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Statistical downscaling for paleo-precipitation in southeastern Patagonia

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We use statistical downscaling models to estimate local precipitation in southeastern Patagonia for the Mid-Holocene (7 ka BP – 4.5 ka BP) from large-scale atmospheric circulation simulated with a GCM. This is important to overcome the scale mismatch between local proxy data and GCM model output. The basis of our analysis are two transient simulations for the Mid-Holocene, one with only orbital forcing, the other with additional solar and greenhouse gas forcing. These are compared to a pre-industrial quasi-equillibrium simulation. For downscaling purposes we use principal component regression analysis. In a first step we setup statistical models for the different seasons based on reanalysis sea level pressure (SLP) and observed precipitation in the second half of the 20^{th} century. These models are then used to downscale the simulated SLP during the Mid-Holocene. In the setup of the downscaling models emphasis was given to the physical plausibility of the regression models, since we want to apply the statistical relationships in a climate supposedly significantly different from present-day conditions. Due to the simplicity of our downscaling models and the climatic conditions in southeastern Patagonia the skill in an independent validation period is only moderate. When the downscaling models are applied to the GCM output, the estimated precipitation in southeastern Patagonia is higher during the Mid-Holocene in March to August and reduced during September to February compared to the pre-industrial period. This result is evident in both Mid-Holocene simulations. At decadal to centennial time-scales, however, also differences in precipitation among the two Mid-Holocene simulations are evident.