Geophysical Research Abstracts,
Vol. 11, EGU2009-6941, 2009
EGU General Assembly 2009

Southern Ocean thermal response to the interrannual variability of the Southern Annular Mode.

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A major climate signal in the Southern Hemisphere is the strengthening and southward shift of the westerly wind belt associated with the SAM trend. The southern ocean response to this trend appears to be more complex than what low resolution ocean climate model would predict, with mesoscale eddies turning out to be a key ingredient in shaping the southern ocean thermal response to a higher SAM index. Nonetheless there is still much debate about the vertical structure of this eddy-induced response. In this study, we use a 50 years 1/4° hindcast ocean simulation performed during the DRAKKAR project to assess the role of the SAM and ENSO in driving the interrannual variability of heat and buoyancy budgets along streamlines in the ACC. A novel diagnostic approach related to ertel potential vorticity budgets is developed which allows for the estimation of tracer budgets along closed streamlines in a recirculating flow. This new technique is applied to establish budgets of heat and buoyancy for fictitious fluid parcels traveling at constant depth along the path of the ACC. The resulting budgets involve contributions associated with surface fluxes, eddy fluxes, local mixing, geostrophic advection and Ekman flow. At a given depth, interranual variations of tracers are due to one of these contributions deviating the fluid parcel from a natural state of balance. In the ACC belt, three different regimes corresponding respectively to the surface layers, to intermediate layers and to deep layers are identified and discussed. In particular, the diabatic contribution of mesoscale eddies is shown to be a key contribution to buoyancy budgets in the surface layers.