Citation:

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Summary

1) Data files

Ocean microstructure measurements were obtained from a Rockland Scientific (RSI) MicroRider (MR, serial number 324) attached to an electric Slocum glider. The glider Odin is a 1000-m electric Teledyne Webb Slocum glider (G3, serial number 775). The glider was operated close to the marginal ice zone, west of Spitsbergen, during the ATWAICE cruise on board Polarstern (PS131) in July 2022.

The glider mission started on 6 July 2022 and ended on 2 August 2022. In addition to the turbulence package, the glider was equipped with a pumped Seabird conductivity-temperature (CTD) sensor. Both the CTD and the MR were configured to sample during dives and climbs of the glider.

The dissipation rate was measured using two airfoil shear probes. The dataset has been processed and formatted in accordance with the SCOR Working Group ATOMIX guidelines and recommendations. One NetCDF (NC) file per instrument's native file (typically one file between consecutive surfacings of the glider) is provided. Each provided NC file is organized in four hierarchical groups including continuous time series of data converted into physical units, cleaned time series used for spectral analysis, wavenumber spectra, and dissipation rate estimates. The first group also includes time series, matched with the MR time, of longitude, latitude, temperature, salinity and flight parameters from the glider.

The grouped NC files are large and may be impractical to download and merge. There are 208 files in total (file numbers 10 to 217). For users only interested in the dissipation estimates and other time-averaged profiles, we also provide two separate NC files with all dissipation rate (and other related parameters) profiles and 1-s averaged sensor data, including flight parameters, collated into one file each. For more detailed information, please refer to the comments within the data file.

2) Collated files

This set of two NetCDF (NC) files are constructed by concatenating time series from the individual NC files per instrument's native file.

MERGED_SLOW contains the data from selected sensors, along with flight parameters, averaged in 1-second windows, and then concatenated in a 1-D time series.

MERGED_EPSI contains dissipation rate estimates together with quality control parameters concatenated in a 1-D time series.

A section (a more general term for a profile) is a continuous part of the time series that has been selected for dissipation estimates. As the glider moves through the water while collecting data, its flight characteristics may change and at times may not meet the conditions necessary for good dissipation estimates. This can result in multiple separated sections of dissipation estimates per dive or climb. Each such section has a unique section identifier number. The two NetCDF files described below are constructed from the 636 sections.

When producing the merged files, in addition to the automated quality assurance, we performed manual quality screening and updated the flag values. The screening removed data (i.e., replaced with NaN) during times with malfunctioning probes, contamination from altimeter effects, abrupt flight behavior changes, and when hotel data were not available. More details can be found in the description and attributes of the two merged NC files. In the MERGED_EPSI file, quality flags are applied to EPSI_FINAL time series.

The data in the concatenated files are not gridded in time or pressure. Each data point has its own time stamp and a pressure value, with time increasing monotonically from the start of the first section. Sections when the glider ascends (climbs) will therefore have pressure values decreasing with time.

3) Additional details

Ocean turbulence data were collected using a Rockland Scientific (RSI) MicroRider (MR-1000, serial number 324) attached to a Slocum electric glider as platform. The glider Odin is a 1000-m electric Teledyne Webb Slocum glider (G3, serial number 775). It was deployed on 6 Jul 2022 18:00 UTC and recovered on 2 Aug 2022. The payload included a pumped Seabird conductivity-temperature (CTD41CP, SN9545) and the MR turbulence package. The MR was fitted with two shear probes (S1=M2469, S2=M2470) and two thermistors (T1=T2115, T2=T2220) for measuring turbulence microstructure. Both the CTD and the MR were configured to sample during dives and climbs of the glider. The glider was operated close to the marginal ice zone, west of Spitsbergen, during the ATWAICE cruise on board Polarstern (PS131). Some interruptions in the data collection of the MR occurred (for example, for about 15 hours from 7 July 16:00, and on 25 July between 04:00 and 07:00) due to mission aborts.

The data from the MR include measurements from 2 shear probes, 2-axis piezo-accelerometers (vibration), an inclinometer (pitch and roll) and a pressure transducer. The turbulence and vibration channels were sampled at a rate of 512 per second, while the other channels were sampled at 64 per second. The glider was operated with fixed battery positions during dives and climbs to reduce vibrations from the servo mode. Glider grounded twice during the segment on 18 July afternoon, due to altimeter being set too deep (200 m), this was corrected during next surfacing. The glider did not ground during any subsequent surfacings. The glider hit the sea ice on 31 July, approximately 11:50 UTC (by the end of DAT_217.P), when all probes of the MicroRider were broken.

In total 208 files are processed (file numbers 10 to 217) out of a total of 217, excluding the short files when the glider was on deck or at the surface, and the files using the servo mode. The 208 files resulted in 636 sections. A section (a more general term for a profile) is a continuous part of the time series that has been selected for dissipation estimates. As the glider moves through the water while collecting data, its flight characteristics may change and at times may not meet the conditions necessary for good dissipation estimates. This can result in multiple separated sections of dissipation estimates per dive or climb. Each such section has a unique section identifier number. The two NetCDF files described below are constructed from the 636 sections. Users interested in concatenated dissipation profiles and 1-second time-averaged sensor data can use these files and avoid downloading of full records from the individual NC files.

The processing of the data and the format of this data set follows the recommendations and guidelines of the SCOR Working Group 160, ATOMIX (https://atomix.app.uib.no/), as decribed in Lueck et al. (2024). The processing was based on the standard Matlab routines provided by Rockland Scientific, which were adjusted for the ATOMIX recommendations.

One NetCDF (NC) file per instrument's native file (one file between consecutive surfacings of the glider) is provided. Each NC file includes four hierarchical groups:

L1_converted : time series from all sensors converted into physical units
L2_cleaned : selected signals that are filtered and/or despiked before spectral analysis. Time stamp and length of the signals are the same as in L1.
L3_spectra : wavenumber spectra from shear probes and vibration sensors
L4_dissipation: dissipation estimates together with quality control parameters

The glider (the so-called hotel), in addition to the temperature and salinity, also recorded roll and pitch. Together with the angle of attack and flow speed past sensors estimates using a hydrodynamic flight model, the hotel data are also included in L1_converted. The glider data are processed using the GEOMAR Matlab Slocum glider processing toolbox (Krahmann, 2023).

Spectral calculation and dissipation rate estimate details are given in the attributes and processing parameters. Initial processing using 4-s fft length resulted in low-wavenumber contamination of the shear spectra. To avoid this, spectra are obtained using 2-s fft length. The short fft length, however, is not ideal for resolving low dissipation rates. Dissipation estimates are obtained over 10 s segments, overlapping by 5 s (50% overlap). Detailed data processing parameters and choices can be found in the attributes. Shear and vibration spectra, their complex cross-spectra, and the cleaned shear spectra using the Goodman method are provided. L4 includes estimates from both shear probes, using the cleaned spectra, along with a final estimate obtained by averaging over estimates that passed the quality checks, and quality control parameters. We used figure of merit (FOM) and mean absolute deviation (MAD) relative to the Lueck model spectrum.

Data quality flags for dissipation estimates are summarized in the attributes of the variable EPSI_FLAGS within the L4 group. Any final dissipation estimate, EPSI_FINAL, failing the data quality control is reported as NaN. However, individual dissipation estimates from each probe are accessible in the EPSI parameter.

Substantial data losses occurred in shear probe measurements when the glider's altimeter was activated during dives, at variable depths depending on the total water depth. These instances are visible in the data as gaps in EPSI_FINAL and with large (typically >0.2) values of DESPIKE_FRACTION_SH (refer to attributes for description). We applied a despike_shear_fraction_limit of 0.15, and users may want to apply additional quality screening. Furthermore, for the glider data we used an inclusive FOM threshold of 1.4 (i.e., relatively large deviations from the model spectrum are accepted). For dissipation estimates less than 1e-10 W/kg, we relaxed this threshold by a factor of two (to 2.8), as this parameter is not well-constrained for low dissipation rates. We observed systematically larger FOM values with decreasing dissipation rates, most with marginally acceptable estimates. This choice was made to retain noise-level estimates instead of introducing gaps in the data. Users may want to apply additional quality screening. In processing of individual files, we only applied an automated quality screening, using the threshold values given in the attributes.

Because each file includes data sampled at full rate at two levels and their spectra in the third group, the grouped NC files are large and may be impractical to download and merge. For users only interested in the dissipation estimates and other time-averaged profiles, we provide two separate NC files containing all dissipation rate sections (along with other related parameters) and 1-second averaged sensor data including flight parameters, collated into one file each. These files contain long, 1-dimensional time series records. Data in the collated files are not gridded in time or pressure. Each data point has its own time

stamp and pressure value, with time increasing monotonically from the start of the first section. Sections where the glider ascends (climbs) will therefore have pressure values decreasing with time. When producing the merged files, we performed additional quality screening, and updated the flag values, for eventual malfunctioning probes, altimeter effects and abrupt flight behavior changes, and used only good data (i.e., quality flags are applied). More details can be found in the description and attributes of the two merged NC files.

References

https://atomix.app.uib.no/;

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