Geophysical Research Abstracts
Vol. 12, EGU2010-555, 2010
EGU General Assembly 2010

A modelling study of carbon dioxide up take in a temporate seasonally stratified shelf sea

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Recent observations indicate seasonally stratified temperate and polar shelf seas display a significant summer dissolved inorganic carbon (DIC) deficit, which maintains a major CO_2 sink. Here we couple a simple vertical exchange model with the CO2SYS carbon chemistry model to investigate the role of the diapycnal nutrient flux in maintaining the summer surface water DIC deficit. Two mixing mechanisms are parameterised within the model; (i) barotropic tidal mixing is introduced through two semi-diurnal constituents to simulate the effect of the spring-neap cycle on the water column stratification and (ii) 'internal wave' mixing is implemented directly, by adding energy, within the thermocline. The results highlight the potential importance of the magnitude and temporal variability of diapycnal mixing in determining the strength of the CO_2 pump, through the introduction of nutrients from the dark lower layer into the photic zone, thus highlighting the importance of the correct parameterisation of vertical mixing in shelf sea biogeochemical models.