Geophysical Research Abstracts
Vol. 13, EGU2011-9098, 2011
EGU General Assembly 2011

A dynamical Constraint on the Vertical Structure of Biogeochemical Tracers

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To understand the distribution of dissolved inorganic carbon and nutrients in the ocean interior and the physical processes affecting their transport and storage, a theoretical framework derived analytically from momentum and tracer equations is put forward. The framework, leading to an integral constraint around closed pressure contours in steady state, can be described as a balance between vertical fluxes of carbon or nutrients due to horizontal advection (friction), vertical advection, mixing, eddies, biological productivity and air-sea exchange. Using the output of an ocean general circulation model which includes biogeochemical tracers, the dynamical balance setting the tracers' spatial structure is found to be rather different in the Pacific and Atlantic, especially in the upper ocean. The differences between the subpolar and subtropical gyres will be discussed as well. This diagnostic revealed the importance of the ageostrophic flow due to frictional forces on the vertical structure of the tracers.