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WaypointsAlongTransect – Manual

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Introduction

In marine research, measurements are often taken along a transect during an expedition; e.g. from 20° N; 22°W to 15° S; 22° W. Along this route, the research vessel stops at regular intervals to lower different types of probes into the depths. The app "WayPointsAlongTransect" calculates the positions (latitude and longitude) of these stops. The user only has to specify the latitude and longitude from the beginning and end of the transect. Then he can calculate the total length (in nautical miles) to estimate the number stops according to the planned regular intervals. The total length is displayed for a distance calculated with a constant course (rhombus line) and in comparison along a great circle. The water depth profile is shown to the user, first using the default rhombus line for the distance on the X axis. The user can save the high-resolution depth profile to a TXT file and use it for any other purpose. In the next step, the user selects the regular distance between stops/stations (Spacing Value) this value is set to "Nautical Miles" by default. Now the latitude and longitude, the positions, of the stops/stations can be calculated with button "Compute Waypoints". The waypoints are then placed as vertical red lines over the high-resolution depth profile. Above this, the depth profile is plotted in red in the resolution resulting from the selected station distance. To the left of

this, the positions are plotted in a map. If the user is satisfied with the result, he can insert a station manually. To do this, he clicks on the button "Insert Profile" and moves the mouse the mouse pointer is now a small cross, into the depth profile at the position (water depth/distance) where the profile should be inserted. A click on the left mouse button shows the inserted profile in green. This process can be repeated several times. Finally, the positions of all waypoints are saved to a text file with button "Save Waypoints". Users who have created a cruise plan using the "Perplex7" app (see Mathworks File Exchange) can insert this text file/section using the “Import” menu. Instead of using a distance in "Nautical Miles", the user can also specify "Minutes" instead of “Nautical Miles”. Default is “latitude”. E.g. “Spacing Value = 30 “, then means that stations along 22°W are calculated at 22°N; 21° 30' N; 21° N; 20° 30' N and so on. If the transect is essentially meridional, the check mark ("LAT") is set. However, if this runs more zonally, the check mark can be deleted so that, for example, waypoints are placed at 22° 00.0' W; 22° 30.0' W; 23° 00.0' W etc. and corresponding latitude.

Installation:

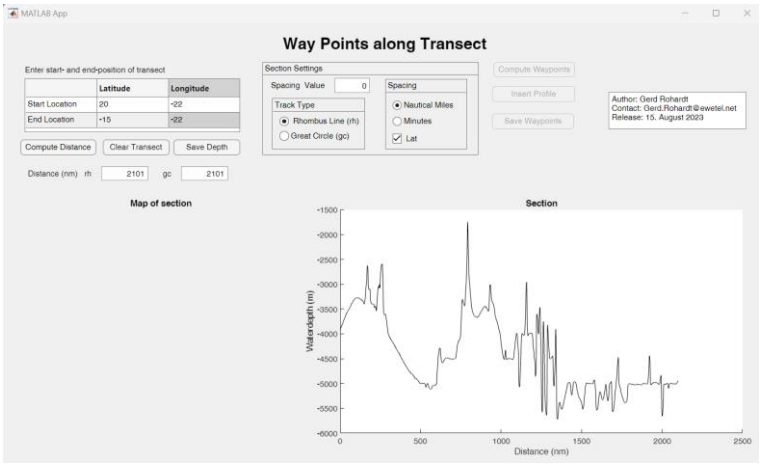
Let e.g. MyMatlab be your personal Matlab work directory, e.g. c:\MyMatlab

1. Create subfolder for WaypointAlongTransect source code:
   c:\MyMatlab\ WaypointAlongTransect
2. Create subfolder:
   a. c:\MyMatlab\ WaypointAlongTransect \Dataset (used to save GEBBCO one minute topographic grid; GRIDONE_2D.mat)
   b. c:\MyMatlab\ WaypointAlongTransect \Export (used to save text file with the waypoints)
3. Copy download from File Exchange to e.g. c:\MyMatlab\ WaypointAlongTransect
4. Download GEBCO One Minute Grid from link below, unzip and save GRIDONE_2D.nc in folder c:\MyMatlab\ WaypointAlongTransect. Afterwards execute GRIDONEnc2mat.m (this converts the netCDF into a MAT-file . Select the output folder c:\MyMatlab\ WaypointAlongTransect \Dataset.
   (https://www.gebco.net/data_and_products/historical_data_sets/#gebco_one)

Operation

Start and end of an transect

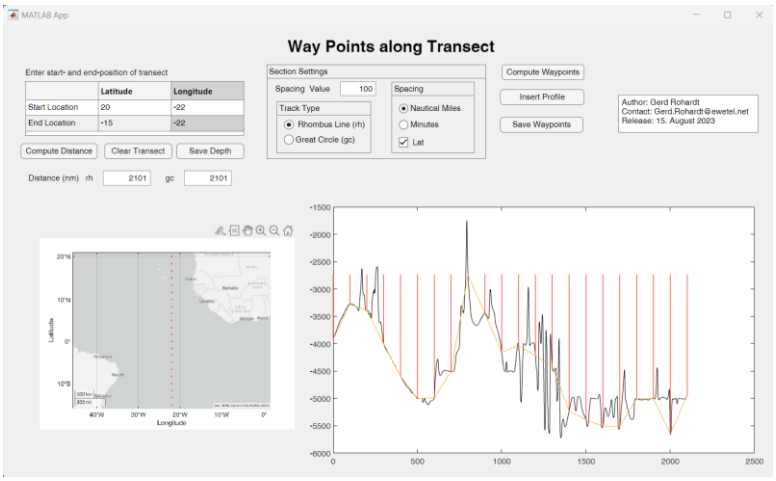
After starting the program, the input fields for the start and end position of a planned transect are empty. The planned transect runs from 20°N to 15°S along the meridian 22° W. Positions can be entered. Latitude and longitude can be specified in decimal degrees or in degrees and minutes (e.g. 20.5 or 20 30 or 20 30.0). Conversion to decimal degrees takes place automatically.



As soon as the start and end of the transect have been entered, [Compute Distance] is active and can be pressed. Alternatively, press [Clear] to delete the entry and correct it. Press [Save Depth] to save the topography in a text file in a selectable directory. sec_rh*.txt is for the transect along a straight line or in sec_gc*.txt for the great circle (both files are identical in this case; see Example in Appendix).

Enter Spacing and Compute Waypoints

In panel Section Settings enter the Spacing Value. As standard, the distance here is set in nautical miles, as is the track type on Rhombus Line. Press [Compute Waypoints] and this will then show the stations as vertical red lines in the high-resolution depth profile. The depth profile is also superimposed in red over the black depth profile, as it appears at distance of 100 nm.



The positions are shown on a map to the left of the depth profile.

Manually Insert a Station

If the station spacing in certain areas does not correspond to the high-resolution depth profile, a profile can be inserted manually. To do this, press [Insert Profile]. Finally, the mouse is moved into the depth profile and a cross hair is displayed. The cross hair is then moved to the desired position on the high-resolution depth profile and the left mouse button (LMB) is pressed.

The additional position inserted in this way is plotted as a straight vertical line. The closer station spacing at this position can also be seen on the map.

Save Waypoints

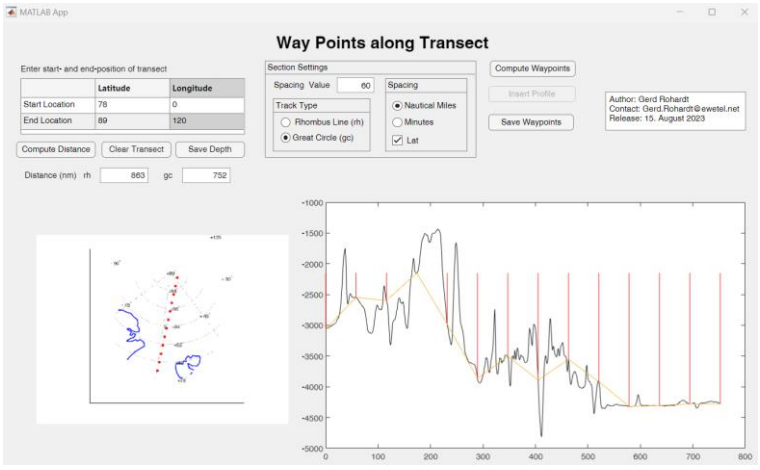
Press [Save Waypoints], a menu will open to select a directory and enter a file name, e.g. Section_Atlantic_22West.txt; see Appendix.

If the cruise planning software "Perplex7" (see Mathworks File Exchange; Perplex7.mlapp) is used, the waypoints calculated and saved with WayPointsAlongTransect.mlapp can be imported when planning a cruise with Perplex7; see Perplex-Manual.

Transect along Great Circle

The previous section is saved and now a section in the Arctic from 78°N; 0° longitude to 89°N, 120°E along the great circle is to be calculated immediately afterwards.

Press [Clear Transect] and enter the start and end of the next transect. This shows that the transect along the great circle is almost 110 nm shorter than the rhombus line.



In addition to the great circle, we now also select that the distance should be 60 minutes geographic latitude, i.e. starting at 78° N, then 79° N, 80° N, 81° N and so on. See Appendix: Section_Arctic_78.txt

In another example, the transect is predominantly zonal, so that waypoints are calculated every even degree of longitude. Note the check mark in panel Spacing “Lat” was removed; see Section_Arctic_78_lon in Appendix.

Appendix

Save Depth

File: sec_rh_20_22.txt

Latitude	Longitude	Distance [nautical miles]	Waterdepth [m]
20.0000	-22.0000	0.0	-3917.0
19.9833	-22.0000	1.0	-3909.0
19.9667	-22.0000	2.0	-3900.0
19.9500	-22.0000	3.0	-3892.0
19.9333	-22.0000	4.0	-3884.0
19.9167	-22.0000	5.0	-3876.0
19.9000	-22.0000	6.0	-3868.0
19.8833	-22.0000	7.0	-3860.0
19.8667	-22.0000	8.0	-3852.0
19.8500	-22.0000	9.0	-3844.0
19.8333	-22.0000	10.0	-3837.0
19.8167	-22.0000	11.0	-3830.0
19.8000	-22.0000	12.0	-3823.0
19.7833	-22.0000	13.0	-3817.0
19.7667	-22.0000	14.0	-3811.0
19.7500	-22.0000	15.0	-3803.0
19.7333	-22.0000	16.0	-3795.0
19.7167	-22.0000	17.0	-3785.0
19.7000	-22.0000	18.0	-3776.0
19.6833	-22.0000	19.0	-3766.0
19.6667	-22.0000	20.0	-3757.0
19.6500	-22.0000	21.0	-3747.0
19.6333	-22.0000	22.0	-3739.0
19.6167	-22.0000	23.0	-3730.0
19.6000	-22.0000	24.0	-3721.0

Save Waypoints

Section_Atlantic_22West.txt
(Latitude <TAB> Longitude)

```
 20.0000   -22.0000
 18.3357   -22.0000
 16.6712   -22.0000
 15.0063   -22.0000
 13.3412   -22.0000
 11.6759   -22.0000
 10.0104   -22.0000
  8.3448   -22.0000
  6.6790   -22.0000
  5.8802   -22.0000
  5.0131   -22.0000
  3.3471   -22.0000
  1.6810   -22.0000
  0.0150   -22.0000
 -1.6511   -22.0000
 -3.3172   -22.0000
 -4.9832   -22.0000
 -6.6491   -22.0000
 -8.3149   -22.0000
 -9.9805   -22.0000
-10.7218   -22.0000
-11.6460   -22.0000
-13.3113   -22.0000
-14.9764   -22.0000
```

Section_Arctic_78.txt

```
 78.0000    0.0000
 79.0000    0.3675
 80.0000    0.8082
 81.0000    1.3470
 82.0000    2.0214
 83.0000    2.8910
 84.0000    4.0568
 85.0000    5.7047
 86.0000    8.2213
 87.0000   12.5684
 88.0000   21.9995
```

Section_Arctic_78_lon.txt

```
 87.0000    0.0000
 87.0440    1.0000
 87.0879    2.0000
 87.1319    3.0000
 87.1759    4.0000
 87.2198    5.0000
 87.2638    6.0000
 87.3078    7.0000
 87.3517    8.0000
 87.3957    9.0000
 87.4397   10.0000
 87.4836   11.0000
 87.5276   12.0000
 87.5715   13.0000
 87.6128   14.0000
 87.6312   15.0000
 87.6497   16.0000
 87.6681   17.0000
 87.6866   18.0000
 87.7050   19.0000
 87.7234   20.0000
 87.7419   21.0000
 87.7603   22.0000
 87.7787   23.0000
```

87.7972	24.0000
87.8156	25.0000
87.8341	26.0000
87.8525	27.0000
87.8709	28.0000
87.8894	29.0000
87.9078	30.0000
87.9262	31.0000
87.9447	32.0000
87.9631	33.0000
87.9816	34.0000

Utilities

GRIDONEnc2mat.m

The WaypointsAlongTransect software requires the global topographical data set with a resolution of one minute. The data set can be downloaded from here:
https://www.gebco.net/data_and_products/historical_data_sets/#gebco_one

For the WaypointsAlongTransect software, the data set, which is available in netCDF format, must be converted into a MAT file. This can be done with the function/m-file GRIDONEnc2mat.m before WaypointsAlongTransect is used for the first time. Save the MAT-file in

c:\MyMatlab\ WaypointAlongTransect \Dataset

Acknowledgment

I would like to thank Mathworks for providing me with a "sponsored license". With this license I was able to adapt the cruise planning software Perplex to the AppDesigner after my retirement from the Alfred Wegener Institute. WaypointsAlongTransect is an extension for Perplex7, which is used as a stand-alone app now.