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Impacts of the NAO on atmospheric pollution in the Mediterranean Basin

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The measured concentrations of air pollutants in the lower atmosphere are the result of the combined effect of local-, meso -, and synoptic scale processes. However, there are several inherent problems in attributing pollution concentrations to changes in large-scale atmospheric circulation: 1) the year to year variability being modulated by both, changes in circulation and changes in upwind emissions, 2) the shorter life-time of some pollutants precluding a meaningful relationship with changes in circulation, and 3) the both-ways interaction between trace gases, aerosols and climate.
In order to understand the relationship between atmospheric circulation to climatically related variables such as air pollutants, few examples are presented while using Yarnal's (1993) both fundamental approaches: "Circulation to Environment" and "Environment to Circulation". In the first method, an atmospheric circulation classification is performed and then related to an environmental phenomenon. In the second method, the circulation classification is carried over along specific environment-based criteria set for a particular environmental phenomenon.
Simulations of transport of anthropogenic CO for high and low phases of the NAO are presented followed by an observational-based study relating the ozone seasonal variability across North Atlantic and the Western Mediterranean to the NAO. Both phases of the NAO controlling dust transport to the Mediterranean are described: the positive phase during summer over the western region and the negative one regulating dust transport over the Eastern Mediterranean in winter. Low NAO indices have been related to a higher cyclonic activity over the western basin. However, Avila and Roda (2002) found no correlation between annual wet deposition of African dust-related elements and the NAO. Their results indicate that, contrary to the Eastern Mediterranean, the two variables (precipitation inversely and dust updraft directly) controlling wet deposition over the western region vary in an opposite direction with respect to the NAO therefore canceling each other effects. Several studies using the "Environmental to Circulation" approach which deal with the role of green-house-gases forcing on the NAO are reviewed. Although, at present, there is no consensus on the process responsible for the observed low-frequency variations in the NAO, most of them predict the continuation of the positive NAO state until the mid 21rst century implying a predominantly zonal circulation over the western Mediterranean. This imply a reduced import of European trace gases, an enhancement of long range transport of air pollutants from North American sources and conditions in favor of mobilization and transport of North African dust mainly to the western part of this fragile basin.