Southern Ocean Argo: characterisation of Argo float profiles associated with ACC fronts and zones

Usage guidance

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Outline

This guide outlines the deployment of a series of code to retrieve Southern Ocean Argo float profile data from the ifremer Global Data Assembly Centre (GDAC). The code characterises profile location into zones according to core profile data in accordance with literature-based criteria. The code is deployable in MATLAB, with a prerequisite of an enabled FTP server connection via a Linux terminal/WinSCP to retrieve float data.

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Deployment requirements:

Code deployment:

- MATLAB 2016a or newer (netCDF api-enabled)

For full data retrieval from ftp.ifremer.fr

- data storage space of ~300 GB

For non-automated retrieval of Argo netCDF profiles from GDAC for **windows**

- WinSCP https://winscp.net/eng/index.php

For non-automated retrievel of Argo netCDF profiles from GDAC for **mac**

- FileZilla https://filezilla-project.org/

For automated retrieval of Argo netCDF profiles from GDAC

- UNIX/Linux interface

Plotting of argo profiles

m_map

The plotting function soarc_plotzones.m uses m_map, a freely available mapping toolbox for oceanographic data, found at https://www.eoas.ubc.ca/~rich/map.html. Downlaod m_map and save it to the working directory.

Bathymetry data

The bathymetry data used in soarc_plotzones.m is the 1-minute arc dataset, ETOPO1v1. The data file can be found at https://www.ngdc.noaa.gov/mgg/global/relief/ETOPO1/data/ice_surface/grid_registered/binary/. There is also an ETOPO2v2 bathymetry dataset (2-minute arc) which is a smaller file due to lower spatial resolution. The bathymetry file is called in m_etopo2.m, and an example of this function compatible with the ETOPO1v1 bathymetry data set is provided. The user should check the correct function path is called within m_etopo2.m.

Colour maps

The Argo float profile data is plotted into fronts and zones using a perceptually uniform colour-blind friendly colormap obtained from

https://uk.mathworks.com/matlabcentral/fileexchange/45208-colorbrewer-attractive-and-distinctive-colormaps. The colormap folder should be in the working directory. The soarc_plotzones.m provides an example usage.

Before deploying the code:

If you are not able to perform a remote connection to an FTP using a terminal, install WinSCP freely available here: https://winscp.net/eng/index.php

To download real-time Argo profiles in WinSCP:

a. Choose 'FTP' from the drop-down 'file protocol' menu
b. Enter host name as ftp.ifremer.fr and select anonymous login
c. See 'retrieve real-time Argo profiles using WinSCP'

Retrieve real-time Argo profiles using WinSCP

Following successful login to ftp.ifremer.fr

1. Download the profile index file ftp.ifremer.fr/ifremer/argo/ar_index_global_prof.txt
   a. This file contains the profile index of every profile since 1997 format *file,date,latitude,longitude,ocean,profiler_type,institution,date_update*

   e.g. aoml/13857/profiles/R13857_001.nc,19970729200300,0.267,-16.032,A,845,AO,20181011180520

2. Set up a transfer settings configuration that filters to download only real-time argo profiles

- Go to transfer settings → configure → add → preferences
- To filter and retrieve all files that begin with 'R' and 'D' and exclude in the file mask text box type */R* ; */D* | */BR*.nc (see https://winscp.net/eng/docs/file_mask)

3. Create a dac folder in your working directory
4. Drag and drop by dac

note: the whole dac folder contains ~280 GB of data so depending on the processing power available to you it is advised to not copy the whole folder in one go

Code usage (in order of use):

Master code

All code can be run from **soarc_master.m**. The only user input required when running this script is a Y/N for a read-in parameter file for soarc_sortprofs.m.

All functions from soarc_argo must be located in the working directory along with a parameter file (example provided: **soarc_param_driver_userexample.txt)**

Code running order:

1. soarc_sortprofs.m

Usage: Read in the argo profile index file **ar_index_global_prof.txt.** Filter this file for profiles based on Southern Ocean files of > 30° S. Further filter this file using user-defined latitude, longitude and date constraints

Input:

- ar_index_global_prof.txt from ftp://ftp.ifremer.fr/ifremer/argo
- Driver file, with user-defined lat/lon/year/month bounds (example **soarc_param_driver_userexample.txt)**

Output:

- A .txt file containing **all** Southern Ocean profile indexes
- A user-defined .txt file containing Southern Ocean profile indexes within lat/lon/year/month bounds

2. soarc_processprofs.m

Usage: read in desired netCDF files indexed in the Southern Ocean profile file
Check data quality and remove profiles that do not meet requirements for T, S and P. See Argo quality control manual Appendix 4.1
https://archimer.ifremer.fr/doc/00228/33951/32470.pdf)

Input:

- ar_index_realtimeSO_soarc_param_driver_lat_lon_mmyyyy.txt from soarc_sortprofs.m

Output:

Structure *fronts_profiles* containing

- Float profile index data: profile ID, lat, lon, time

- Float profile core data: T, S and P readings of profiles, and QC flag info

3. soarc_zonelogical.m

Usage: return logical structure of profile core and metadata into ACC fronts and zones based on defined characterisation

Input:

- float profile data structure
- criterion for front/zone characterisation

Output:

Structure *fronts_logical* based on

- logical array determining profile index front and zone

4. soarc_zonechar.m

Usage: characterisation all data into front and zones

Input: logical structure of front/zone criteria, *fronts_logical*

Output: structural array of final front/zone characterisation with all core profile data, *fronts_char*

5. soarc_outfile.m

Usage: create output index file of float profiles and subsequent zone characterisation

Input: *fronts_char* characterisation structure

Output: ar_index_soarc_char_v##_ddmmyy.txt; **format**: float,lat,lon,time,zone

6. soarc_plotzones.m

Usage: create surface plots of Argo data grouped as fronts and zones

Input: front/zone characterisation structure *fronts_char*

Output: Annotated surface plots of argo zones