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Marine climate data and research priorities for the IPCC 5th Assessment.

David Parker, CLIMAR3, Gdynia, May 2008

Key aspects

- Digitization – Rob Allan, Philip Brohan, Eric Freeman, Clive Wilkinson…
- Bias reduction – John Kennedy, Matt Palmer…
- Sydney workshop October 2007
- ARGO
- Voluntary Observing Fleet
- Ocean carbon

Digitization

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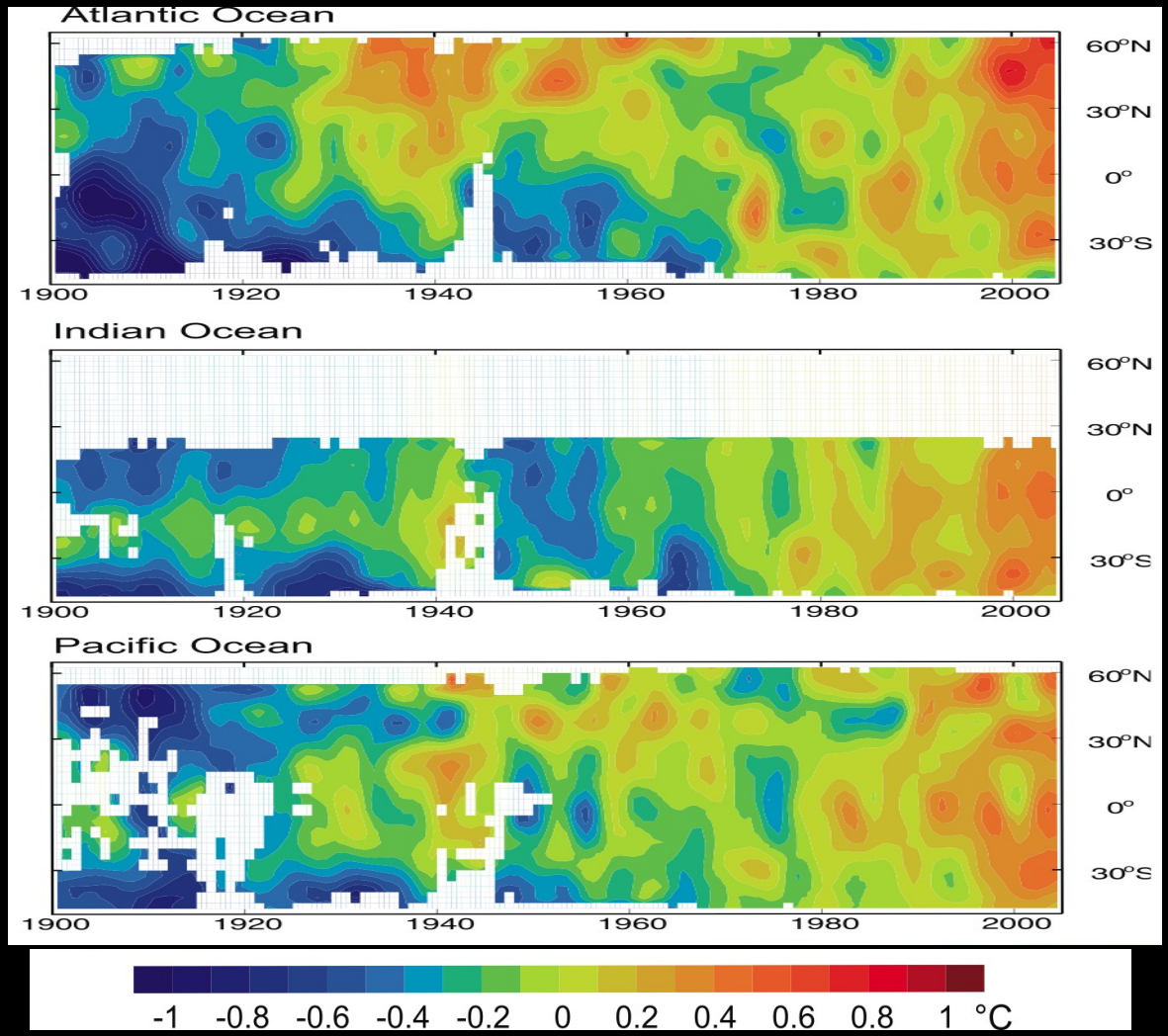
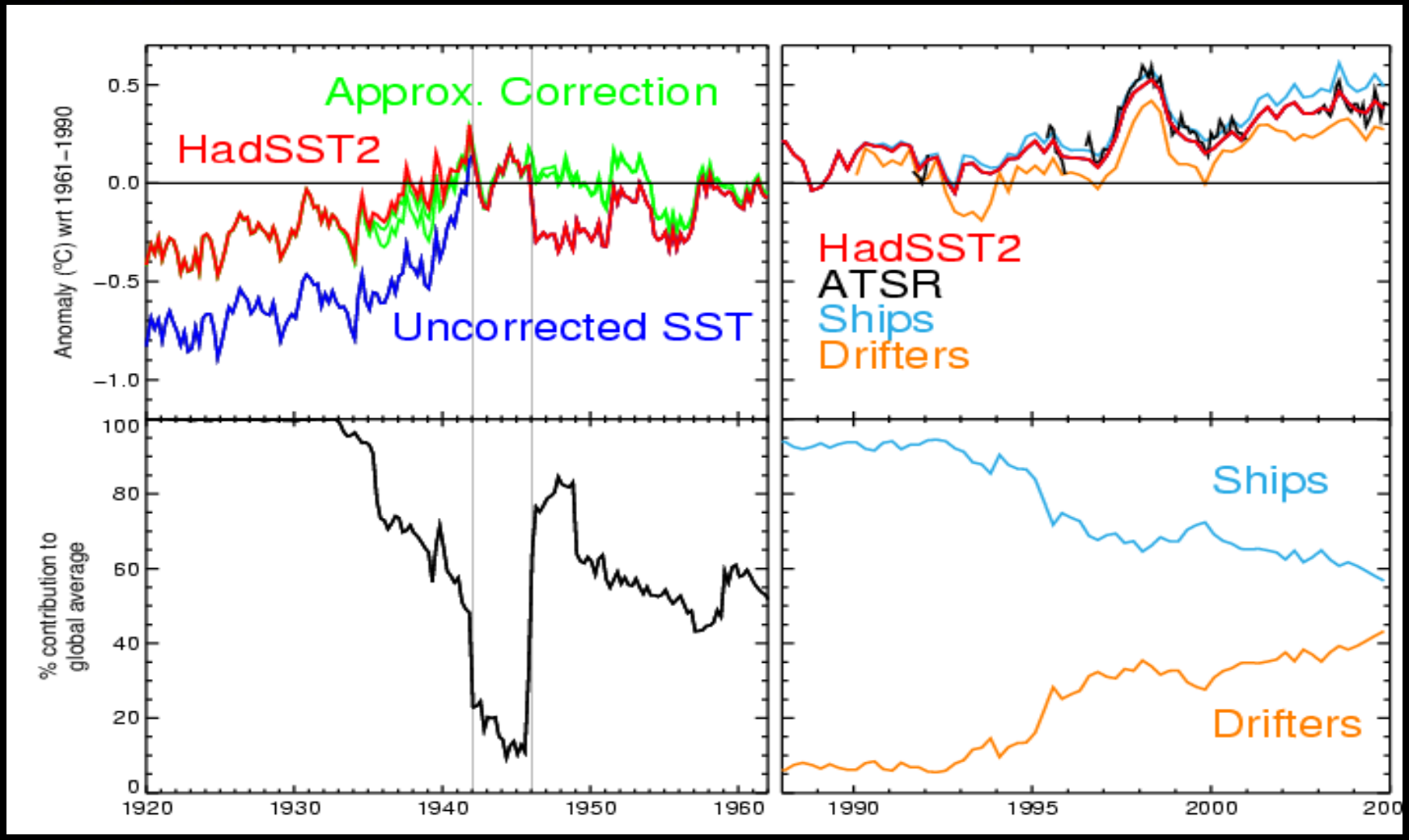
Figure 3.5 of IPCC WG1 AR4 shows zonal-average ocean-basin SST anomalies since 1900… with gaps.

1940s being filled thanks to Rob Allan, Philip Brohan, Eric Freeman, Clive Wilkinson…

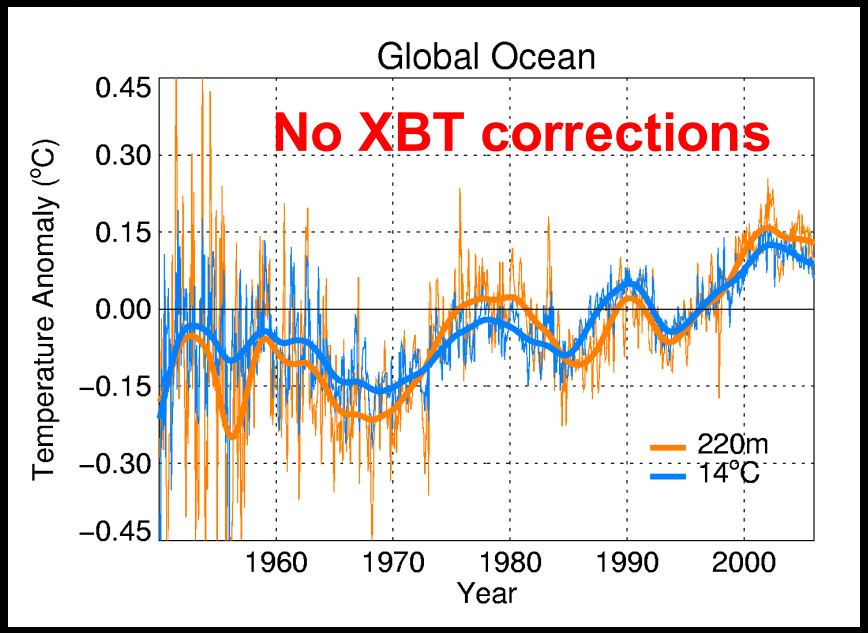
Let's get 1900-25 sorted, as well as the 19th Century!

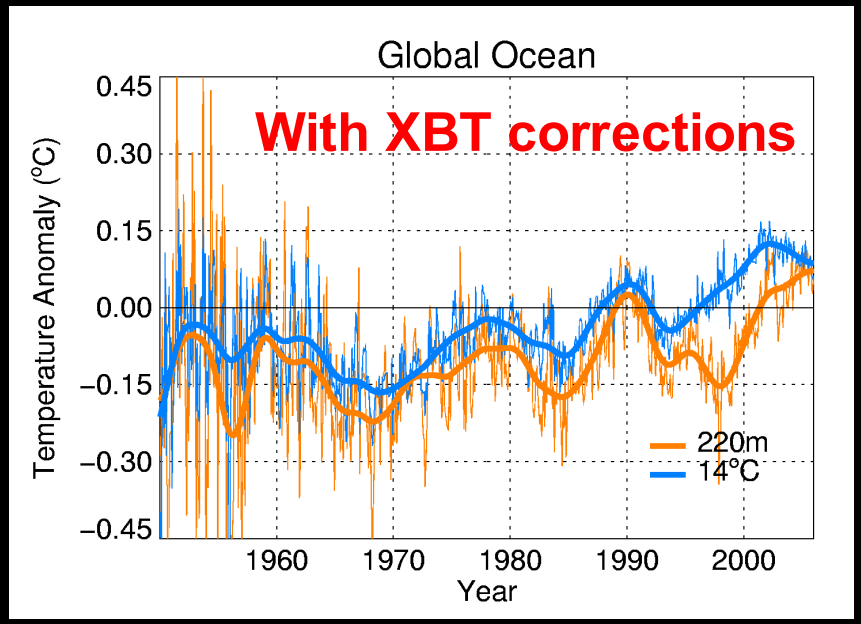


Bias reduction (1): mid-20th Century SST buckets and recent ship-buoy-satellite mélange - courtesy John Kennedy.



Bias reduction (2): investigating ocean heat uptake using HadGOA – courtesy Matt Palmer.





- The average temperature above a fixed isotherm (blue) is a less noisy index of ocean warming than is the average temperature above a fixed depth (red). It is also immune to the effect of incorrect expendable bathythermograph (XBT) fall rates [Wijffels et al., J. Climate in press 2008]
- Analyses relative to fixed isotherms elucidate mechanisms behind ocean heat content variability

Sydney workshop October 2007

Future Climate Change Research and Observations: GCOS, WCRP and IGBP Learning from the IPCC 4th Assessment: Sydney, October 2007

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 - Summary

- Recommendations were made for improving specific areas of climate science (process-level understanding, models, and observational systems) and for better tailoring climate information systems to address decisions related to mitigation, adaptation and vulnerability to climate change.
- Paper by Sarah Doherty (NOAA-PMEL) *et al.* has been submitted to *Bull. Amer. Meteorol. Soc.*
- Focus below on (1) GCOS Implementation Plan which the workshop built upon; and (2) recommendations related to the oceans: mainly ARGO and ocean carbon cycle.

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – GCOS Implementation Plan background for oceans (1)

- Key Action 16: Complete and sustain initial oceanic observing system for climate; national agents for implementation; effective partnership between research and operational communities; timely, free and unrestricted data exchange.
- Key Action 17: Climate quality and continuity for essential ocean satellite observations [scatterometer winds; sea-ice; μ-wave & IR SST; ocean colour; altimeters].
- Key Action 18: Provide sustained global coverage of ocean surface:
  - GCOS baseline network of tide gauges;
  - enhanced drifting buoy array;
  - enhanced Tropical Moored Buoy network;
  - enhanced Voluntary Observing Ship Climatology network;
  - globally-distributed reference mooring network.

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – GCOS Implementation Plan background for oceans (2)

- Key Action 19: Provide sustained global coverage of sub-surface ocean:
  - ARGO profiling float array;
  - Systematic sampling of global ocean full-depth water column;
  - Ship-of-Opportunity Expendable Bathythermograph (XBT) trans-oceanic sections;
  - Tropical Moored buoy and reference mooring networks (Key Action 18);
  - Satellite altimetry.

GCOS/WCRP/IGBP and IPCC: Sydney October 2007

- Nathan Bindoff (Univ. Tasmania and CSIRO: IPCC WG1) focussed on key research questions in the area of oceanic climate change, namely global-scale temperature and salinity changes, regional-scale changes, understanding of the ocean carbon cycle, and sea level changes. He stressed the need for sustained observations of the oceans, both *in situ* and satellite-based, timely access to the data, and enhanced multi-disciplinary research in order to address the totality of ocean changes and impacts of these changes.
- One respondent to the pre-workshop survey noted that carbon and nutrient fluxes (dissolved organic and inorganic carbon, particulate organic carbon, NO_3) from land to ocean are missing from the GCOS implementation Plan.

ARGO schematic from NOC Southampton UK

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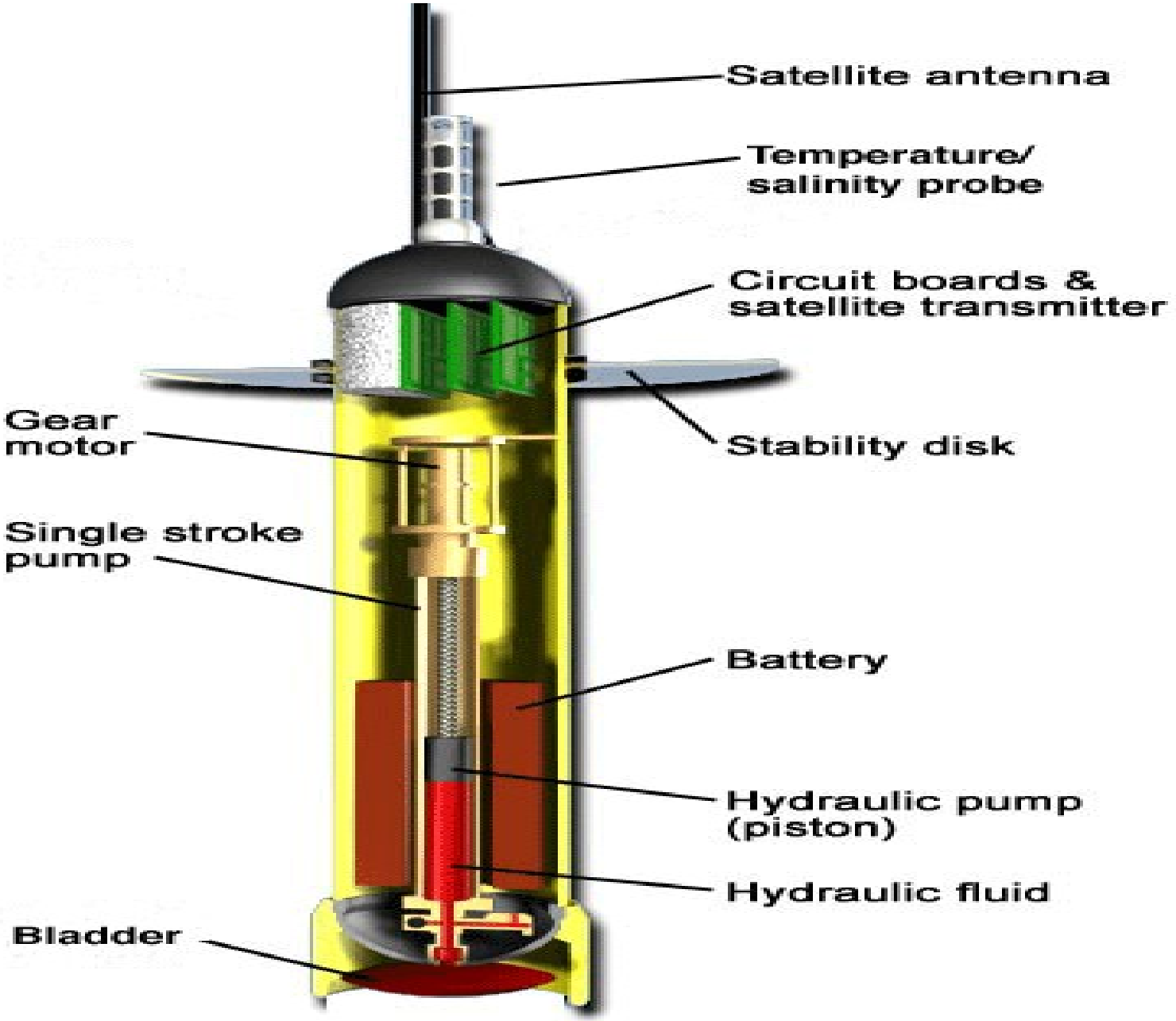

3006 ARGO Floats Nov 2007

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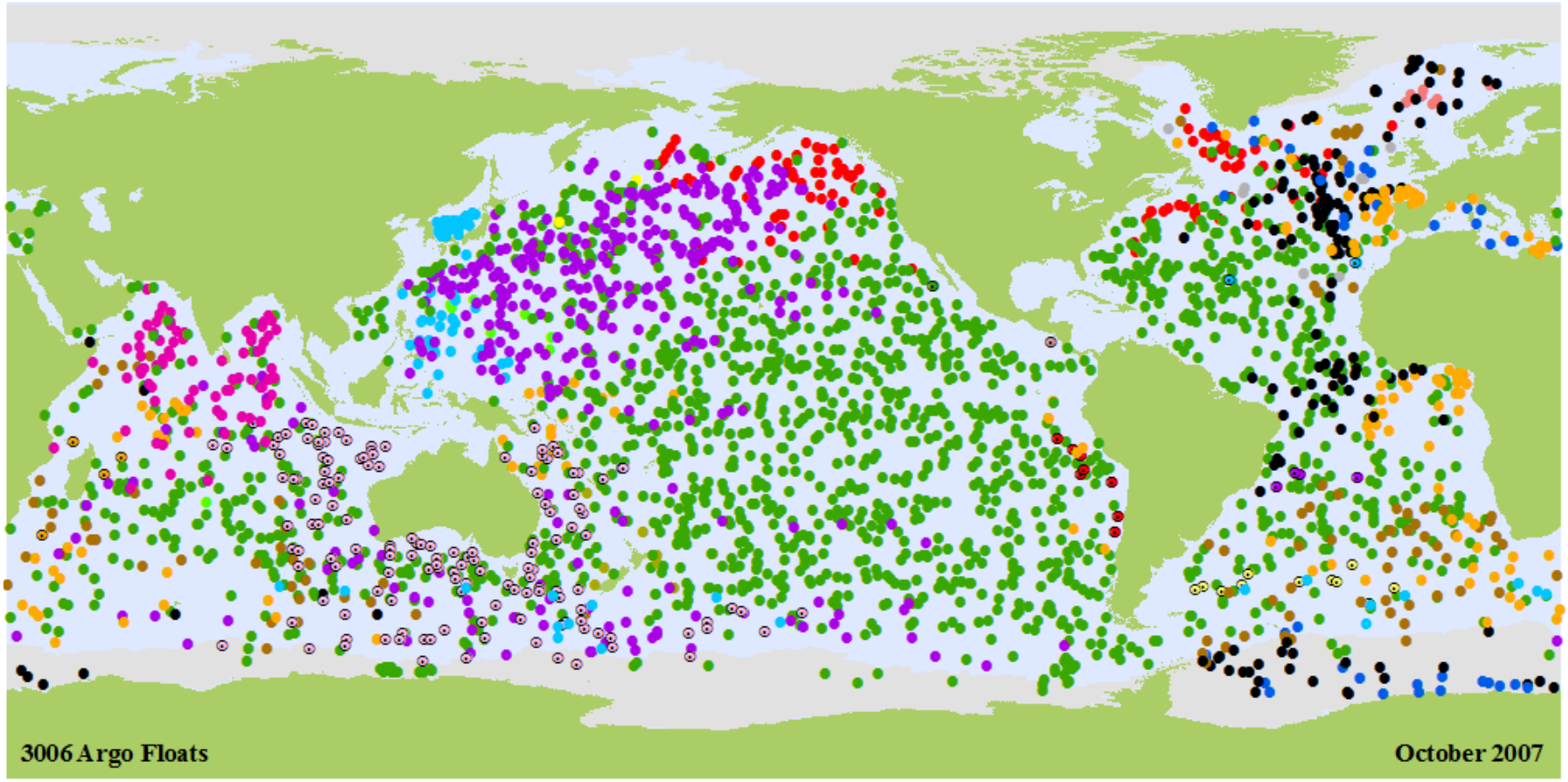


jcommops

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – ARGO+ (1)

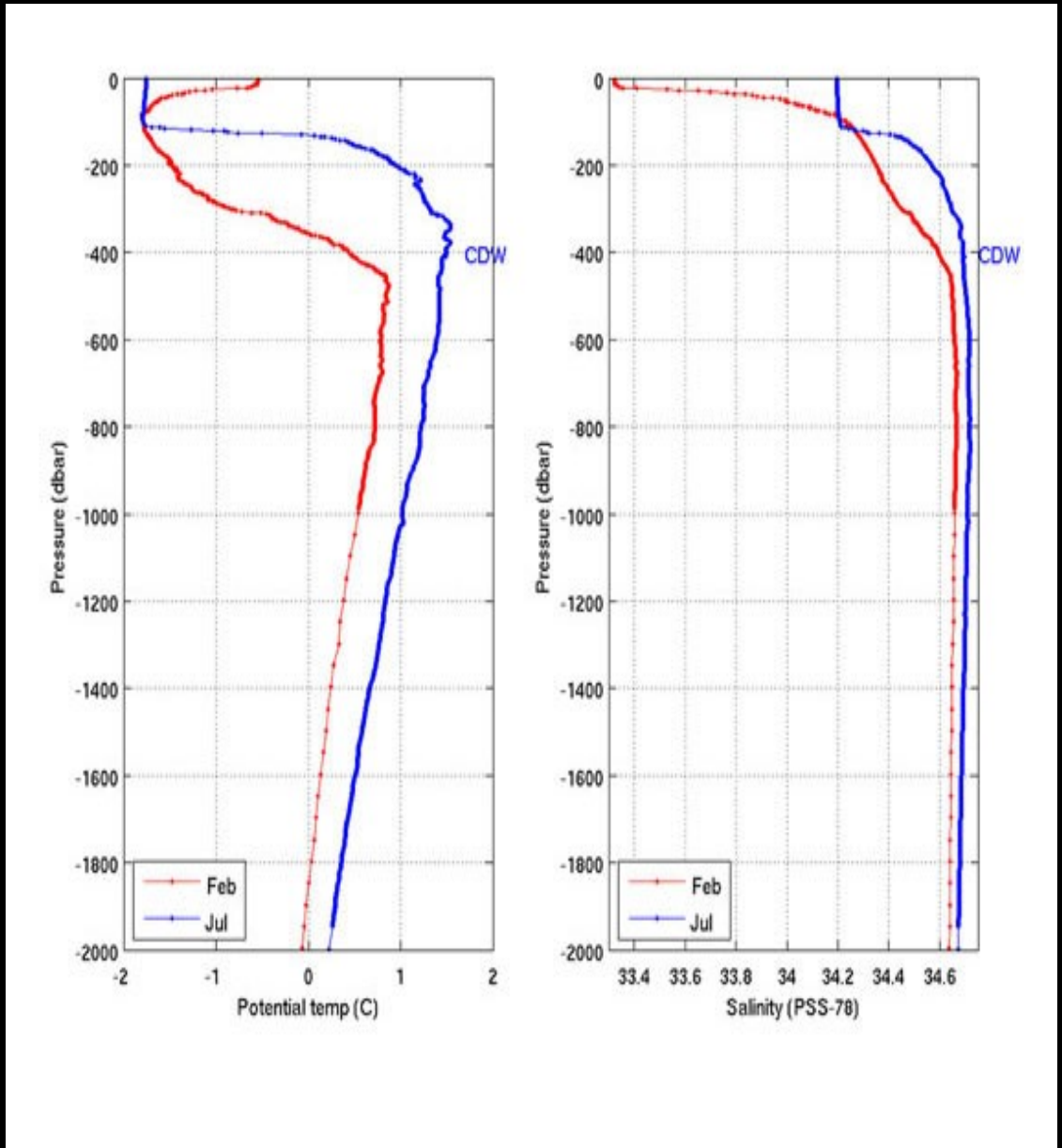
- Ensure ARGO network is maintained at the present density or greater and yields homogeneous data for > 50 years.
- Maintain strong quality-control of ARGO salinity profiles and surface salinity data from the Ships of Opportunity Programme (SOOP).
- Strongly reaffirm maintenance and continuity of satellite and *in situ* observing systems such as ARGO for measuring sea-level change and the underlying processes. Maintain *in situ* observations from tide-gauges with GPS receivers. Increase synergy between sea-level modelling and observations.

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – ARGO+ (2)

- With the initial implementation of ARGO complete, the array needs to be maintained and extended into the ice-covered oceans using new technologies.
- The design and implementation of a deep ocean observing system is of high priority.
- Provide ongoing key ocean and terrestrial observations, e.g. ARGO and satellite-based data, to support simulations of regional climate on seasonal to decadal time-scales.

Floats required beneath sea-ice

Antarctic ARGO Profiles, Feb and July 2007, 2000m to surface.



ARGO: conclusions

- Maintenance of global ARGO network long-term will enable us to:
  - Create a consistent climate data record using ARGO and earlier data, and thus to analyse and interpret trends of regional and global ocean heat content and salinity.
  - Understand and predict shorter-term variations such as El Niño and the Interdecadal Pacific Oscillation, which have major impacts in developing countries.
  - Close the sea-level budget
  - Possibly reduce uncertainties in trends in the meridional overturning circulation.
  - Monitor influences on fish and other ocean life

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – Ocean carbon (1)

- Better process modelling and understanding of feedbacks in the carbon cycle will require a denser and more evenly distributed network of sustained *in situ* observations of carbon on land, in the oceans and in the atmosphere.
- In the ocean, critical processes include stratification (which influences the carbon uptake rate), large-scale changes in patterns of ocean warming, and acidification. The net effect of these factors on the biological carbon pump is unknown.
- Issues with data continuity and consistency persist, since observing systems (for both ocean and land) are largely based on short-term research efforts, and often operated without common measurement protocols or data management.

GCOS/WCRP/IGBP and IPCC: Sydney October 2007 – Ocean carbon (2)

- Accelerate the creation of global collections of quality-controlled carbon data.
- Accelerate the collection of data on biogeochemical variables including ocean carbon content, ocean alkalinity, pH and pCO_2
- Progress the standardization and harmonization of field observation protocols

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WCRP
World Climate Research Programme

GLOBAL CHANGE
IGBP

FUTURE CLIMATE CHANGE RESEARCH AND OBSERVATIONS:

GCOS, WCRP AND IGBP LEARNING FROM THE IPCC FOURTH ASSESSMENT REPORT

GCOS – 117 / WCRP – 127 / IGBP Report No. 58
WMO/TD No. 1418 January 2008

CSIRO ARC NESS GREENHOUSE 2007 Australian Government Bureau of Meteorology Australian Government Department of the Environment and Water Resources Australian Greenhouse Office

ICSU International Council for Science WMO INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE UNEP UNESCO IOC NASA

WMO UNEP Australian Universities Climate Consortium

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Questions and answers

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Spare slides

GCOS Climate Monitoring Principles

1. Impact of new systems/changes to existing systems should be assessed prior to implementation.
2. A suitable period of overlap for new and old observing systems.
3. Metadata should be documented and treated with the same care as the data themselves.
4. The quality and homogeneity of data should be regularly assessed as a part of routine operations.
5. Needs for environmental and climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.
6. Operation of historically-uninterrupted stations and observing systems should be maintained

GCOS Climate Monitoring Principles (continued)

7. High priority for additional observations should be focussed on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution.

8. Long-term requirements should be specified to network designers, operators and instrument engineers at the outset of system design and implementation.

9. Conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted.

10. Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.