

Precipitation Induced Changes in Surface Ocean $p\text{CO}_2$: Observations from the Eastern Tropical Pacific During SPURS-2

David T. Ho

Department of Oceanography, University of Hawaii, Honolulu, HI 96822, USA



**SCHOOL OF OCEAN AND EARTH
SCIENCE AND TECHNOLOGY**
UNIVERSITY OF HAWAI'I AT MĀNOA

Background...

Fate of anthropogenic CO₂ emissions (2007–2016)

Sources = Sinks



34.4 GtCO₂/yr
88%



12%
4.8 GtCO₂/yr



17.2 GtCO₂/yr
46%



30%
11.0 GtCO₂/yr



24%
8.8 GtCO₂/yr

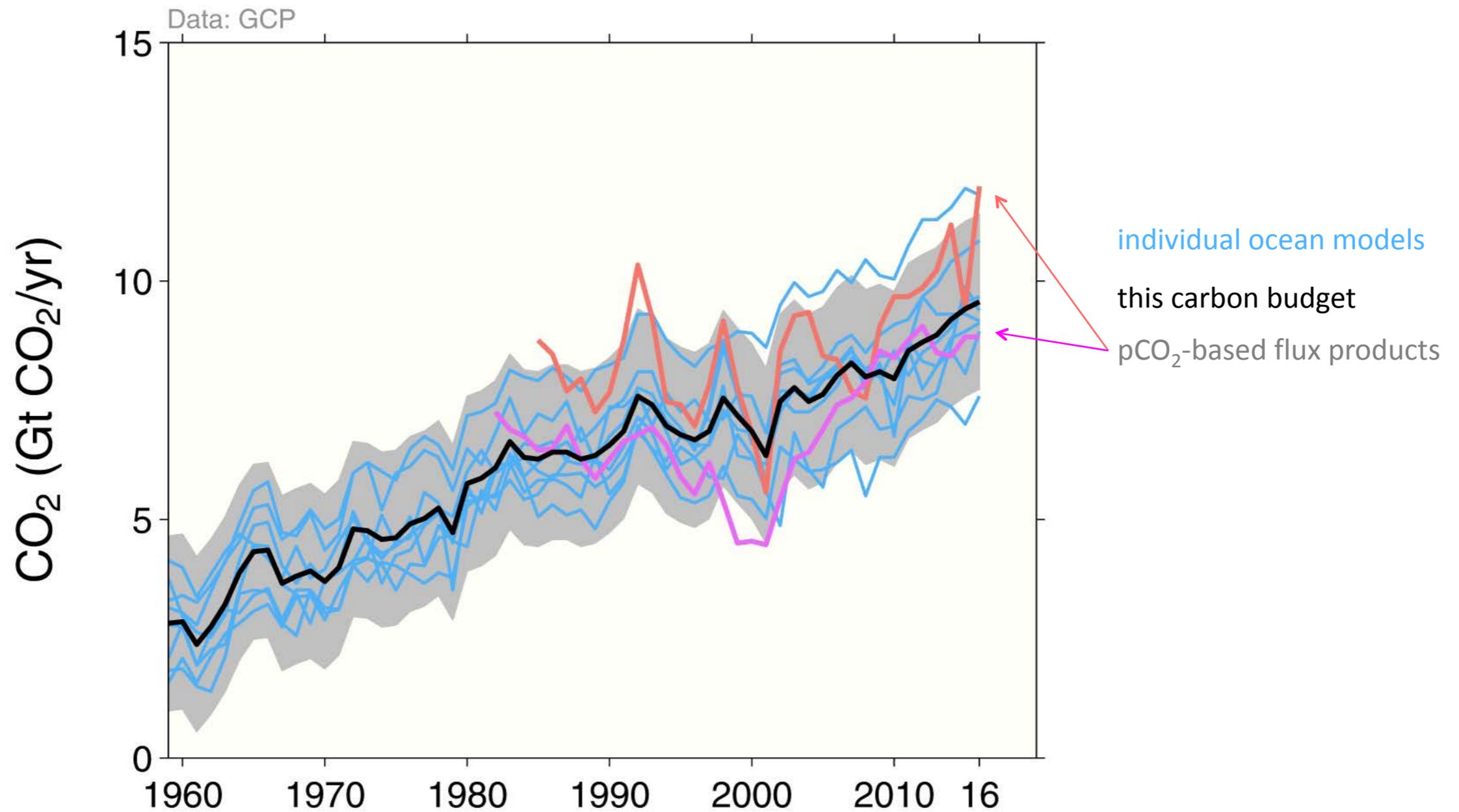
Budget Imbalance:

(the difference between estimated sources & sinks)

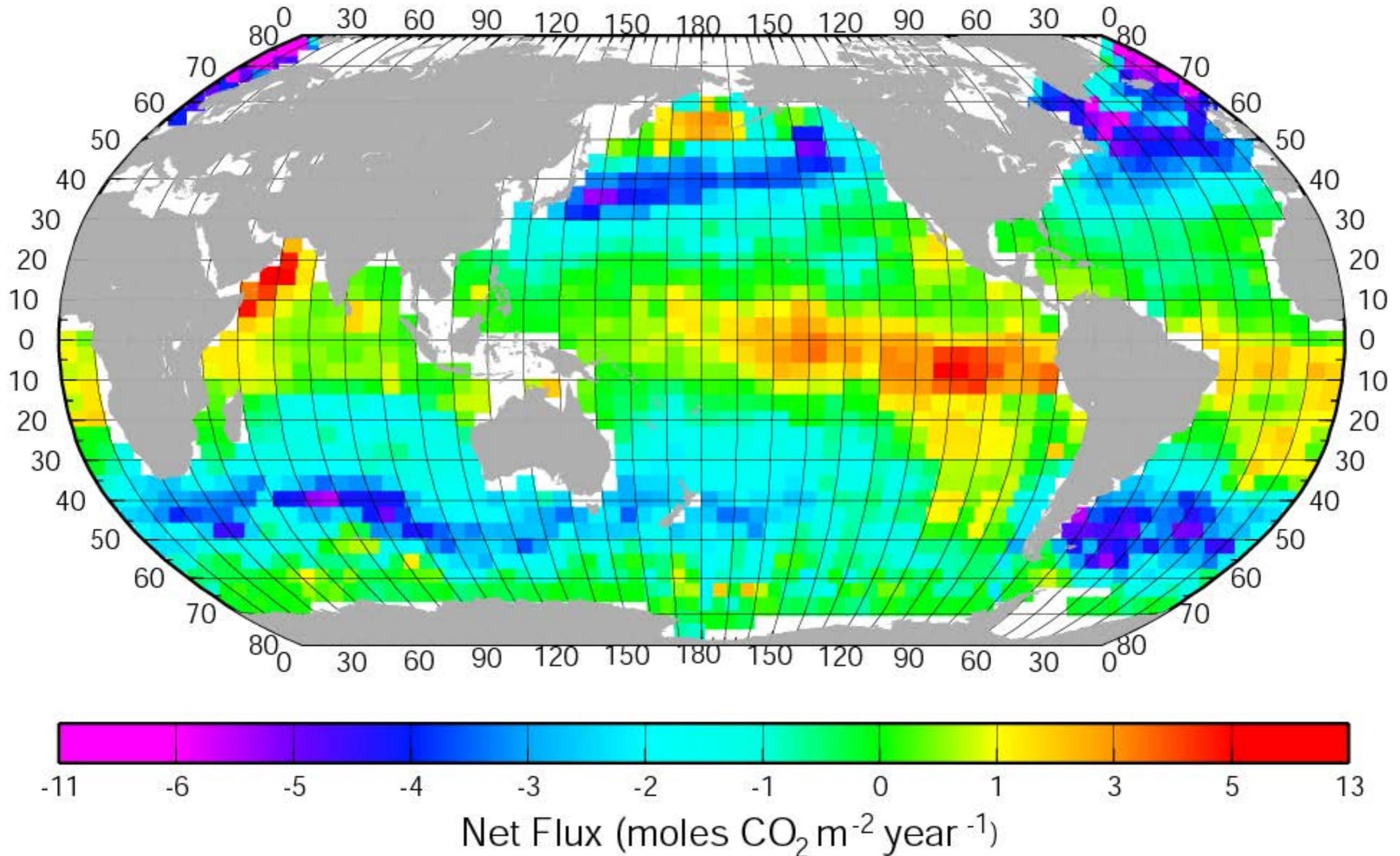
6%

2.2 GtCO₂/yr

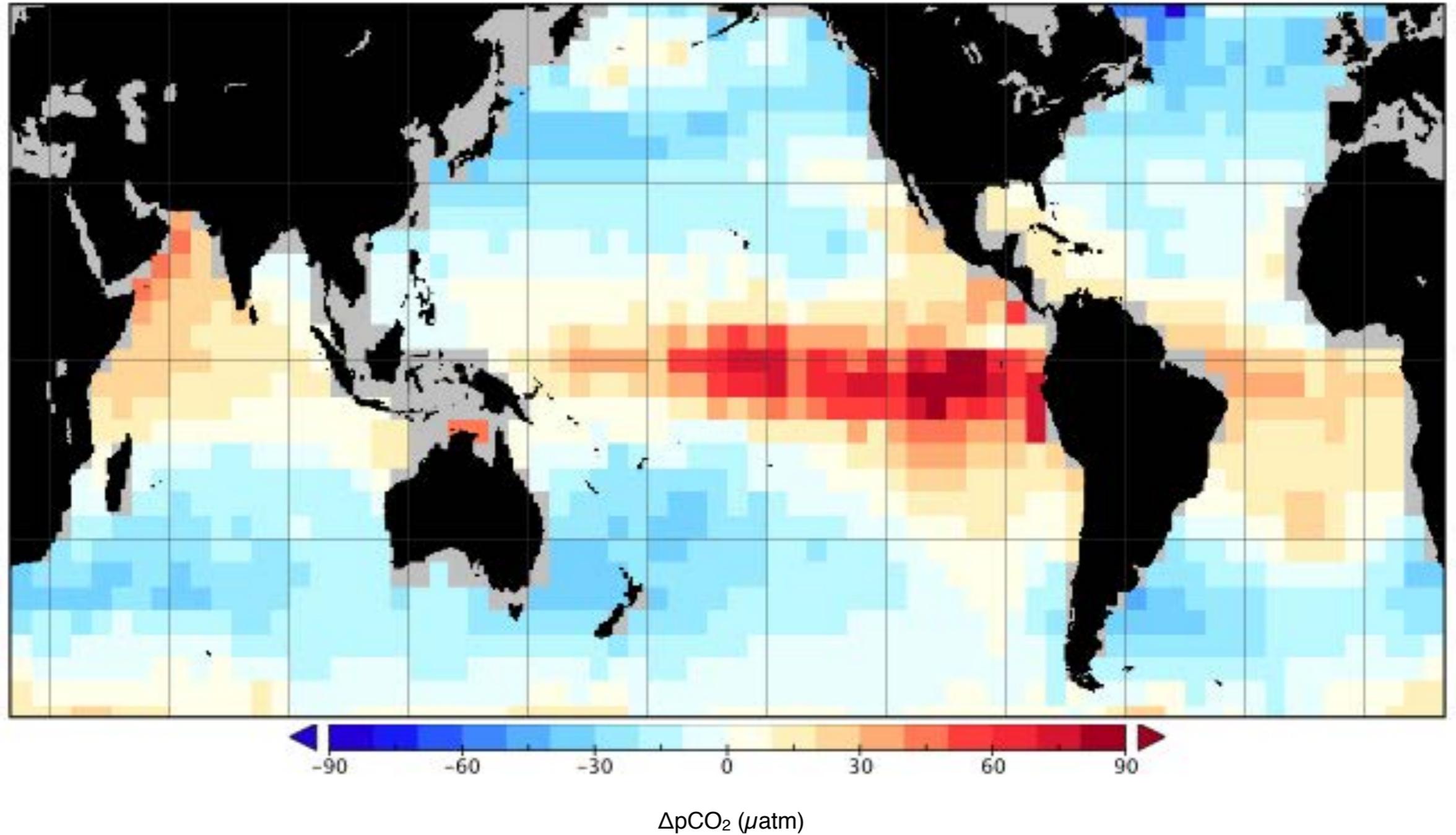
The ocean carbon sink continues to increase
 8.7 ± 2 GtCO₂/yr for 2007–2016 and 9.6 ± 2 GtCO₂/yr in 2016



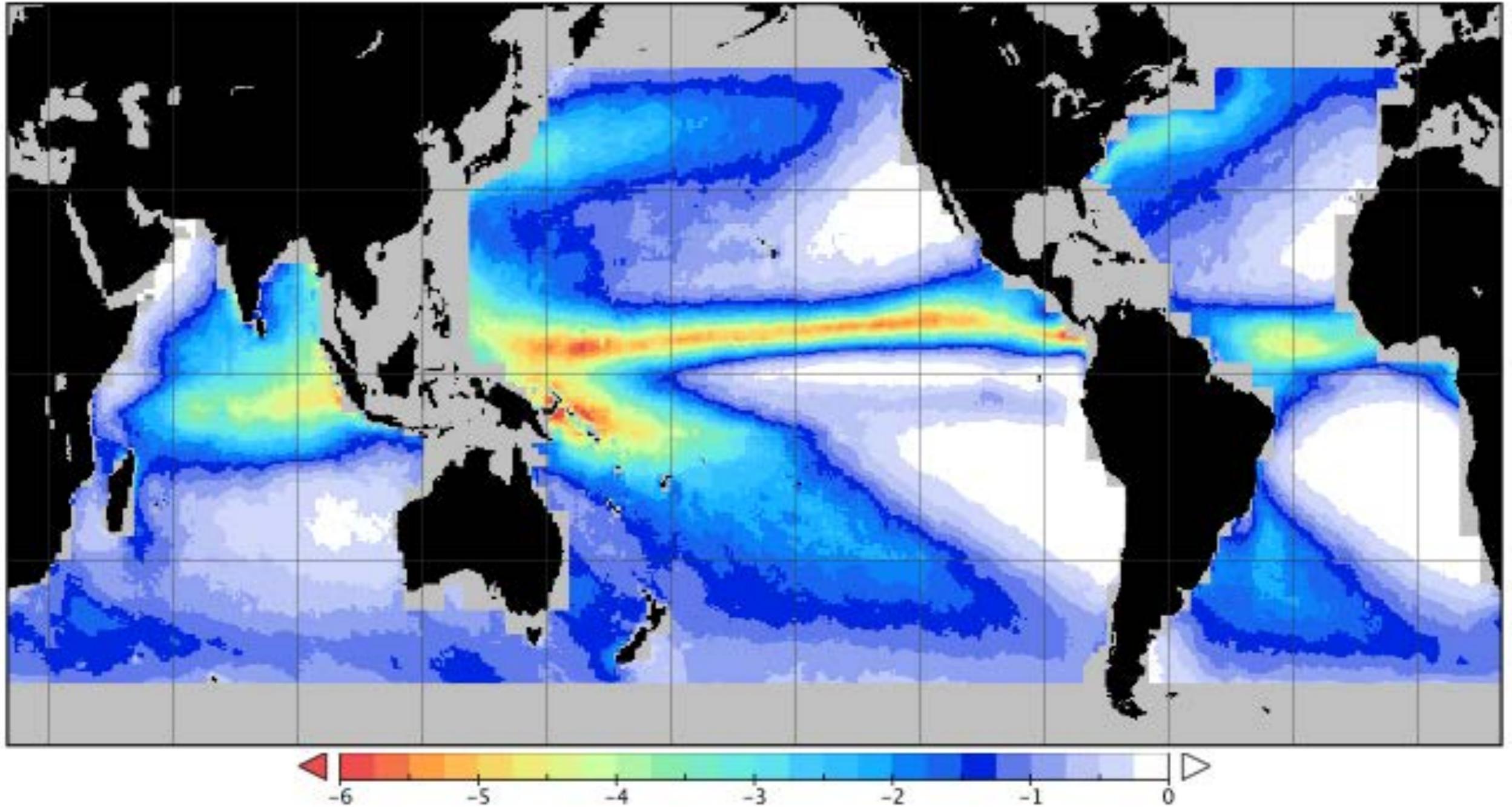
Uptake of Atmospheric CO₂



$\Delta p\text{CO}_2$ climatology (seawater - atm in μatm)

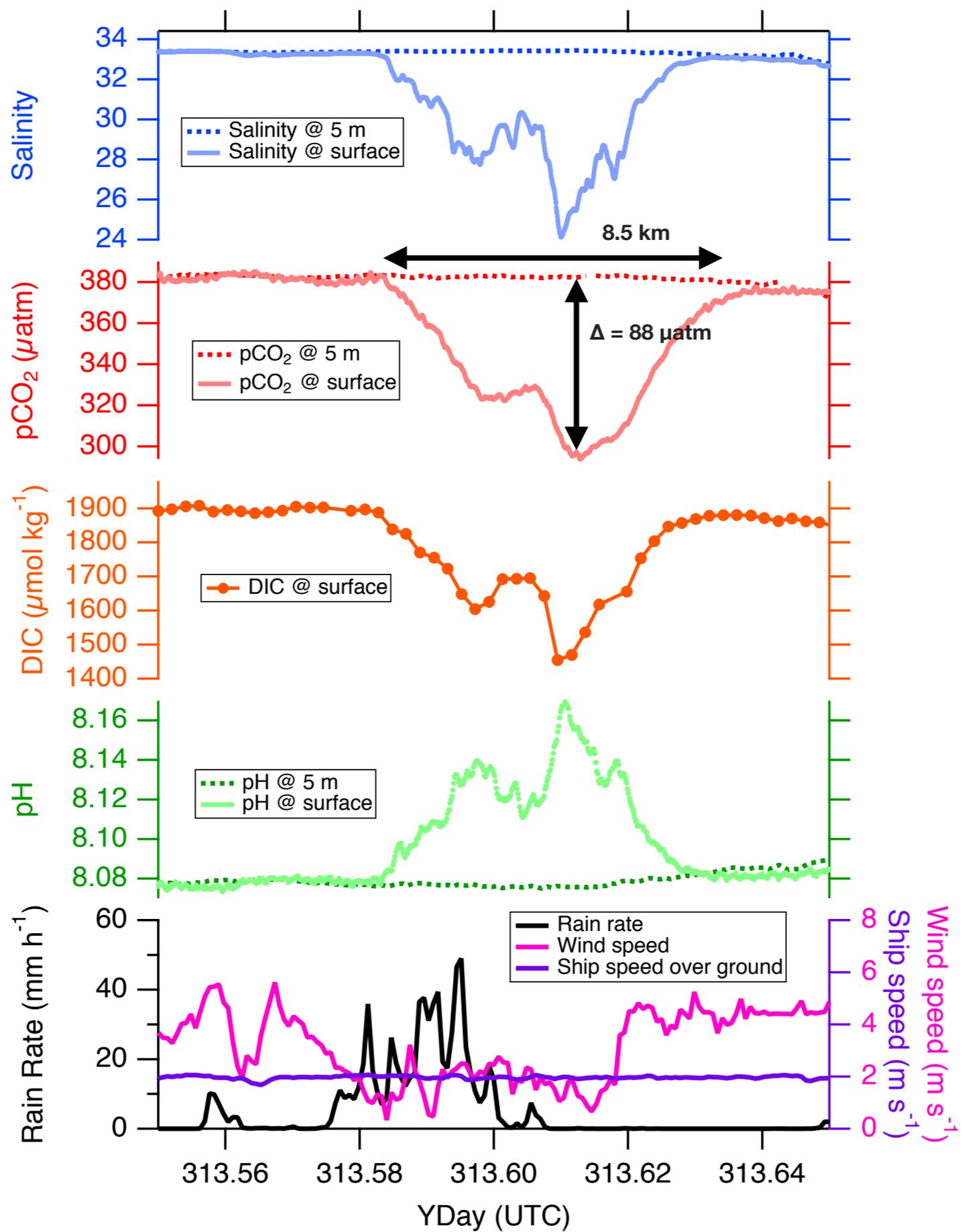


Modeled surface pCO₂ reduction (in μatm) due to rain for year 2000



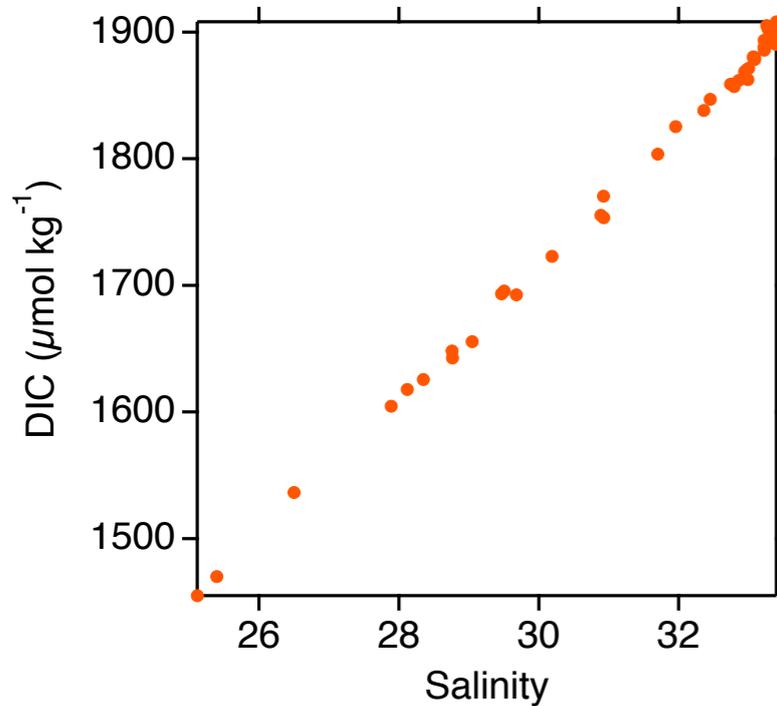
Data from SPURS-2...

YD 313, SPURS-2

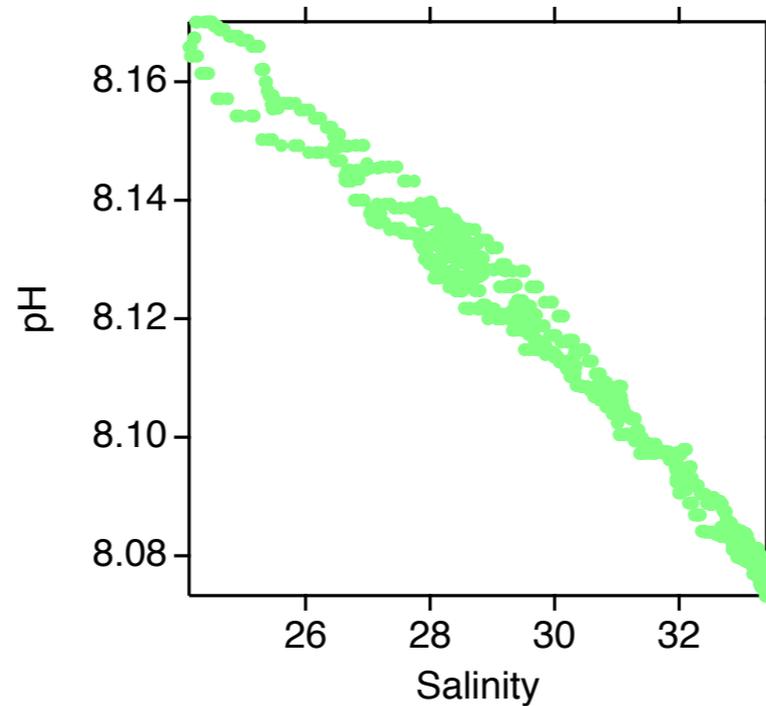


Relationships between DIC, pH, pCO₂ and salinity (YD 313, SPURS-2)

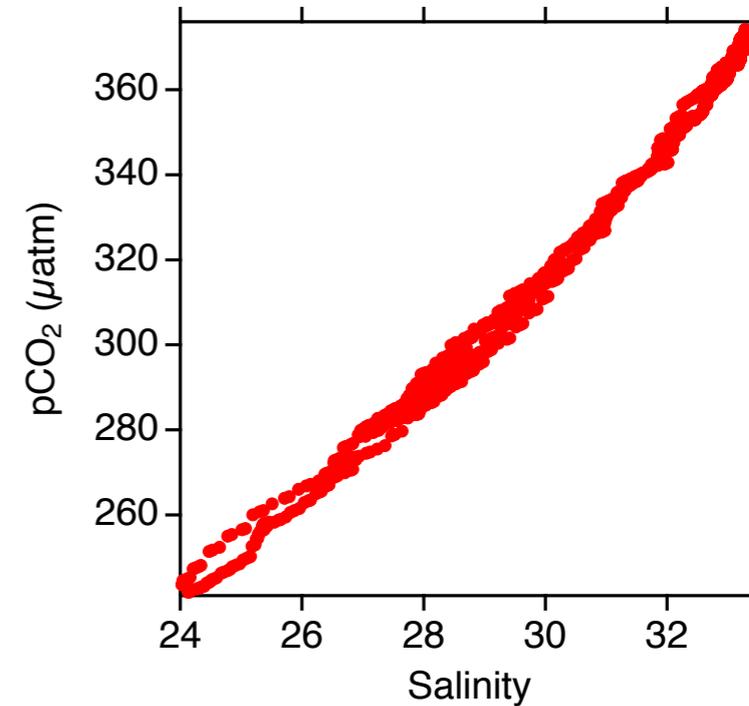
DIC



pH



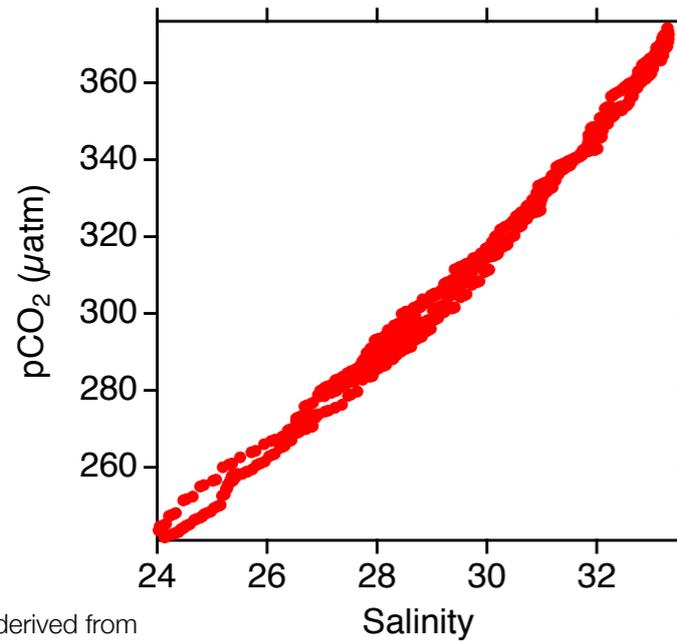
pCO₂



Ultimately...

Effect of rain on air-sea CO₂ flux: Results from SPURS-2 and satellite salinity

Relationship between salinity and pCO₂ from SPURS-2

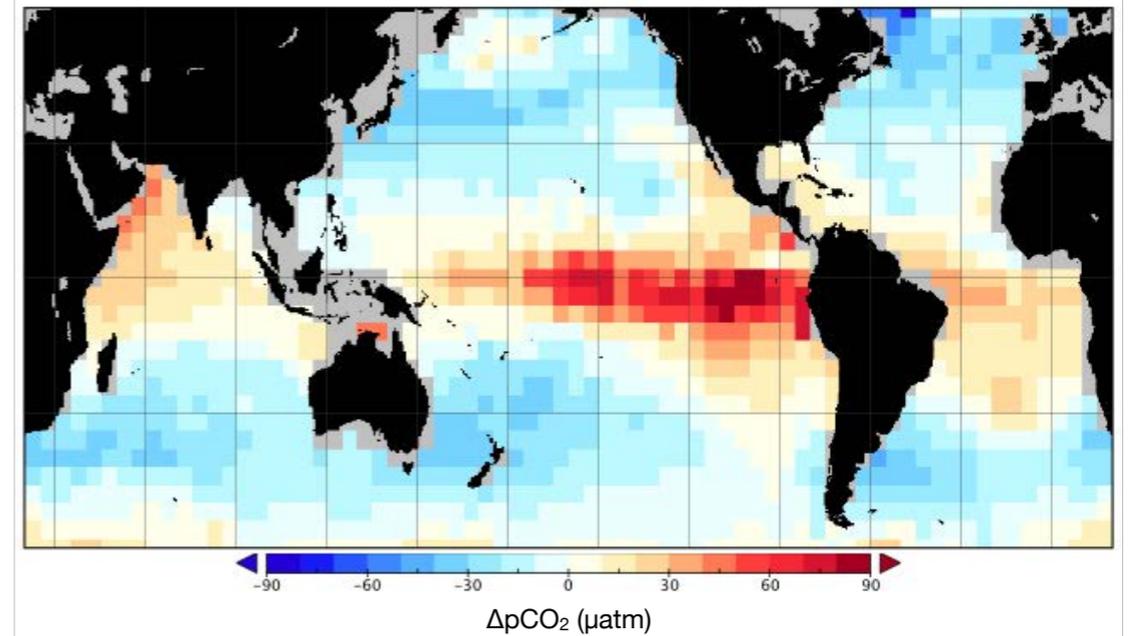


relationship derived from observation made on YD 313, 2017 during SPURS-2

+

use SPURS-2 data and satellite salinity to modify ΔpCO₂ climatology

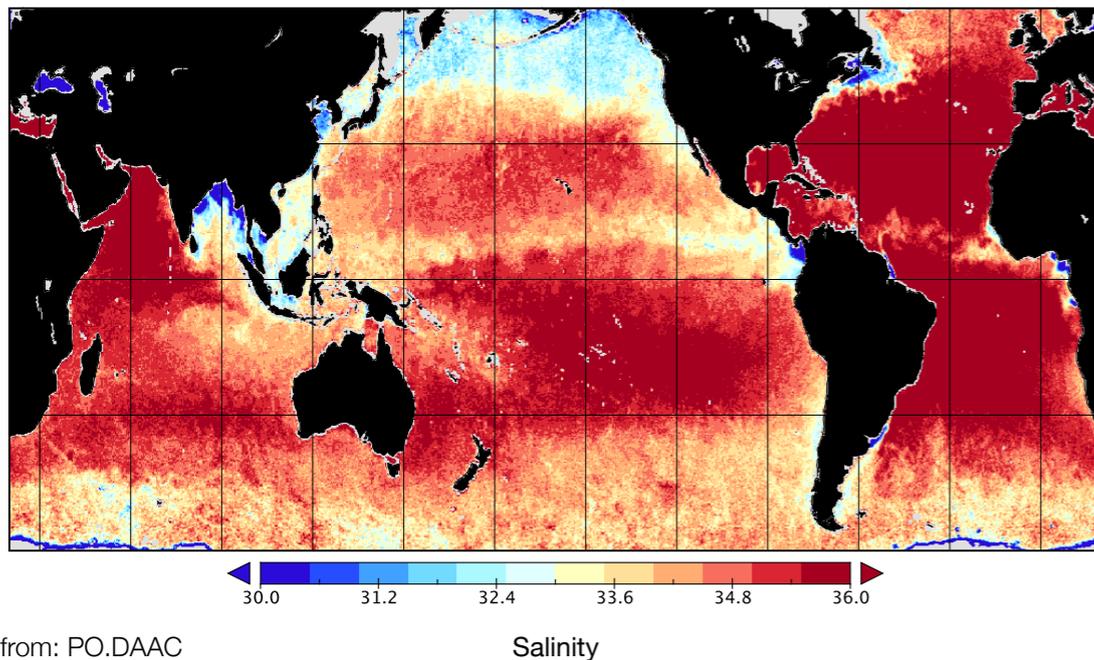
Takahashi ΔpCO₂ climatology



data from: <http://www.ldeo.columbia.edu/res/pi/CO2/>

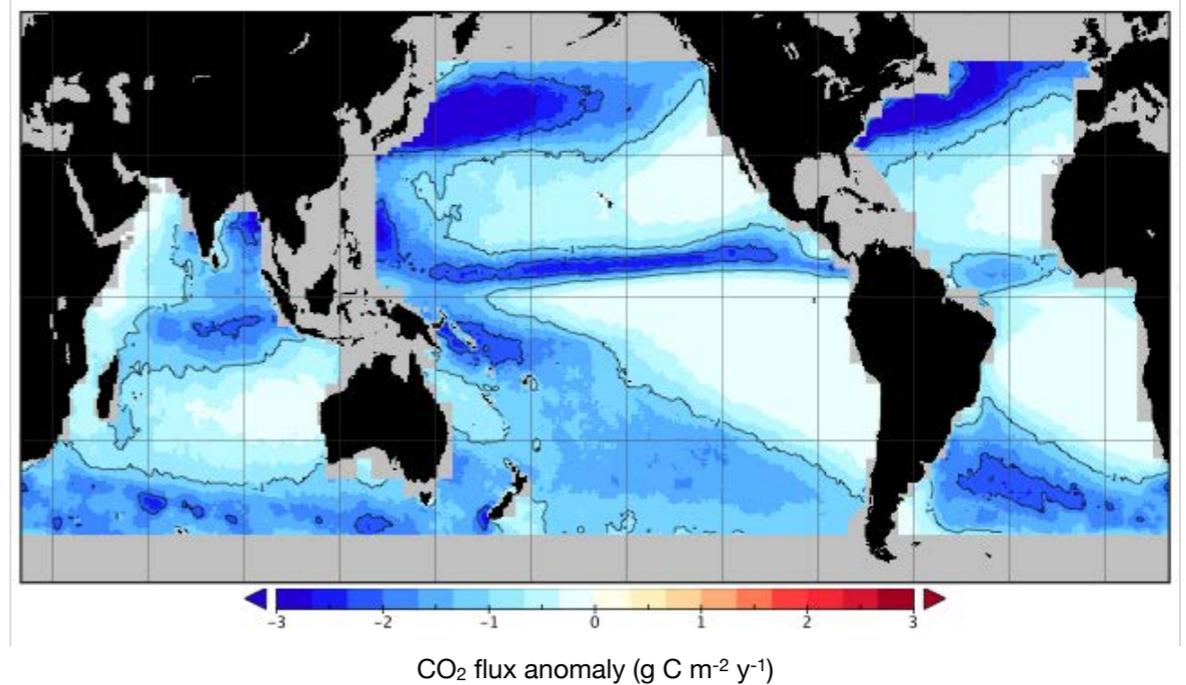
Determine CO₂ flux based on modified ΔpCO₂ climatology

SMAP Sea Surface Salinity (YD 131; 2017)



data from: PO.DAAC

Difference in air-sea CO₂ flux due to rain



Develop parameterization between wind, rain, etc. and pCO₂

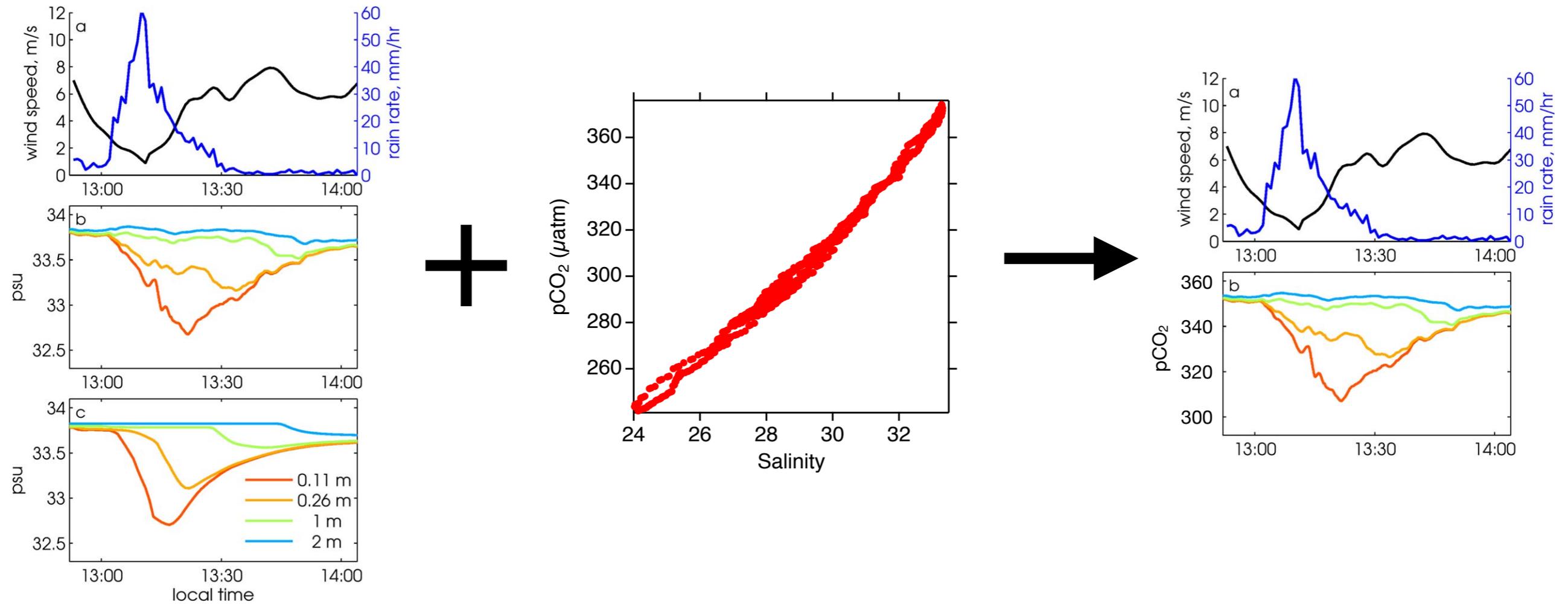
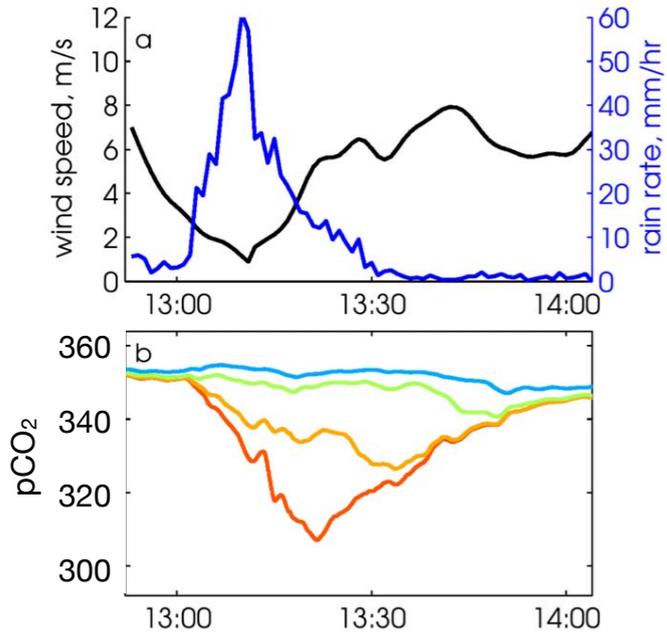


Figure 1. Observed and modeled rain event from the central Pacific Ocean. (a) Ship-based measurements of wind speed and rain rate made in 2011. (b) Salinity at four depths measured by the SSP. (c) GOTM simulation of salinity at the same four depths.

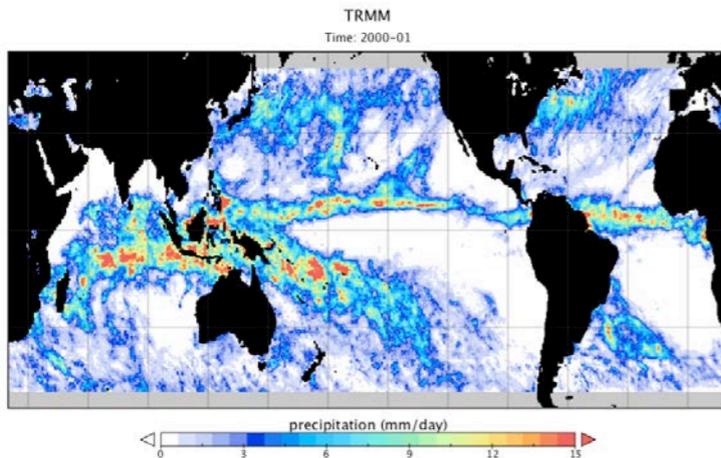
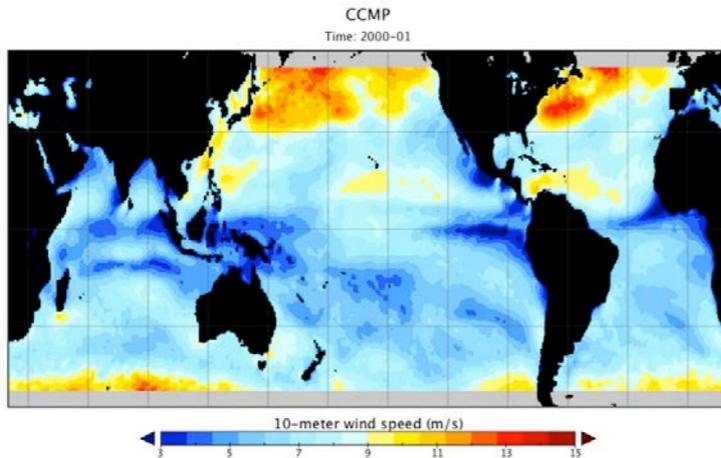
Effect of rain on air-sea CO₂ flux: Results from parameterization

Parameterization between wind, rain, etc. and pCO₂



+

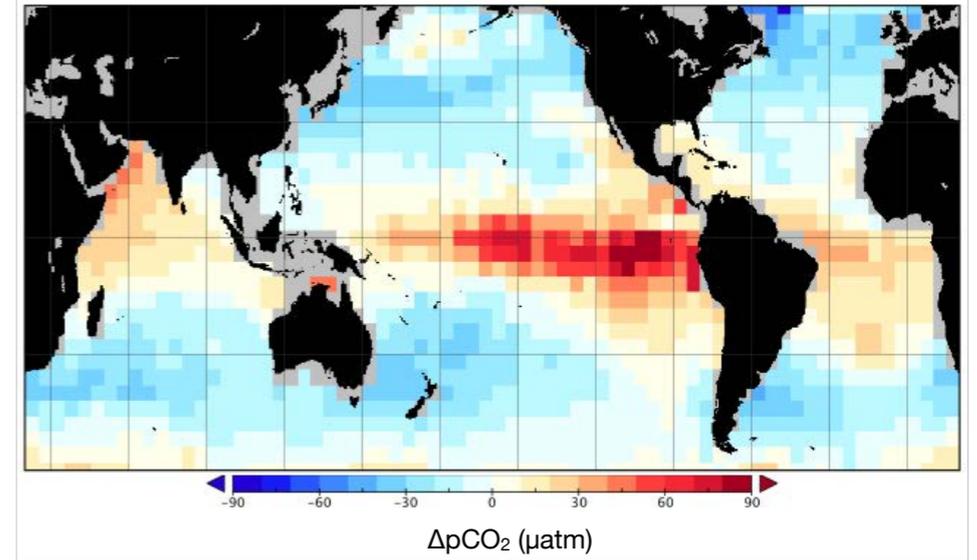
Modeled or measured wind speed and rain rates



&

use parameterization and wind and rain to modify ΔpCO₂ climatology

Takahashi ΔpCO₂ climatology

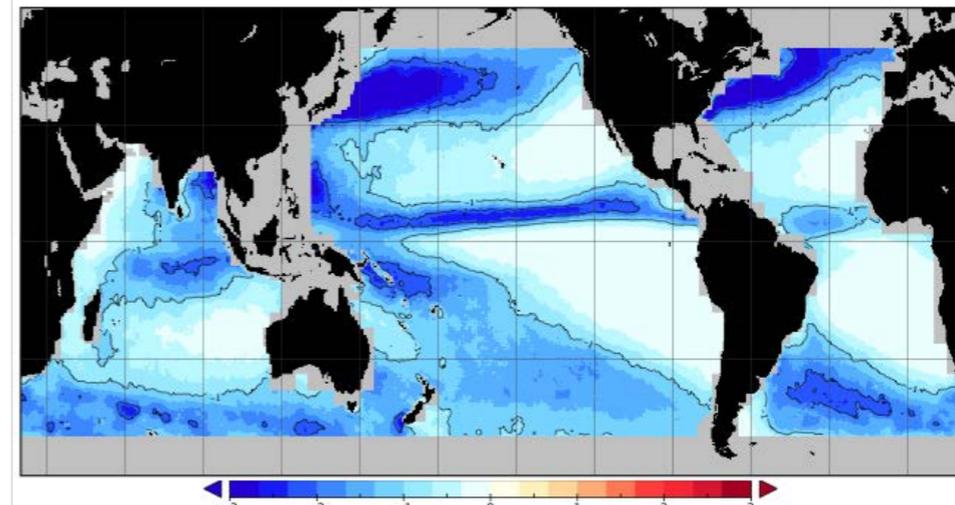


data from: <http://www.ldeo.columbia.edu/res/pi/CO2/>



Determine CO₂ flux based on modified ΔpCO₂ climatology

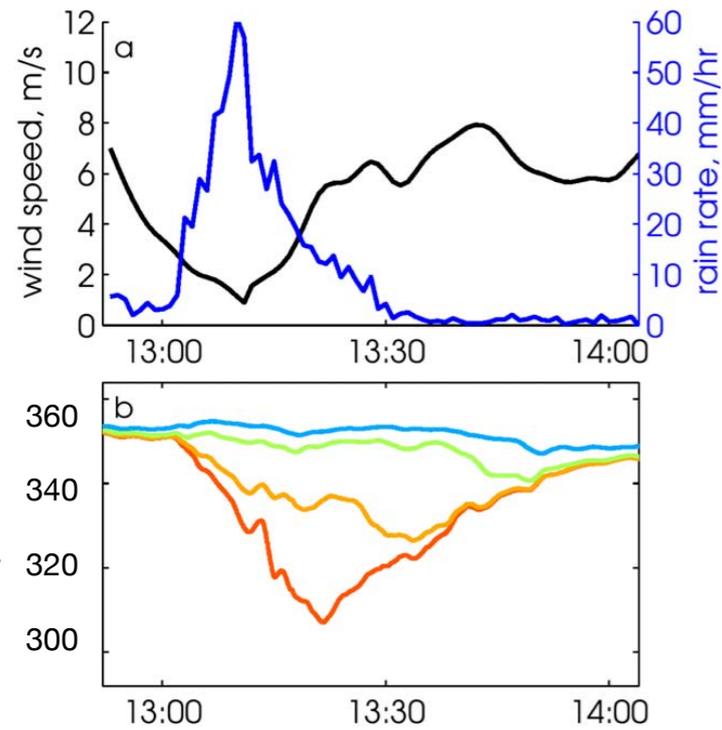
Difference in air-sea CO₂ flux due to rain



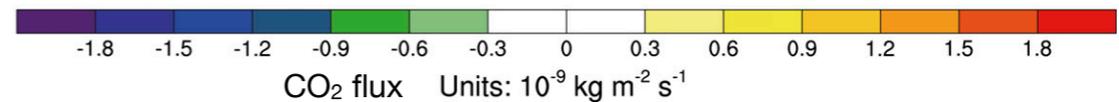
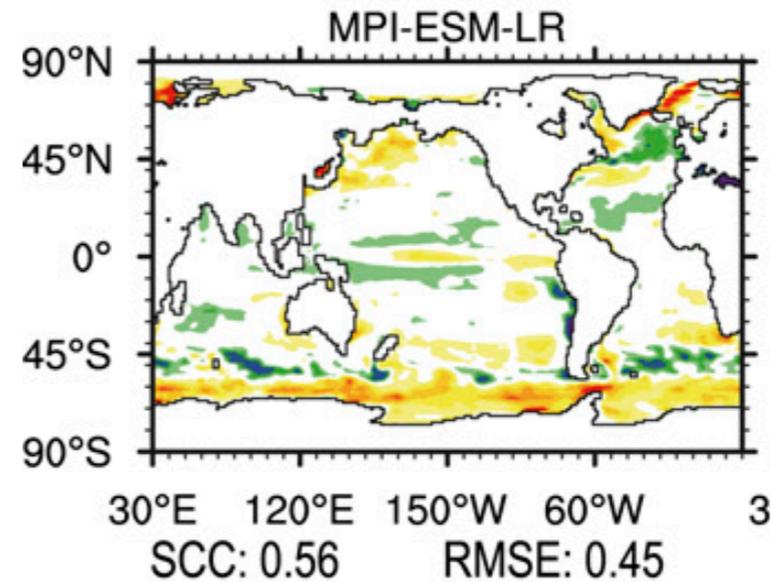
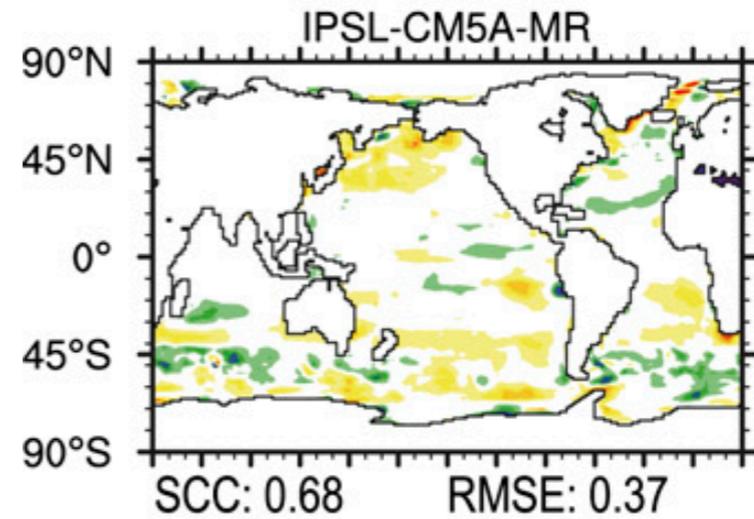
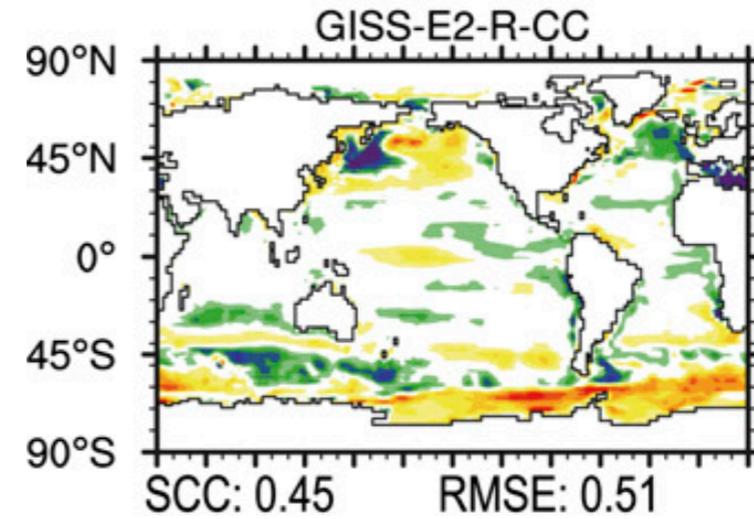
CO₂ flux anomaly (g C m⁻² y⁻¹)

Effect of rain on air-sea CO₂ flux: Results from GCMs

Parameterization between wind, rain, etc. and pCO₂



use parameterization in global climate model with full carbon cycle



German Climate Computing Centre (DKRZ)