



## **The changing climate of the Southern Ocean: influence of the meandering pathway of the Antarctic Circumpolar Current (Fridtjof Nansen Medal Lecture)**

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The Southern Ocean is a region of potentially dramatic climate change impacts, due to the large amount of fresh-water tied up in the Antarctic ice sheet and the potential for sea level rise accompanying loss of that ice. It is the region of the largest deep ocean heat gains of the global ocean, likely due to changes in production of dense waters in coastal regions of Antarctica. It is also a region of climate change surprises, where sea ice cover is slightly advancing rather than retreating, surface waters are not necessarily warming, and carbon may be outgassing from the deep ocean at greater rates than hitherto expected.

These effects can largely be attributed to strengthened winds, which enhance upwelling of deep waters to the sea surface. Southeastward and upward spiraling of northern deep waters into the Southern Ocean and through the Antarctic Circumpolar Current (ACC) brings the cool, but not freezing, deep waters to the Antarctic margin in the regions where the overlying ice shelves are losing the most mass. This spiraling pathway is not uniformly southeastward nor is upwelling along the pathway uniform: the location of the fronts where carbon-rich upwelled water reaches the surface is strongly steered by topography and by the subpolar Ross and Weddell gyres, while upwelling itself is enhanced by strongly localized eddy fields where the ACC crosses major topography. The pattern of topographically-steered meanders of the ACC dictates the regions where winter sea ice is expanding versus contracting in response to stronger winds.