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Describing temporal variability of the mean Estonian precipitation series in climate time scale

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Applicability of the random walk type models to represent the temporal variability of various atmospheric temperature series has been successfully demonstrated recently (e.g. Kärner, 2002). Main problem in the temperature modeling is connected to the scale break in the generally self similar air temperature anomaly series (Kärner, 2005). The break separates short-range strong non-stationarity from nearly stationary longer range variability region. This is an indication of the fact that several geophysical time series show a short-range non-stationary behaviour and a stationary behaviour in longer range (Davis et al., 1996). In order to model series like that the choice of time step appears to be crucial. To characterize the long-range variability we can neglect the short-range non-stationary fluctuations, provided that we are able to model properly the long-range tendencies. The structure function (Monin and Yaglom, 1975) was used to determine an approximate segregation line between the short and the long scale in terms of modeling. The longer scale can be called climate one, because such models are applicable in scales over some decades. In order to get rid of the short-range fluctuations in daily series the variability can be examined using sufficiently long time step.

In the present paper, we show that the same philosophy is useful to find a model to represent a climate-scale temporal variability of the Estonian daily mean precipitation amount series over 45 years (1961-2005). Temporal variability of the obtained daily time series is examined by means of an autoregressive and integrated moving average (ARIMA) family model of the type (0,1,1). This model is applicable for daily precipitation simulating if to select an appropriate time step that enables us to neglet the short-range non-stationary fluctuations. A considerably longer time step than one day (30 days) is used in the current paper to model the precipitation time series variability. Each ARIMA (0,1,1) model can be interpreted to be consisting of random walk in a noisy environment (Box and Jenkins, 1976). The fitted model appears to be weakly non-stationary, that gives us the possibility to use stationary approximation if only the noise component from that sum of white noise and random walk is exploited. We get a convenient routine to generate a stationary precipitation climatology with a reasonable accuracy, since the noise component variance is much larger than the dispersion of the random walk generator. This interpretation emphasizes dominating role of a random component in the precipitation series. The result is understandable due to a small territory of Estonia that is situated in the mid-latitude cyclone track.

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