

Introduction

The Sahel, in West Africa, is a semi-arid region experiencing high temperatures during the most important part of the year. Unfortunately extreme heat events in this region are not well documented despite their negative impacts on health and socio-economic activities. In other regions of the globe, diverse thermal indices have been used in order to account for the actual impact of weather conditions on human comfort.

This work aims at

- 1-detecting heatwaves based on some of these indices and comparing the associated characteristics
- 2-investigating the physical processes underlying these heatwaves.

Data

ERA-I at 1°*1° resolution

Period: 1979-2017

Domain: 20W-30E and 10 to 20 N.

Thermal indices

1-Temperature : classic heat index, shielded conditions

2-Heat-Index HI (T,RH): moisture effect

$$HI = -42.37 + 2.04T + 10.14RH - 0.22 T.RH - 6.83 * 10^{-3}T^2 - 5.48 * 10^{-2}RH^2 + 1.22 * 10^{-3}T^2.RH + 8.52 * 10^{-4}T.RH^2 - 1.99 * 10^{-6}T^2.RH$$

3-Apparent Temperature AT (T,e,wind) : shielded outdoor conditions

$$AT = T + 0.33e - 0.7V - 4$$

4-Net Effective Temperature NET (T, RH, wind) : shielded outdoor conditions + human physiology

$$NET = 37 - \frac{37-T}{0.68-0.0014RH+\frac{1}{1.76+1.4V^{0.75}}} - \frac{0.29T}{1-0.001RH}$$

5-Environmental Stress Index ESI (T, RH, incoming shortwave radiation) : exposed outdoor condition

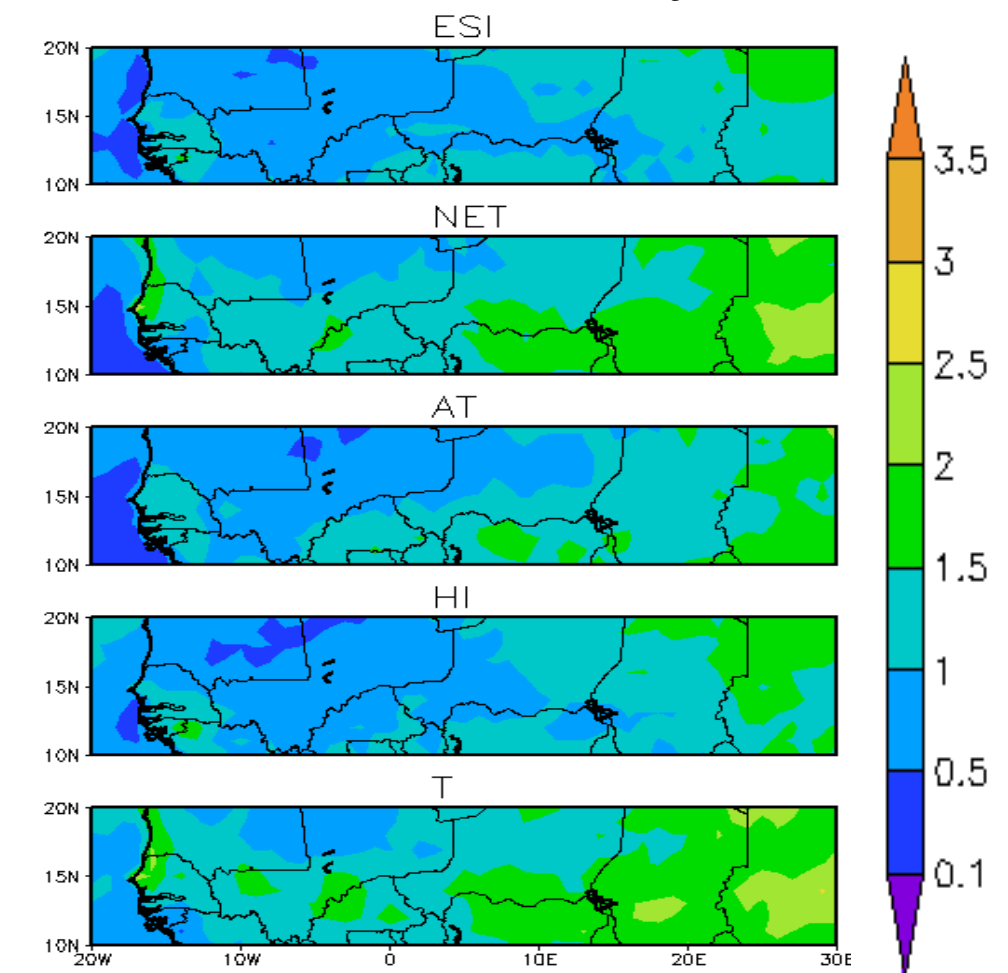
$$ESI = 0.62T - 0.007RH + 0.02SR + 0.043 T.RH - \frac{0.078}{0.1+SR}$$

What is a Sahelian heatwave?

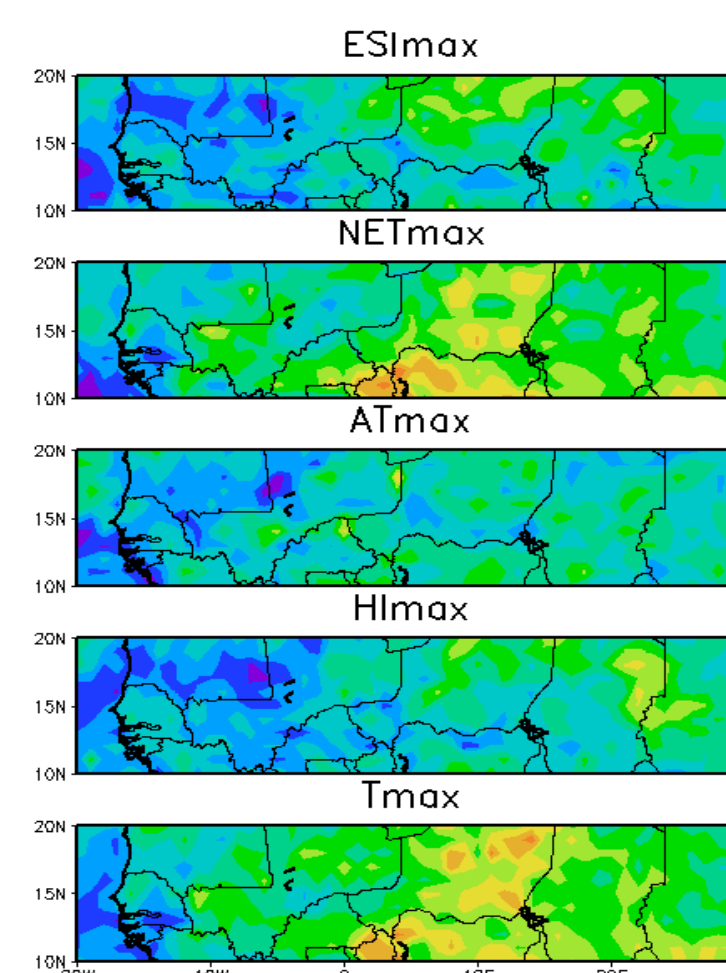
A period of **at least three (03) consecutive** days between **February and November** during which the extreme value of an index exceeds -the 75th percentile of its **annual distribution** AND - the 90th (95th) percentile of its **calendar day distribution** if it falls out of(within) the monsoon season.

Results

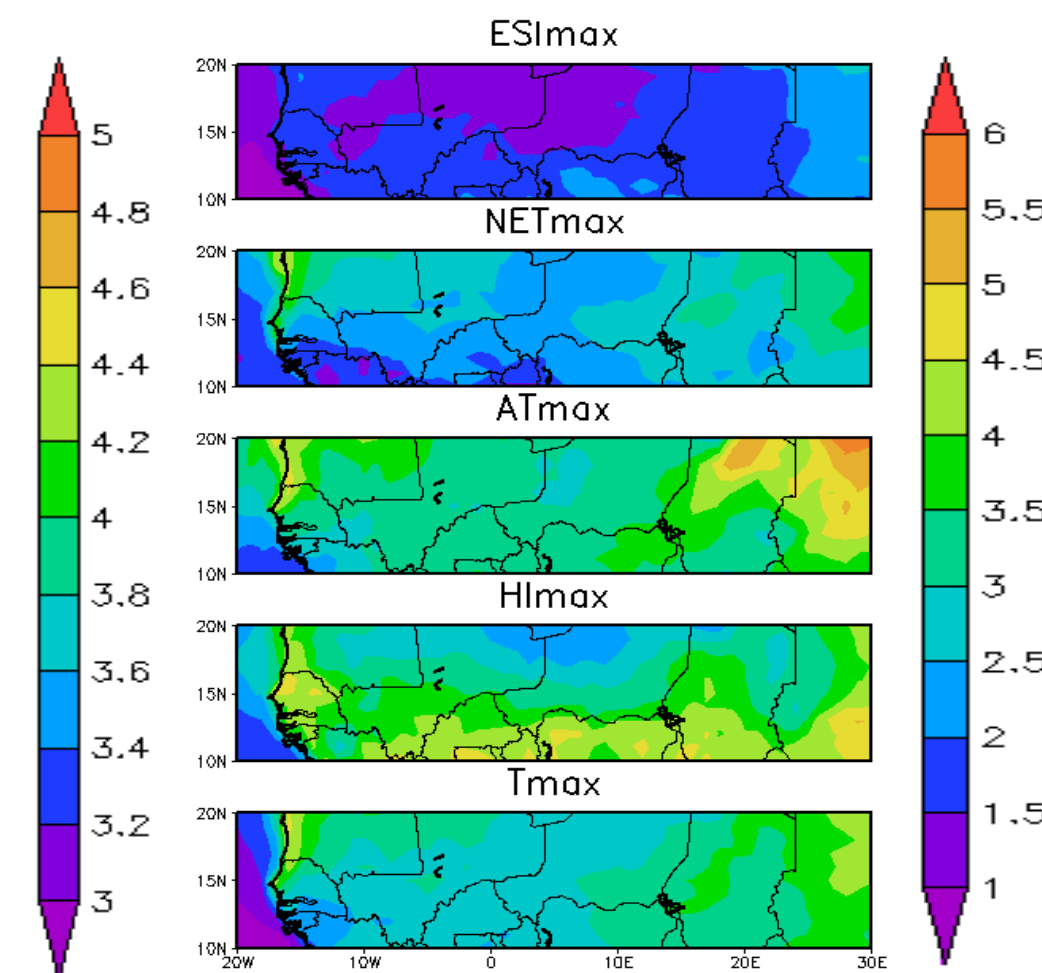
Number of events a year



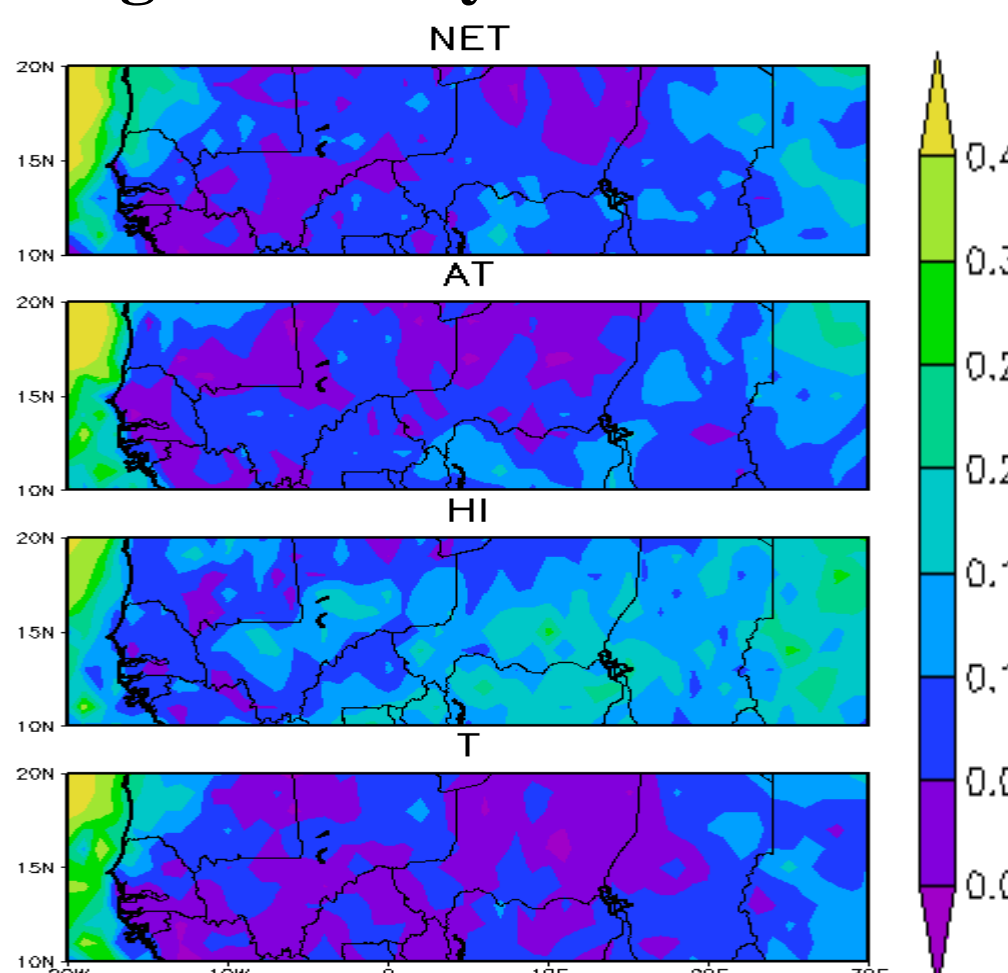
Average duration



Intensity



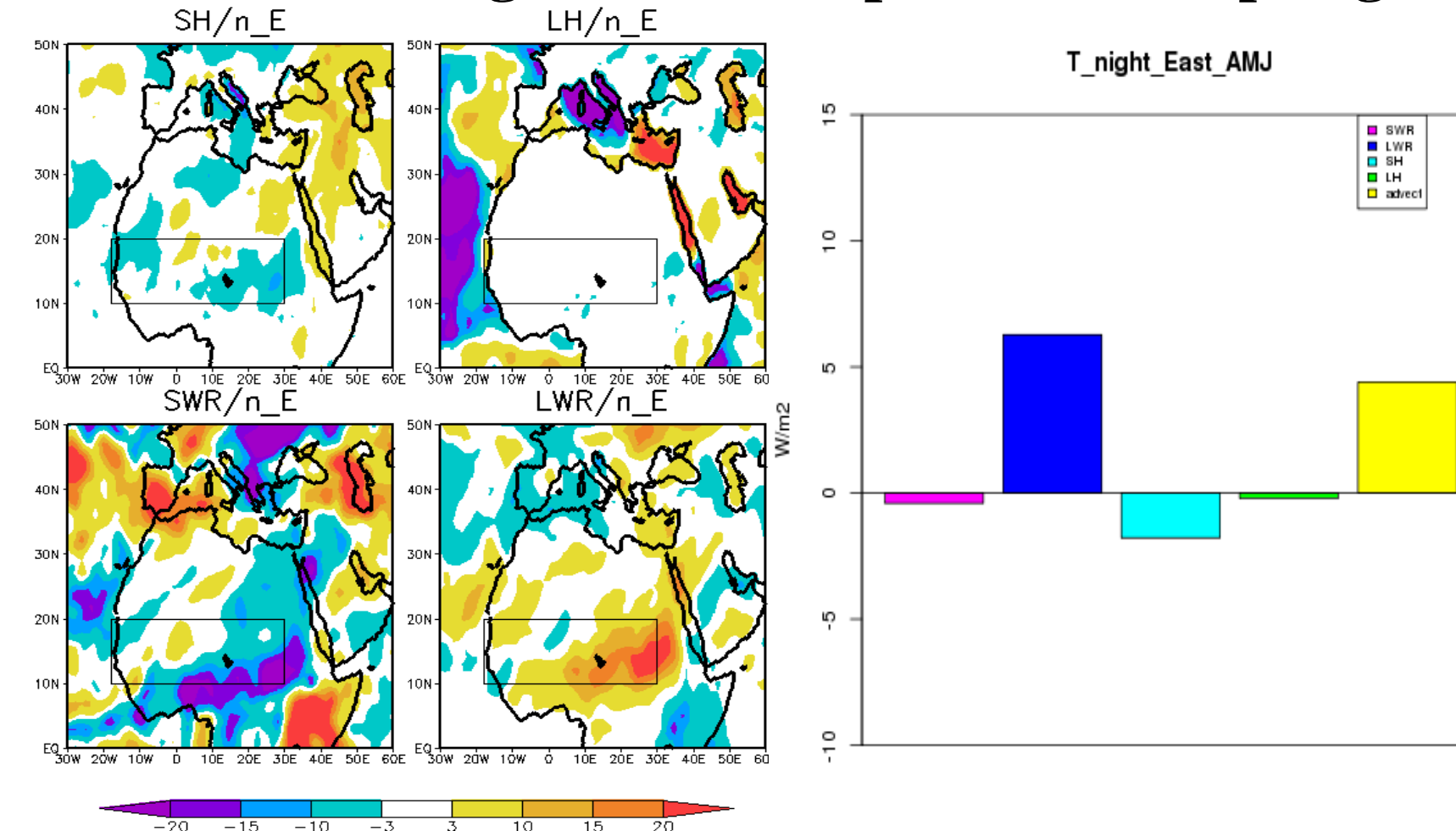
night and day HW coincidence



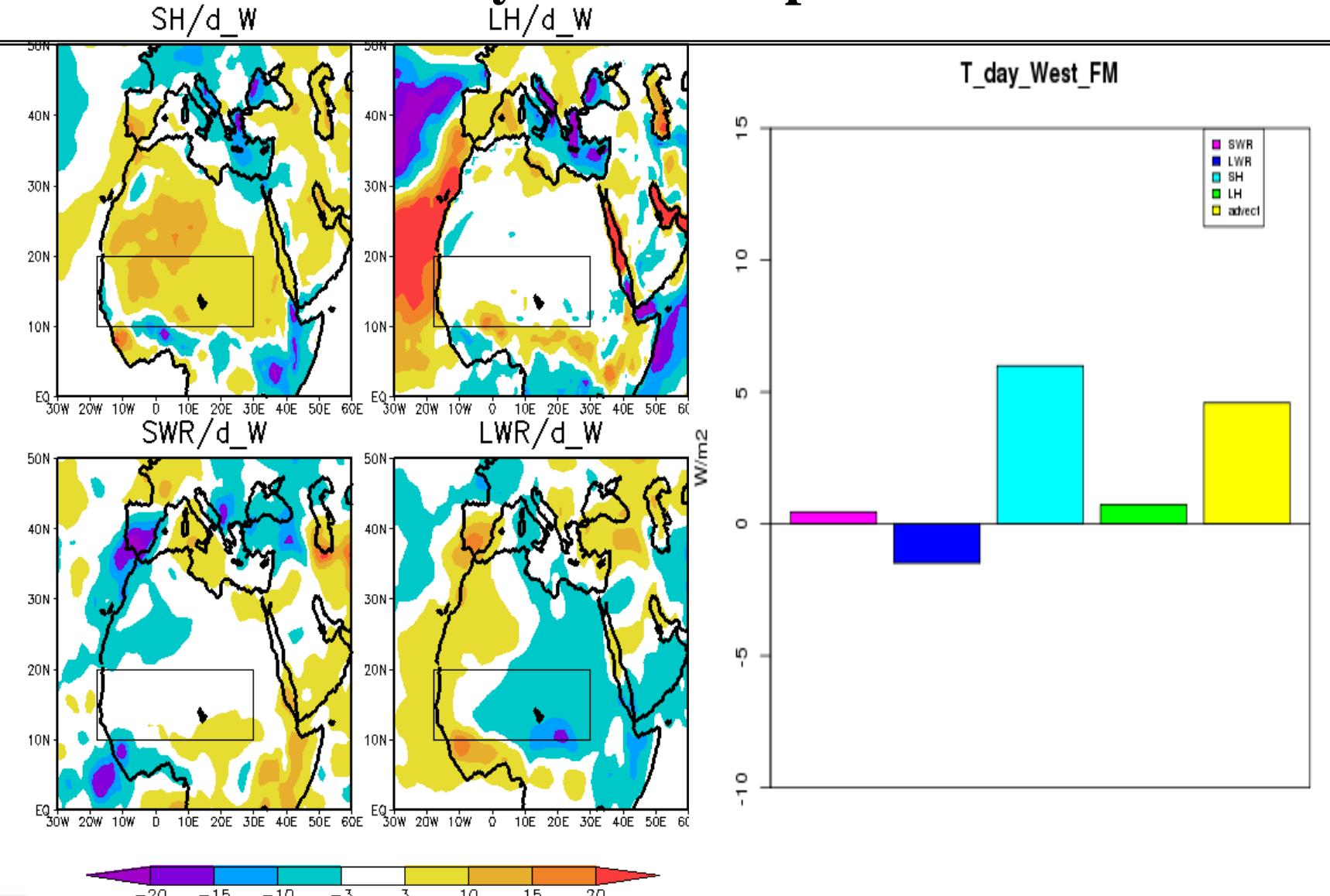
Large scale HW occurrence

	T		HI		AT		NET		ESI	
	night	day	night	day	night	day	night	day	night	day
totals	193	614	153	330	237	337	163	544	345	345
Feb	0	59	0	5	0	2	0	55	0	0
Mar	31	152	30	35	21	63	39	139	24	24
Apr	45	177	34	87	45	95	40	155	87	87
May	65	127	59	110	89	101	48	110	126	126
Jun	45	81	23	77	53	54	31	69	87	87
Jul	4	4	7	3	2	4	2	4	7	7
Aug	0	3	0	5	0	2	0	1	5	5
Sep	0	5	0	5	5	4	0	3	6	6
Oct	3	0	3	3	22	11	3	2	3	3
Nov	0	6	0	0	0	1	0	6	0	0
FM	31	211	30	40	21	65	39	194	24	24
AMJ	155	385	116	274	187	250	119	334	300	300
JAS	4	12	7	13	7	10	2	8	18	18
ON	3	6	3	3	22	12	3	8	3	3

Eastern Sahel nighttime HWs processes on spring



Western Sahel daytime HWs processes on late winter



Conclusion

- The condition of exceedance of the 75th percentile of annual distribution casts out lots of potential events.
- Low coincidence of nighttime and daytime events.
- Fair coincidence between different indices.
- Sensible heat flux, advection and greenhouse effect are the main physical processes.
- Potential impact of West African monsoon, Heat Low, and mid-latitudes Rossby waves to further investigate.