The Antarctic Circumpolar Current (ACC) is the strongest current in the global ocean, yet there remains substantial debate regarding its structure, dynamical balance and sensitivity to forcing. In this talk we will review the contending theories describing the transport of the ACC and evaluate these theories against high resolution ocean models.

Traditional ACC theories predict a strong relationship (usually linear or square root) between Southern Ocean wind stress and circumpolar transport. These theories can be contrasted with the “eddy saturation” hypothesis, in which ocean eddies control the diapycnal transfer of momentum to remove any dependence of transport upon wind stress. Coarse-resolution models have tended to support the former theory, while fine resolution models (that explicitly simulate eddies) are consistent with the latter. Recent results indicate that the parameter regime of the ACC is likely to lie close to (but not exactly equal to) the eddy saturated state.

However, many studies into the ACC have presumed that the transport is sensitive only to wind stress forcing, and not buoyancy forcing. Recent simulations indicate parameter regimes, close to the eddy-saturated state, where buoyancy forcing exerts the primary control on ACC transport. In this regime transport is well described by a simple thermal wind relationship.

A thermal wind relationship for transport implies that wind stress (which drives upwelling associated with the upper limb of the Southern Ocean overturning circulation) can modify circumpolar transport via tilting isopycnals. We will clarify the complex relationship between Southern Ocean overturning circulation and circumpolar transport.