EMS Annual Meeting Abstracts
Vol. 20, EMS2023-204, 2023, updated on 10 Oct 2023
https://doi.org/10.5194/ems2023-204
EMS Annual Meeting 2023

Understanding the variability of 7Be surface concentrations in Europe: the role of teleconnection patterns

Miguel Ángel Hernández-Ceballos[1], **Jelena Ajtić**[2], and Erika Brattich[3]
[1]Department of Physics, University of Cordoba, Rabanales Campus, 14071, Cordoba, Spain
[2]Faculty of Veterinary Medicine, University of Belgrade, Bulevar oslobođenja 18, 11000, Belgrade, Serbia
[3]Department of Physics and Astronomy "Augusto Righi", Alma Mater Studiorum University of Bologna, via Irnerio 46, 40126, Bologna (BO), Italy

The temporal and spatial variability of atmospheric compounds and pollutants is largely driven by a combination of local, mesoscale and synoptic meteorological conditions influencing atmospheric processes, such as horizontal and vertical dispersion, deposition, chemical reactions rates and velocity. At the same time, different anthropogenic and natural radionuclides have long been used as tracers to understand and describe surface and atmospheric processes and their influence on transport and deposition. Among these substances, ^{7}Be, a cosmogenic radionuclide produced by spallation reactions in the stratosphere and upper troposphere, is frequently used as tracer of different atmospheric processes**.** Many studies have reported how the variability of ^{7}Be surface concentration is driven by the movement of air masses, atmospheric deposition processes, tropospheric vertical mixing, and the vertical exchange between the stratosphere and the troposphere.

With an aim to elucidate the influence of teleconnection and tropospheric circulation dynamics, several studies have investigated the influence of the main modes of large scale and regional climate variability in Europe, such as North Atlantic Oscillation (NAO), Arctic Oscillation (AO), East Atlantic (EA), East Atlantic/Western Russia (EA/WR), Scandinavian pattern (SCAND), and Western Mediterranean Oscillation (WeMO) on the surface ^{7}Be activity concentrations. This paper, in particular, presents a summary of recent results achieved by our team working on this topic, focusing firstly at the European scale and then to northern Europe.

Analysing ^{7}Be surface concentrations measured at 15 European sampling stations over 2005–2014 and combining the calculation of air mass trajectories and cluster analysis with time series of teleconnection indices, we found that extremely high values of the ^{7}Be surface concentrations are largely connected with the negative phase of NAO and We-MO, and with the positive EA phase. These results showed a latitudinal division between the northern and southern sites, with a similar influence of teleconnection patterns, while the sites located in the central part of Europe present a larger variability in the impact of teleconnection patterns. A detailed analysis in northern Europe revealed that extreme ^{7}Be surface concentrations observed during winter were associated with variability of the Arctic polar vortex and linked with high values of the SCAND index.

The findings provide a classification of meteorological conditions associated with high surface ^{7}Be concentrations and thus offer a basis for forecasting these events. In a general view, the findings also help in understanding the seasonal and inter-annual atmospheric variability at different scales and its impact on airborne concentrations of radionuclides and pollutants.