frontiers | Frontiers in Marine Science

TYPE Editorial
PUBLISHED 11 January 2024
DOI 10.3389/fmars.2024.1358174



OPEN ACCESS

EDITED AND REVIEWED BY
Hervé Claustre,
Centre National de la Recherche Scientifique (CNRS), France

*CORRESPONDENCE
Andrew P. Rees
APRE@pml.ac.uk

RECEIVED 19 December 2023
ACCEPTED 02 January 2024
PUBLISHED 11 January 2024

CITATION
Rees AP, Smyth TJ and Brotas V (2024) Editorial: The Atlantic Meridional Transect programme (1995-2023).
*Front. Mar. Sci.* 11:1358174.
doi: 10.3389/fmars.2024.1358174



# Editorial: The Atlantic Meridional Transect programme (1995-2023)

Andrew P. Rees[1]*, Timothy J. Smyth[1] and Vanda Brotas[2]

[1]Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth, United Kingdom, [2]Marine and Environmental Science Centre (MARE), Faculdade de Ciencias, Universidade de Lisboa, Lisbon, Portugal

KEYWORDS

**AMT, Atlantic Meridional Transect, sustained observations, biodiversity, biogeochemistry, environmental change**

Editorial on the Research Topic
The Atlantic Meridional Transect programme, (1995-2023)

## Introduction

Since 1995 the Atlantic Meridional Transect (AMT) has undertaken measurements of oceanographic and atmospheric variables during 30 research cruises on a passage between the UK and destinations in the South Atlantic (Aiken and Bale, 2000; Robinson et al., 2006; Robinson et al., 2009; Rees et al., 2017). The transect spans more than 100° of latitude, samples to ocean depths of up to 1000 m and crosses a range of ecosystems from sub-polar to tropical, from eutrophic shelf seas and upwelling systems, to oligotrophic mid-ocean gyres. AMT has enabled the acquisition of repeat measurements of several Essential Ocean Variables and other ecosystem parameters and rate processes at a resolution of ~160 km (over ~13000 km). In delivering these activities AMT has facilitated long-term collaborations with NASA and ESA for the calibration and validation of satellite ocean colour sensors; with the UK Met-Office, NOC, NOAA, SOCCOM and University of Washington for ARGO and Bio-ARGO float deployment; and has maintained a long-term mooring in the South Atlantic Gyre (2009 to 2023). AMT data is archived and managed by the British Oceanographic Data Centre (BODC), whilst key data are also directed to other focus specific databases (e.g. NASA SeaBASS, ESA OC-CCI, SOCAT, CDIAC, SeaDataNet).

The generation of sustained observations of ocean biogeochemical variables is invaluable in monitoring ecosystem function and health during this period of rapid climate and environmental change. Globally there are a number of initiatives which aim to make repeated observations which include ship transects such as GO-SHIP and GEOTRACES and deployment of hydrodynamical and biogeochemical sensors as part of the ARGO programme. Examples of fixed point observations in the Atlantic include: The European Station for Time-Series in the Ocean (ESTOC) which has provided observations of the eastern sub-tropical Atlantic for more than twenty five years (González-Dávila and Santana-Casiano, 2023), the Bermuda Atlantic Time Series (BATS) in the western sub-tropical Atlantic, which, since 1988 has documented increases in temperature, ocean acidification and decreasing oxygen (Bates and Johnson, 2021); In the north-east Atlantic,

the Western Channel Observatory (WCO) has records dating to the early 20th century and in recent decades has further evidenced climate related shifts in plankton communities alongside increases in temperature and ocean acidification (McEvoy et al., 2023); the Estación Permanente de Estudios Ambientale (EPEA) in the western South Atlantic has evidenced increases in chlorophyll associated with an increased proportion of small celled phytoplankton (Lutz et al., 2023). The AMT offers a unique and alternative approach by making repeat measurements along a transect which incorporates the latitudinal range of all these fixed-point stations.

AMT provides an inclusive platform for multi-disciplinary ocean research with cruise berths open to the international community upon request. The thirty research expeditions to date have involved 310 sea-going scientists from 81 institutes representing 31 countries, resulting in 400 refereed papers which are available here.

## Research topic preview

The collection of eleven manuscripts in the current Research Topic reflect the diversity of measurements made during AMT cruises and the multi-disciplinarity of studies performed. The topics range between bacterial biodiversity through to the surface ocean exchange of greenhouse gases, and whilst some papers synthesise data from multiple cruises others present data from a single transect.

In their investigation of the bacterioplankton biogeography of the Atlantic during the AMT25 expedition in 2015, Allen et al. used the ratio of total 16S RNA gene sequences to active 16S gene sequences in order to inform on the active microbiome of the Atlantic Ocean and to provide insights towards the ecology and life history strategies of biogeochemically and ecologically significant bacterioplankton. Reintjes et al. also used molecular tools to describe particle associated bacterial communities observed during AMT22 which provided new insights into the composition, community dynamics and the potential for catabolic activity of several polysaccharides associated with their host particles. Several of the manuscripts focus on aspects of the biodiversity of phytoplankton groups. Phongphattarawat et al. combined data from AMT and BATS in their study of phytoplankton pigments and were able to describe species specific relationships between seasonal and depth dependent variability in photosynthetic and photoprotective pigments which were often reflected in variable carbon: chlorophyll ratios (C:Chl). The C:Chl provides a widely used proxy for estimation of ocean carbon content and formed the focus of the study by Smyth et al. Here the authors used analytical flow cytometry and machine learning techniques to analyse cyanobacterial cells of *Prochlorococcus* sp. and *Synechococcus* sp. from laboratory cultures and from samples collected on AMT cruise numbers 18 to 29 in order to predict C:Chl from dissolved nutrient concentrations. Quartly et al. compared AMT measurements of chlorophyll-a from the surface and deep chlorophyll maximum with surface satellite observations, profiles from biogeochemical ARGO floats and two different biogeochemical models. Brewin et al. employed traditional and contemporary techniques to estimate phytoplankton biomass on four AMT cruises between 2013 and 2018 and compared them satellite derived measurements; a high degree of similarity was reported across all methods used giving great confidence in comparability across decades of observations. Brotas et al. took similar datasets and complimented them with microscopic analysis to provide contemporary descriptions of phytoplankton biodiversity, size structure and carbon content from AMT cruises in 2018 and 2019 which were compared to similar measurements made two decades earlier. Guerreiro et al. focused on oceanographic features, macronutrient concentrations and aerosol dust deposition in controlling distribution and abundance of the calcite containing coccolithophore phytoplankton.

Serret et al. used their data from AMT22 to further refine empirical relationships between measures of community productivity and respiration in working towards a model for satellite estimation of net community production. Li et al. examined the biogeographical distribution of the *Tintinnina*, single celled protozoa, along the AMT29 transect. They found that *Tintinnina* species were divided into four biogeographic distribution patterns constituting four sub-assemblages which could largely be characterised by a number of dominant species in each group. Brown et al., 2023 combined a latitudinal transect from AMT27 with a longitudinal transect at 24.5°N to validate a novel instrument design which provided high frequency, high precision measurements of the potent greenhouse gases nitrous oxide and methane.

The AMT project has a rich history of observations over nearly three decades, but the future outlook is uncertain. In an age when financial and carbon budgets provide a severe limitation upon large research ships and expeditions, the development and integration of autonomous vehicles and sensors offer great promise of an alternative approach to delivering sustained observations along repeat ocean transects. This paper is AMT contribution number 403.

## Author contributions

AR: Writing – original draft, Writing – review & editing. TS: Writing – review & editing. VB: Writing – review & editing.

## Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. The Atlantic Meridional Transect is funded by the UK Natural Environment Research Council through its National Capability Long-term Single Centre Science Programme, Climate Linked Atlantic Sector Science (grant number NE/R015953/1).

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



## References

Aiken, J., and Bale, A. J. (2000). An introduction to the Atlantic Meridional Transect (AMT) programme. *Prog. Oceanogr.* 45, 251–256. doi: 10.1016/s0079-6611(00)00004-5

Bates, N. R., and Johnson, R. J. (2021). Ocean observing in the north atlantic subtropical gyre. *Oceanography* 34, 32–34. doi: 10.5670/oceanog.2021.supplement.02-14

González-Dávila, M., and Santana-Casiano, J. M. (2023). Long-term trends of pH and inorganic carbon in the Eastern North Atlantic: the ESTOC site. *Front. Mar. Sci.* 10. doi: 10.3389/fmars.2023.1236214

Lutz, V., Chidiak, M., Frouin, R., Negri, R., Dogliotti, A. I., Santamaria-del-Angel, E., et al. (2023). Regulation of CO2 by the sea in areas around Latin America in a context of climate change. *Environ. Monit. Assess.* 195, 417. doi: 10.1007/s10661-023-10997-1

McEvoy, A. J., Atkinson, A., Airs, R. L., Brittain, R., Brown, I., Fileman, E. S., et al. (2023). The Western Channel Observatory: a century of oceanographic, chemical and biological data compiled from pelagic and benthic habitats in the Western English Channel. *Earth Syst. Sci. Data Discuss.* 2023, 1–42. doi: 10.5194/essd-2023-311

Rees, A. P., Nightingale, P. D., Poulton, A. J., Smyth, T. J., Tarran, G. A., and Tilstone, G. H. (2017). The atlantic meridional transect programme, (1995-2016). *Prog. Oceanogr.* 158, 3–18. doi: 10.1016/j.pocean.2017.05.004

Robinson, C., Holligan, P., Jickells, T., and Lavender, S. (2009). The atlantic meridional transect programme, (1995-2012) foreword. *Deep-Sea. Res. Part Ii-Topical. Stud. Oceanogr.* 56, 895–898. doi: 10.1016/j.dsr2.2008.10.005

Robinson, C., Poulton, A. J., Holligan, P. M., Baker, A. R., Forster, G., Gist, N., et al. (2006). The Atlantic Meridional Transect (AMT) Programme: A contextual view 1995-2005. *Deep-Sea. Res. Part Ii-Topical. Stud. Oceanogr.* 53, 1485–1515. doi: 10.1016/j.dsr2.2006.05.015