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Characterizing and understanding the climatic determinism of high- to low-frequency variations in precipitation in northwestern France using a coupled wavelet multiresolution/statistical downscaling approach

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Geophysical signals oscillate over several time-scales that explain different amount of their overall variability and may be related to different physical processes. Characterizing and understanding such variabilities in hydrological variations and investigating their determinism is one important issue in a context of climate change, as these variabilities can be occasionally superimposed to long-term trend possibly due to climate change. It is also important to refine our understanding of time-scale dependent linkages between large-scale climatic variations and hydrological responses on the regional or local-scale. Here we investigate such links by conducting a wavelet multiresolution statistical dowscaling approach of precipitation in northwestern France (Seine river catchment) over 1950-2016 using sea level pressure (SLP) and sea surface temperature (SST) as indicators of atmospheric and oceanic circulations, respectively. Previous results demonstrated that including multiresolution decomposition in a statistical downscaling model (within a so-called multiresolution ESD model) using SLP as large-scale predictor greatly improved simulation of low-frequency, i.e. interannual to interdecadal, fluctuations observed in precipitation. Building on these results, continuous wavelet transform of simulated precipiation using multiresolution ESD confirmed the good performance of the model to better explain variability at all time-scales. A sensitivity analysis of the model to the choice of the scale and wavelet function used was also tested. It appeared that whatever the wavelet used, the model performed similarly. The spatial patterns of SLP found as the best predictors for all time-scales, which resulted from the wavelet decomposition, revealed different structures according to time-scale, showing possible different determinisms. More particularly, some low-frequency components ($\sim$3.2-yr and $\sim$19.3-yr) showed a much wide-spread spatial extentsion across the Atlantic. Moreover, in accordance with other previous studies, the wavelet components detected in SLP and precipitation on interannual to interdecadal time-scales could be interpreted in terms of influence of the Gulf-Stream oceanic front on atmospheric circulation. Current works are now conducted including SST over the Atlantic in order to get further insights into this mechanism.