Lab 1– Using Hydra in McIDAS-V for Interrogating Hyperspectral Data and Exploring Spectral Properties of Clouds and Moisture
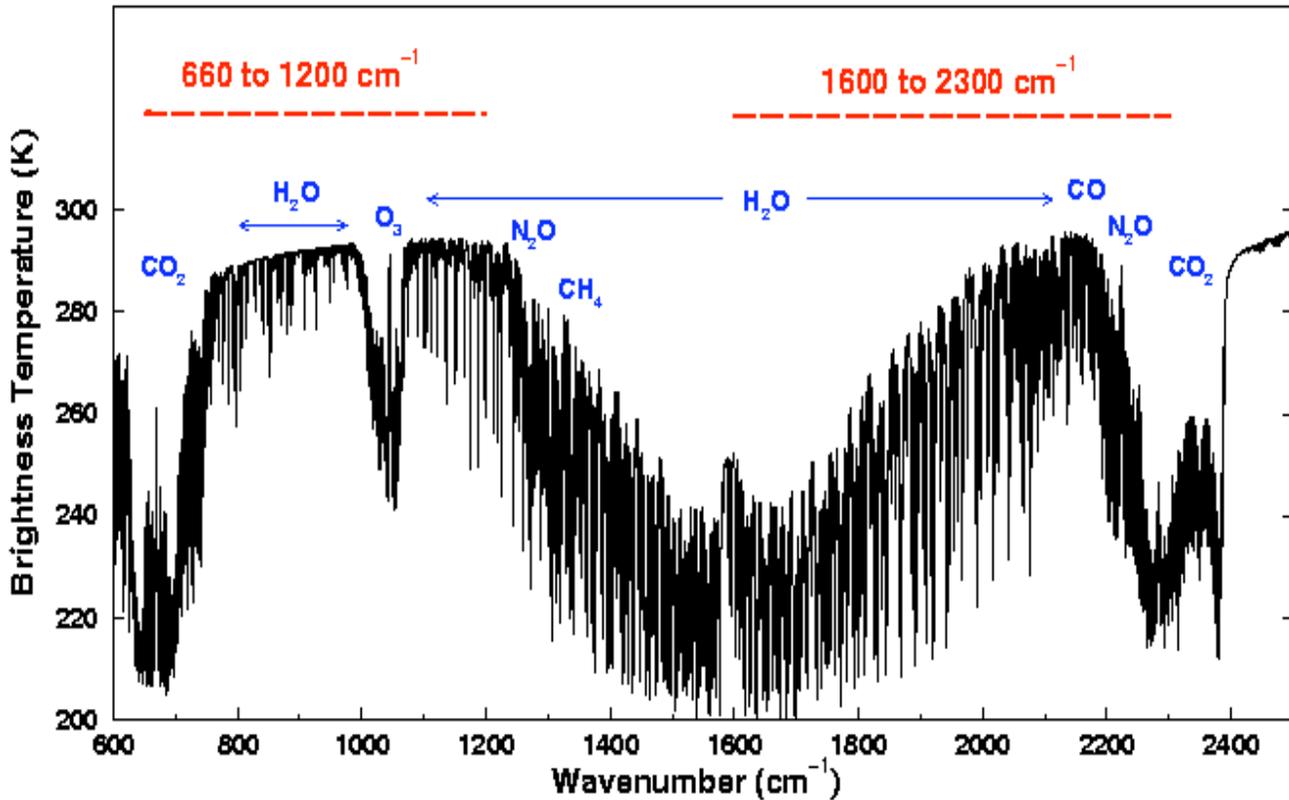

Figure 1: High resolution atmospheric absorption spectrum and comparative blackbody curves

1. Launch **McV** and within the **Data Explorer** window, choose **HYDRA** under the *Data Sources* tab and in the adjoining window select the IASI IASI_xxx_1C_M02_20070115_1140.nc file and then click on the *Add Source* button. From the *Field Selector* tab, the MultiSpectral Display should be highlighted. Click on the *Create Display* button. A small segment of data should appear in the Display 1 tab over Southern Europe, the Mediteranean Sea and North Africa. Zoom in on the image by holding down the Shift and Left mouse buttons together and using the mouse to drag a box completely around the image. Under the *Projections* drop down menu in the Display 1 tab, select *Use Displayed Area*. This will move the pointer to the center of your IASI image. To display the IASI spectra, go back to the **Data Explorer** window and choose *BrightnessTemp.* under Panel 1. This will display the Spectra for the centered box in the middle of the IASI image under the Layer Controls tab.   Please see Figure 2 for a depiction of the IASI granule and the spectra.
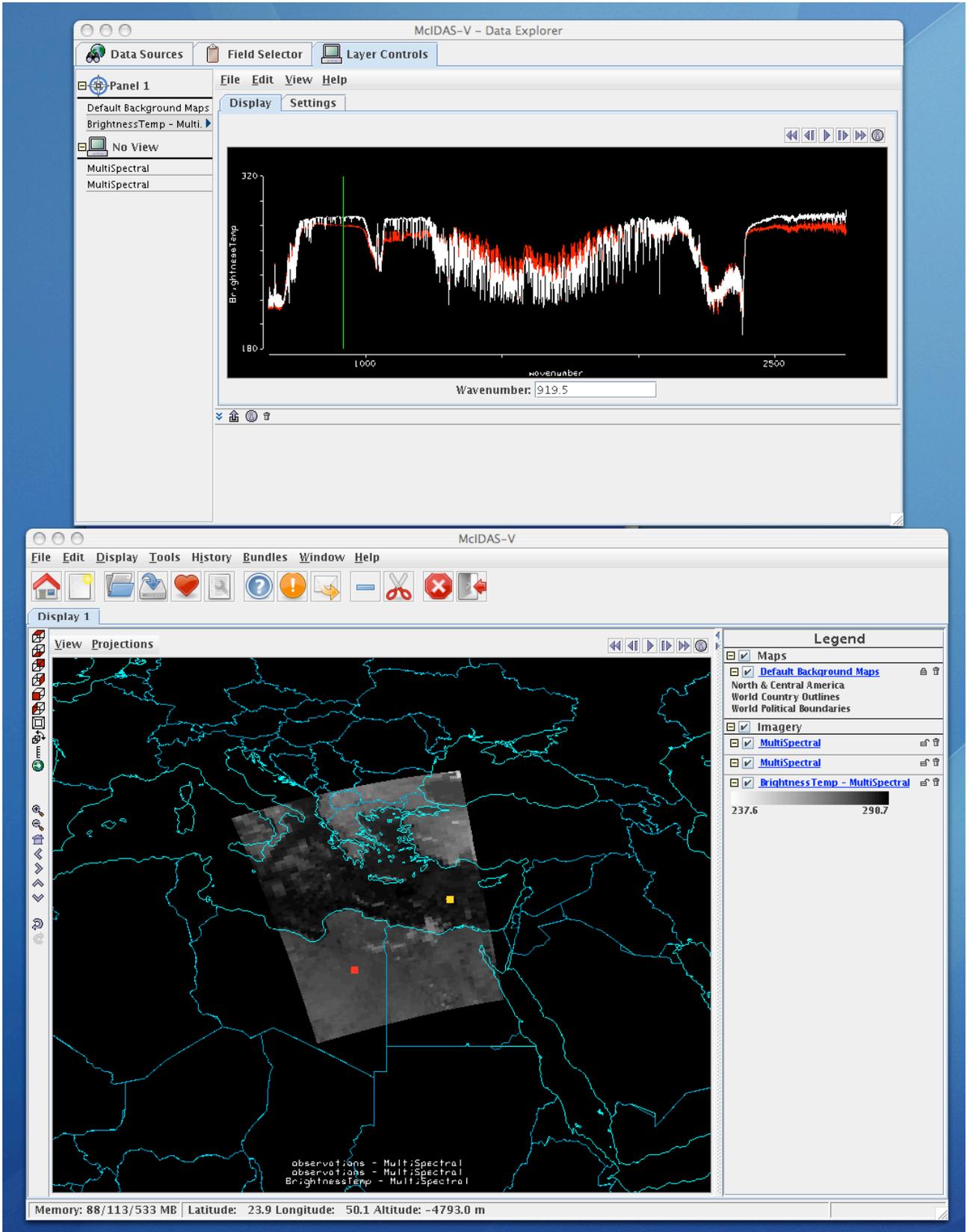
Figure 2. IASI data granule from 15 January 2007 and the associated spectra as viewed using McIDAS-V.

1a. Explore the image to view spectra measured in various pixels. The image displayed is the 919.50 cm-1 spectral region (10.8 micron window). To do this grab the orange box in the center of the data image by right clicking and holding as you move the mouse around the scene. You will also see a red box which can serve as a reference spectrum. Move this over the extreme southern port of the image for now. Move the orange box around the image slowly, watching the white spectra change from pixel to pixel. View a spectrum over the Mediterranean Sea in clear skies and note the features. Why are the brightness temperatures not the same everywhere in this clear sky region? Can you identify the O2, O3, and H2O absorption features? Now view a spectrum in the clouds at the extreme northeastern edge of the image. The absorption features have been severely diminished. Why? The BT at shorter wavelengths is now increasing as wavelengths decreases. Why?

1b. Now drag the reference spectrum icon (red box) over the western portion of the Black Sea (Figure 3) and then move the original spectrum icon (orange box) to a site over the cold cloud in the northeastern portion of the image. Why is the spectrum from the cloudy field of view showing a much smaller change in brightness temperature as a function of wavenumber?
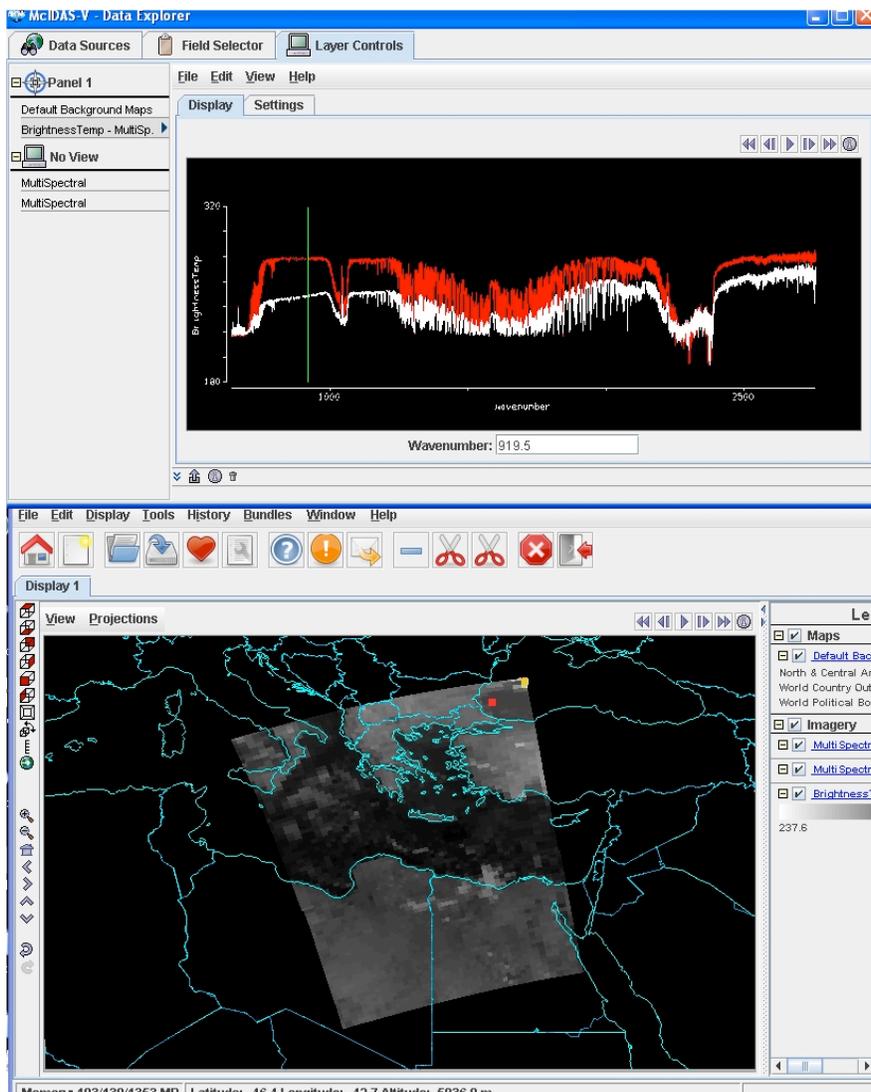

Figure 3: McIDAS-V display with reference spectrum on showing cloudy and clear sky spectra over the Black Sea

1c. Zoom in on the spectra at 700 cm-1 where the clear and cloudy spectra begin to separate (***Control+Left+Drag*** to zoom, if you miss the region, ***Shift+Left*** returns to the full spectra). Look at band images at 697.5 and 710 cm-1 by typing in the wavenumbers into the **Wavenumber:** box, or by clicking the center mouse button over the spectra which will move the green vertical line to the chosen wavenumber. Clouds are evident in one image but not the other. Explain why. How could you use this information to determine the height of the cloud?

 2. Change the wavenumber to 1349.75 cm-1 (7.4 microns) by deleting the number shown in the wavenumber box and typing in the new number. Is this an absorption region? Explain your answer.
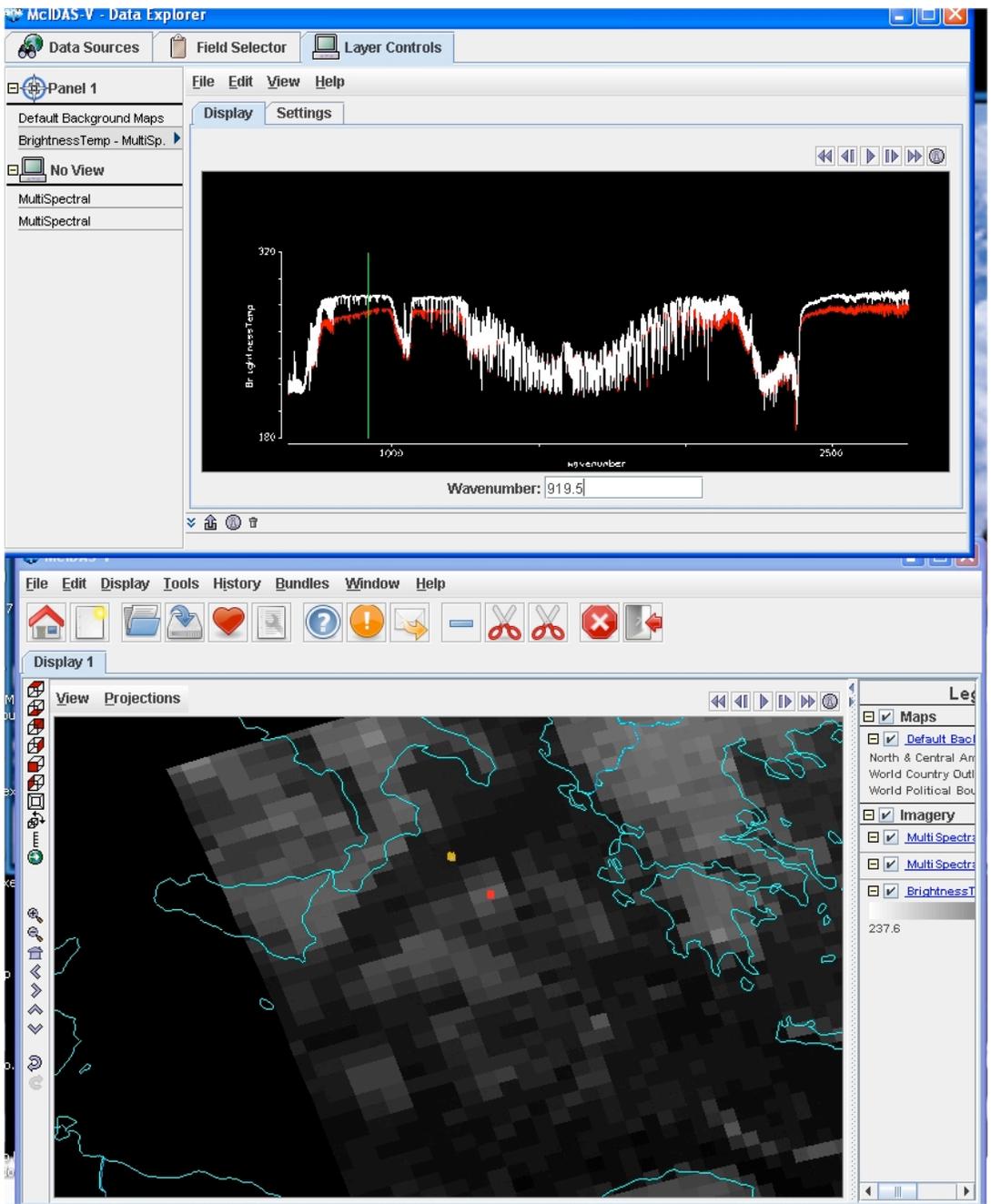

Figure 4: McIDAS-V display of full resolution IASI data showing partly cloudy and clear sky spectra over the Meditteranean Sea.

3. Move your two boxes to the northwestern portion of the image and zoom in on this region (see Figure 4). You can zoom via **Shift+Right Click+Roll over** image window or by using the mouse scroll wheel. The arrow icons on the left utility bar can be used to move the image. Change the wavenumber to 919.5 cm-1. Compare the spectra for a clear pixel and a pixel covered by thin cloud as shown in Figure 4. What does the infrared window portion of the spectrum look like? Estimate the brightness temperature change over this IR window range (950 to 800 cm-1) for the clear and thin cloud scenes. Why is the difference larger for the cloud scene? Use the home icon to go back to the original display.

4a. Now examine a region over Egypt as seen in Figure 5. Move the reference spectrum over the water and the other spectrum over the colder land. Look at both complete spectra. Why are the land Brightness Tempeatures generally colder except over the water vapor absorption region (1300-2000 cm-1)? Look closely at the IR window region again. Zoom in on the 950-800 cm-1 region. Why are the absorption lines so much flatter over the land? Calculate the average on line/off line difference between the land and water spectra around 850 cm-1. How might this help you calculate the amount of H20 in the atmosphere?
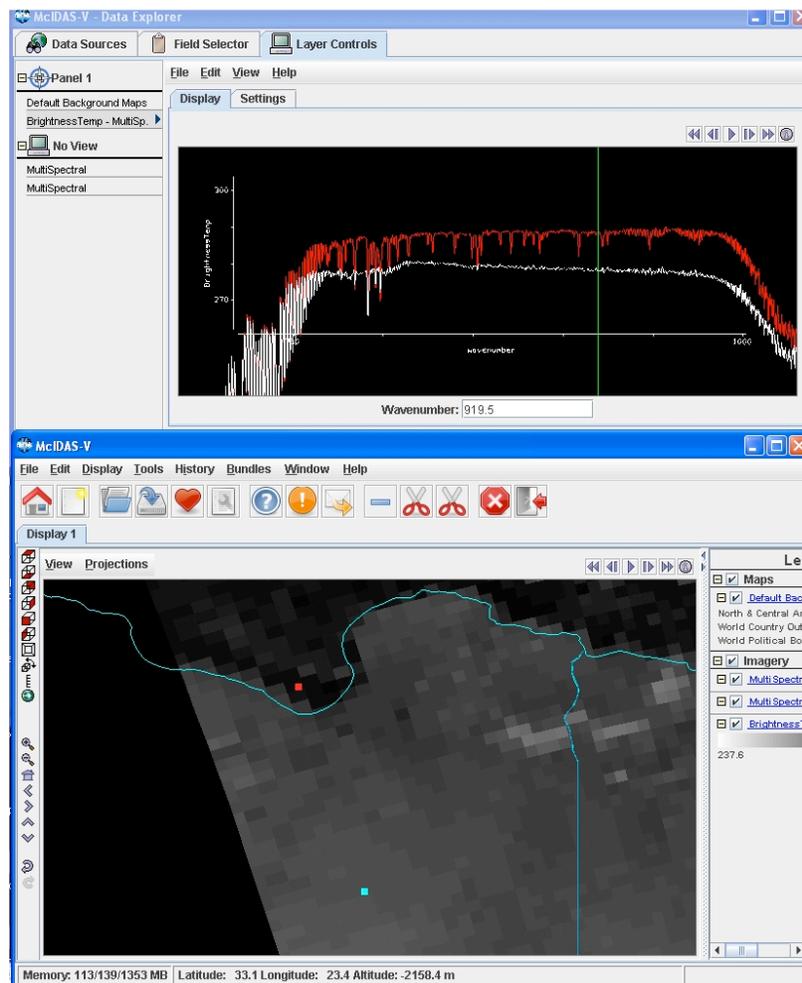

Figure 5. McIDAS-V display of spectra and image from a clear water and clear land scene over Egypt.

4b. Look at the slope of the spectrum over the land in the same window region (white spectrum in Figure 5). How does it differ from the thin cloud slope of exercise 3? What is the approximate difference in Brightness Temperatures over the 950 to 805cm-1 range? What is the cause of this?

4c. Now look closely at the two spectra in the regions before and after the ozone absorbtion band which lies approximately between 1000-1075 cm-1. Compare the changes that occur in the spectra on either side? Why are the absorbtion lines going in opposite directions on the 1075cm-1 side? Try choosing sites closer to the Sea. Do you see the same change in Brightness Temperatures from one side of the ozone band to another?   Explain the cause of this feature. How might this information be useful?

5. Now select the region over Greece and the adjacent Mediterranean Sea as shown in Figure 6. Move the reference spectrum over the water and pick a scene over the land as shown in Figure 6 for the other pointer. Zoom in on the specta in the 850cm-1 range. Keep picking scenes over the land until you have a spectra like that shown in Figure 6 (white spectrum). What is the cause of the difference in the way the absorption lines are pointing?   Can you estimate the strength of the atmospheric effect that is causing this feature? How could this be useful in operations?
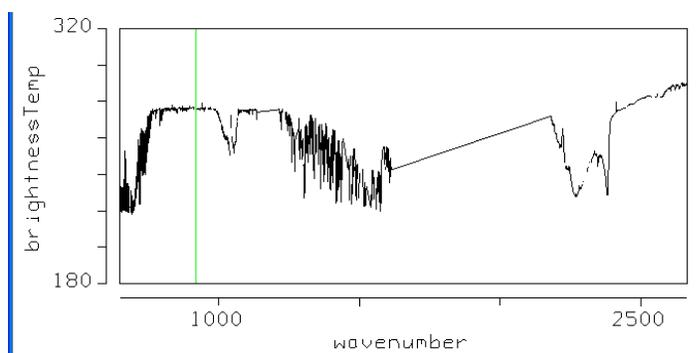

Figure 6. Zoomed in McIDAS-V screen shot of IASI data near and inland coastal Greece.
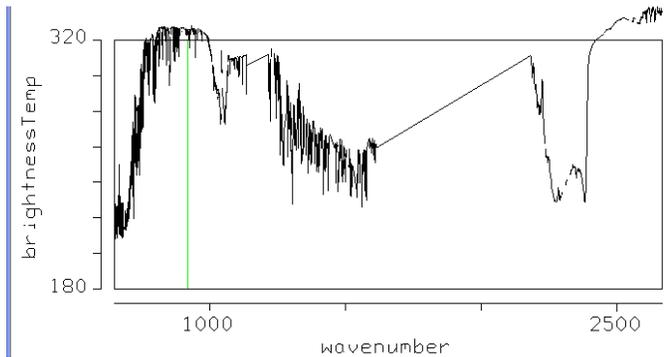
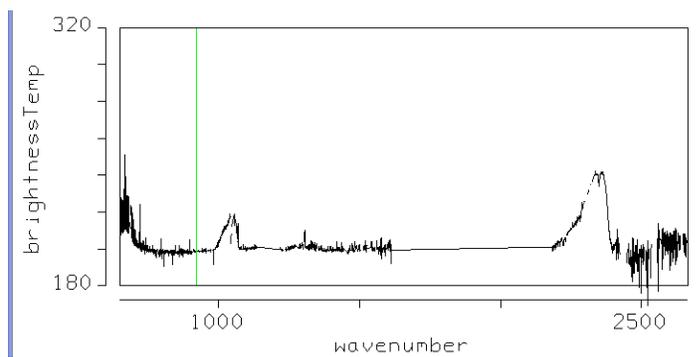1. For each figure select the correct answer(s)

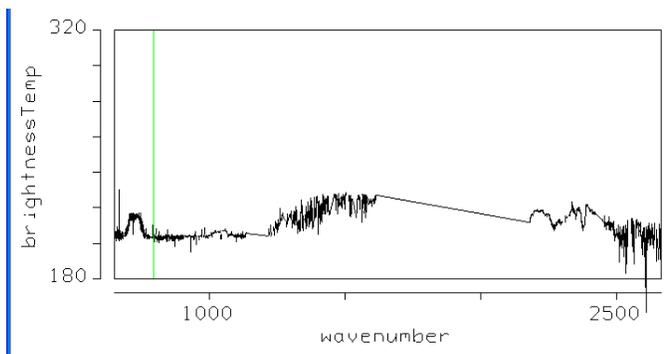1) DAY, NIGHT, OCEAN, ICE, CLOUD
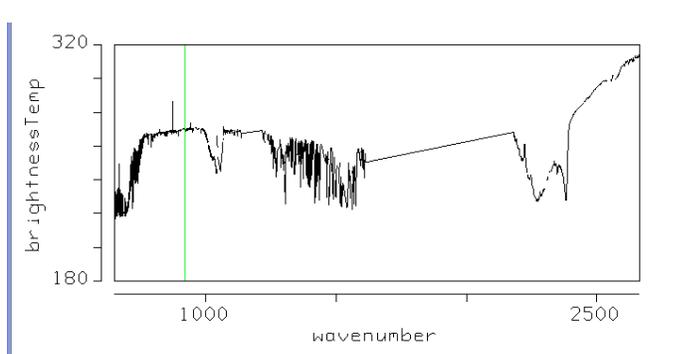

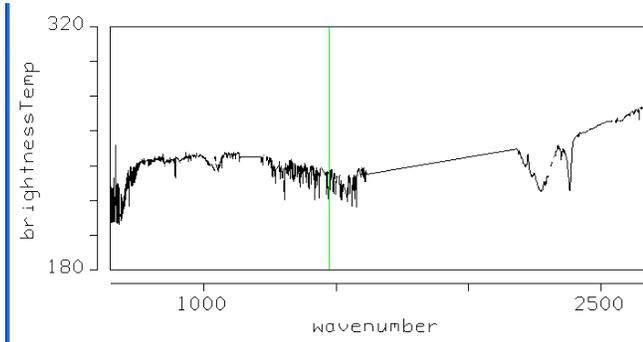2) NIGHT, OCEAN, DESERT, CLOUD

3) CLOUD, NIGHT, OCEAN, DESERT
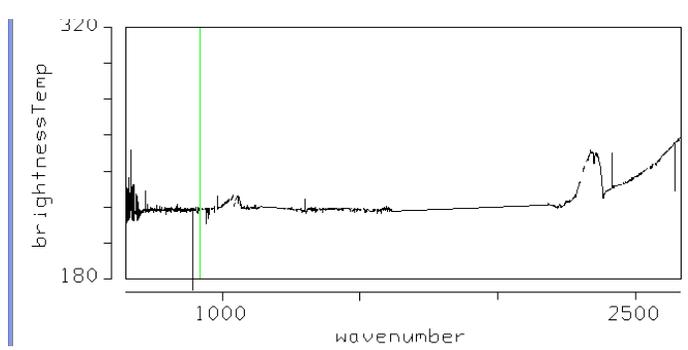

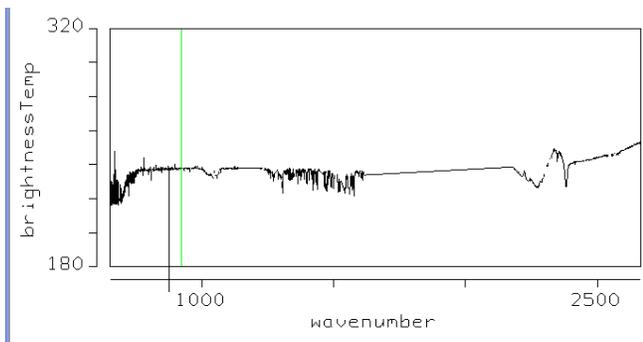4) DAY, NIGHT, OCEAN, ICE, CLOUD

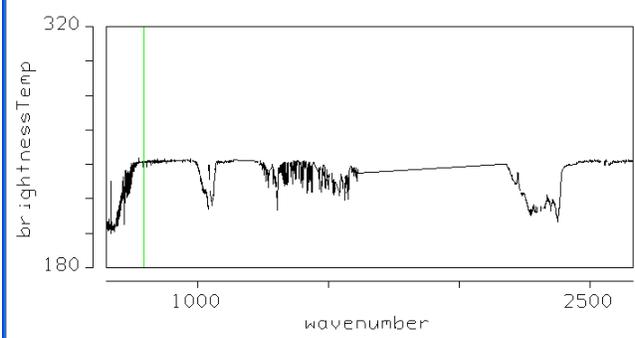5) CLOUD, OCEAN, ICE, NIGHT
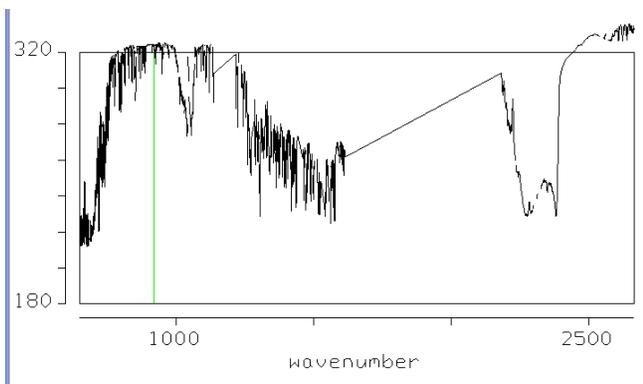

6) OCEAN, ICE, CLOUD

7) DAY, CLOUD, OCEAN
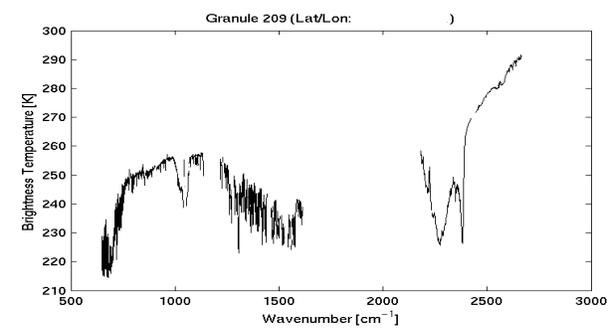

8) ICE, OCEAN,NIGHT

9) LOW, CLOUD, HIGH CLOUD

10) DAY, HIGH CLOUD, OCEAN

11) LOW, CLOUD, DESERT, OCEAN

12) OCEAN, ICE, DAY, HIGH CLOUD

Short Summary of Hydra Commands in McIDAS-V

Spectra

Select spectra - write wavenumber in box or middle button click
Select portion of spectra to zoom in on *Control+Left click+Drag*
Return to full spectrum *Shift+Left click*
Move spectrum right or left – *Right Click + Drag*
Read Brightness Tempertures and Wavenumbers – click middle mouse button (or wheel). This will provide the value of the Brightness Temperature and Wavenumber at the point on the graph you are clicking. It will also move the green line and change the image to that wavenumber.

Image

Change pixel that spectra is displaying – *Left Click* on a dot and drag
Change band – used spectra window - write wavenumber in box or middle button click
Move image up or down – use left utility bar arrow icons
Zoom – *Shift+Right Click+Roll over* window –or- mouse scroll wheel forward or backward
Return to Original Image View – Click on house icon in the left utility bar