

Estimating the Hydrologic and Physiographic Characteristics of the Lower Niger River Basin – A 2012 and 2022 Post-Flood Assessment in Nigeria using Globally Available Data

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Background

- Over the years, satellite observations and products have been demonstrated as invaluable in flood monitoring, inundation mapping, exposure, and risk assessments in ungauged basins located in flood prone globally.
- Here, we evaluated the efficacy and potential of satellite observations and measurement to:
 - Characterize the hydrologic and physiographic settings in the Lower Niger River Basin post 2012 and 2022 floods.
 - Estimate the magnitude and frequency of the 2012 and 2022 flood in a section of the basin.

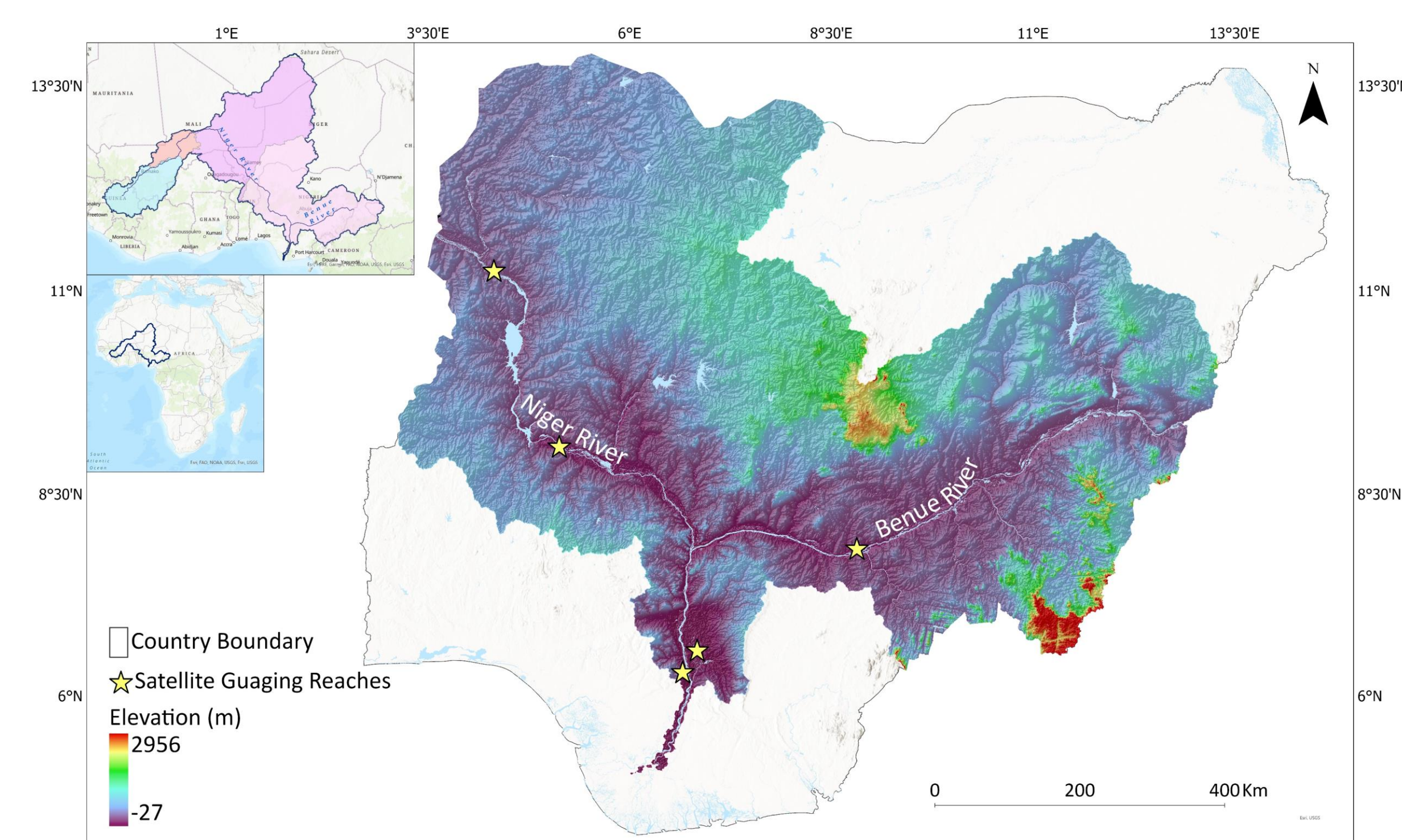


Figure 1: Map of the Lower Niger River Basin in Nigeria and the Niger River Basin in West Africa.

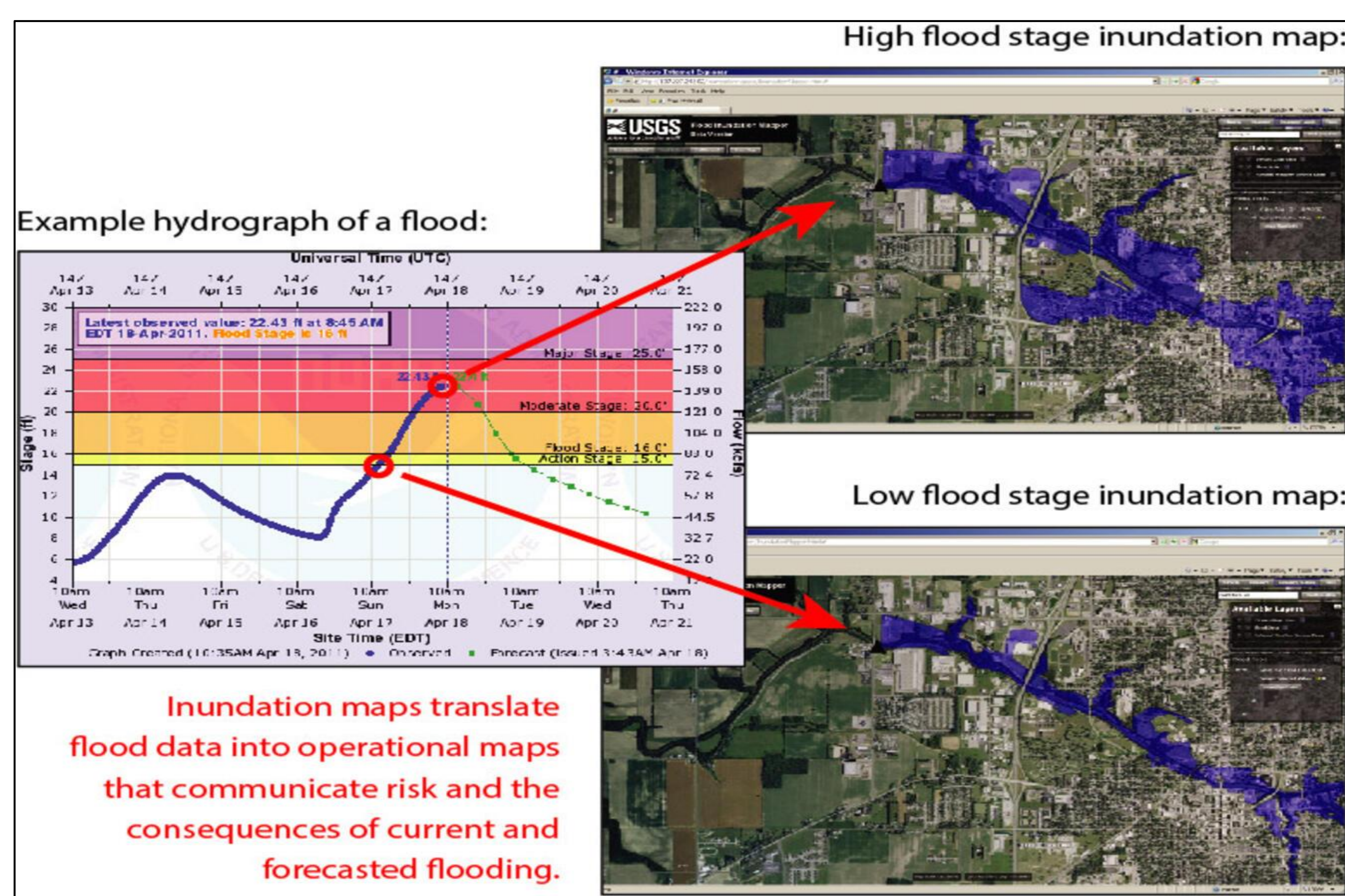


Figure 2: Graphical representation of a flood hydrograph and inundation extent from the USGS real-time stream data and National Weather Service flood forecasts. (Source/Usage: Public Domain)

Method

- Step 1 — 2012 and 2022 Flood Extent Mapping**
 - To estimate the spatial extent of flooding along the Niger and Benue Rivers.
- Step 2 — Flood Depth Estimation using FwDET 2.1 and HAND Model.**
 - To estimate the depths of water within the delineated inundation extent.
- Step 3 — Flood Frequency Analysis**
 - To quantify and estimate the magnitude and flood frequency at the satellite gauging reaches.

Preliminary Result

I. Flood Extent Mapping in the Lower Niger River Basin

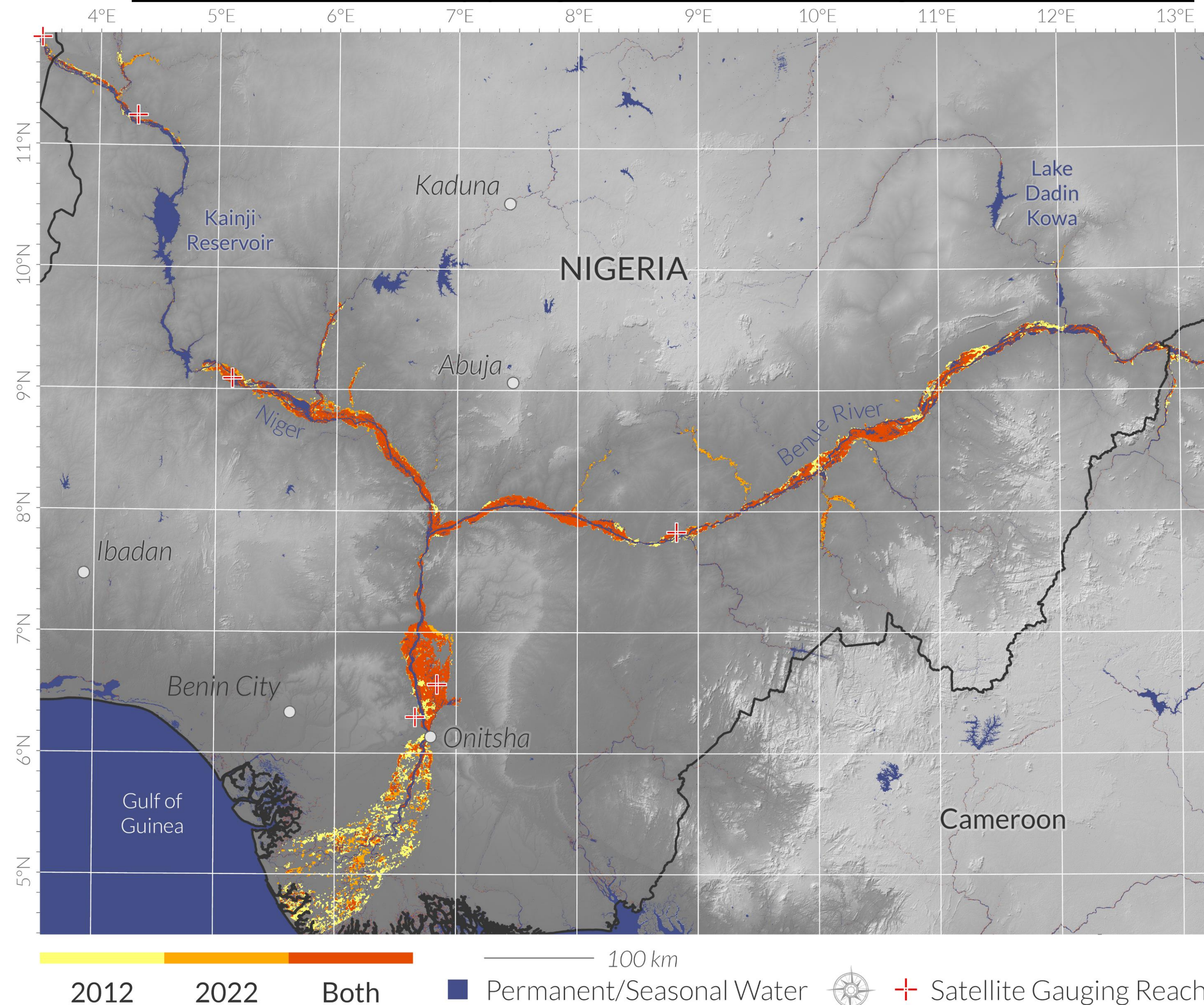


Figure 3: Flood Inundation Extent for 2012 and 2022 Floods in Nigeria.

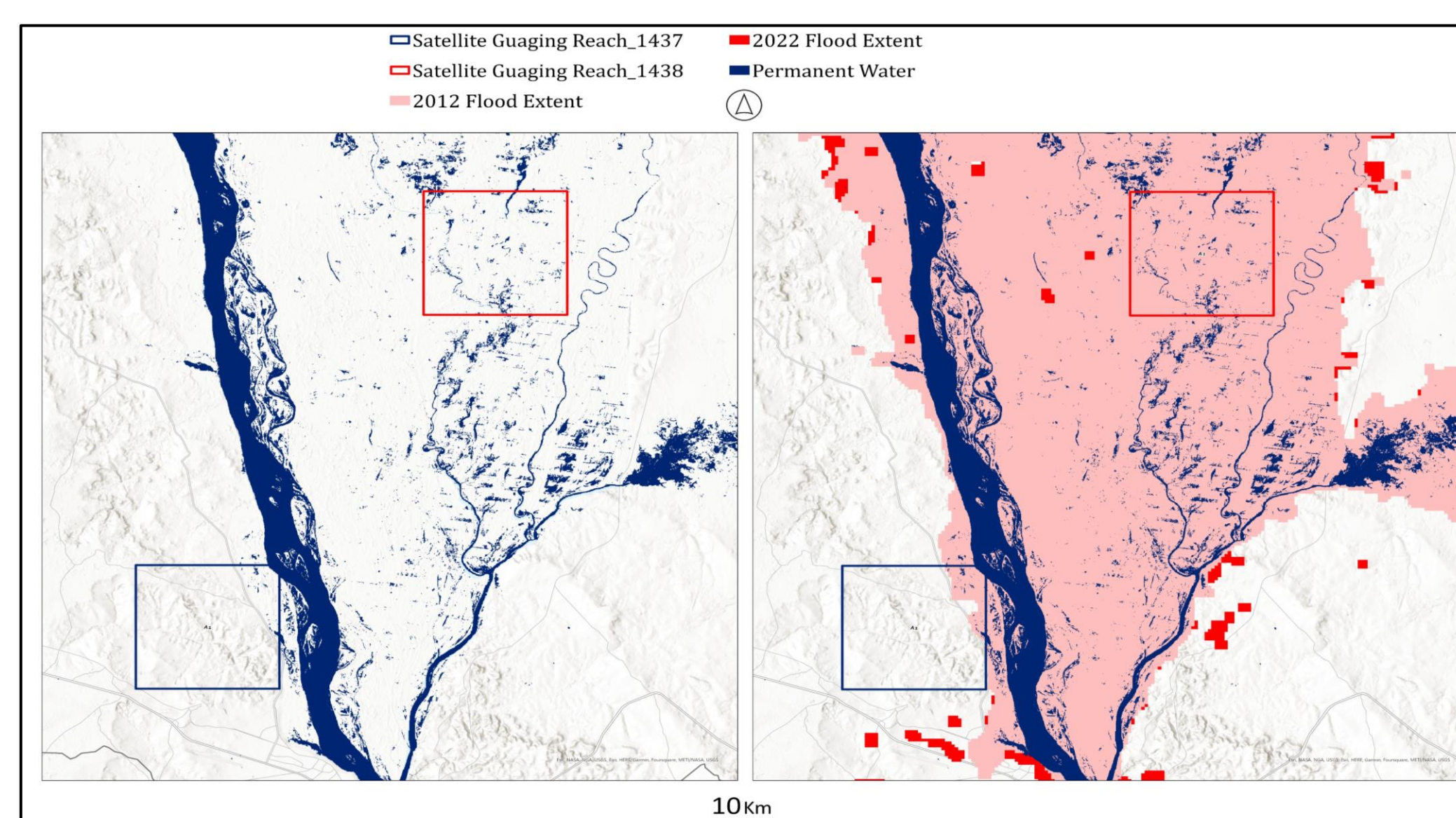


Figure 4: Pre- and Post Flood Condition for some Satellite Gauging Reaches.

II. Flood Depth Estimation in the Lower Niger River Basin

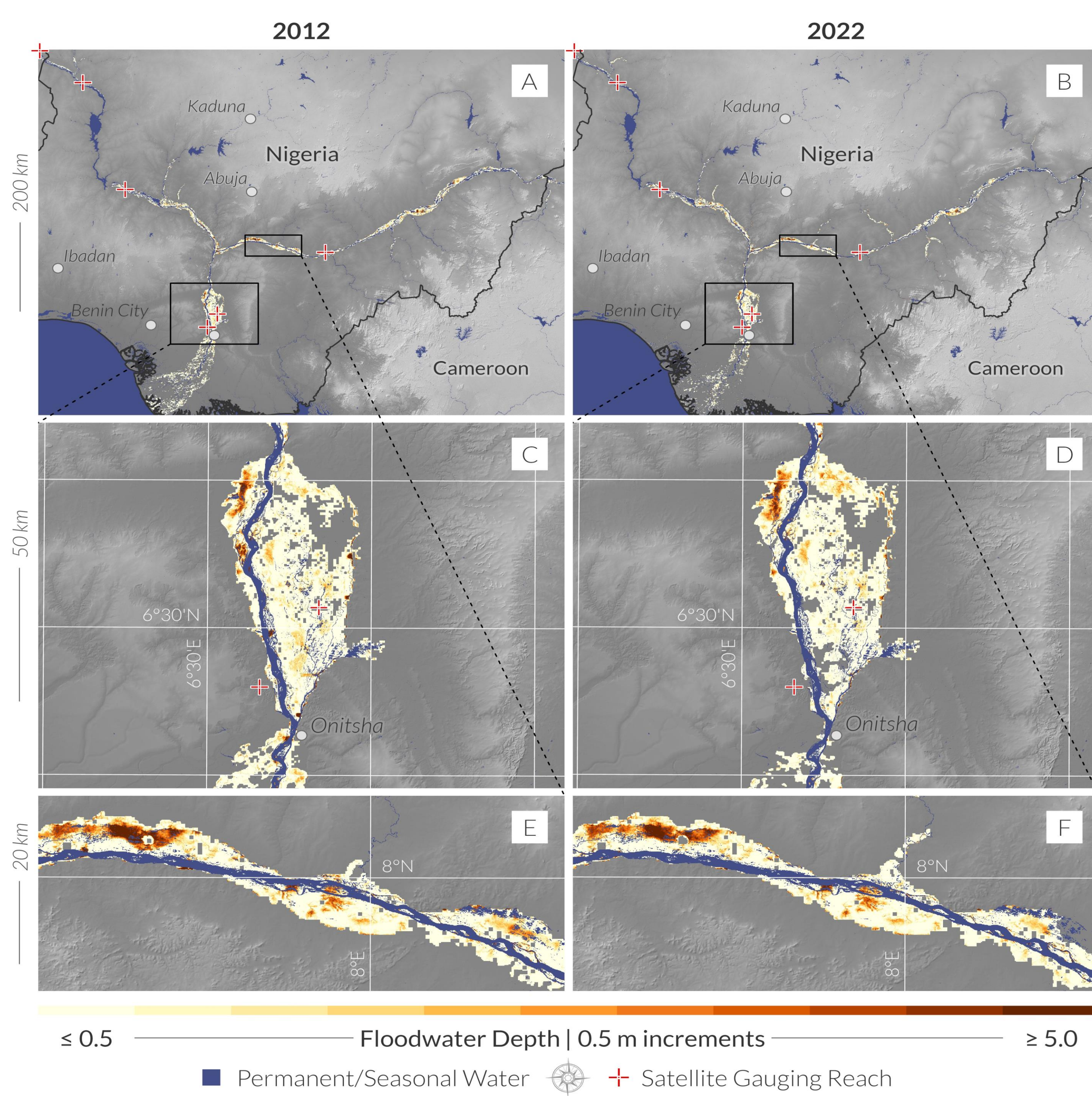


Figure 5: Flood Depth along the Niger and Benue Rivers.

III. Flood Frequency Analysis in the Lower Niger River Basin

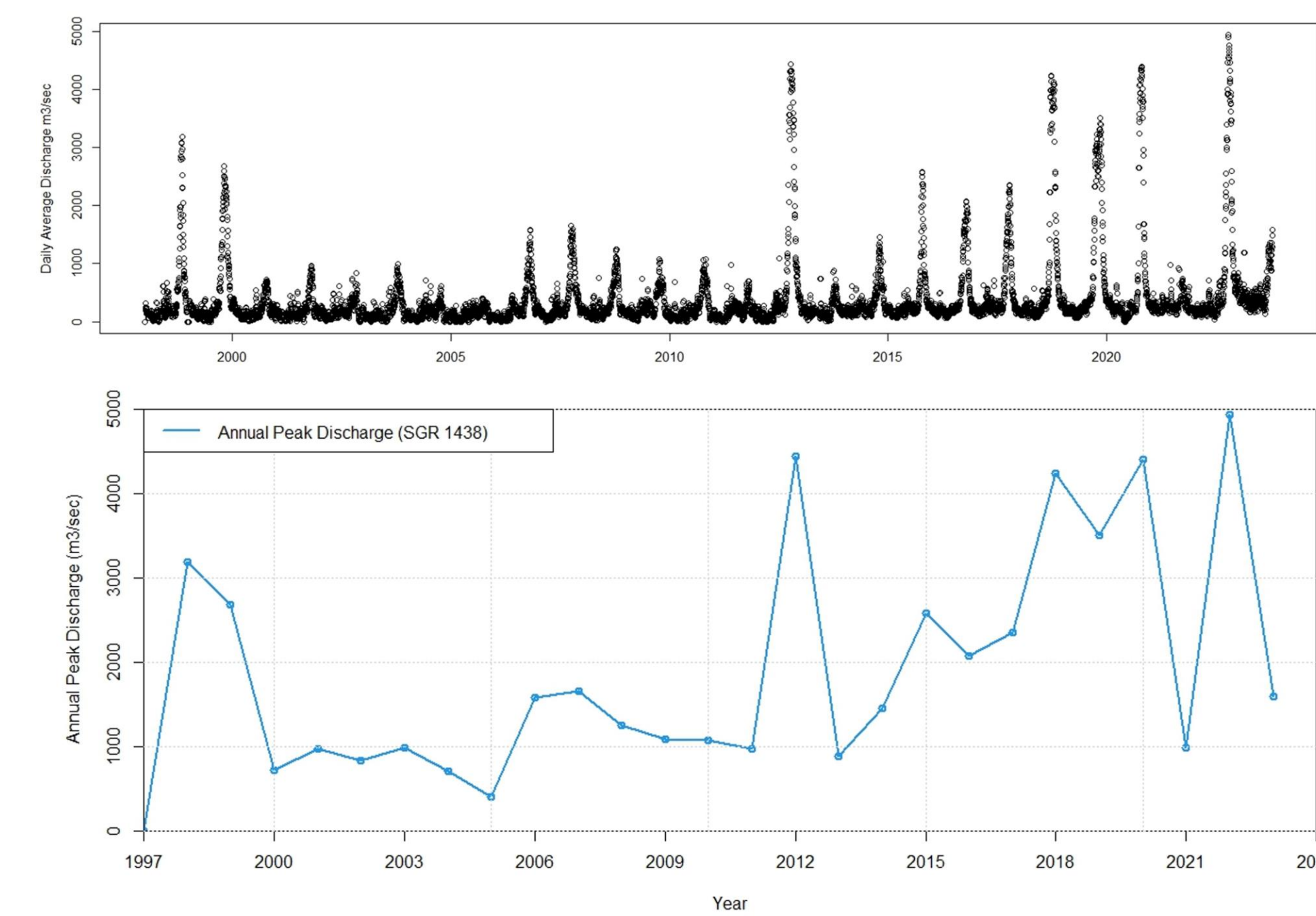


Figure 6: River Watch daily discharge (top) and annual peak discharge (bottom) for 2012 and 2022 are 4447m³/sec and 4943 m³/sec respectively.

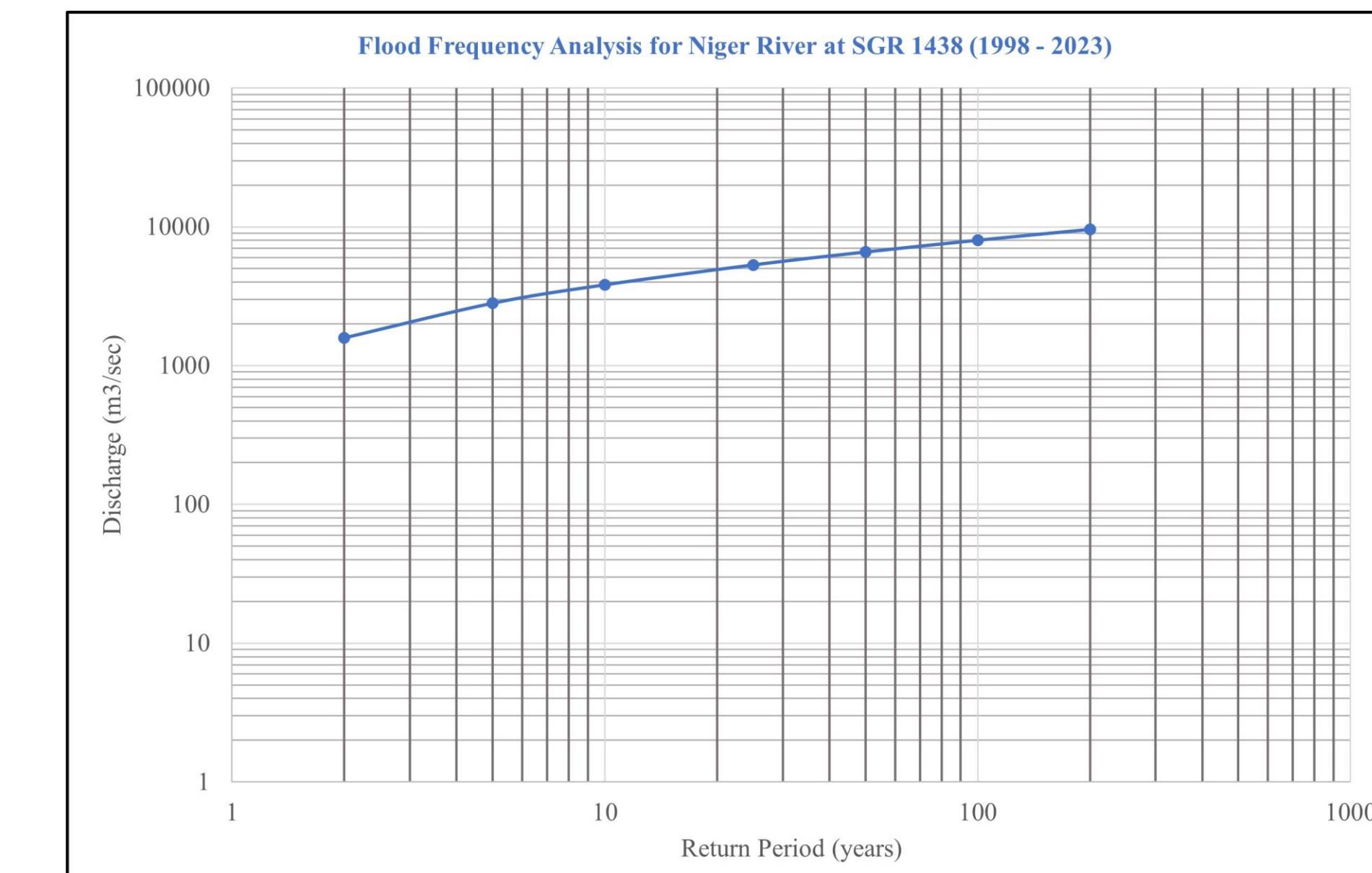


Figure 7: Log Pearson III analysis of the flood frequency at SGR 1438 shows the 2012 and 2022 floods to be 17-year and 20-year floods respectively.

IV. Floods Hydrologic and Impact Analysis

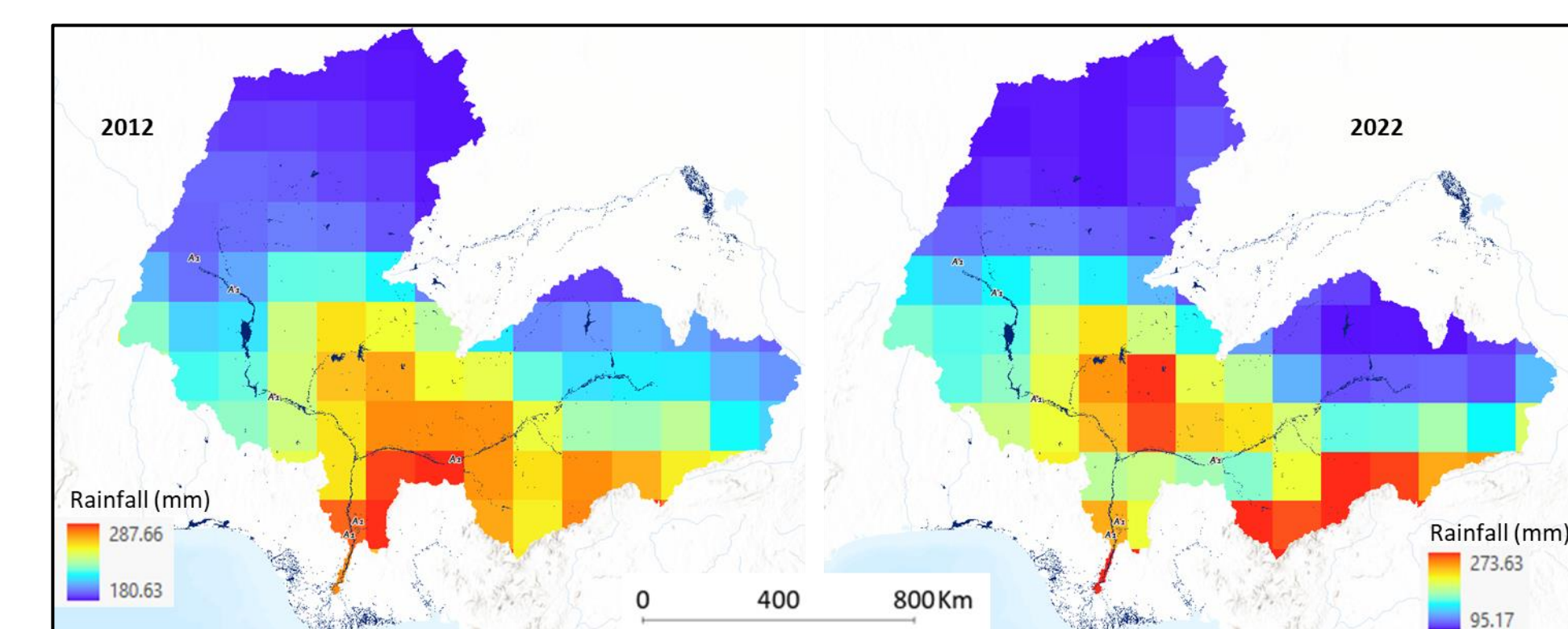


Figure 8: Mean Precipitation Amount (GPCC) within the LNRB for 2012 and 2022.

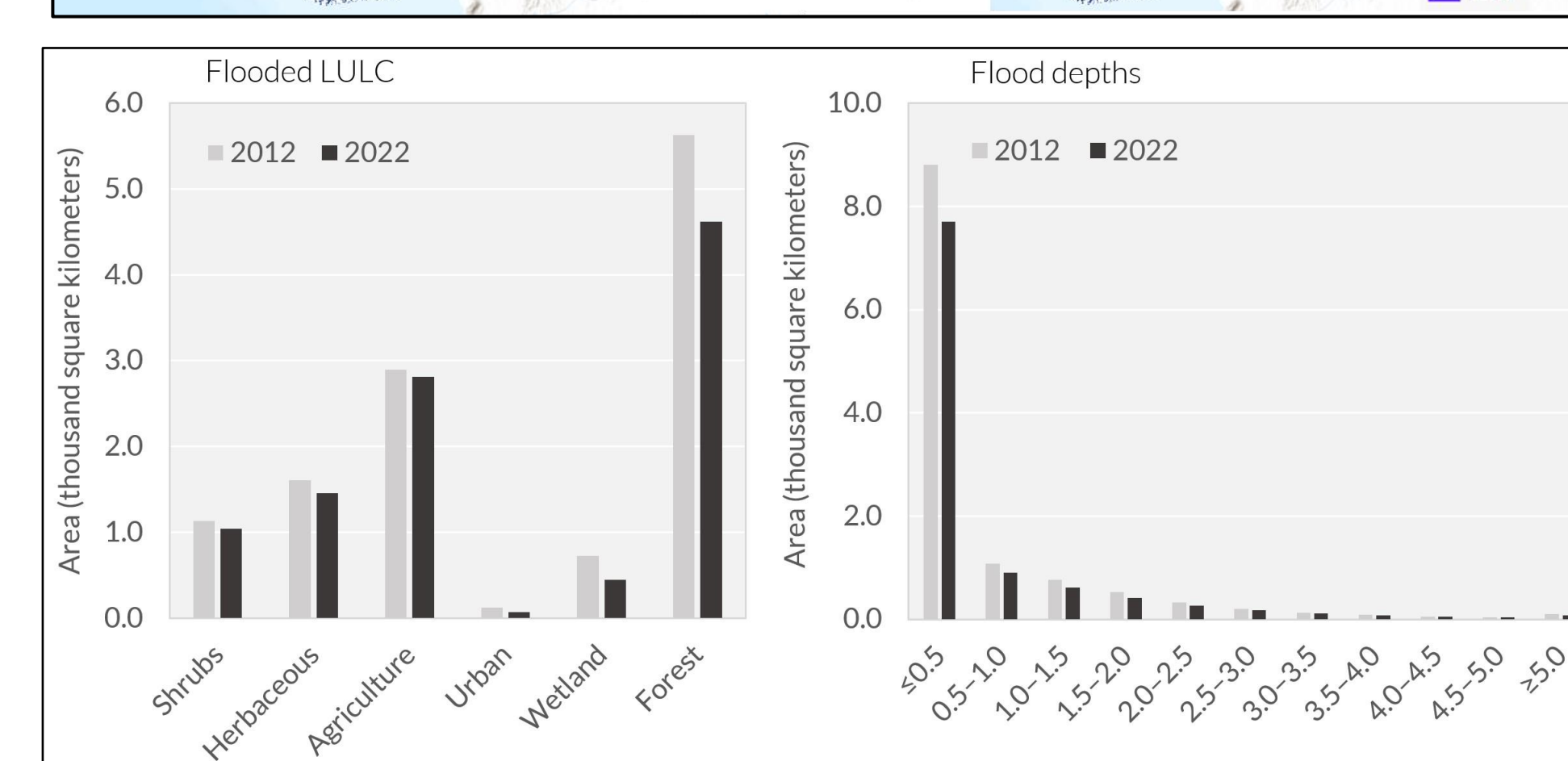


Figure 9: Comparison of the flood inundation extent to Land Use/Land Cover (left), and flood depth (right).

Limitations

- Presence of cloud cover in optical satellite products (MODIS).
- Depending on DEM spatial resolution, water depth might be undetectable by FwDET.
- Ground truth data availability for performance validation.

Conclusion & Future Work

- Satellite products could be invaluable as a component of an Early Flood Warning System in sparsely gauged to ungauged basins.
- Further evaluation of satellite products efficacy and accuracy for operational flood prediction, forecasting, monitoring & disaster response and management in LNRB.

Acknowledgement

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References



Personal Website