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Multiple cascading effects in freshwater ecosystems: from atmospheric modes to interannual plankton fluctuations

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In the past two decades there has been an increasing use of teleconnection indices based on different climatic patterns in order to understand the mechanisms linking weather and temporal changes in ecosystems. Many investigations showed a strong impact of the North Atlantic Oscillation (NAO) on the air temperatures and atmospheric precipitation over large areas of the northern hemisphere in winter. In southern Europe, further studies confirmed a causal connection between NAO and precipitation, whereas the relationships between NAO and temperatures appeared not always of general value. The first studies carried out in Lake Garda proved how the winter NAO had only a slight, non-significant influence on the winter climate and water temperatures at maximum spring overturn. By converse, in the very recent years, investigations showed a strong impact on the local subalpine winter climate of at least two distinct modes of atmospheric oscillations, namely the East Atlantic pattern (EA) and the Eastern Mediterranean Pattern (EMP). Winter interannual fluctuations of the EA and EMP triggered a long chain of causally-linked effects, including changes in spring water temperatures, deep spring mixing dynamics, hypolimnetic oxygen changes, and epilimnetic spring replenishment of nutrients as well as changes in phytoplankton development and phenology of the dominant cladocerans. These results were confirmed also in a recent analysis made in the other deep lakes south of the Alps (Salmaso et al.¹). It will be stressed how the East Atlantic pattern and the Eastern Mediterranean Pattern could represent two efficient teleconnection indices useful to analyse the interannual changes in aquatic environments located in the whole Mediterranean region.

Reference

¹Salmaso N, Buzzi F, Cerasino L, Garibaldi L, Leoni B, Morabito G, Rogora M, Simona M. Influence of atmospheric modes of variability on the limnological characteristics of large lakes south of the Alps: a new emerging paradigm. Manuscript submitted.

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Biosketch: Nico Salmaso is researcher at the Foundation E. Mach – Istituto Agrario di S. Michele all’Adige (FEM-IASMA), where he is Head of the research group Limnology and River Ecology. He graduated in Natural Sciences from the University of Padua, and obtained his PhD in Ecology from the University of Parma. His interest is mainly focused on the ecology and long term dynamics of plankton and toxic cyanobacteria in different freshwater environments and in relation to human impact and climate change.

He has participated in the scientific planning and implementation of several different national and international limnological projects in lakes and river ecosystems, mainly in the alpine-subalpine region. He is the contact person for the Long Term Ecological Research (LTER) station Lago di Garda and of the research site Southern Alpine Lakes. He is member of the editorial boards of *Advances in Oceanography and Limnology* (Taylor & Francis) and *Journal of Limnology* (PAGEPress).

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