**Figure 1**: High resolution atmospheric absorption spectrum and comparative blackbody curves

1. Open **Hydra** and load the file: AIRS.2005.08.28.103.L1B.AIRS_Rad.v4.0.9.0.G05241172839.hdf. Under *Start* open the *MultiChannel Viewer* and the following should appear.
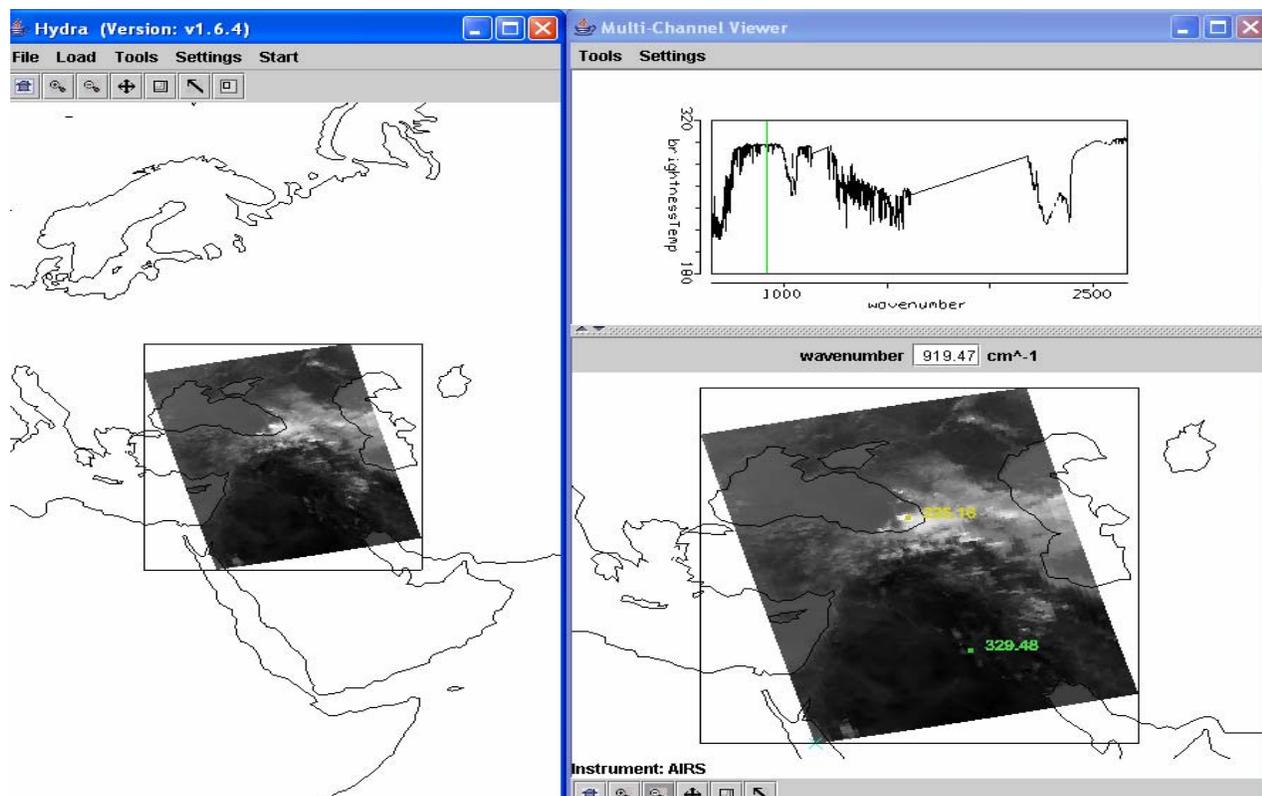


**Figure 1:** Hydra display of AIRS data showing BT spectra from warmest pixel and IRW image over the Black and Caspian Seas on 28 August 2005.

1a. Explore the image to view spectra measured in various pixels. To do this click on the arrow icon in the tool bar at the bottom of the MultiChannel Viewer and move the cursor around the image slowly, watching the spectra change from pixel to pixel. View a spectrum over the Black Sea in clear skies and locate the $CO_2$, $O_3$, and $H_2O$ absorption features. Now view a spectrum in the clouds at the eastern edge of the Black Sea. The absorption features have been severely diminished. Why? The BT at shorter wavelengths is now increasing as wavelengths decreases. Why?

1b. Engage the reference spectrum icon (look under **Tools** and find **Reference Spectrum** and click on). Show both the spectra from 1a simultaneously by engaging the arrows in the bottom tool bar (Figure 2).
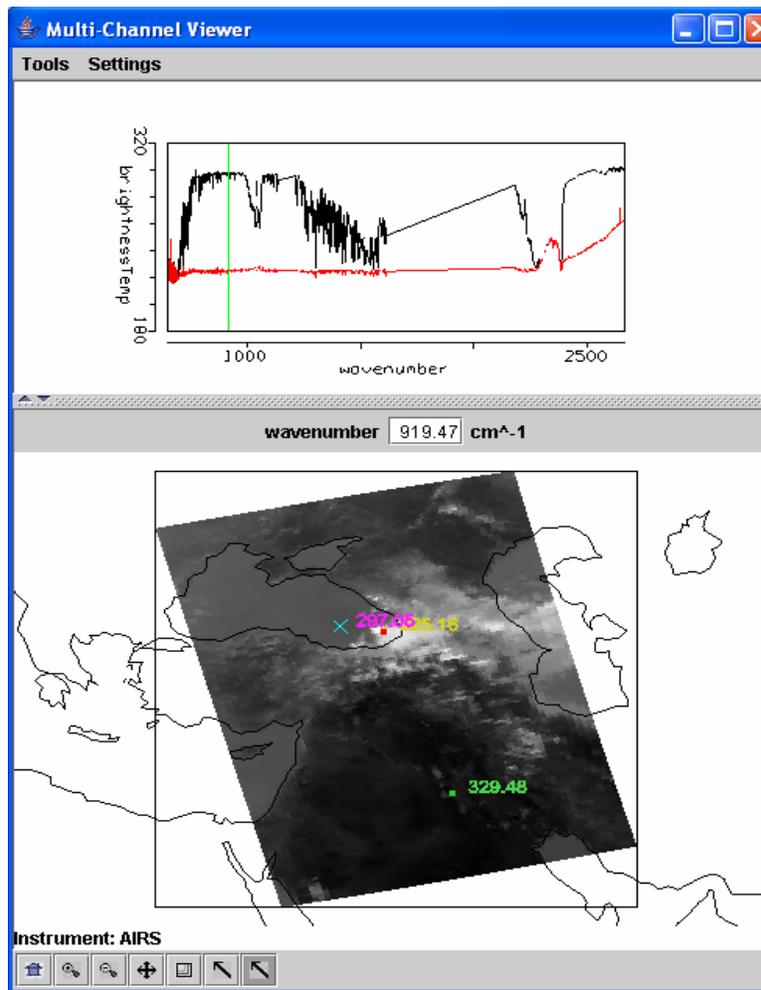


**Figure 2:** MultiChannel Viewer display with reference spectrum on showing cloudy and clear sky spectra over the Black Sea

2. Zoom in on the cloudy spectra at 1050 cm-1 (click on the zoom icon third from the right on the toolbar at the bottom and click and drag over the desired part of the spectra). The O3 absorption feature over clouds shows warmer BT as the wavenumber gets closer to the center of the absorption band. What does this tell you about the height of the cloud? Explain.

3. Restore the full spectra (click on the left icon on the toolbar at the bottom and click over the spectra). Go back to the Hydra main window and display the eastern portion of the Black Sea at full resolution (see Figure 3). Compare the spectra for a clear pixel and a pixel covered by thin cloud. What does the infrared window portion of the spectrum look like?
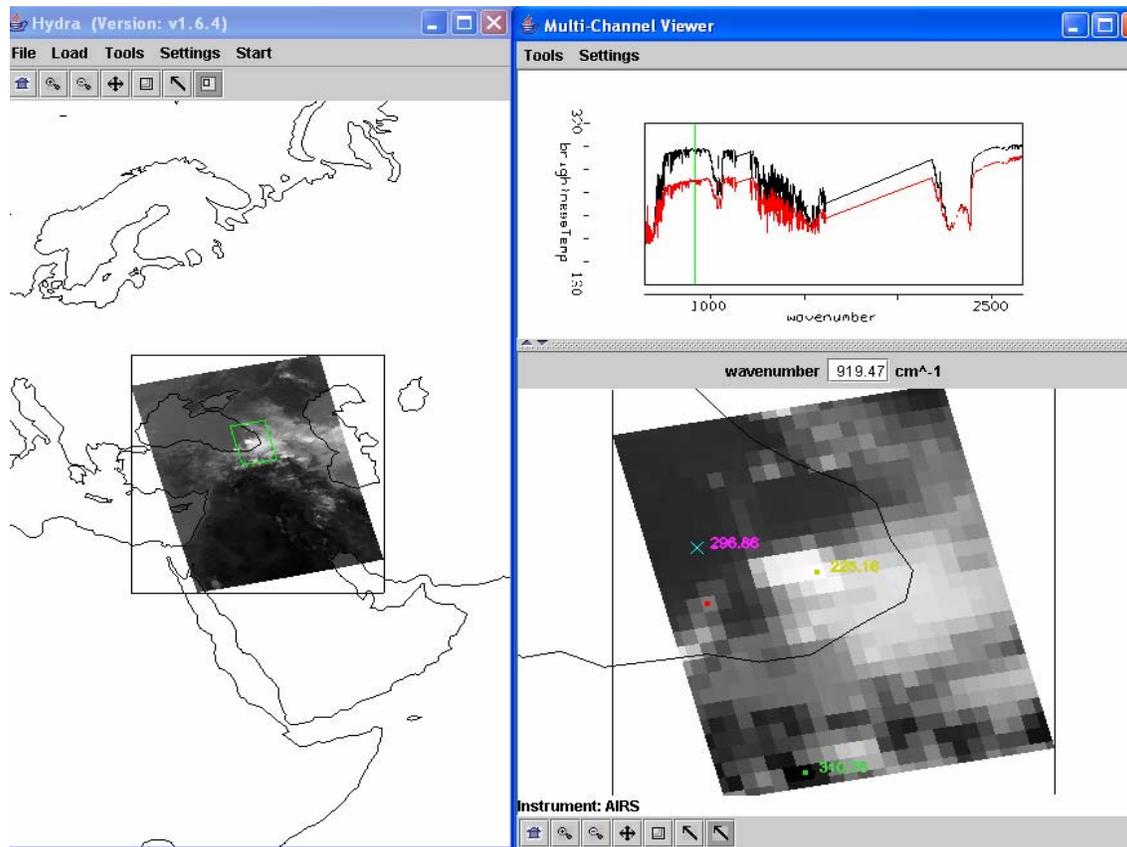


**Figure 3:** MultiChannel Viewer display of full resolution AIRS data showing partly cloudy and clear sky spectra over the Black Sea

4. Engage *Linear Combinations* (under *Tools*) to open the Channel Combination Tool display. What is the temperature difference for on-line off-line spectra at 735 cm$^{-1}$ for this scene? What is the temperature difference for on-line off-line spectra at 720 cm$^{-1}$ (at the Q branch of the $CO_2$ absorption band) for this scene? What does this imply about the 720 cm$^{-1}$ weighting function with respect to the 735 cm$^{-1}$ weighting function?

5. Calculate the BT difference on and off a H2O absorption line in the infrared window region (e.g. try 947.4 minus 948.2 cm-1). Color display the difference image (see Figure 4). What is the range of values in the scene? Differences in the eastern Black Sea are smaller than differences further west; what does this tell you about low level moisture? Explain.
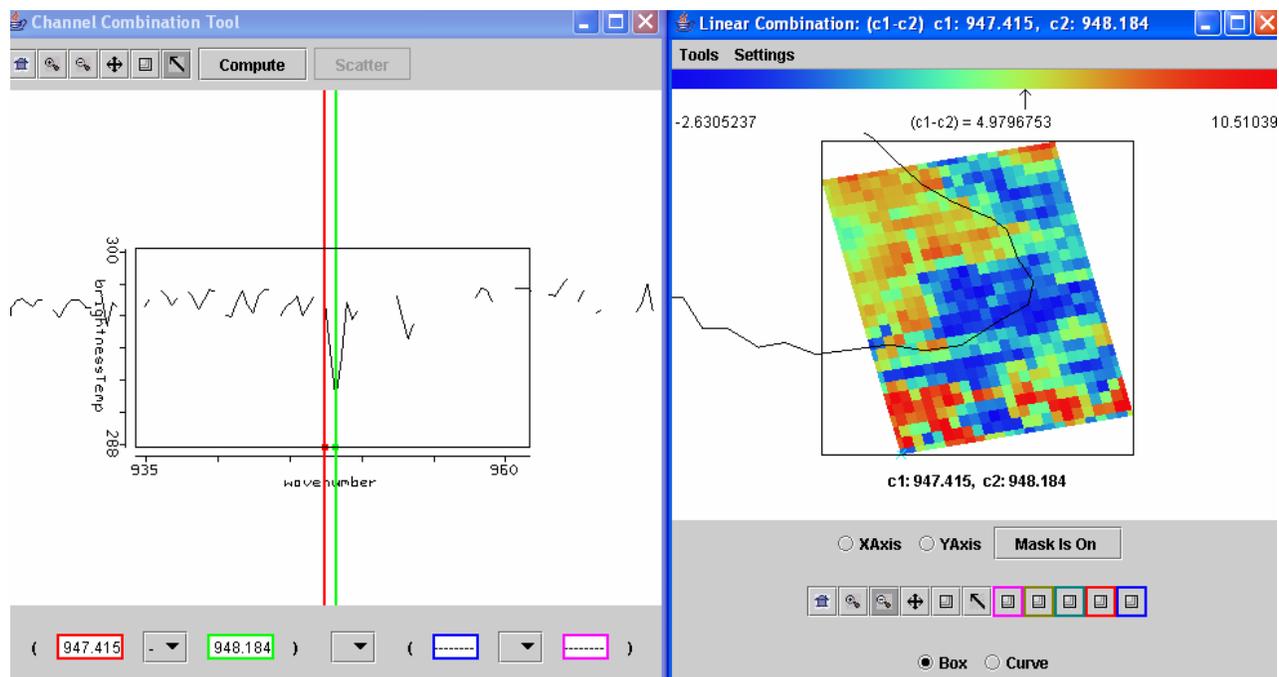
**Figure 4:** Channel Combinations display of BT947.4 minus BT948.2.