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Contribution of the ocean to the oxygen isotope excess of atmospheric N_2O

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The oxygen isotope excess $\Delta(^{17}O)$ in atmospheric nitrous oxide N_2O is regarded to be mainly a result of atmospheric chemical in-situ production, e.g. by reaction of NO_2 with NH_2 radicals (Röckmann et al., 2001) in the troposphere or the reaction of $O(^1D)$ with N_2 in the stratosphere (Estupiñàn et al., 2002). However, Kaiser et al. (2004) suggested that biological cycling of N_2O can also have an influence on the $\Delta(^{17}O)$ signature and needs to be considered as a tropospheric source of isotope excess from soils and the ocean.

$\Delta(^{17}O)$ was measured in seawater samples collected from the Atlantic Ocean, the Scotia Sea and the Weddell Sea. For the Scotia and Weddell Seas, as well as upwelling water at the equator in the Atlantic Ocean, the isotope excess of N_2O was close to atmospheric values of about $0.9‰$ or slightly lower. However, elevated values of up to $3.5‰$ were found in the Atlantic Ocean between 50° N and 40° S, mainly between the surface and 300 m depth.

Preliminary analysis showed no obvious relationship between $\Delta(^{17}O)$ and sampling depth, seawater density, oxygen concentrations and or apparent oxygen utilization (AOU) in any of the three datasets. This suggests that higher values for $\Delta(^{17}O)$ could be due to production by different organisms, processes or substrates, e.g. atmospheric nitrate deposition.