

**Labs in Madison
Menzel**

Lab 2 - Using HYDRA to Inspect Multispectral Remote Sensing Data

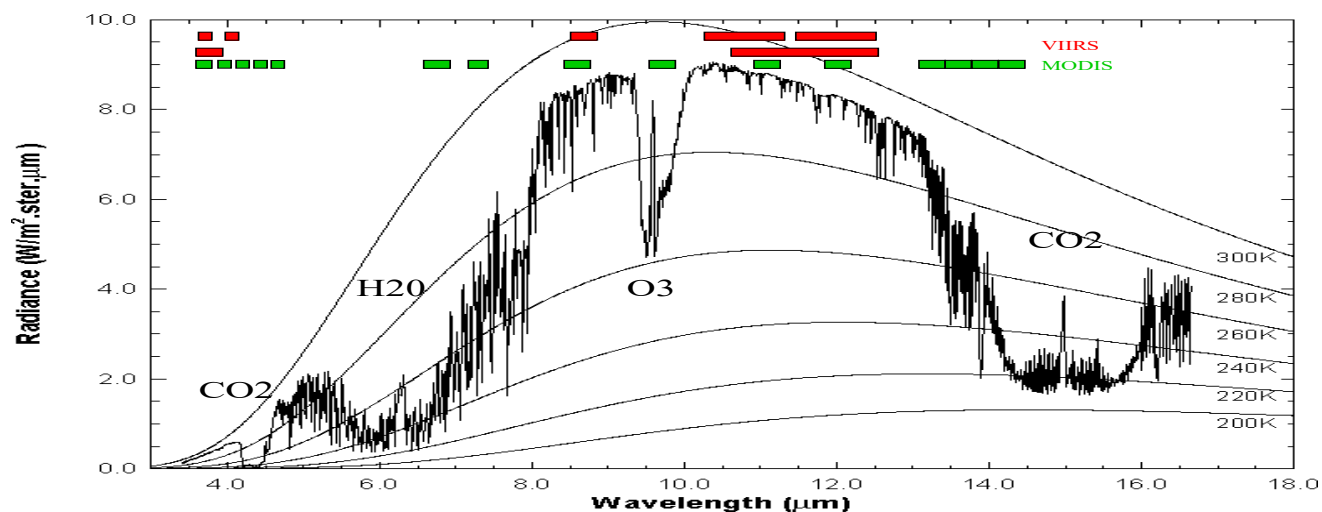
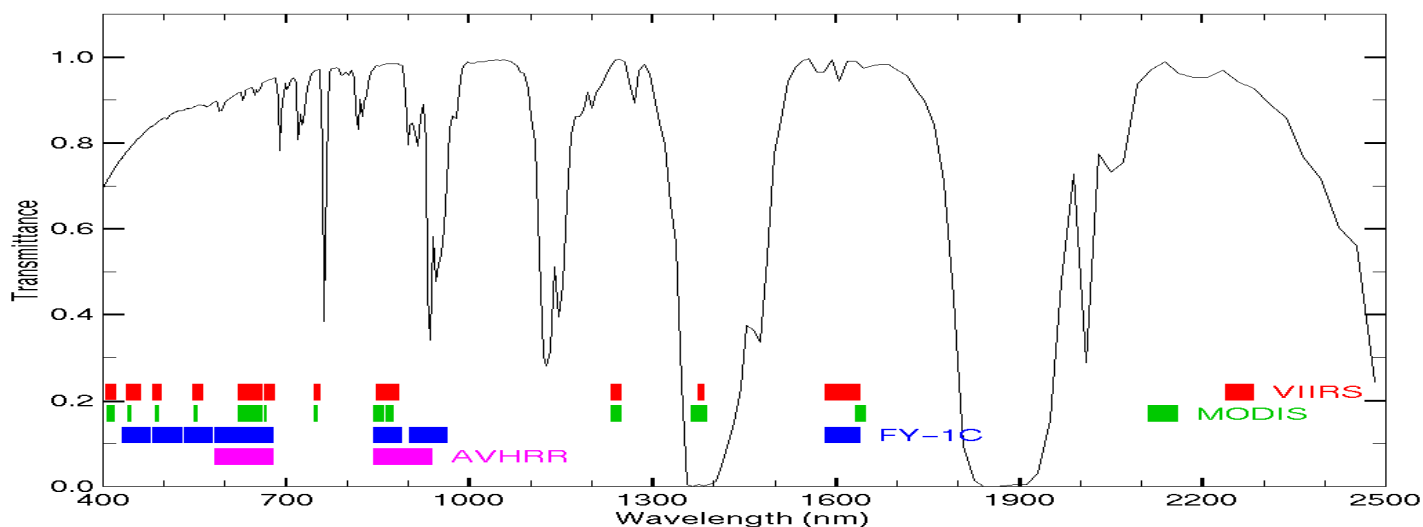
Table 1: VIIRS Bandl Number, Wavelength (μm), and Primary Application

Reflective Bands			Emissive Bands		
M (780 m FOV)					
1,2	0.412, 0.445	ocean color/aerosols	12	3.74	sfc/cld temperature
3,4	0.488, 0.555	“	13	4.05	SST, fires
5-7	0.672, 0.746, 0.865	“	14	8.55	cloud properties
8	1.24	cloud particle size	15	10.8	SST, clouds
9	1.38	thin cirrus	16	12.0	SST, moisture
10	1.61	snow vs cloud			
11	2.25	cloud particle size			
I (390 m FOV)					
1	0.64	imagery	4	3.74	imagery clouds
2	0.86	NDVI	5	11.5	cloud imagery
3	1.61	snow map			

Table 2: Comparable MODIS Bands

MODIS		VIIRS-M	
8, 9	0.415, 0.443	1,2	ocean color
10, 12	0.490, 0.565	3,4	“
14-16	0.681, 0.75, 0.865	5-7	“
5**	1.24	8	cld particle size
26	1.38	9	thin cirrus
6**	1.61	10	snow
7**	2.13	11	cloud properties
20	3.75	12	sfc/cld temp
23	4.05	13	sfc temp
29	8.55	14	sfc/cld temp
31	11.0	15	sfc/cld temp
32	12.0	16	sfc/cld temp
		VIIRS-I	
1*	0.645	1	imagery
2*	0.865	2	“
6**	1.64	3	“
20	3.75	4	“
31	11.0	5	“

* available at 250 m, ** available at 500 m resolution



1. Inspect the scene over Korea on 30 August 2012 detected by VIIRS using HYDRA 2.8.2. After engaging HYDRA, the HYDRA window will appear (Figure 1). Click on File and then on VIIRS directory; guide HYDRA to the file in your data base. When the file is loaded, an image of the 11 micron brightness temperature (BT) of Band M15 appears, as shown in Figure 2.

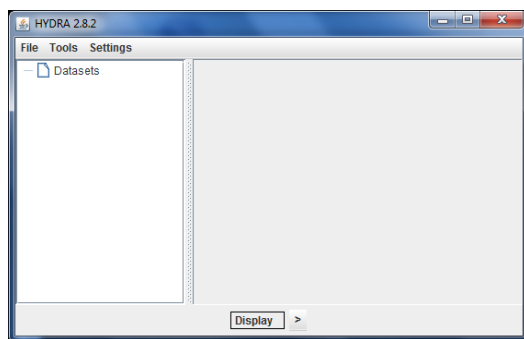


Figure 1: The HYDRA2 window.

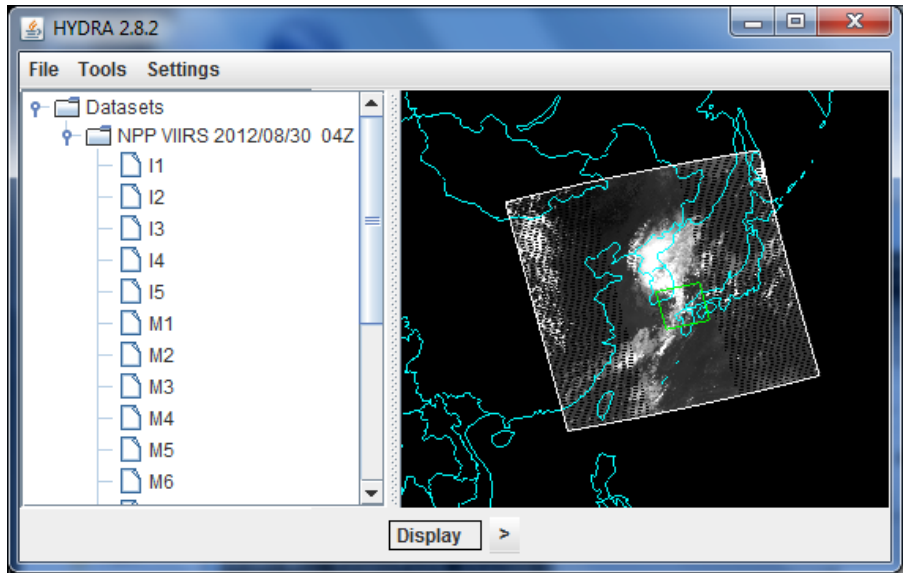


Figure 2: HYDRA window with a VIIRS L1B 1KM file loaded.

2. A subset of the scene is indicated in the HYDRA window. To display the subset data at full resolution (shift left click drag to change from default subset) click on Display and a new window will open as shown in Figure 3.

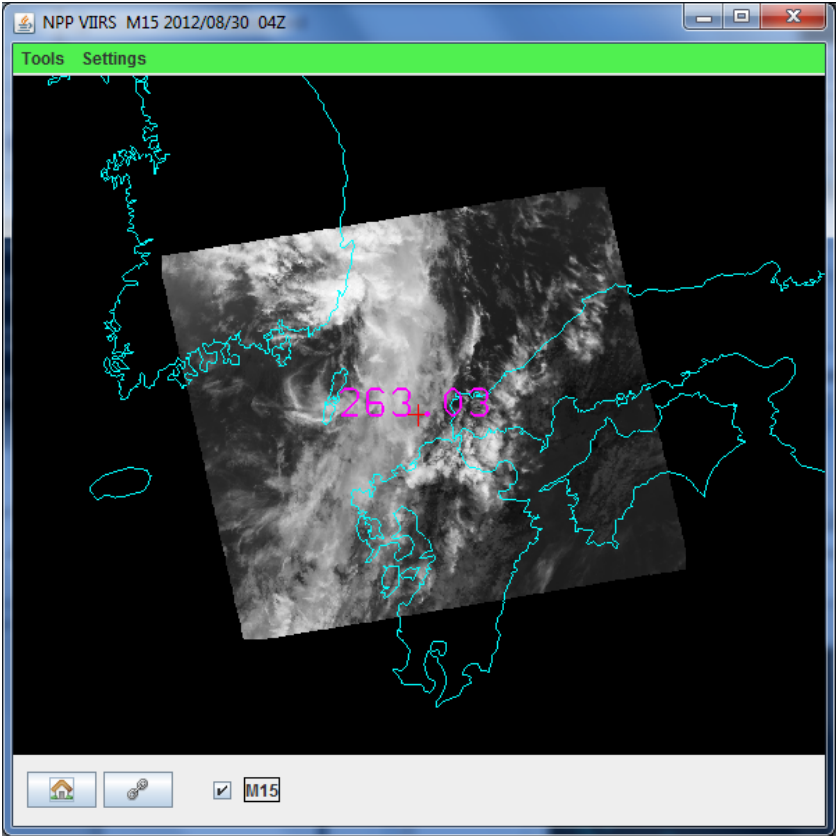


Figure 3. Display window showing VIIRS Band M15 at 780 m resolution

Zoom in (shift right click drag up) on the cloud feature. Explore the BT values in the cloud and in clear sky over the ocean (left click drag on chosen pixel indicated by the plus). What is the change in brightness temperature? Adjust the image range to enhance cold cloud features (click on the spectral band indicator at the bottom of the screen to enable black to white scale adjustment). Now adjust the image range to enhance warm surface features; are there regions in the ocean that are warmer than others.

3. Investigate the infrared window Bands M12 and M15. Note the difference that reflected solar contributions make in Band M12. Explain why sub-pixel cloud features are much colder in Band M15 than in Band M12. Explore the differences using the transect and scatter tools. When finished, close this display.

4. Following the same procedure of step 2, create displays of Band M5 and M7 at 0.65 and 0.86 microns in the northern part of China See Figure 4). Track the reflectance values for vegetated, barren, and cloudy areas in both spectral bands simultaneously. Note the min and max reflectances for both. Under the Tools click on Transect; move the ends of the transect from clear to cloud and note the reflectance change (see Figure 5). Make a ppt of your results.

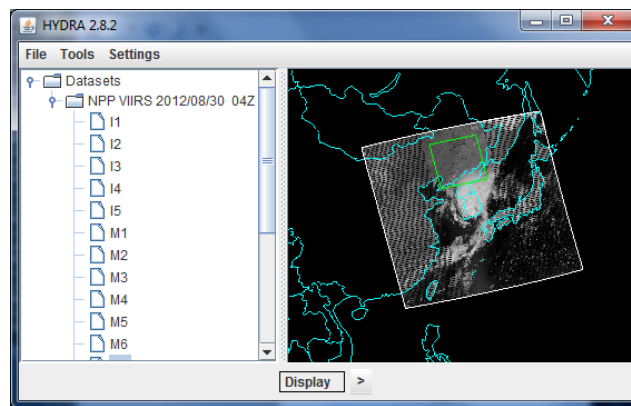


Figure 4: Desert, vegetation, and cloud in northern China

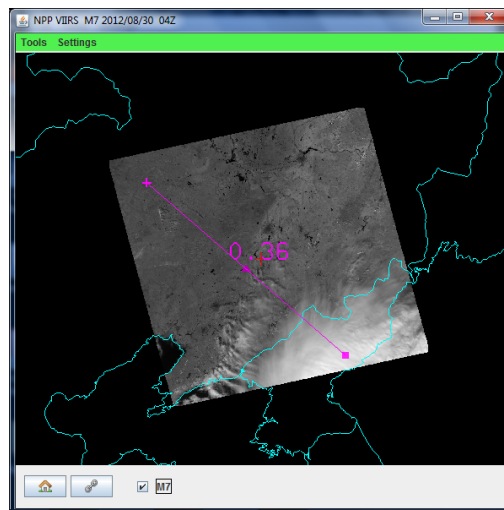


Figure 5: Transect from clear to cloud in northern China.

5. Use **FourChannelCombine** to combine spectral bands M5 and M 7. Explore the vegetation index that is based on the relatively low leaf and grass reflectance from spectral bands below 0.72 μm and relatively high reflectance from spectral bands above.

5a. Construct a pseudo image of normalized vegetation index $\text{NDVI} = [\text{Band M7 } (0.86\mu\text{m}) - \text{Band M5 } (0.65\mu\text{m})] / [\text{Band M7 } (0.86\mu\text{m}) + \text{Band M5 } (0.65\mu\text{m})]$. Can you discriminate regions with some vegetation from those with little? What are the NDVI values in regions without significant vegetation; what are they in vegetated regions? Create a color image of NDVI and save in a ppt slide. Make a transect of BT for Band M15 (11 μm) and NDVI through vegetated to non-vegetated clear skies. Save in a ppt slide and comment on the effect of vegetation on surface temperature.

6. Now focus on the cloud feature in South Korea. Zoom over the cloud in the VIIRS Band M15 image and enhance the cloud features by changing the image range to 210 to 230 C. What are the bright spots in the cloud.

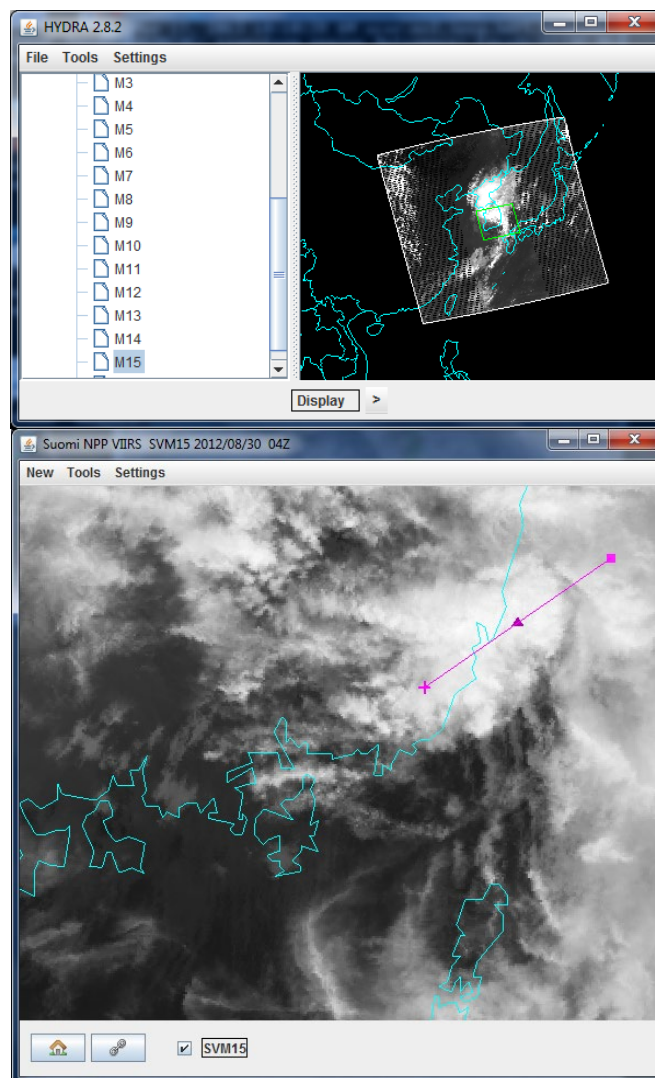
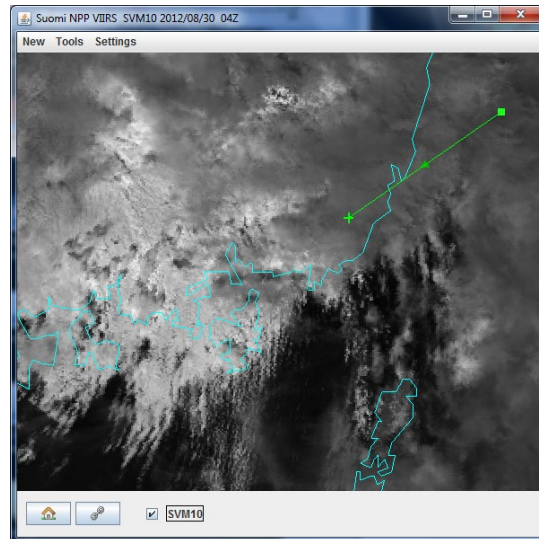


Figure 6: Cloud feature of interest in South Korea.

Load the VIIRS Band M10 for the same region over the cloud and inspect the cold features from Band M15 in the reflectance features of Band M10. Try different enhancement for the Band M10 image. Is the cloud ice or water?



Load Band M9 for the same region. Note the additional details in the cloud structure that are now evident. Can you infer the highest cloud tops?

7. Load the corresponding MODIS data from 30 August 2012 (MYD021KM.A2012243.0440.005.2012243160722.hdf) and stage MODIS Band 31 for comparison with VIIRS Band M15. Note the difference in brightness temperature (BT) for cloudy and clear ocean pixels. Which sensor is seeing warmer BTs? Compare the 11 μm BTs and 0.6 μm reflectances for MODIS and VIIRS transects through the cloud. Which sensor captures the colder features in the clouds? Which sensor sees more reflectance? Look at a transect in both VIIRS and MODIS going across a coastline; note the difference in detail captured. Inspect a scatter plot of the MODIS and VIIRS 11 μm bands. Comment on the inter-calibration. Repeat a few comparisons with VIIRS Band I4 and MODIS Band 31

8. Load the DNB for 26 August 2012. Open a display covering North and South Korea. Enhance the display using gamma 0.3. Zoom and roam to identify sources of night light inland and just off the shore.