Storyline Approach for the Evaluation of Near-Term Regional Climate Changes in southern South America

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Abstract

The precipitation variability in Southeastern South America (SESA) is naturally forced from interannual to multi-decadal time scales by the conditions of the tropical oceans through Rossby waves, that can in turn be reinforced or inhibited by the variability of the extratropical eddy-driven jet. The latter is also affected by the variability of the stratospheric polar vortex. In addition, these remote drivers (RDs) of regional circulation are affected by anthropogenic forcing. Uncertainty in the RD responses to anthropogenic forcing allows for a storyline description — namely, pathways of physically plausible climate changes — of RD responses in the recent past (1980-2020) and the near future (2020-2050). Here, we first use ERA5 reanalysis to develop a causal effect network (CEN) that quantifies causal relationships between tropical, extratropical and polar processes to explain how these can combine to give rise to regional circulation patterns associated with extreme low-frequency precipitation anomalies in SESA. To articulate the uncertainty in both the internal variability and the response to forcing of each RD we combine the CEN with storylines of recent past RD responses to forcings to provide different plausible attributions for recent past changes in the region. In a second step, storylines for the near-future RD responses to forcings are combined with interannual and multi-decadal variability to provide predictions of near-future decadal precipitation changes in SESA.

Keywords: storylines, causal discovery, south america, anthropogenic forcing

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