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Warming in the Southern Ocean: Assessing the impact of eddies and meandering fronts

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Comparisons of historical hydrographic data with modern measurements indicate that the Southern Ocean has warmed measurably since the 1950s. This warming could be a sign of increased poleward eddy heat transport or of a poleward displacement of the entire Antarctic Circumpolar Current (ACC), possibly in response to a decadal-scale intensification of the Southern Annular Mode. Regardless of mechanisms, the long-term warming trend suggests the possibility that more (or warmer) Upper Circumpolar Deep Water may be coming into contact with the Antarctic Ice Shelves, particularly in regions where the southern edge of the ACC is closest to the Antarctic continent (i.e. in the Indian Ocean sector, between 40°E and 160°E, and in the eastern Pacific, between 140°W and 50°W.) Poleward heat transport across the ACC is explored using a suite of methodologies. Satellite altimeter data indicate that meandering of the ACC is closely linked to El Niño variability on seasonal timescales, but provide a more ambiguous signal on longer time scales. Argo profiles provide evidence to assess the vertical structure of poleward heat transport in the region of the ACC. An assimilating model, the Southern Ocean State Estimate, provides an assessment of the heat budget and its variability on the shelf of Pine Island Bay, where few in situ observations are available and where glacial melt appears exceptionally rapid.