



Microwave Imagery

An Introduction using HYDRA2

Laboratory Exercise, GUAM WFO April 2018

Jordan Gerth, Liam Gumley, Derrick Herndon,
Scott Lindstrom, Kathy Strabala



Cooperative Institute for Meteorological Satellite Studies
(CIMSS) at UW-Madison

You have learned about the Microwave Imagery that is streaming to you AWIPS via the Direct Broadcast antenna. This lab will help you understand the differences between channels, with a principal focus on the ~35 Ghz and ~80 Ghz bands that are part of the MiRS (The operational Microwave Integrated Retrieval System) package.

The software package we are using, HYDRA2 (HYperspectral data viewer for Development of Research Applications), was developed at CIMSS to explore data from Polar Orbiting satellites. You used HYDRA2 yesterday in your labs.

Your first task is to load up ATMS data at 4 different times that include Typhoon Jelawat at different strengths. These times are 0421 UTC and 1655 UTC on 29 March 2018, and at 0402 UTC and 1636 UTC on 30 March 2018. Ask your instructors where these data sit on the machine you are using for this Laboratory exercise. Once the datasets are loaded, your initial HYDRA2 window should resemble Figure 1, below. The first thing to do is to highlight each Dataset, and then create a Display to work with. You will end up with four separate Displays, then, as shown and described in Figure 2. Figure 3 shows AWIPS displays of VIIRS 11.45 μm imagery (and ATMS Channels and derived rain rate) from the same time.

After creating the displays, change the default greyscale enhancement to Heat, or Rainbow. These are my two preferred enhancements because warmer temperatures are red and colder temperatures are blue, which seems more natural to me. If you want, choose a different enhancement.

Most of the work in this Laboratory Exercise will consider Ch 2 and Ch 16 from ATMS. The observation frequencies are 31.4 and 88.2 Ghz. These data are also available in your AWIPS – but (and this is important): HYDRA data from this lab is not parallax corrected, but they are parallax corrected in

AWIPS. That means you do not have cooler temperatures near the edge in AWIPS like you do with the imagery (at some frequencies it's more noticeable than others) in this laboratory exercise.

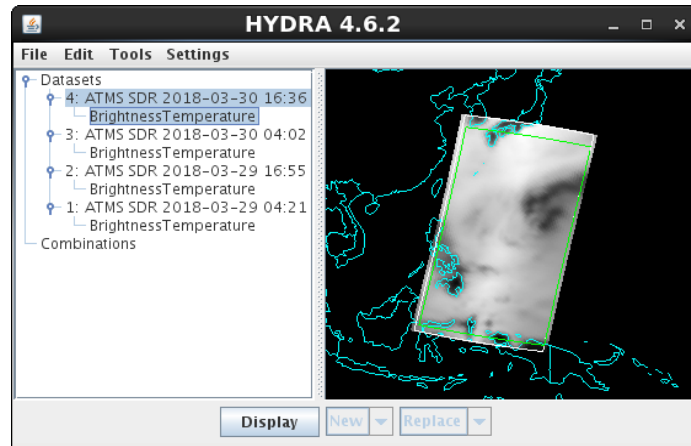


Figure 1: HYDRA window after loading ATMS data from four different Suomi NPP overpasses

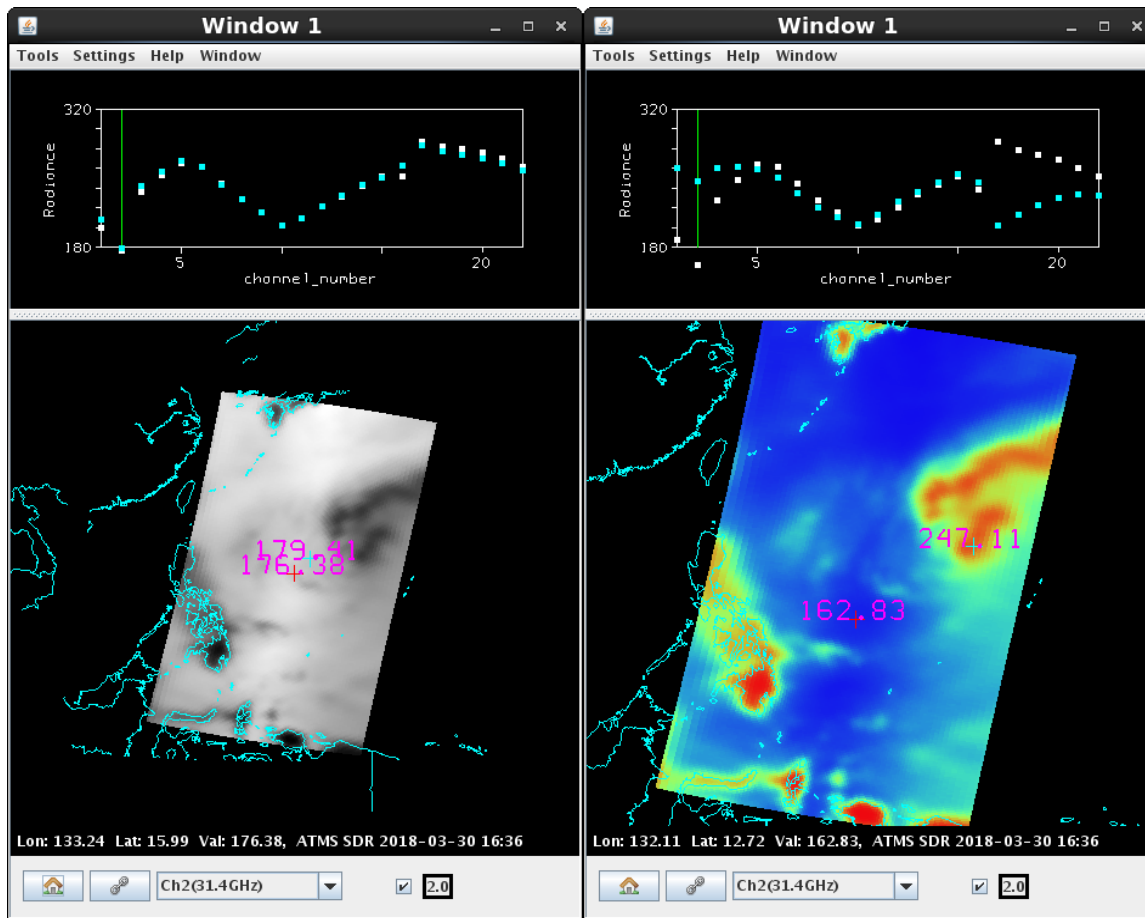


Figure 2: ATMS Display – default (left) and color-enhanced (right) – from 1636 UTC on 30 March

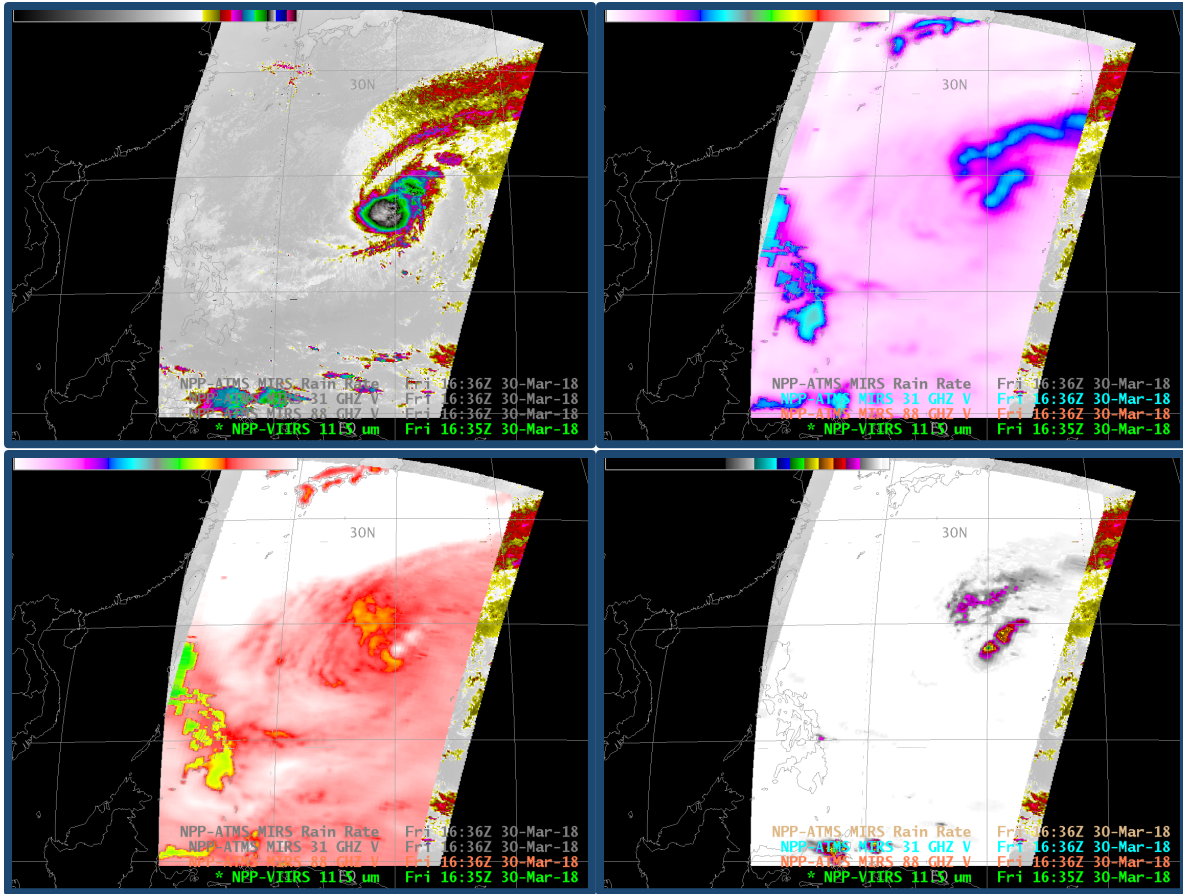


Figure 3: Suomi NPP VIIRS Imagery (11.45μm, upper left), ATMS Imagery (31 Ghz, upper right; 88 Ghz, lower left), MiRS Rain Rate, all from 1635 UTC on 30 March 2018

1. Find the warmest and coolest brightness temperatures in these microwave images, all 4 of them. What can you say about the character of the emitting surface? (Note: The Min/Max tool in HYDRA2 might be helpful here!)

Time of Image (Ch Frequency)	Warmest Temperature		Character of warm surface		Coldest temperature		Character of cold surface	
	31.4	88.2	31.4	88.2	31.4	88.2	31.4	88.2
0421 UTC/29 Mar								
1655 UTC/29 Mar								
0402 UTC/30 Mar								
1636 UTC/30 Mar								

2. Are there any day/night differences that are obvious between the 04z and 16z imagery?

3. As you step through the Channels 1-16, do you see any obvious resolution differences? Low frequency channels are less energetic than high frequency channels. You can use the transect tool to estimate pixel size if you wish. And you can zoom in to pixel resolution as well.

4. For three of the four images, look at the center of Jelawat at 31.4 and at 88.2 Ghz. Are the centers overlapping? If there is a shift in parallax, this could arise from either a sheared system, or from parallax shifts in the view. Parallax is most important as you move away from satellite nadir.

In the next section of this lab, you'll be using HYDRA2 to compare regions of the plots in the two channels, 2 (31.4 Ghz) and 16 (88.2 Ghz). You can do this at more than one time too, during different phases of Typhoon Jelaneke's lifecycle.

Close all Display Windows – but keep the main HYDRA window (as shown in Figure 1) open. Choose the time you wish to investigate, and click on the 'Display' Button. 'Window 1' will appear on your Computer screen. Choose Ch2 (31.4 Ghz) for this window (it might load as that), and change the color enhancement to 'Heat'. Go back to the HYDRA window and click on the 'Display' Button again. This will open up 'Window 2', and you can change the display to 'Ch16(88.2 Ghz)' and also change the color enhancement to 'Heat'.

Under 'Tools' in Window 1, select 'Scatter'. Next, under 'Tools' in Window 2, also select 'Scatter'. You will end up with a plot that looks like Figure 4, below.

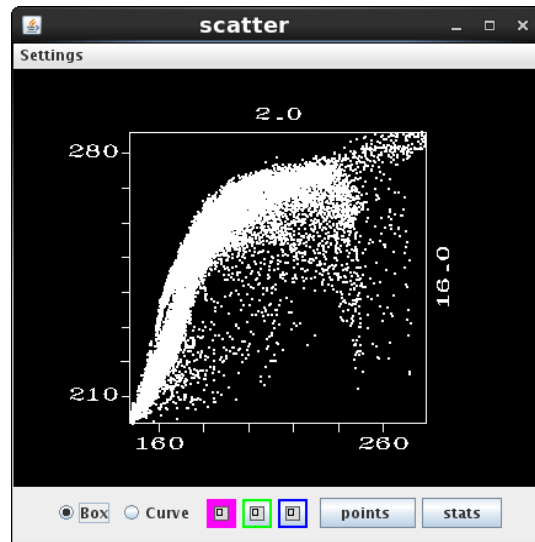
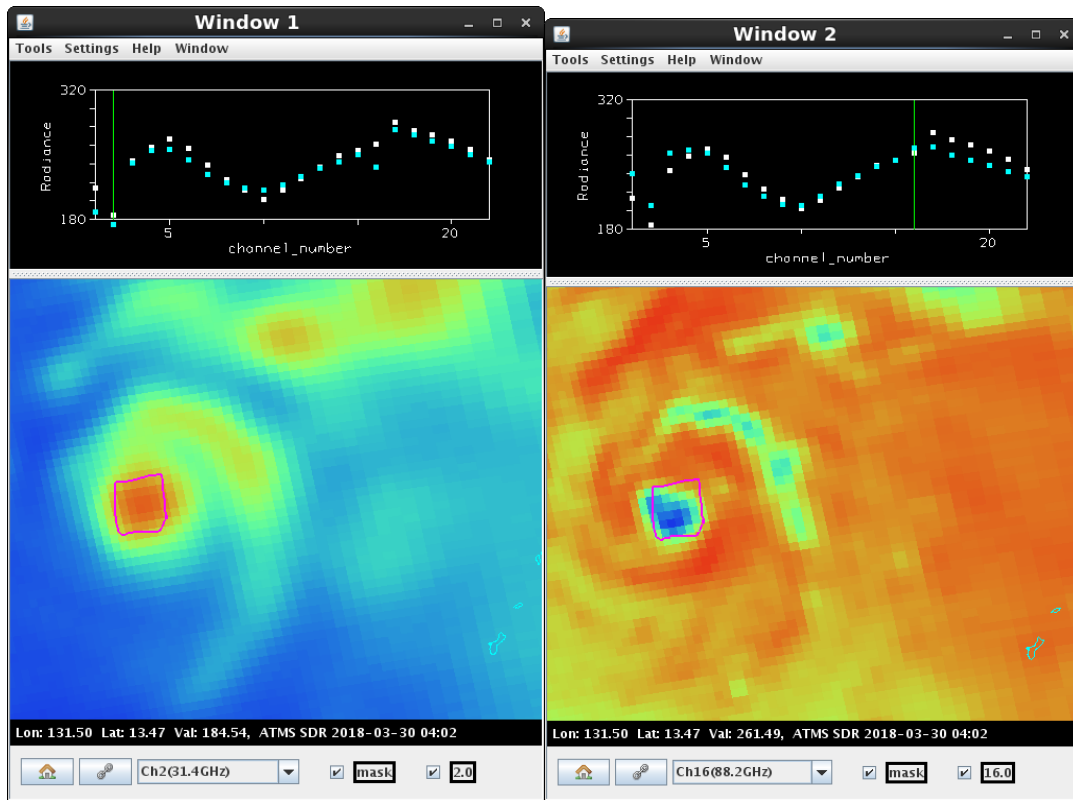


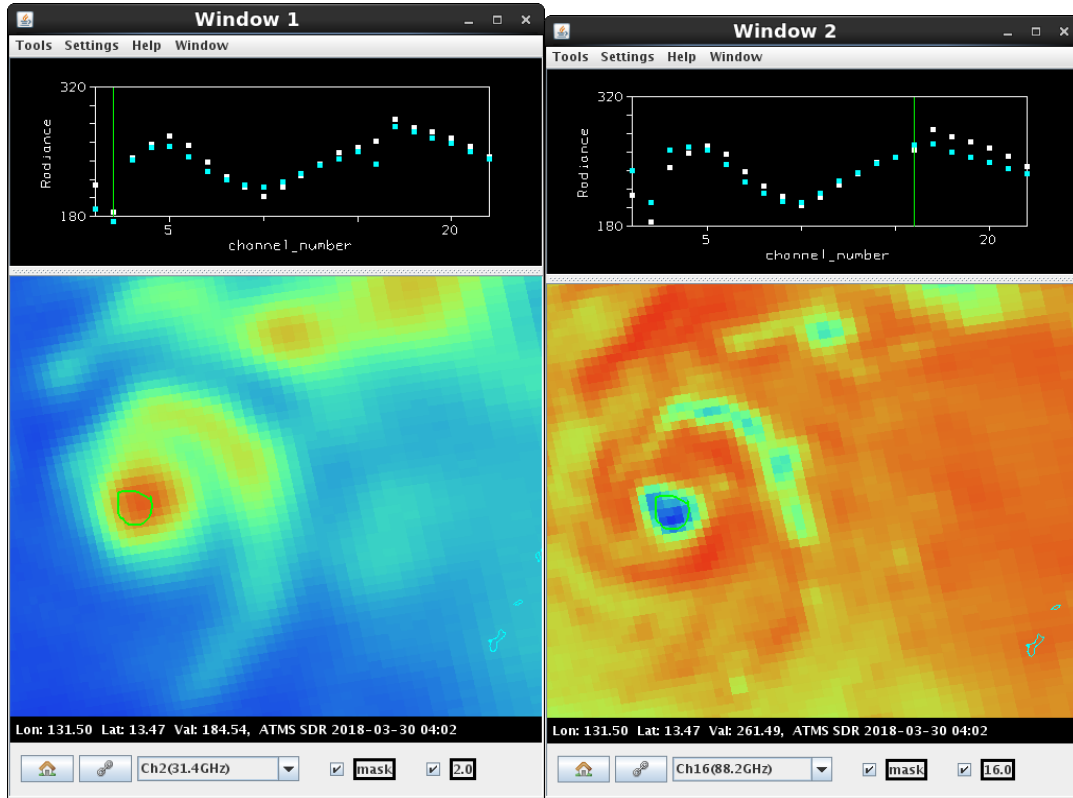
Figure 4: Scatter diagram comparing Ch2 (x-axis) and Ch16 (y-axis). Units are of Brightness Temperature.

5. Click on 'Curve' – and in one of the windows, draw a curve that includes all of the southern Philippine island of Mindanao. Which part of the scatter diagram is highlighted when you do this? What conclusion do you draw about emissivity over land at 31.4 and at 88.2 Ghz?
6. Draw a curve – or click 'Box' and create a Box – over the clear water away from Jelanek. Which part of the scatterplot is highlighted? Write that down, and we'll talk about what you conclude during the discussion.
7. Draw a curve around a part of the Scatterplot that you find interesting. Where do the points show up in the two microwave images? This will be discussed in class as well.
8. Now, zoom in to the eye of Jelawat – if you've loaded an image with an eye – or to near where the eye might form otherwise, or maybe the CDO. Draw a circle around the warmest

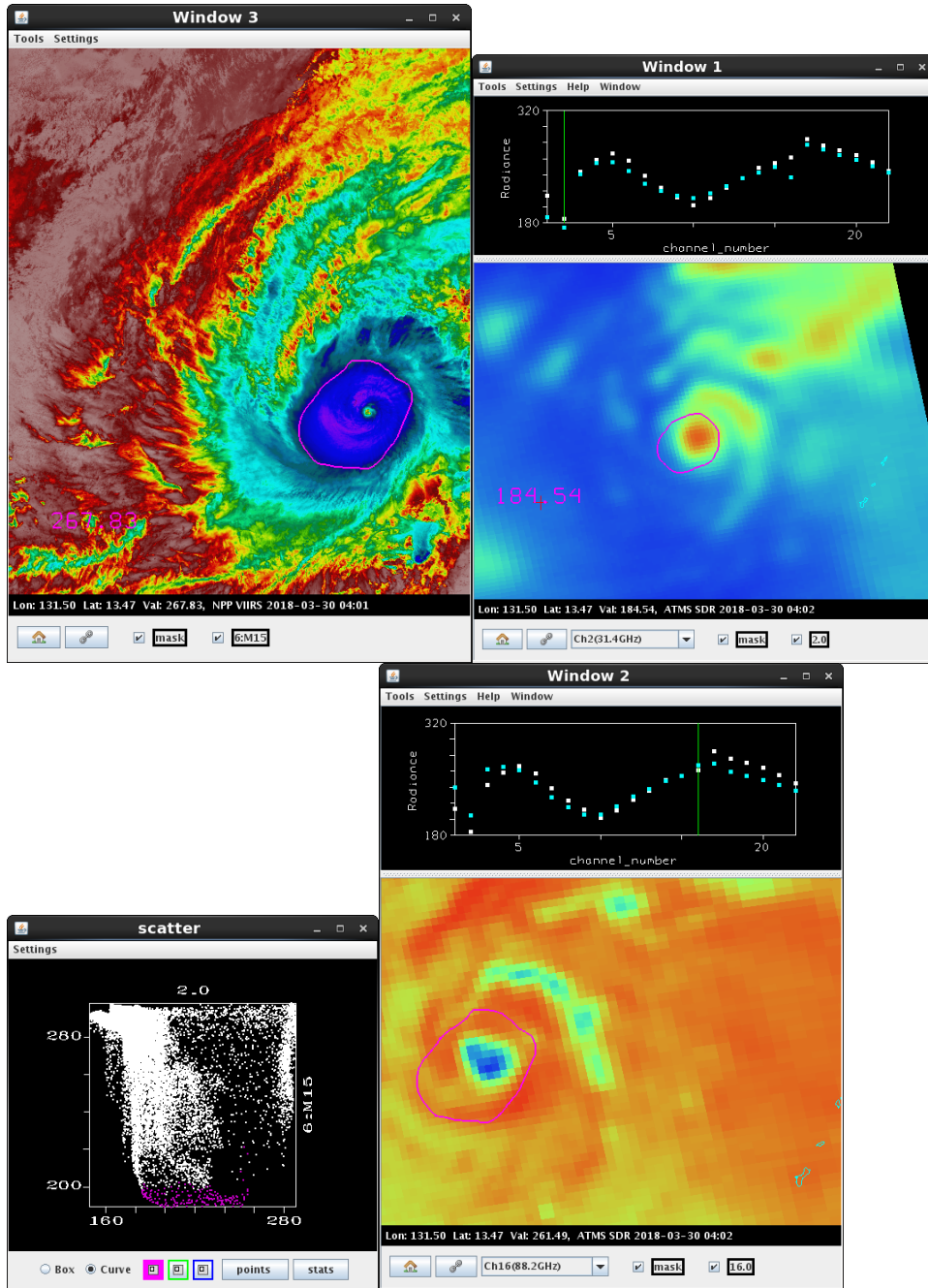
temperatures in the 31.4 Ghz imagery. How would you characterize this area in the 88.2 Ghz imagery? See the examples below as a guide.

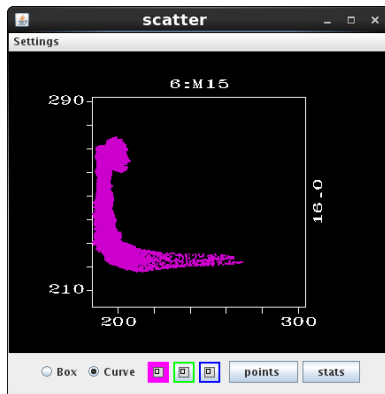


9. Now draw a circle around the warmest part of the 88.2 Ghz imagery. What region has been circled in the 31.4 Ghz image? See the example below as a guide.



10. Finally load up the VIIRS 10.8 (M15) image for the same time as the microwave imagery. Note: VIIRS data contains many many many (MANY!) more points. I haven't tested this on your machines, but it did work on my laptop. Investigate structures in the VIIRS image and compare them to the microwave. See the examples below as a guide.





11. Think about what you have learned in this lab. Write down three sentences that summarize how this information can be used operationally

a.

b.

c.