTRY OF WATER RESOURCES Water Resources Data for Sustainable Development

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 780118

Motivation

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- Several floods in West Africa: 2019, 2018, 2017, 2016, 2012 …
- Serious consequences: lives lost, economic damages, millions affected
- Needs vary by country, but a key need for many is to have access to operational hydrological forecasts & alerts that are up-to-date and reach the vulnerable populations
- Climate change projected to increase frequency of streamflow peaks. One concrete approach of climate adaptation is to have a functioning early-warning system

Andersson et al 2017, https://doi.org/10.1016/j.pce.2017.02.010

Floods in Nigeria Kill More Than 100, Wiping Out Homes and Farms

The New York Times

https://www.nytimes.com/2018/09/17/world/africa/nigeria-floods.html

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The FANFAR project

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- Research & Innovation project financed by European Commission (2018-2020)

Vision

- Efficient flood management
- Forecasting system operated by regional & national West African institutions & partners

Overall aims

- Provide an operational hydrological forecasting and alert pilot system for West Africa (updated every day)
- Reinforce cooperation between West Africa and Europe → building system together!

System should be:

- Co-designed: working group defining prioritized needs
- Co-adapted: jointly modified & developed according to needs
- Integrated: all components working together
- Co-operated: jointly operated and maintained
- Provide reliable and timely access to information
- Robust ICT, relevant for West African conditions (electricity, internet etc.)
- Sustainably financed & maintained

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3D FANFAR approach

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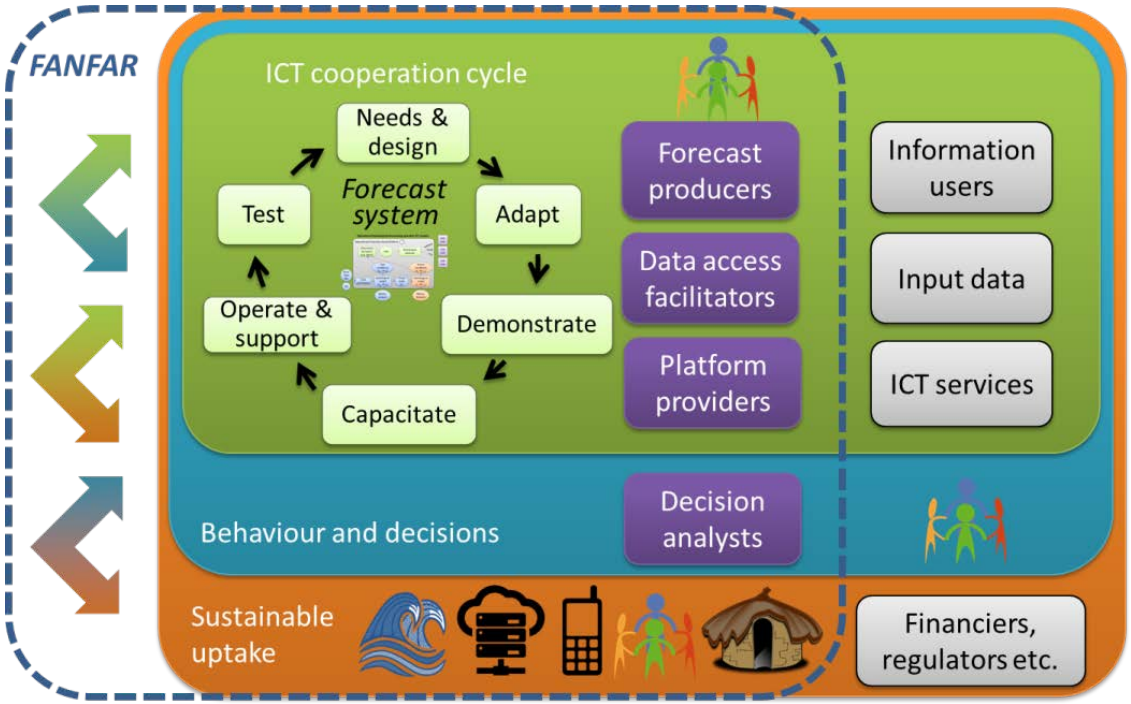

A: Iterative cooperation cycle

- 4 workshops: define & prioritize user needs, co-design adaptations, explain system & hands-on training
- In-between workshops: build, refine, operate, support & test the forecasting & alert system

B: Behaviour & decisions

- Identify & prioritize user needs
- Analyse behaviour

C: Sustainability

- Capacity development
- Support
- Financing, human resources, institutional roles etc.

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Key achievements & experiences

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Co-design

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- Participatory approach with 30+ organisations from 17 West & Central African countries: hydrological services, emergency management agencies, river basin organisations, regional expert agencies
- Multi-Criteria Decision Analysis used to clarify & prioritize system objectives and configurations
- Most important objectives: high accuracy, clear flood risk information, reliable access, and timely production
- Example priority: more important with a functioning operational forecasting chain than with many features or more complex features
- More details in Lienert et al. (2020) → https://doi.org/10.5194/egusphere-egu2020-8127


Niamey, 2018


Abuja, 2020

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Flood forecasting & alert system

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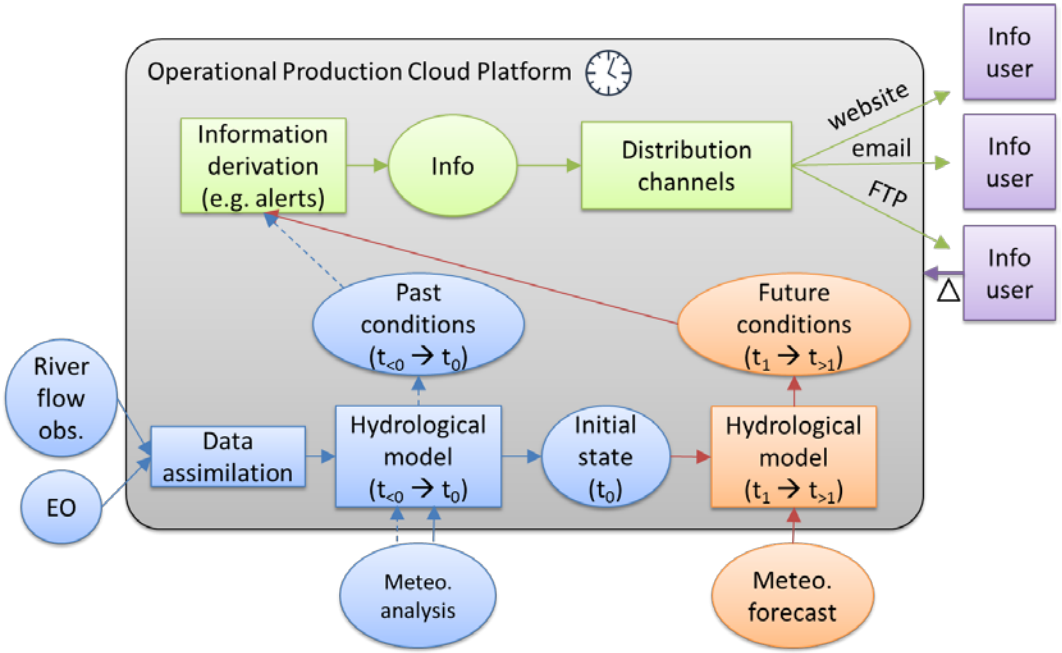

- Pilot system producing openly accessible forecasts & alerts updated every day since September 2018
- Co-developed: 5 partners responsible for different system components
- Co-operation: expert exchanges, bi-weekly meetings, 24/7 monitoring
- Continuously developed: below configurations valid for April 2020

- Meteorological data: HydroGFD analysis, ECMWF deterministic 10-day forecasts
- Gauge data from national and regional agencies (streamflow, water level)
- Water levels from satellite-altimetry: Sentinel-3, Saral-Altika, JS3
- Several hydrological models: Niger-HYPE, World-Wide HYPE

- Multiple flood risk indicators: streamflow magnitudes, people affected
- Distribution: web visualisation, e-mail & SMS notifications, API for data
- Automatic processing on cloud infrastructure: hydrology-tep.eu
- Operational procedures: protocols, version control, 24/7 monitoring

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FANFAR visualisation portal (https://fanfar.eu/ivp/) – access new results every day

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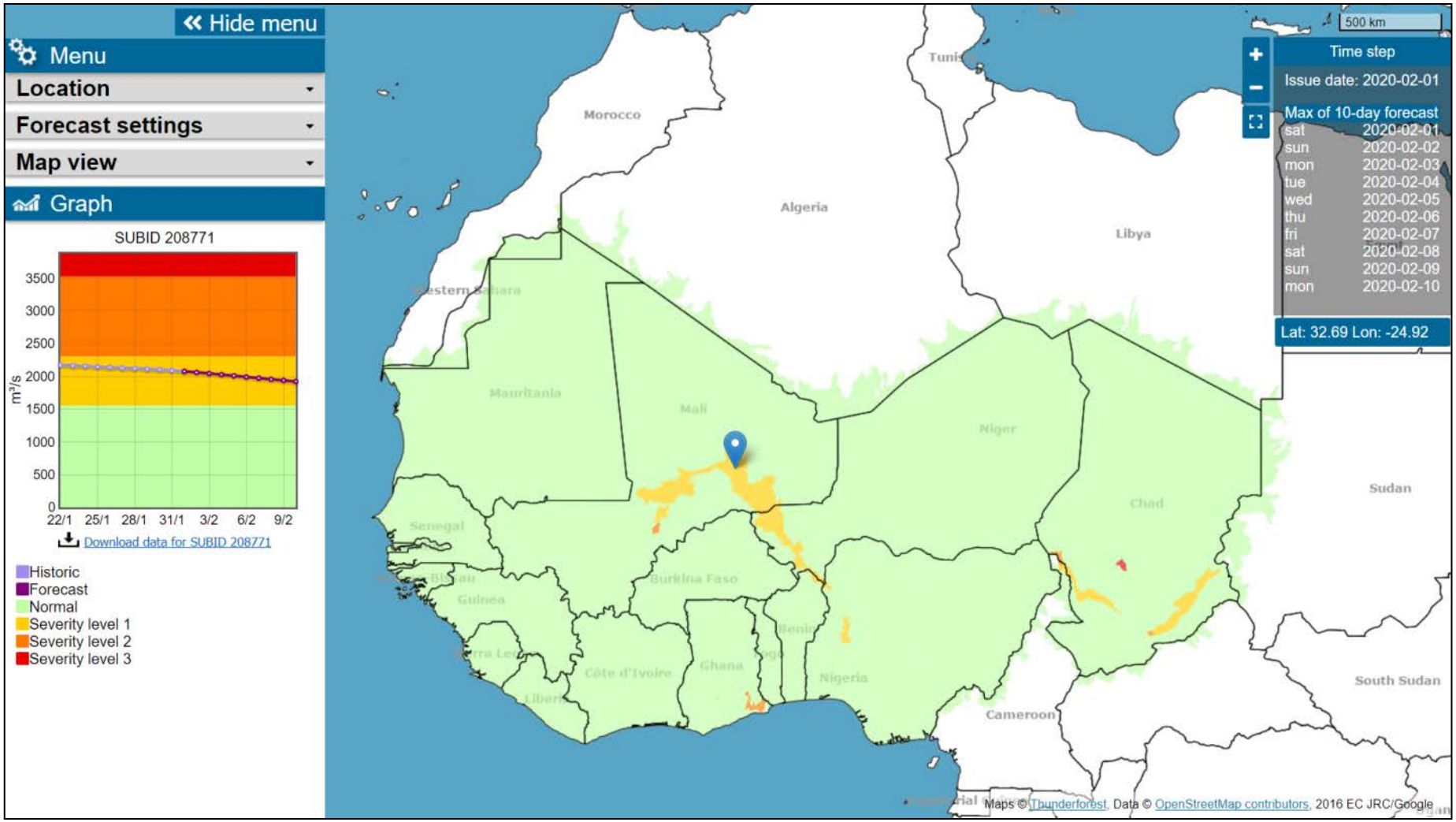

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Forecasts vs. Reality: Experience from Ivory Coast, Sep. 2018

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Flooded road at Marahoue

Photo courtesy of Edouard Ouattara

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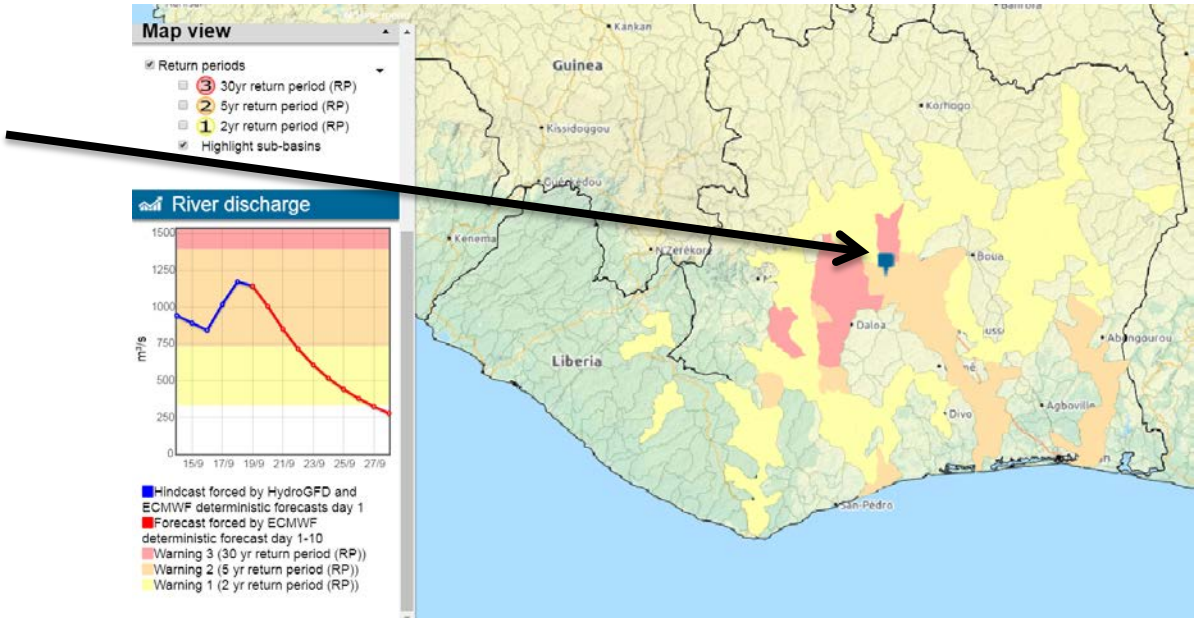

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Forecast vs. Reality: Experiences from 2019 rainy season

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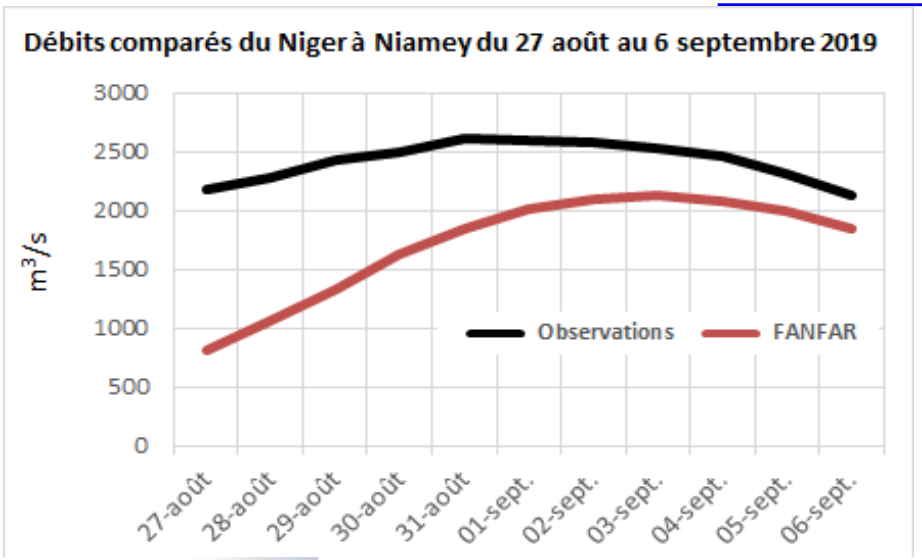
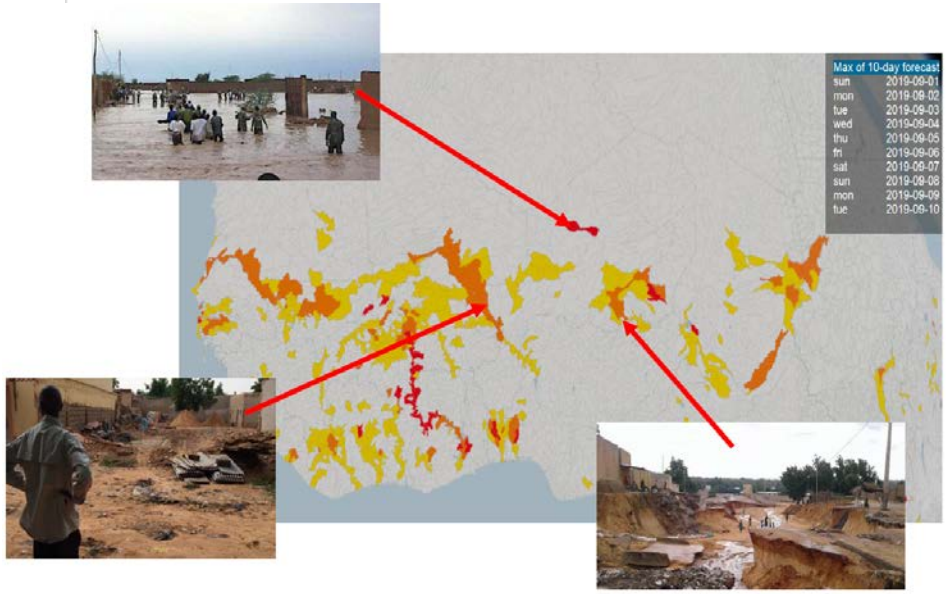
Reality

- Serious floods occurred: lives lost, displacements, damaged infrastructure etc.

Forecast performance

- Varies by location
- Good capture of timing & location of peak flows in many areas (± 1-2 days)
- Underestimated peak magnitudes: 5-50% below observations
- Forecasted severity levels lower in e.g. Nigeria but higher in e.g. Ghana compared with field observations
- Some false alarms but overall not a big problem





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Current forecast skill vs. gauge observations

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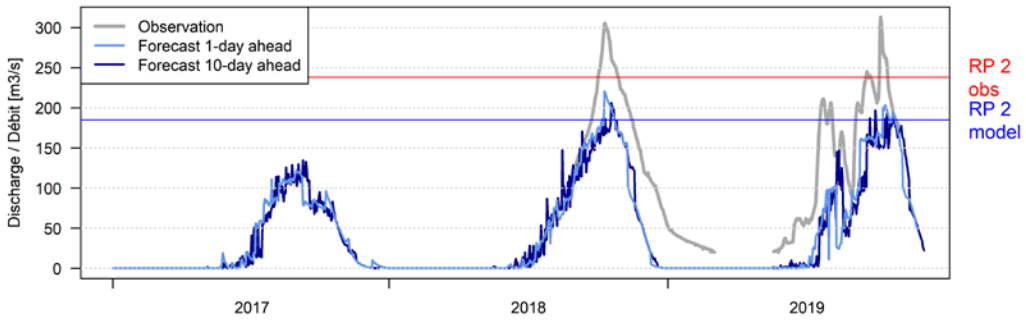
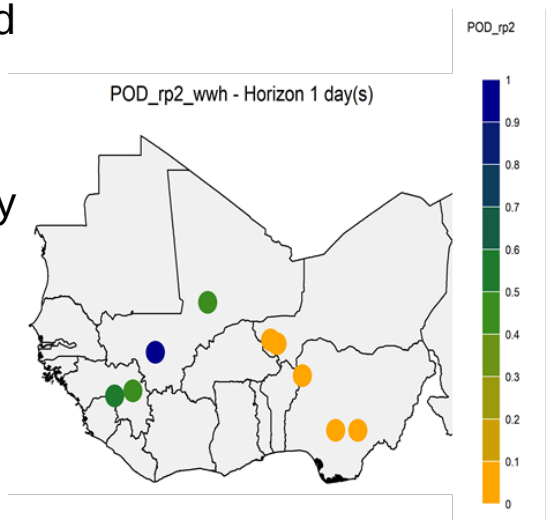
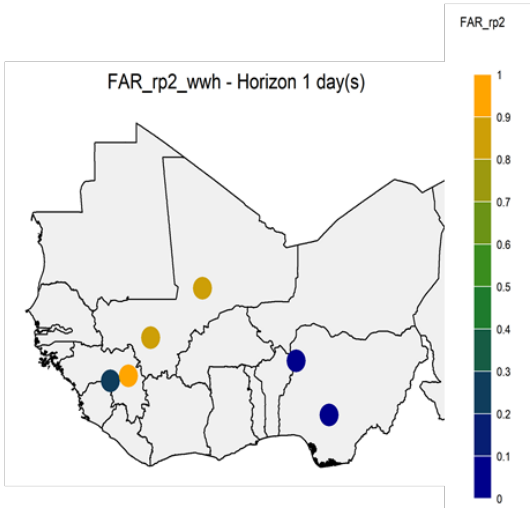
- Preliminary investigation based on 1095 daily re-forecasts (2017-2019) with World-Wide HYPE1.3.6, HydroGFD2 and ECMWF det. forecasts compared with observations at 9 streamflow gauges
- Evaluation based on exceeding flood hazard thresholds (return periods) defined separately for observations and simulations
- Results
  - Upper Niger River: high probability of detection (POD) but high false alarm ratio (FAR)
  - Lower Niger River: low FAR but also low POD
  - Thresholds are critical
  - Conclusions preliminary since only 3 years were assessed







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Work-in-progress to improve forecast skill

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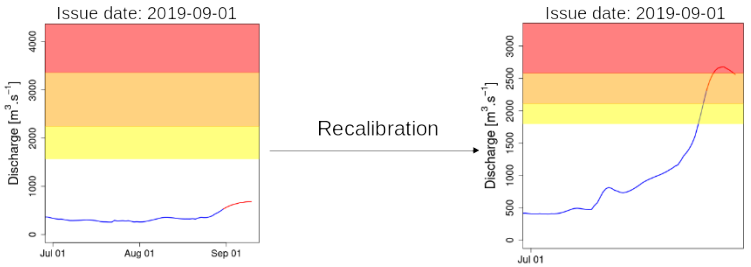
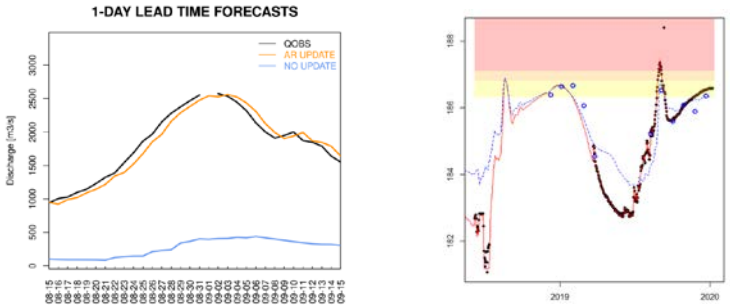
- Up-to-date meteorological data: HydroGFD version 3, West African observations
- Hydrological models: recalibration, operate multiple models
- Local hydrometric observations: operational collection and assimilation of gauged water level & streamflow data
- Satellite data: assimilation of water levels from satellite altimetry
- Refined flood hazard thresholds: water level forecasting + bias adjustment + locally determined critical flood thresholds
- Details in FANFAR deliverables 3.1, 3.2 & 3.3 https://fanfar.eu/resources/

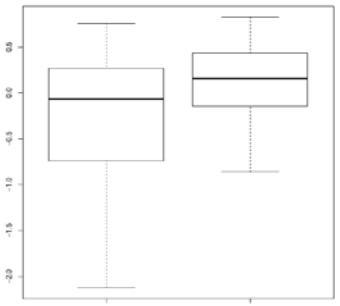
Recalibration of hydro. model



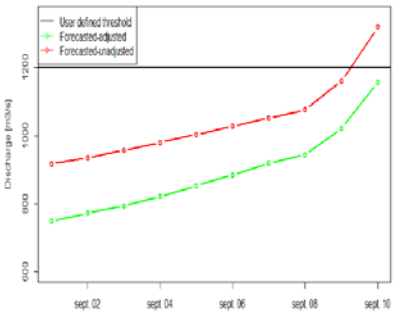
Assimilation: gauges & EO water levels



Meteo. inputs



Local flood thresholds



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Capacity development & support

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- Hands-on training at each workshop
- In-depth courses, e.g. on hydrological modelling
- Spin-off training sessions: e.g. during the Masters courses at AGRHYMET and at the PRESASS regional climate outlook forum

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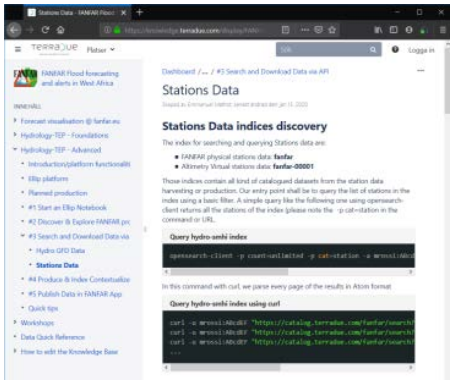
- Documentation, user guides, workshop material
- Open forum for questions
- Dedicated support channel for solving specific issues
- Multi-lingual



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Outlook

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Potential for significant societal value

- More secure societies, less detrimental flood impacts (lives, money, migration etc.)
- Ambition is to move from post-catastrophe crisis management to informed preparation, actions to minimize impact, and planned response
- Raised value of public services, NGOs, and companies

Future plans

- Test & refine the system in 2020
- Forecast skill experiments & publications
- Sustainability: financing, human resources, roles & agreements

Join us to realize the vision!

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