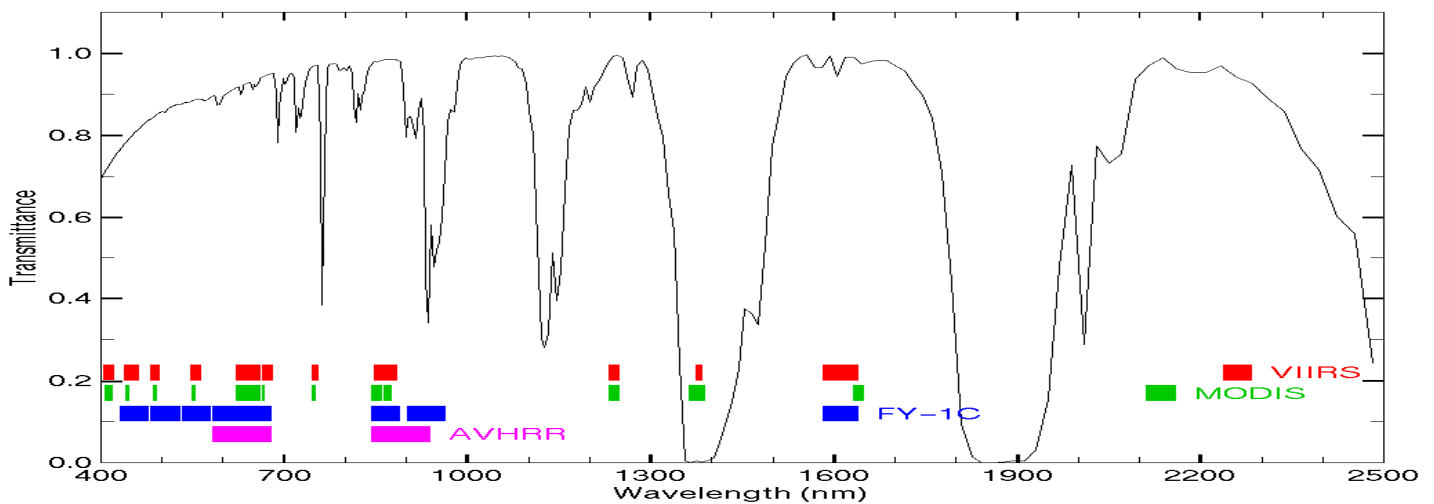
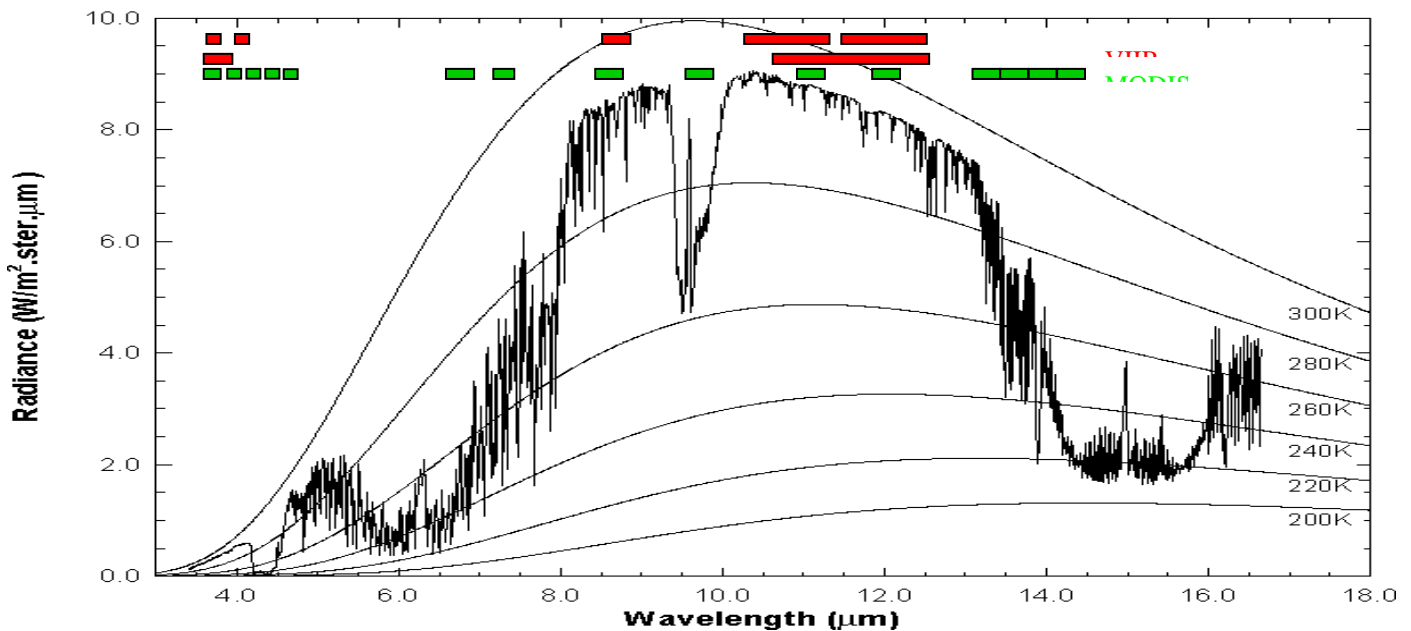


Table: MODIS Channel Number, Wavelength (μm), and Primary Application

Reflective Bands			Emissive Bands		
1,2	0.645, 0.865	land/cld boundaries	20-23	3.750(2), 3.959, 4.050	sfc/cld temperature
3,4	0.470, 0.555	land/cld properties	24,25	4.465, 4.515	atm temperature
5-7	1.24, 1.64, 2.13	“	27,28	6.715, 7.325	water vapor
8-10	0.415, 0.443, 0.490	ocean color/chlorophyll	29	8.55	sfc/cld temperature
11-13	0.531, 0.565, 0.653	“	30	9.73	ozone
14-16	0.681, 0.75, 0.865	“	31,32	11.03, 12.02	sfc/cld temperature
17-19	0.905, 0.936, 0.940	atm water vapor	33-34	13.335, 13.635,	cld top properties
26	1.375	cirrus clouds	35-36	13.935, 14.235	cld top properties



High resolution atmospheric absorption spectrum and comparative blackbody curves.



Inspect the scene over Italy on 29 May 2001 detected by MODIS using HYDRA (see the attached instruction sheet explaining how to run HYDRA). After engaging HYDRA the HYDRA window appears (Figure 1). To load a MODIS Level-1B 1KM file from disk, click on “data | local” and select the file to be loaded (e.g., MOD021KM.A2001149.1030.003.2001154234131.hdf). When the file is loaded, an image of the 11 μm radiances appears, as shown in Figure 2.

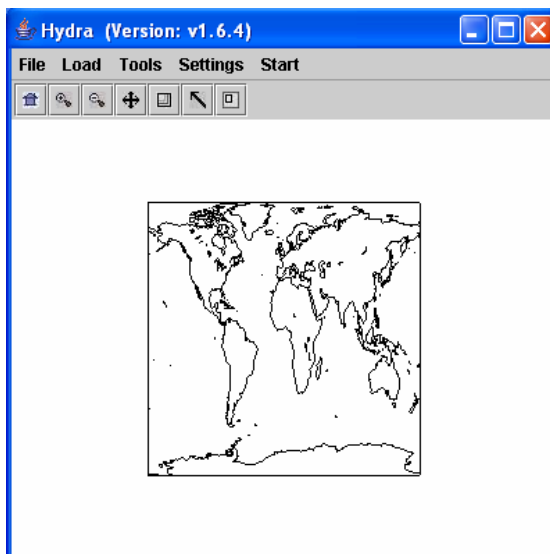


Figure 1: The HYDRA window.

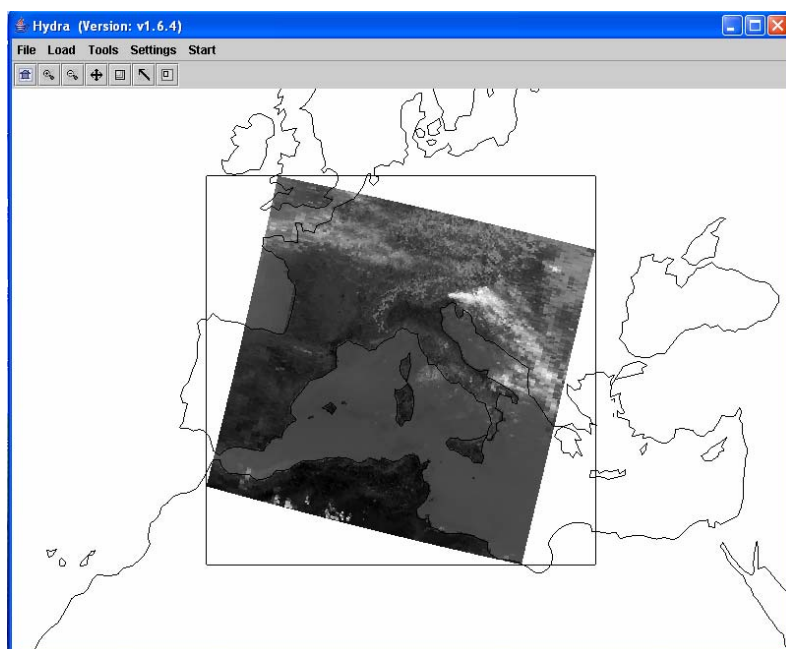


Figure 2: HYDRA window with a MODIS L1B 1KM file loaded.

1. Get familiar with the command menu *Settings*. Band 31 (11 μm) is automatically displayed at reduced resolution. Try different black and white enhancements by adjusting the color range (*Set Color Range*). Use the toolbar at the top to zoom in and zoom out and translate the image. Reset the image. Display the image in color and try different color enhancements.

2. **Start** the **Multichannel Viewer**. Display the data at full resolution by selecting a subset of the data displayed in the Hydra window (right most icon in toolbar in the Hydra window). The one kilometer resolution data will appear in the Multichannel Viewer window (see Figure 3). Use the arrow icon at the bottom of the Multichannel Viewer window to scroll around in the full resolution image – locate the lat & lon of the min and max brightness temperature values in the image.

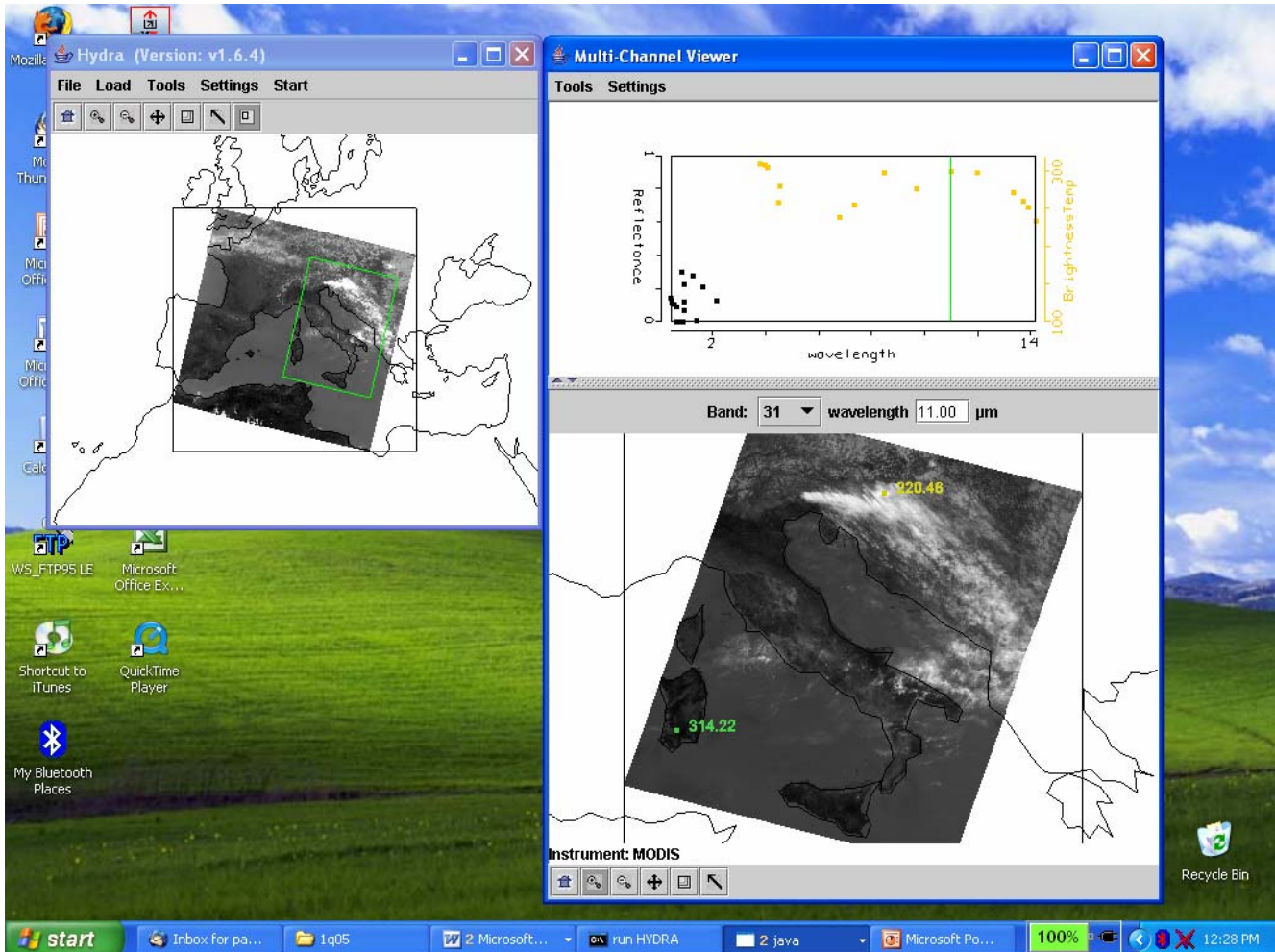


Figure 3: One kilometer resolution data displayed in the Multichannel Viewer window

3. Now select **Band number** 20 (3.8 μm) and display the image. Note how much warmer the 3.8 μm brightness temperatures are than those for 11 μm. What can be responsible for this?

4. Display a **Reference Spectrum** (under **Tools**). Find some locations A and B where the 3.8 μm brightness temperatures are warmer at A but the 11 μm brightness temperatures are warmer at B (see Figure 4). What can be responsible for this? Could this happen at night-time?

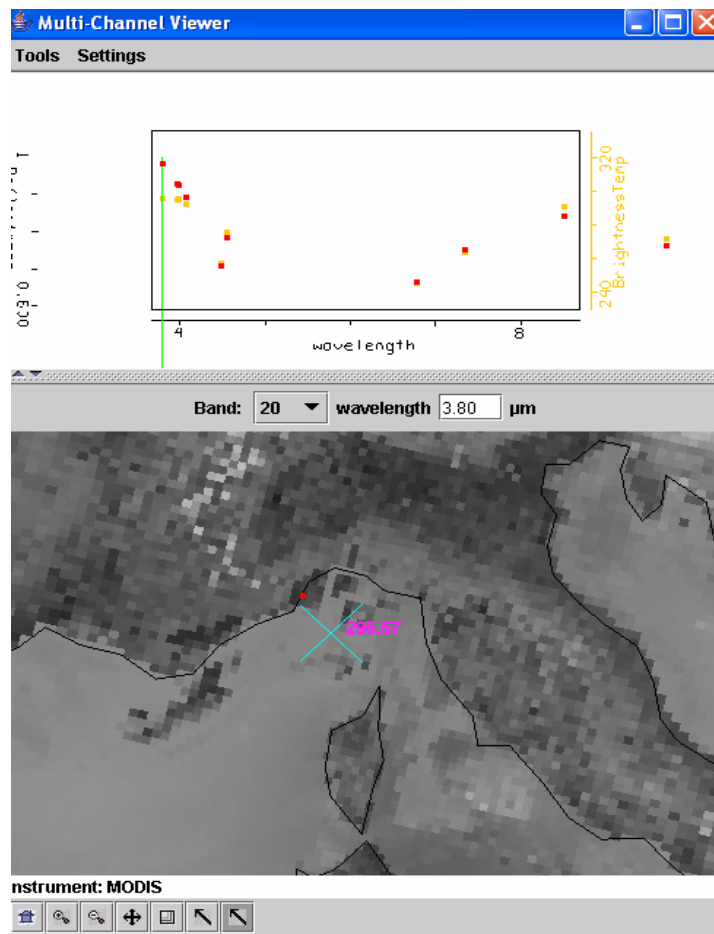


Figure 4: Multichannel Viewer window display of reference spectrum.

5. Display a *Transect* (under *Tools*) in the 3.8 μm image going through clouds, sea, and desert (see Figure 5) . What are the min and max brightness temperatures encountered. Do the same for 11 μm. Discuss the difference.

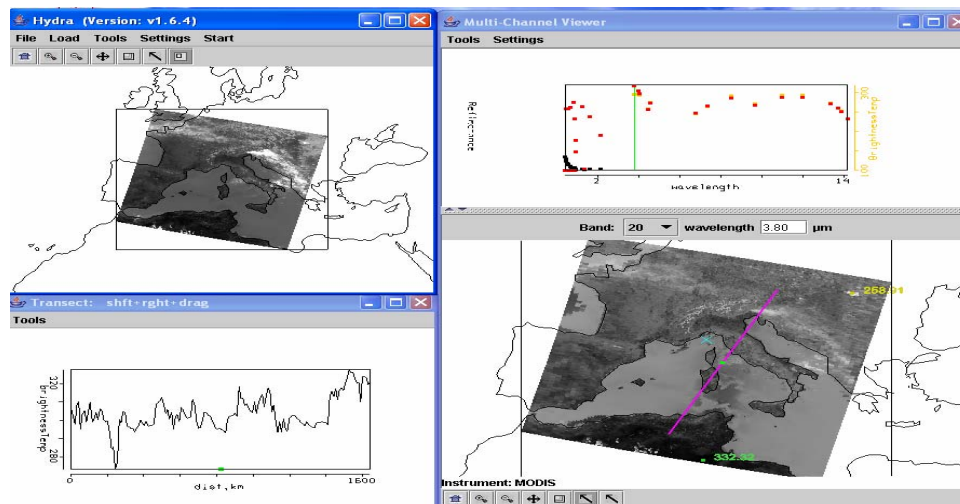


Figure 5: Brightness temperature transect of line displayed in Multichannel Viewer window

6. Open **Linear Combinations** (under **Tools**) and display 0.55 μm reflectances on the y-axis and 11 μm brightness temperatures on the x-axis of a scatter plot. Using the color areas boxes (or curves to encircle areas) to highlight pixels in the scatter plot and find where they are located in the images. Explain high / low reflectances and cold / warm brightness temperature combinations. Construct the same scatter plot with radiances ($\text{W}/\text{ster}/\text{m}^2/\mu\text{m}$) instead of reflectances and brightness temperatures.

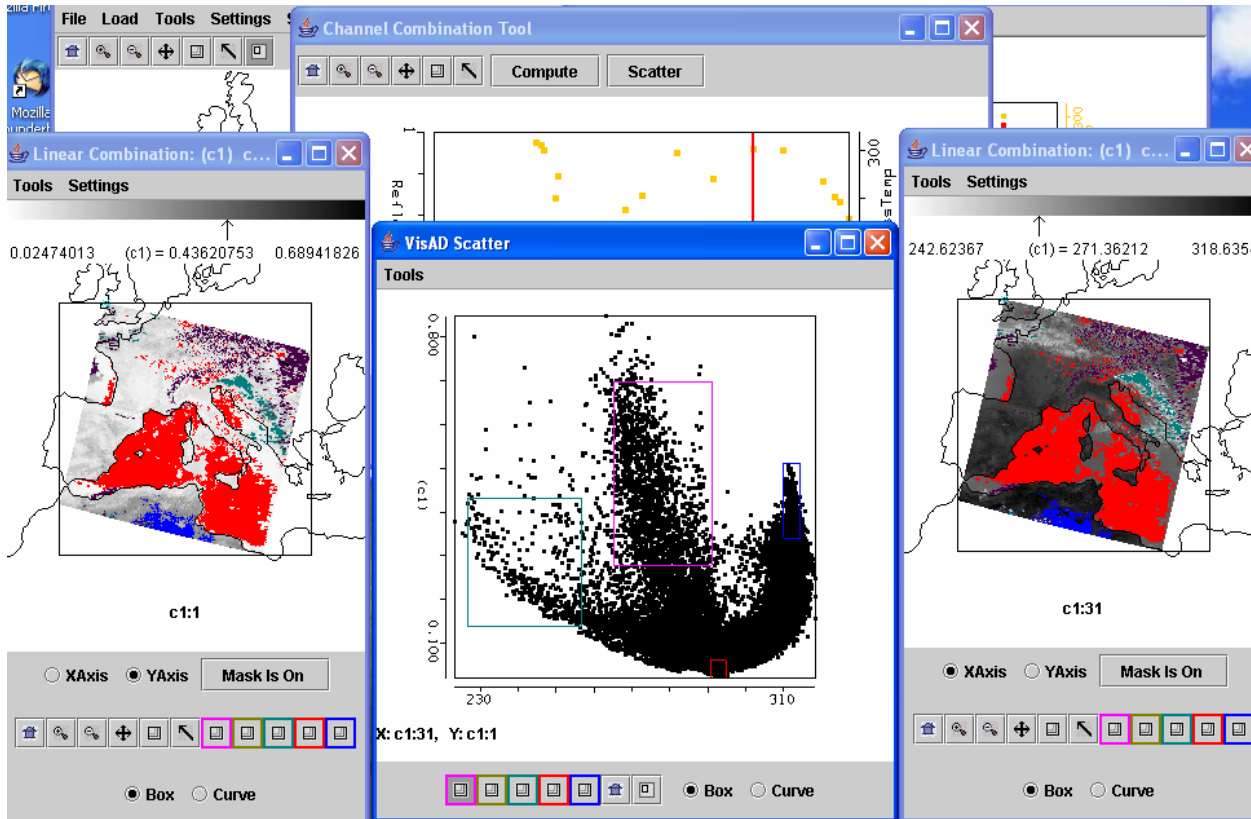


Figure 6: Scatter plot of vis on y-axis and IRW on x-axis

7. Repeat 7. with 4 μm instead of 11 μm .

8. Display the difference of 4 μm minus 11 μm brightness temperatures. What is the range of values for this scene? What is causing the large differences for these two window channels? Explain.

9. With reference to one of the homework questions, consider the following application. An infrared radiometer with 2 spectral bands is viewing a clear field of view (fov). The following table presents wavelength and noise equivalent temperature. The surface temperature is 300 K. A little bit of high opaque cloud at 230 K moves in. How much cloud can be present in the fov (what percentage) and still not be detected (be within instrument noise) for each band? Use B proportional to T^x where $x=c_2/(\lambda T)$.

Band	Wavelength (μm)	NEDT (deg K)
1	4	0.05
2	11	0.05