# Assessing RegCM's Performance in Simulating Drought: A Case Study for Hungary

**Tímea Kalmár** [1,2], **Rita Pongrácz** [1]

[1] *ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Meteorology, Budapest, Hungary*
[2] *Institute of Atmospheric Physics of the Czech Academy of Sciences, Prague, Czech Republic*

Drought is increasingly a worldwide problem due to global climate change. As drought increases in intensity and duration, it can lead to major consequences, making it one of the costliest natural hazards. Hungary, located in Central-Eastern Europe, has already experienced multiple droughts that have caused substantial damage, as nearly 55% of its land is used for agriculture. The driest year was 2011 since 1901, when the annual precipitation in Hungary was only 72% of the climatological normal [1].

To better understand drought and to provide information for adaptation strategies and risk-management systems, there is a strong need for a methodological framework to simulate drought events. However, it is uncertain whether climate models can simulate extreme droughts given the well-known model bias of simulating too light rainfall too frequently [2]. Therefore, the aim of this study is to investigate how different model settings affect the reproduction of drought characteristics.

To quantify the impact of the use of different parameterization schemes on regional climate model outputs, hindcast experiments were completed applying RegCM4.7 to Central and Eastern Europe at 10-km horizontal resolution using ERA-Interim reanalysis data as initial and boundary conditions. In this study, we tested various combinations of the physics schemes (land surface, microphysics, cumulus and planetary boundary layer schemes) for the year 2011. Each parameterization combination leads to different simulated climates, so their spread is an estimate of the model uncertainty arising from the representation of the unresolved phenomena. The present study focuses on the quantification of the use of the four groups of parameterization schemes and their combinations on RegCM outputs in capturing the unique characteristics of drought as well as to provide insights into the mechanisms driving drought formation in the region.

The results indicate that RegCM is the most sensitive to the applied convection scheme, but the interactions with the other schemes (e.g., land surface or microphysics) also affect the precipitation. Due to the different treatment of moisture in the schemes, there are differences not only between the representation of the precipitation cycle, but also in other climatological variables such as soil moisture, latent and sensible heat fluxes, and cloud cover, which all affect the drought characteristics. The results also show that the effect of each group of parameterization schemes depends on the seasons.

[1] Szentes, O., Lakatos, M., Pongrácz, R. *Int. J. Climatol.* **43**(10), 4457-4471. (2023).
[2] Maraun D. *J. Clim*. **26**, 2137–2143. (2013).