Deep Ocean Observing

OceanSITES Virtual Meeting
16 Sept. 2020
14:45 - 16:15 UTC

Format:

- Pre-recorded short talks by panelists, focusing on the role of their work in OceanSITES, their views of OceanSITES, and their questions and ideas for OceanSITES
- Summary by session chairs, reflecting on OceanSITES and extracting questions and ideas from the talks
- Panel discussion

Session Chairs:

R. Venkatesan
National Institute of Ocean Technology
Chennai, India

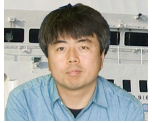
M. Lankhorst
Scripps Institution of Oceanography
La Jolla, CA, USA

Panel Members

Lisa Levin
Scripps Institution of Oceanography, La Jolla, CA, USA

Nathan Anderson
NOAA Pacific Marine Environmental Laboratory, Seattle, WA, USA

James Potemra
School of Ocean and Earth Science and Technology, Honolulu, HI, USA



Keisuke Ariyoshi
Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

Dariia Atamanchuk
Dalhousie University, Halifax, Canada

Jochen Klinke
Sea-Bird Scientific, Bellevue, WA, USA

List of Pre-Recorded Presentations

1. L. Levin: **Deep Ocean Observing Strategy**
2. M. Lankhorst: **Science Highlights: Deep Salinity and Temperature Observations in the Atlantic**
3. N. Anderson: **Abyssal Measurements: Present and Future Ocean Climate Station Observations**
4. J. Potemra: **Pinning Models Down in the Deep**
5. G. Johnson: **GO-SHIP, Deep Argo & Ocean Sites: DOOS Complementarities**
6. R. Venkatesan: **Deep Ocean Observing**
7. D. Atamanchuk: **Deep moorings as reference sites for the ocean observing networks. Quality control and utility of oxygen time-series from the optodes**
8. K. Ariyoshi: **Future Perspective for effective utilization of ocean bottom pressure gauges**
9. J. Klinke: **Recent Developments in Deep Ocean Sensor Technology at Sea-Bird Scientific**

Preliminary Discussion Items from Session Description

- Technical
  - Coordinated approaches to calibration and validation across observing systems
  - What technical requirements are unique to the deep ocean, and how to address them efficiently (e.g. signals are small, calibration/validation data are sparse, available ship time to visit sites is limited, instruments need to withstand high pressure and corrosion)
  - Insights from OceanSITES Working Group on Deep Ocean Temperature and Salinity Observations
- Infrastructure
  - Organisation and delivery of data in different “levels”: derived data products versus in-situ data at native resolution in space and time
  - Does the focus on EOVs help accelerate or organize our results?
  - Collaboration with other observing groups: DOOS, Deep Argo, GO-SHIP, IAPSO Best Practice Study Group on Moored CTD Measurements. How can these be fostered and deliver tangible results?
- Science
  - What science is enabled by existing deep ocean observing, and what would we like to address in the future?
  - Is real-time data telemetry from the deep ocean important?
  - What is the role of time series observations made by OceanSITES, and how do they fit in with other systems such as Argo and GO-SHIP? Does DOOS articulate these relationships properly?
  - What is the relevance of mid-water-column data versus near-bottom data, and for which science questions is each of them important?
  - What science disciplines are underrepresented in OceanSITES observations of the deep ocean? E.g.: biology, optical measurements and cameras, seismic and geophysics, cabled observatories. Biogeochemistry, sediment traps, carbon (and other) fluxes through the earth system. How should this evolve until 2030?

Summarizing Points from Videos

L. Levin: **Deep Ocean Observing Strategy**

- Design the observing system around essential ocean variables (EOVs - physics, BGC, and ecosystem variables) that are mapped against user groups and high-level science objectives.
- Observations >200m, heat/salinity budgets, bottom water formation, deep transport/mixing + pressure
- Bridge observing networks, data + modeling communities for public impact.

M. Lankhorst: **Science Highlights: Deep Salinity and Temperature Observations in the Atlantic**

- Sensor calibration, drift, accuracy. Use IAPSO WG as vehicle. Can we develop joint procedures or share software and database with Deep Argo and GO-SHIP for cal/val?
- Science: (Multi-)Decadal time series enable climate studies

N. Anderson: **Abyssal Measurements: Present and Future Ocean Climate Station Observations**

- Papa mooring: Degraded quality from bottom strikes (fixed), small offsets/outliers <0.01 PSU
- KEO mooring: False 0.03 - 0.06 PSU salinity drift each year from sediment accretion. Add instruments?
- T↑ 2013 - 2017, stabilizes in 2019. T linked to upper ocean KE index, internal waves, or atmosphere?

Summarizing Points from Videos

J. Potemra: **Pinning Models Down in the Deep**

- Need more clarity and traceability which observations are used in which numerical simulations
- Numerical simulations do not currently represent deep temperatures well (not the mean, and neither in amplitude nor time scales of variability). Overestimates at NTAS and WHOTS sites in particular.

G. Johnson: **GO-SHIP, Deep Argo & Ocean Sites: DOOS Complementarities**

- OceanSITES samples at higher frequency than other programs, improving uncertainty estimates.
- GO-SHIP is a global, reference-quality survey (decadal), while Deep Argo targets global T/S (10-day). Deep Argo is increasing coverage, contributing to better spatial sampling at >2000m.
- Combined view across all systems gives better insights across multiple time and space scales into processes as well as data fidelity

R. Venkatesan: **Deep Ocean Observing**

- Deep T/S is measured at many locations within the Indian Ocean mooring network. 15N 89E sees variation at 2000m (less at depth), with a general increasing S trend.
- A primary justification for deep measurements is tsunami early warning and satellite validation.
- Tsunameter pressure records being made available, as well as temperature data collected from tsunameter installations.

Summarizing Points from Videos

D. Atamanchuk: **Deep moorings as reference sites for the ocean observing networks. Quality control and utility of oxygen time-series from the optodes.**

- Addition of oxygen sensors to the OSNAP and GOHSNAP arrays
- An optode drift occurs in the first 2-3 weeks of a deployment as instruments acclimate to depth; comparison CTD cast can be utilized to correct the drift
- Use in deep-ocean flux estimates, oxygen utilization rates (biological carbon pump)

K. Ariyoshi: **Future Perspective for effective utilization of ocean bottom pressure gauges**

- Seafloor pressure from cabled observatories for research and operational purpose - earthquake and tsunami warnings. Real-time data and evaluation.
- Can some of the seafloor observatories (funded and operational for >20 years) be expanded to make water-column observations?
- How to bridge gap between geophysics (seafloor motion) and oceanography (water column)?

J. Klinke: **Recent Developments in Deep Ocean Sensor Technology at Sea-Bird Scientific**

- Working on improved accuracy and stability of conductivity and pressure sensors, driven by Deep Argo. Thorough analysis of long-term SBE37 sensor (temperature & conductivity) behavior.
- pH sensor technology development: pressure-compensated design will improve accuracy and allow deep-ocean use
- New software developments for instrument interfaces

Questions and Discussion:

From L. Levin's talk:

- How is OceanSITES interacting with GOOS (e.g., OOPC)?
- How does OceanSITES help shape EOV requirements for deep ocean in particular?
- How does OceanSITES interact with modeling efforts, e.g., with climate modeling or ocean reanalysis groups/centers? How are data being used? Are there use cases? Known issues?
- How can we promote OceanSITES-DOOS interactions?

Organize thoughts according to:

- Technical / Infrastructure / Scientific Developments
- Actionable in near future (2 years) / Long-term vision (10 years)

Short term Goals

1

2

3

Long term Goals

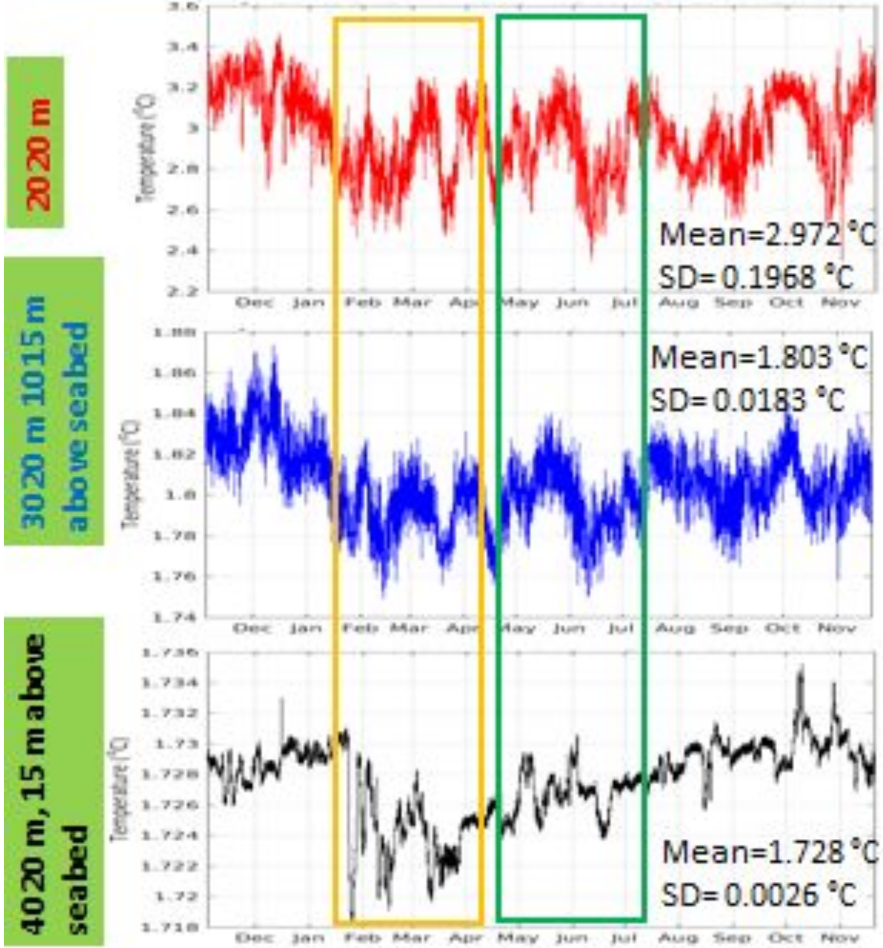
1

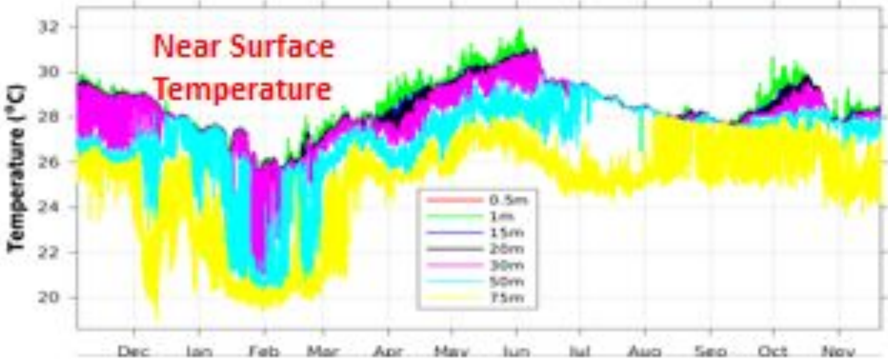
2

3

Additional analysis - Deep T/S

OceanSITES: Abyssal record of Temperature in Central Arabian Sea (15N, 68.8E) 2018-19





- Some of the prominent features in the abyssal temperature record are consistent throughout the water column up to seabed and show similarity to the near surface temperature variability.
    - Cooling event observed near seabed coincide with winter convective cooling in late January.

OceanSITES: Abyssal record of Salinity in Central Arabian Sea (15N, 68.8E) 2018-19