



Flood Frequency Analysis (FFA) in data-sparse regions of Iran using GLOFAS

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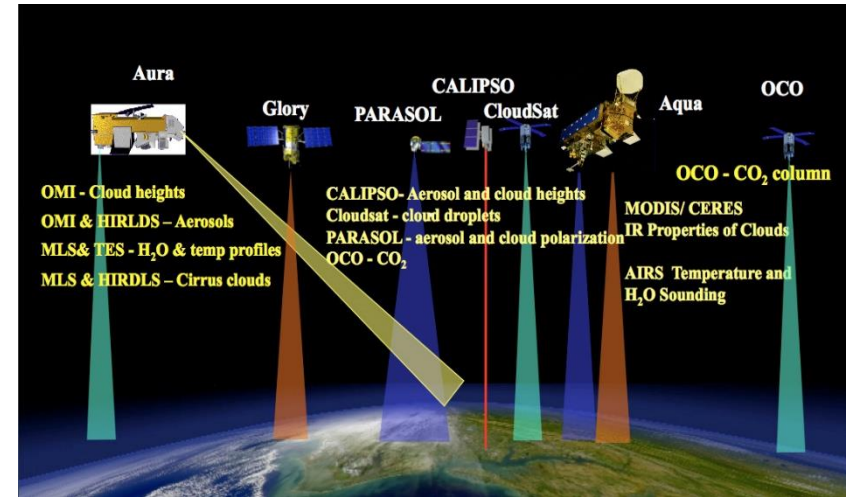
FFA Definition

Floods are dangerous natural hazards that can threaten lives, livelihoods, and property. Without information on flood risk, the planning, design, and management of infrastructure along rivers would be forced to proceed without quantitative scientific analysis.

Flood-frequency analysis provides information about the magnitude and frequency of flood discharges based on records of annual maximum instantaneous peak discharges collected at stream gages. In essence, flood-frequency analysis is used to estimate the probability of flooding at specific river locations.

Applicability of FFA

- Design flood-risk management projects
- Floodplain definition
- River engineering and river protection studies
- Design the hydraulic structures (Spillway, bridge and culverts)
- Reservoir design floods
- Flood damage estimation for different return periods.



Statistical Frequency Curves

Using annual peak flow data that is available for a number of years, flood frequency analysis is used to create frequency distribution graphs. The best frequency distribution is chosen from the existing statistical distributions such as Gumbel, Normal, Log-normal, Exponential, Weibull, Pearson and Log-Pearson. After choosing the probability distribution that best fits the annual maxima data, flood frequency curves are plotted. These graphs are then used to estimate the design flow values corresponding to specific return periods which can be used for hydrologic planning purposes.

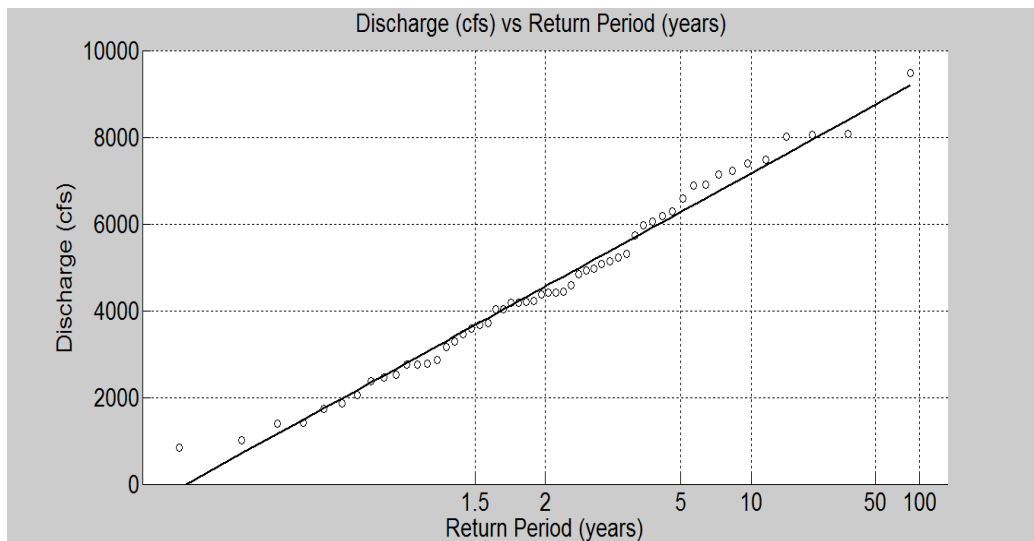
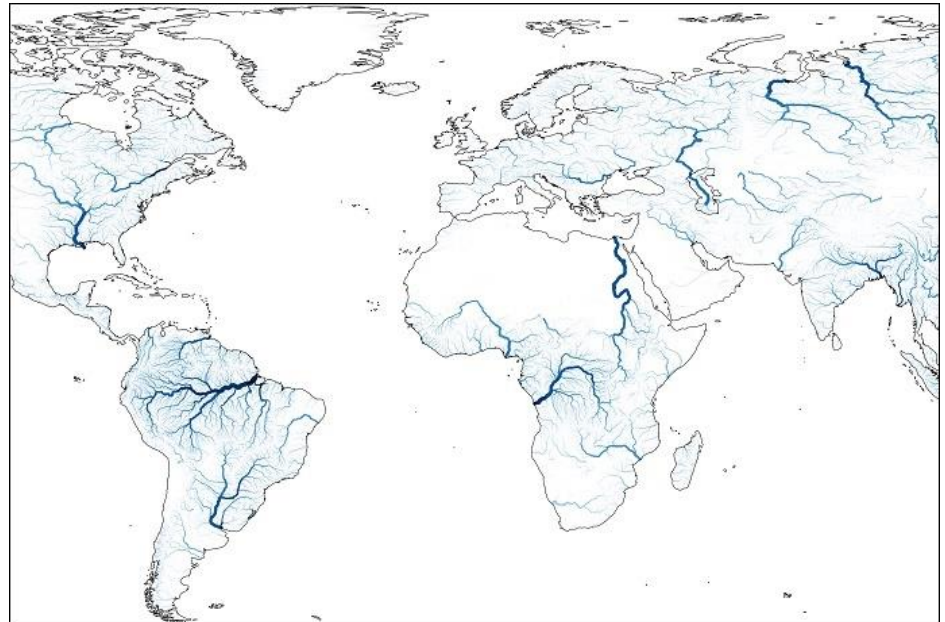


Table 1: Probability Density functions for selected

S.N	Distributions	$f(x)$
1	Normal	$f(X) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{X-\mu}{\sigma}\right)^2\right]$
2	Log Normal	$f(X) = \frac{1}{\sigma_y\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{\log_e(X) - \mu_y}{\sigma_y}\right)^2\right]$
3	Pearson Type III	$f(X) = \frac{(X - X_0)^{\gamma-1} e^{-\alpha(X-X_0)/\beta}}{\beta^\gamma(\gamma)}$
4	Log Pearson Type III	$f(X) = \frac{1}{ \beta (\gamma)\bar{X}} \left[\frac{\log_e X - y_0}{\beta}\right]^{\gamma-1} \exp\left[-\frac{\log_e X - y_0}{\beta}\right]$
5	Gumbel	$f(X) = \frac{1}{\alpha} \exp\left[-\frac{X-U}{\alpha} - e^{-\frac{(X-U)}{\alpha}}\right]$
6	Log Gumbel	$f(X) = \frac{1}{\alpha} \left[1 - k\left(\frac{X-\mu}{\alpha}\right)\right]^{k-1} e\left[1 - k\left(\frac{X-\mu}{\alpha}\right)\right]^{\frac{1}{k}}$

Global Flood Awareness System (GloFAS)

The Global Flood Awareness System (GloFAS) is the global extension of the European Flood Awareness System, for forecasting floods across the world. It has been developed since 2011 by the Joint Research Centre in close collaboration with the European Centre for Medium-Range Weather Forecasts (ECMWF), and is in full operation since 2018 under the Copernicus Emergency Management Service.



Global Flood Awareness System (GloFAS)

GloFAS is an operational, freely accessible web service for global hydrological forecasting and monitoring. It provides probabilistic hydrological predictions and overviews across the world on time scales from days to few months, independent of administrative and political boundaries. It is therefore especially beneficial for the flood risk management of large trans-national river basins, as well as for international and national water management or aid-related organizations.

<https://cds.climate.copernicus.eu/cdsapp#!/dataset/cems-glofas-historical?tab=overview>



The screenshot shows the top section of a web page. At the top, there are logos for the European Union, Copernicus (with the tagline 'Europe's eyes on Earth'), ECMWF (with the tagline 'IMPLEMENTED BY'), and the Climate Change Service. Below the logos is a dark red navigation bar with the following links: Home, Search, Datasets, Applications, Toolbox, Support, Live. The main heading of the page is 'River discharge and related historical data from the Global Flood Awareness System'.

Please note that accessing this dataset via CDS for time-critical operation is not advised or supported.

We suggest checking the list of known issues on the GloFAS wiki [here](#) before downloading the dataset (last updated 28/03/22).

Please note the legacy version of GloFAS (v2.1) was decommissioned on 11/09/22 and no longer produces new data (see [announcement](#)

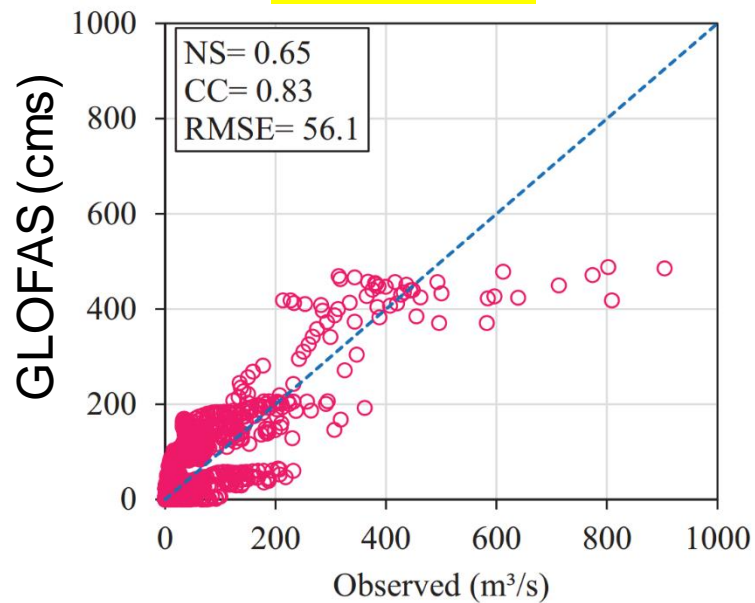
[↗](#)).

Case Study: Sefidrood River Basin

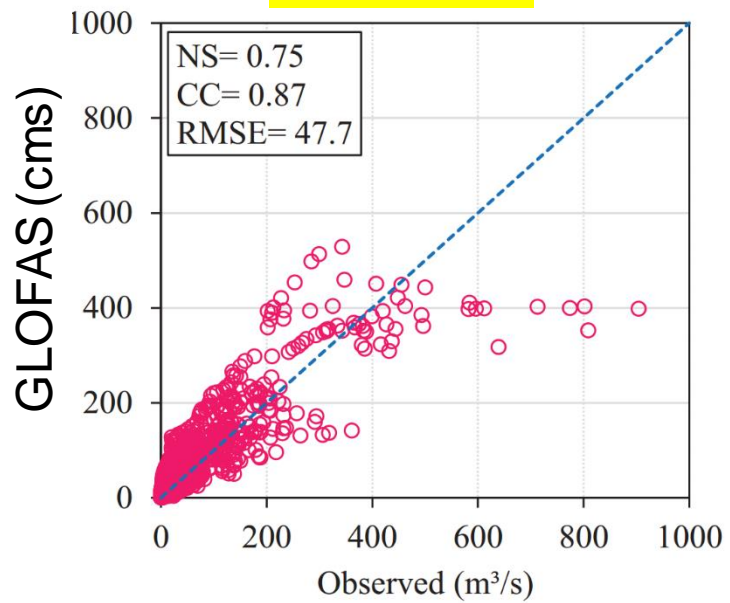


In this study 4 different hydrometric stations (S1, S2, S3, S4) are used to evaluate the performance of GLOFAS dataset in estimation of daily flow time Series.

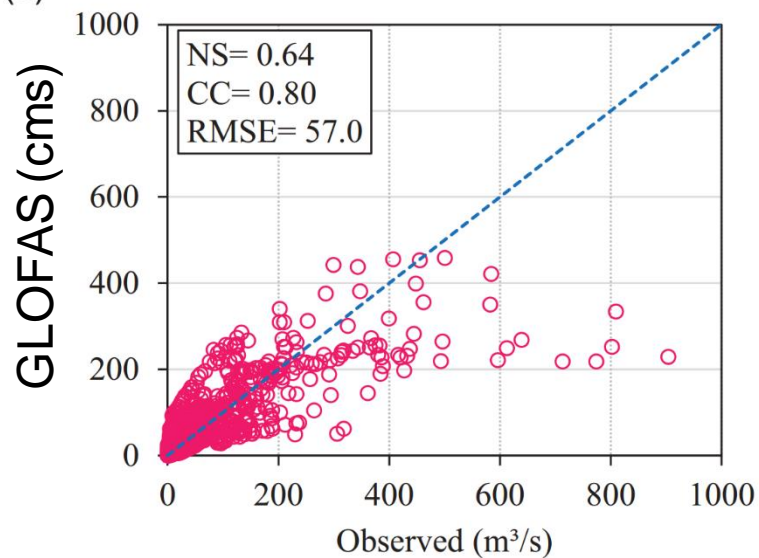
Station1



Station2

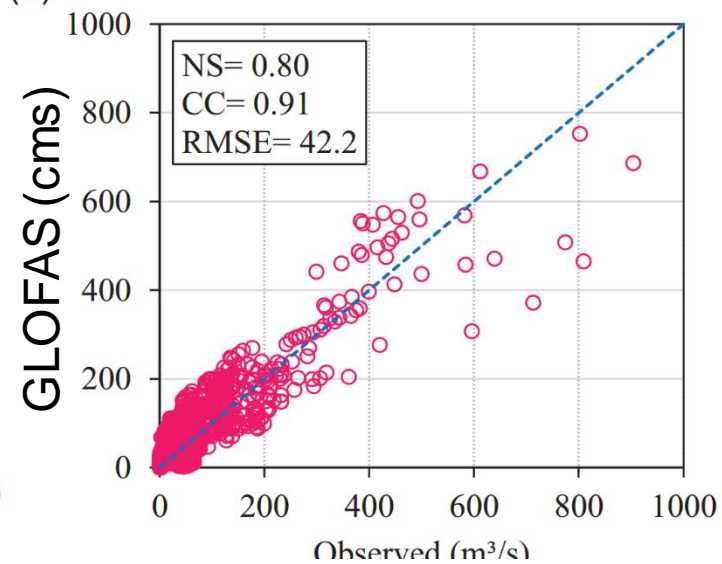


(c)

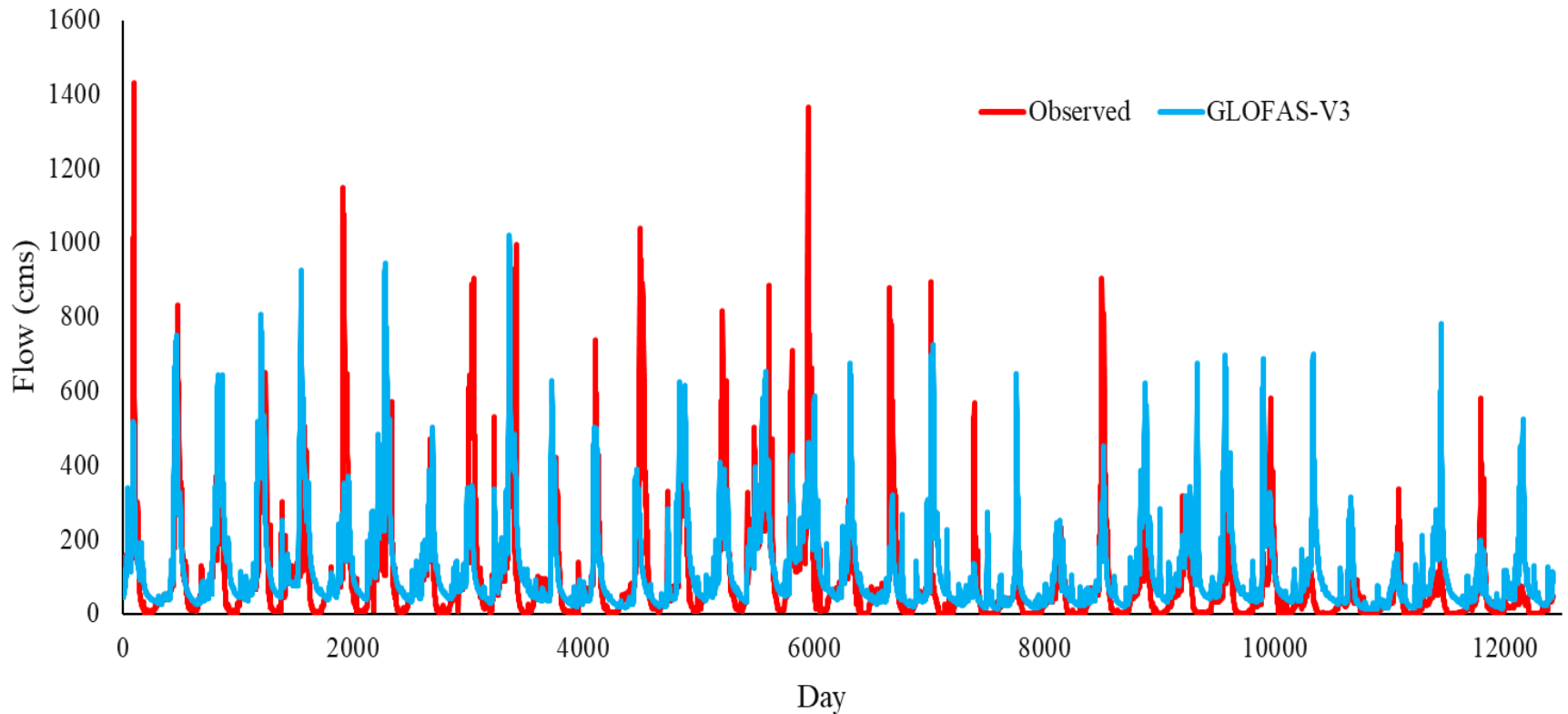


Station3

(d)

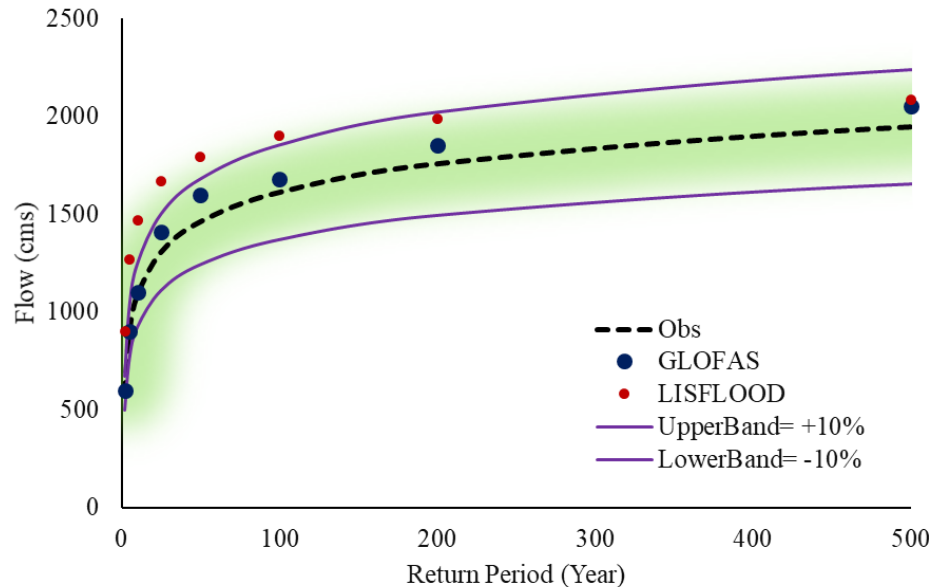
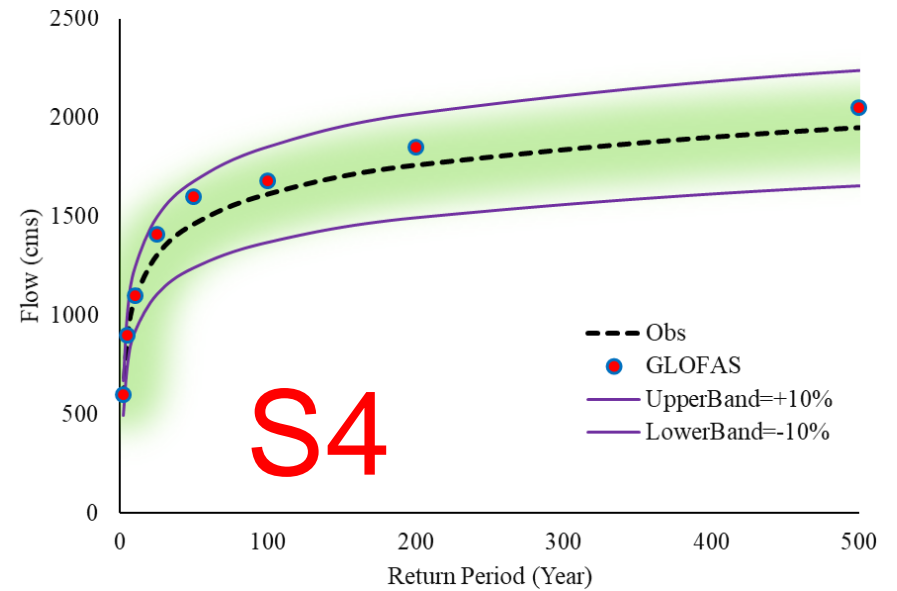
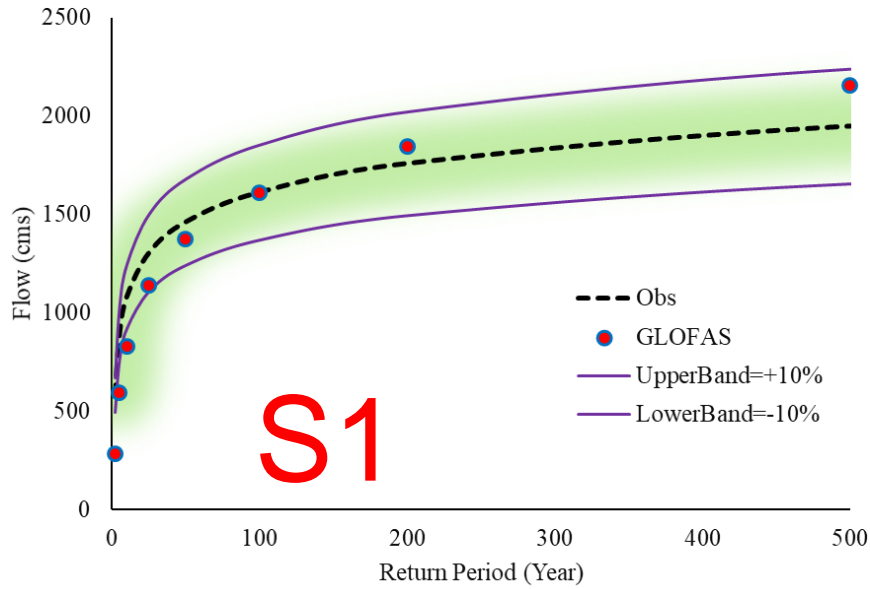


Station4



**Comparison of daily flow time Seri at Station2
from 1985 to 2020**

FFA for S1 and S4



Performance of GLOFAS dataset and LISFLOOD in estimation of Floods with different return periods

RetrunPeriods	GLOFAS	LISFLOOD
	ARE (%)	
2	2.9	54.0
5	0.5	41.7
10	1.5	35.3
25	8.0	27.9
50	9.4	22.7
100	4.2	17.7
200	5.2	13.0
500	5.2	6.9
1000	0.5	2.6
MARE (%)	4.2	24.6



Thank you!