Atmospheric isoprene measurements reveal larger-than-expected Southern Ocean emissions

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Isoprene is a key trace component of the atmosphere emitted by vegetation and other organisms. It is highly reactive and can impact atmospheric composition and climate by affecting the greenhouse gases ozone and methane and secondary organic aerosol formation. Marine fluxes are poorly constrained due to the paucity of long-term measurements; this in turn limits our understanding of isoprene cycling in the ocean. Here we present the analysis of isoprene concentrations in the atmosphere measured across the Southern Ocean over 4 months in the summertime. Some of the highest concentrations (> 500 ppt) originated from the marginal ice zone (MIZ) in the Ross and Amundsen seas, indicating the MIZ is a significant source of isoprene at high latitudes. Using the global chemistry-climate model UKESM1 we show that current estimates of sea-to-air isoprene fluxes underestimate observed isoprene by a factor >20. A daytime source of isoprene is required to reconcile models with observations. The model presented here suggests such an increase in isoprene emissions would lead to >8% decrease in the hydroxyl radical in regions of the Southern Ocean, with implications for our understanding of atmospheric oxidation and composition in remote environments, often used as proxies for the pre-industrial atmosphere.