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Summary

1) Data files

Ocean microstructure measurements were obtained from a Rockland Scientific (RSI) MicroRider attached to an electric Slocum glider. Data were collected during the cruise KB2017618 onboard R.V. Kristine Bonnevie, as a part of the PROVOLO (Watermass transformation processes and vortex dynamics in the Lofoten Basin of the Norwegian Sea) project, funded by the Research Council of Norway (project number 250784).

The glider mission started on 6 September 2017 outside of the Lofoten Vortex, a permanent anticyclonic eddy in the Lofoten Basin of the Norwegian Sea. The glider was then navigated into the core of the eddy until the mission ended on 12 September 2017. In addition to the turbulence package, the glider was equipped with an unpumped Seabird conductivity-temperature (CTD) sensor, a Wetlab ECO-puck (fluorescence and turbidity), and an Andreraa oxygen optode. All instruments were configured to sample during dives and climbs of the glider.

The dissipation rate was measured using two airfoil shear probes. Turbulence channels sampled at a rate of 512 per second, and the slow channels at 64 per second. 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 is provided (typically one file between consecutive surfacings of the glider, 106 files in total). 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, dissolved oxygen concentration, turbidity, chl-a fluorescence, and flight parameters from the glider (so-called hotel).

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 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 is the collection of time series from selected sensors including temperature, salinity, dissolved oxygen concentration, turbidity, chl-a fluorescence, as well as flight parameters, averaged in 1-second windows.

MERGED_EPSI is the collection of time series of dissipation rate estimates together with quality control parameters.

212 sections from the 106 files are concatenated. 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 212 sections.

The concatenated time series differ from the individual NC files as follows.

1) When producing the merged files, in addition to the automated quality assurance during the processing, 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. A final dissipation estimate, EPSI_FINAL, failing the data quality control is reported as NaN; however, the individual dissipation estimates from each probe are accessible in the EPSI parameter.

2) The practical salinity and temperature from the glider are corrected against shipboard measurements using constant offsets of Toffset = -0.044C and Soffset = 0.0077 (in the form Scorrected = Smeasured + Soffset). Finally, 1-s salinity data are de-spiked using a 5 point median filter and 2 standard deviations threshold. Potential density anomaly is re-calculated, similarly de-spiked and smoothed using 11 point moving mean. The corrections, de-spiking and smoothing are not applied in the individual NC files.

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 microstructure measurements were obtained from a Rockland Scientific (RSI) MicroRider (MR) attached to an electric Slocum glider. Data were collected during the cruise KB2017618 onboard R.V. Kristine Bonnevie, as a part of the PROVOLO (Watermass transformation processes and vortex dynamics in the Lofoten Basin of the Norwegian Sea) project, funded by the Research Council of Norway (project number 250784). The glider mission started on 6 September 2017 outside of the Lofoten Vortex, a permanent anticyclonic eddy in the Lofoten Basin of the Norwegian Sea. The glider was then navigated into the core of the eddy until the mission ended on 12 September 2017.

The glider Gnaa is a Teledyne Webb Research 1000m electric glider (Slocum G1, SN103). The glider was equipped with an upumped Seabird conductivity-temperature (SN 0069), a Wetlab ECO-puck (fluorescence and turbidity, FLNTU SN 771), an Andreraa oxygen Optode (3830, SN 903), and an integrated RSI MicroRider (MR-1000-LP, SN059) with two shear probes (S1=M833, oriented vertical; S2=M666 oriented horizontal) and two thermistors (T1=T864, T2=T996; both sensors malfunctioned) for measuring turbulence microstructure. Both the CTD and the MR were configured to sample during dives and climbs of the glider.

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 pressure transducer was damaged and we rely on the pressure record from the glider's sensors. Data from both thermistors were of low quality and are not included in the files. Turbulence channels sampled at a rate of 512 per second, and the slow channels at 64 per second. The glider was operated with fixed battery positions during dives and climbs to reduce vibrations from the servo mode. Shallower dives prior to fixing the battery position are excluded from the data set. In total 106 files are processed, out of a total of 114, excluding the short files when the glider was on deck or at the surface. The 106 files resulted in 212 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.

Dissipation rate was measured using the shear probes on the MR. 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 (uncalibrated) dissolved oxygen concentration, turbidity and chl-a fluorescence, as well as 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 an earlier version of 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, as well as their average (EPSI_FINAL), together with quality control parameters. The figure of merit (FOM) and mean absolute deviation (MAD) relative to the Lueck model spectrum are used.

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

Because each file includes data sampled at a rate of 512 per second at two levels and their spectra in the third group, the grouped NC files are large in size and may be unpractical to download and merge. 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. When producing the merged profiles, only good data are used (i.e., quality flags are applied). Note that the data in the collated files are not gridded in time or pressure. Each data point has its own time stamp and pressure value. More details can be found in the description and attributes of the two merged NC files.

References

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

Lueck, R., I. Fer, C. E. Bluteau, M. Dengler, H. P., R. Inoue, A. LeBoyer, S.-A. Nicholson, K. Schulz, and C. Stevens (2024), Best practices recommendations for estimating dissipation rates from shear probes, Frontiers in Marine Science, 11, https://doi.org/10.3389/fmars.2024.1334327.

Krahmann, Gerd (2023) GEOMAR FB1-PO Matlab Slocum glider processing toolbox. https://doi.org/10.3289/SW_4_2023.

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