# Ocean currents and upwelling around Antarctica

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#### Abstract

The ocean around Antarctica – the Southern Ocean, is a major player for biological production and global ocean circulation. The currents around Antarctica connect and mix the water masses of the Pacific, the Atlantic and the Indian Ocean. This is the Antarctic Circumpolar Current (ACC), a wind driven current and the strongest current in the world. The strong flow also isolate Antarctica from warm waters to the north, keeping it cool. This is an important feature for sea-ice production. The same winds that drive the ACC also drive Ekman-upwelling both a lower and an upper cell. This is critical for the overturning of deep and bottom water. Since the deeper upwelling water is nutrient rich, the Southern Ocean mixed layer is a favourable place for biology. One famous example is the Southern Ocean trap. This is a feature that traps dissolved silicon in the region, making it the habitat for many silicifiers, for example diatoms and radiolaria. Going in the opposite direction as the ACC is the slope current. This current is generated by dense sinking water masses that are deflected by the Coriolis force.

#### Antarctic Slope Current





## Atlantic Circumpolar Current



Figure: Map of the Antarctic Slope Current and other currents around the Antarctic. Taken from Thompson et al. (2018).

The Antarctic Slope Current (ASC) almost goes around Antarctica and points in the opposite direction of the ACC. Near the coast the water is densified by cooling and/or brine release. This denser water masses flow then down the slope. During that the flow gets deflected by the Coriolis force turning the whole current left. Without friction the current would not sink further down, but with friction it approximately sinks 1m for every 400m traveled. Entrainment increases and modifies the water masses that originally formed the plume.

#### The Southern Ocean Trap



(a) Distribution of silicic acid at 250m depth. Taken from Ragueneau et al. (2000).



(b) Schematic of the overturning circulation in the Southern Ocean.Taken from Thomas (2017).

Figure: Climatological positions of the subantarctic front (SAF) and polar front (PF) are marked in orange. The green arrows show the speed of the surface ocean currents. Taken from Marshall and Speer (2012).

# Meridional Overturning Circulation



Figure: Cross section of the Ocean showing the upper and lower cell of the meridional overturning circulation taken from Marshall and Speer (2012).

A combination of high biological production of Opal (biogenic silica) and the upwelling system of the antarctic traps the dissolved silica in the southern Ocean.

## QR-Code & References



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