

# Forecasting regional flood hazard

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## Summary

In 2008, a seasonal forecast of an increased likelihood of above-normal rainfall in West Africa led the Red Cross to take early humanitarian action, assuming that this forecast implied heightened flood risk across the region. However, there are a number of factors that lead to non-linearity between precipitation anomalies and regional flood hazard.

This non-linearity is a pertinent issue for applications that use a precipitation forecast as a proxy for imminent flood hazard. To look at these non-linearities in more detail, we introduce the concept of floodiness to represent flood hazard over large areas, and using a recently developed historical dataset (a global-scale hydrological model driven by the ERA-Interim Land precipitation reanalysis) show that precipitation forecasts should not be used as a proxy for floodiness.

Why is floodiness important? When floodiness during a rainy season is higher than normal, it can put pressure on humanitarian resources (Figure 1). Moving forward, we are developing new techniques for forecasting floodiness to support humanitarian operations.

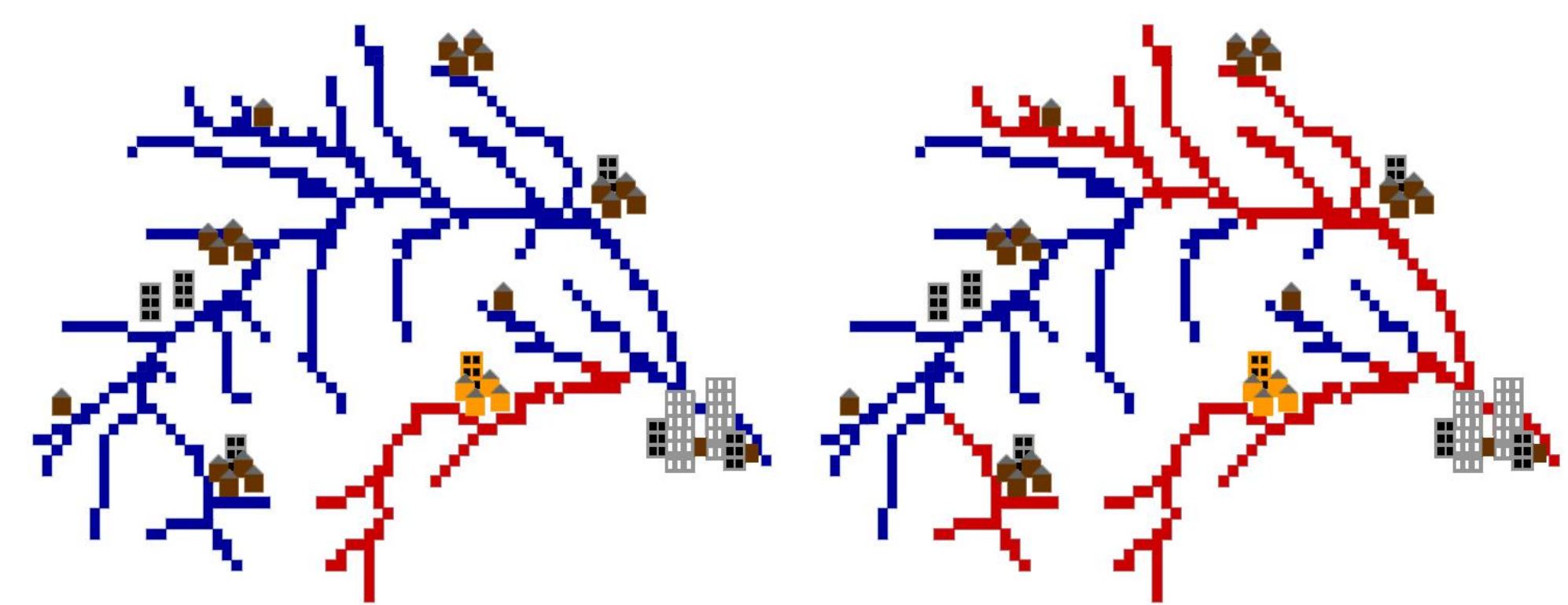


Figure 1: Variations in floodiness can put different pressures on humanitarian resources. Left – Town in orange flooded, floodiness low. Right – Town in orange flooded, floodiness high.

## Method

We introduced new indices to assess large-scale flood hazard, or floodiness, and, using a global-scale hydrological model driven by the ERA-Interim Land precipitation reanalysis (1980–2010), quantified the link between monthly precipitation, river discharge and floodiness anomalies at the global and regional scales. Here we define Floodiness as:

- the percentage of major river cells (e.g. cells with <1000km<sup>2</sup> upstream area) that exceed a defined flow threshold (e.g. 1 in 100 year) during a given time period.

## Results

Here results are plotted for the Giorgi region of East Africa, with Figure 2 showing the weak correlation between precipitation and floodiness, therefore showing that forecasts of precipitation anomalies can not be used as a proxy for floodiness. Figure 3, a time series of monthly floodiness in East Africa presents an interesting side-by-side comparison of the two time series. For example, demonstrating a peak in floodiness centred around 1995 that is not visible in the precipitation or discharge data.

### References:

- Giorgi, F., and R. Francisco (2000), Uncertainties in regional climate change prediction: A regional analysis of ensemble simulations with the HADCM2 coupled AOGCM, *Clim. Dyn.*, 16(2–3), 169–182, doi:10.1007/PL00013733.
- Stephens, E., J. J. Day, F. Pappenberger, and H. Cloke (2015), Precipitation and floodiness, *Geophys. Res. Lett.*, 42, 10,316–10,323, doi:10.1002/2015GL066779.

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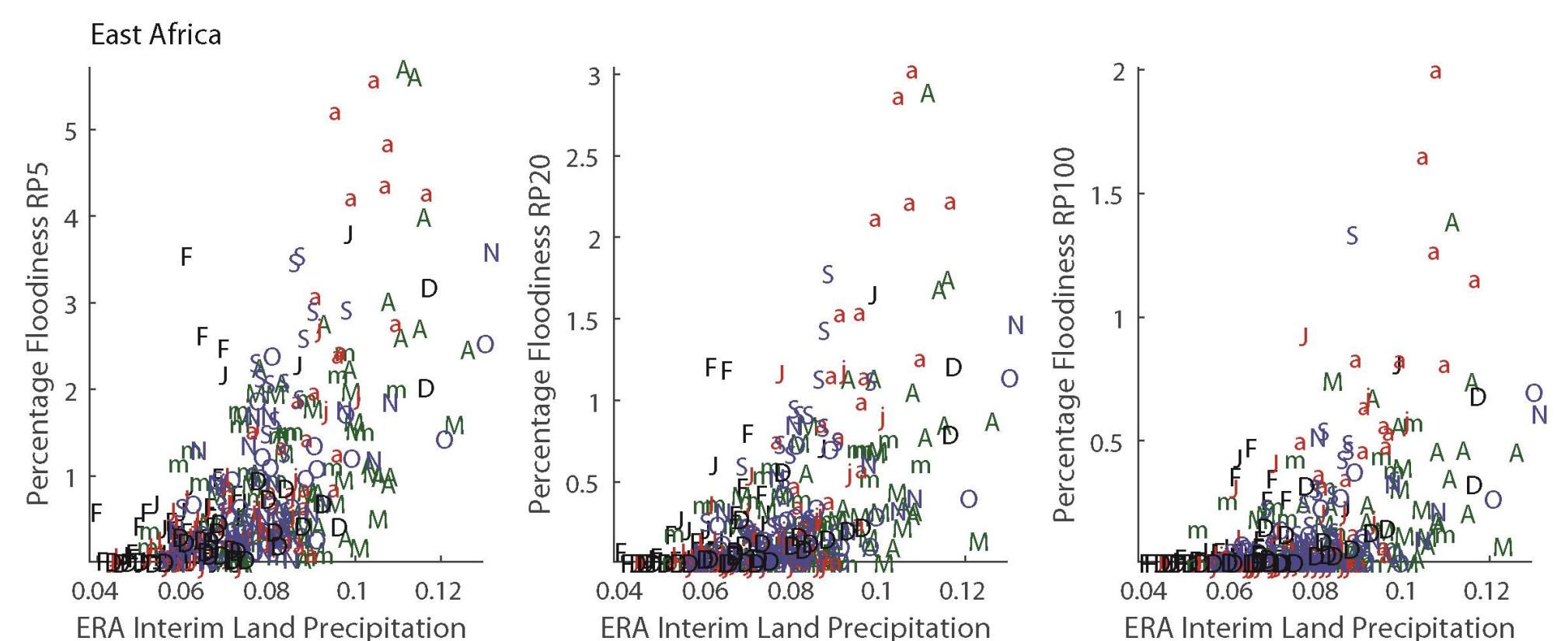


Figure 2: The relationship between precipitation and floodiness in East Africa

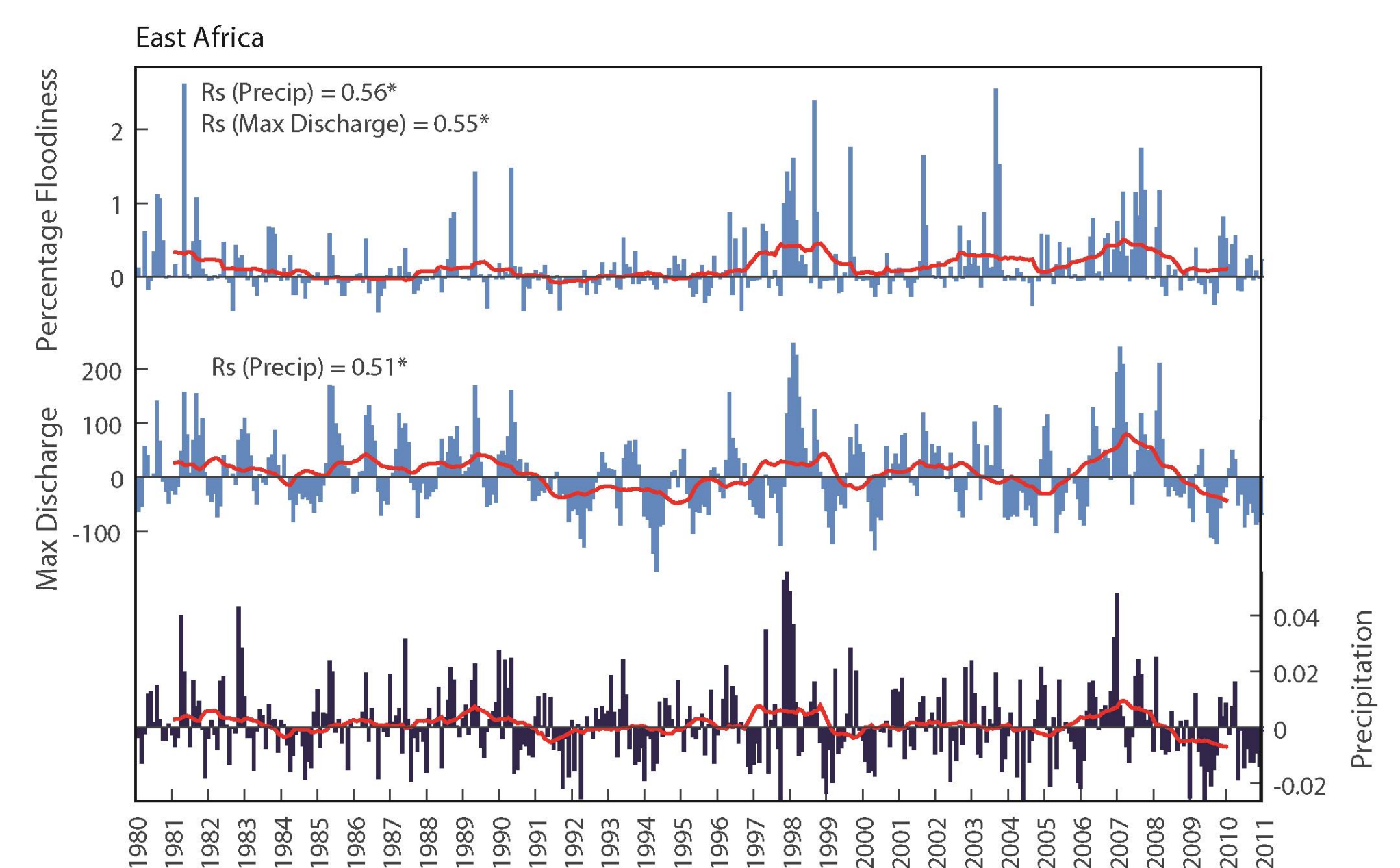


Figure 3: Time series of monthly floodiness anomalies in East Africa, 1980-2010, red line shows two-year running mean

## Conclusions

The results show that monthly floodiness anomalies are not well correlated with precipitation anomalies, therefore demonstrating the need to develop forecasting systems that forecast floodiness directly.

Current work is focussed on developing floodiness forecasts at regional and national scales, both by considering the links between floodiness and the major modes of climate variability and by developing hydrometeorological forecasts within the GloFAS. Figure 4 provides an example forecast of weekly floodiness against a reference climatology for East Africa, which is currently in development for the Global Flood Awareness System.

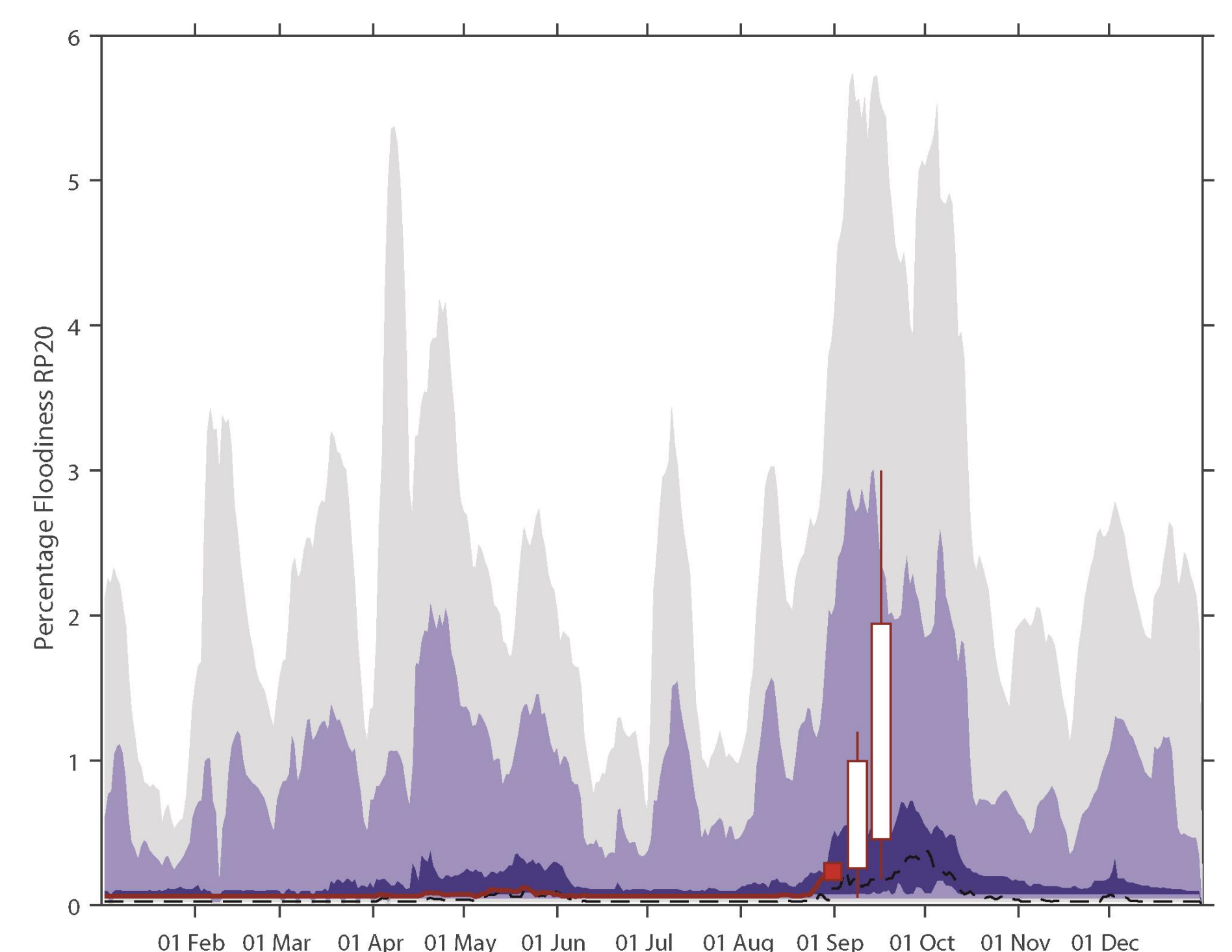


Figure 4: Development of a floodiness forecast for East Africa