DYNAMO Sea Glider Sub Surface Ocean Data

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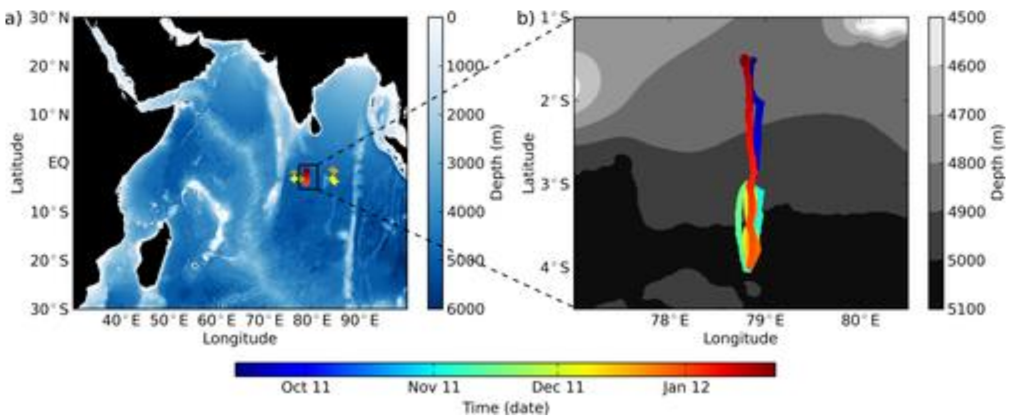
1. Data Set Overview:

The R/V *Revelle* was dispatched during CINDY/DYNAMO to make air-sea observations in the central equatorial Indian Ocean. The ship also deployed three pairs of surface and subsurface moorings and a sea glider (this data set). The sea glider conducted 738 dives during the campaign. The sea glider data provide detailed high vertical resolution (e.g., ~1m near the surface) subsurface ocean profiles that have been used to characterize the diurnal warm layer and the response to equatorial ocean Rossby waves.

Time period: 14 September 2011 – 23 January2012.

Physical location: The sea glider was deployed by the R/V *Revelle* in late September and made several S – N trips along 79°E between 1.5 - 4°S.



Bathymetry of the Indian Ocean (grayscale) and location of the Seaglider (scatter points), colored by time (see legend). Orange and yellow crosses in (a) indicate the location of Argo profiles used for comparison with the Seaglider data at the deployment and section locations, respectively. After Webber et al. [2014], their Fig. 3.

2. Instrument Description

The data provided here were measured using a Seabird SBE13 conductivity-temperature (CT) sensor. Temperature is rated accurate to 0.01 C and salinity to 0.01 PSU. Measurements were made continuously every 5 s (15 s) at 0-300 m (300 – 1000 m) for an effective resolution of 0.5 m (1.5 m).

The following description is from Matthews et al. [2014].

“The Seaglider is a 1.8-m, 50-kg unmanned buoyancy-driven autonomous underwater vehicle (AUV), instrumented for oceanographic research to measure pressure, temperature, conductivity, dissolved oxygen, chlorophyll fluorescence, and turbidity (Eriksen et al. 2001). A typical glider dive cycle has a sawtooth profile, with a dive phase from the surface to a specified depth (maximum 1000 m) and a climb phase back to the surface.”

“The Seaglider SG537 “Fin” was deployed in the equatorial Indian Ocean on 14 September 2011 at 1°30’S, 79°50’E. It was then piloted southward along the 79°50’E meridian to 3°S (30 September 2011). The glider then made 10 transects between 3° and 4°S, arriving at 3°S for the final time on 5 January

2012. It then continued northward to the retrieval location (same as deployment, at 1°30'S, 79°50'E) on 23 January 2012, with a total mission duration of 131 days."

"During the mission, the glider carried out 738 dive cycles, an average of 5.6 dive cycles per day or a time interval between the start of successive dives of 4.3 h. Of these, 564 dives (76%) were to 1000-m depth; the remaining dives were to 300 or 500 m. The glider vertical velocity is in the range 0.15–0.25 m s−1. Temperature and salinity were sampled every 5 s, hence the effective vertical resolution is approximately 1 m."

3. Data Collection and Processing

The glider data were corrected for thermal lags, sensor response time, and nonsynchronicity of sensor readings. A further correction was made to the pressure measurements, to remove long-term drift of the pressure sensor over the mission duration and also to account for hysteresis within each dive." a subjective despiking algorithm to remove outliers in $\Theta - S_A$ space.

Data were provided by the PI as individual files for each dive in netCDF format. Brandon Kerns aggregated the data into a single NetCDF file using the Python NetCDF4 module. Interpolation was not done—the data retain the spatial resolution provided by the PI.

4. Data Format

The seaglider data is contained in a single NetCDF file with the format below:

```
netcdf ocean.revelle.seaglider {
dimensions:
        dive = 738 ;
        sample = 3000 ;
variables:
        short dive(dive) ;
                dive:units = "1" ;
                dive:long_name = "Dive Number" ;
        byte sample(sample) ;
                sample:units = "1" ;
                sample:long_name = "Sample Number" ;
        double time(sample, dive) ;
                time:units = "hours since 1970-1-1 0:00:00 0:00" ;
                time:description = "Sample time in GMT epoch format" ;
        double decimal_day(sample, dive) ;
                decimal_day:units = "days since 2011-1-1 0:00:00 0:00" ;
                decimal_day:description = "Decimal days since 1 Jan 2011." ;
        double longitude(sample, dive) ;
                longitude:units = "degrees_east" ;
        double latitude(sample, dive) ;
                latitude:units = "degrees_north" ;
        double depth(sample, dive) ;
                depth:units = "meters" ;
                depth:description = "Distance below the surface, corrected for
latitude" ;
        double pressure(sample, dive) ;
                pressure:units = "dbar" ;
                pressure:standard_name = "sea_water_pressure" ;
        double temp(sample, dive) ;
                temp:units = "degree_C" ;
                temp:standard_name = "sea_water_temperature" ;
```

```
                temp:description = "corrected for first-order lag" ;
        double conductivity(sample, dive) ;
                conductivity:units = "S m-1" ;
                conductivity:standard_name = "electrical_conductivity" ;
                conductivity:description = "corrected for first-order lag" ;
        double salinity(sample, dive) ;
                salinity:units = "none" ;
                salinity:standard_name = "sea_water_salinity" ;
        double sigma_t(sample, dive) ;
                sigma_t:units = "kg m-3" ;
                sigma_t:standard_name = "sea_water_potential_density" ;
                sigma_t:ref_pressure = 0LL ;
        double theta(sample, dive) ;
                theta:units = "degree_C" ;
                theta:standard_name = "sea_water_potential_temperature" ;
                theta:description = "corrected for first-order lag" ;
        double density(sample, dive) ;
                density:units = "kg m-3" ;
                density:standard_name = "sea_water_density" ;
        double sigma_theta(sample, dive) ;
                sigma_theta:units = "kg m-3" ;
                sigma_theta:standard_name = "sea_water_potential_density" ;
                sigma_theta:ref_pressure = 0LL ;
        double soundvel(sample, dive) ;
                soundvel:units = "m s-1" ;
                soundvel:standard_name = "speed_of_sound_in_sea_water" ;
        double u_da(dive) ;
                u_da:units = "m s-1" ;
                u_da:description = "Eastward component of depth averaged current" ;
        double v_da(dive) ;
                v_da:units = "m s-1" ;
                v_da:description = "Northward component of depth averaged current" ;

// global attributes:
                :Conventions = "CF-1.7" ;
                :title = "DYNAMO Seaglider Data: Dynamo Legacy Collection" ;
                :institution = "University of East Anglia" ;
                :contact = "Adrian Matthews (a.j.matthews@uea.ac.uk), Brandon Kerns
(bkerns@uw.edu)" ;
                :source = "Seaglider deployed from the R/V Revelle during
CINDY/DYNAMO" ;
                :history = "Brandon Kerns obtained the data (NetCDF) from Adrian
Matthews in March 2018 and aggregated them in to a single file with selected
variables." ;
                :references = "" ;
                :comment = "Seaglider data recorded by the R/V Revelle during the
CINDY/DYNAMO field campaign from September to early December 2011.  Original file
names like: p5370738.nc." ;
}
```

5. Data Remarks

The data can be accessed using the myriad of software that is able to interact with NetCDF format files, including ncdump, ncview, Matlab, Python, IDL, and NCL.

The data from each dive were aggregated into a single file. Quality control has not been carried out beyond what was provided by the PI.

6. References

Eriksen, C., T. Osse, R. Light, T. Wen, T. Lehman, P. Sabin, J. Ballard, and A. Chiodi (2001), Seaglider: A long-range autonomous underwater vehicle for oceanographic research, IEEE J. Oceanic Eng., 26(4), 424–436.

Matthews, A.J., D.B. Baranowski, K.J. Heywood, P.J. Flatau, and S. Schmidtko, 2014: The Surface Diurnal Warm Layer in the Indian Ocean during CINDY/DYNAMO. J. Climate, 27, 9101–9122, https://doi.org/10.1175/JCLI-D-14-00222.1.

Webber, B. G. M., A. J. Matthews, K. J. Heywood, J. Kaiser, and S. Schmidtko, 2014: Seaglider observations of equatorial Indian Ocean Rossby waves associated with the Madden–Julian oscillation. J. Geophys. Res. Oceans, 119, 3714–3731, doi:https://doi.org/10.1002.

van der Wiel K, Matthews AJ, Joshi M, Stevens DP, 2016: The influence of diabatic heating in the South Pacific Convergence Zone on Rossby wave propagation and the mean flow. Quart. J. Roy. Meteorol. Soc., 142, 901-910.