BNL Doppler Radar Spectra Visualization Java Toolkit

User Manual

Preliminary Draft
30-June-2014

Introduction

The BNL Doppler Radar Spectra Visualization and Analysis Java Toolkit is an application supporting all ARM profiling radars that collect Doppler spectra. It is designed to facilitate the efficient interactive exploration, discovery, and physical characterization of novel radar Doppler spectrum features as recorded by one or more collocated radars, aided by the context provided by a range of additional non-radar measurements.

The toolkit simultaneously visualizes any user-defined combination of parameters from one or more radars, including power spectra, time/height spectrograms, and MicroARSCL extended moments (e.g. spectral skewness, kurtosis etc) in co-polarized and/or cross-polarized modes. Support is also provided to co-visualize five types of lidar data (Doppler, Raman, micropulse, HSRL, and Vaisala ceilometer), balloon soundings, microwave radiometers, and irradiance sensors to exploit known and unknown synergies.

As the user dynamically explores a quantity of interest, adjusting resolution at will, all other data displays remain synchronized in extent and positioning across all dimensions (time, height, and velocity) to elucidate relationships among all parameters. Providing the user with a high degree of flexibility to adapt to the specifics of a particular application is a core design principle.

Installation of the toolkit

Step 1

Create a directory on your computer in which to install the toolkit and additional libraries.

Step 2

Download the toolkit software package BNLSpecVisToolkit-current.jar to the directory created in step one.

Step 3

Download the latest UCAR Java NetCDF library (currently netcdfAll-4.3.jar) to the directory created in step one, which can be obtained from the download page at www.unidata.ucar.edu/downloads/netcdf/netcdf-java-4/index.jsp.

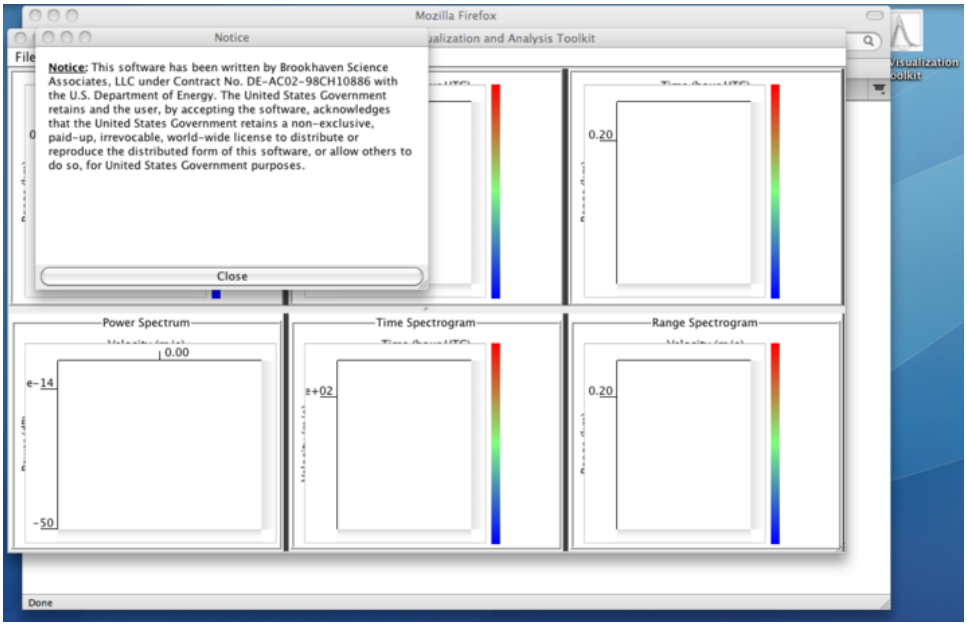
Step 4

Test your installation by opening a command shell and executing the following command:

```
java -classpath netcdfAll-4.3.jar:BNLSpecVisToolkit-current.jar SpectraVisualizationToolkit
```

Use the correct path to the two .jar files in the above command if they are not in your current directory.

The toolkit should start and appear similar to the image below.



To get you started on using the toolkit's capabilities, one of the menu choices is a quick-start help guide.

You can now close the tool.

Since radar Doppler spectra files can be very large, you will likely need to raise the amount of your RAM memory that can be allocated to the tool above the default setting. Using the command option -Xmx1G, -Xmx2G, -Xmx3G, or -Xmx4G will raise this limit to 1, 2, 3, or 4 gigabytes respectively, as in the following example:

```
java -Xmx1G -classpath netcdfAll-4.3.jar:BNLSpecVisToolkit-current.jar SpectraVisualizationToolkit
```

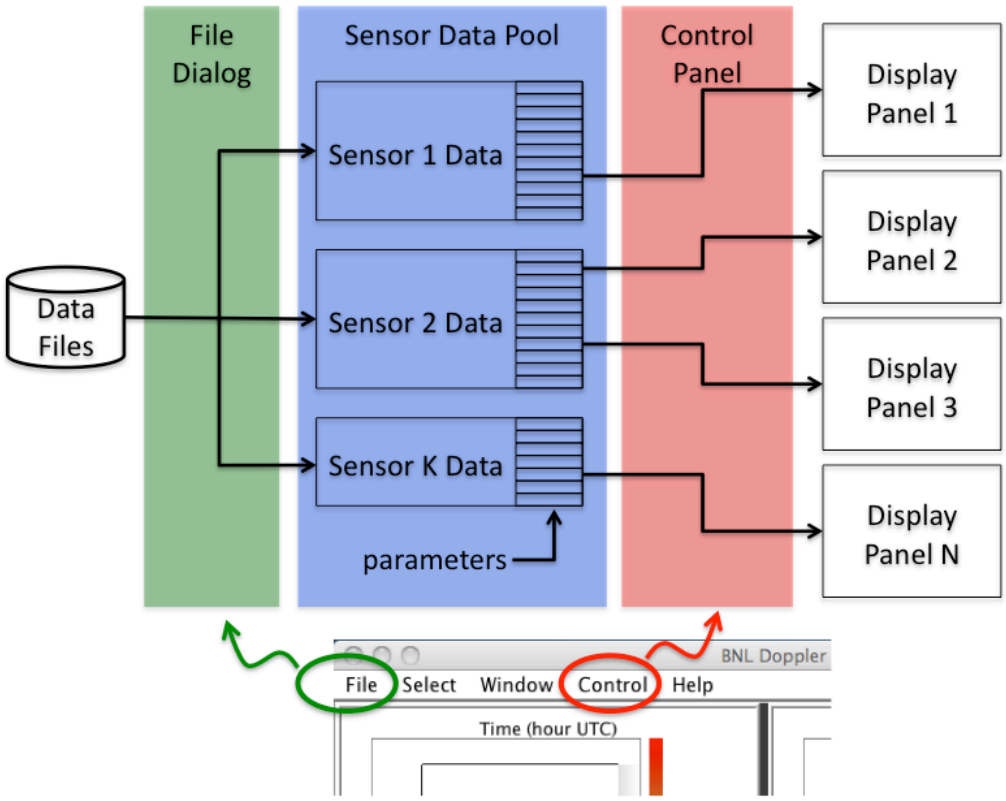
Step five

For convenience, depending on the details of your operating system, create a shortcut to execute the command in step four.

Principle of operation

The toolkit maintains a pool of one or more datastreams that are loaded by the user using the **File** menu. The first data file loaded must be a radar Doppler spectra file. Additional data files of any supported type may subsequently be loaded. Data belonging to any loaded datastream becomes visible after the user maps it to a display panel. To map a parameter of any loaded datastream to a display panel, the **Control** menu is used to make the connection. Upon loading of the first data file, a default mapping to six display panels is

initialized, providing default views of the data. When additional data files are loaded into the pool, they have no immediate effect on any display panel. The content of any display panel can be changed by mapping a different parameter to that panel with the **Control** menu.

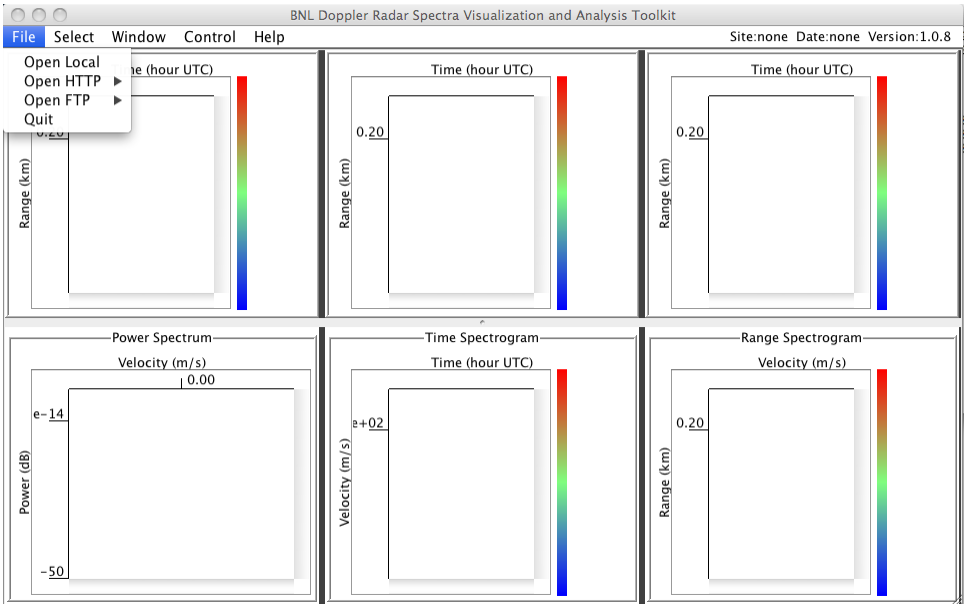


Each datastream in the pool is listed as an item in the **Sensor** dropdown of the Control Panel. Available parameters for a given sensor appear in the **Parameter** dropdown list of the control panel. Any sensor/parameter is mapped to a display panel by "attaching" it to the panel. The next section provides step-by-step details on this procedure.

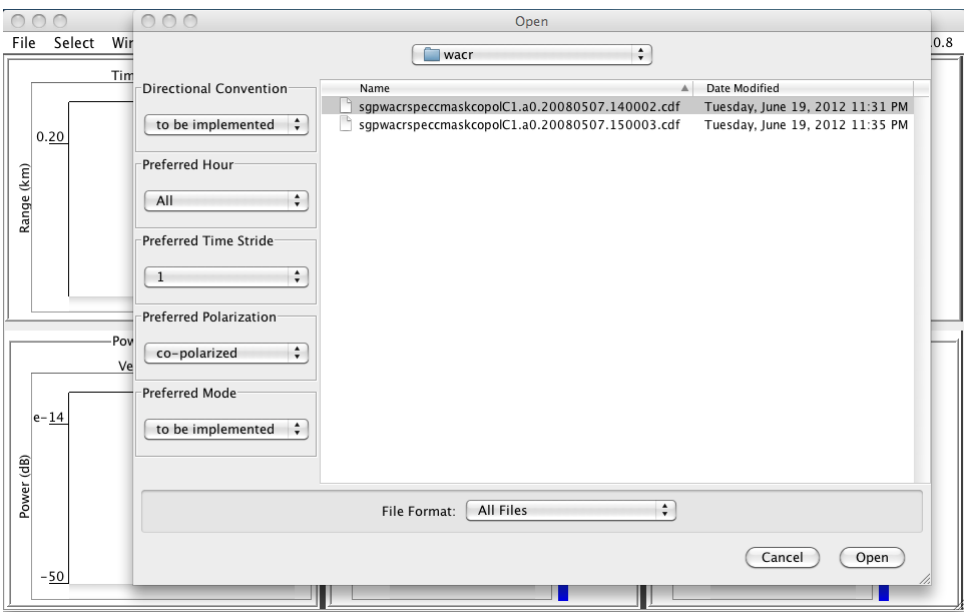
Once data are visible in the display panels, they can be explored interactively by designating positions of interest in time, range, and velocity with left mouse clicks, zooming by rolling a thumbwheel over axes, and panning by sliding scrollbars. Display panels can be added and removed at will using the **Window** menu.

Loading data files

After starting the toolkit, the first action required is to load a radar Doppler spectra file. The majority of these are of an hourly timeframe. From the **File** menu, select **Open Local**:

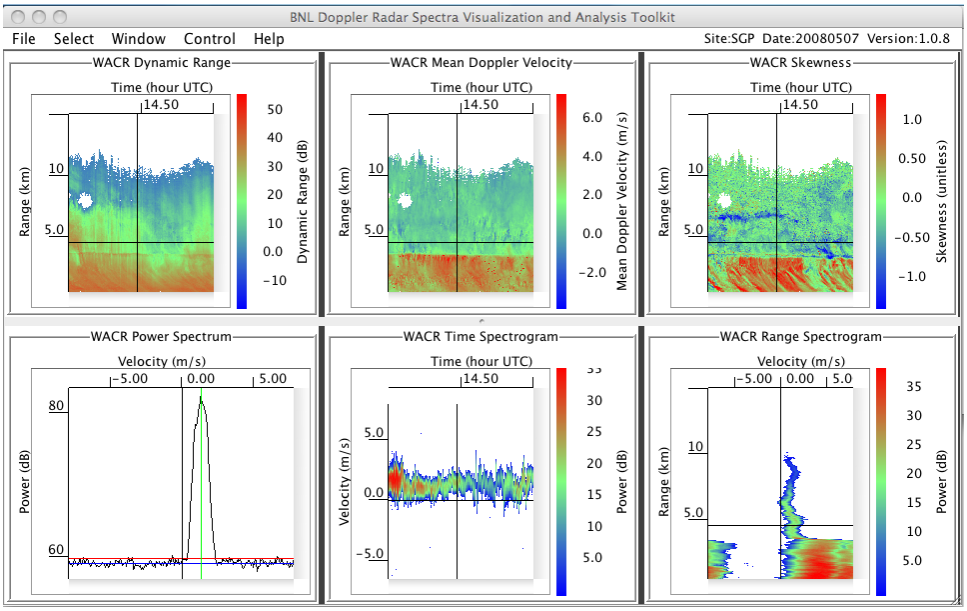


A file selection dialog will open:



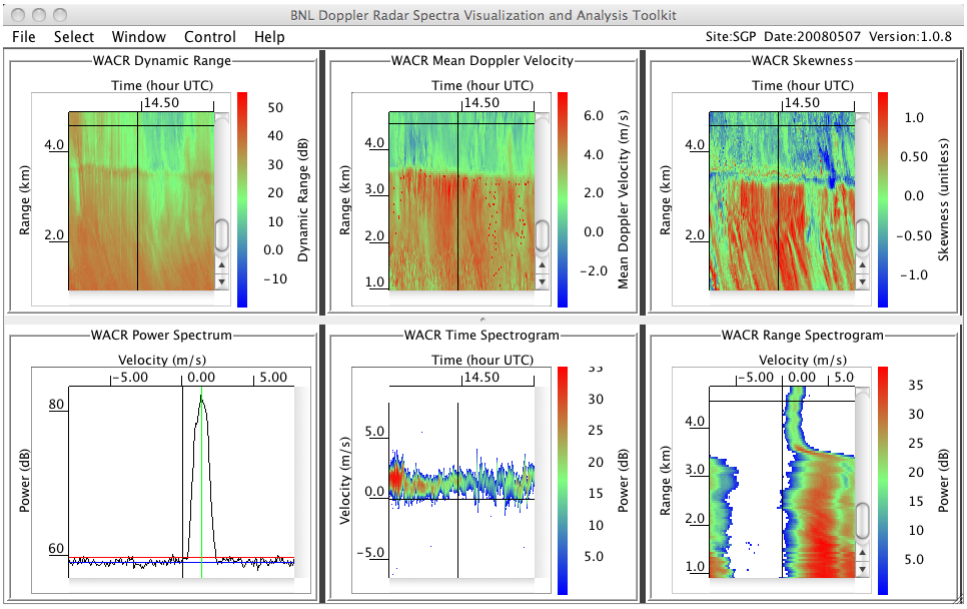
Choose a radar spectra file. Then click **Open**. A WACR file from the SGP will be used in this example.

A progress dialog will open while the spectra file is loaded and processed. Upon completion, the display panels will be initialized to their defaults:

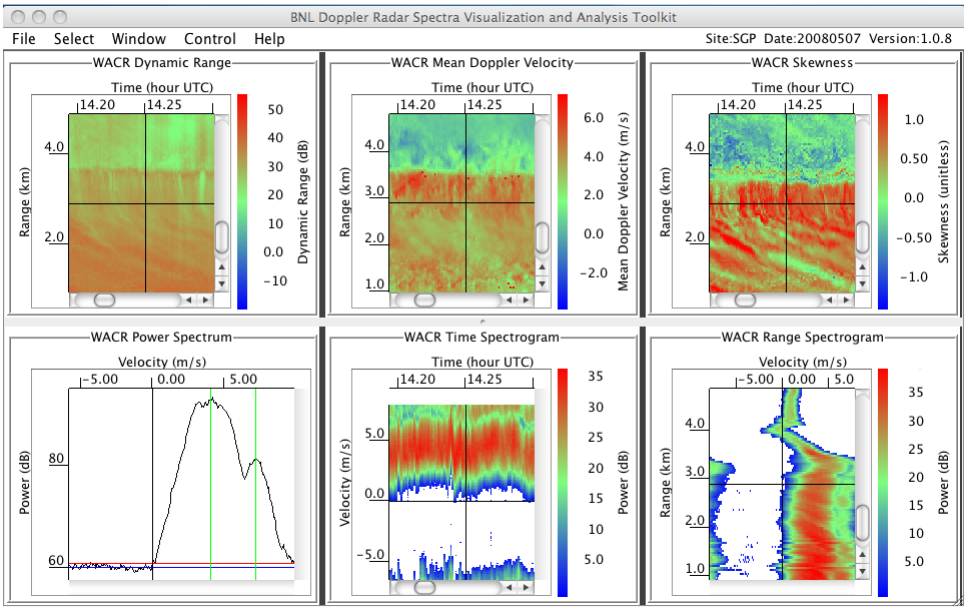


A left mouse click in any of the upper panels will place a crosshair at the designated coordinates in time and height. The power spectrum, time spectrogram, and range spectrogram in the lower panels will update to these coordinates.

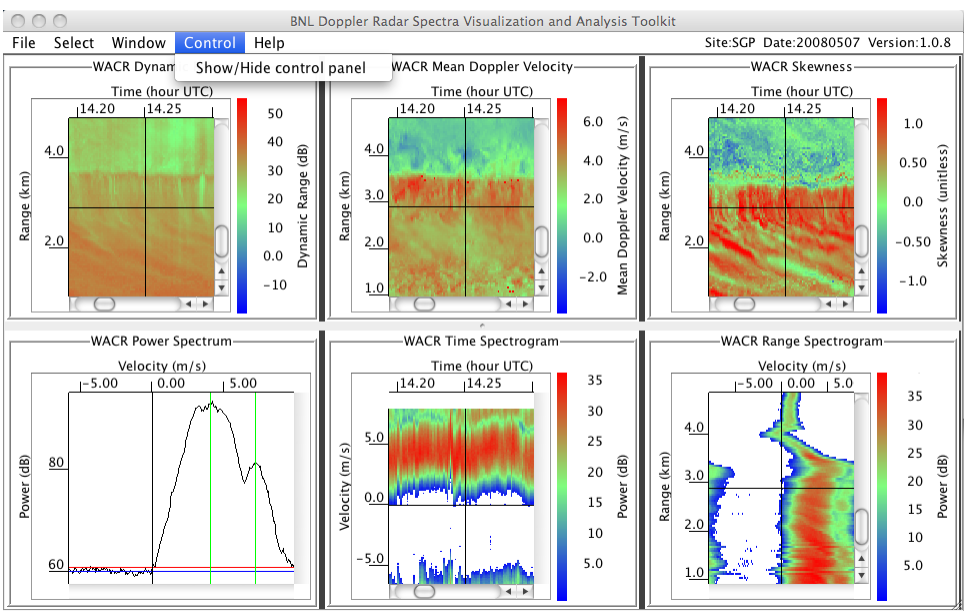
Rolling the thumbwheel over the vertical axis number scale will cause this dimension to zoom. Alternatively, successive left mouse clicks over the number scale will also zoom in; right mouse clicks will zoom out:



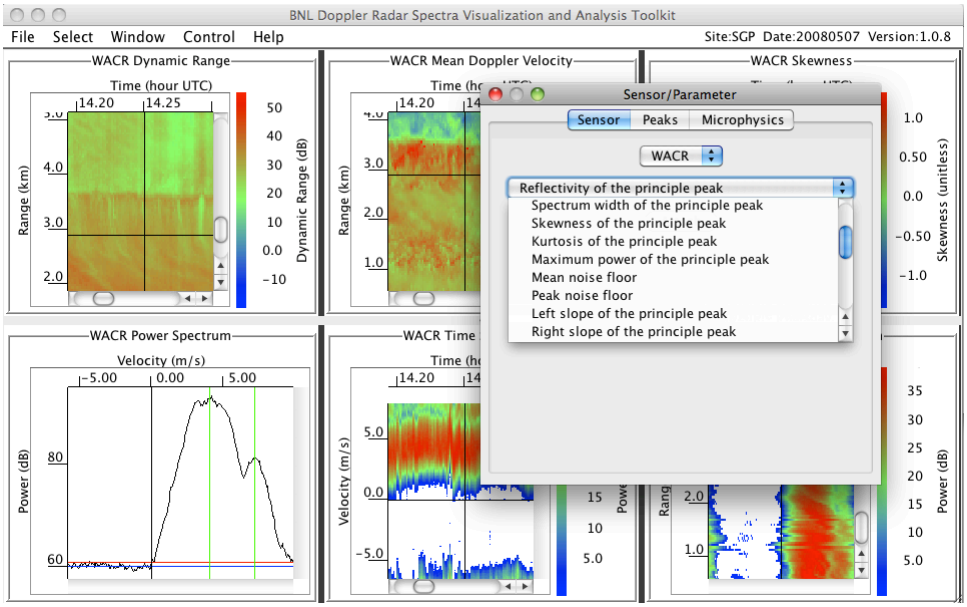
Rolling the thumbwheel over the horizontal axis number scale will cause this dimension to zoom. Alternatively, successive left mouse clicks over the number scale will also zoom in; right mouse clicks will zoom out:



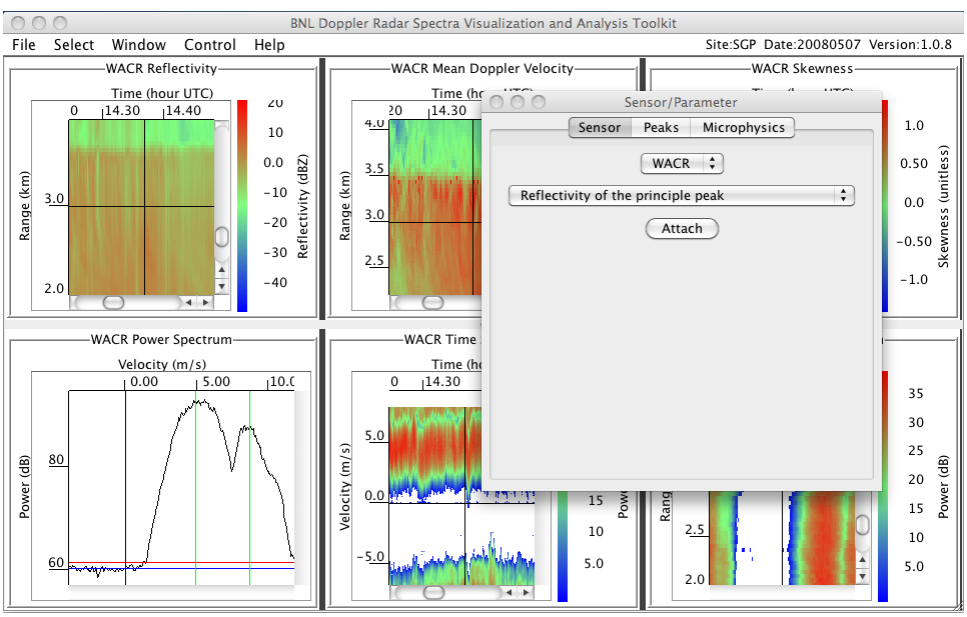
To change a displayed parameter, start by opening the Control Panel from the **Control** menu:



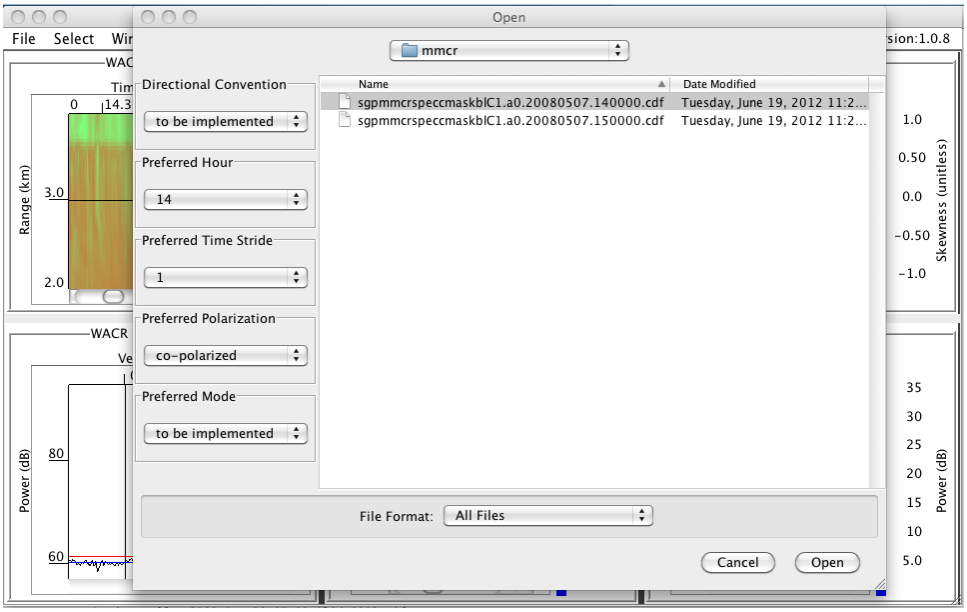
The Control Panel contains a Sensor pane, which is used to designate which sensor and parameter to map to a given display panel:



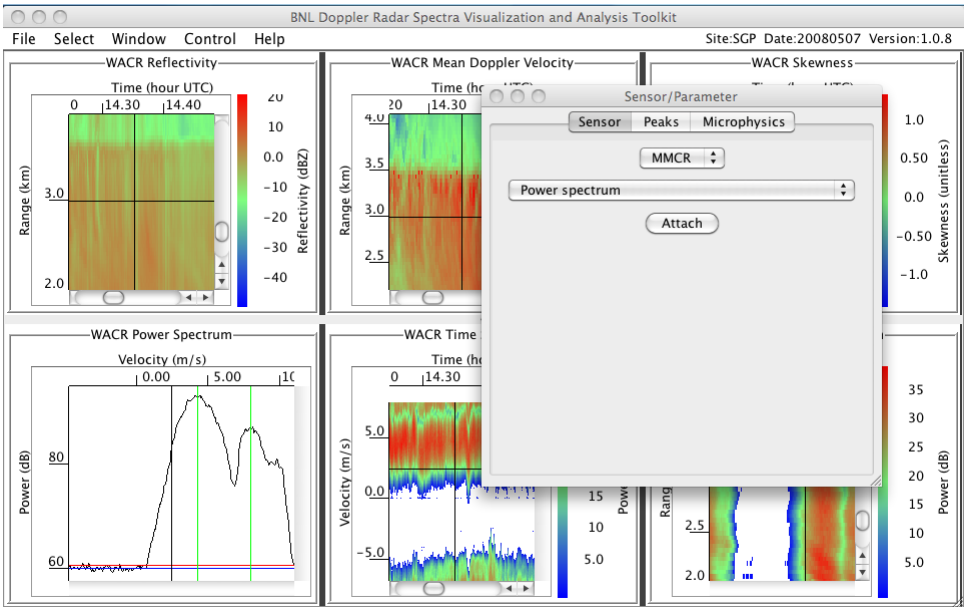
The parameter in the upper left panel can be changed as follows. First, left or right click the upper left panel. Next, select the desired sensor parameter; this example will use "Reflectivity of the principle peak". Finally, click the **Attach** button. The upper left display panel will update to the new parameter:



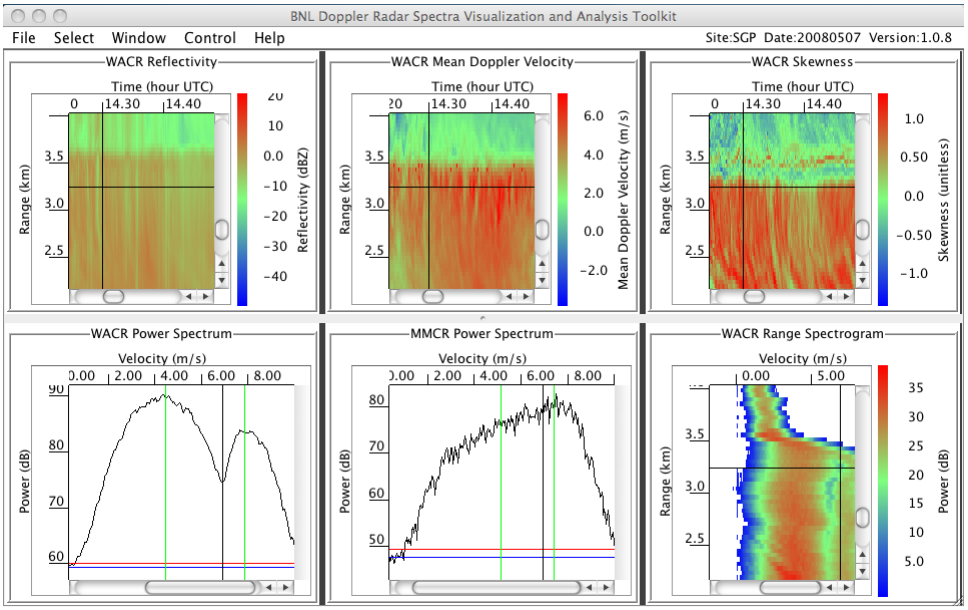
Additional spectra files can now be loaded from different collocated radars for this hour. An MMCR file from the SGP will be used in this example:



After the MMCR data has loaded, the Control Panel can be used to display MMCR data in any panel. This example will place MMCR power spectra in the lower middle panel. First, left or right click the lower middle panel to designate it as the target. Next select the MMCR from the **Sensor** dropdown and its power spectrum from the **Parameter** dropdown. Finally, click **Attach**:



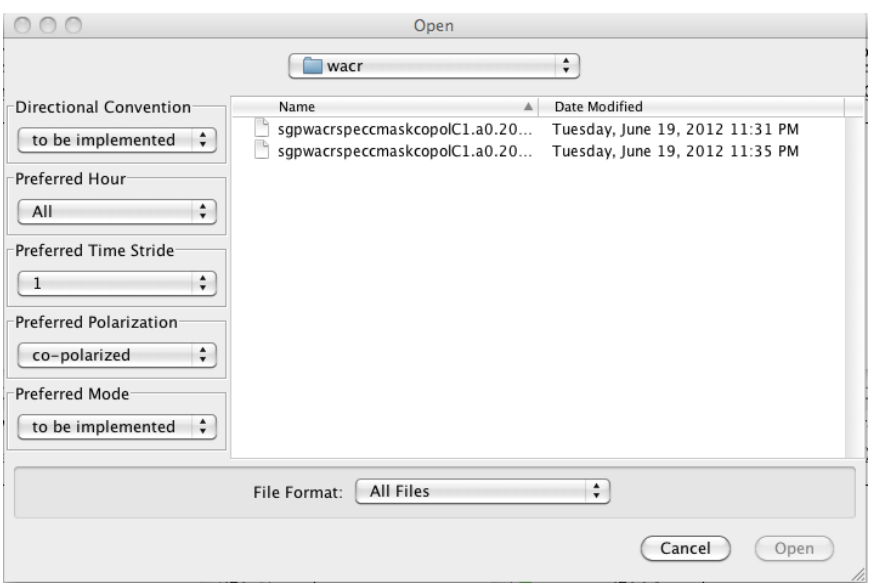
The lower middle panel updates to the MMCR power spectrum. Now, power spectra from two different wavelength radars can be compared at identical times and ranges:



The crosshair in this view is positioned several hundred meters below the melting layer of a stratiform rain event. The pronounced differences between the MMCR and WACR power spectra are attributable to the respective effects of Rayleigh and non-Rayleigh scattering at 35 and 95 GHz. In the velocity dimension, a left mouse click on the Mie-notch of the WACR spectrum positions a black vertical marker at approximately 6.8 m/s. A black marker is also automatically placed at the same velocity in the MMCR power spectrum display to facilitate comparison. The crosshair in the range spectrogram updates to this velocity as well.

File selection dialog options

The file selection dialog contains several settings that can be applied when a file is loaded:



The **Directional Convention** dropdown will allow a preferred up/down sign convention to be set. **Preferred Time Stride** causes a subset of spectra data to be loaded at the selected coarser interval than that stored in the file. This is very useful for conserving available RAM memory when working with very large and/or multiple spectra files.
Preferred Polarization will load data of the selected polarization in the case of a file that contains data of multiple polarizations; otherwise, this selection is ignored.
Preferred Hour is used to limit the time span of data loaded from a file. This is primarily intended to truncate non-radar data stored in daily files to the same time span of the radar data. **Preferred Mode** is used to support radar spectra file formats that store more than one mode in a single file, such as the UAZR and older MMCR formats.

Loading non-radar datastreams

The principles of handling non-radar datastreams are essentially the same as those described above, but with some differences. Discussion of other sensors, along with other toolkit capabilities will be documented here shortly as work on this manual continues.