



NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL



Meteorological and hydrological drought monitoring in the Eastern Nile River Basin

Anwar A. Adem, Melania Peter and Mubarak Omer

Introduction

- Drought is one of the natural disaster experienced in the Eastern Nile (EN) countries.
- In Ethiopia, droughts of **1973–1974, 1983–1984, 1994–1995, 2003–2004** and **2014-2015** were reported as the major drought years.
- In Sudan and South Sudan two widespread droughts occurred during **1967-1973** and **1980-1984**.



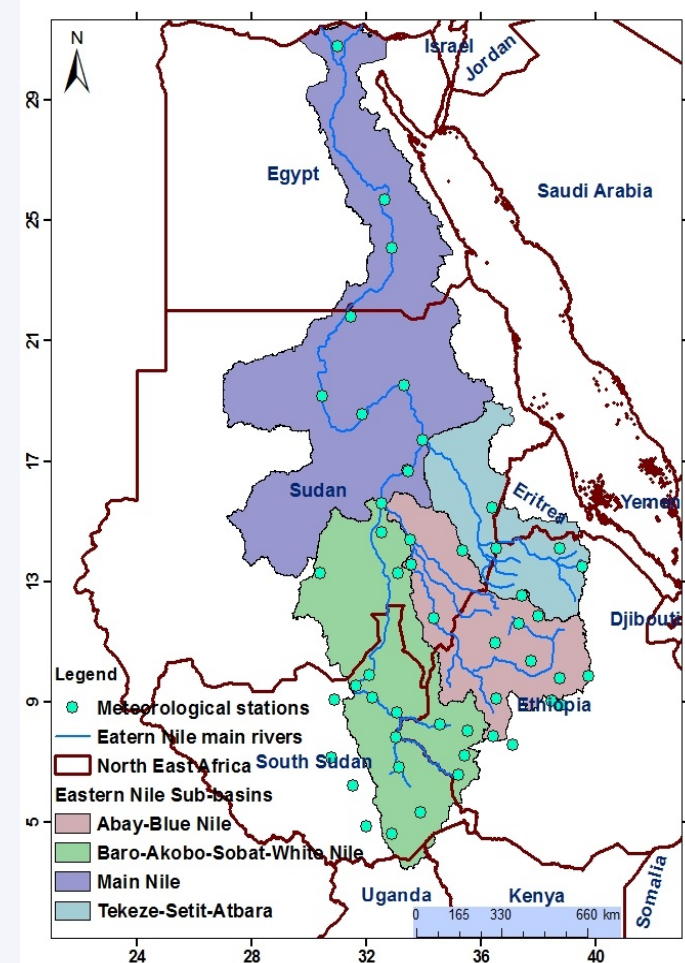
Introduction

- In last 30 years of Egypt, 10 droughts events with marked water flow deficit were recorded in **1972, 1979, 1982, 1983, 1984, 1986, 1987, 1990, 2002, and 2010.**
- Rainfall variability in the Ethiopian highlands and Lake Victoria caused **significant inter-annual and inter-decadal variability in Nile flows.**
- However, less progress has been made in **monitoring** and **forecasting** water deficits



Eastern Nile Basin

- Has varied landscapes,
 - ✓ rugged highlands of Ethiopia in the East
 - ✓ wetland areas of Sudan and Ethiopia in the south,
 - ✓ deserts of Sudan and Egypt in the north.
- Constitutes over 60% of the area of the Nile River Basin
- Contributes over 86% of the average annual flow of the main Nile River
- Has 4 sub-basins.



Dataset

- **Historical rainfall data**
 - ✓ 46 stations in the Eastern Nile basin having 30 years data
 - ✓ The data period was between 1971-2016.
- **Satellite rainfall data**
 - ✓ Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) (0.05°) precipitation data between 1981 and 2018.
- **Stream flow**
 - ✓ 26 stations monthly stream flow data was used for the analysis from 1971-2002.

Data Analysis

Standardized Precipitation Index (SPI)

- ✓ GeoCLIM: used CHIRPS satellite rainfall
- ✓ SPI generator: reads observed precipitation data
- ✓ SPI-3 and SPI-12 was used to monitor the meteorological drought.
- ✓ Batch classification, projection and masking

Standardized Streamflow Index (SPI)

- ✓ SSI is statistically similar to SPI
- ✓ Uses the SPI generator program along with streamflow data..

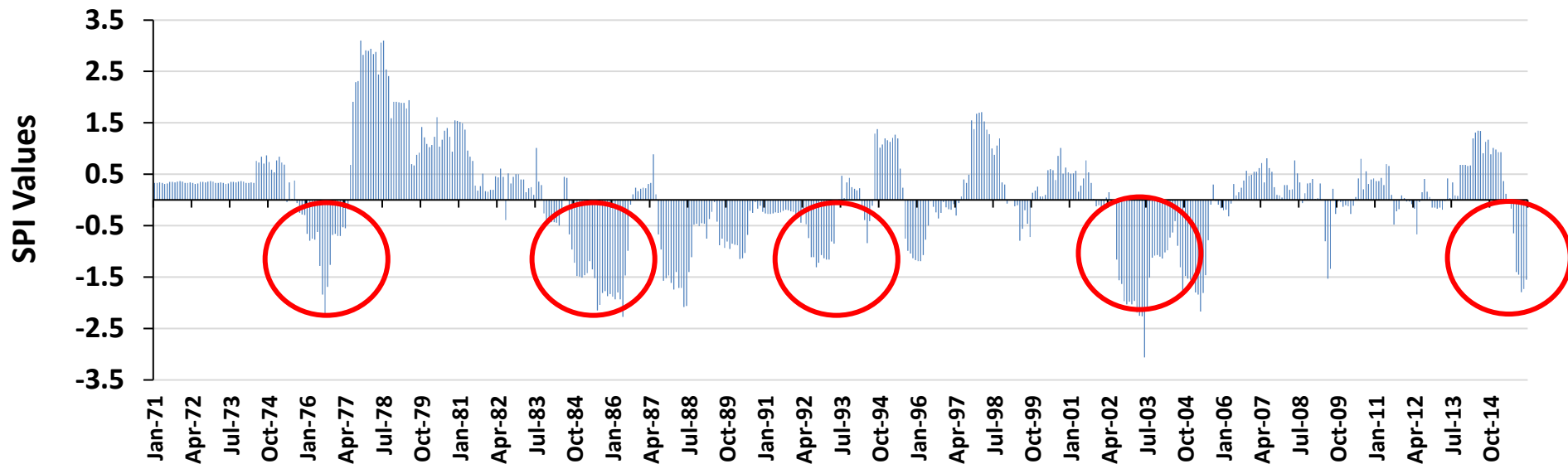
SPI values	Drought Category
-2 or less	Extremely drought
-1.99 to -1.5	Severely drought
-1.49 to -1	Moderately drought
-0.99 to 0.99	Near normal
1 to 1.49	Moderately wet
1.5 to 1.99	Very wet
2 or more	Extremely wet

Key findings

SPI from historical rainfall

- In Ethiopia, there is a recurrent drought signal in every 10 years which are 1974, 1984, 1995, 2004 and 2015.

Debre Tabor-Ethiopia

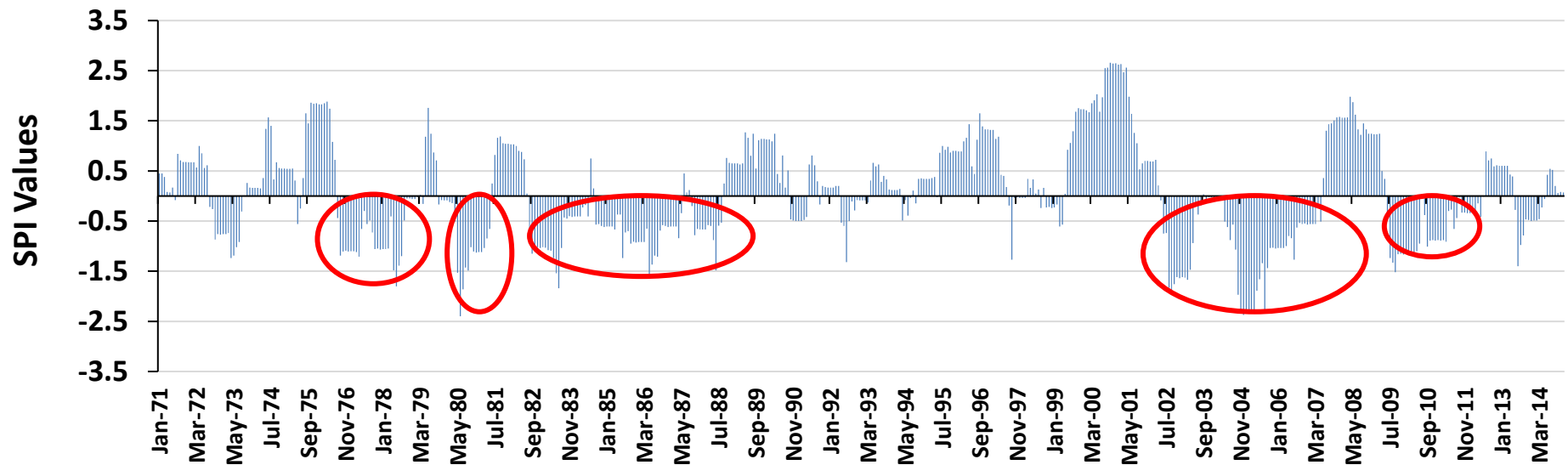


Key findings

SPI from historical rainfall

- In South Sudan, it is observed that between 1976-1978, 1982-1989, 1994-1997, 2009-2010 were the drought years

Malakal-South Sudan

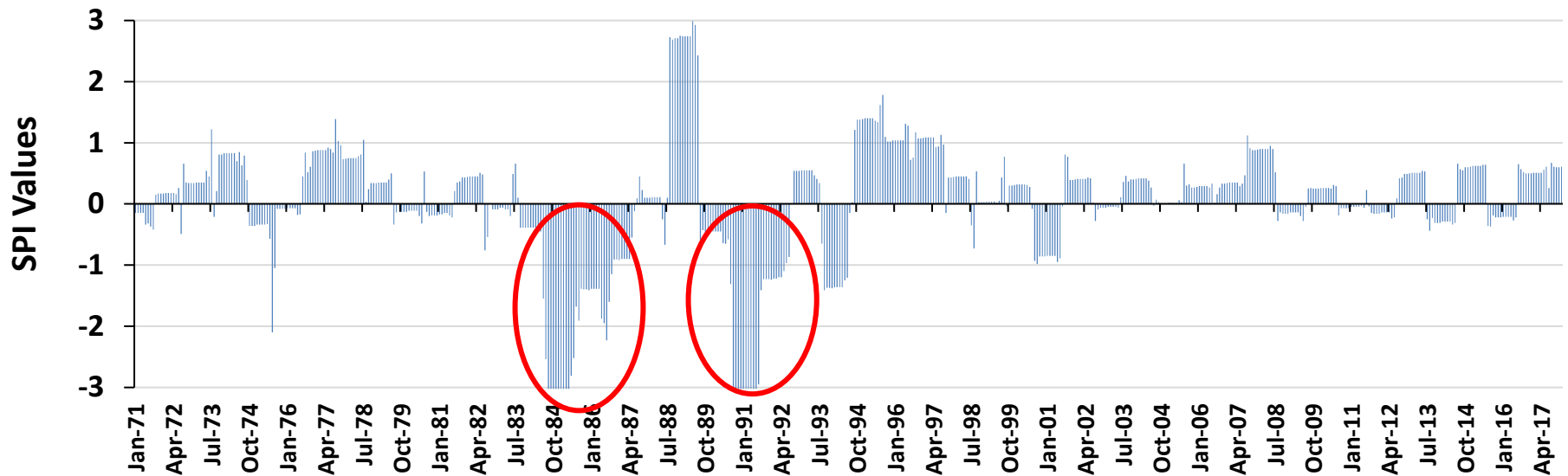


Key findings

SPI from historical rainfall

- Sudan experienced historical drought in 1984, 1985, 1986, 1990, 1991 and 1992.

Khartoum-Sudan

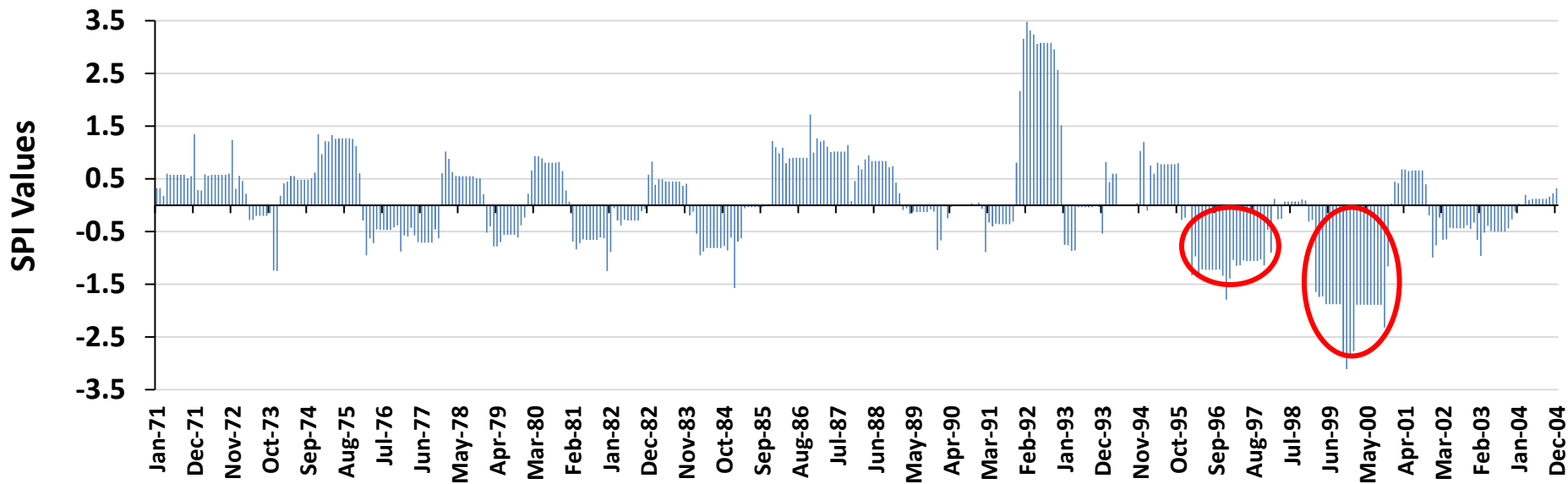


Key findings

SPI from historical rainfall

- Based on the Tanta station SPI values, Egypt experience less frequent and intense meteorological drought.

Tanta-Egypt

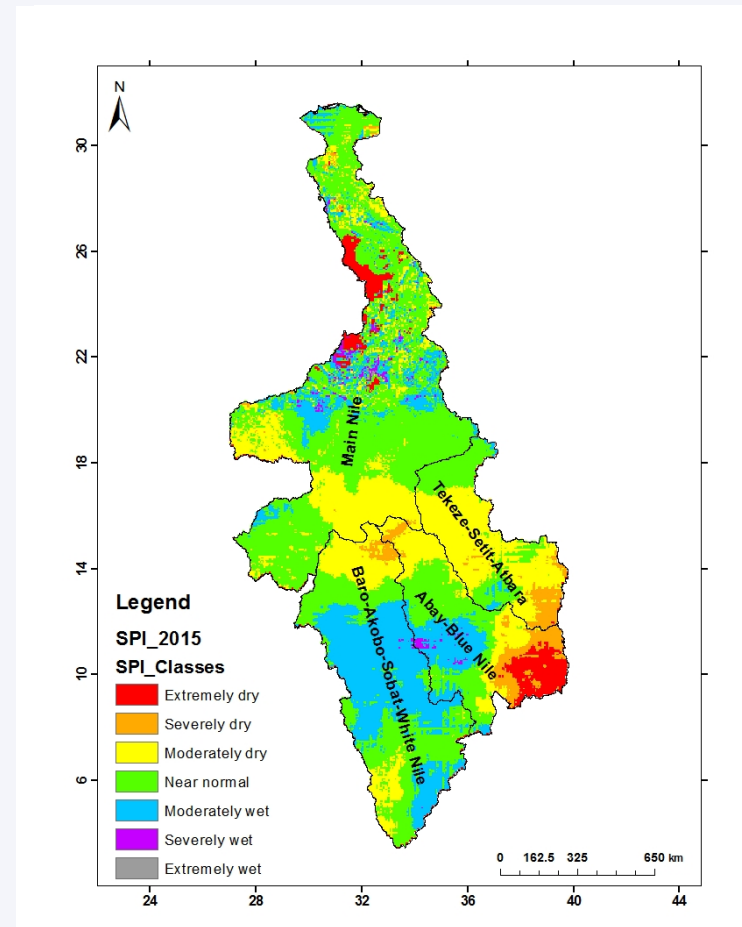


Key findings

SPI from satellite rainfall

SPI-12

- 1984, 1994, 2004 and 2015 the most drought year in EN

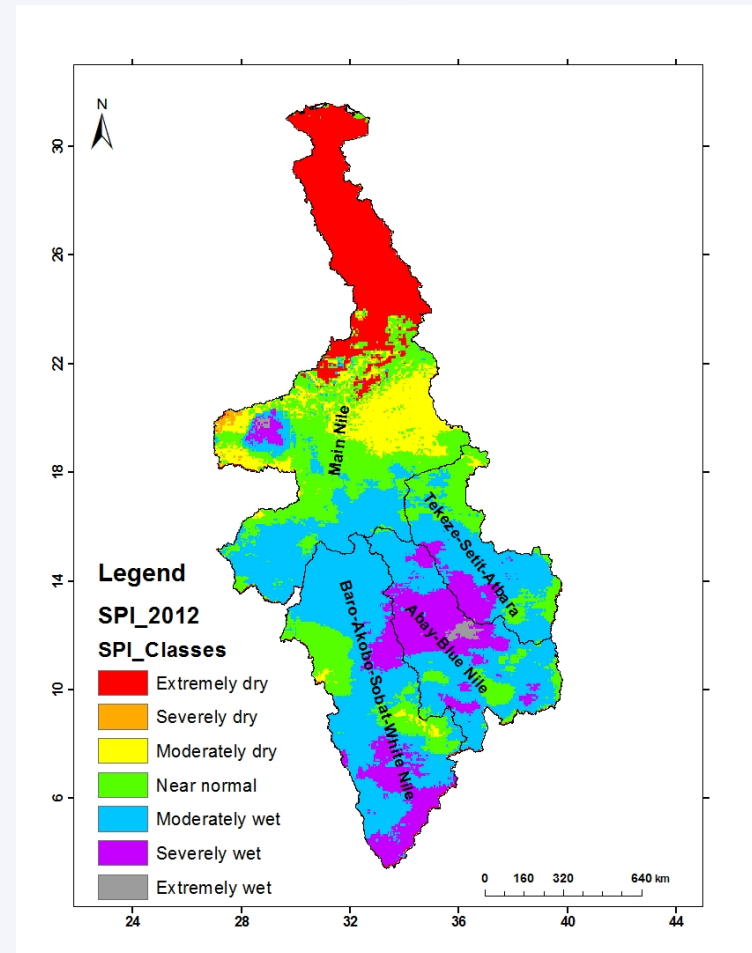


Key findings

SPI from satellite rainfall

SPI-3

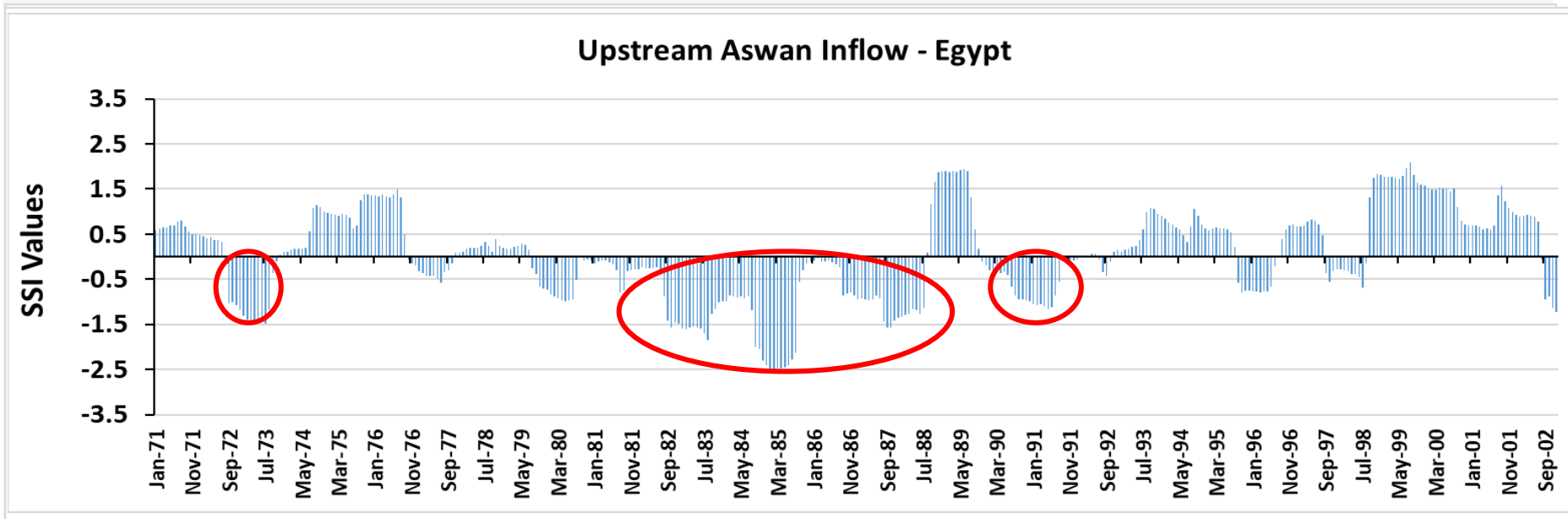
- In 1984 the most drought year in EN
- In 2004 and 2015 the region was more affected with seasonal drought rather than the annual drought.
- In 1984, the annual drought was severe than the seasonal drought.



Key findings

SSI-12

- Most of the Eastern Nile basin experience two main periods of drought (1972 - 1974 and 1982 – 1988).



Conclusions

- In monitoring meteorological drought satellite products like CHIRPS are very important.
- The low streamflow volume from in the Blue Nile was a direct reflection of the low rainfall received in the Ethiopian highlands.
- This intern impact the storage capacity of dams in the basin.

Recommendations

- Increasing the number of weather stations is useful for future drought monitoring studies.
- Other meteorological, hydrological and agricultural drought indices need to be considered in drought monitoring.
- Drought forecasting and drought risk assessment are important issues that could be addressed in the EN..



NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL



THANK YOU!