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Reconstructing Paleosalinity from δ^{18}O during the Last Glacial Maximum, Last Interglacial and Late Holocene

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Reconstructions of salinity are used to diagnose changes in the hydrological cycle and ocean circulation. The most widely used method of determining past salinity uses oxygen isotope (δ_{Ow}) residuals, relying on a constant relationship between δ_{Ow} and salinity throughout time.

An isotope-enabled fully coupled General Circulation Model (GCM) has been used to assess how the relationship between δ_{Ow} and surface salinity varies in response to past climate changes. We undertake simulations of the Late Holocene (LH), Last Glacial Maximum (LGM), and Last Interglacial (LIG) focussed on 0 ky, 21ky, and 125 ky respectively.

The results show considerable variability in the δ_{Ow}-salinity relationship, with large differences observed between spatial and temporal δ_{Ow}-salinity gradients. We find that the largest sources of uncertainty in salinity reconstructions are caused by changes in regional freshwater budgets, ocean circulation, and sea ice regimes. These can cause reconstruction uncertainties exceeding 4 psu. We find that paleosalinity reconstructions in the South Atlantic, and Indian Oceans should be most robust, since these regions exhibit relatively constant δ_{Ow}-salinity relationships across spatial and temporal scales. Largest uncertainties will affect North Atlantic and high latitude paleosalinity reconstructions. Finally we show that it is very difficult to generate reliable salinity estimates for regions of dynamic oceanography, such as the North Atlantic Current, without additional constraints. Paleosalinity is a good example where combining models and data can help constrain the terms affecting δ_{Ow} and thus improve the interpretation of δ_{Ow} in relation to past climate change.