



# **Understanding drought in the Volta basin (2015)**

**FLOOD AND DROUGHT MANAGEMENT TOOL PROJECT**

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**6th Africa Water Week – Tanzania – 2016**



# Objectives

- Demonstrate the use of real time satellite data in drought assessment
- Understand the linkage between climate variability and drought impact
- Illustrate the methodology based on 2015's climate conditions in the Volta basin

# Setting the scene...



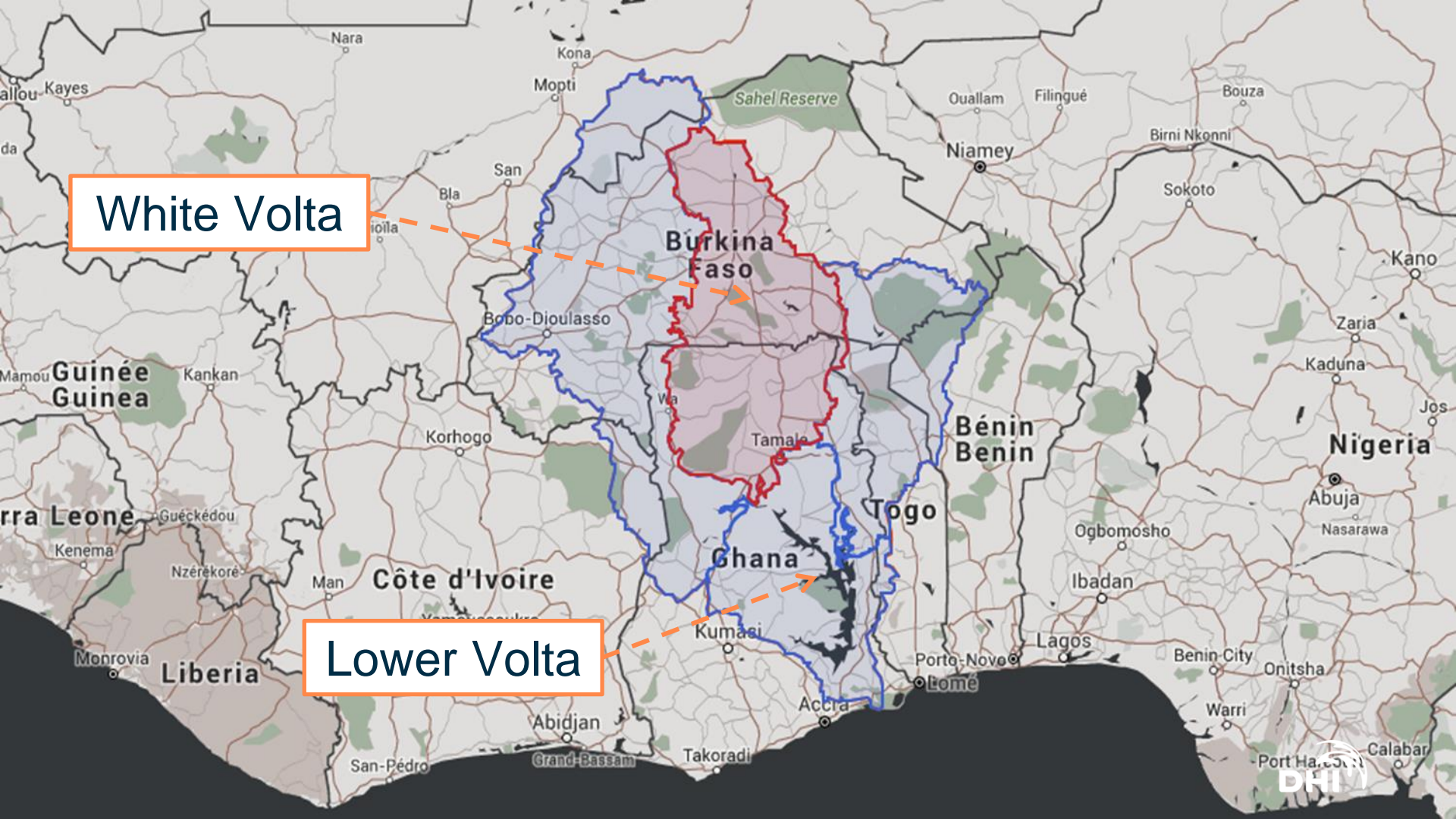
**2/3**

**of Burkina Faso and  
Ghana are within  
the Volta basin**





White Volta



Lower Volta



# 90%

**of population in Burkina Faso  
is actively involved in the  
agricultural sector**



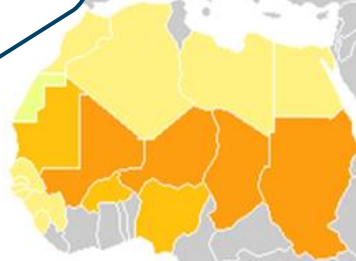
**Table 3.** Summary of drought events recorded for 1900–2013 in EM-DAT database.**I. Masih et al.: A review of droughts on the African continent**

Region/countries	Drought years	# of events	# of people killed	# of people affected	Economic damage (USD × 10 <sup>3</sup> )
Overall African Continent		291	847 143		
North Africa		18	150 012		
Algeria	1981, 2005	2	12		
Morocco	1966, 1971, 1983, 1984, 1999	5	0		
Tunisia	1977, 1988	2	0		
Sudan	1980, 1983, 1987, 1990, 1991, 1996, 1999, 2009, 2012	9	150 000		
Middle Africa		25	3058		
Angola	1981, 1985, 1989, 1997, 2001, 2004, 2012	7	58		
Cameroon	1971, 1990, 2001, 2005	4	0		
Central Africa Republic	1983	1	0		
Chad	1910, 1940, 1966, 1969, 1980, 1993, 1997, 2001, 2012	9	3000		
Congo	1983	1	0		
Sao Tome et Principe	1983	1	0		
Zaire/Congo Dem Rep	1978, 1983	2	0		
West Africa		94	170 012	74 500 255	507 354
Benin	1969, 1980	2	0	2 215 000	651
Burkina Faso	1910, 1940, 1966, 1969, 1976, 1980, 1988, 1990, 1995, 1998, 2001, 2011	12	0	8 413 290	0
Cape Verde Is	1900, 1910, 1920, 1940, 1946, 1969, 1980, 1992, 1998, 2002	10	85 000	40 000	0
Cote d'Ivoire	1980	1	0	0	0
Gambia The	1910, 1940, 1968, 1969, 1976, 1980, 2002, 2012	8	0	1 258 000	700
Ghana	1971, 1977, 1980	3	0	12 512 000	100
Guinea	1980, 1998	2	12	0	0
Guinea Bissau	1910, 1940, 1969, 1980, 1980, 2002, 2006	6	0	132 000	0
Liberia	1980	1	0	0	0
Mali	1910, 1940, 1966, 1976, 1980, 1991, 2001, 2005, 2006, 2010, 2011	11	0	6 927 000	~
Mauritania	1910, 1940, 1965, 1969, 1976, 1978, 1980, 1993, 1997, 2001, 2010, 2011	12	0	7 398 907	
Niger	1903, 1906, 1910, 1940, 1966, 1980, 1988, 1990, 1997, 2001, 2005, 2009, 2011	13	85 000	23 655 058	
Nigeria	1981	1	0	3 000 000	

Burkina Faso is affected by a number documented drought events over the last 100 years

# Sahel region

has been largely studied  
unlike droughts in the  
Volta basin



Famin- ■

Near famin- ■

Drought/heavy  
sand storms- ■

No figures avalball,  
but their were probably  
at ' ■ ' stage- ■



## Drought assessment in the Volta basin

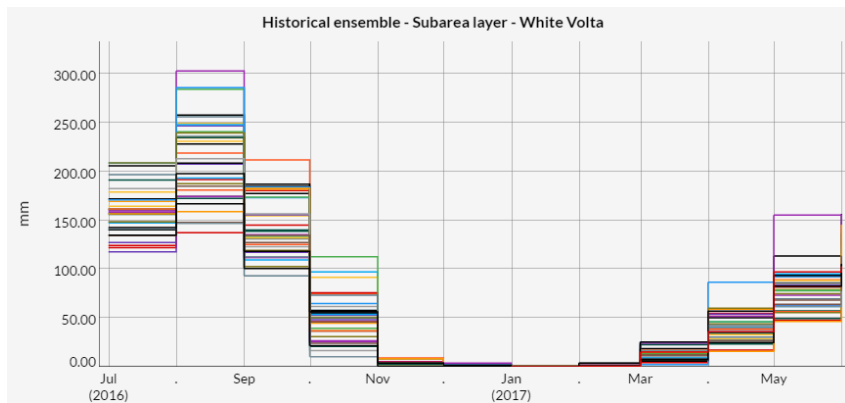
- Climate variability from North (Sahel) to South (coast)  
→ spatiotemporal drought assessment is required
- Few studies in the region and only based on precipitation as the major climate variable  
→ Multi drought indices approach is required in complex environment
- 90% of Burkina Faso population actively involved in the agricultural sector  
→ Drier climate might lead to food insecurity and poverty

# Analysis of different remotely sensed datasets

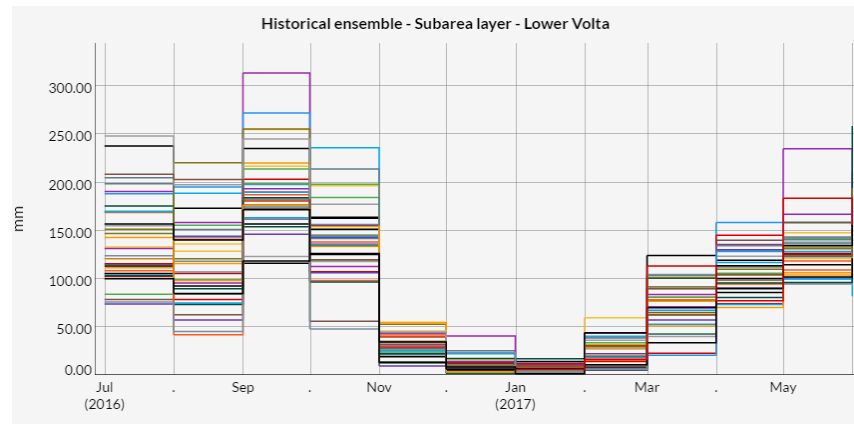


# Climatology in sub-basins

## White Volta



## Lower Volta



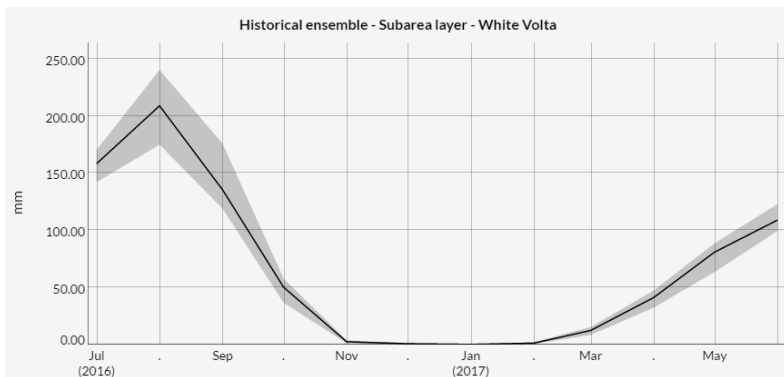
Monthly rainfall from 1981 to 2016 (Climate variability during 1981 to 2016)

*Differences in yearly climatic conditions between the two basins.*

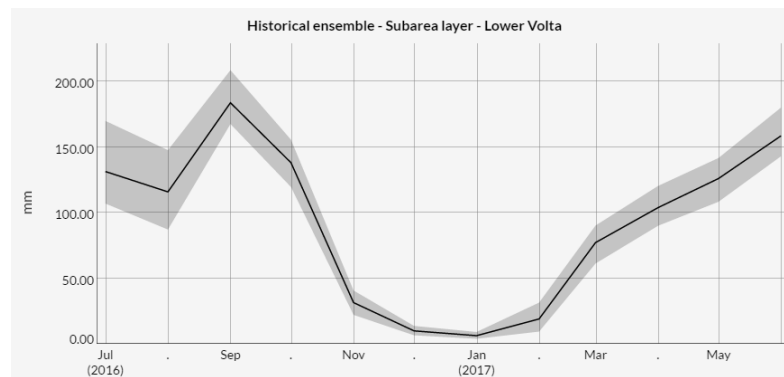


# Climatology in sub-basins

## White Volta



## Lower Volta



Monthly rainfall from 1981 to 2016

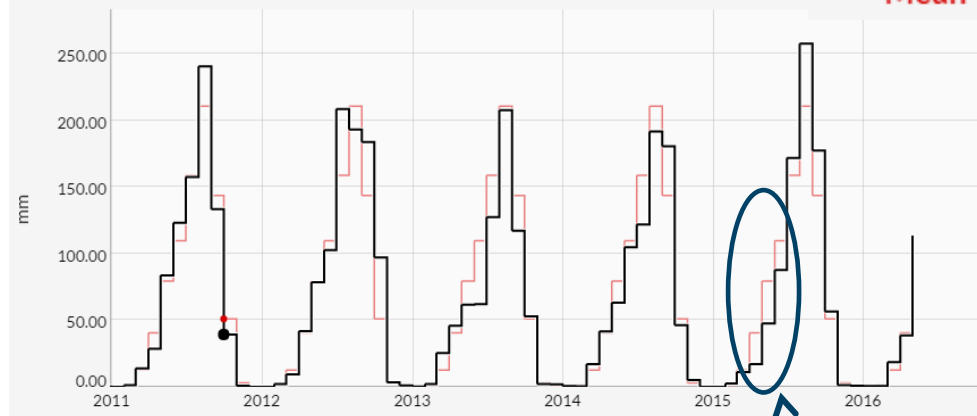
*Black line shows the monthly rainfall median and the envelop is defined by the 25th and 75th percentile*

# Monthly rainfall compared to long term mean

White Volta

Rainfall (CHIRPS) - Subarea layer - White Volta

— Data  
— Mean

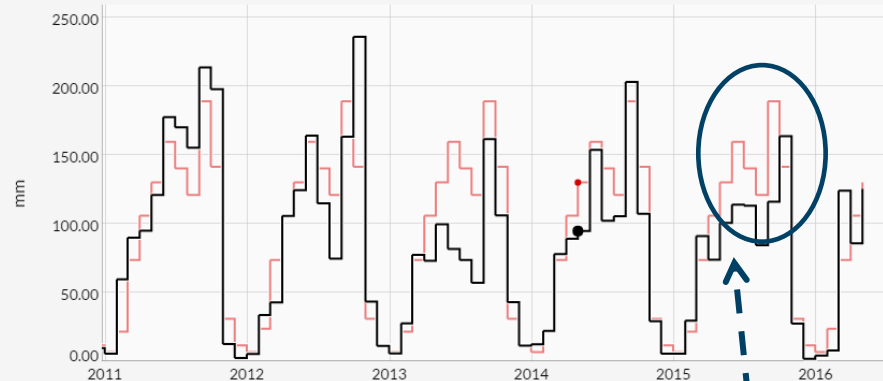


Rainfall deficit in early 2015

Lower Volta

Rainfall (CHIRPS) - Subarea layer - Lower Volta

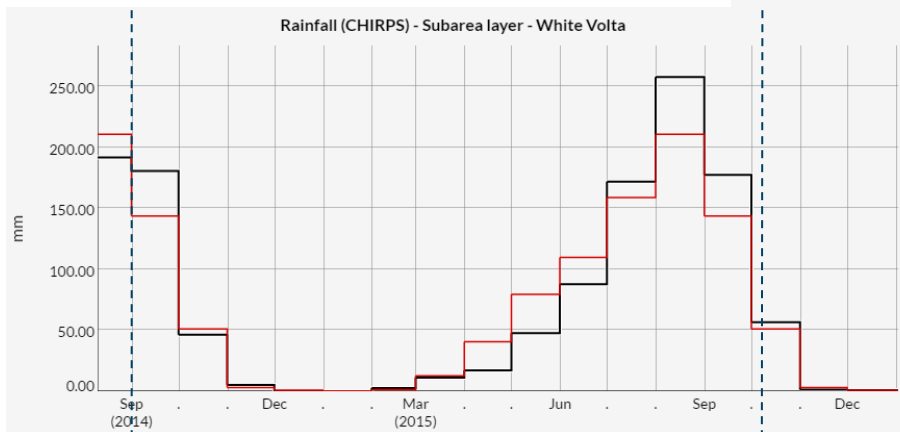
— Data  
— Mean



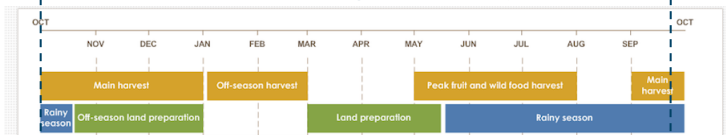
Rainfall deficit in late 2015

# Rainfall deficit during growing season

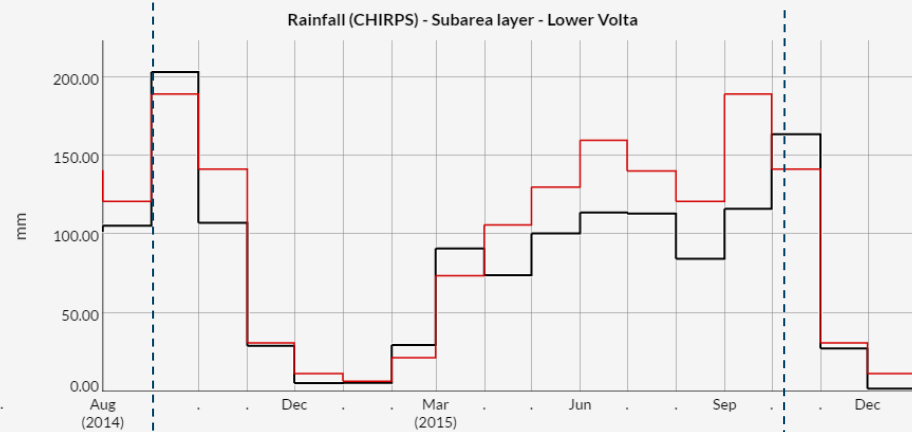
## White Volta



Rainfall deficit



## Lower Volta



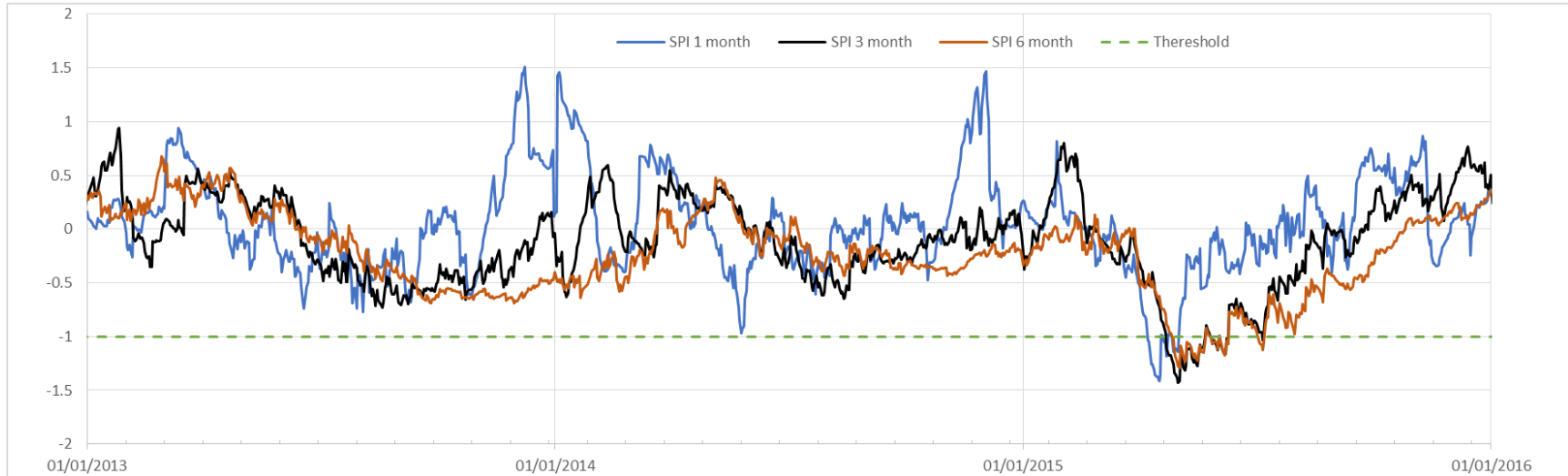
Rainfall deficit





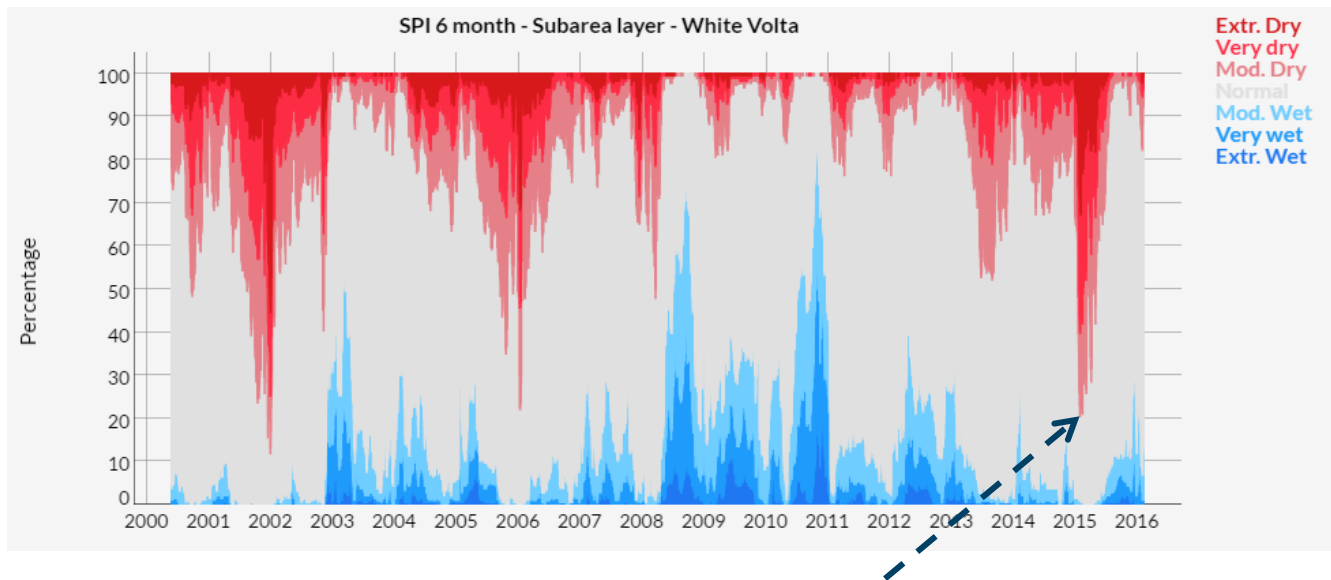
# Standardized Precipitation Index

White Volta



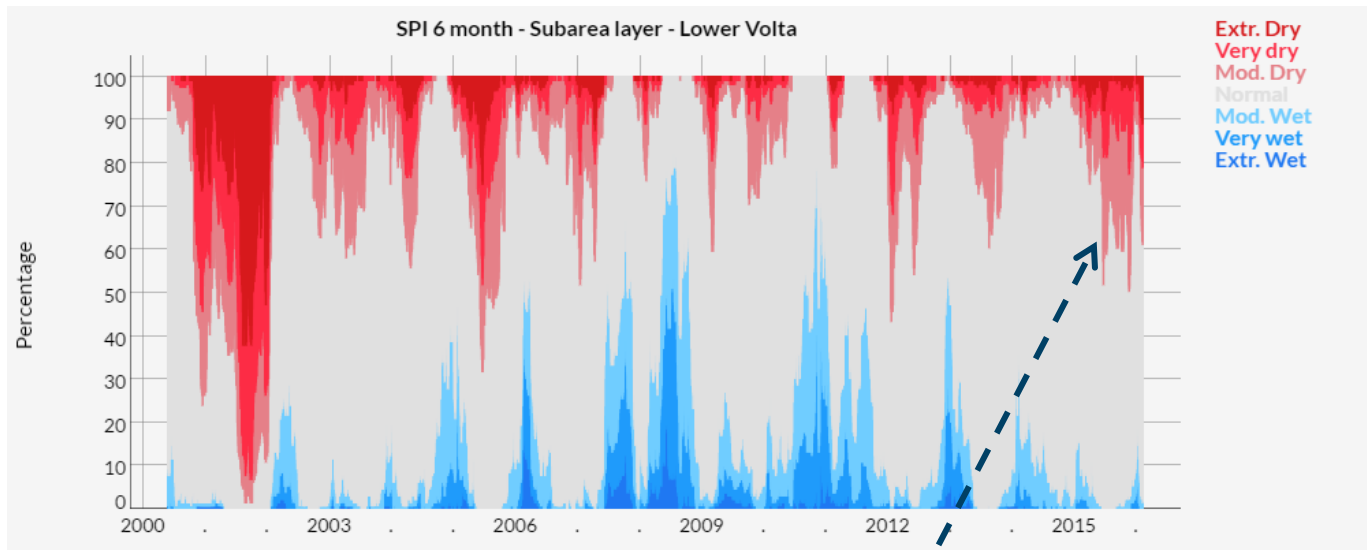
SPI is one of the most common used indices for evaluation of rainfall variability

# SPI indicates large rainfall deficit in White Volta



Large percentage (about 80%) of the White Volta affected by low rainfall ( $SPI < -1$ )

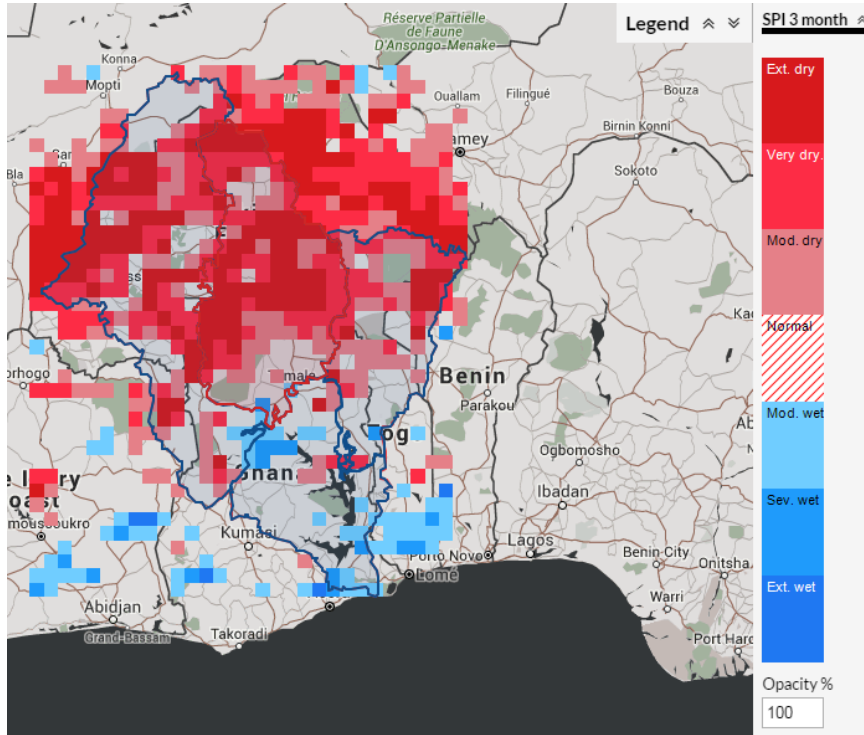
# SPI indicates smaller rainfall deficit in Lower Volta



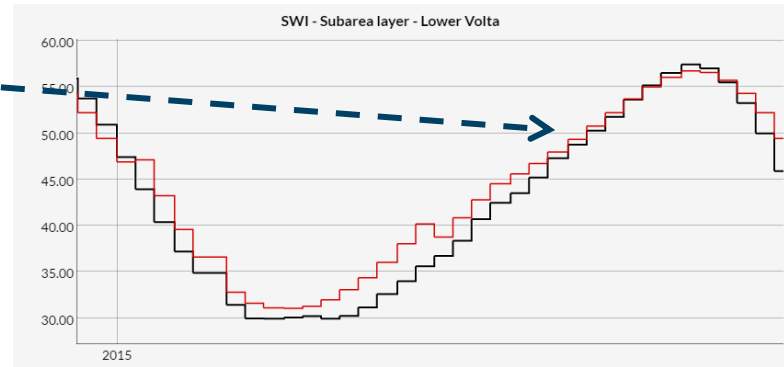
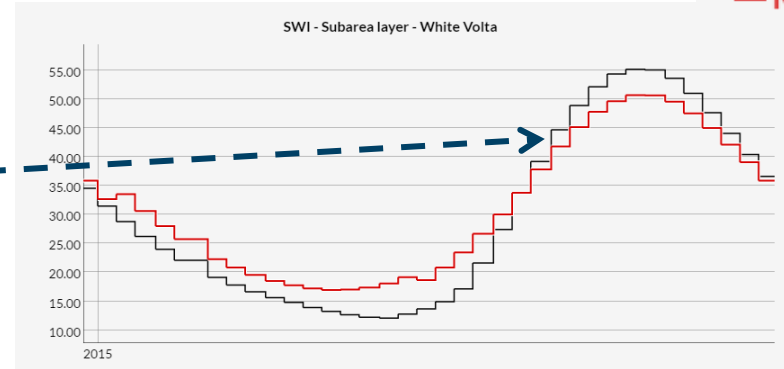
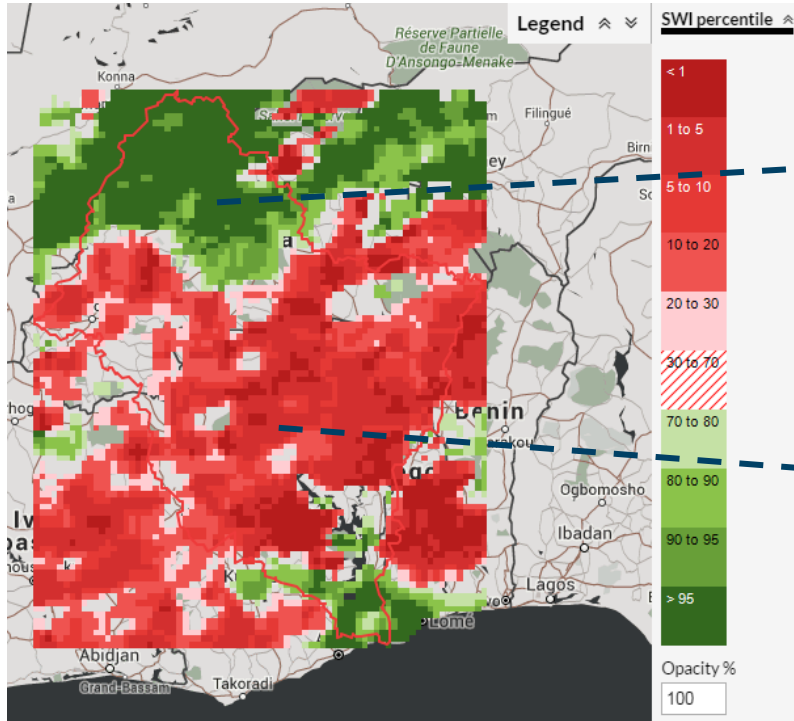
Longer duration and later in 2015 but impacts a smaller area



# Spatiotemporal distribution of rainfall deficit



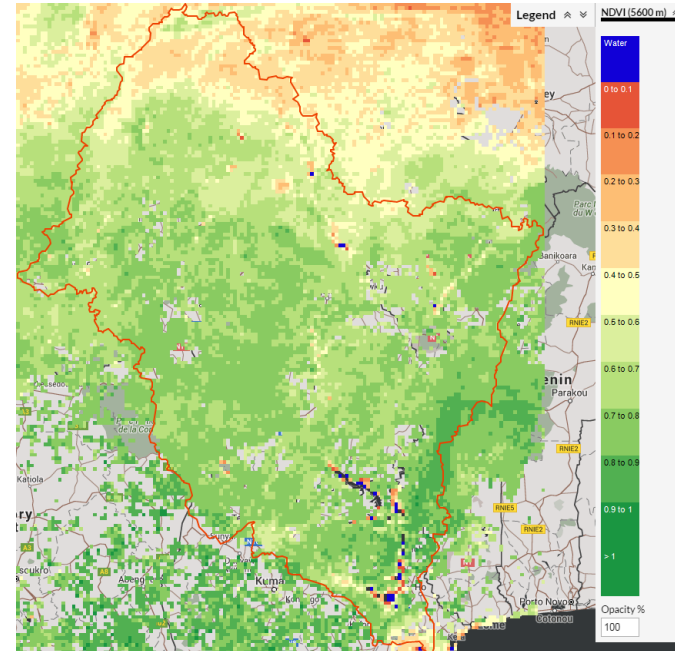
# Soil moisture



Map of soil moisture index in August 2015

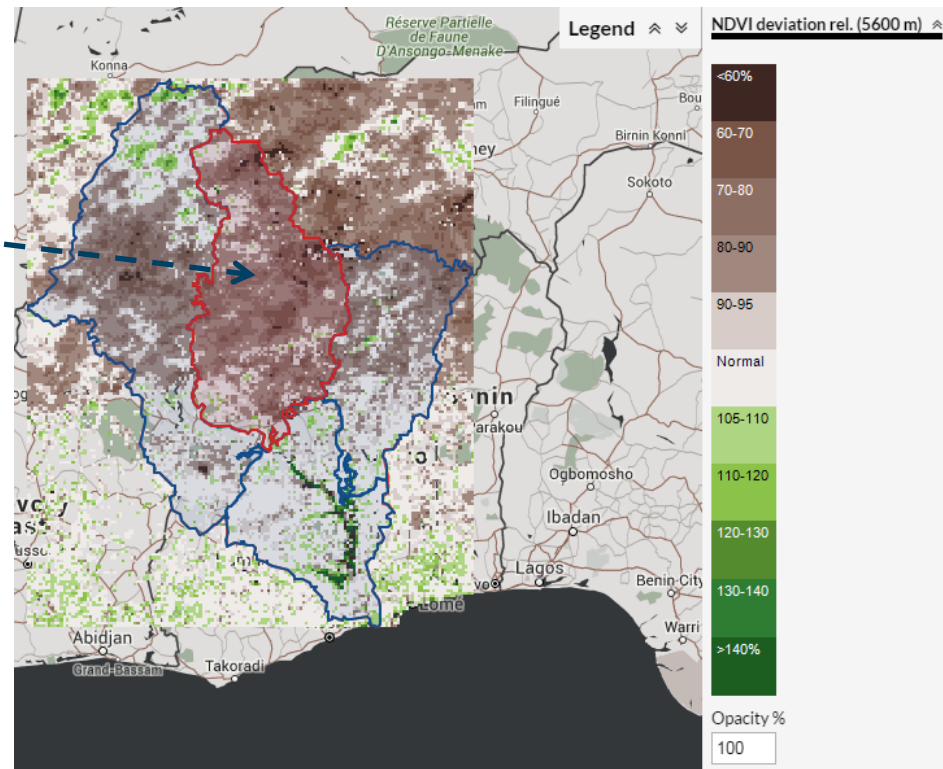
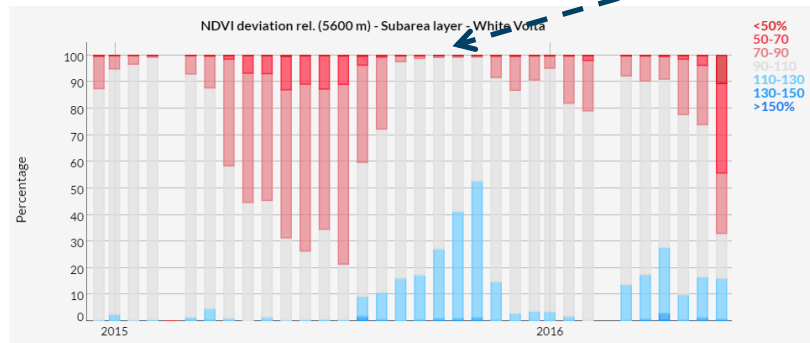
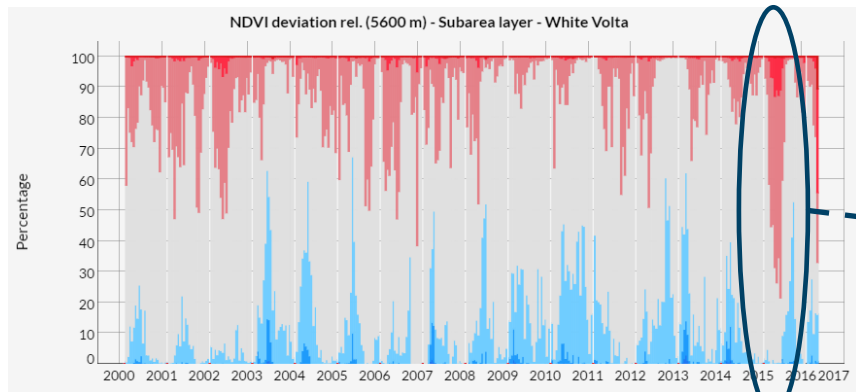
# Vegetation impact

- Normalized difference vegetation index (NDVI)
  - Varies between -1 and +1
  - Dense vegetation canopy (0.3 – 0.8)
  - Water surface (very low positive or even slightly negative values)
- Correlation with leaf area index and biomass



NDVI for Volta basin in August 2015

# Vegetation impact in White Volta in August 2015





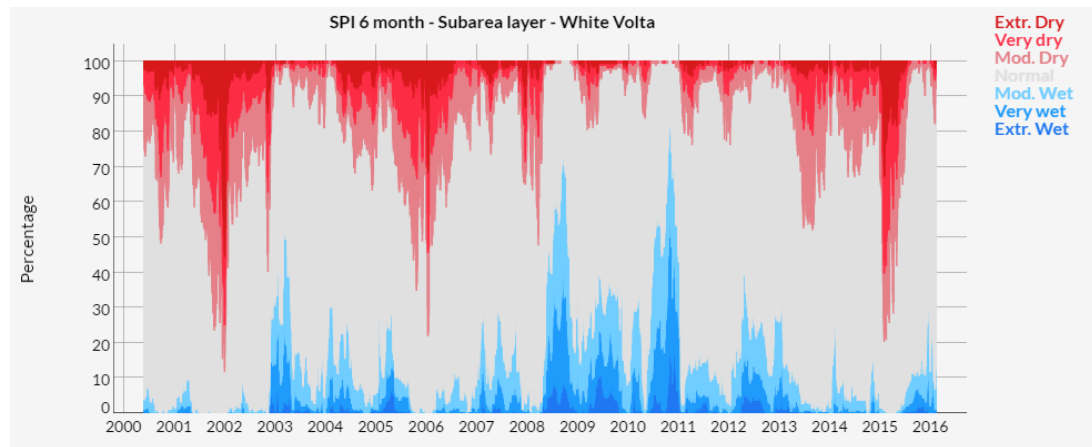
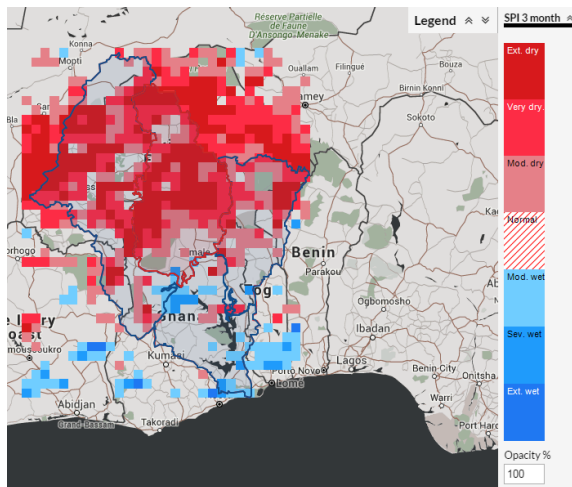
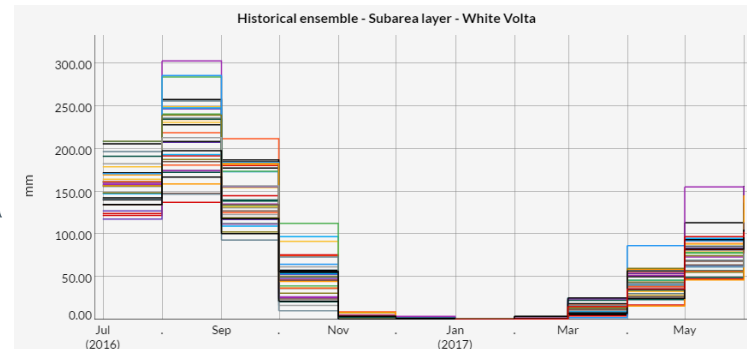
# Conclusions...





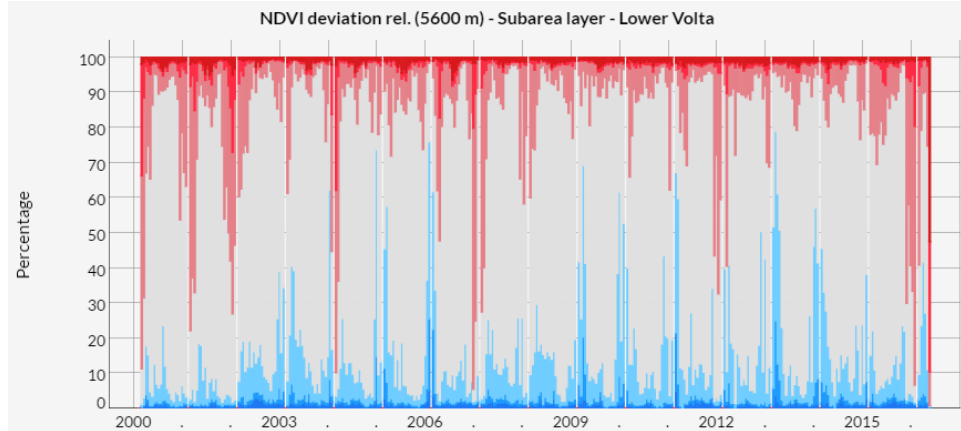
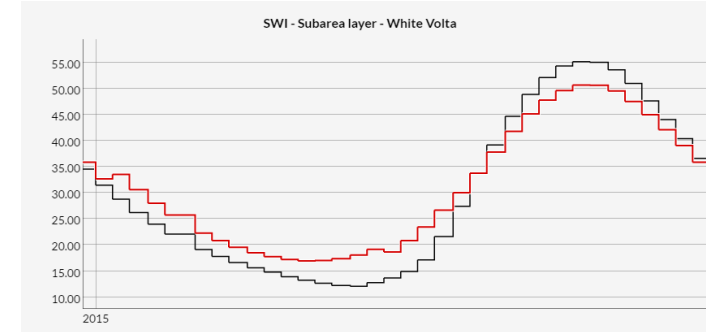
# Wrap up

- Climate variability based on historical data
- Identify temporal and spatial rainfall deficit



# Wrap up

- Soil moisture impact
- Vegetation impact



# Conclusions

- Satellite based data provides temporal and spatial monitoring of drought impacted areas in close to real time from Flood and Drought Data portal
- Spatial and temporal assessment is required for drought monitoring
- Drought monitoring is the first step in drought planning

# FLOOD & DROUGHT MANAGEMENT TOOLS



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