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The North Atlantic Oscillation controls air pollution transport to the Arctic

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Abstract. This paper studies the interannual variability of pollution pathways from northern hemisphere (NH) continents into the Arctic. Using a 15-year model simulation of the dispersion of passive tracers representative of anthropogenic emissions from NH continents, we show that the North Atlantic Oscillation (NAO) exerts a strong control on the pollution transport into the Arctic, particularly in winter and spring. For tracer lifetimes of 5 (30) days, surface concentrations in the Arctic winter are enhanced by about 70% (30%) during high phases of the NAO (in the following referred to as NAO^+) compared to its low phases (NAO^-). This is mainly due to great differences in the pathways of European pollution during NAO^+ and NAO^- phases, respectively, but reinforced by North American pollution, which is also enhanced in the Arctic during NAO^+ phases. In contrast, Asian pollution in the Arctic does not significantly depend on the NAO phase. The model results are confirmed using remotely-sensed NO_2 vertical atmospheric columns obtained from seven years of satellite measurements, which show enhanced northward NO_2 transport and reduced NO_2 outflow into the North Atlantic from Central Europe during NAO^+ phases. Surface measurements of carbon monoxide (CO) and black carbon at high-latitude stations further corroborate the overall picture of enhanced Arctic pollution levels during NAO^+ phases

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