Flash Flood Forecasting in West Africa

Evaluating the performance of regional and global numerical weather prediction models

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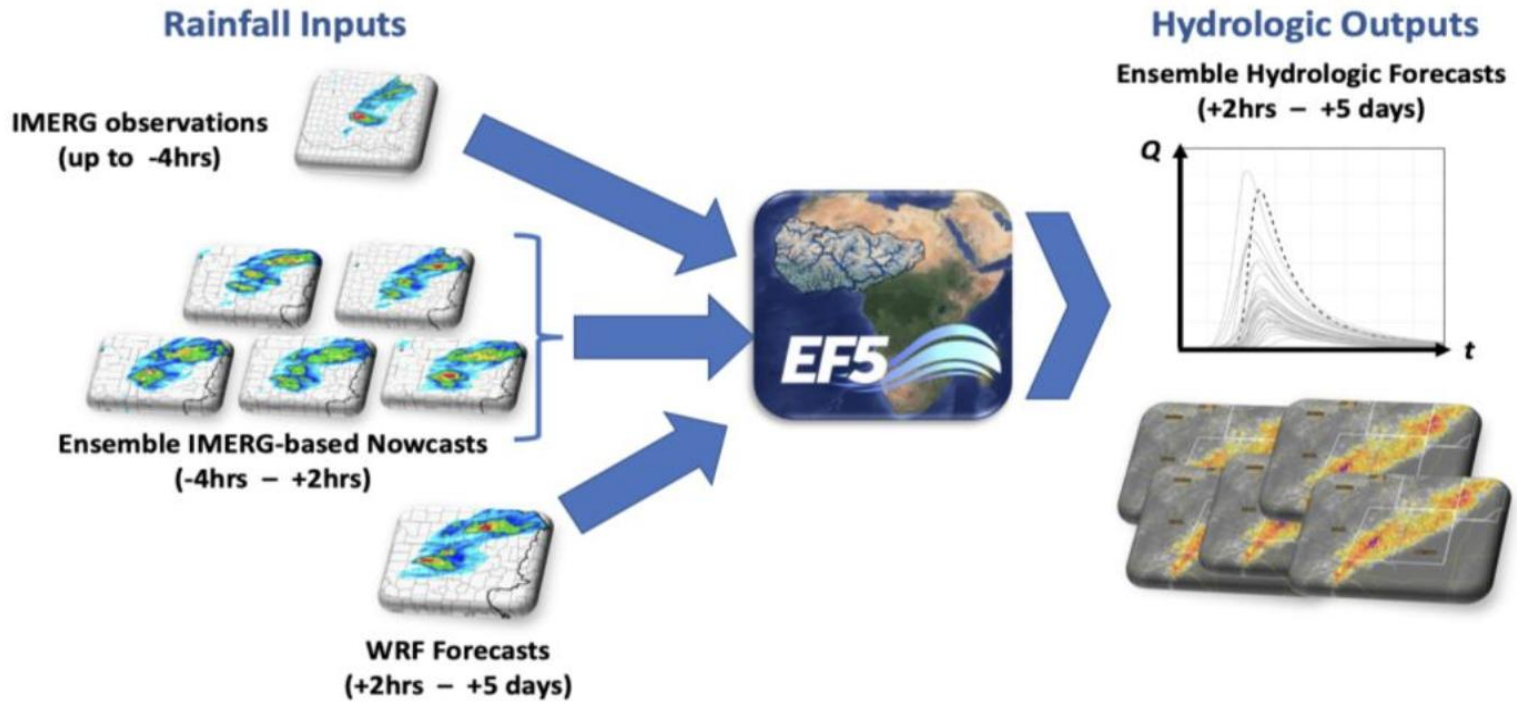
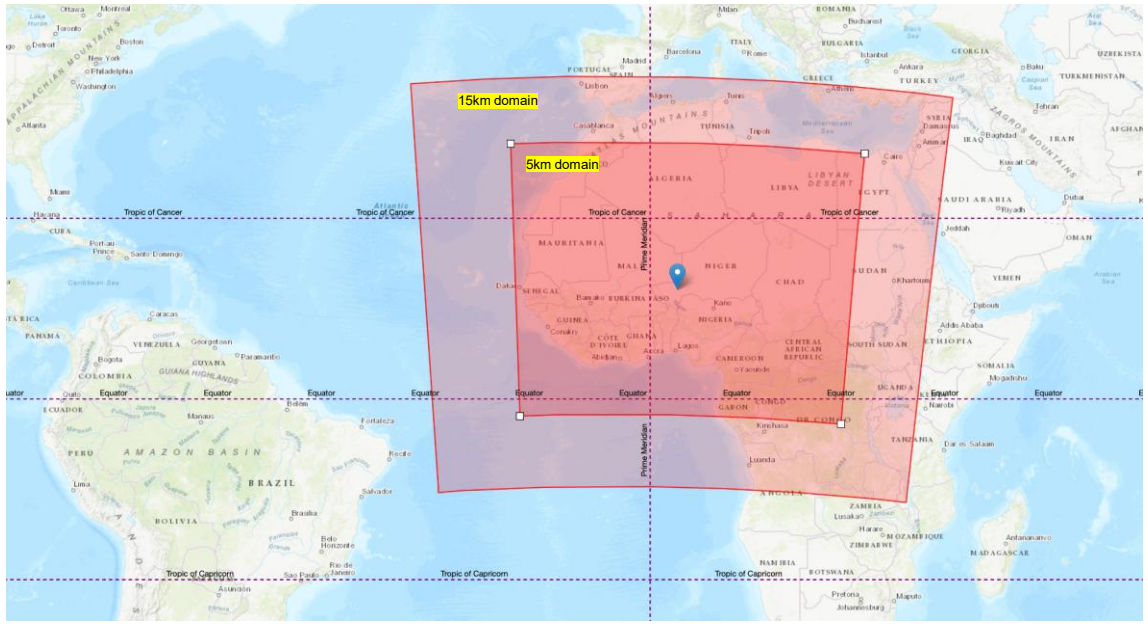
Background

Develop a flash flood nowcasting/forecasting system to **advance the institutional capacity** of the West Africa countries to mitigate flash flood risk.



Objective

Comparision of **Regional Forecast (WRF)** model and **Global Forecasting System (GFS)** with **IMERG Early V07** for flood events in West Africa.



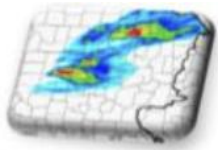
Methodology

SERVIR

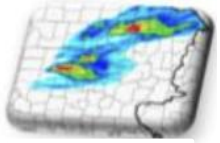
Events Data

Flooding Events

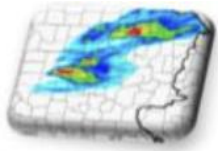
Precipitation Data



IMERG Early-V07



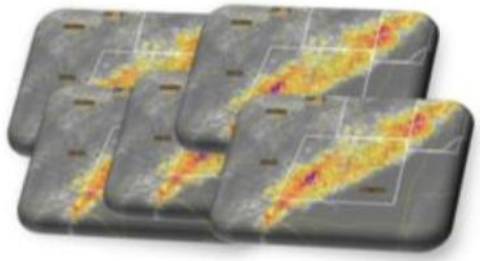
WRF



GFS

Simulations

Outputs



Maximum Streamflow

Maximum Unit Streamflow

Precipitation Accumulation

Analysis

Obibia Flash Flood, Nigeria (July 26, 2018)

Obibia stream

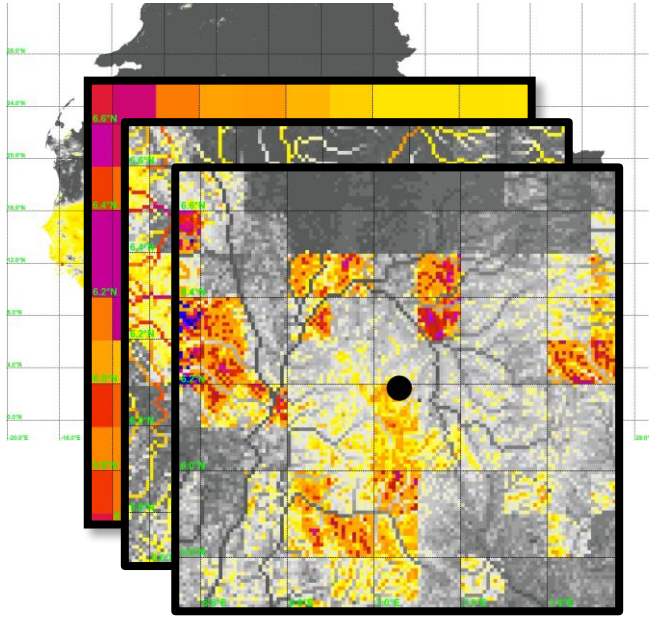
July 26: – Flash flood killed a 14-year old at Obibia stream behind Governor's Lodge Amawbia Awka South local Government Area, Anambra State. She was with four other people in a 504 Peugeot vehicle that was swept away. The girl was in the flood for over four hours and was still alive when rescued but later died at the hospital. The stream normally overflows its bank whenever there is a heavy down pour.

Source: *https://www.vanguardngr.com/2018/08/rains-of-fury-nigeria-loses-141-lives-to-rainstorm-flood-in-2018*

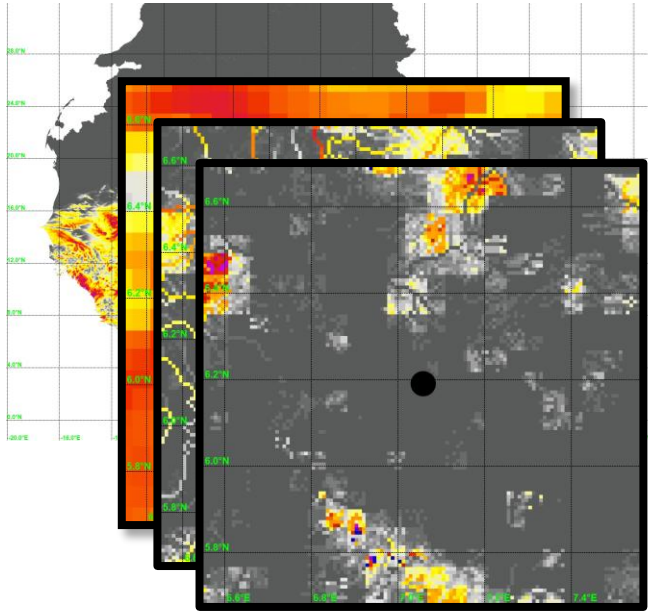
EF5 Outputs (Flash Flood)

Maximum Unit Streamflow

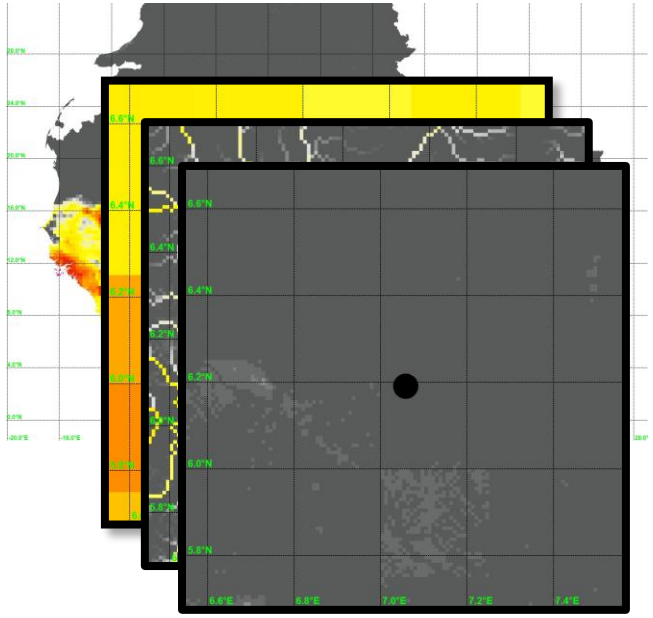
IMERG E-V07



WRF

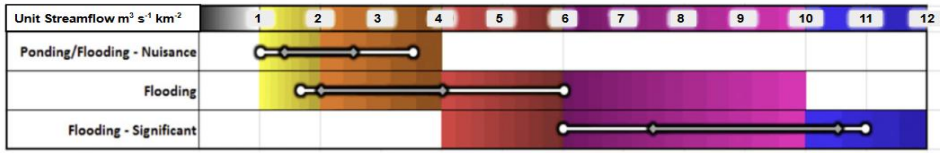


GFS



H-Res WRF captures precipitation magnitude but spatially misaligns.

Unit: cms/sqkm



IDP Flood, Burkina Faso (June 5, 2020)

West Africa – Rains and Floods Damage IDP Camps in Nigeria and Burkina Faso

11 JUNE, 2020 BY FLOODLIST NEWS IN AFRICA, NEWS

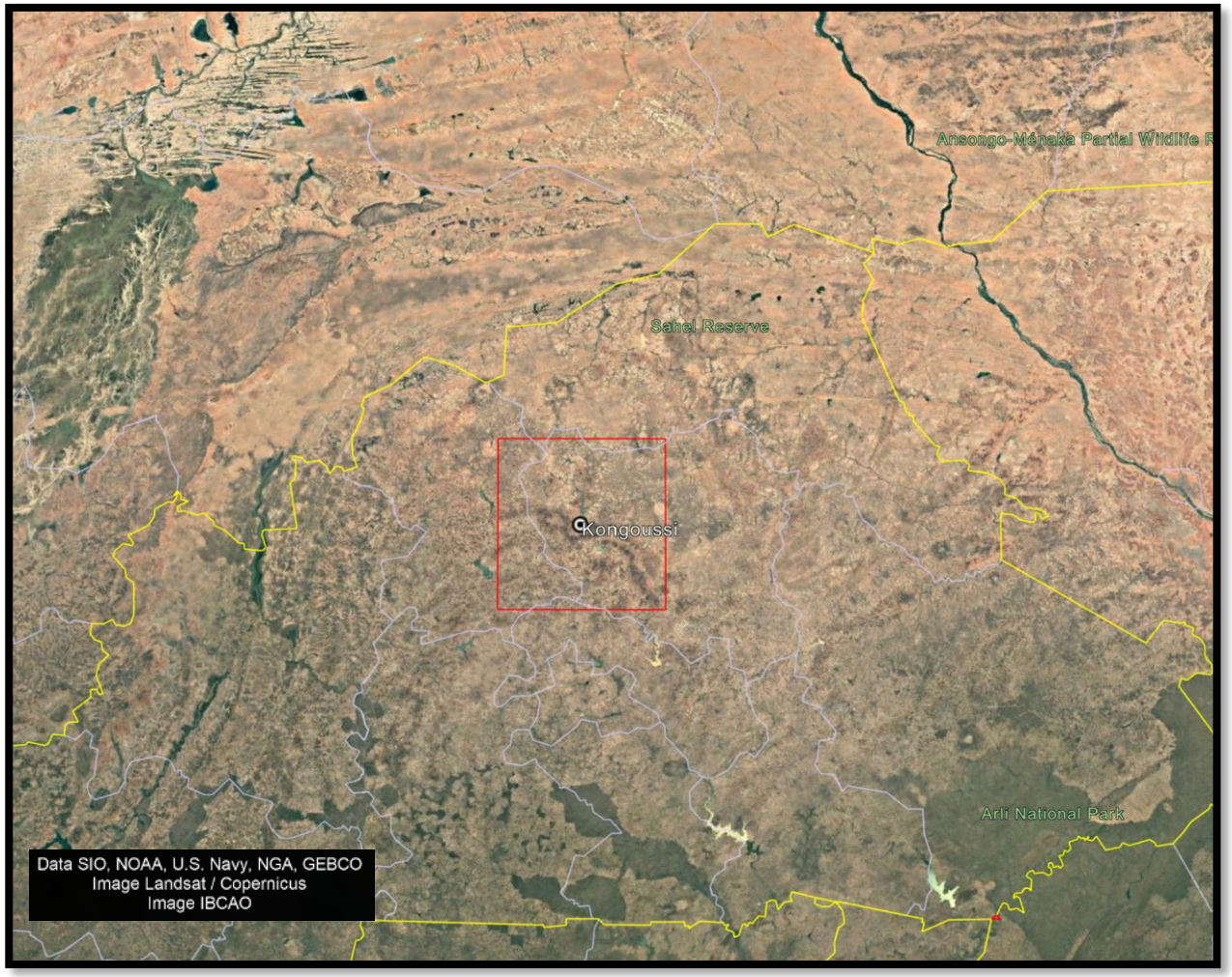
Severe weather has caused widespread destruction in several Internally Displaced People's (IDP) camps in West Africa over the last few days.

In Burkina Faso, the UN reported heavy rainfall from 05 June caused flooding in several communes in Burkina Faso's Centre Nord region, including Kongoussi, Pensa and Barsalogho.

Kongoussi is about 100km north of the capital, Ouagadougou, which recorded 29mm of rain on 09 June. Around 100 km west of Kongoussi, Ouahigouya the capital of the Yatenga Province, recorded 47 mm of rain on 08 June.

The flooding in Centre Nord region caused damage to IDP camps hosting 140,000 people. According to the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) 24 people were injured, around 700 shelters were destroyed and 2,900 damaged.

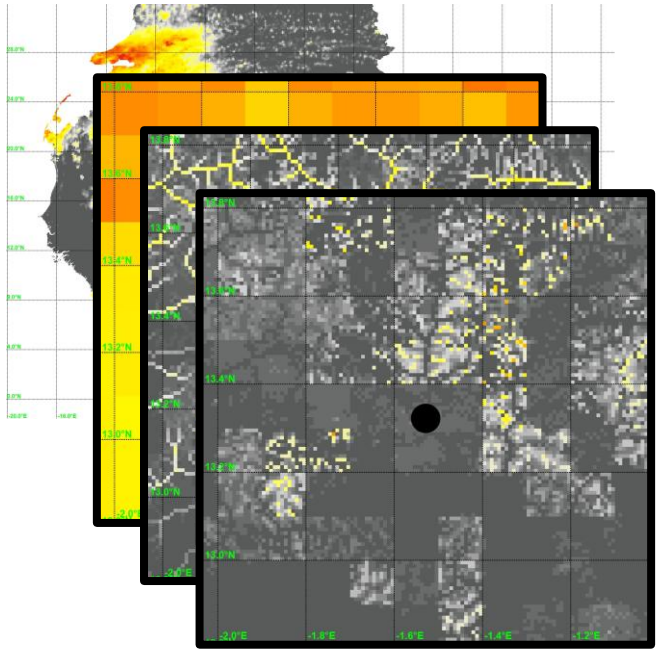
Source: Floodlist



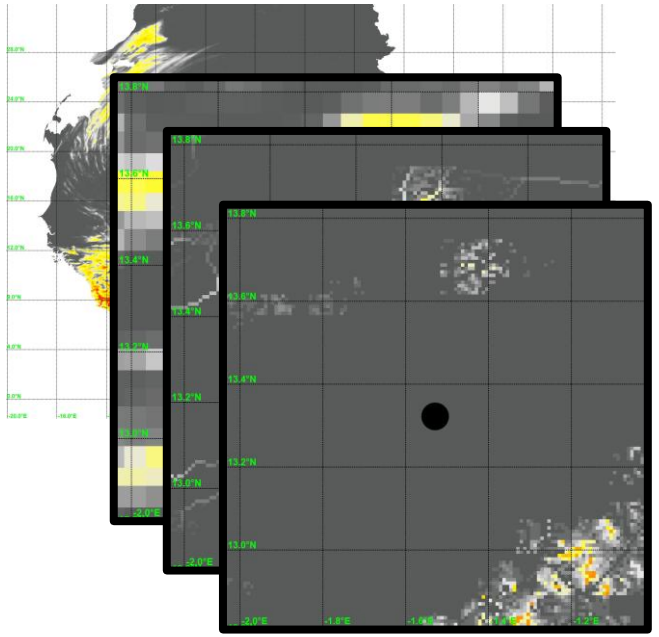
EF5 Outputs

Maximum Unit Streamflow

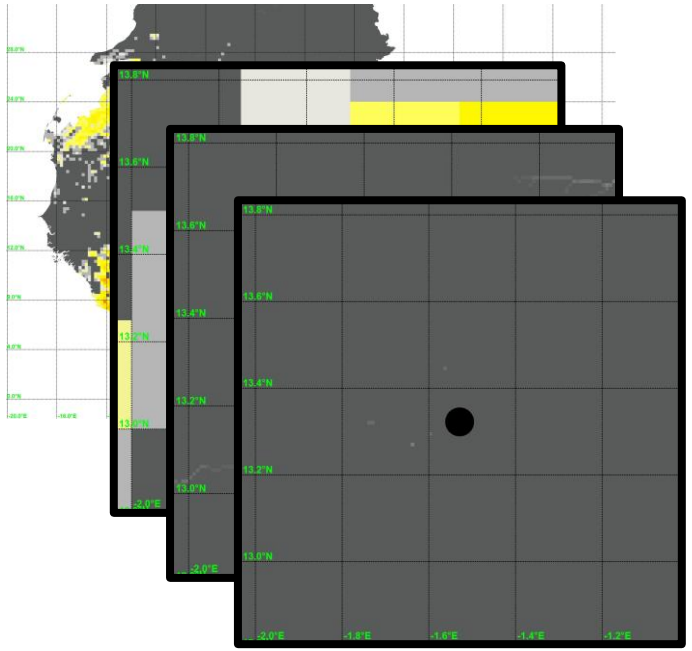
IMERG E-V07



WRF

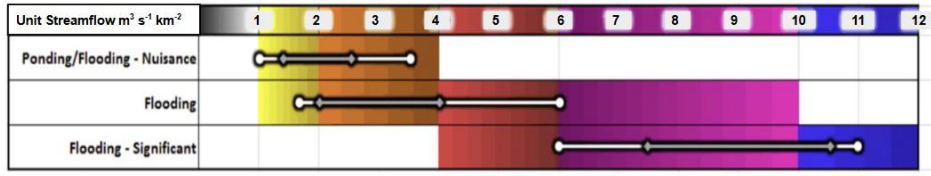


GFS



Spatial misalignment by WRF and underestimation by GFS.

Unit: cms/sqkm



Damaturu Flood, Nigeria (July 24,2018)

July 24: – Flood displaced hundreds of Damaturu residents following a down pour which lasted many hours. The rains destroyed houses and shops in places such as Nayi Nawa, Shago Tara, Fulatari, Pompomari and Bulabulin.

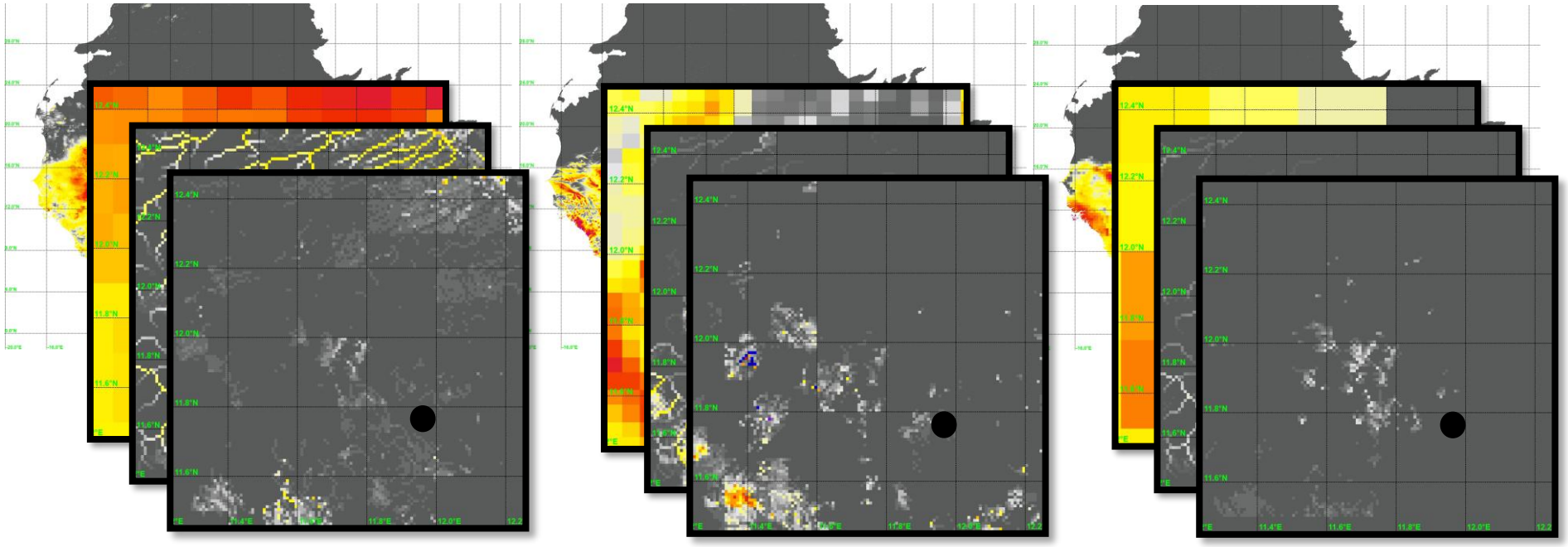
- 19,369 people displaced, 5,732 houses destroyed
- Katsina worst hit with 61 deaths

Source: *https://www.vanguardngr.com/2018/08/rains-of-fury-nigeria-loses-141-lives-to-rainstorm-flood-in-2018*

EF5 Outputs

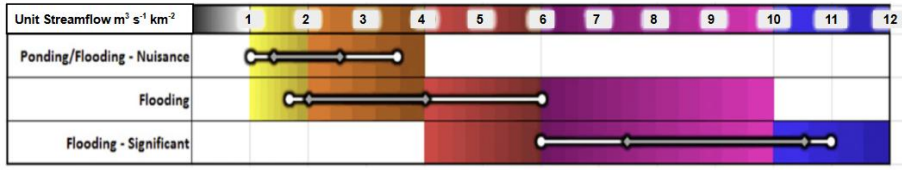
Maximum Unit Streamflow

IMERG E-V07 | WRF | GFS



IMERG and GFS fails to detect flooding.

Unit: cms/sqkm



Accra Flash Flood, Ghana (October 10, 2020)

Ghana – Flash Floods Cause Traffic Chaos in Accra

10 OCTOBER, 2020 BY FLOODLIST NEWS IN AFRICA, NEWS

Flooding struck in Accra and surrounding areas in Ghana on 10 October after heavy rainfall.

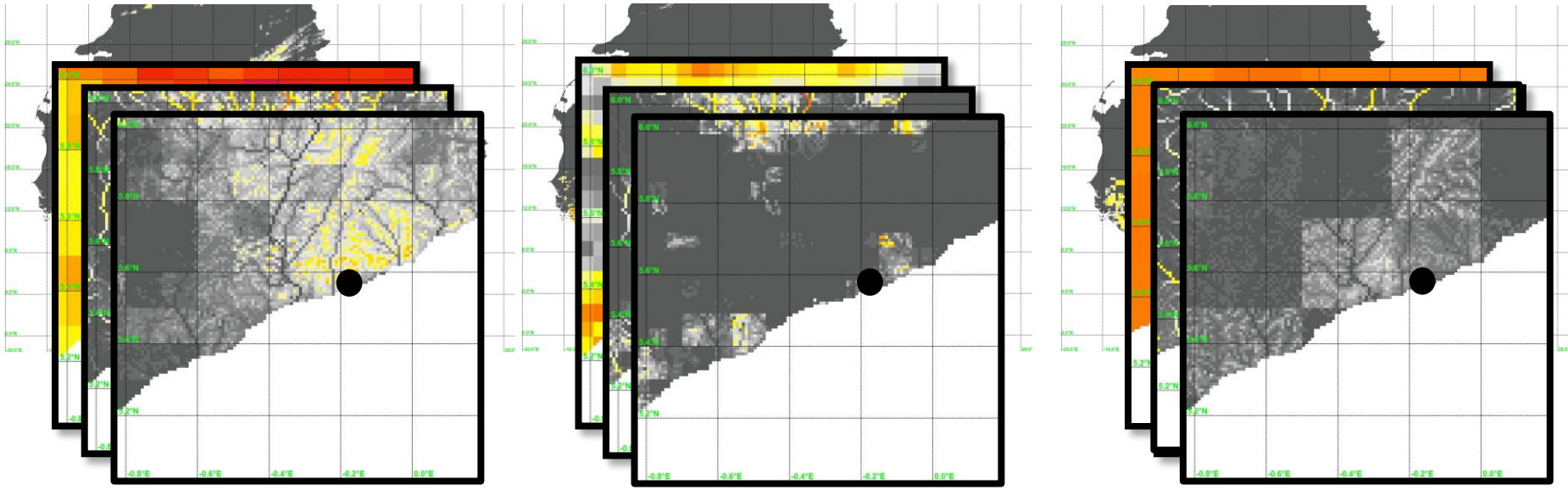
Media reported a heavy downpour lasting several hours, early on 10 October, causing floods in areas of Accra and neighbouring Kasoa in Central Region. Just over 78 mm of rain was recorded at Kotoka International Airport in Accra in 24 hours to 10 October.

Source: https://floodlist.com/africa/ghana-flash-floods-cause-traffic-chaos-in-accra

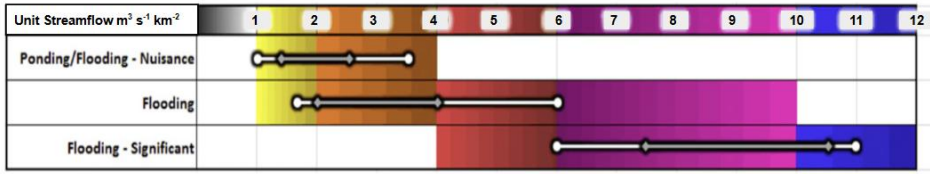
EF5 Outputs (Flash Flood)

Maximum Unit Streamflow

IMERG E-V07 | WRF | GFS



IMERG detects flooding; WRF spatially misaligns and GFS significantly underestimates.



Unit: cms/sqkm

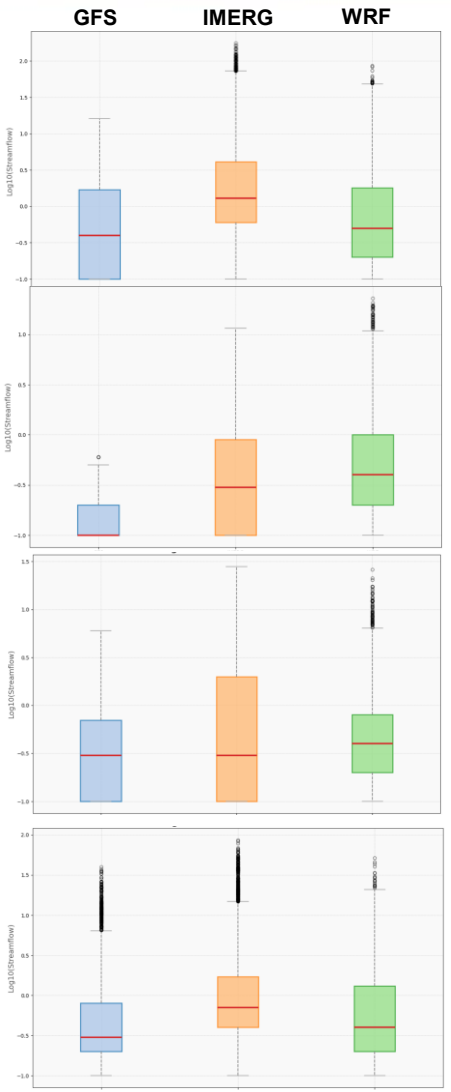
Distribution and pixelwise comparison

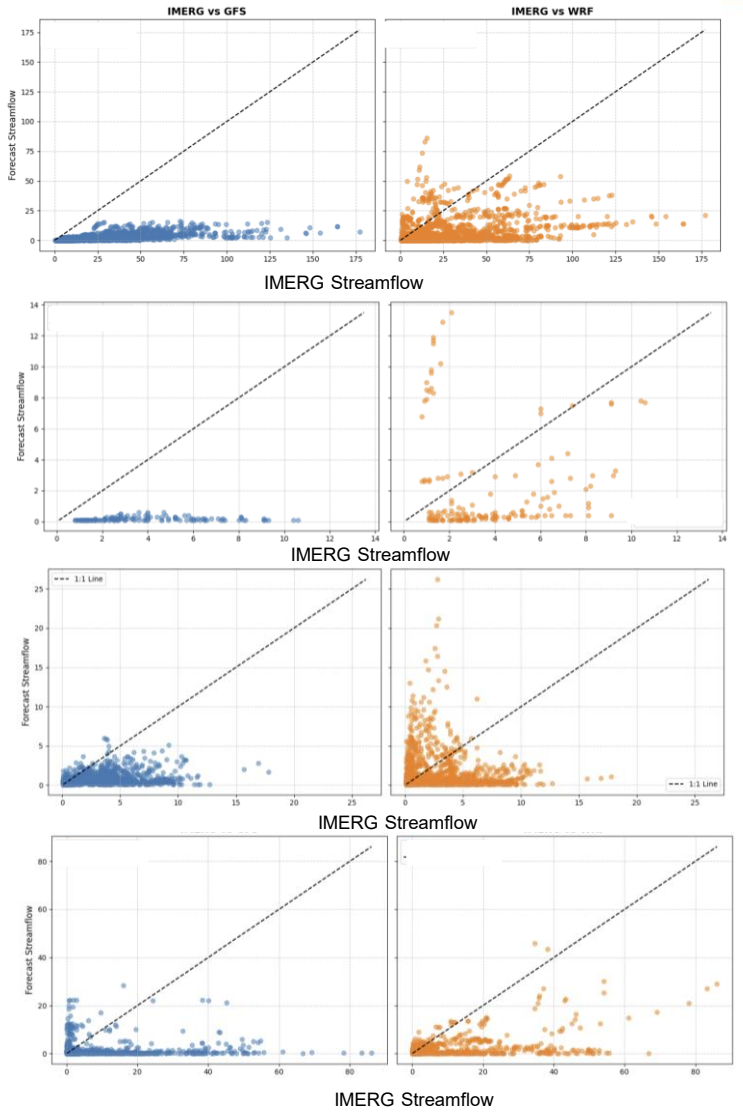
Obibia Flash Flood, Nigeria (July 26, 2018)

IDP Flood, Burkina Faso (June 5, 2020)

Damaturu Flood, Nigeria (July 24,2018)

Accra Flash Flood, Ghana (October 10, 2020)





IMERG was not able to detect the flood at all.

Conclusions

- Uncertainty in precipitation forecasts pose a significant challenge for flash flood forecasting in west Africa.
- The regional 5km WRF model demonstrates superior performance compared to global 25km GFS in predicting the overall magnitude of streamflow for the events examined.
- There are cases where WRF spatial precipitation pattern is shifted, with respect to IMERG, resulting in insufficient streamflow generation at the locations where incidents were reported.
- Future research will include analysis of ensemble nowcasting precipitation fields.

Any Questions?