Abstract

The Southern Ocean plays a pivotal role in the global ocean circulation and climate. There, the deep water masses of the world ocean upwell to the surface and subsequently sink to intermediate and abyssal depths, forming two overturning cells that exchange substantial quantities of heat and carbon with the atmosphere. The sensitivity of the upper cell to climatic changes in forcing is relatively well established. However, little is known about how the lower cell responds, and in particular whether small-scale mixing in the abyssal Southern Ocean, an important controlling process of the lower cell, is influenced by atmospheric forcing. Here, we present observational evidence that relates changes in abyssal mixing to oceanic eddy variability on timescales of months to decades. Observational estimates of mixing rates, obtained along a repeat hydrographic transect across Drake Passage, are shown to be dependent on local oceanic eddy energy, derived from moored current meter and altimetric measurements. As the intensity of the regional eddy field is regulated by the Southern Hemisphere westerly winds, our findings suggest that Southern Ocean abyssal mixing and overturning are sensitive to climatic perturbations in wind forcing.

摘要

南極海域在全球海水循環以及全球氣候扮演重要的角色。在那裡，匯聚了來自全部海洋的深層海水，會上升至表層，且依序下沉至海的中層和底層，形成兩個傾倒的胞，可與大氣做大量的熱和碳轉換。上層的胞對氣候變遷的敏感度相對較佳；然而對下層的胞的反應了解較少，在特定情況下，是否在南極海域深層的小尺度的混合(下層胞的重要控制過程)，會被大氣運動影響。

在此，我們提出了一個觀察到的證據，深層的混合變化相對於海洋渦流變化的時間尺度長達數個月甚至是數十年，觀察到的混合變化率估計值(由 Drake Passage 附近反覆的水文特徵得到)，顯示了其受區域海洋渦流能量的影響，可以從 moored current meter 合反矩陣的計算推得。

當區域渦流場強度受到南半球西風影響時，我們發現南極海域的深層混合以及傾倒情形，對於氣候的風強擾動相當敏感。