Carbon: From Land to Lake to Atmosphere & Sea

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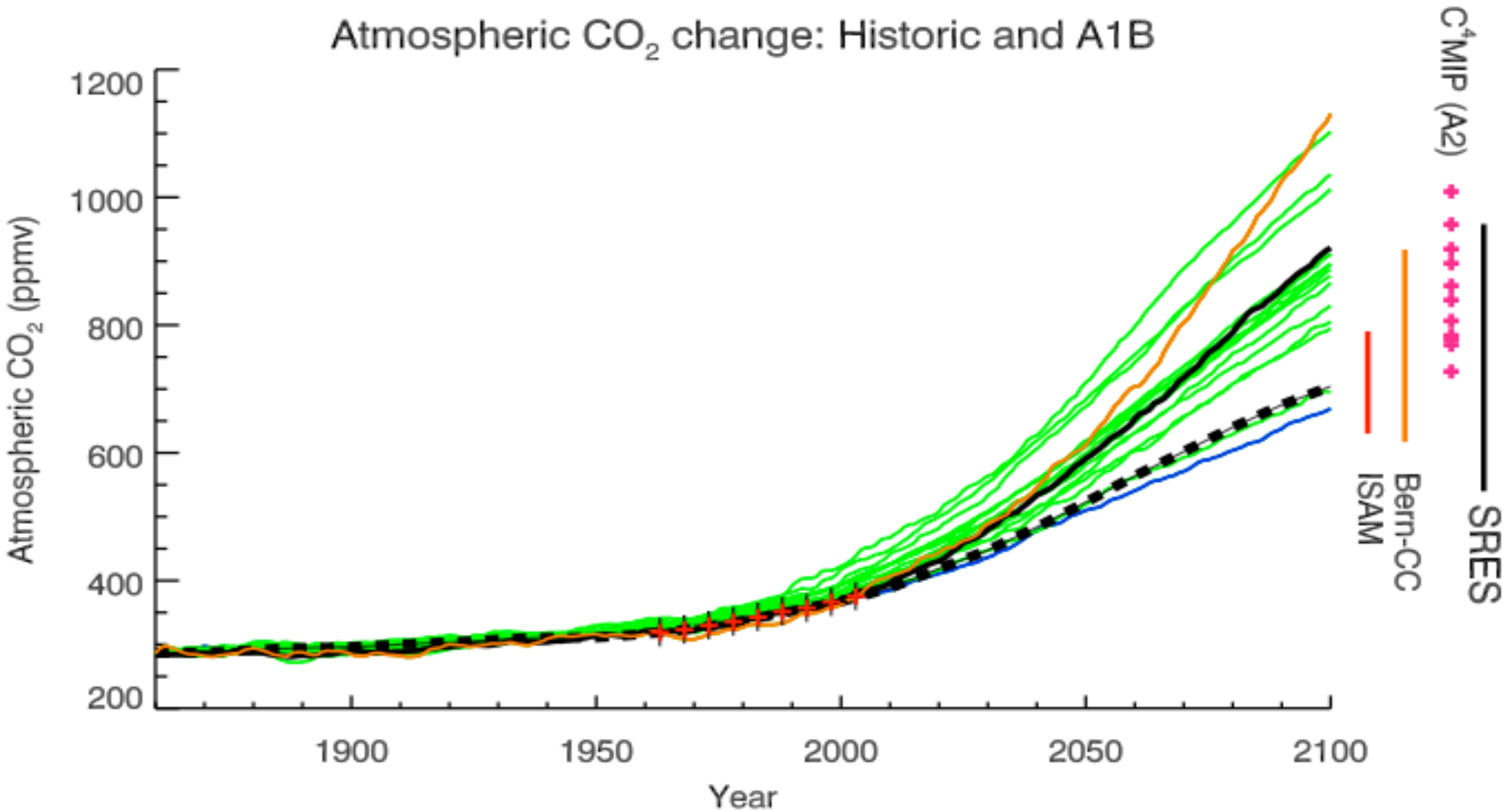
12 Oct 2012

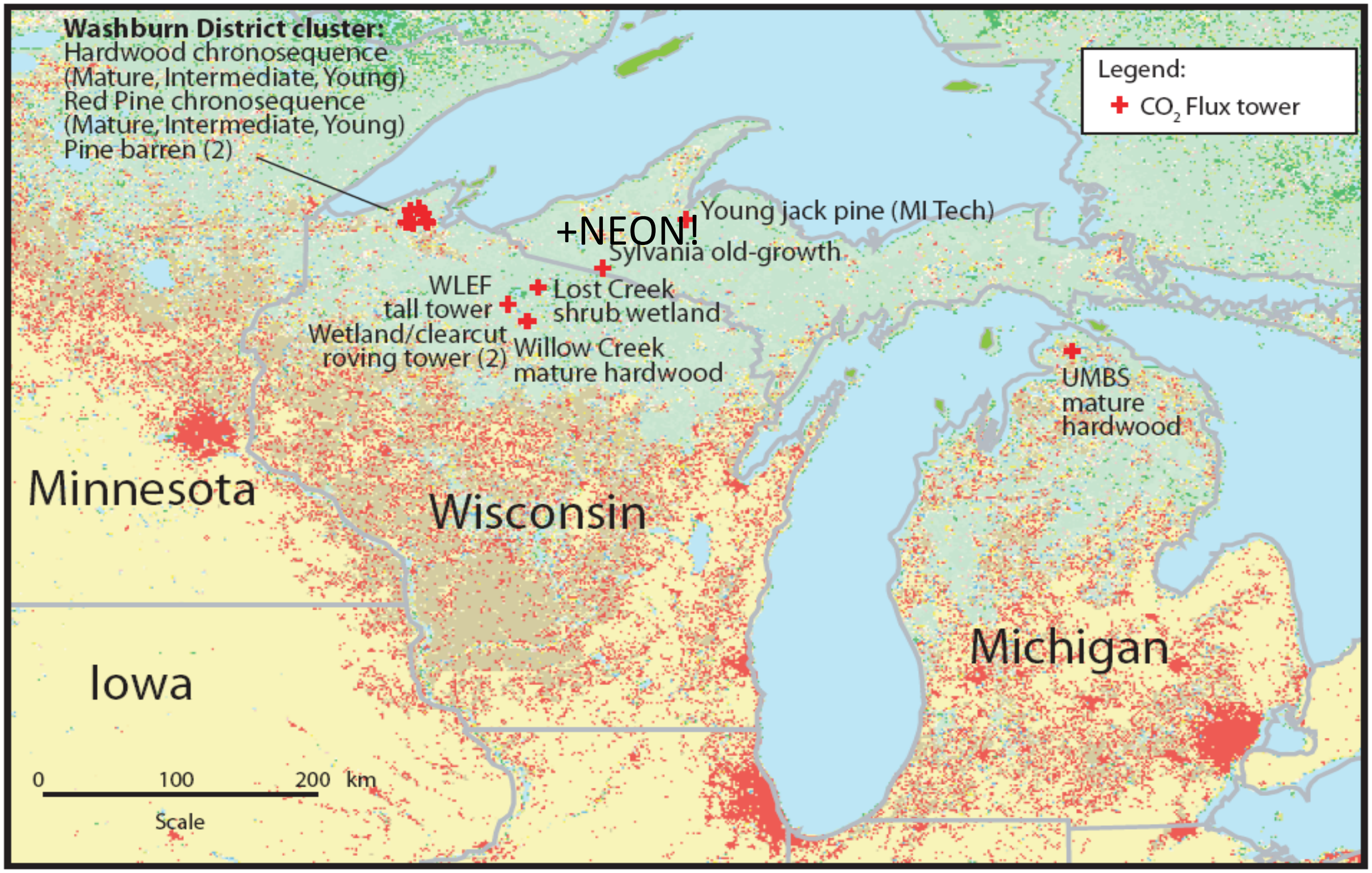
NTL-LTER PI Meeting

Terrestrial carbon cycle feedbacks now dominate non-anthropogenic sources of response uncertainty in many climate models



Booth et al, ERL, 2012

We do a decent job monitoring regional terrestrial carbon uptake and emissions

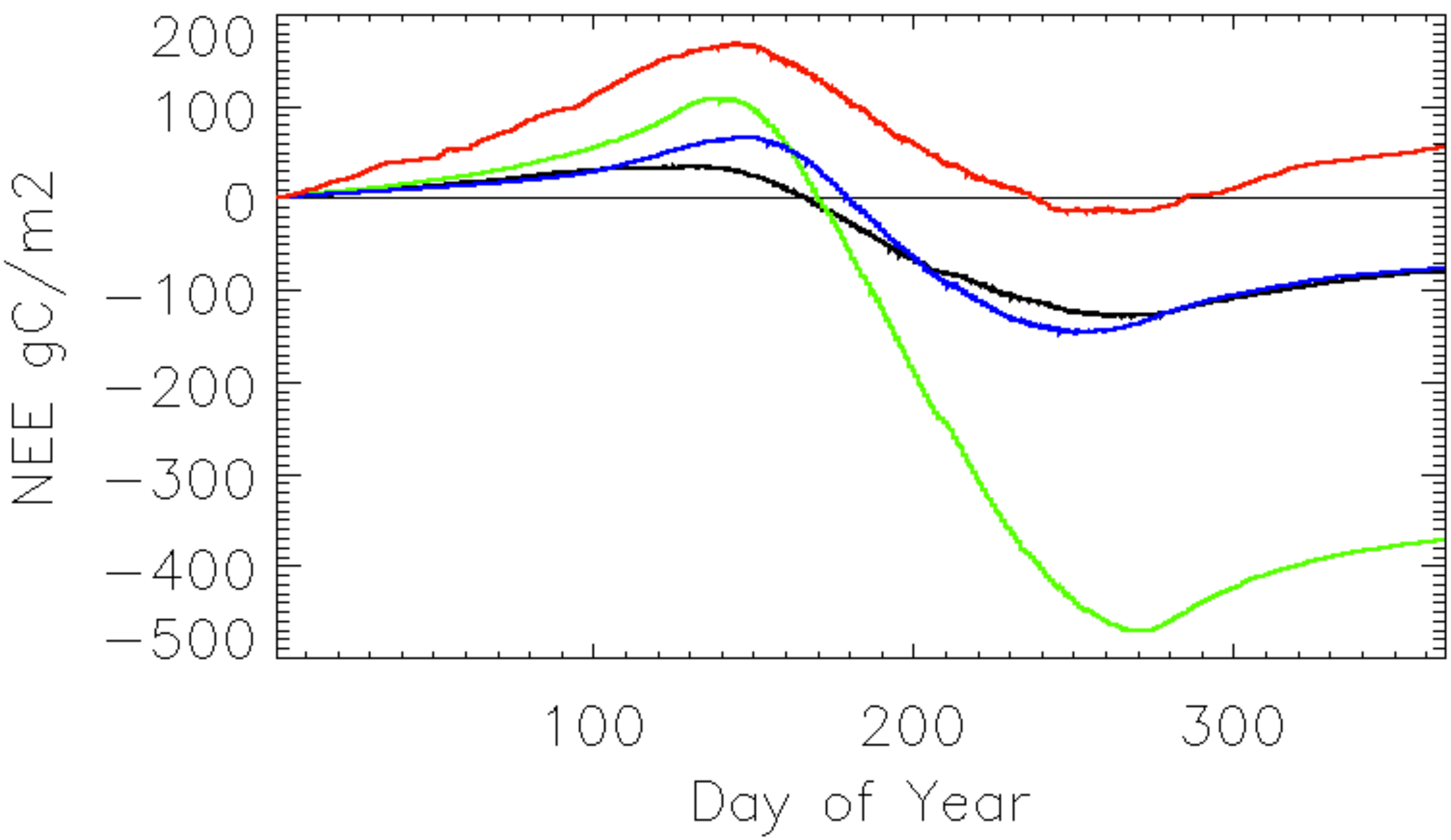


Eddy covariance is mature technology

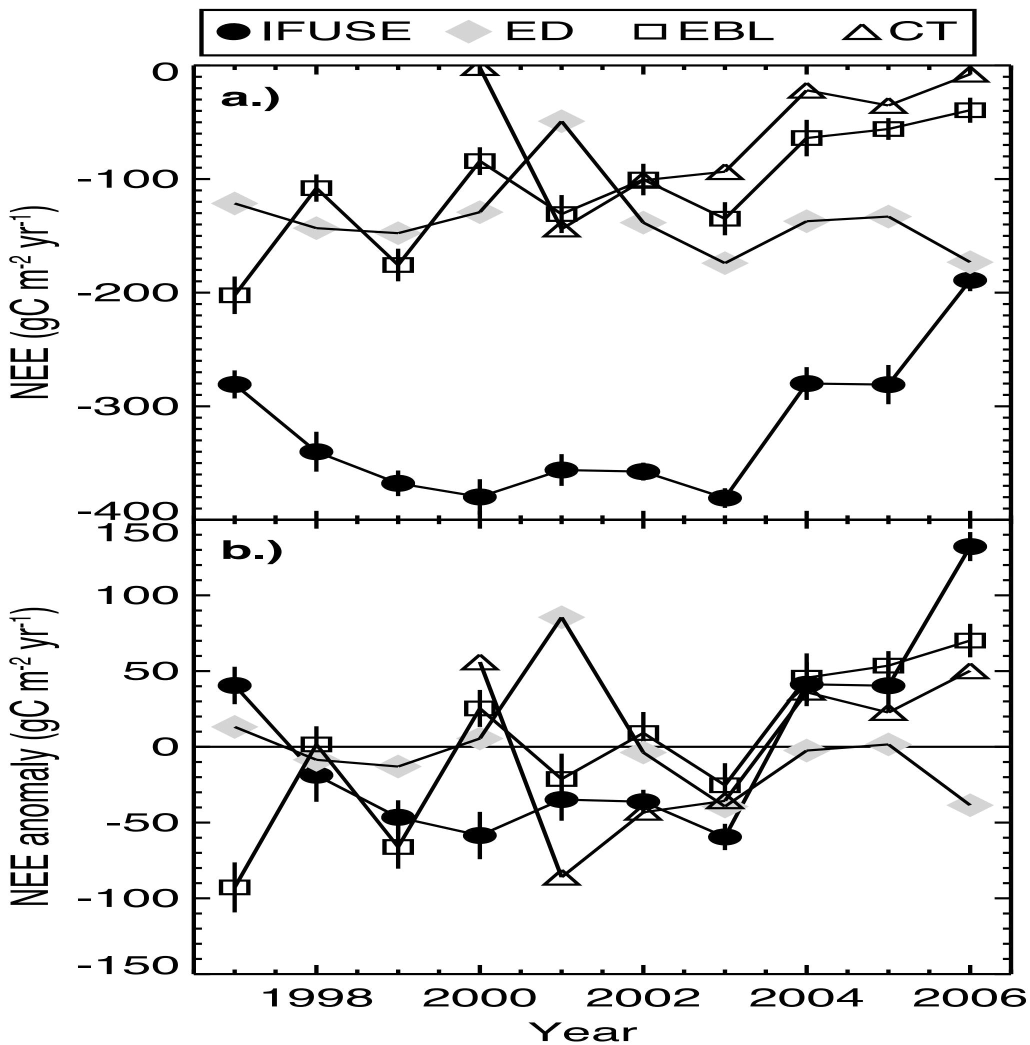
B. Cook

Forests are growing!

Black = WLEF, Green = Willow Creek, Red = Sylvania, Blue = Lost Creek

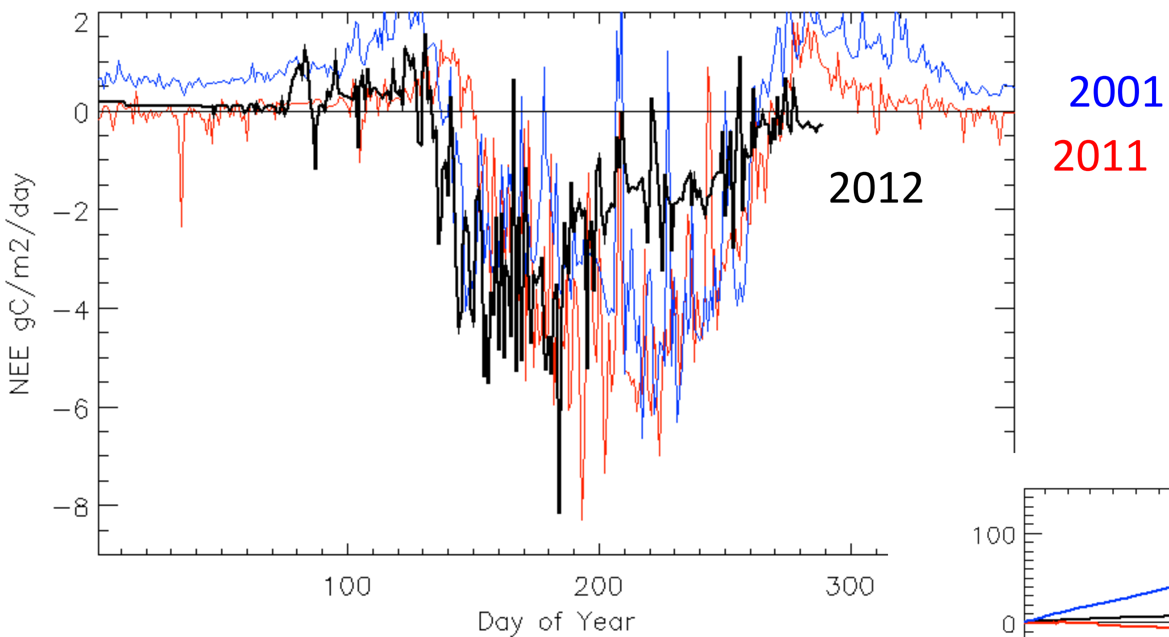


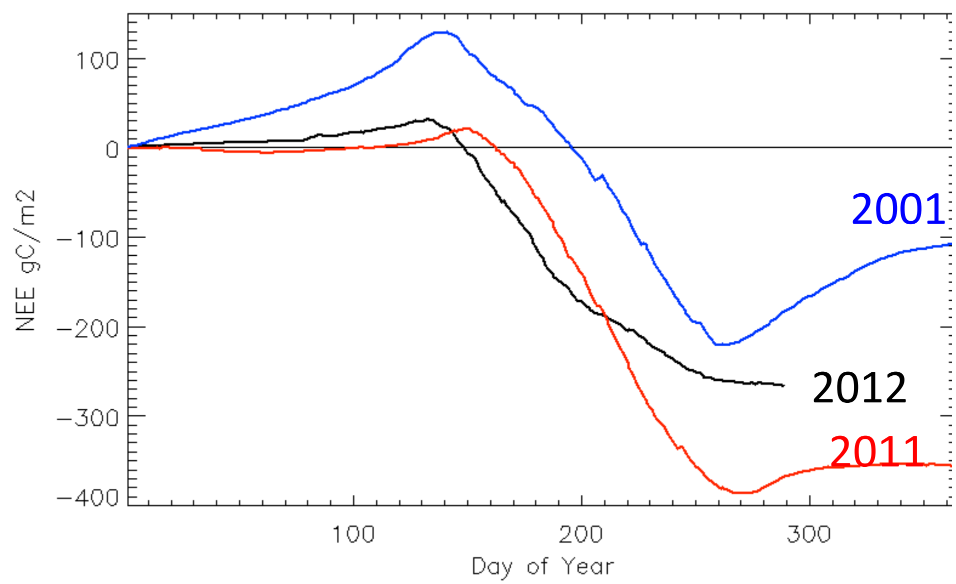
But: Disagreement on magnitude



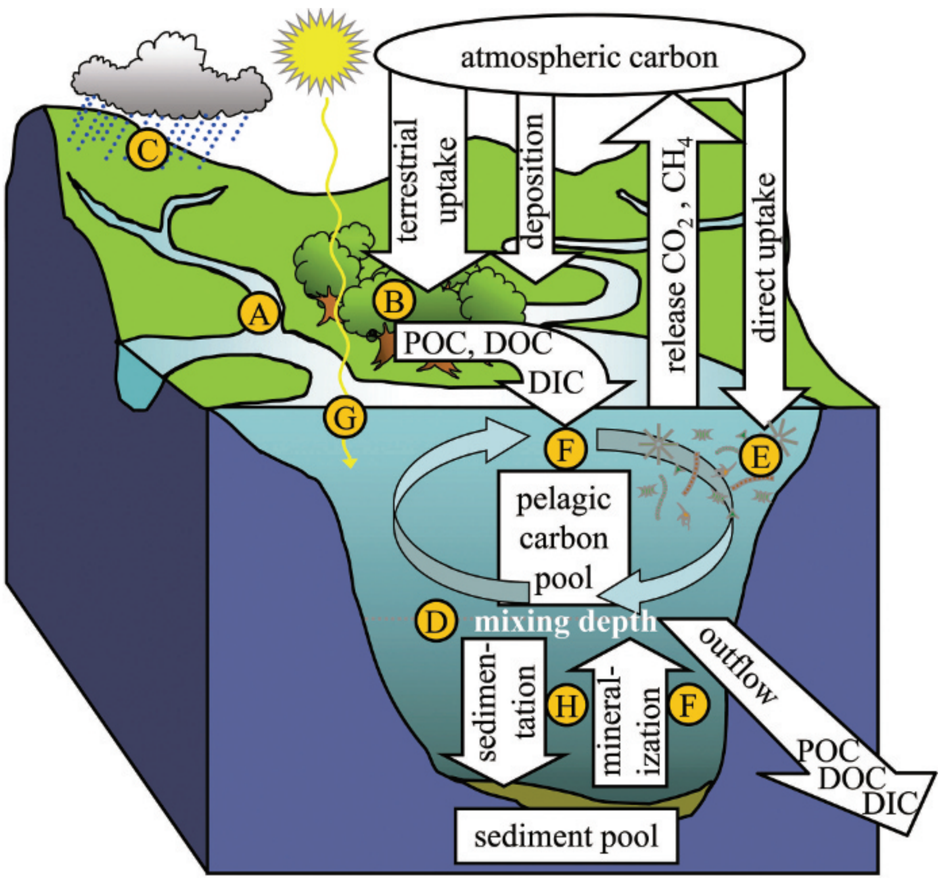
Desai et al., 2010

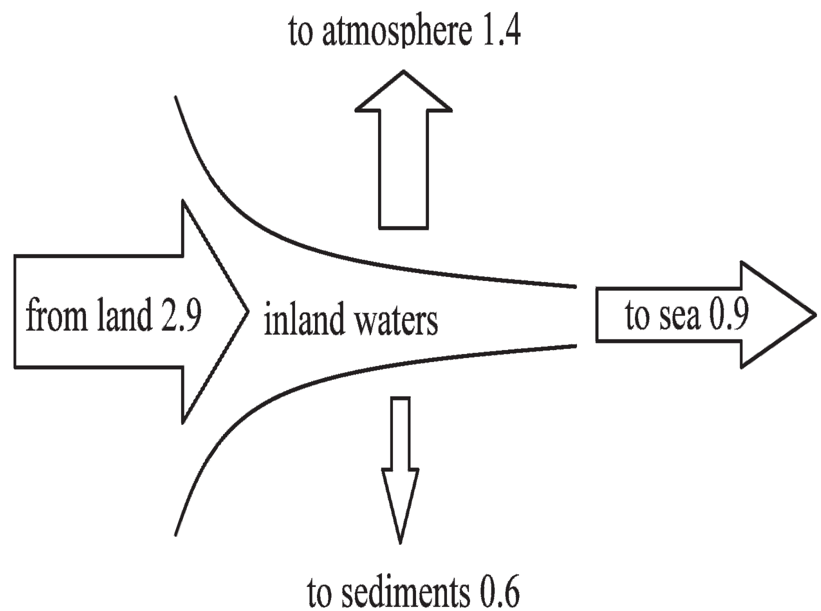
But: Interannual variability is not insignificant!





But: lakes and riverine systems process much of this carbon!

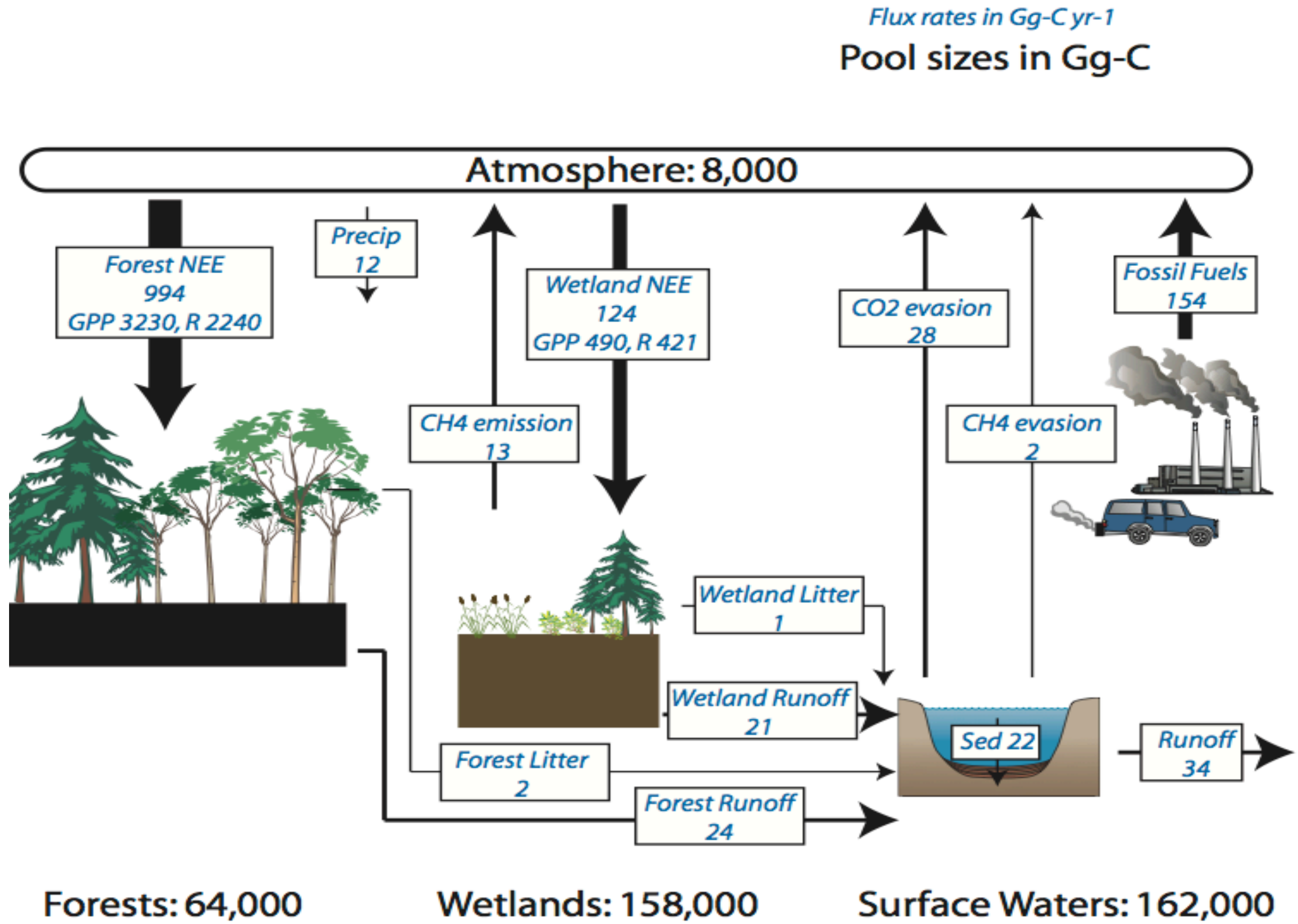




Tranvik 2009

Adrian et al 2009

And: Freshwater system carbon cycles are embedded in complex regional networks



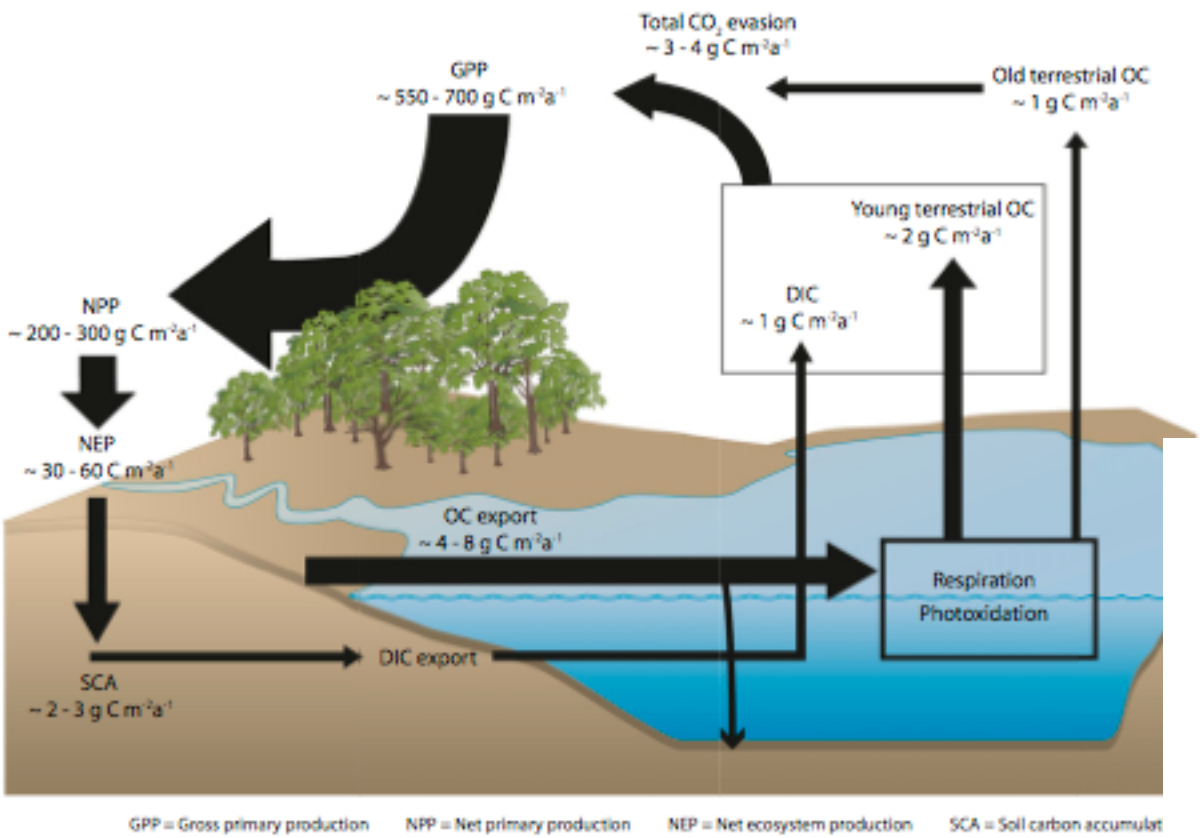
Buffam et al., 2011

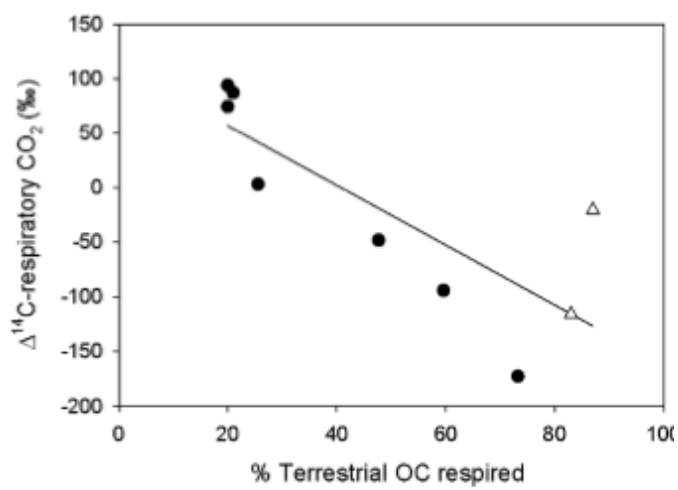
So: Lakes and streams processes much allocthonous carbon

Evidence for the respiration of ancient terrestrial organic C in northern temperate lakes and streams

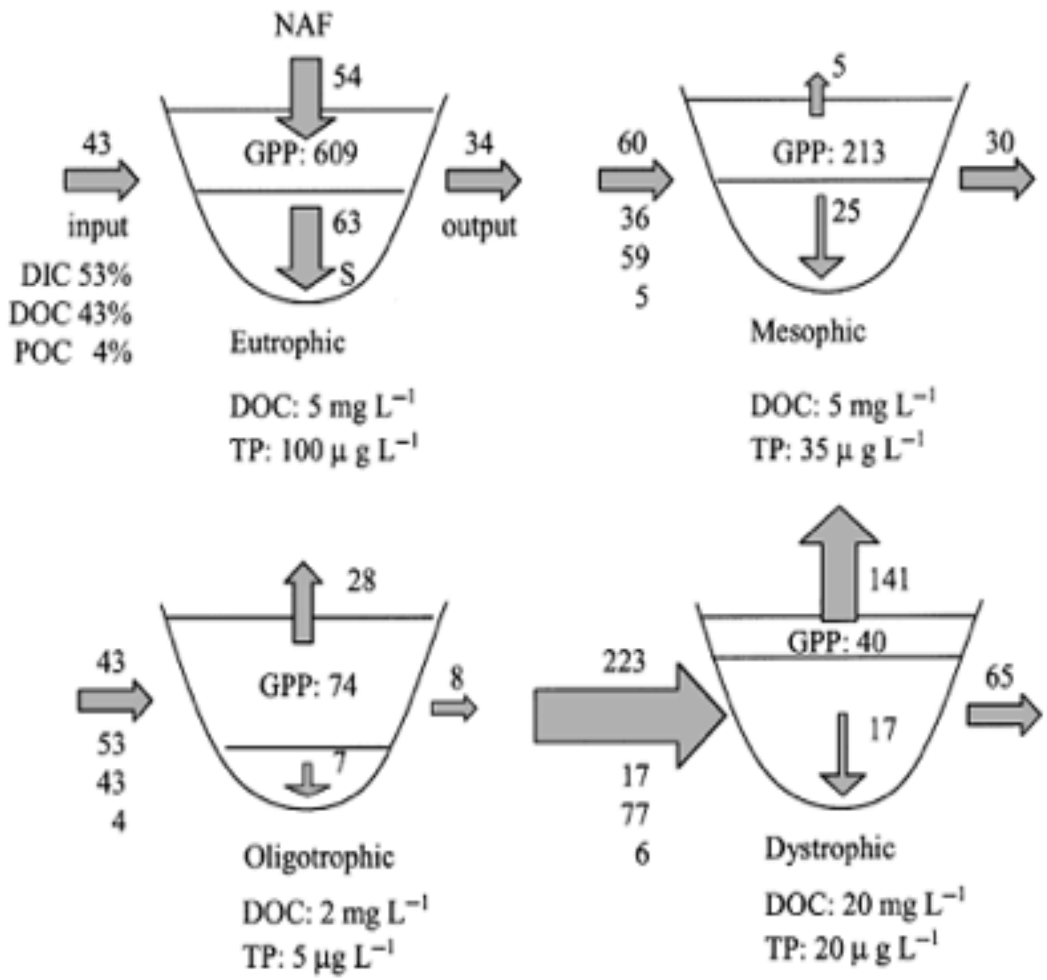
PNAS, 2012

S. Leigh McCallister[a,1] and Paul A. del Giorgio[b]



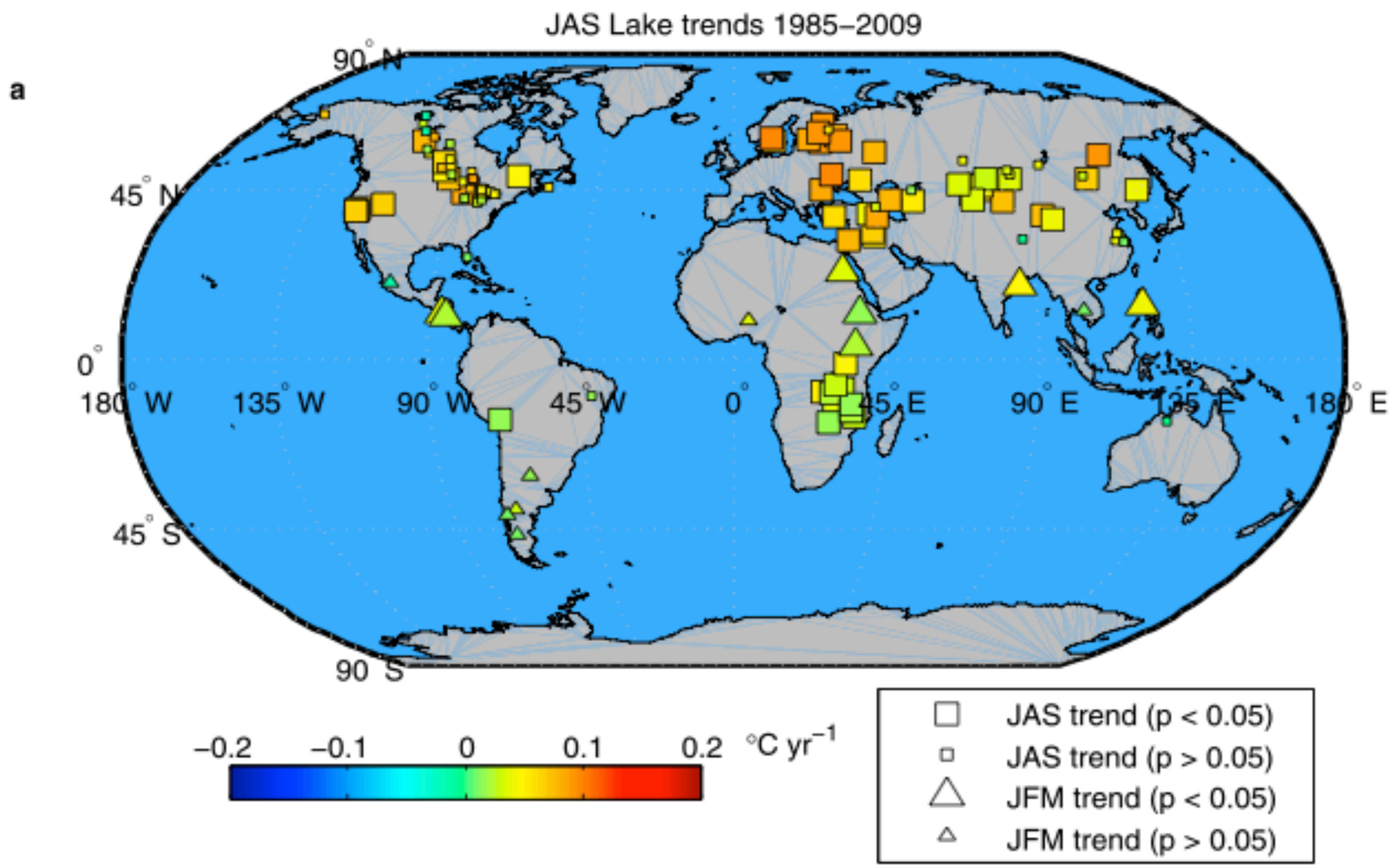


Trophic status affects magnitude of carbon budget terms



Hanson 2004

Globally, lakes are warming faster than the atmosphere



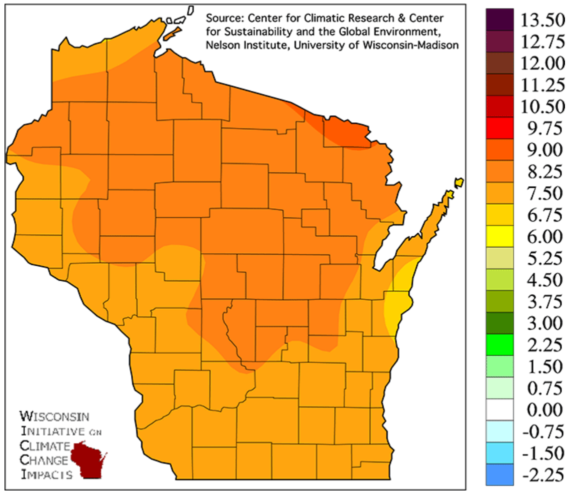
Schneider and Hook, 2010 GRL

Regionally: Warmer winters, drier summers

Summer

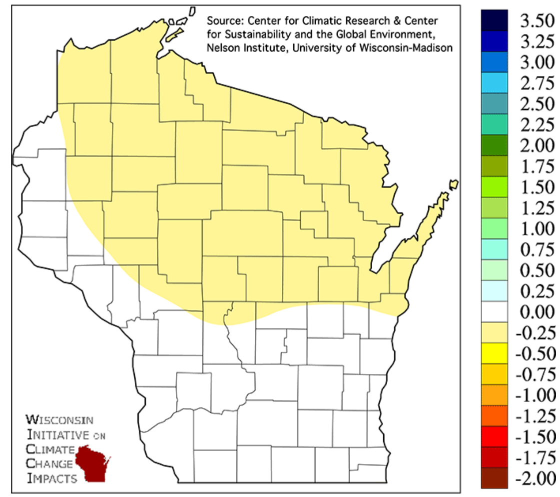
Temperature

Projected Change in Summer Average Temperature (°F)
from 1980 to 2090 (A1B)



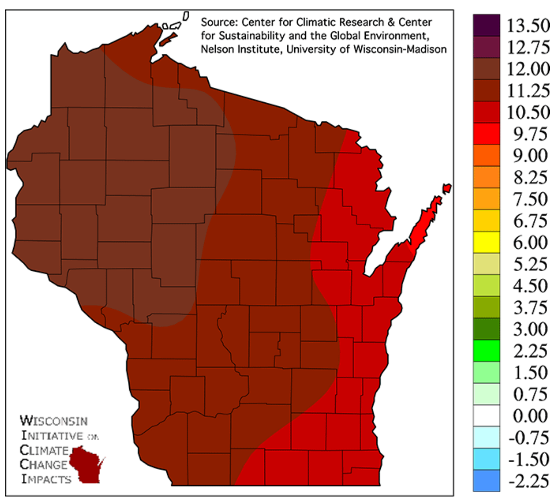
Precipitation

Projected Change in Summer Average Precipitation
(inches) from 1980 to 2090 (A1B)

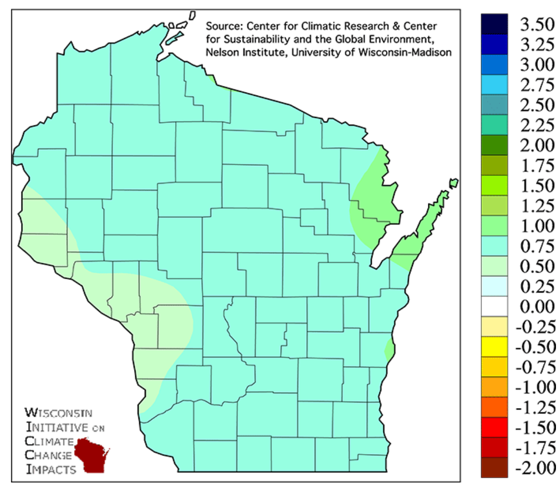


Winter

Projected Change in Winter Average Temperature (°F)
from 1980 to 2090 (A1B)



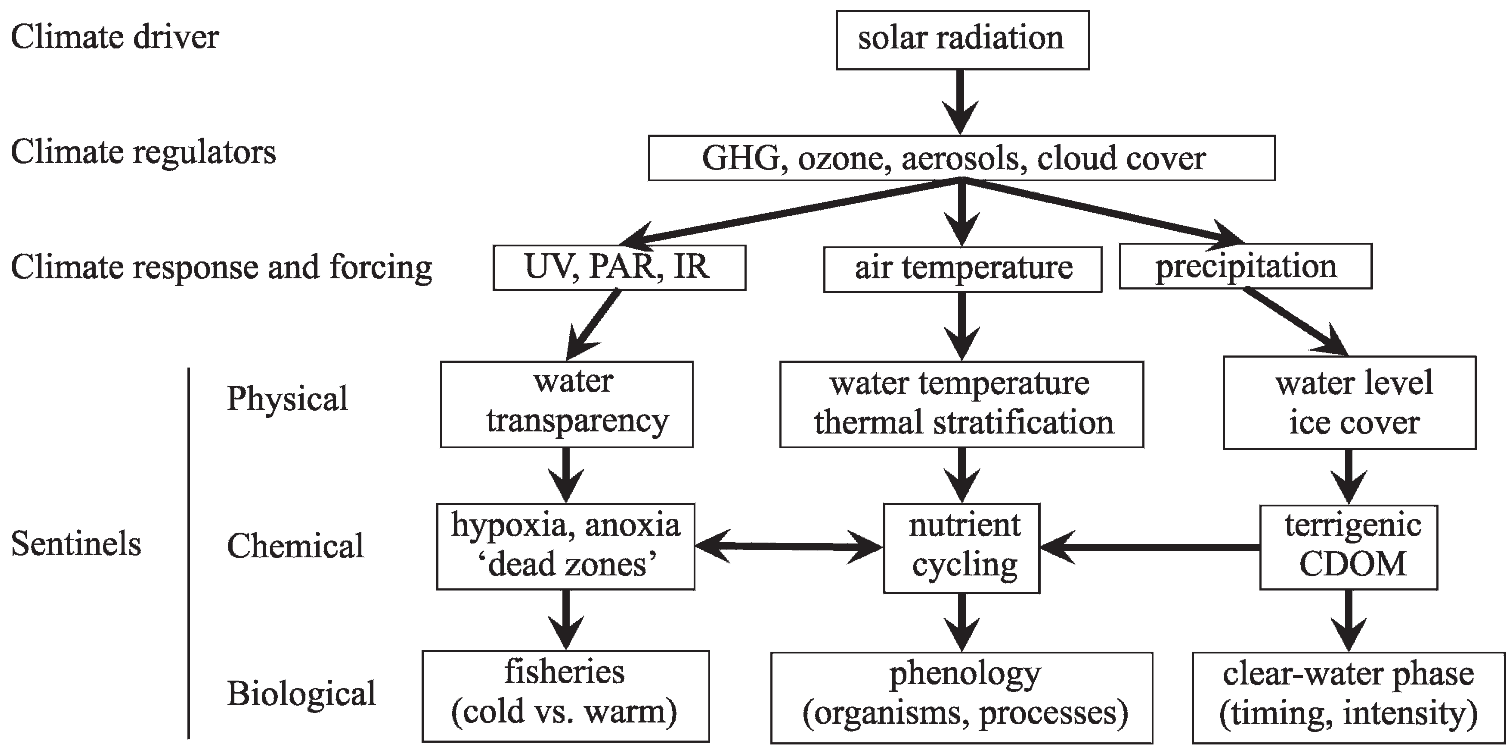
Projected Change in Winter Average Precipitation
(inches) from 1980 to 2090 (A1B)



http://www.wicci.wisc.edu/

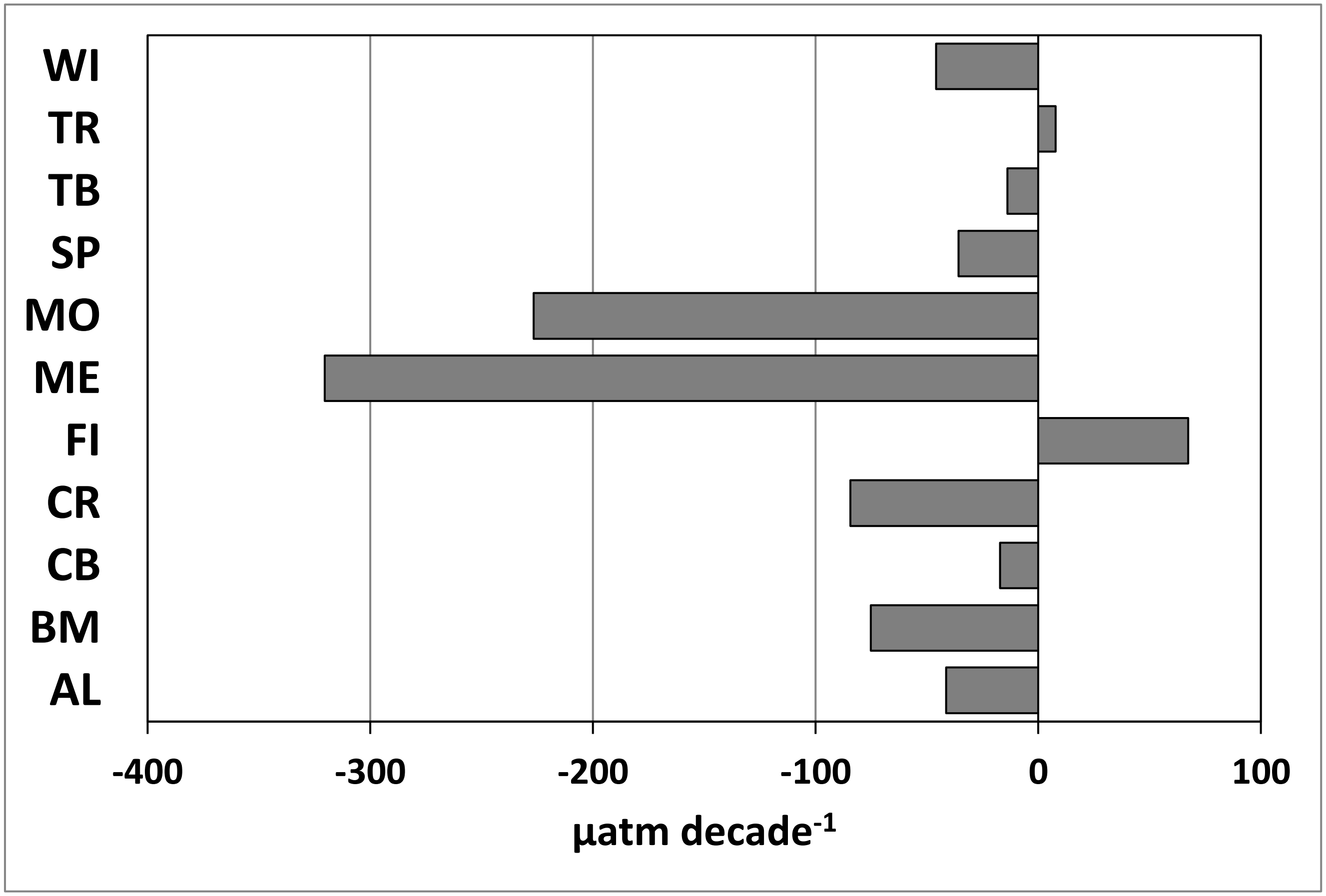
2090-2099
A1B

Greenhouse gas forcing manifests in lakes in a variety of ways that we can measure and should analyze



Williamson 2009

pCO2 trends are evident in NTL-LTER lakes



Epilimnetic pCO_2 for entire NTL record (25 yr North, 15 yr South)

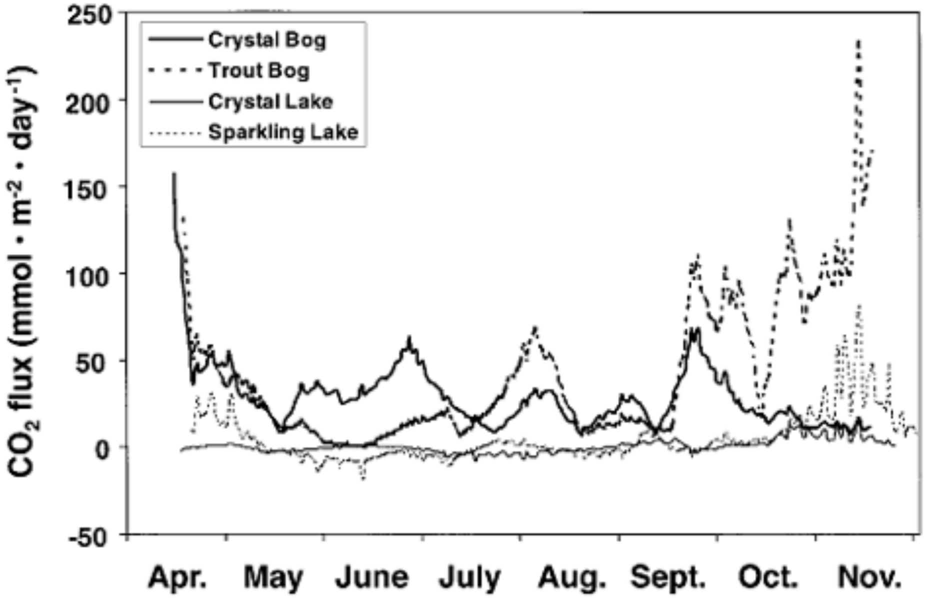
M. Golub

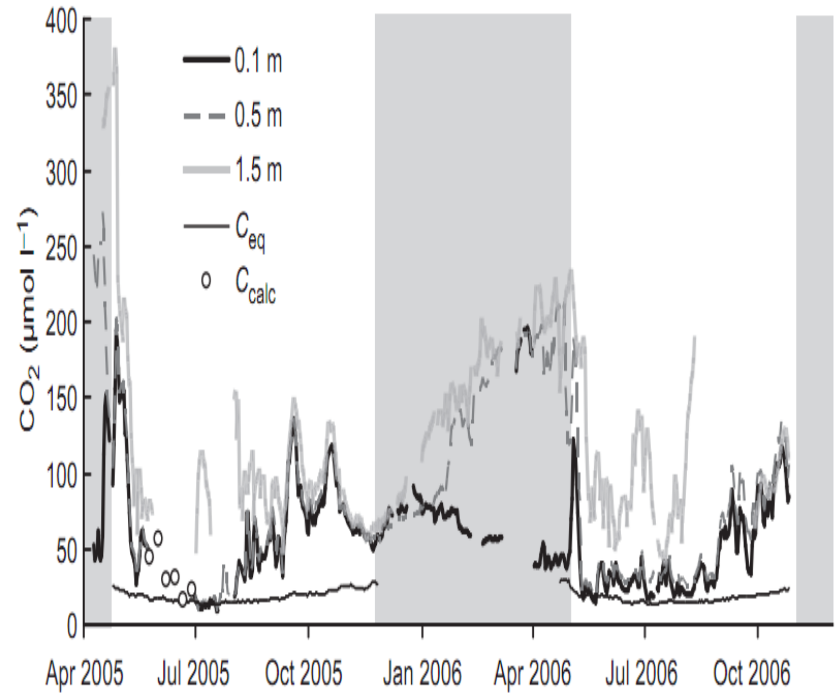
Aquatic carbon: we could do more!

Trout Lake(Oligotrophic)

Lake Mendota(Eutrophic)

Ice covered lake CO_2 is systematically under-sampled in winter

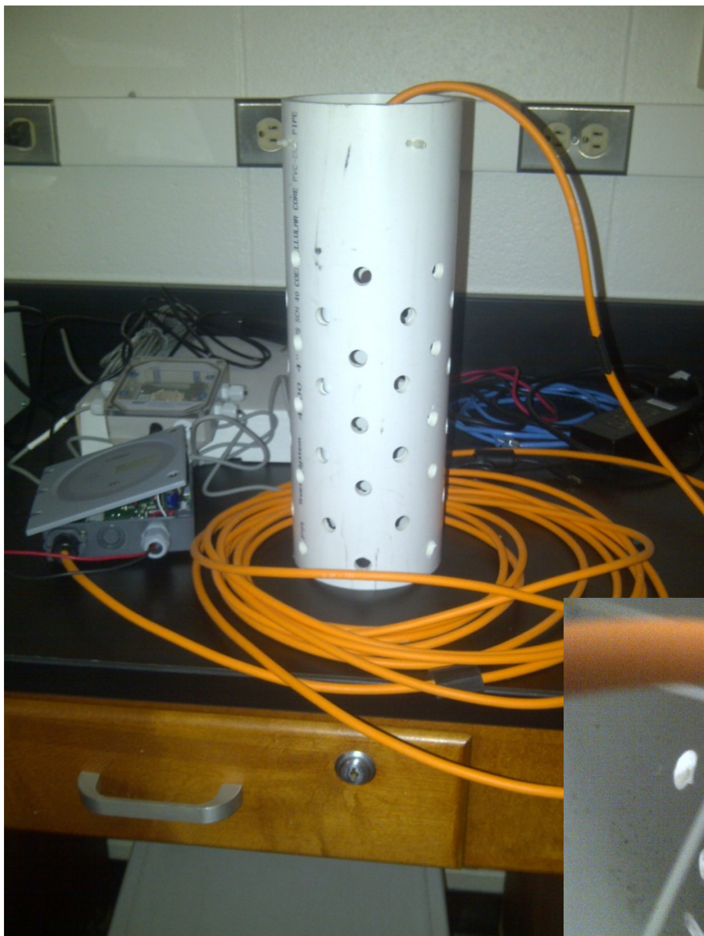


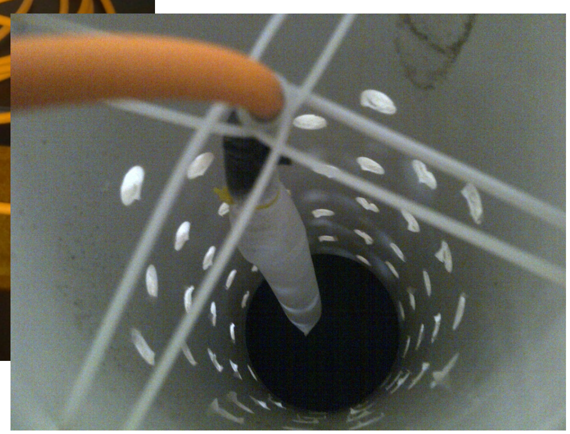


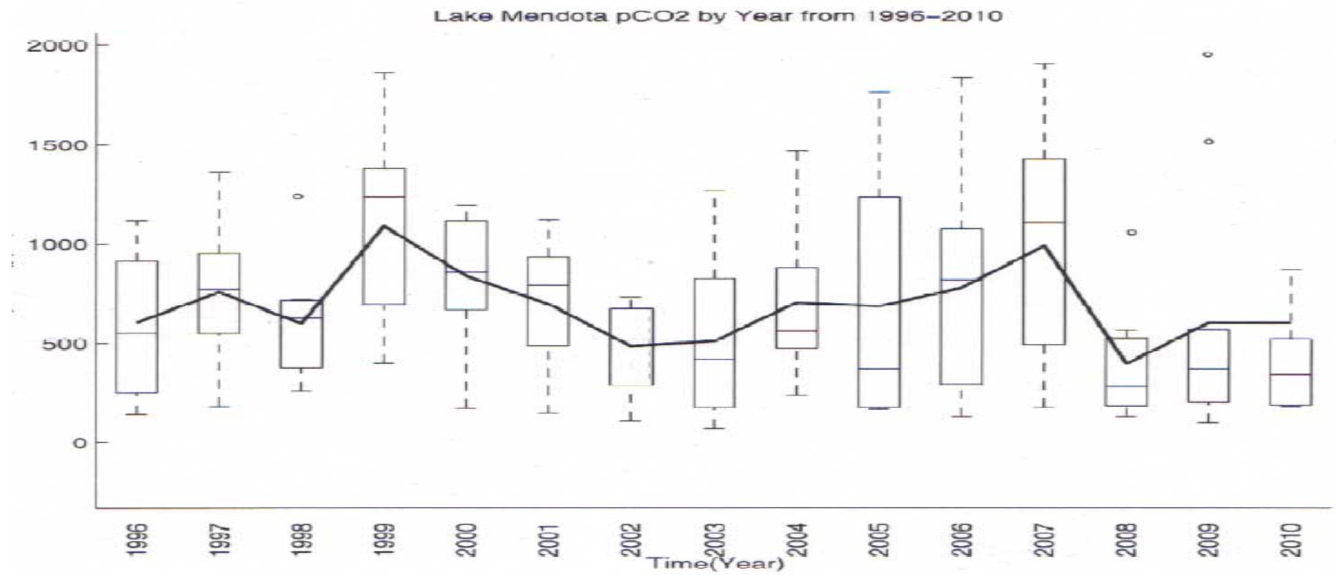
Riera et al 1999

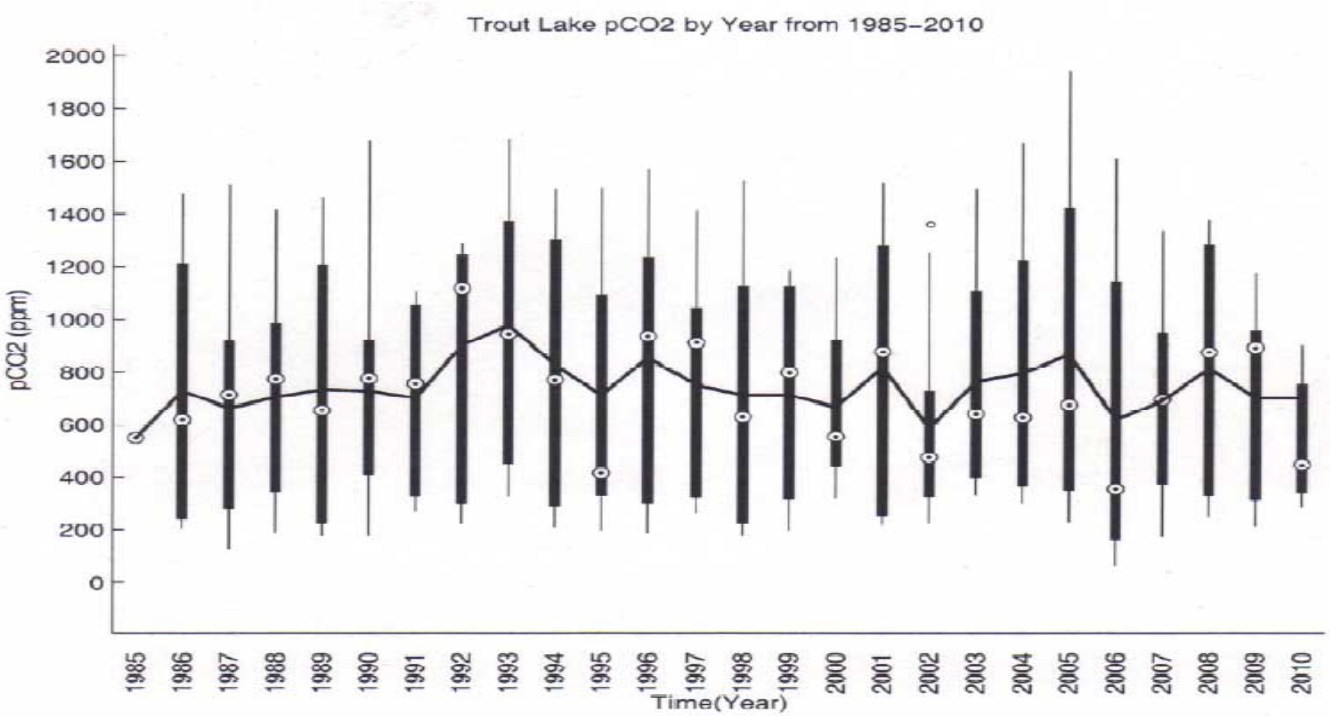
Huotari et al 2009

We could fix that

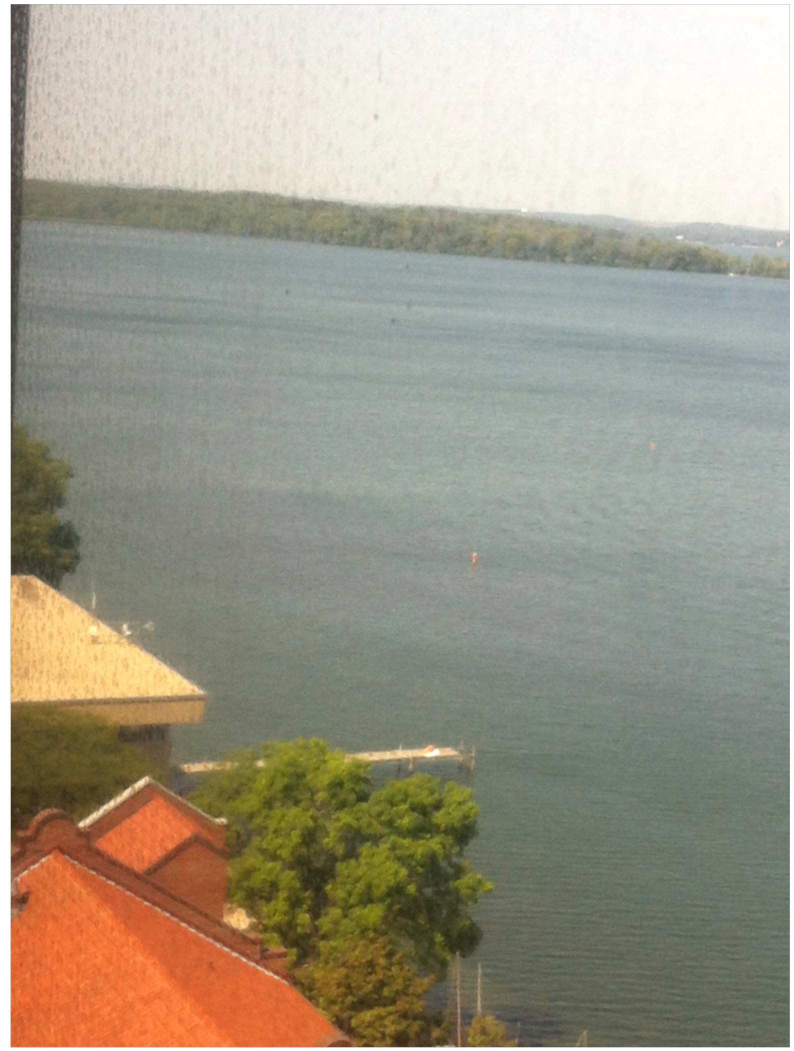





Lake Mendota pCO2 by Year from 1996-2010
2000
1500
1000
500
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Time(Year)

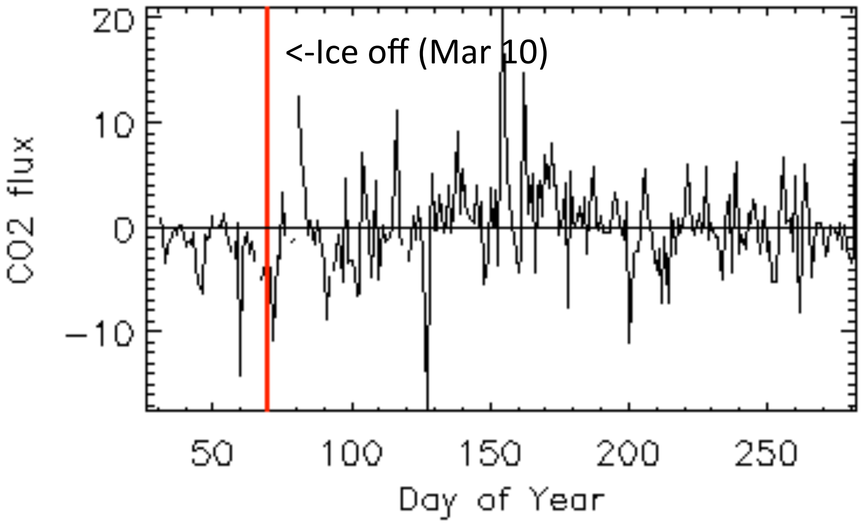

Trout Lake pCO2 by Year from 1985-2010
pCO2 (ppm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Time(Year)

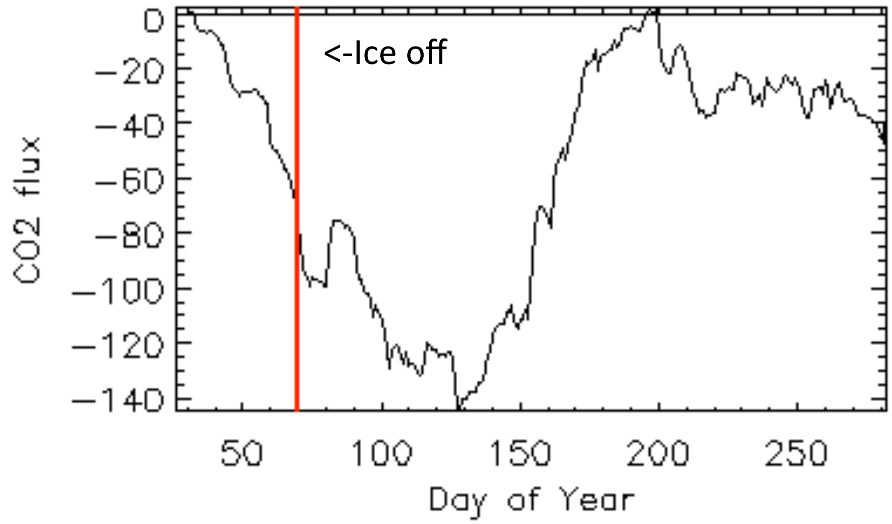
We can build flux towers on lakes too!



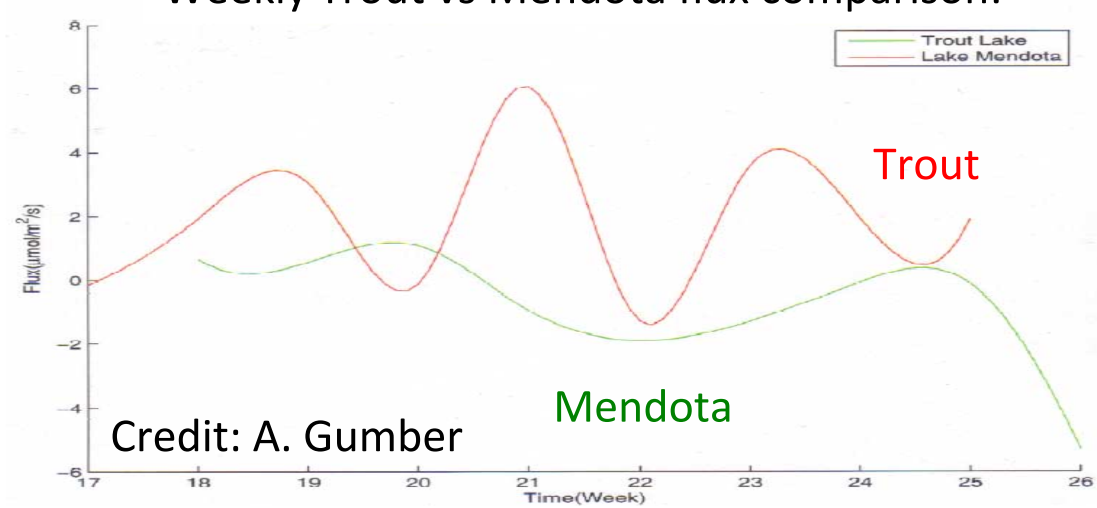
And scratch our heads about it!

Mendota daily CO_2 flux in gC/m^2/day from Jan-Oct 2012:





Weekly Trout vs Mendota flux comparison:



What else might we do?

- Keep monitoring terrestrial carbon cycles
  - Add NTL-LTER to the mix (lakes, wetlands, and forests?)
- Investigate automated under-ice carbon cycle observation
  - Interface with GLEON about global lake monitoring of carbon
- Get a linked landscape modeling working group going; new LTER working group on long-term trends proposed by C. Thomas (Oregon State)
- Whatever smart people like Carpenter, Hanson, and Stanley say we should do!