Application of the *World Ocean Database* to climate studies

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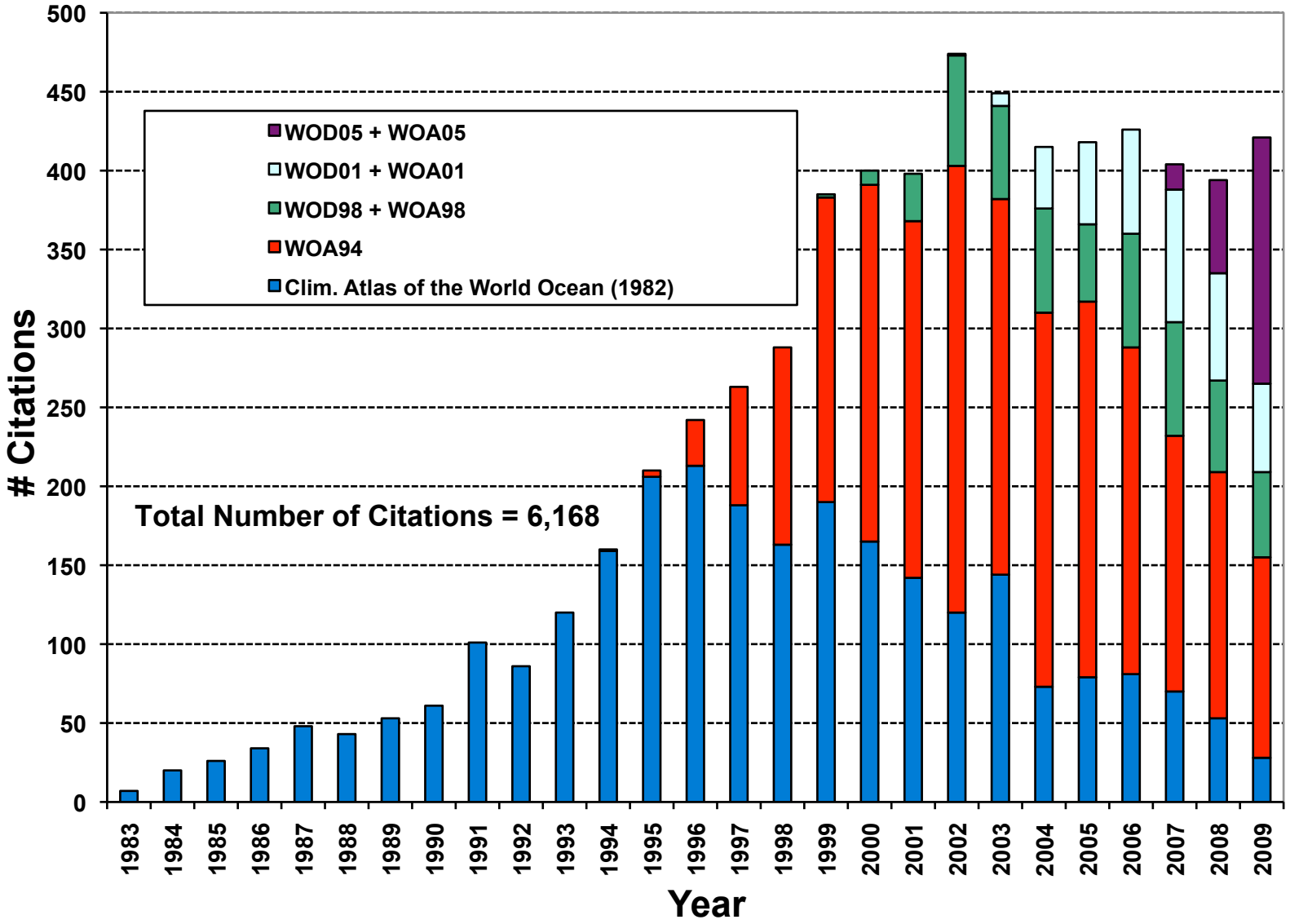
Utility of NODC/WDC profile data as indicated by citations to NODC databases & atlases in the scientific literature

Based on a search of the ISI *Scientific Citation Index* as of August 2010

This is due to international cooperation in building ocean profile-plankton databases. Many of the studies are climate related.



IPCC

IPCC Assessment "Climate Change 2007" chapter on-

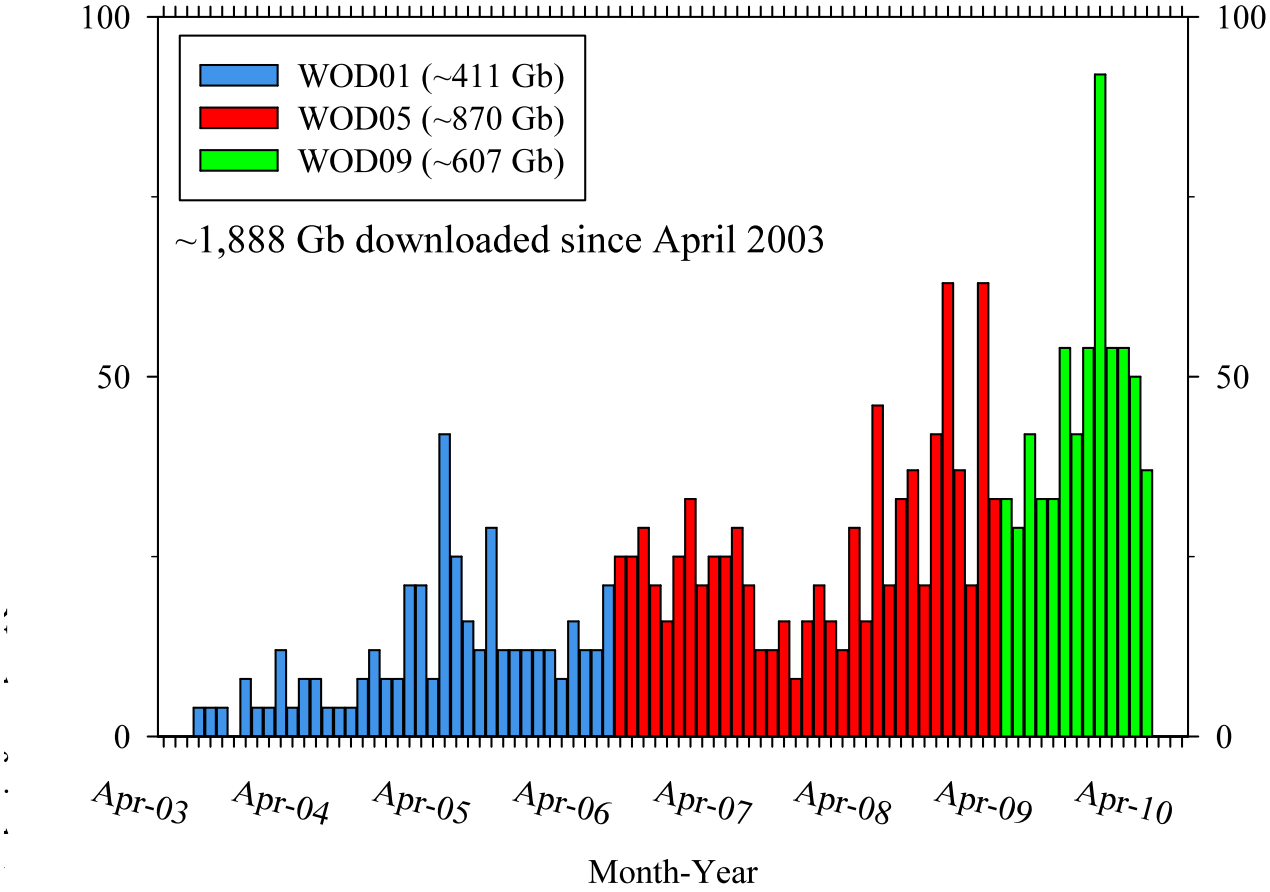
Observations: Ocean Climate Change and Sea Level.

This chapter reported on changes on:

1) **Ocean Heat Content**
2) **Salinity**
3) **Oxygen**
4) **Nutrients**
5) **Carbon**
6) **Sea Level.**

The next IPCC Assessment will also have a similar chapter.

World Ocean Database time series of the number of ocean stations downloaded by month



Since implementation in April 2003, WOD*select:*

(1) has responded to 31,453 database queries,

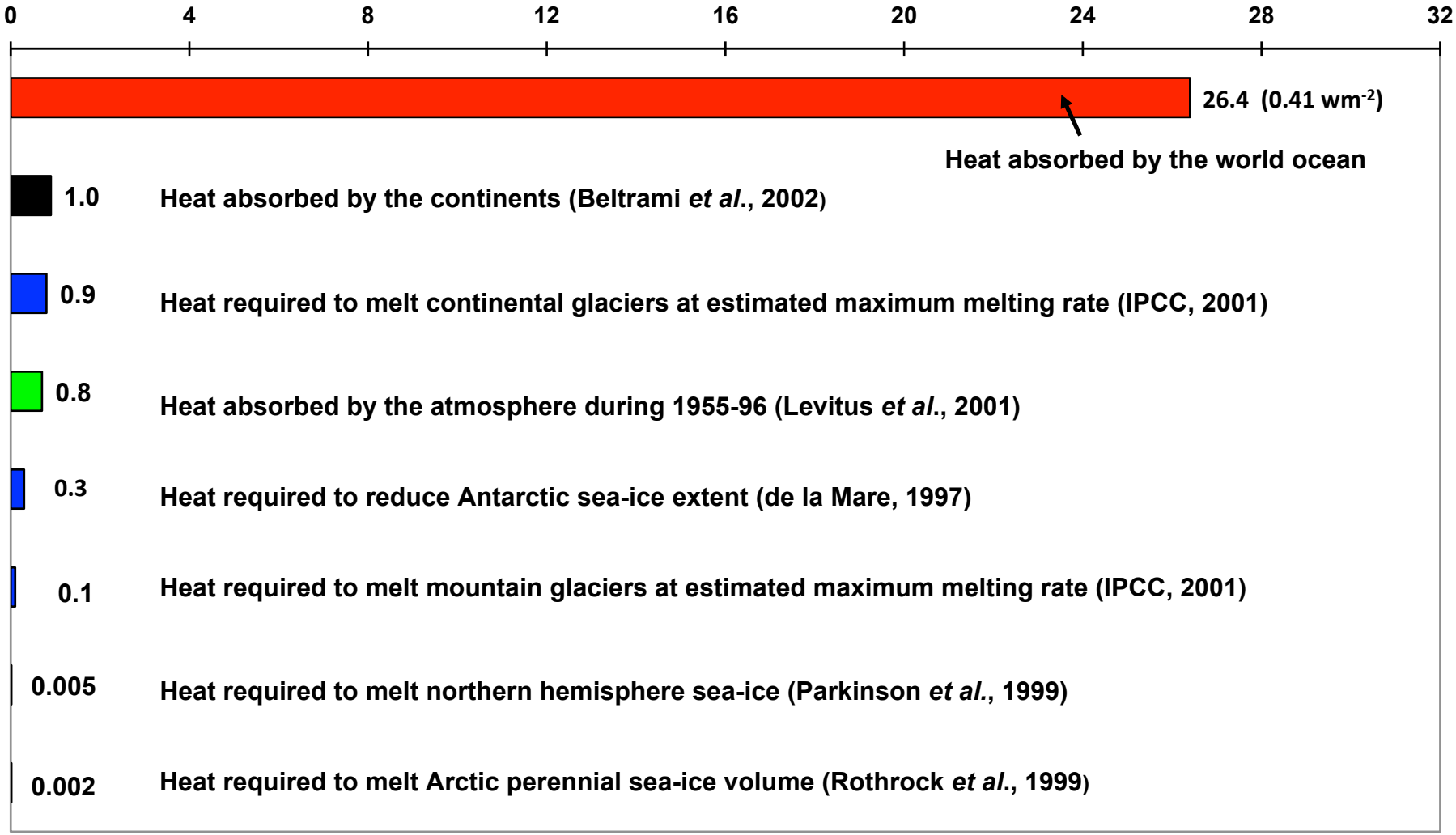
(2) served over 1.9 Billion stations (1.9 Terabytes).

via the NODC FTP server as of April, 2010.

If you can only download one ocean station at a time you can obviously not achieve such results.

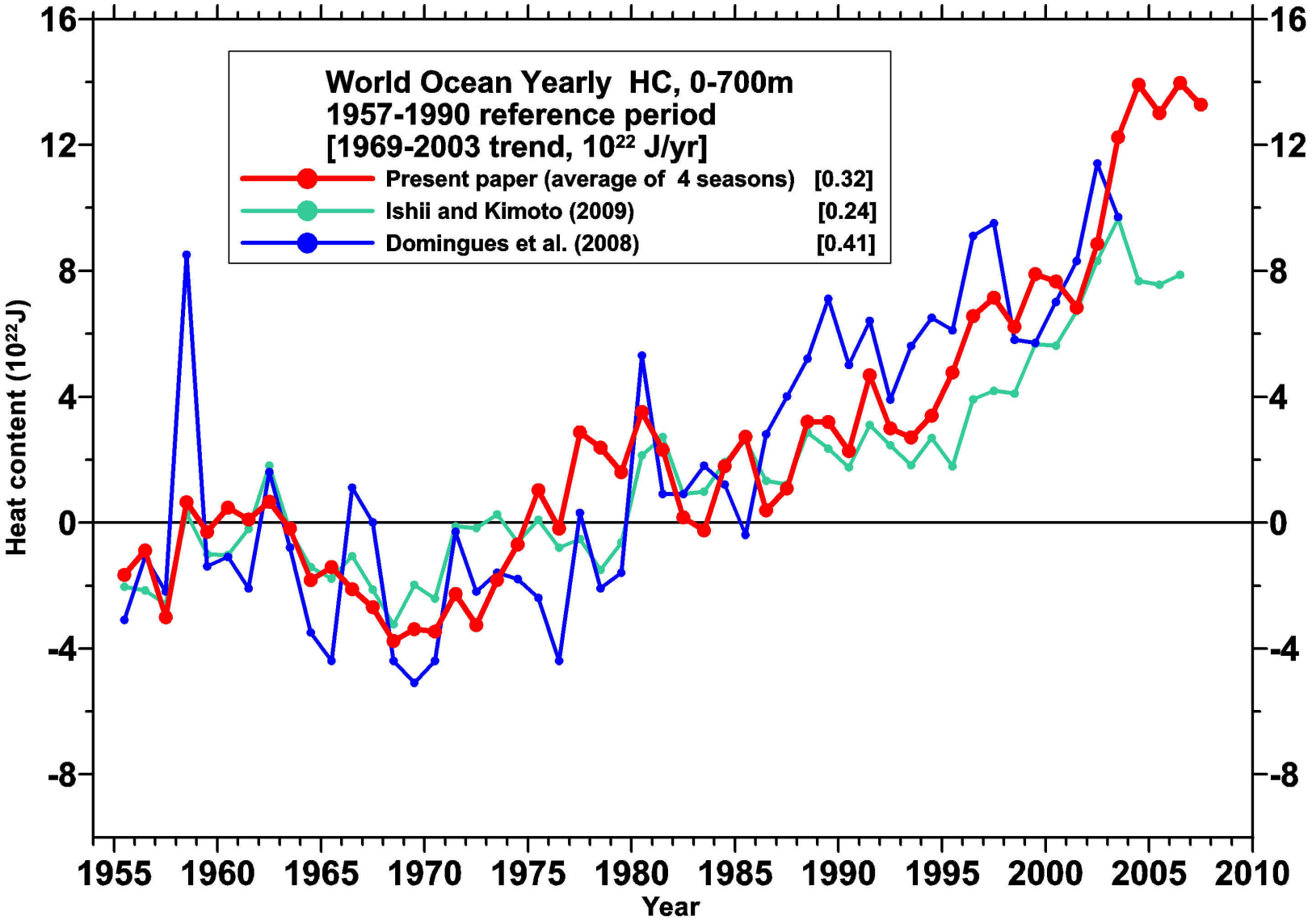
Rossby was correct, the ocean dominates earth's heat balance

Changes in Earth's Heat Balance Components (10^{22} J) during 1955-2009 from Levitus *et al.* (2011, to be published).

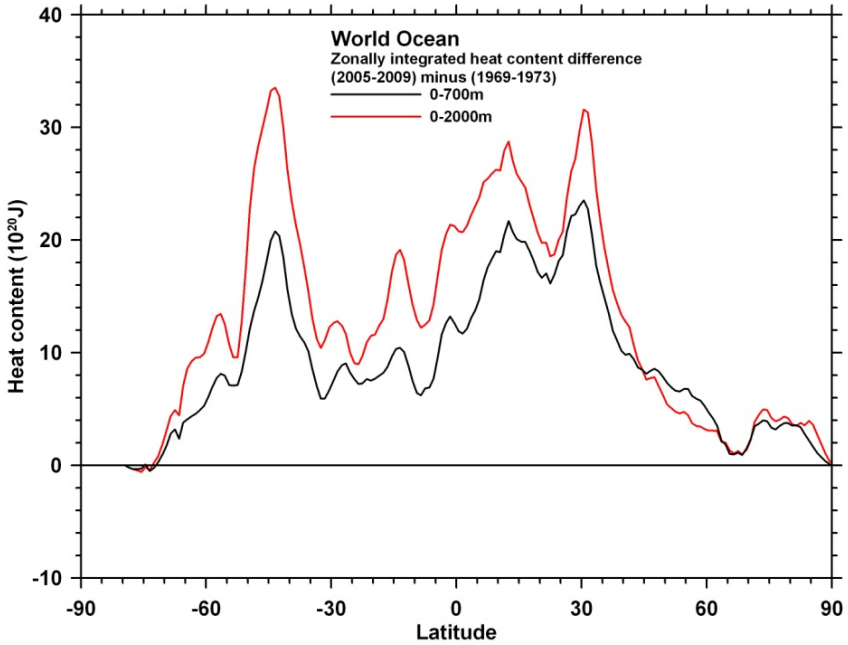


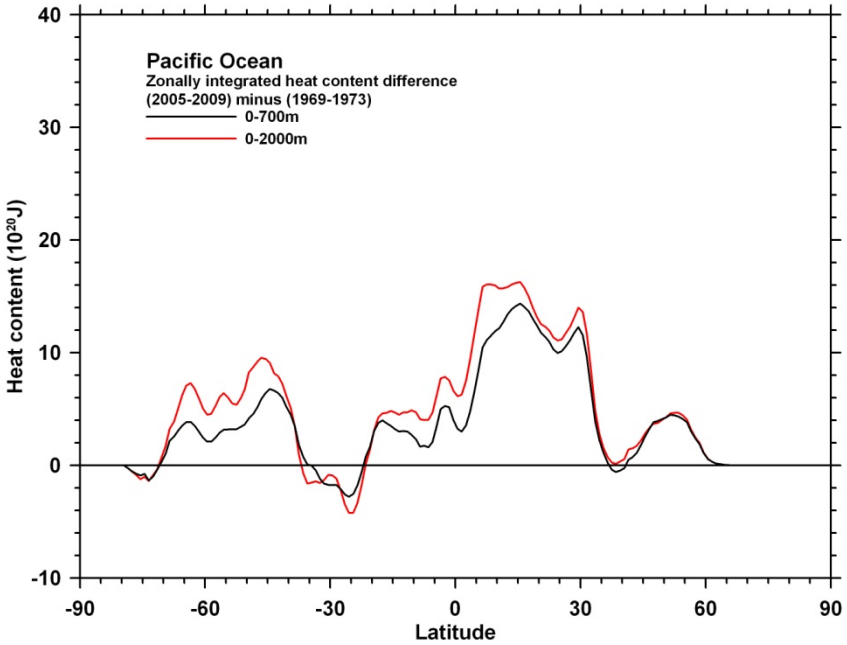
The world ocean accounts for ~90% of the heat absorbed by the earth system during 1955-2009.

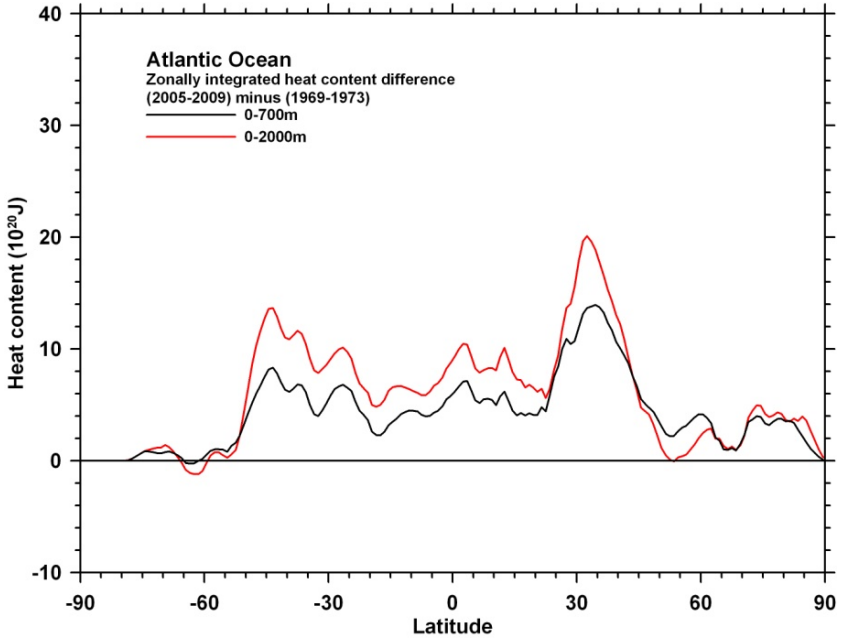
Observed OHC computations are being performed by several groups world wide.
A comparison of three global ocean heat content (0-700 m) time series estimates.

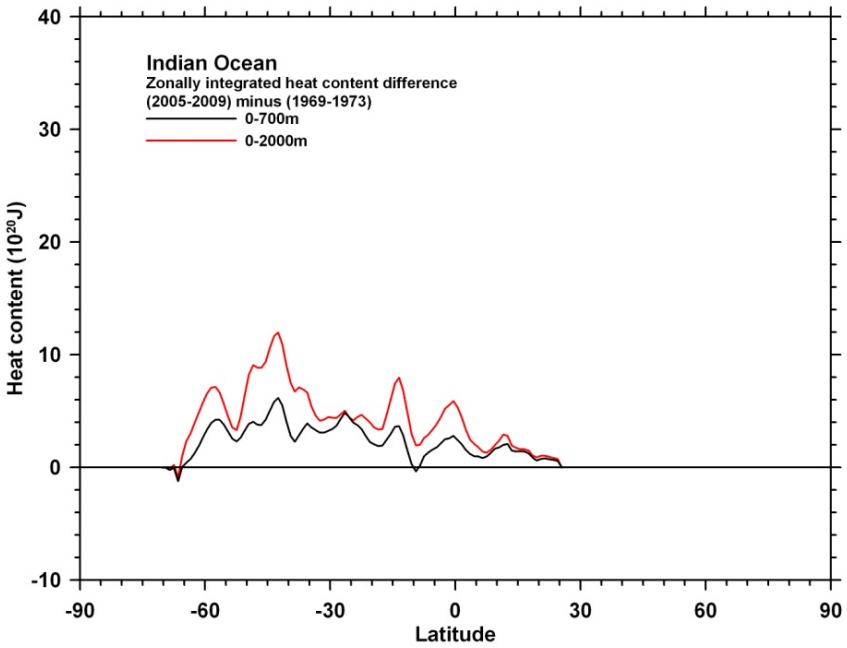


Zonally integrated pentadal heat content differences 10^{20} J (2005-2009) minus (1969-1973) [pentadal analyses]



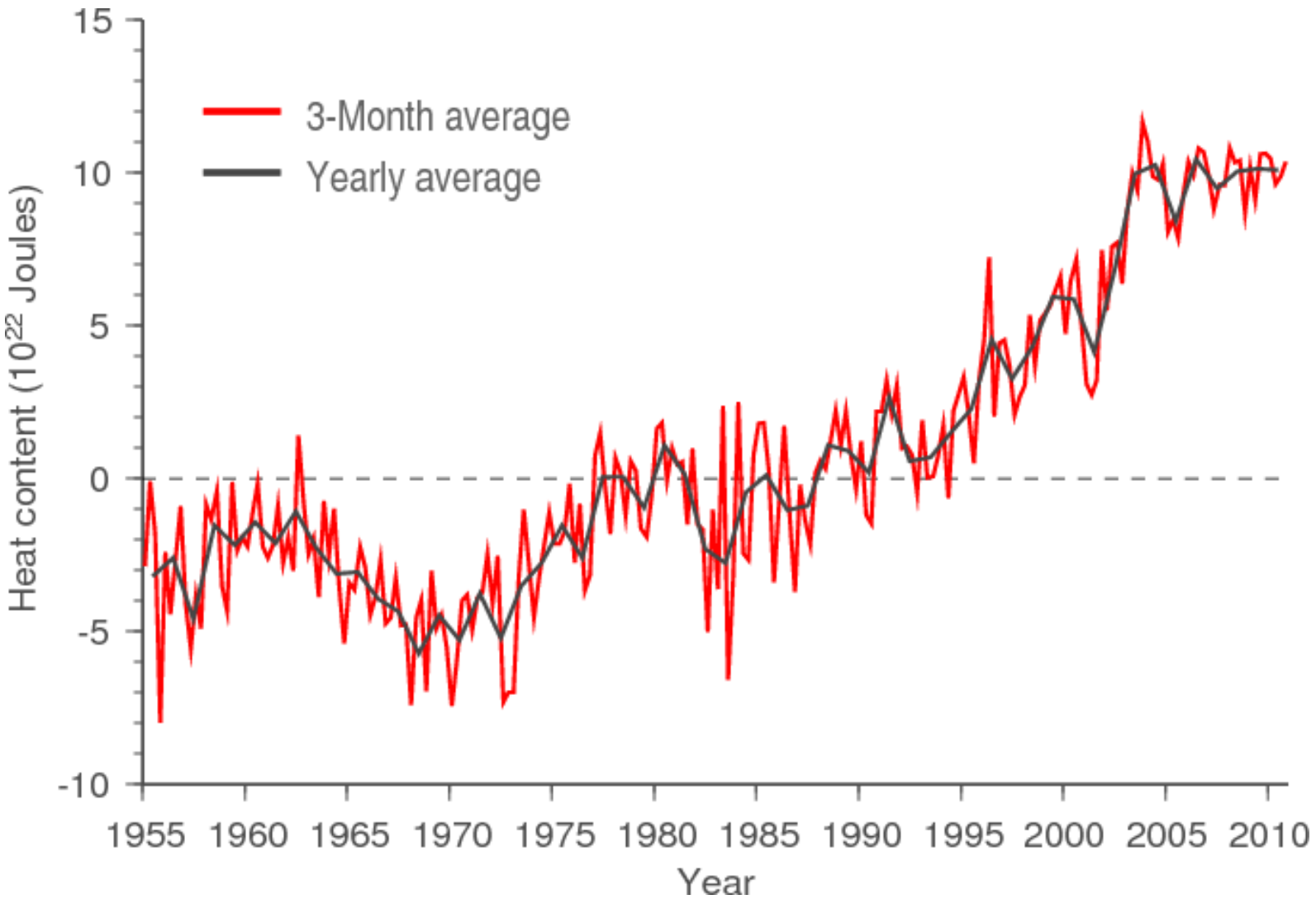






Ocean Heat Content (0-700 m)

Online (www.nodc.noaa.gov) and updated every 3 months



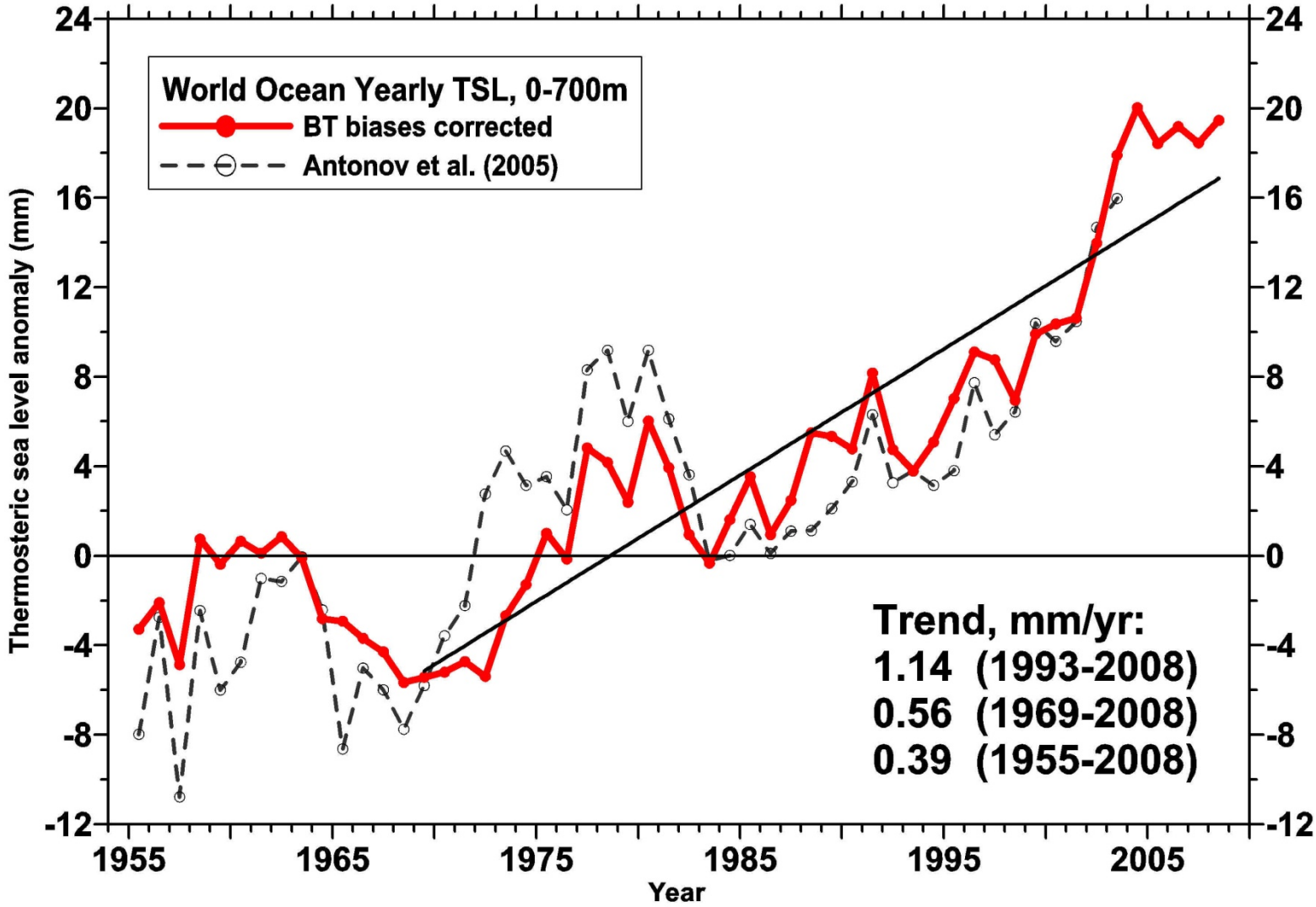
Rossby (1959) (2)

"The assumption that our planet as a whole stands in firm radiation balance with outer space cannot be accepted without reservations, even if periods of several decades are taken into account."

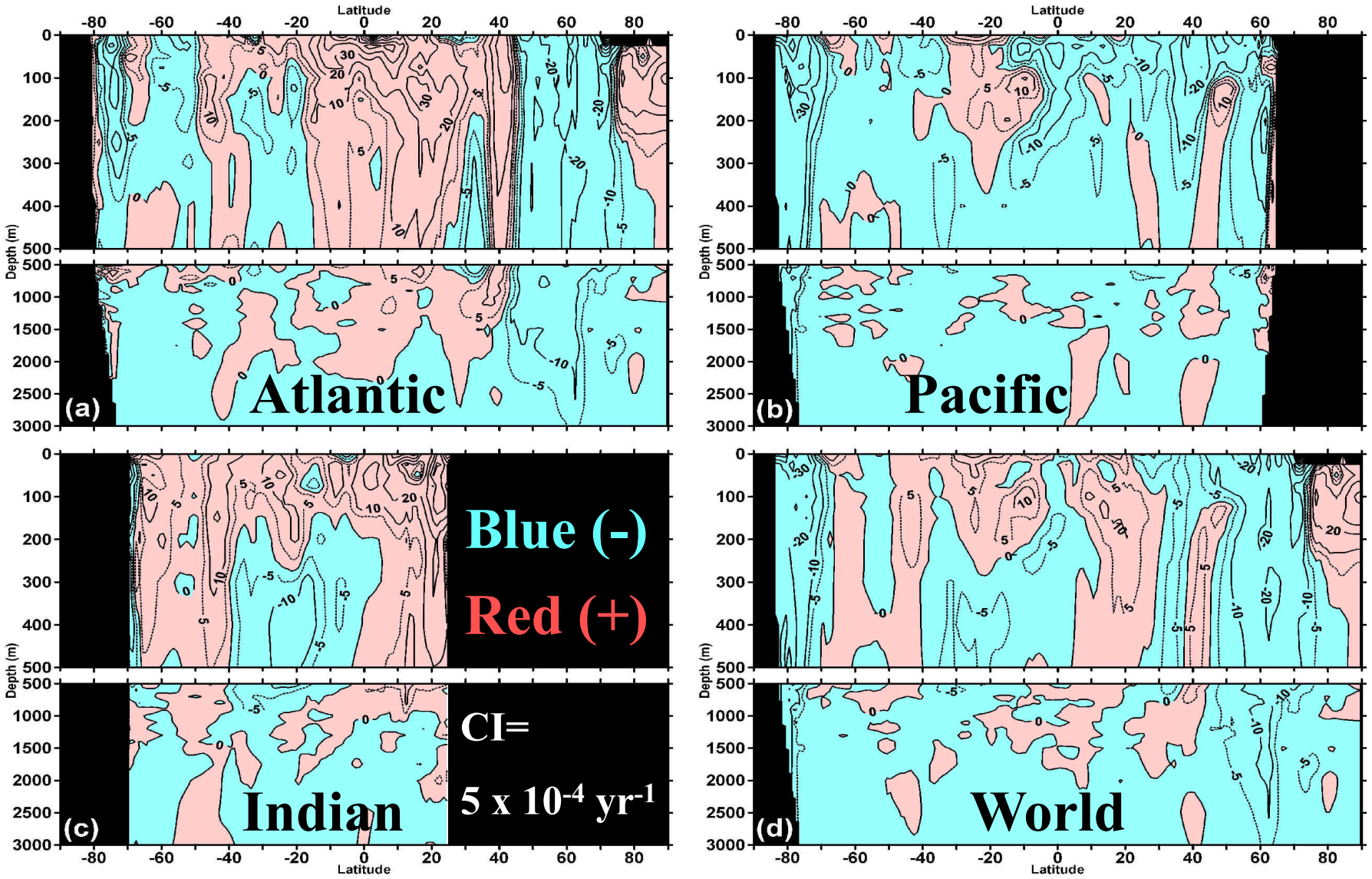
"Anomalies in heat probably can be stored and temporarily isolated in the sea and after periods of the order of a few decades to a few centuries again influence the heat and water vapour exchange with the atmosphere."

Thermosteric component of sea level change (mm), 0-700 m [1955-2008]

The observed rise is consistent with the rise expected due to the observed increase of greenhouse gases (GHGs) in earth's atmosphere and with AOGCMs forced by increasing GHGs.

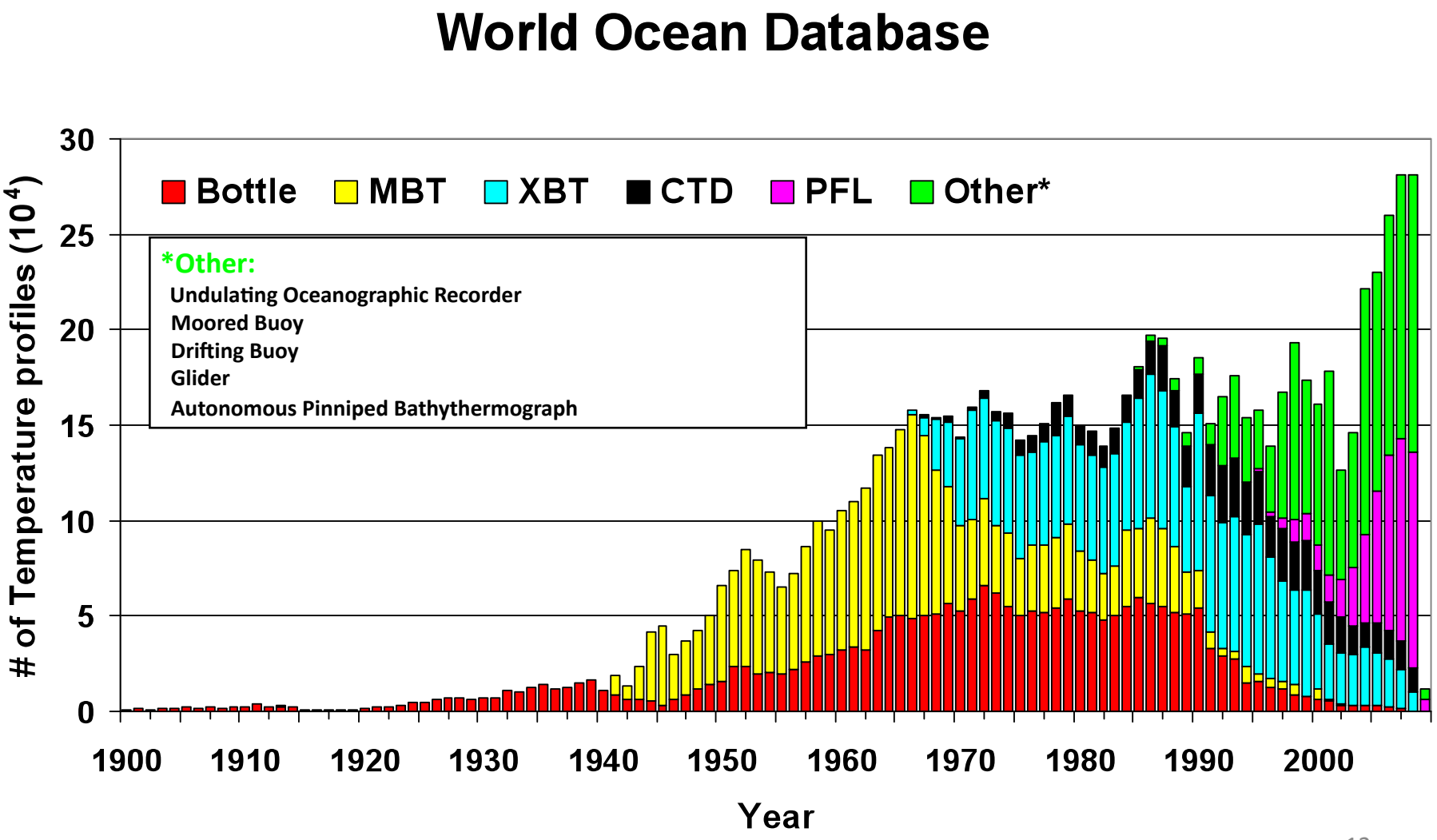


Linear Trend in Salinity (x 10^{-4} $year^{-1}$) of the zonally averaged pentadal salinity anomaly (1955/59 to 1994/98)

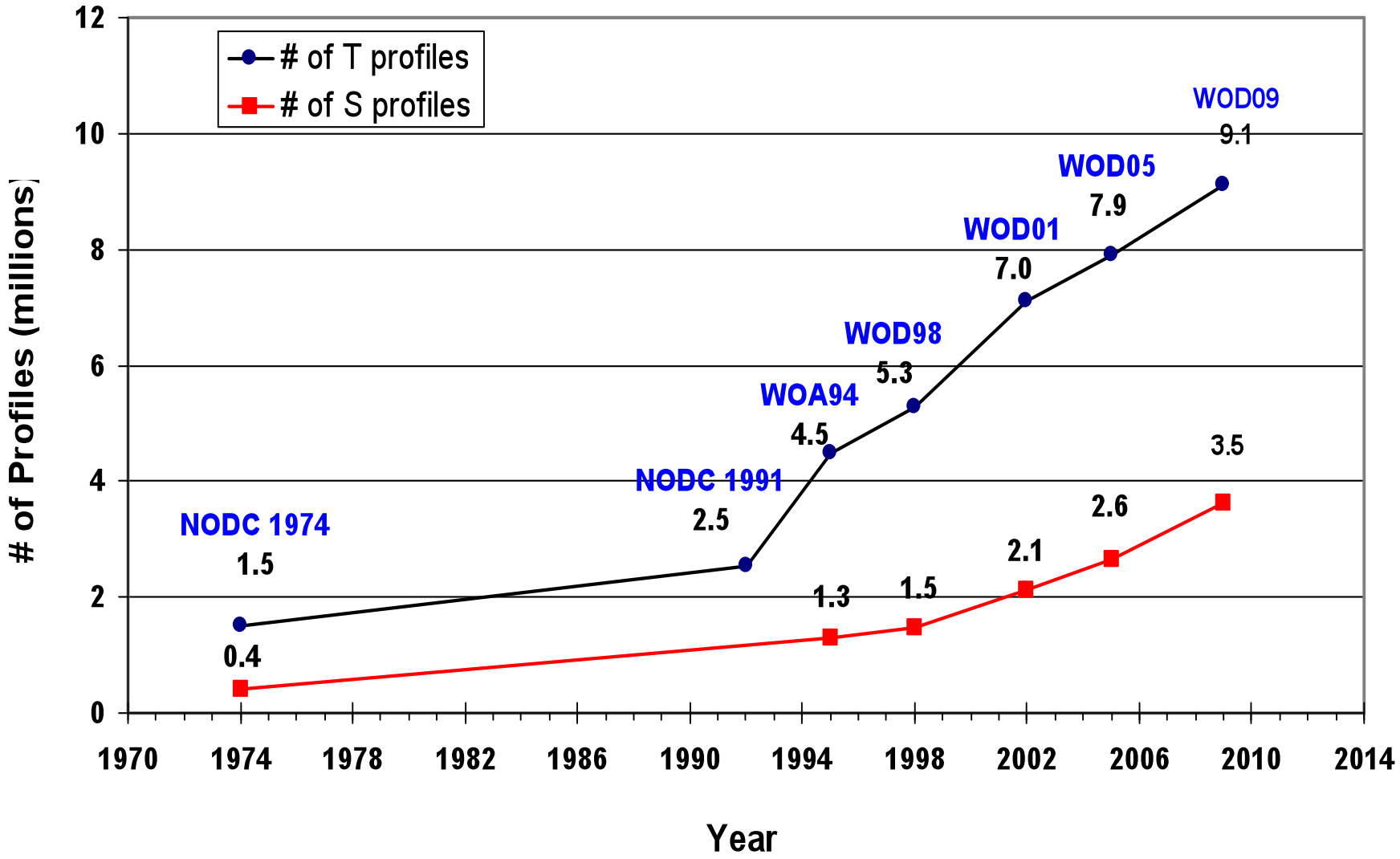


Boyer *et al.*, 2005- Also see work by Durack *et al.* (2010)

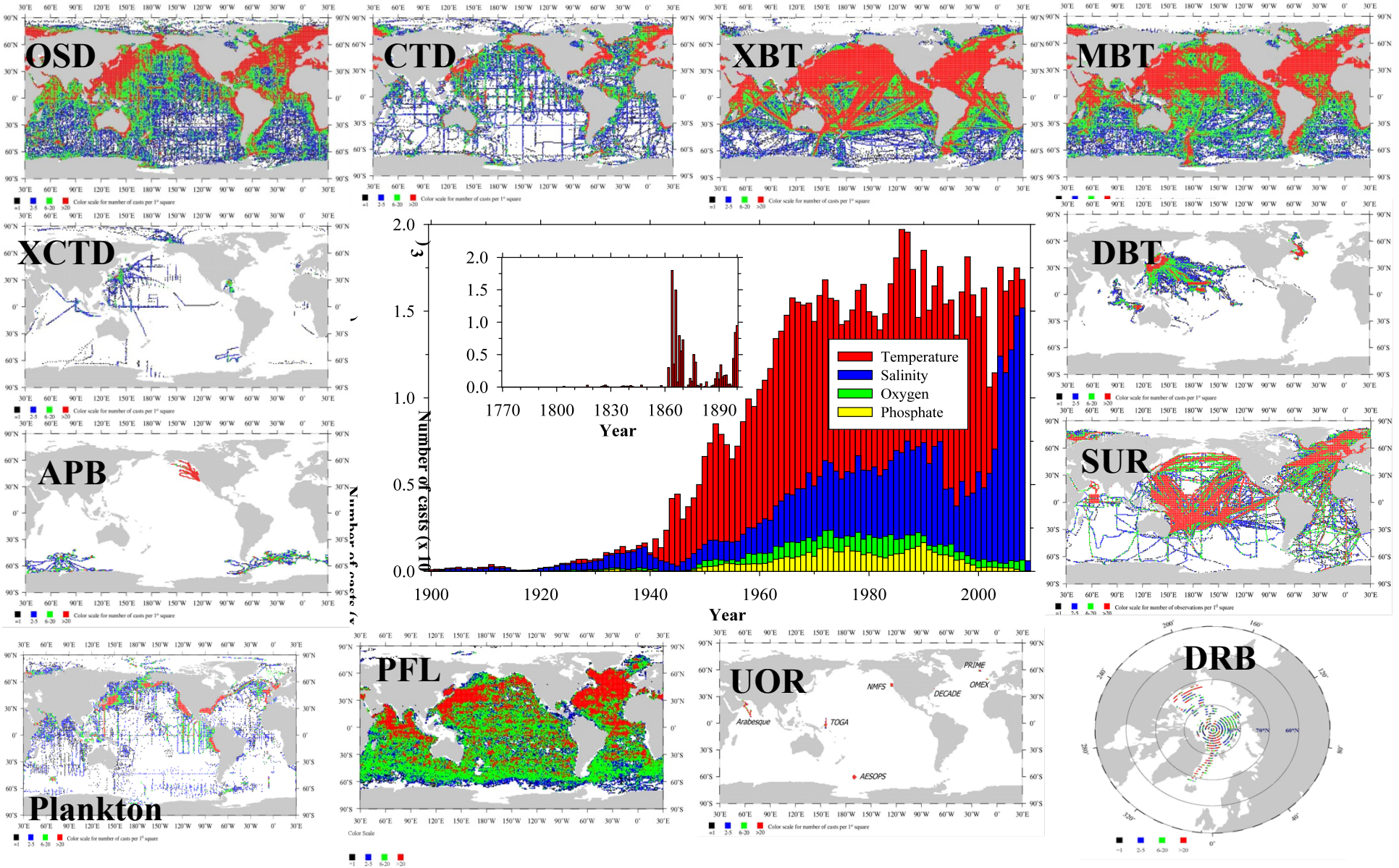
History of ocean profile data sets available in electronic form from NODC/WDC as contained in WOD09



NODC/WDC temperature & salinity profile time series growth- as of April 2 2009



WOD09 spatial and temporal data coverage



OSD: Ocean Station data; **MBT:** Mechanical bathythermograph; **XCTD**: Expendable CTD; **DBT:** Digital Bathythermograph; PFL: Profiling Float

APB: Autonomous Pinniped Bathythermograph; MRB: Moored buoy data; DRB: Drifting buoy data; UOR: Undulating Oceanographic Recorder; GLD: Glider data

Approach

- **Normal exchange of ocean data via the Intergovernmental Oceanographic Commission (IOC) (data centers) and the International Council of Science (ICSU).**

- **NODC Ocean Climate Lab. Director (Levitus) leads two international projects for the IOC that have lead to enhanced ocean data exchange:**

  1) Global Oceanographic Data Archaeology and Rescue (GODAR) project and the
  2) World Ocean Database (WOD) project.

- **GODAR focuses on historical data and WOD focuses on modern data and products such as atlases.**

- **Excellent cooperation from the international data management and scientific communities.**

Schedule

- WOD is updated online every three months with all data we have processed for that quarter.
- All “real-time” and delayed-mode QC problems reported to GTSPP.
- Other QC problems reported to data submitters.

Lessons Learned

Data management activities such as:

1) *World Ocean Database* (WOD) development;

2) *Global Oceanographic Data Archeology and Rescue* project

are demonstrably successfully by metrics such as:

1) used by the scientific community, *e.g.*, citations and amount of data downloaded;
2) data used in assessments such as the IPCC.

Recommendations

The scientific community has requested more of these products and more "advanced" versions of these products such as:

a) High vertical-horizontal resolution climatologies;

b) More frequent releases of products, *e.g.*, monthly T, S, OHC fields etc..

Thank you!