

US GO-SHIP (2015-2020): Overview

<https://usgoship.ucsd.edu/>

Alison Macdonald (WHOI)

With slides and input from the US GO-SHIP Executive Council, especially Lynne Talley (SIO) and Greg Johnson (NOAA/PMEL) Co-Chairs



US GO-SHIP

OCB Workshop June 24-27, 2019

GO-SHIP Executive Council

Co-chairs: Greg Johnson NOAA/PMEL & Lynne Talley SIO

Leticia Barbero: NOAA/AOML

Molly Baringer: NOAA/AOML

Craig Carlson: UCSB

Brendan Carter: NOAA/PMEL

Andrew Dickson: SIO

Scott Doney: U. Virginia

Richard Feely: NOAA/PMEL

Alison Macdonald: WHOI

Jim Swift: SIO

Andreas Thurnherr: LDEO

Mark Warner: UW

Rik Wanninkhof, ex officio (Intl. GO-SHIP co-chair) NOAA/AOML

U.S. GO-SHIP Committee: All NOAA/NSF funded PIs + chief & co-chief scientists within 3 years of their last cruise + ...



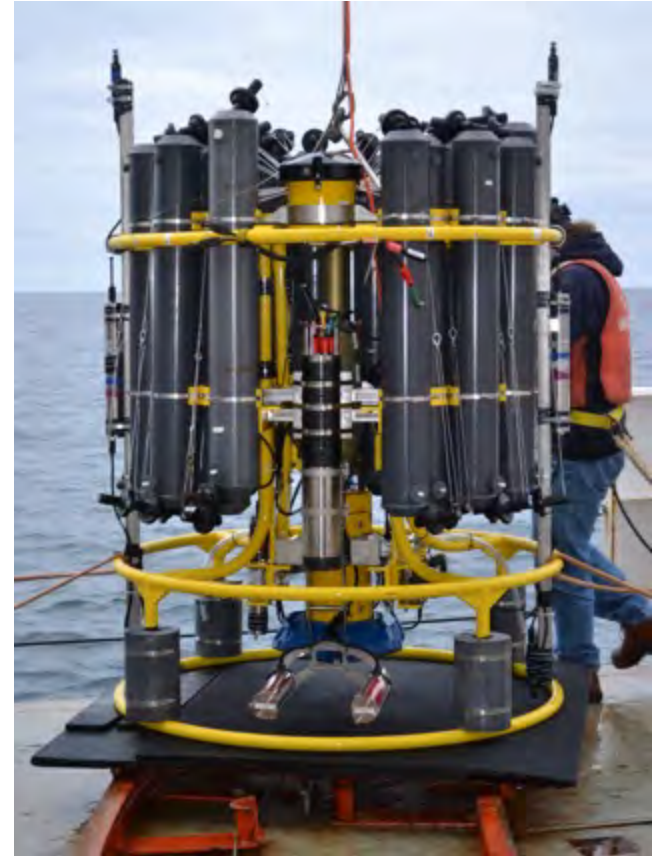
GO-SHIP principal scientific objectives:

- understanding & documenting large-scale ocean property distributions, their changes, & drivers of those changes
- addressing questions of a future ocean that will
 - see increases in dissolved inorganic carbon, acidification & stratification, and
 - experience changes in circulation & ventilation processes due to global warming and a changing water cycle.



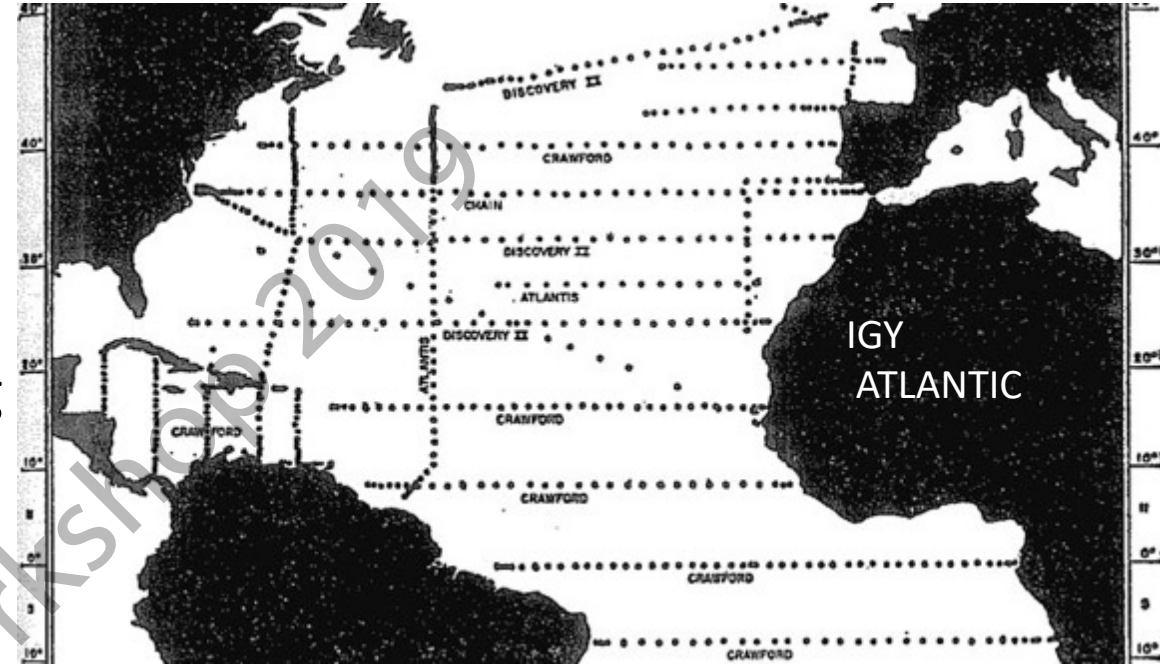
GO-SHIP provides
the highest required accuracy **global**
~decadal scale, **basin-wide**,
full water column,
observations of multiple properties

To resolve changes in
heat, freshwater, carbon **oxygen**,
nutrient & transient tracer inventories

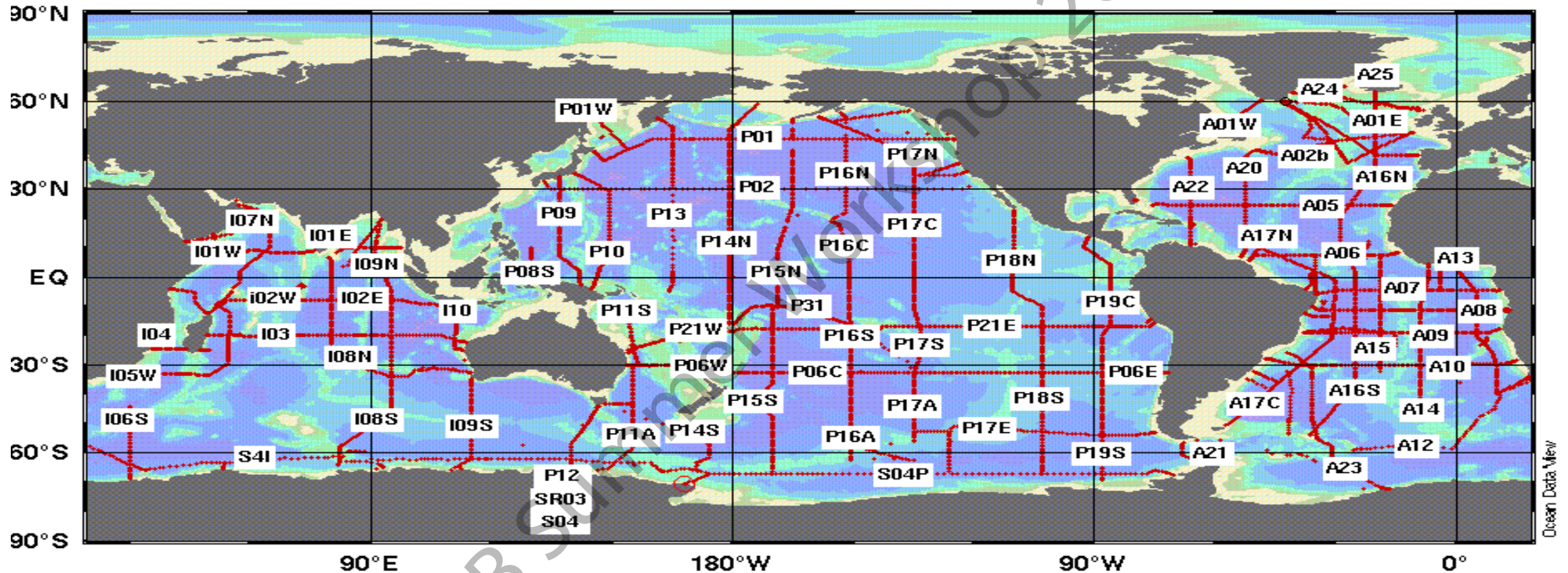


Prior Global Surveys

- **IGY 1957-1958**
 - multiple coast to coast transects
 - .e.g. Atlantic 24N mean 160 km spacing
 - T, S, O₂, nutrients
- **GEOSECS 1970s**
 - Full N/S lines in each major basin
 - 150 stations global
 - 50 30L samples/station
 - 270-1000 L samples at 20 depths per station
- **Pre-WOCE**
 - First coast-to-coast, closely spaced, full-depth sections of GO-SHIP core parameters
 - arguably AJAX, now A13.5 along 0°E, followed by SAVE, TPS-10, etc.

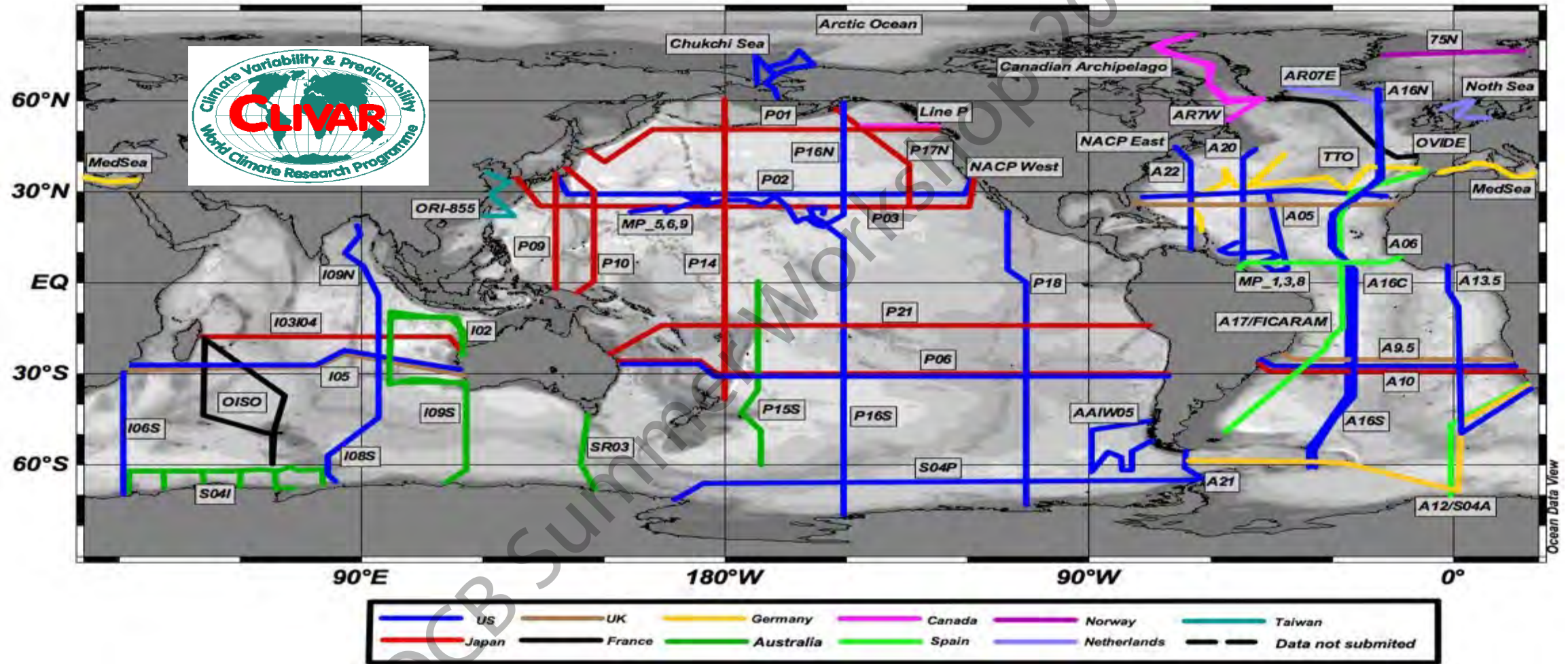


WOCE/JGOFS 1990s: executed global baseline survey
emphasizing increased spatial coverage over repeats of previous lines



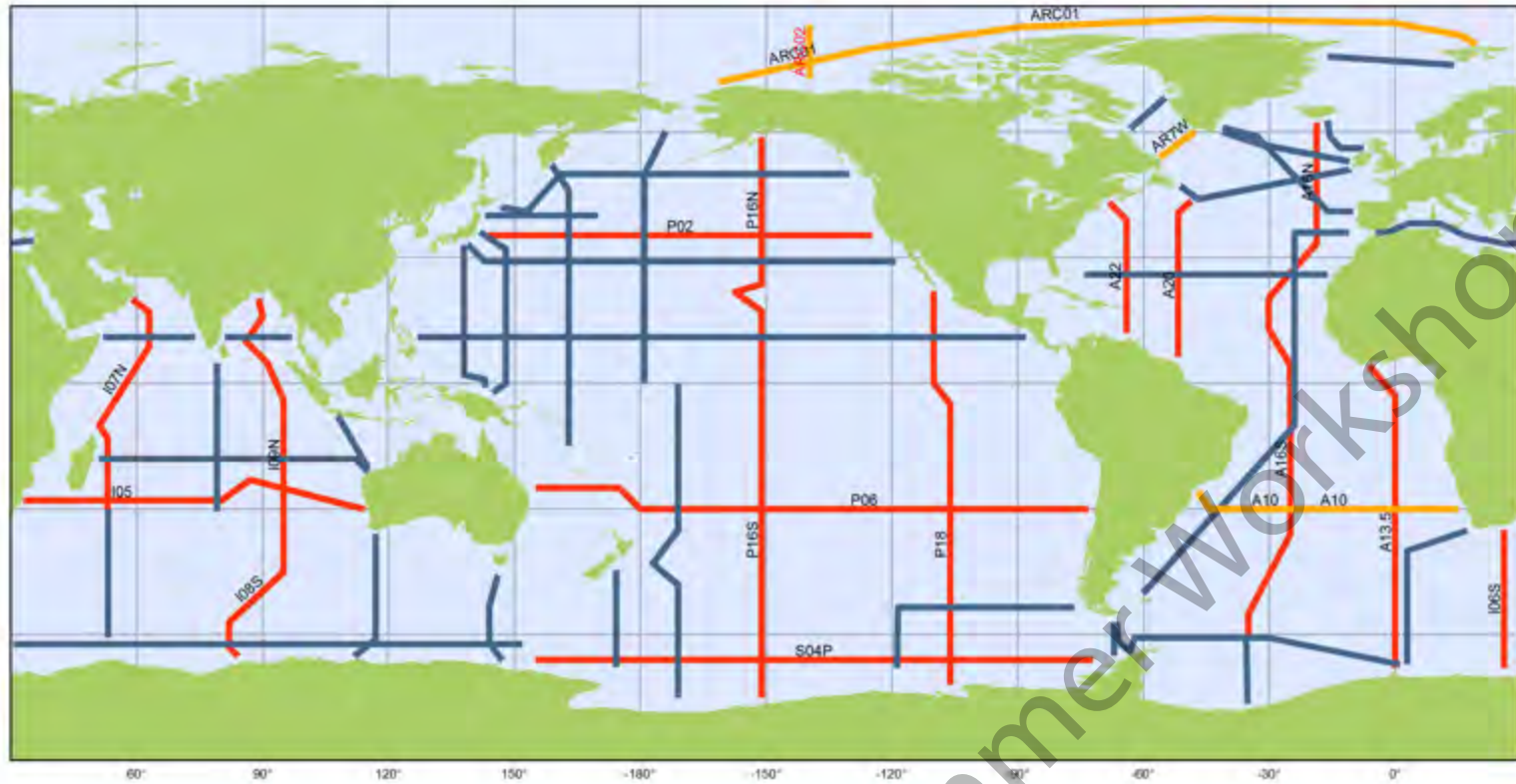
- ≤ 50 nm station spacing
- 24-36 depths per station
- Specified standards for accuracy & precision
- JGOFS provided chemistry & in particular carbon parameters
- (U.S.) 2 yr to open data policy

CLIVAR 2000s: reoccupation of key, zonal mid-latitude flux & meridional inventory sections in each deep basin



- Aiming for 30 nm station spacing
- Specified standards for accuracy & precision
- Support of ancillary projects
- Immediate open data policy (US)

US GO-SHIP 2015-2020: second decadal reoccupation



US - GO-SHIP as integral part of international GO-SHIP



— US-Lines
— US and others
— Other Nations



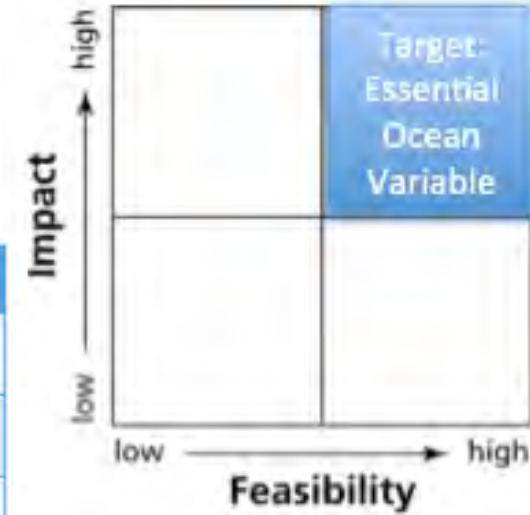
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Global
Ocean
Ship-based
Hydrographic
Investigations
Program

3rd decade – coming up!

- Aiming for 30 nm station spacing
- Specified standards for accuracy & precision
- Support of ancillary projects
- Immediate open data policy (for all)

U.S. GO-SHIP defines Measurement Priorities through Essential Ocean Variables (EOVs): defined by GOOS Expert Panels



EOVs are central to GOOS strategic mapping, which describes the observing system in terms of its relation to the **GOOS mandates**

PHYSICS	BIOGEOCHEMISTRY	BIOLOGY AND ECOSYSTEMS
Sea state	Oxygen	Phytoplankton biomass and diversity
Ocean surface stress	Nutrients	Zooplankton biomass and diversity
Sea ice	Inorganic carbon	Fish abundance and distribution
Sea surface height	Transient tracers	Marine turtles, birds, mammals abundance and distribution
Sea surface temperature	Particulate matter	Hard coral cover and composition
Subsurface temperature	Nitrous oxide	Seagrass cover and composition
Surface currents	Stable carbon isotopes	Macroalgal canopy cover and composition
Subsurface currents	Dissolved organic carbon	Mangrove cover and composition
Sea surface salinity	Ocean colour	Ocean Sound
Subsurface salinity		Microbe biomass and diversity (*emerging)
Ocean surface heat flux		Benthic invertebrate abundance and distribution (*emerging)



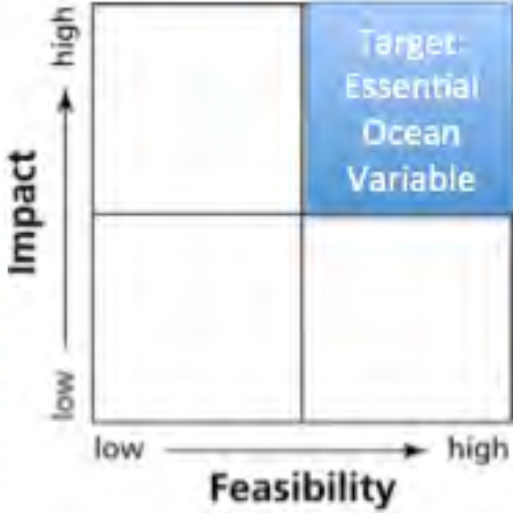
US GO-SHIP

MEASUREMENTS

U.S. GO-SHIP:

Essential Ocean Variables (EOVs): defined by the GOOS Expert Panels

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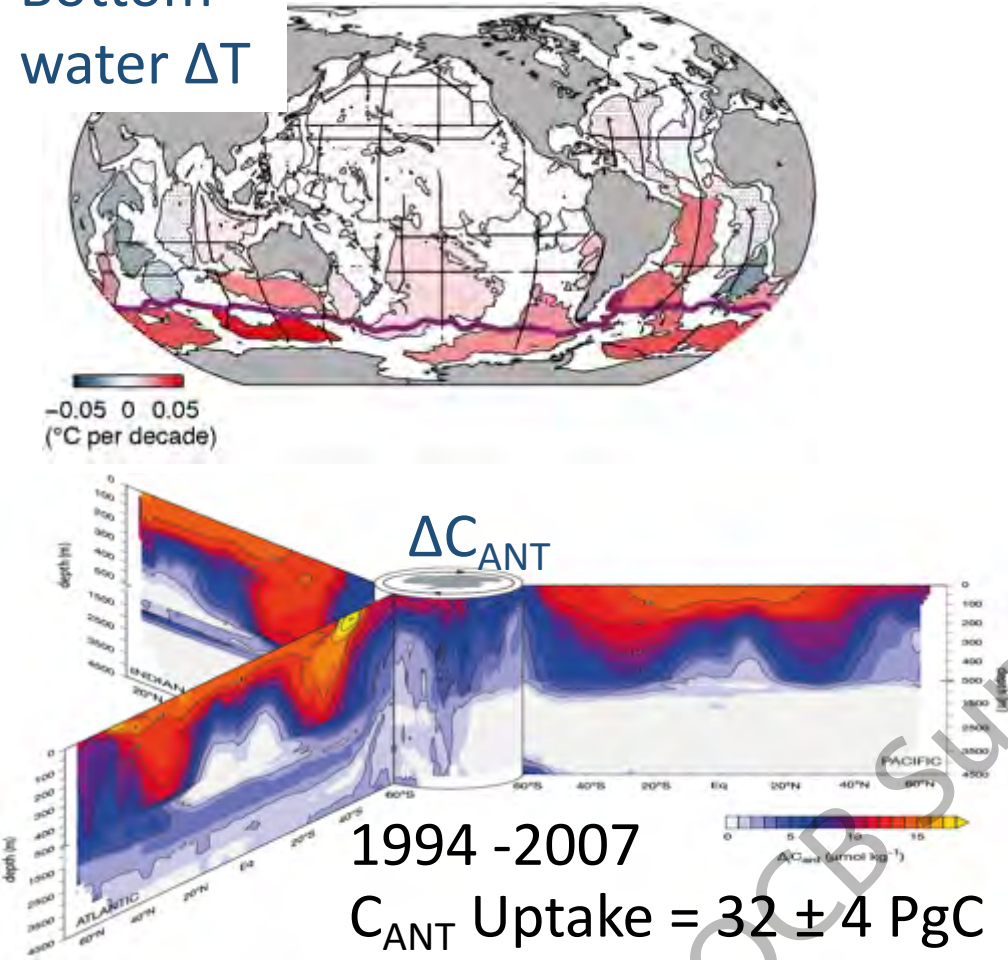
US GO-SHIP measurements

Other parameters (biological) ancillary, under discussion by SCOR WG 154 & to be discussed at OceanObs19

US GO-SHIP Level 1 measurements: **required** with strict data policy

From <http://usgoship.ucsd.edu/about>

Bottom
water ΔT



Dissolved inorganic carbon (DIC)
Total Alkalinity (TALK)
pH
CTD pressure, temperature, salinity (calculated)
CTD oxygen (sensor)
Bottle salinity
Nutrients by standard auto analyzer (NO₃/NO₂, PO₄, SiO₃)
Dissolved oxygen
Chlorofluorocarbons (CFC-11, -12) and SF₆
Dissolved organic carbon
Dissolved organic nitrogen
Surface underway system (T, S, pCO₂)
ADCP shipboard
ADCP lowered
Underway navigation and bathymetry
Meteorological.



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MEASUREMENTS: LEVEL 1

Level 2: **Highly desirable** (with strict data policy)

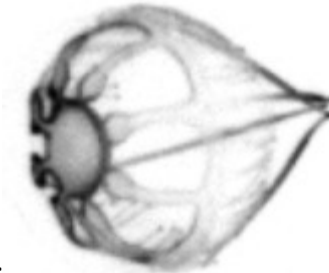
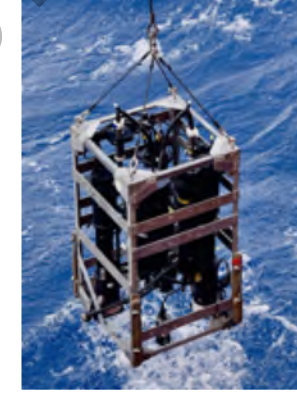
- CTD Transmissometer
- Tritium-3He - was previously L1
- Discrete pCO₂
- ¹⁴C by AMS
- CCl₄
- CFC-113 - was previously L1
- δ¹³C of DIC
- Fe/trace metals
- Surface underway system: nutrients, O₂, Chl, skin temperature

From <http://usgoship.ucsd.edu/about>

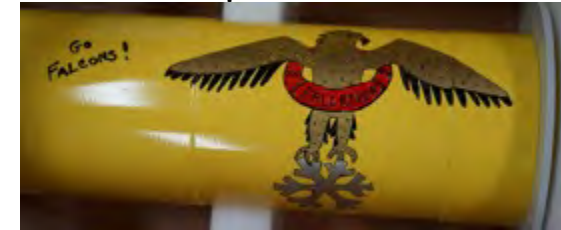
* EOVs

Level 3: **Ancillary** (Data policy set outside GO-SHIP) **Leveraging:** new technology, biology, etc

- Chlorophyll
- Primary production
- HPLC pigments
- POC*
- UVP*
- Optical instruments*
- CDOM*
- Fluorometry and backscatter*
- Rare earth elements (REE)
- Experimental continuous analyzers
- δ¹⁵N
- Isotopes of NO₃
- ³²Si
- δ¹⁸O of H₂O
- NH₄
- Low level nutrient
- Total organic phosphorus



- Isotopes of O₂
- N₂, Ar, O₂
- Methyl halides
- DMS
- N₂O* - move to L1?
- Bacterial Abundance
- Bacterial Production
- Dissolved combined neutral sugars
- DNA
- Floats
- Gliders
- Drifters
- Chipods/turbulence



US GO-SHIP

MEASUREMENTS: LEVELS 2 & 3

Goals for US GO-SHIP (2015-2020)

- **Reoccupy global survey of key full-depth coast-to-coast sections** for assessment of changes in ocean property inventories and transports (heat, freshwater, oxygen, carbon, transient tracers, etc)
- **Provide climate-ready, reference standard data** as part of international GO-SHIP, contributing to GOOS and GCOS, providing reference datasets for Argo and other autonomous platforms
- **Provide opportunities for synergistic experimental and emerging programs:** contact Jim Swift and/or Isa Rosso (SIO) for information
- **Data management** for all Level 1 (required), 2 (recommended), 3 (ancillary) data sets
- **Training** early career scientists and students: see website and contact Isa Rosso (SIO) and/or chief scientist for information
- **Analysis and publication** of results (**funding is currently limited** to postdocs & C_{ANT} analysis)

Now Planning for the Next 5 years



CLIVAR/OCB U.S. GO-SHIP Review



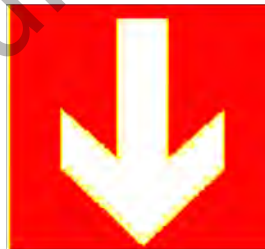
Strengths



Weaknesses



Opportunities



Threats



US GO-SHIP

Heather

