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The role of atomic chlorine in glacial-interglacial changes in the carbon-13 content of atmospheric methane

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Methane (CH_4) is an important atmospheric constituent on account of its potency as a greenhouse gas and its influence on the tropospheric oxidising capacity. The ice-core record of $\delta^{13}CH_4$ has largely been used to constrain past changes in CH_4 sources. However, CH_4 sinks also affect $\delta^{13}CH_4$, and changes in the strength of a relatively minor one, oxidation by atomic chlorine in the marine boundary layer (Cl_{MBL}), have been invoked to explain spatial and inter-annual variations in $\delta^{13}CH_4$. Here, we explore for the first time the contribution that changes in the strength of the Cl_{MBL} sink could have made to changes in $\delta^{13}CH_4$ on glacial-interglacial timescales.

Combining wind and temperature data from a variety of general circulation models with a simple formulation for the concentration of Cl_{MBL}, we find that circulation-driven changes in the strength of this sink, alone, could have been responsible for changes in $\delta^{13}CH_4$ of the order of 10% of the glacial-interglacial difference observed. In light of the many other factors affecting Cl_{MBL} that we have not explored, we highlight the need to quantify past changes in the strength of this sink, and consider these when interpreting glacial-interglacial changes in $\delta^{13}CH_4$.