

Objective Analysis of Temperature and Salinity for The World Ocean on a 1/4° Grid

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<http://www.nodc.noaa.gov/OCL/>

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OUTLINE

- **Introduction**
- **Methods**
- **Some examples**
- **Summary**

World Ocean Database 2001

- **Global, comprehensive, integrated, quality controlled with all data in one well-documented format (see [wod01](#))**
- **WOD01 available on-line and via CD-ROM (see [products](#)).**
- **WOD01 data updates available on-line (see [updates](#)).**
- **Multiple data sources**
 - Data from 55,897 cruises**
 - Data from 3057 ships and other platforms**
 - Data from 489 institutes**
 - Data from 112 countries**

WOD01 Data Contributors

- **IOC Member States**
- **IODE Projects: GTSP, GODAR**
- **EU projects: MEDAR/MEDATLAS**
- **International science projects: IGY, WOCE, JGOFS, GLOBEC,...**
- **Oceanographic institutes**
- **Oceanographic Data Centers**
- **Individual scientists**

NOAA/NODC/WDC/OCL staff that contributed to WOD01

- Sydney Levitus (Director)
- John Antonov
- Olga Baranova
- Tim Boyer
- Margarita Conkright
- Carla Forgy
- Hernan Garcia
- Robert Gelfeld
- Alexandra Grodsky
- Undergraduate students
- Michelle Levesque
- Daphne Johnson
- Ricardo Locarnini
- Paulette Murphy
- Todd O'Brien
- Charlotte Sazama
- Igor Smolyar
- Cathy Stephens
- Renee Tatusko

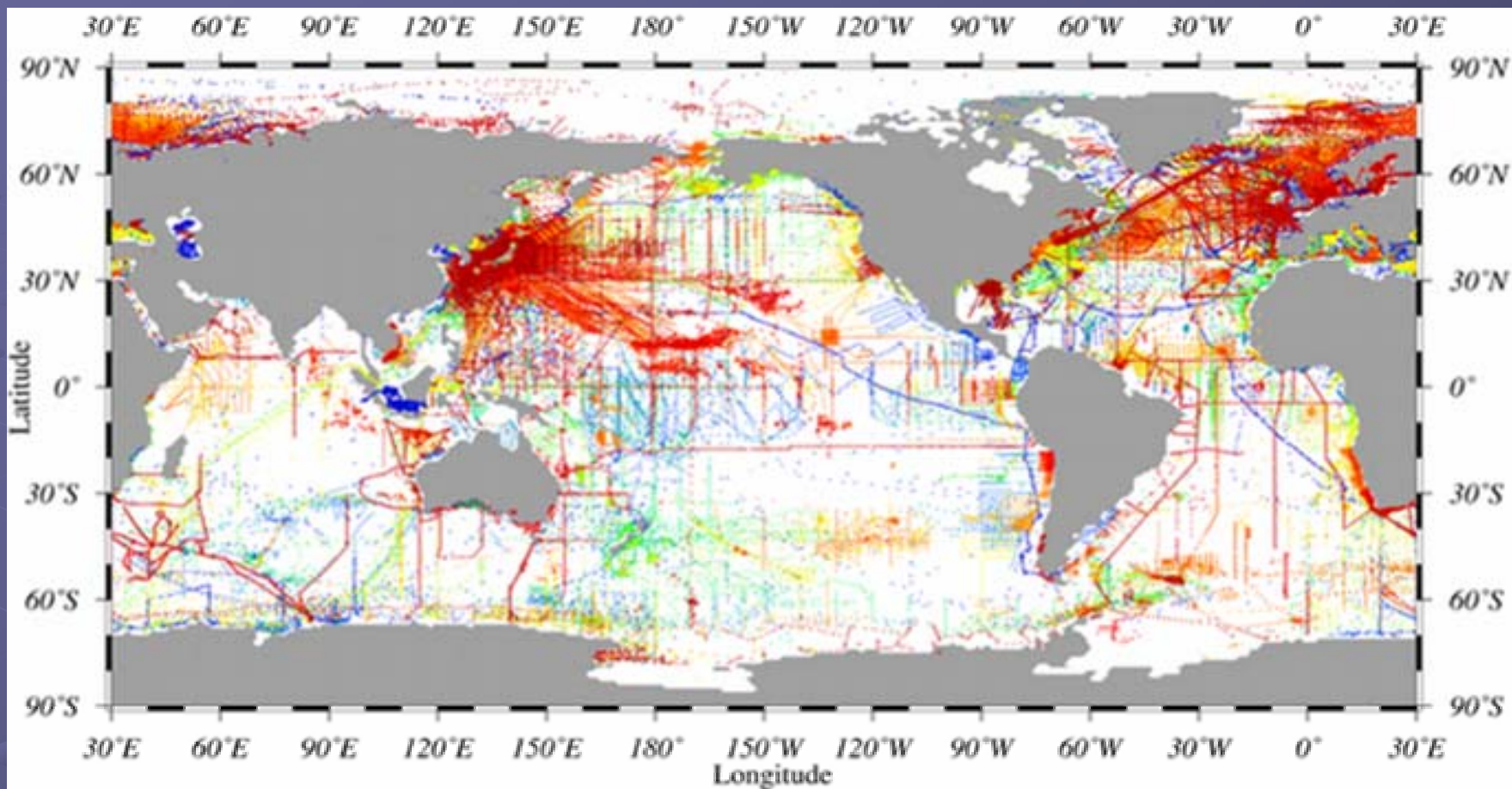
<http://www.nodc.noaa.gov/OCL/>

Temperature & Salinity instrument types

- Bottle (Ocean Station Data)
- High Resolution CTD
- Expendable Bathythermograph
- Mechanical Bathythermographs
- Profiling Floats
- Drifting and Moored Buoys
- Undulating Oceanographic Recorder
- Surface-Only

***EXAMPLES OF NEW DATA
ADDED TO WOD01
SINCE THE RELEASE OF
WOD98***

EXAMPLE OF BOTTLE (OSD) DATA ADDED TO WOD01 SINCE WOD98



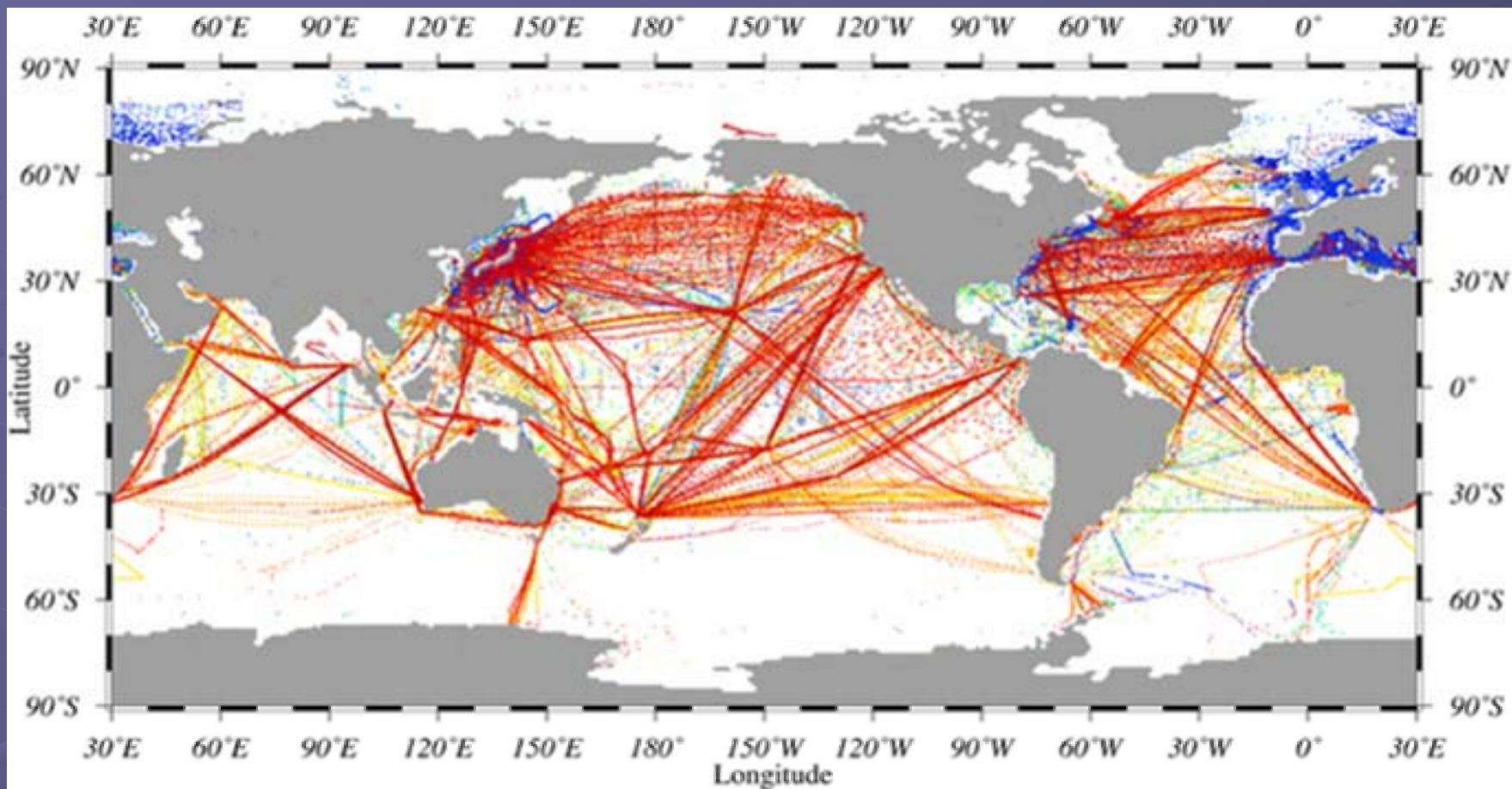
Location of bottle (OSD) profiles added to WOD01 since the release of WOD98

Total number of profiles = 690557

Total number of cruises = 23480

Ocean Climate Laboratory
WOD01

EXAMPLE OF XBT DATA ADDED TO WOD01 SINCE WOD98



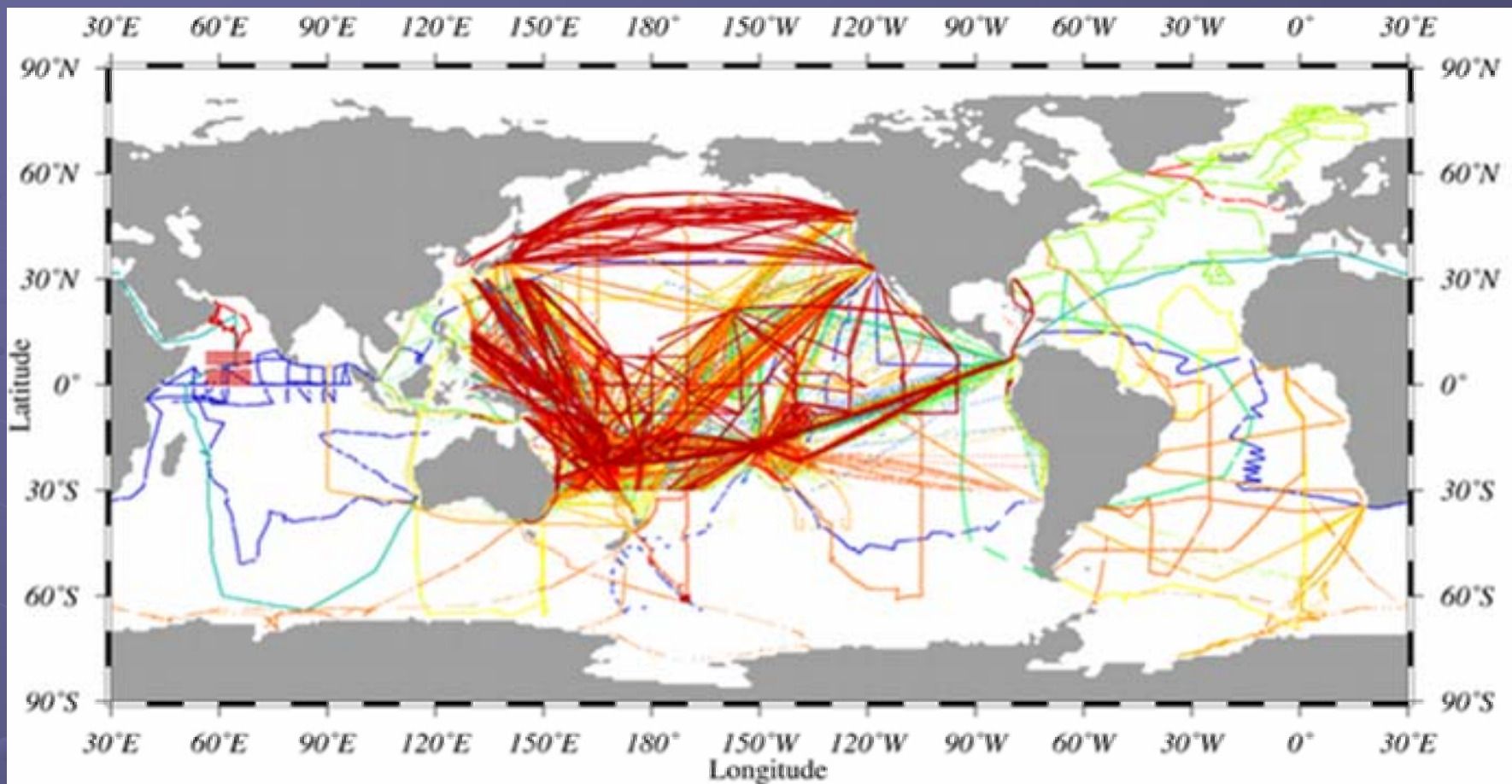
Location of XBT profiles added to WOD01 since the release of WOD98

Total number of profiles = 223305

Total number of cruises = 8353

Ocean Climate Laboratory
WOD01

EXAMPLE OF SURFACE DATA ADDED TO WOD01 SINCE WOD98



Location of surface data added to WOD01 since the release of WOD98

Total number of profiles = 1810644

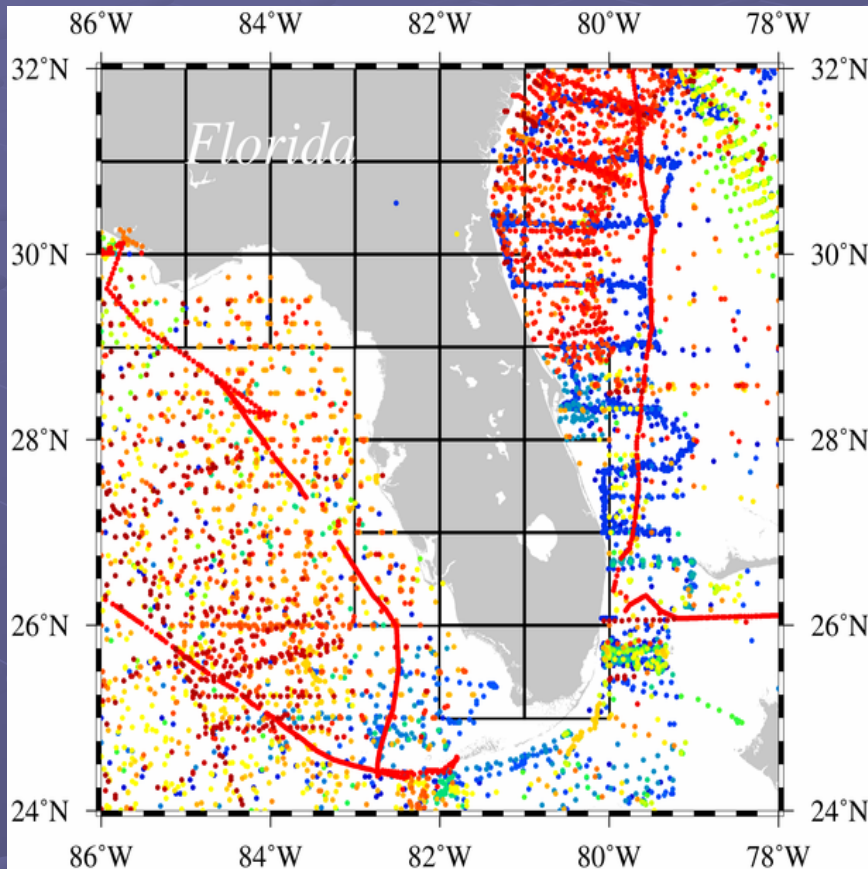
Total number of cruises = 4734

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WOD01

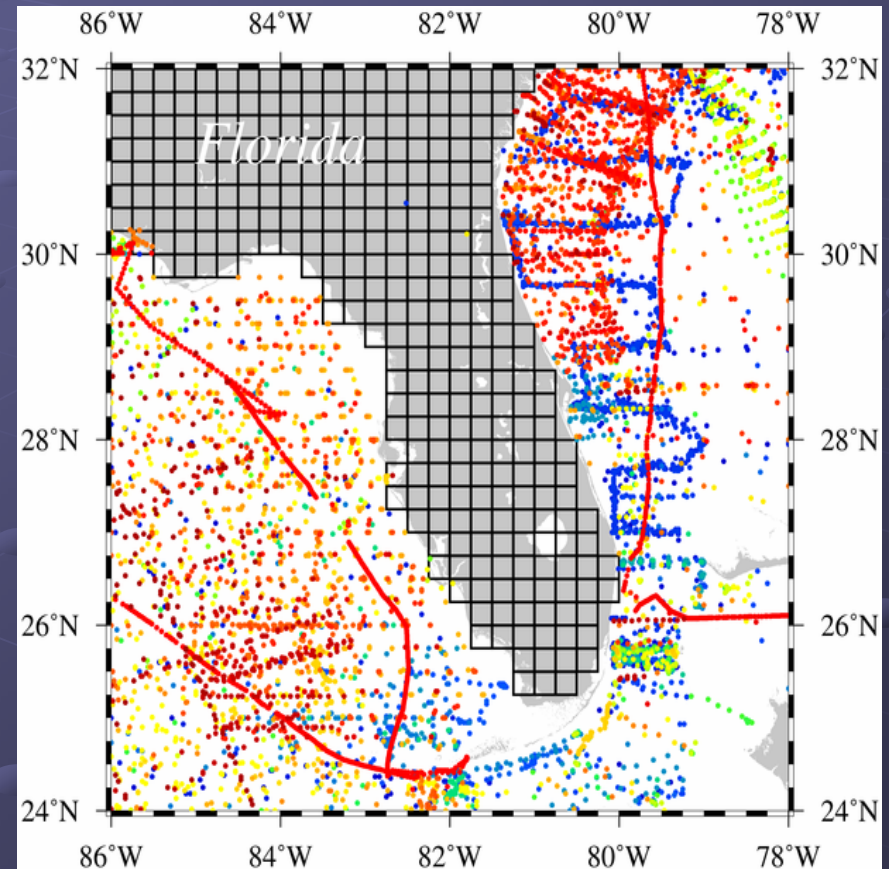
NET AMOUNT OF DATA?

Example of bottle data flagged based on 1° and 1/4° grid land/sea mask at the surface ocean

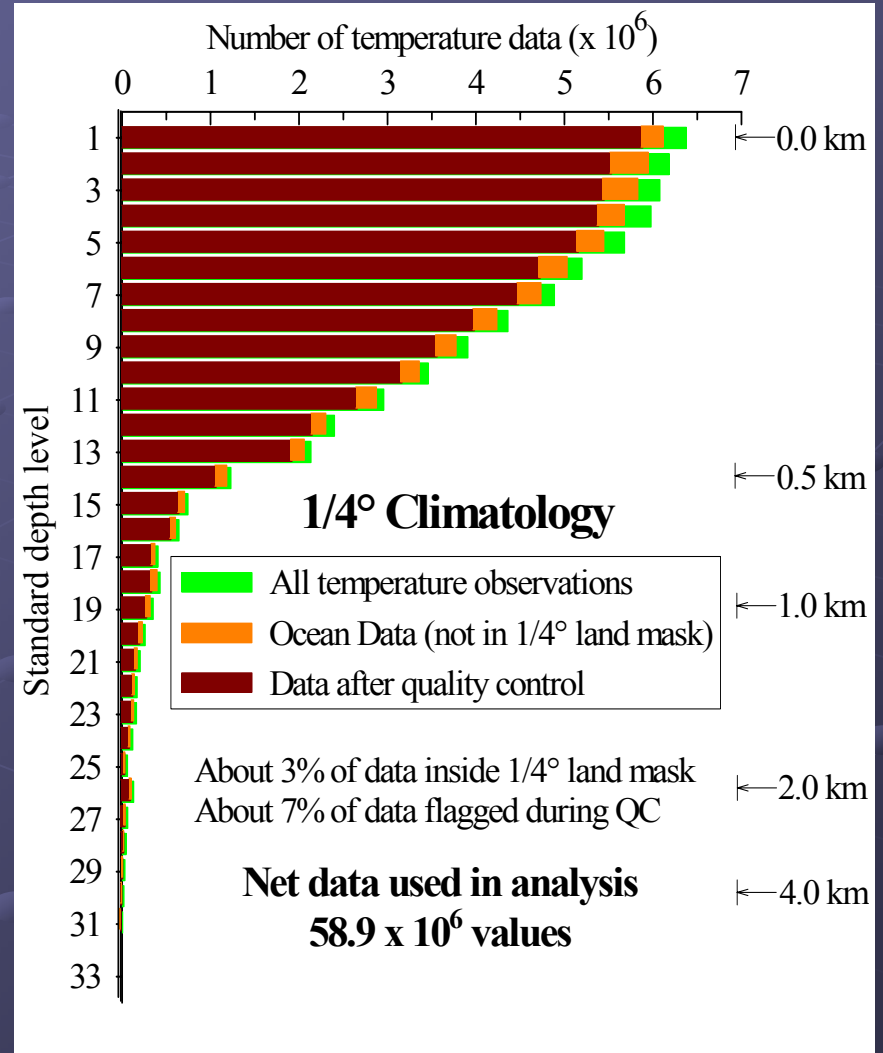
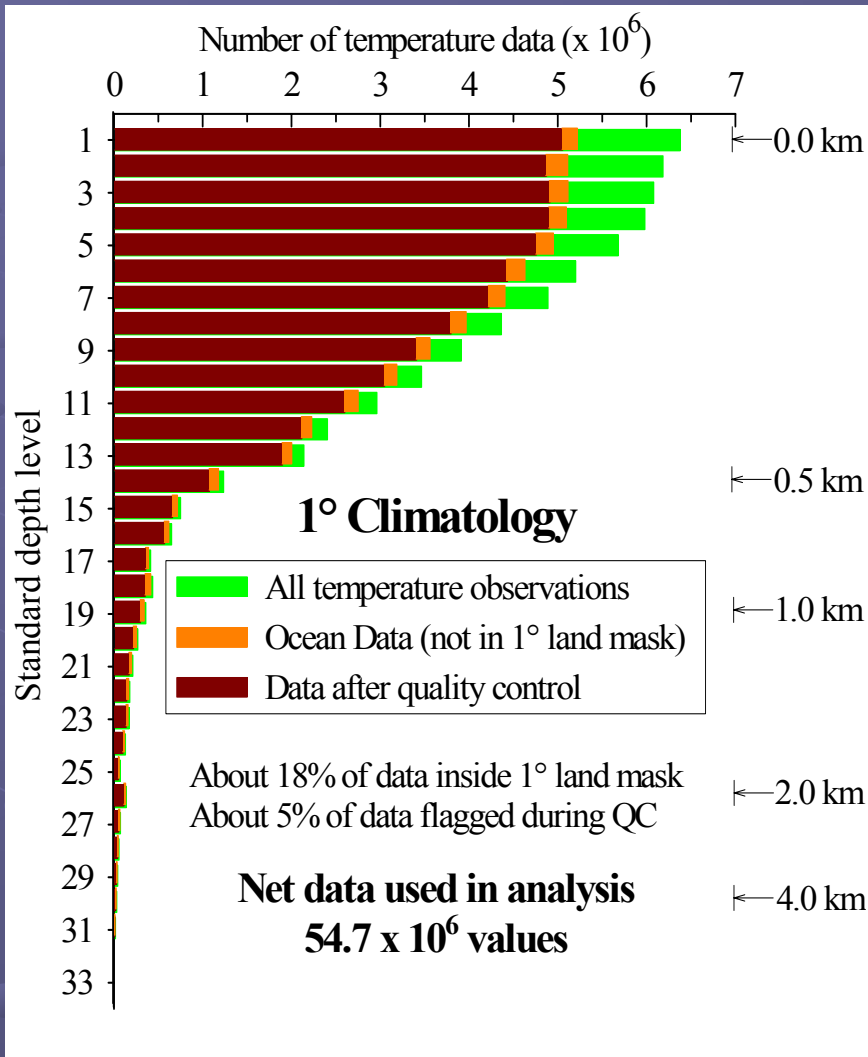
1° Grid



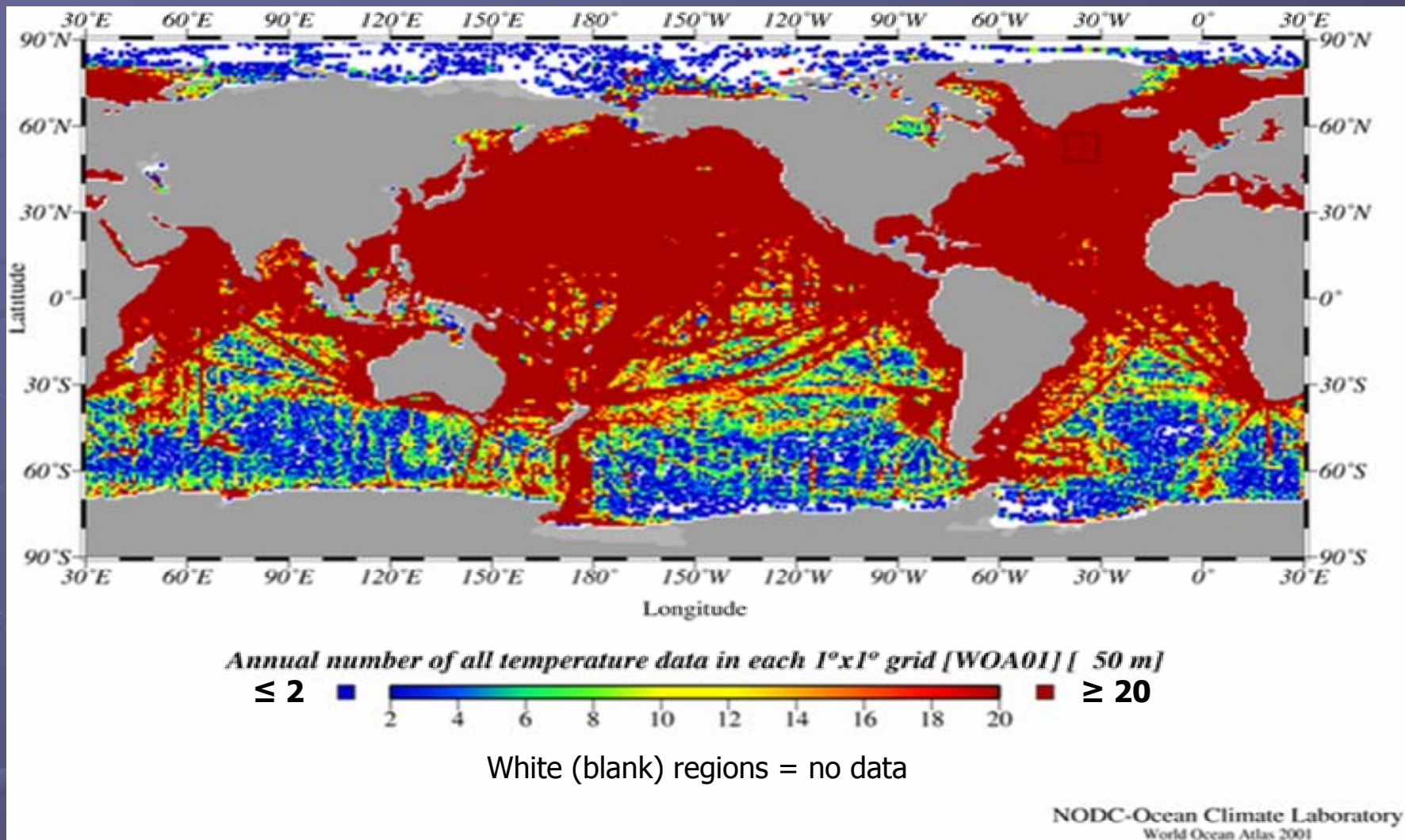
1/4° Grid



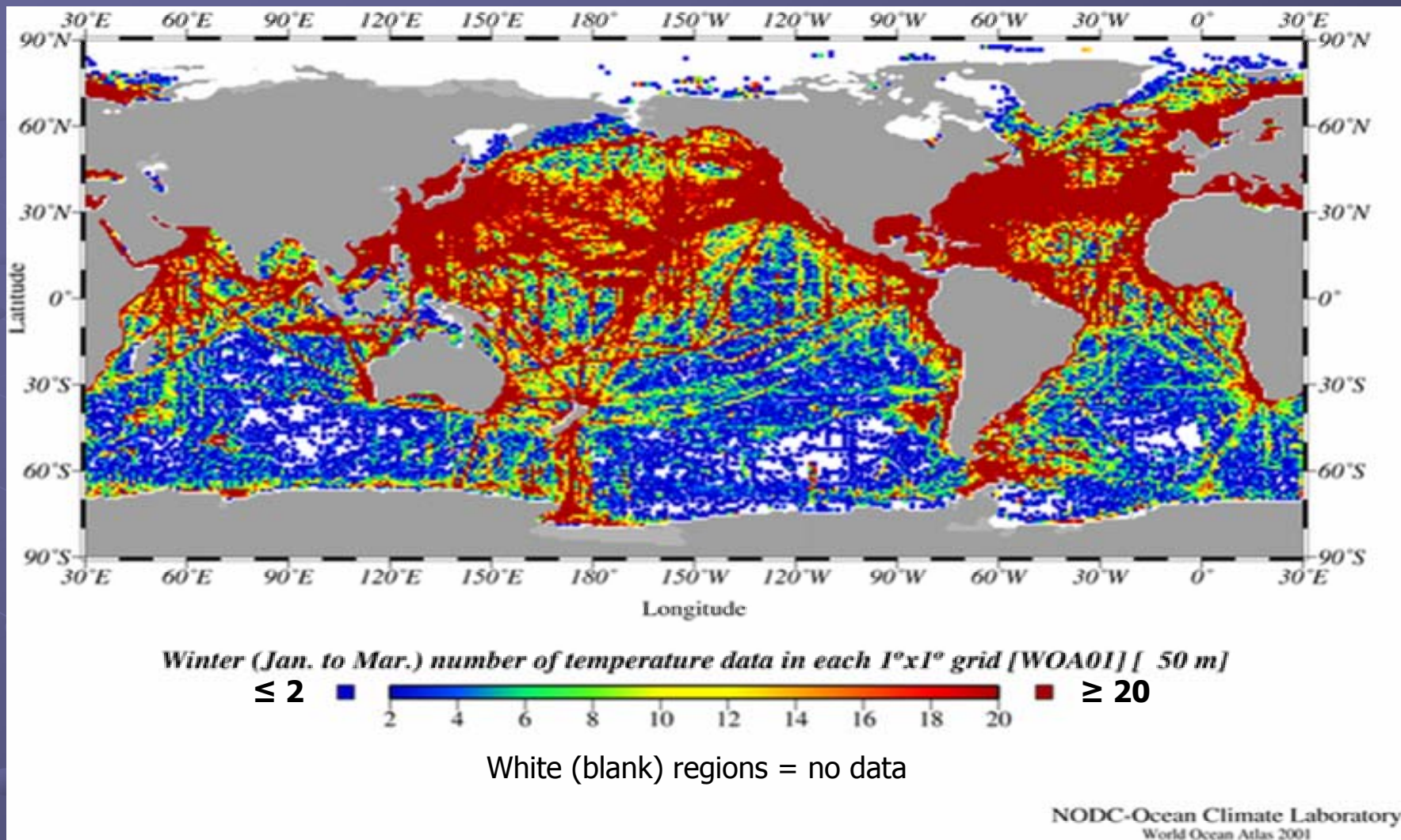
Net Number of temperature data used in the 1° and 1/4° fields



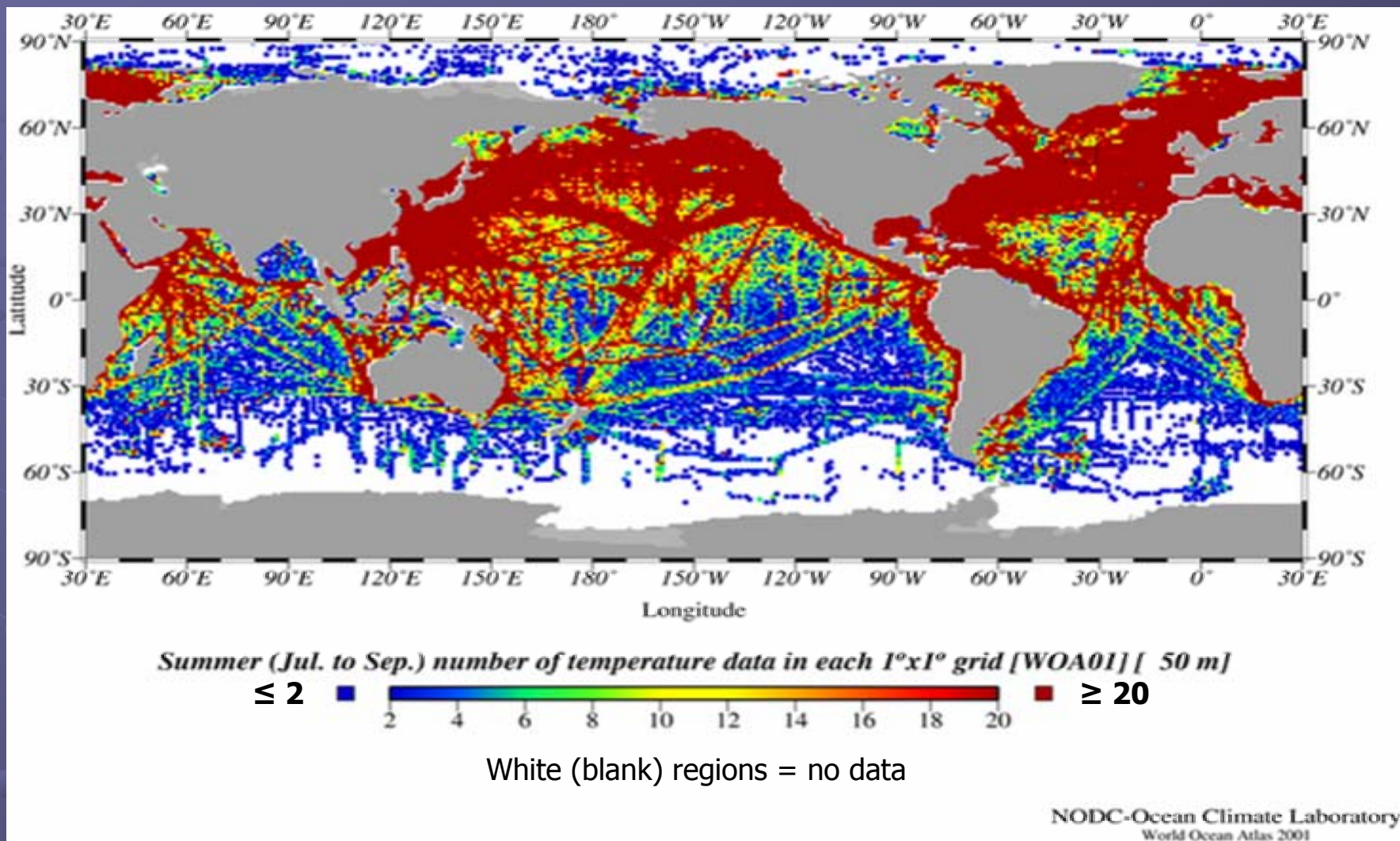
Number of all temperature data in each 1° grid at 50 m Depth based on WOD01



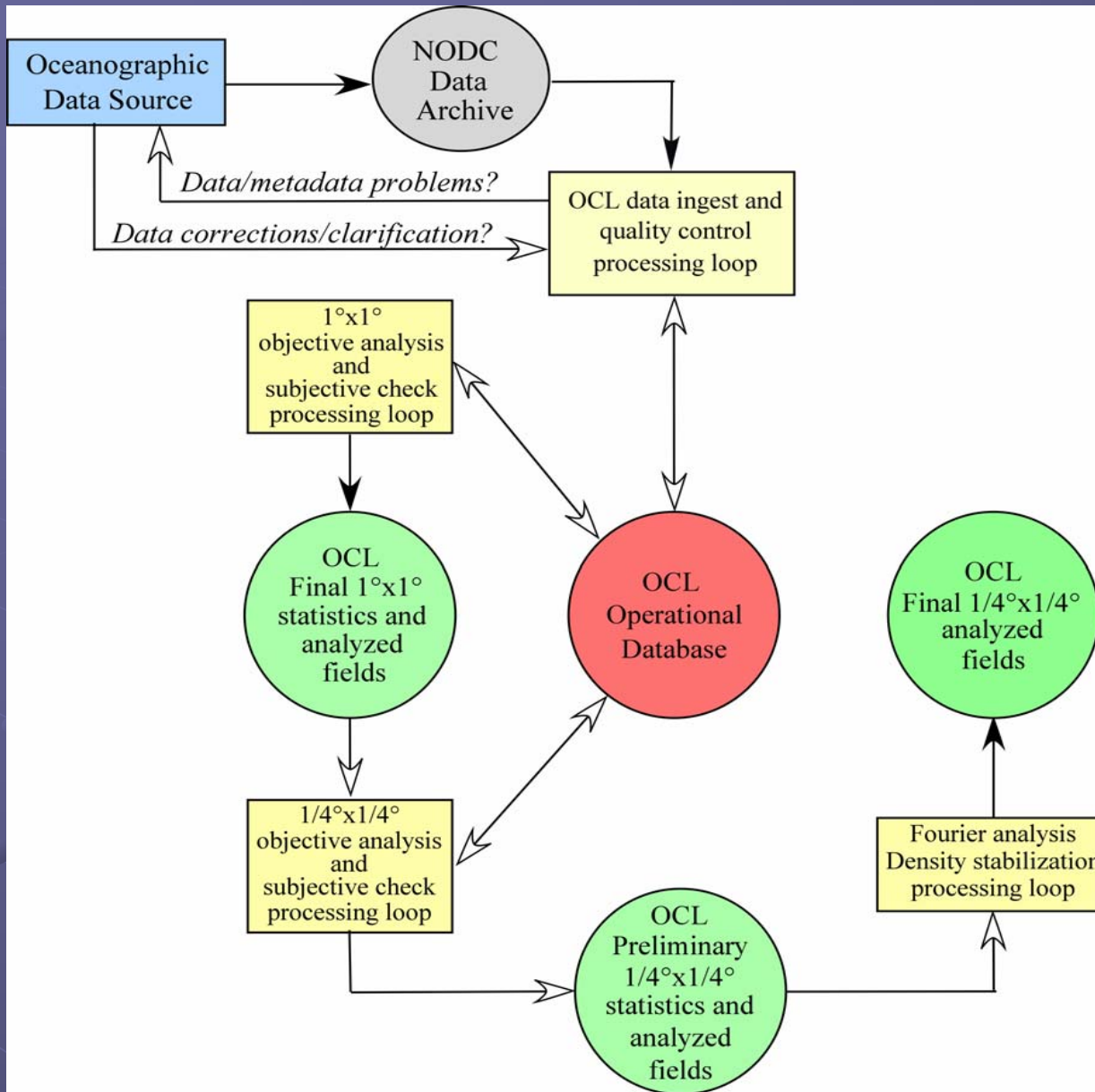
Winter (Jan. to Mar.) number of temperature data in each 1° grid at 50 m Depth based on WOD01



Summer (Jul. to Sep.) number of temperature data in each 1° grid at 50 m Depth based on WOD01



METHODS

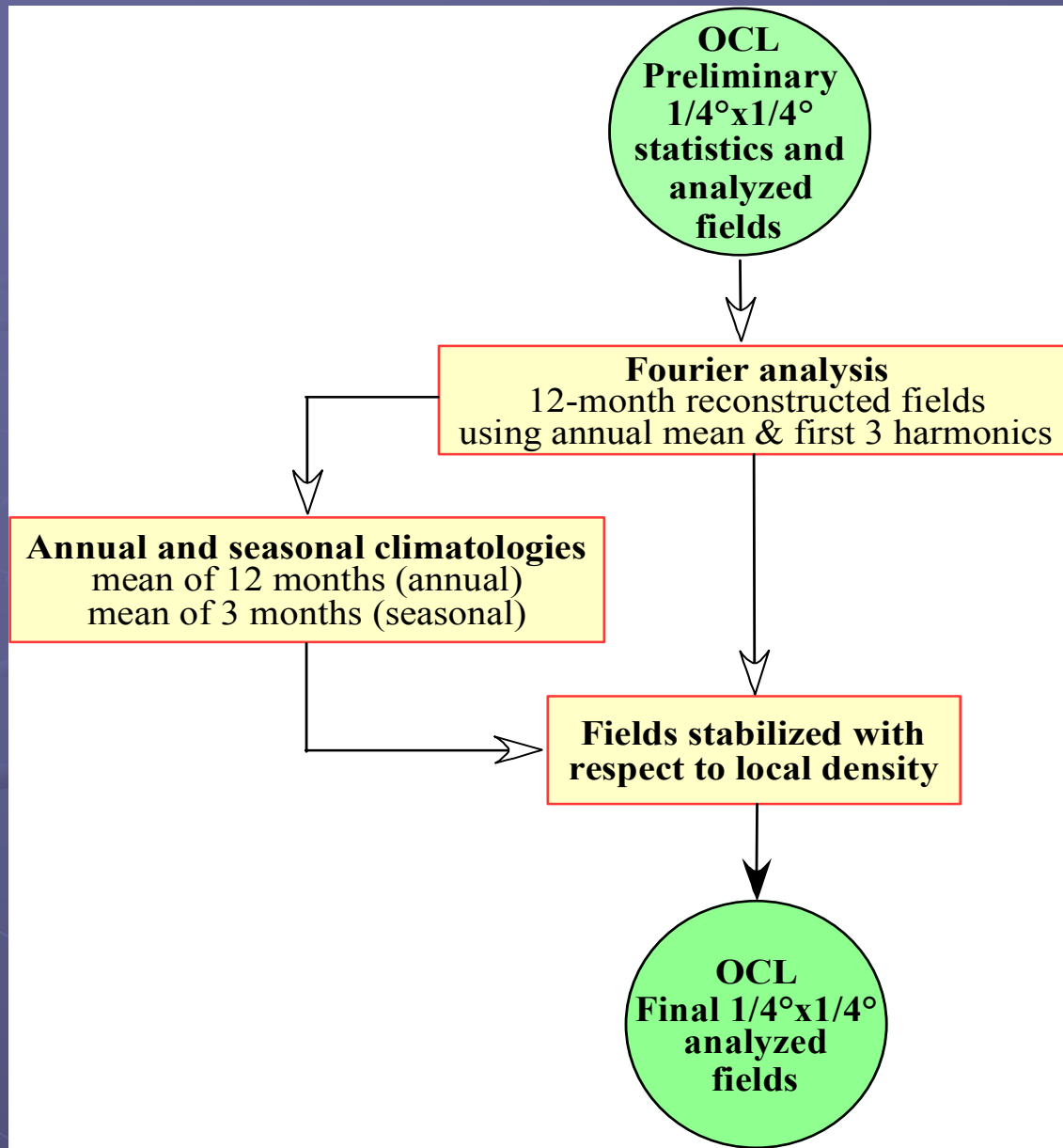


OCL DATA PROCESSING SUMMARY

Sasaki (1960);
 Barnes (1964);
 Levitus, [1982];
 Stephens *et al.*, [2002];
 & Boyer *et al.*, [2002]

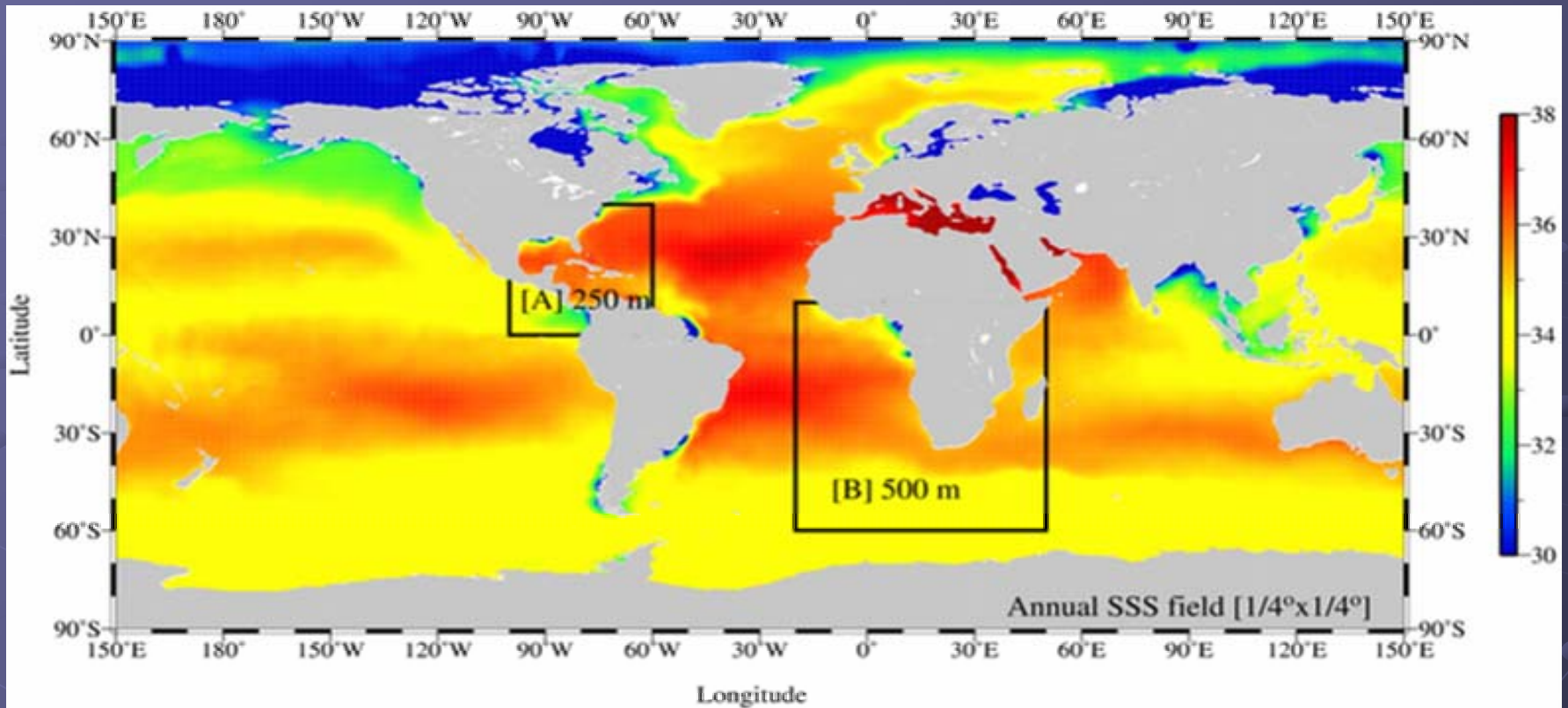
Fourier Analysis and Density Stabilization Processing Loop

Jackett & McDougal, 1995



***EXAMPLES OF
SALINITY AND TEMPERATURE
ON 1° AND 1/4° GRID***

Examples of annual salinity distribution on 1° and 1/4° grid

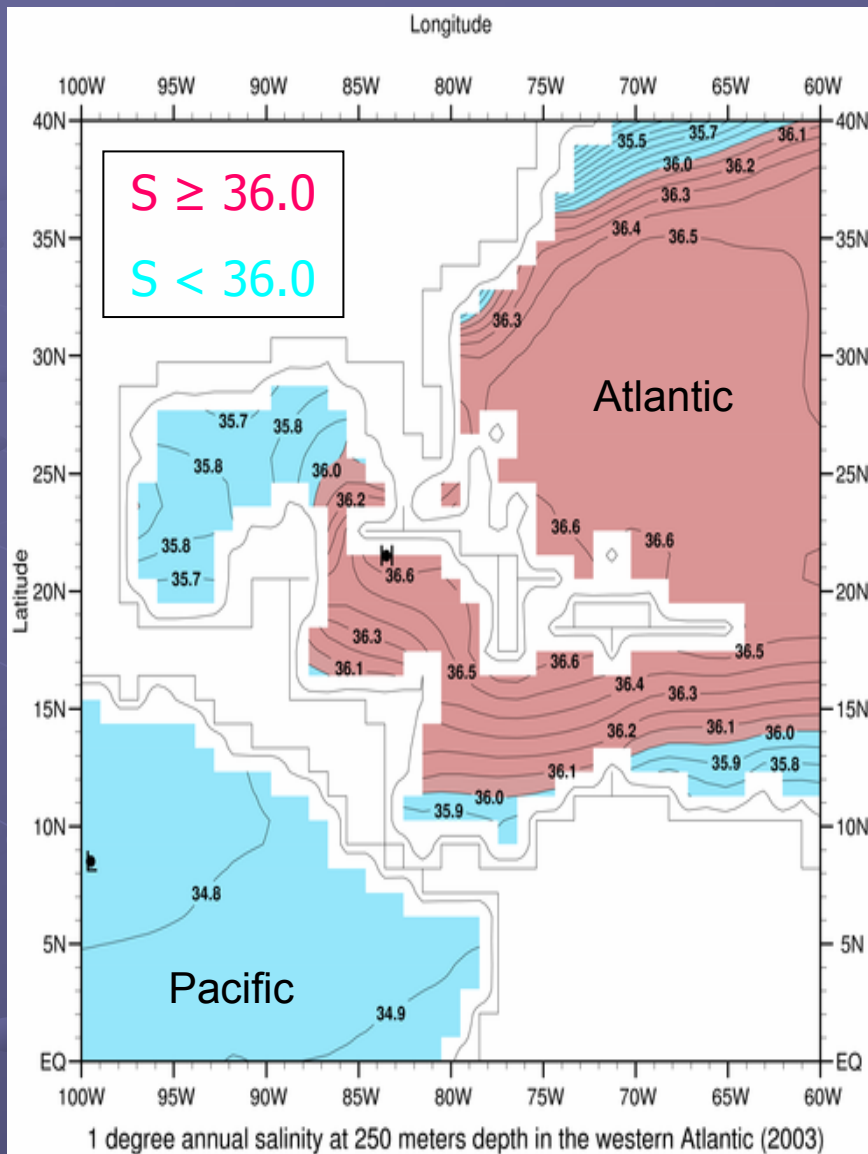


Examples of the salinity 1°x1° and 1/4°x1/4° fields

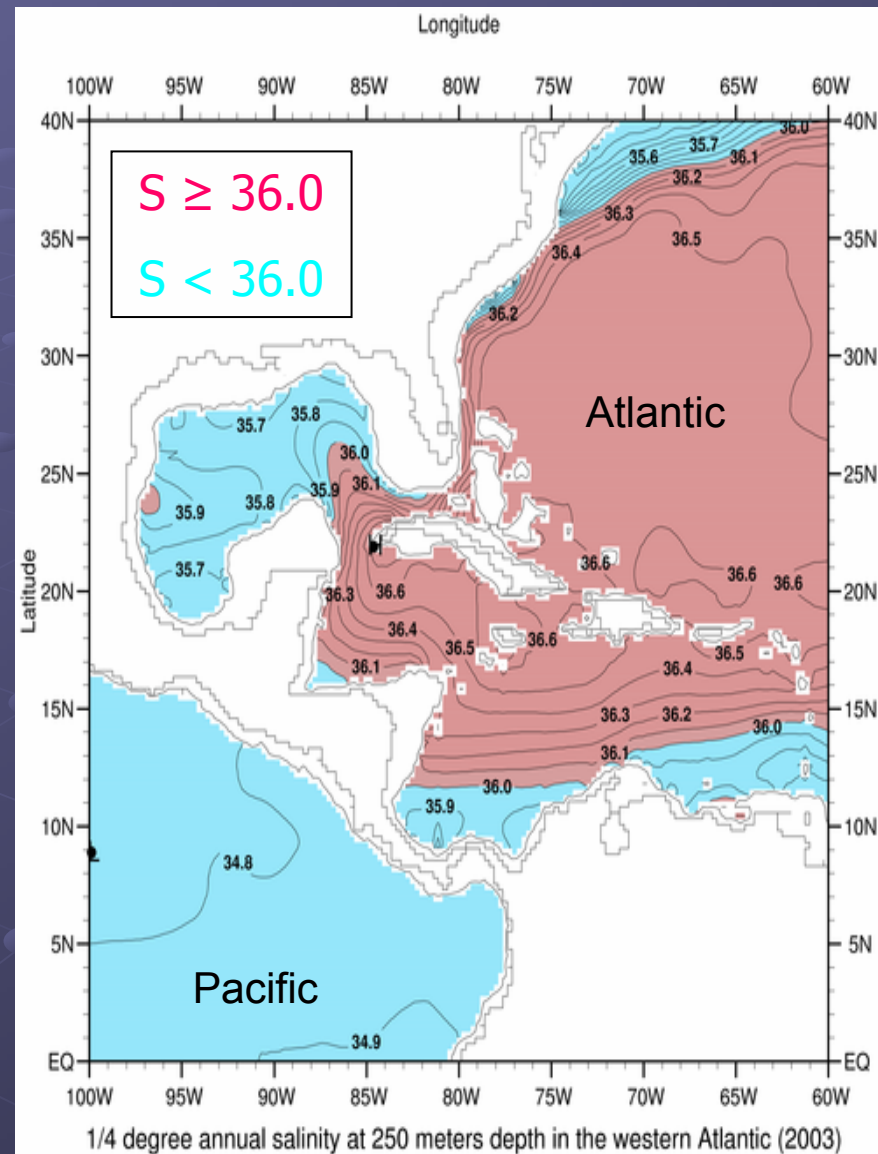
NODC-Ocean Climate Laboratory
World Ocean Atlas

Annual Salinity in the Gulf of Mexico at 250 m depth

1° Grid

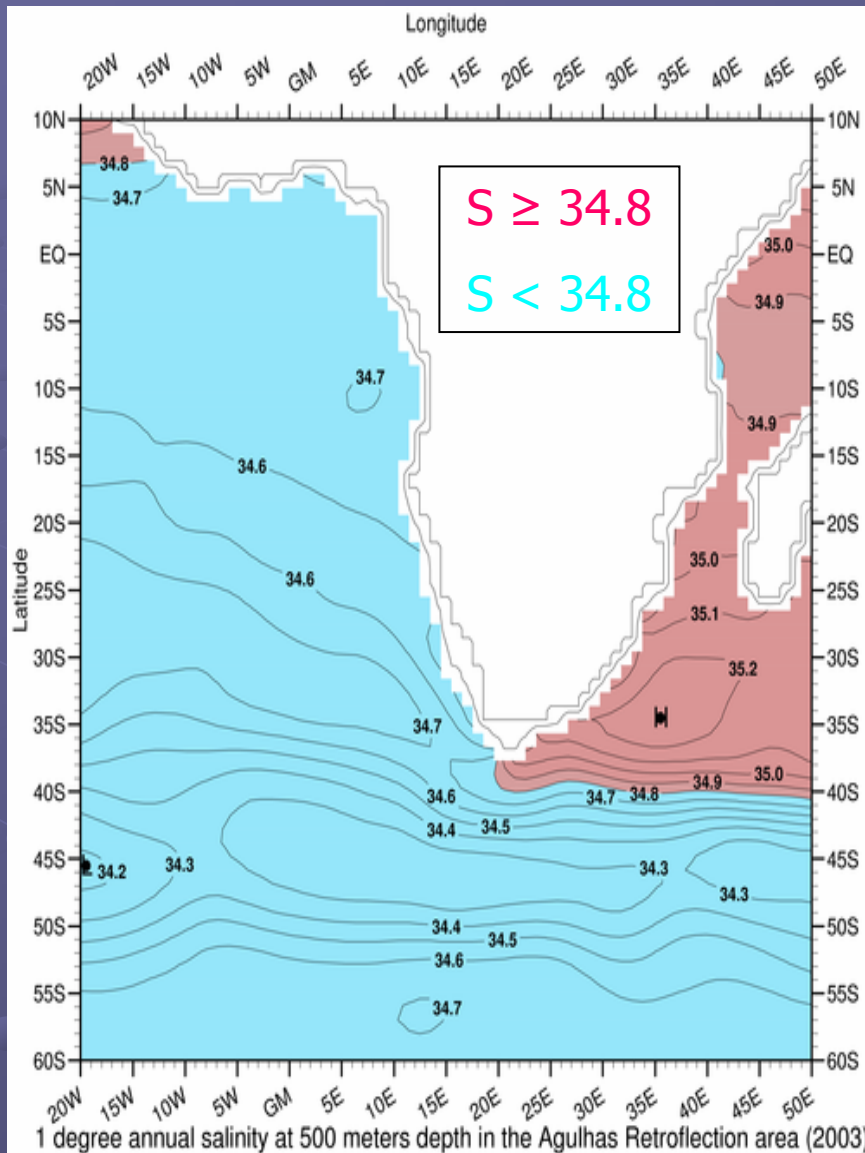


1/4° Grid

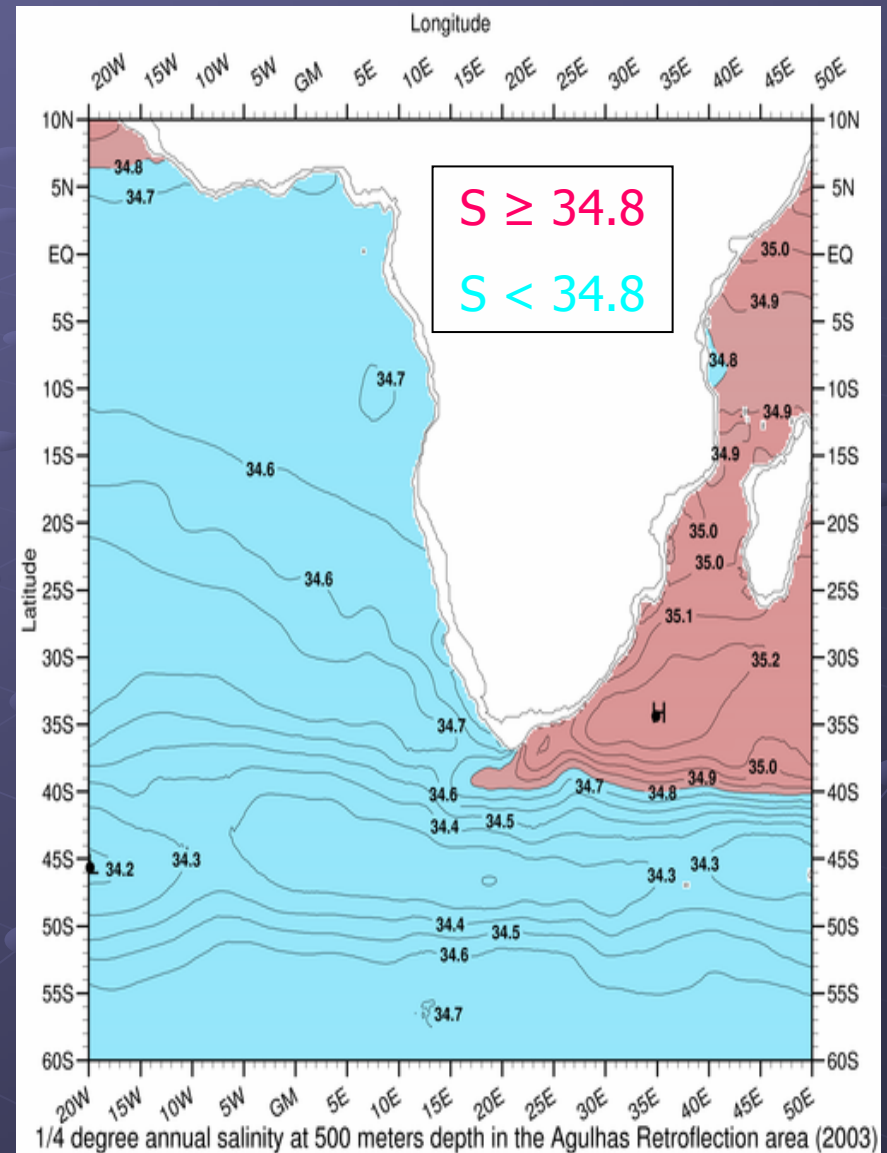


Annual Salinity in the Agulhas Region at 500 m depth

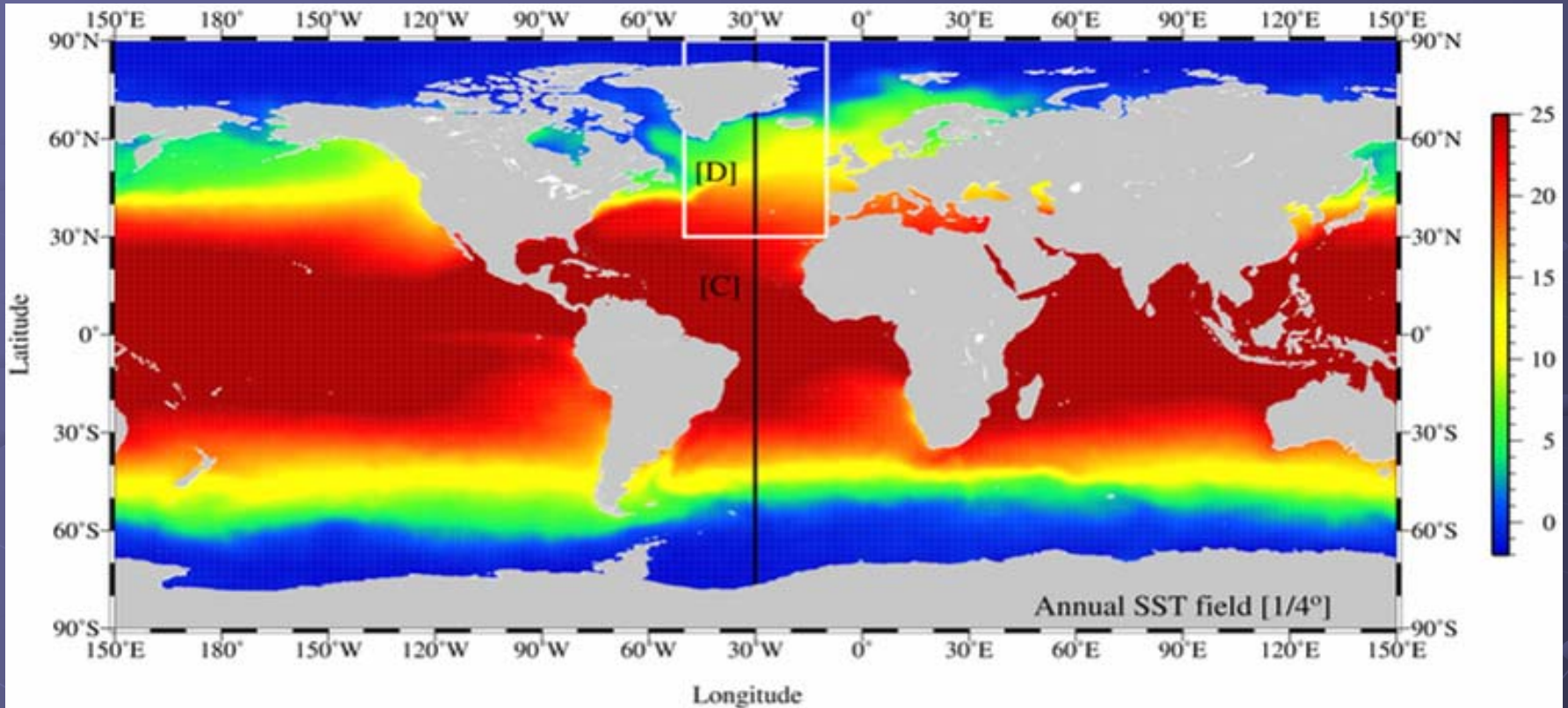
1° Grid



1/4° Grid



Example of seasonal temperature distribution on 1° and 1/4° grid



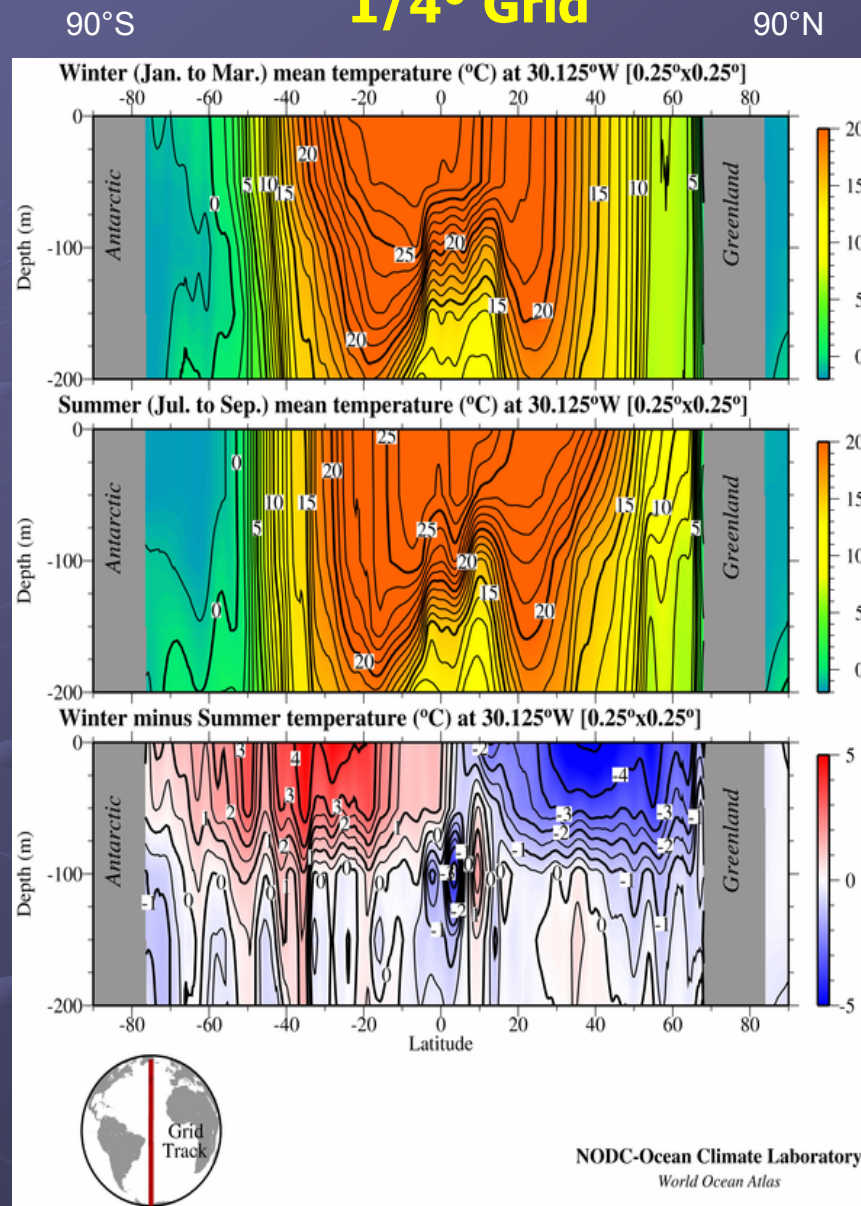
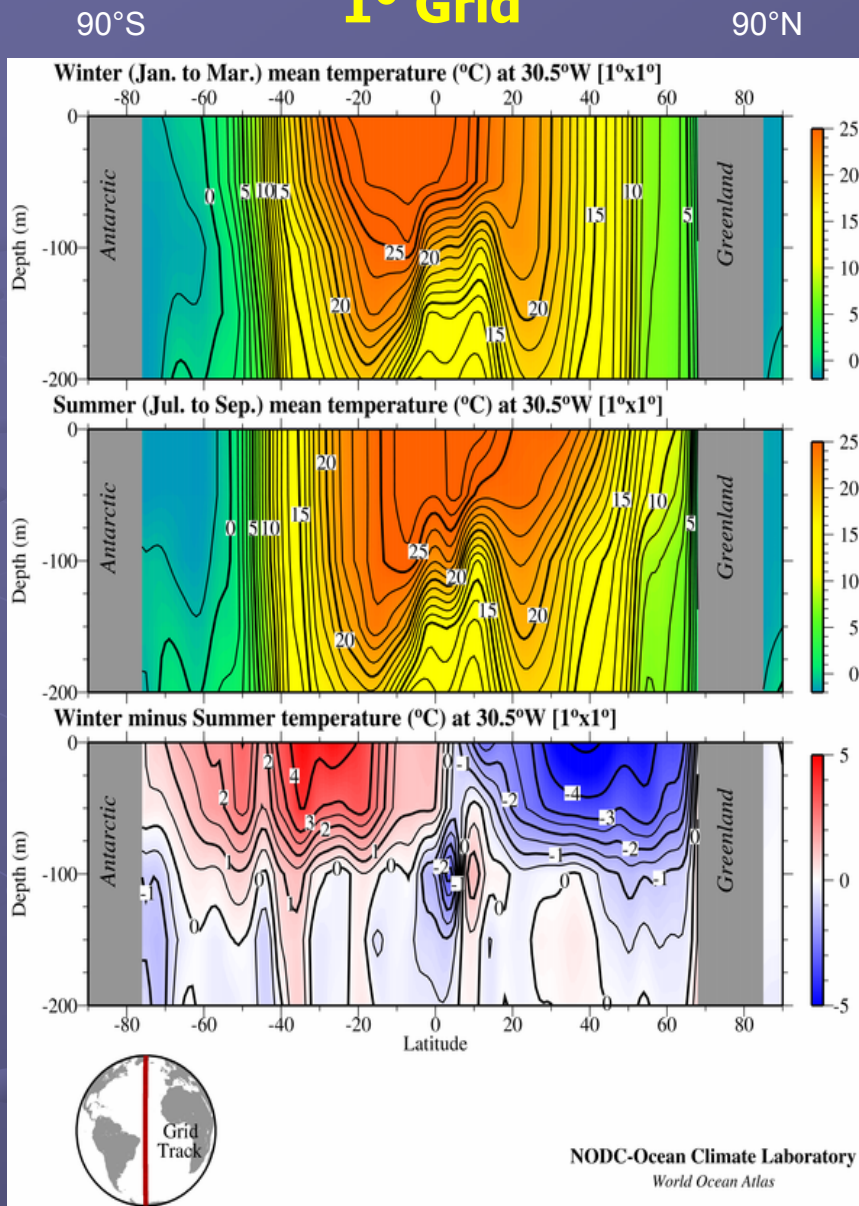
Examples of the annual temperature on 1° and 1/4° grids

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World Ocean Atlas

Meridional section of temperature nominally at 30°W [90°S-90°N]

1° Grid

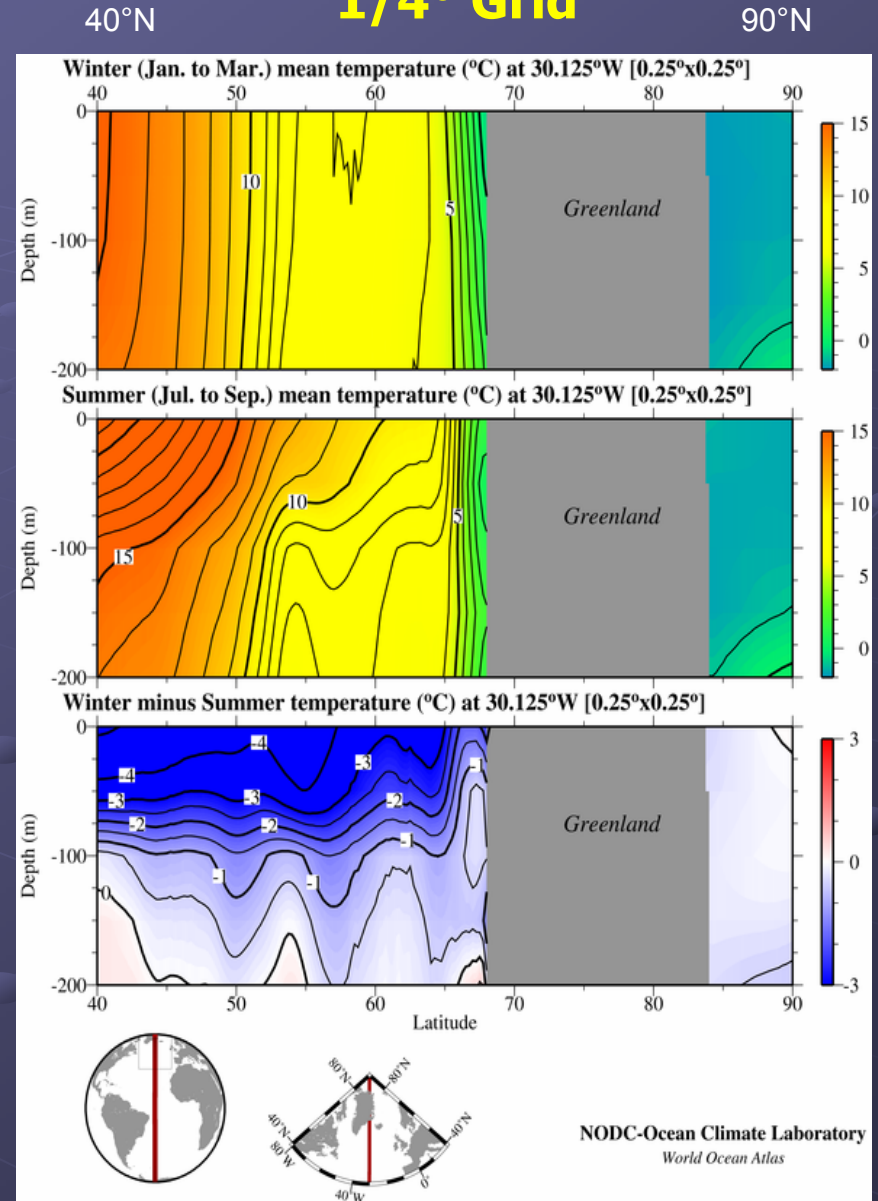
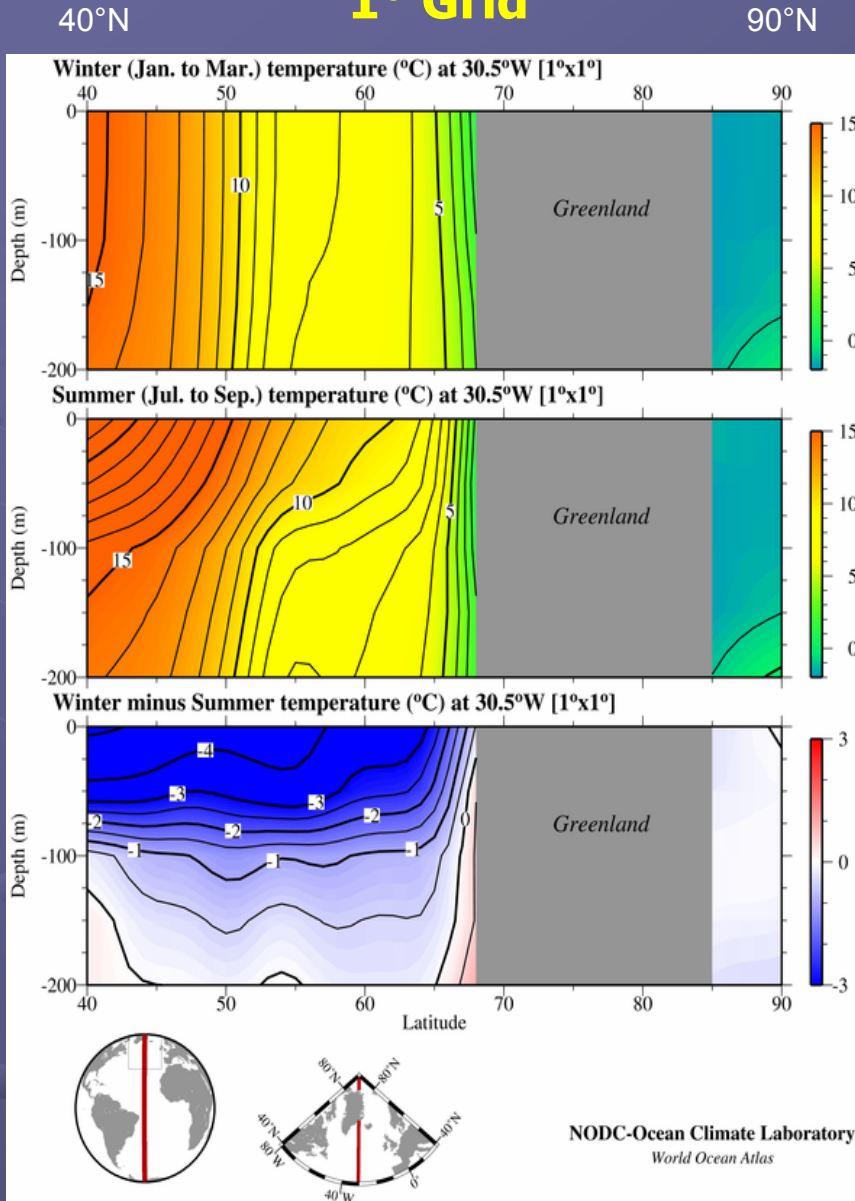
1/4° Grid



Meridional section of temperature nominally at 30°W [40°-90°N]

1° Grid

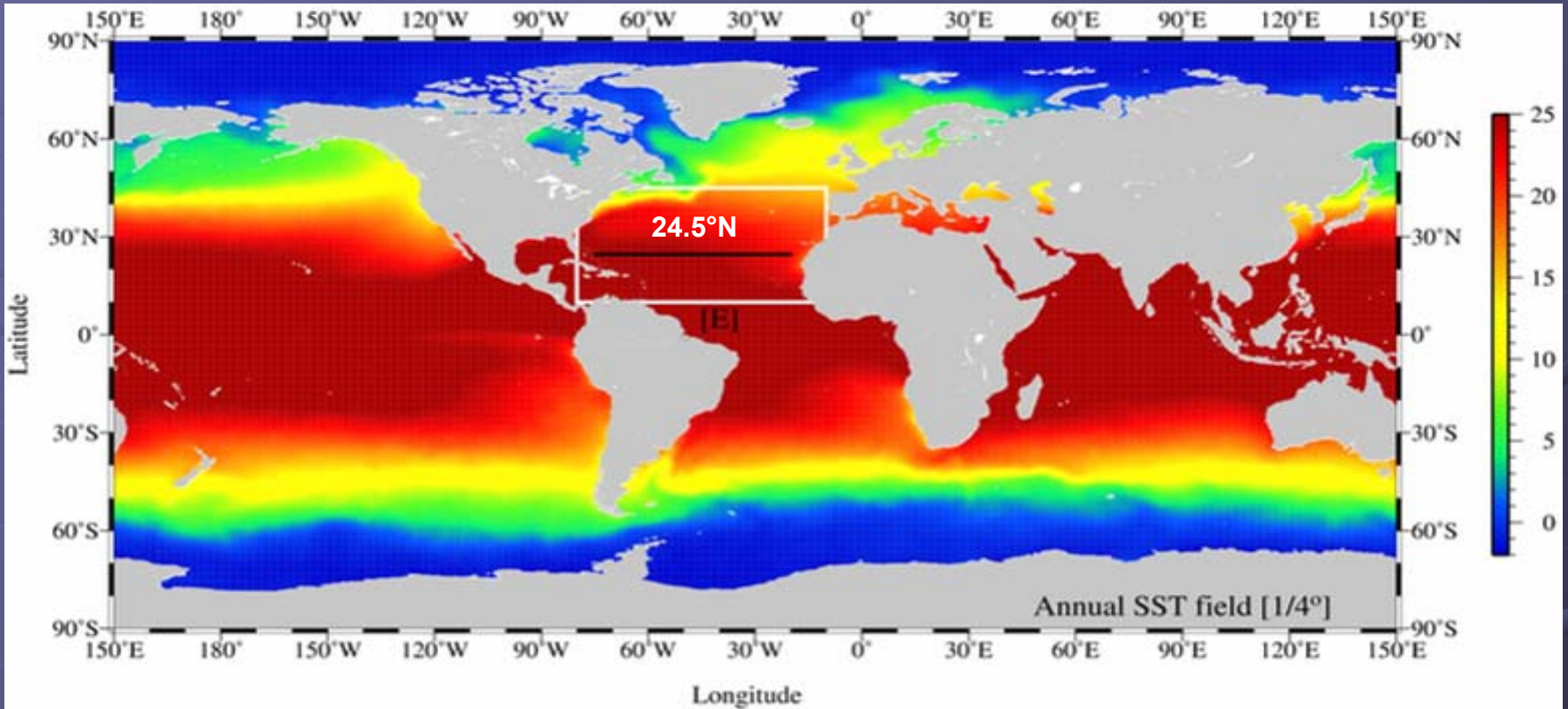
1/4° Grid



REALITY CHECK

**Comparison of $1/4^\circ$ fields with
synoptic historical data**

Example comparison of a zonal section of temperature on $1/4^\circ$ grid with synoptic WOCE data for the Atlantic Basin

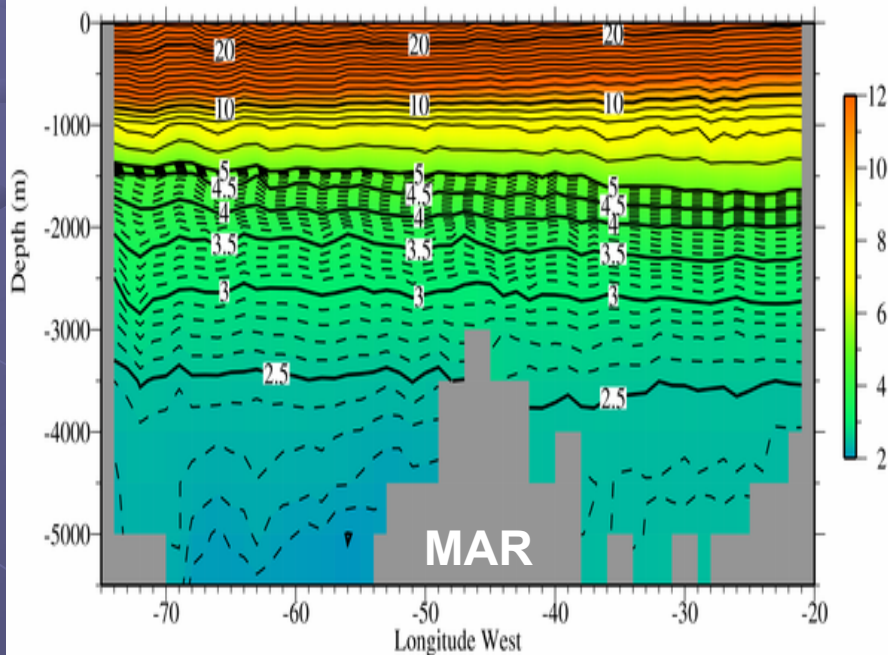
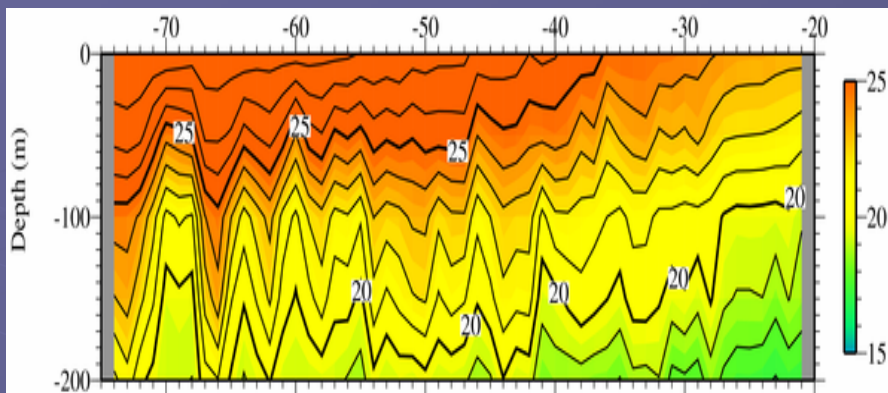


Example of the annual temperature on $1/4^\circ$ grid and synoptic data

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World Ocean Atlas

Zonal temperature based on WOCE A5 line (August 1992) nominally along 24.5°N

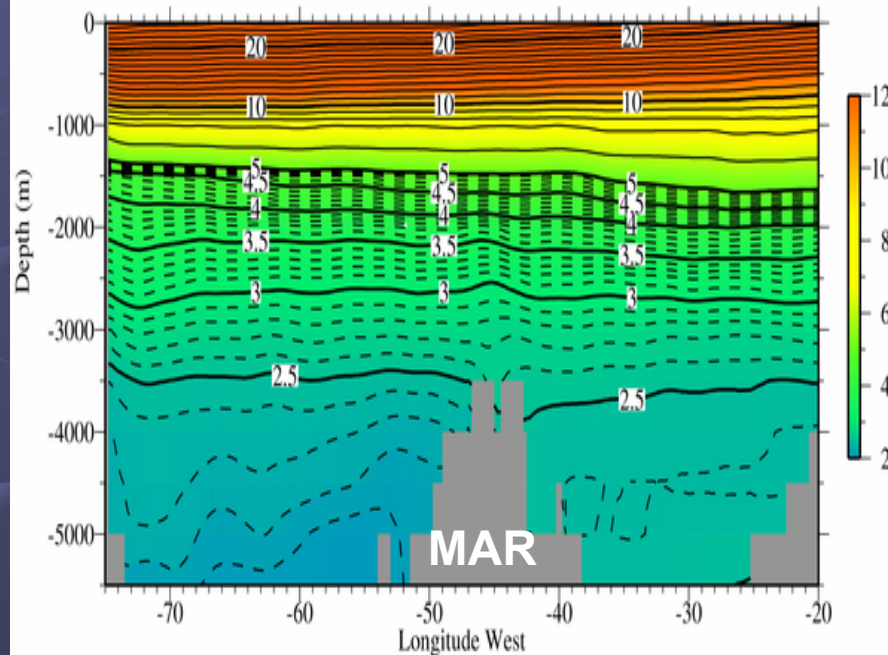
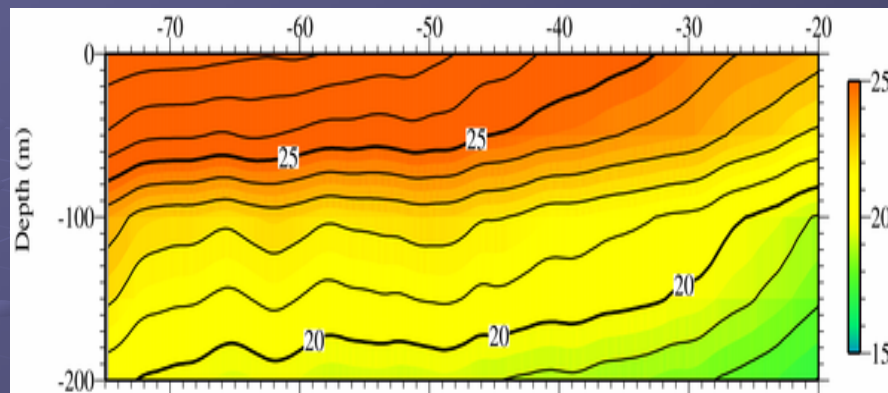
80°W 20°W



WOCE A5 (Aug., 1992) CTD in-situ temperature (°C) nominally at 24.5°N

Summer (Jul. to Sep.) zonal temperature on 1/4° grid nominally along 24.6°N

80°W 20°W



Summer (Jul to Sep) temperature (°C) at 24.625°N [0.25°x0.25°]

SUMMARY

- A global ocean T and S climatology on a $1/4^\circ$ grid (annual, seasonal, monthly fields) is presented based on objective analysis of quality controlled historical oceanographic data ([see methods and data on-line](#))
- Data quality control of the T and S data on a $1/4^\circ$ grid improves the earlier 1° WOA01 analysis ([see woa01 on-line methods, data and graphics](#)).
- The analysis on a $1/4^\circ$ grid helps resolve meso-scale features which tend to be more smoothed in the 1° grid.
- There are limitations in the analysis due to non-uniform temporal and spatial data coverage.
- The large-scale distributions of T and S in the $1/4^\circ$ analysis are comparable to synoptic data. But it is difficult to verify meso-scale features particularly in data sparse regions.

REFERENCES

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- Boyer, T. P., C. Stephens, J. I. Antonov, M. E. Conkright, R. A. Locarnini, T. D. O'Brien, and H. E. Garcia, 2002, *World Ocean Atlas 2001 Volume 2: Salinity*, S. Levitus, Ed. NOAA Atlas NESDIS 50, U. S. Government Printing Office, Washington, D. C., 176 pp. ([see pdf documentation](#))
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- Levitus, S., 1982, *Climatological Atlas of the World Ocean*, NOAA Professional Paper 13, U. S. Government Printing Office, Washington, D. C., 173 pp.
- Sasaki, Y., 1960. An objective analysis for determining initial conditions for the primitive equations. Ref. 60-1 6T, Atmospheric Research Lab., Univ. of Oklahoma Res. Institute, Norman, 23 pp.
- Stephens, C., J. I. Antonov, T. P. Boyer, M. E. Conkright, R. A. Locarnini, T. D. O'Brien, and H. E. Garcia, 2002, *World Ocean Atlas 2001 Volume 1: Temperature*, S. Levitus, Ed., NOAA Atlas NESDIS 49, U. S. Government Printing Office, Washington, D. C., 176 pp. ([see pdf documentation](#))