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Relative influence of soil moisture and SST on climate variability within ensembles of AMIP-type simulations.

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Three ensemble of AMIP-type simulations using the Arpege-Climat coupled land-atmosphere model have been designed to assess the relative influence of SST and soil moisture on climate variability and predictability. The study takes advantage of the GSWP2 land surface reanalysis covering the 1986-1995 period. The GSWP2 forcings have been used to derive a global soil moisture climatology that is fully consistent with the model used in this study. One ensemble of 10 atmospheric simulations has been forced by climatological SST and the simulated soil moisture is relaxed toward the GSWP2 reanalysis. Another ensemble has been forced by observed SST and soil moisture is evolving freely. The last ensemble combines the observed SST forcing and the relaxation toward GSWP2.

First, an analysis of variance has been used to compare the effects of the SST and soil moisture boundary forcings on the variability and potential predictability of near-surface temperature and precipitation. While in the tropics SST anomalies clearly maintain a potentially predictable variability throughout the seasonal cycle, in the mid-latitudes the SST forced variability is only dominant in winter and soil moisture plays a leading role in summer. The seasonal cycle of the hindcast skill has been also evaluated against available observations and indicates that soil moisture is supporting a significant part of the skill in the summer mid-latitudes. Focusing on boreal summer, we have investigated different aspects of the soil moisture and SST contribution to climate variations in terms of spatial distribution and time-evolution. A particular attention has then been paid to two contrasted cool/wet and warm/dry years over North America and Europe. Our model results suggest that, while the SST forcing is necessary for a realistic representation of the large-scale atmospheric circulation, soil moisture is also likely to contribute to the predictability of summer climate anomalies in these regions.