Recent trends in climate variability at local scale: case of Paris region, France

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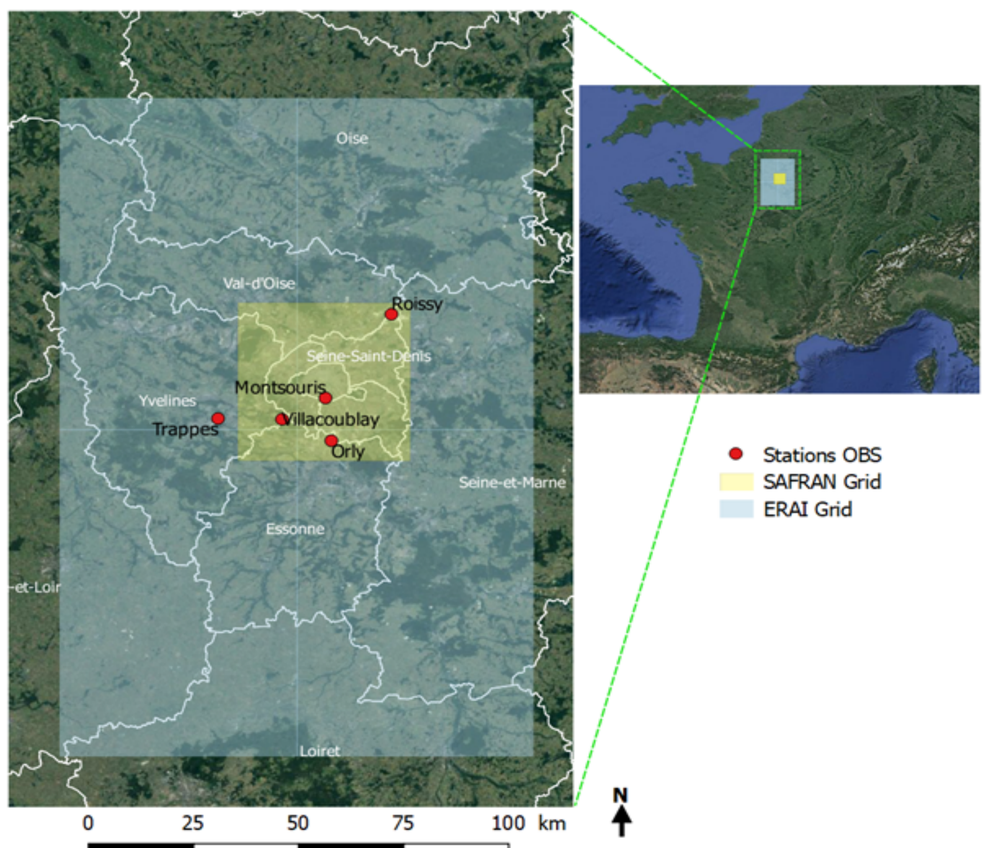
CONTEXT

Global warming trend was accompanied by consistent changes in climate extremes and these extremes tend to increase more strongly than mean temperatures [Vogel, 2017].
These phenomena can be explained by various mechanisms like feedback mechanisms, in particular soil moisture-temperature feedbacks [Whan et al., 2015].
Nevertheless, climate variability is driven by large-scale circulation but also by local processes. To better understand the climate variability that affects environment, it is necessary to work on a smaller scale to characterize the changes observed in order to understand these changes in terms of processes and feedbacks from observations.

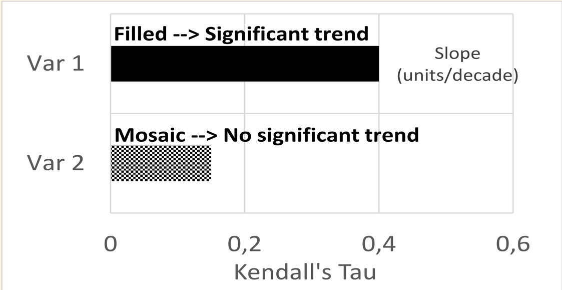
DATA

Time series : 1979-2017
OBS Météo France
(5 stations mean)



METHODS

- Mann-Kendall Trend Test for 1979-2017 series

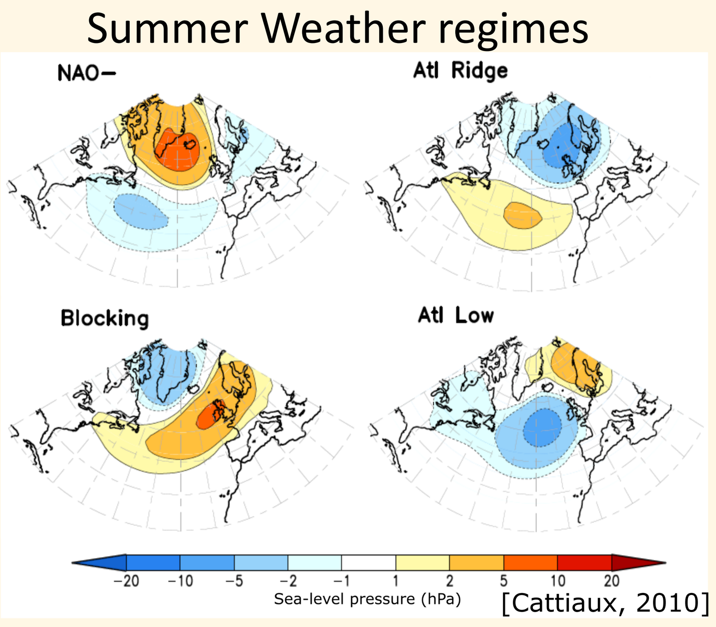


Kendall's Tau = Variable correlated with time [Mann, 1945; Kendall, 1975]

- Comparison of distributions between 2 periods: 1979-2002 and 2003-2017

- Weather regimes in Winter and Summer [Yiou et al., 2008]

Summer Weather regimes



[Cattiaux, 2010]

- Climatological indexes (from Climdex)

Temperature

INDEX	DEFINITION	UNIT
SU	Annual count when Tx*> 25 ° C	Days
Tx90p	% of days when Tx > 90th percentile	%
Tx10p	% of days when Tx < 10th percentile	%
Tn90p	% of days when Tn > 90th percentile	%
Tn10p	% of days when Tn < 10th percentile	%
TR	Annual count of days when Tn > 20°C	Days
FD	Annual count of days when Tn < 0°C	Days

Precipitation

INDEX	DEFINITION	UNIT
%Rainy	Annual rainy days	%
R90pTOT	Annual total PRCP when RR > 90th percentile	mm
SDII	Annual PRCP divided by the nb of wet days	mm/d
CDD	Maximum nb of consecutive days with RR < 0,2mm	Days

*Tx=Tmax and Tn=Tmin

RESULTS

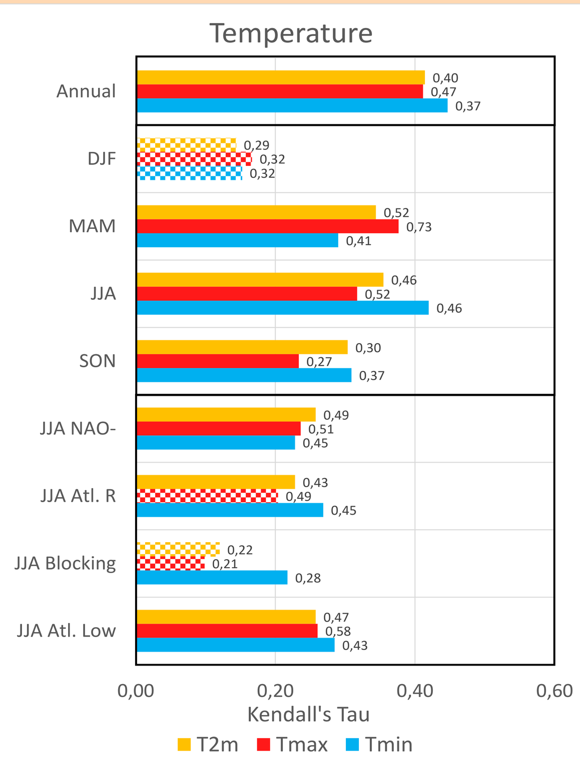
As expected, over the last 40 years, we detect ...

T2m Tmax Tmin ➡ ↗ T2m in 40 years each season; with ↗ Tmax > ↗ Tmin and ↘ cold anomalies and ↗ warm anomalies
RH ➡ ↘ is generalized to all seasons and particularly in summer
PRCP ➡ no significant trends but change in intensities frequency

TEMPERATURES TRENDS

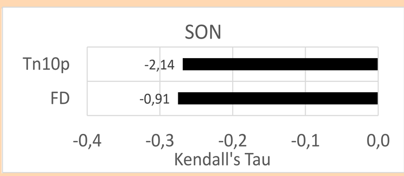
Annual Trends

Strong ↗ Tmax +1.9°C



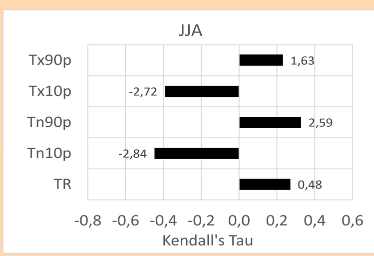
Seasonal Trends

SON
↗ Tmax < ↗ Tmin
Much less frost nights

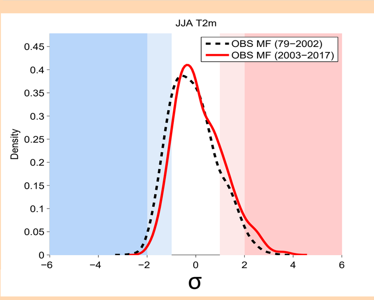


DJF
Much less very cold anomalies (T2m Tmax Tmin)

MAM
↗ T2m (+2.1°C) and Tmax (+2.9°C) in mean; but no change in Tmax and Tmin anomalies

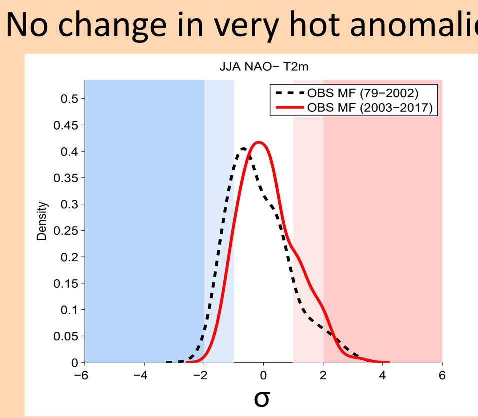


JJA
Strong ↗ for Tmin (+1.8°C)
Strong trend in temperature indices
Strong change in daily anomalies
(↗ very hot anomalies)



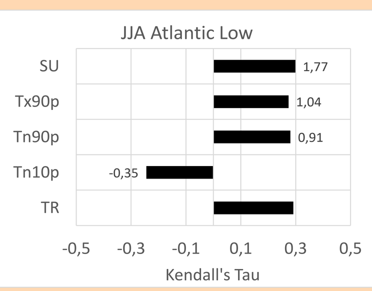
Summer Weather Type Trends

NAO-
Strong ↗ T2m (+2.1°C)
↘ cold anomalies
↗ warm anomalies (only T2m)
No change in very hot anomalies

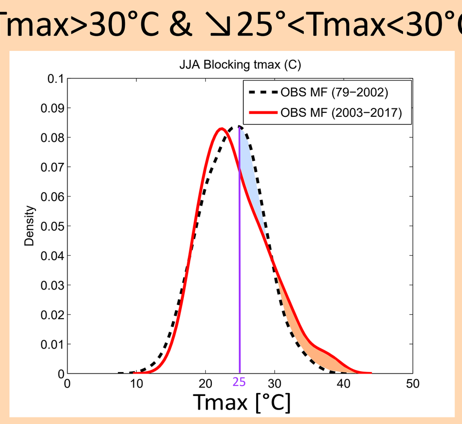


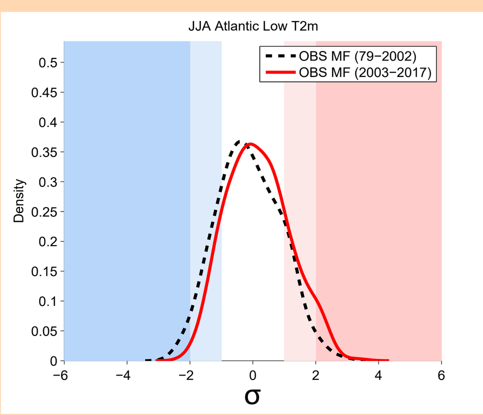
Atlantic Ridge
↗ (very) hot anomalies
no change in cold anomalies

Atlantic Low
Strong ↗ Tmax (+2.3°C)
↗ very hot anomalies
Strong trend of temperature indices
Change in daily Tmax and Tmin anomalies



Blocking
↗ very hot anomalies (T2m, Tmax Tmin)
Only ↗ Tmin significant
↗ Tmax>30°C & ↘25°<Tmax<30°C



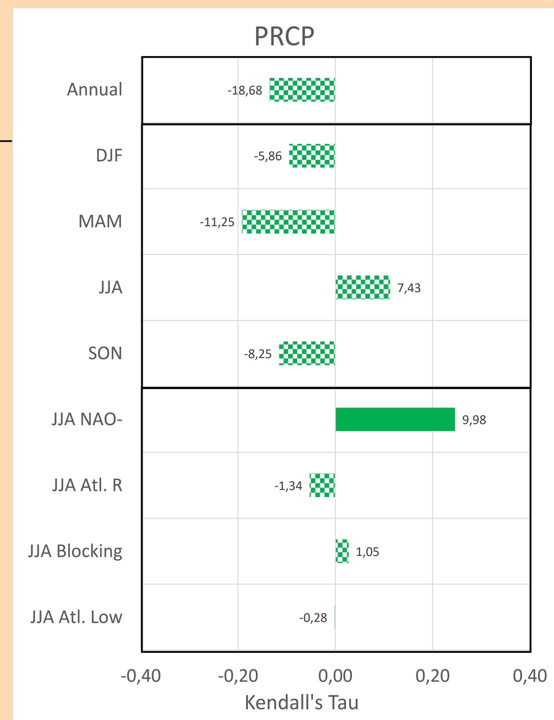


more surprising we also detect ...

PRECIPITATION TRENDS

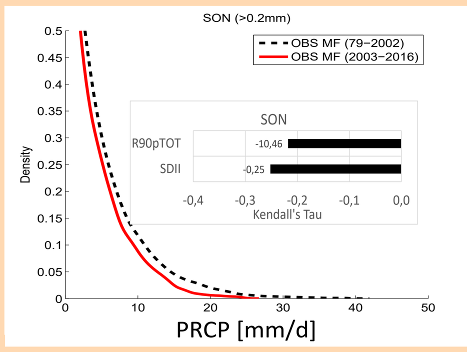
Annual Trends

↘ in extreme intensities



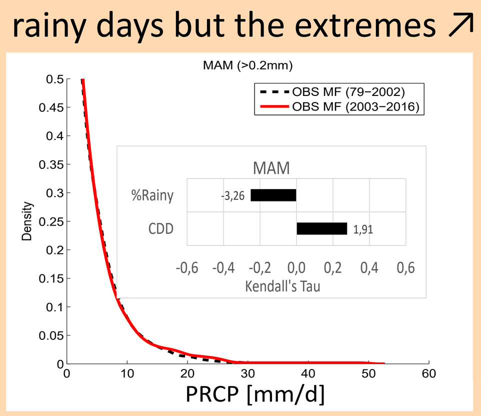
Seasonal Trends

SON
Rainfall is less intense

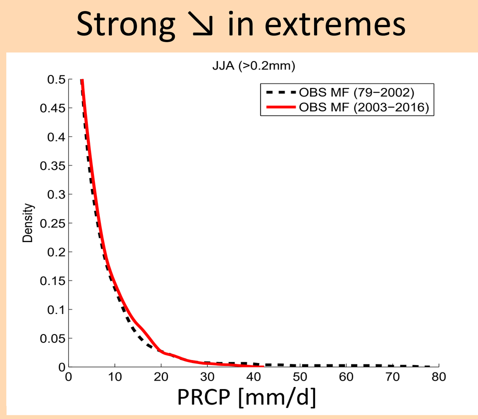


DJF
↘ in extreme intensities

MAM
The weather is drier with fewer rainy days but the extremes ↗

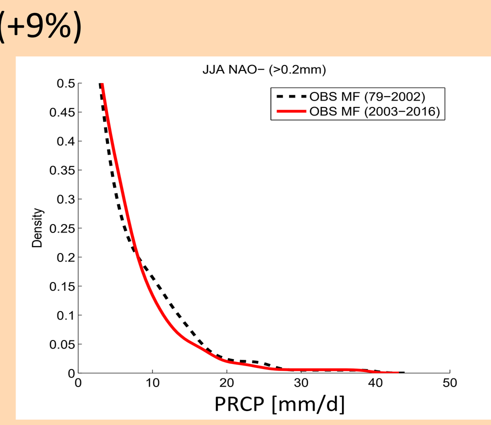


JJA
Strong ↘ in extremes

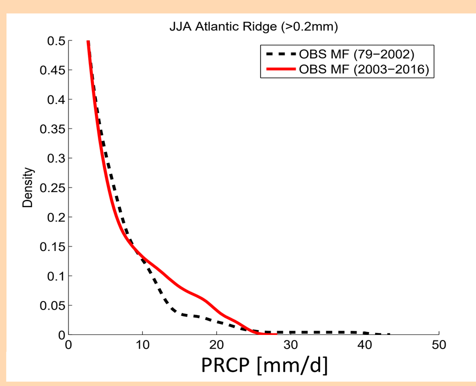


Summer Weather Type Trends

NAO-
↗ rainfall is only due to the ↗ in the frequency of days in NAO- (+9%)



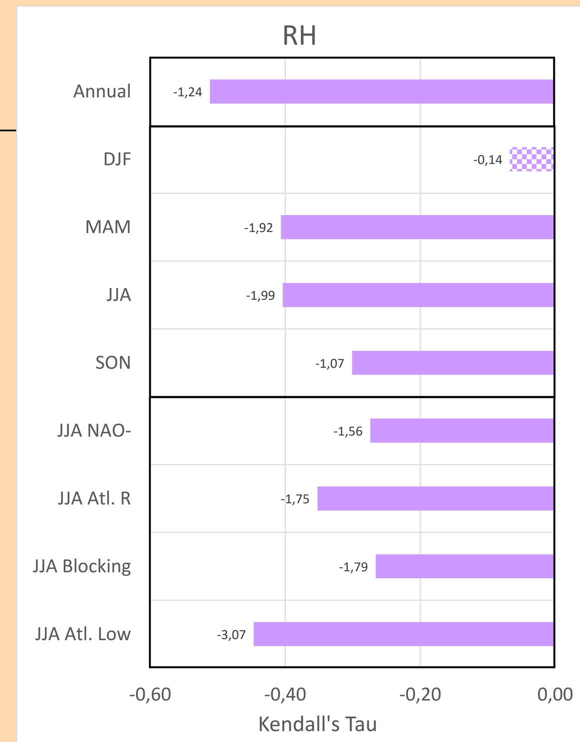
Atlantic Ridge & Blocking
↘ in high intensities
↗ in moderate intensities



RELATIVE HUMIDITY TRENDS

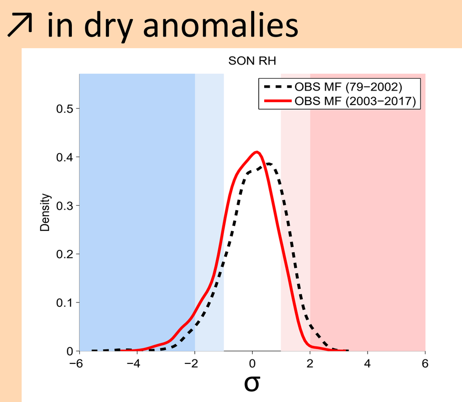
Annual Trends

Strong ↘ RH (-5%)

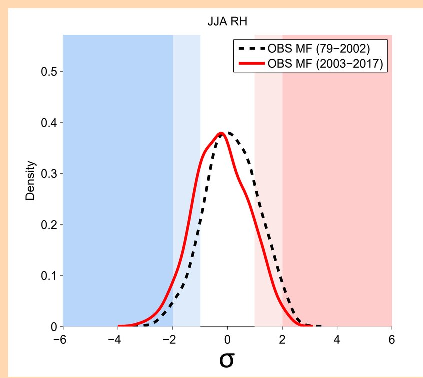


Seasonal Trends

SON
↘ in wet and very wet anomalies
↗ in dry anomalies



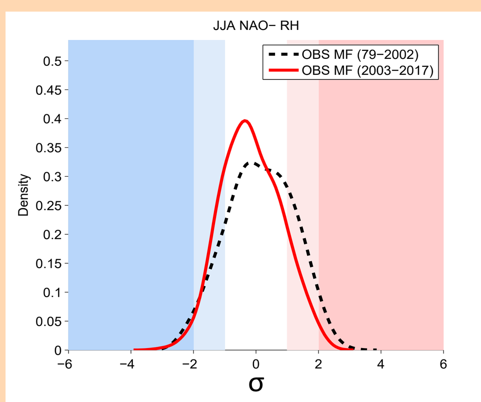
MAM and JJA



Strong ↘ in average (-8%)
↗ in dry anomalies

Summer Weather Type Trends

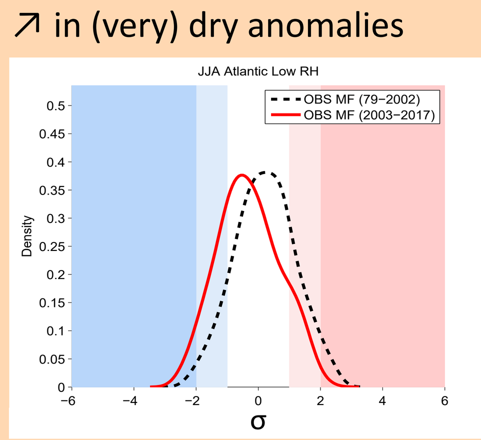
NAO-
↘ in wet anomalies



Atlantic Ridge
↘ in wet anomalies
↗ in (very) dry anomalies

Blocking
↗ in (very) dry anomalies

Atlantic Low
Very strong change with -12.3%
↘ in (very) wet anomalies
↗ in (very) dry anomalies



PERSPECTIVES

➡ Understand the process and feedback mechanisms that come into play in these new distributions.
(1) using a complete dataset of variables not only meteorological but also profiles and radiosondage available at SIRTA [Chiriaco et al., 2018]
(2) by looking at the evolution of the large scale via the analogs method to find out if regimes are stable or not in time.
➡ Link between these atmospheric changes and changes in hydrology (example of flows)

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