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Poleward heat transport at the SACCF over the Kerguelen Plateau

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One-year time series measurements of current and temperature were made in 2009 at the SACCF (Southern Antarctic Circumpolar Current Front) across the Fawn Trough of the Kerguelen Plateau. Located close to the southern flank of the ACC, this passage of depths $<$2800 m forms the principal cross-plateau passage, strongly channelling most of the circumpolar flow passing between the Polar Front and Antarctica. We used these mooring data to estimate the meridional eddy heat flux across the front at four levels around mean depths of 335, 1026, 1510, 2311 m. The mooring motion, which affects significantly both temperature and velocity time series at a fixed level, was previously corrected using a standard method before conducting the heat flux estimation. The time series were also band-pass filtered for retaining only periods between 2 and 90 days, a band of eddy periods frequently cited in the literature. Across-front velocity was estimated at daily intervals as the velocity component perpendicular (positive to the left) to the time varying direction of 90-days low-pass filtered current vectors.

The results are mixed: poleward heat flux is observed only at two levels, with -2.46 kW m^{-2}at 335 m (significant at 95%) and -0.71 kW m^{-2}at 2311 m (significant at 90%), while the flux is equatorward at 1026 m (+1.7 kW m^{-2}, significant at 95%) and at 1510 m (+0.31 kW m^{-2}, not significant at 90%). The vertically averaged heat flux at the Fawn Trough amounts to -0.24 kW m^{-2}, which is significantly less by a factor of 4 than at the southern Drake Passage (-0.9 kW m^{-2}). These values on the southern flank of the ACC correspond to a circumpolar poleward heat flux of 0.02 to 0.07 PW, if distributed uniformly over an ocean depth of 4 km at 56°S. Our value at the Fawn Trough falls below the lower limit of poleward heat fluxes suggested in the literature for this latitude, which vary between 0.05 to 1 PW. However, it is worth emphasising that over much of the Southern Ocean, the estimate of annual mean air-sea heat exchange is plagued by lack of observations and even the sign of the net heat flux is uncertain and dependant on dataset.