The Global Ocean Observing System
www.ioc-goos.org

Wrap-up in a global GOOS perspective

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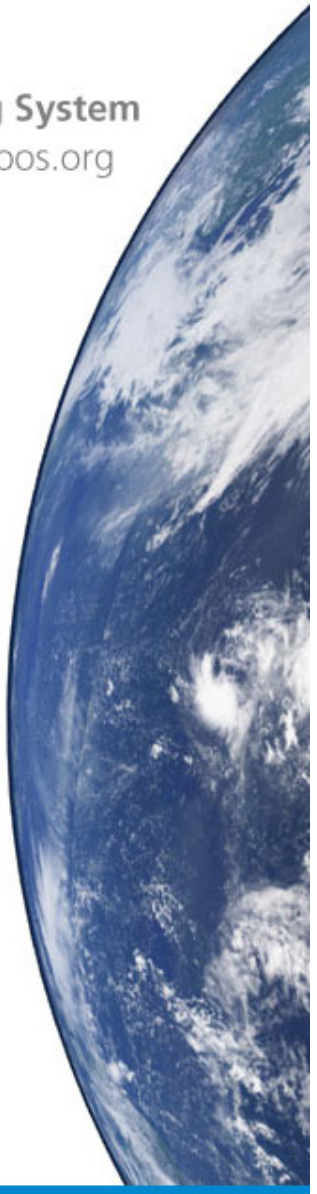
IOC/UNESCO

Kostas Nittis Scientific and Strategic Workshop, Athens, Greece, 26 May 2015



UNESCO | IOC | WMO | UNEP | ICSU

Wrap-up in a global perspective

What we want, where to go, how we want to reach this point

- Relevance of observing systems for marine sciences (users?)
- Resolving processes at appropriate scales
- New technological developments (innovation challenge)
- Coupling biogeochemical with physical systems (challenge)
- Integration of existing structures and networks (big challenge)
- Sustained funding for sustained observation system (big, big challenge)

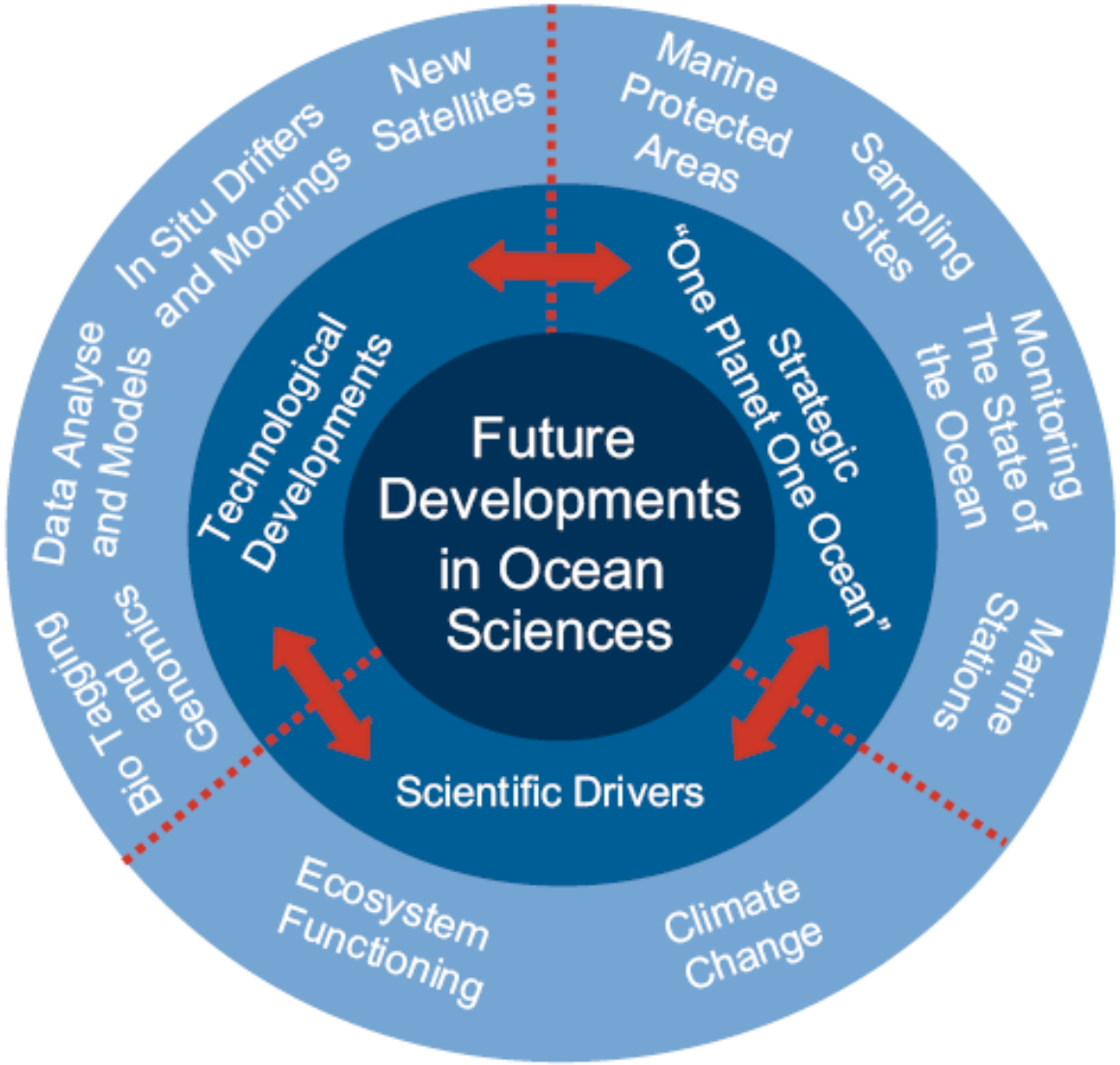
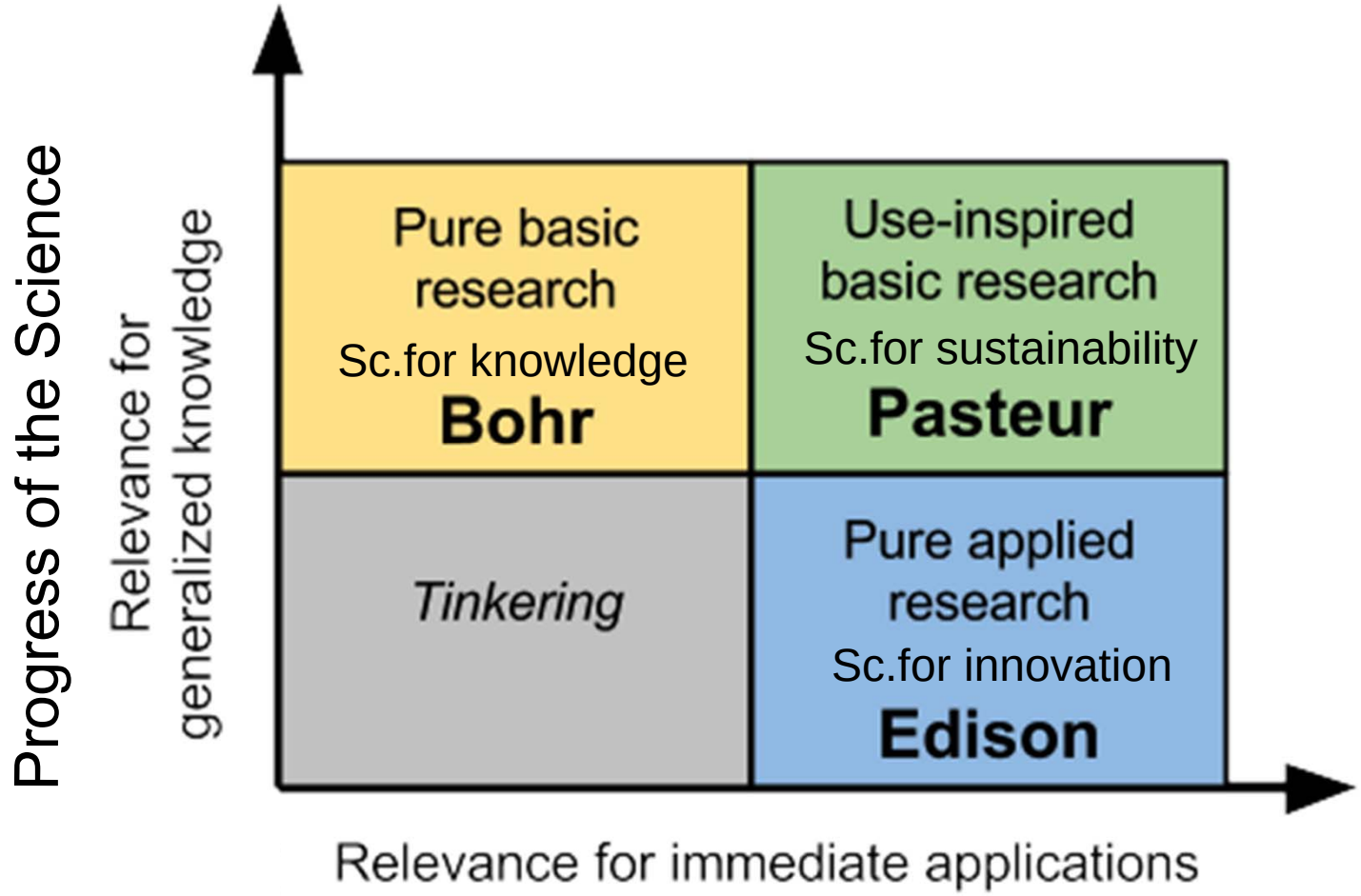


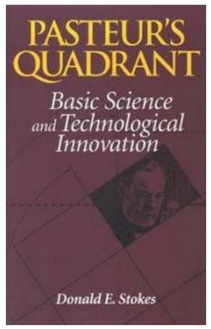
Figure 1. Critical elements identified by the Intergovernmental Oceanographic Commission for future developments in ocean sciences.

Valdés et al. 2010. Oceanography, 23 (3)

Pasteur’s quadrant: Coupling knowledge to action



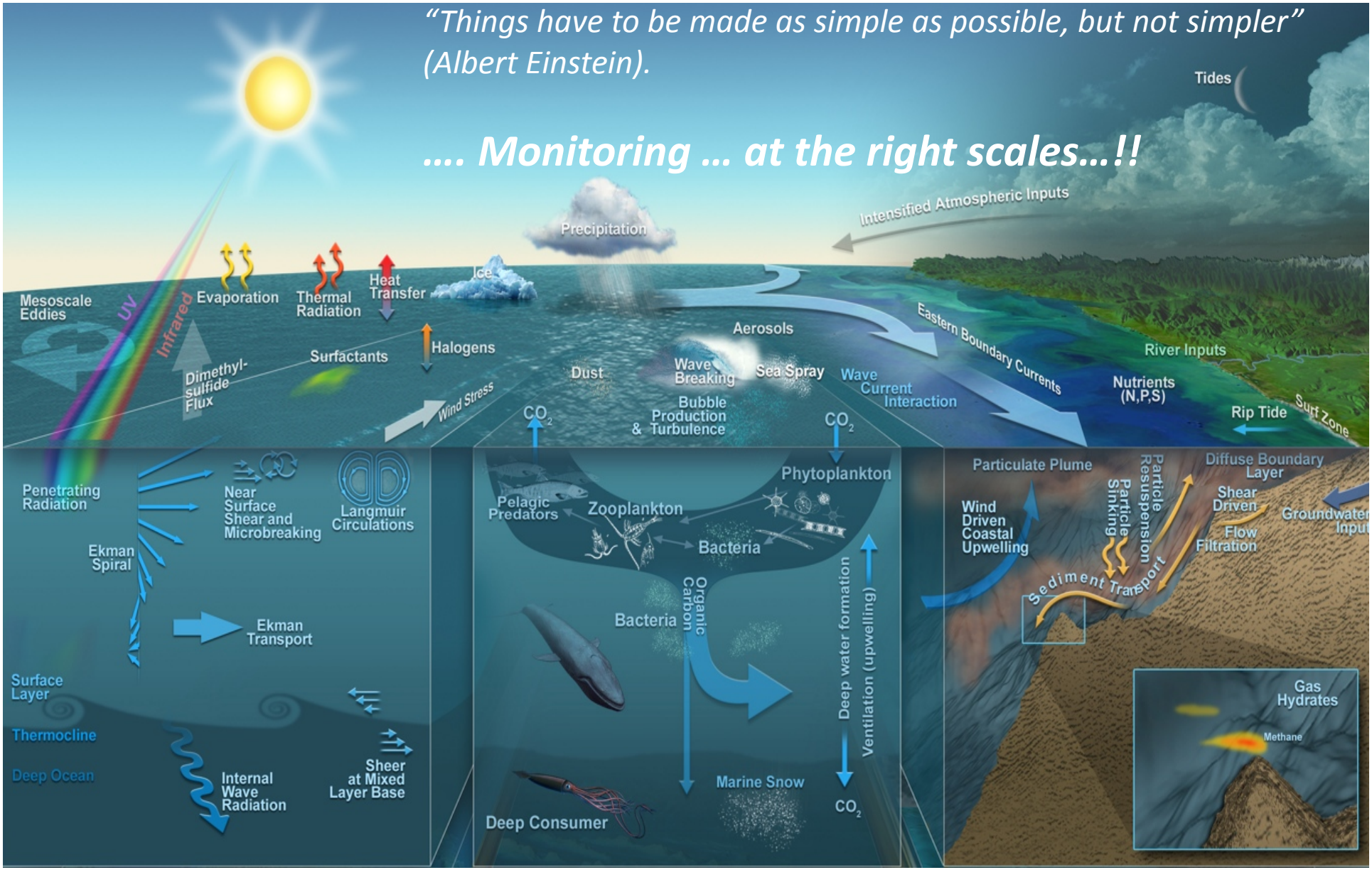
Stokes D. E. 1997. *Pasteur’s Quadrant: Basic Science and Technological Innovation.* Brookings Institution Press, Washington, D.C.



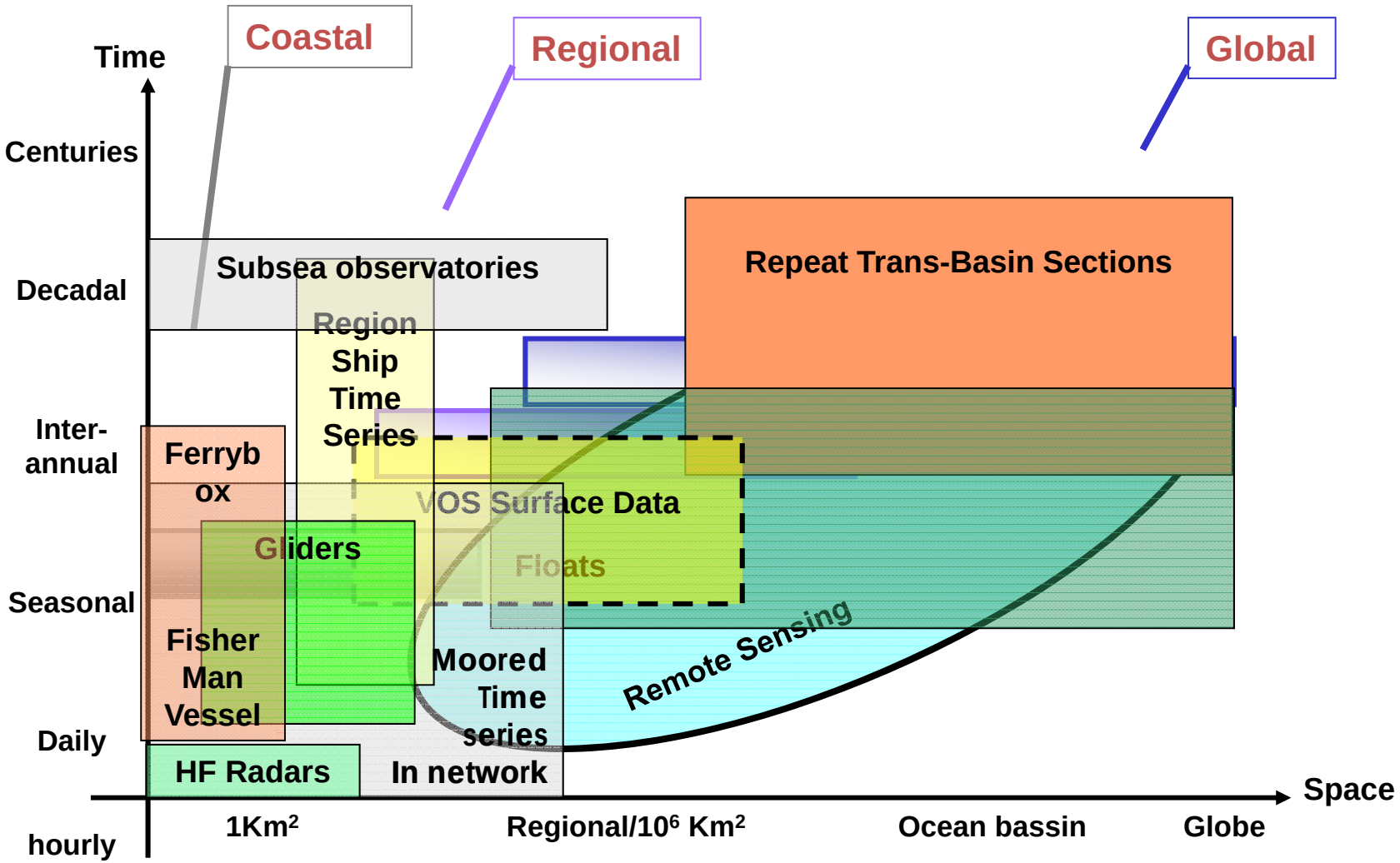
Oceans and coastal interactions. Scales interactions.

(Joaquin Tintoré, IORC Barcelona 2014)

OOI, Regional Scale Nodes (Delaney, 2008)

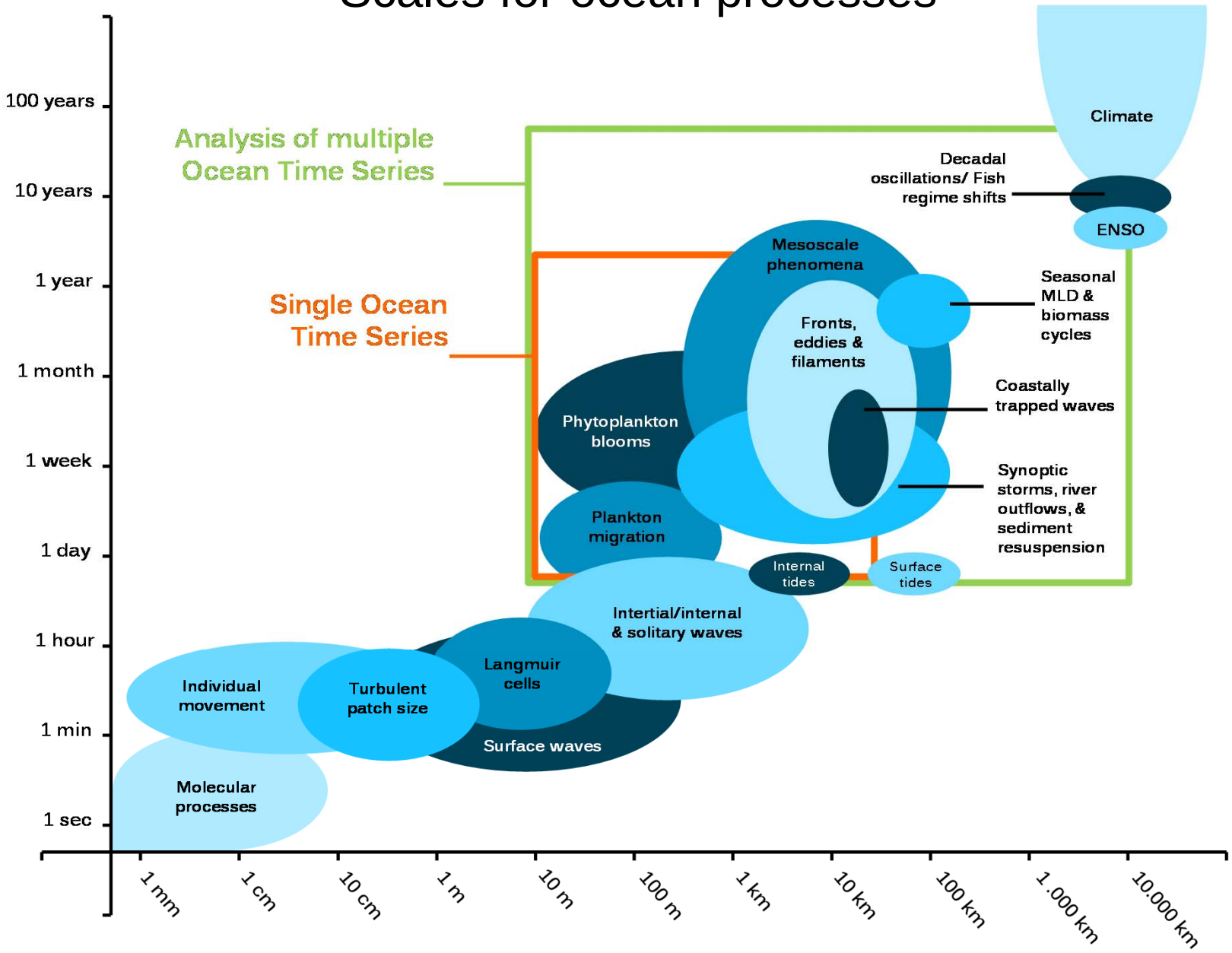


Global to Regional to Coastal

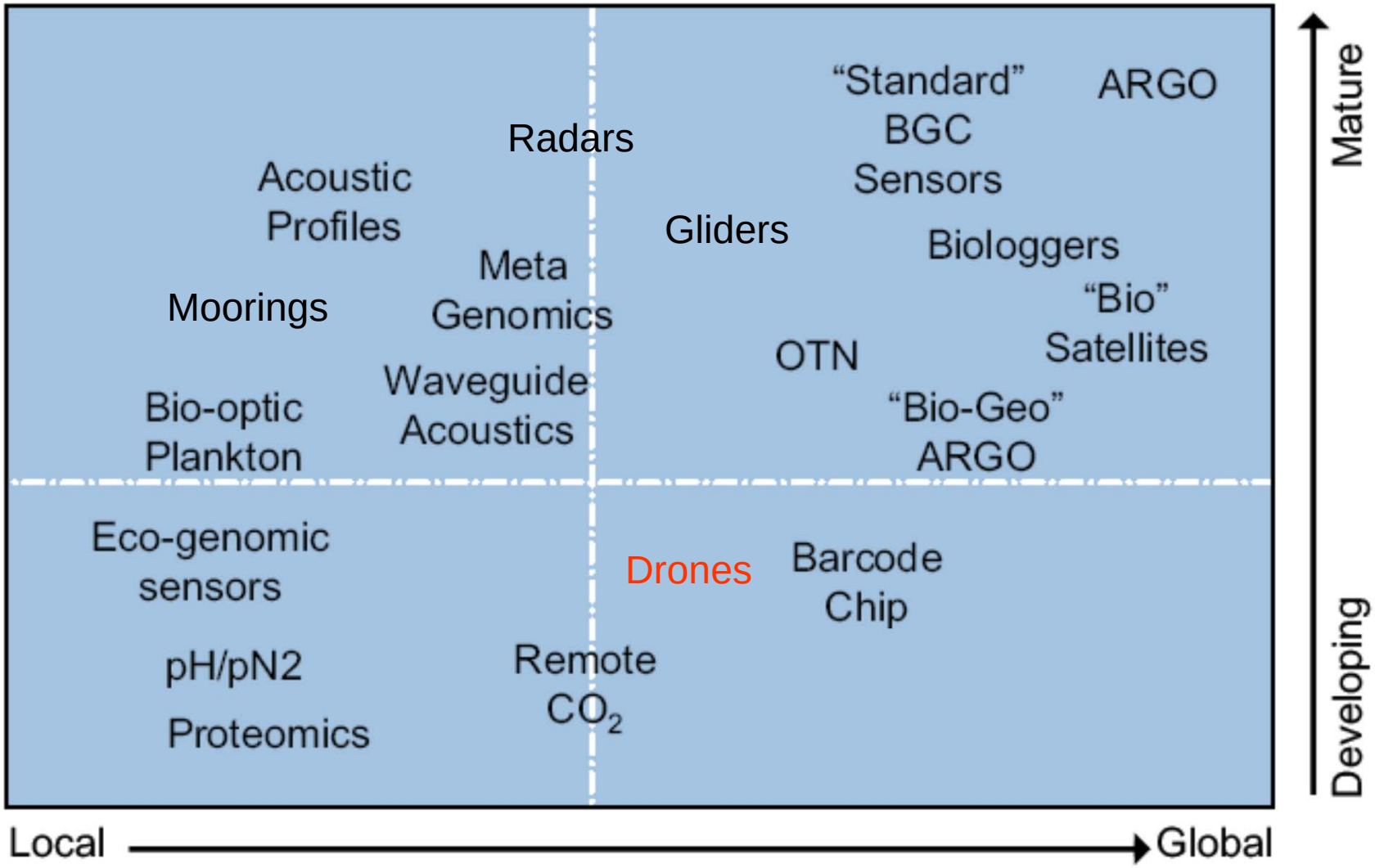


Source:EuroGOOS

Scales for ocean processes



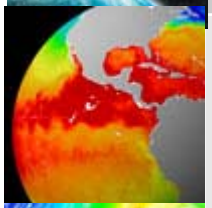
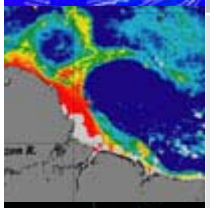
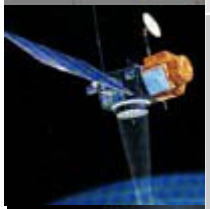
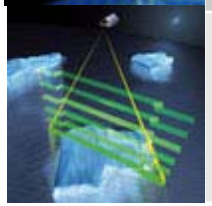
Modified from Dickey 2002



New technology for remote observation of global ocean processes. Adapted from Gunn (2009)

Valdés et al. 2010. Oceanography, 23 (3)

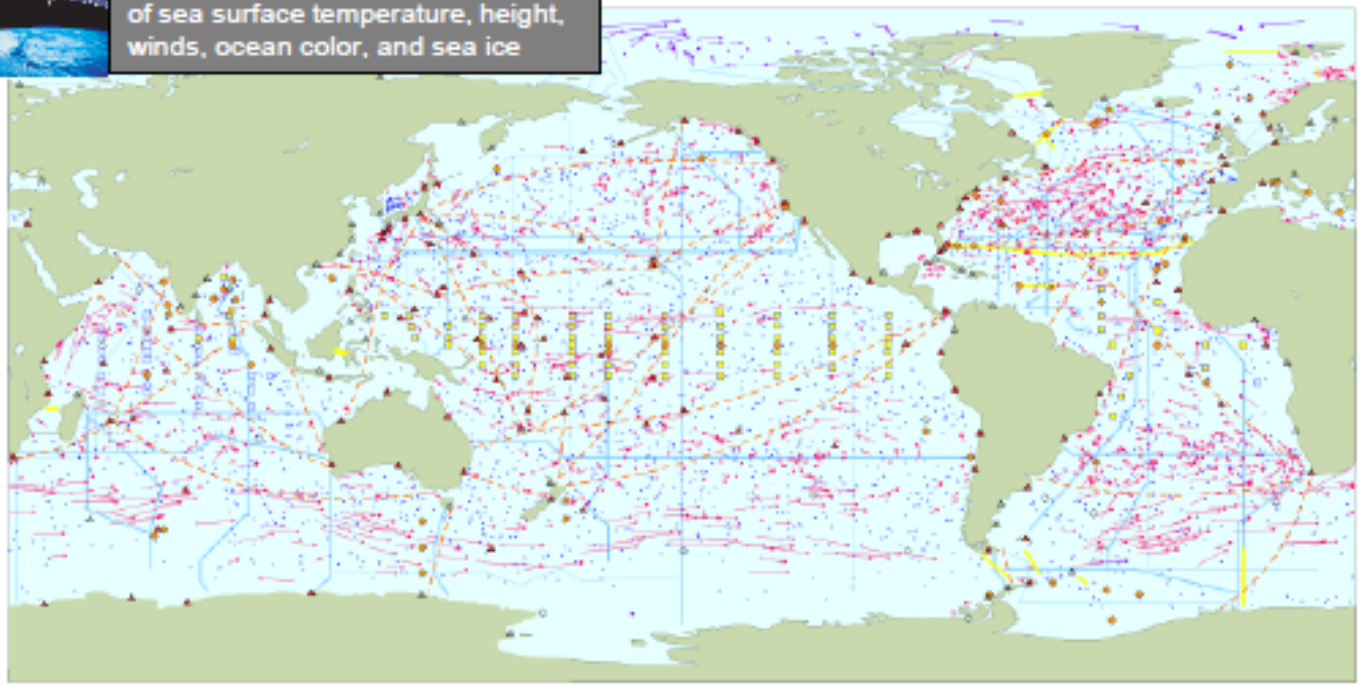
GOOS System of Systems

Satellites		Surface In Situ		Sub-surface In Situ	
	Infrared *SST, Sea Ice*		Global Surface Drifting Buoy Array		Repeat XBT Line Network
	AMSR-class microwave *SST, Wind, Sea Ice*		Global Tropical Moored Buoy Network		Global Tropical Moored Buoy Network
	Scatterometers *Surface Vector Wind, Sea Ice*		Volunteer Observing Ship Fleet		Global Ship-based Repeat Hydrography
	Ocean Colour *Chlorophyll concentration*		VOS Climate Network		Argo Float Network and Gliders
	Altimeters *Sea Level*		Global Reference Mooring Network		Global Reference Mooring Network
	Synthetic Aperture Radar *Sea Ice, Sea State*		GLOSS Core Sea-Level Network		Ocean Tracking Network

GOOS/GCOS 2010 implementation goals for **climate** observations

continuous satellite measurements of sea surface temperature, height, winds, ocean color, and sea ice

Total in situ networks **67%** Dec 2014



100% **Surface measurements** from volunteer ships (VOS)

250 ships in VOSclim pilot project

100% **Global drifting surface buoy array**

Ice buoys

5° resolution array: 1250 floats

40% **Tide gauge network** (GLOSS committed)

300 real-time reporting gauges

39% **XBT sub-surface temperature section network**

37000 XBTs deployed

100% **Argo profiling float network**

3° resolution array: 3200 floats

66% **Global time series network**

87 combined sites

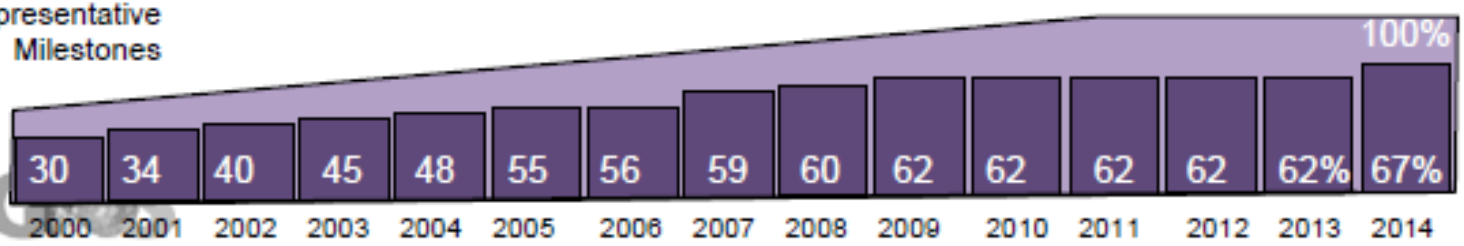
76% **Global tropical moored buoy network**

125 moorings planned

62% **Repeat hydrography and carbon inventory**

Full ocean survey in 10 years

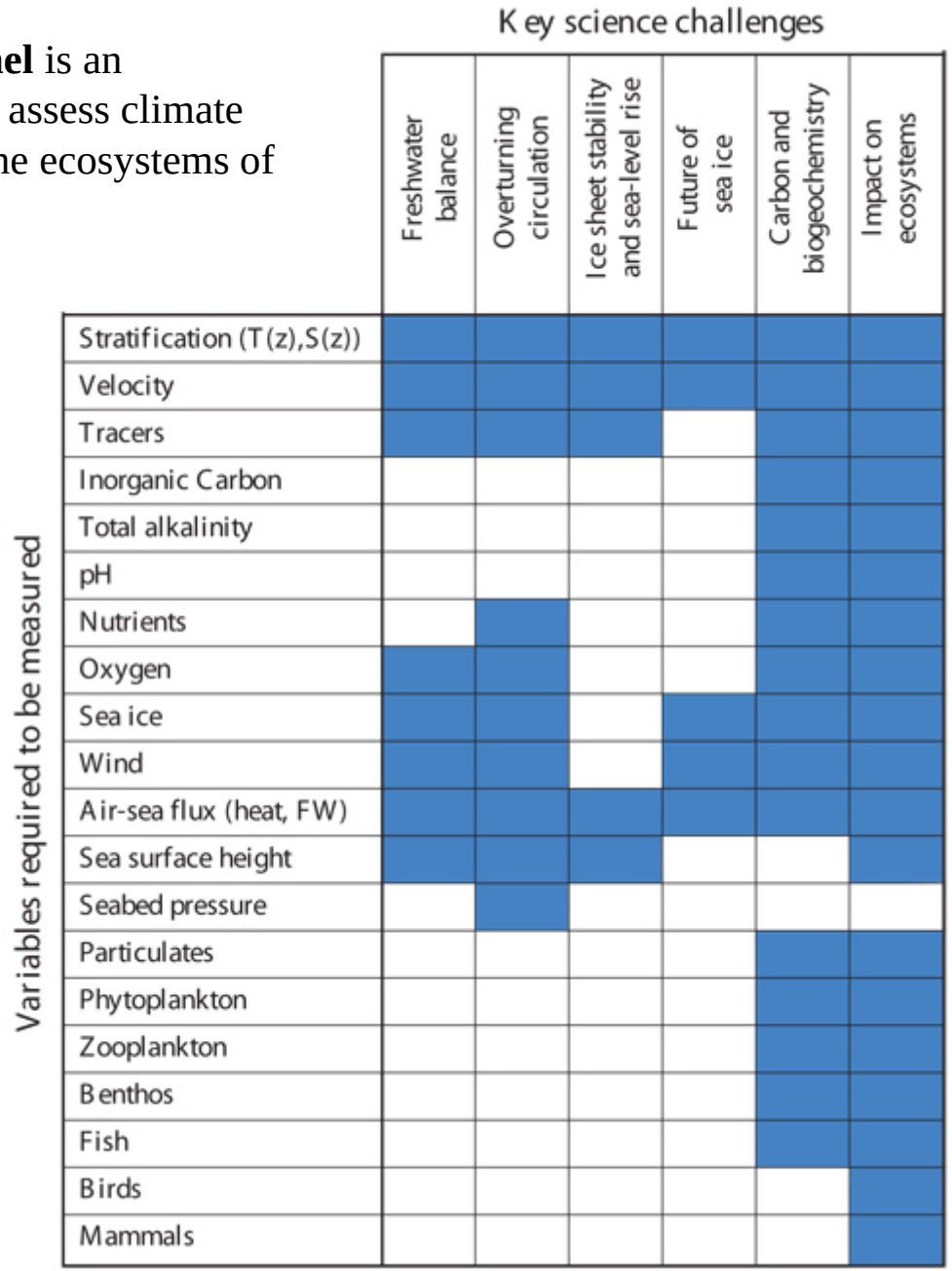
Representative Milestones



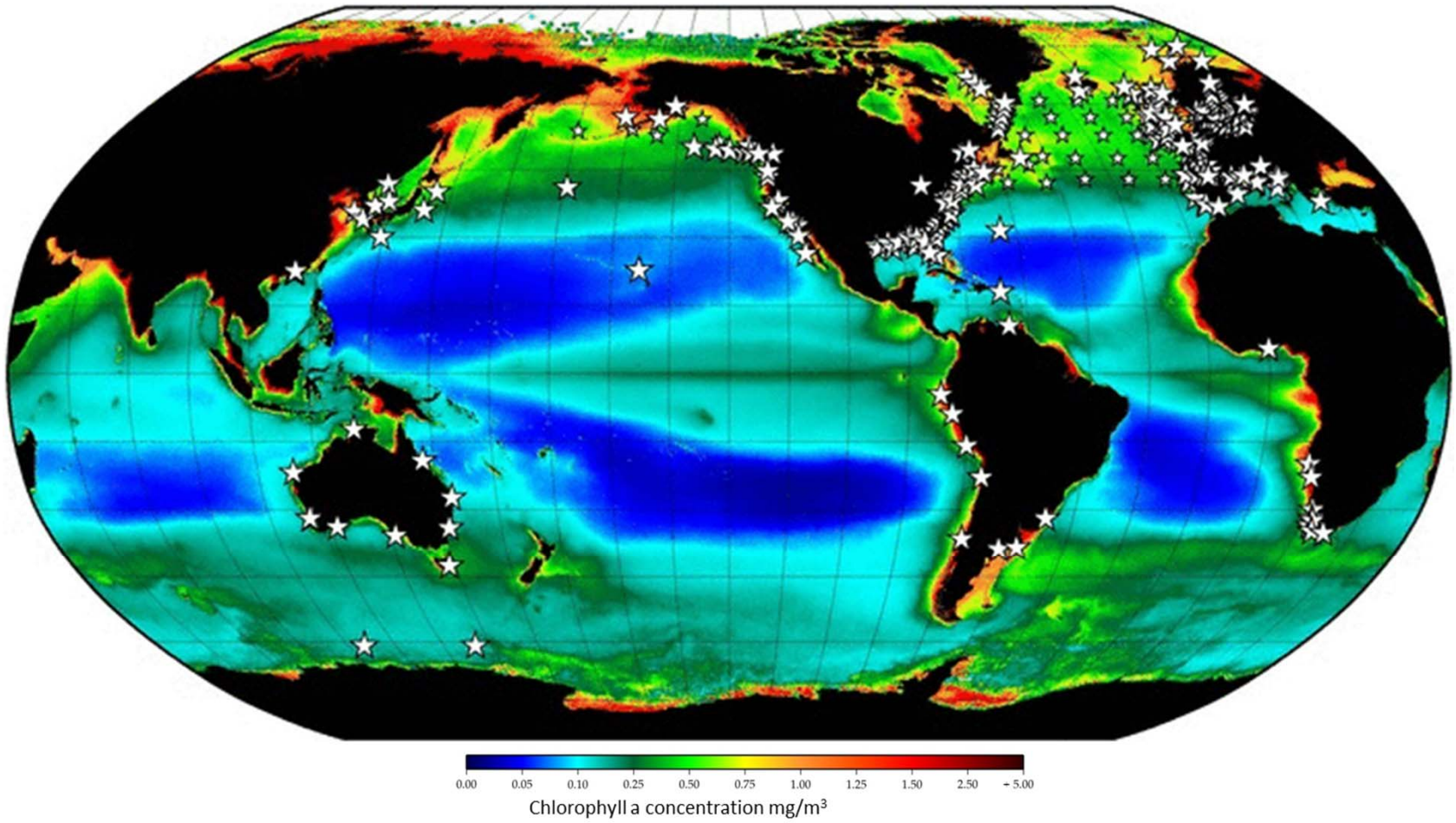
Original goal for full implementation by 2010

System % sustained, of initial goals

Southern Ocean Sentinel is an international program to assess climate change impacts on marine ecosystems of the Southern Ocean.



International Group for Marine Ecological Time Series



Coupling biogeochemical with physical systems (big challenge)

IGMETS

nternational Group for
Marine Ecological Time Series

Version: 2015-May-22

See legend below main map.

Active TIME WINDOW
5 year (1998-2012)

[◉ World | ○ Arctic | ○ **ATL-all** [○ N ○ S] | ○ Southern | ○ Indian | ○ **PAC-all** [○ N ○ S] | ○ N-America] [* RESET-Interface *]

Symbol Layer: ***Choose a variable below***
○ No Symbols (*turn off symbol layer*)

Hydrography	Tr	Ct	Cc	Ci
Temp	○	○	○	
PSal	○	○	○	
D-Oxy	○	○	○	
SST(R)	○			
PSAL (H)	○	○	○	
WIND(I)	○	○		

Chemistry / Carbon	Tr	Ct	Cc	Ci
N-NO3	○	○	○	
P-PO4	○	○	○	
Si-SiO4	○	○	○	
CHL(S)	○	○		
Chl-a	○	○	○	
Chl+PCI	○	○	○	

Biology	Tr	Ct	Cc	Ci
Copepods	◉	○	○	
ZooMass	○	○	○	
ZooCombo	○	○	○	
Diatoms	○	○	○	
Dinoflags	○	○	○	
DiaDinRatio				

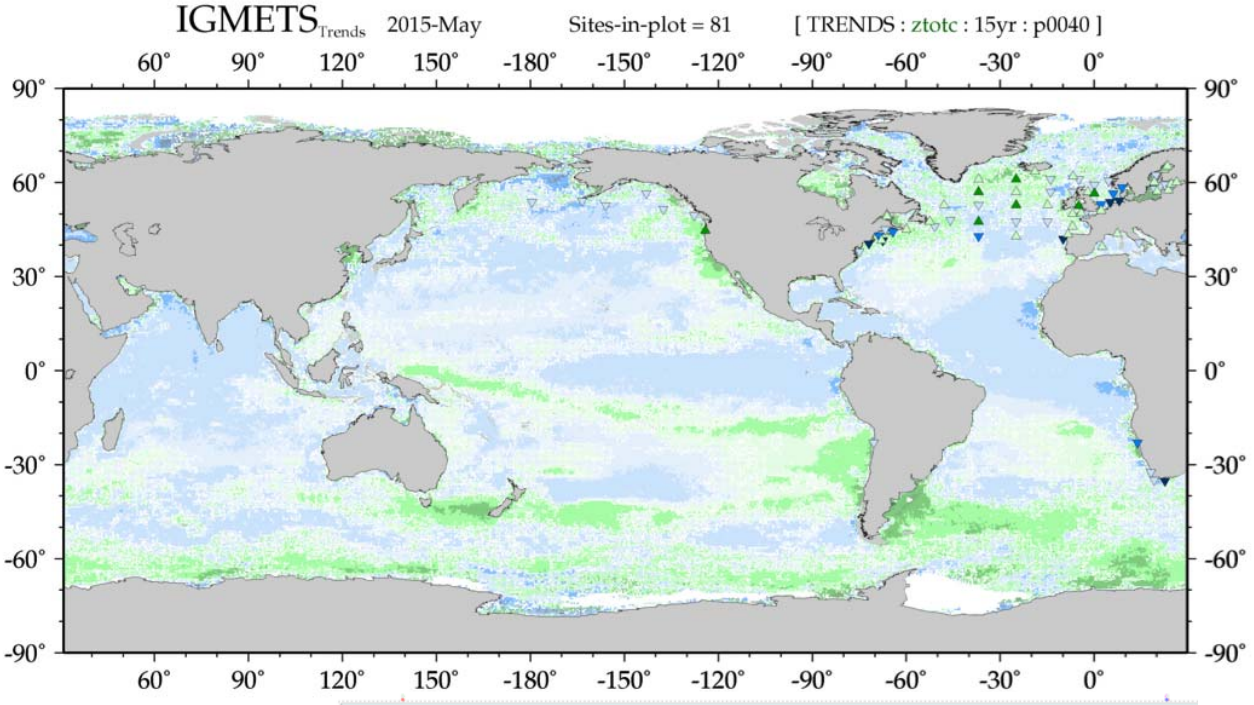
Time Windows & Salinity Ranges

TWin	Salinity
	Any/All
○ 05yr	00-40 ◉
○ 10yr	*Ranges*
◉ 15yr	26-39 ○
○ 20yr	01-26 ○
○ 25yr	00-01 ○
○ 25yr	

Background Fields
◉ Trends ○ SST-vs ○ CHL-vs

Temporal Trends	*	S	n
Var			
SST	○	○	○
CHL	◉	○	○
Rain	○	○	○
AirTemp	○	○	○

BackFade	
NONE	○
FADED	○
LITE	○
MED	◉
DARK	○
DARK!	○



SYMBOL LAYER:
15 year (1998-2012) temporal-trends in Total Copepods.

NEG (p<0.01) NEG (p<0.05) NEG (non-sig) POS (non-sig) POS (p<0.05) POS (p<0.01)

Trends over Time (biologically-related variables)

BACKGROUND FIELDS:
15 year (1998-2012) rates of change in Chlorophyll (mg/m3/yr). SeaWiFS/MODIS-A

< 0.05/yr | < 0.01/yr | < 0.001/yr | < 0.00/yr | > 0.00/yr | > 0.001/yr | > 0.01/yr | > 0.05/yr

Principles

I. No substitute exists for adequate observations

II. Observations which are not made today, are lost forever!

III. Existing observations are useless if are not made accessible.

IV. Collective value of data sets is greater than its dispersed value.

V. Models will evolve and improve, but, without data, will be untestable.

VI. Today's climate models will likely prove of little interest in 100 years. But adequately sampled, carefully quality controlled and archived data for key elements of the climate system will be useful indefinitely.

Valid for ship-based and remote observations!

Challenges:

Ensure that all the necessary measurements are being made to do the science we want.

Ensure that there are no gaps or unnecessary duplications in the system.

Ensure integration of existing structures and networks

Ensure that data from each system are compatible with the others.

Favour scientific experiments through international collaboration.

Ensure funding sources for a sustainable operational system

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