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Heat fluxes in Drake Passage

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Determining the processes responsible for the Southern Ocean heat balance is fundamental to our understanding of the weather and climate systems. Therefore, in the last decades, various studies aimed at analyzing the major mechanisms of the oceanic poleward heat flux in this region. Previous works stipulated that the cross-stream heat flux due to the mesoscale transient eddies was responsible for the total meridional heat transport across the Antarctic Circumpolar Current (ACC). Several numerical modelling and current meters data studies have recently challenged this idea. These showed that the heat flux due to the mean flow in the southern part of the Antarctic Circumpolar Current could be larger than the eddy heat flux contribution by two orders of magnitude [Sekma et al., 2012].
Eddy heat flux and heat flux by the mean flow distributions of were examined in Drake Passage. The in situ velocity and temperature time series used to estimate the poleward heat flux in Drake Passage were obtained at five mooring sites across the Yaghan Basin (from January 2006 to March 2009), and at four mooring sites across Ona Basin (from February 2006 to April 2008).
In the northern part of Antarctic Circumpolar Current (Yaghan Basin), the computed eddy heat flux was significant only in the northern branch of the Subantarctic Front (∼90 kW m-2). The poleward eddy heat flux on the southern flank of the ACC (Ona Basin) was significant across the Polar Front and Southern Antarctic Circumpolar Current Front (∼10 kW m-2). However, eddy activity on the southern flank of the ACC is too weak to transport sufficient heat poleward to accomplish the Southern Ocean heat balance required task.
The mean velocity vectors were observed to rotate with depth indicating consistent downwelling except at mooring located in the center of Ona Basin. A rotation of the mean velocity vector with depth is associated with a cold or warm advection in the entire water column. The estimated poleward heat flux by the mean flow (varying from 989 kW m-2 to 101 kW m-2 depending the mooring sites) was larger than the eddy heat flux by as much as one order of magnitude. The vertical structure of the mean flux in several topographically constricted passages is seen as the major responsible of the Southern Ocean heat balance.