

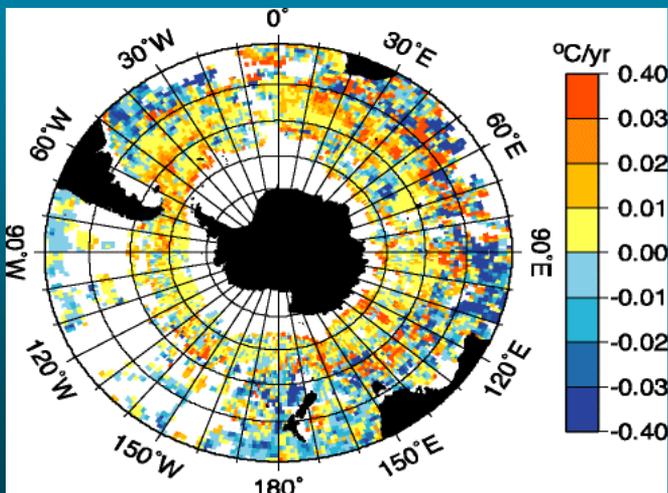
Impact of Climate Change on Biogeochemical Cycles: Detecting Change

Richard Matear

Outline

- Observed temperature and salinity changes
- Projected physical and biogeochemical responses of climate change
- Detecting change with biogeochemical tracers
- Future effort to monitor and detect change

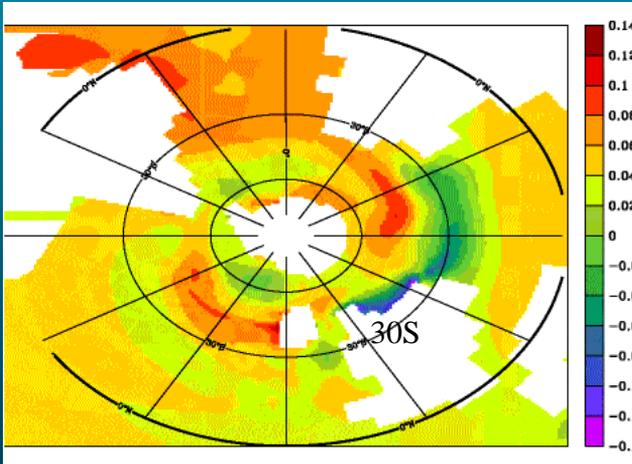
Observed Temperature change in the Southern Ocean



- Temperature change per decade at 800-1100 m from the difference between ALACE float data and hydrographic data

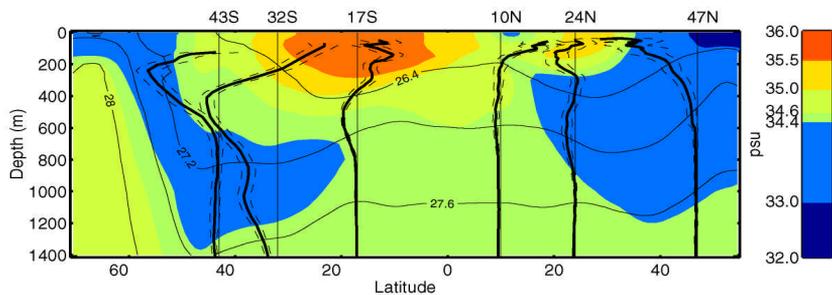
Gille 2002, Science

Simulated Temperature trend from the CSIRO Climate Model



- 900 m depth
- Projected temperature trend in °C/decade between 1980 and 2030

Observed Salinity change in the Pacific

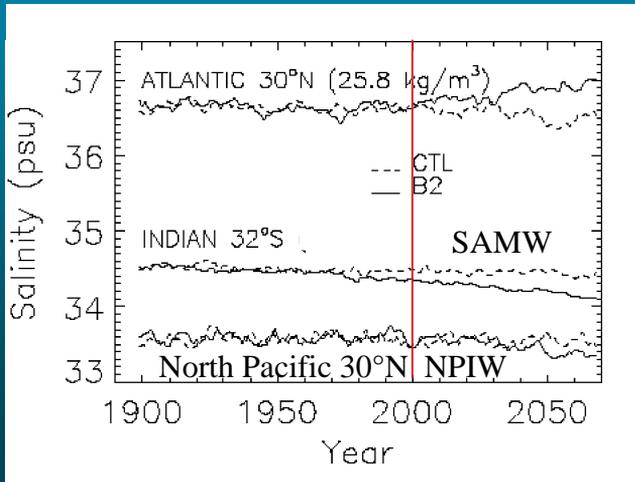


Wong et al 1999, Science

0,1 psu 0 +0,1 psu

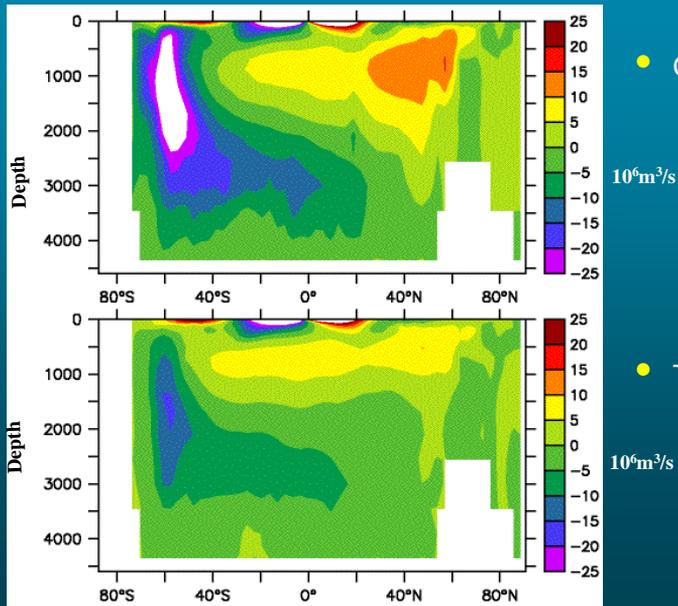
- Changes in mode and intermediate water masses
- Freshening on density surfaces and that is consistent with increased Freshwater fluxes to the high latitudes
- Agrees with climate change model prediction

Simulated salinity changes in mode and intermediate water



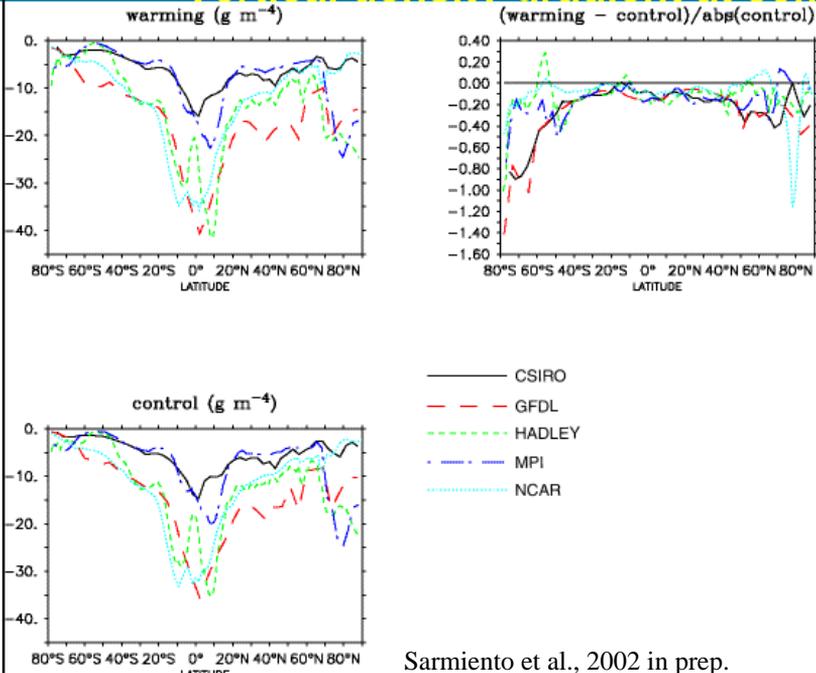
Banks et al., 2000, GRL

Thermohaline Circulation for the years 2090-2100



Matear and Hirst, Tellus 1999

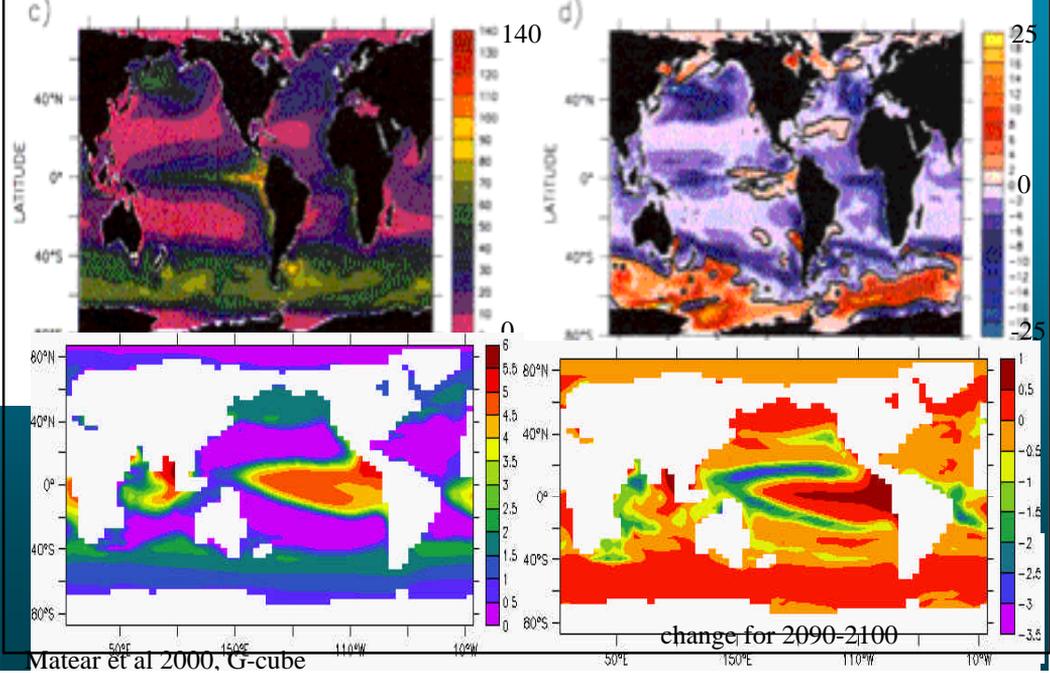
Vertical density gradient at 50m



• 2040-2060 period

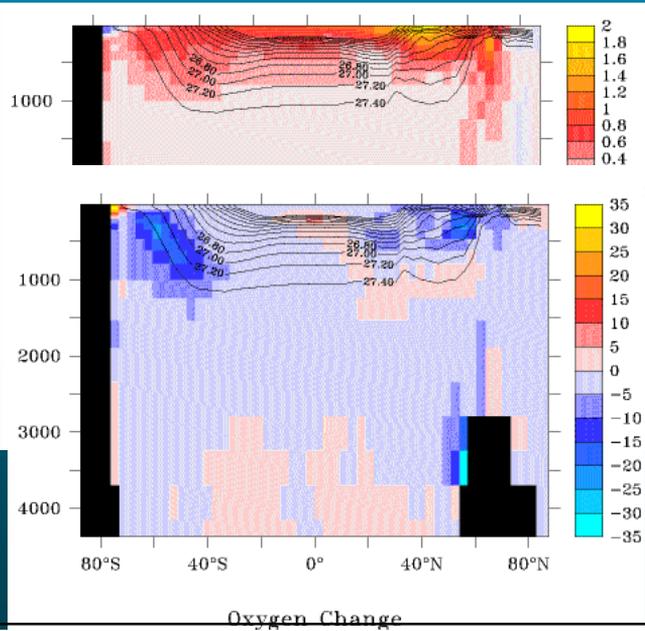
Sarmiento et al., 2002 in prep.

Simulated Changes in Export Production

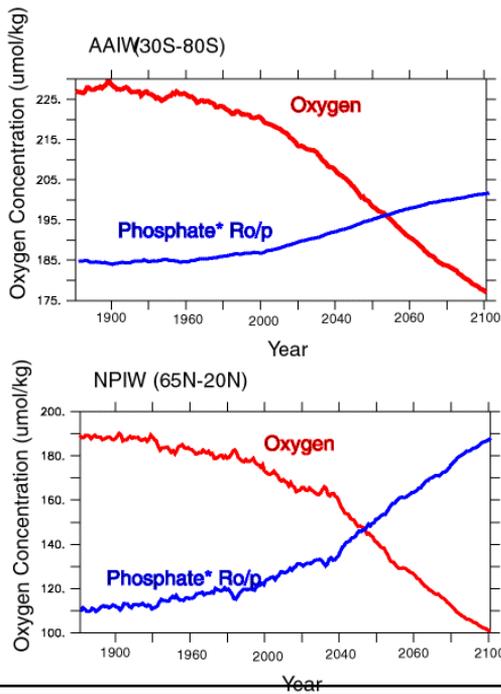


Matear et al 2000, G-cube

Temperature Change

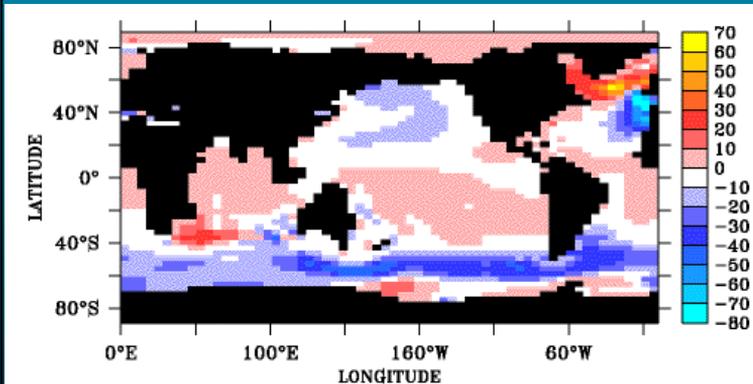


- Change at 2000-2010
- Oxygen change



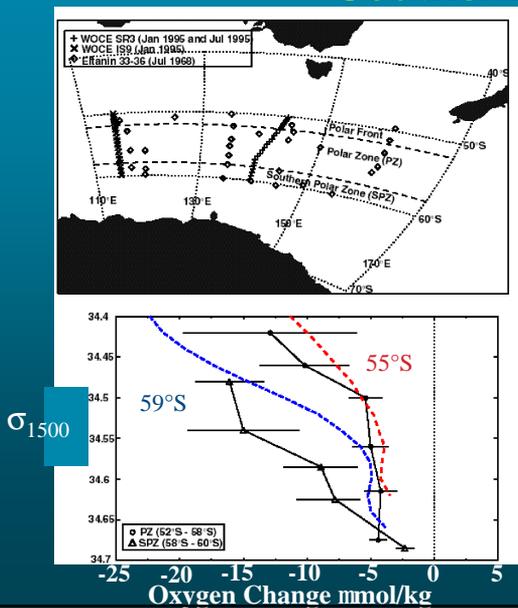
- Oxygen and phosphate change in the Antarctic and North Pacific Intermediate Waters

Simulated change in ocean ventilation from changes in pCFC11



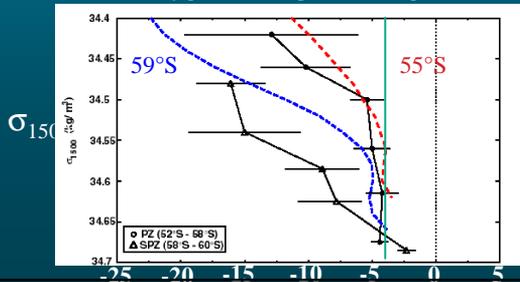
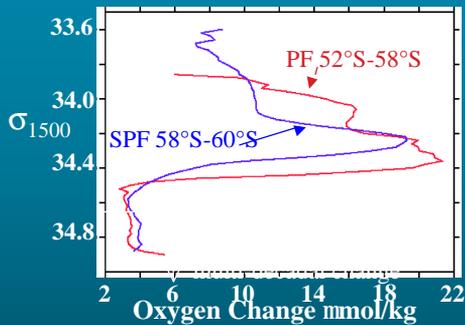
- Change in pCFC11 with climate change at year 2000 based on the CSIRO climate model
- At 500m

Observed changes in dissolved oxygen in the Southern Ocean



- Observed changes between 1968 and 1995
- Dashed Lines are the predicted changes between the Control and Greenhouse Experiments for the 1990s

Observed interannual variability in dissolved oxygen in the Southern Ocean



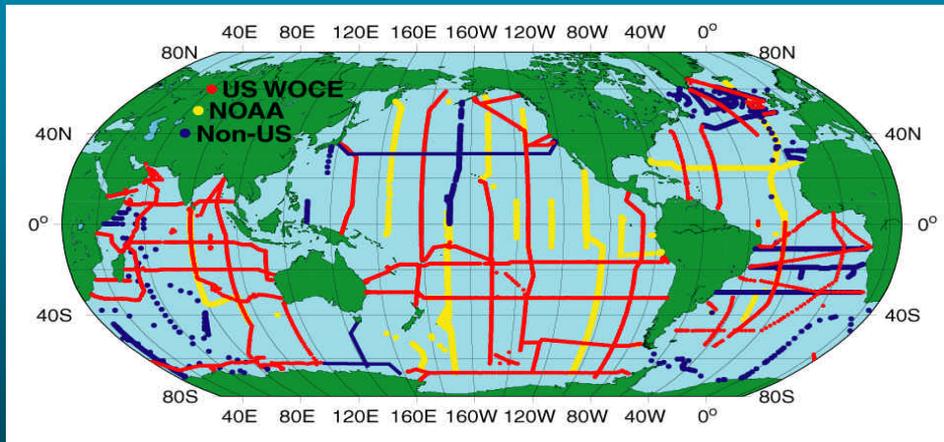
- 5 Cruises along WOCE SR3 are used (1992, 1994, 1995, 1996, and 1998)
- High Seasonal Variability in the upper ocean (above 34.4)
- Observed interannual variability between 34.5 and 34.7 is less than 1/2 the multi-decadal signal

Monitoring and Detecting Change

- Changes are occurring in the large-scale water properties in the ocean - Is it Climate Change?
- Biogeochemical and transient tracers can provide additional insight into reason for these changes
- Biogeochemical tracer provide information on changes in ecosystem dynamics that cannot be easily monitor
- How can we monitor and detect change?



WOCE/JGOFS/OACES Global CO₂ Survey

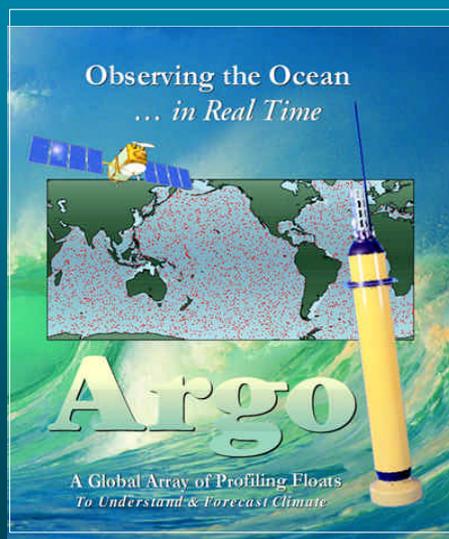


New in situ observations

- Complements the repeat sections
- Autonomous profiling of the ocean temperature and salinity

BUT

we need to add biogeochemical measurements



Discussion

