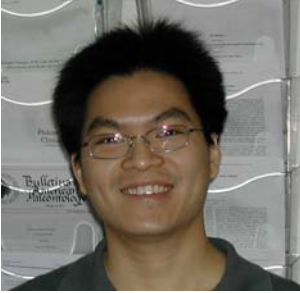


Adjoint Sensitivity of Global Sea-Air CO₂ flux in a Marine Ecosystem Model



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Abstract

The regional sensitivity of air-sea CO₂ flux (FCO₂) to ecosystem components and parameters in a three-dimensional ocean carbon cycle model is estimated using an adjoint model. Adjoint sensitivities to the global air-sea CO₂ flux reveal that the biological component of the model is the dominant process in the higher latitudes of both hemispheres and in the Equatorial Pacific. More detailed analysis indicates that zooplankton grazing activity plays a major role in the carbon exchange in these regions. The herbivores' ingestion parameter regulates the flux of remineralized biogenic nutrients; and, thus, substantially controls the biological production and the dissolved inorganic carbon (DIC) concentration in the euphotic zone. These results indicate that climate induced changes in the marine ecosystem structure are of importance for the future uptake of atmospheric CO₂. The assimilation of Takahashi FCO₂ data significantly improves the model forecast. These experiments indicate that the adjoint model, despite its many uncertainties, is generally capable of optimizing sensitive parameters in the model.