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Diatoms in ice cores for reconstructing past wind variability in the Southern Hemisphere Westerly Wind belt

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The Southern Hemisphere Westerly Winds play a critical role in the global climate system by modulating the upwelling and the transfer of heat and carbon between the atmosphere and the ocean. Since observations started, the core of the westerly wind belt has increased in strength and has contracted towards Antarctica. It has been proposed that these deviations are among the main drivers of the observed widespread warming in West Antarctica, threatening the stability of ice shelves, and ultimately contributing to global sea-level rise.

Over the last decades, it has been widely believed these atmospheric changes have occurred in response to recently increased greenhouse gas concentrations and ozone depletion. However, the lack of long-term wind records in the Southern Hemisphere mid-latitudes hinders our ability to assess the wider context of the recently observed changes. This lack of a clear consistent timing limits our understanding of the causes of westerly wind changes and the roles they have played in driving recent environmental changes in Antarctica. Addressing these questions is crucial for future climate predictions.

Here, we present multiple records of diatoms preserved in a set of ice cores retrieved from the southern Antarctic Peninsula and the Ellsworth Land region. The diatom abundances and species assemblages from these ice cores represent the regional variability in wind strength and atmospheric circulation patterns. We use this novel proxy to produce an annual-to-quinquennial reconstruction of winds in the Pacific sector of the Southern Hemisphere Westerly Wind belt over the last 400 years. This wind reconstruction allows exploring the link between the recent increase in wind strength, greenhouse gases and ozone depletion in the atmosphere.

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