

Parameter	Mean (present-day)	Observed range (present-day)	Units	Notes
[DIC]	2017	1837 to 2204	$\mu\text{mol kg}^{-1}$	strong variation with latitude
$[A_T]$	2305	2171 to 2458	$\mu\text{mol kg}^{-1}$	moderate spatial variability
$[\text{CO}_3^{2-}]$	207	80 to 303	$\mu\text{mol kg}^{-1}$	strong variation with latitude
Ω_c	5	1.9 to 9.2		strong variation with latitude
Ω_a	3.3	1.2 to 5.4		strong variation with latitude
pH	8.10	7.91 to 8.46		strong spatial variability
$p(\text{CO}_2)$	366	127 to 567	μatm	strong spatial variation
$[\text{Ca}^{2+}]$	10600		$\mu\text{mol kg}^{-1}$	little spatial or seasonal variation
$[\text{Mg}^{2+}]$	55000		$\mu\text{mol kg}^{-1}$	little spatial or seasonal variation
Temp.	18.7	-1.9 to 29.6	$^{\circ}\text{C}$	strong variation with latitude
Salinity	34.8	10.8 to 37.5	-	moderate spatial variation
$[\text{PO}_4^{3-}]$	0.53	0.02 to 2.11	$\mu\text{mol kg}^{-1}$	strong variation with latitude
$[\text{SiO}_2]$	7.35	0.37 to 101	$\mu\text{mol kg}^{-1}$	high in Southern Ocean

Table 3.1 Mean and range of variation in the main ocean carbonate system parameters over open ocean surface waters of the world. This table can be used as a reference in the design of experiments including near present-day (1990's) carbonate system values (future conditions will obviously differ for some parameters). The ranges of total dissolved inorganic carbon (DIC) and total alkalinity (A_T) are from the gridded GLODAP database (Key *et al.*, 2004) and represent surface water (0 and 10 m) of the open ocean, i.e. excluding coastal, shelf, and enclosed seas, near-shore, and estuarine environments. Other carbonate system parameters were calculated from DIC and A_T using the *seacarb* software (see main text); temperature (Stephens *et al.*, 2001) and salinity (Boyer *et al.*, 2001) were taken from the World Ocean Atlas (Antonov *et al.*, 2006; Garcia *et al.*, 2006; Locarnini *et al.*, 2006) database. The mean values are weighted averages according to the surface areas of the grid cells. Mean pH was calculated from mean $[\text{H}^+]$.

The goal of this chapter is to provide an overview of factors that influence the choice of atmospheric CO_2 levels used in ocean acidification studies, based on experimental design, target environments, location, and analytical approach. The overriding philosophy for these guidelines is that ocean acidification research should attempt to provide predictive capabilities concerning the response of the oceans, including its physics, biochemistry, and biology, to a realistic range of future atmospheric $p(\text{CO}_2)$ levels.

3.2 Approaches and methodologies

We investigate the issue of target levels of atmospheric $p(\text{CO}_2)$, discuss the conversion of atmospheric values into equivalent parameters of ocean carbonate chemistry, and then provide recommendations depending on the number of treatment levels that can be manipulated.