

Lab 1b - Multi-spectral Surface, Dust, and Ash Properties

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

Table: Summary of Hydra Commands

Hydra menu

Displays world map with image control functions indicated on the bottom

Reset

Zoom in (left click plus drag)

Zoom out (left click plus drag)

Rubber band zoom (left click plus drag to create box for enlargement)

Translate (left click plus drag)

Pick image (left click plus drag displays location of the chosen pixel)

Subset image (left click plus drag to create subset of image; this is automatically transferred from Hydra into the Multichannel viewer when both are engaged)

Also shows menus for **Data**, **Settings**, and **Start** at top

Data menu:

Local allows you to scroll through local directories to find data

Remote allows you to find an AIRS granule from a remote server (a) MODIS Direct Broadcast or
 (b) Goddard DAAC

Exit

After a MODIS or AIRS granule is selected hydra displays the infrared window on a world map

Settings menu

Set color range (left click shows VisAD histogram – color range can be altered with
 a right click plus drag at either end of the color scale)

Set color scale gives choice of color, grey, or inverse grey (which produces white clouds)

Start opens **Multichannel Viewer**

wherein a spectra (wavenumber on x-axis and radiance on y-axis) is displayed along with a spectral band superimposed on a world map. Left click on pick image in bottom tool bar the allows you to see the pixel value for a given lat-lon (using left click and drag)

Tools menu

Linear Combinations opens channel combination tool display where you can specify
 linear combinations of spectral bands a,b,c and d

(a ±×÷ b) ±×÷ (c ±×÷ d)

Compute creates an image of the selected linear combination (indicate at the

bottom preference for this linear combination to be x- or y-axis in the scatter plot)

Scatter allows you to create a scatter plot of the chosen x- and y-axis linear combinations. Five color area boxes (or area curves) can be initiated at the bottom of the scatter plot; a left click drag in the scatter plot highlights the chosen points in the scatter plot and simultaneously in the x- and y-axis images. Conversely left click drag in the x- or y- axis images shows the locations of the chosen pixels in the scatter plot. Each color area box (or area curve) can be erased with a left click when the color box is engaged; after erasure another area box (or area curve) can be selected for this color.

Transect allows you to create a line on the image and see the temperatures or radiances of the transect. This is enabled with a left click drag.

Capture Display makes jpeg in location you specify

Statistics allows you to display min and max values and locations on image (toggle on or off)

Settings menu

Set color range opens VISAD histogram of brightness temperature (BT) values

Radiance – BT allows you to select radiance or brightness temperature in the display

Projection allows you to put the data in a given projection (mercator is the default)

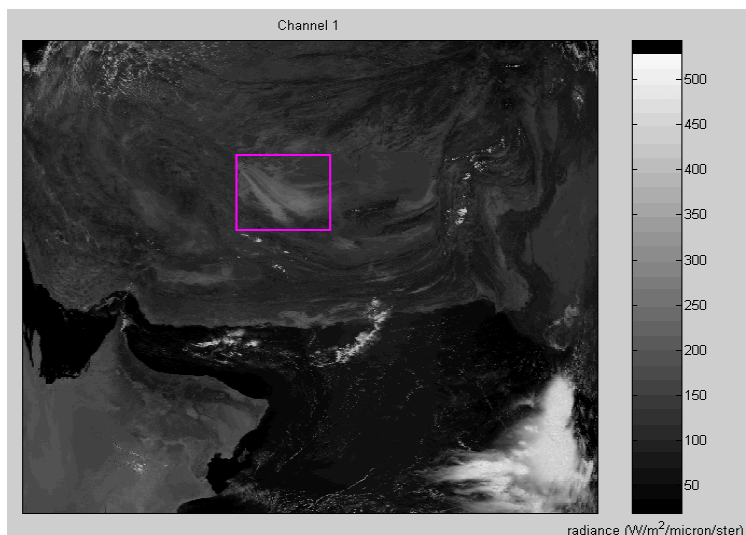
Set Color Scale gives you the choice of color, grey, or inverted grey

Exercise 5 - NDVI

In the Hydra main menu load MODIS data over Italy on 29 May 2001 found in MOD021KM.A2001149.1030.003.2001154234131.hdf. Explore the vegetation index that is based on the relatively low leaf and grass reflectance from spectral bands below $0.72 \mu\text{m}$ and relatively high reflectance from spectral bands above. Construct a pseudo image of normalized vegetation index $[\text{band } 2 (0.86\mu\text{m}) - \text{band } 1 (0.65\mu\text{m})] / [\text{band } 2 (0.86\mu\text{m}) + \text{band } 1 (0.65\mu\text{m})]$. 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?

Exercise 6 – Dust Storm

In the Hydra main menu load MOD021KM.A2001162.0645.003.2001167183512.hdf. This shows a dust storm over Iran. Highlight the approximate region of the dust storm (see below):

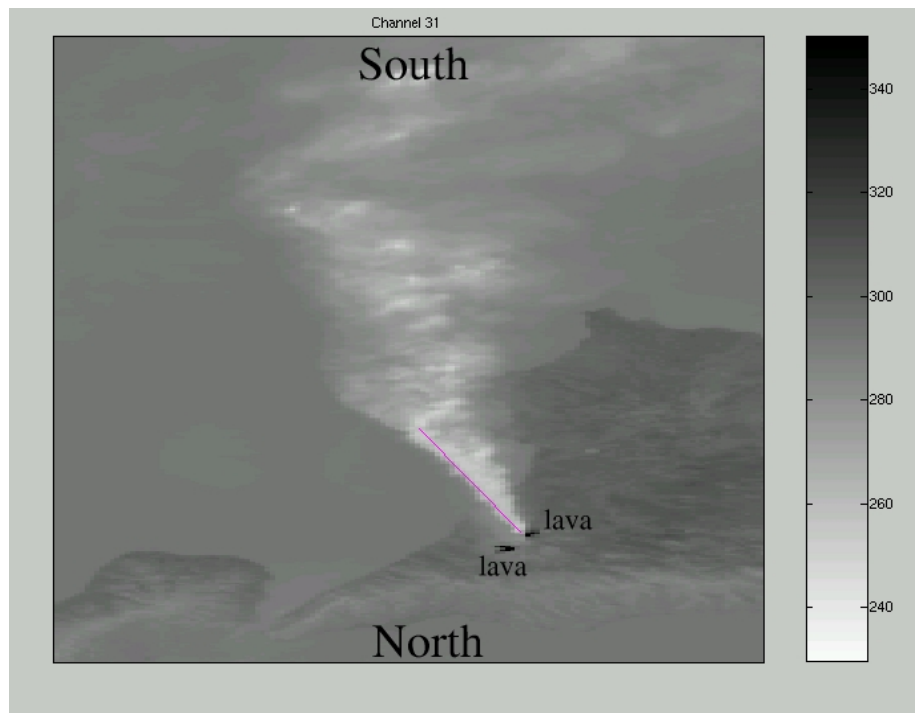


Dust scene over Iran.

Plot Band 31 (11 μm) on the x-axis and [Band 31 (11 μm) minus Band 32 (12 μm)] on the y-axis and show the scatter plot. Repeat with Band 31 (11 μm) on the x-axis and [Band 29 (8.6 μm) minus Band 31 (11 μm)] on the y-axis. Which brightness temperature differences show a larger range of values? How does this compare to the same plots in clouds? Do you think you can distinguish dust storms from clouds using these channels?

Exercise 7 – Volcanic Ash

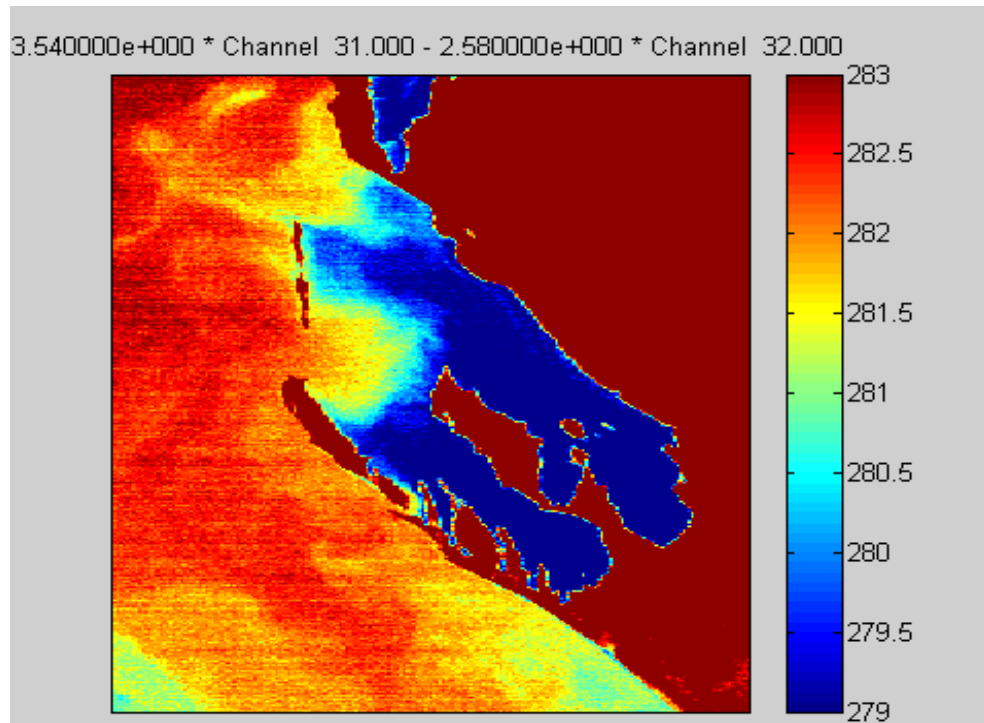
In the Hydra main menu load MODIS measurements of a volcanic eruption of Mt Etna on 28 October 2002 (MOD021KM.A2002301.1215.003.2002302200901.hdf). Select Region to focus on the eruption (see below). Plot Band 31 (11 μm) on the x-axis and [Band 31 (11 μm) minus Band 32 (12 μm)] on the y-axis and show the scatter plot. Convince yourself that the volcanic ash produces negative temperature differences (between 0 and –6 C) in the split window; the denser ash produces the larger differences.



Mt Etna Eruption

Exercise 8 – SST and Chlorophyll

In the Hydra main menu load MODIS measurements of Western Australia on 19 August 2000 (MOD021KM.A2000232.0300.004.2002365101900.hdf). Focusing on the Shark Bay region (see below) construct a pseudo image of the sea surface temperature derived from the split window band 31 (11 μm) and band 32 (12 μm). It should be obvious that the waters within Shark Bay are much cooler than the Leeuwin current waters along the WA coastline. Now construct a scatter plot of band 31 (11 μm) on the x-axis and (band 9 (0.44 μm) / band 12 (0.57 μm)) on the y-axis. Band 9 has relatively high and band 12 has relatively low water absorption for chlorophyll; the low ratio values are an indication of chlorophyll concentrations. How does the chlorophyll correlate with SST?



Shark Bay SST

The spectral absorbancy of chlorophyll is shown in the figure below. Design a three channel remote sensing radiometer that can distinguish between chlorophyll a and b concentrations in the water. Explain your channel choices and outline the your chlorophyll index algorithm.

