



## **Distribution of marine boundary layer ammonia over the Atlantic and Indian Oceans**

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Measurements of marine boundary layer ammonia were performed during the Aerosols99 cruise over the Atlantic Ocean and southern Indian Ocean. An overall large variation in gas phase ammonia was encountered with peak values occurring in regions heavily influenced by the smoke plume from biomass combustion and continental sources on the African continent. Concentrations were typically in the range 7 to 22 nmol m<sup>-3</sup>. Over the remote clean South Atlantic and Indian Oceans median gas phase ammonia concentrations ranged between 1.1 and 3.2 nmol m<sup>-3</sup>, but were occasionally as high as 8.1 nmol m<sup>-3</sup> or as low as 0.3 nmol m<sup>-3</sup>. It was reasonable to assume that the ocean was a net emitter of ammonia to the atmosphere and thus responsible for the ammonia levels measured. An average residence time of the order of a few hours was estimated. One implication of such a rapid removal of ammonia is that it prevented attainment of equilibrium between the gas phase and particulate phase ammonium. In areas under the influence of African biomass burning or dust however, the particulate phase ammonium was concluded to be in equilibrium with the gas phase ammonia. The removal of atmospheric ammonia during the time of travel from the African continent to the position of the ship was estimated using a simplified Lagrangian approach. A response or residence time of 20 to 130 hours resulted. Thus in order to explain the observed atmospheric ammonia levels at the ship it seemed necessary to allow for an ammonia residence time of the order of several days within the plume which differs widely from previous reported estimates.