

README

This document describes the data used in:

Crews, L., Lee, C. M., Rainville, L., and Brenner, S. (2023). Sea ice leads increase ice and ocean inertial oscillation strength during an Arctic winter storm. Submitted to *Journal of Physical Oceanography*.

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ADCP velocity and mixed layer depth for the full mooring deployments

ADCP ocean velocity measurements and mixed layer depth for the full deployments of the SODA moorings are available from the data archive:

Data Accompanying "Acoustic Sensing of Ocean Mixed Layer Depth and Temperature from Uplooking ADCPs", by Brenner et al., 2022.
<https://digital.lib.washington.edu/researchworks/handle/1773/49495>

We used the products `adcpCmb.mat` for ADCP velocity data and `combinedMLD.mat` for mixed layer depth during the time period described in our study.

This archive's data are included in the following files:

- SODA_A_timeseries.csv
- SODA_A_CTD.csv
- SODA_A_ADCP.nc

- SODA_B_timeseries.csv
- SODA_B_CTD.csv
- SODA_B_ADCP.nc

- SODA_C_timeseries.csv
- SODA_C_CTD.csv
- SODA_C_ADCP.nc

Descriptions of each of the data files are given below.

SODA_{A,B,C}_timeseries.csv

These files contain timeseries of data for each SODA mooring location (SODA-A, SODA-B, or SODA-C). All data are reported at hourly timesteps; products at daily timesteps (e.g., AMSR2 sea ice concentration) are resampled at a constant, daily value to match the hourly sampling of the mooring ADCP data.

Basic information for each mooring

- Time in Matlab date format [days since January 0, 0000]
- Longitude [decimal °E]: Location of mooring
- Latitude [decimal °N]: Location of mooring
- Coriolis frequency [1/s]

Sea ice concentration, draft, and leads

- Observed sea ice fraction: Daily average from ADCP altimeter data ([Brenner et al., 2021](#))
- ERA5 sea ice fraction: Daily average of all [ERA5](#) grid-points within a 30-km radius of mooring
- AMSR2 sea ice fraction: Daily [ice concentration](#) from the grid cell nearest the mooring location
- Lead fraction: [lead area / \(ice area + lead area\)](#) in a 100 km x 100 km region around the mooring
- Sea ice draft [m]: Hourly average from ADCP altimeter data ([Brenner et al., 2021](#))

Drag coefficients used to run the slab model

- Air-ocean drag coefficient C_{ao} calculated from wind speed (Large and Yeager, 2004)
- Air-ice drag coefficient C_{ai} calculated from sea ice concentration (Hersbach et al., 2023)
- Ice-ocean drag coefficient C_{io} calculated using a force-balance (Brenner et al., 2021)

Daily mixed layer depth derived from ADCP backscatter and near-inertial shear

- Mixed layer depth [m]: From [Brenner et al. \(2023b\)](#)

Wind data used to force the slab model are the average of all ERA5 grid-points within a 30-km radius of the mooring location, consistent with Brenner et al. (2021, 2023a)

- ERA5 10 meter wind u-component [m/s]
- ERA5 10 meter wind v-component [m/s]

Eastward/zonal u-components and northward/meridional v-components of observed ice velocity and observed ocean velocity depth-averaged in the mixed layer before and after inertial filtering

- Observed ice u-component [m/s]
- Observed ice v-component [m/s]
- Observed ice near-inertial u-component [m/s]
- Observed ice near-inertial v-component [m/s]
- Observed mixed layer u-component [m/s]
- Observed mixed layer v-component [m/s]
- Observed mixed layer near-inertial u-component [m/s]
- Observed mixed layer near-inertial v-component [m/s]

Eastward/zonal u-components and northward/meridional v-components of slab modeled ice velocity and ocean velocity before and after inertial filtering

- Modeled ice u-component [m/s]
- Modeled ice v-component [m/s]
- Modeled ice near-inertial u-component [m/s]
- Modeled ice near-inertial v-component [m/s]

- Modeled mixed layer u-component [m/s]
- Modeled mixed layer v-component [m/s]
- Modeled mixed layer near-inertial u-component [m/s]
- Modeled mixed layer near-inertial v-component [m/s]

Eastward/zonal u-components and northward/meridional v-components of daily sea ice drift from the NSIDC [Polar Pathfinder](#) grid cell closest to the mooring location

- Polar pathfinder ice u-component [m/s]
- Polar pathfinder ice v-component [m/s]

Additional parameters used to run the slab model

- Air density [kg/m³]
- Ocean density [kg/m³]
- Ice damping coefficient r_i
- Ocean damping coefficient r_o

SODA_{A,B,C}_CTD.csv

These files contain data collected by USCGC *Healy*'s shipboard CTD during the 2018 SODA mooring deployment cruise. Data from each cast were averaged into 1-m depth bins.

Temperature and salinity data from the rosette's two sensors were then averaged together. Conservative temperature and absolute salinity were calculated using the Gibbs SeaWater (GSW) Oceanographic Toolbox Version 3.0.11 functions `gsw_CT_from_t.m` and `gsw_SA_Sstar_from_SP.m` available at <http://www.TEOS-10.org>.

For WKB calculations at each mooring, two or three density profiles taken in the vicinity of the mooring were averaged together. Not all casts were unique to the mooring (for example, the SODA-A and SODA-B WKB calculations shared two casts that were taken between the mooring locations). The averaged density profiles were smoothed before WKB calculations were performed. Averaging and smoothing removes small-scale density variations as WKB theory assumes density changes occur on larger scales than the vertical scale of internal waves. The files contain data for all casts used for WKB calculations at that mooring, with casts distinguished by cast number (as well as time and location).

Variables

- CTD cast number for Healy Cruise 1802
- Time in Matlab date format of cast start [days since January 0, 0000]
- Longitude [decimal °E]: Location of cast start
- Latitude [decimal °N]: Location of cast start
- Depth [m]
- Conservative temperature [°C]
- Absolute salinity [g/kg]
- Potential density [kg/m³] referenced to the surface

SODA_{A,B,C}_ADCP.nc

These netCDF files contain hourly velocity profiles at each mooring; these data are identical to those reported in Brenner et al. (2023a, 2023b) and are included here for completeness.

Data from the Nortek Signature-500 and Teledyne Workhorse-300 ADCPs at each mooring were combined to create ocean velocity profiles spanning the upper 80 m of the water column in 2-m vertical bins at hourly temporal resolution (see Brenner 2022, Chapter 2.3.2). Data from the uppermost 6 m of the water column were discarded due to sidelobe reflections.

Each file contains the following global attributes:

- Longitude [decimal °E]: Location of mooring
- Latitude [decimal °N]: Location of mooring

Each file also contains the following variables:

- mattime: Time in Matlab date format of cast start [days since January 0, 0000]
 - z: Depth [m]
 - u: Eastward/zonal velocity [m/s]
 - v: Northward/meridional velocity [m/s]
 - u_inertial: Near-inertial eastward/zonal velocity [m/s]
 - v_inertial: Near-inertial northward/meridional velocity [m/s]
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References

- Brenner, S., 2022: The role of sea ice in mediating atmosphere-ice-ocean momentum transfer. <http://hdl.handle.net/1773/49108>.
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- Brenner, S., J. Thomson, L. Rainville, L. Crews, and C. Lee, 2023a: Wind-driven motions of the ocean surface mixed layer in the western Arctic. *Journal of Physical Oceanography*, 53, 1787–1804, <https://doi.org/10.1175/JPO-D-22-0112.1>.
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- Hersbach, H., and Coauthors, 2023: ERA5 hourly data on single levels from 1940 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), <https://doi.org/10.24381/cds.adbb2d47>.
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