4. Posterior distributions of the parameters

We assume that the non-informative distribution of $\theta$ is $\theta \sim \mathcal{U}(0,1)$

The posterior distribution of $\theta$ does not have a closed form. It is usually
shown (see also Falkner and Ferando, 2007) for some models and for
Kassambara et al., 2011) the non-informative distribution $\theta^2 \sim \mathcal{U}(0,1)$

Additionally, the widest confidence regions are wider.

5. Posterior predictive distributions

We define $\mathcal{L}(y_{n+1} | \theta) = q_{n+1} | \theta$ where $q_{n+1} \sim \mathcal{L}(y_{n+1} | \theta)$

The posterior predictive distribution $\mathcal{L}(y_{n+1} | \theta)$ is given by

$\mathcal{L}(y_{n+1} | \theta) = \int f(y_{n+1} | \theta, \alpha) \pi(\theta, \alpha) \, d\alpha$,

where $\pi(\theta, \alpha)$ is the prior distribution of $\theta$ and $\alpha$.

For a first-order autoregressive (AR(1)) stochastic process, the ACT is given by

$\rho_y = 0.8, 0.9, 0.95, 0.99, 0.999$ (1)

For a Hurst-Kolmogorov (HK) stochastic process, the ACT is given by

$\rho_y = 0.8, 0.9, 0.95, 0.99, 0.999$ (2)

6. Climatic variable of interest

Following the framework by Kassambara et al., 2011) we define the climatic variable of interest to be the 30-year moving average as follows:

$\mathcal{L}(y_{n+1} | \theta) = \int f(y_{n+1} | \theta, \alpha) \pi(\theta, \alpha) \, d\alpha$

To calibrate the distribution of this variable, we first simulate from (6) (13) and then use the posterior samples (13) to simulate from (9) (13). We examine the following output:

- White Noise.
- AR(1).
- AR-ARCH behavior of AR(1) $\rho_y = 0.8$.
- AR-ARCH behavior of AR(1) $\rho_y = 0.9$.
- AR-ARCH behavior of AR(1) $\rho_y = 0.95$.
- AR-ARCH behavior of AR(1) $\rho_y = 0.99$.
- AR-ARCH behavior of AR(1) $\rho_y = 0.999$.

7. Posterior probability distributions for the AR(1) and HK parameters for the Boeoticos Kephisos river basin

8. Posterior probability distributions for the AR(1) and HK parameters for the temperature at Berlin and Vienna

9. Hydroclimatic prognosis for the Boeoticos Kephisos river basin

10. Hydroclimatic prognosis for temperature at Berlin and Vienna

11. Hydroclimatic prognosis for Berlin and Vienna, excluding historical data from last 30 years

12. Conclusions

- We developed a Bayesian statistical methodology to enable hydroclimatic prognosis in terms of estimating future confidence regions on the basis of a stationary stochastic process.
- We applied this methodology to five cases, namely the runoff, the rainfall and the temperature at Boeoticos Kephisos river basin, as well as the temperature at Berlin and Vienna.
- We derived the posterior distributions of the parameters of the models. It turned out that when we look into account the Hurst-Kolmogorov behaviour of the examined process, the confidence regions of the parameters become wider.
- This resulted in a wider confidence region for the 30-year moving average, which represents a climatic variable.
- In all cases the HK model seemed to work well. WN and AR(1) did not seem to capture the variability.
- In one case, when we excluded the last 30 years of the data set of the Vienna temperature, it seemed that due to the increase of temperature in last decade, the model did not work well. But when we examined the full data set, the behaviour in last 30 years did not appear extraordinary.