

Distribution and Estimation of Total Dissolved Inorganic Carbon Dioxide below the Upper Layer of the World Oceans

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Abstract

Compared with historically accumulated hydrographic and nutrients measurements taken at sea, total inorganic carbon dioxide (TCO₂) data are far from enough to produce a gridded mapping of high resolution on a global scale, which is crucial to evaluate the carbon budget in the oceans and provide initial values to constrain the biochemical models. In order to get a better understanding of TCO₂ in the oceans and contribute the large historical database to TCO₂ estimation, TCO₂ properties and its relation with nutrients in the world oceans are presented and discussed using ship data from several international programs, especially recent WOCE cruises during which the accuracy of TCO₂ measurements are believed to have been significantly improved. Based on these, a new parameterization method is proposed and tested to estimate TCO₂ below the upper oceans (> 400 m) where its seasonal variations are comparatively small. Compared with the ship data which have not been involved in the parameterization procedure, the mean bias and standard deviation are 0.8 μmol/kg and 7.0 μmol/kg respectively for Pacific Ocean, while they are 0.5 μmol/kg and 5.4 μmol/kg respectively for Atlantic Ocean. Calculated TCO₂ in the global oceans can be obtained at Levitus grid point (1°×1°) from 400 m down to the depth of 5,500 m, including vast ocean areas where field investigations of TCO₂ have never been performed.