

Joint occurrence of temperature and precipitation extreme events in Argentina

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Introduction

Temperature and precipitation extreme events have been widely studied along the globe since their occurrence severely influences the society and the ecosystem. Agriculture, energy demands, human health, among others, can be affected both by extremely high or low temperatures and by extremely dry or wet conditions. The simultaneous or proximate occurrence of both types of extremes leads to more disastrous consequences. For example, a dry period can have more negative consequences on the agriculture if it is overlapped with or followed by a period of extremely high temperatures.

Objective

The aim of this study is to analyse the joint occurrence of dry or wet conditions and high or low temperature events at different stations from Argentina based on the observed daily data available from the twentieth century. The simultaneous occurrence of both types of extremes is analysed, as well as the occurrence of one type of extreme immediately followed by the other type. Different extreme severity levels are considered for both types of extremes by considering different thresholds based on the empirical distribution of each variable.

Methodology

All days in the period 1941-2000 are given a precipitation and temperature (minimum and maximum) category based on different percentiles.

Temperature	
Category	Description
-3	$T < 5\text{th perc}$
-2	$5\text{th perc} \leq T < 10\text{th perc}$
-1	$10\text{th perc} \leq T < 25\text{th perc}$
0	$25\text{th perc} \leq T \leq 75\text{th perc}$
1	$75\text{th perc} < T \leq 90\text{th perc}$
2	$90\text{th perc} < T \leq 95\text{th perc}$
3	$95\text{th perc} < T$

Precipitation	
Category	Description
0	$P \leq 75\text{th perc}$
1	$75\text{th perc} < P \leq 90\text{th perc}$
2	$90\text{th perc} < P \leq 95\text{th perc}$
3	$95\text{th perc} < P$

Tables 1 and 2. Categories of extremes for daily minimum and maximum temperature (left) and precipitation (above).

Results

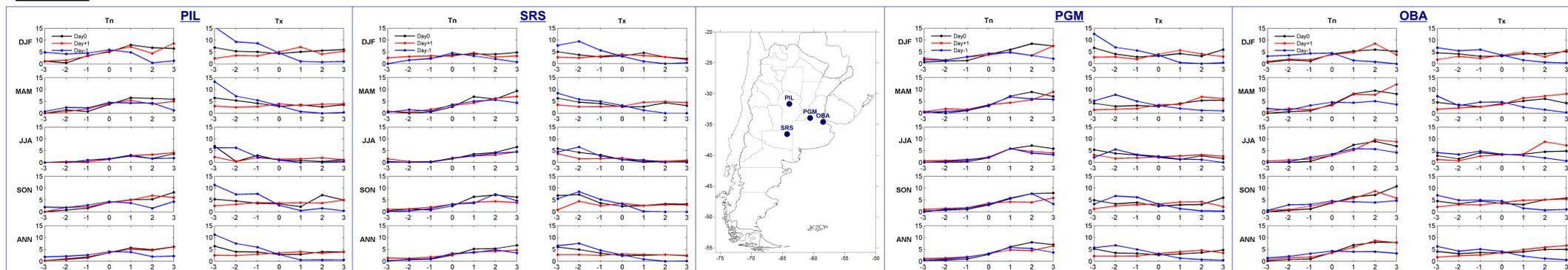


Figure 1. Proportion of days with extreme precipitation in category 1 given that an extreme temperature event has occurred (categories -3 to 3) over all extreme temperature events in the period. Precipitation extreme events occur (black) same day, (red) day after or (blue) day before a temperature extreme event. Also shown, location of the stations used in this study.

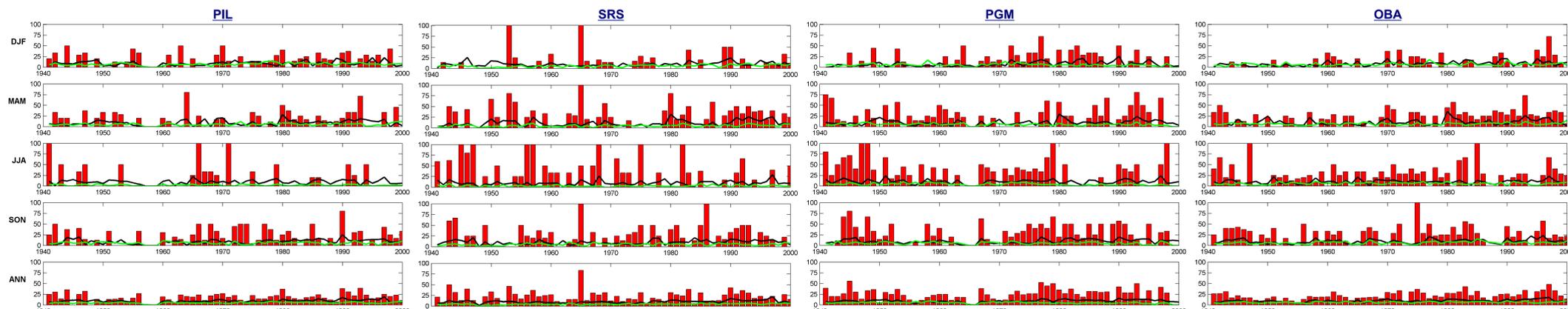


Figure 2. (red columns) Proportion of extreme precipitation events (defined as $P > 75\text{th percentile}$) occurring on a warm night (defined as $T_n > 90\text{th percentile}$), over all warm nights in the corresponding season. (black line) Proportion of warm nights and (green line) extreme precipitation days over the complete season.

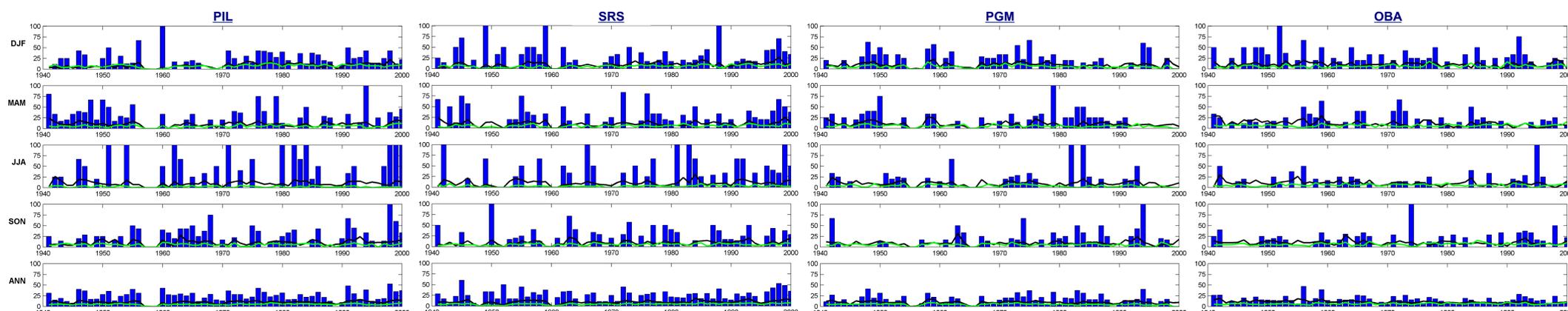


Figure 3. (blue columns) Proportion of extreme precipitation events (defined as $P > 75\text{th percentile}$) occurring the day before a cold day (defined as $T_x < 10\text{th percentile}$), over all cold days in the corresponding season. (black line) Proportion of cold days and (green line) extreme precipitation days over the complete season.

Conclusions

- ✓ Extreme precipitation extremes are more associated with warm minimum temperature extremes than cold minimum temperature extremes. The opposite occurs for maximum temperature, although not so markedly.
- ✓ Extreme precipitation events are more frequent on the same day or the day after a warm minimum temperature extreme event, but the day before a cold maximum temperature extreme day.
- ✓ The behaviour of the joint occurrence of extreme events differs from one station to the other, and also between seasons.
- ✓ There's no evidence of a linear trend, but interdecadal variability influences the time series of joint occurrence of extremes.

Future work

- ✓ Analyse the atmospheric circulation associated to the joint occurrence of temperature and precipitation extreme events.
- ✓ Analyse interdecadal variability of the joint distribution of extremes events.
- ✓ Analyse the capacity of models to simulate the occurrence of both extreme events.