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Mid-Holocene PMIP3 simulated precipitation in South America compared to a multiproxy data compilation

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One of the main concerns associated to the undergoing changes in climate is related to our ability to make future climatic projections as reliably as possible. This is an issue of utmost importance for planning and implementing adaptation and mitigation policies. Climate model simulations are important tools to understand these projected changes. However, they cannot reproduce reality perfectly, either because of poor and scarce observed background fields or by imperfect dynamical description of physical mechanisms. One of the possible solutions to this problem is to use proxy records to validate model results by comparison. Here we compare precipitation conditions inferred from proxy records with paleo-climate model results for the mid-Holocene (7,000 – 5,000 years Before Present, B. P.) in South America. The mid-Holocene is characterized by different than present orbital parameters, which caused changes in seasonality so that mid-Holocene southern hemisphere summers received less insolation if compared to Present-day summers, and vice-versa. Different mid-Holocene simulated mean precipitation fields from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) and third phase of Palaeoclimate Modelling Intercomparison Project (PMIP3) were compared to a South America multiproxy data compilation (0°-40°S; 10°-60°W). The used model outputs correspond to the experiments performed with the IPSL-CM5 (Institut Pierre-Simon Laplace – Coupled Model version 5, France), MIROC-ESM (Model for Interdisciplinary Research on Climate – Earth System Model, Japan) and NCAR-CCSM4 (National Center for Atmospheric Research Coupled Climate Model version 4, USA). CO_2 values were the same for both mid-Holocene and Pre-industrial simulations. Mid-Holocene annual precipitation anomalies were calculated by subtracting the Pre-industrial values from the mid-Holocene annual climatology. The multiproxy data compilation was derived from 92 studies, which included pollen assemblies, stable isotope analyses in foraminifers and speleothems, soil geochemistry, lake sediments and others. Paleodata were classified semi-quantitatively, according to their age model and sampling resolution. Proxy data characterizes a drier Southern Brazil and South Atlantic Convergence Zone (SACZ) axis if compared to modern conditions, but a wetter/similar to present Northeastern Brazil. This could correspond to a weaker South America Monsoon (SASM) System during the mid-Holocene if compared to the modern strength of the SASM. The analyzed model simulations could reproduce a similar pattern, with a southward shift of the Intertropical Convergence Zone, related to a weaker South Atlantic Subtropical High, and negative annual precipitation anomalies over the SACZ area. Nevertheless, regional differences between the analyzed models were clearly observed. CCSM4 shows a similar to present SACZ, while MIROC-ESM shows a similar to present Southern Brazil climate. All other features reproduced by the models are similar to those reconstructed by the paleodata. Based on our comparison, we conclude that the mid-Holocene output from the IPSL-CM5 has the simulation which better fits with our multiproxy data compilation.