Improved anticipation of floods on the White Nile (INFLOW)

Prof Liz Stephens (Co-PI) | Dr Mohammed Hassan (Co-PI) | Dr Ross Maidment (Project Manager)

Communities cut off by flood waters, South Sudan (Credit: Sean Sutton / MSF)

Outline

South Sudan faces a humanitarian crisis, with over 2 million people living in poverty and flood-prone areas INFLOW aims to strengthen early warning systems in the White Nile catchment by improving hydrological models and enhancing humanitarian response. It focuses on conflict-affected communities, especially women and children, through collaboration across research, government, and humanitarian partners.

Approach and Methods

INFLOW's research is focused on these four areas:

- Using diverse datasets to **understand key hydrological processes** from Lake Victoria to the Sudd Wetlands.
- **Desk and field research in conflict-affected communities**: to examine how floods affect different groups, especially women and marginalized communities.
- **Improving forecast skill and usability** through co-produced frameworks, working with regional forecasting centres and national agencies.
- Applying new insights to **strengthen humanitarian contingency and anticipatory planning**.

Outcomes to date

1. Flood forecasts for South Sudan using AI

Leveraging high-resolution satellite-derived flood extent maps, lake levels and rainfall estimation, the INFLOW-AI model provides forecasts of flood extent out to 6 dekads (Fig. 1).
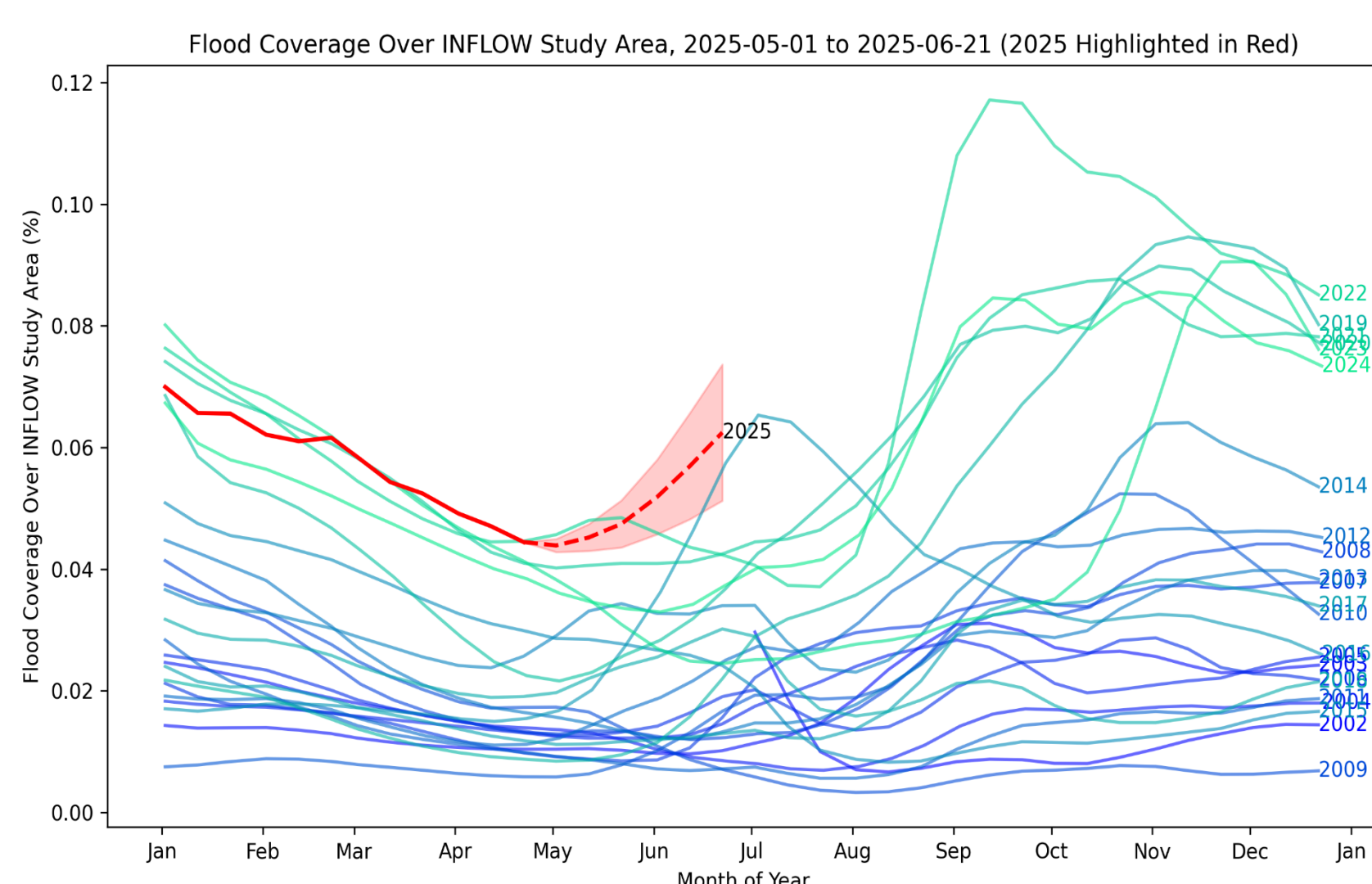

Fig 1. South Sudan total flood extent, derived by WFP. Blue/green lines show recent years while the red line shows the current year and the dashed line with confidence bounds is the INFLOW-AI forecast (credit: Jessica Rapson).

2. Improving reliability of satellite flood detection

Remote sensing is critical for monitoring flood extent in data-sparse regions. Our analysis is quantifying and interpreting differences seen between satellite-derived flood products (Fig. 2).
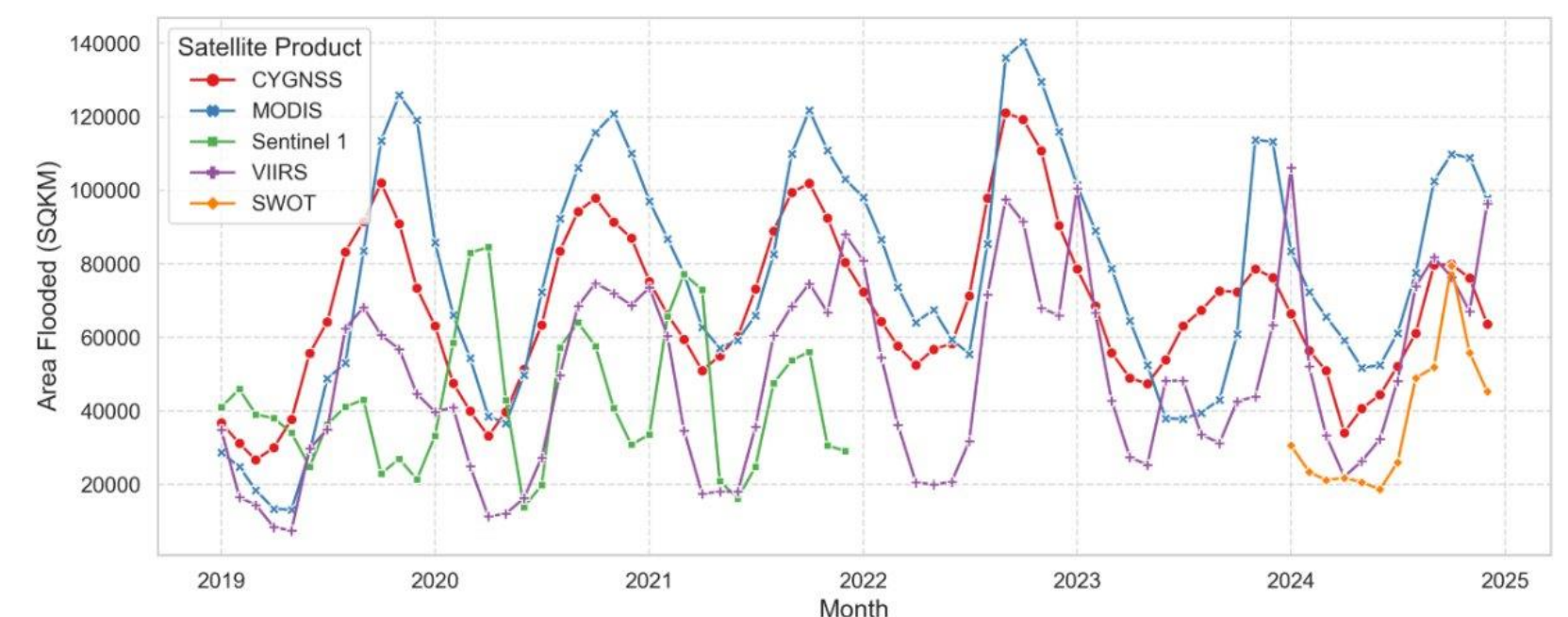

Fig 2. Time-series of South Sudan flood extent from different satellite products (Credit: Evet Naturinda).

3. Improving understanding of the hydrological timeline

Key to understanding the region's hydrological dynamics requires detailed analysis of water fluxes within the White Nile Basin. A part of this is knowing the flow regimes, as highlighted in Fig. 3. Such knowledge is supporting analysis of hydrological timelines in the region.
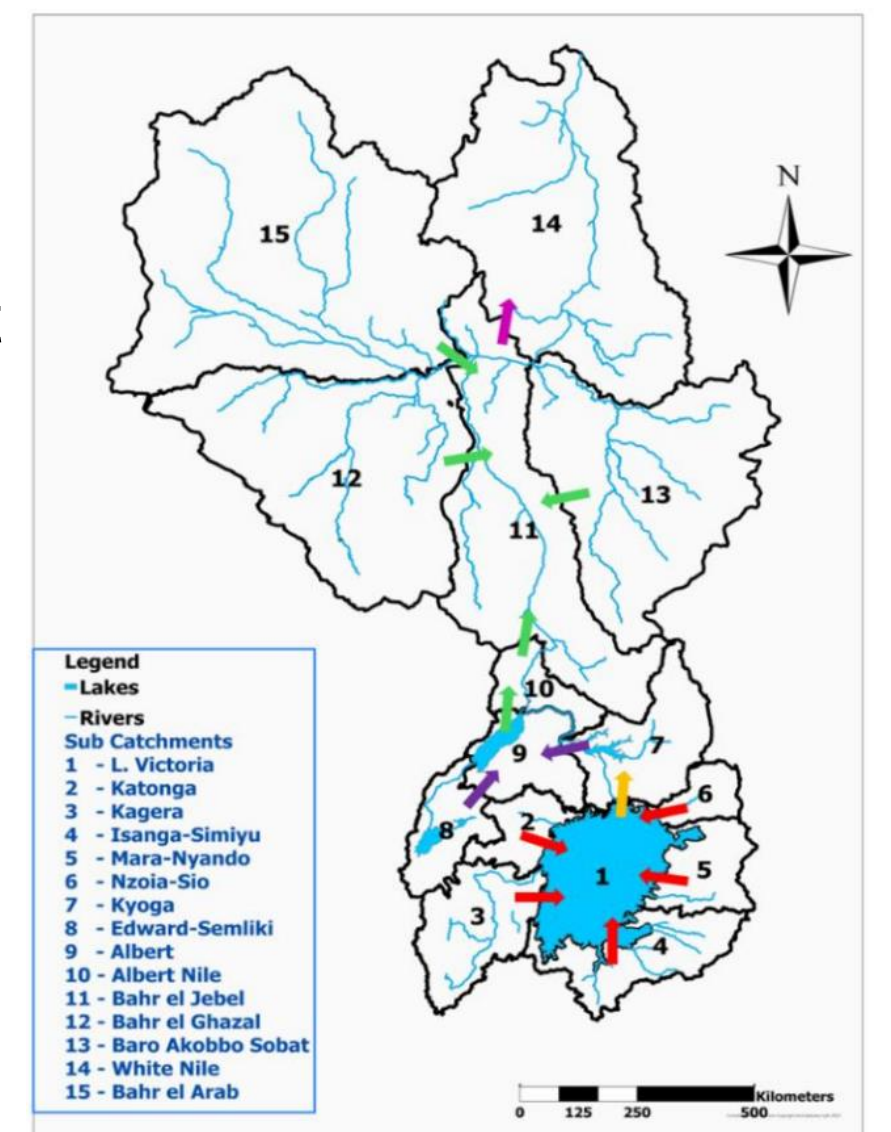

Fig 3 (right). White Nile Basin sub-catchments and major water bodies and rivers. Arrows denote drainage direction between catchments. (Credit: Douglas Mulangwa)

4. Supporting the UN-led Flood Task Force

The INFLOW team provide expert insights into South Sudan's fortnightly Flood Task Force, leveraging the INFLOW-AI forecasts and interpretation of satellite imagery.

5. Other key developments

- Development of Early Action Protocols for the South Sudan Red Cross using the INFLOW-AI flood predictions.
- Fieldwork led by Makerere University to better understand the impact of flooding on marginalised communities.
- ICPAC GeoSFM model development for basin-wide streamflow and lake level predictions.

What's next within INFLOW?

Developing flood forecast bulletins for sustained use by South Sudan Ministry of Water Resources and Irrigation and the Flood Task Force. Working with humanitarian partners to integrate project findings into anticipatory action plans.

INFLOW Partners and Collaborators

Partners: University of Reading, ICPAC (IGAD Climate Prediction and Applications Centre), Makerere University, Red Cross Crescent Climate Centre, Uganda Red Cross Society (URCS)

Collaborators: Médecins Sans Frontières, South Sudan Ministry of Water Resources and Irrigation, World Food Programme (WFP), FEWSNET

Contact details of INFLOW members at CLAREExchange2025

- Ross Maidment | r.i.maidment@reading.ac.uk
- Tom Kanyike | Tom.Kanyike@igad.int