

Factors Influencing the Regional Climate Variability of the South-Eastern Europe

Tsvetelina Velichkova¹, Natalya Kilifarska¹, Antonia Mokreva¹

¹Climate, Atmosphere and Water Research Institute at Bulgarian Academy of Sciences, Sofia,
Bulgaria

E-mail: tsvetelinavelichkova@abv.bg; natalyakilifarska@gmail.com; antmokreva@gmail.com

Abstract

This study investigates the primary factors influencing regional climate variability in South-Eastern Europe, focusing on the role of the North Atlantic Oscillation (NAO) and its internal and external drivers. The analysis considers the impacts of the lower stratospheric ozone, geomagnetic field variations, solar activity, galactic cosmic rays (GCR), and atmospheric CO₂. By applying both linear and nonlinear Artificial Neural Networks (ANNs) statistical methods, the study identifies ozone and geomagnetic variability as the most influential factors shaping NAO behaviour over the last century.

The working hypothesis, considering the mechanism of the above factors on NAO variability, suggests that changes of the geomagnetic field modulate cosmic ray fluxes, which in turn affect ozone production near the tropopause. Resulting ozone variations influence atmospheric temperature and moisture structure, contributing to changes in surface pressure and indirectly affecting climate conditions in South-Eastern Europe through the NAO-related dynamics.

In addition to pressure anomalies, NAO phase shifts are accompanied by distinct changes in wind circulation over the region, influencing the transport of heat and moisture. While not part of the underlying mechanism, these wind changes reflect the broader impact of NAO variability on the regional climate.

Keywords: *North Atlantic Oscillation, South-Eastern Europe, stratospheric ozone, geomagnetic field, climate variability*