



Mechanisms of North American export and transport to the central North Atlantic lower free troposphere during the summers of 2003 and 2004

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In this study, we present three case studies of the export and transport of North American pollution to the central North Atlantic in July, 2003, and comment on the frequency of similar events during the ICARTT period (summer, 2004). The analysis is based on simulations with the FLEXPART lagrangian particle dispersion model and the HYSPLIT trajectory model, and measurements made at the PICO-NARE station (2.2 km asl in the Azores, Portugal). The selected cases are representative of the North American transport events observed for the study period. In most such events, North American pollution was lofted out of the boundary layer into the lower or mid-free troposphere in association with a frontal system or cyclone, and then transported to the Azores in a route governed by the Azores-Bermuda High and transient northerly lows. One event in which the transport was governed by flows associated with a frontal system was observed. In the first case studied, U.S. pollution was lifted out of the boundary layer into the mid-troposphere by a cold front passing over the midwestern and eastern U.S. and then rapidly transported to the station in the gradient wind created between the Azores-Bermuda High and two northern lows, one to the northwest of the high, over eastern Canada, and one to the northeast of the high, between the Azores and the U.K. In the second case, North American pollution was lifted out of the boundary layer into the lower free troposphere in a weak cyclone, formerly tropical storm Bill, and transported eastward to the station in a flow again governed by the relative location of the Azores/Bermuda High and northerly lows. In the third case,

North American pollution was lofted to the upper free troposphere in the warm conveyor belt of a cyclone, where it wrapped around to the west side of the upper level of the low and became entrained in the cyclone's dry air stream and subsequently transported downward and southeastward to the station.