

Multispectral investigations of land with MODIS

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 temp
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 temp
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 temp
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

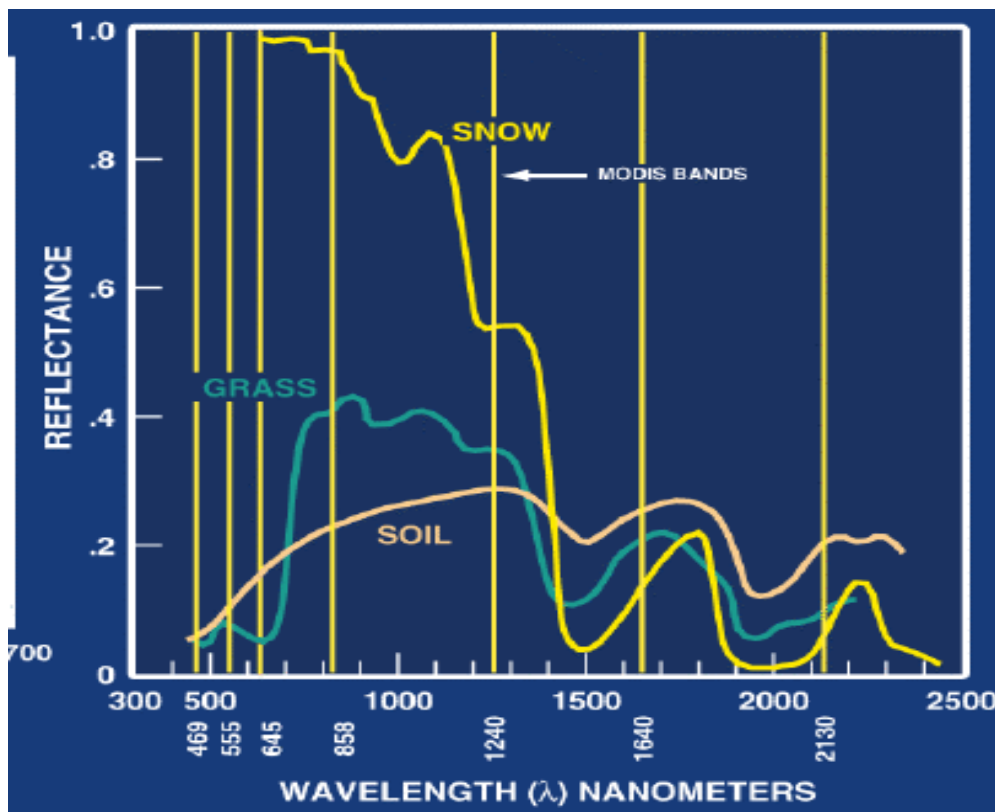


Figure 1: Spectral signatures from land, ocean, and atmosphere

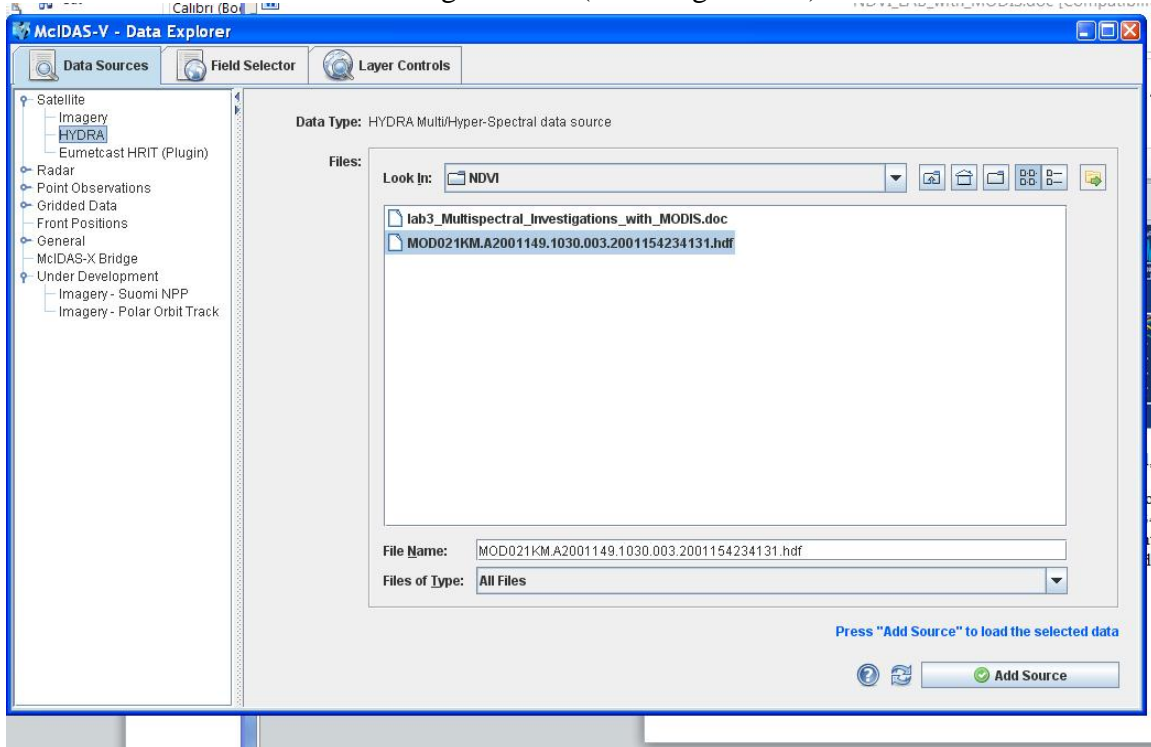
1. Use McIDAS-V to analyze the scene over Italy on 29 May 2001 detected by MODIS (find MOD021KM.A2001149.1030.003.2001154234131.hdf and load it into McIDAS-V). You will then browse through the scene in several different wavelengths in the **Multi-Channel Viewer** window. To load the data:

Data Sources > Satellite > HYDRA

Then Look In: NDVI folder and select

MOD021KM.A2001149.1030.003.2001154234131.hdf

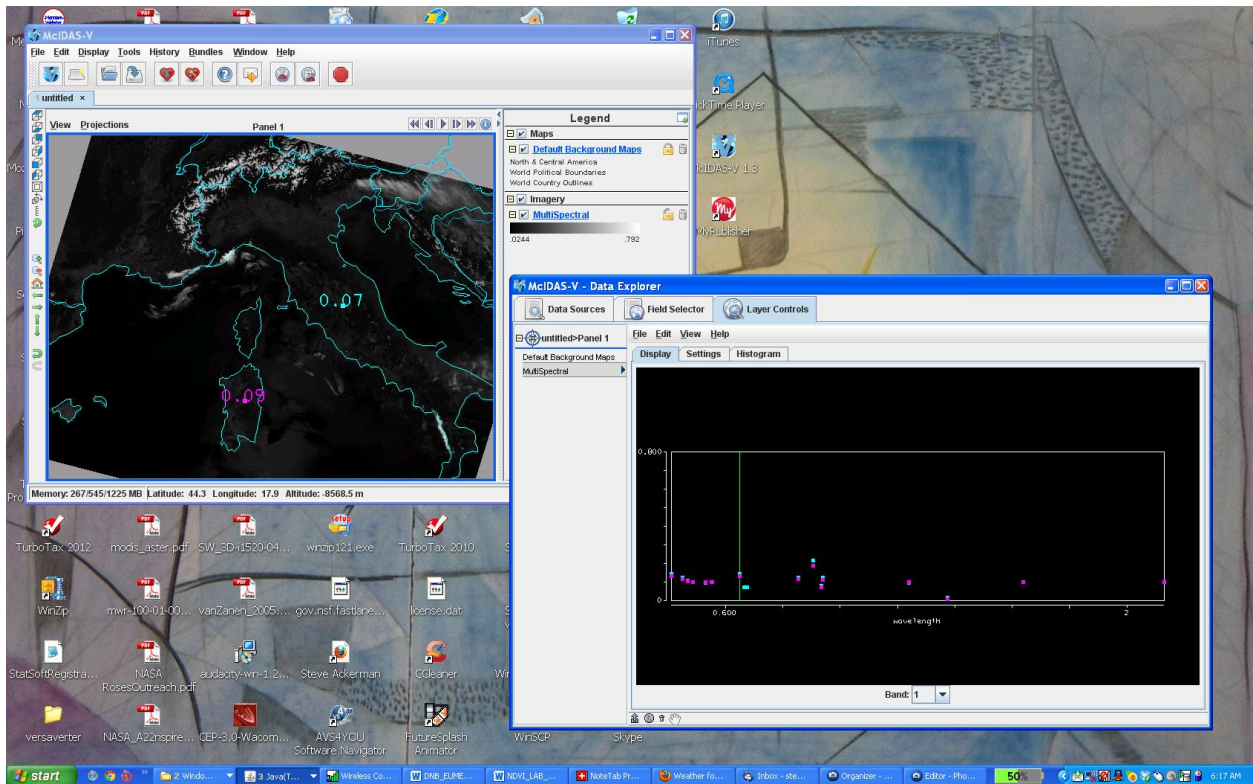
And click **Add Source** in lower right corner (See image below)



Now load the bands, under the field selector, click on the ‘flag’ on **MultiSpectral** and select **Reflective_Bands**, then in the **Displays** window, click the flag on **Imagery** and select **MultiSpectral** Display.

In the image that appears below, select a region that encompasses Italy and the Alps (control and left-mouse button). Then, in the **McIDAS-V –Data Explorer** window, at the top, select the **Layer Controls** tab, and then the **Display** tab. As you select a channel, you will see the image in the **McIDAS-V window** update to display that channel. Find the small box with the number next to it. That number is the reflectance for that spot.

Left click on the square, holding down the mouse button you can now drag it to a new spot. As you move the spot around the image, the spectral reflectance will change. Another color box will appear, you can move that one too to compare the spectral reflectance of different regions.



1a. Verify that the surface features are distinguishable in the infrared window channels while in the infrared absorption channels they are not.

1b. Look at clouds, ocean, and vegetated surfaces in different reflective bands. For each type describe the changes in reflectance for different channels (panel of Multi-channel viewer window).

1c. Demonstrate some of the spectral signatures indicated in Figure 1. In each case identify which spectral signature you are demonstrating.

- i. Look at snow in the Alps in 0.65 and 1.6 μm .
- ii. Look at clouds and vegetation in northern Italy in 0.65 and 0.86 μm .
- iii. Look at near shore waters in 0.55 and 0.45 μm .

In the Edit tab in the **McIDAS-V** window, click **Edit** -> **remove** -> **all Layers and Data Sources**

Then in the **McIDAS-V – Data Explorer** window, Select **Satellite, HYDRA** and the **MOD021KM...** Data set again, and hit **Add Source**.

2. Use **Linear Combination** to stage 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.

To compute the NDVI, first load the data again,

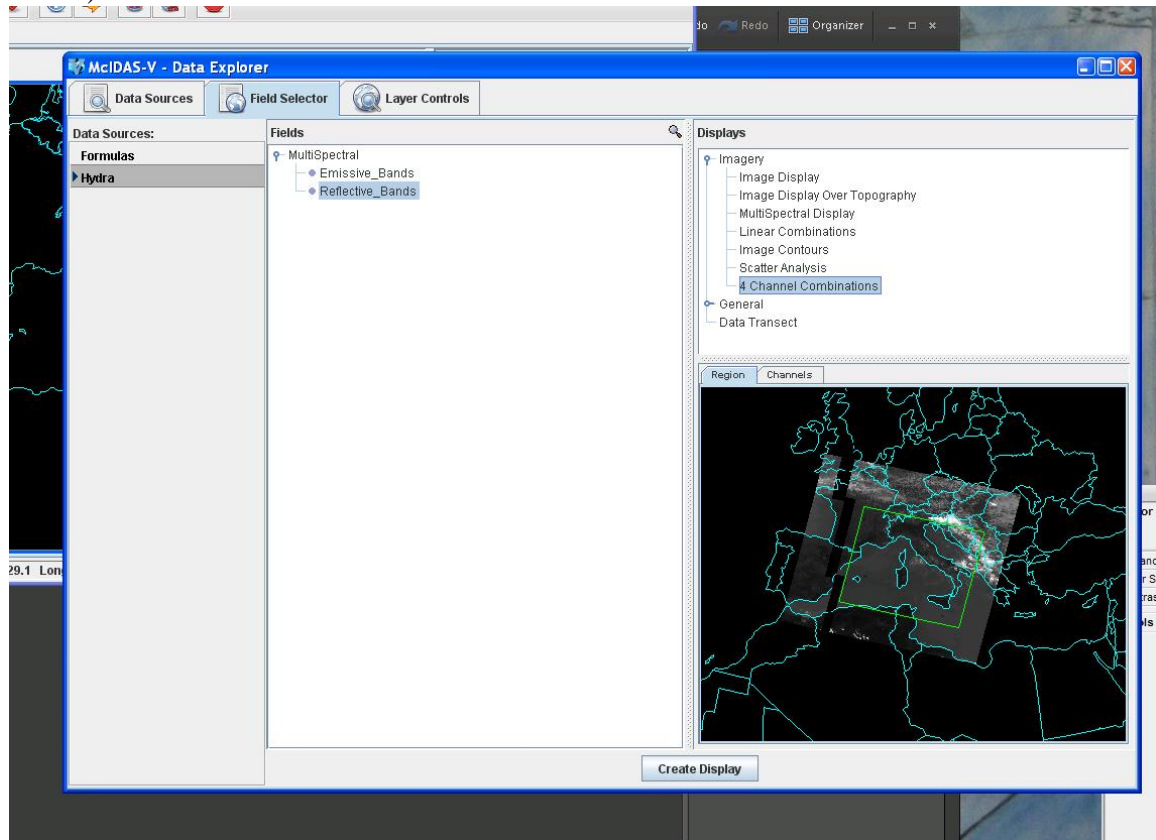
Data Sources > Satellite > HYDRA

Then Look In: NDVI folder and select

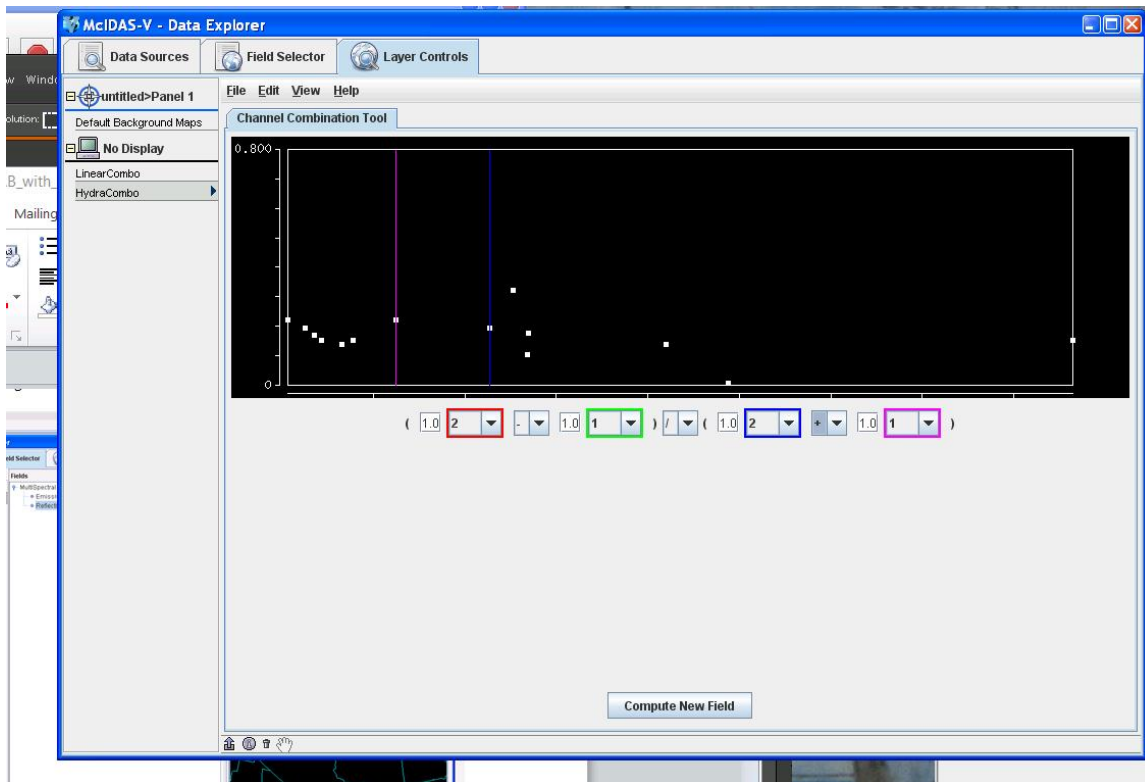
MOD021KM.A2001149.1030.003.2001154234131.hdf

And click Add Source in lower right corner (See image below)

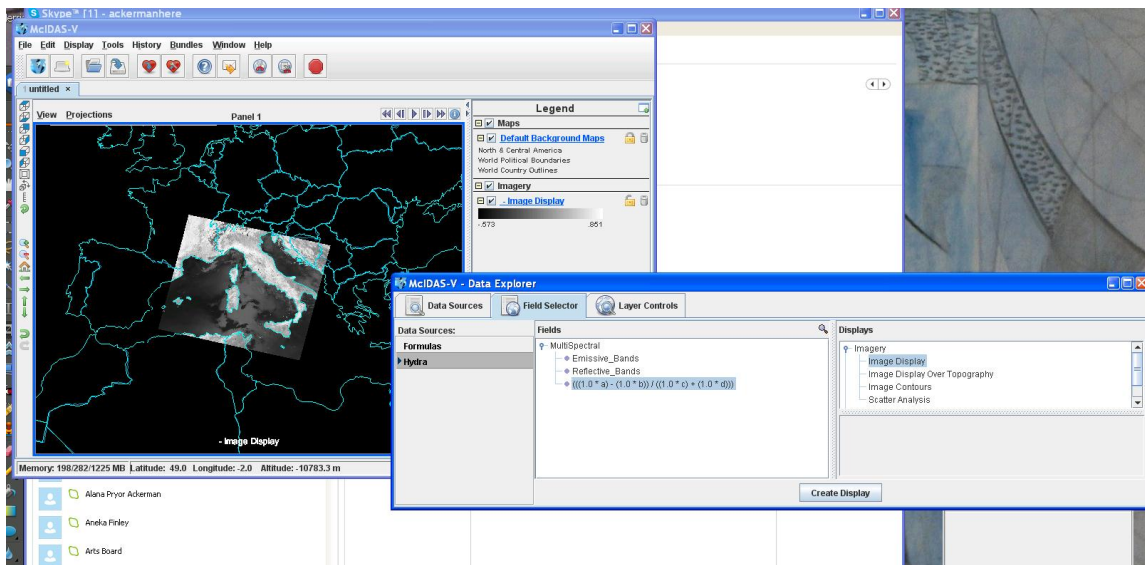
In the **McIDAS-V Data Explorer** window, highlight **Hydra**, click on the **MultiSpectral** flag and highlight **Reflective Bands**, then in the display wind, select **Linear Combinations**. Using **Shift-mouse_left_button** select a region to zoom in on, (see below)



When you hit **Create Display** Button in the bottom of the window, you will get an option to select channels to make a normalized index,



Once you enter your formulae, click on the **Compute New Field** button. Then, in the **McIDAS-V – Data Explorer** window, in the **Field Selector** tab, you will see a formula, click that and make sure **Image Display** is highlighted under **Imagery** in the **Displays** window, and an NDVI image will be generated.



2a. Construct a pseudo image of normalized vegetation index $NDVI = [Band\ 2\ (0.86\mu m) - Band\ 1\ (0.65\mu m)] / [Band\ 2\ (0.86\mu m) + Band\ 1\ (0.65\mu m)]$. **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?** If you

press down on both mouse buttons (or the middle button) and roam the image, you will get a read out of the values in the image. Create a color image of NDVI.

Left click on the color legend bar, select **satellite**, select **GOES**, and select **NDVI**. (later you can pick a pretty, colorful one)

Can you find the city of Rome?

3. Let's try another index, called the Normalized Difference Snow Index (NDSI). Select from the McIDAS-V Data Explorer window:

First, determine what spectral channels you want to use in your NDSI.

Field Selector - > **Reflective_Bands** -> **4 Channel Combination** to combine spectral bands that can be used to detect clouds from snow (see figure 1).

$$[\text{Band A} - \text{Band B}] / [\text{Band A} + \text{Band B}]$$

What are values of NDSI for snow regions?

What are values of NDSI for water bodies?

What are values of NDSI for vegetation?