



## **Estimates of the sequence of precipitation states in the Danube Basin for the 21st century, by a statistical downscaling procedure based on NHMM**

Constantin Mares (1), Ileana Mares (2), and Mihaela Mihailescu (3)

(1) National Institute of Hydrology and Water Management, Bucharest, Romania (constantin\_mares\_ro@yahoo.com), (2) Institute of Geodynamics, Romanian Academy, Bucharest, (3) Agricultural University, Bucharest, Romania

In the Danube lower basin, the highest discharges are recorded in spring months. Precipitation in the Danube upper and middle Basin are the main indicators for the Danube discharge at the entry in the lower basin. The best links of the spring discharges in the lower basin are with the winter precipitation from 15 stations situated especially in the middle Danube basin.

In the first stage, we focused on finding some robust predictors from the sea level pressure (SLP) for precipitation in winter, and then by a statistical downscaling procedure we have obtained precipitation estimation for 21 st century.

We have identified a new atmospheric index called Greenland-Balkan-Oscillation-Index (GBOI) that has a great impact on precipitation in the Danube basin (mainly middle and lower) in winter. Simultaneous correlations (0.75-0.84), stable for two series of 42-yr, with high level of significance were found between GBOI and the first temporal component of the decomposition in the Empirical Orthogonal Functions of precipitation (PC1-PP). This link is much closer than with other large-scale phenomena such as the North Atlantic Oscillation.

Using the simulations by the HADGEM1 model (scenario A1B, stream 1), a stochastic modeling was performed between GBOI and PC1-PP by means of a nonhomogeneous hidden Markov model (NHMM) with three states.

Using probabilistic relation between PC1-PP and GBOI in the 20th century, and modifying GBOI simulated by HADGEM1 for two periods in the 21st century, we obtained an estimate of precipitation in the 21st century.

For the normal state of precipitation, in both periods in the 21st century, the occurrence probability of this state is lower than that for the 20th century. For the state indicating a deficit of precipitation, the occurrence probability of this state in the 21st century (especially in the first period) is much higher than in the 20th century. The state representing precipitation in excess occurs with lower probabilities in the 21st century than in the 20th century.