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Synthetic ice core records of the past 1.5 million years

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The search is on for a site in Antarctica where an ice core older than 800 ka can be retrieved. A key issue will be to date the core correctly and synchronise it to other records. We still have hopes of accessing the old ice rapidly with new drilling tools that would allow profiles of water isotopes, dust and methane to be retrieved. However, the main ice core will be a challenge to date. A host of methods will be used, involving parameters with orbital signals, cosmogenic isotopes, and radiometric methods. However another option will be to match the new records with existing data from dated marine or terrestrial data.

To do this, we need to look at existing marine and terrestrial datasets that have shown similarities with the ice core record over the 800 ka that already exists, using various approaches to consider whether the similarity should be expected to continue in the deeper ice. While the primary purpose is to assess what a well-preserved record should look like, we can also consider how diffusion and ice deformation might affect the records we retrieve.

For the water isotopes, we consider the marine sediment record. It has been argued that the deep-sea temperature (Mg/Ca) record at a southern Pacific site has the same pattern as Antarctic δD. With newer data is this still supported? Similarly, dust proxies in southern hemisphere marine records show similar patterns to dust in Antarctic ice, and there is a good theoretical reason to expect this if they have the same source. We will consider both the similarities and differences in the two datasets. It is hard to predict the overall pattern of methane, but recent data showing the millennial scale variability in well-resolved marine cores off Portugal raise the possibility of matching the millennial event pattern between methane in ice and oxygen isotopes in these cores. Our aim in this paper is to predict what some of the ice core measures may look like so they can be used as “self-tuning targets”.