VIIRS Labs
Menzel
Lab 1 – Using HYDRA to Inspect Multispectral Remote Sensing Data

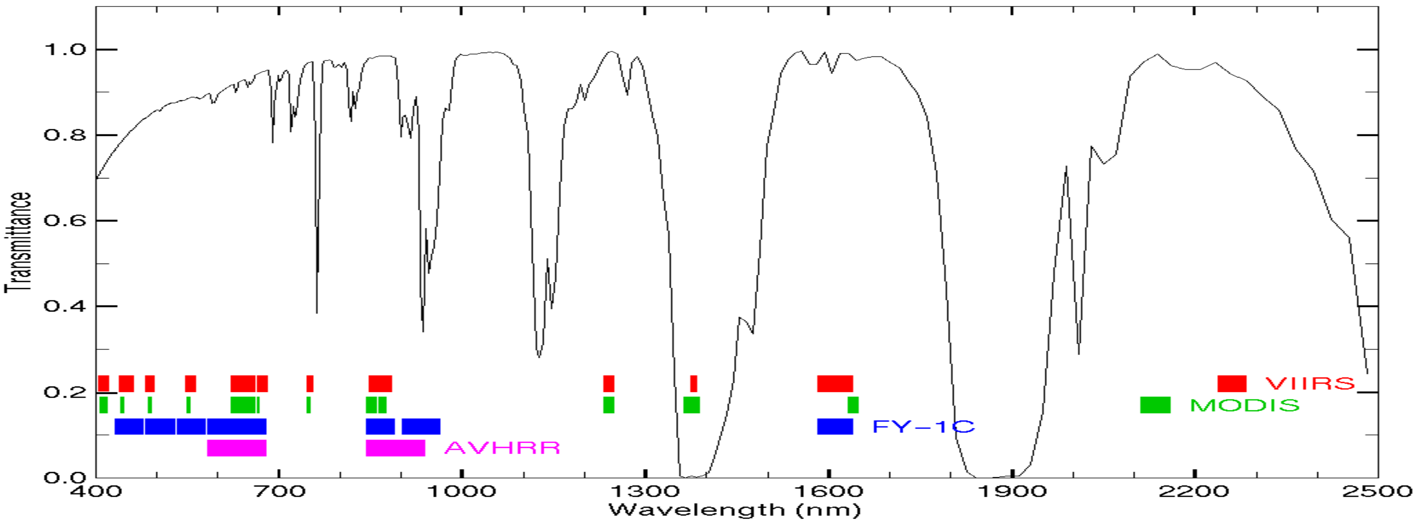
Table 1: VIIRS Channel Number, Wavelength (µm), and Primary Application

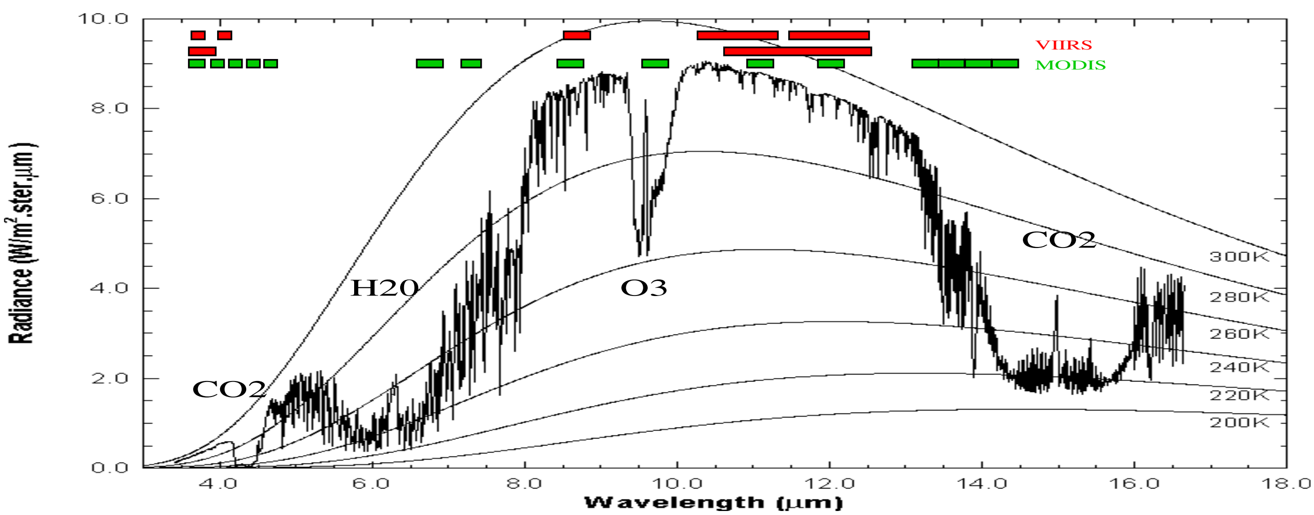
Reflective Bands			Emissive Bands		
M (880 m FOV)					
1,2	0.412, 0.445	ocean color/aerosols	12	3.74	sfc/cld temperature
3,4	0.488, 0.555	"	13	4.05	SST, fires
5-7	0.672, 0.746, 0.865	"	14	8.55	cloud properties
8	1.24	cloud particle size	15	10.8	SST, clouds
9	1.38	thin cirrus	16	12.0	SST, moisture
10	1.61	snow vs cloud			
11	2.25	cloud particle size			
I (440 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 Channels

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 Autralia on 20 January 2012 detected by VIIRS using HYDRA2 (see the attached instruction sheet explaining how to run HYDRA). After engaging HYDRA2, the HYDRA2 window will appear (Figure 1). To open a VIIRS directory, find the selected folder in your data base. When the file is loaded, an image of the 0.412 reflectances of Channel 1 appears, as shown in Figure 2.

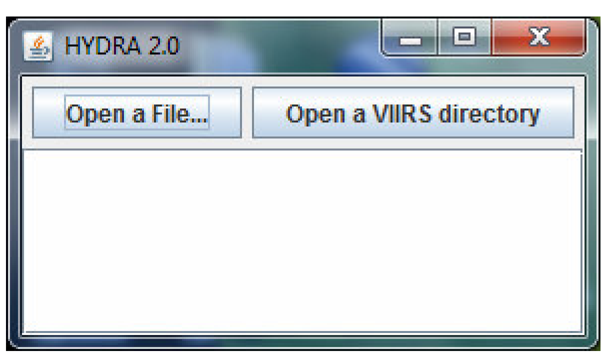


Figure 1: The HYDRA2 window.

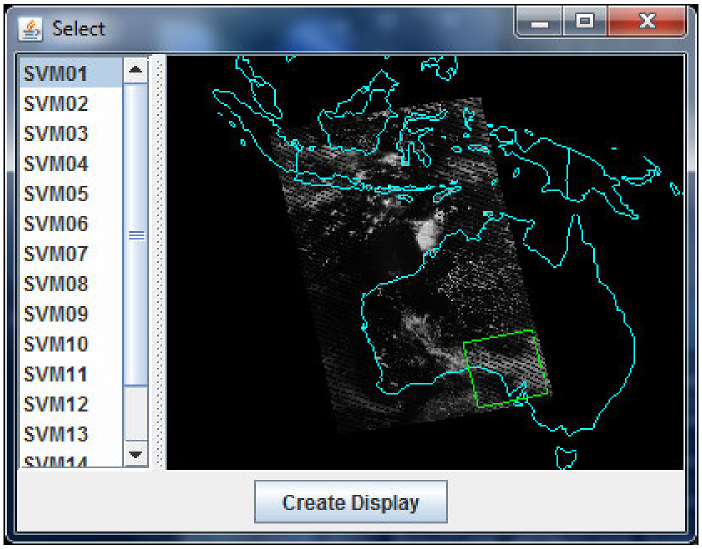


Figure 2: HYDRA window with a VIIRS L1B 1KM file loaded.

2. Select a subset of the scene as indicated in Figure 2 to display the data at full resolution (shift left click drag). Then click on Create Display and the Display window will open as shown in Figure 3.

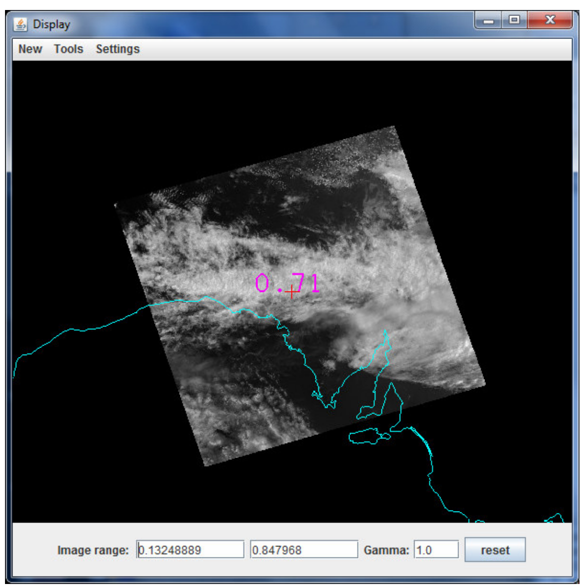
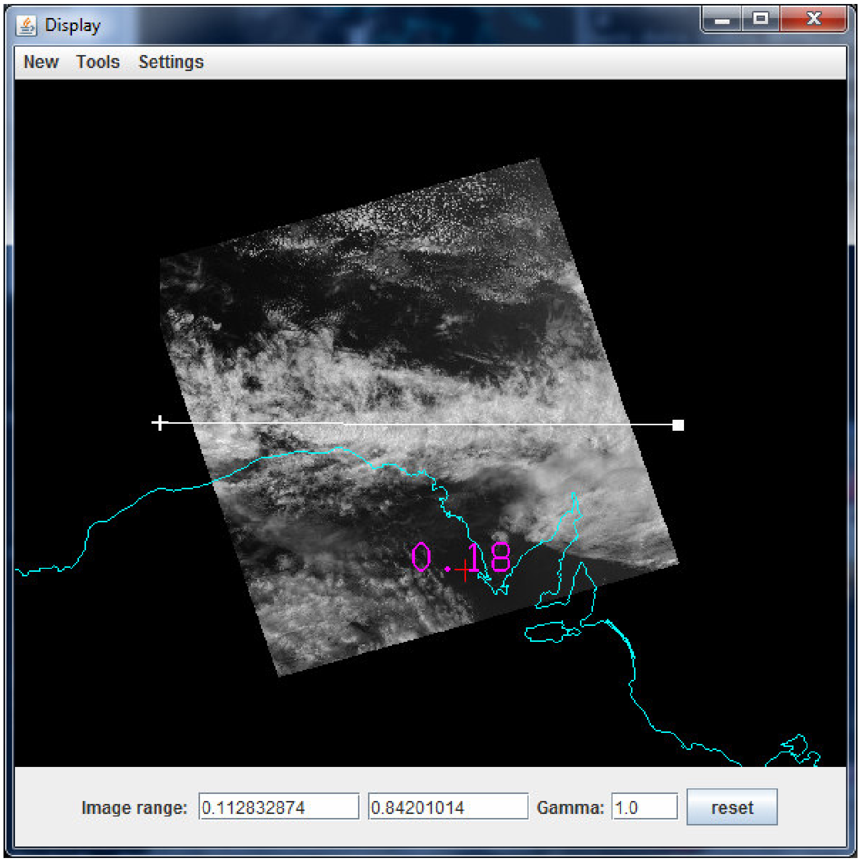


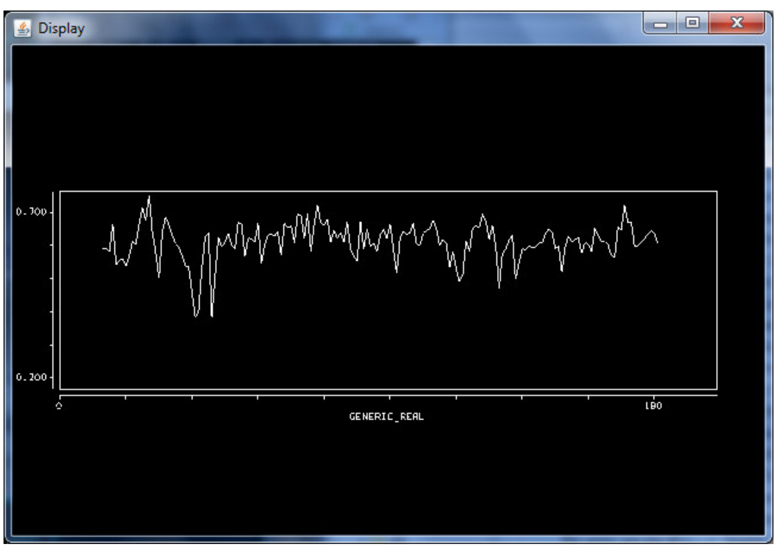
Figure 3. Display window showing VIIRS channel 1 at 880 m resolution

Zoom in (shift right click drag up) on the cloud feature. Explore the reflectance values in the cloud and in clear sky over the ocean (left click drag).

3 Following the same procedure of step 2, create displays of Channel 5 and 7 at 0.65 and 0.86 microns and track the reflectance values for clouds and clear sky in all three channels simultaneously. Record the min and max reflectances for all three.

4. Under the Tools click on Transect. Figure 4 shows the resulting displays. Move the ends of the transect from clear to cloud and note the reflectance change.





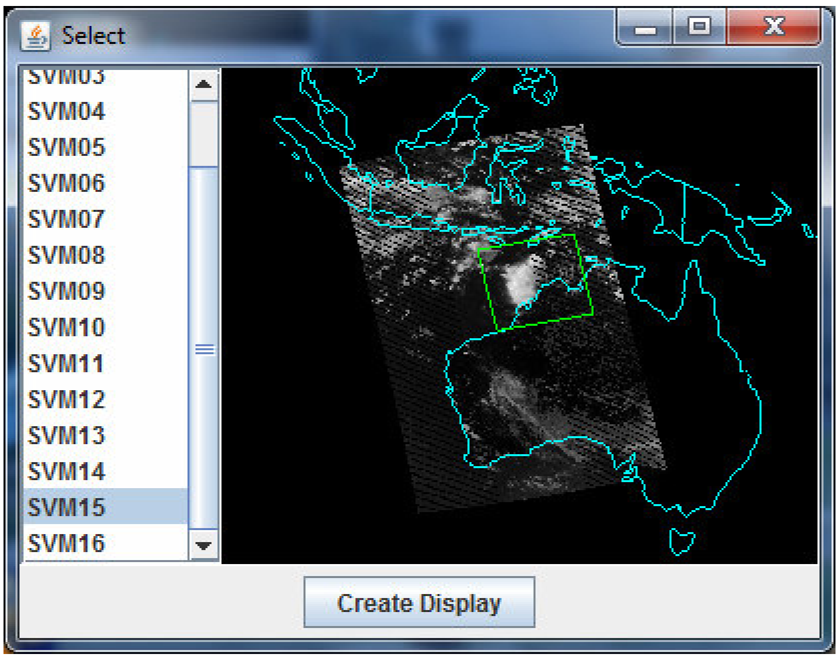
5. Investigate the infrared window Channels 12 and 15. Note the difference that reflected solar contributions make in Channel 12. Explain why sub-pixel cloud features are much colder in Channel 15 than in Channel 12.

6. Load the corresponding MODIS data from 20 January 2012 (MYD021KM.A2012020.0505.005.NRT.hdf) and stage MODIS Channel 31 for comparison with VIIRS channel 15. Note the difference in brightness temperature (BT) for cloudy and clear ocean

pixels. Which sensor is seeing warmer BTs? Estimate a spectral bias adjustment factor that adjusts VIIRS BTs into agreement with MODIS BTs values.

7. Compare the ocean sensing MODIS Channel 8 and VIIRS Channel 1. Estimate a spectral bias adjustment factor that adjusts VIIRS Channel 1 reflectances into agreement with MODIS Channel 8 reflectance values.

8. Select another area including the cloud formation off the northwestern part of Australia in the VIIRS image (indicated below). Load the collocated MODIS data in file (MYD021KM.A2012020.0510.005.NRT.hdf). Compare the 11 um BTs and 0.6 um reflectances for MODIS and VIIRS transects through the cloud. Which sensor captures the colder features in the clouds? Which sensor sees more reflectance? Which sensor saw the clouds first?



Appendix – Summary of HYDRA2 Commands

Shift-left click-drag to highlight subset of image for display

Left click-drag to move cursor within display

Right click-drag to move image within display

Shift-right click-drag to zoom in image within display

SBAF

$$\overline{\rho}_{\lambda(A)} = \frac{\int \rho_\lambda \, RSR_\lambda \, d\lambda}{\int RSR_\lambda \, d\lambda}$$

$$SBAF = \frac{\overline{\rho}_{\lambda(A)}}{\overline{\rho}_{\lambda(B)}} = \frac{\left(\int \rho_\lambda \, RSR_{\lambda(A)} \, d\lambda\right) \,/\, \left(\int RSR_{\lambda(A)} \, d\lambda\right)}{\left(\int \rho_\lambda \, RSR_{\lambda(B)} \, d\lambda\right) \,/\, \left(\int RSR_{\lambda(B)} \, d\lambda\right)}$$

$$\overline{\rho}^{*}{}_{\lambda(A)} = \overline{\rho}_{\lambda(A)} \,/\, SBAF$$

Where

RSR_λ = Relative Spectral Response of the sensor [unitless]

ρ_λ = Hyperspectral TOA reflectance profile [unitless]

$\overline{\rho}_{\lambda(A)}$ = Simulated TOA reflectance for sensor A [unitless]

$\overline{\rho}_{\lambda(B)}$ = Simulated TOA reflectance for sensor B [unitless]

$\overline{\rho}^{*}{}_{\lambda(A)}$ = Compensated TOA reflectance for sensor A using the SBAF to match sensor B TOA [unitless]