

## Calculating the Energy Spectrum in MAGMAP

This *Calculating the Energy Spectrum in MAGMAP* guide introduces you to energy spectrum in MAGMAP. The procedures are designed to show you how to calculate and display the radially averaged and 2D energy spectrum.

In addition to producing the Fourier Transform, the Forward FFT option (FFT2IN.GX) also produces a file containing the radially averaged energy spectrum (2D Power Spectrum) in a format similar to the following example:

```

/ 2-D RADIALLY AVERAGED POWER SPECTRUM
/ WAVENUMBER INTERVAL      DWE =  1.428571E-01
/ AVERAGE SPECTRAL DENSITY LOG(ETOT) =  1.940511E+01
/
/      CYC/KM #_SAMP      LOG_P      3_DEPTH      5_DEPTH
/ -----
0.000000E+00      1  6.953915E+00  2.017633E-01      *
1.428571E-01      8  6.591711E+00  3.892244E-01      *
2.857143E-01     12  5.556448E+00  5.608587E-01  4.363967E-01
4.285714E-01     16  4.578010E+00  3.591071E-01  3.645031E-01
5.714285E-01     32  4.267114E+00  1.735434E-01  2.545823E-01
7.142857E-01     28  3.954922E+00  2.310963E-01  2.454431E-01
1.000000E+00     40  2.764027E+00  3.829211E-01  2.908998E-01
.
9.428572E+00    424 -7.545702E+00  1.084567E-01  1.966618E-02
9.571428E+00    420 -7.829783E+00 -3.100928E-02  1.257935E-02
9.714286E+00    416 -7.434367E+00 -3.970939E-02  4.879844E-02
9.857142E+00    448 -7.687212E+00  2.171140E-01      *
1.000000E+01    394 -8.213891E+00  2.933830E-01      *
1.014286E+01    340 -1.024793E+01      *      *
1.028571E+01    348 -1.104301E+01      *      *
1.042857E+01    272 -1.107746E+01      *      *

```

The radially averaged energy listed in the third column represents the spectral density (energy) averaged for all grid elements at the wavenumber in the first column. The second column indicates the number of elements that were used to determine the average. The energy is normalized by subtracting the log of the average spectral density.

The 3-DEPTH and 5-DEPTH columns are ensemble magnetic depth estimates based on 3 and 5 point averages of the slope of the energy spectrum (Spector and Grant, 1970). The depth to a statistical ensemble of sources is determined by the following expression:

$$h = -\frac{s}{4\pi}$$

where:

$h$  is depth

$s$  is the slope of the log (energy) spectrum

The above estimates can be used as a rough guide to the depth of magnetic source populations.

The system enables you to create and view a radially averaged spectrum automatically.

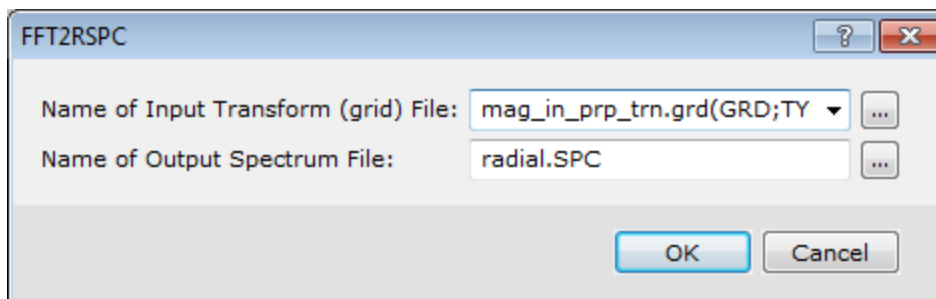
## Calculating Radially Averaged Power Spectra

To better understand the filter operator, calculate a radially averaged power spectrum in the wavenumber domain and display the filter superimposed with the actual data signal.

### To Calculate the Radially Averaged Spectrum

1. From the *MAGMAP* menu, select *Spectrum Calculation and Display* and then select **Radial Average Spectrum**.

The *FFTRSPC* dialog appears.



2. Select the *Name of Input Transform (grid) File*.



*The Input Transform grid file is created when you apply the Forward FFT to your prepared grids and is automatically populated.*

3. Specify the *Name of Output Spectrum File*, the default name is "radial.SPC".
4. Click the **OK** button. The system computes the spectrum.

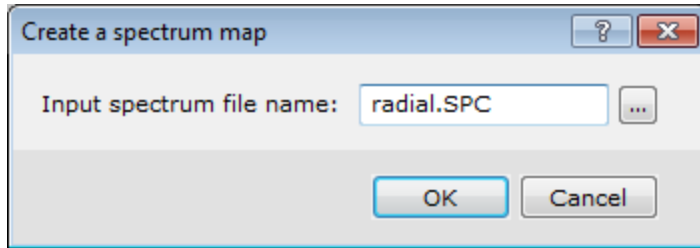
## Displaying Radially Averaged Spectra

You can view the spectra calculated in the previous step in your project. The spectra are automatically formatted to fit on a page when printed. To examine a sample plot, see the energy spectrum on page 1.

### To Display Radially Averaged Spectrum

1. From the *MAGMAP* menu, select *Spectrum Calculation and Display* and then select **Display Spectrum**.

The *Create a spectrum map* dialog is displayed.

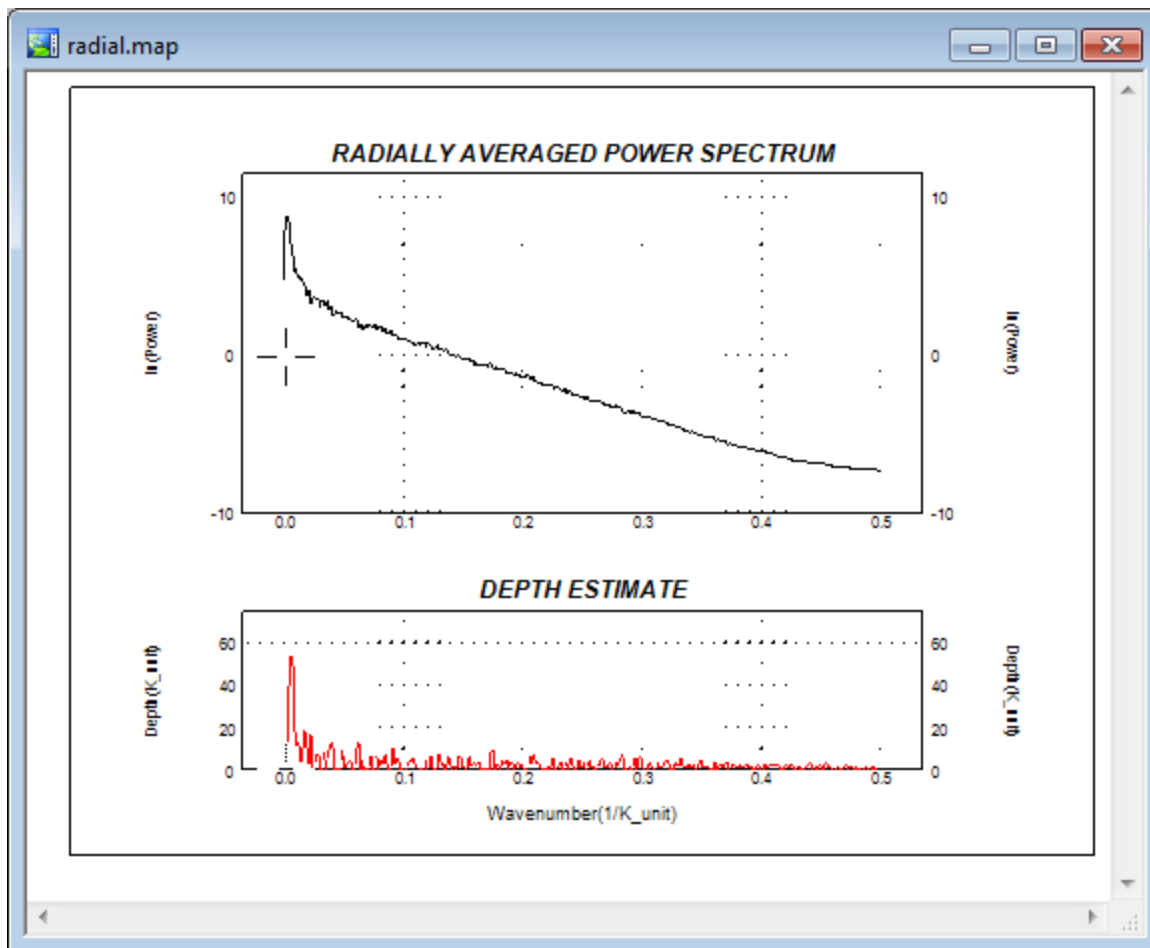


- Using the *Browse* button locate the *Input spectrum file name*.



The *Input Spectrum file* is created when you calculate the *radially averaged spectrum* (previous step) and is automatically populated.

- Click the **OK** button.  
The spectrum map is displayed.



The power spectrum is radially averaged. As a result, the larger the grid, the smoother the power spectrum will be. The file "radial.SPC" is an ASCII file with 5 fields - the wavenumber increment, the number of samples averaged for that wavenumber, the logarithm of the averaged wavenumber, and a 3 and 5 point depth estimate.

The magnetic depth estimate displayed in the lower graph is the average of the slope of the energy spectrum over 5 points. The depth to a statistical ensemble of sources is determined by the expression,

$$h = \frac{-s}{4\pi}$$

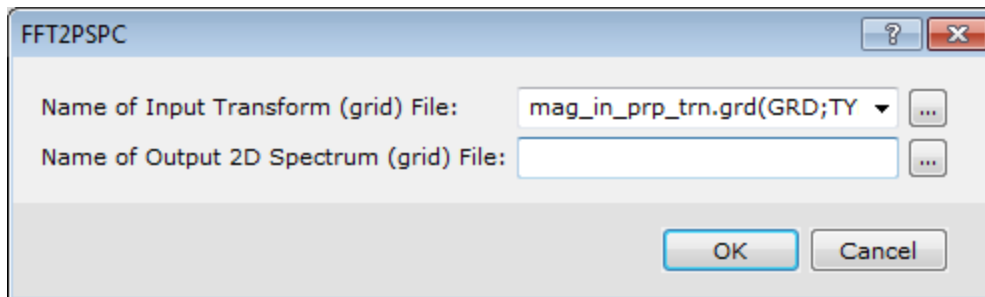
## Calculating and Displaying 2D Power Spectra

If you are performing a more complex interpretation, you may be interested in computing and displaying the 2D power spectrum for your grid.

### To Calculate and Display 2D Power Spectra

1. From the *MAGMAP* menu, select *Spectrum Calculation and Display* and then select **2D Power Spectrum**.

The *FFTPSPC* dialog is displayed.



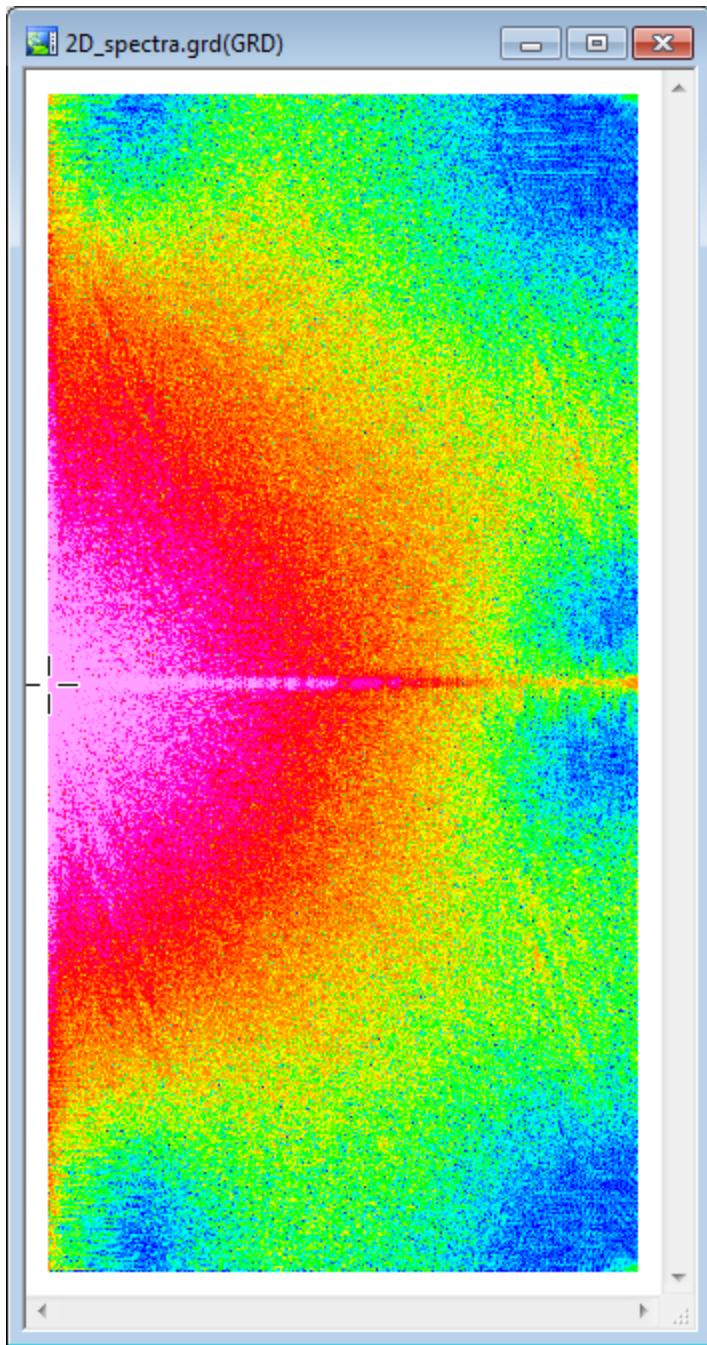
2. Use the *Browse* button to select the *Name of Input Transform (grid) File*.



*The Input Spectrum file is created when you calculate the radially averaged spectrum and is automatically populated.*

3. Specify the *Name of Output 2D Spectrum (grid) File*.
4. Click the **OK** button.

The system computes the spectrum grid and displays it in a temporary map file.



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