We present new estimates of the eddy momentum and heat fluxes from repeated high-resolution upper-ocean velocity and temperature observations in Drake Passage and interpret their role in the regional Antarctic Circumpolar Current (ACC) momentum balance. The observations span 7 years and are compared to eddy fluxes estimated from a 3-year set of output archived from an eddy-resolving global Parallel Ocean Program (POP) numerical simulation. In both POP and the observations, the stream-averaged cross-stream eddy momentum fluxes correspond to forcing consistent with both a potential vorticity flux into the axis of the Subantarctic Front (SAF), and a sharpening of all three main ACC fronts through Drake Passage.

The comparison between POP and observed eddy heat fluxes was less favourable due partly to model bias in the water mass stratification. Observed cross-stream eddy heat fluxes are generally surface-intensified and poleward in the ACC fronts, with values up to approximately $-290 \pm 80$ kW m$^{-2}$ in the Polar and Southern ACC Fronts. Interfacial form stresses, derived from observed eddy heat fluxes in the SAF, show little depth-dependence below the Ekman layer. The form stress appears to balance the surface wind stress directly, but its estimated interfacial form stress divergence is only an order of magnitude greater than the eddy momentum forcing in the SAF. Thus although the eddy momentum forcing is of secondary importance in the momentum balance, its effect is not entirely negligible.