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Global Interpolation of Surface Ocean pCO_2

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Introduction

The partial pressure of carbon dioxide (pCO_2) is a fundamental determinant of the air-sea flux of carbon dioxide, and as such is critical to understanding the global carbon cycle. There is a paucity of available surface ocean pCO_2 measurements, meaning that much of the research into this important oceanic variable has been limited to climatologies and decadal trends [*Takahashi et al., 2009a*].

We present for the first time an interpolation of global surface ocean pCO_2 data on a 5°x5° grid at daily resolution for the period 1990-2008. This will be invaluable to climate modellers and others studying the biogeochemical properties of the ocean, and will help in efforts to determine the density and frequency of measurements required to build an accurate picture of surface ocean pCO_2 characteristics and variability.

Methods

The interpolation method was based on interpolations used for other climate variables [*Levitus, 1982*; *Masarie and Tans, 1995*].

The $\sim$4.1 million measurements of the LDEO database [*Takahashi et al., 2009b*] were projected onto a 5°x5° grid with daily temporal resolution. A curve was fitted to the measurements consisting of a linear trend and a set of harmonics to represent the seasonal cycle. The likely accuracy of the fitted curve was assessed using a set of criteria encompassing the number of available measurements, the closeness of the fitted curve to those measurements, and the overall shape of the seasonal cycle.

If a satisfactory curve fit could not be achieved, measurements from nearby grid cells were incorporated into the curve fit to provide additional data points. These extra measurements were given a weighting according to their distance from the original cell, based on the spatial autocorrelation characteristics of the measurements in those cells.

Every value was assigned a confidence score between 0 and 1 based on the level of interpolation required to calculate that value. This is critical in allowing users of the data to understand the likely uncertainties in their results.

Results

The curve fitting and interpolation of measurements has produced a data set of surface ocean pCO_2 values on a 5°x5° at a daily temporal resolution. The data encompasses the entire global ocean except the region north of 70°N, where there are too few available measurements to achieve viable results. Validation of the interpolation technique against model output shows that the interpolated values for each grid cell have a root-mean-squared (RMS) error of $\leq$ 15 ppm over much of the ocean. Regions with very few measurements (the Southern Ocean and eastern equatorial Pacific) have an RMS error of 40-65 ppm.

References

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