Dear Editor

Please find below the review comments and responses. We appreciate the constructive comments which have contributed to an improvement of our manuscript.

With kind regards, and on behalf of all co-authors,

Rhoda Odongo

Response to reviewers

Propagation from meteorological to hydrological drought in the Horn of Africa using both standardised and threshold-based indices

General response

We want to thank referee 2 for the critical review of our manuscript and for the positive words about our paper and its contribution. We have reflected on the added comments/review and we have made some minor revisions that have led to a significant improvement of our manuscript. We hope that the revised version provides enough detail and clarity to cover the original concerns presented. The line changes mentioned refer to the revised manuscript unless stated otherwise.

#Reviewer 2- RC2

Minor comments

I would like to thank the authors for their reply to the questions posed in the first review round and for providing specific assessments to support the answers in the supplementary material.

In my opinion the research work overall is worthy of publication and that indeed it could be an example for other countries and territories affected by a severe lack of data. Precisely for this reason, I believe it is necessary to illustrate the relationship between in situ data (however few, data at the scale of the single basin must exist - see supplementary material) and those deriving from the datasets actually used in the work and the related implications. From the authors' reply I understand they are aware of this consideration, but assigning the topic to a few quick comments that refer to the supplementary material does not seem to me the best proposal. Given the level of complexity with which the article is organized, I understand the difficulty in the preparation of a specifically conceived section and I suggest, as an alternative, at least a critical discussion on the issue (maybe section 5.1?).

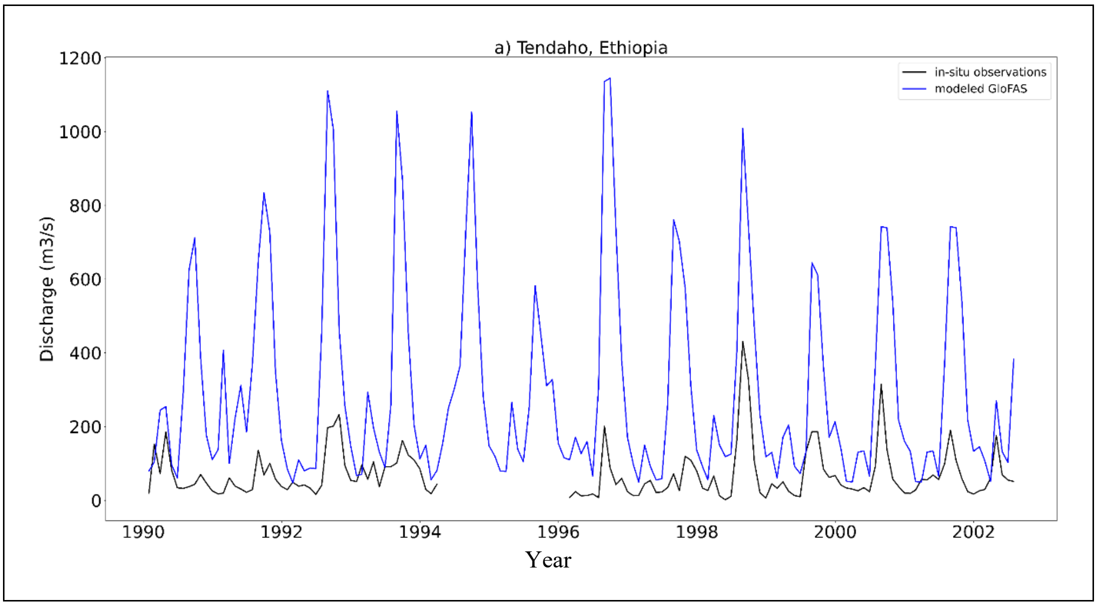
We agree that the best approach would be to include another section in the Discussion on the topic.

Added lines 460 to 496 under section 5.1 Data selection and limitations:

'For this study, our main objective was to work with observational data, or data that is as close to observations as possible for the entire region. The study utilized MSWEP precipitation data because of its consistency with GLEAM (avoiding accumulation of uncertainty resulting from different sources). The latter estimates soil moisture using satellite imagery and a re-analysis approach. MSWEP precipitation data provides a more accurate and consistent representation of precipitation across Western, Eastern, and Southern Africa. It has shown a strong correlation with in-situ observations and substantial agreement with Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), making it a valuable tool for drought monitoring and assessment in the region. CHIRPS data has been popularly applied in the region because it has been found to show a good depiction of rainfall seasonality, and in a study by Musie et al., (2019), they used CHIRPS

precipitation to model daily and monthly streamflow and the simulated streamflow data matched streamflow observations). MWEP has better results when compared to ERA-Interim precipitation data (which was originally applied in the generation of GloFAS river discharge data). These findings are reported in studies by Cattani et al., (2021) and Beck et al., (2017). We chose to not use ERA5 precipitation because the quality is not good and there are no rain-gauge data assimilated into the product.

For discharge, we initially also intended to use observation data or a data product that is as close to observations as possible (like GLEAM for soil moisture). However, the spatial and temporal coverage of observed discharge data in the region is too low for this study. Therefore, we decided to use modelled data for discharge, but there is no dataset available that uses MSWEP for precipitation input. GloFAS uses ERA5 Land total precipitation data from EMCWF, as input to the hydrological model LISFLOOD. We could have used ERA5 Land precipitation as our precipitation data in this study (for consistency with GloFAS), but we decided against this because ERA5 has been found to highly underestimate/overestimate the precipitation values in the region. Fessehaye et al., (2022) tested the product for Eritrea region and found it highly underestimated precipitation values. Gleixner et al., (2020), on the other hand, tested the product against CHIRPS dataset and found it overestimated precipitation in East Africa (see Gleixner et al., (2020). GloFAS is calibrated and evaluated against in-situ river discharge, but mainly for perennial rivers at mid-latitudes (Harrigan et al., 2020; Hirpa et al., 2018). When we compared the GloFAS discharge values with GRDC and CETRAD in-situ observations in the study region (with discharge values from 1981 onwards: total of 26 stations), we found that there often was a strong bias in absolute values (Figure 8a, b and c), and that the anomalies (value divided by annual mean discharge) are captured well (Figure 9 a and b stations in Ethiopia). As we work only with relative indices for our drought study (either standardized, or with a relative threshold), the absolute bias is not an issue in our application. Therefore, we decided to use GloFAS data for discharge.



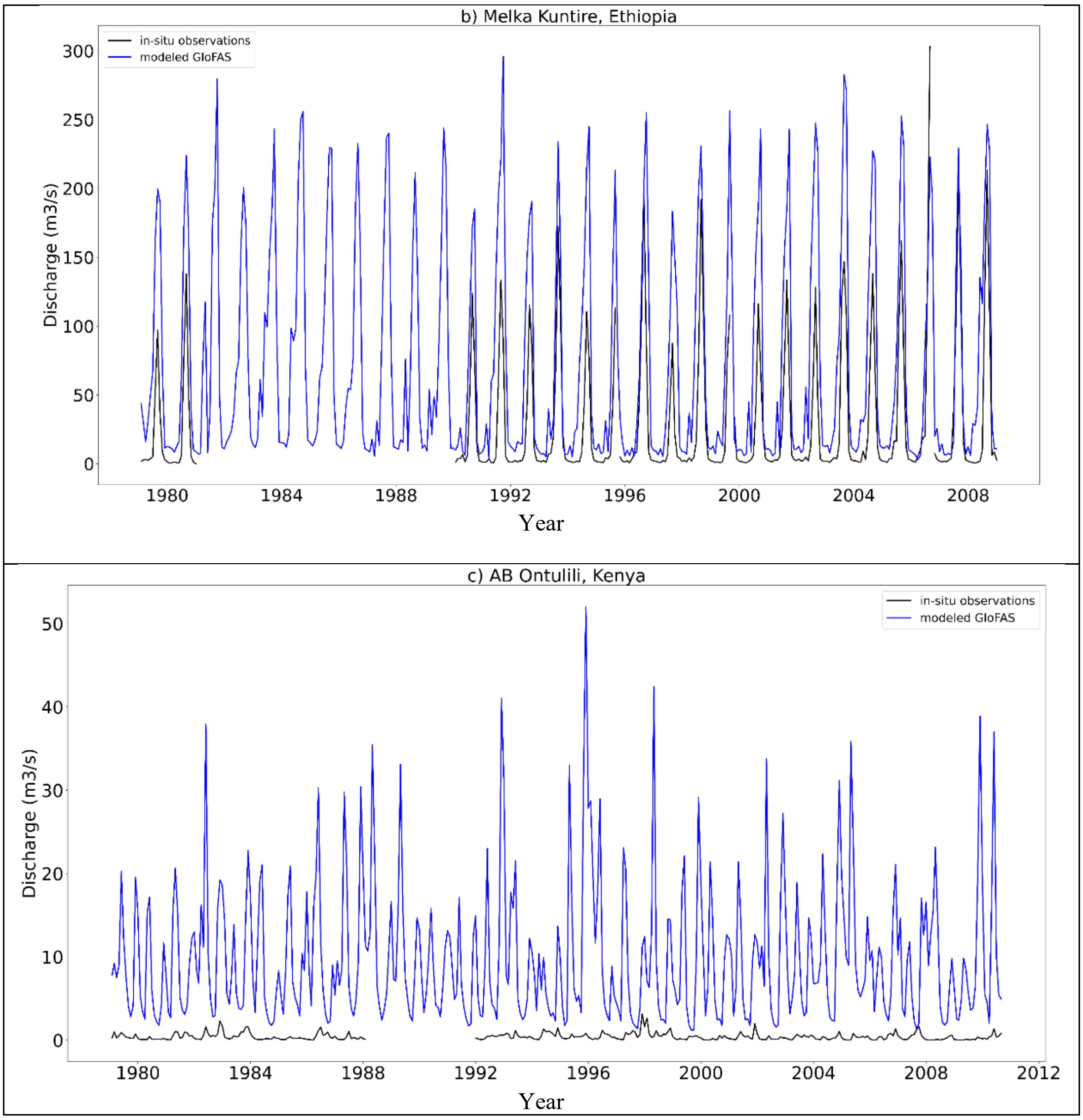
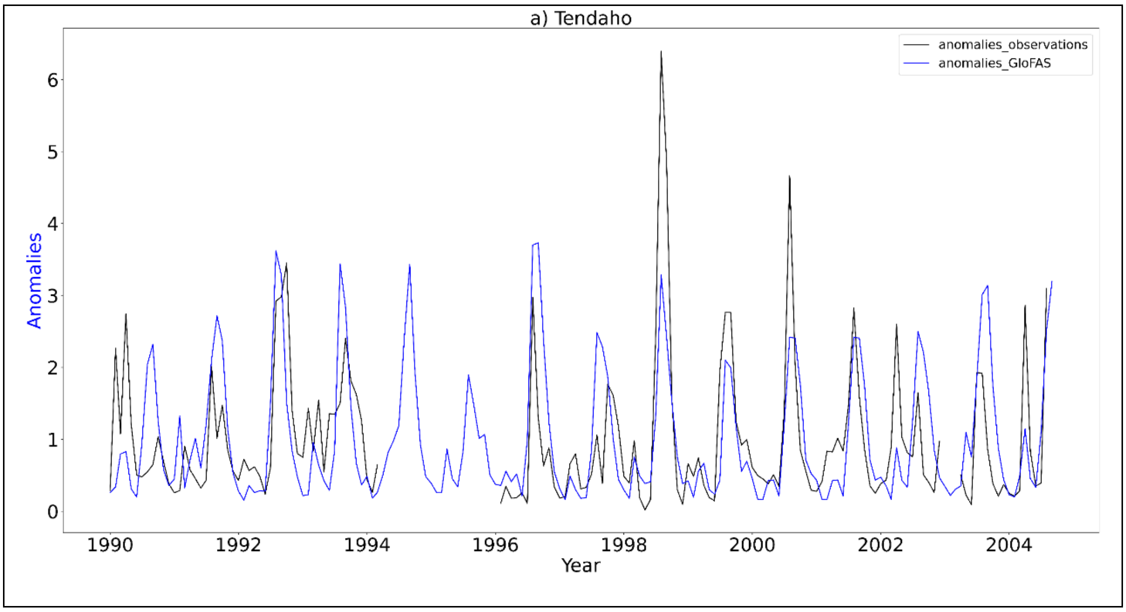


Figure 1: GloFAS river discharge against in-situ discharge observations in three different gauging stations in HOA; a) Tendaho gauging station, Ethiopia, b) Melka Kuntire gauging station, Ethiopia and c) AB Ontulili gauging station, Kenya.



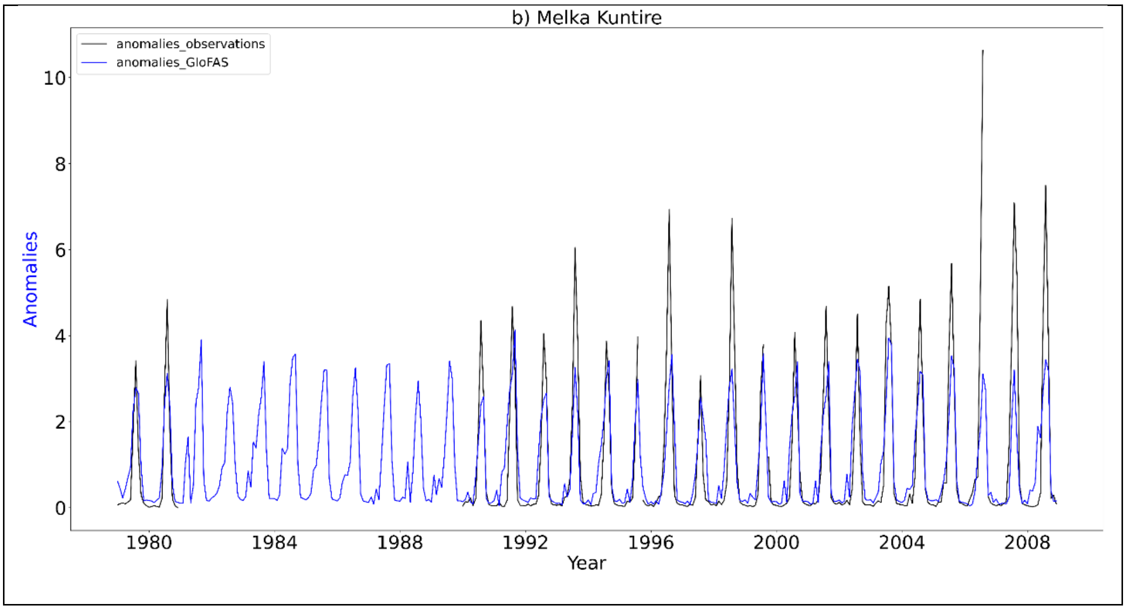


Figure 2: Discharge anomalies between the observed data and GloFAS streamflow data for two different stations in Ethiopia; a) Tendaho gauging station and b) Melka Kuntire gauging station. The deviations are similar.

The use of appropriate data sources is crucial for accurate modelling and understanding of drought conditions. This study serves as an example of the challenges faced in selecting data sources for regions with limited observed data and highlights the importance of considering multiple factors, including the performance of previous studies and calibration against in-situ observations, when selecting datasets for drought analysis.'

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