A new indicator can assess absorption capacity for carbon dioxide and ocean acidification

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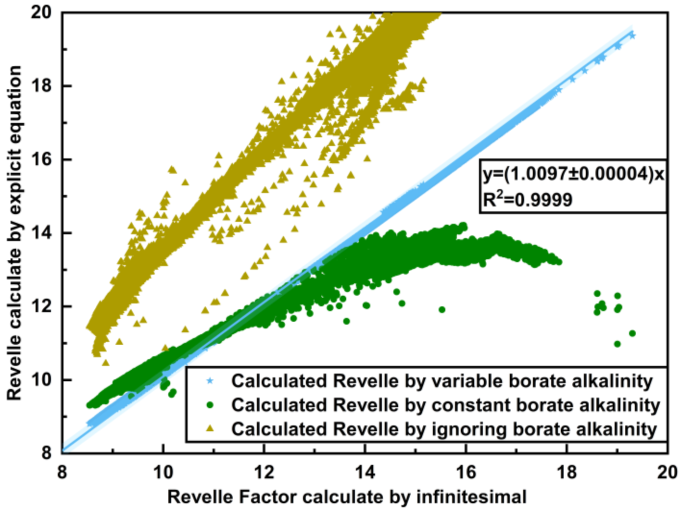
Supplementary Method. The equilibrium of the seawater inorganic carbon system.

The seawater absorption capacity for CO_2 depended on its carbonate system and equilibrium reactions (Eq.S1-S5). The other parameters could be calculated by knowing any two of the following: pCO_2, pH, Alk, and DIC, combined with temperature and salinity.

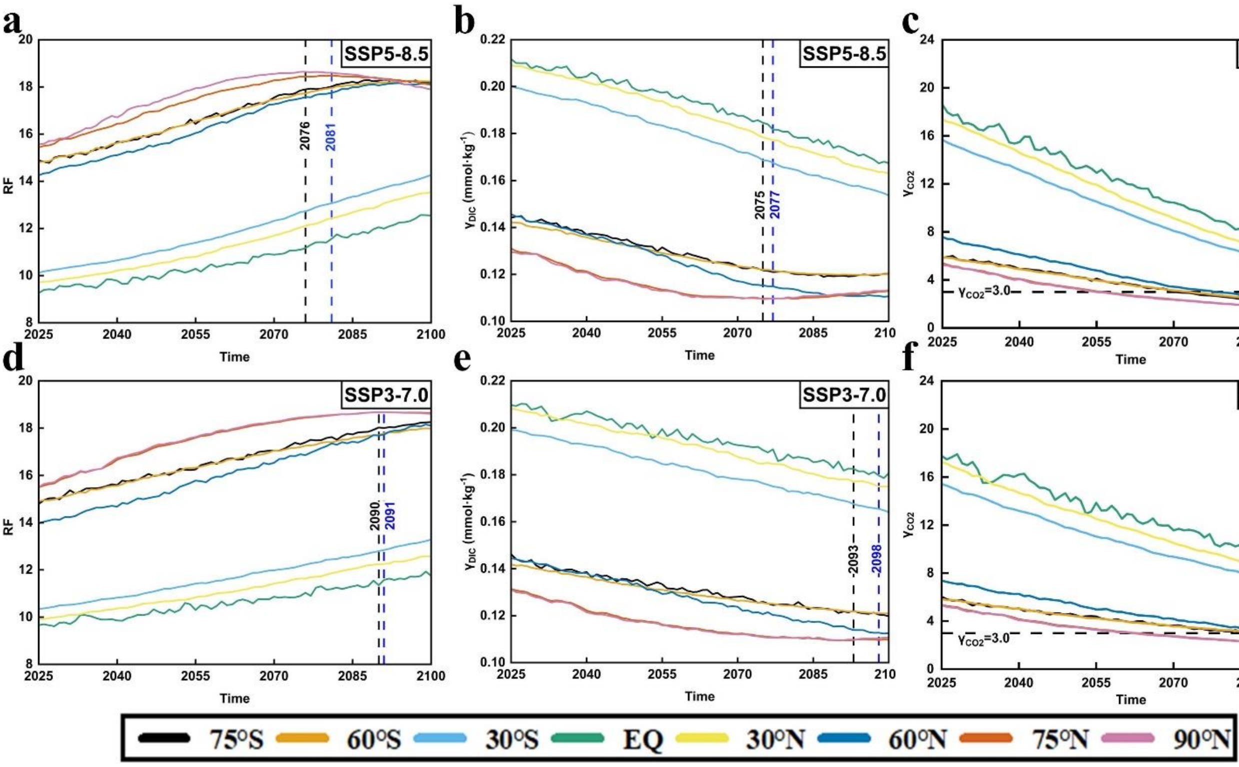
$CO_2(g) \overset{K_0}{\leftrightarrow} CO_2(aq)$	(S1.1)	$[CO_2] = K_0\, pCO_2$	(S1.2)
$CO_2 + H_2O \overset{K_1}{\leftrightarrow} HCO_3^- + H^+$	(S2.1)	$[HCO_3^-] = \frac{K_1\,[CO_2]}{[H^+]}$	(S2.2)
$HCO_3^- \overset{K_2}{\leftrightarrow} CO_3^{2-} + H^+$	(S3.1)	$[CO_3^{2-}] = \frac{K_1\,K_2\,[CO_2]}{[H^+]^2}$	(S3.2)
$DIC = [CO_2] + [HCO_3^-] + [CO_3^{2-}] = [CO_2]\,(1 + \frac{K_1}{[H^+]} + \frac{K_1\,K_2}{[H^+]^2})$			(S4)
$Alk = [HCO_3^-] + 2[CO_3^{2-}] + [B(OH)_4^-] + [OH^-] - [H^+] = \frac{K_1\,[CO_2]}{[H^+]} + \frac{2K_1\,K_2\,[CO_2]}{[H^+]^2} + \frac{B_{TOT}\,K_B}{(K_B + [H^+])} + \frac{K_w}{[H^+]} - [H^+]$			(S5)

Note: K_0, K_1, K_2, K_B, and K_W are seawater CO_2 solubility ($mol \cdot kg^{-1}$), carbonate primary ionization constant, carbonate secondary ionization constant, boric acid ionization constant, and water ionization constant, respectively.



Supplementary Figure 1. Revelle factor is calculated using explicit equation and infinitesimal method.

It was calculated from 2020 Grid data. The yellow dots are calculated by ignoring $\frac{10^{-pH}\,K_B\,B_{TOT}}{\left(K_B+10^{-pH}\right)^2}$ and the green dots are calculated by constant $\frac{10^{-pH}\,K_B\,B_{TOT}}{\left(K_B+10^{-pH}\right)^2}$. The purple dots are calculated by variable $\frac{10^{-pH}\,K_B\,B_{TOT}}{\left(K_B+10^{-pH}\right)^2}$.



Supplementary Figure 2. Latitudinal variations in the trends of RF, γ_{DIC} and γ_{CO2} under SSP5-8.5 and SSP3-7.0 scenarios.

The black dashed lines indicate the years when RF and γ_{DIC} reach their maximum (minimum) value at 75°N, while the blue curves represent the corresponding years at 90°N.

Supplementary Table 1. Summary of global ocean acidification parameters in past and future simulations based on historical data and CMIP6.

Year/Scenarios (2100)	1992	2020	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5	Southern Ocean (SSP5-8.5)
Level of radiative forcing (W/m^2)	/	/	2.6	4.5	7.0	8.5	8.5
Development mode	/	/	Sustainable	Moderate	Local	Conventional	Conventional
Surface temperature (℃)	18.1	18.3	20.0	20.7	21.7	22.8	2.05
Surface salinity	34.8	34.8	34.2	34.2	34.2	34.0	33.2
Surface pCO_2 (µtam)	341.8	392.8	445.2	593.7	845.2	1109.3	1032.5
Surface DIC ($\mu mol \cdot kg^{-1}$)	1991.4	2048.0	2046.6	2089.2	2138.7	2164.5	2198.3
Surface pH	8.097	8.058	8.005	7.898	7.764	7.658	7.642
Surface Ω_{arag}	3.143	2.799	2.860	2.417	1.942	1.639	0.666
Surface γ_{CO2}	17.78	15.50	13.64	9.71	6.40	4.71	1.99
γ_{CO2} compared to 2020	2.28	/	-1.80	-5.79	-9.10	-10.79	/