SpectraPlotterMap 12 User Guide

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SpectraPlotterMap version 12, included in Radial Suite Release 8, displays two and three dimensional plots of power spectra generated by the SeaSonde. The power spectrum is a visual representation of the sea echo received by the SeaSonde which is used to evaluate the quality and the nature of the signal.

SpectraPlotterMap 12 supports Cross Spectra version 6 files, which contain more meta data than prior versions and embedded first order limit lines.

SpectraPlotterMap 12 generates spectral plots for the two loop antennas and the vertical antenna (previously referred to as the monopole or the dipole). Buttons on the main window allow easy access to the information, range slice, doppler slice, and first order windows.

SpectralPlotterMap 12 adds keyboard-controlled zoom capabilities with enhanced pixelation, font size control, and Portable Document Format (PDF) export for clean graphics.

SpectraPlotterMap Features

Graphically enhanced power spectra plots

Manipulate font size of graphic labels and export to PDF format for high quality report and scientific study figures

Navigate data with multiple keyboard short cut options

Activate and deactivate spectra for one, two, or three antenna elements new toolbar buttons

Basics

Open a cross spectra (spectra) file by:

Open SpectraPlotterMap and follow the prompt to drop a spectra file onto the window with tray icon

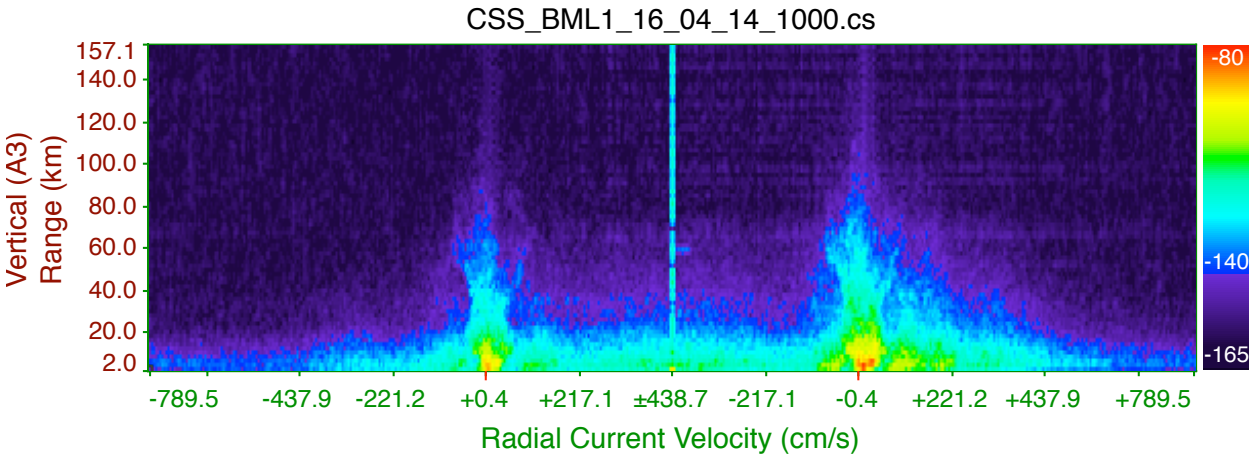
Drag and drop the spectra file on the SpectraPlotterMap icon

Drag and drop the spectra file into the SpectraPlotterMap window

Open SpectraPlotterMap, select main menu **File->Open** and locate spectra file

Once a SpectraPlotterMap session has been initiated, double click spectra file to launch it into SpectraPlotterMap

Spectra data will appear in the main window of SpectraPlotterMap. The example used throughout this Guide is from the BML1 site located in Bodega Bay, California, United States.

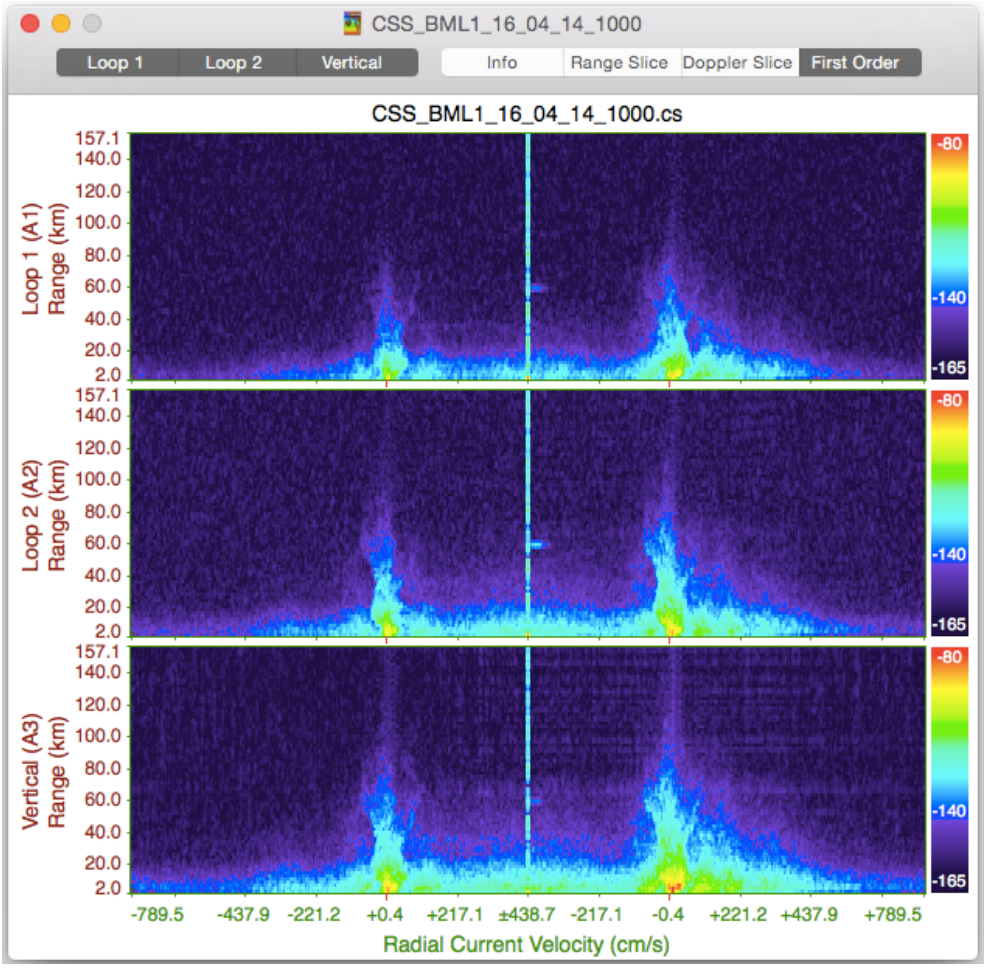


Main SpectraPlotterMap Window

Spectra Color Map

The Spectra Color Map is the power received from the three antenna elements over range and Doppler. The vertical axis is range (radial distance) from the site. The horizontal axis is sea-echo Doppler represented here as radial current velocity. The left half is echo from Bragg waves moving towards the site while the right half is from Bragg waves moving away from the site. Both Bragg waves are shown here as current velocity moving towards (positive) and away from (negative) the site. Each dot in the plot represents a single range cell and doppler bin whose power is plotted as color. The power in dBm is represented by color based on the scale on the right which is adjustable for best contrast of the spectra.

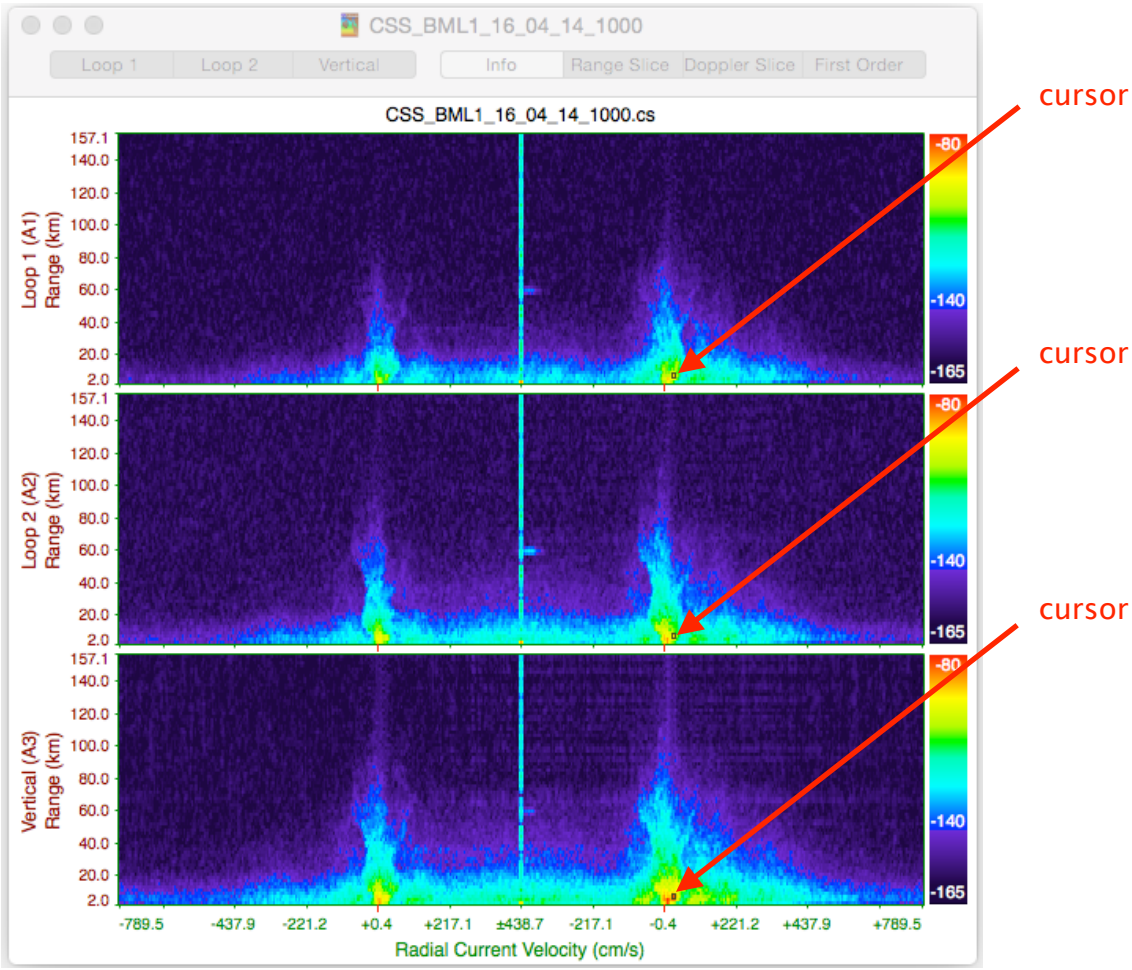
SpectraPlotterMap's enhanced main window features a new toolbar that provides access to all spectra data. The three buttons in the upper left corner control the plots that appear in the Spectra Color Map. Spectra for loop 1 (A1), loop 2 (A2), and the vertical antenna (A3) can be viewed together as shown below or removed from view by toggling the toolbar buttons. The Information, Range Slice, Doppler slice, and First Order Settings windows can be opened with their respective buttons in the upper right corner.



Range can be expressed as distance or as range cells which are the discrete processing distances. The range nearest the SeaSonde contain the warmest intensity colors (yellow and green in this example) because their signal is strongest. The signal tends to decrease with increasing distance from the SeaSonde, as reflected in the progressing cooling of intensity coloration from cyan to blue to dark purple.

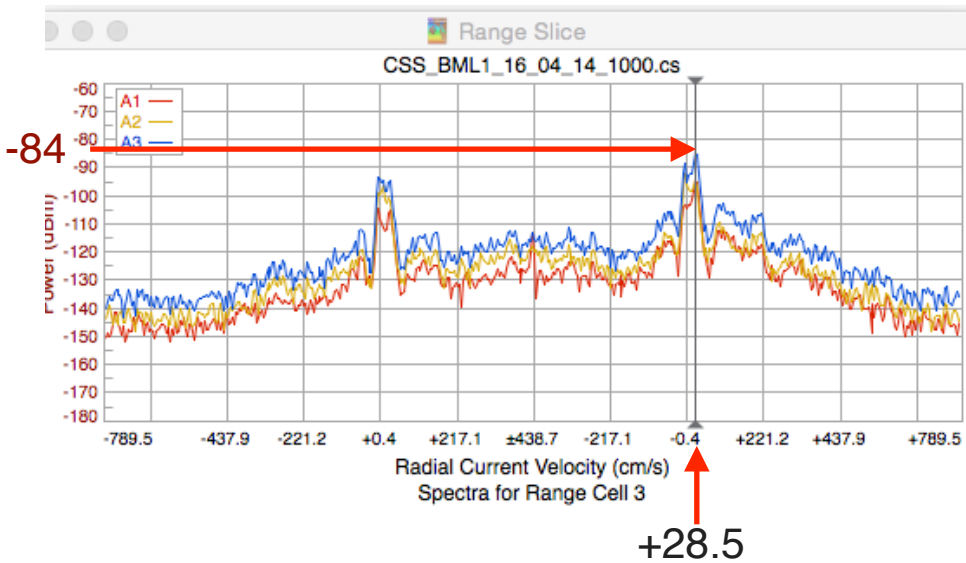
Clicking in the body of any of the three panels in the Spectra Color Map will add a cursor (small black rectangle indicated below by the large red arrow) to select a single range cell and Doppler bin. The Range Slice, Doppler Slice, and Information windows all track this cursor; the up and down arrow keys will

move the cursor around the Spectra Color Map and within the Range Slice, Doppler Slice, and Information windows. Here, the cursor is located at radial current velocity +28.5 cm/s and range cell three. For the vertical antenna, which we focus on for this example, range cell three has a power of approximately -80 dBm, given its orange coloring.



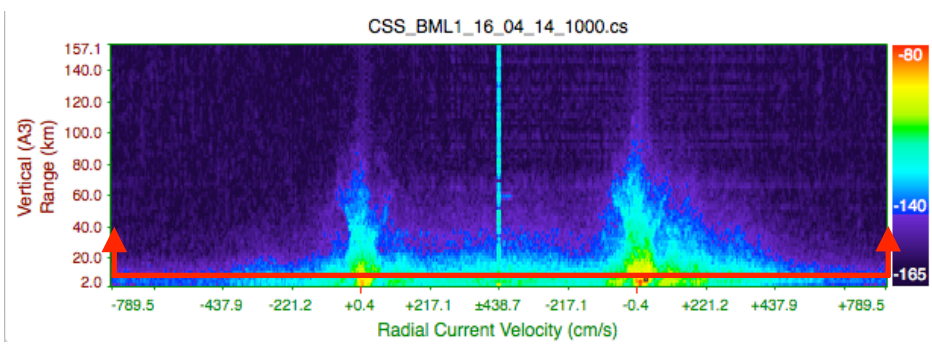
Range Slice

The Range Slice is a plot of power versus Doppler for a selected range cell. This plot is useful for looking at first and second order for a single range cell.



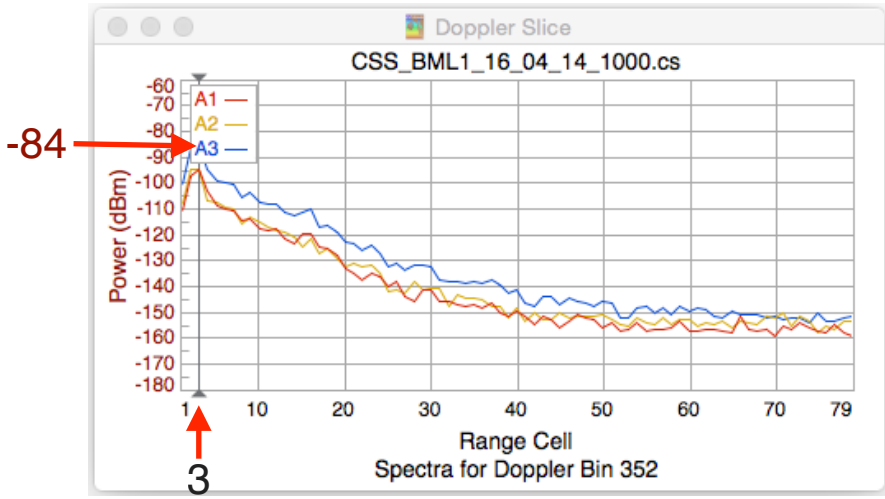
The vertical grey line at power −84 dBm and frequency +28.5 cm/s is consistent with the coordinates of the cursor in the Spectra Color Map.

The Range Slice plot for range cell three plots data along this horizontal conceptual red horizontal line:



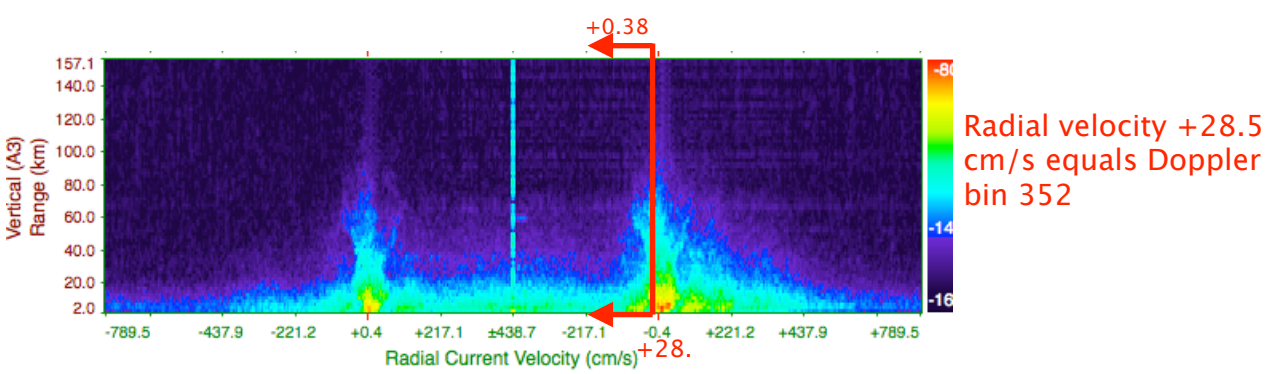
Doppler Slice

The Doppler Slice is a plot of power versus range for a Doppler bin. This plot is useful for examining how first order Bragg echo decays in range and where bistatic echoes show up by looking at the DC (zero velocity) Doppler bin.



The vertical grey line at power −84 dBm and range cell three is consistent with the coordinates of the cursor in the Spectra Color Map.

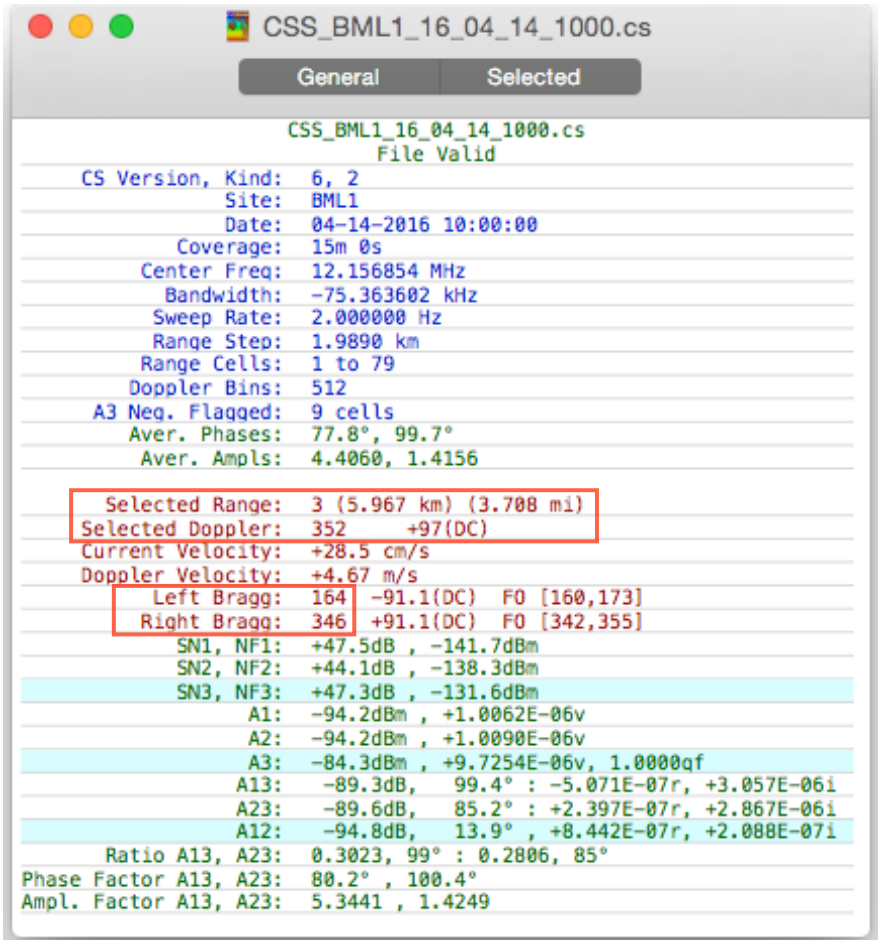
The Doppler Slice plot for Doppler bin 352 (radial velocity +28.5 cm/s) plots data along this vertical conceptual red horizontal line, looking to its left. Note the peak of the Doppler Slice is on the far left side of the graph, which is where it falls on the conceptual red line in the Spectra Color Map:



Information

Information window is a text box with meta data describing the spectra file and SeaSonde site parameters in the first section, the active range cell in the second section, and the active Doppler bin in the third section. The Information window will appear when you click the “Info” button.

The selected range cell is shown as range cell three, and the selected Doppler bin is bin 352 (same as above example). Left Bragg and Right Bragg have Bragg indices in terms of Doppler bin, where the Bragg index occurs at a current velocity of zero.



First Order Settings

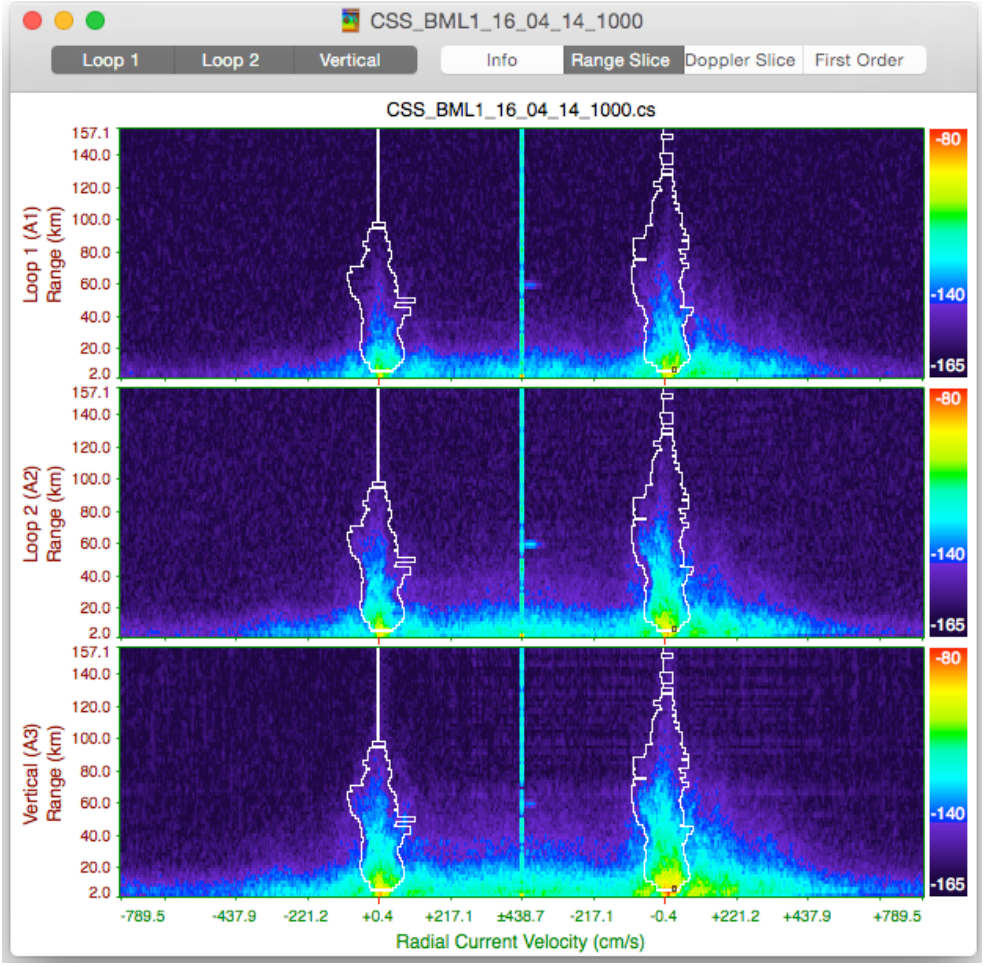
Introduction

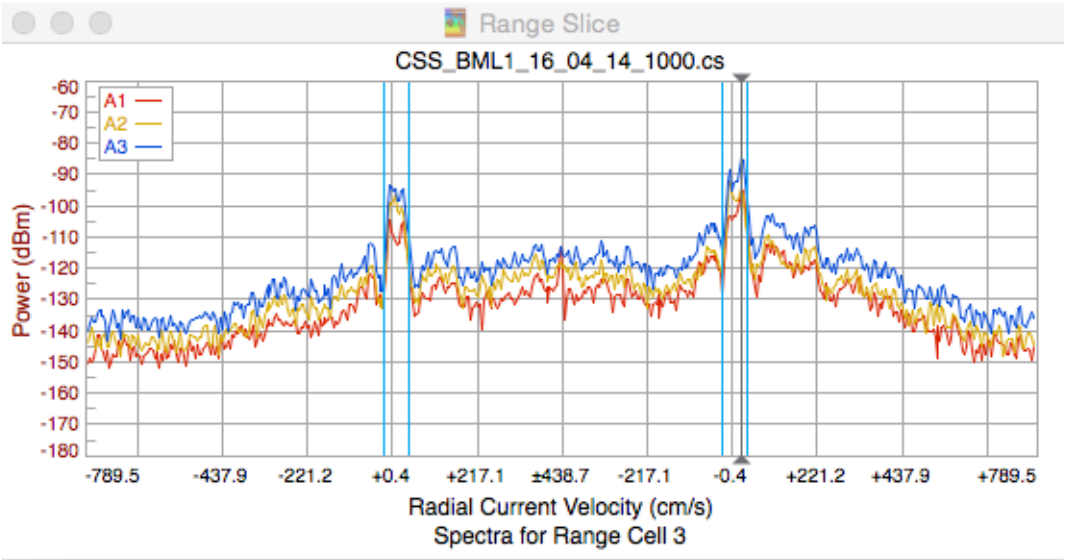
Radials, waves, and ellipticals require accurately determining the first order region in the sea echo for optimal processing. The First Order Settings dialog adjusts the parameters that define how the first order determination algorithm operates. Changing these settings requires a fair amount of skill; please, contact CODAR support to obtain the best settings. The help notes on the right hand panel of the dialog provide a summary of each parameter and recommendations for settings. Hover over a parameter with your mouse to see these help notes.

The first order lines delineate the boundary of the first order region, which is the portion of the spectrum used to generate radial velocities. The first order is also used to normalize the second order for waves computations, where overestimating the first order region is preferable to underestimating it for computational stability. Elements of first order line settings for waves, therefore, might be looser than they are for radials. Elements of first order settings for elliptical calculations might also differ from radial settings because of their geometric complexity. If you wish to adjust first order lines for waves or ellipticals, first define them for radials, because two of the seven parameters are shared.

Default first order line parameters are first established in the default settings of SeaSondeRadialSiteSetup and are documented in the RadialConfigs file. The range cells selected to be processed (the processing range cells) are also identified in SeaSondeRadialSiteSetup. The first range cell, for example, is typically not processed, and the second range cell is seldom processed.

The processed first order lines are white in the Color Spectra Map and blue in the Range Slice plot. These processed first order lines are the result of the first order determination made by radial processing. The processed first order lines will not plot if they are missing from the cross spectra.





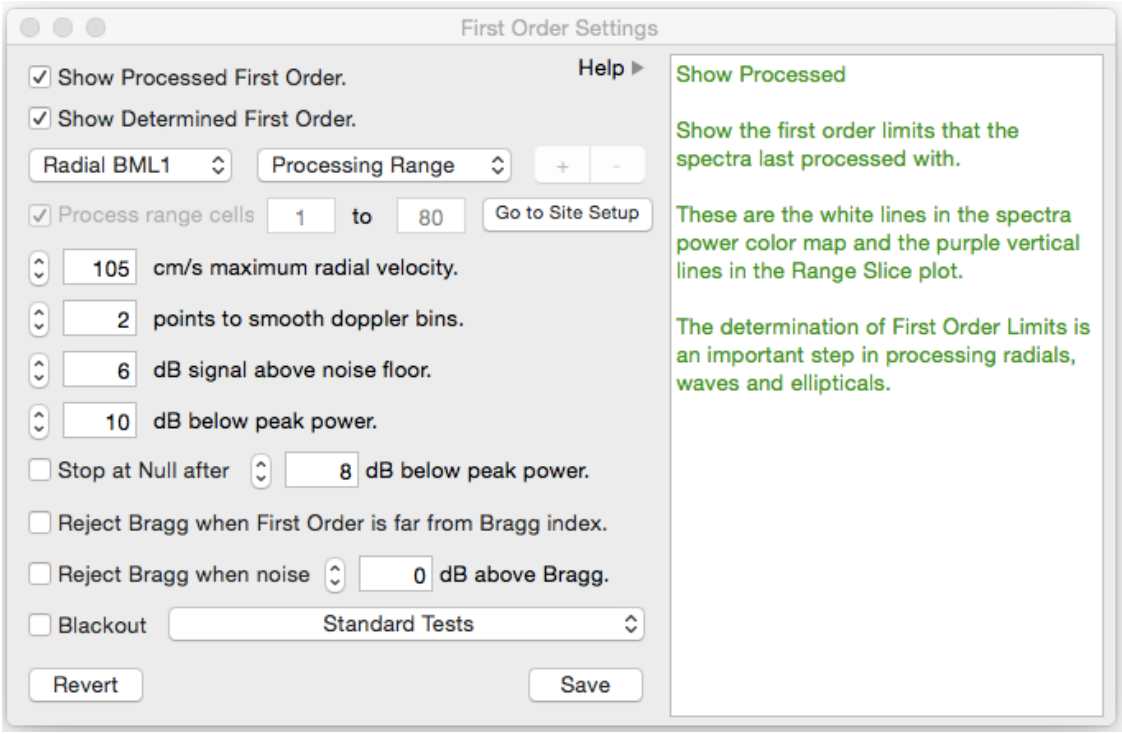
Selecting “Show Determined First Order” will display results of an immediate rough approximation of first order line placement if the settings in the First Order Settings window are applied to the processing spectra. The determined first order lines are plotted in pink in the Color Spectra Map and Range Slice

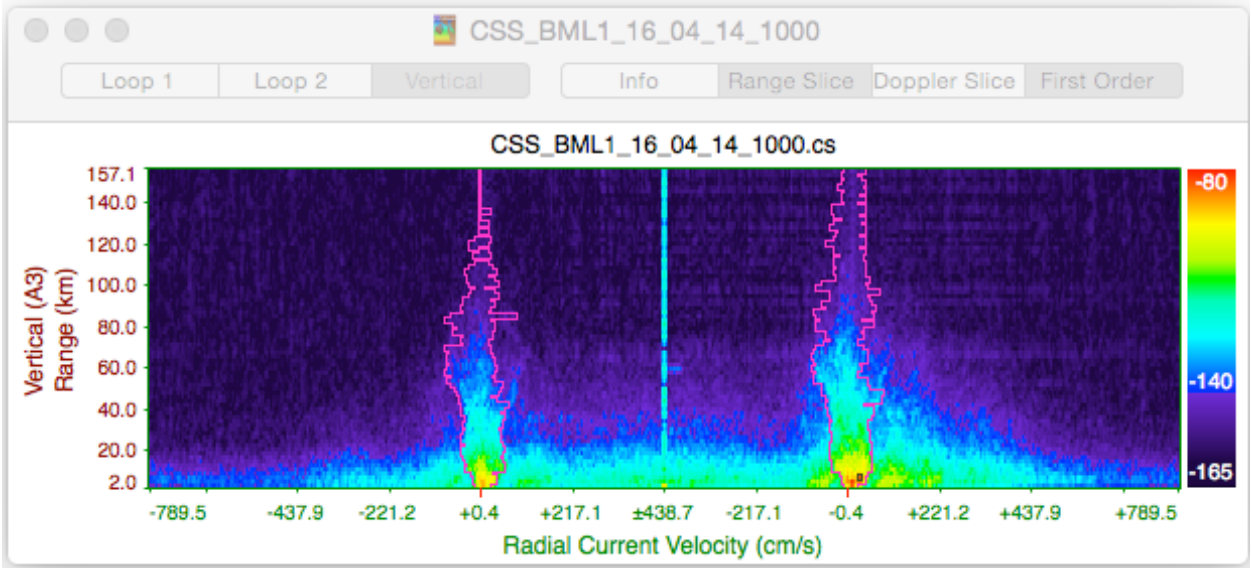
plot.

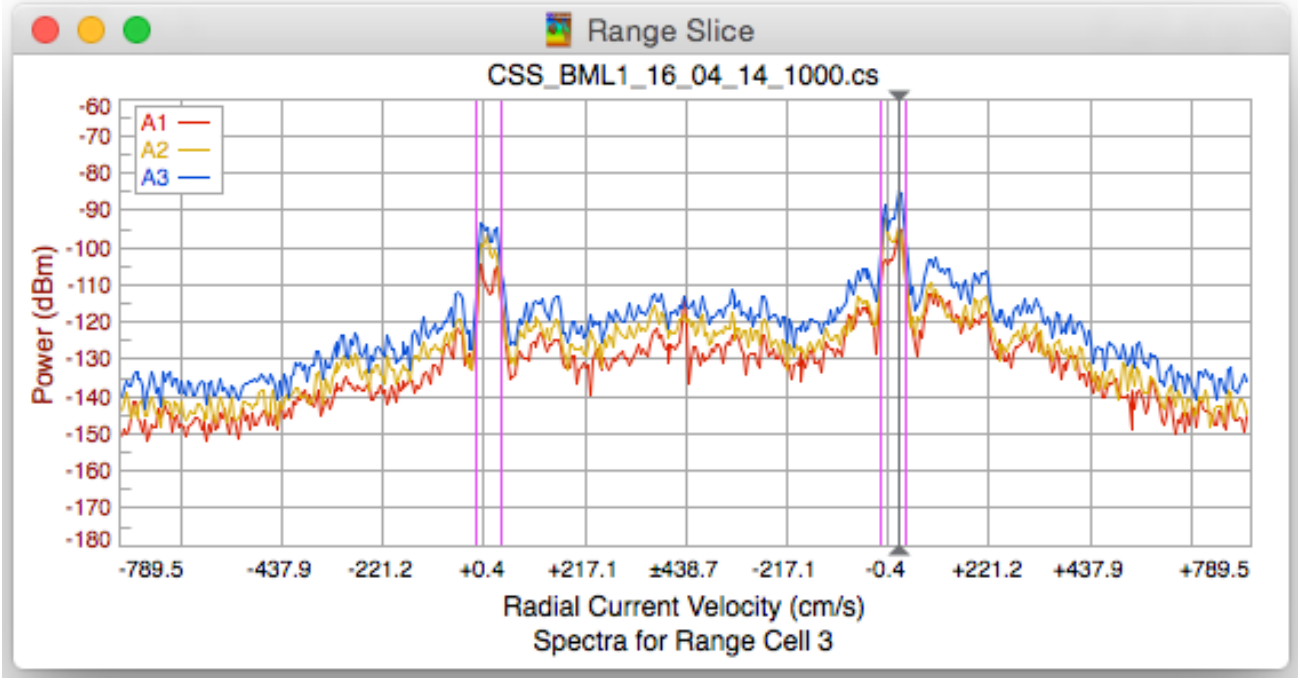
In this example, “Radial BML1” appears in the dropdown in the upper left, indicating that the first order settings used to generate radials (and not waves or ellipticals) are active in the dialog. “Processing Range” appears in the dropdown in the upper right indicating that default settings were applied to all of the range cells that were selected to be processed. Here we show the First Order Settings window and the resulting approximation of first order lines for the vertical antenna.

If the estimation of the first order needs adjustment, the parameters within First Order Settings can be modified.

All these parameters below can be adjusted to see what might happen to the first order and do not take effect until you click the Save button which will then update the RadialConfigs folder and will be applied to any future radial, elliptical, and wave processing. Clicking Revert button will reload this dialog with the RadialConfigs settings. Quitting without doing Save button will leave the RadialConfigs untouched.

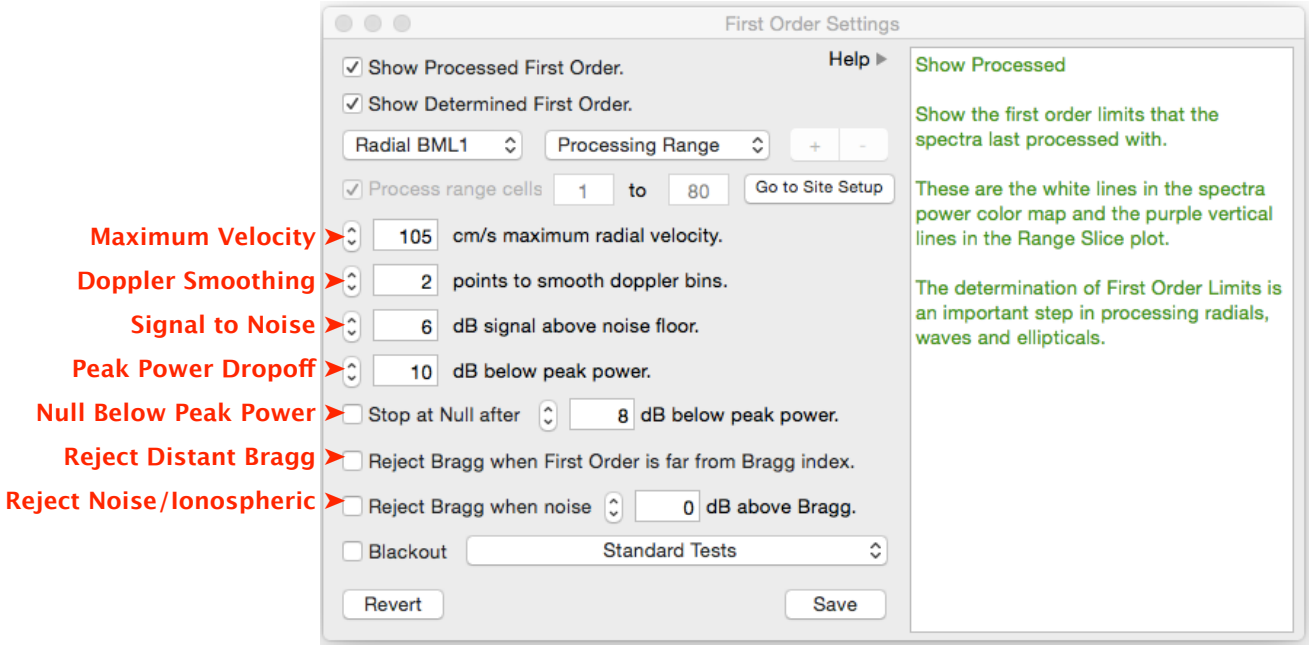



CSS_BML1_16_04_14_1000
Loop 1
Loop 2
Vertical
Info
Range Slice
Doppler Slice
First Order
CSS_BML1_16_04_14_1000.cs
Vertical (A3)
Range (km)
157.1
140.0
120.0
100.0
80.0
60.0
40.0
20.0
2.0
-80
-140
-165
-789.5
-437.9
-221.2
+0.4
+217.1
±438.7
-217.1
-0.4
+221.2
+437.9
+789.5
Radial Current Velocity (cm/s)


Range Slice
CSS_BML1_16_04_14_1000.cs
A1
A2
A3
Power (dBm)
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-789.5
-437.9
-221.2
+0.4
+217.1
±438.7
-217.1
-0.4
+221.2
+437.9
+789.5
Radial Current Velocity (cm/s)
Spectra for Range Cell 3

First Order Setting Parameters

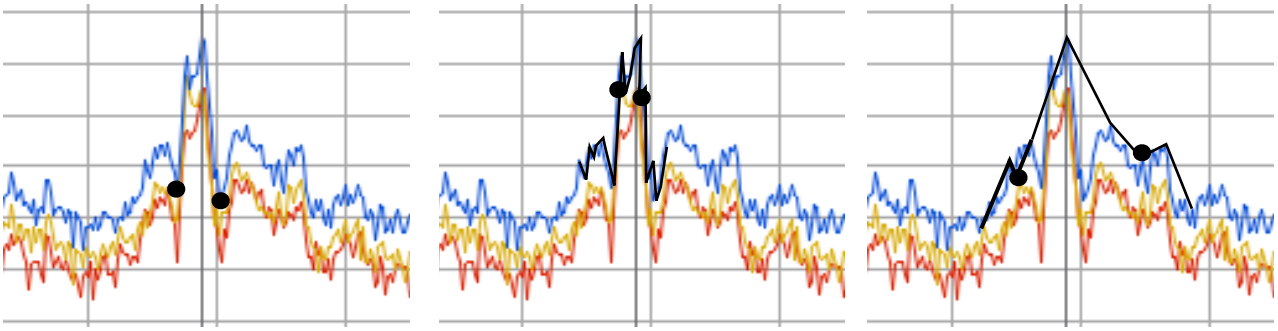
These seven adjustable first order line parameters are labeled below. The first four parameters are required and create the determined first order lines. The remaining three, optional parameters are used to narrow them if necessary.



Maximum Velocity establishes a threshold beyond which velocities are excluded from the first order. The maximum radial velocity expected to occur at a given site should be entered. If this setting is too high, then non-Bragg data may be incorporated into the first order yielding an overestimated radial velocity. If it is too low, then first order data may be omitted and radial velocities will be underestimated. Maximum Velocity effectively establishes a maximum allowable first order width which is equal to +/- the maximum velocity.

The **Doppler Smoothing** factor is applied to remove irregular, jagged edges from the sea echo which might obscure the true boundary of the first order. The degree of smoothing is proportional to the number of points indicated by Doppler Smoothing. Smoothing aids in a later step, where the algorithm estimates the location of the low point (null) between the first order and either the second order or the noise floor. The image below on the left shows an example of the actual nulls represented by black dots for the spectra plotted in blue (A3). If the spectra are not smoothed sufficiently (Doppler Smoothing set too low), many jagged edges will remain. The algorithm will choose a null that is actually inside the first order, and the first order will be more narrow than it should be. This is represented in the middle image below. If the spectra have been over-smoothed (Doppler Smoothing set too high), too many points will be removed, the actual null between the first and second orders will disappear,

and portions of the second order will be incorporated. The first order will be wider than it should be. An example of this shown in the image to the right.



Nulls **Nulls with not enough smoothing** **Nulls with too much**

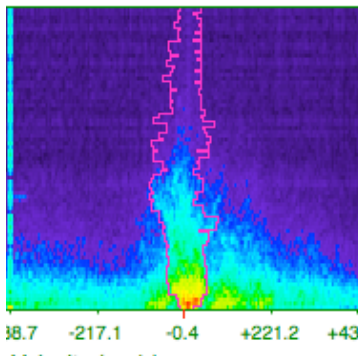
After the Doppler are smoothed, the algorithm moves down from the peak power and within the width generated by the maximum velocity to locate the first order limits within the smoothed Doppler. To confine this search, First Order Settings provide two thresholds. **Signal to Noise** limits the lower end of the search with the noise floor. If the algorithm hits the noise floor, defined in dB, then it will stop its search and set limits. The descent from peak power is also confined by **Peak Power Dropoff**, expressed in dB. If the algorithm reaches this distance, then first order limits are set. If this threshold is set too large, the algorithm may ascend too far down and incorporate data that is non-Bragg. If set too low, the algorithm may stop while still inside the first order and omit portions of it.

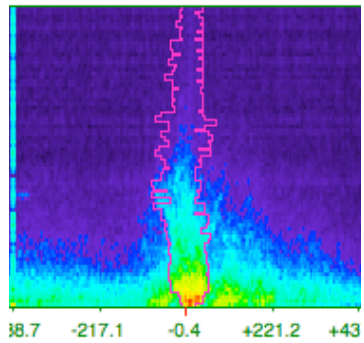
The more conservative of Signal to Noise and Peak Power Dropoff will prevail; if the Peak Power Dropoff limit is reached before the noise floor, then limits are set at that point. If the noise floor is reached before the Peak Power Dropoff value, then limits are set at the noise floor.

At this point, the first order lines have been set and the remaining optional First Order Settings may be initiated to tighten the first order lines if they appear too broad.

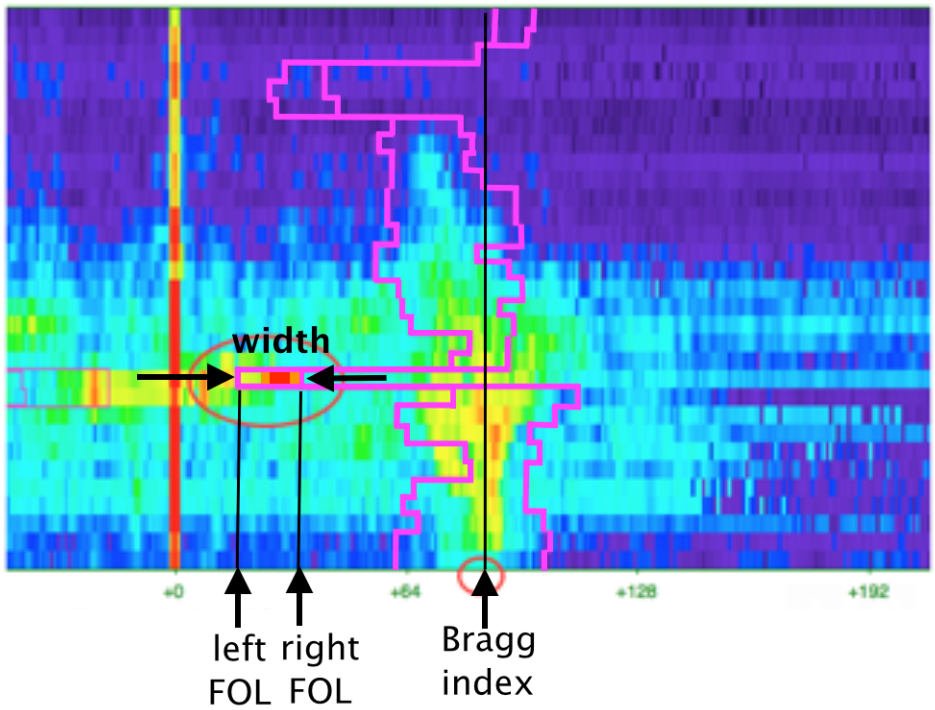
N**ull Below Peak Power** addresses conditions in which the second order signal is very close to the first order signal. This can occur in the presence of high, short waves that are just slightly longer in period and wavelength than Bragg waves. If the Null Below Peak Power box is checked, first order limits will stop at the first null that is beyond the minimum specified quantity below peak power in dB. Null Below Peak Power will have no effect if set higher than the Peak Power Dropoff, which would trip before the Null Below Peak Power value is met. This parameter was left unchecked for the positive Bragg shown on the left, while Null Below Peak Power was checked and given a value of 6 dB for the

example on the right, which shows a slightly narrower first order region at about mid-range.

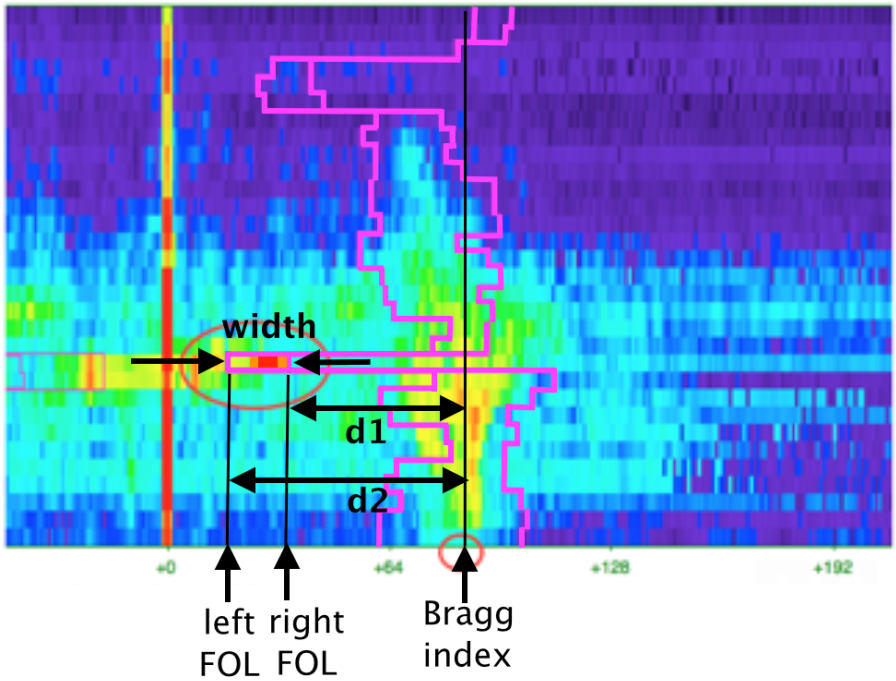




Checking the **Reject Distant Bragg** box will prevent the misallocation of short bursts of energy, such as those associated with ships, as first order Bragg signal. A distance check prevents this error, as illustrated in the example below. Here, the determined first order lines deviate to the left from an otherwise reasonable delineation to include a high intensity region. The Bragg index, located at current velocity zero, is marked below along with the left and right first order lines for this range cell. The width of the erroneous first order region is called out.



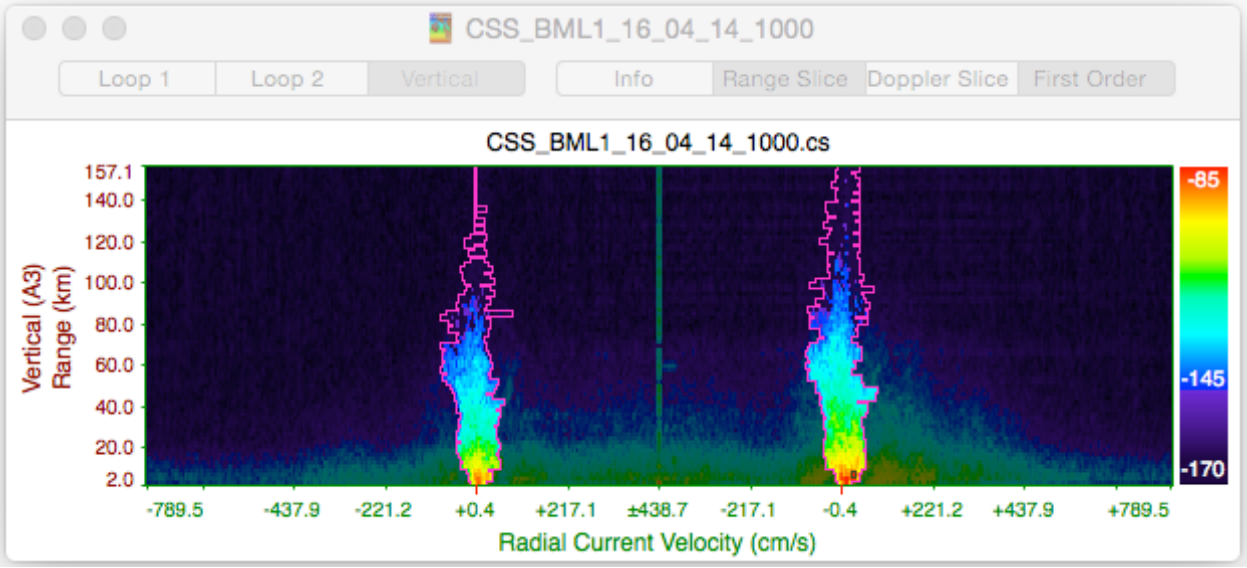
If this width is smaller than the distance between either first order line and the Bragg index, than the selection will be rejected because it is too far away to reasonably constitute the first order.



Clearly, the selected first order width is smaller than distance d1 (right first order line and the Bragg index) and distance d2 (left first order line and the Bragg index), so the selected first order for this range cell is rejected which means that the positive(right) Bragg for this range cell will not be processed into future radials. If the negative(left) Bragg is also rejected, then there won't be any radial vectors for the range cell, which is good because they're likely invalid. When tripped, all the doppler bins for Bragg half will be plotted much darker as an indicator unless the menu item **Power -> Grey Doppler for Rejected Bragg** is unchecked.

Reject Noise/Ionospheric rejects Bragg when the total non-Bragg power within a given range cell is greater than the power within the first order. This prevents inclusion of contaminated data at times and locations where significant noise is expected. Just like Reject Distance Bragg above, when tripped, there won't be any future radials for that range cell and Bragg half and all the doppler bins for Bragg half will be plotted much darker unless the menu item **Power -> Grey Doppler for Rejected Bragg** is unchecked.

When checked, **Blackout** shows an estimate of the regions in the spectral plot that would be rejected if the settings in the First Order Settings window were implemented. The drop down menu allows selection of all or specific tests. This is very useful in understanding how First Order Settings might impact the region in the Spectra Color Map identified as first order. The menu item **Power -> Adjust Blackout Opaque** provides a scale for adjusting the opaqueness of the blackout, where 100% is fully black and 0% is barely visible. This example shows the effects of a 70% setting.



Blackout can also show where SpectraAverager had decided to leave out data from the averaged spectra due to ships and interference by flagging the vertical antenna (A3) with a negative value.

Tailoring First Order Settings to Seasonal and Spatial Variation

When adjusting the First Order Settings, do not try to perfect them for a single file, rather, establish reasonable first order lines for a given set of files. Scroll forward (backward) through a folder of files using the <command> ‘ (<command> ;) keyboard shortcut and observe the processed and determined first order lines. Try to make adjustments that are loose enough as to benefit, or at least not hinder, the other spectra files.

Because environmental conditions change over time, checking back periodically to evaluate the performance of your settings is recommended. If seasonal conditions create predictable changes in the first order region, you can develop First Order Settings for two or more different seasons and manually enter them at the appropriate time.

If your site contains a region with distinct features that influence the Bragg region like an enclosed bay or channel, establishing first order settings for one or more groups of range cells allows you optimize your site. For example, a shallow, nearshore area in an otherwise deep region may benefit from having unique first order settings. An area with significant river inflow may also warrant its own first order settings. SpectraPlotter Map allows the creation of different settings for distinct groups of range cells.

Click the “+” button next to “Processing Range” to add a sub-group of range cells. Select a sub-group in the dropdown and edit the range cell numbers in the box below. If you require range cells that lie outside of the group of processing range cells, click the “Go to Site Setup” button. This will launch SeaSondeRadialSetup and allow you to adjust the radial processing range. In the First Order Settings window, select the sub-group of range cells you wish to edit, enter the desired settings, and save these settings. While you can create up to 32 sub-groups, adding just one sub-group, if at all, is more typical.

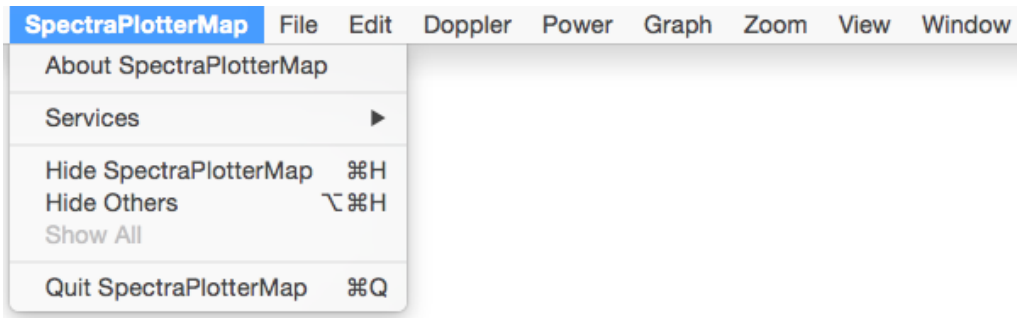
To adjust first order line settings for waves, use the dropdown menu under “Show Determined First Order” to select the wave option. The parameters that apply to wave processing will be editable, those that do not apply will be greyed out. To adjust first order line settings for ellipticals, use the same dropdown to select the elliptical option and modify the editable parameters. Settings for waves and ellipticals requires advanced skill; please, contact CODAR support to obtain the best settings for your site(s).

Saving First Order Settings

After you have made the desired adjustments, click the “Save” button to save them. If you wish to undo them and see the original settings, click the “Revert” button. Saving the settings will effect all future radial, elliptical and wave processing.

SpectraPlotterMap Menu

Find version information about SpectraPlotterMap under **SpectraPlotterMap->About SpectraPlotterMap**. Hide SpectraPlotterMap will remove SpectraPlotterMap from view, Hide Others hides all other open applications, and Show All brings them back into view. Quit SpectraPlotterMap closes the application.

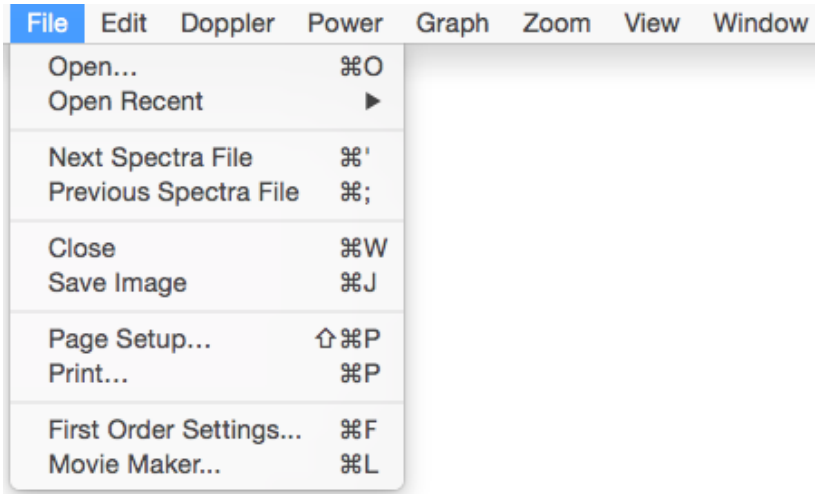


Main Menu

The application has eight pulldown menus: File, Edit, Doppler, Power, Graph, Zoom, View, and Window. Keyboard shortcuts are shown to the right of each item, for example, <command> O is the shortcut to open a file.

File Menu

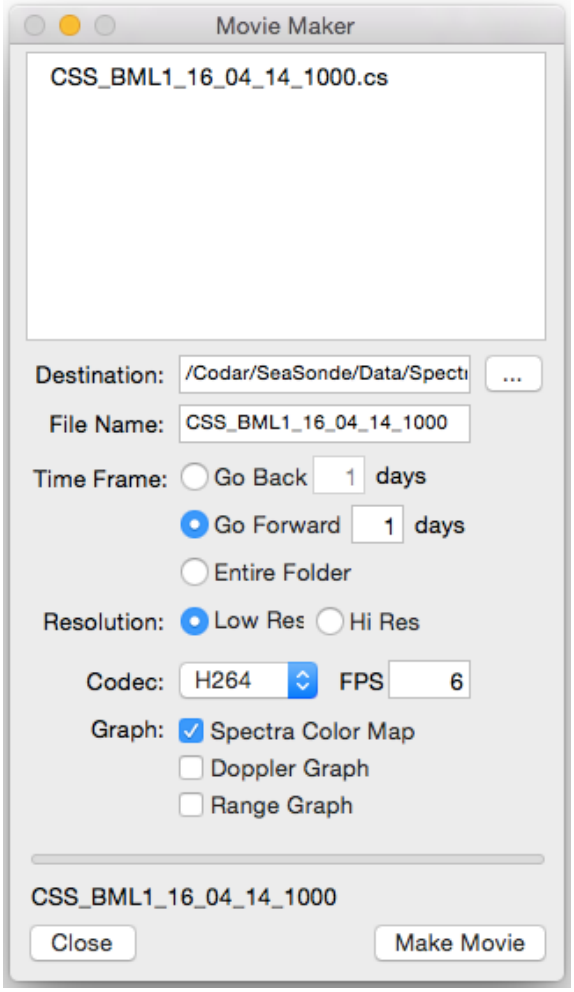
Files and file navigation are managed under the File menu. Spectra files can be opened from the main menu under **File->Open**. **Next Spectra File** (**Previous Spectra File**) and its keyboard shortcut <command> ‘ and <command> ; uploads the next and previous spectra file in the folder where the currently active spectra resides.



File->Close closes the active window. **File->Save Image** saves the main window image as a PDF or PNG file. The infinite resolution PDF format provides figures for scientific studies and reports of publishable quality. **File->Page Setup** provides a dialog with printer settings. **File->Print** opens a Print dialog with multiple options, including sending the main window image to a printer, a PDF file, or to the body of an email.

File->First Order Settings opens up the dialog with parameters that define how the first order line algorithm operates. See First Order Settings section above for details.

File->Movie Maker opens a dialog for making movies comprised of a series of sequential frames from Spectra Color Map, Doppler Slice, or Range Slice. Movie Maker consists of these parameters:



Destination – Click the "…" button to navigate to the folder where your movie will be saved, or type it in the adjacent window.

Time Frame – indicate the time frame to be included. Select "Entire Folder" to include content from all spectral files in the folder that contains your active file.

Resolution – select a low or high resolution option.

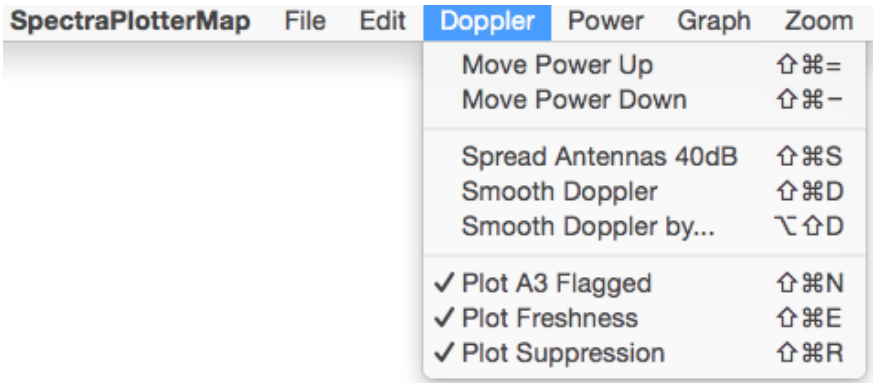
Codec – specify the desired file format and frames per second (FPS).

Graph – select the content of your movie.

Click "Make Movie" to generate a *.mov file, and click "Close" to close out.

Doppler Menu

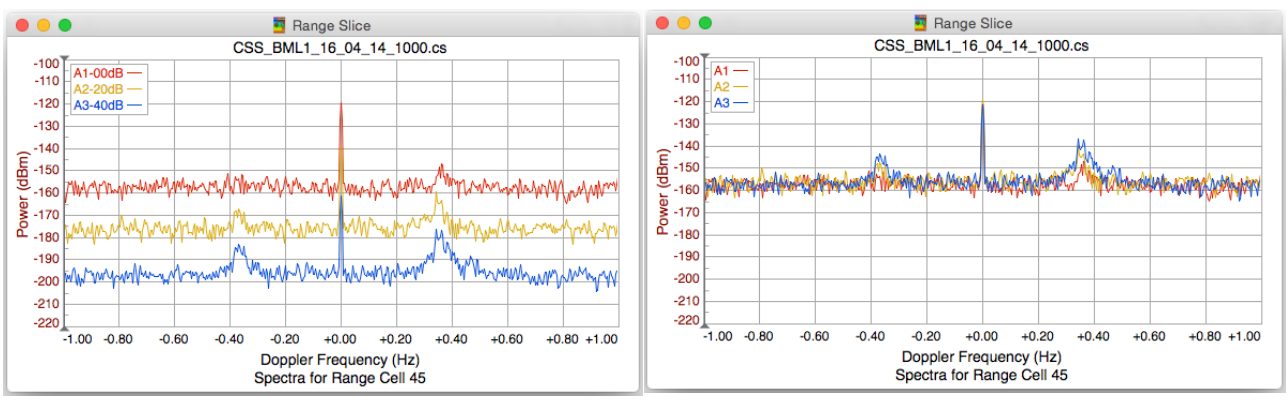
The Doppler menu and keyboard shortcuts manipulate the Doppler and Range Slice.



Doppler -> Movie Power Up makes an upward shift in the values of the vertical axes in the Doppler and Range Slice. This shifts the vertical placement of data down.

Doppler -> Movie Power Down makes an downward shift in the values of the vertical axes in the Doppler and Range Slice. This shifts the vertical placement of data up.

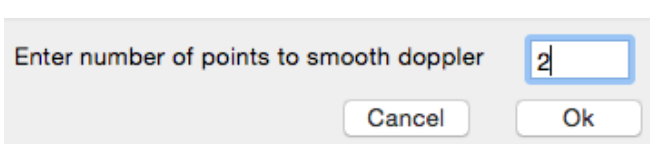
Doppler -> Spread Antennas 40dB spreads power data for each antenna element in the Doppler and Range Slice by 40 dB for legibility. Instead of adding a unique vertical axis for each antenna, it provides a formula with the relative position of each dataset. For the actual power of A2, for example, add 20 dB to the plotted power since 20 dB were subtracted to shift it downward. An original



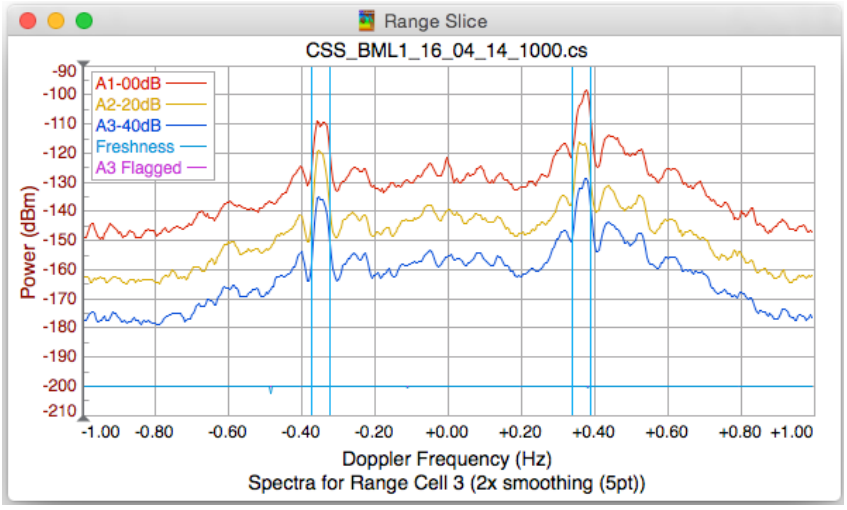
Range Slice is shown on the left, and an adjusted plot is on the right:

Doppler -> Smooth Doppler toggles Doppler smoothing in the Range Slice as set by next menu item.

Doppler -> Smooth Doppler by... opens a smoothing factor dialog which sets



the degree of smoothing applied to the Range Slice as shown below.



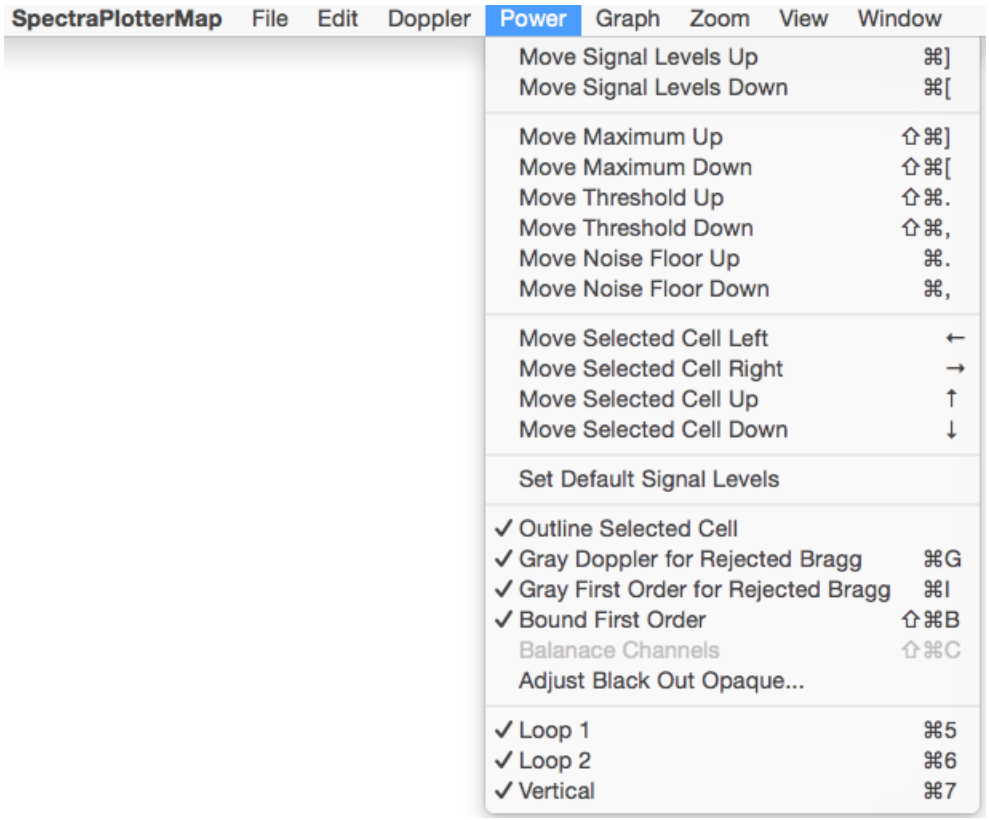
Plot A3 Flagged toggles display of pink data line across the last horizontal graticule (-200 in above plot) that jumps up a couple of dB where the doppler cell was flagged by SpectraAverager as having some of the source spectra omitted from the average due to ship or interference.

Plot Freshness toggles display of a blue data line across the last horizontal graticule (-200 in above plot) that drops to the graph edge (-210) as an indication by SpectraAverager that data does not contain any newer (fresh) spectra in the average.

Plot Suppression toggles display of orange data line across the last horizontal graticule (-200 in above plot) that drop to the graph edge (-210) as an indication by SeaSondeAcquisition where stripe suppression was applied.

Power Menu

The Power menu and keyboard shortcuts manipulate the Spectra Color Map. If the default settings do not reveal enough detail about an area of interest, like the peak power region of the first order, the Power menu provides the means to modify how the data are plotted. Some of its features also impact the appearance of the Doppler and Range Slice.



Power -> Move Signal Levels Up makes an upward shift in all values of the Spectra Color Map color bar, which shifts the colors plotted in the map down towards cooler tones. It also makes an upward shift in the values of the vertical axes in the Doppler and Range Slice. This shifts the vertical placement of data down.

Power -> Move Signal Levels Down makes a downward shift in all values of the Spectra Color Map color bar, which shifts the colors plotted in the map up towards warmer tones. It also makes an downward shift in the values of the vertical axes in the Doppler and Range Slice. This shifts the vertical placement of data up.

Power -> Move Maximum Up raises the highest value of the Spectra Color Map color bar and the Spectra Color Map. It has the same impact on the Doppler and Range Slice as Move Signal Levels Up.

Power -> Move Maximum Down lowers the highest value of the Spectra Color Map color bar and the Spectra Color Map. It has the same impact on the Doppler and Range Slice as Move Signal Levels Down.

Power -> Move Threshold Up increases the mid-range value of color bar and opens up the spectrum of values plotted beneath it. It has no impact on the Doppler and Range Slice.

Power -> Move Threshold Down decreases the mid-range value of color bar and opens up the spectrum of values plotted above it. It has no impact on the Doppler and Range Slice.

Power -> Move Noise Floor Up raises the noise floor of the Spectra Color Map; increases the lowest intensity value plotted so that more of the map's noise region is effectively blacked out.

Power -> Move Noise Floor Down lowers the noise floor of the Spectra Color Map; decreases the lowest intensity value plotted so that gradation is enhanced in the map's noise region.

Power -> Move Selected Cell Left moves the cursor to the left (see below for toggling the cursor on).

Power -> Move Selected Cell Right moves the cursor to the right (see below for toggling the cursor on).

Power -> Move Selected Cell Up moves the cursor to the up (see below for toggling the cursor on).

Power -> Move Selected Cell Down moves the cursor to the down (see below for toggling the cursor on).

Power -> Set Default Signal Levels undoes above commands that change intensity levels in the color bar and Spectra Color Map plot and reverts to original settings.

Power -> Outline Selected Grey Cell toggles the cursor on if a cell is selected in the Spectra Color Map.
Power -> Gray Doppler for Rejected Bragg shows the results of the Reject Distant Bragg and the Reject Noise/Ionospheric tests by coloring the rejected range cells dark gray in the Spectra Color Map. These two tests must be checked in the First Order Settings window for this feature to display.

Power -> Gray First Order for Rejected Bragg shows the results of the Reject

Distant Bragg and the Reject Noise/Ionospheric tests by coloring the first order lines in a paler pink than the accepted first order region in the Spectra Color Map. These two tests must be checked in the First Order Settings window for this feature to display.

Power -> Bound First Order replaces the continuous first order line with its vertical elements only.

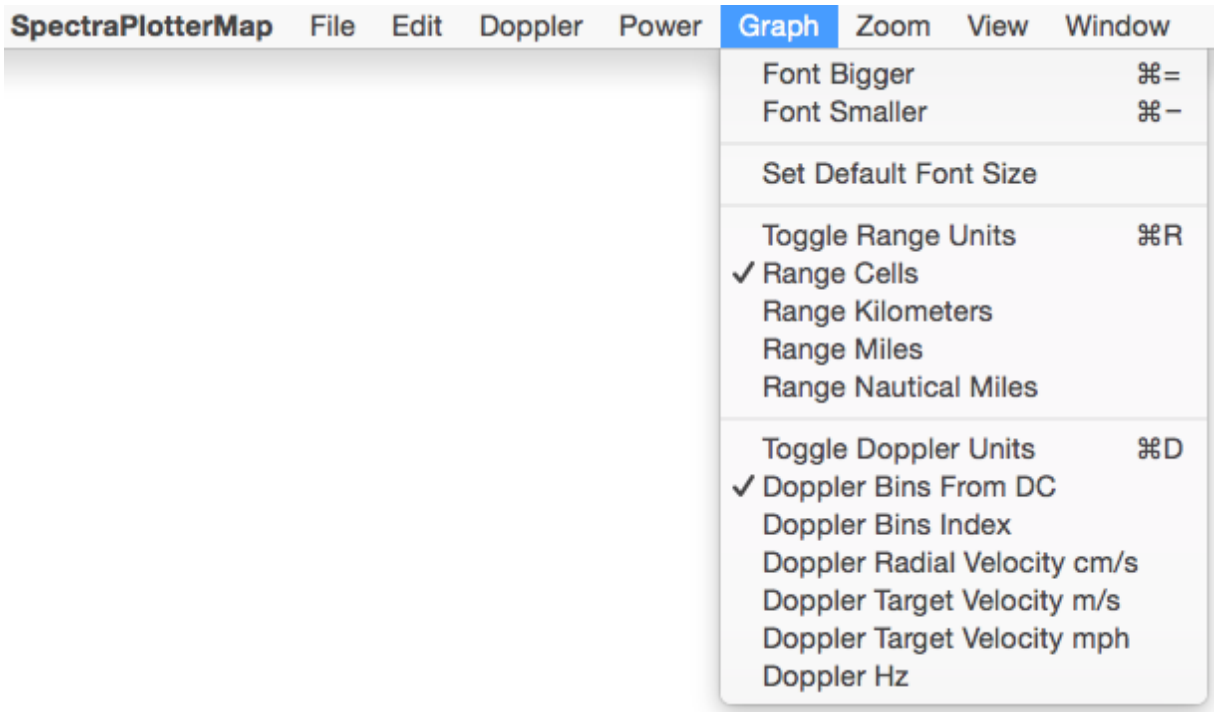
Power -> Adjust Black Out Opaque… adjusts the opaqueness of the black out portion of the Spectra Color Map when Blackout is checked. Selecting 100% hides the underlying data, whereas lowering it allows it to bleed through.

Power -> Loop 1 toggles the appearance of the loop 1 plot in the Spectra Color Map.

Power -> Loop 2 toggles the appearance of the loop 2 plot in the Spectra Color Map.

Power -> Vertical toggles the appearance of the vertical antenna plot in the Spectra Color Map.

Graph Menu



The Graph menu controls font size of axes and the variables that are plotted.
Graph -> Font Bigger increases the font size of all three plots.

Graph -> Font Smaller decreases the font size of all three plots.

Graph -> Set Default Font Size applies the default font size of all three plots.

Graph -> Toggle Range Units cycles through available options for range units (displayed on the horizontal axis of the Doppler Slice and on the vertical axis of the Spectra Color Map).

Graph -> Range Cells sets the units of range in terms of range cell.

Graph -> Range Kilometers sets the units of range in terms of kilometers.

Graph -> Range Miles sets the units of range in terms of miles.

Graph -> Range Nautical Miles sets the units of range in terms of nautical miles.

Graph -> Toggle Doppler Units cycles through available options for Doppler. units (displayed on the horizontal axis of the Range Slice and on the horizontal axis of the Spectra Color Map).

Graph -> Doppler Bins from DC sets the units of Doppler in terms of Doppler bins from DC (zero Doppler).

Graph -> Doppler Bins Index sets the units of Doppler in terms of Doppler bin index.

Graph -> Doppler Radial Velocity cm/s sets the units of Doppler in terms of radial current velocity in centimeters per second.

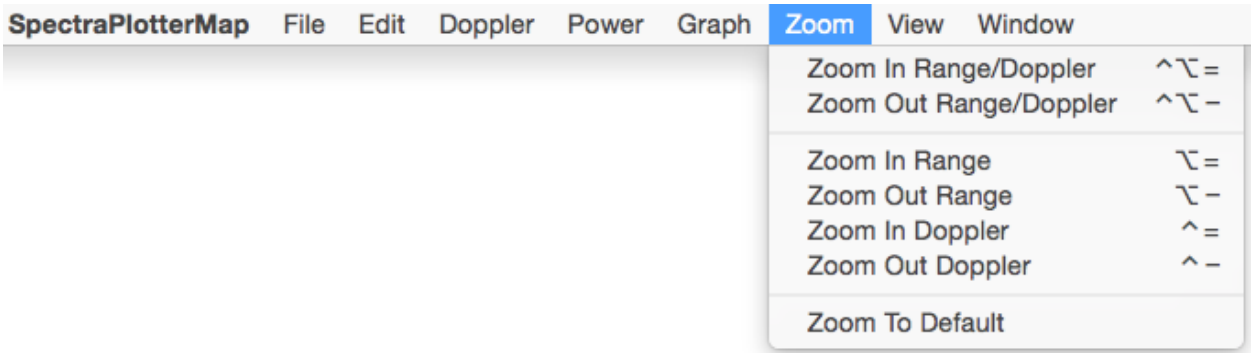
Graph -> Doppler Target Velocity m/s sets the units of Doppler in terms of Doppler velocity in meters per second.

Graph -> Doppler Target Velocity mph sets the units of Doppler in terms of Doppler velocity in miles per hour.

Graph -> Doppler Hz sets the units of Doppler in terms hertz.

Zoom Menu

The zoom window controls the size of the Spectra Color Map window. The Info, Doppler Slice, and Range Slice windows can be adjusted by right selecting a corner and dragging the mouse. The Spectra Color Map window, however, is comprised of pixels that can't be adjusted as freely.



Zoom -> Zoom In Range/Doppler increases both dimensions of the Spectra Color Map window.

Zoom -> Zoom Out Range/Doppler decreases both dimensions of the Spectra Color Map window.

Zoom -> Zoom In Range increases the vertical dimension of the Spectra Color Map window.

Zoom -> Zoom Out Range increases the vertical dimension of the Spectra Color Map window.

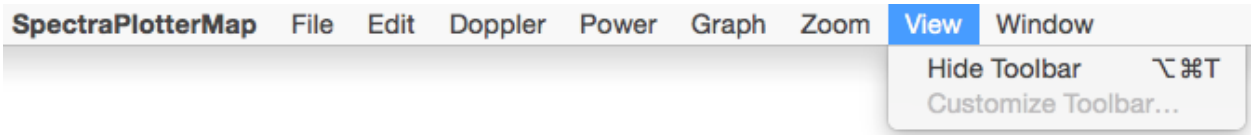
Zoom -> Zoom In Doppler increases the horizontal dimension of the Spectra Color Map window.

Zoom -> Zoom Out Doppler increases the horizontal dimension of the Spectra Color Map window.

Zoom -> Zoom To Default returns the Spectra Color Map window to its original state.

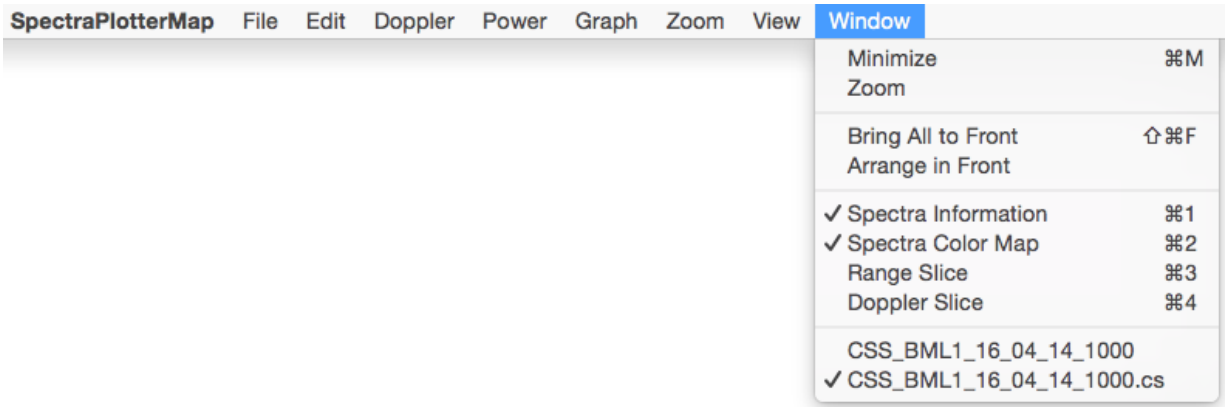
View Menu

View -> Hide Toolbar toggles the appearance of the toolbar in Spectra Color Map.



Window Menu

The Window menu controls which windows are active and how they appear. Pressing the option key before the Minimize or Zoom commands applies them to all open windows. Bring All to Front and Arrange in Front provides a quick way to locate your open SpectraPlotterMap windows.



The Spectra Information, Spectra Color Map, Range Slice, and Doppler Slice can be activated and deactivated with this menu. See above sections on these windows for details about their content. The active spectra file is shown at the bottom of this menu.

Revision History

First Draft Sep 14, 2016

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