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# Mini ozone holes due to dust release of iodine

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Desert dust as a source of iron and other micronutrients is recognized to fertilize oceans, but little attention has been paid to dust as a source of iodine. Empirical observations find iodate on dust measured during ship cruises downwind of the Sahara desert. However, it remains unclear whether iodine in dust is the result of marine iodine uptake on dust during transport in the marine boundary layer, or whether such iodine accumulates over geological time scales, and is emitted together with dust. Significant enhancements of iodine have been observed in Sahara dust events in form of methyl iodide ($CH_3I$) and iodine monoxide (IO) radicals, but atmospheric models currently do not consider dust as a source of iodine. Furthermore, dust plumes are often accompanied by significant ozone loss, which is commonly attributed to reactive uptake of $O_3$ and other odd oxygen species (i.e., $N_2O_5$, $HNO_3$) on dust surfaces. However, laboratory experiments struggle to reproduce the large reactive uptake coefficients needed to explain field observations, and do not consider iodine chemistry. We present evidence that dust induced "mini ozone holes" in the remote (Southern Hemisphere) lower free troposphere west of South America (TORERO field campaign) are largely the result of gas-phase iodine chemistry in otherwise unpolluted (low $NO_x$) dust layers that originate from the Atacama and Sechura Deserts. Ozone concentrations inside these elevated dust layers are often 10-20 ppb, and as low as 3 ppb, and influence entrainment of low ozone air from aloft into the marine boundary layer. Ozone depletion is found to be widespread, extending up to 6km altitude, and thousands of kilometers along the coast. Elevated IO radical concentrations inside decoupled dust layers are higher than in the marine boundary layer, and serve as a source of iodine, and vigorous ozone sink following entrainment to the marine boundary layer. The implications for our perception of iodine sources, surface air quality, oxidative capacity, and climate are briefly discussed.