Animal Borne ocean Sensors - AniBOS

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1. Highlight the key network successes

2. AniBOS is celebrating 20 years of continuous oceanographic (CTD) observations in the Southern Indian Ocean.
3. In total over 800,000 vertical profiles of Temperature and Salinity (TS) have been collected, primarily by seals in the polar seas, since 2004
4. The MEOP-CTD database version 2024-03-08 is a major update on the previous version, with more than 150,000 new TS profiles made available freely. https://www.meop.net/news/
5. Funding has been secured to 2027 to deploy CTDs to seals in the Southern Ocean from IMOS
6. IMOS has invested in an expanded (to 2027) animal borne ocean observing programme in the tropical seas to the north of Australia. This programme will deploy 20 CTDs on turtles in the Timor and Arafura seas.

7. How has the network advanced across the OCG Network Attribute areas[1]

Sub-surface TS profiles in the world's tropical ocean remain rare and the expansion of animal borne observations into tropical regions provide TS profiles to 150 m and key oceanographic observations to improve ocean model forecasts in tropical and subtropical areas. Along with STORM[2,3] this new IMOS funding will provide crucial observations to assess and better forecast Tropical Cyclone properties to better protect live and property[4].

There is a growing community and number of institutions providing TS profiles from animals as summarized in Figure 1.

[1] https://oceanexpert.org/downloadFile/45372

[2] Bousquet, O. et al. Sea Turtles for Ocean Research and Monitoring: Overview and Initial Results of the STORM Project in the Southwest Indian Ocean. Frontiers in Marine Science 7 (2020). https://doi.org:10.3389/fmars.2020.594080

[3] Bousquet, O. et al. Impact of Tropical Cyclones on Inhabited Areas of the SWIO Basin at Present and Future Horizons. Part 1: Overview and Observing Component of the Research Project RENOVRISK-CYCLONE. Atmosphere 12, 544 (2021). https://doi.org:10.3390/atmos12050544

[4] Holbach, H. M. et al. Recent Advancements in Aircraft and In Situ Observations of Tropical Cyclones. Tropical Cyclone Research and Review 12, 81-99 (2023). https://doi.org:10.1016/j.tcrr.2023.06.001

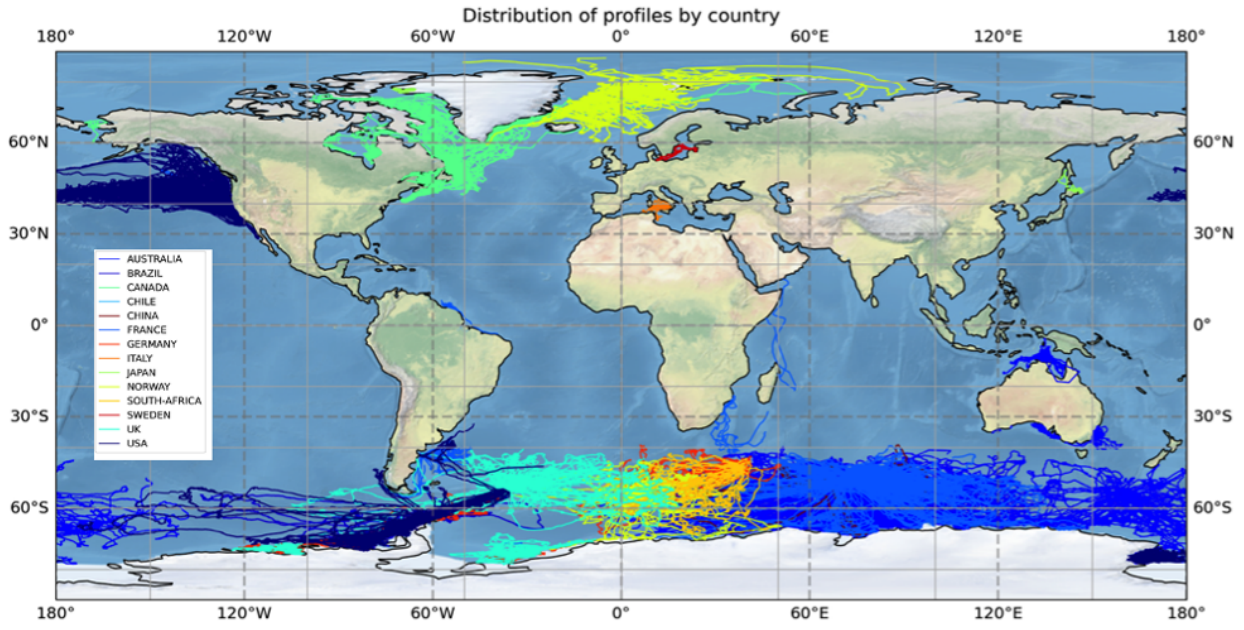

Figure 1. The updated (March 2024) world map showing the distribution of CTD profiles (i.e. vertical profiles of temperature and salinity) currently available in the MEOP-CTD database.

8. Future Plans[5] and Opportunities - at network and/or cross-network OCG level

Integrating physics and biological observations to better understand how in situ physical structure affects biological productivity and animal performance remains a fertile field of study that is a focus for the AniBOS community (see Appendix below). We aim to do this by:

a. Establishing the links between water column physical properties and phytoplankton bloom dynamics (start, duration, and magnitude)
b. Evaluating to what extent phytoplankton blooms in different coastal polynyas exhibit fluorescence characteristics indicating iron stress or availability
c. Exploring the use of oxygen sensors as a new approach to help constrain the physical influences on biological processes in polynyas

Our multinational (Australia, France & Sweden) research project (Using animal-borne sensors to unravel East Antarctic coastal productivity - DP230101368) funded by the Australian Research Council provides the funding (AUD 807K) for the study to 12/2026.

9. Challenges and Concerns - at network and/or cross-network OCG level

The AniBOS data committee (ADC) identified the 3 needs:

a. Hosting in-person Data Management meetings, ideally twice annually.

[5] Future plans on implementation, instrumentation, data management, test, new sensors, plan for new EOV/ECV observations, capacity development, etc.

b. Periodic 1-2 day in-person meetings will allow the Committee to progress essential tasks far more efficiently than through our regular monthly Zoom meetings.
c. ADC members spend considerable time taking on AniBOS tasks, but this lacks continuity - non-AniBOS responsibilities take priority. 1 FTE position to support AniBOS data management development & operation would greatly help.

In parallel, the bird flu is taking a huge toll on some population of elephant seals, and more generally on marine birds and marine mammals. Ticking bomb 💣

10. Asks from OCG (Exec, networks, OceanOPS, and/or GOOS), perhaps related to the responses to parts 3 and 4 and how OCG can support your network

a. Can OCG help identify funding opportunities to support data management & OceanOPS?
b. OceanOPS has raised funding concerns, how will this affect emerging networks that rely on off research funding (noting of course that AniBOS has built and maintained a continuous times series of ocean observing for 21 years)?
c. OceanOPS is a key partner to manage metadata, clear directives from OceanOPS on mutual obligations can facilitate solutions

11. Recent publications, articles, etc. (if you want to share)

a. Gouretski, V., Roquet, F., Cheng, L., 2024. Measurement Biases in Ocean Temperature Profiles from Marine Mammal Dataloggers. J. of Atm. Ocean. Tech. 41, 629–645.

b. McMahon, C., Roquet, F. et al., 2025. An enduring, 20-year, multidisciplinary seal-borne ocean sensor research collaboration in the Southern Ocean. Accepted in Elementa.

Delivering biological information from the AniBOS network to OBIS

Progress to date

In late 2024, Pye & Jonsen developed a pilot project using IMOS-ATF southern elephant seal satellite tracking data collected from SMRU SRDL-CTD tags deployed at Iles Kerguelen in the Southern Ocean. The pilot does the following:

1. Runs the IMOS-ATF satellite location data Quality Control process for SMRU SRDL-CTD tags (Jonsen et al. 2024) using the ArgosQC R package (https://github.com/ianjonsen/ArgosQC).
    1.1. This is an automated process that pulls the latest tag data from the SMRU data server and applies a state-space model to estimate a time-series of most plausible locations from the error-prone Argos satellite-derived locations.
    1.2. These quality-controlled locations are appended to every time-stamped measurement recorded by the tags - CTD profiles & diving activity.

2. Pulls the locations and associated metadata from the QC process for each tagged animal & then:
    2.1. Merges the QC'd locations and deployment metadata
    2.2. Summarizes the data down to hourly records
    2.3. Translates the occurrence data to the Darwin Core (DwC Event Core) schema
    2.4. Compresses the DwC Event Core .csv files, pushes to the OTN IPT for final processing & publication on OBIS

The workflow for step 2 is documented here: https://github.com/ocean-tracking-network/rt-sat-to-obis

Next Steps:

- A second pilot is being drafted to similarly handle QC'd Wildlife Computers tag data and publish DwC Event Core data to OBIS.
    - To facilitate this, Jonsen has developed a proof-of-concept QC script for Wildlife Computers SPOT6 and Mk10 tags and is in the process of incorporating this capability into the ArgosQC R package for general, automated use by AniBOS Data Assembly Centres (expected completion by June 2025).

- The ability to summarize and publish other biological (diving & surface behaviour) and (possibly) physical (salinity - temperature) data will be added.

- Elements of the workflow described in 1 and 2 above can run as automated (unsupervised) processes. By October 2025, we aim to fully automate the data QC and OBIS publication processes so that QC'd occurrence data can be made available on a near-real time basis.