Sea surface $p\text{CO}_2$ and diurnal mixed-layer dynamics

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Diurnal warm layers are as regular as the rising sun in many ocean regions, particularly those regions where winds are insufficient to vertically mix the accumulated heat. This widespread and infinitely repeating process has a number of important consequences for sea surface $p\text{CO}_2$ and air-sea fluxes. Surface heating alters CO$_2$ fluxes by increasing the $p\text{CO}_2$ at the surface [McNeil and Merlivat, 1996; Ward et al., 2004]. Nocturnal breakdown of the warm layer leads to a strong increase in convective velocities that subsequently increase gas fluxes [McGillis et al., 2004]. Isolation of the warm layer can deplete or accumulate CO$_2$ at the surface and change the sea surface $p\text{CO}_2$ within a short time frame [DeGrandpre et al., 2004]. The mixed-layer also determines the volume over which the loss or gain of CO$_2$ through the air-sea interface is distributed. Prediction of the evolution of sea surface $p\text{CO}_2$ at a given saturation level is therefore strongly dependent upon mixed-layer depth. In this presentation, we focus on depletion of CO$_2$ in the isolated warm layer and the importance of the diurnal mixed layer in ocean CO$_2$ models. We use a mixed-layer model to show that the diurnal air-sea loss of inorganic carbon in eastern equatorial Pacific water reduces the sea surface $p\text{CO}_2$ by 1-2 µatm [DeGrandpre et al., 2004]. The importance of including the diurnal mixed-layer depth in models is evaluated by comparison of model results using mixed-layer depths in the equatorial Pacific Ocean and the Labrador Sea.

REFERENCES


