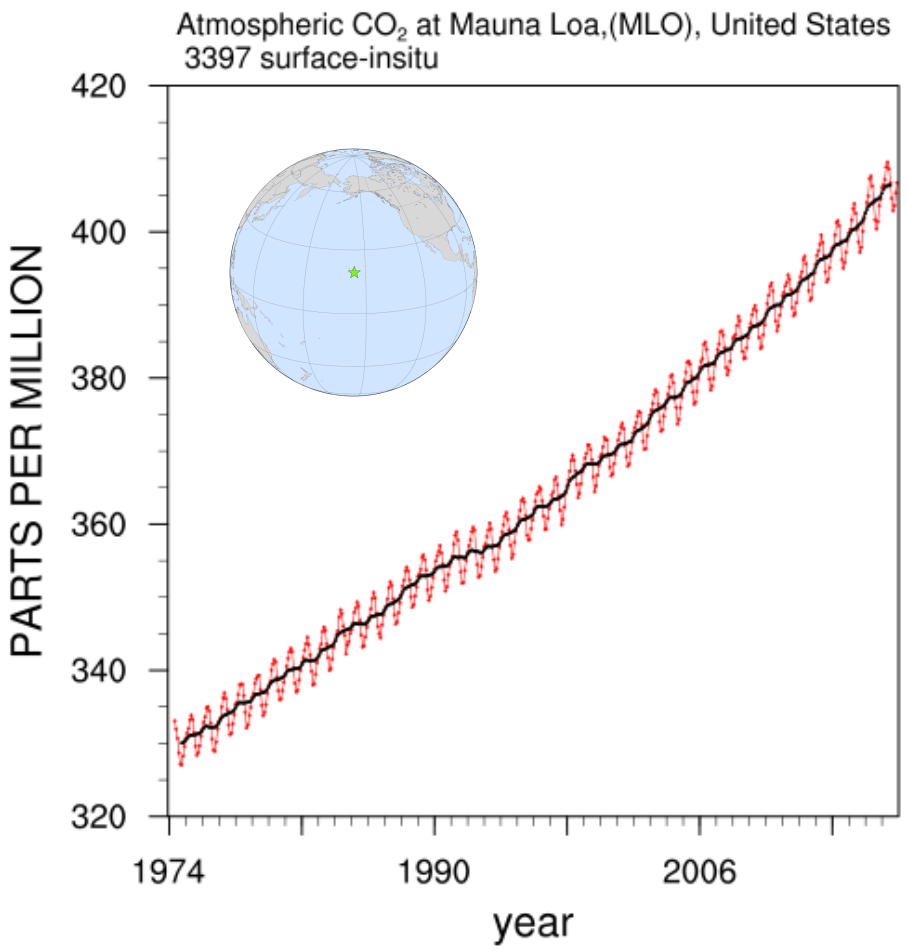
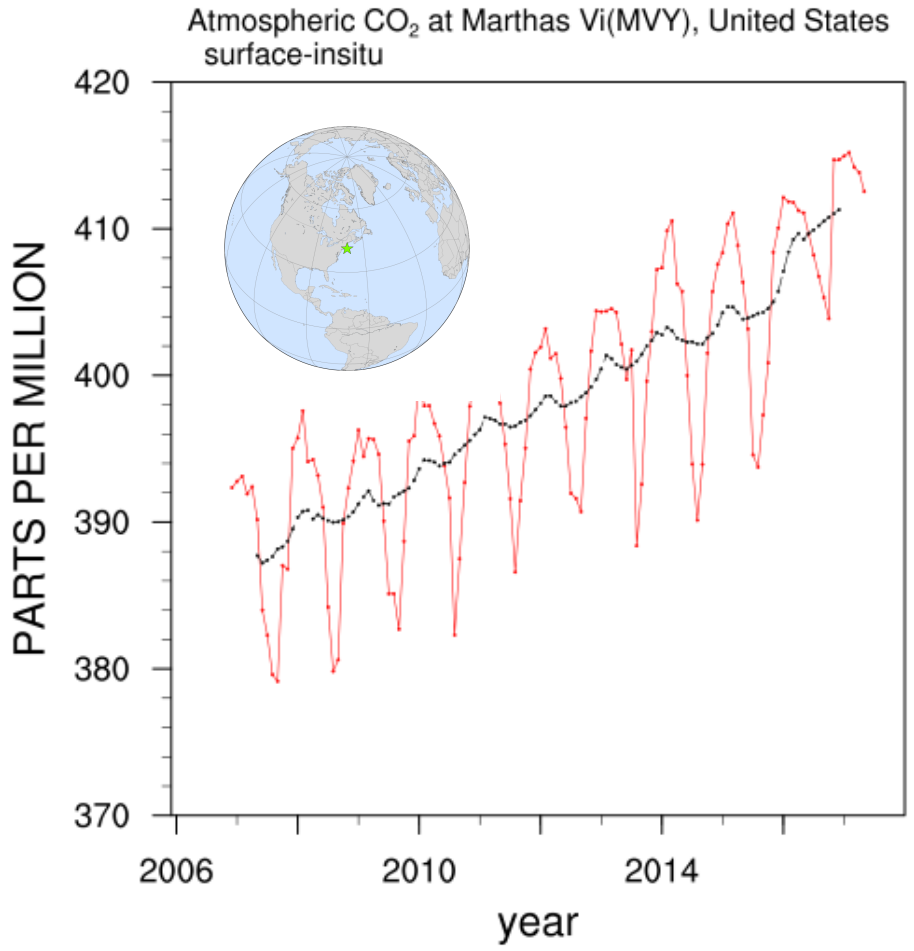
Ocean Acidification and New York

A presentation to New York State Ocean Acidification Task Force

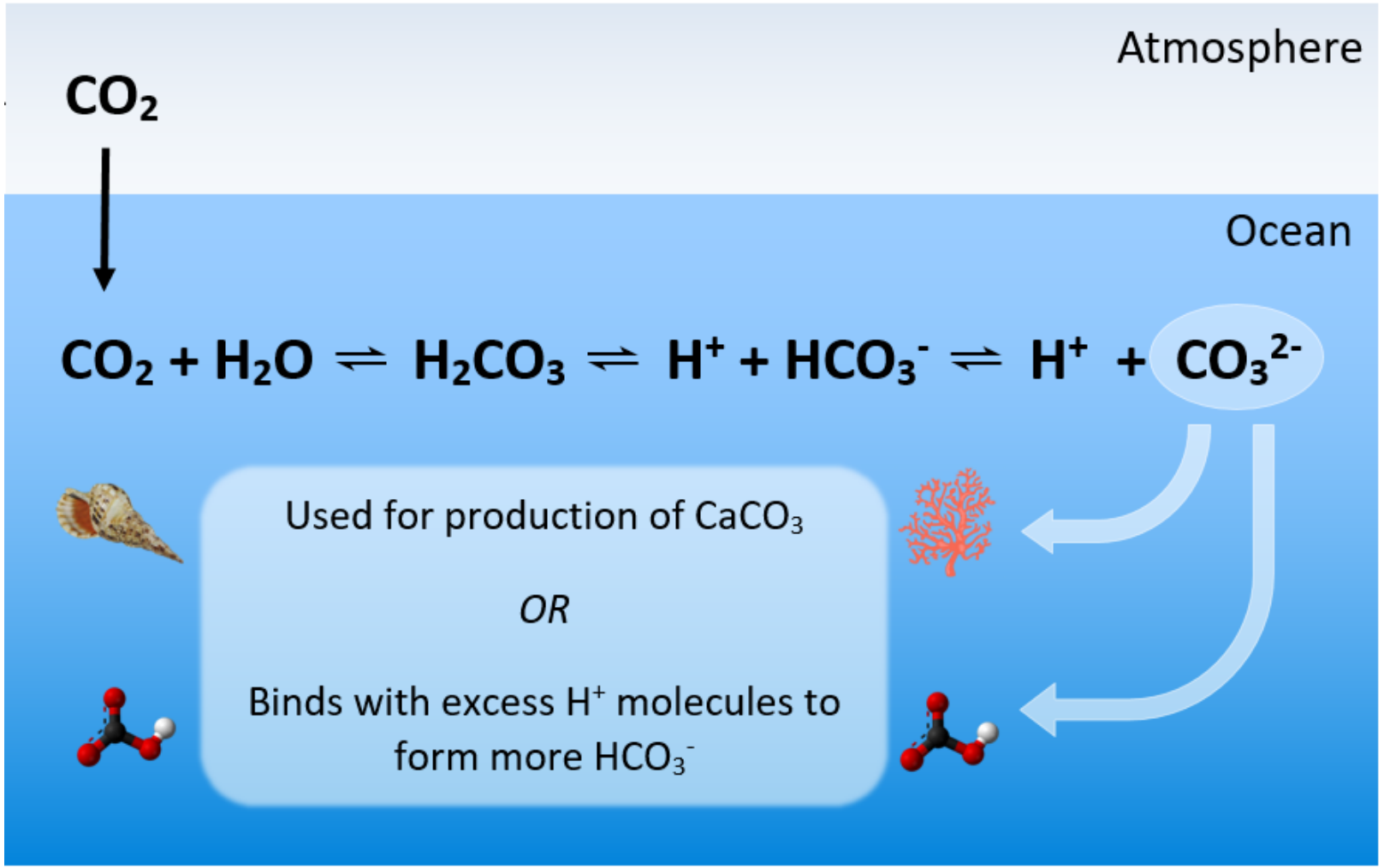
Dr. Janet Nye

Increasing carbon dioxide in the atmosphere

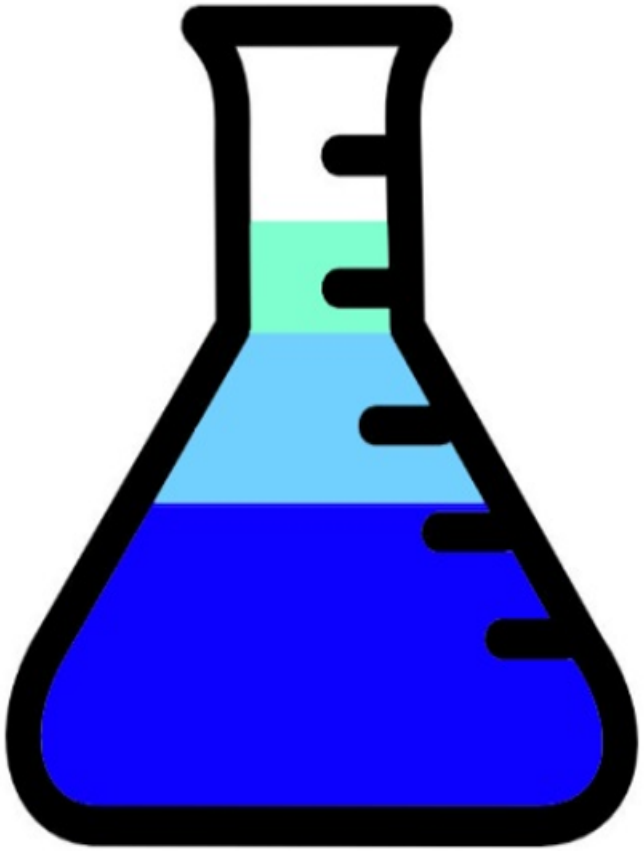




Ocean acidification



Carbonic acid “steals” bicarbonate ions from shell-forming animals



Carbon dioxide
Carbonate ions
Bicarbonate ions

Coastal acidification

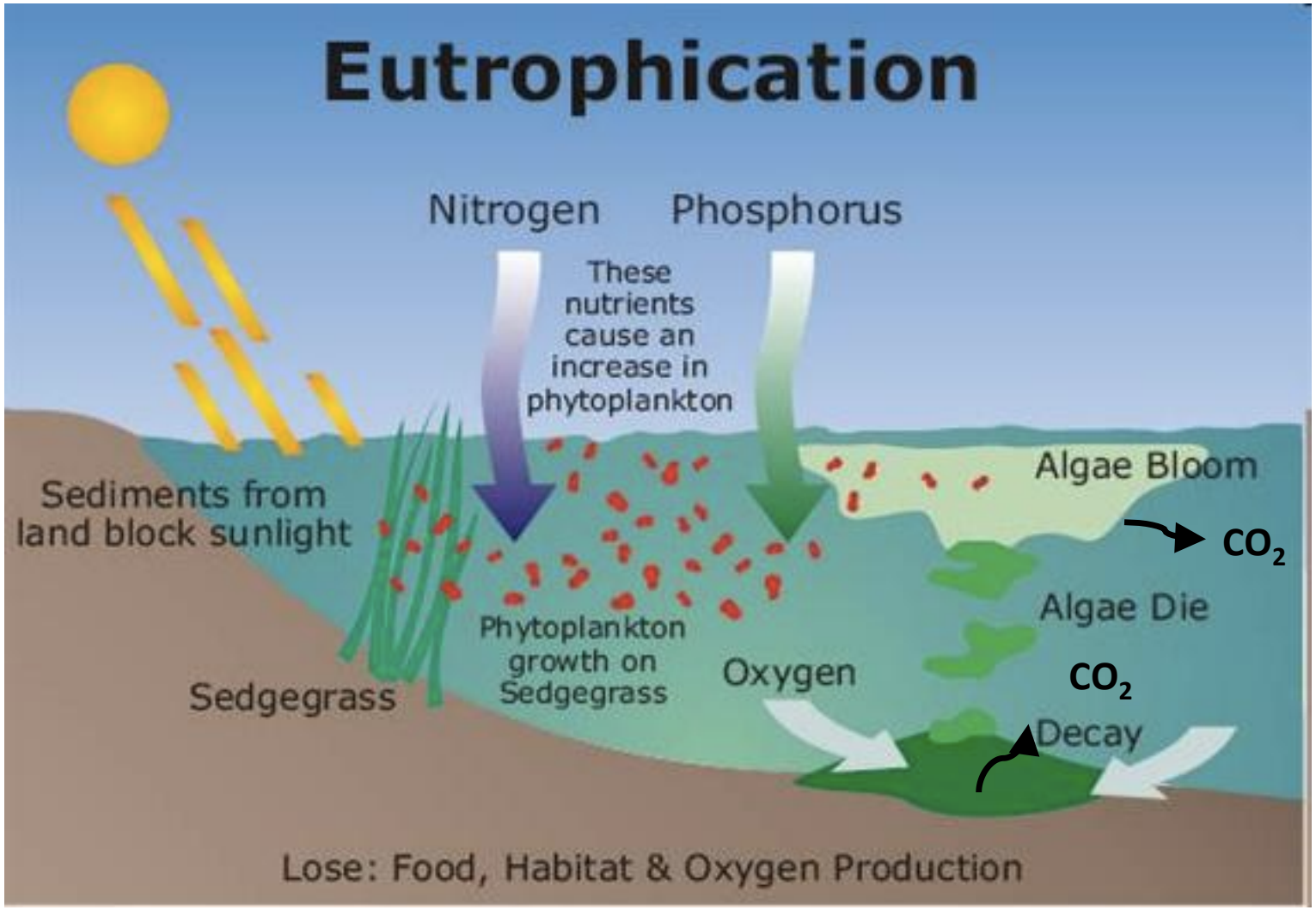
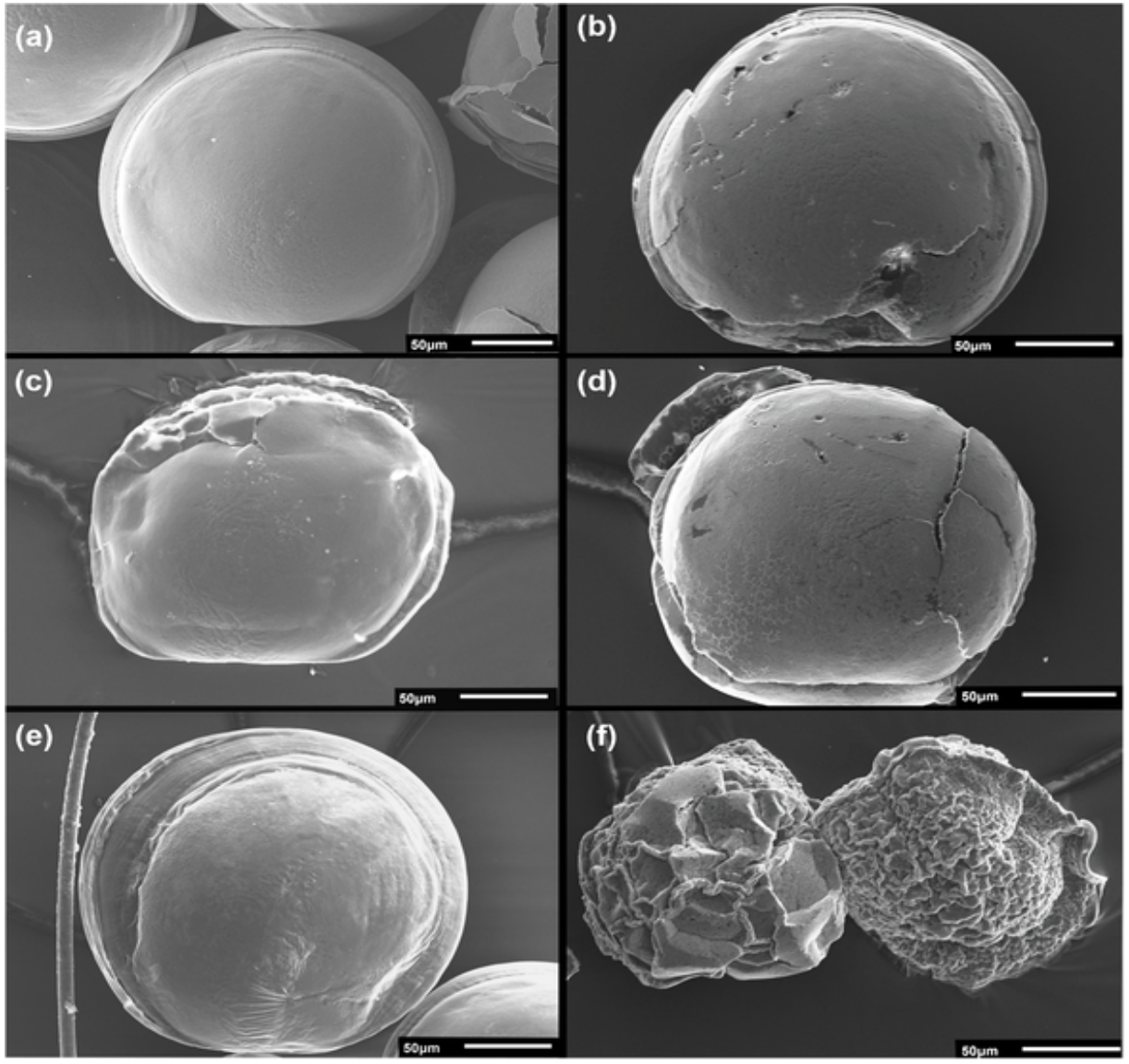
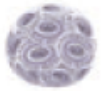


Fig 3. SEM images of D-larvae from various experimental treatments.



Bylenga CH, Cummings VJ, Ryan KG (2017) High resolution microscopy reveals significant impacts of ocean acidification and warming on larval shell development in Laternula elliptica. PLOS ONE 12(4): e0175706. https://doi.org/10.1371/journal.pone.0175706
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0175706

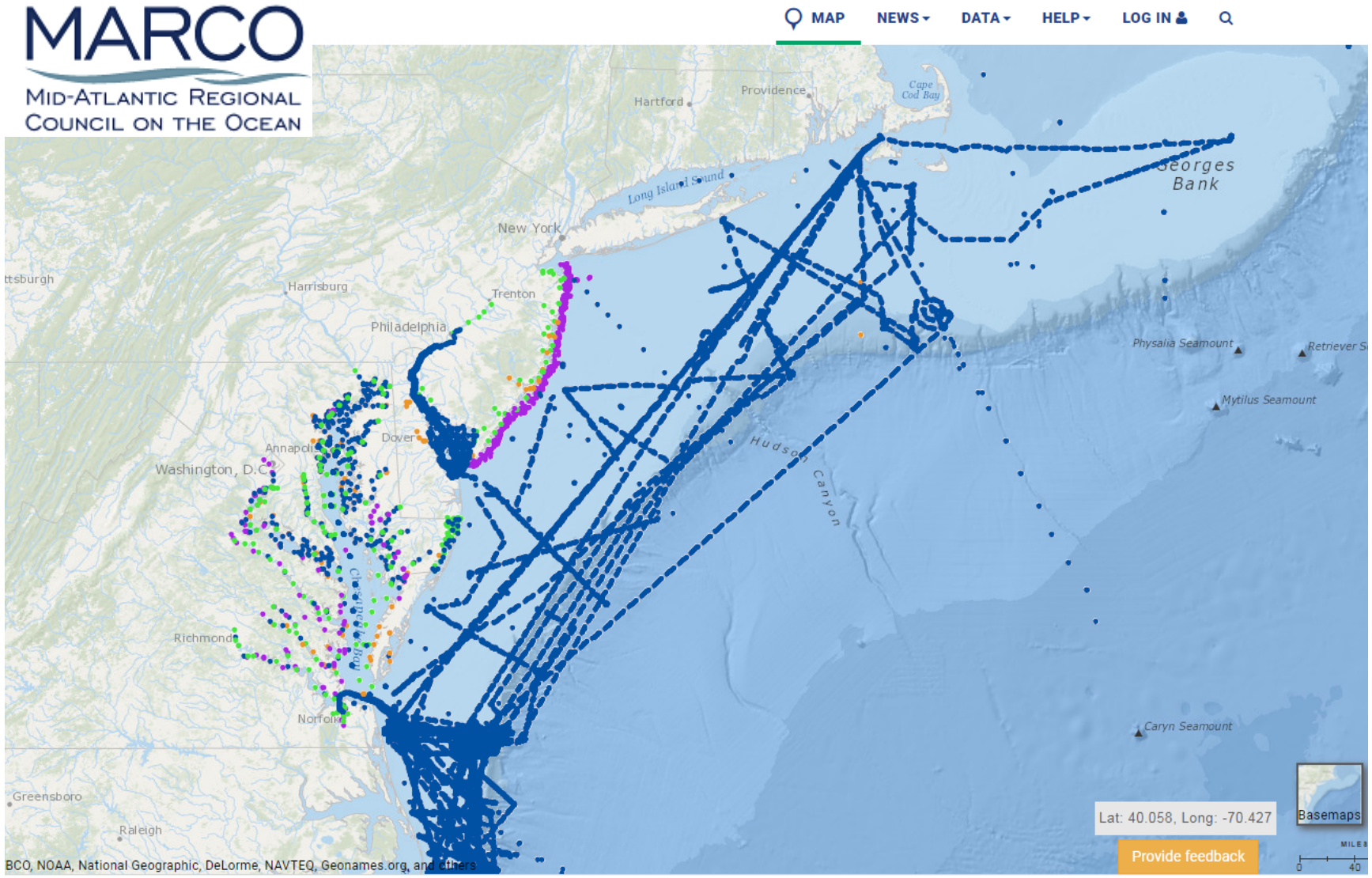
Taxa	Response	Mean Effect
 Calcifying algae	Survival	
	Calcification	
	Growth	
	Photosynthesis	−28%
	Abundance	−80%
 Corals	Survival	
	Calcification	−32%
	Growth	
	Photosynthesis	
	Abundance	−47%
 Coccolithophores	Survival	
	Calcification	−23%
	Growth	
	Photosynthesis	
	Abundance	
 Mollusks	Survival	−34%
	Calcification	−40%
	Growth	−17%
	Development	−25%
	Abundance	
 Echinoderms	Survival	
	Calcification	
	Growth	−10%
	Development	−11%
	Abundance	
 Crustaceans	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
 Fish	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
 Fleshy algae	Survival	
	Calcification	
	Growth	+22%
	Photosynthesis	
	Abundance	
 Seagrasses	Survival	
	Calcification	
	Growth	
	Photosynthesis	
	Abundance	
 Diatoms	Survival	
	Calcification	
	Growth	+17%
	Photosynthesis	+12%
	Abundance	

- Not tested or too few studies
- Enhanced <25%
- 95% CI overlaps 0
- Reduced <25%
- Reduced >25%

What are the consequences?

- When all taxa are pooled together, the effects are generally negative
- Shell-forming organisms are the most at risk while primary producers are the least at risk
- There are many taxa for which we don’t know the risks
- We don’t understand how predator-prey interactions and other ecological processes are altered by OA

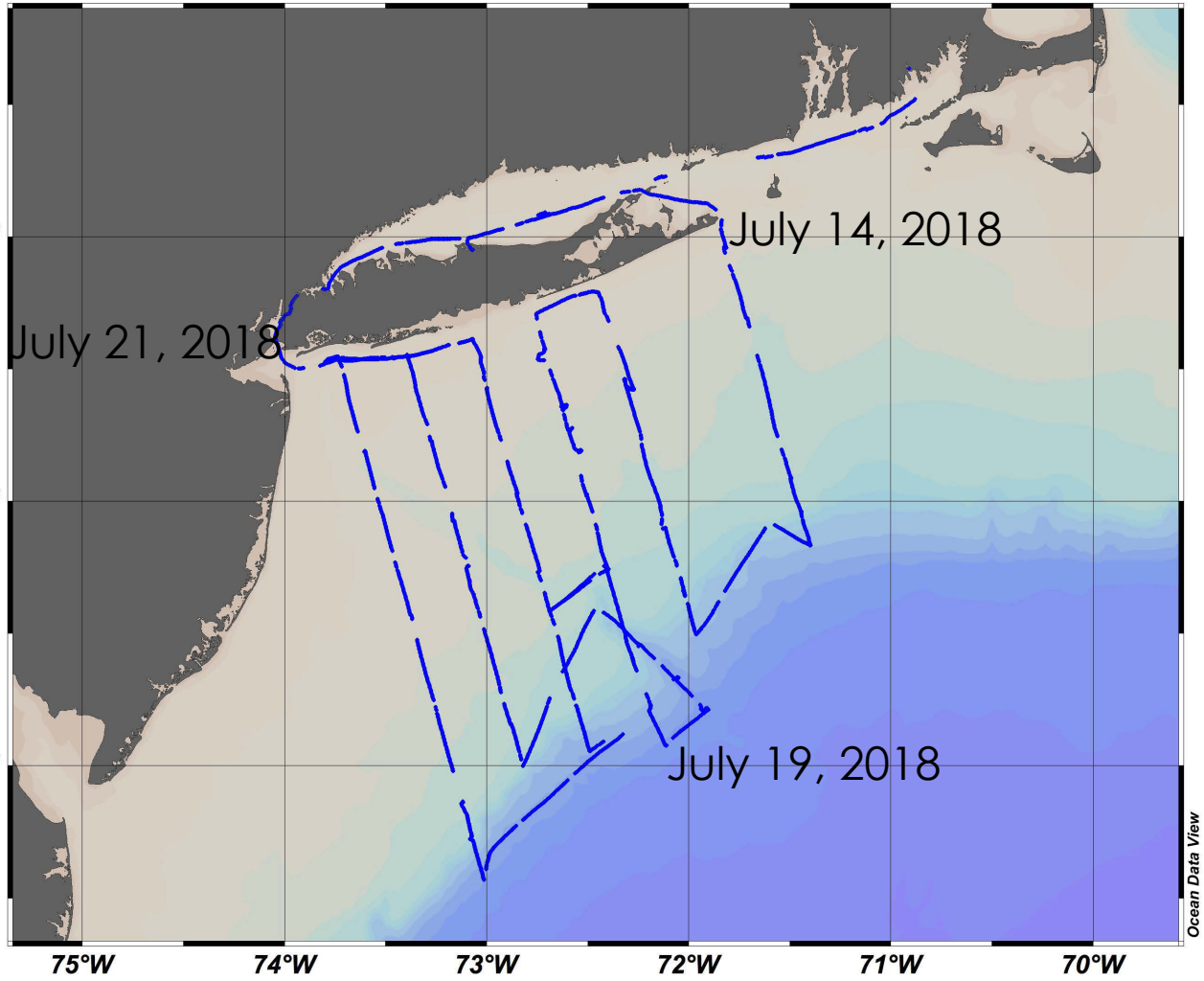
Monitoring carbonate chemistry in New York



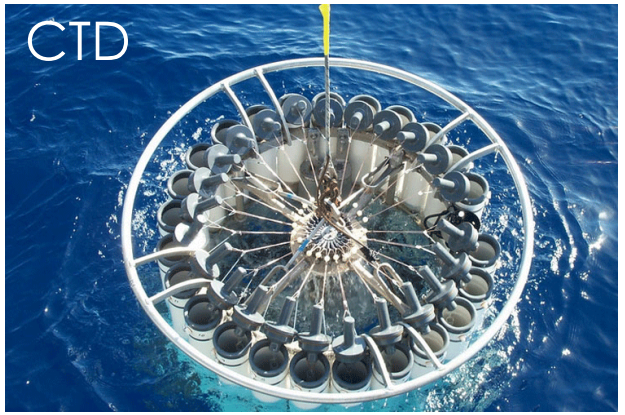
Gobler Laboratory monitoring sites in NY

NYB0718 Observations

July 14-21



Cruise track of NYB0718

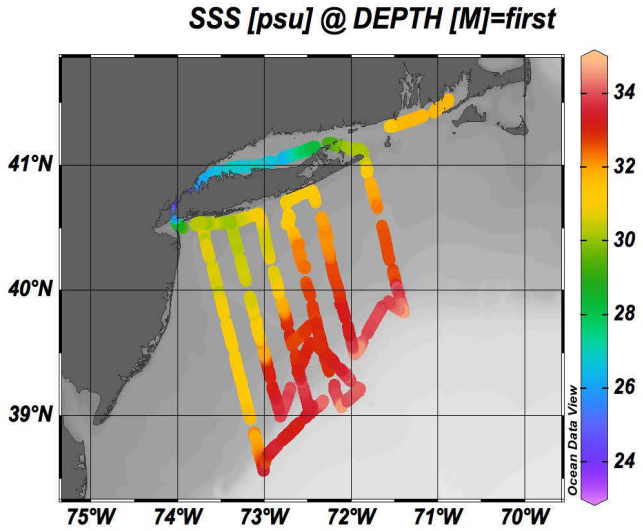


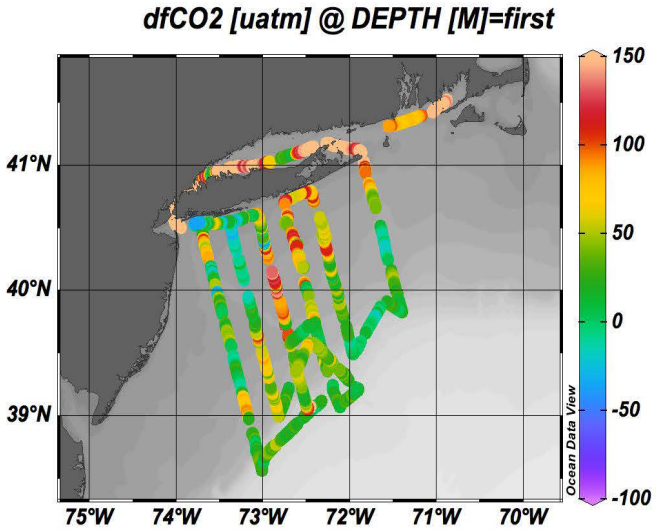
T
S
Pressure
pH
DO
Nitrogen
Saturate
Fluorescence

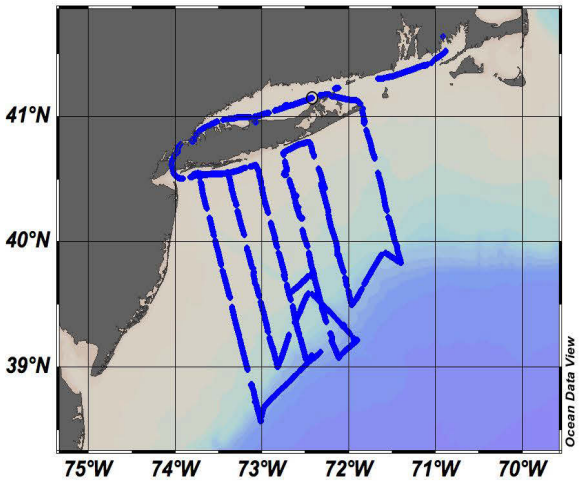
Underway pCO_2 system

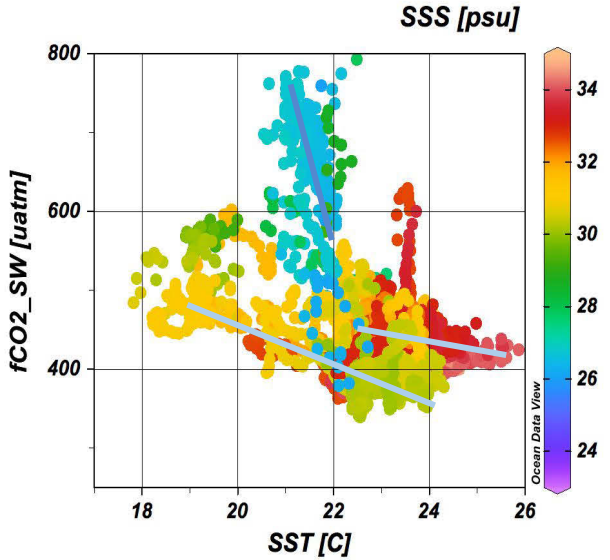
xCO2
T
S

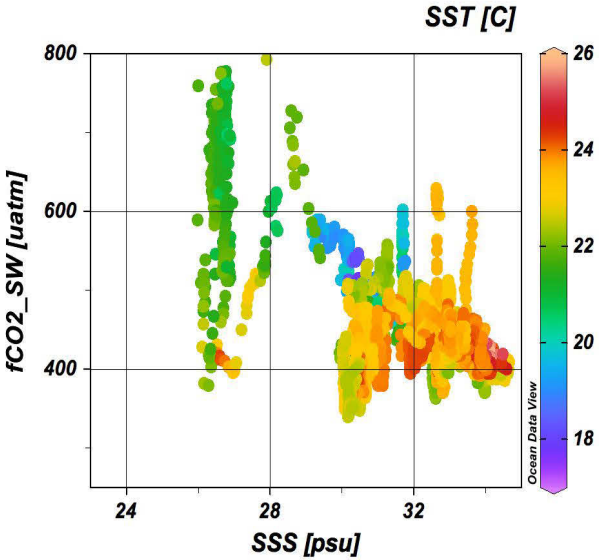
Underway pCO2 measurements



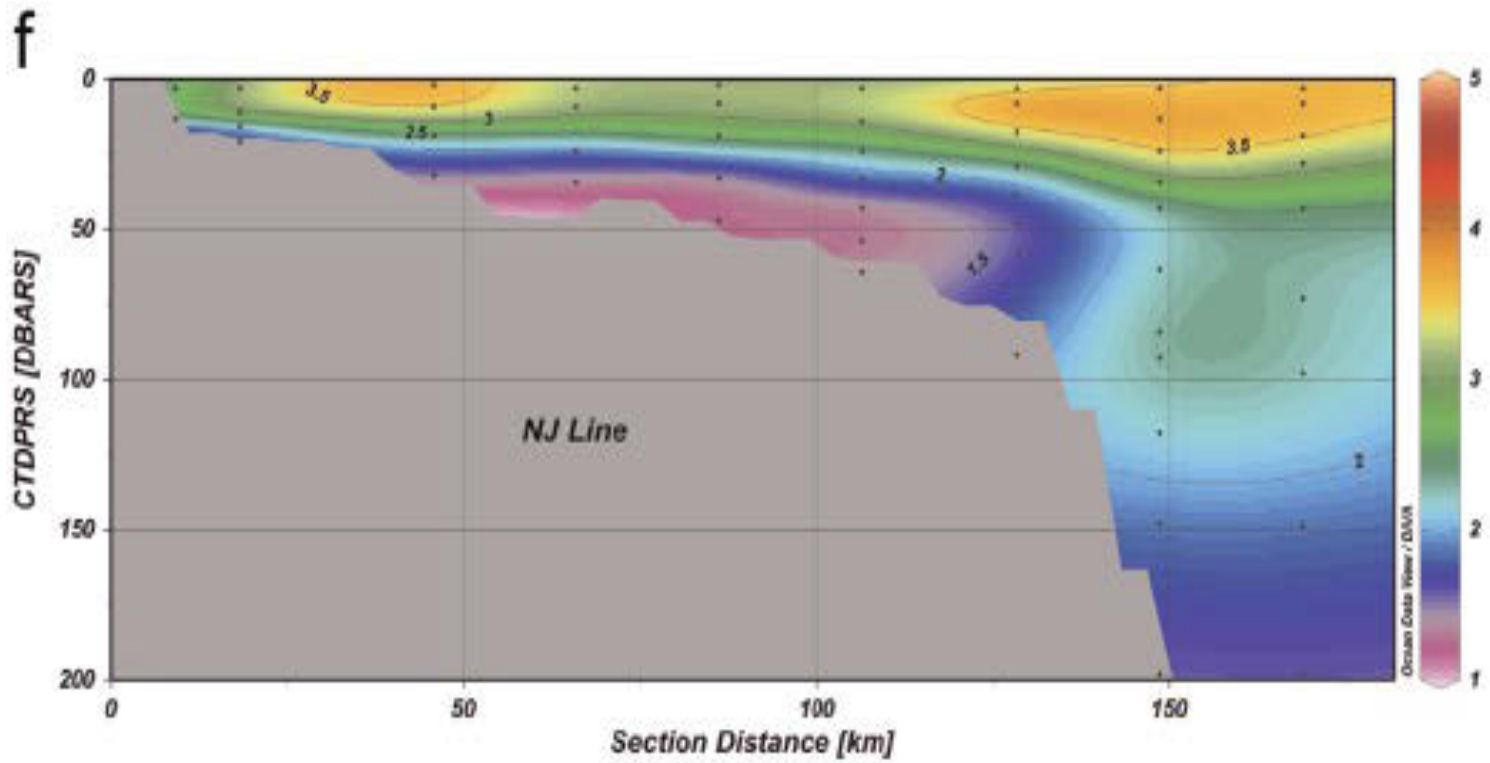




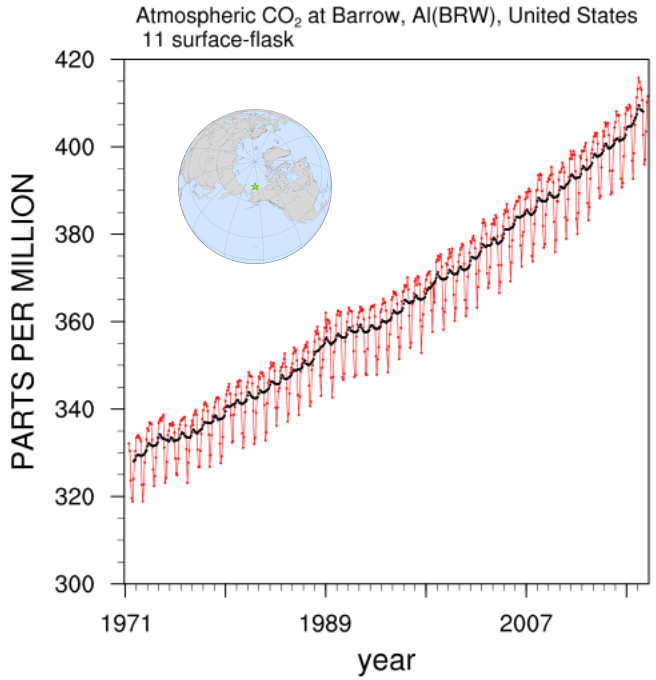


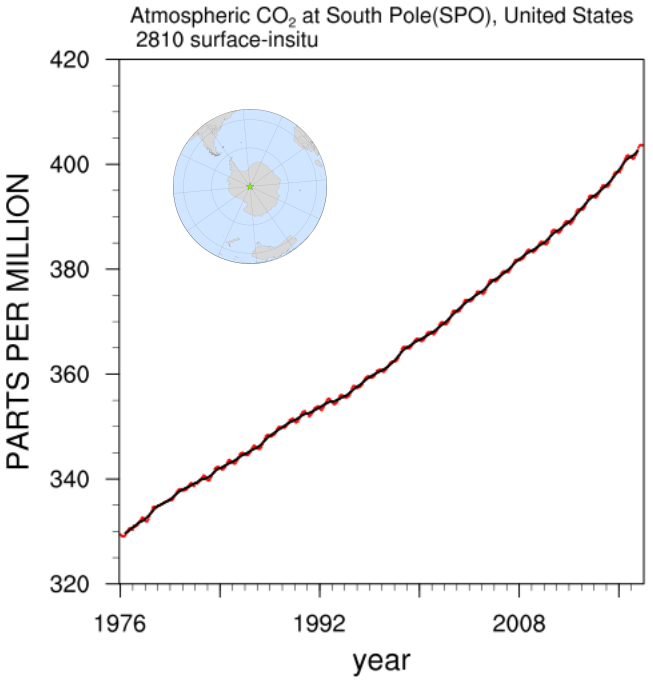


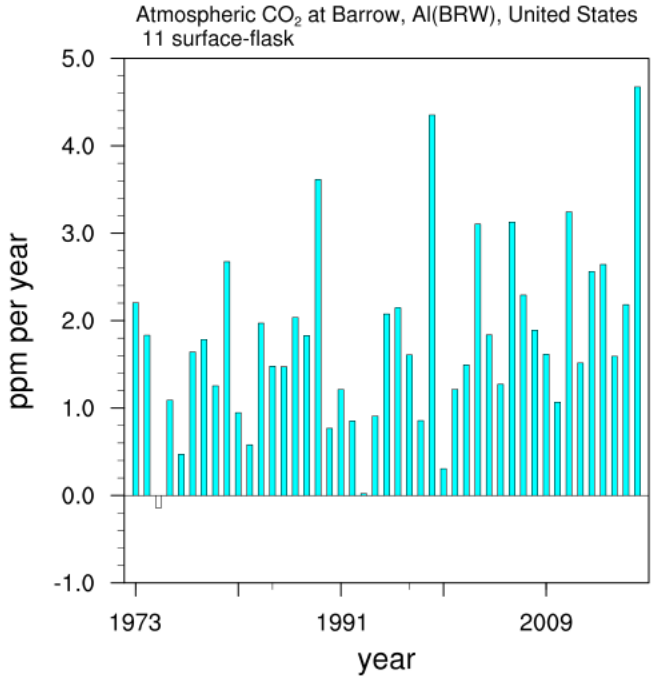
Aragonite = carbonate available to organisms

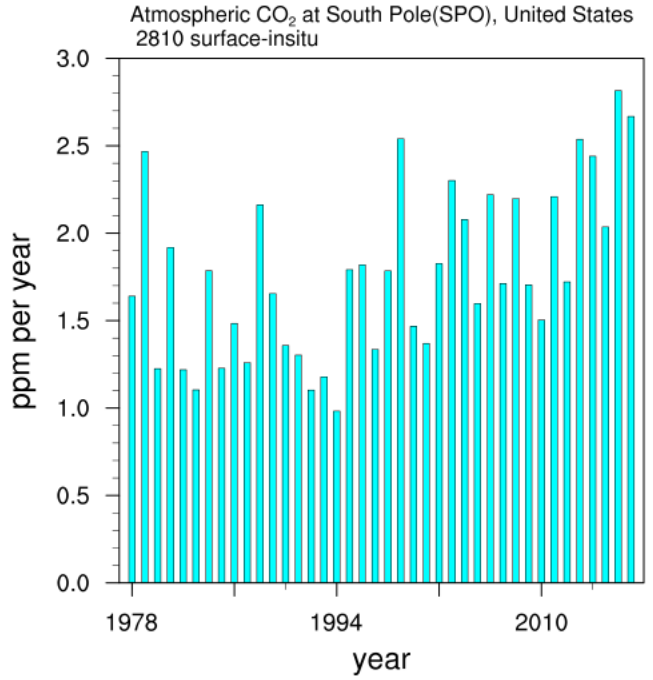


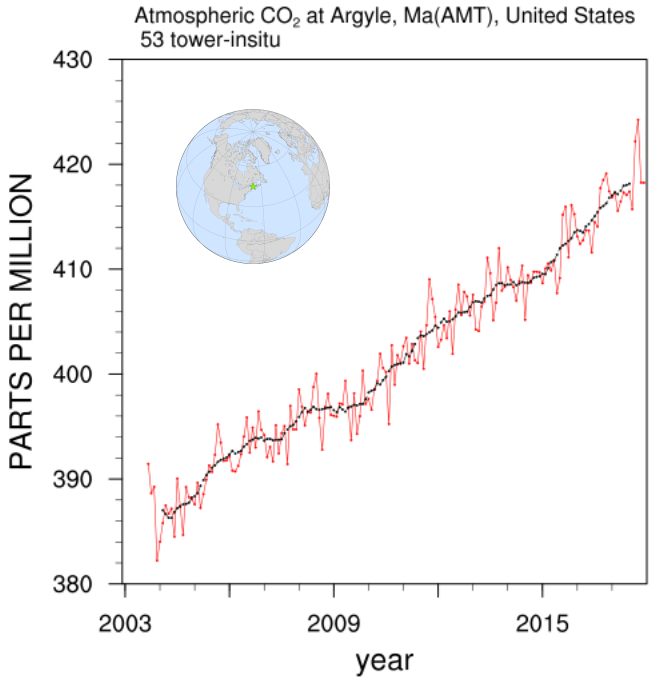
Questions?

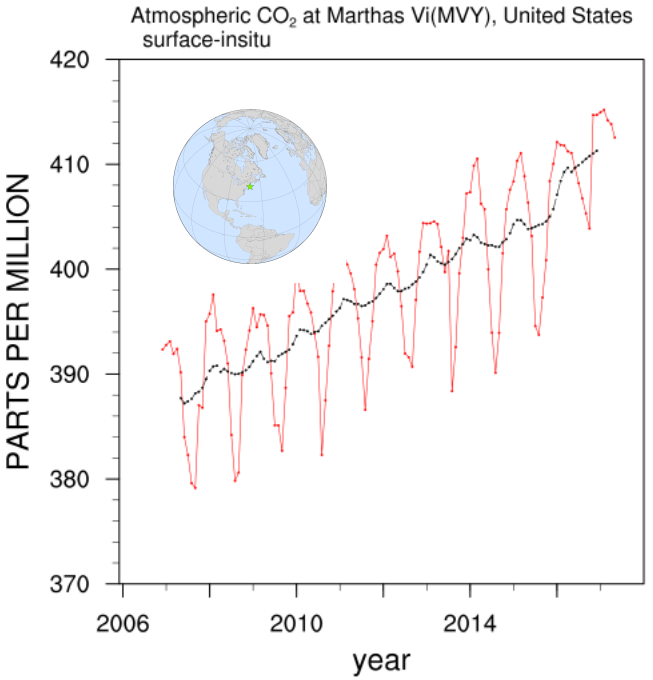

Atmospheric CO2 at Barrow, AI(BRW), United States
11 surface-flask
PARTS PER MILLION
420
400
380
360
340
320
300
1971
1989
2007
year

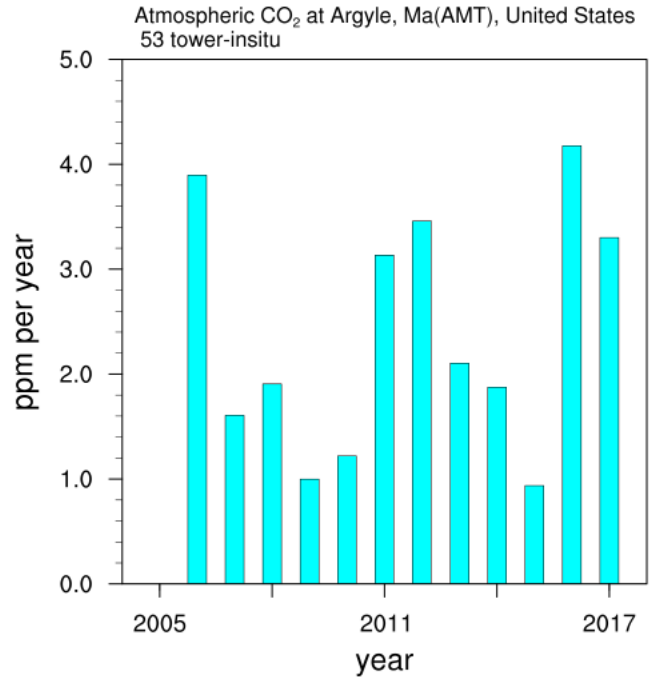

Atmospheric CO2 at South Pole(SPO), United States
2810 surface-insitu
PARTS PER MILLION
420
400
380
360
340
320
1976
1992
2008
year

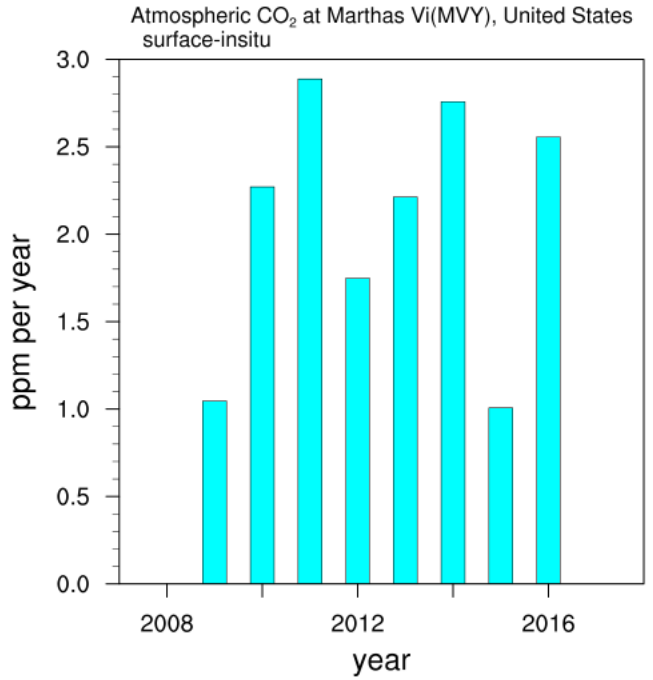

Atmospheric CO2 at Barrow, AI(BRW), United States
11 surface-flask
ppm per year
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
1973
1991
2009
year

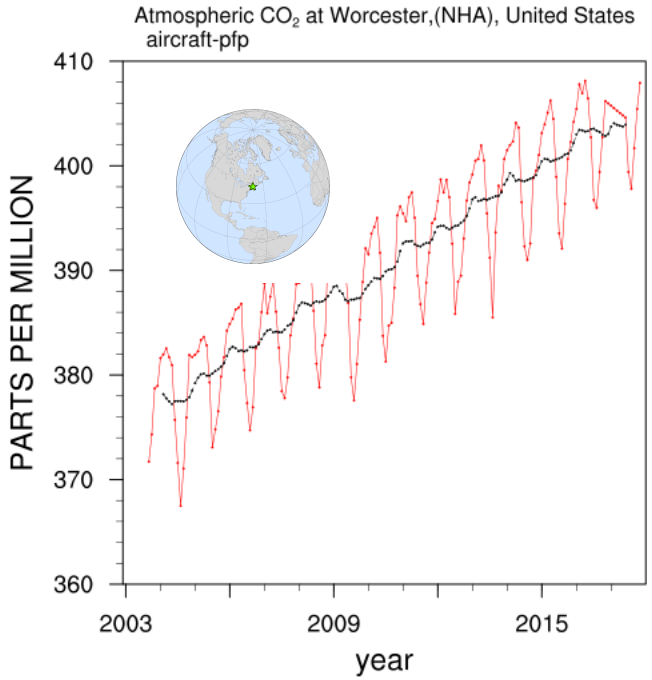

Atmospheric CO2 at South Pole(SPO), United States
2810 surface-insitu
ppm per year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1978
1994
2010
year

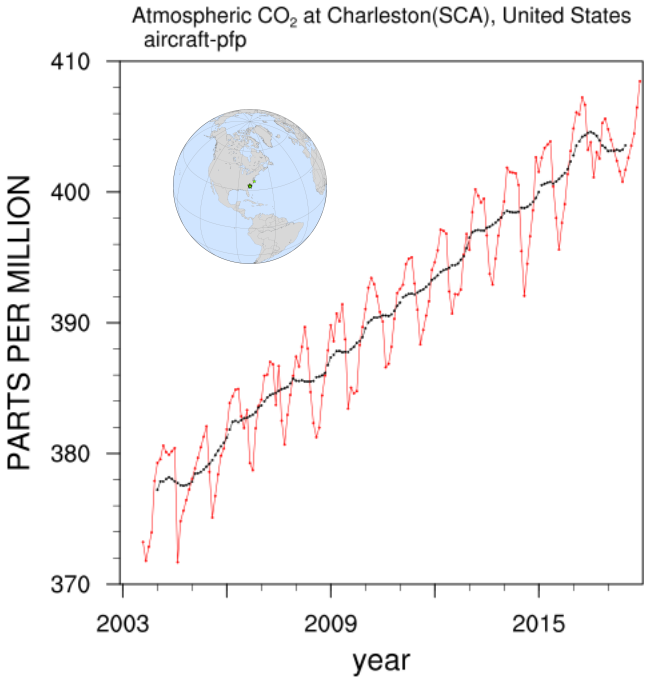

Atmospheric CO_2 at Argyle, Ma(AMT), United States
53 tower-insitu
PARTS PER MILLION
430
420
410
400
390
380
2003
2009
2015
year

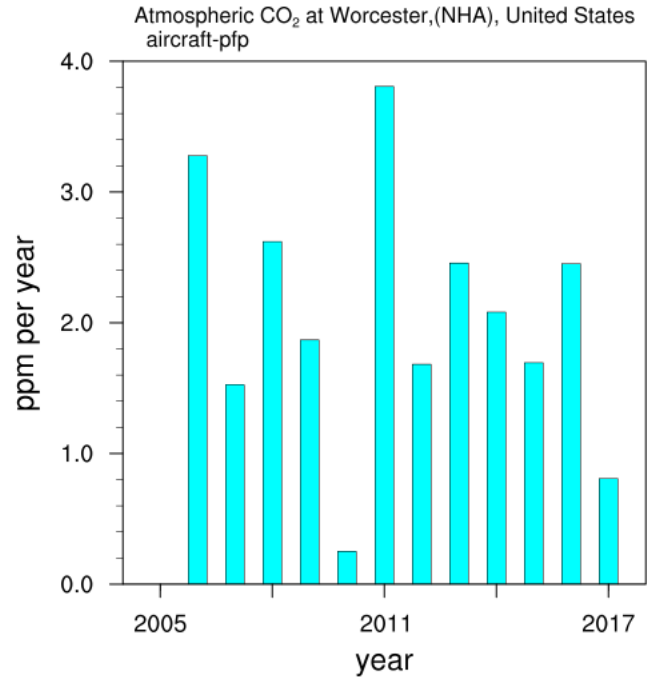

Atmospheric CO_2 at Marthas Vi(MVY), United States
surface-insitu
PARTS PER MILLION
420
410
400
390
380
370
2006
2010
2014
year

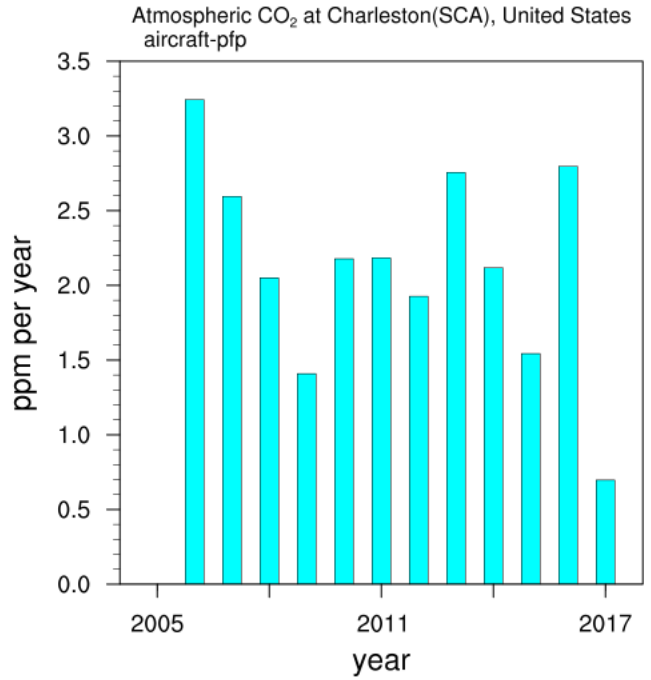

Atmospheric CO_2 at Argyle, Ma(AMT), United States
53 tower-insitu
ppm per year
5.0
4.0
3.0
2.0
1.0
0.0
2005
2011
2017
year


Atmospheric CO_2 at Marthas Vi(MVY), United States
surface-insitu
ppm per year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2008
2012
2016
year


Atmospheric CO_2 at Worcester,(NHA), United States
aircraft-pfp
PARTS PER MILLION
410
400
390
380
370
360
2003
2009
2015
year


Atmospheric CO_2 at Charleston(SCA), United States
aircraft-pfp
PARTS PER MILLION
410
400
390
380
370
2003
2009
2015
year


Atmospheric CO_2 at Worcester,(NHA), United States
aircraft-pfp
ppm per year
4.0
3.0
2.0
1.0
0.0
2005
2011
2017
year


Atmospheric CO_2 at Charleston(SCA), United States
aircraft-pfp
ppm per year
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2005
2011
2017
year