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Introduction: There are few studies about extreme temperature events in Southeastern South America (SREX, 2009), although these events generate human health impacts and big economical loses. Southeastern South America is one of the major agricultural production regions worldwide. Particularly in Uruguay, agricultural production represents a high percentage of the GDP and, in the last 15 years there has been a significant increase in the area used for that economic activity. Based on previous studies that showed a negative trend in the ocurrence of warm days (TX90) during summer (DJF) and a negative trend of cold nights (TN10) during autumn (MAM) and winter(JJA) (Renom, 2009; Donat et al., 2013, etc), the aim of this study is to detect if this observed trends are correlated with changes in heat waves and frost days.

Data and methodolgy:

We used a high quality daily maximum (Tx) and minimum temperature (Tn) database from 11 meteorological stations in Uruguay, covering the period 1950-2009. The figure shows the location of the stations analysed. Observed trends were calculated using the non-parametric Sen method (Sen, 1968) and the statistical significance was assessed at the 5% level.



Definitions:

•FROST PERIOD (FP) : Covers from the date of the first to the last frost recorded for each time series. The common frost period extends from May to September.

•HEAT WAVES (HW) : We define a heat wave based on maximum and minimum temperature as follows. Based on an autocorrelation analysis a 5day window was used to determine the daily 90th percentile of each temperature series, from December to February for the period: 1950-2009. A HW was defined when during 3 or more days the daily maximum and minimum temperature exceed the daily long-term 90th percentile, not interrupted by more than one day where one of the variables does not fulfil these conditions.

HEAT WAVES (Dec-Jan-Feb)

Daily long-term 90th percentile









For the HW analysis we work with 6 stations, because of missing data in temperature series.

The daily long-term 90th the percentile shows evolution during summer time to define a HW.

The interannual variability shows a very low number of cases and no significant trend was detected in the frequency of ocurrence.

Considering the persistence of HWs, overall an event doesn't persist more than 4 days. Just 2 events that lasted for 5 and 6 days were detected in sixty years.

• We also explore the intensity of HW considering the °C above the 90th percentile, only of the maximum temperature. Large positive deviations tend to correspond to La Niña years (blue arrows).

Extreme Temperature Events: Summer heat waves and frost days in Uruguay-Southeastern South **America. Observed changes during 1950-2009.**

•FROST DAY(FD) : When the daily minimum temperature is below 0 °C.







CONCLUSIONS:

- observed.
- decade.

FROST DAYS (May-Jun-Jul-Aug-Sep)

Although frost events are expected to occur only during winter time, they generate large agricultural loses (ex. forestry, citrus, etc). We analysed different aspect that characterize them.

The long term trend analysis doesn't show a clear spatial behavior. Only 2 stations show a negative trend and one a positive.

We also compute the seasonal trends of cold nights index (TN10), because in Uruguay the 10th percentile of the minimum temperature is above 0°C so the frost days are included in this index. We didn't found a clear correlation in the trends detected between both indices, although our results show that during the first decades (1950-1970) occur 15 to 20 events, while in the last decades (1990-2000) no more than 10 events are observed.

Regarding the frost intensity we analysed the consecutive frost days (CFD) index, which shows that the usual length is around 2-4 days. The decadal analysis shows that during the first decades events lasting 4-5 days were common, while in the last decades isolated events were detected.

We also study the intensity considering the ocurrence of events in diferent ranges of temperature: [0,-1], [-1,-2] and below -2°C. Overall, during the 90's there are more events below -2 C, while during the 2000s although there were less events in the coastal stations they are more intense. In order to detect if there exist decadal differences between regions we considered Rocha and Paysandu stations that present a negative trend in frost days. Considering the FP, Paysandu shows a clear negative linear trend, while Rocha presents clear decadal variability. Moreover, while Paysandu presents an increase in the ocurrence of FD, but a decrease in the FP, Rocha does not present a clear change in FP.

• Overall few cases of HW were detected for the analyzed period. It is important to mention that during the last decade no more than 2 events were

• The long-term trends for FD does not present a clear spatial behavior, but all stations present more ocurrence of FD during the first two decades compared with the last ones. On the other hand an increase in the ocurrence is detected during the 90s.

• Considering the intensity, no changes were detected in the persistence, but some stations presents more events with T below -2°C during the last

• Two of the stations that present a negative trend in FD, but belong to different homogeneity regions, were analyzed considering the FP. The most continental station (Paysandu) presents a decrease in the FP, while the one located in the coastal region presents a decadal variability.

• Overall both extreme events, HWs and FDs, do not present a clear correlation between the trends detected in percentile temperature indices and the ocurrence of these events for the period 1950-2009.



