

Perplex7 – Manual

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Introduction

PERPLEX stands for **P**rogram for **E**xpedition **R**oute **P**Lanning and **E**Xecution. I, Gerd Rohardt, a physical oceanographer, developed this software in Matlab® during working at AWI.

At Alfred-Wegener-Institute for Polar- and Marine Research (AWI), Bremerhaven - Germany, PERPLEX has been used for about 22 years, mainly for voyages with RV POLARSTERN and supports the chief scientist in the coordination of various scientific programs as well as in the logistical tasks that POLARSTERN performs, e.g. for the supply of the Neumayer III Station. PERPLEX has also proven its efficiency during short cruises or one-day cruises, e.g. with RV HEINCKE in the German Bight.

A version compiled with the Matlab Compiler® from the source codes could be downloaded temporarily from an AWI web site. PERPLEX was thereby also used by other institutions. Most effective for distribution had been the cruises with POLARSTERN itself, where participants could directly experience the great benefits of using PERPLEX, e.g. the time-accurate station plans and that the chief scientist could quickly make changes and always react to changing requirements.

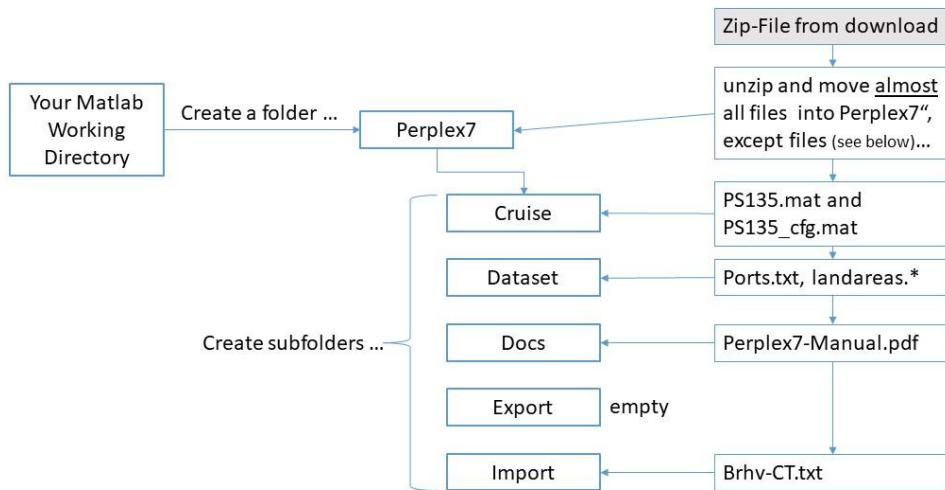
Nevertheless, it is understandable that institutions were hesitant to use PERPLEX. It was impossible not to notice that PERPLEX was very much oriented to the special requirements of AWI. Also, knowing that the support depends on only one (my) person is a disadvantage. This last point, which concerns me, is of great importance indeed, because I am retiring as of January 1, 2022.

Initially, I just wanted to "clean up" the source code and upload them to Mathworks FileExchange. At that time I had made the graphical user interface of PERPLEX with the GUIDE (Graphical User Interface Developer). Despite a tool to transfer this into the App Designer (*.mlapp), I had decided to completely redesign PERPLEX. The goal of doing so was to make the source code clearer and more understandable for users. Furthermore, I do not think it makes sense that the new version PERPLEX7 should reflect the complete functionality of PERPLEX-V5. For this, I will make independent extensions step by step and upload them to FileExchange later. (For example, a routine that calculates positions along a transect when a certain distance between stations is specified; see "Define Section" in Perplex-V5.) This would also make it easier for users to include their own applications or modify existing ones.

This release of PERPLEX7 contains the essential functionality needed to plan and execute a research cruise at sea. These are described in the following sections.

Installation:

Create folders and subfolders as shown below to install and execute Perplex7 in your Matlab-environment.



The folder “Cruise” is used to save your cruise plan. The Zip-file also contains an example “PS135.mat” and “PS135_cfg.mat”, which you can use, see menu [File – Open].

The folder “Export” is used to save station schedule as text file and the export of the cruise plan as Excel files.

The folder “Import” is used to save your txt-files with waypoints to be imported in the cruise file, see menu [In-Out – Import from txt-file].

Before Perplex7 can be executed, the following steps **must** be carried out:

- Topography: Perplex7 required the GEBCO topography, which must be available as a MAT file (GRIDONE_2D.mat). Download GEBCO One Minute Grid from link below, unzip and save GRIDONE_2D.nc in your Matlab working directory. To convert “nc-format” into “mat-format” execute ..\Perplex7\GRIDONEnc2mat.m. This function will request you to selecting a folder for the output. Chose folder: ..\Perplex7\Dataset. (Remark: The water depth is determined from this file for each position in the station list using the longitude and latitude. This data set is also used to display selected depth contours on the map.)
(https://www.gebco.net/data_and_products/historical_data_sets/#gebco_one)
- Default_InstrTable.csv: (Must be saved in folder ..\Perplex7.) This text file contains information from which Perplex calculates the duration to use an instrument. The details can also be changed when running Perplex7. However, in order to always use the same details when creating a new trip, we recommend users to editing the Default_InstrTable.csv file accordingly. An example of this is shown and explained in the Appendix. Caution: If Default_InstrTable.csv is changed with Wordpad or another text editor, a copy should be saved beforehand.

- Ports.txt: (Must be saved in folder ..\Perplex7\Dataset.) This file is a template of a list of ports with their position (latitude and longitude). Ports.txt is used when creating a new cruise to simply select the port of departure and port of destination by name from a list without having to explicitly specify the position. Check the list to see whether the ports you need for your travel plans are included and add any missing ports if necessary. Of course, you can also delete ports from the list that you will never need. Caution: If you modify Ports.txt with Wordpad or another text editor, a copy should be saved beforehand.

Optionally, the following steps **can** be carried out now or later:

- Exclusive Economic Zones (EEZ): Download World_EEZ from <https://www.marineregions.org/downloads.php#marbound>. Unzip and save eez_v11.* (6 files) in folder ..\Perplex7\Dataset.
- Sea Ice Concentration: See Chapter "Display Sea Ice Concentration in the Map".

Waypoints, Stations and Casts

The cruise route with a research vessel leads from the port of departure to the working area and from there to the destination port. However, the cruise can also end at the same port. The route is specified as precisely as possible with waypoints, e.g. in order to know the arrival time in the working area as good as possible. In the working area the route results from the stations, which get consecutive station numbers. Stations are waypoints where instruments were deployed. Cast 1 indicates the deployment of the first instrument used at a station. If further measurements follow at the same station, they are numbered consecutively; Cast 2, Cast 3, and so on. If a station or position is visited a second time during the cruise, the station number will still be numbered consecutively.

Operation

Execute Perplex7.mlapp

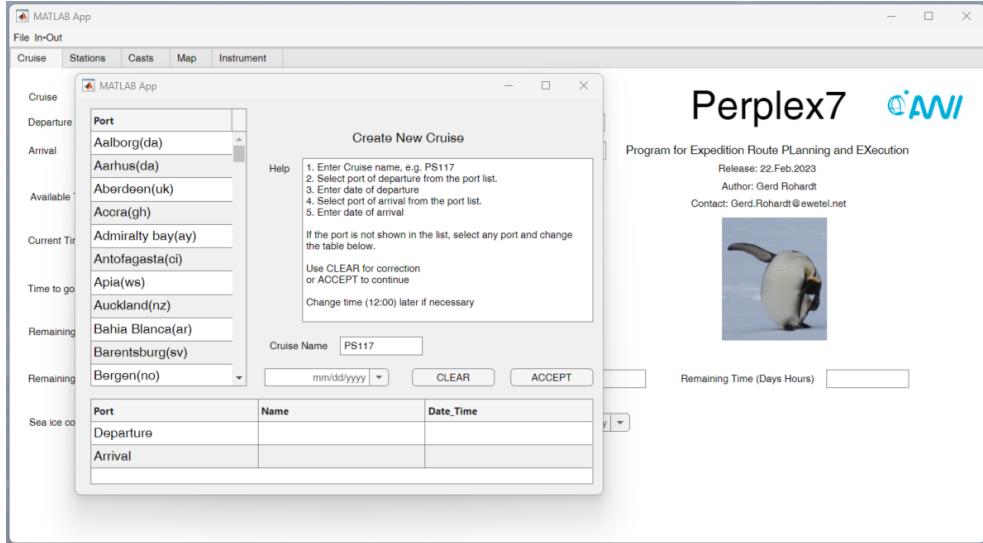
First of all, it is checked whether the required files are available in the respective folders (see Installation). If one or more files are missing, the missing files are displayed in an error message. Only after this has been corrected, Perplex7.mlapp can be executed again.

Further on the file Perplex7_cfg.mat in folder c:\MyMatlab\Perplex7 is searched for, in which is indicated, which was the last opened and/or worked on cruise file.

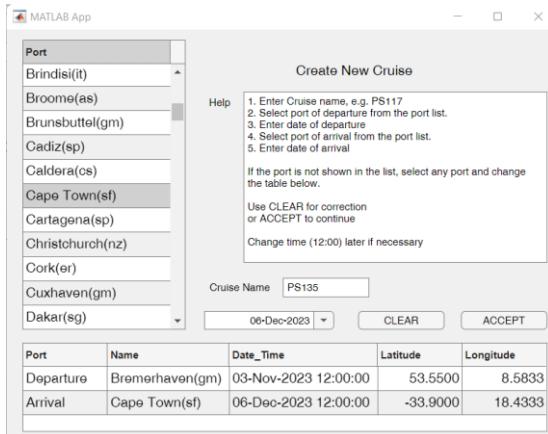
If this file exists there, it is loaded, i.e. Perplex7 continues the last session. If the file is not available there, Perplex7 starts with the menu for entering a new cruise. If the folder ..\Perplex7\Cruise contains older cruise plans (e.g. PS135.mat and PS135_cfg.mat), the planning of a new voyage can be canceled with [X] (see top right corner in the window) and a file *_cfg.mat can be selected with the menu [File - Open]. Perplex7 loads this cruise file and editing can be continued, if necessary also saved under a new name beforehand.

Create a new cruise

Use the menu [File – New] or if Perplex7_cfg.mat does not exist, the app for creating a new cruise will be executed automatically. See screen shot below.

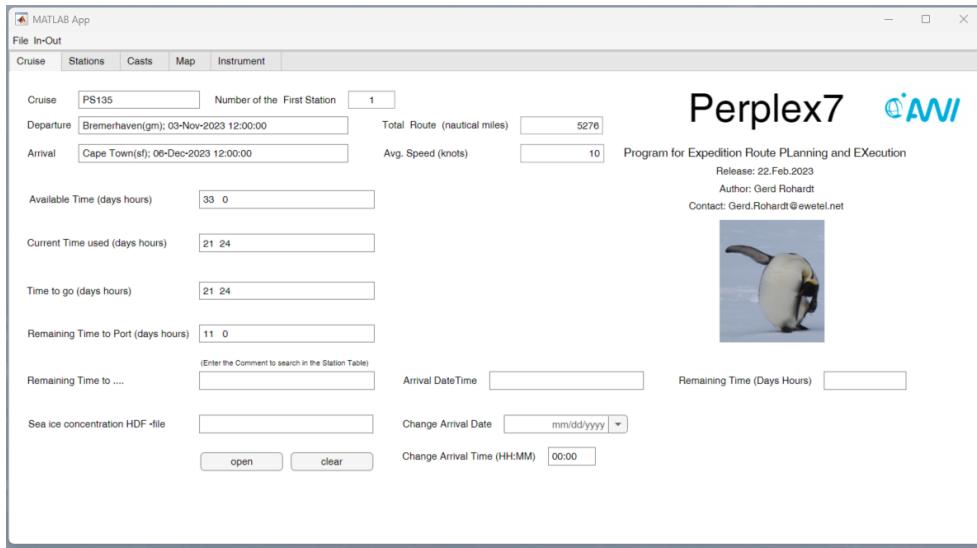


The app (DialogNew_Cruise.mlapp) shows a list of ports read from Ports.txt. When selecting a port, it is associated with the latitude and longitude as specified in Ports.txt. Follow the steps shown in the help. Ports.txt can be changed according to your own requirements, then only the ports you typically need will be shown in the list. Copy Ports.txt under a different filename first for safety.



As an example, a transit of the POLARSTERN from Bremerhaven to Cape Town is to be recreated as voyage PS135. In the input field Cruise Name type: PS135, then mark Bremerhaven in the list on the left. Then click on ▼ and select the date of departure (3.11.2023). With OK this appears at the table below. Afterwards mark Cape Town and change the date (6.12.2032). A click on [ACCEPT] shows the cruise PS135

The Cruise tab below now displays general information about the trip, with the route first connecting the two ports. Before going into more detail on the Cruise tab, the other tabs will be explained briefly.



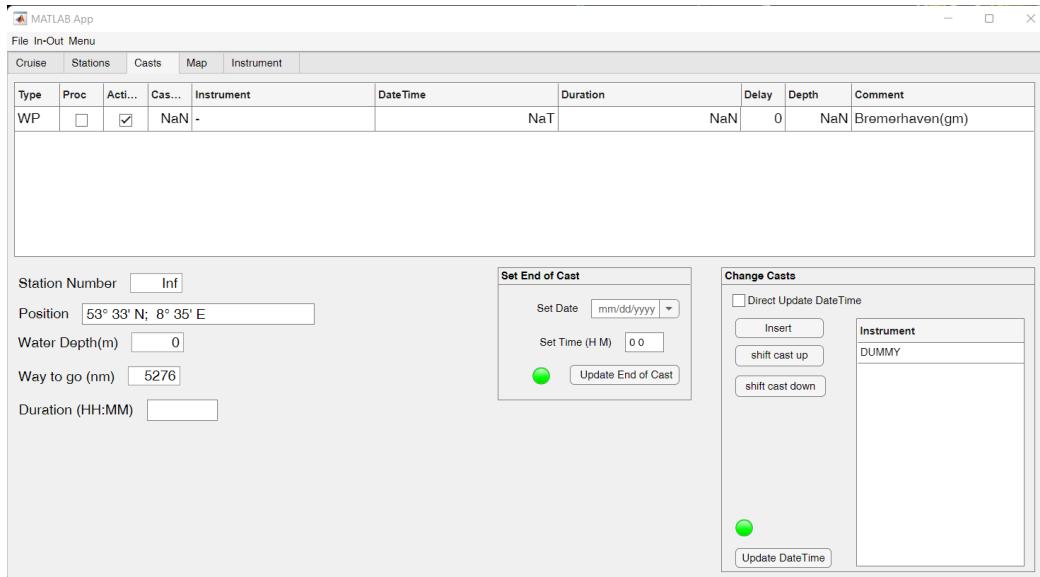
Tab Stations displays waypoints and stations with corresponding information. Initially, only the port of departure and port of arrival are displayed. It was indicated that Cape Town should be reached on 6.12.2023; see Cruise Tab; Arrival. However, in the Station Tab DateTime is 25.11.2023, because DateTime is always calculated from the port of departure from the distance (5276 nm) and ship speed (10 knots). The difference 11/25/2023 to 12/6/2023 is 11 days, see Cruise Tab above. Vessel speed 10 knots in row 1 is the speed at which steaming occurs up to line 2. For the distance/way to go in nautical miles in row 1 is the distance to the next row, respectively row 2 in this case. Type (column 2) indicates WP = waypoint and ST = station, were instruments were deployed. Proc = processed (column 3) false or true is used to indicate completed waypoints or stations. Active (column 4) false or true (default) allows to temporarily deactivate stations/waypoints.

Stations														
Nr	Type	Proc	Acti...	StatNr	DateTime	Latitude	Longitude	Depth	Speed	Way to go	Delay	No. Casts	Duration	Comment
1	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	03-Nov-2023 12:00:00	53.5500	8.5833	0	10	5.2761e+03	0	NaN	0	Bremerhaven(gm)
2	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	25-Nov-2023 11:36:32	-33.9000	18.4333	0	10	0	0	NaN	0	Cape Town(sf)

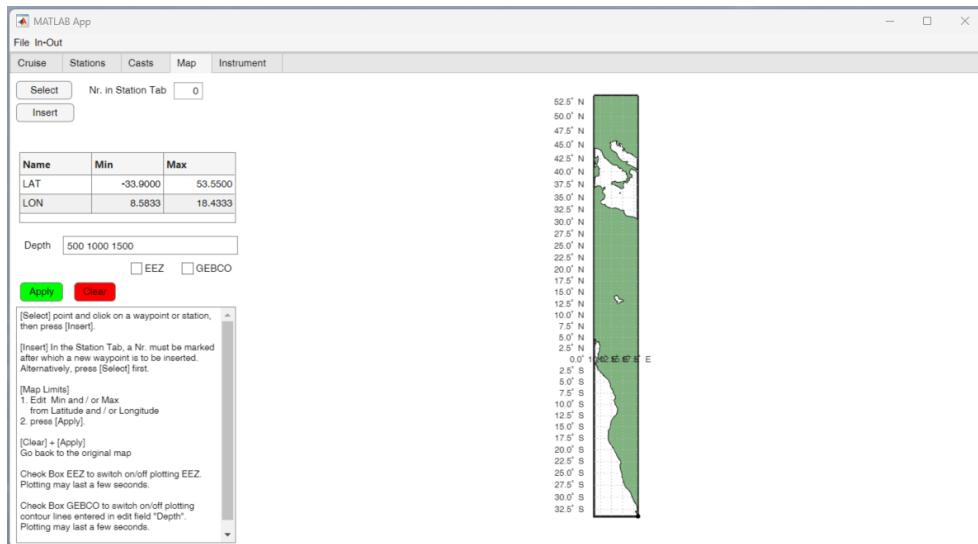
Change List	Change Speed	Convert DM to Degrees
<input checked="" type="radio"/> delete Start Row <input type="text" value="0"/> <input type="button" value="Clear"/> <input type="radio"/> insert End Row <input type="text" value="0"/> <input type="button" value="Execute"/> <input type="radio"/> C-paste	Ship Speed [knots] <input type="text" value="10"/> <input type="button" value="Change"/> Use Start Row and End Row (see left panel) to change Speed in Station Table.	+/- DD MM.mm <input type="text" value="-00 00.00"/> DD.dd <input type="text" value="0.0000"/> <input type="button" value="Update"/>

Select the cell (row 1; column 5 = StatNr) before switching to the Cast Tab.

In the Cast Tab, instruments can be inserted that are to be used at this position. Because only the positions of the port of departure and the port of destination are available at the beginning, the Cast Tab contains the display shown below. You can also see here that no instruments have been specified yet. "dummy" is the default. Instruments are specified in the Instrument Tab.



The Map Tab is not informative at this stage. The map limits are simply taken from the positions of the port of departure and the port of destination. Furthermore, the Map Tab is still being worked on. Further explanations will follow.



Instrument Tab shows the table from file Default_InstrTable.csv that is automatically used when a new trip is created. This table is used to calculate how long it takes to deploy an instrument at a station.

Instrument									
Active	Instrument	Description	User	Fixed	Handling	Down	Trawling	Up	
<input type="checkbox"/>	ADCP	Acoustic Doppler Current Profiler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AEROS	Aerosol Sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AIRGN	Airgun + Seismic Source	nn	0	0	0	0	0	0
<input type="checkbox"/>	AIRS	Air sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	ALTI	Altimeter	nn	0	0	0	0	0	0
<input type="checkbox"/>	ATURBP	Air Turbulence Profiler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AUV	Autonomous underwater vehicle	nn	0	0	0	0	0	0
<input type="checkbox"/>	BC	Box Corer	nn	0	0	0	0	0	0
<input type="checkbox"/>	BN	Bottom Net	nn	0	0	0	0	0	0
<input type="checkbox"/>	BOAT	Boat	nn	0	0	0	0	0	0
<input type="checkbox"/>	BOO	Boomer + Seismic Source	nn	0	0	0	0	0	0
<input type="checkbox"/>	BS	Benthos Sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	BT	Bathythermograph	nn	0	0	0	0	0	0
<input type="checkbox"/>	BUOY	Buoy	nn	0	0	0	0	0	0
<input type="checkbox"/>	CALIB	Calibration	nn	0	0	0	0	0	0
<input type="checkbox"/>	CCN	Cloud Condensation Nuclei	nn	0	0	0	0	0	0
<input type="checkbox"/>	CHAM	Benthic chamber	nn	0	0	0	0	0	0
<input type="checkbox"/>	CM	Current Meter	nn	0	0	0	0	0	0
<input type="checkbox"/>	CO2S	CO2 Sensor	nn	0	0	0	0	0	0
<input type="checkbox"/>	CORER	Corer	nn	0	0	0	0	0	0
<input type="checkbox"/>	CPT	Cone penetration testing-lance	nn	0	0	0	0	0	0
<input type="checkbox"/>	CRS	Cloud Radar System	nn	0	0	0	0	0	0
<input type="checkbox"/>	CSEM	Controlled Source Electromagn...	nn	0	0	0	0	0	0
<input type="checkbox"/>	CTD	CTD	nn	0	0	0	0	0	0

Units

Fixed : hours
Handling: minutes
Down : m/s
Trawling : minutes
Up : m/s

Sort

Update

First, the instruments that will be used during the trip are activated. In the following example, these are Box Corer, CTD (here with water sampler), Float, Mooring (deployment), Plankton Net and Fish Net. The above instruments are therefore activated. **Clicking on [Sort] moves the activated instruments to the top of the table.**

Now complete the table: User: Name of the person responsible, Fixed: (hours) e.g. the deployment of a mooring does not directly depend on the length or water depth. Experience shows that it takes 4 hours. Handling: (minutes) Time to bring the equipment to water and back to deck. Down: Lowering speed (m/s), Trawling: (minutes) e.g. trawling a fish net, Up: Lifting speed (m/s).

The settings (times or down/up speed) can be changed later during the trip so that the operating times match the actual times required as closely as possible.

If the table has been changed, [Update] must be pressed. The red lamp additionally indicates this.

Active	Instrument	Description	User	Fixed	Handling	Down	Trawling	Up	0.5000
<input checked="" type="checkbox"/>	BC	Box Corer	Norbert	0	15	1	0	0	0.5000
<input checked="" type="checkbox"/>	CTD	CTD	Sandra	0	30	1	0	0	1
<input checked="" type="checkbox"/>	FLOAT	Float	Olaf	0	10	0	0	0	0
<input checked="" type="checkbox"/>	FN	Fish Net	Sigi	0	30	1	1	0.5000	0.5000
<input checked="" type="checkbox"/>	MOOR	Moorings	Matthias	4	0	0	0	0	0
<input checked="" type="checkbox"/>	PLA	Plankton Net	Sigi	0	10	0.5000	0	0.5000	0.5000
<input type="checkbox"/>	ADCP	Acoustic Doppler Current Profiler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AEROSOL	Aerosol Sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AIRGN	Airgun - Seismic Source	nn	0	0	0	0	0	0
<input type="checkbox"/>	AIRS	Air sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	ALTI	Altimeter	nn	0	0	0	0	0	0
<input type="checkbox"/>	ATURBP	Air Turbulence Profiler	nn	0	0	0	0	0	0
<input type="checkbox"/>	AUV	Autonomous underwater vehicle	nn	0	0	0	0	0	0
<input type="checkbox"/>	BN	Bottom Net	nn	0	0	0	0	0	0
<input type="checkbox"/>	BOAT	Boat	nn	0	0	0	0	0	0
<input type="checkbox"/>	BOO	Boomer - Seismic Source	nn	0	0	0	0	0	0
<input type="checkbox"/>	BS	Benthos Sampler	nn	0	0	0	0	0	0
<input type="checkbox"/>	BT	Bathythermograph	nn	0	0	0	0	0	0
<input type="checkbox"/>	BUOY	Buoy	nn	0	0	0	0	0	0
<input type="checkbox"/>	CALIB	Calibration	nn	0	0	0	0	0	0
<input type="checkbox"/>	CCN	Cloud Condensation Nuclei	nn	0	0	0	0	0	0
<input type="checkbox"/>	CHAM	Benthic chamber	nn	0	0	0	0	0	0
<input type="checkbox"/>	CM	Current Meter	nn	0	0	0	0	0	0
<input type="checkbox"/>	CONC	Conc. Sampler	nn	0	0	0	0	0	0

Units
Fixed : hours
Handling: minutes
Down : min
Trawling : minutes
Up : m/s

Sort Update

After pressing [Update], the light changes back to green and now the activated devices also appear in the Cast Tab.

Type	Proc	Acti...	Cas...	Instrument	DateTime	Duration	Delay	Depth	Comment
WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	-	NaT	NaN	NaN	0	Bremerhaven(gm)

Station Number: Inf

Position: 53° 33' N; 8° 35' E

Water Depth(m): 0

Way to go (nm): 5276

Duration (HH:MM):

Set End of Cast

Set Date: mm/dd/yyyy

Set Time (H M): 0 0

Update End of Cast

Change Casts

Direct Update DateTime

Insert

shift cast up

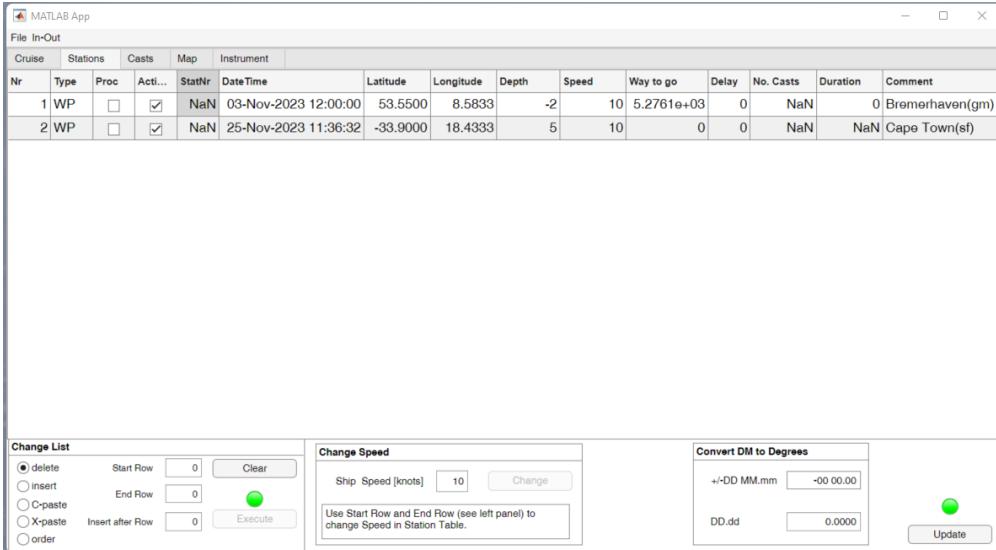
shift cast down

Update DateTime

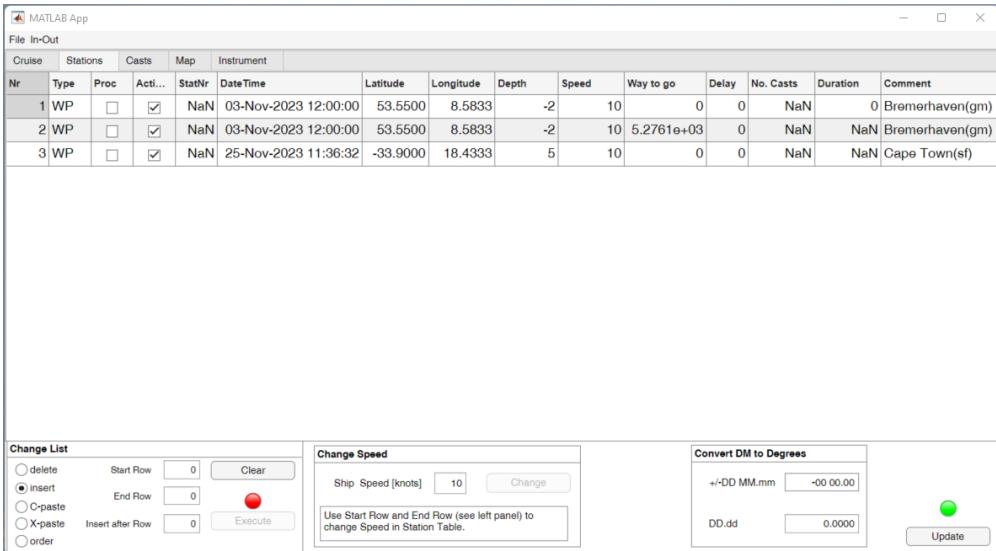
Instrument
BC
CTD
FLOAT
FN
MOOR
PLA

Insert waypoints – in Station Tab:

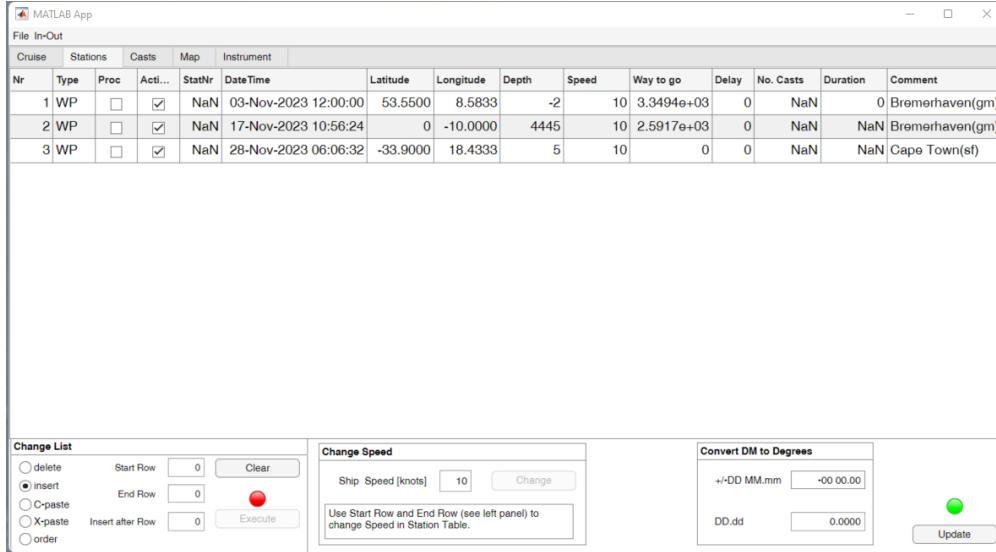
Go to Station Tab and select the cell (1,1); always (row,column). At the bottom left are menus to change the station list; see "Change List". By marking the cell (1,1) Start Row = 1. Now activate the radio button "insert" and press [Execute].



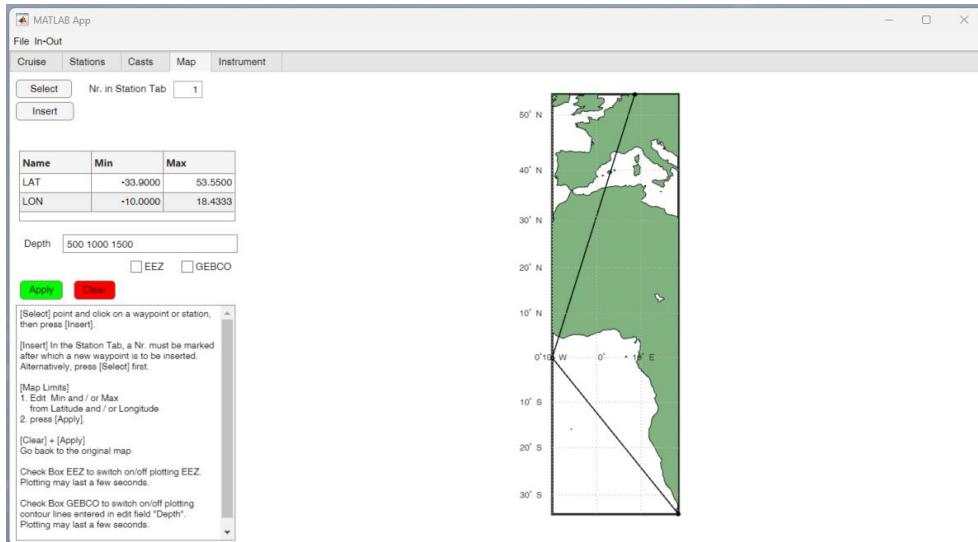
The lamp changes briefly to red and is green as soon as after the insert also an "Update" was executed.



Now change the Latitude = 0 and Longitude = -10 of row 2. The lamp at the bottom right changes from green to red and reminds you to press [Update]. With the update, the water depth was taken from gridone.grd based on the new position. Furthermore, Way to go and accordingly DateTime was recalculated. If speed in row 2 had also been changed, e.g. from 10 to 8 knots, then the time in row 3 would also be later than 28. Nov.



The changes are immediately visible in the Map Tab and also in the Cruise Tab, where for example the Total Route has increased from 5276 to 5941 nm.



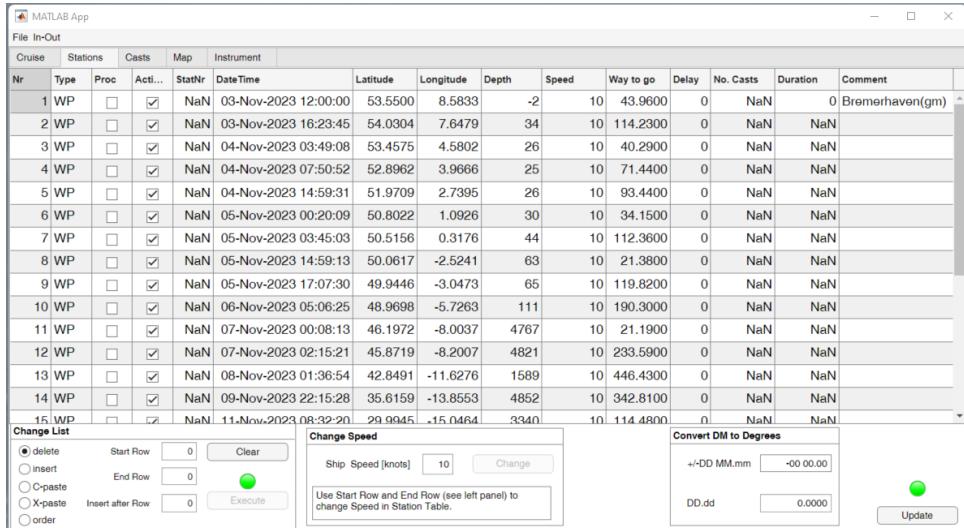
Latitude and longitude are entered in decimal degrees. If you have the information e.g. in the form $12^{\circ} 23.348' S$, in the Station Tab [Convert DM to Degrees] helps you with the conversion. Decimal degrees are displayed when the input in the upper field is completed with [Enter] or a click in the lower field ($12^{\circ} 23.348' S$: enter $-12 23.348 = -12.3891$).

Analogously, more waypoints could be inserted so that the route does not go over land.

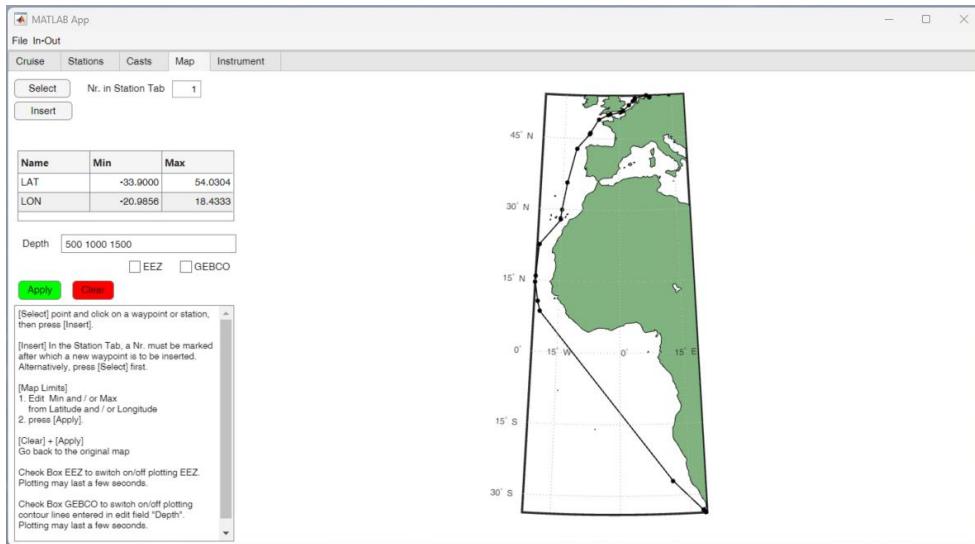
Insert waypoints – import from txt-file

FS POLARSTERN makes the crossing Bremerhaven - Cape Town very often and therefore there is already a list with the positions of the waypoints along the route; see file in Appendix: Brhv-CT.txt

Select from the menu bar [In-Out - Import from txt-file]. This will open the explorer where the needed file can be selected. If [open] is pressed, the waypoints or positions are inserted. If in the Station Tab in Change List Start Row = 0, then the waypoints are inserted after row 1, the port of departure. As with inserting a new waypoint, an update is performed and DateTime and Way to do are recalculated. At the same time, the overview in the Cruise tab is also updated, e.g. the length of the route is now 6638 nm.



Map tab after inserting file. If you do not see the complete route, press [Clear] and [Apply].



Insert additional waypoints – import from txt-file

As in the file Brhv-CT.txt, for example, there is another file AddWPs.txt, which should be inserted further.

Example: AddWPs.txt

Latitude (decimal degrees) <TAB> Longitude (decimal degrees)

(North, East == +; South, West == -)

0.0 -10.0

-10.0 0.0

-15.0 5.0

In Station Tab in row 22 (Nr) the latitude is 8.4796. Therefore, the waypoints from AddWPs.txt must be inserted after row 22.

- In Station Tab: Click twice on the cell (22,1), i.e. on the 22. A 22 appears at Start Row; see Change List. (If an incorrect number is displayed, press [Clear]. One also can type in 22 directly in the Start Row input field.)
- Select from the menu bar [In-Out - Import from txt-file] and open file AddWPs.txt.

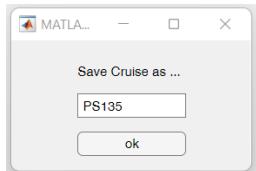
The screenshot shows the MATLAB App interface with the 'Station' tab selected. The main table displays cruise data with rows numbered 12 through 26. Rows 23, 24, and 25 are newly inserted after row 22. The 'Change List' panel on the left contains several options: 'delete' (radio button selected), 'Start Row' set to 22, 'Clear' button, 'insert' (radio button), 'End Row' set to 0, 'Execute' button, 'C-paste' (radio button), 'Insert after Row' set to 0, and 'Order' (radio button). The 'Change Speed' panel in the center has 'Ship Speed [knots]' set to 10 and a 'Change' button. The 'Convert DM to Degrees' panel on the right shows 'DD.dd' set to 0.0000 and an 'Update' button. A note at the bottom of the central panel says: 'Use Start Row and End Row (see left panel) to change Speed in Station Table.'

Note rows 23 - 25 and look at the changes in Cruise Tab and Map Tab.

Save or Open Cruise File

Attention: After changes and when they have been controlled, you should secure the cruise. Select from the menu bar [File - Save]. If you want to save the current state in another file in order to access it later, you have the following option. Select from the menu bar [File – Save as].

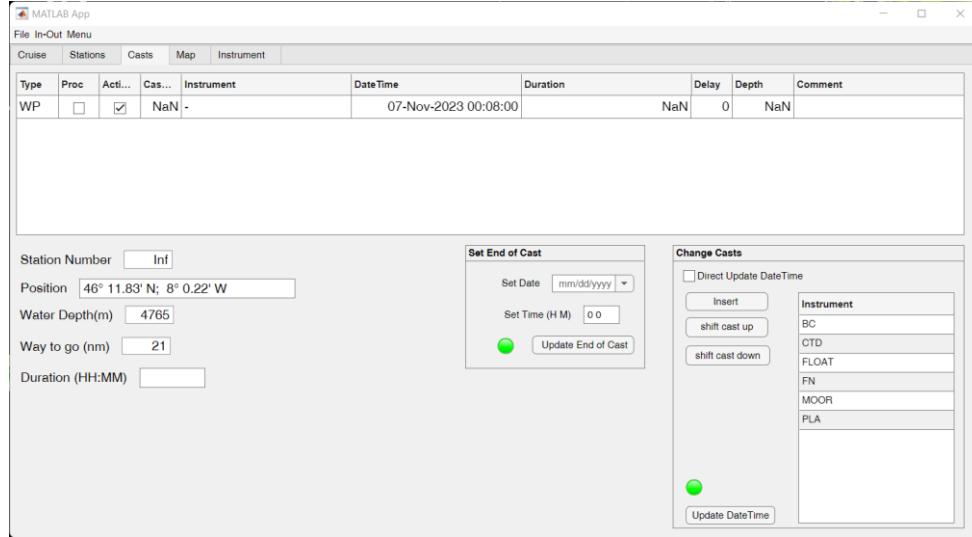
In the shown window change PS135 e.g. to PS135-01



If PS135 is to be processed further afterwards, select from the menu bar [File – Open]. The explorer shows the files in ..\Cruise. There are PS135_cfg.mat and PS135-01_cfg.mat.; open PS135_cfg.mat and continue editing!

Setup a station – insert instruments:

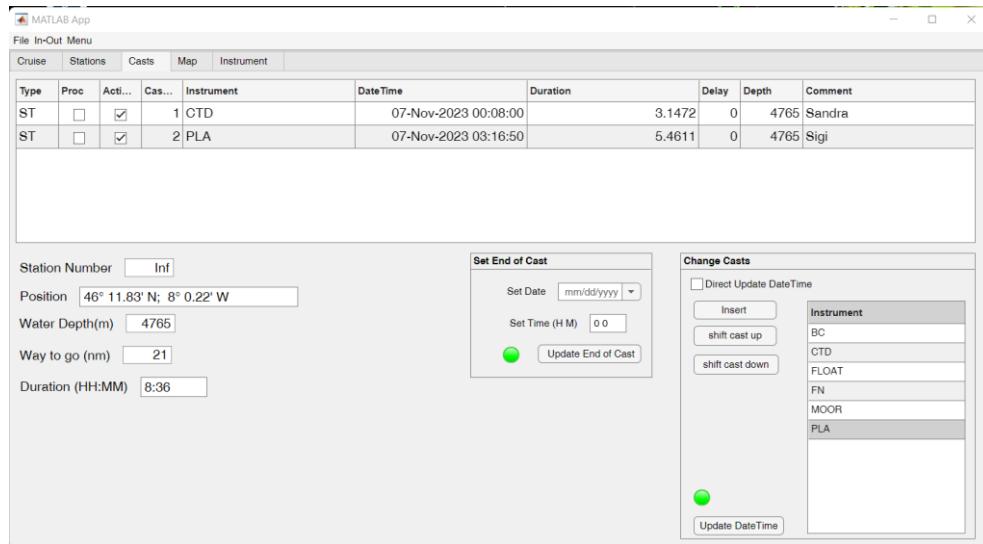
Devices should be tested at the first deep position of the route. Go to Station Tab. Here in row 11 the depth is 4765 m; see (c). Mark cell (11,4) where StatNr = NaN, Type == WP (Waypoint). Then switch to the Cast Tab.



The CTD and the plankton net will be tested.

- Mark CTD in the list of instruments and press [insert]. The lamp above [] changes to red.
- Mark PLA in the list of instruments and press [insert].

First the CTD is inserted as Cast 1 and then PLA as Cast 2 at the top of the table. DateTime and Duration are NaT and NaN respectively. Finally press [Update DateTime]. If the Direct Update DateTime switch is enabled in Change Casts, Update DateTime is executed immediately with each change.



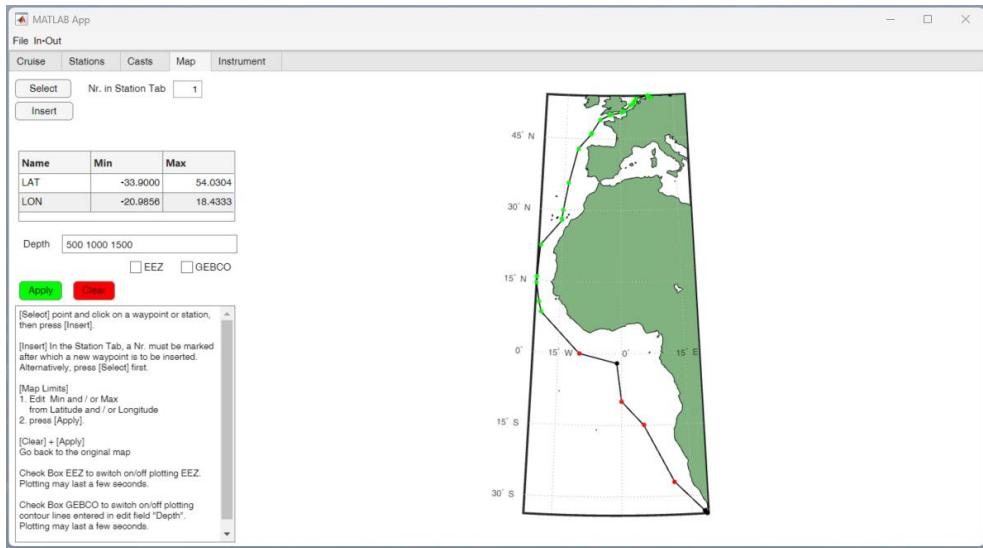
The Update DateTime execution calculates DateTime and the duration of the operation based on the setting in Instrument Tab. The name of the responsible person is transferred to Comment.

The CTD needs 3.15 hours for 4765 m, the plankton net (PLA) 5.46 hours. However, it only makes sense to use this up to 200 m depth. Edit the depth of cast 1 and change it to 200, activating "Direct Update DateTime" before and this will change Duration to 0.39 hours. For some reason, the plankton

net is to be deployed before the CTD. Mark cell (2,5) "PLA" and press [shift cast up]. After that, Cast 1 will be the PLA to 200m and will start at 00:08. Cast 2, the CTD to the seafloor, will consequently start at 00:31.

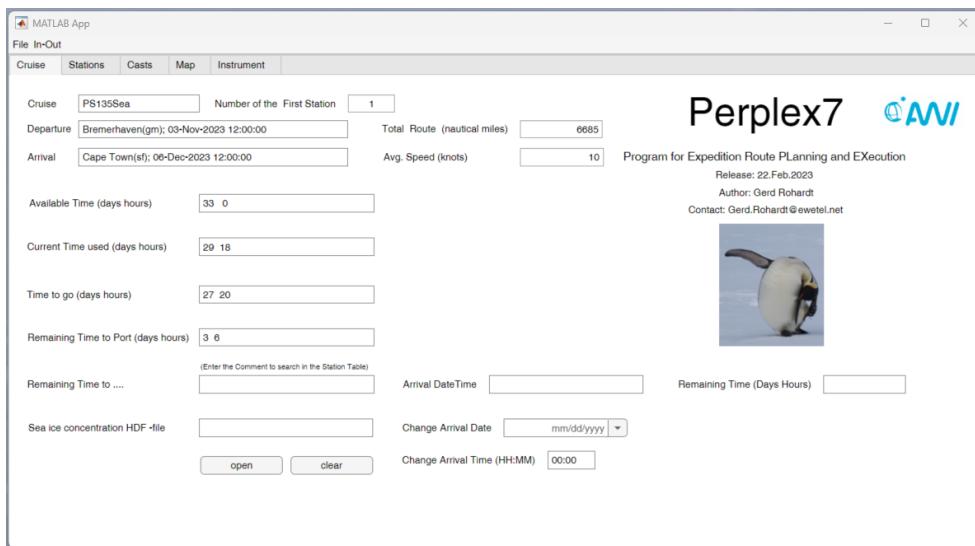
In the same way, 6 stations have been entered in this example to explain further possibilities of Perplex7.

Here is shown the map. In green are the processed waypoints or stations. Not processed the waypoints are in black and stations are marked in red.



Change the date and time of the departure and arrival:

The Cruise Tab displays Remaining Time to Port (days hours): 3 6. First, let postpone the departure by 18 hours, therefore change the date and time of the departure from 03-Nov-2023 12:00 to 04-Nov-2023 06:00.



Enter the date and time directly in the Departure input field and pay attention to the given date/time format. An update will take place immediately and shows that Cape Town is reached 18 hours later; Remaining Time to Port (days hours): 2 12. To compensate for the delay, the arrival can be postponed to the 7th. Type in the new date in the Cruise Tab in Arrival input field, where an update is also done automatically and immediately Remaining Time to Port (days hours): 3 12.

Change the ship speed:

Another way to have more time for station work can be achieved with a higher ship speed. In the Station Tab, change "speed" (in knots) from 10 to 11, starting at Station 2 (row 17) and ending with row 26, so that about 50 nm off Cape Town steaming at 10 knots again. You can change the speed directly in the station table or use the panel "Change Speed". In this case you do not need pressing the update button.

While changing speed row by row, the light at the bottom right above the [Update] button is red. [Update] must be pressed at the end and lamp switched to green. The changes made will also show up in the Cruise Tab, e.g. Remaining Time to Port (days hours): 5 23 and the average speed has changed from 10 to 10.67 knots.

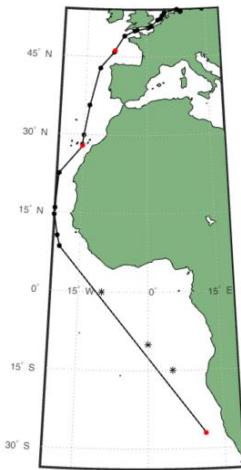
The screenshot shows the MATLAB App interface with the 'Station' tab selected. The main area displays a table of station data with columns: Nr, Type, Proc, Acti..., StatNr, Date/Time, Latitude, Longitude, Depth, Speed, Way to go, Delay, No. Casts, Duration, and Comment. Rows 17 through 26 are highlighted, indicating they are being modified. Below the table is a 'Change List' panel with options for delete, insert, copy/paste, x-paste, and order. A 'Change Speed' panel is open, showing the current speed as 11 knots and a 'Change' button. To the right is a 'Convert DM to Degrees' panel with input fields for +/-DD MM.mm and DD.dd, and an 'Update' button with a red light.

Deactivate stations and/or waypoints

There is also the possibility to deactivate stations or waypoints, in case time is not available for the execution in case of bad weather conditions or other reasons. Column 4 (Active is used for this purpose, in which a check mark (= true) is set by default. To deactivate, simply click on the check mark in the corresponding row. As an example, rows 23 to 25 are deactivated. Afterwards the [Update] button must be pressed. During the update, rows 23 - 25 are no longer taken into account; see Cruise Tab too.

This screenshot is identical to the previous one, but rows 23, 24, and 25 in the 'Station' table now have an empty checkbox in column 4 ('Acti...'), indicating they are deactivated. The 'Change Speed' and 'Convert DM to Degrees' panels remain the same.

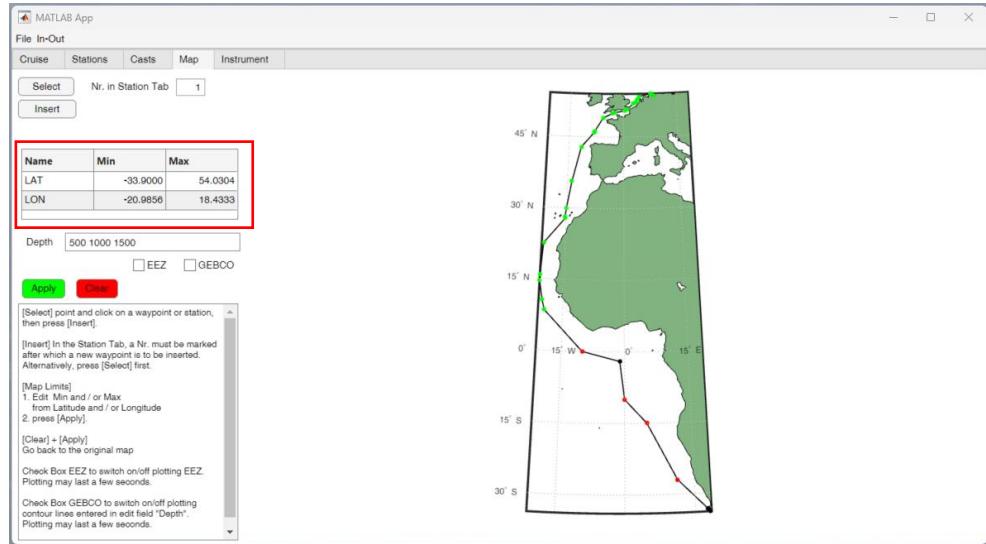
The station numbers (column 5) will be renumbered. In the map (Map Tab), the new track is shown, while the deactivated positions remain visible; see *. At any time, the deactivation of all or only a specific position can be reset.



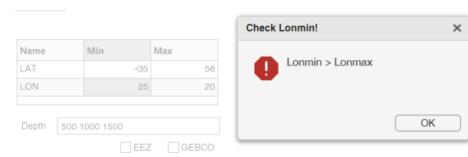
Use of the map

Zoom in and Zoom out

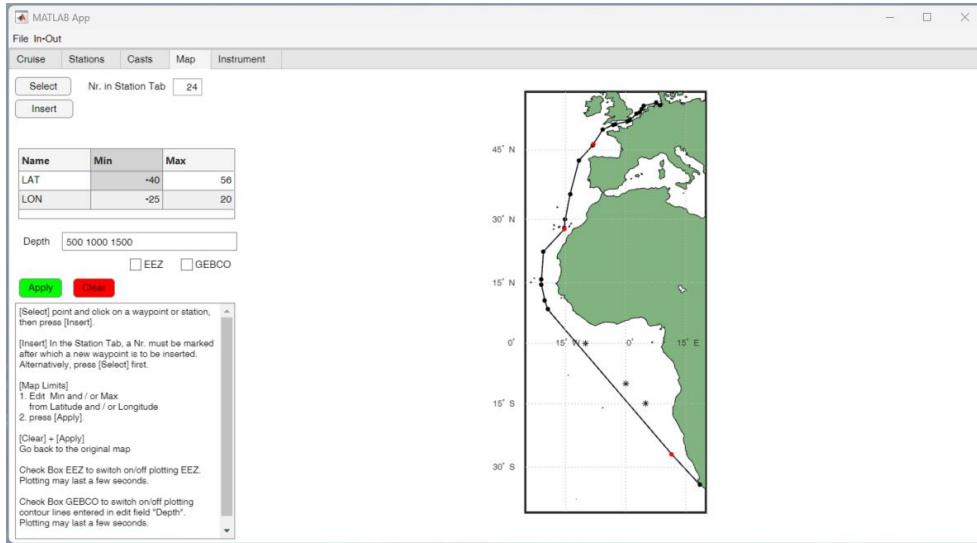
The boundary of the map is automatically determined from the minimum and maximum of all geographic latitudes and geographic longitudes from the station list, see Station Tab. Pressing the [Clear] and [Apply] buttons always causes the boundaries to be recalculated and the original map to be restored.



For a better overview of the map, i.e. not having the route directly on the edge of the map, the boundaries of the map can be changed. To do this, the values of Lat-Min/Max and Lon-Min/Max can be edited in the table as required. A warning message is displayed if incorrect entries are made, see below. The allowed values are: Latitude: -90 to +90, Longitude: -180 to +180.



For the map shown below, the table in the Map Tab has been changed. Then press [Apply] so that the changes are applied. Once again as a reminder: Pressing the [Clear] and [Apply] buttons always causes the boundaries to be recalculated and the original map to be restored.

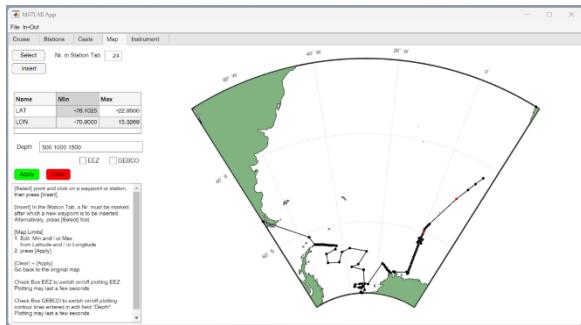


Display EEZ, Contour Lines or Seoice Concentration

Optionally, the EEZ (Exclusive Economic Zones (EEZ)) can be plotted in the map. Download World_EEZ from <https://www.marineregions.org/downloads.php#marbound>. Unzip and save eez_v11.* (6 files) in folder ..\Perplex7\Dataset.

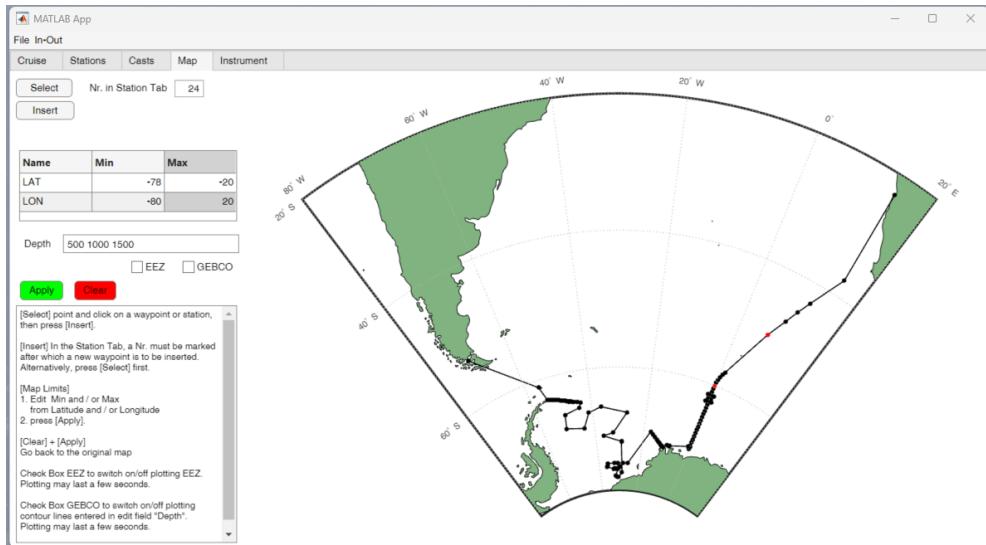
As mentioned at the beginning, a check is made at the start of the program whether the required data sets are available. At the same time, it is also checked whether the file with the EEZ boundaries is available. If this file is available, the EEZ Check Box in the Map Tab is enabled, i.e. EEZ can be used optionally.

In order to also explain the plotting of sea ice concentration together with EEZ and contour lines of water depth, a cruise to the Weddell Sea is first opened as an example.

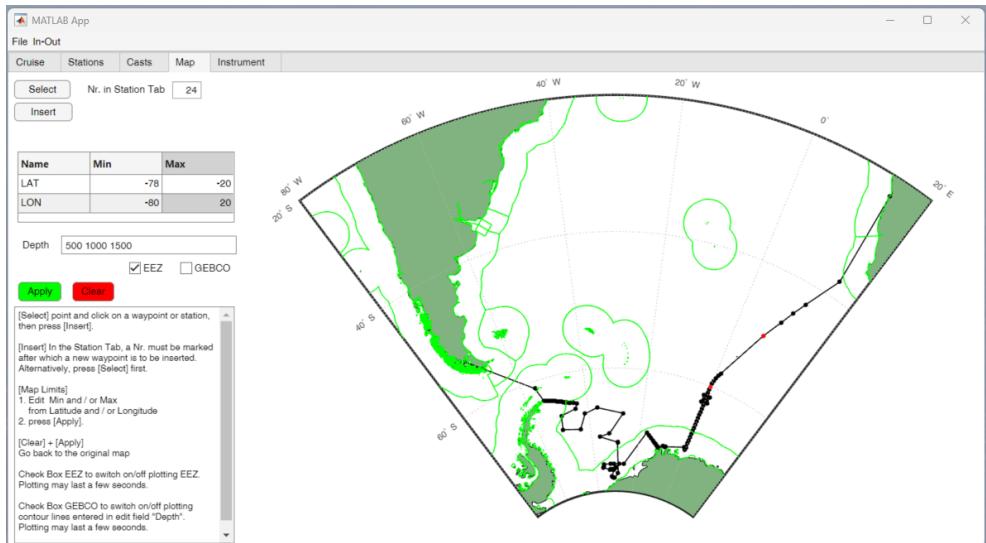


First, the map section is enlarged.

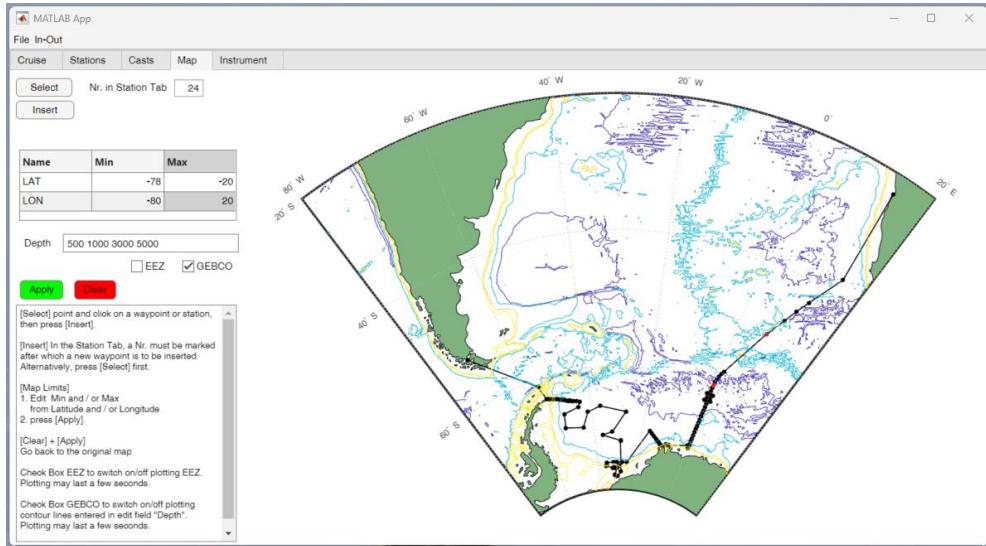
Below the table with the boundaries of the map section there is an input field with the depth lines [500 1000 1500]. These are not important at first because the "GEBCO" check box - the grid of the global topography - is not activated.



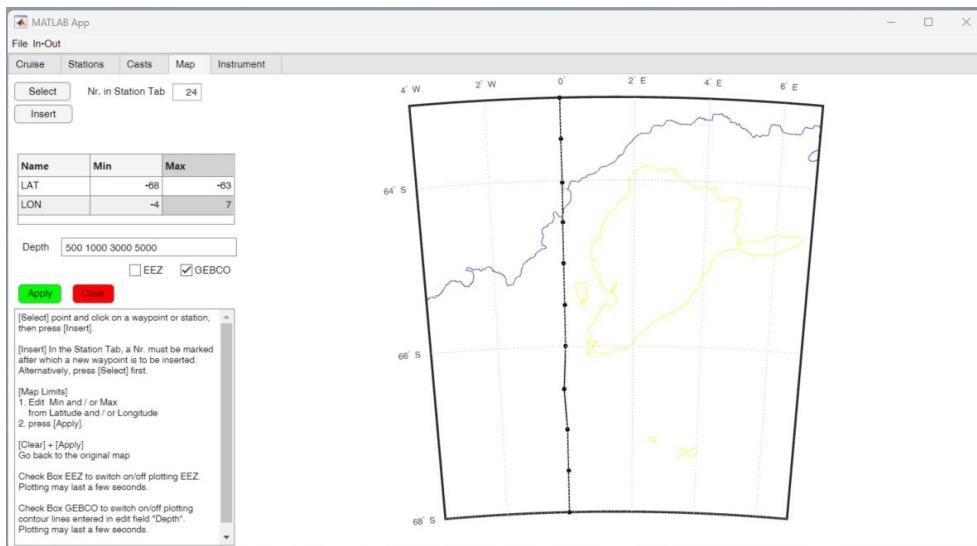
Initially, for example, the EEZ should be plotted. To do this, the EEZ check box is activated - recognizable by the check mark in the box, see figure below.



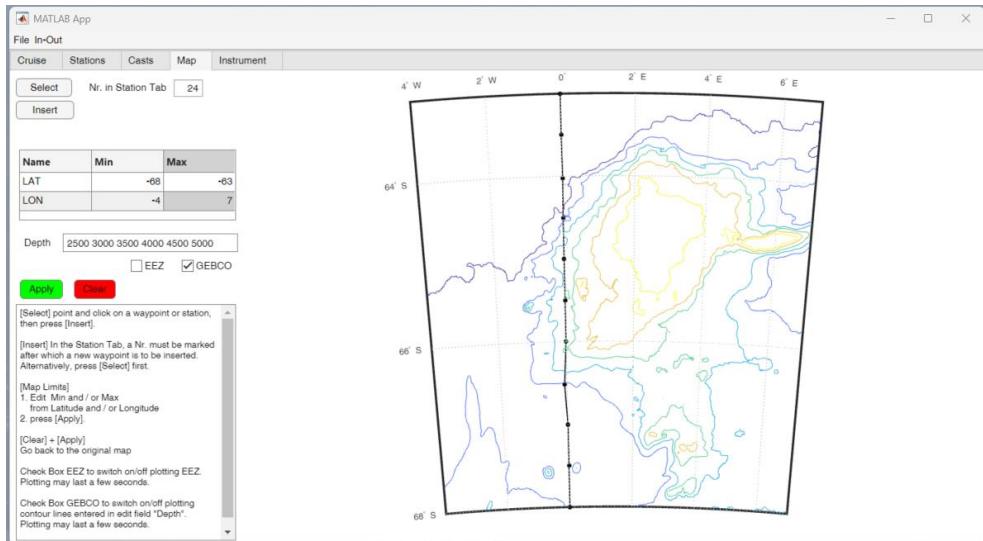
The following depth lines [500 1000 3000 5000] should then be plotted on the map. We therefore transfer these to the "Depth" input field. Note that the EEZ check mark is still active. But as soon as the check mark "GEBCO" is activated, the following map appears.



If the "EEZ" check mark is activated again, the map with the EEZs would appear again. The "GEBCO" check mark is automatically removed. However, we keep to this representation and increase the area and Maud Rise by entering the LAT-Min = -68, LAT-Max = -63, LON-Min = -4, LON-Max = 7 in the table. Then press [Apply].



You can only see the 3000 m and 5000 m depth contours. To better resolve the structure of Maud Rise, edit the "Depth" input field as follows. [2500 3000 3500 4000 4500 5000] and close it with the Enter key.



The new plot appears automatically after pressing the enter key. Also note that the depth lines in small map sections have a much finer structure. Because the Matlab function "GRIDONE_2D_subset.m" changes the original resolution of one minute (from GRIDONE_2D.MAT) according to the selected map section. For a world map, depth lines would be resolved from a 4-degree grid instead of a 1-minute grid.

Display Sea Ice Concentration in the Map

The sea ice concentration can be found here:

<https://data.meereisportal.de/relaunch/index.php?lang=en>

Go to *Maps & Data*, next to *Parameter* and then select *Sea ice concentration*.

For example, if you are planning a trip to Antarctica in December and January, you can download the currently available data on December 1, December 15, January 1, January 15 and January 31. However, the corresponding data set with the geocoordinates (longitude, latitude) must also be downloaded beforehand; see red arrow in Figure 3 and find “LongitudeLatitudeGrid-s6250-Antarctic.hdf” in your download folder.

The screenshot shows the MEEREIS Portal homepage with the title "MEEREIS Portal" and a sub-section "Daten portal". Below the title, there are navigation links: "WELCOME", "MAPS & DATA", "ANIMATIONS", and "INTERACTIVE MAPS". The main heading "Sea ice concentration" is displayed. To the right, a large blue box titled "SELECTION MENU" contains various input fields and options. The "Region" dropdown is set to "Antarctic". The "Temporal resolution" dropdown is set to "daily". Under "Time period from:", the year is 2023, month is 12, and day is 1. Under "Time period to:", the year is 2023, month is 12, and day is 1. The "Maps preview" dropdown is set to "yes". The "Repeat annually time period" dropdown is set to "no". At the bottom of the menu are two buttons: "display" and "clear". Red arrows point from the text in the main text area to the "display" button and the "repeat annually time period" dropdown.

The data, maps and sea ice analyses of the Arctic and Antarctic available for download are based on the information of the satellite radiometers mentioned below. Measurements of the satellite radiometer AMSR-E range from June 19th, 2002 until September 30th, 2011. On Oct 4, 2011, measurements of AMSR-E stopped.

AMSR-E's successor AMSR2 was successfully deployed to orbit on May 18th 2012. Since August 1st, 2012 AMSR2 has been sending microwave data from which daily sea ice concentrations are derived. Sea ice concentration based on SSMIS has been available from October 1st, 2011 up to today. Data of AMSR2 is of higher quality than SSMIS data. On meereisportal.de, SSMIS data is therefore only used to fill data gaps of AMSR2. The sensor used to define sea ice concentrations is recorded in the name of the respective daily file.

The sea ice concentration data is written in HDF-format. The coordinates and land mask files needed for further processing can be downloaded here and will be needed only once per hemisphere.

All sea ice concentration data of the Arctic and the Antarctic, including data until June 19th 2002, (HDF-format) from the University of Bremen ([Institute of Environmental Physics](http://www.ifm.uni-bremen.de/)) can be accessed there. This site includes data sets for Arctic, Antarctic and, in a higher temporal resolution (3.125km), a number of regional maps. They use a polar stereographic projection with equal area at 70° latitude. The geographical coordinates of the pixels are given in separate files for Arctic ([geographical coordinates Arctic \(HDF\)](#)) and for Antarctica ([geographical coordinates Antarctic \(HDF\)](#)).

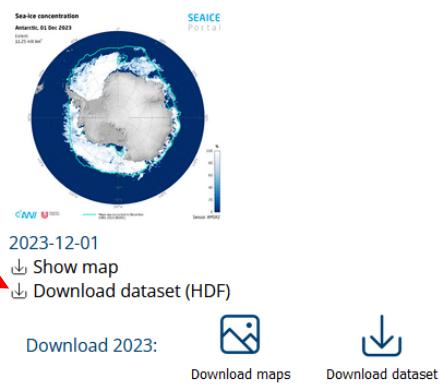
Furthermore, downloads of daily updated KMZ files usable for Google Earth depictions are available for the Arctic ([daily updated KMZ file Arctic](#)) and Antarctic ([daily updated KMZ file Antarctic](#)).

Fig. 3: “Meereis Portal” to download sea ice concentration and geographical coordinates. Both, for Arctic and Antarctic are needed; see red arrow.

After pressing [display], the map with the sea ice concentration is displayed. The data can then be downloaded as an HDF file. Data from a different date can be saved in the same way. Find in your download folder: “asi-AMSR2-s6250-20231201-v5.4.hdf”; see Figure 4.

Sea ice concentration

2023



SELECTION MENU

Region:

Temporal resolution:

Time period from:
 Year: Month: Day:

Time period to:
 Year: Month: Day:

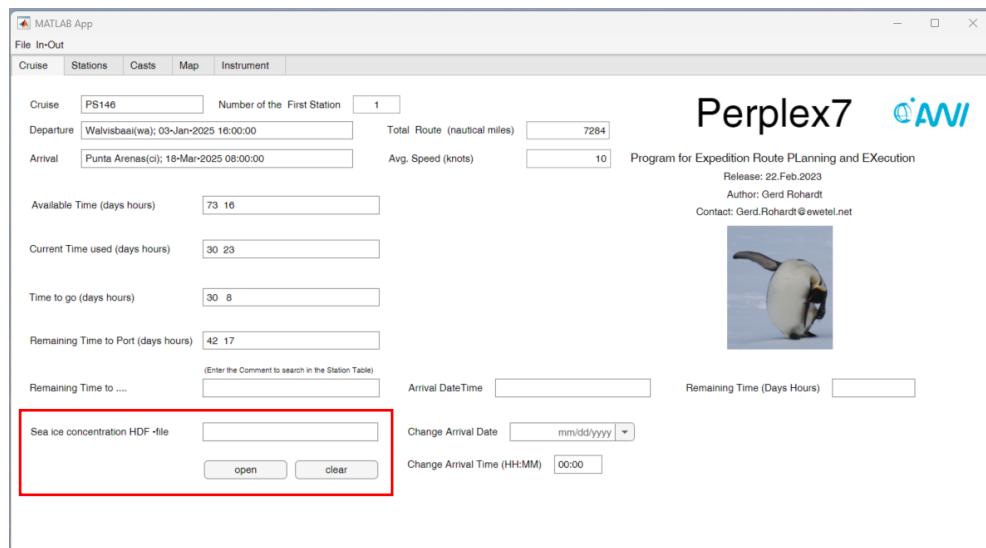
Maps preview:
 Repeat annually time period:

display
clear

Fig. 4: Shows the Sea ice concentration of December 1st 2023. The red arrow shows where to get the HDF file, which we like to display in the map of the Perplex7 software.

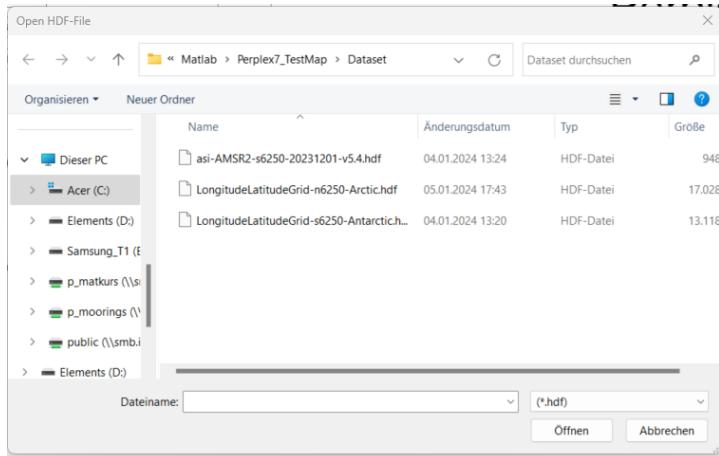
Move the HDF-Files into your Matlab directory: C:\<your perplex working directory>\Data set.

In the Cruise tab there is an area at the bottom left to select an HDF file of the sea ice concentration. Press the [open] button.

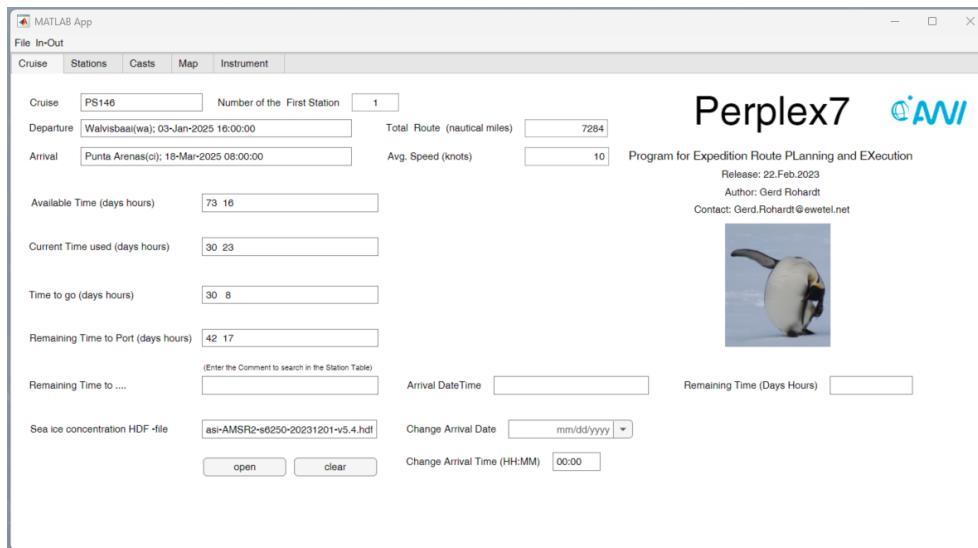


All HDF files in the ..\Dataset folder are then displayed in a window, see below. In this case, only one sea ice concentration file from Antarctica is displayed - asi-AMSR2-s6250-20231201-v5.4.hdf. 20231201 is the date = yyyyymmdd and in "s6250" the "s" stands for "south", i.e. for Antarctica. The "s" connects this file later for plotting with the corresponding geographic grid coordinates, here with LongitudeLatitudeGrid-s6250-Antarctic.hdf

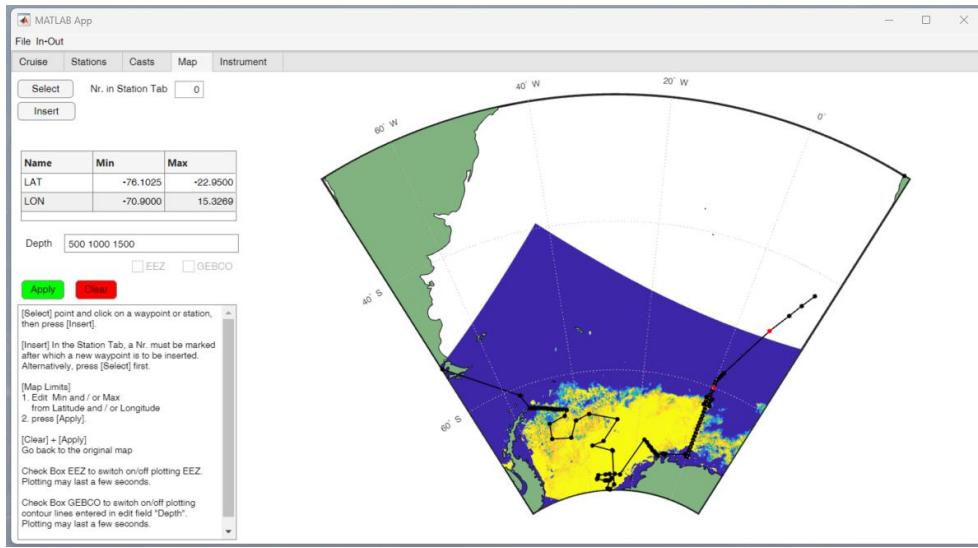
For the Arctic it would be: LongitudeLatitudeGrid-n6250-Antarctic.hdf and the sea ice concentration asi-AMSR2-n6250-20231201-v5.4.hdf. So in each case an "n" for "north".



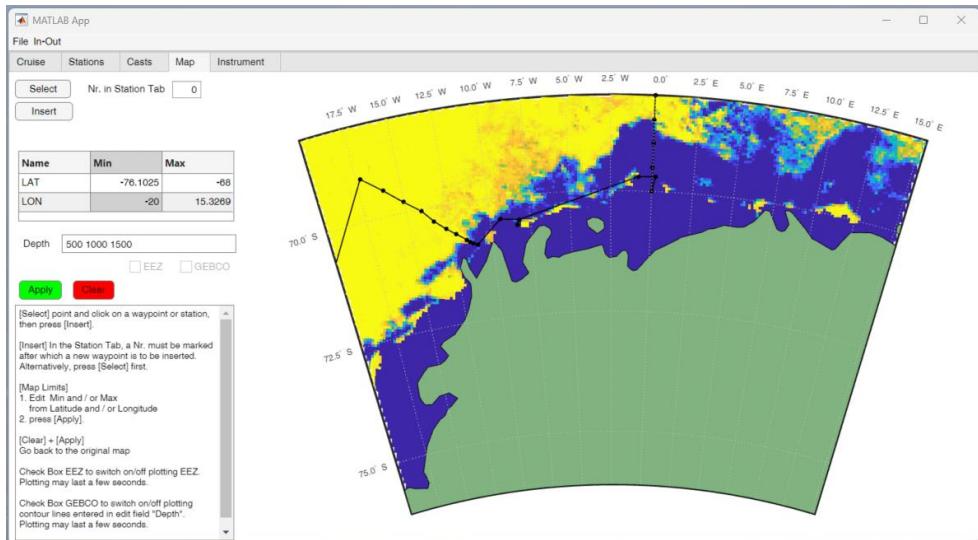
Select asi-AMSR2-s6250-20231201-v5.4.hdf and press [öffnen] /[open]. LongitudeLatitudeGrid-s6250-Antarctic.hdf must not(!) selected. The selected file then appears in the text field.



Now switch to the Map tab, where the sea ice concentration is now displayed.



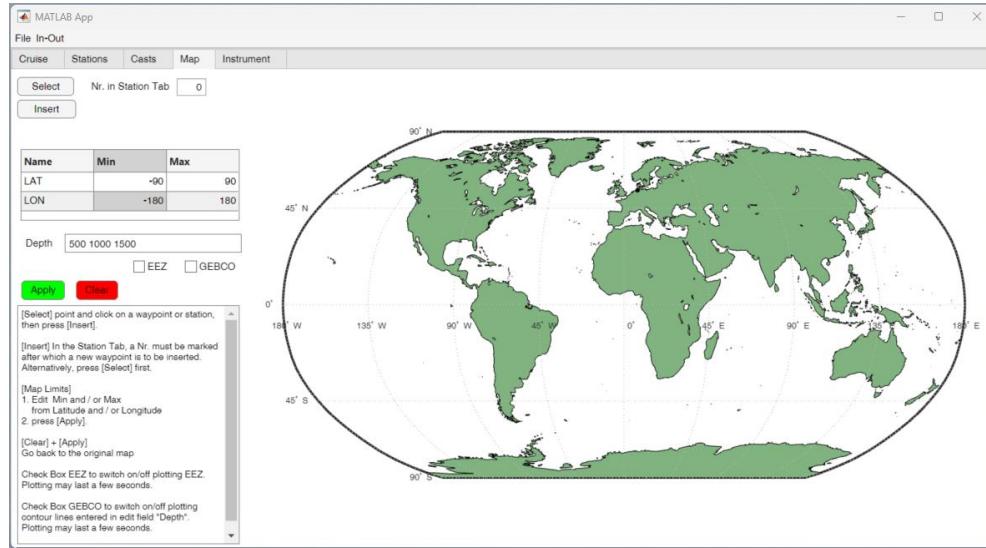
Note that the EEZ and GEBCO check boxes are disabled, i.e. EEZ or depth contours cannot be displayed in addition.



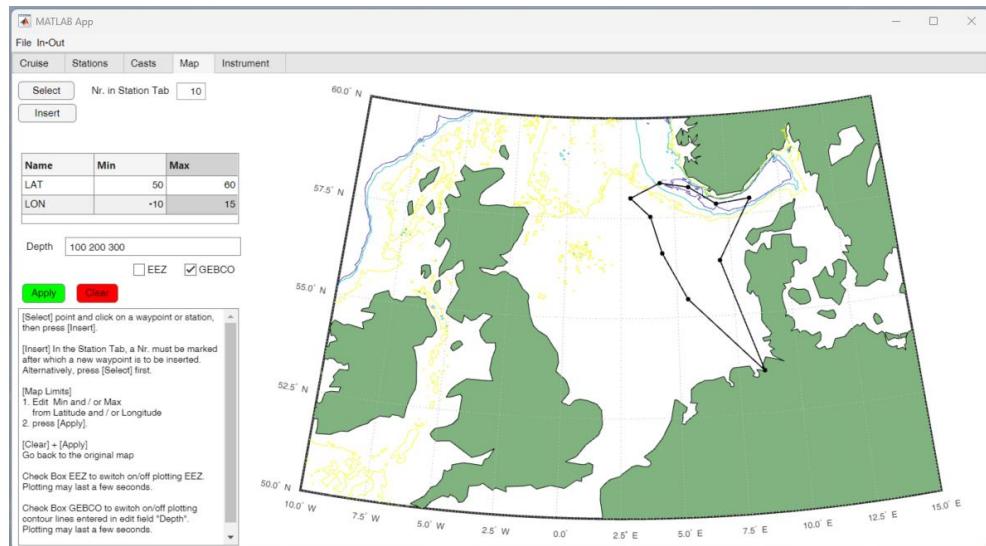
Change the limits of the map to better recognize details of the sea ice concentration of a section. If you have HDF files of different dates, you can view them one after the other. To do this, simply open another HDF file in the Cruise Tab and switch back to the Map Tab to easily observe the development over time.

New Cruise – Same Port of Departure and Arrival

This example shows how to plan a cruise from Bremerhaven into the North Sea and back. In this case, the boundaries of the map cannot be determined automatically and are therefore defined as shown in the figure below. The waypoints are inserted using the mouse. This could be just a first planning step to estimate, e.g. how much of the 9 days are needed just for the steaming.



First of all, the boundaries of the map are changed to the intended area of cruise. In the Station Tab, the cell (1,1) (no. 1) is marked because [Select] cannot clearly hit the first waypoint with the mouse in the Map Tab. Then switch back to the Map Tab and press [Insert], move the mouse to the map, click once on the RMB (cursor becomes a small cross) and now slowly move the mouse to the desired waypoint. The return route to Bremerhaven also appears as a dashed line. Note that the number of the last waypoint inserted is always displayed. You can therefore press [Insert] again immediately afterwards and insert another waypoint as described above. If necessary, depth lines are set (100, 200, 300) to define the route accordingly.



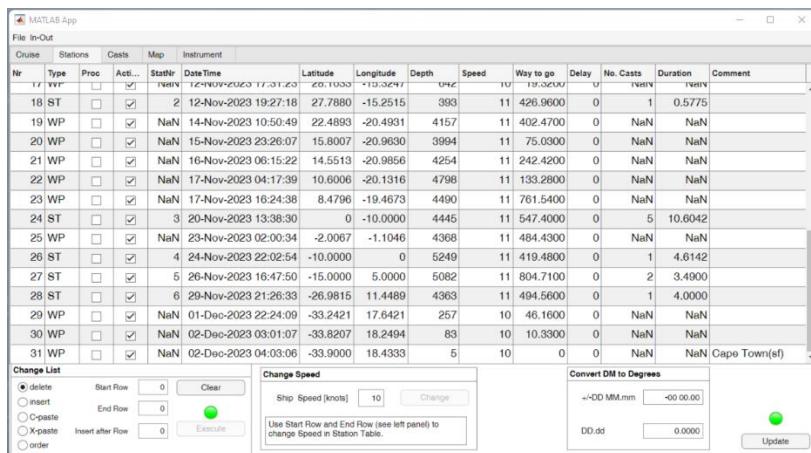
Operation at Sea

This section describes how Perplex7 supports the tasks of the chief scientist.

After boarding, the cruise the chief scientist and the captain will communicate on the key dates of the cruise, i.e. to what extent the time of departure and arrival have changed and how many knots can most likely be steamed with the current weather conditions. How the chief scientist changes this in his Perplex file has already been described. Further on, date and time when the station work must be finished should be coordinated with the captain too. In this section it is described how the chief scientist can keep an eye on this subject in his cruise plan.

Final check and clean-up of the cruise plan

It is recommended to carefully check the cruise plan once again. In this example, there are still two waypoints (rows 24 and 25) that can be deleted.



Nr	Type	Proc	Act...	StatNr	Date/Time	Latitude	Longitude	Depth	Speed	Way to go	Delay	No. Casts	Duration	Comment
18	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	12-Nov-2023 19:27:18	27.7880	-15.2515	393	11	426.9600	0	1	0.5775	
19	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	14-Nov-2023 10:50:49	22.4893	-20.4931	4157	11	402.4700	0	NaN	NaN	
20	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	15-Nov-2023 23:26:07	15.8007	-20.9630	3994	11	75.0300	0	NaN	NaN	
21	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	16-Nov-2023 08:15:22	14.5513	-20.9856	4254	11	242.4200	0	NaN	NaN	
22	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	17-Nov-2023 04:17:39	10.6006	-20.1316	4798	11	133.2800	0	NaN	NaN	
23	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	17-Nov-2023 16:24:38	8.4796	-19.4673	4490	11	761.5400	0	NaN	NaN	
24	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3	20-Nov-2023 13:36:30	0	-10.0000	4445	11	547.4000	0	5	10.6042	
25	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	23-Nov-2023 02:00:34	-2.0067	-1.1046	4368	11	484.4300	0	NaN	NaN	
26	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4	24-Nov-2023 22:02:54	-10.0000	0	5249	11	419.4800	0	1	4.6142	
27	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	26-Nov-2023 16:47:50	-15.0000	5.0000	5062	11	804.7100	0	2	3.4900	
28	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	29-Nov-2023 21:26:33	-26.9815	11.4489	4363	11	494.5600	0	1	4.0000	
29	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	01-Dec-2023 22:24:09	-33.2421	17.6421	257	10	46.1600	0	NaN	NaN	
30	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	02-Dec-2023 03:01:07	-33.8207	18.2494	83	10	10.9300	0	NaN	NaN	
31	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	02-Dec-2023 04:03:06	-33.9000	18.4333	5	10	0	0	NaN	Cape Town(sf)	

Change List Change Speed Convert DM to Degrees

Convert DM to Degrees

DD.dd 0.0000 Update

Start Row: 0 Clear End Row: 0 Execute

Ship Speed [knots]: 10 Change

Use Start Row and End Row (see left panel) to change Speed in Station Table.

In Station Tab click in cell (24,1) (column: Nr) and watch what changes in the box Change List, Start Row should show 24, then click on cell (25,1) and End Row shows a 25. If necessary press [Clear]. Alternatively enter 24 in Start Row and 25 in End Row directly in die edit field. "delete" is already the default, so that only [Execute] must be pressed.

Double check Speed

Also check the "Speed" column, because a typing error has a big impact - especially if it means a long way to go.

Double check Delay

Maybe the date/time has been changed unnoticed in one row when editing the cruise plan. In this case, the row before in the column Delay no longer shows a zero, but a value > or < 0. Initially, there should always be a zero in column Delay. This check is particularly important if a cruise plan has been copied (see menu [File – Save as] so that it can be used again in the following year).

Double check Duration

Are there any stations that take a noticeably long time, especially if No. Casts is small? If so, this may be due to incorrect entries in the Instrument Tab. Check the entries in the Instrument Tab too.

Check and update Instrument Tab

The settings in the instrument table are based on experience or have been used satisfactorily on previous cruises. Nevertheless, the specifications should be clarified once again with the users.

Because of the time required for handling, consultation with the 1. Officer is advisable. Under certain circumstances, the deployment of instruments may be new to the deck crew, so that more time would have to be planned for it in the beginning.

When fishing, check with the user at what depth the net should be trawled and for how long. In order to protect the catch, it is necessary to clarify the trawling speed (ship speed) and also the lifting speed of the net (up-speed).

Instrument									
Active	Instrument	Description	User	Fixed	Handling	Down	Trawling	Up	
<input checked="" type="checkbox"/>	BC	Box Corer	Norbert	0	15	1.0000	0	0.5000	
<input checked="" type="checkbox"/>	CTD	CTD	Sandra	0	30	1.0000	0	1.0000	
<input checked="" type="checkbox"/>	FLOAT	Float	Olaf	0	10	0	0	0	
<input checked="" type="checkbox"/>	FN	Fish Net	Sigi	0	30	1.0000	1	0.5000	
<input checked="" type="checkbox"/>	MOOR	Mooring	Matthias	4	0	0	0	0	
<input checked="" type="checkbox"/>	PLA	Plankton Net	Sigi	0	10	0.5000	0	0.5000	
<input type="checkbox"/>	ADCP	Acoustic Doppler Current Profiler	nn	0	0	0	0	0	
<input type="checkbox"/>	AEROS	Aerosol Sampler	nn	0	0	0	0	0	
<input type="checkbox"/>	AIRGN	Airgun + Seismic Source	nn	0	0	0	0	0	
<input type="checkbox"/>	AIRS	Air sampler	nn	0	0	0	0	0	
<input type="checkbox"/>	ALTI	Altimeter	nn	0	0	0	0	0	
<input type="checkbox"/>	ATURBP	Air Turbulence Profiler	nn	0	0	0	0	0	
<input type="checkbox"/>	AUV	Autonomous underwater vehicle	nn	0	0	0	0	0	
<input type="checkbox"/>	BN	Bottom Net	nn	0	0	0	0	0	
<input type="checkbox"/>	BOAT	Boat	nn	0	0	0	0	0	
<input type="checkbox"/>	BOO	Boomer - Seismic Source	nn	0	0	0	0	0	
<input type="checkbox"/>	BS	Benthos Sampler	nn	0	0	0	0	0	
<input type="checkbox"/>	BT	Bathythermograph	nn	0	0	0	0	0	
<input type="checkbox"/>	BUOY	Buoy	nn	0	0	0	0	0	
<input type="checkbox"/>	CALIB	Calibration	nn	0	0	0	0	0	
<input type="checkbox"/>	CCN	Cloud Condensation Nuclei	nn	0	0	0	0	0	
<input type="checkbox"/>	CHAM	Benthic chamber	nn	0	0	0	0	0	
<input type="checkbox"/>	CM	Current Meter	nn	0	0	0	0	0	
	ccap	ccap	nn	0	0	0	0	0	

Sort

Update

Update of the cruise plan while steaming to the first station

As planned POLARSTERN has sailed on 4.11.2023 at 06:00 h. The first meeting will take place on the first day at sea at 09:00. At the meeting, the chief scientist wants to present the position reached at 08:00 in order to announce a first estimate for arrival at Station 1. For this purpose, the chief scientist notes the position indicated at about 8:00 h [e.g. 52° 18.0' N / 3° 30.0' E]. Go to Station Tab. This position is after row 4. In Change List enter "5" in Start Row edit field and select "insert" – should be active, then [Execute] is pressed and Nr. 5 is duplicated. In row 5 the position in the columns Latitude and Longitude are then changed to the noted values [in decimal degrees: 52.3 N / 3.5 E]. If necessary, "Convert DM to Degrees" can be used. DateTime is changed to 05-Nov-2023 08:00 [press [Enter] direct afterwards]. Furthermore the column "Proc" (=processes) from row 1 to 5 - the 8 o'clock position - is activated, i.e. marked as processed. With [Update] the station list is recalculated.

Cruise Stations Casts Map Instrument														
Nr	Type	Proc	Acti...	StatNr	DateTime	Latitude	Longitude	Depth	Speed	Way to go	Delay	No. Casts	Duration	Comment
1	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	04-Nov-2023 06:00:00	53.5500	8.5833	-2	10	43.9600	0	NaN	0	Bremerhaven(gm)
2	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	04-Nov-2023 10:23:45	54.0304	7.6479	34	10	114.2300	0	NaN	NaN	
3	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	04-Nov-2023 21:49:08	53.4575	4.5802	26	10	40.2900	0	NaN	NaN	
4	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	05-Nov-2023 01:50:52	52.8962	3.9666	25	10	39.6300	2.1...	NaN	NaN	
5	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	05-Nov-2023 08:00:00	52.3000	3.5000	21	10	34.2900	0	NaN	NaN	
6	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	05-Nov-2023 11:25:44	51.9709	2.7395	26	10	93.4400	0	NaN	NaN	
7	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	05-Nov-2023 20:46:22	50.8022	1.0926	30	10	34.1500	0	NaN	NaN	
8	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	06-Nov-2023 00:11:16	50.5156	0.3176	44	10	112.3600	0	NaN	NaN	
9	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	06-Nov-2023 11:25:26	50.0617	-2.5241	63	10	21.3800	0	NaN	NaN	
10	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	06-Nov-2023 13:33:43	49.9446	-3.0473	65	10	119.8200	0	NaN	NaN	
11	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	07-Nov-2023 01:32:38	48.9698	-5.7263	111	10	190.3000	0	NaN	NaN	
12	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1	07-Nov-2023 20:34:26	46.1972	-8.0037	4767	10	21.1900	0	2	3.5361	
13	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	08-Nov-2023 02:13:44	45.8719	-8.2007	4821	10	233.5900	0	NaN	NaN	
14	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	09-Nov-2023 01:35:17	42.8491	-11.6276	1589	10	446.4300	0	NaN	NaN	
15	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	10-Nov-2023 22:13:52	35.6159	-13.8553	4852	10	342.8100	0	NaN	NaN	

delete Start Row

insert End Row

Copy Insert after Row

Order

Change Speed

Ship Speed [knots]

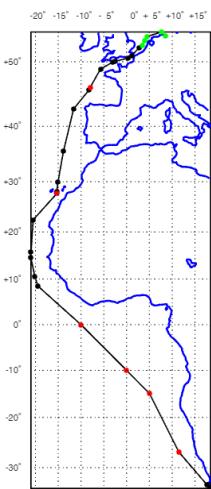
Use Start Row and End Row (see left panel) to change Speed in Station Table.

Convert DM to Degrees

+/-DD MM.mm

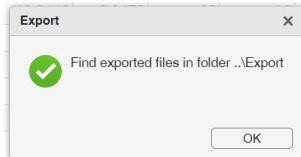
DD.dd

This first forecast for arrival at the 1. station shows 07.Nov.2023 20:34. In the map, the green dots show the completed part of the track. This can be done again for the daily meetings. And so the plan is always up to date.



Export the Cruise Plan and Station Plan

Select the [In-Out - Export to Excel] menu. No further specifications are required. A message informs you when the export is complete and where the Excel tables were saved. Press [OK] to close the message.



The directory ..\Export contains:

- PS135Sea.xlsx
- PS135Sea-Stat-1.xlsx
- PS135Sea-Stat-2.xlsx
- PS135Sea-Stat-3.xlsx
- PS135Sea-Stat-4.xlsx
- PS135Sea-Stat-5.xlsx
- PS135Sea-Stat-6.xlsx

PS135Sea.xlsx contains the complete table, as in the Station Tab and for each station number (Type = ST) there is an xlsx file (e.g. PS135Sea-Stat-1) with the instruments deployed, as displayed in the Cast Tab.

Example from PS135Sea.xlsx

Nr	Type	Done	Used	StatNr	DateTime	Latitude	Longitude	Depth	Speed	Dist	Delay	NoCast	Duration	Comment
1	WP	WAHR	WAHR		04.11.2023 06:00	53,55	8,5833	0	10	43,9615233	0		0	Bremerhaven(gm)
2	WP	WAHR	WAHR		04.11.2023 10:23	54,0304	7,6479	34	10	114,217775	0			
3	WP	WAHR	WAHR		04.11.2023 21:49	53,4575	4,5802	26	10	40,2896496	0			
4	WP	WAHR	WAHR		05.11.2023 01:50	52,8962	3,9666	26	10	39,6345758	2,18964761			
5	WP	WAHR	WAHR		05.11.2023 08:00	52,3	3,5	21	10	34,2912751	0			
6	WP	FALSCH	WAHR		05.11.2023 11:25	51,9709	2,7395	25	10	93,4380063	0			
7	WP	FALSCH	WAHR		05.11.2023 20:46	50,8022	1,0926	31	10	34,1498037	0			
8	WP	FALSCH	WAHR		06.11.2023 00:11	50,5156	0,3176	44	10	112,35762	0			
9	WP	FALSCH	WAHR		06.11.2023 11:25	50,0617	-2,5241	63	10	21,3797119	0			
10	WP	FALSCH	WAHR		06.11.2023 13:33	49,9446	-3,0473	65	10	119,810292	0			
11	WP	FALSCH	WAHR		07.11.2023 01:32	48,9698	-5,7263	111	10	190,288977	0			
12	ST	FALSCH	WAHR	1	07.11.2023 20:34	46,1972	-8,0037	4765	10	21,1870322	0	2	3,53611111	
13	WP	FALSCH	WAHR		08.11.2023 02:13	45,8719	-8,2007	4821	10	233,571603	0			

Example from PS135Sea-Stat-1.xlsx

Type	Done	Used	CastNr	Instrument	DateTime	Duration	Delay	Depth	Comment
ST	FALSCH	WAHR	1	PLA	07.11.2023 20:34	0,388888889	0	200	Sigi
ST	FALSCH	WAHR	2	CTD	07.11.2023 20:57	3,147222222	0	4765	Sandra

Daily Station Schedule

To inform the ship's crew and the participants of a cruise about the work of a day, the information from the Station Tab and the corresponding Casts Tab can be compiled into a text file. First, the corresponding rows are selected in the Station Tab; select cell (nstart,1) so that the row number appears in "Change List" as Start Row. Then select cell (nstop,1) so that the row number appears as End Row. Then the [In-Out - Daily schedule] menu is selected. The text file was saved in folder ..\Export.

From the example PS135Sea.mat e.g. Start Row = 11 and End Row = 19, we got two text files:

Station-1.txt

```
Station: 1
Latitude: 46° 11.83' N Longitude: 46° 11.83' E
Water Depth: 4765 [m]
Way to go (next Waypoint or Station): 2.118703e+01 [nm]
Cast   Instrument   DateTime           Duration (h)       ProfileDepth (m)
Comment
1      PLA          07-Nov-2023 18:08:00    0.39            200   Sigi
2      CTD          07-Nov-2023 18:31:20    3.15            4765  Sandra
```

Station-2.txt

```
Station: 2
Latitude: 27° 47.28' N Longitude: 27° 47.28' E
Water Depth: 459 [m]
Way to go (next Waypoint or Station): 4.269335e+02 [nm]
Cast   Instrument   DateTime           Duration (h)       ProfileDepth (m)
Comment
1      BC           12-Nov-2023 19:26:59    0.63            459   Norbert
```

Set Start of a Station to a Specific Time

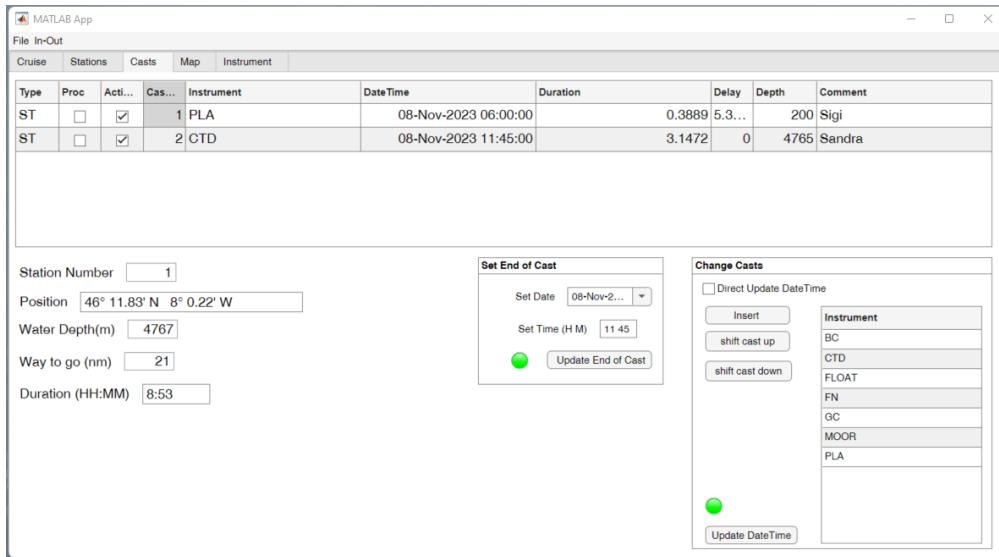
In the example of cruise PS135Sea, the station should start on November 8, 2023 at 06:00. Go to Station Tab and change the cell (12,6) "DateTime" to 08-Nov-2023 06:00:00. Note the format. Then press [Update] and in the cell (11,12) "Delay" appears: 9.4 hours. The new start of the station is also copied to the Cast Tab. If you want to go back to the original time, a 0 is set in cell (11,12) in the Station Tab. After [Update] the original table can be seen again.

Set End (Time) of a Station or a Cast

Station 1 has been reached and the first instrument goes into the water. Mark this station in cell (12,5) in the Station Tab. Switch to the Casts Tab, where the casts of station 1 are displayed. Due to problems, e.g. with the winch, the deployment of the plankton net (PLA) took until 11:45. So to change the start of the cast (CTD) do the following:

In the Casts Tab, select cell (1,4) "CastNr". In the panel "Set End of Cast" the date from cell (1,6) is displayed in Set Date. If the end of the cast should be connected with a date change, this can be changed in the Date Picker menu. Enter time in Set Time (H M) (no ":" between hours and minutes). A change here will cause the lamp to turn red, indicating that [Update End Cast] must be pressed/executed. After that, the delay in hours is displayed for Cast 1 in cell (1,8) "Delay", here 5.3...

Cast 2, the CTD, consequently begins at 11:45.

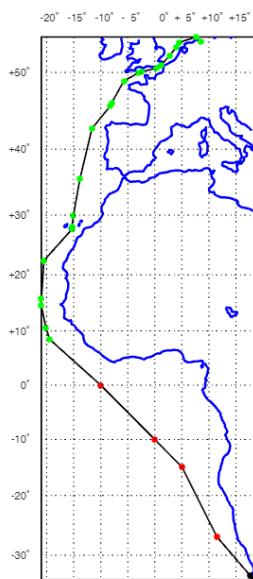


Incorrect entries can be corrected by setting "Delay" back to 0 and then pressing [Update DateTime] in the "Change Casts" panel.

Normally, only the end (date/time) of the last cast of a station was set. If, for example, several stations take place during the night hours, it is sufficient if the chief scientist changes the end of the last station in the morning as described. "Delay" is then the complement of all stations that took place during the night.

Change Settings for an Instrument in the Instrument Tab during the Cruise

The time required when deploying an instrument is calculated from the depth of the profile and the down- and up-speed. During a cruise, it becomes apparent to what extent the information in the Instrument Tab is realistic. As an example, it might have turned out that 1.0 m/s was clearly overestimated. Now the first two stations are already completed and before the 3rd station, up- and down speed should be changed to 0.85 m/s.



First, in the Station Tab, the 3rd column "Proc" (processed) from row 1 to 23 is check marked. This has the effect that [Update] is no longer performed for this part of the table - stations and the belonging casts; see map below

Map showing the completed waypoints and stations.

Cruise										
Active		Instrument		Description		User	Fixed	Handling	Down	Trawling
<input checked="" type="checkbox"/>	BC	Box Corer	Norbert	0	15	1.0000	0	0.5000	0	0.5000
<input checked="" type="checkbox"/>	CTD	CTD	Sandra	0	30	0.8500	0	0.8500	0	0
<input checked="" type="checkbox"/>	FLOAT	Float	Olaf	0	10	0	0	0	0	0
<input checked="" type="checkbox"/>	FN	Fish Net	Sigi	0	30	1.0000	1	0.5000	0	0
<input checked="" type="checkbox"/>	MOOR	Mooring	Matthias	4	0	0	0	0	0	0
<input checked="" type="checkbox"/>	PLA	Plankton Net	Sigi	0	10	0.5000	0	0.5000	0	0
<input type="checkbox"/>	ADCP	Acoustic Doppler Current Profiler	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	AEROS	Aerosol Sampler	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	AIRGN	Airgun - Seismic Source	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	AIRS	Air sampler	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	ALTI	Altimeter	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	ATURBP	Air Turbulence Profiler	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	AUV	Autonomous underwater vehicle	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BN	Bottom Net	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BOAT	Boat	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BOO	Boomer - Seismic Source	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BS	Benthos Sampler	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BT	Bathythermograph	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	BUOY	Buoy	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	CALIB	Calibration	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	CCN	Cloud Condensation Nuclei	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	CHAM	Benthic chamber	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	CM	Current Meter	nn	0	0	0	0	0	0	0
<input type="checkbox"/>	COOS	COOS sensor	nn	0	0	0	0	0	0	0

Then switch to the Instrument Tab and change "Down" and "Up" for the CTD from 1.0 (m/s) to 0.85. Note the red light, i.e. [Update] must be pressed.

Note that the CTD deployment now takes a little longer; see the "Duration" column in the Casts tab and Station tab. However, it can also be seen that the start of Station 3 has not changed, but the change in up- and down-speed only has an effect from Station 3 on. (CTD at station 3, duration has changed from 2.9 to 3.4 hours).

The Remaining Time to a given Waypoint

In the Cruise Tab, the Chief Scientist can see after each change how much time is still available to arrive at the destination port on time. On a voyage, in addition to the destination port, there are other destinations that must be reached at a certain time, e.g. Atka Bay to supply Neumayer III, but there could also be certain positions in the ocean that are to be reached at a time that coincides with a satellite overflight, for example. In the simplest case, it is the position and time to finish the research work so that the remaining transit distance can be covered in the time available to arrive on time.

Nr	Type	Proc	Act...	StatNr	Date	Time	Latitude	Longitude	Depth	Speed	Way to go	Delay	No. Casts	Duration	Comment
18	ST	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2	13-Nov-2023	12:40:45	27.7880	-15.2515	393	11	426.9600	0	1	0.5775	
19	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	15-Nov-2023	04:04:16	22.4893	-20.4931	4157	11	402.4700	0	NaN	NaN	
20	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	16-Nov-2023	16:39:34	15.8007	-20.9630	3994	11	75.0300	0	NaN	NaN	
21	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	16-Nov-2023	23:28:49	14.5513	-20.9856	4254	11	242.4200	0	NaN	NaN	
22	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	17-Nov-2023	21:31:06	10.6006	-20.1316	4798	11	133.2800	0	NaN	NaN	
23	WP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	18-Nov-2023	09:38:05	8.4796	-19.4673	4490	11	761.5400	0	NaN	NaN	
24	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3	21-Nov-2023	06:51:56	0	-10.0000	4445	11	547.4000	0	5	11.0400	
25	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	23-Nov-2023	19:40:09	-2.0067	-1.1046	4368	11	484.4300	0	NaN	NaN	
26	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4	25-Nov-2023	15:42:30	-10.0000	0	5249	11	419.4800	0	1	4.6142	
27	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	27-Nov-2023	10:27:25	-15.0000	5.0000	5082	11	804.7100	0	2	3.9882	
28	ST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	30-Nov-2023	15:36:03	-26.9815	11.4489	4363	11	494.5600	0	1	4.0000	End of Work
29	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	02-Dec-2023	16:33:39	-33.2421	17.6421	257	10	46.1600	0	NaN	NaN	
30	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	02-Dec-2023	21:10:36	-33.8207	18.2494	83	10	10.3300	0	NaN	NaN	
31	WP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NaN	02-Dec-2023	22:12:35	-33.9000	18.4333	5	10	0	0	NaN	NaN	Cape Town(sf)

Change List

- delete Start Row
- insert End Row
- C-paste
- X-paste Insert after Row
- order

Change Speed

Ship Speed [knots]

Use Start Row and End Row (see left pane) to change Speed in Station Table.

Convert DM to Degrees

DD.MM.mm

DD.dd

The Captain requests the Chief Scientist that the station work be completed at 30°S on 04-Dec-2023 at 20:00.

In the Map Tab, position was inserted with the mouse cursor at 30° S on the track as described in Chapter Use the map; see row 28 (Latitude = -29.9397). In this row, this waypoint is labeled "End of Work" in Comment.

Switch to the Cruise tab. Enter in field Remaining Time to "End of Work". Immediately after the input the Arrival DateTime is displayed, which is the same as from the Station Tab cell(28,6) "DateTime" - the calculated arrival time at this waypoint. If this does not happen, the name in the Comment was not entered correctly in the Cruise tab.

Cruise	PS135Sea	Number of the First Station	1
Departure	Bremerhaven(gm); 04-Nov-2023 00:00:00	Total Route (nautical miles)	6683
Arrival	Cape Town(sf); 07-Dec-2023 12:00:00	Avg. Speed (knots)	10.67
Available Time (days hours)	33 6		
Current Time used (days hours)	27 8		
Time to go (days hours)	26 2		
Remaining Time to Port (days hours)	5 22		
(Enter the Comment to search in the Station Table)		Arrival DateTime	30-Nov-2023 07:51:38
Remaining Time to		Remaining Time (Days Hours)	
		Change Arrival Date	mm/dd/yyyy
		Change Arrival Time (HH:MM)	00:00

30-Nov-2023 07:51:38 can now be changed to the time specified by the captain (04-Dec-2023 at 20:00). Use the Date Picker for the date. The time (HH:MM) is entered in the field below.

The screenshot shows a MATLAB App window titled "MATLAB App" with the tab "Cruise" selected. The interface includes fields for Cruise (PS135Sea), Departure (Bremerhaven(gm); 04-Nov-2023 06:00:00), Arrival (Cape Town(sf); 07-Dec-2023 12:00:00), Number of the First Station (1), Total Route (nautical miles) (6683), Avg. Speed (knots) (10.67), Available Time (days hours) (33 6), Current Time used (days hours) (27 8), Time to go (days hours) (26 2), Remaining Time to Port (days hours) (5 22), and Remaining Time to (End of Work). It also features an "Arrival DateTime" field set to 04-Dec-2023 20:00:00, a "Remaining Time (Days Hours)" field (4 12), and buttons for "Change Arrival Date" (set to 04-Dec-2023) and "Change Arrival Time (HH:MM)" (set to 20:00).

Remaining Time shows here now how much time is available for research.

In the Station Tab, several intermediate points with fixed time can be used in the same way, e.g. to set the arrival time in Las Palmas. After depart from Las Palmas switch to “End of Work” in the Cruise Tab.

Appendix

Instrument Settings

After a copy has been made for security purposes, the csv file can be saved using an editor. It is best to use a simple text editor because Excel often leads to problems, e.g. it automatically uses a comma as the decimal point, which should not be the case.

Here we have changed the settings for the CTD, shown in red. In Perplex7, the "1" ensures that the CTD is displayed in the Cast Tab. "Sanda" appears in the "daily schedule" as the person responsible for this instrument. "15" minutes is a fixed duration to bring the CTD con deck into the water including back from the water to the deck. The CTD is lowered at an average speed of 0.8 m/s and also hoisted at this speed.

Modify the csv file for all devices that are used. The abbreviation of the instrument can also be changed. However, lines of instruments that will never be used do not necessarily have to be deleted.

The "1" at the beginning of the line only determines whether the instrument is displayed in the Cast Tab, i.e. whether the duration of use is also calculated for it.

Default_InstrTabel.csv

```
Used,Instrument,Description,User,Fixed,Handling,Down,Trawling,Up
0,ADCP,Acoustic Doppler Current Profiler,nn,0,0,0,0,0
0,AEROS,Aerosol Sampler,nn,0,0,0,0,0
0,AIRGN,Airgun - Seismic Source,nn,0,0,0,0,0
0,AIRS,Air sampler,nn,0,0,0,0,0
0,ALTI,Altimeter,nn,0,0,0,0,0
0,ATURBP,Air Turbulence Profiler,nn,0,0,0,0,0
0,AUV,Autonomous underwater vehicle,nn,0,0,0,0,0
0,BC,Box Corer,nn,0,0,0,0,0
0,BN,Bottom Net,nn,0,0,0,0,0
0,BOAT,Boat,nn,0,0,0,0,0
0,BOO,Boomer - Seismic Source,nn,0,0,0,0,0
0,BS,Benthos Sampler,nn,0,0,0,0,0
0,BT,Bathythermograph,nn,0,0,0,0,0
0,BUOY,Buoy,nn,0,0,0,0,0
0,CALIB,Calibration,nn,0,0,0,0,0
0,CCN,Cloud Condensation Nuclei,nn,0,0,0,0,0
0,CHAM,Benthic chamber,nn,0,0,0,0,0
0,CM,Current Meter,nn,0,0,0,0,0
0,CO2S,CO2 Sensor,nn,0,0,0,0,0
0,CORER,Corer,nn,0,0,0,0,0
0,CPT,Cone penetration testing-lance,nn,0,0,0,0,0
0,CRS,Cloud Radar System,nn,0,0,0,0,0
0,CSEM,Controlled Source Electromagnetics,nn,0,0,0,0,0
1,CTD,CTD,Sandra,0,15,0.8,0,0.8
0,DOAS,Differential Optical Absorption Spectrometers,nn,0,0,0,0,0
0,DRG,Dredge,nn,0,0,0,0,0
0,DRIFT,Drifter,nn,0,0,0,0,0
.
.
.
and so on
```

Transit from Bremerhaven to Cape Town

Here is an example of a text file that can be inserted into the cruise plan using the menu [In-Out - Import from txt-File].

Useful Note:

In marine research, measurements are often taken along a transect. Stations are located at regular intervals along this section. The distances are in nautical miles (e.g. every 10 nm) or the stations are located e.g. zonal or meridional at 20° 00', 20° 15', 20° 30', 20° 45' and so on.

For this purpose, please refer to the Matlab app "WayPointsAlongTransect.mlapp", which you can download from here:

<https://github.com/rohardt/WaypointsAlongTransect>

or

<https://de.mathworks.com/matlabcentral/fileexchange/>

(and search for: *WayPointsAlongTransect*)

The app "WayPointsAlongTransect" calculates the positions (latitude and longitude) of stations and saves it in a text file in exactly the same form as file Brh-CT.txt (see below). Thus menu [In-Out - Import from txt-File] can also be used to insert sections in a cruise plan.

The file "Brhv-CT.txt" contains the waypoints (latitude and longitude in decimal degrees; + := N respectively E; - := S respectively W) of a route that is frequently taken between Bremerhaven and Cape Town.

If, for example, a new trip is planned from Cape Town to Bremerhaven, this file can be selected and inserted using the menu [In-Out - Import from txt-File]. However, the order of the waypoints must be reversed. In the Station Tab, use the radio button "order" in the "Change List" panel at the bottom left.

If users have planned a cruise using Perplex7 and want to travel the same route again later, they can use the [In-Out - Export to Excel] menu. All columns are deleted from this Excel table except for latitude and longitude. If necessary, duplicate items must be deleted. Finally, the Excel table is saved as text with <TAB> as the separator. Also note that Excel may have used a "," instead of a ".". This can be corrected with "search & replace" later. The waypoints saved in this way can then be inserted for planning a new trip.

File: ..\Import\Brhv-CT.txt

54.0304	7.6479
53.4575	4.5802
52.8962	3.9666
51.9709	2.7395
50.8022	1.0926
50.5156	0.3176
50.0617	-2.5241
49.9446	-3.0473
48.9698	-5.7263
46.1972	-8.0037
45.8719	-8.2007
42.8491	-11.6276
35.6159	-13.8553
29.9945	-15.0464
28.1033	-15.3247
27.7880	-15.2515
22.4893	-20.4931
15.8007	-20.9630
14.5513	-20.9856
10.6006	-20.1316
8.4796	-19.4673
-26.9815	11.4489
-33.2421	17.6421
-33.8207	18.2494

Ports.txt

Hier ist beim Editieren auf Einhalten des Formats zu achte. Die Kopfzeile nicht löschen, sonst können nicht benötigte Häfen gelöscht werden oder benötigte eingefügt werden. Dabei ist es sinnvoll auf die alphabetische Reihenfolge zu achten.

```
Port; Latitude; Longitude
Aalborg(da); 57.05; 9.9333
Aarhus(da); 56.15; 10.2167
Aberdeen(uk); 57.15; -2.0833
Accra(gh); 5.5333; -0.2
Admiralty bay/ay); -62.0833; -58.4167
Antofagasta(ci); -23.65; -70.4167
Apia(ws); -13.65; -171.7667
Auckland(nz); -36.85; 174.7667
Bahia Blanca(ar); -38.7833; -62.2667
Barentsburg(sv); 78.0667; 14.2333
Bergen(no); 60.4; 5.3167
Borgholm(sw); 56.8833; 16.65
Bremen(gm); 53.1167; 8.7167
Bremerhaven(gm); 53.55; 8.5833
Brest(fr); 48.3833; -4.5
.
.
.
and so on
```

Utilities

GRIDONEnc2mat

This function converts GRIDONE_2D.nc from netCDF format to a MAT file. GRIDONE.mat is read by Perplex7.mlapp; see *startupfcn* and used to determine the water depth from waypoints or stations based on latitude and longitude.

Acknowledgment

PERPLEX was developed at the Alfred Wegener Institute for Polar and Marine Research (AWI) and improved during numerous research cruises with RV POLARSTERN. From 2005 until 2009, PERPLEX was distributed by the software company WERUM AG, Lüneburg (Germany). WERUM improved the design of the graphical user interface and applied routines as especially for map plotting which considerably increased the performance of the software. Furthermore, WERUM provided a professional user manual. At this point, I would like to personally thank Mr. Manfred Stein from WERUM, because he was very involved in sales and advertising at that time. He significantly contributed to the distribution of the software.

Since 2010, PERPLEX has been distributed and supported by AWI itself. Prof. Dr. Eberhard Sauter (AWI, Technology Transfer Office) accompanied the project in advice and in action and ensured that PERPLEX was protected as a trademark.

I would like to thank the AWI that I could use the AWI network and that the AWI Helpdesk always took care of me when I had a problem.

Furthermore, I would like to be able to help users as independently as possible in the long term. This was realized with a “sponsored license” from Mathworks. I would like to thank the responsible persons of Mathworks for this. Converting PERPLEX, which was developed over many years and included up to 200 files, to the latest Matlab release initially encountered significant problems. Dr. Mihaela Jarema from Mathworks Support provided help with great personal engagement, so that the project could be completed in a relatively short time.