Final report of the Salinity Working Group

Salinity as the marine extension of the earth's hydrologic cycle

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Activities

- *Role of Ocean Salinity in Climate I, II, III* at the Ocean Sciences Meeting, February, 2006
- *US CLIVAR Salinity Workshop* held in Woods Hole, MA 8-10 May NASA *Aquarius Science Team Meeting*
- EOS meeting report
- whitepaper

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Charge to Committee

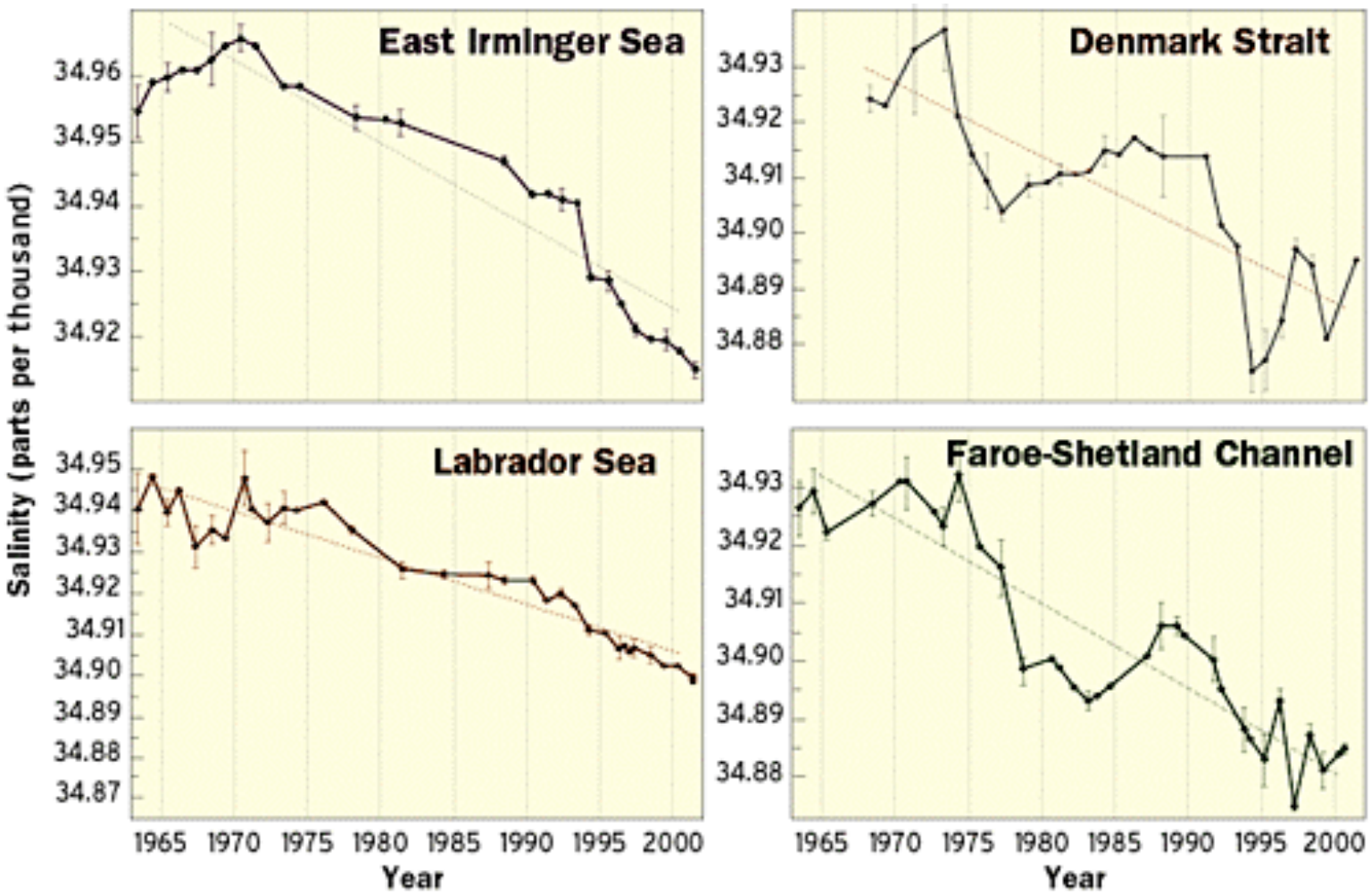
- Describe the value of ocean salinity in refining our quantitative understanding of the global water cycle; in governing the global ocean circulation and overturning circulation; and in investigating the spatial and temporal scales of climate variability (including trends).

- Identify the requirements and challenges for analyzing, observing, and monitoring salinity, as well as for valid numerical simulation of those processes critical for determining the ocean's role in transport and storage of freshwater.

- Provide guidance to NASA (and the international community) on observational and scientific activities that should be considered in advance of and during the Aquarius/SAC-D mission to improve the measurement, analysis, and utilization of salinity information for the purposes stated above.

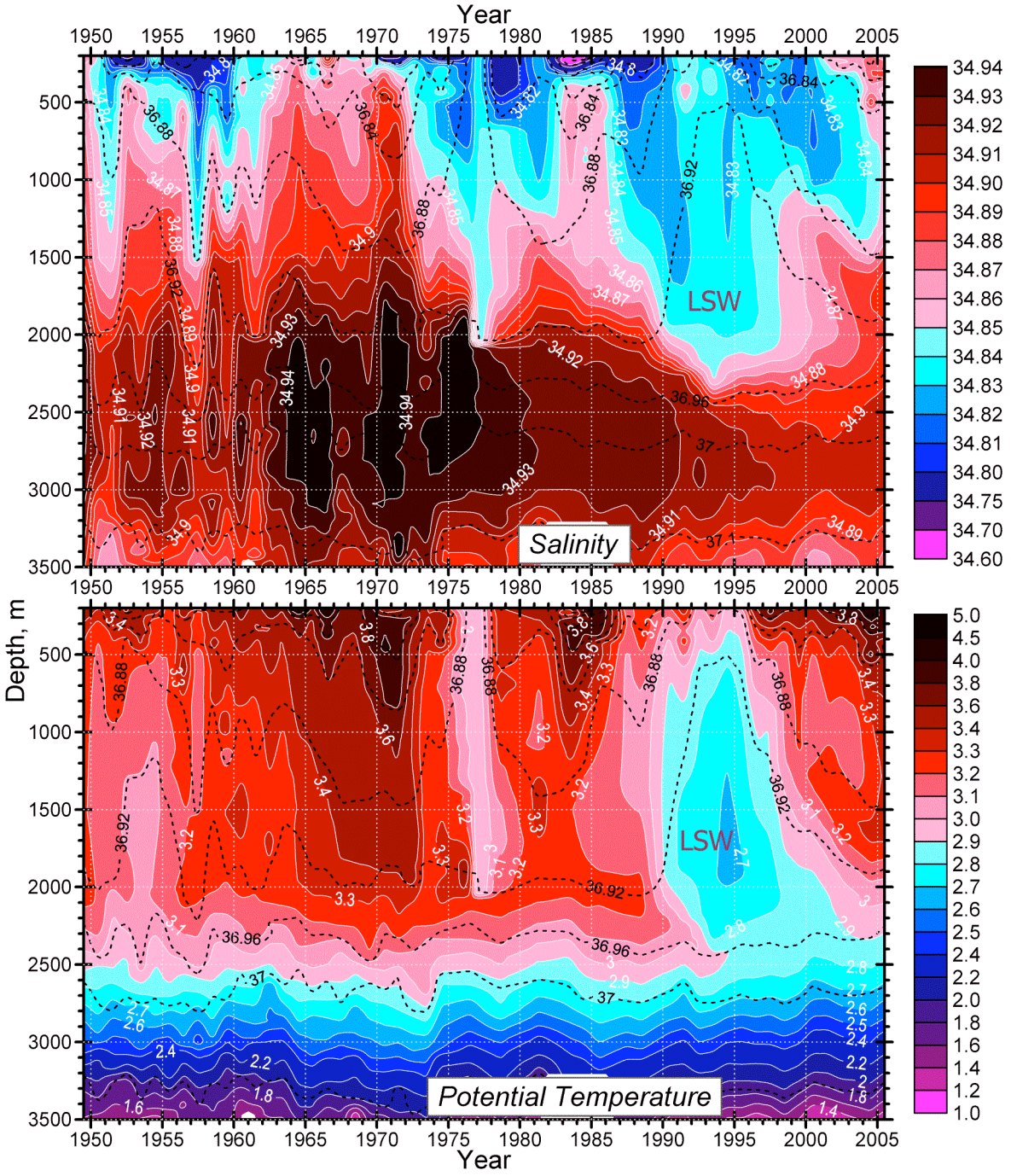
Contents of Report

Northern subpolar Atlantic is freshening



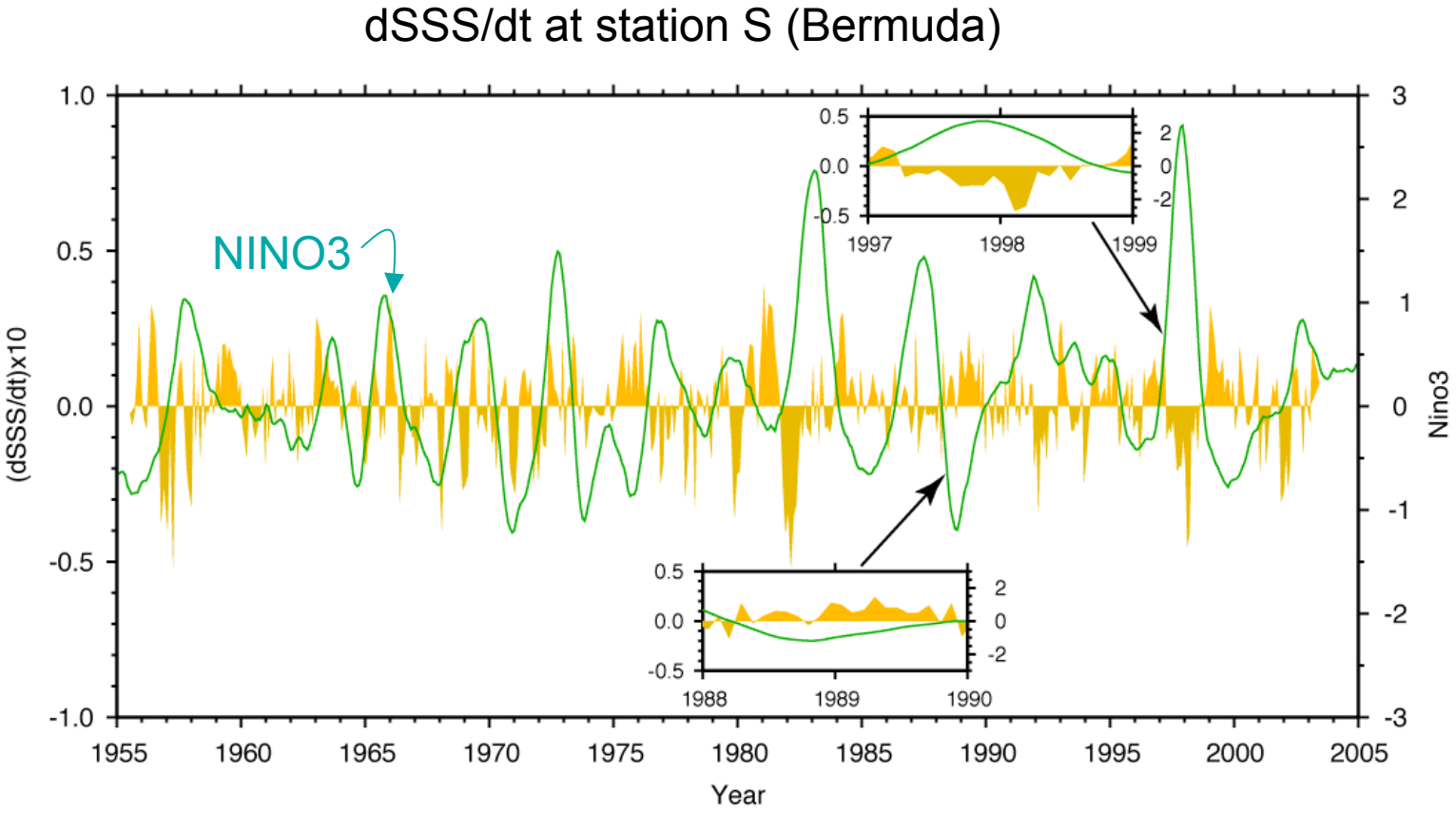
Dickson, et. al., *Nature,* 2002

Salinity in the Central Labrador Sea



(*Igor Yashayaev, Personal Communication*). Note the decadal decrease in salinity followed by a weak rebound since 2000

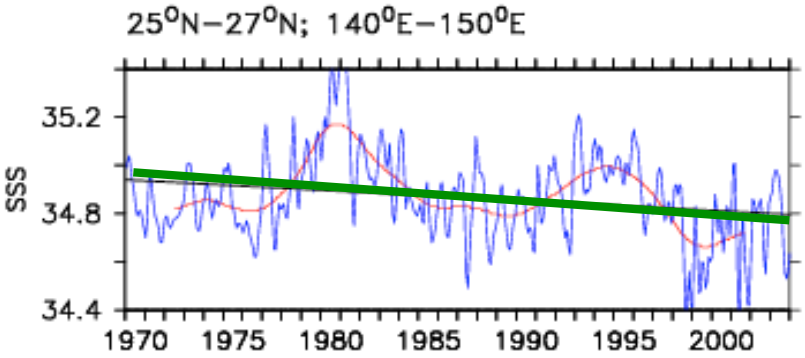
Subtropical Atlantic: ENSO response

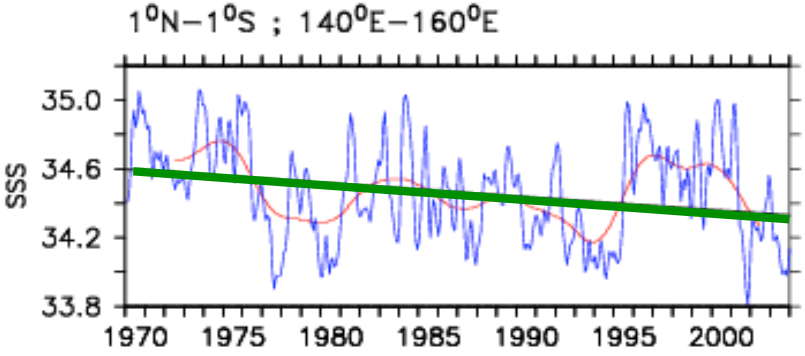


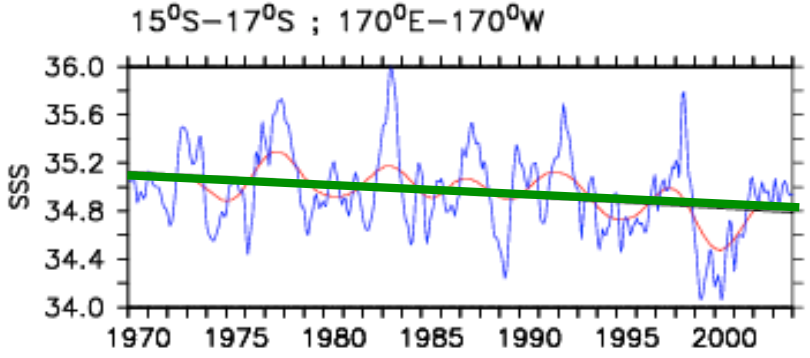
(A. Gordon, personal communication)

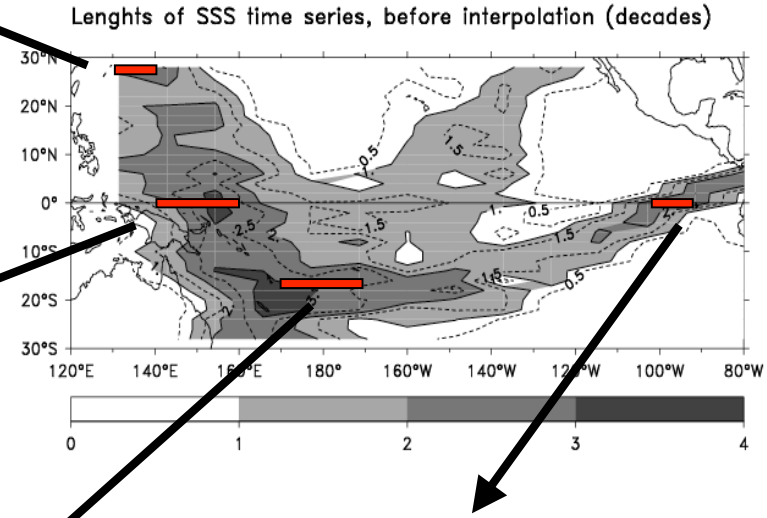
Tropics: west Pacific is freshening

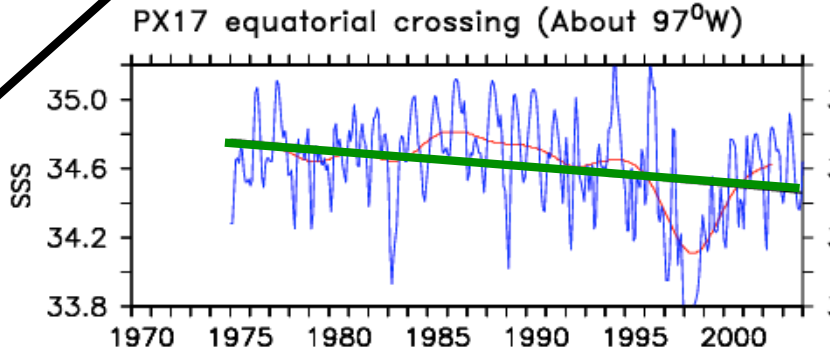
Trend : psu / 30 years =
- 0.12
- 0.23
- 0.29 - 0.32 (-0.11)







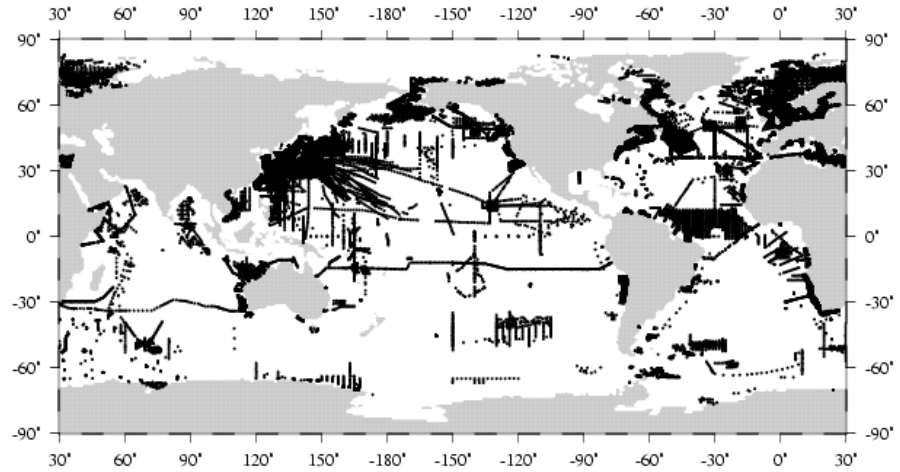




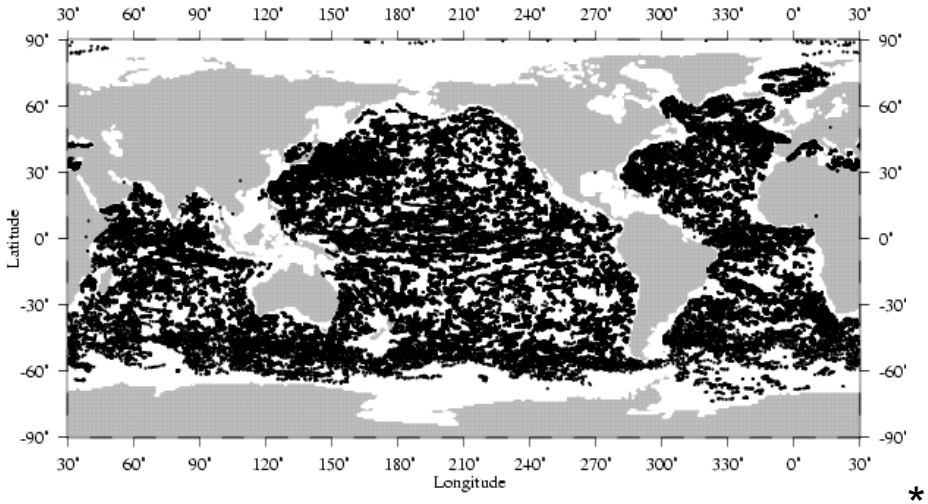
T. Delcroix

Argo contribution to data coverage

1987

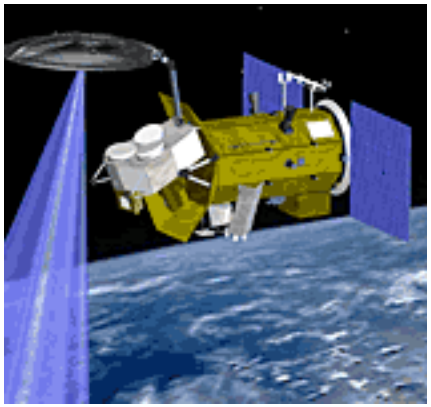


2005*



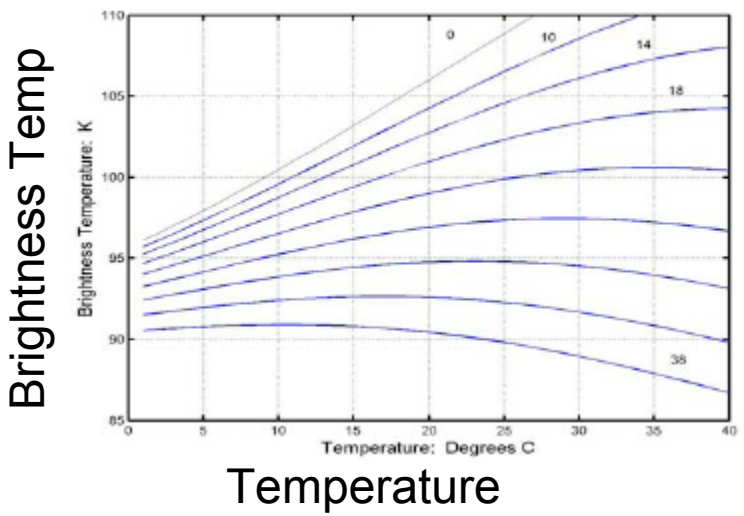
*(70,000)

Aquarius / SAC-D Salinity Mission



- Launch in 2009, 3yr mission
- Orbit: 98^{o} inclination, coverage every 7 dy
- 390 km swath width
- Radiometer: 1.43GHz polarimetric radiometer
- Accuracy: 0.2psu, 150km

!.4GHz (L-band)



Temperature

Key science questions

- What are our key knowledge gaps that limit the fidelity of coupled climate models in representing and predicting changes in the global water cycle and coupling to ocean circulation and climate variability?

- What are the physical mechanisms that control the Atlantic MOC and its sensitivity to interannual SSS variability, and what regions are the highest priority for long term salinity observations?

- How does surface freshwater forcing influence ocean mixed layer dynamics in both the tropics and high latitudes and regulate heat exchange with the atmosphere, and how do these processes feed back on ocean-atmosphere coupling on intra-seasonal, seasonal and interannual time scales?

- How do varying surface fluxes of freshwater and heat generate temperature-salinity anomalies in mid-latitude waters and how are such anomalies incorporated into the central waters of the thermocline?

Priority Recommendations

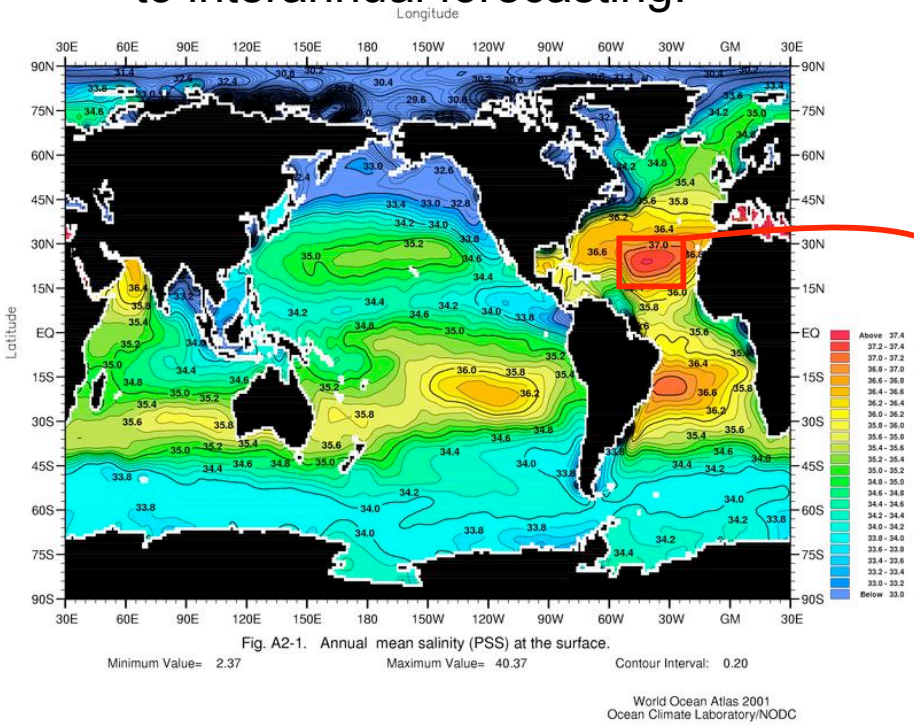
- Support the maintenance and expansion of the current *in situ* observing system, especially Argo and the Volunteer Observing Ship thermosalinographs. We recommend enhancements to the global observing system specifically directed towards improved estimation of sea surface salinity:
  - Expand the Argo instrument suite to include Surface Argo Salinity Measurements (Upper 5-m sensor) to allow a more precise calibration of AQUARIUS.
  - Support development and testing of sea surface salinity sensors for deployment on the surface drifters of the Global Drifter Program.
  - Support accurate estimation of salt transport across key passages. Current technology based on CTD sections or innovative combinations of glider and mooring technology may be developed for this task, perhaps as part of a comprehensive program to monitor other parameters such as carbon transport.

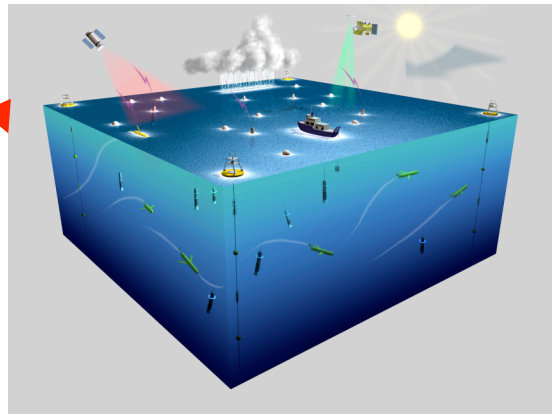
- We propose a control-volume-type process experiment in which a volume of the upper ocean would be closely monitored in a defined geographic region

Process-oriented experiment

Observations constrain the storage of freshwater and heat as well as the fluxes across the boundaries. Detailed modeling tests the way climate models handle hydrologic processes.

1) Evaporative subtropical gyre: precipitation, salt advection and eddy activity are weak, water properties are set for incorporation into the thermocline, and our observing systems and models best able to quantitatively constrain the water cycle.
2) High precipitation tropical regime could contribute to improvement of seasonal to interannual forecasting.





Oceans: Dominant in Global Water Cycle
Salinity: Marine Hydrologic Cycle Indicator

Mapping onto NOAA COP Objectives

Weather & Water

- Closure of Marine Hydrological Cycle

Climate/Climate Change Research

- Circulation: Meridional Overturning, SubTropical Cells, etc.
  - Dynamically Vital and as Tracer
- Alkalinity, CO_2 Air-Sea Exchange Rate

Climate Prediction

- Seasonal/Interannual Air-Sea Interaction (Barrier Layers)
  - Improved Thermal Structure in Assimilations
- Density-Driven Circulation

Climate Application

- Ground truth for Aquarius/SMOS(2009/2007)
- Nearshore, fisheries, biogeochemistry