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Atmospheric circulation patterns and teleconnections over southern South America in CMIP5 GCMs

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Global Circulation Models (GCMs) are fundamental tools for climate studies and provide the initial information for the generation of regional climate change scenarios through dynamical and/or statistical downscaling. The basic assumption of applying downscaling methods is that the main drivers of local climate conditions are credibly simulated by GCMs. In this context, this study aims at evaluating the skill of a set of CMIP5 GCMs in representing circulation types and teleconnection patterns in Southern South America. To this end, we test the ability of GCMs to reproduce (a) sea level pressure patterns using several classification methods, including rotated principal component analysis in a T-mode, several implementations of cluster analysis, Jenkinson-Collison scheme, Lund's correlation method, and circulation prototypes, and (b) mid tropospheric (500 hPa) circulation in terms of teleconnection patterns (modes of low-frequency variability). Several reanalysis datasets are taken as reference: NCEP/NCAR, ERA-40, JRA-55, 20CRv2, and ERA-20C. The validation analysis for circulation types is performed in two domains, covering subtropical (20 - 40 S) and mid (40 – 60 S) latitudes of South America, and focuses on the frequency of occurrence of the types and their lifetime (persistence). The teleconnection patterns affecting southern South America, i.e. the Southern Annular Mode and two Pacific-South America patterns, are considered. We demonstrate that the rank of GCMs regarding their ability to simulate atmospheric circulation depends on the reference reanalysis and the classification method used. Therefore, we recommend that for a fair assessment of atmospheric circulation in GCMs, multiple classifications and multiple reference datasets (reanalyses) are required.