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The annual cycle of the climate change signal – An improved method for use in impact studies

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Accurate runoff simulations for climate change scenarios are crucial for decision makers to establish appropriate response strategies for potentially increased risks of floods or low flow periods. An important step in such simulations is the downscaling of hydrometeorological information from a low-resolution climate model to a hydrological runoff model with the requirement of high spatial resolution. The "delta change method" combined with a spatial interpolation is a simple statistical downscaling method that has widely been used for this purpose. The delta change signal is defined as the mean difference or quotient of a variable (such as temperature or precipitation) between scenario and control periods. It is usually calculated for fixed monthly or seasonal periods, and the choice of these periods is to some extent arbitrary. Here we analyze the associated implications and present an alternative formulation. Specific consideration is given to the annual cycle of temperature and precipitation to the north of the Alps.

To begin with, the delta change signal is derived using a moving window with a length of 90 days. Results reveal a noisy signal, on the grid point level but also in an aggregated domain along the northern Alpine ridge. This provides evidence that the average delta change signal for a specific month or season depends upon the partly arbitrary choice of the time window, as moving the averaging window by a few days substantially affects the amplitude of the delta change signal.

We have developed a method to extract reliable information out of the noisy annual delta change signal produced by the moving average, which is based on spectral analysis. The reasoning behind this methodology is in principle applicable to other downscaling methods.