The Southern Ocean Observing System

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SOOS
SOUTHERN OCEAN OBSERVING SYSTEM

International Council for Science
SCOR
Scientific Committee on Oceanic Research

THE INTERNATIONAL COUNCIL FOR SCIENCE
SCAR
SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

3 key points:-

- The Southern Ocean is globally important, and is changing
- Understanding these changes and their impacts is critically limited by lack of data
- We can, must, and will do better, and this requires strategic planning and prioritization of observations

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Point 1: The Southern Ocean is globally important, and is changing

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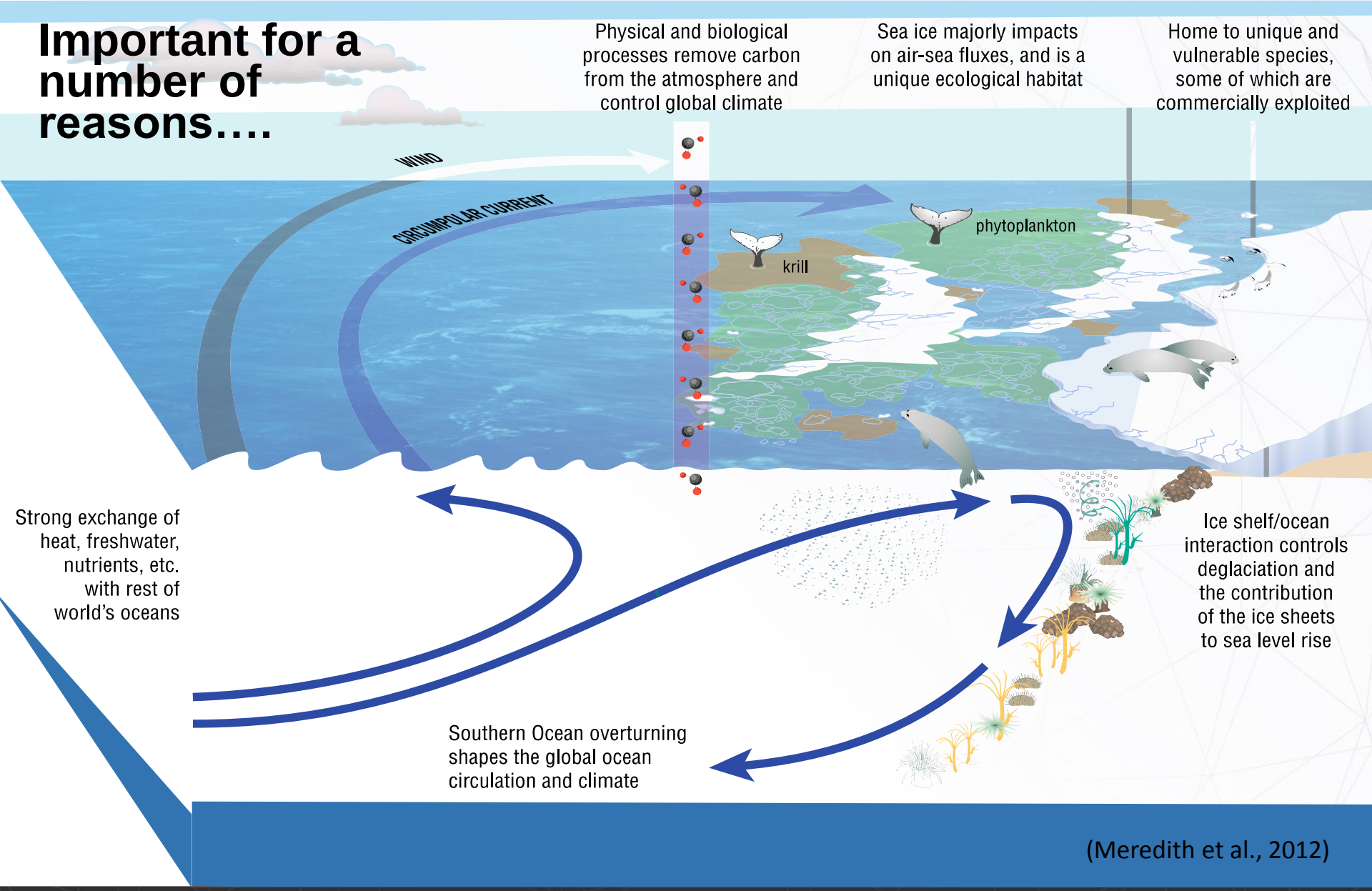
Important for a number of reasons….



(Meredith et al., 2012)

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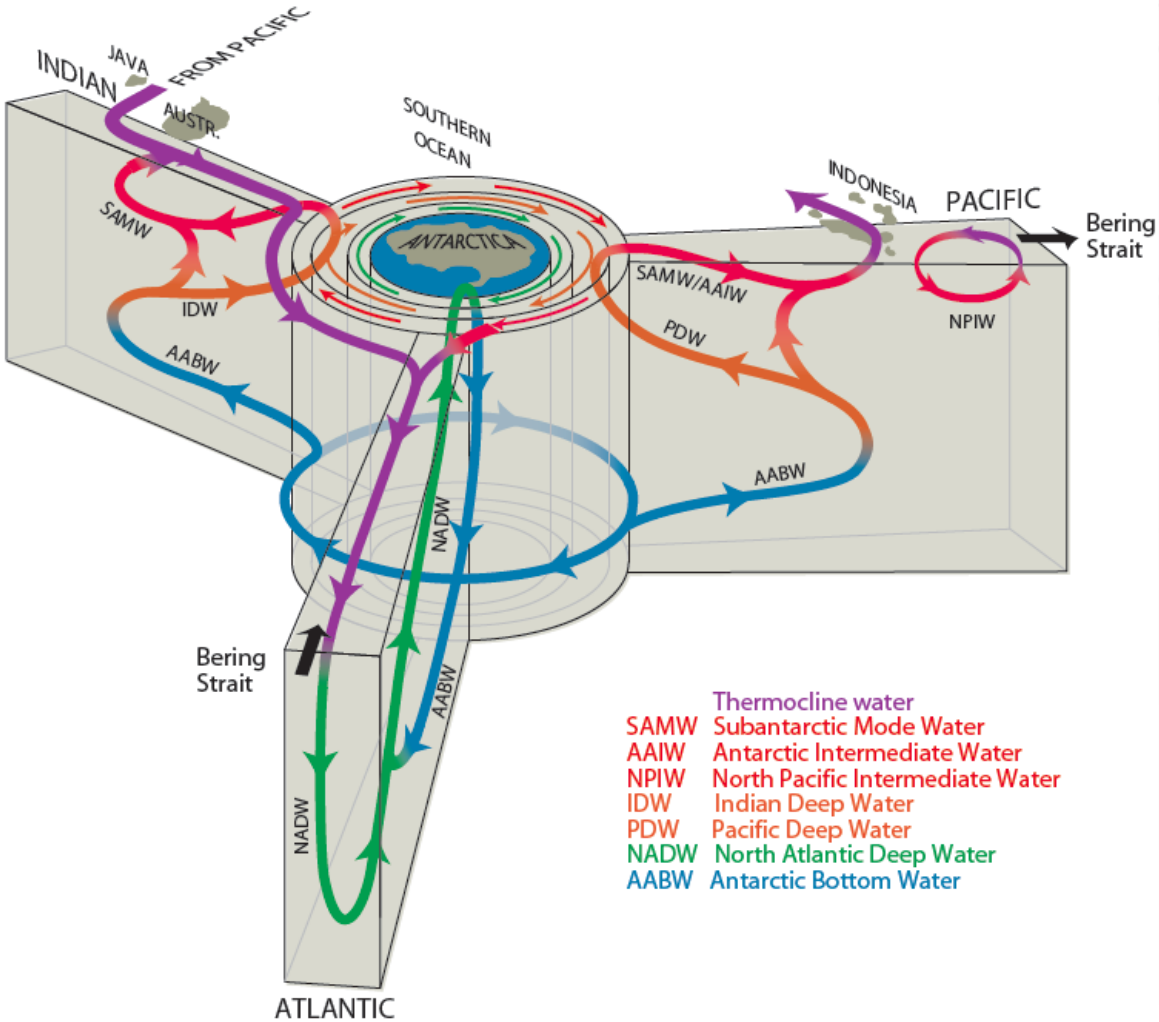
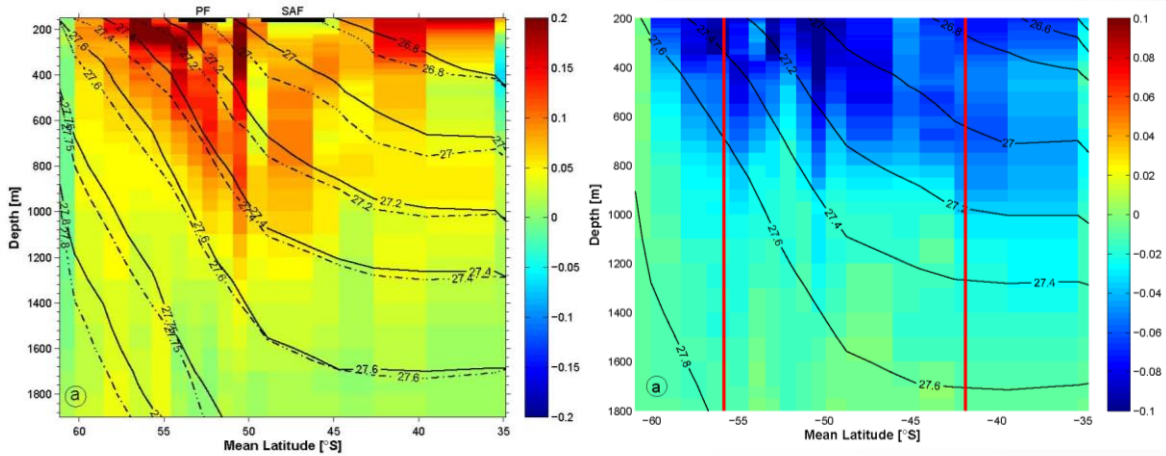
The central connector of the worlds major ocean basins



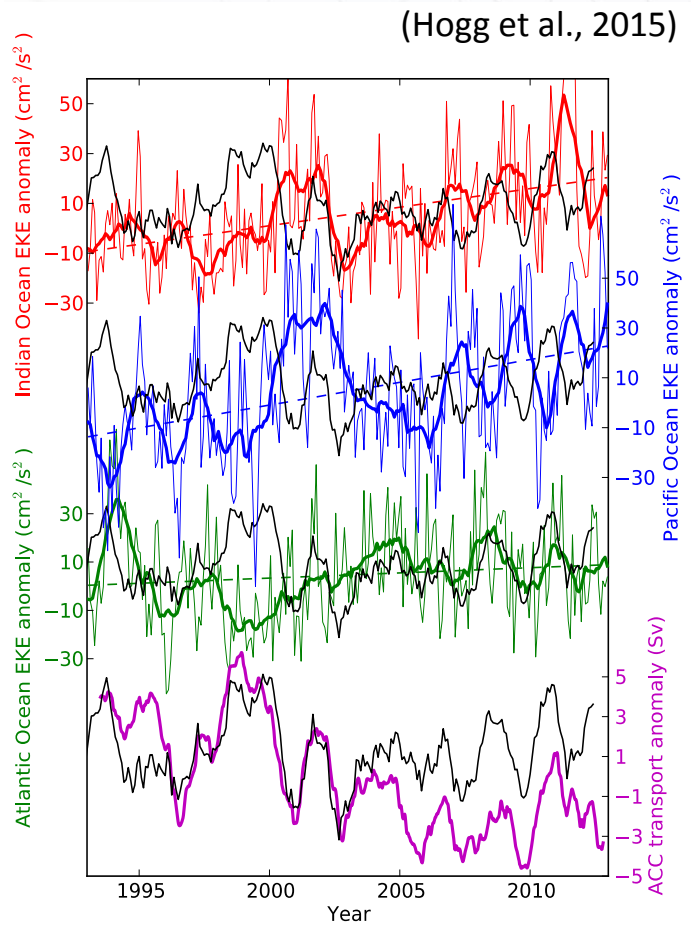
Plays a major role in driving global ocean circulation because it's a site of deep ocean water mass formation

A driving force in global movement of heat, freshwater and nutrients

Some aspects are changing dramatically; others more subtle



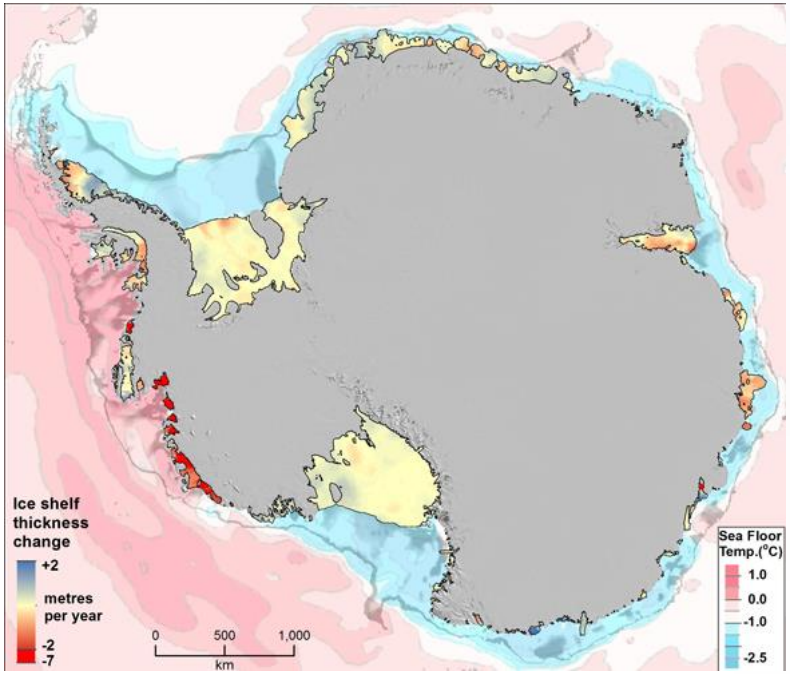
(Boning et al., 2008)



Rate of warming exceeds that of the global ocean as a whole, for reasons not fully determined.

Freshening is consistent(ish) with an accelerating hydrological cycle.

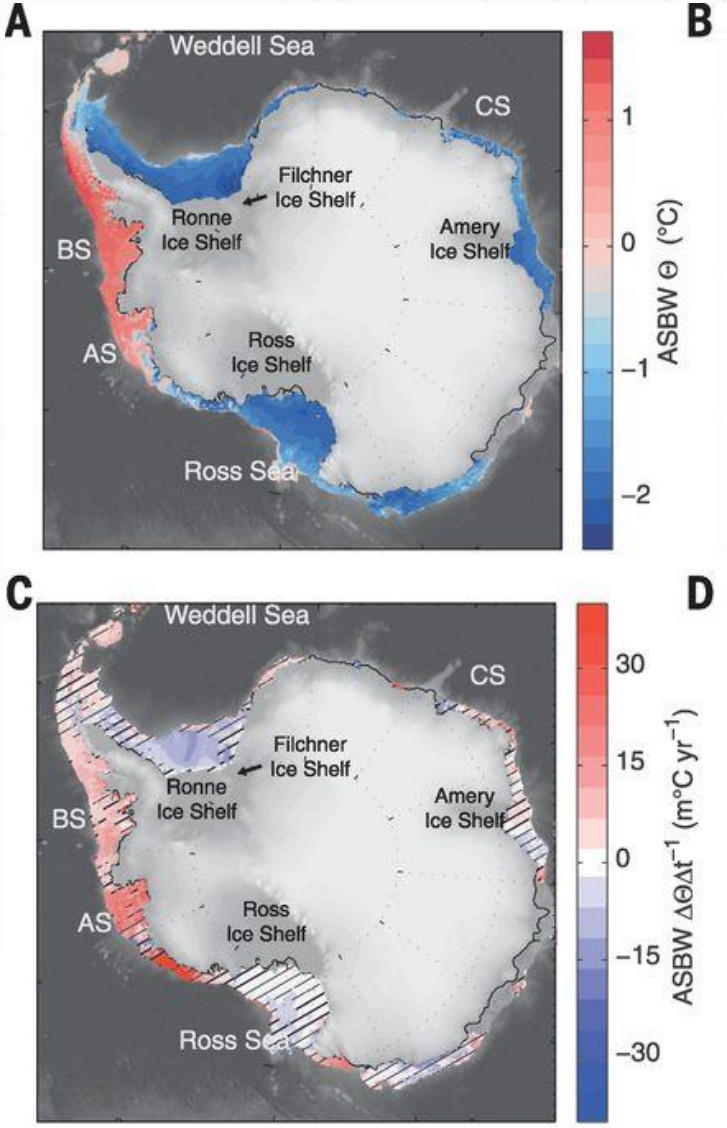
ACC transport changing rather little; eddy intensity changing more…



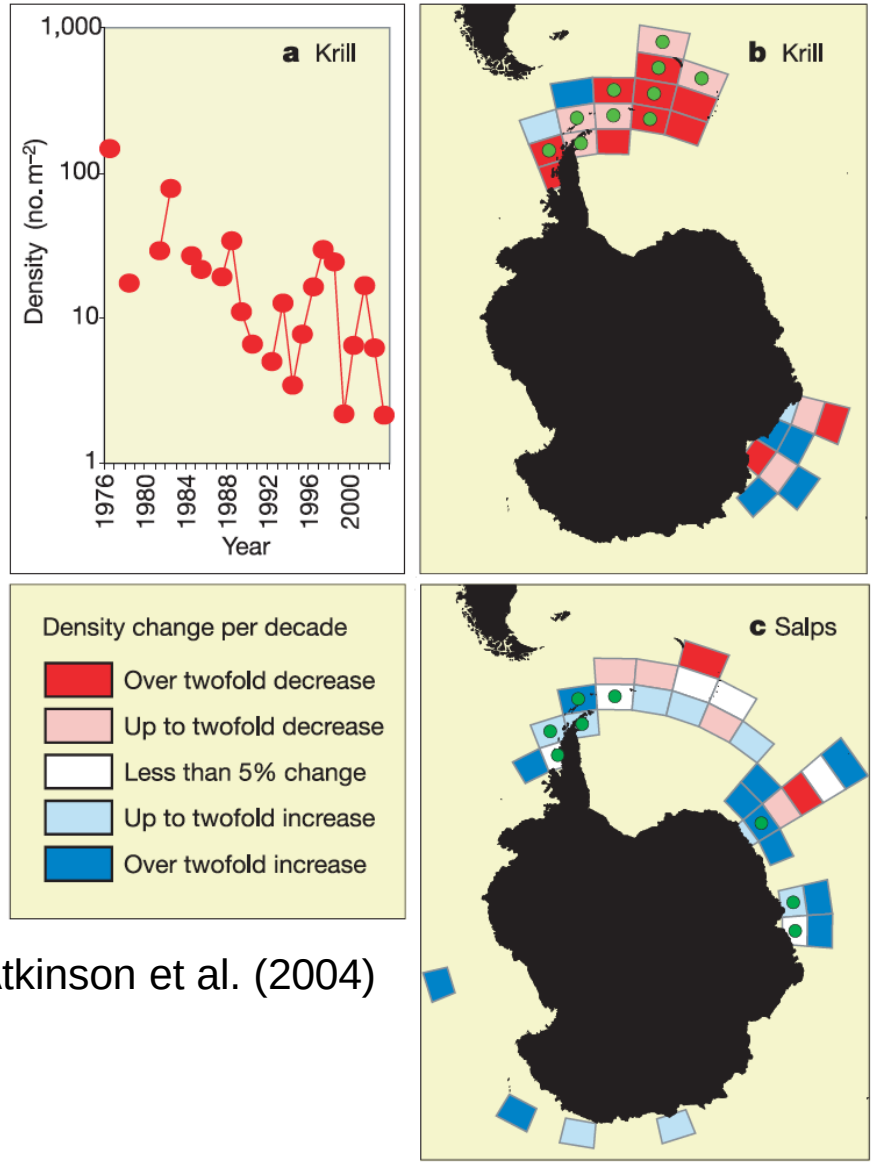
Pritchard et al. (2012)

Warmer ocean appears to be increasing melt in parts of the fringes of Antarctica.

Strong implications for ice sheet stability and hence **sea level rise**.

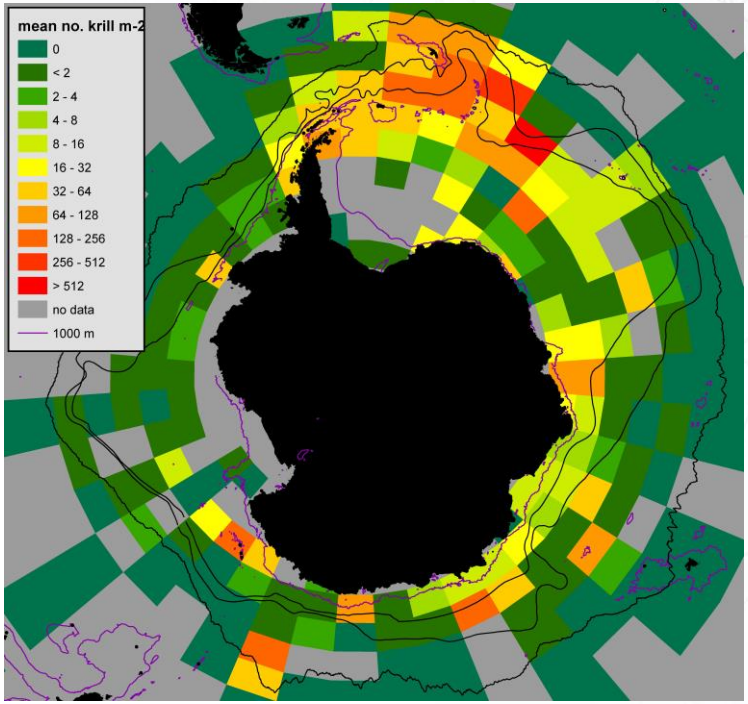


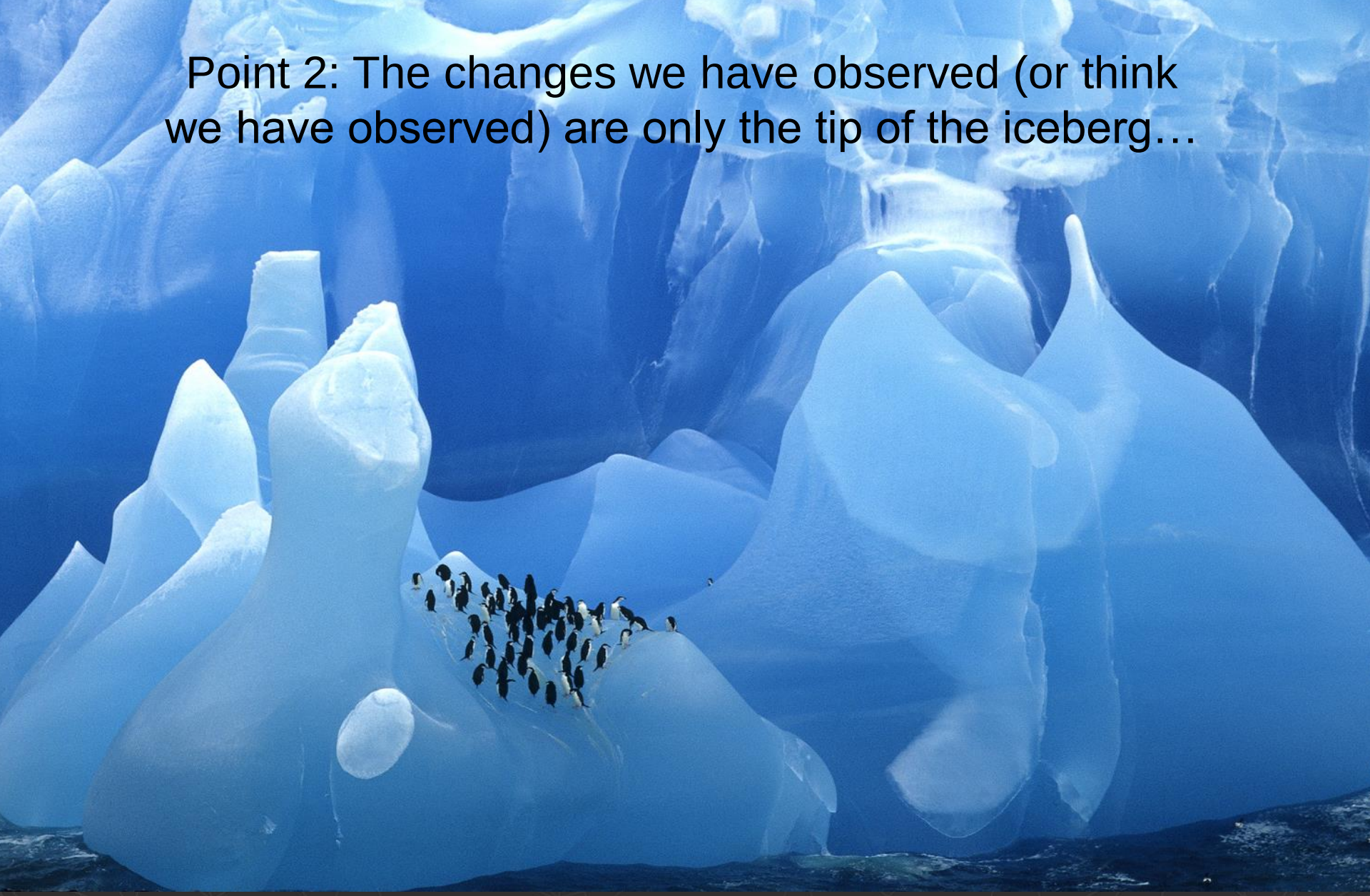
Schmidtko et al. (2014)



Atkinson et al. (2004)

Declines seen in krill and a concurrent increase in salps …





Point 2: The changes we have observed (or think we have observed) are only the tip of the iceberg…

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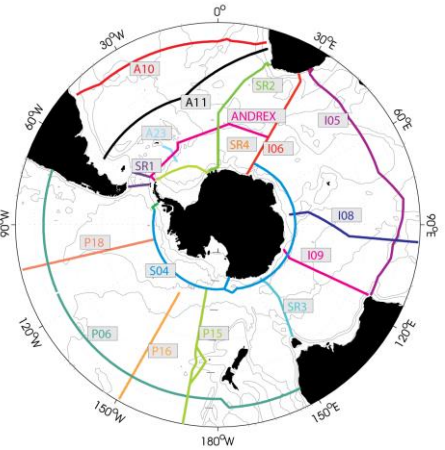
… the reason being that the Southern Ocean has been, and continues to be, one of the world's biggest data deserts…

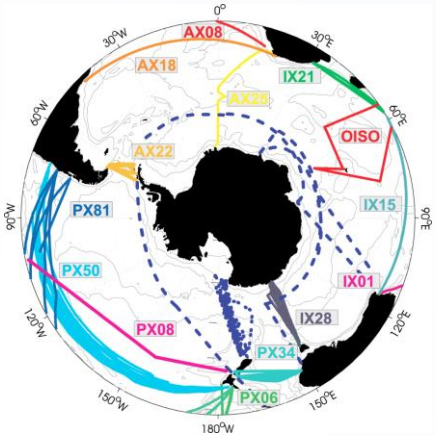
Each of the changes outlined has been identified using (in large part) data from one of a very small number of sources:-

- **Ship-based measurements (and very few ships ply the Southern Ocean, esp. in winter)**
- **Shore-based measurements (and Antarctica is the least-inhabited continent)**
- **Instruments deployed from ships, such as floats, moorings etc (invaluable, but sparse and easily lost in hostile conditions)**
- **Satellites (invaluable data, but can't do everything)**

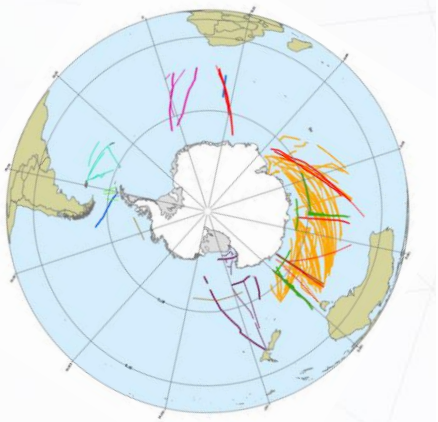
Existing observing system elements



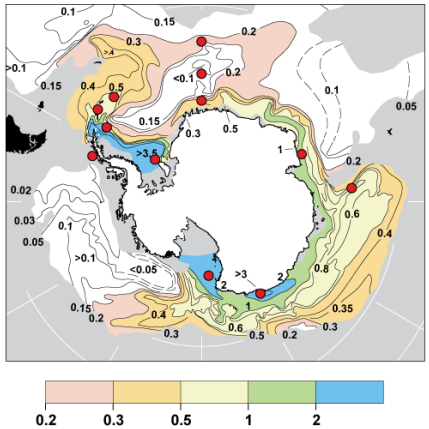
GO-SHIP



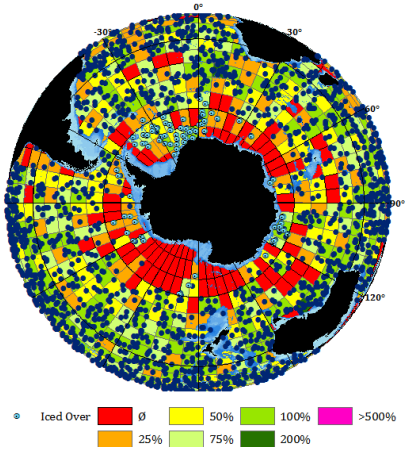
SOOP



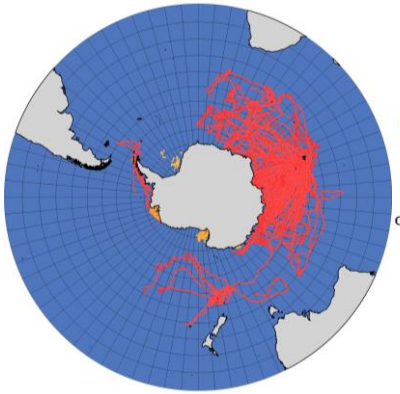
CPR



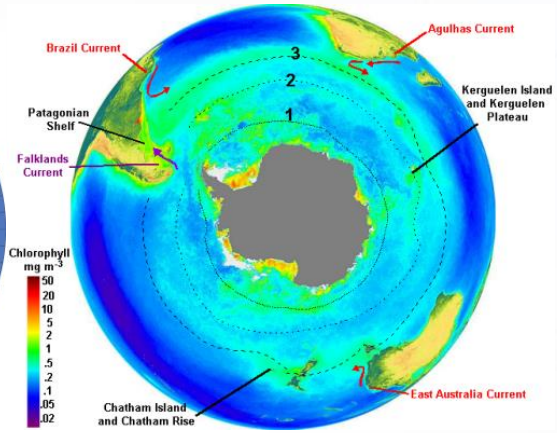
Moorings



Argo



Instrumented seals



Satellites

Etc

Etc

Etc…

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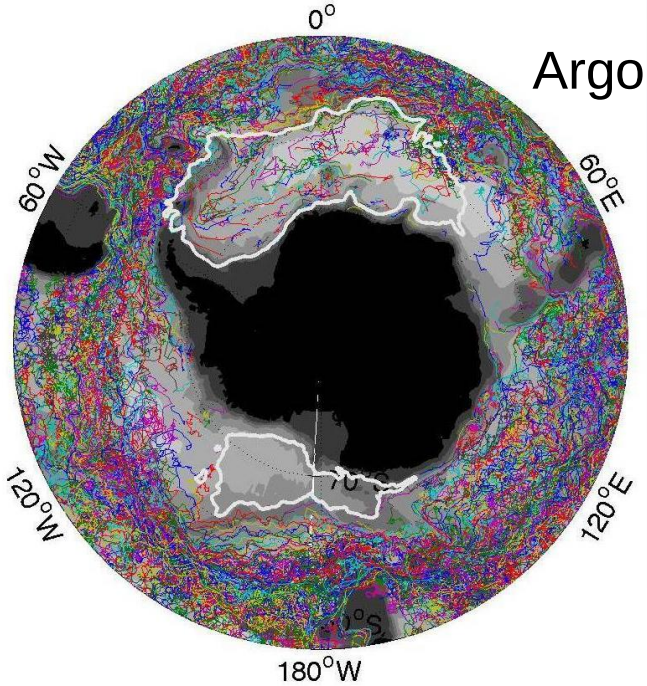
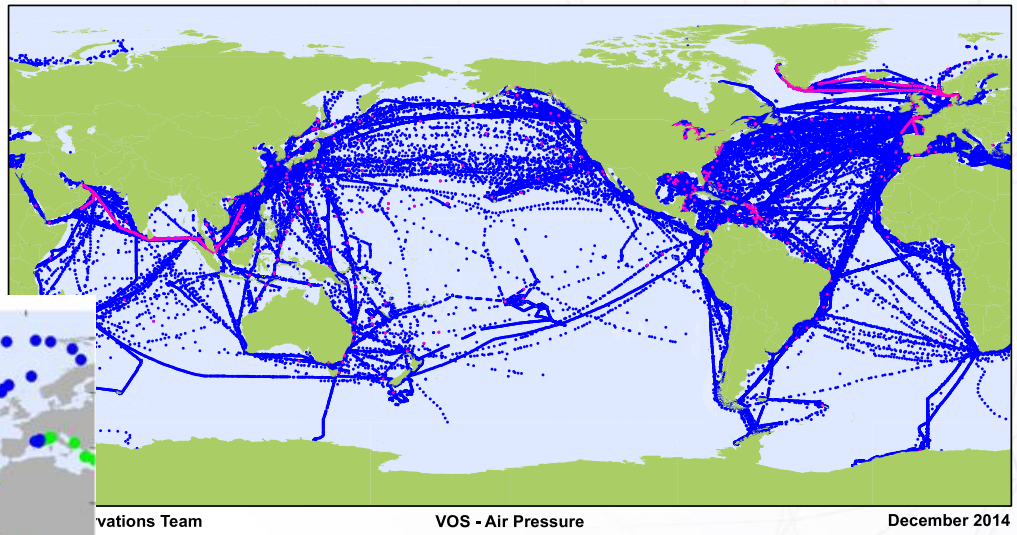


Argo

As indicators, coverage of profiling floats drops off dramatically when the sea ice zone is reached…

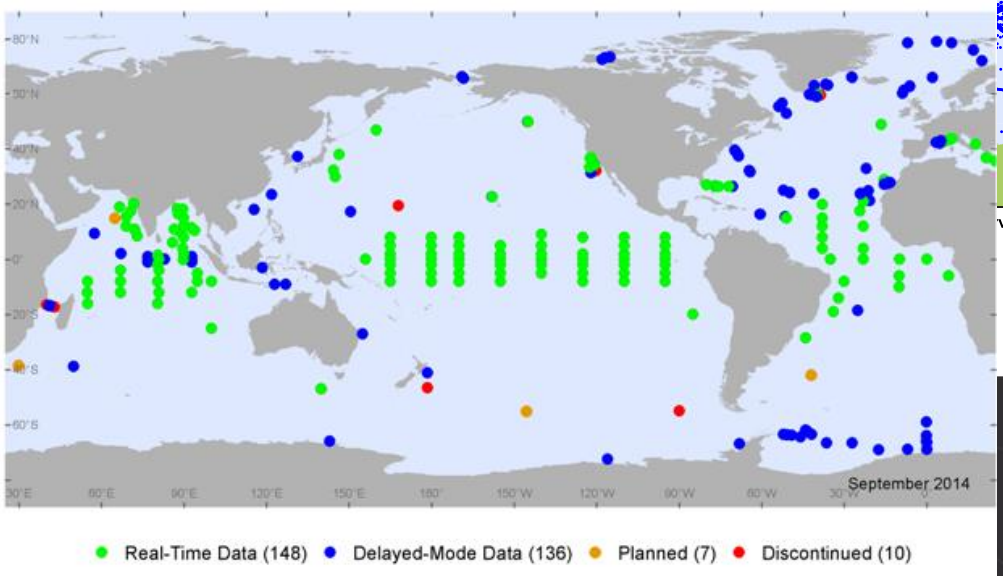
Sustained moorings coverage is poor (except Weddell Sea).

VOS lines are very sparse.



VOS

OceanSITES



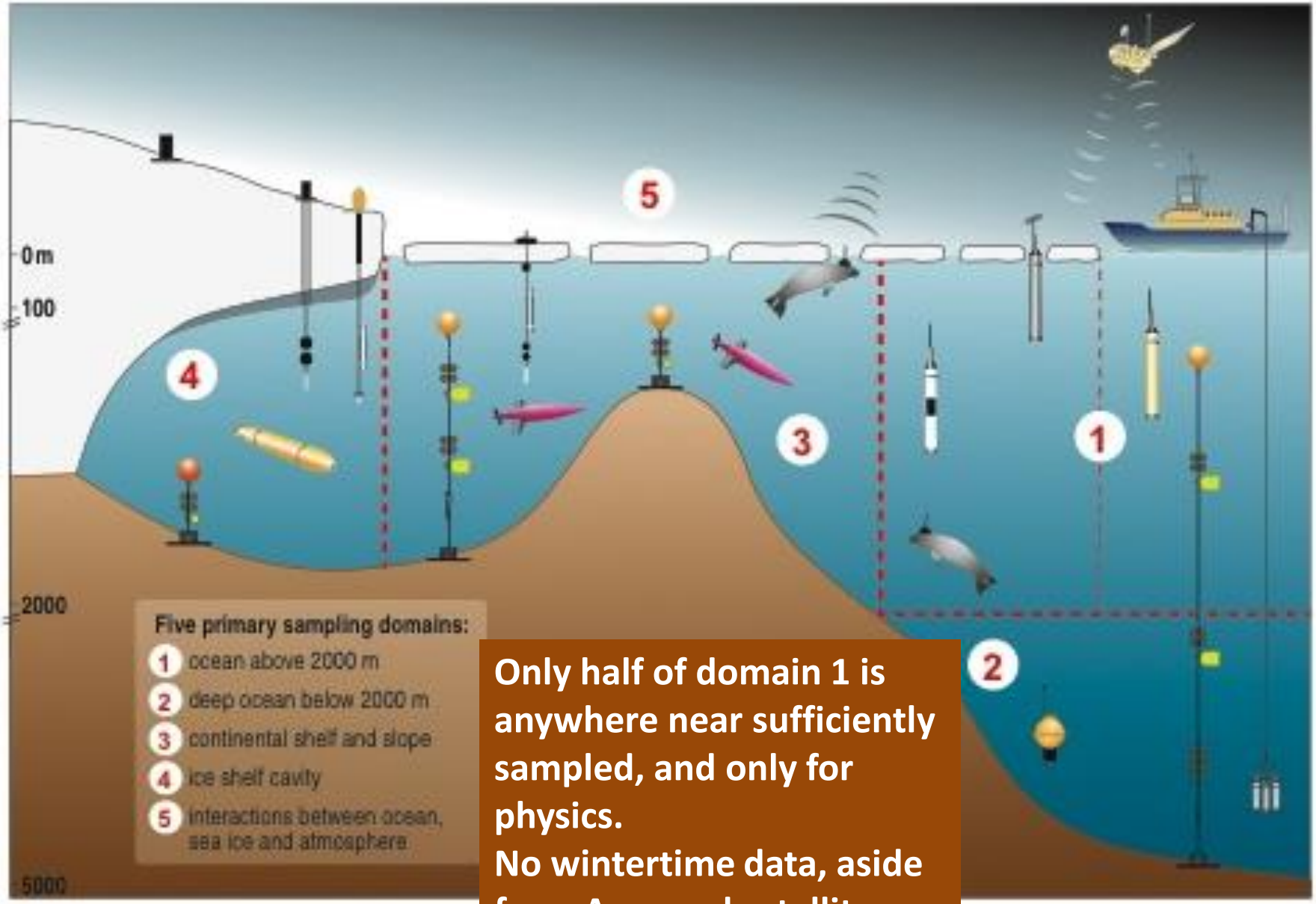
A sobering example: the annual BAMS “State of the Climate” report now includes a Southern Ocean section for the first time…

What could be assessed for 2014?

- Surface temperature, circulation, sea ice, etc (from satellites)
- Upper-ocean heat content, MLD, some water mass changes (from Argo)
- Bits about the shelf regions, though very regionally dependent
- Bits about carbon, from underway sampling primarily

What could not be assessed?

- Deep ocean water masses, aside from bits of repeat hydrography
- Biogeochemistry across very large areas
- Under the sea ice, aside from bits in the Weddell etc
- Under the ice shelves
- Biological variables, aside from some specific sites
- etc



Only half of domain 1 is anywhere near sufficiently sampled, and only for physics.
No wintertime data, aside from Argo and satellites.
Long time series virtually non existent

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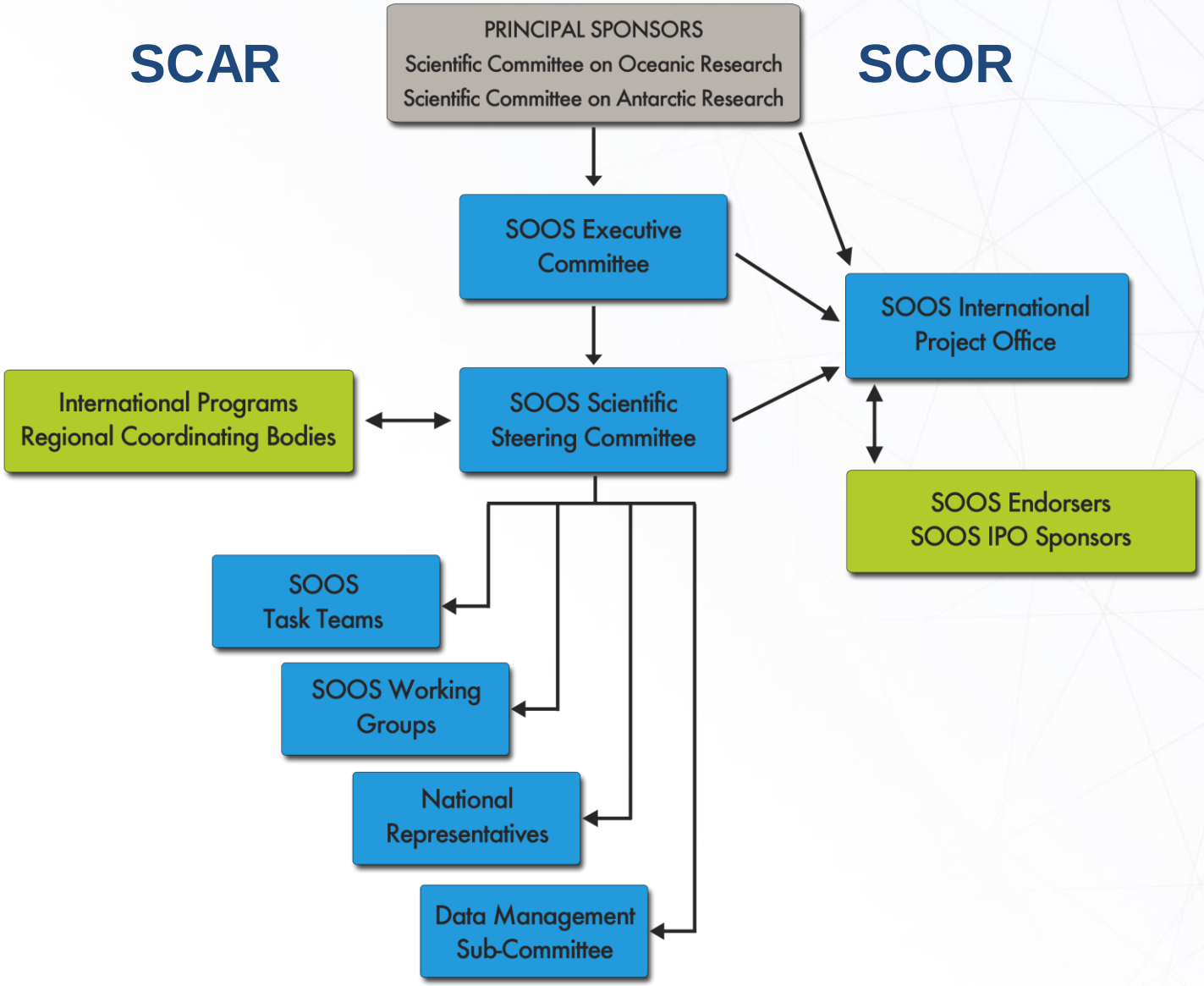
The international scientific community recognised this need, and worked together to develop SOOS

SOUTHERN OCEAN OBSERVING SYSTEM

ne Southern Ocean Observing System facilitates, internationally, the llection and delivery of essential observations on variability and change of outhern Ocean systems to all stakeholders (researchers, governments, dustries), through design, advocacy, and implementation of cost-effective bserving and data delivery systems.

B. Wallis AAD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Scientific Committee on Oceanic Research
Scientific Committee on Antarctic Research
SCOR
SOOS Executive Committee
SOOS International Project Office
International Programs Regional Coordinating Bodies
SOOS Scientific Steering Committee
SOOS Endorsers
SOOS IPO Sponsors
SOOS Task Teams
SOOS Working Groups
National Representatives
Data Management Sub-Committee

SOOS

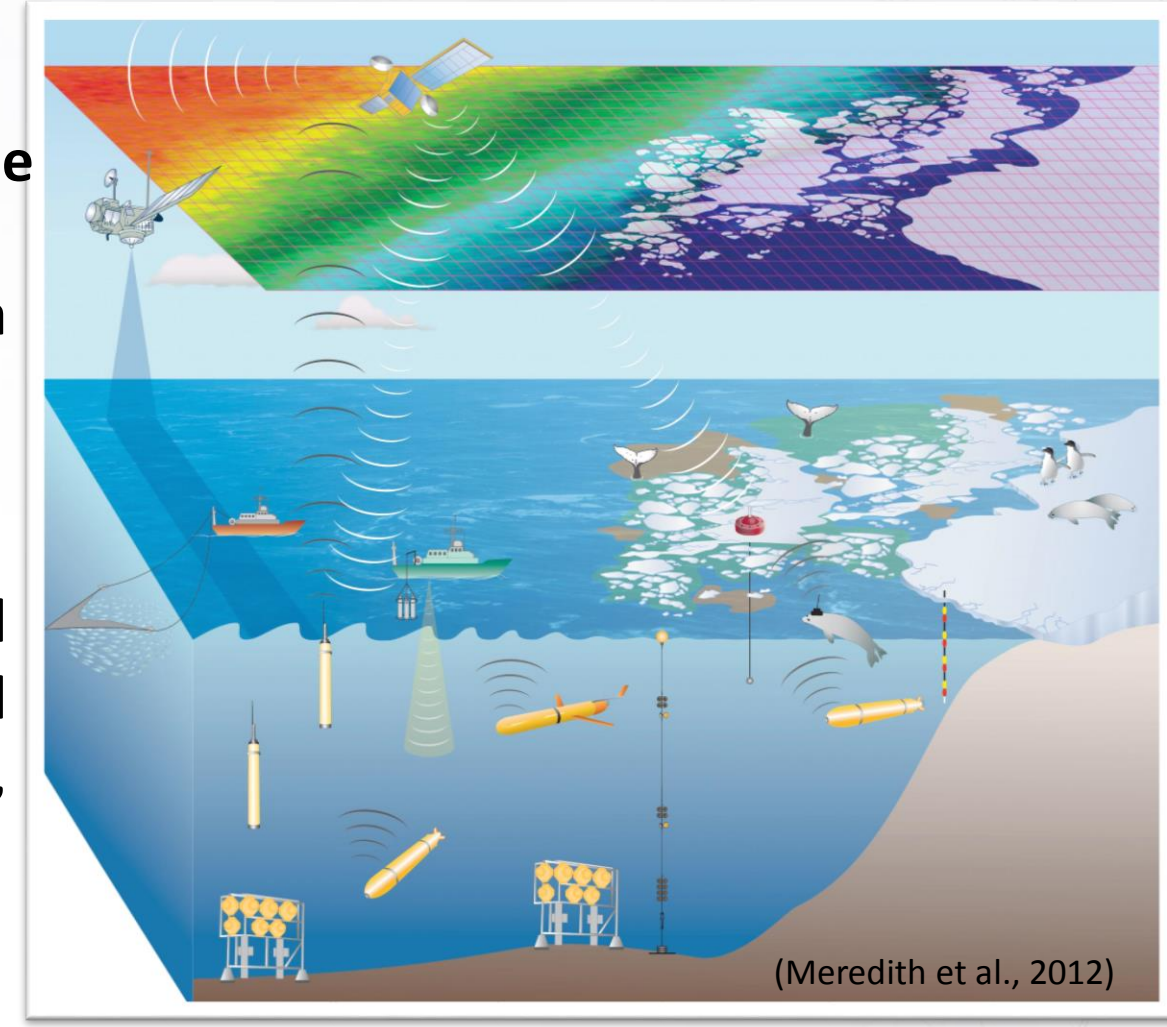
SOOS Objectives (6 objectives)

1) **Facilitate the design and implementation of a comprehensive and multi-disciplinary observing system for the Southern Ocean**

Long-term vision (20 years?):

The concept is to develop a cyberinfrastructure-based system, whereby a backbone of autonomous platforms relay multi-disciplinary data via satellite for real-time assimilation into models.

These models can then feed back to platform design and missions, e.g. moving them, prioritizing other measurements, changing sampling rates, depths etc..



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Identify Essential Observation Variables (EOVs)

Many international efforts to define EOVs for various marine and terrestrial systems. SOOS is working with the Southern Ocean community to identify EOVs for the Southern Ocean…to *design the observing system*

SOOS has developed a list of *candidate* variables across all disciplines. The next step is to then prioritise these by asking which ones are *essential* (done through activities like Observing System Simulation Experiments (OSSE)).

- Physical Oceanographic EOVs accepted by the community (e.g., temp, salinity, O2, velocity, microstructure, tracers, bottom topography, sea-surface height, seabed pressure, wind)
- Sea-ice EOVs accepted by the community
- Biogeochemical variables are being defined globally and will be tailored to Southern Ocean specific requirements (e.g., Iron needs to be included)
- Biological EOVs, key milestone for SOOS has been a community agreed process for identifying what a biological EOV is, and a list of candidates.

SOOS Objectives

1) Facilitate the design and implementation of a comprehensive and multi-disciplinary observing system for the Southern Ocean

2) Advocate and guide the development of new observation technologies

The number of these is not likely to increase significantly in the foreseeable future, if ever.

The number of these is rising rapidly, and is set to continue…

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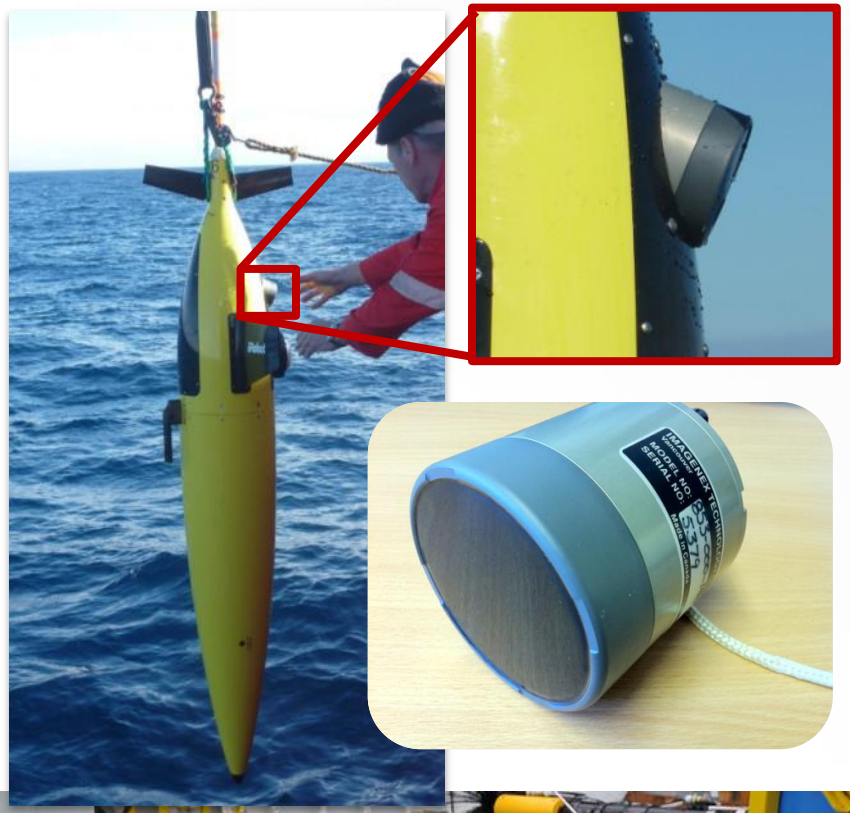
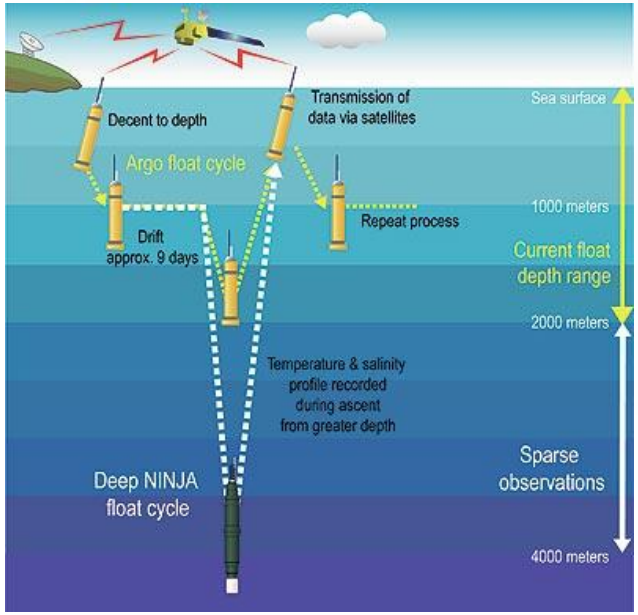


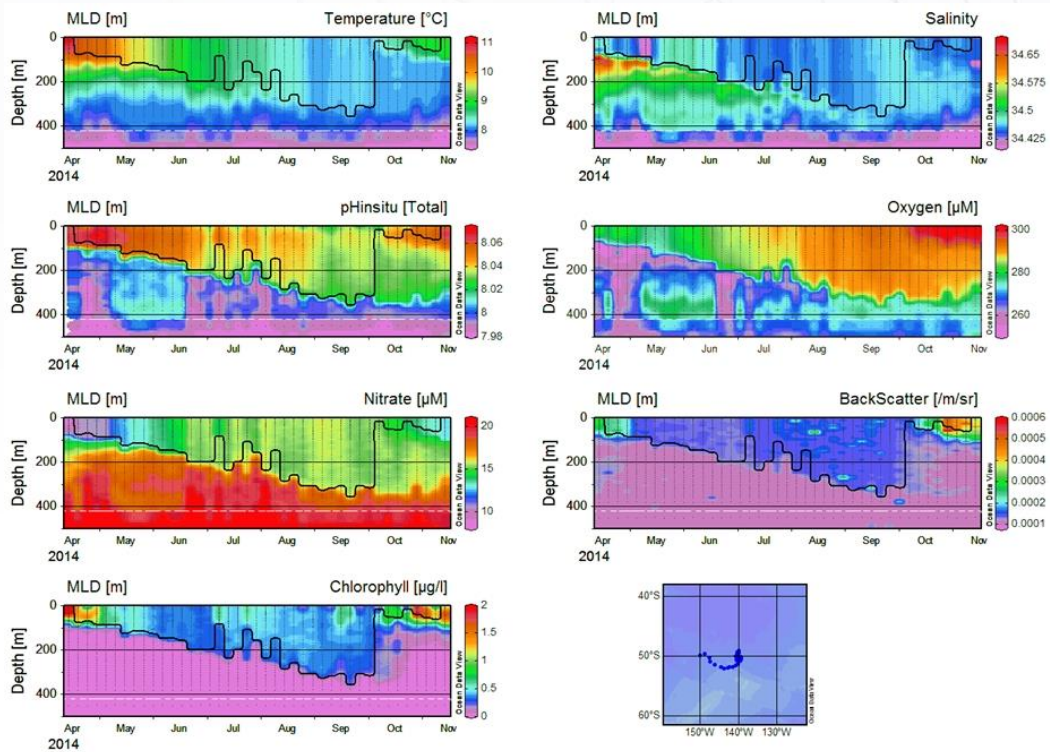
Autonomous vehicles give greater spatial coverage than ships, plus control concerning where the data is collected.

Can carry any number of exotic sensors.

Enhancements to “conventional” Argo …



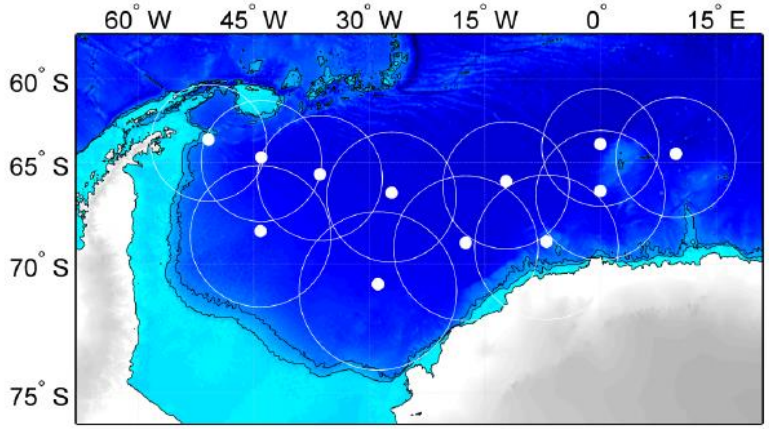
e.g. deep Argo …

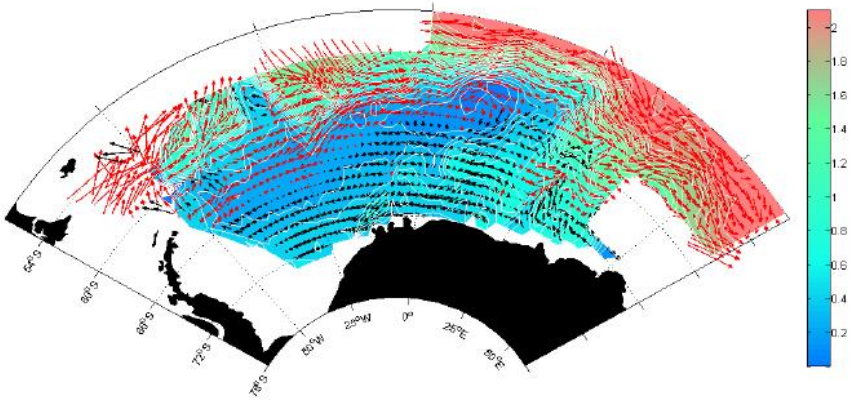


e.g. biogeochemical sensors on large float arrays (courtesy Ken Johnson)

SOCCOM

SOOS

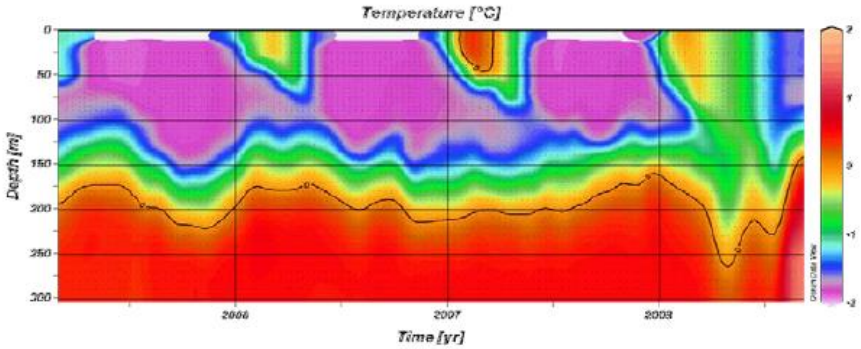




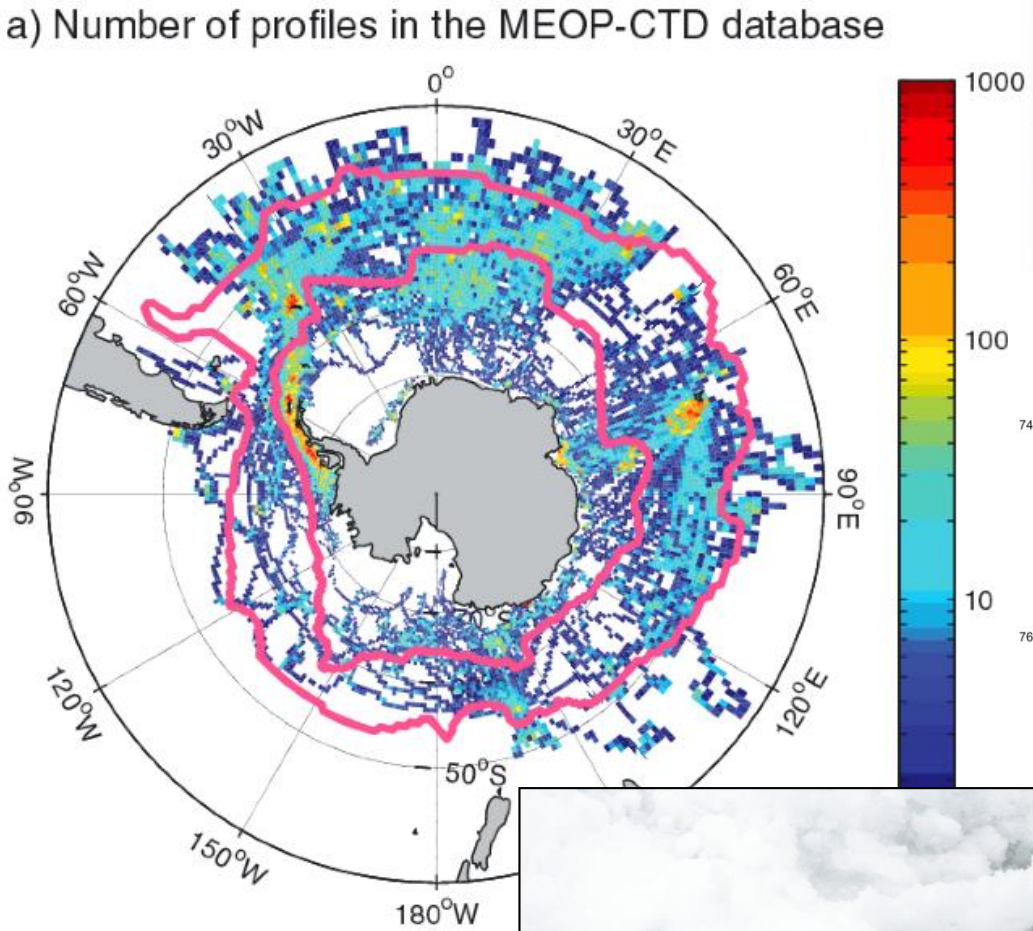
Sound source arrays for tracking of floats beneath sea ice …

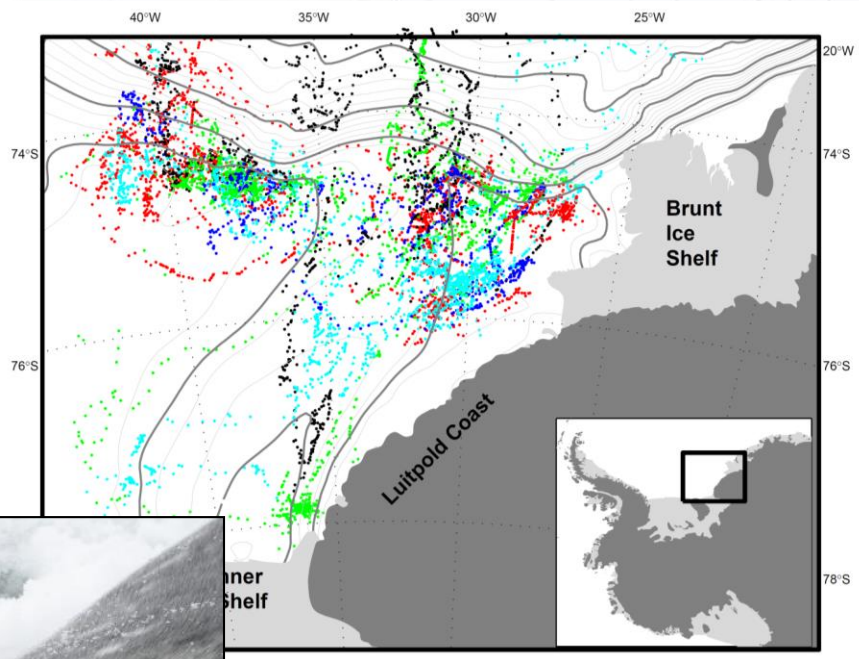
Technology is proven (Alfred-Wegener-Institute array in Weddell Sea), but needs to be sustained, and needs rolling out in other ice-covered regions …

Need to expand network capability to include under-ice gliders



Needs to be sustained systematically (c.f. UK example!)





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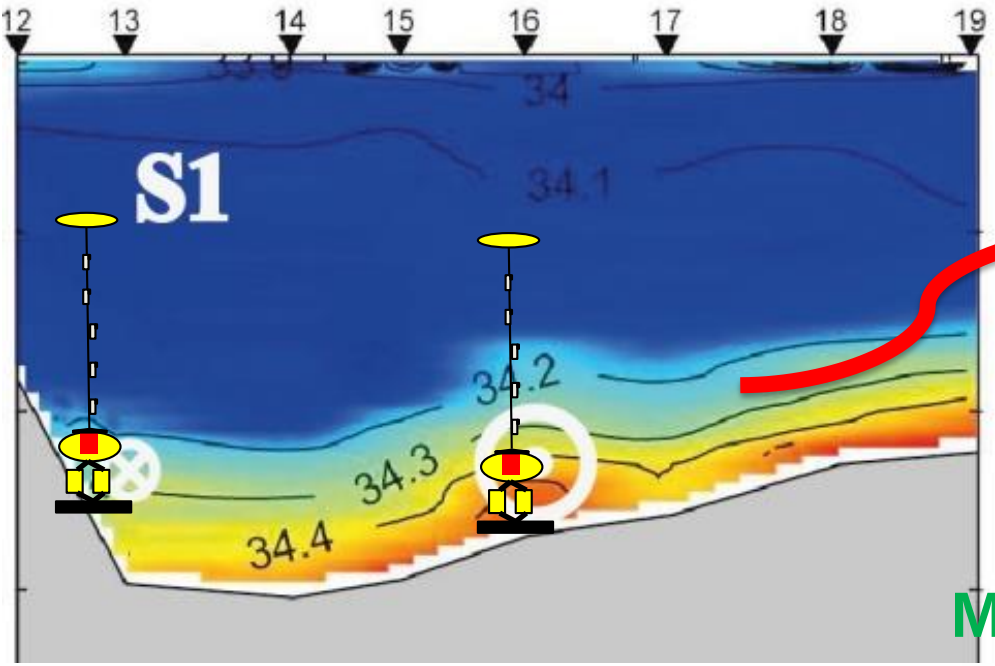
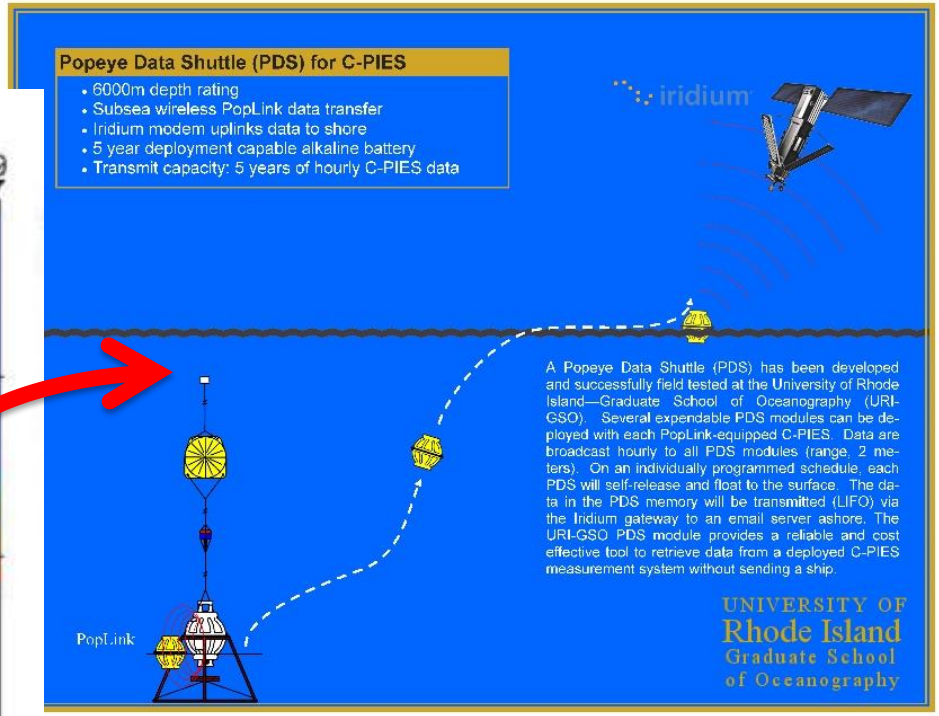
Necklace: UK invention of a ground-based downward-looking radar that measures ice shelf thickness to millimetre precision.
Very timely technology
Very cheap and easily deployed

SOOS is helping to coordinate the uptake of this technology by nations working on or near ice shelves to encourage circumpolar network of ice shelf melt observations over the next 5 years.

Bottom landers





Measures many parameters
Expensive
Requires icebreakers
Requires planning horizons

Measures only essential (e.g. bottom T)
Cheap
Ship-of-opportunity
Sea ice proof, data via satellite
Task Team being formed...
J. Kuttenkeuler, KTH
R. Watts, URI

SOOS Objectives

1) Facilitate the design and implementation of a comprehensive and multi-disciplinary observing system for the Southern Ocean

2) Advocate and guide the development of new observation technologies

3) Compile and encourage use of existing international standards and methodologies, and facilitate the development of new standards where required

SOOS is working with the community to compile international standards and methodologies and is advocating for their use by all nations

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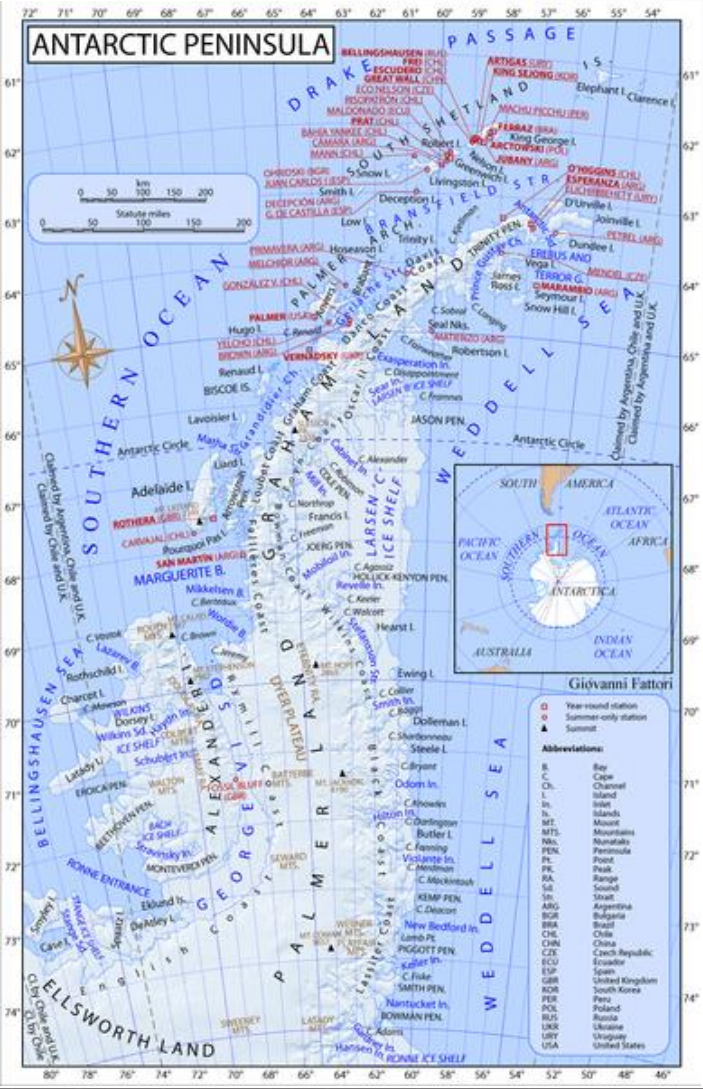
4) Unify and enhance current observation efforts and leverage further resources across disciplines, and between nations and programmes

Regional Working Groups to foster collaboration and data sharing (June 2015)

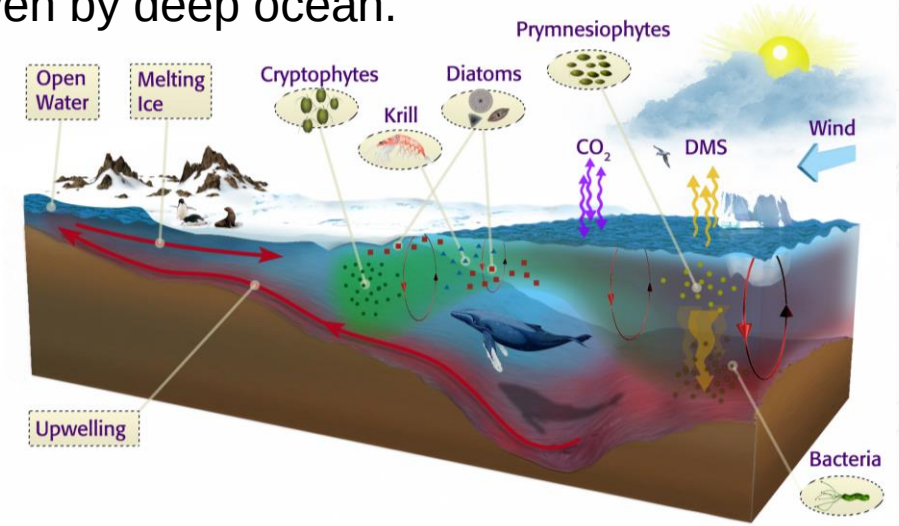
Online tools to facilitate collaboration e.g., Webcam of Field Programs

Antarctic Peninsula



- Significant levels of infrastructure present
- Many nations already work in region, therefore many international efforts that can be pulled together

Area of rapid change from physics to ecosystems driven by deep ocean.



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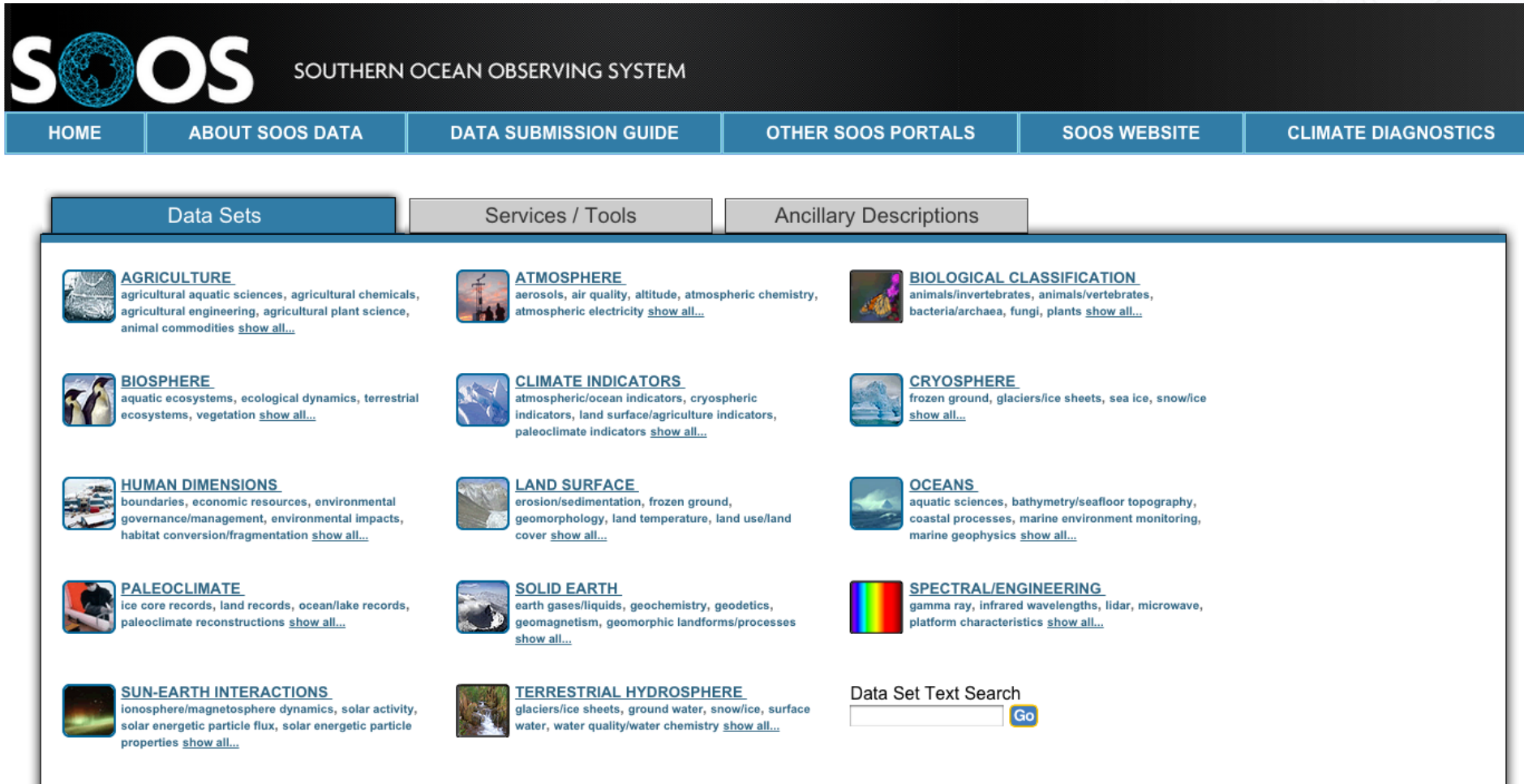
5) Facilitate linking of sustained long-term observations to provide a system of **enhanced data discovery and delivery, utilising data centres and programmatic efforts combined with, as needed, purpose-built data management and storage systems**

Facilitate linking of sustained long-term observations to provide a system of enhanced data discovery and delivery, utilising data centres and programmatic efforts combined with, as needed, purpose-built data management and storage systems

Step 1 – Data Discovery

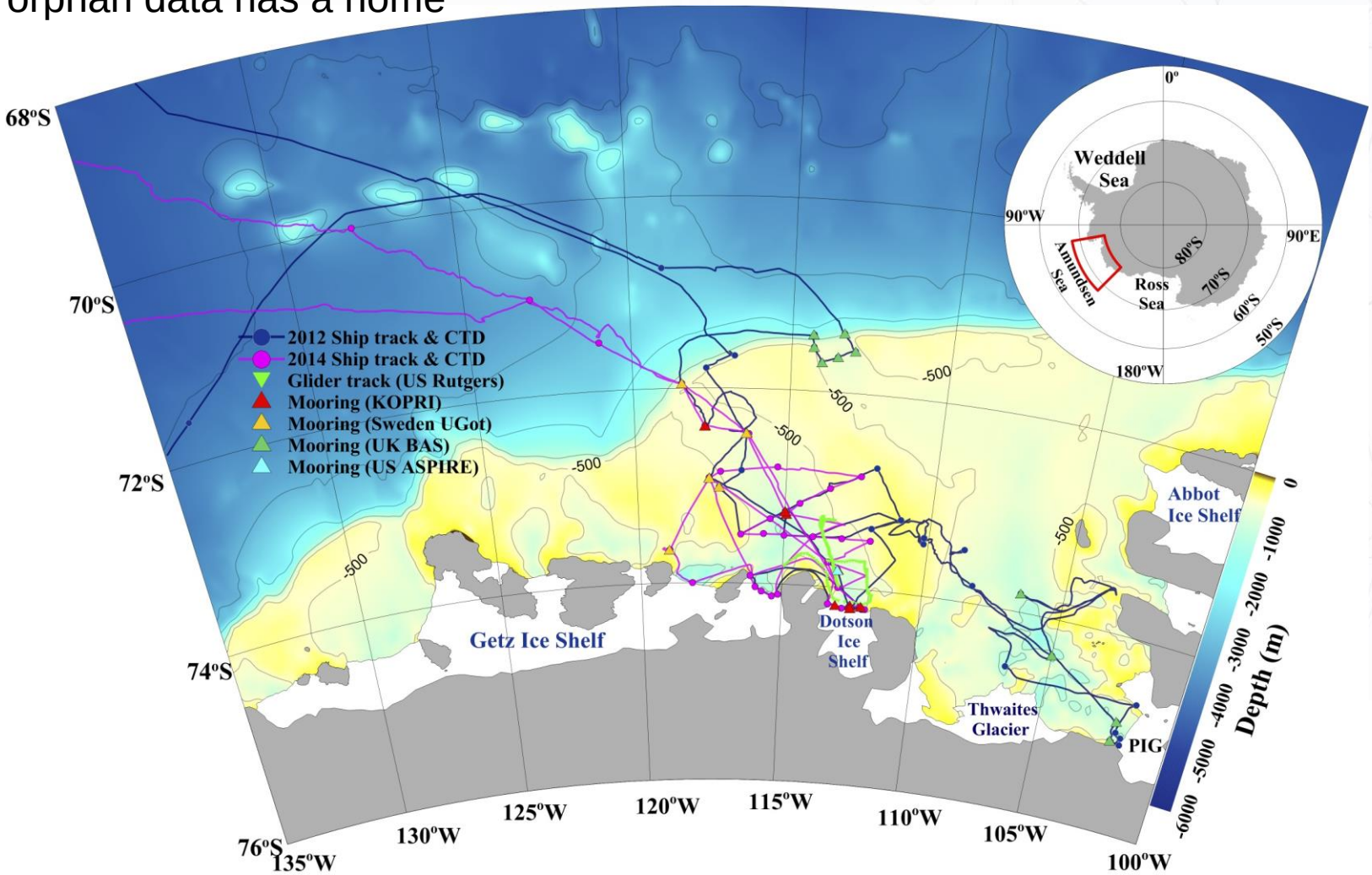
Ensure all relevant Southern Ocean METADATA is visible through the SOOS Metadata Portal



Facilitate linking of sustained long-term observations to provide a system of enhanced data discovery and delivery, utilising data centres and programmatic efforts combined with, as needed, purpose-built data management and storage systems

Step 1 – Data Discovery

Ensure all orphan data has a home



Facilitate linking of sustained long-term observations to provide a system of enhanced data discovery and delivery, utilising data centres and programmatic efforts combined with, as needed, purpose-built data management and storage systems

Step 1 – Data DELIVERY

Requires more resources then currently at the disposal of SOOS

Need to leverage off existing infrastructure and efforts

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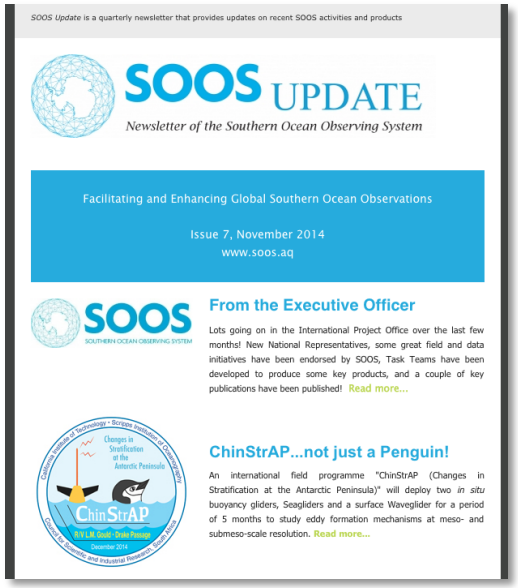
6) Provide services to communicate, coordinate, advocate and facilitate SOOS objectives and activities

Provide services to communicate, coordinate, advocate and facilitate SOOS objectives and activities

IPO Core activities

- Website
- Newsletter
- Workshops
- Informing all stakeholders



SOOS Update is a quarterly newsletter that provides updates on recent SOOS activities and products

SOOS UPDATE

Newsletter of the Southern Ocean Observing System

Facilitating and Enhancing Global Southern Ocean Observations

Issue 7, November 2014
www.soos.aq

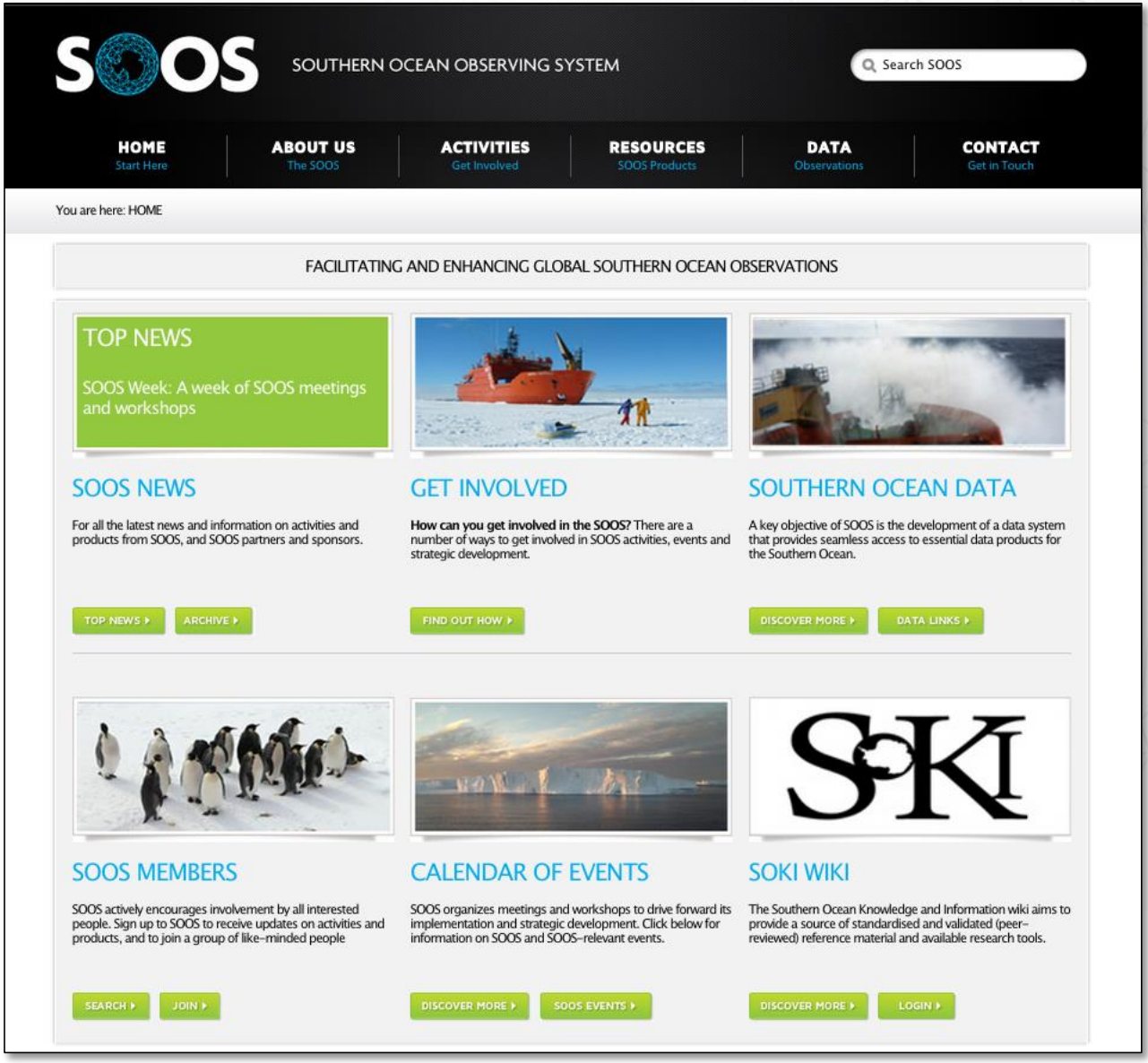
SOOS
SOUTHERN OCEAN OBSERVING SYSTEM

From the Executive Officer

Lots going on in the International Project Office over the last few months! New National Representatives, some great field and data initiatives have been endorsed by SOOS, Task Teams have been developed to produce some key products, and a couple of key publications have been published! Read more...

ChinStrAP...not just a Penguin!

An international field programme "ChinStrAP (Changes in Stratification at the Antarctic Peninsula)" will deploy two *in situ* buoyancy gliders, Seagliders and a surface Waveglider for a period of 5 months to study eddy formation mechanisms at meso- and submeso-scale resolution. Read more...



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FACILITATING AND ENHANCING GLOBAL SOUTHERN OCEAN OBSERVATIONS

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SOOS Week: A week of SOOS meetings and workshops

SOOS NEWS

For all the latest news and information on activities and products from SOOS, and SOOS partners and sponsors.

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GET INVOLVED

How can you get involved in the SOOS? There are a number of ways to get involved in SOOS activities, events and strategic development.

FIND OUT HOW ▸

SOUTHERN OCEAN DATA

A key objective of SOOS is the development of a data system that provides seamless access to essential data products for the Southern Ocean.

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SOOS MEMBERS

SOOS actively encourages involvement by all interested people. Sign up to SOOS to receive updates on activities and products, and to join a group of like-minded people

SEARCH ▸ JOIN ▸

CALENDAR OF EVENTS

SOOS organizes meetings and workshops to drive forward its implementation and strategic development. Click below for information on SOOS and SOOS-relevant events.

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SOKI WIKI

The Southern Ocean Knowledge and Information wiki aims to provide a source of standardised and validated (peer-reviewed) reference material and available research tools.

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Status and activity …

Embryonic but growing. Some of the elements are ~mature; others still being developed (e.g. sustained under-ice obs).

Some of the complex biological elements still require full specification, in terms of what is needed, plus standardized protocols.

Assessments are being conducted to define temporal/spatial sampling requirements, and identify gaps.

Regional groups being formed to conduct gap analyses and drive implementation (some things easier to fund regionally).

Data and data product system being built.

Development of **infrastructure/technology**; pilot(s). To progressed ….

(Full details available from Louise Newman; newman@soos.aq)

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