Projected changes in precipitation, temperature and their extremes over tropical South America through the RegCM4

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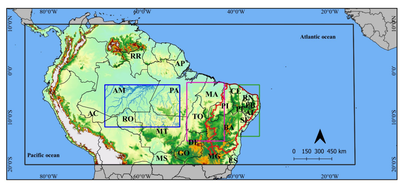
The problem

- The frequency and intensity of extreme events induced by global warming have increased significantly, causing impacts on the development of society and ecosystems [1];
- In this sense, the RegCM4.7, was run to produce simulations and projections based on low (RCP2.6) and high (RCP8.5) GHG emission scenarios;
- Besides evaluating the AV of RegCM4.7 in reproduce spatio-temporal features, this study attempts to answer the following question:

According to RegCM4.7, how will the climate crisis affect extreme events in TSA?

Experiment design

- Tropical South America (TSA) domain (Figure 1);
- ICTP RegCM4.7 regional climate model [2];
- HadGEM2-ES (CMIP5);
- 1986-2005 (Historical) and 2079-2099 (Projection);
- 25 km horizontal grid spacing;
- Model setup [3];
- Extreme climate indices (ETCCDI) [4];
- Model evaluation: climatology mean, added value and variability.



Results

Figure 2. MBE and AV maps of precipitation and temperature over TSA. Dots represent the statistical significance of Student's t-test at a 95% level.

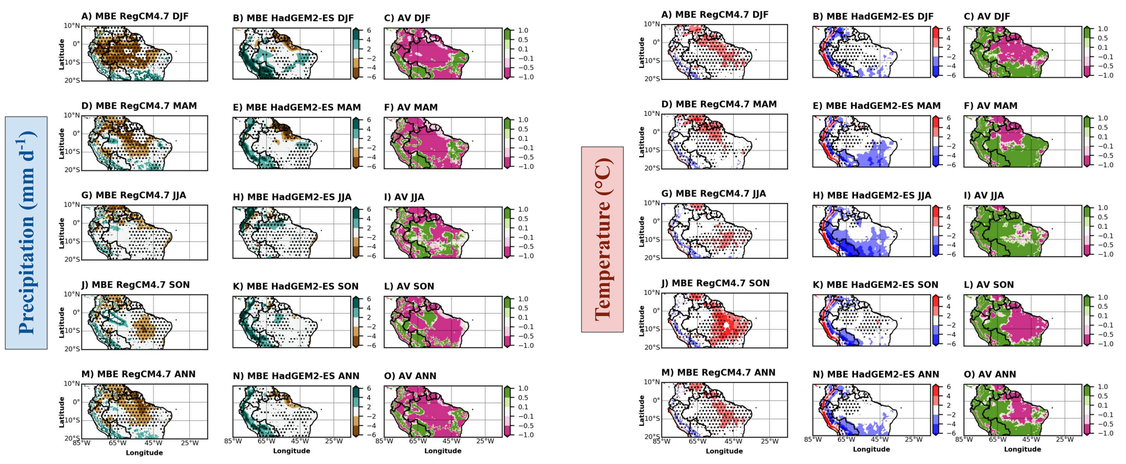


Figura 3. Hovmöller diagram for the annual cycle of the precipitation and temperature over the 80°W-15°W.

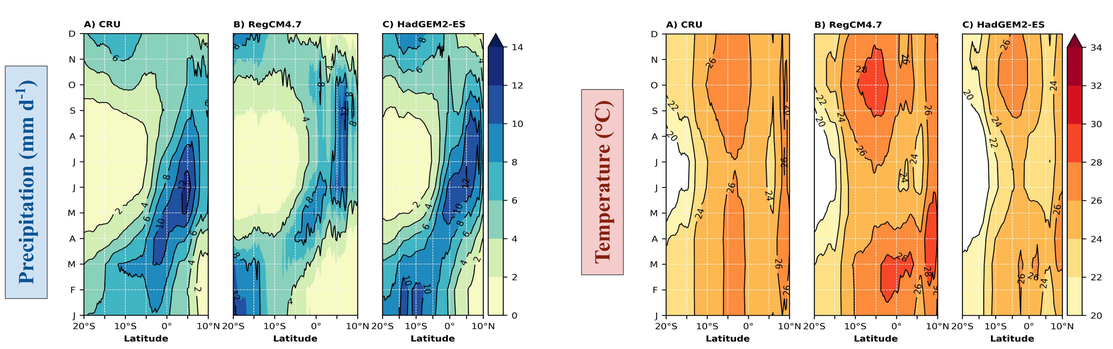


Figura 4. Annual cycle and Taylor diagram of precipitation and temperature for the TSA subregions: SAMZ, ENEB and MATOPIBA.

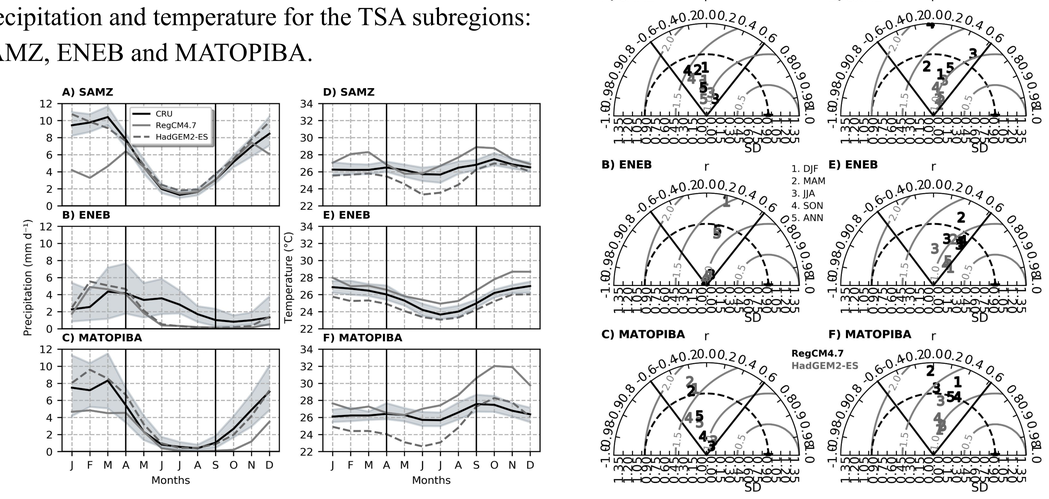


Figure 5. Spatial patterns of projected changes for precipitation (%) and Temperature (°C) in TSA. Dots represent the statistical significance of Student's t-test at a 95% level.

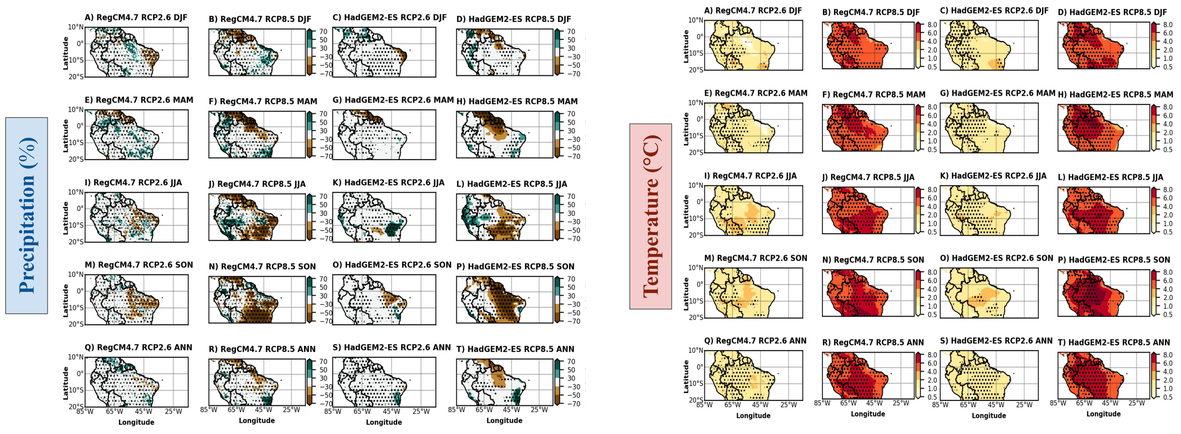


Figure 6. Spatial pattern of MBE and AV of the precipitation and temperature indices in TSA. The left panels are MBE of RegCM4.7, the middle panels are MBE of HadGEM2-ES, and the right panels are AV. Dots represent the statistical significance of Student's t-test at a 95% level.

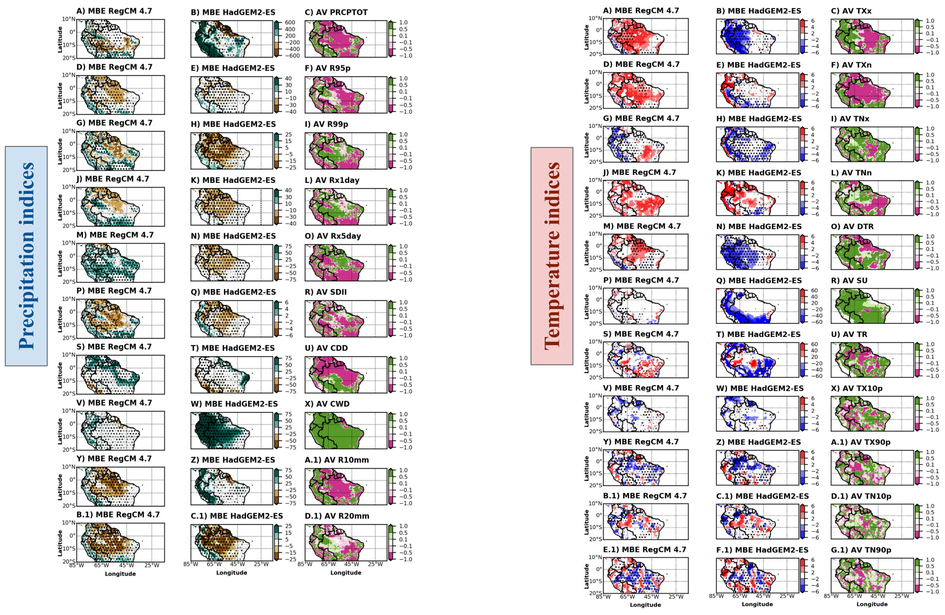


Figure 7. Spatial changes of precipitation and temperature indices in TSA for the period 2080-2099 with respect to the period 1986-2005. Dots represent the statistical significance of Student's t-test at a 95% level.

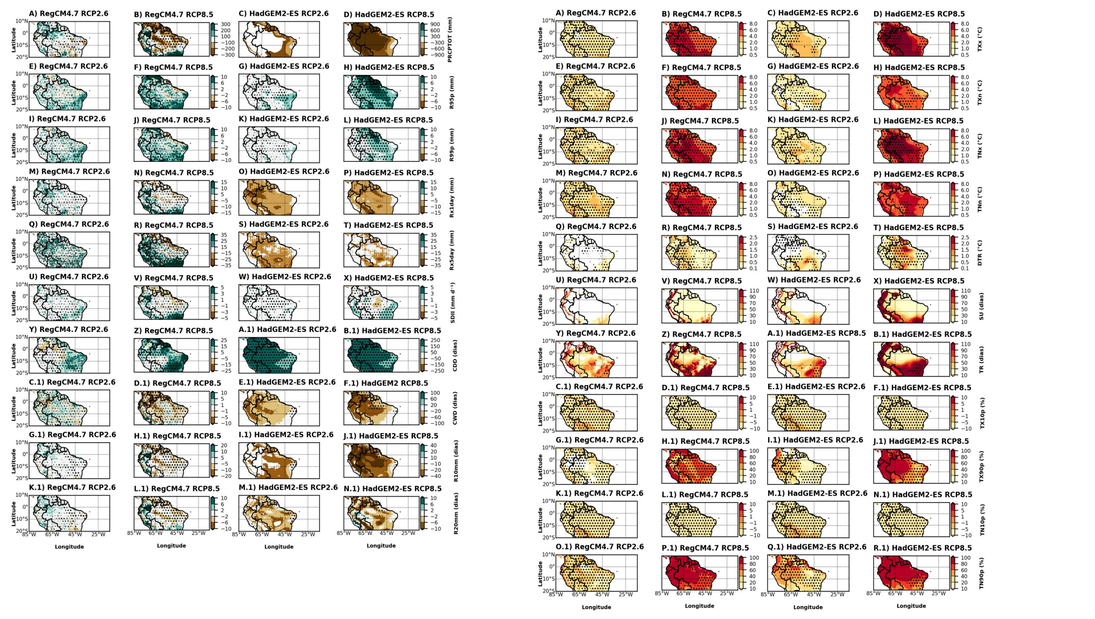
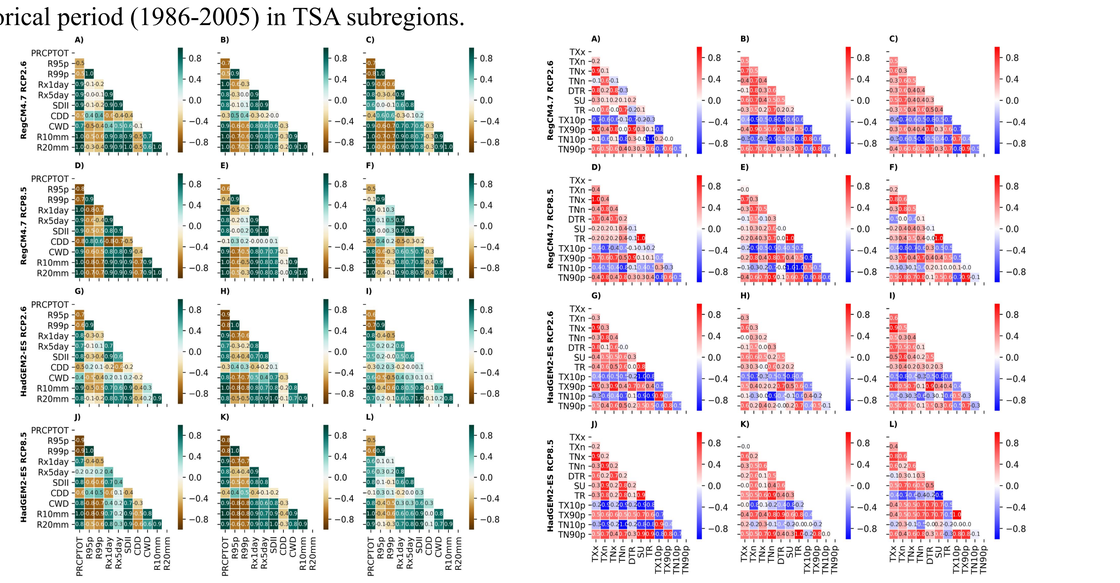


Figure 8. Relationships of precipitation and temperature indices between the far future (2080-2099) and the historical period (1986-2005) in TSA subregions.



Conclusions

- RegCM4.7 is capable of AV in the mean climate over NEB and part of the Andes. However, it does not adequately represent precipitation over the AMZ;
- The underestimation of precipitation in AMZ is a persistent feature of the regional climate models [3];
- Systematic errors of HadGEM2-ES were persisted by RegCM4.7;
- RegCM4.7 improves the projected changing patterns and modifies the precipitation signal in some cases. Both models project a higher temperature rise for RCP8.5. However, RegCM4.7 presents a more refined and realistic spatial distribution;
- Over the TSA, the magnitude and severity of climate change will increase by the end of the 21st century the frequency and intensity of extreme events.

References

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