



Preparation of *in situ* temperature and salinity profile data CDRs for joint studies of sea level with altimeter and GRACE data

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Outline

- Brief Project Overview
- Approach (1-2 slides)
- Results/Accomplishments (1-3 slides)
- Validation Strategy/Results (1-2 slides)
- Algorithm/Product Maturity
- Issues/Risks & Work-Off Plans
- Schedule
- Research-to-Operations or Delivery Plan
- Resources

Overview

- Production of temperature and salinity profile CDRs for use in study of sea level variability in conjunction with altimetric and gravity data.
- All CDRs become part of WOD and are available online every three months.
- All data are scientifically quality-controlled and all data are in one well-documented common format.
- Data acquired from U.S. and international sources including data centers

Uses of ocean profile temperature and salinity data and products based on such data:

- 1) Diagnostic studies describing role of the ocean as part of earth's climate system;
- 2) Boundary and Initial conditions for numerical models;
- 3) Ocean data assimilation studies;
- 4) Verification for ocean and atmosphere simulations;
- 5) "Sea truth" for satellite ocean altimetry measurements";
- 6) Initial state for acoustic tomography inversions;
- 7) Establishing fields of temperature and salinity for paleoclimatic studies (e.g. CLIMAP);
- 8) Weather forecasting with coupled models.

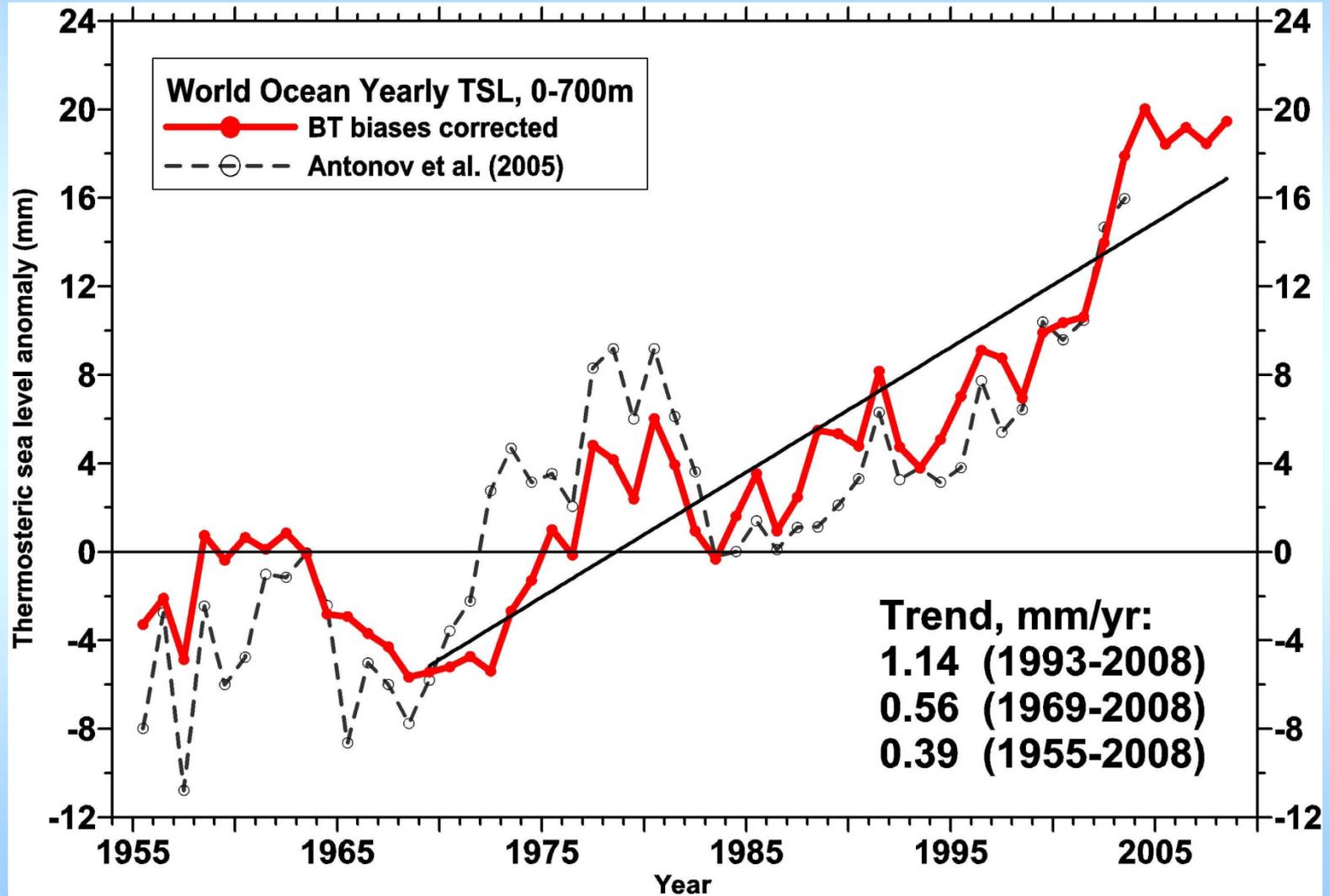
Approach

- 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) and the
 - 2) World Ocean Database (WOD) project.
- GODAR focuses on historical data and WOD focuses on modern data.
- Outstanding cooperation from the international data management and scientific communities.

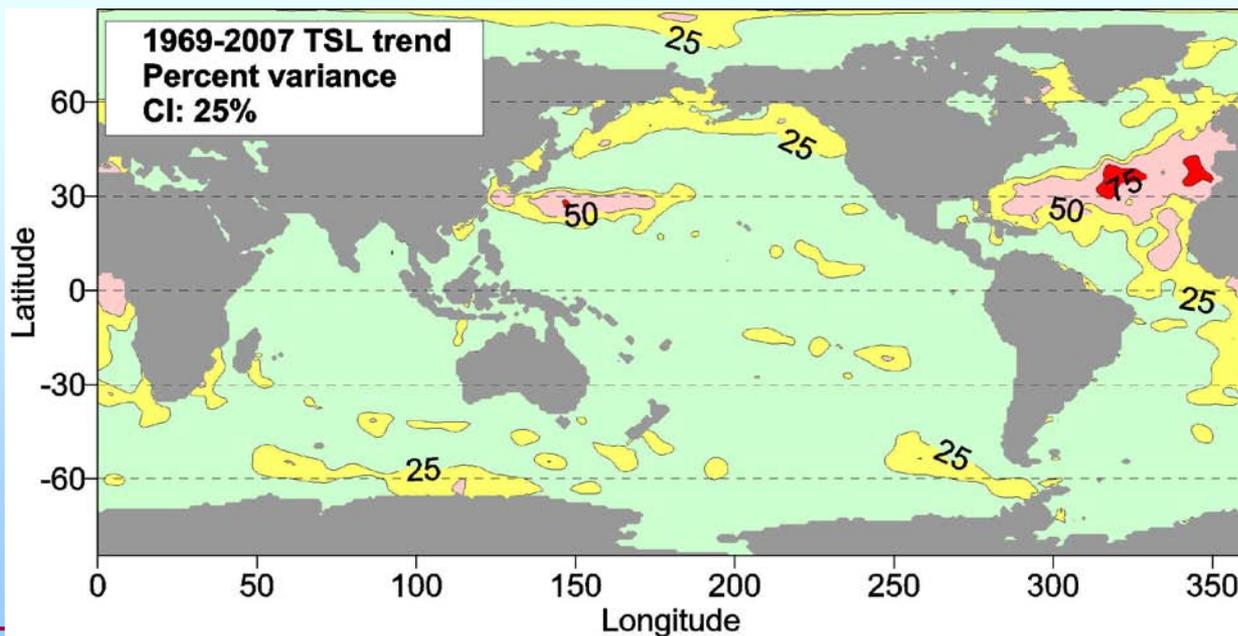
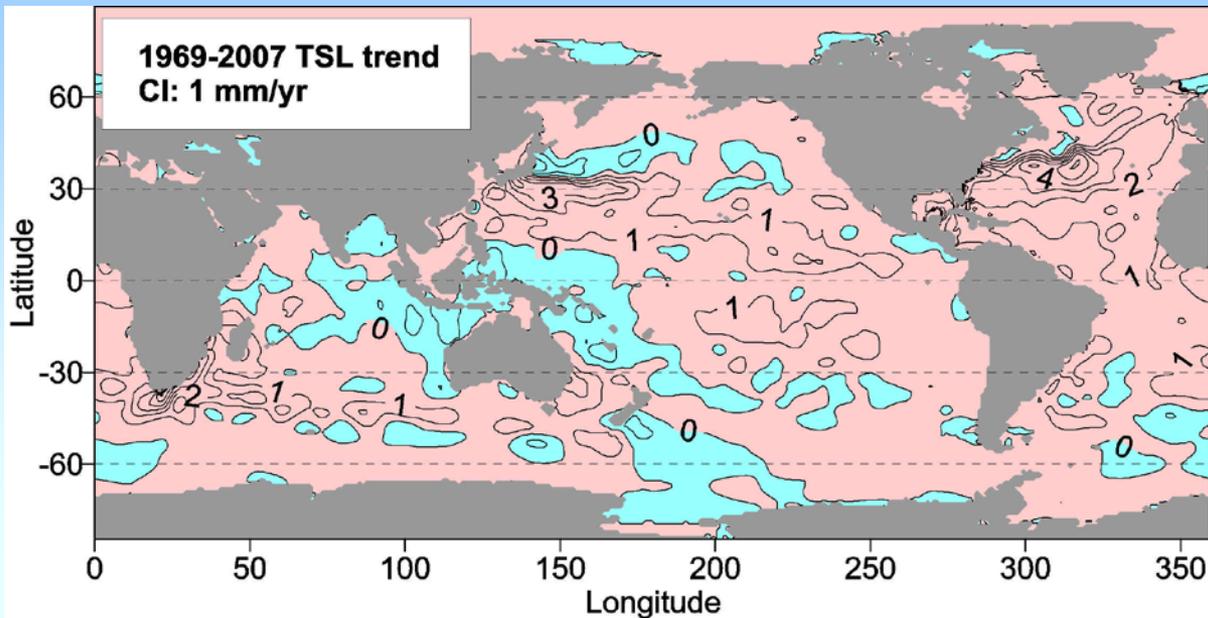
Results/Accomplishments (1-3 slides)

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 of the thermosteric component of sea level change, 1969-2007



Data Archaeology & Rescue \implies Improved data coverage for past years

\implies ability to provide global estimates of heat content, salinity, thermosteric component of sea level change for the past 50 years for the first time!

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Intense interest by media, Congress, scientific community, IPCC.



WODselect, an on-line access tool

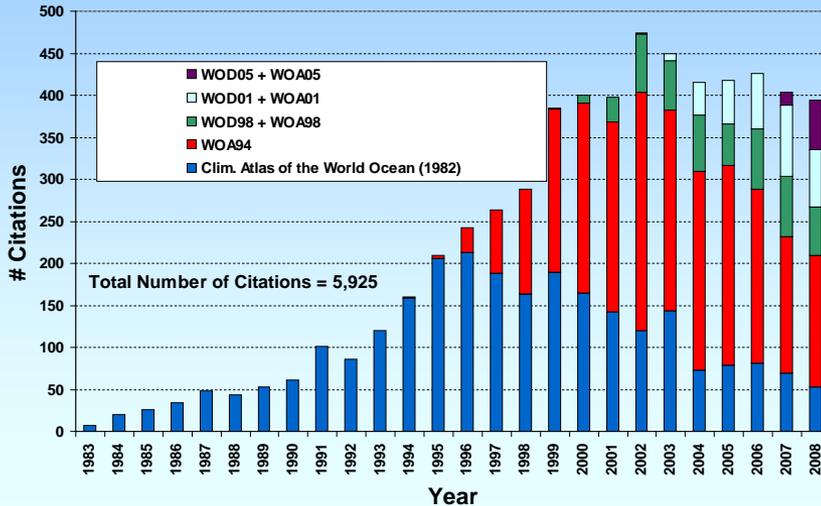
WOD*select* allows users to select data on-line from the WOD using the following criteria:

- 1) Geographic area
- 2) Period of observation
- 3) Instrument type
- 4) Measured variables, *e.g.*, temperature, salinity, oxygen, ...
- 5) Deepest measurement in the profile
- 6) Country
- 7) Ship/platform name
- 8) Project name
- 9) Institute name
- 10) Quality control flags
- 11) Biology (plankton)

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Impact

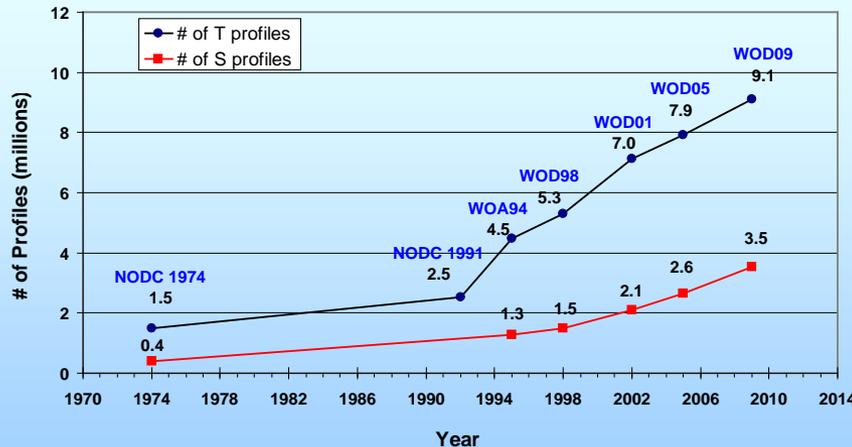


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Thus, NODC/OCL works accounted for approximately ~5.8% of all citations of NOAA publications during the 1991-2001 period.

Output



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Another metric:

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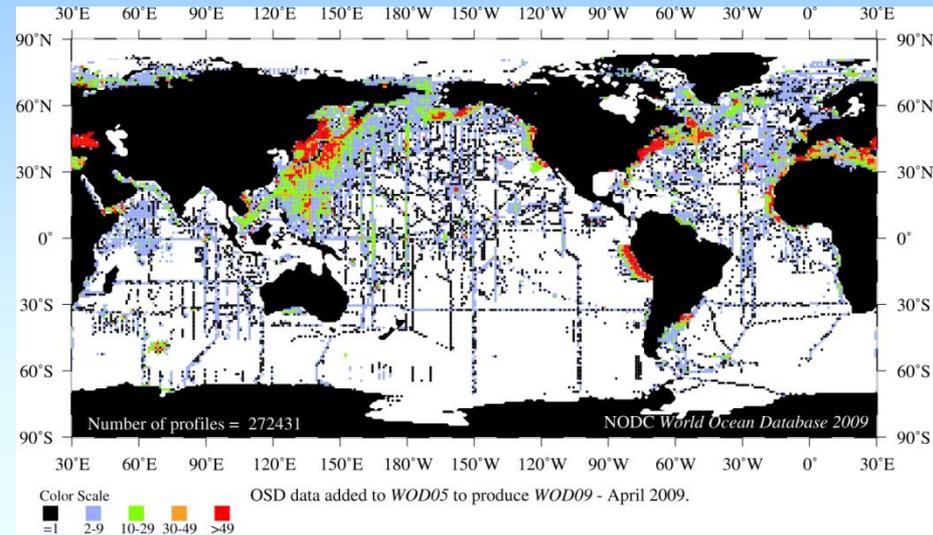
World Ocean Database 2009 (WOD09)

	INSTRUMENT TYPE	WOD05	ADDED	WOD09	% increase
1	Bottle (OSD)	2,258,437	272,431	2,530,868	12.1
2	High Resolution Conductivity/Temperature/Depth (HCTD)	443,953	191,023	634,976	43.0
3	Mechanical Bathythermograph (MBT)	2,421,940	5,337	2,427,277	0.2
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5	Moored Buoys (<i>e.g.</i> , TAO, TRITON, PIRATA)	445,371	121,169	566,540	27.2
6	Drifting Buoys	108,564	13,662	122,226	12.6
7	Profile Floats (P-ALACE, SOLO, APEX, PROVOR)	168,988	351,818	520,816	208.2
8	Undulating Ocean Recorder (<i>e.g.</i> , Towed CTD)	46,699	41,485	88,184	88.8
9	Glider	338	5,519	5,857	1632.8
10	Autonomous Pinniped Bathythermograph	75,665	13,933	89,558	18.4

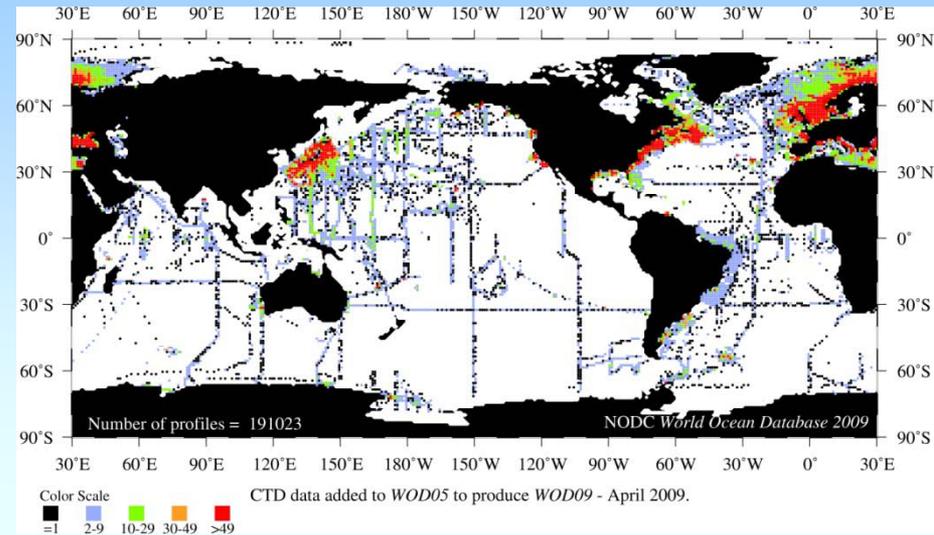


Data added to WOD05 to form WOD09

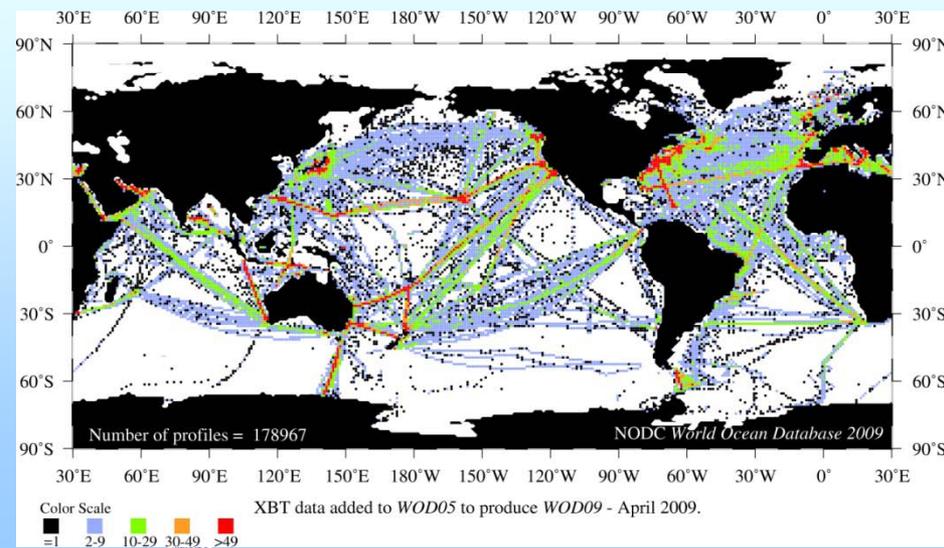
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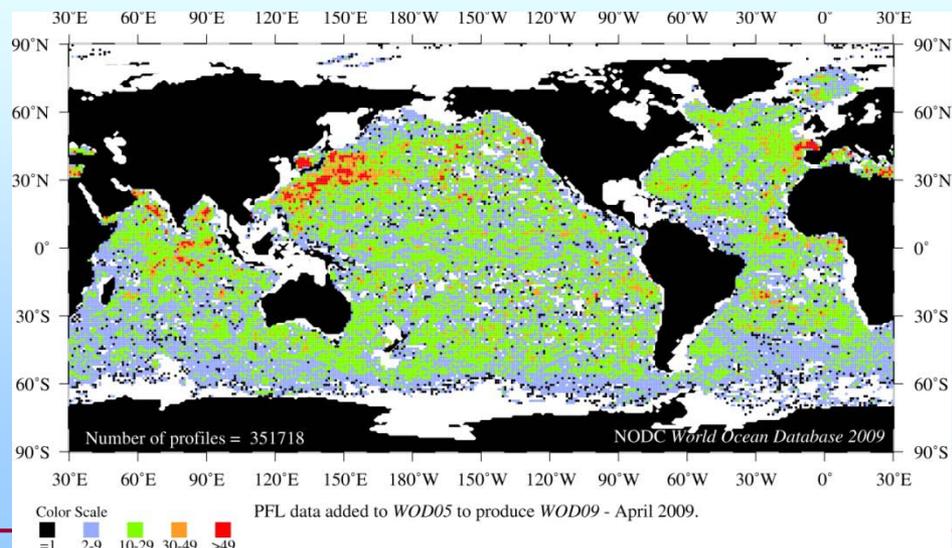
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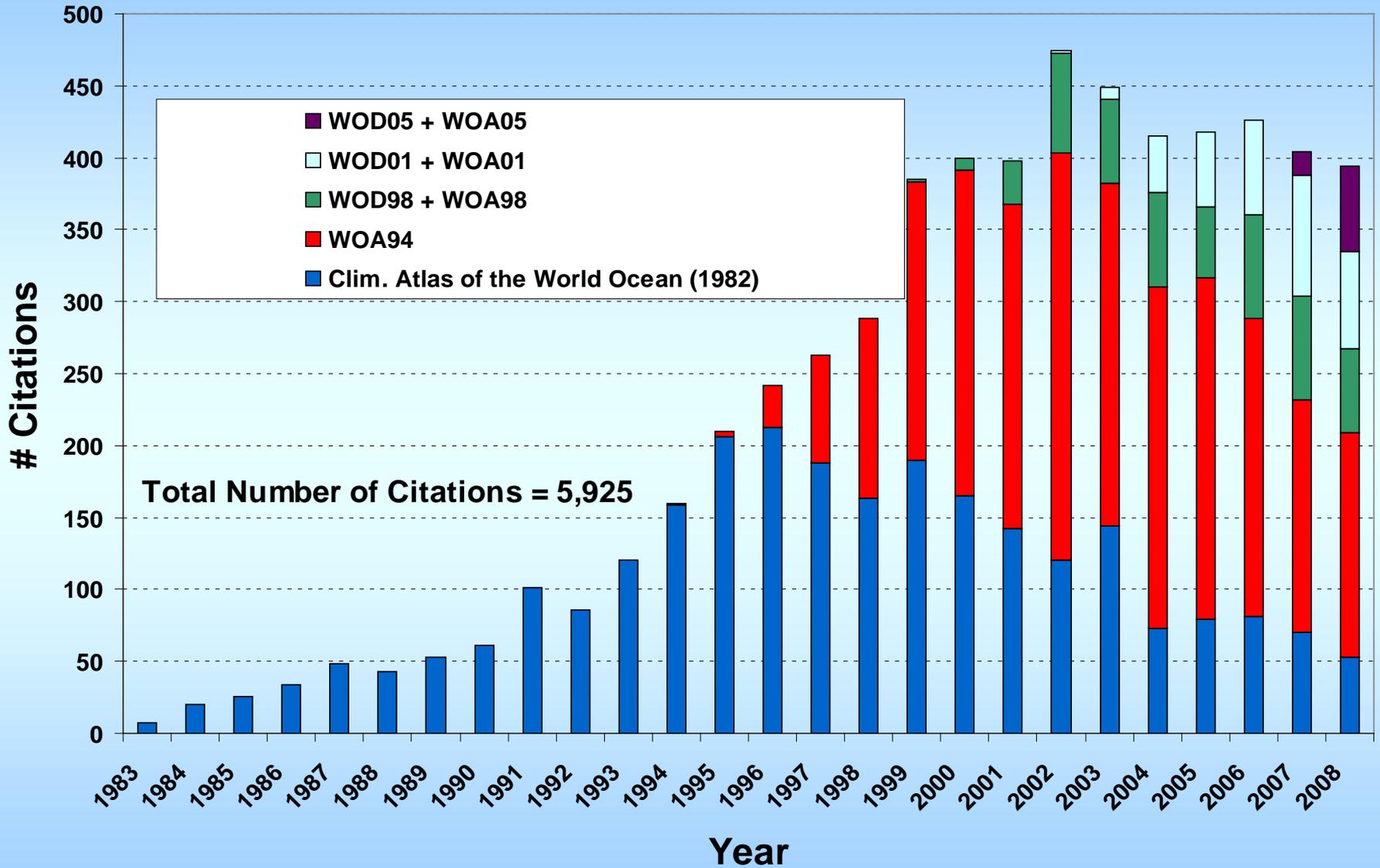
Profiling Float casts: ~352,000 casts



Validation Strategy/Results (1-2 slides)

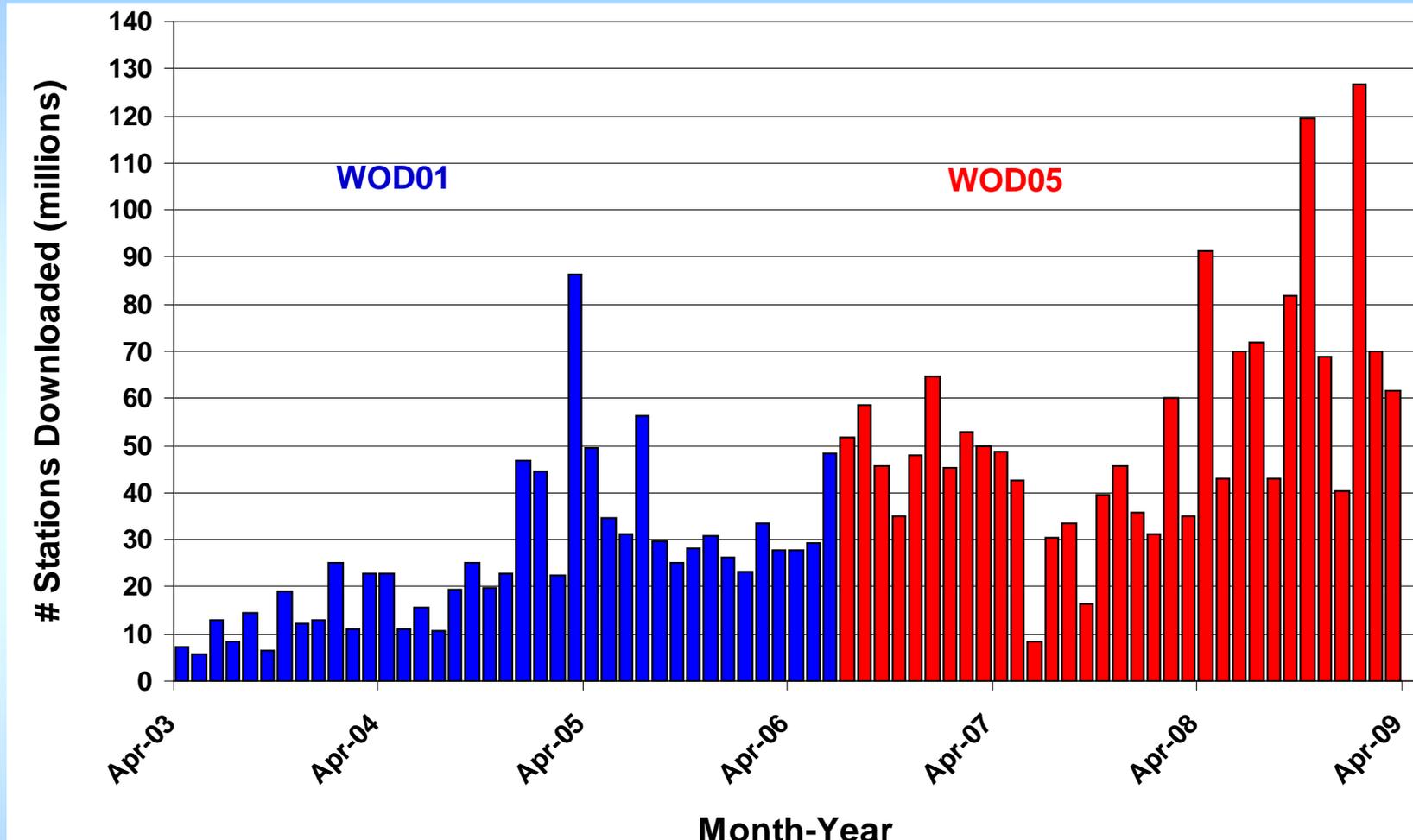
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Utility of NODC/WDC profile data as indicated by citations in the scientific literature



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Since the implementation of WODselect in April 2003, WODselect has responded to 63,037 database queries, served over 1.90 billion stations (1007 gigabytes) via the NODC FTP server as of April 2009.

Product Maturity

Recently discovered systematic biases in XBT and MBT profiles are still the subject of investigation by several groups world-wide.

All temperature received at NODC/OCL are processed and made available every 3 months.

Issues/Risks & Work-Off Plans

- Please note
 - current or possible future problems, and
 - approaches to get around or mitigate the problem(s), as appropriate

Lack of funding to perform mission.

“Research-to-Operations” is a myth since our budgets have remained flat and the amount and types of data we receive are increasing.

Funding from C2D2 and SDS are critical to the success of the WOD.



Schedule

- WOD is updated online every three months with all data we have processed for that quarter.

Research-to-Operations or Delivery Plan

NODC is “operations”.

WOD is updated every three months at NODC and is always available online.

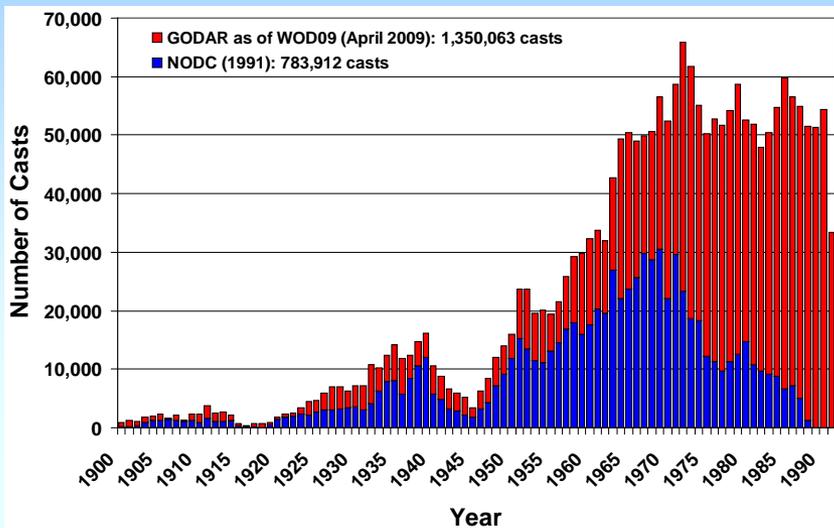
Resources

- Number of personnel employed for project
SDS grant supports 1 contractor.

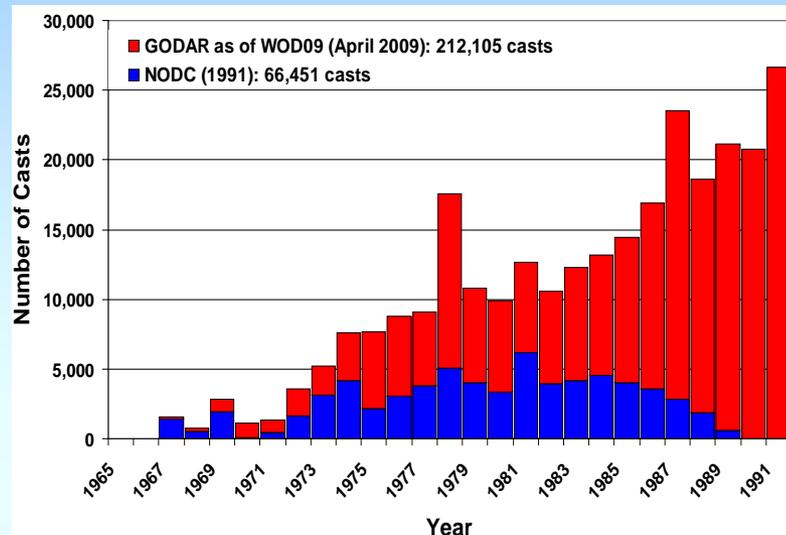
Supplementary slides

GODAR results as of April 2009

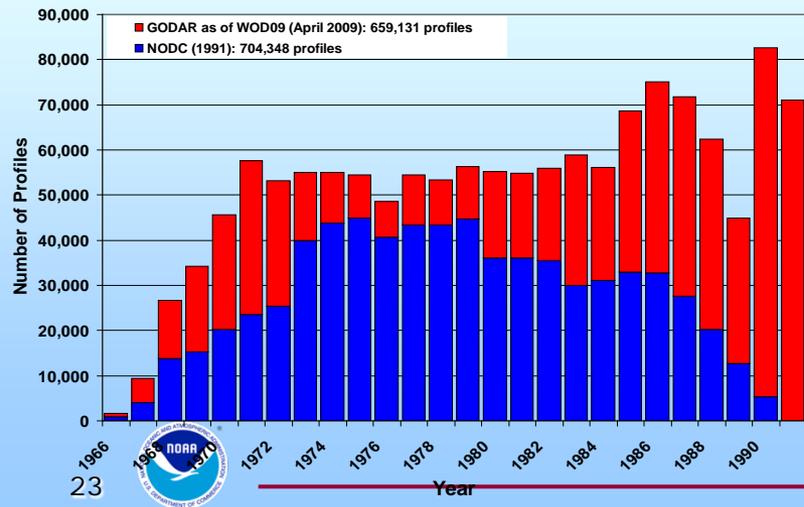
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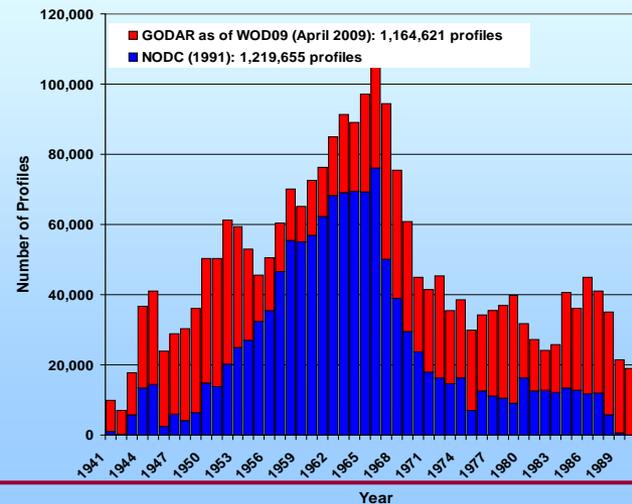
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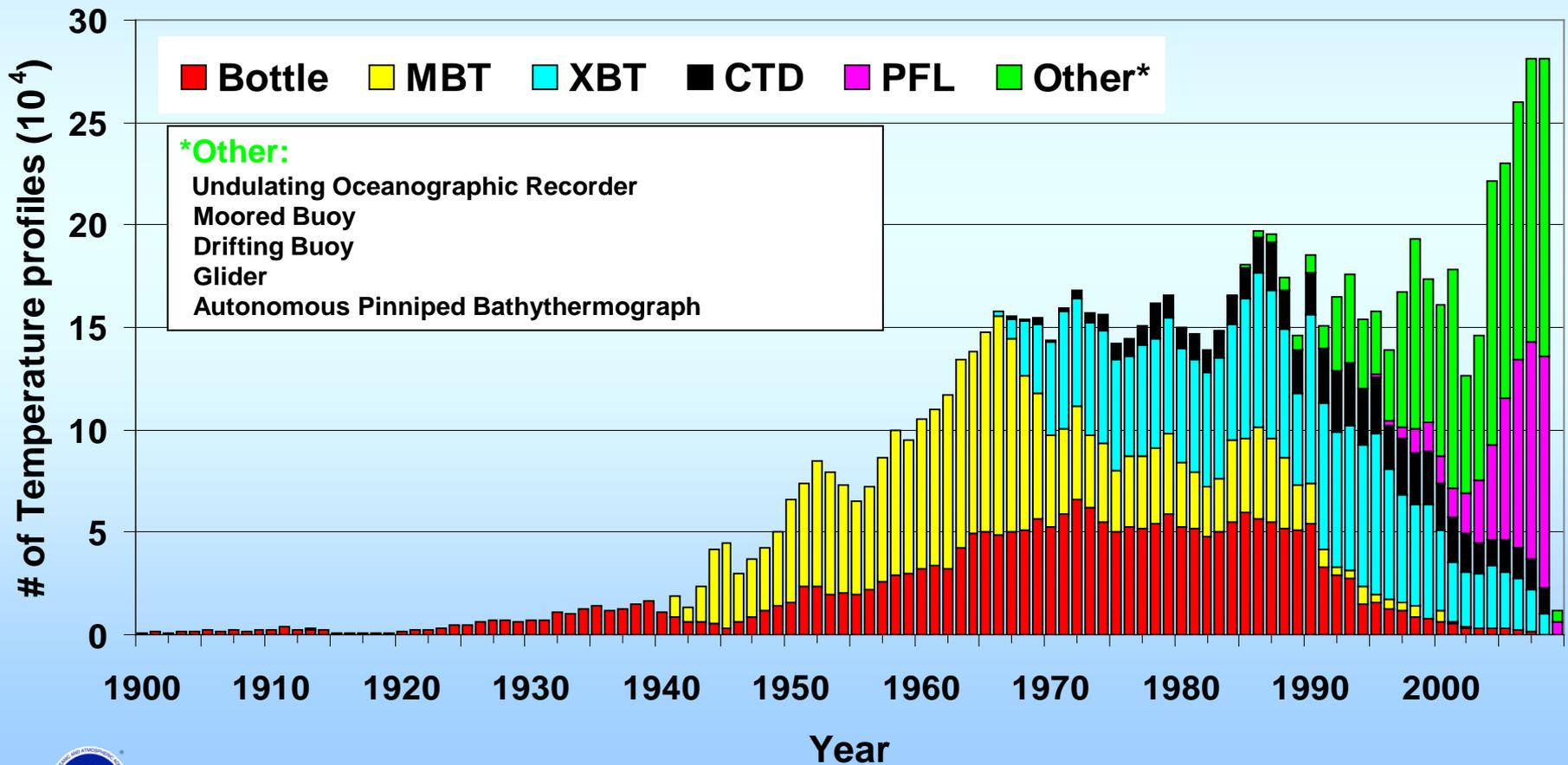


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History of ocean profile data sets available in electronic form from NODC/WDC as contained in WOD09

World Ocean Database



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21	University of Michigan	12,378	21	Inst. Physique du Globe (France)	11.41
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World Ocean Database Development

Syd Levitus

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Overview

- The World Ocean Database (WOD) and “data archaeology and rescue” projects have the goal of producing the most comprehensive ocean profile database available internationally without restriction.
- A great deal of national and international cooperation has resulted in a substantial increase in the amount of ocean profile data available to the large WOD user community.
- WOD and associated metadata are available online and via DVD.
- All data are quality-controlled and all data are in one well-documented common format.

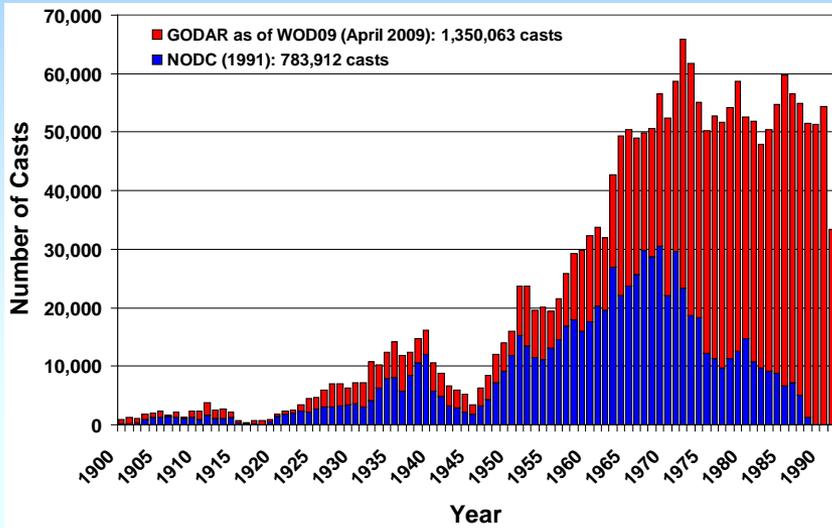
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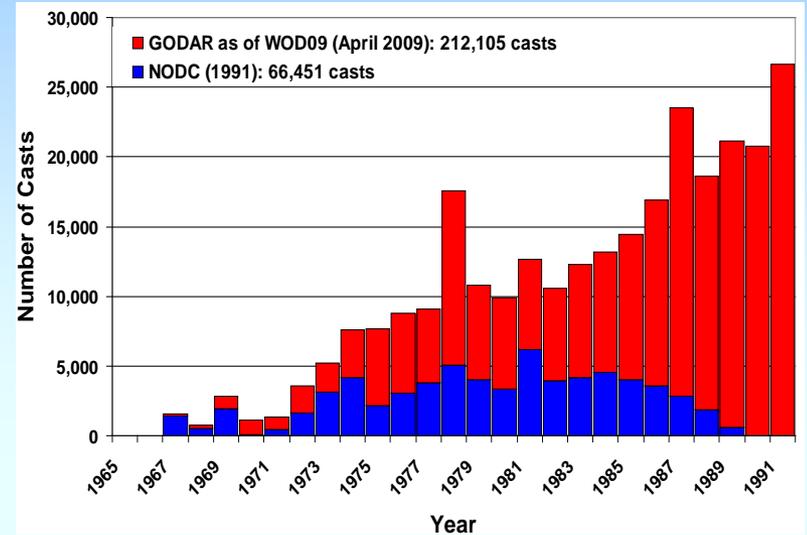
Results/Accomplishments

GODAR results as of April 2009

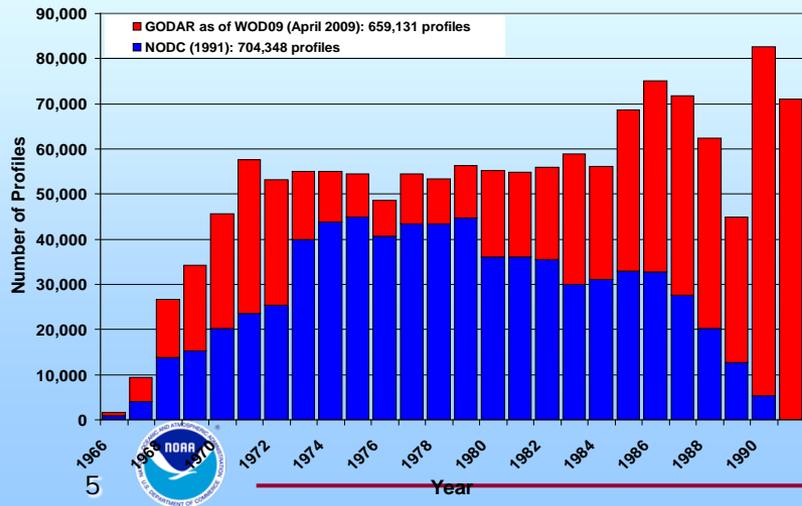
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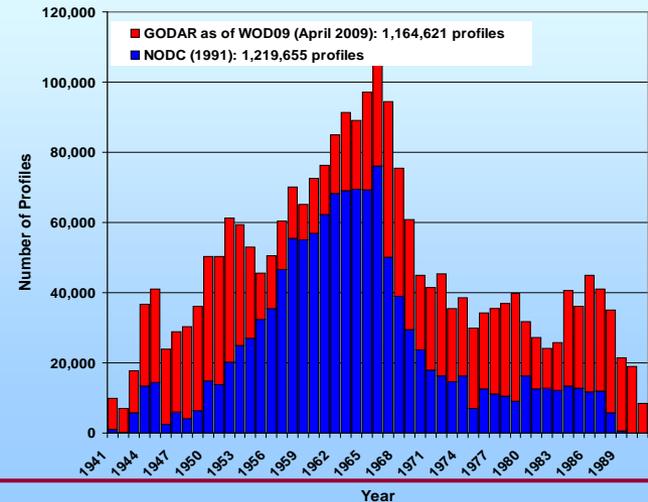
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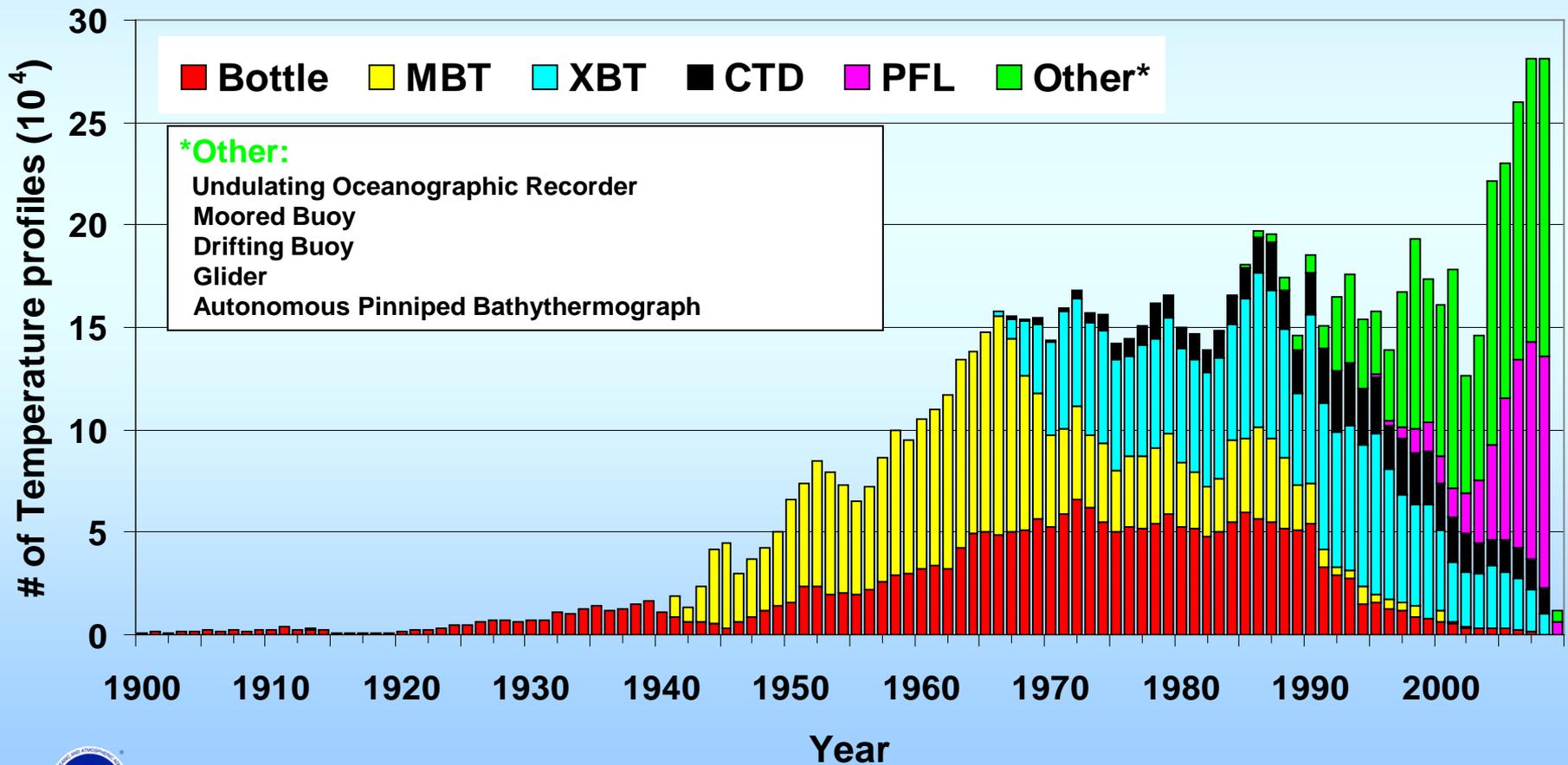


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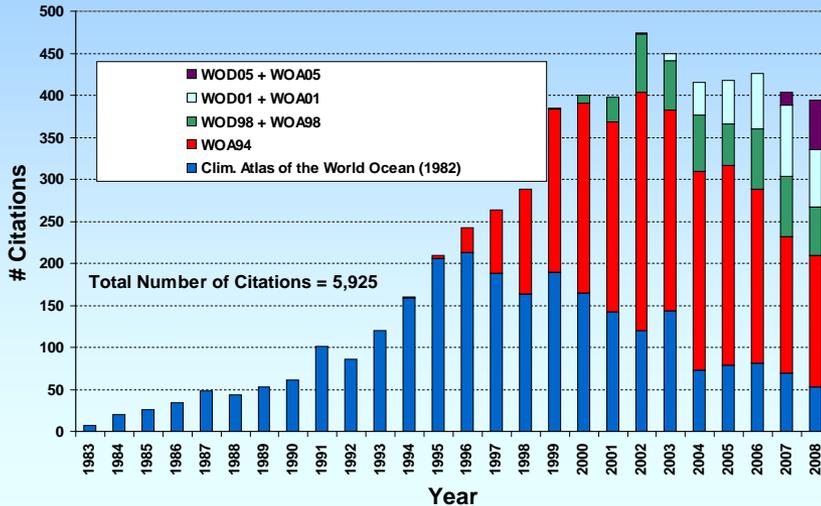
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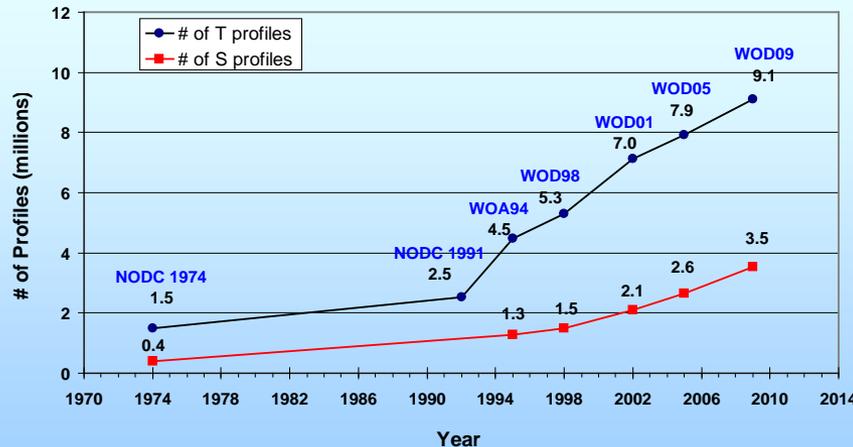


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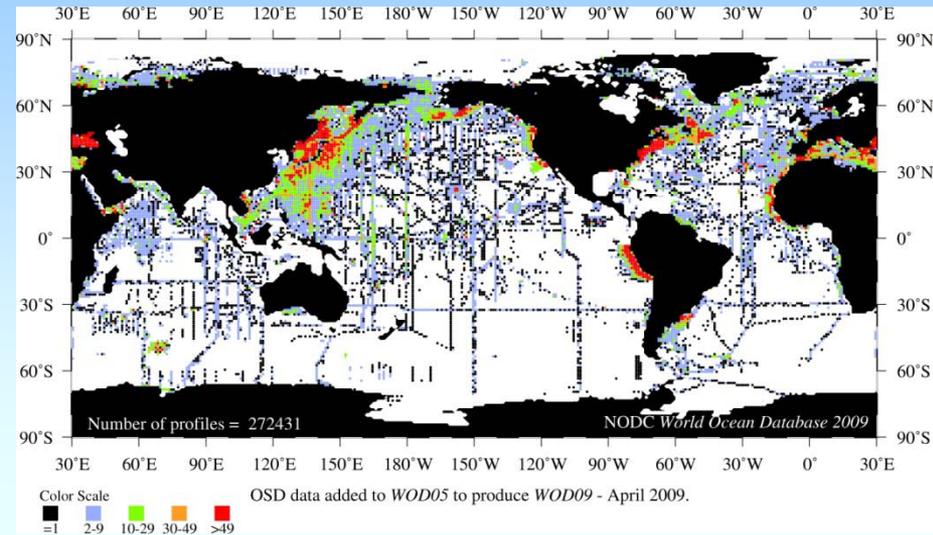
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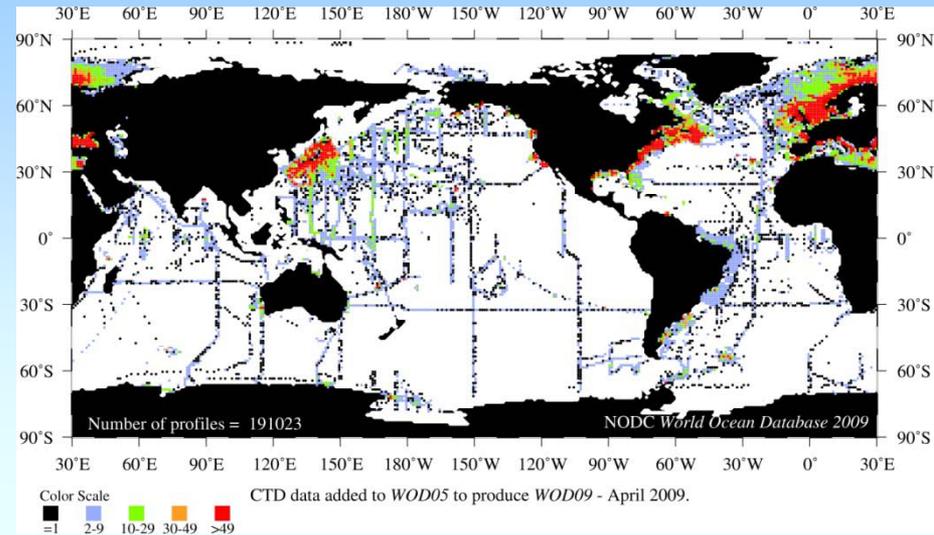
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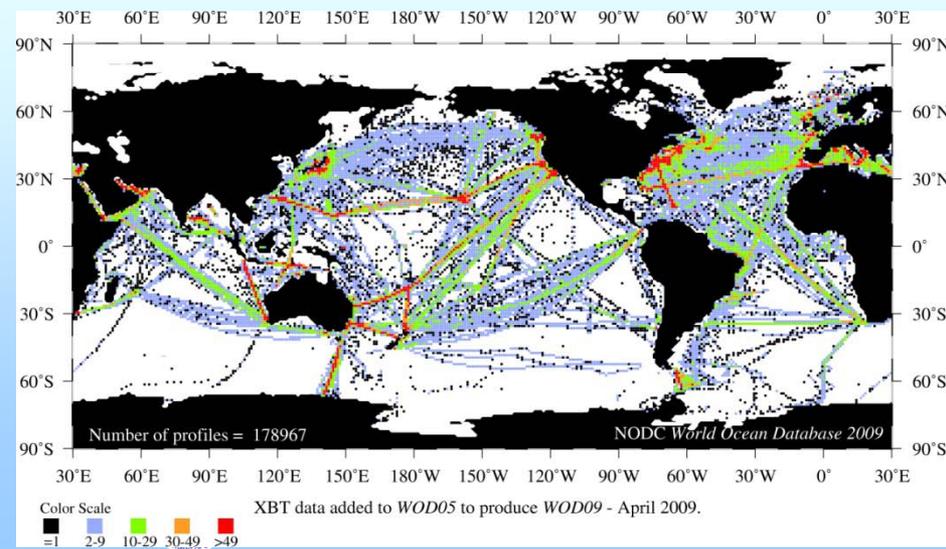
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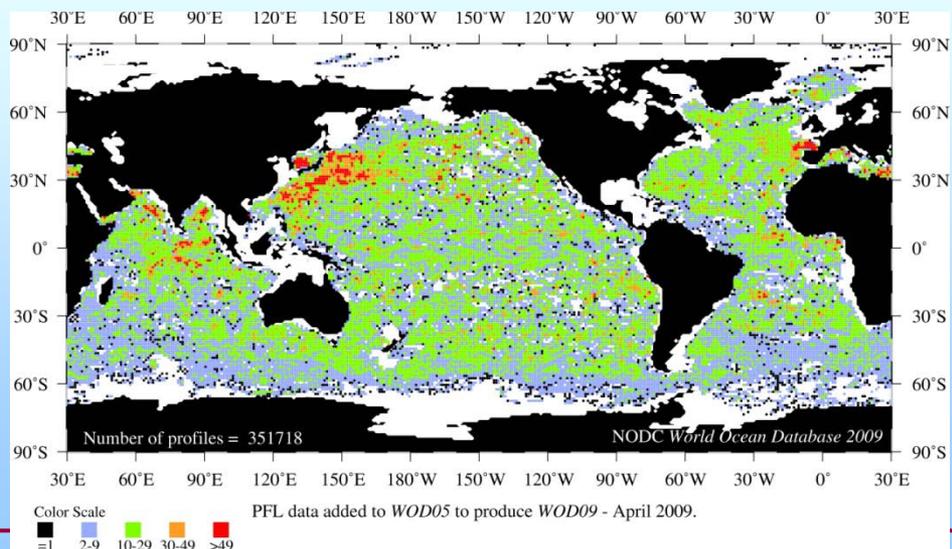
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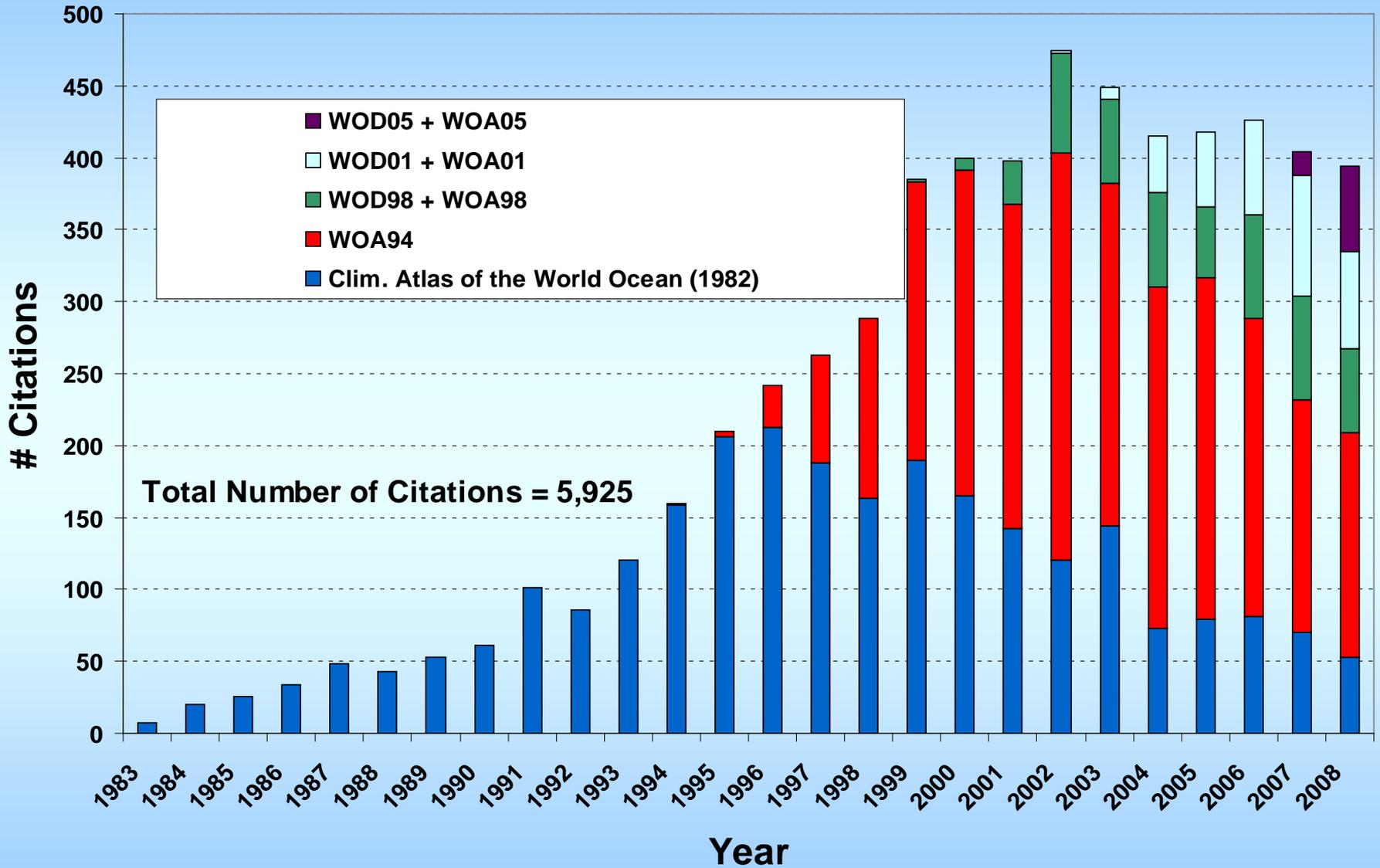
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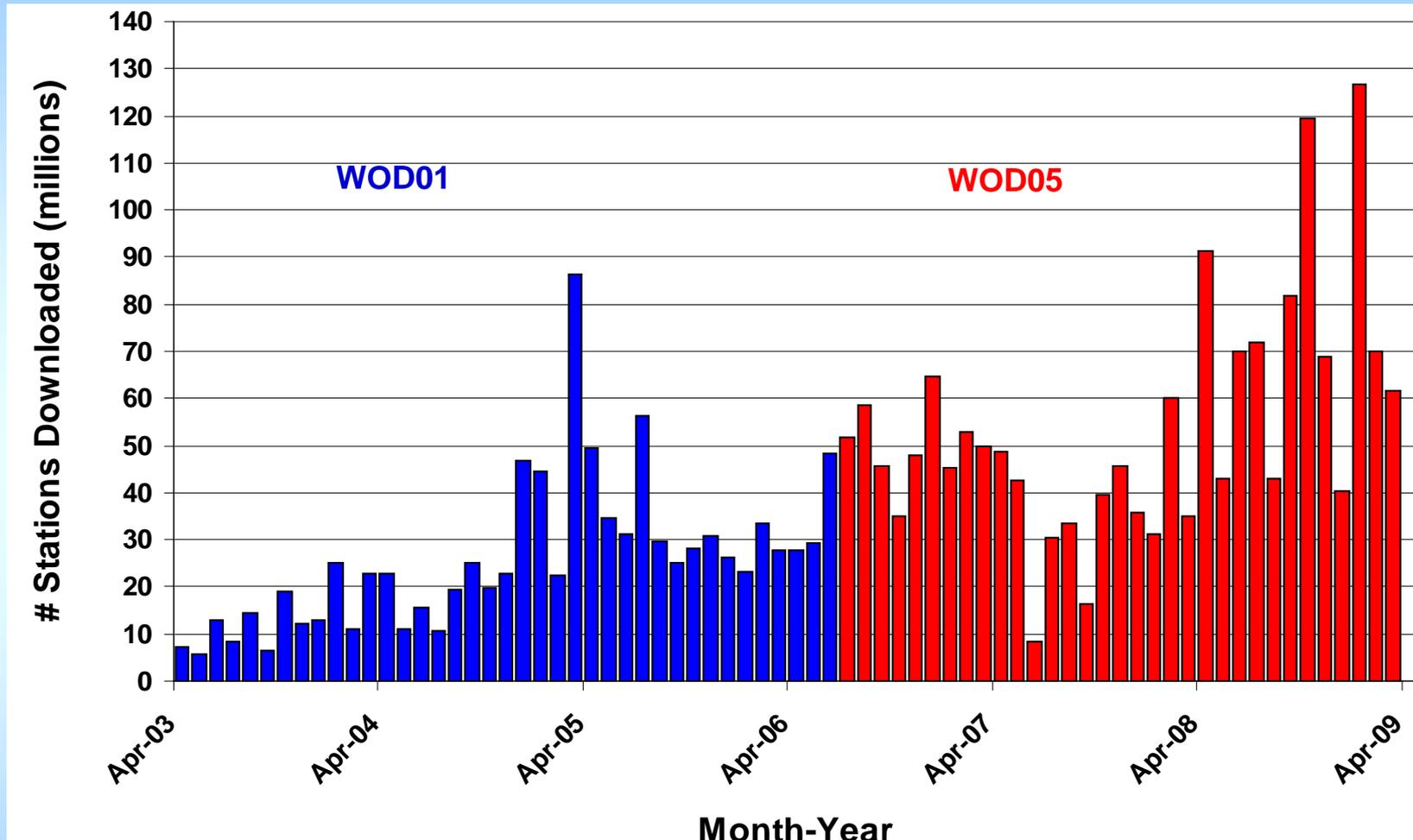
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5	Moored Buoys (<i>e.g.</i> , TAO, TRITON, PIRATA)	445,371	121,169	566,540	27.2
6	Drifting Buoys	108,564	13,662	122,226	12.6
7	Profile Floats (P-ALACE, SOLO, APEX, PROVOR)	168,988	351,818	520,816	208.2
8	Undulating Ocean Recorder (<i>e.g.</i> , Towed CTD)	46,699	41,485	88,184	88.8
9	Glider	338	5,519	5,857	1632.8
10	Autonomous Pinniped Bathythermograph	75,665	13,933	89,558	18.4



WODselect, an on-line access tool

WOD*select* allows users to select data on-line from the WOD using the following criteria:

- 1) Geographic area
- 2) Period of observation
- 3) Instrument type
- 4) Measured variables, *e.g.*, temperature, salinity, oxygen, ...
- 5) Deepest measurement in the profile
- 6) Country
- 7) Ship/platform name
- 8) Project name
- 9) Institute name
- 10) Quality control flags
- 11) Biology (plankton)

Data Archaeology & Rescue \implies Improved data coverage for past years

\implies ability to provide global estimates of heat content, salinity, thermosteric component of sea level change for the past 50 years for the first time!

Paper	# Citations
Antonov, J. I., S. Levitus, T. P. Boyer, 2002: Steric sea level variations during 1957-1994: Importance of salinity. J. Geophys. Res.- Oceans, 8013, doi:10.1029/2001JC000964.	51
Boyer, T.P., J. I. Antonov, S. Levitus, R. Locarnini, 2005: Linear trends of salinity for the world ocean, 1955-1998. Geophys. Res. Lett., 32, L01604, doi:1029/2004GL021791.	47
Antonov, J. I., S. Levitus, T. P. Boyer, 2005: Thermosteric sea level rise, 1955-2003. Geophys. Res. Lett., 32, L12602, doi:10.1029/2005GL023112.	36

NOAA/CPO/NODC/OCL is the pioneer and world leader in this research area.

Intense interest by media, Congress, scientific community, IPCC.

