# Physical Oceanography Work Package 4:

# Procedure for implementing Conductivity and Salinity correction for gliders

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For further information, refer to: \*insert link to future document here\*.

Code Description: This code outlines the process to "correct" glider conductivity (and therefore salinity and potential temperature) using corrected ship CTD data. The method involves the creation of a Theta-S diagram of "background" ship data, and "test" glider data. The whitespace maximisation method is then carried out, whereby the test data is iteratively shifted along the x (salinity) axis, and a calculation of the whitespace area in the Theta-S diagram figure is carried out. The iterative procedure continues adjusting the conductivity correction coefficient (i.e. the coefficient that ultimately leads the shift in the test data to the left or right) until the whitespace area of the figure has reached a maximum. This occurs when the test data is directly (as much as possible) overlying the background data.

This procedure requires several subjective expert decisions, which largely influence the outcome of the correction. The appropriate background data needs to be used, where both spatial and temporal separation of the datasets should be as small as possible, and yet, the danger of using background data from just one cruise campaign may result in correcting the glider data to a specific cruise campaign and not to the sensor offset. Also, the axis of the Theta-S diagram needs to be appropriate for the correction, such as excluding the highly variable surface data, and avoiding areas where the background data-points are densely populated and cover a larger area than the deepest, most stable part of the water column (where the variation in salinity is smallest, and thus the data points are densely overlying each other, but covering a relatively small area of the Theta-S diagram). Because of these subjective decisions, at each stage, the option to create two Theta-S diagrams occur, where user input is required to determine which background data is used, what axis limits to use, and which data are on the topmost layer of the diagram (and are thus most visible). The user is advised to create a plot of all background data and the test data to allow for a sensible decision on which background ship data should be used, first for the whole axis range and then for a "zoomed" diagram. In stage 2, the code will provide recommendations for the background data but still requires user input on how those recommendations are carried out. The user a have to rerun segments of the code if they are not satisfied with the decisions they have made.

In stage 3, the whitespace maximisation procedure will require user input to decide on the axis limits, and create final Theta-S diagrams of the background and test data to check the user is happy with the decisions made. The whitespace procedure will be carried out three times with different initial guesses for the correction coefficient. One of these guesses should always be 1 (i.e. no initial shifting of the test data). The other two initial guesses, the user is advised to use an initial guess that shifts the test data to the left and to the right of the background data. Final Theta-S diagrams of the corrected test data over the background data for all three scenarios will be created and the user will be asked to select the "best" initial guess value (to make sure the whitespace maximisation procedure has been adequately carried out). The user is also asked to estimate error, which should be carried out by looking at the thickness of the "thinnest" segment of the Theta-S diagram and estimating the range of salinity values the test data could effectively be.

In section 4, final Theta-S diagrams showing background data, and uncorrected and corrected test data are created, with user defined axis limits (recommended to create one plot of the whole figure and one zoomed into the "tail" end of the Theta-S diagram. A mat file is created detailing the correction coefficient, error estimate, standard deviation of the corrected ship background data, and a summary of the correction procedure applied.

INPUT:

1. NetCDF glider data from <http://thredds.socib.es>
2. Structured array of corrected ship half metre binned CTD data: ‘*SHIP\DATA\CTD\CTD\_correction\_files\****SHIP\_allDATA\_halfm\_corrected.mat***’

OUTPUT: 'TESTDAT': structured array of test (glider) data with:

1. Corrected conductivity, corrected salinity and corrected potential temperature.
2. Meta-data providing information regarding: correction coefficient, error estimate, background CTD data, and a correction method summary.

NESTED FUNCTIONS:

1. mapWMED(N,S,E,W); Creates map of coastline on which data coordinates can be plotted.

2. [SEASON,MNTHS] = SEASON\_of\_Cruise(Campaign,'GLIDER',STARTdate); Determines the season of the input data based on start date of campaign and lists the months that define that season.

3. TSdiags\_from\_Struct(withGlider,GliderCorr,TESTdat,depNUM\_glider); Creates Theta-S diagram of corrected half metre ship CTD data (user selects which cruises to plot) and has the option of plotting over the top with uncorrected and corrected glider data, and of deciding which data should be plotted on the very top layer.

4. [Campaign,Pname\_in\_comp] = Matching\_Cruise\_recommendation(Campaign,TYPE,bgrndRegions,first10); Based on user input options of which cruises to use (e.g. all cruises in one season or year, or the closest corresponding cruise, etc.) provides the ship campaign name of the recommended data for the background data by which the test (glider) data will be compared and corrected.

5. [guess, value, iterations] = optim3steps(func, init\_guess, step\_major, step\_minor, step\_miniscule, max\_iterations, varargin)

6. [area] = imageArea\_V2(A, condGlider, tempCondCellGlider, pressureGlider, ptempGlider, salinityShip, ptempShip, imageDir,AXISlims,counter)

MATLAB PACKAGES:

1. seawater sw\_ package (for salinity/conductivity/potential temperature conversions)

2. gsw\_ package (for salinity/conductivity/potential temperature conversions)

3. Mapping toolbox