Ocean Acidification:
CO_2 Emission Targets and Ocean Acoustics

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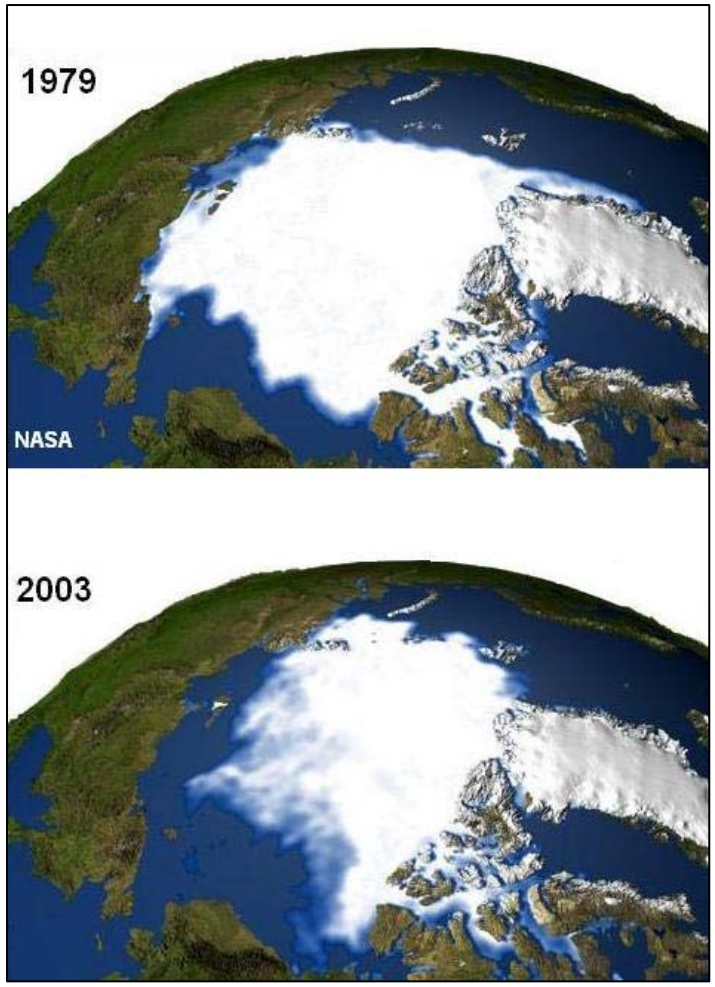
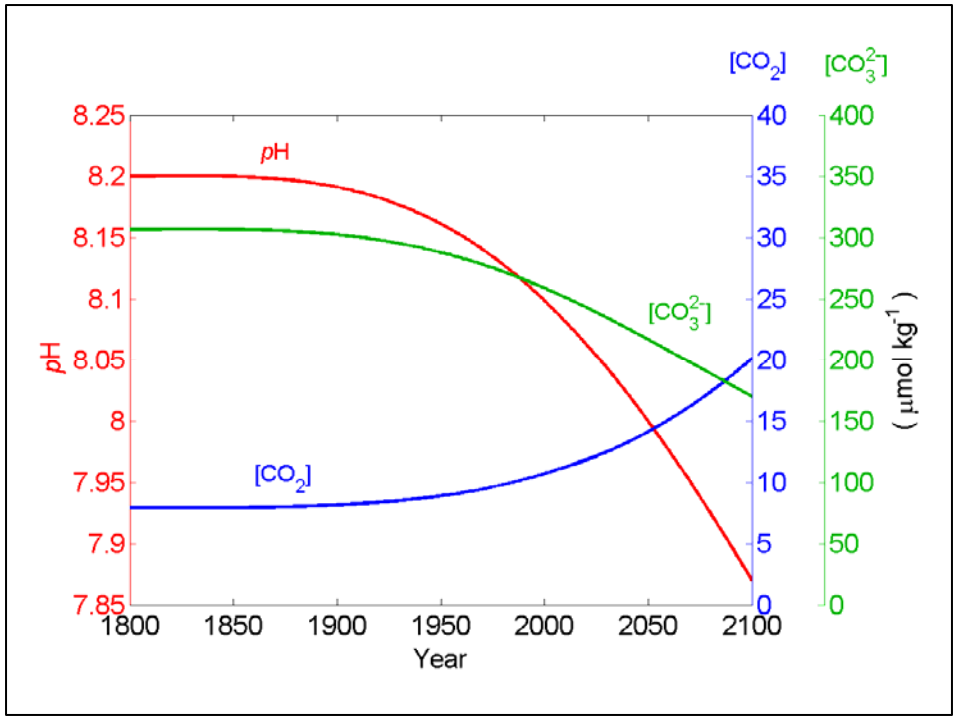




Wolf-Gladrow et al., 1999; Zeebe & Wolf-Gladrow, 2001.

→ CO_2 Emission Targets?

1. Emission Targets

Establishing CO_2 emission targets

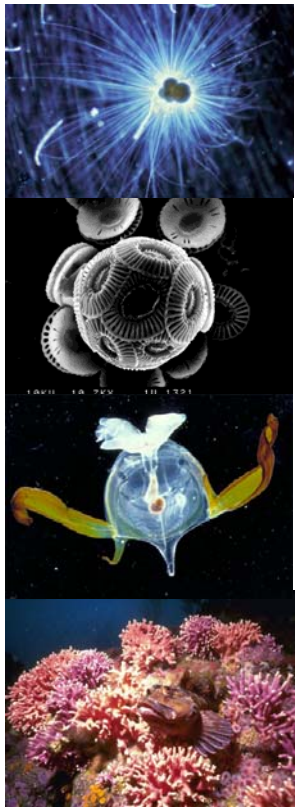
- What is allowable *p*H change?

  Needs to be addressed in current/ future research.

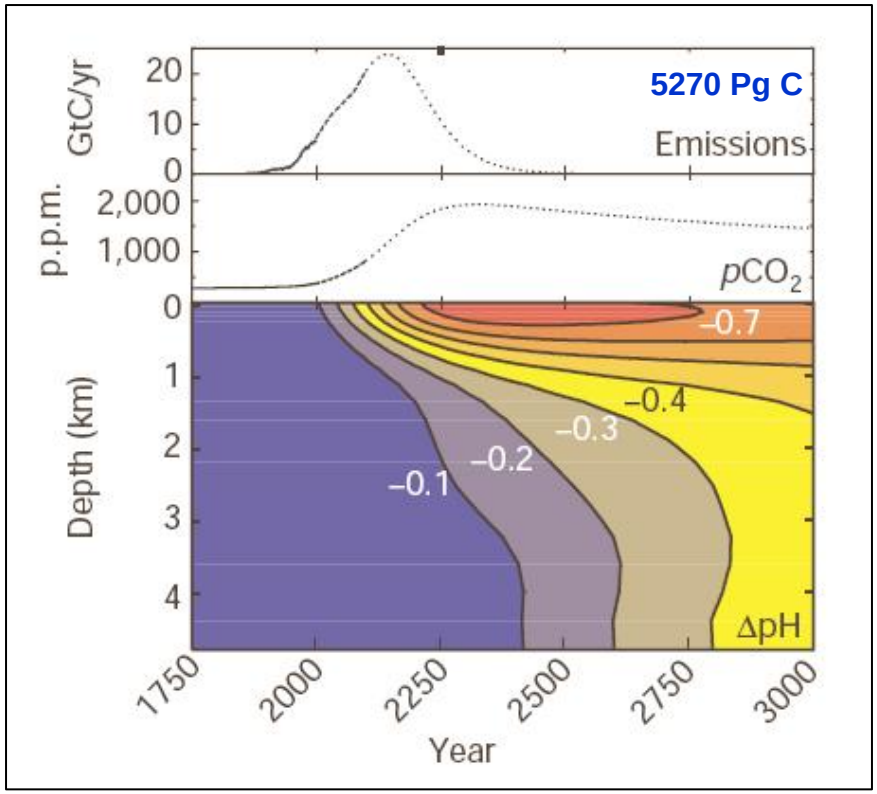
- Given a target of surface ocean *p*H decline, emissions can confidently be calculated.

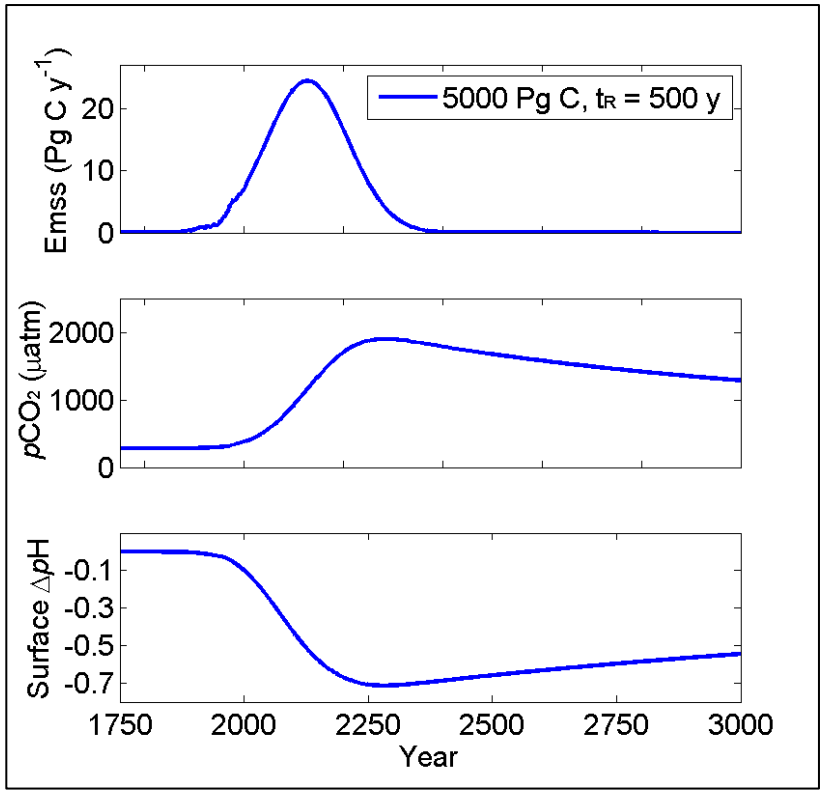
  Chemistry is easier than climate!

  Needs a model.



What about other marine organisms?

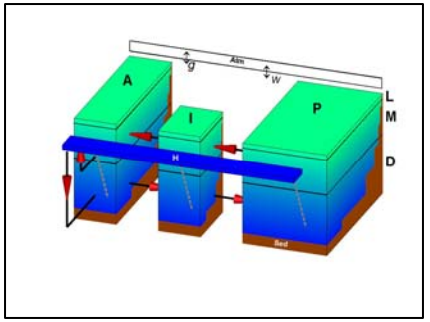




OGCM
Caldeira & Wickett (2003)

LOSCAR
(this study)

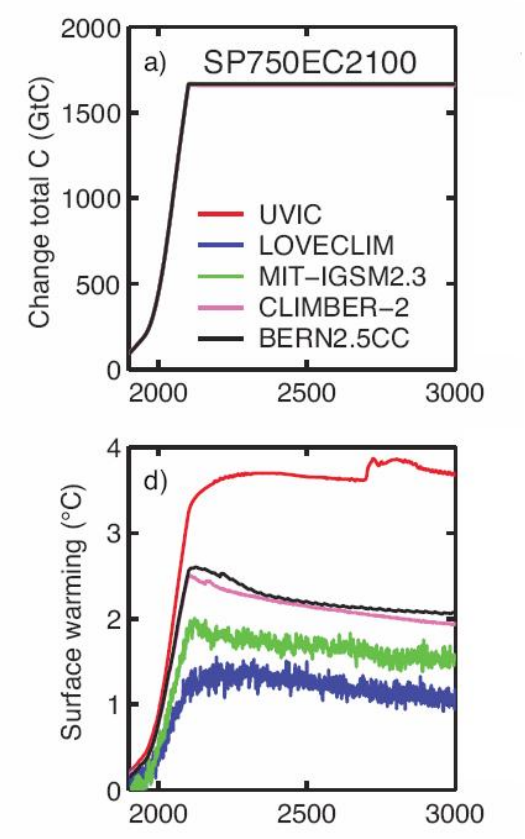
Walker and Kasting (1992)
Zeebe and Zachos (2007)



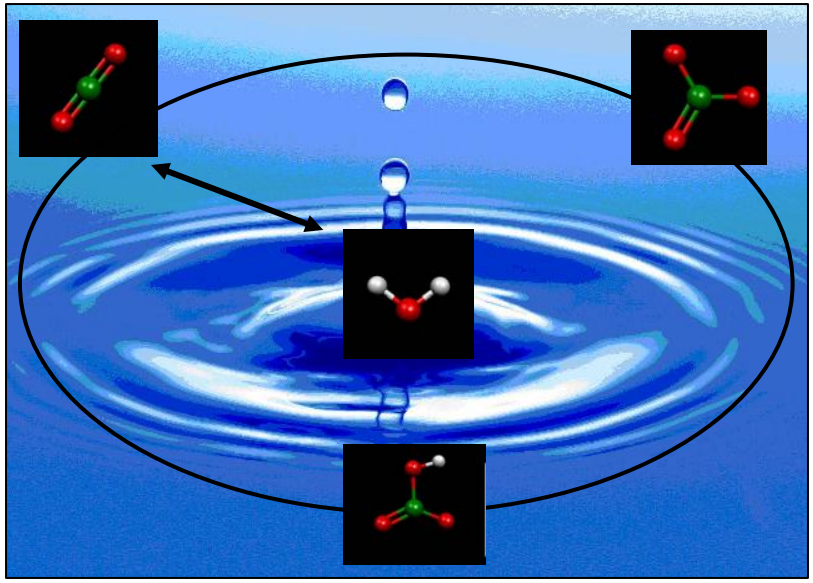
Chemistry

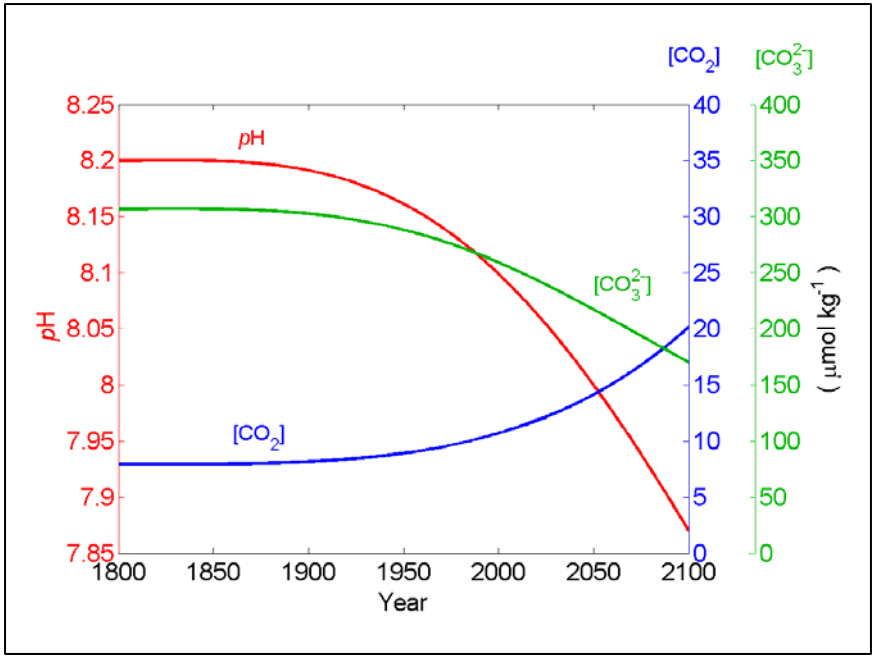
Model	Emissions (Pg C)	pCO_2^{max} (ppmv)	ΔpH^{max}
UVic	5134	1970	−0.74
CLIMBER-2	5134	1900	−0.75
LLNL	5270	1950	−0.77
LOSCAR	5134	1950	−0.72

Climate (IPCC, 2007)



Carbonate Chemistry is well known.

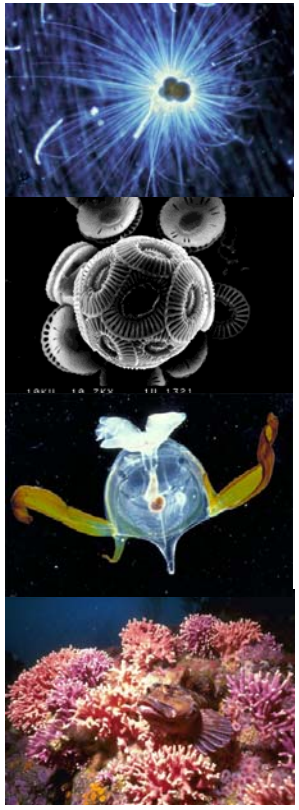


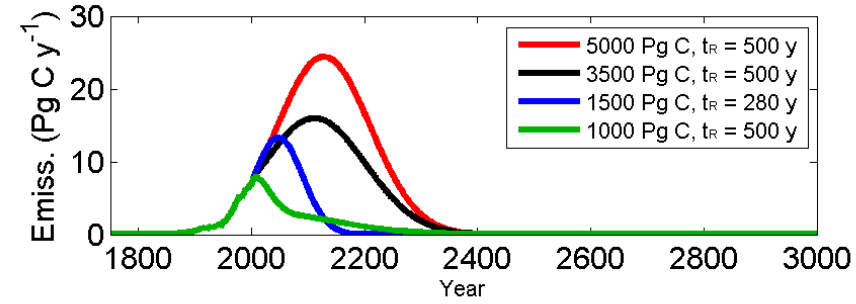


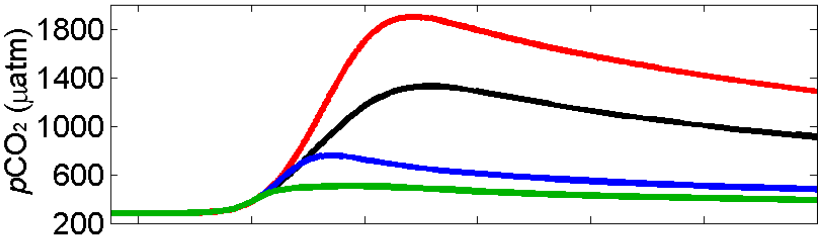
Zeebe & Wolf-Gladrow (2001)

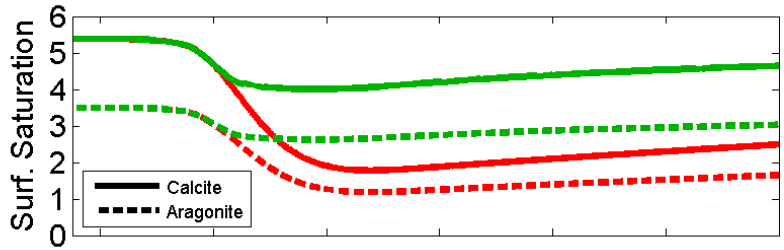
Predictions are less complicated (compared to climate).

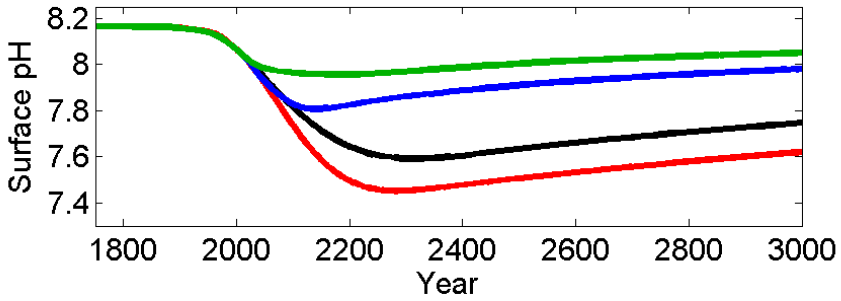
Emission Targets





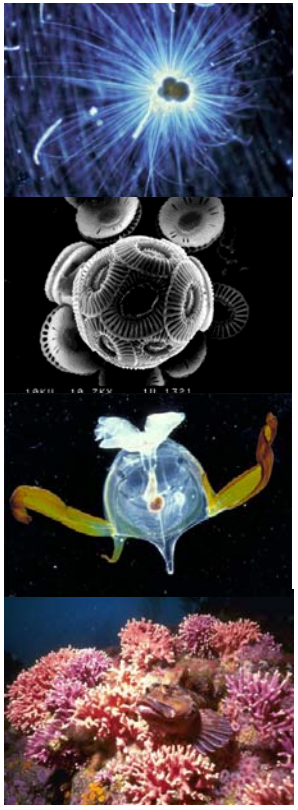




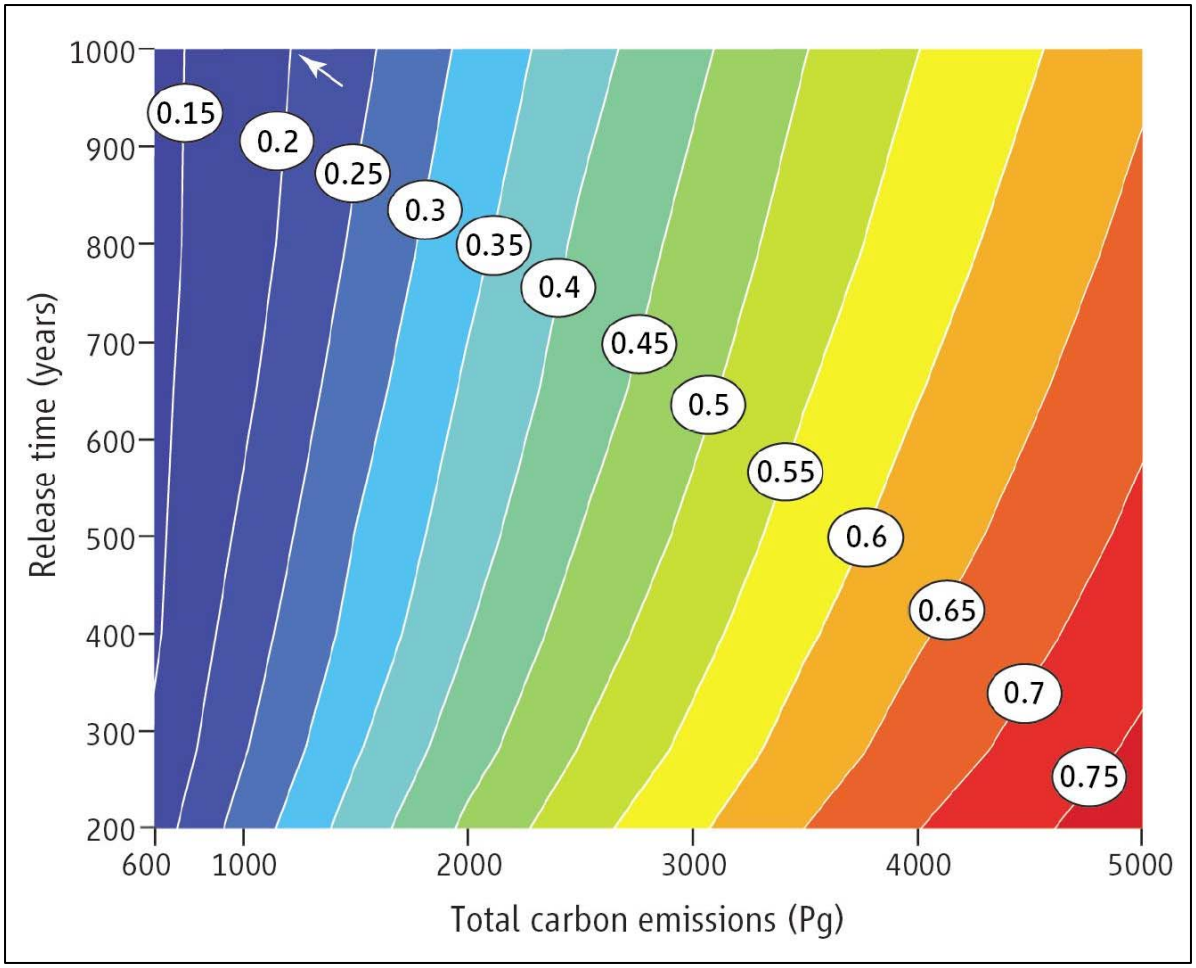


$$10^{-7.5}/10^{-8.2} \simeq 5$$

Emission Targets



Surface Ocean *p*H Decline



OCEANS PERSPECTIVES

Carbon Emissions and Acidification

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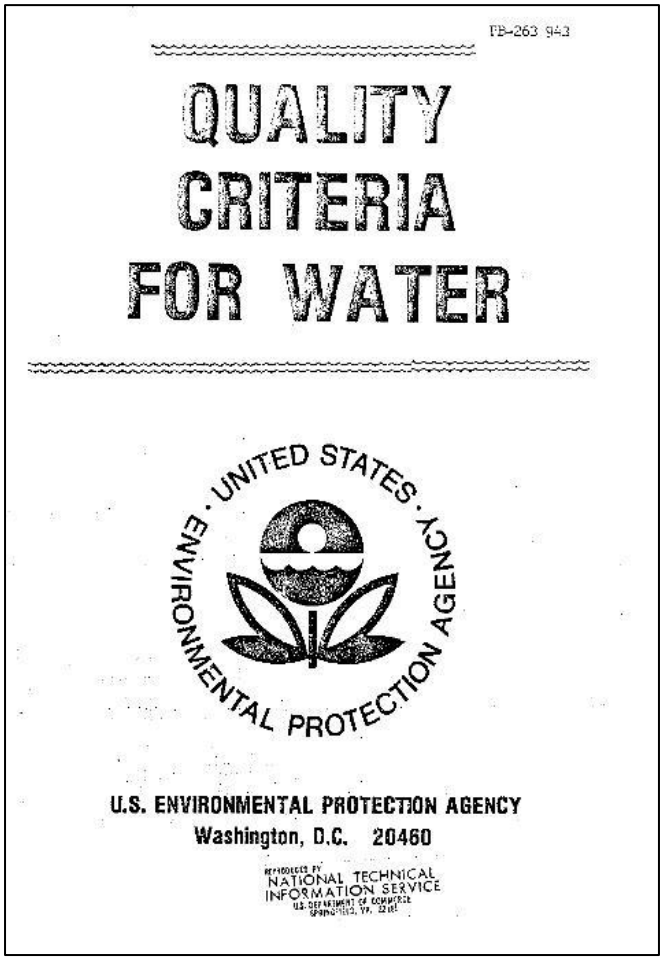
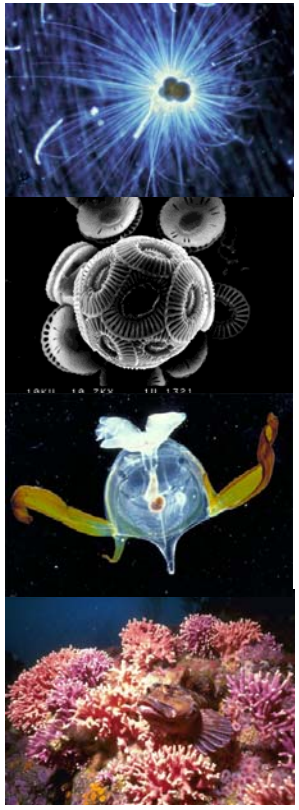


Standards?

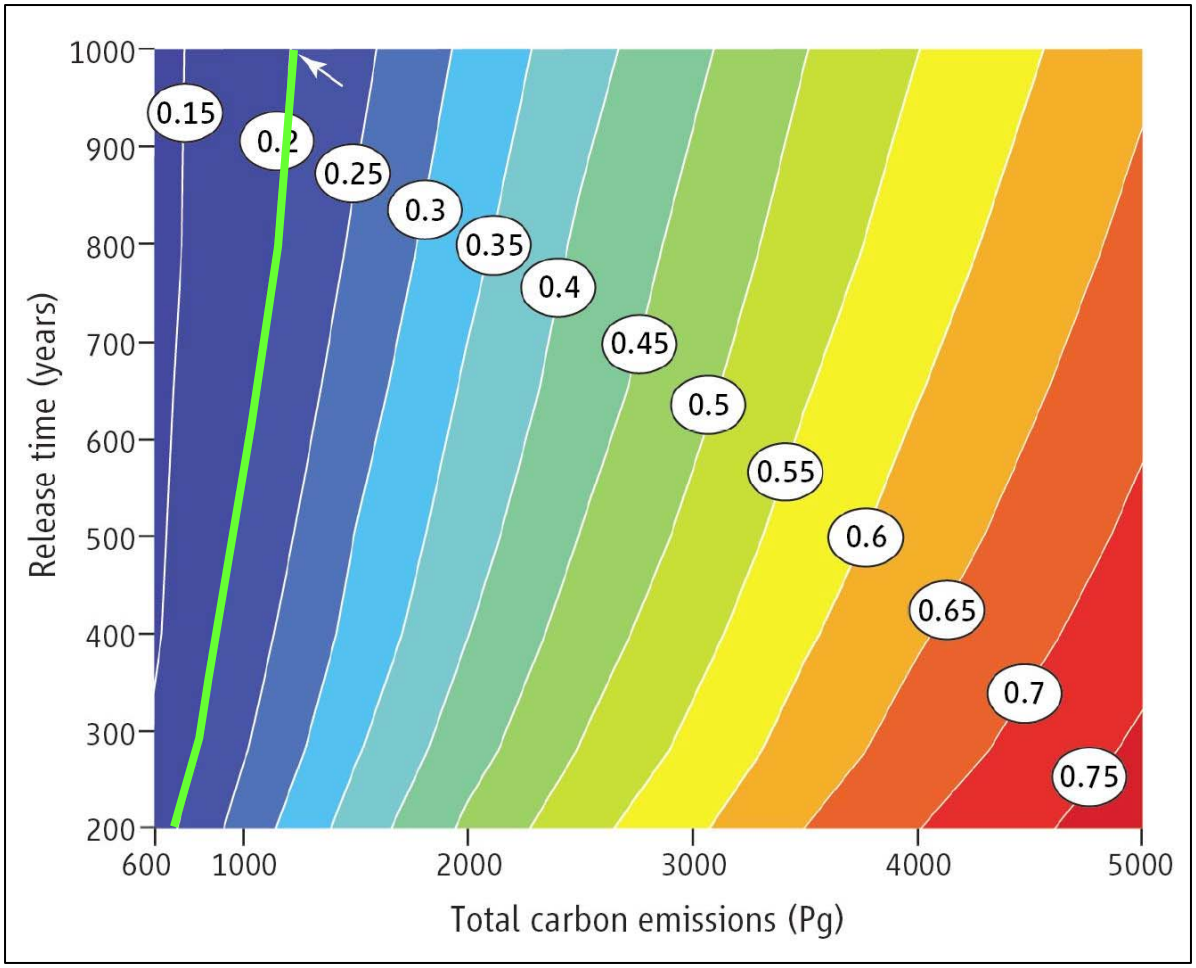
U.S. Environmental Protection Agency (1976):

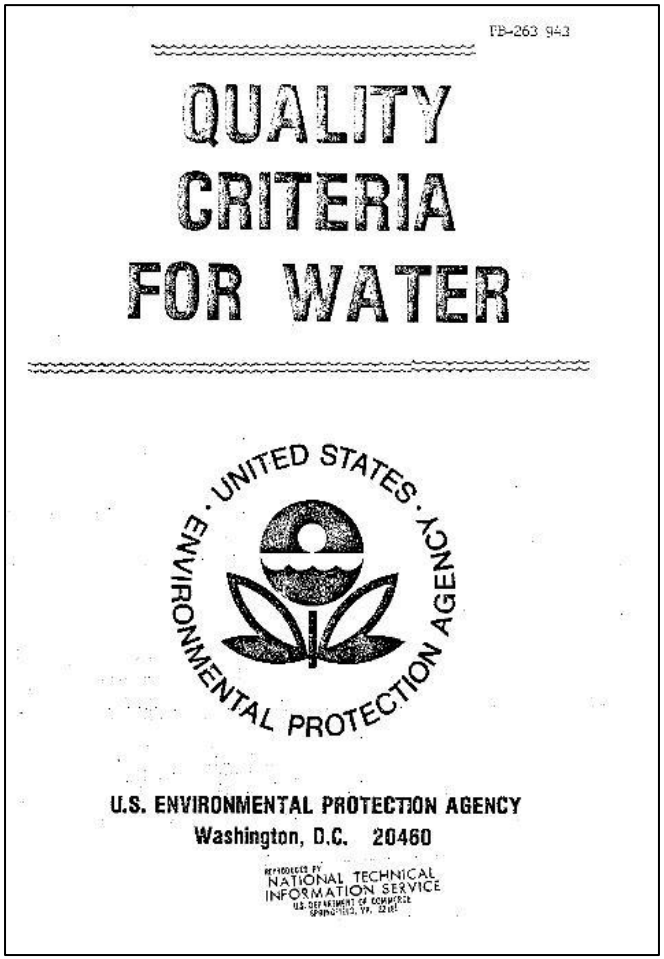
"For marine aquatic life, *p*H should not be changed more than 0.2 units outside of the normally occurring range"

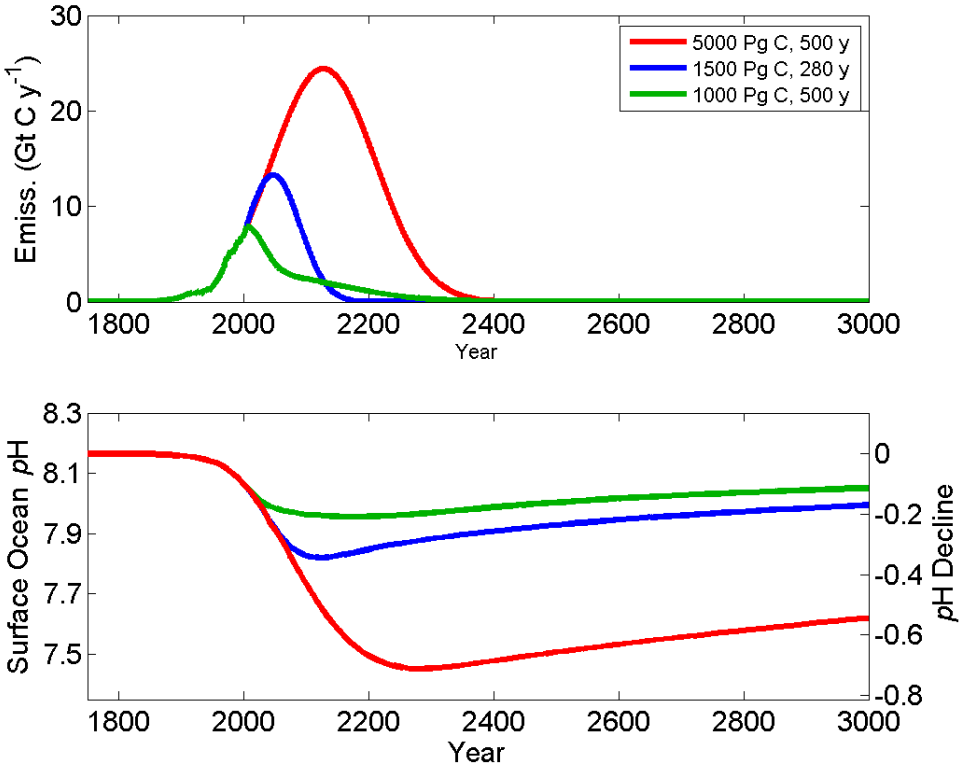
Emission Targets



Surface Ocean *p*H Decline







Following U.S. Environmental Protection Agency Criteria, emission need to be reduced ***immediately***.