Reactions with seawater – a sink of atmosphere ozone and a source of isoprene

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Dry deposition to the ocean surface is a significant loss for tropospheric ozone and this process appears to be sensitive to seawater organic content. Reactions between ozone and seawater further lead to productions of volatile organic compounds that are important for atmospheric chemistry, oxidative capacity, and aerosol formation. Here we present laboratory measurements for the production of isoprene from reactions between seawater and artificially generated ozone, in an efficient and rapid exchange bubble equilibrator.

Three types of seawater were investigated: a) natural seawater from the L4 marine station in the south-west UK, b) aged seawater spiked with algal culture, and c) aged seawater spiked with fatty acids (FA). A seasonal comparison was made between natural seawater sampled in Feb-May (spanning across the spring algal bloom) and Sep-Nov (post-bloom). The mean (±SD) ozone-driven production ratio (VOC produced per ozone uptake) was almost x10 and x2.5 higher in the autumn (0.011±0.004), compared to the pre-bloom (0.0012±0.0005) and spring bloom (0.0029±0.0015) periods. We estimate that the ozone-driven isoprene emission to the atmosphere is comparable or greater in magnitude than the diffusive sea-to-air isoprene emission

The experiments with spiked seawaters contained dissolved organic carbon concentrations with a similar order of magnitude as the natural coastal seawater at L4. The algal culture (E. huxleyi) resulted in lower amounts of isoprene production (x5-60 lower) relative to the natural samples. Furthermore, oleic acid and nonanoic acid, an unsaturated and saturated FA respectively, were both also shown to produce isoprene in minimal amounts.