Composition of the troposphere over the Indian Ocean during the monsoonal transition

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Abstract. The atmosphere over the equatorial Indian Ocean is a unique environment in which to study the chemical and radiative effects of an intense source of anthropogenic emissions from the northern hemisphere directly coupled to the relatively pristine background conditions present in the southern hemisphere. As an initial investigation into the role of the intertropical convergence zone (ITCZ) on interhemispheric transport of pollutants, a number of trace atmospheric species were measured aboard the National Oceanic and Atmospheric Administration (NOAA) R/V Malcolm Baldrige between Durban, South Africa, and Colombo, Sri Lanka, from March 11 to April 22, 1995. Sharp increases in the concentrations of carbon monoxide (CO), carbon dioxide (CO2), and aerosols were associated with four distinct meteorological regimes transected by the cruise track from 33°S to 9°N. Across the ITCZ, aerosol concentrations, including non-sea-salt sulfate, nitrate and ammonium, increased by a factor of 4. Surface ozone measurements showed a latitudinal gradient with a minimum near the equator and a strong diurnal variation in the equatorial regions. The latitudinal profile of gas-phase reactive nitrogen paralleled ozone and was higher in the remote southern hemisphere than in the remote northern hemisphere. Evidence of direct anthropogenic impact on the region was observed more than 1500 km from the southern tip of India. Back trajectories, calculated with NOAA's medium range forecast data using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HY-SPLIT) program, identified the origin of the air mass regimes characterized by the trace gas and aerosol data. Continental emissions in the northern hemisphere were shown to have a major impact on the radiative properties and oxidizing capacity of the marine atmosphere.

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