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How does natural climate variability on decadal timescales affect timeseries analysis?

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The world meteorological organization (WMO) defined the classical length of climate analysis to be 30 years. Even if this definition allows the uniformity of climate studies, such 30 years period might not be appropriate for different reasons. One example is the presence of non-stationary processes in a time-serie such as the solar cycle or the NAO. Another example is the computational constraints inherent to convection resolving climate simulation that often results in shorter time period integrations. To identify the minimum length required for climate integrations, it is essential to know the uncertainty related to the natural climate variability.

The objective of this study is to assess this uncertainty of using a time-limited period for climate analysis with an application to precipitation in Belgium. The precipitation weather generator approach is used for the production of synthetic time-series from which the time-average and the return value are derived. The weather generator integrates three main components, i) a 5th order Markov that models the occurrence of dry, wet and extremely wet days, ii) a gamma generalized linear model that reproduces the amplitude of wet events and iii) a gamma Pareto generalized linear model that reproduces the amplitude of extreme events. These three models use quasi-periodic signal derived from an empirical mode decomposition analysis, as predictors to reproduce cycle signal such as solar cycle, NAO, ENSO, etc... From these models 10000 synthetic time-series are produced allowing the derivation of the uncertainty of the time-averaged and the return value of precipitation.

This method has been applied to evaluate the uncertainty related to natural climate variability over a 10 years period. It was found that it represents 10% and 20% of respectively the time-averaged and the return value of daily precipitation in Belgium.