The Southern Ocean RADiolarian (SO-RAD) dataset: a new compilation of modern radiolarian census data – response to reviews.

Reviewer comment - Boltovskoy:

The SO-RAD database is undoubtedly a major aid for future radiolarian-based biogeographic and paleoclimatic studies. It is thoroughly edited and the compilation of the data is clear and informative, with an excellent coverage of both the data included and the potential shortcomings. I browsed through the text and the database file, and did not find any typos or errors. For future enhancements of this database, I have the following suggestions:

(1) For each sample, the provenance of the data (i.e., publication) could be included

Author's response 1.1: We agree that providing publication information for each site as an additional variable in the dataset would be of benefit to future users. The amended dataset, including the variable *Reference* in place of the variable *Percentage included* (the authors decided having both the *Percentage included* variable and the *Other Radiolarians* variable is confusing and may lead to issues with future users). The updated dataset has been sent to the Pangaea repository for them to action.

Changes to manuscript: The variable *Reference* has been added to *Table 1: Description of variables in the SO-RAD dataset*.

(2) Consider the inclusion of additional sources with data for the area covered. Some potential candidates are:

Molina-Cruz, A. 1978. Late Quaternary oceanic circulation along the Paciic coast of South America. Unpublished Ph.D. Thesis, Oregon State University, Oregon, USA.

Boltovskoy, D. 1987. Sedimentary record of radiolarian biogeography in the equatorial to Antarctic western Pacific Ocean. Micropaleontology, 33:267-281.

Pisias, N.G., Roelofs, A. and Weber, M. 1997. Radiolarian-based transfer functions for estimating mean surface ocean temperatures and seasonal range. Paleoceanography, 12:365-379.

CLIMAP. 1997. Relative abundance of radiolaria in surface sediments, doi:10.1594/PANGAEA.51928 [CLIMAP Project Members (1976): The surface of the ice-age earth, Science, 191:1131-1144]

Morley, J.J. 1977. Upper Pleistocene climatic variations in the South Atlantic derived from a quantitative radiolarian analysis: accent on the last 18,000 years. Unpublished Ph.D. Thesis, Columbia University, New York, USA.

Hollis, C.J. and Neil, H.L. 2005 Sedimentary record of radiolarian biogeography offshore eastern New Zealand. New Zealand Journal of Marine and Freshwater Research, 39:165–192.

Nigrini, C.A. 1967. Radiolaria in pelagic sediments from the Indian and Atlantic Oceans. Bulletin of the Scripps Institution of Oceanography, University of California, San Diego, 11:1-125.

Ling, H.Y. and McPherson, L.M. 1973. Polycystine Radiolaria from surface sediments of the northern Tasman Sea, p. 281-284. In Fraser, R. (comp.), Oceanography of the South Pacific, New Zealand National Commission for UNESCO, Wellington.

Renz, G.W. 1976. The distribution and ecology of Radiolaria in the Central Pacific: plankton and surface sediments. Bulletin of the Scripps Institution of Oceanography, University of California, San Diego, 22:1-267.

Author's response 1.2: One of the benefits of the SO-RAD database is that the samples were counted by a small number of people who use similar taxonomic concepts regarding Southern Ocean radiolarians. We do envisage this database will be a community resource with future input from other radiolarian researchers. The authors of the database are open to the idea of re-counting existing slides to include census counts from additional sites and improve coverage of the dataset. For example, all sites included in the Hollis & Neil (2005) study were re-counted for inclusion in Cortese & Prebble (2015) and were subsequently included in the SO-RAD database.

The taxonomic concepts used in some of the past studies, such as CLIMAP (1997), Morley (1977) and so on, are now outdated and may not correspond with those used in SO-RAD. Converting existing census counts to the taxonomic concepts used in the SO-RAD database may introduce taxonomic biases. Ideally, one would need to recount the original slides before including the additional data. Locating, obtaining access to, and re-analysing fossil content of those slides would require a substantial amount of time and this may be pursued in the future.

Changes to manuscript: None.

(3) Consider including an appendix with a reference or references for the taxonomic interpretation of each species and, if possible, several representative images.

These additions, however, do not in any way diminish the value of the database, and the authors might have reasonable arguments for NOT including them.

Author's response 1.3: Reference/s for each species identified in the SO-RAD database is/are included in Supplement 2 (originally Supplement 1) to this paper. These references were chosen because they provide images and/or descriptions of radiolarian specimens included in our dataset and they correspond to our taxonomic concepts. Additional references have been added for some species in response to this comment.

Providing images for each species included in the SO-RAD database is outside of the scope of the SO-RAD database/this publication. Three PhD candidates (Lawler, Civel-Mazens and Lowe) are involved in the SO-RAD project and will likely be including images as part of their theses and/or publications. In this vein, a companion paper to our publication (Civel-Mazens et al., in prep), will include plates for 75 species/groups of species that are used for the

authors' SO-RAD-based transfer function. Additionally, the SO-RAD dataset can be modified in the future to provide links or references to images as they are published.

Changes to manuscript: None in the manuscript itself, some additional references added to Supplement 2 (originally Supplement 1).

References

CLIMAP. 1997. Relative abundance of radiolaria in surface sediments, doi:10.1594/PANGAEA.51928 [CLIMAP Project Members (1976): The surface of the ice-age earth, Science, 191:1131-1144]

Cortese, G. and Prebble, J.: A radiolarian-based modern analogue dataset for palaeoenvironmental reconstructions in the southwest Pacific, Mar. Micropaleontol., 118, 34–49, https://doi.org/10.1016/j.marmicro.2015.05.002, 2015.

Hollis, C.J. and Neil, H.L. 2005 Sedimentary record of radiolarian biogeography offshore eastern New Zealand. New Zealand Journal of Marine and Freshwater Research, 39:165–192.

Morley, J.J. 1977. Upper Pleistocene climatic variations in the South Atlantic derived from a quantitative radiolarian analysis: accent on the last 18,000 years. Unpublished Ph.D. Thesis, Columbia University, New York, USA.

Reviewer comment - Anonymous:

Lawler et al. present a compilation of published and newly generated dataset radiolarian assemblages from 228 Southern Ocean sites. The dataset is significant, and it will be very useful for the micropaleontological community focused on biogeography, paleoecology and transfer functions in the Southern Ocean.

However, there are some inconsistencies, incompleteness and lack of transparency in some cases. For example, there is a reasonable argument about the criteria used for sample inclusion, which includes 25% of tropical subtropical samples, but only for some regions. Why Abelmann et al 1999 was included, if it was not counted/recounted by the authors, and others potential datasets with full census counts were not included (e.g. Pisias et al 1997; Hollis and Neil 2005? There is missing information about taxonomic harmonization for some datasets (Abelmann et al 1999), missing environmental data and erroneous information about sample preparation (and subsequent inconsistencies in the fraction used for slide preparation). For this, I recommend major revisions, and I hope the authors can improve the quality of the data set for an article in a journal of the standing of ESSD.

Major comments:

If samples from Indian Ocean were recounted to ensure taxonomic consistency, why the 44 sites were published by Abelmann et al. (1999), who is not in the author list, were not recounted too? How the authors are sure that there is a taxonomic consistency? Did the authors check somehow that taxonomy and nomenclature was consistent among the post-2000's datasets/publications? The authors should explain why they included an incomplete and apparently non-harmonized dataset in their compilation. The final dataset has 74 samples which have <100% (31% of the total dataset); 13 less than 60%. Some of the criteria used by Abelmann et al. (1999) to remove species can be justified

and reasonable (rare taxa below certain threshold), although it is not optimal when you are trying to assemble a robust modern dataset. Other criteria, such as depth habitat or clarity of identification, are not so clear, and can lead to substantial biases when Abelmann et al. (1999) is combined with the other datasets which have all the species identified and sum up to 100%. If having 100% of the assemblage is not a major criteria to include samples, why the authors did not decide to include other studies which cover gaps in the distribution of surface sediment samples?

Author's response 2.1: The choice to include the Abelmann et al., 1999 dataset was dictated by the need for taxonomic consistency. Our co-author (Cortese), a Southern Ocean radiolarian specialist, worked as a post-doc for 9 years in Andrea Abelmann's group at AWI. During his first post-doc, he was tasked with updating and expanding the Abelmann et al. dataset by including samples from the subtropical region of the Atlantic Sector. Cortese used this updated version of the Abelmann et al. (1999) dataset to reconstruct temperatures in core ODP1089, Leg 177 and in core PS2821-1 from radiolarian assemblages he counted (Cortese and Abelmann, 2002). At that time, he made sure that A. Abelmann and his own taxonomic concepts were the same. In our new paper, those concepts have only been modified slightly (e.g., the radiolarian category "Larcoid" was changed to Pylonoiidae/Litheliidae, or Antarctissa cylindrica was added to Antarctissa spp.), due to new studies appearing after the 90s that updated modern concepts of radiolarian taxonomy (Suzuki and Aita, 2011; Lazarus et al., 2015; Matsuzaki et al., 2015). Therefore, we stress here, that the Abelmann et al. (1999) dataset, was checked thoroughly and that its taxonomy is the same as the rest of SO-RAD. This taxonomic consistency need is also the reason we decided not to include other datasets which were not counted by any group members, particularly so if they were quite dated (e.g., CLIMAP, 1997; Pisias et al., 1997), as the different counting conventions and taxonomy would make it very difficult to harmonize those data to the rest of our dataset. The obvious solution would be to obtain the original samples/slides and recount them, but this may not practicable as the authors of those datasets have retired. Incidentally, we perceive data accessibility as one of the main benefits of the present SO-RAD compilation. We have adopted this approach for two datasets for which slides were available to us: Hollis and Neil (2005) for samples around New Zealand, and the Rogers' samples from the Indian Sector (Rogers & De Deckker, 2007). For both of these, Cortese recounted all slides.

For the future expansion of the dataset, the intention is that the authors of the dataset will seek out existing samples, as well as samples from upcoming voyages, and add those data to improve the spatial coverage of the SO-RAD dataset.

Changes to manuscript: None

- Section 2.1.2

The authors say that 'For both the previously published and unpublished sites, slides were prepared using the procedure described in Cortese and Prebble (2015).', and describe the use of a 45µm mesh-size sieve. This is not correct. Rogers and De Deckker (2007) indicate in their material and methods section that 'samples were washed through a 63 µm sieve'. Please correct this, and discuss the implications of merging data which belong to different size fractions.

Author's response 2.2: The reviewer has noted that the size of the sieve used by Rogers and De Deckker (2007) to prepare the slides is in fact 63 µm rather than 45 µm. To state all samples used 45 µm sieve size was incorrect. This was an oversight by the authors and the methods section of the manuscript has been amended accordingly.

Changes to manuscript: Small changes were made in lines 114 – 122, and the following lines added (lines 123-123):

"Note that the specific chemical separation steps may differ between authors, as may the mesh size used. A mesh size of 40-45 µm has been used with the exception of Rogers & DeDeckker (2007) who used a 63 µm mesh size. For detailed methods on slide preparation for previously published data, refer to the references listed in section 2.1.1."

- Complementary data

The authors mention that they extracted different environmental variables at the location of the samples, but these are not included as supplementary material. Moreover, the choice of 100 m depth for extracting those variables seems a bit arbitrary. Although I can accept that higher radiolarian abundances are found at the subsurface, that is not likely true for all the regions included in the dataset. In some cases, higher abundances can even occur deeper in the water column. This section should include the raw environmental data at several standard depths, not just one. This information could be added to Table 1 or included as an additional table.

Author's response 2.3: The use of complementary data in this paper is not for analytical purposes, but to illustrate the environmental coverage of the dataset in each sector. The source of the environmental data used in this paper is referenced and freely available for download.

The SO-RAD dataset consists of radiolarian census counts only. The intention of the authors in building this dataset is not to include environmental data alongside the radiolarian census counts. Future users of the dataset who wish to perform environmental reconstructions, or use the data for other purposes, should select the environmental variables, from which depths and from which data source, best suits their needs. We do not want future users to think that the SO-RAD census counts should only be used with this one set of environmental data, which is why we have not included it in the SO-RAD dataset itself, or as a supplement to this paper.

Changes to manuscript: None

- 2.3 Structure of the SO-RAD dataset

The authors should include a column in Table 1 which indicates the source of the data (publication or new data). Is there any information about the abundance (Radiolarian/gram) or preservation (qualitative estimation) of the radiolarian assemblages at each location? That kind of information is very relevant in paleoceanography.

Author's response 2.4: The reviewer has recommended the inclusion of the source of the data in the SO-RAD database. This column has been added to the dataset and will be submitted to Pangaea for updating.

The reviewer has also requested the inclusion of the radiolarians/gram variable in the dataset. This data is not available for the majority of the samples included in this study and therefore we have not included this as a variable in the SO-RAD dataset. Moreover, the total number of radiolarians/gram of sediment is a different metric used as an indication for radiolarian productivity. This database is mainly focused on providing census counts of radiolarian assemblages.

Changes to manuscript: The variable *Reference* has been added to *Table 1: Description of variables in the SO-RAD dataset*.

- 3.2 Environmental data

As indicated above, the environmental data is not included in the submission, so it can not be evaluated.

As per Author's Response 2.3.

L. 184. This sentence is confusing: …' are well removed from the direct influence of seasonal sea ice.'.

Author's response 2.5: We appreciate this feedback and have modified the wording.

Changes to manuscript: We have modified the wording of this sentence (now line number 181) to '…may be affected by sea ice in certain years.'

- 2.4 Software

According to the ESSD guidelines, 'ESSD data products and data descriptions should include all codes, libraries, statistical or interpolation routines, model versions'. In the case of Lawler et al, they should include the R code used to generate the figures and summary statistics.

Author's response 2.6: R code has not been submitted with this manuscript as there is no code used in the construction of the dataset and there is no code required by future users to work with the dataset. Summary statistics, maps and figures were created using R; however, these could have been made using a variety of other point-and-click software for which no code could have been provided, therefore providing the R code seemed unnecessary.

Changes to manuscript: None

- 4.1 General limitations

One particular issue which is not even discussed in the manuscript is tue quantification of the uncertainties inherited from source data, environmental and radiolarian census counts.

Author's response 2.7: In relation to environmental data, future users of the dataset who wish to conduct palaeoenvironmental reconstructions would be expected to source their own environmental data. Part of their analysis would be to investigate the uncertainties associated with their chosen environmental data set.

Some uncertainties in census counts of microfossils are difficult to quantify as they can be affected by factors such as preferential dissolution of species, differing taxonomic concepts,

and counting procedures. One aspect of uncertainty in census counts which may be quantifiable is how representative the census count is of the natural population. The error associated with dominant species will generally be lower than with rare species. Higher number of counted individuals tends to minimise this type of error (Fatela and Taborda, 2002). These topics are covered briefly in sections 4.1 and 4.2.1 of the paper.

Changes to manuscript: None

Minor comments:

L. 38. Subtropical Southern hemisphere assemblages are not dominated by siliceous microfossils. Subtropical (25° to 40° S).

Author's response 2.8: The authors appreciate this comment and as the statement is not vital to the paper, we have removed that portion of the sentence.

Changes to manuscript: The new sentence reads as follows:

"In the Southern Ocean, two main siliceous microfossil groups, diatoms and radiolarians, have been used to determine past environmental conditions such as ocean temperature."

Paragraph starting at L. 42. There are multiple sentences about feeding strategies, size and habitat in that lack a valid reference. Although radiolarian experts are familiar with those statements, new users may appreciate if the authors could include references to support those statements.

Author's response 2.9: The authors appreciate that readers who are new to working with radiolarians may appreciate more references here.

Changes to manuscript: Additional citations were added, and we included a new sentence on lines 51-52:

"Lazarus et al., (2021) provide an extensive and up-to-date review on radiolarian biology as well as their distribution both in the water column and sediments."

L. 53. Missing reference about carbonate preservation

Author's response 2.10: The authors appreciate this comment and citations were added.

Changes to manuscript: Additional citations were added on line 54.

L. 54. Sentence about the importance of siliceous microfossils is confusing. Importance for what, for the reconstruction of past conditions? Importance for the carbon cycle and biological pump? If that is the case, that is a very simplistic view of the impact of anthropogenic warming on World's oceans. Other studies have observed a poleward expansion of calcareous nanoplankton species relative to non-calcifying groups of phytoplankton (e.g. diatoms) (Winter et al 2014).

Author's response 2.11: The authors appreciate this comment and as the statement is not vital to the paper, we have removed it.

Changes to manuscript: The sentence was removed from the manuscript.

L. 135-138: The authors mention some naming adjustments, so-called taxonomic harmonization, updating of species concept and species grouping. However, there is no any table with information about original names vs. adjusted ones.

Author's response 2.12: As requested, an additional supplementary table will be submitted with the final manuscript. The supplement will list species names that appeared in previously published datasets but have been updated in the SO-RAD dataset to fix inconsistencies in naming, or to align with the most recently accepted species name.

Changes to manuscript: The supplement is referred to in line 133.

L. 225: There is a considerable number of samples which could be considered as tropical and subtropical. If the dataset is called 'Southern Ocean RADiolarian' dataset (although 'Subtropical is included in the discussion, L. 226), it should only include samples from the Southern Ocean (which has its northern limit at 60° S latitude). In its current state, 25% of the samples correspond to the tropical-subtropical domain. I understand the motivation of including lower-latitude samples; to cover potential scenarios of influence of tropical waters in mid-to-high latitudes locations in the past, although I doubt the assemblages in those cases would resemble its composition to modern tropical locations. Perhaps the authors should consider renaming the dataset and using the term Southern Hemisphere, which would be more accurate. Moreover, if the authors have decided to included tropical-subtropical samples, why they did not include samples from other sectors in the Pacific Ocean (which are currently underrepresented)? Publicly available datasets by Pisias et al (1997), Hollis and Neil (2005) or the recent compilation by Hernandez-Almeida et al (2020) have samples which, geographically, would fit in the scope of the current compilation. Although perhaps they are taxonomically different, merging would be possible, as it seems it has been made for the dataset by Abelmann et al (1999).

Author's response 2.13: The reviewer has stated 60°S should be considered as being the northern limit of the Southern Ocean. This 60°S definition of the Southern Ocean may be considered the 'political' boundary of the Southern Ocean. For example, the Antarctic Treaty generally covers the area south of 60°S but expands to 45°S around Kerguelen Island in the Indian sector of the Southern Ocean. The oceanographic northern boundary of the Southern Ocean has several definitions. It can be considered as being the northernmost extent of the Antarctic Circumpolar Current (~38°S), or as far north as 30°S to include all oceanographic conditions south of the Subtropical Front (Sokolov and Rintoul, 2002; Talley et al., 2011). Additionally, the Westerly winds, drivers of the dominating zonal circulation in the Southern Ocean (the ACC), originate well north of 60 ºS. It is therefore beneficial to include samples located as far north as 30 ºS to encompass the full extent of the Southern Ocean.

Moreover, as the reviewer also mentions, if the dataset were used for palaeoceanographic reconstructions, it is important to incorporate a range of sites so that periods warmer than today can be accurately reconstructed. This translates to the need to capture radiolarian assemblages related to Western Boundary currents (Agulhas system, East Australian Current) that feed into the Southern Ocean. Future users of the dataset can subset the sites based on the latitudinal and longitudinal boundaries that are most appropriate to their project aims.

The authors of the dataset intend to expand the dataset by adding sites predominantly within the Southern Ocean's northern oceanographic boundary. There is no intention to ensure coverage of the dataset expands to include the tropics, which represent a different oceanographic and climatic realm, and therefore renaming the dataset as the 'Southern Hemisphere Radiolarian dataset' would be misleading.

Changes to manuscript: None.

L. 280: Even if Abelmann et al (1999) explain in the original publication the rules for the exclusion of certain species, would be interesting to include those here, to help to understand why Abelmann's dataset was included and not other available datasets.

As per Author's Response 2.1.

L. 332: I would never recommend to subset dataset by taxa living at a particular depth, in particular in the Southern Ocean where there is so little information about depth habitats of radiolarians, which may vary zonally, or in the seasonal or multi-annual time-scale. Instead it would be more convenient to include environmental data for multiple depths.

Author's response 2.14: There are many views on subsetting a reference dataset for use in palaeoceanographic reconstructions. Some radiolarists have used species from all depths in their reconstructions, while others have removed species based on their known depth ranges to reconstruct environmental variables at a particular depth: e.g., Abelmann et al. (1999), Cortese and Abelmann (2002), and Matsuzaki and Itaki (2017). The authors of this paper are not prescribing hard and fast rules that future users of the dataset must follow in regard to subsetting radiolarian census count data, but are outlining a range of methods seen in radiolarian literature for future users to consider. They can then decide on the best method given their own project aims. The aim of SO-RAD is to provide as much raw data as possible with harmonized taxonomy and future users will be free to use and adapt SO-RAD to best suit their own needs.

Changes to manuscript: After considering the reviewers comment, we have amended the wording of the sentence 'It may be desirable to limit the reference dataset to taxa that are known to live at the depth for which a specific environmental variable is being reconstructed.' to 'It is possible to limit the reference dataset…' (line 329) to demonstrate a more neutral approach regarding this matter.

References:

Hernandez-Almeida, I., Boltovskoy, D., Kruglikova, S. B., & Cortese, G. (2020). A new radiolarian transfer function for the Pacific Ocean and application to fossil records: Assessing potential and limitations for the last glacial-interglacial cycle. Global and Planetary Change, 190, 103186.

Hollis, C.J. and Neil, H.L. 2005 Sedimentary record of radiolarian biogeography offshore eastern New Zealand. New Zealand Journal of Marine and Freshwater Research, 39:165–192

Pisias, N. G., Roelofs, A., & Weber, M. (1997). Radiolarian based transfer functions for estimating mean surface ocean temperatures and seasonal range. Paleoceanography, 12(3), 365-379.

Winter, A., Henderiks, J., Beaufort, L., Rickaby, R. E., & Brown, C. W. (2014). Poleward expansion of the coccolithophore Emiliania huxleyi. Journal of Plankton Research, 36(2), 316-325.

References for Author's Responses

Abelmann, A., Brathauer, U., Gersonde, R., Sieger, R. and Zielinski, U.: Radiolarian-based transfer function for the estimation of sea surface temperatures in the Southern Ocean (Atlantic Sector), Paleoceanography, 14(3), 410–421, https://doi.org/10.1029/1998PA900024, 1999.

CLIMAP. 1997. Relative abundance of radiolaria in surface sediments, doi:10.1594/PANGAEA.51928 [CLIMAP Project Members (1976): The surface of the ice-age earth, Science, 191:1131-1144]

Cortese, G. and Abelmann, A.: Radiolarian-based paleotemperatures during the last 160 kyr at ODP Site 1089 (Southern Ocean, Atlantic Sector), Palaeogeogr. Palaeoclimatol. Palaeoecol., 182(3), 259–286, https://doi.org/10.1016/S0031-0182(01)00499-0, 2002.

Cortese, G. and Prebble, J.: A radiolarian-based modern analogue dataset for palaeoenvironmental reconstructions in the southwest Pacific, Mar. Micropaleontol., 118, 34–49, https://doi.org/10.1016/j.marmicro.2015.05.002, 2015.

Fatela, F. and Taborda, R.: Confidence limits of species proportions in microfossil assemblages, Marine Micropaleontology, 45(2), 169–174, https://doi.org/10.1016/S0377-8398(02)00021-X, 2002.

Hollis, C.J. and Neil, H.L. 2005 Sedimentary record of radiolarian biogeography offshore eastern New Zealand. New Zealand Journal of Marine and Freshwater Research, 39:165–192.

Lazarus, D., Suzuki, N., Caulet, J.-P., Nigrini, C., Goll, I., Goll, R., Dolven, J. K., Diver, P. and Sanfilippo, A.: An evaluated list of Cenozic-Recent radiolarian species names (Polycystinea), based on those used in the DSDP, ODP and IODP deep-sea drilling programs, Zootaxa, 3999(3), 301, https://doi.org/10.11646/zootaxa.3999.3.1, 2015.

Matsuzaki, K.M., Suzuki, N., and Nishi, H.: Middle to Upper Pleistocene Polycystine Radiolarians from Hole 902-C9001C, Northwestern Pacific, Paleontological Research, 19(s1), 1-77, (13 March 2015)

Matsuzaki, K. M. and Itaki, T.: New northwest Pacific radiolarian data as a tool to estimate past sea surface and intermediate water temperatures, Paleoceanography, 32(3), 218–245, https://doi.org/10.1002/2017PA003087, 2017.

Morley, J.J. 1977. Upper Pleistocene climatic variations in the South Atlantic derived from a quantitative radiolarian analysis: accent on the last 18,000 years. Unpublished Ph.D. Thesis, Columbia University, New York, USA.

Pisias, N. G., Roelofs, A., and Weber, M.: Radiolarian-based transfer functions for estimating mean surface ocean temperatures and seasonal range, 12, 365–379, https://doi.org/10.1029/97PA00582, 1997.

Rogers, J. and De Deckker, P.: Radiolaria as a reflection of environmental conditions in the eastern and southern sectors of the Indian Ocean: A new statistical approach, Mar. Micropaleontol., 65(3), 137–162, https://doi.org/10.1016/j.marmicro.2007.07.001, 2007.

Sokolov, S. and Rintoul, S. R.: Structure of Southern Ocean fronts at 140°E, Journal of Marine Systems, 37, 151–184, https://doi.org/10.1016/S0924-7963(02)00200-2, 2002.

Suzuki, N. and Aita, Y.: Radiolaria: achievements and unresolved issues: taxonomy and cytology, 6, 69, 2011.

Talley, L. D., Pickard, G. L., Emery, W. J., and Swift, J. H.: Chapter 13 - Southern Ocean, in: Descriptive Physical Oceanography (Sixth Edition), edited by: Talley, L. D., Pickard, G. L., Emery, W. J., and Swift, J. H., Academic Press, Boston, 437–471, https://doi.org/10.1016/B978-0-7506-4552-2.10013-7, 2011.