



The North Atlantic Oscillation or the Arctic Oscillation? Volcanic eruptions as Nature's own experiments

Bo Christiansen

Danish Meteorological Institute (boc@dmi.dk)

Since the Arctic Oscillation (AO) was introduced, there has been a vivid debate about its physical reality. Despite considerable efforts including data analysis, modelling, and theory the question is unsettled. In this paper we will exploit the volcanic eruptions as "Nature's own experiment" and analyse the effect of the eruptions on the extra-tropical large scale modes.

We analyse the impact of 13 major stratospheric-aerosol producing volcanic eruptions since 1870 on the large scale variability modes of sea level pressure in the northern hemisphere winter. We focus on the Arctic Oscillation and the North Atlantic Oscillation (NAO) to address the question about the physical nature of these modes.

We find that both the AO and the NAO are excited in the first winter after the eruptions with statistical significance at the 95 % level. Both the signal and the significance is larger for the NAO than for the AO. The excitation of the AO and the NAO is connected with the excitation of a secondary mode which resembles an augmented Pacific-North American Pattern (PNA). This mode has opposite polarity in the Atlantic and the Pacific and interferes negatively with the AO in the Pacific and positively in the Atlantic in the first winter after the eruptions giving the superposition a strong NAO resemblance.

Our results suggest the interpretation that the NAO and not the AO should be credited as the physical mode of variability. This interpretation is more simple and economical than the alternative interpretation that both the AO and the PNA are physical and excited by the volcanic eruptions in such a way that the signal in the Pacific is cancelled out by negative interference.