

Joint occurrence of daily temperature and precipitation extreme events over Southeastern South America

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Objective

The occurrence of individual extremes such as temperature and precipitation extremes can have a great impact on the environment. Agriculture, energy demands, and human health, among other activities, can be affected by extremely high or low temperatures and by extremely dry or wet conditions. However, the simultaneous or proximate occurrence of both types of extremes could lead to even more profound consequences. For example, a dry period can have more negative consequences on agriculture if it is concomitant with or followed by a period of extremely high temperatures. In this study the joint occurrence of heavy precipitation and extreme temperature events is analysed in Southeastern South America based on historical observations of the second half of the 20th century. The ability of RCMs to simulate this relationship is also analysed.

Data

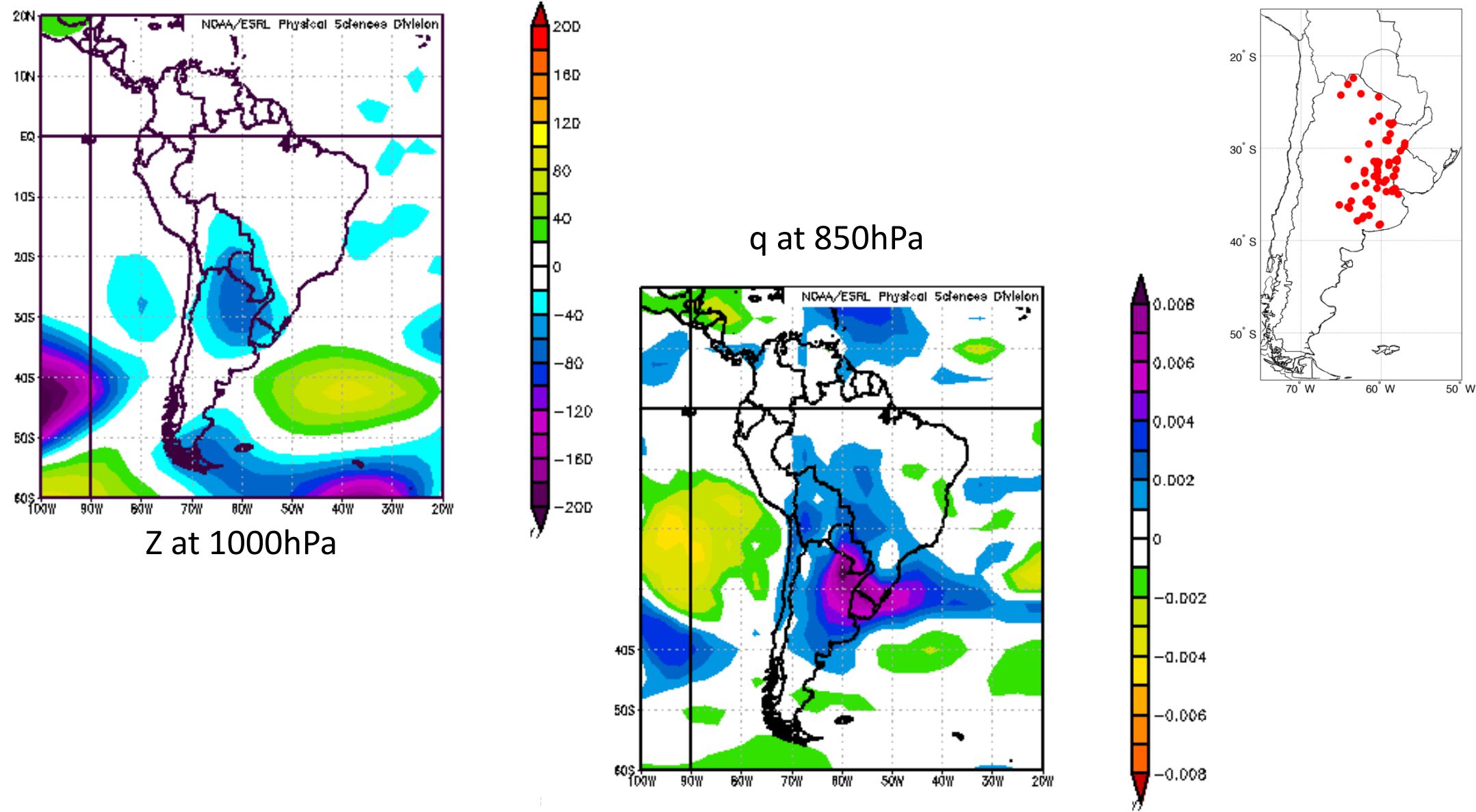
Daily precipitation, maximum and minimum temperature observed at stations from the CLARIS LPB database in Southern South America are used to determine the occurrence of combined extremes during the period 1971-2000. Daily data from RCMs driven by ERA-40 from CLARIS LPB are also used for Southeastern South America.

Methodology

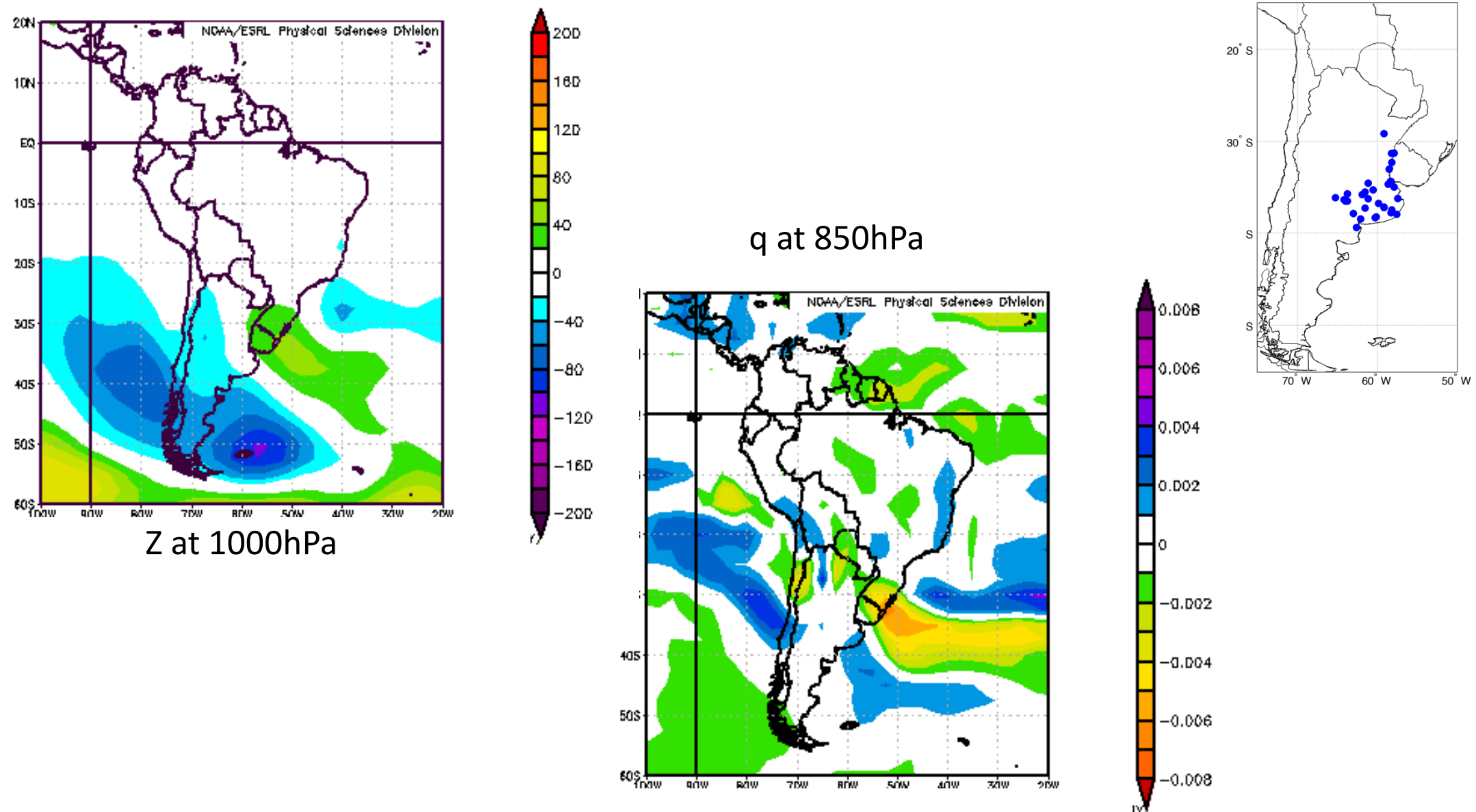
Combined extremes are defined as the occurrence of an extreme in minimum or maximum temperature and the occurrence of a heavy precipitation event on the same day, the day before or the day after. Temperature extremes are defined based on the 10th or 90th percentile of the daily distribution of minimum (cold and warm nights) and maximum temperature (cold and warm days) calculated over the period 1971-2000, using a 5-day-running window. Heavy precipitation events correspond to days with precipitation above the 75th percentile of the distribution of rainy days (pr > 0.1 mm) over a 29-day-running window in the base period.

Case study

Warm night & heavy precipitation event at 68 stations 07-Jun-1973



Cold day & heavy precipitation event at 34 stations 28-Dic-1991



Warm nights & heavy precipitation events

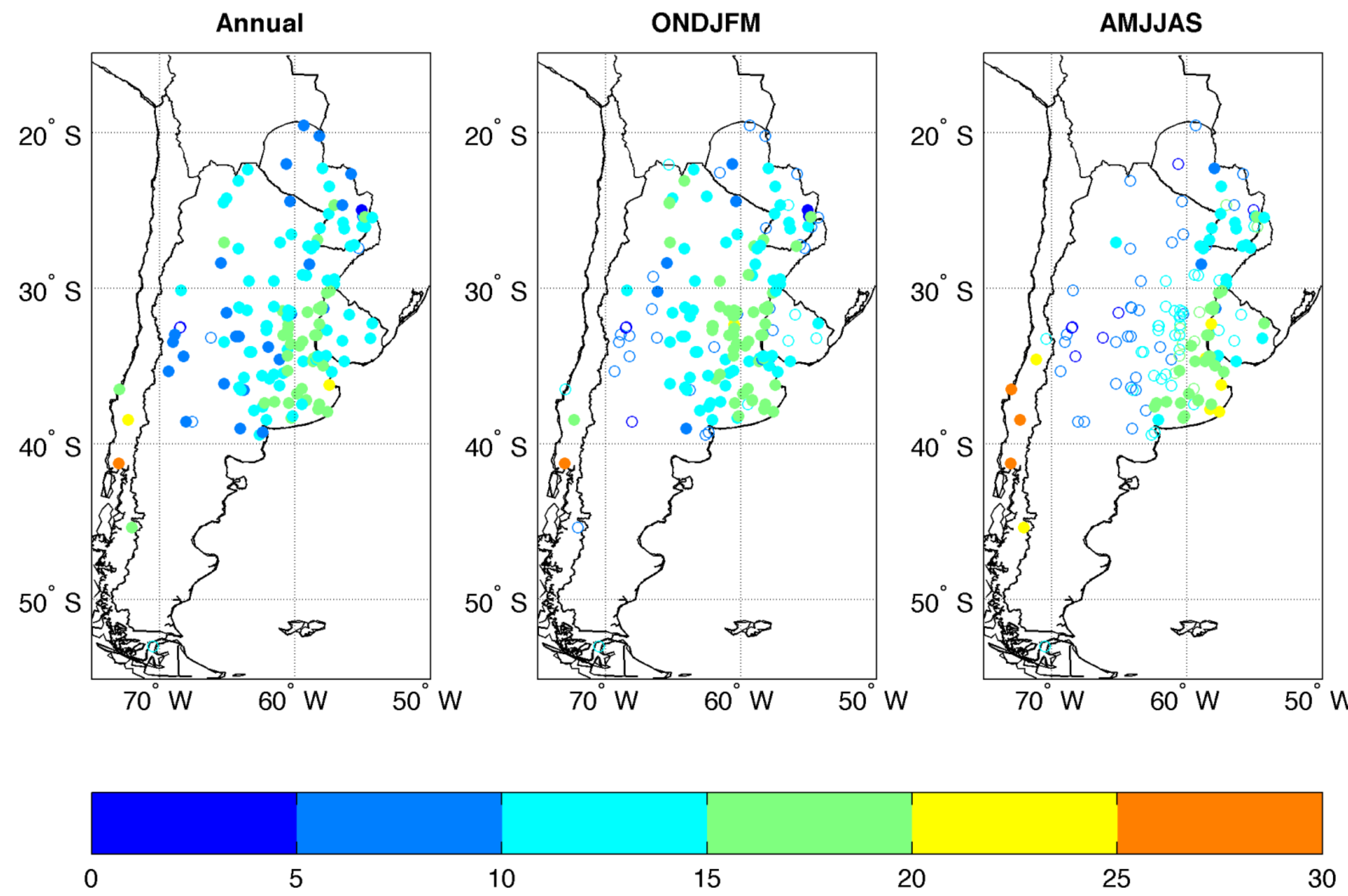
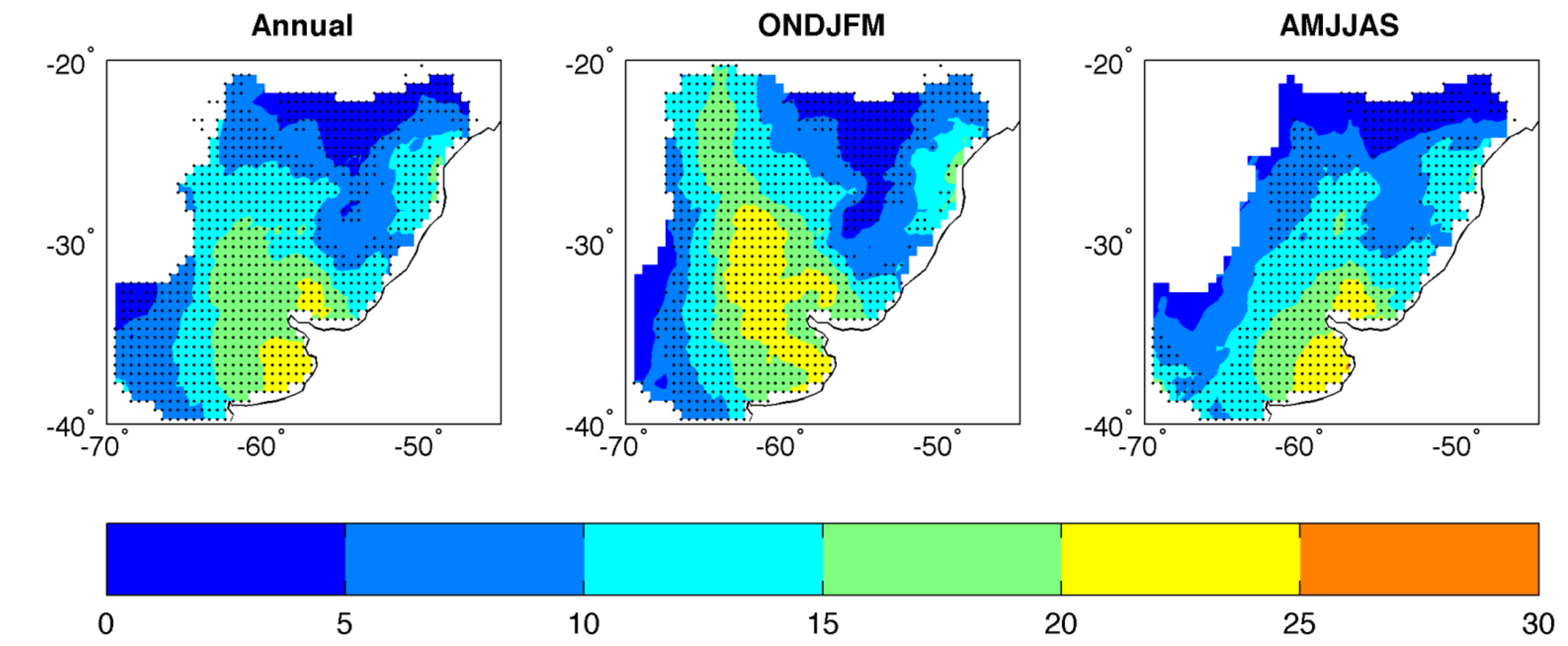


Figure 1. Percentage (%) of warm nights occurring simultaneously with heavy precipitation events per season based on OBSERVED data in the period 1971-2000. Filled symbols in the upper panel and dots in the lower panel indicate a significant relationship at the 5% level.



CLARIS LPB RCM simulations

Warm nights & heavy precipitation events

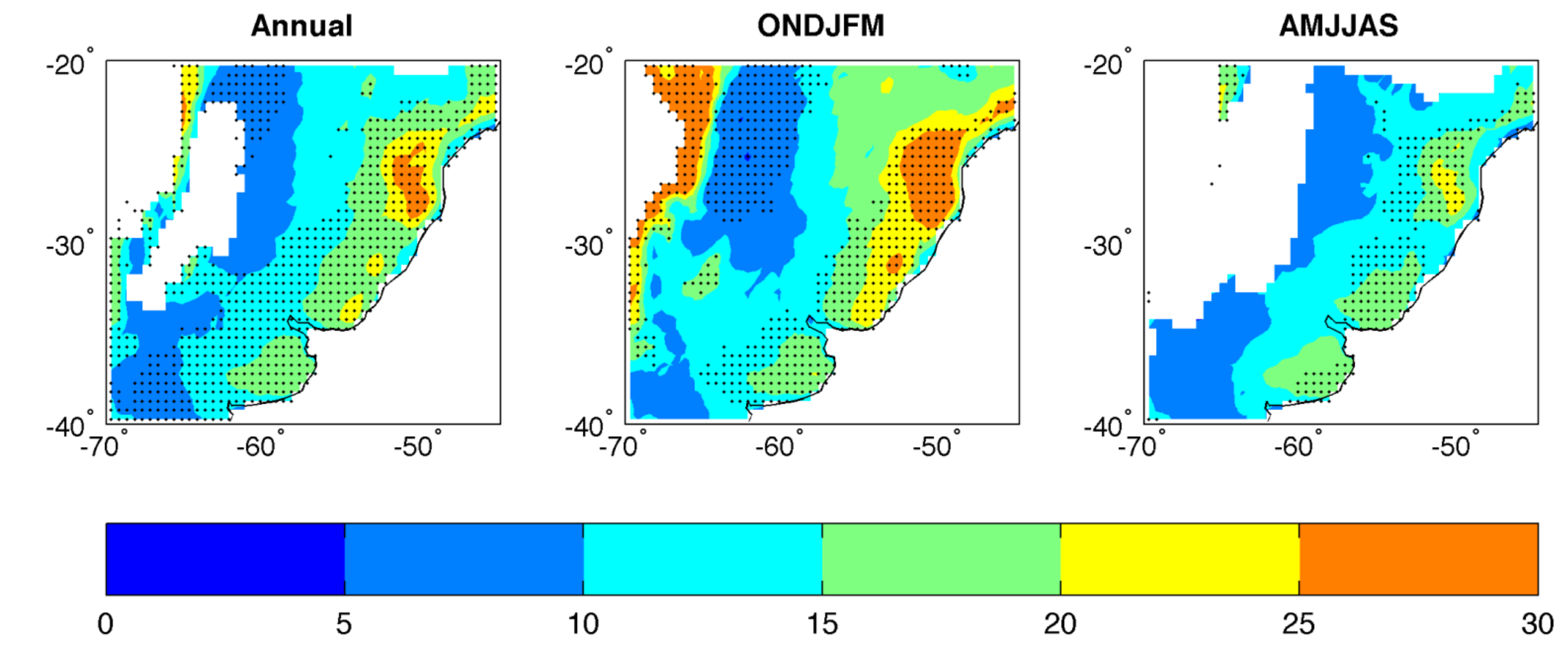


Figure 3. Percentage (%) of warm nights occurring simultaneously with heavy precipitation events per season based on an ensemble of 7 RCM simulations in the period 1990-2008. Dots indicate a significant relationship at the 5% level.

Cold days & heavy precipitation events

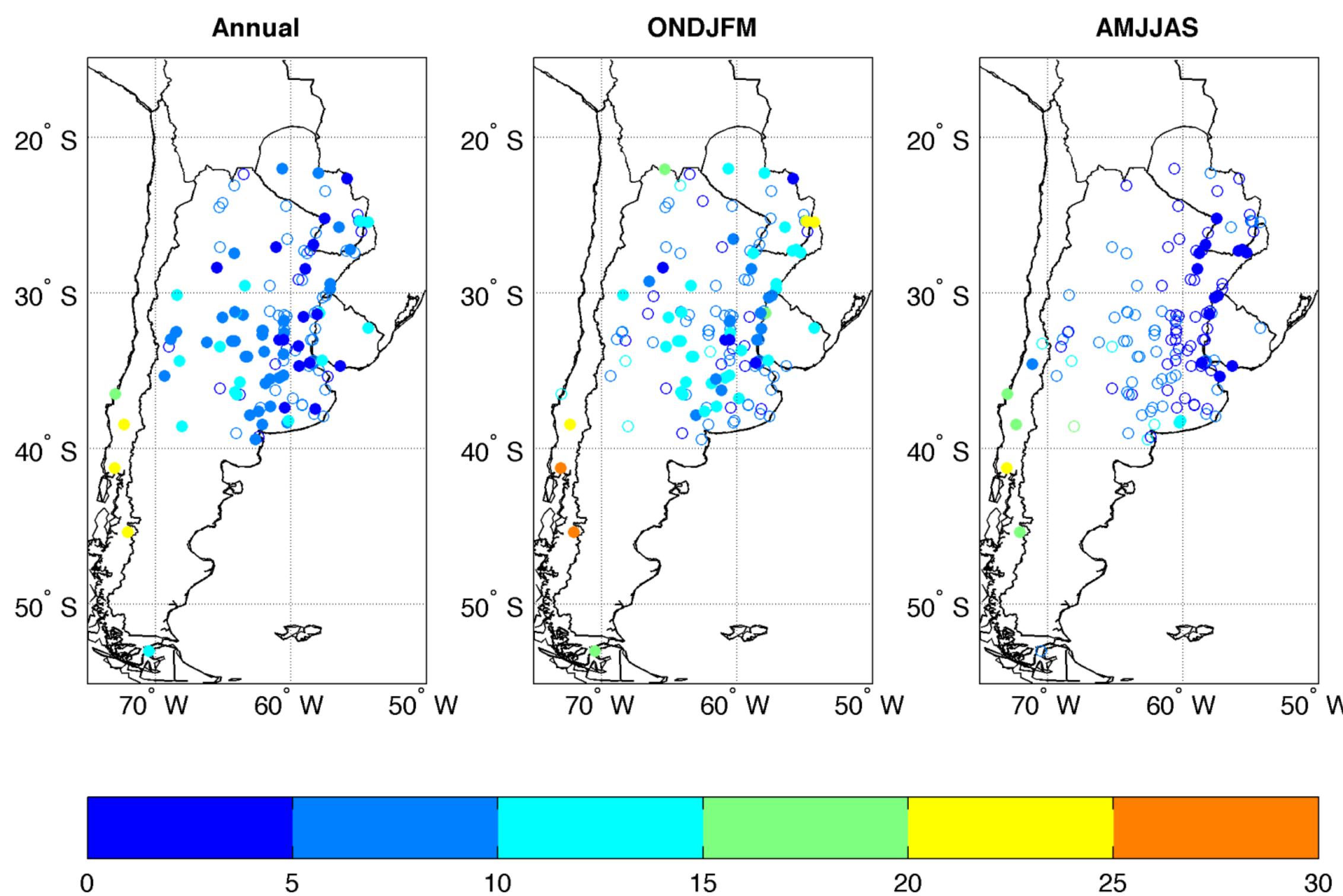
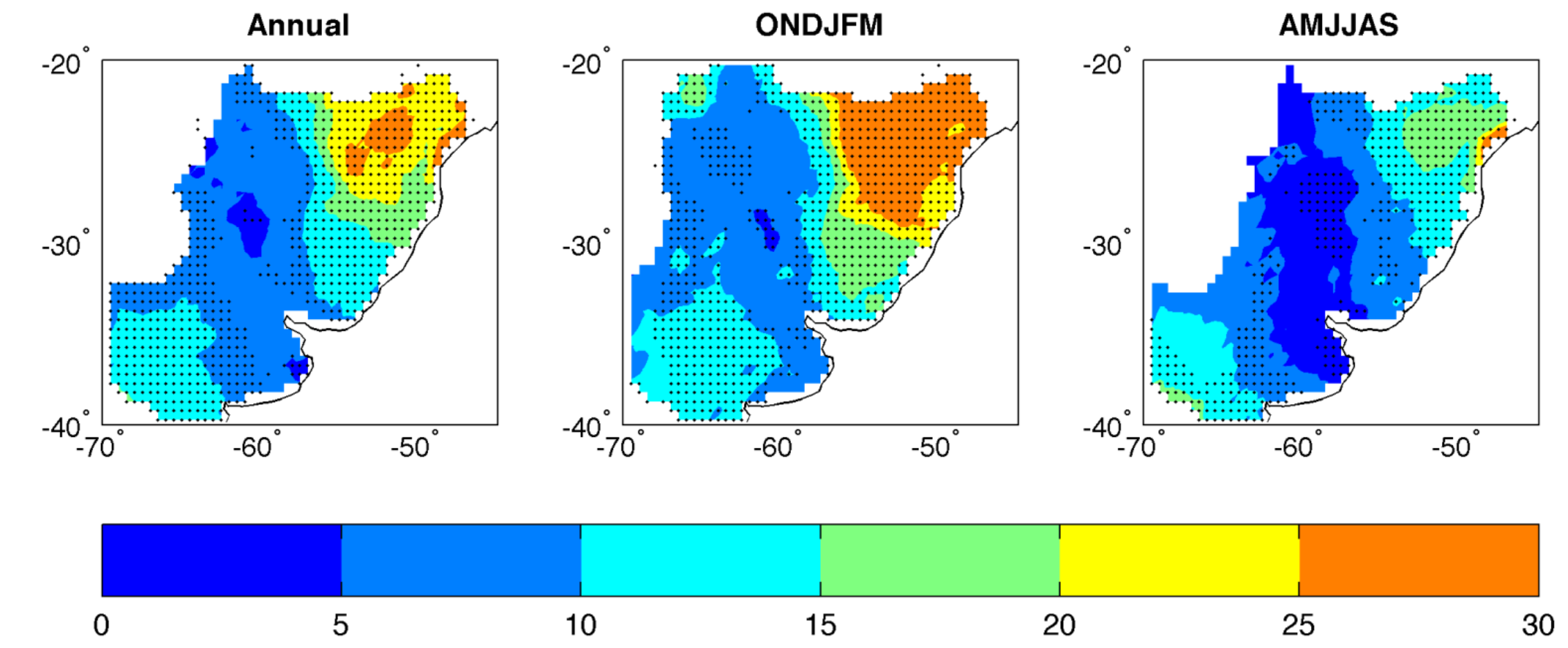


Figure 2. Percentage (%) of cold days occurring simultaneously with heavy precipitation events per season based on OBSERVED data in the period 1971-2000. Filled symbols in the upper panel and dots in the lower panel indicate a significant relationship at the 5% level.



Cold days & heavy precipitation events

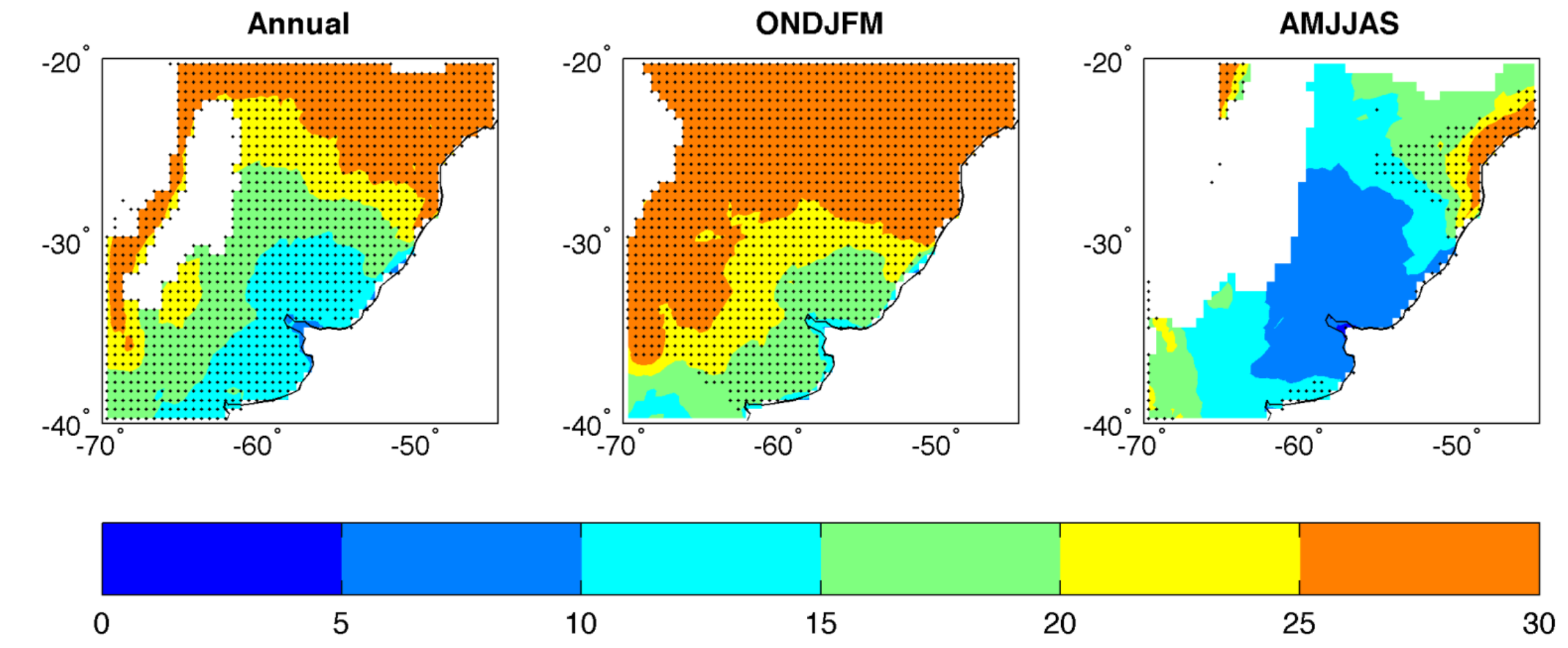


Figure 4. Percentage (%) of cold days occurring simultaneously with heavy precipitation events per season based on an ensemble of 7 RCM simulations in the period 1990-2008. Dots indicate a significant relationship at the 5% level.

Conclusions

- ✓ Warm nights and cold days are the temperature extremes more related to heavy precipitation events, with the strongest and more significant signal during the warm season.
- ✓ The strongest signal for warm nights and heavy precipitation events is found in the central part of the domain during the warm season and in south Chile in the cold season.
- ✓ Heavy precipitation and cold days are more frequent in south Chile and the northeast of the domain.
- ✓ When lagged, cold days occur more often on the day after a heavy precipitation event.
- ✓ RCMs are able to simulate a significative relationship between temperature and precipitation extreme events. However, while the spatial distribution of cold days and heavy precipitation is quite well captured, with stronger signal in the northeast and the coast of southern Brazil, warm nights are not very well represented.

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