

Labs in Madison Menzel

Lab 3a -Interrogating CrIS Data and Exploring Spectral Properties of Clouds and Moisture

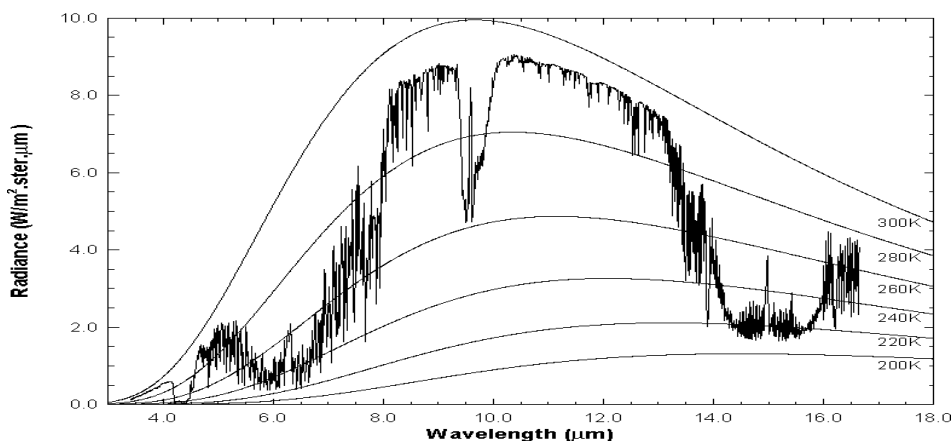


Figure 1: High resolution atmospheric absorption spectrum and comparative blackbody curves

1. Open Hydra, click on File, and open File(s), and find the CrIS data from 30 August 2012 (starting time 0424019).

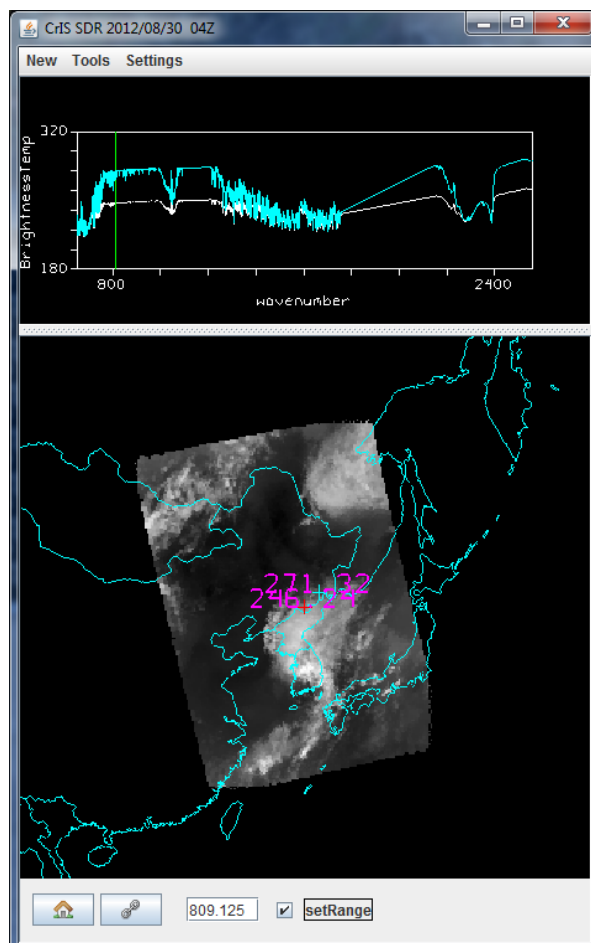


Figure 2: Hydra2 display of CrIS data showing BT spectra from warmest pixel and IRW image centered over South Korea on 30 August 2012.

1a. Explore the image to view spectra measured in various pixels. To do this move the cursor around the image slowly (left click and drag) watching the spectra change from pixel to pixel. View a spectrum over ocean in clear skies and locate the CO₂, O₃, and H₂O absorption features. Now view a spectrum in the clouds over South Korea. The brightness temperature (BT) at shorter wavelengths (wavenumbers greater than 2500 cm⁻¹) is now increasing as wavenumber increases. Why? Compare the spectra from clear sky and cloud (Figure 3). Why is the spectrum from the cloudy field of view showing very little change in brightness temperature as a function of wavenumber?

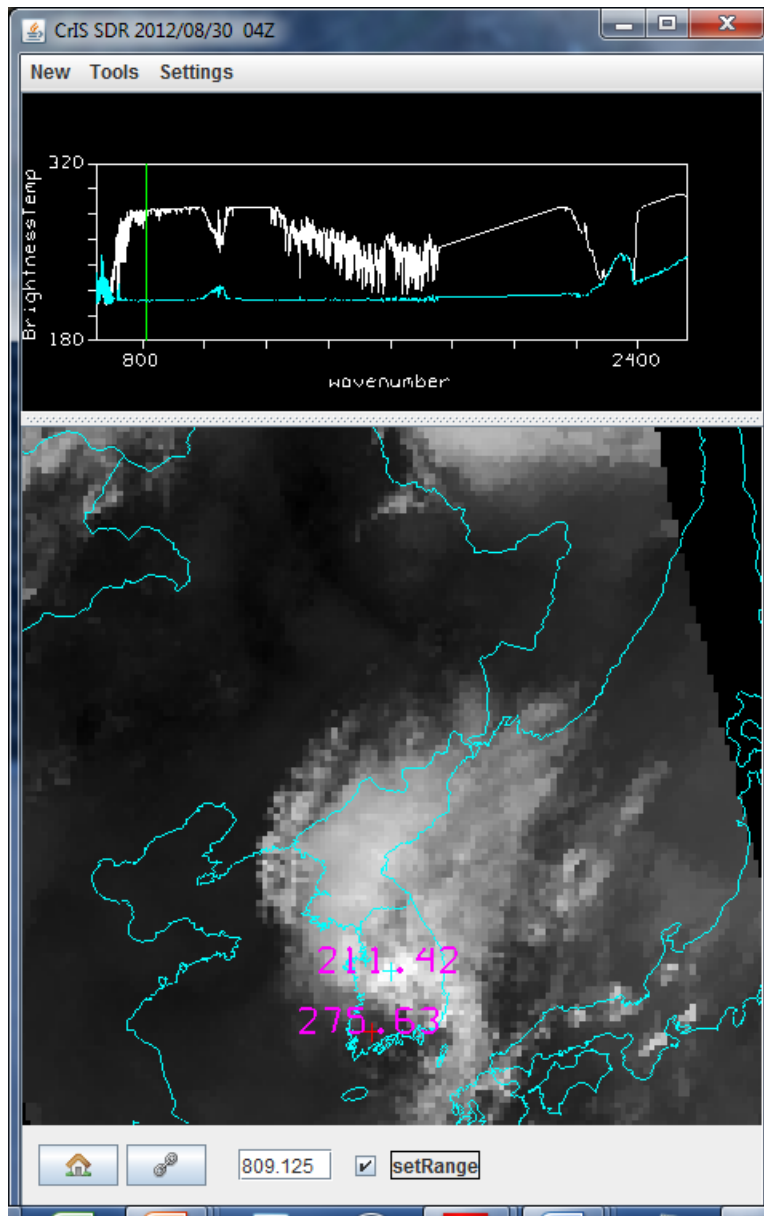


Figure 3: Display with reference spectrum on showing cloudy and clear sky spectra.

2. Zoom in on the spectrum around 690 cm⁻¹ where the clear and cloudy spectra begin to separate. Plot spectral band images at 691.625 and 692.25 cm⁻¹ and save on a ppt. Clouds are evident in one image but not the other. Explain why in the notes. Notice the 692.25 cm⁻¹ measurements near the edge of the image are colder than the nadir measurements. Why?

3. What is the temperature difference for on-line off-line spectra at 735 cm^{-1} for the clear sky pixel? What is the temperature difference for on-line off-line spectra at 720 cm^{-1} (at the Q branch of the CO_2 absorption band) for this pixel? Save in a ppt. What does this imply about the 720 cm^{-1} weighting function with respect to the 735 cm^{-1} weighting function?
4. Load (click on File and again on Files) the CrIS DR retrievals (CrIS_d20120830_t042401.atm_prof_rtv_hydra.h5). Investigate the clear and cloudy retrievals. At what pressure level do the clouds disappear in the temperature retrieval field? What does this imply about the weighting function of the wavenumber where the spectra separate (see part 2)? Explain.
5. Investigate low level atmospheric water vapor by displaying on-line and off-line measurements over the Sea of Japan near 815 cm^{-1} (See Figure 4a). What does the on-line off-line brightness temperature difference in this part of the spectrum tell you about low level moisture? Explain? Open another display so that you can see on-line and off-line measurements simultaneously. Open the transect tool in both displays and draw a transect off the west coast of Russia in the Sea of Japan. Where is the low level moisture the greatest? (see Figure 4b) Now use the FourChannelCombine to display the BT difference image for 814.125 minus 815.375 cm^{-1} ; enhance with rainbow color and adjusted the range. Save as a ppt. Now inspect the CrIS water vapor retrievals. Look at the transect in the 814.125 BT image, the 814.125 minus 815.375 BT image, and the 850 hPa water vapor retrieval. Save as a ppt. Discuss your findings.

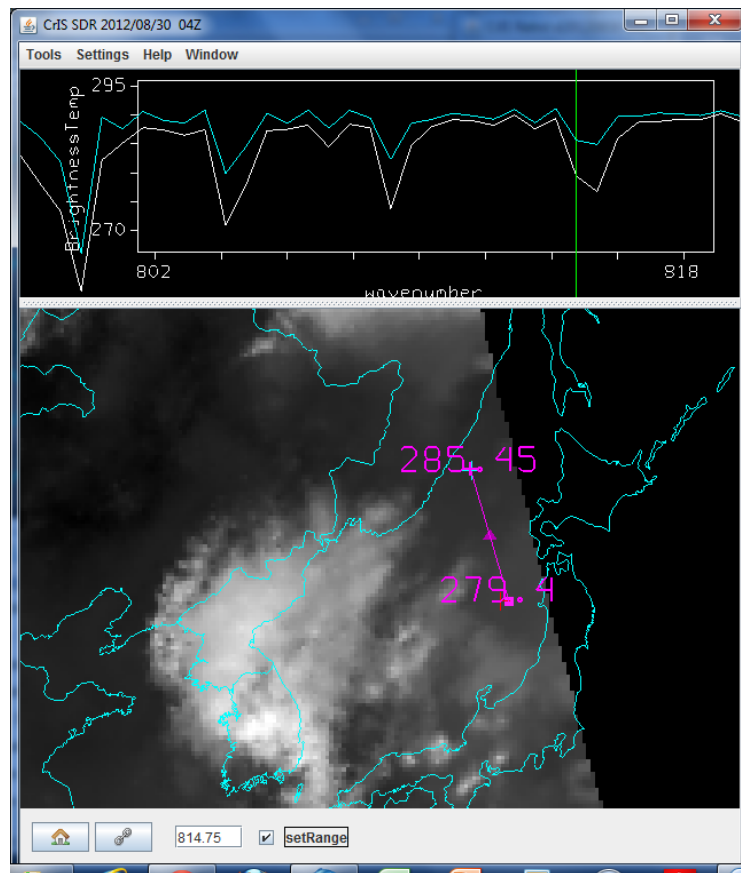


Figure 4a. Display with zoom in on H₂O spectra between 810 and 825 cm⁻¹ over ocean south of the Korean peninsula.

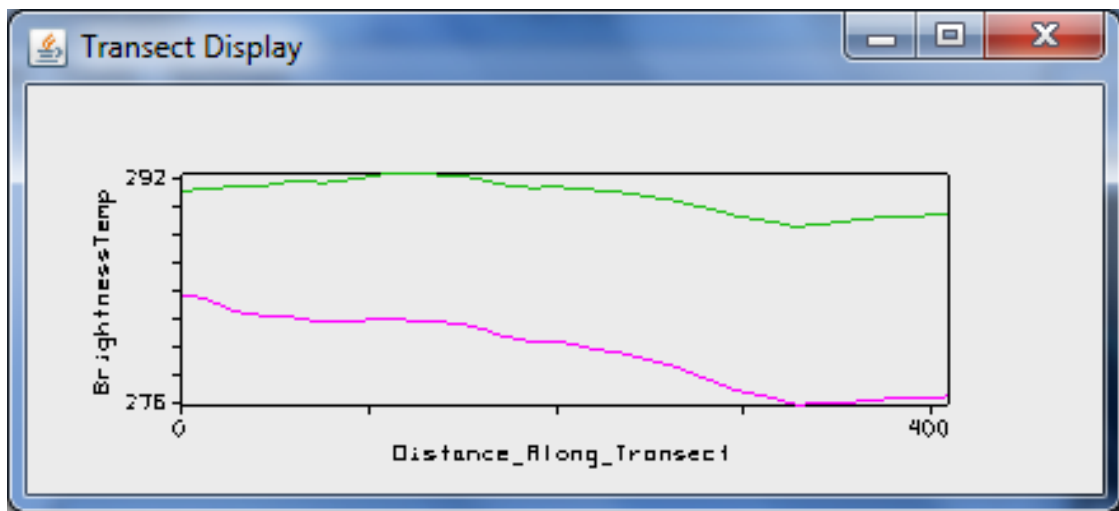


Figure 4b. Display of on-line (purple) and off-line (green line) transect of each off the west coast Russia.

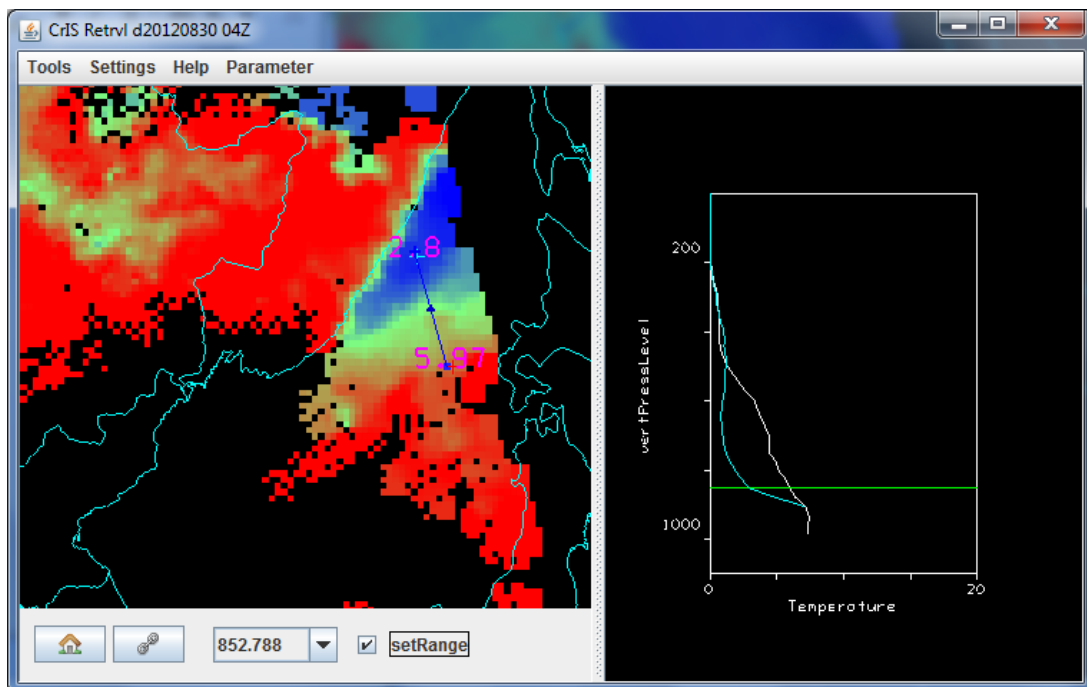


Figure 4c. Display of 850 hPa water vapor retrieval off the west coast Russia in the Sea of Japan.

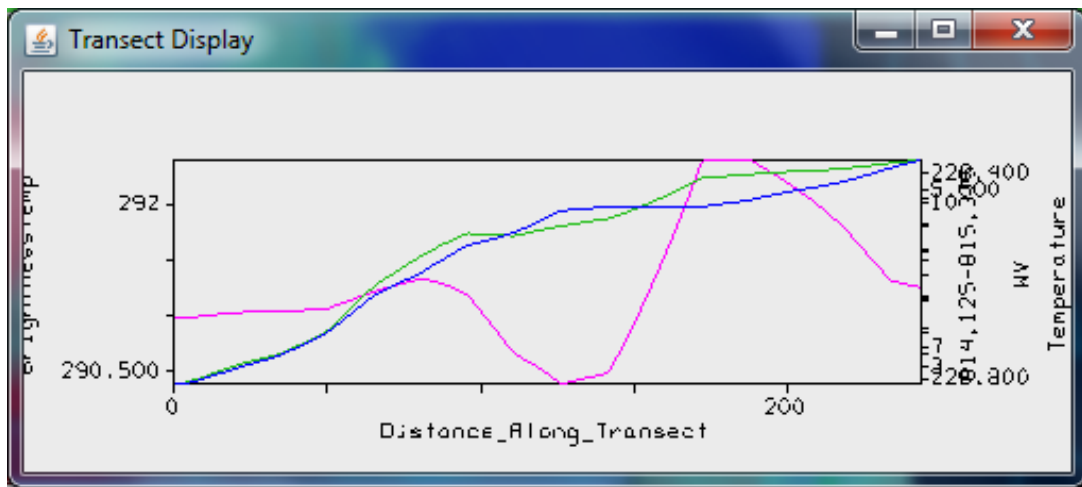


Figure 4d. Transect of 814.125 BT image (purple), the 814.125 minus 815.375 BT image (green), and the 850 hPa water vapor retrieval (blue).

Lab 3b – Investigating ATMS Data

Ch	Ghz	Pol
1	23.8	QV
2	31.4	QV
3	50.3	QH
4	51.76	QH
5	52.8	QH
6	53.596 ± 0.115	QH
7	54.4	QH
8	54.94	QH
9	55.5	QH
10	fo = 57.29	QH
11	fo ± 0.3222 ± 0.217	QH
12	fo ± 0.3222 ± 0.048	QH
13	fo ± 0.3222 ± 0.022	QH
14	fo ± 0.3222 ± 0.010	QH
15	fo ± 0.3222 ± 0.0045	QH
16	88.2	QV
17	165.5	QH
18	183.31 ± 7	QH
19	183.31 ± 4.5	QH
20	183.31 ± 3	QH
21	183.31 ± 1.8	QH
22	183.31 ± 1	QH

ATMS channels

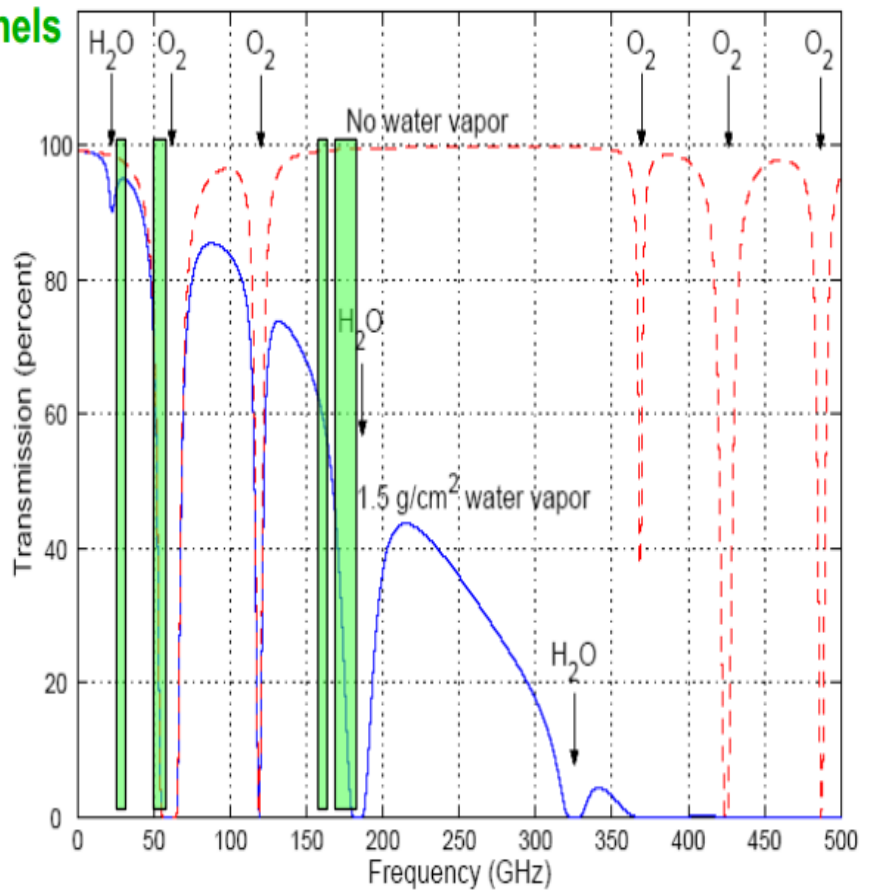


Table 1: ATMS spectral bands.

6. Open Hydra 2.8.4, click on File, click on File(s), and guide HYDRA to the ATMS data from 30 Aug 2012 (with starting time 0423593). The following table indicates the spectral bands. Figure 1 shows the weighting functions. Figure 2 indicates the resulting display.

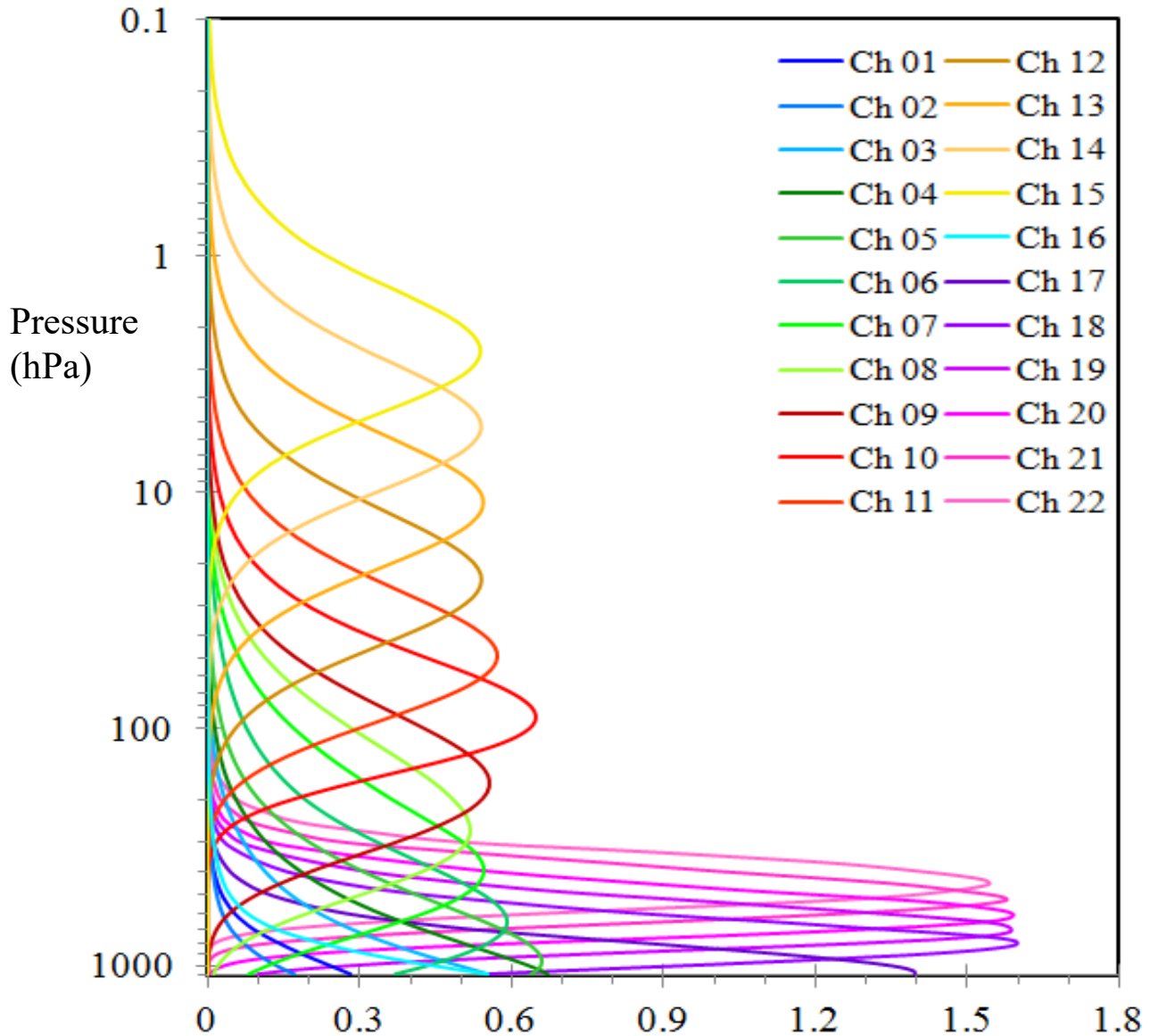


Figure 1: ATMS Weighting Functions

6a. Inspect the spectral bands in sequence from Band 1 (23 GHz) to Band 15 (57 GHz). Note that Bands 1 to 5 and Band 15 show evidence of radiation from the earth surface; how is this obvious? Band 4 is more opaque (due to O₂ absorption) than Band 3; why are the BTs warmer over the ocean in Band 4 than Band 3? Band 9 is more opaque than Band 8; the BTs are colder over the ocean in Band 9 than Band 8 as one would expect. However Band 13 is more opaque than Band 12; but the BTs are warmer over the ocean in Band 13 than Band 12. Can you explain why?

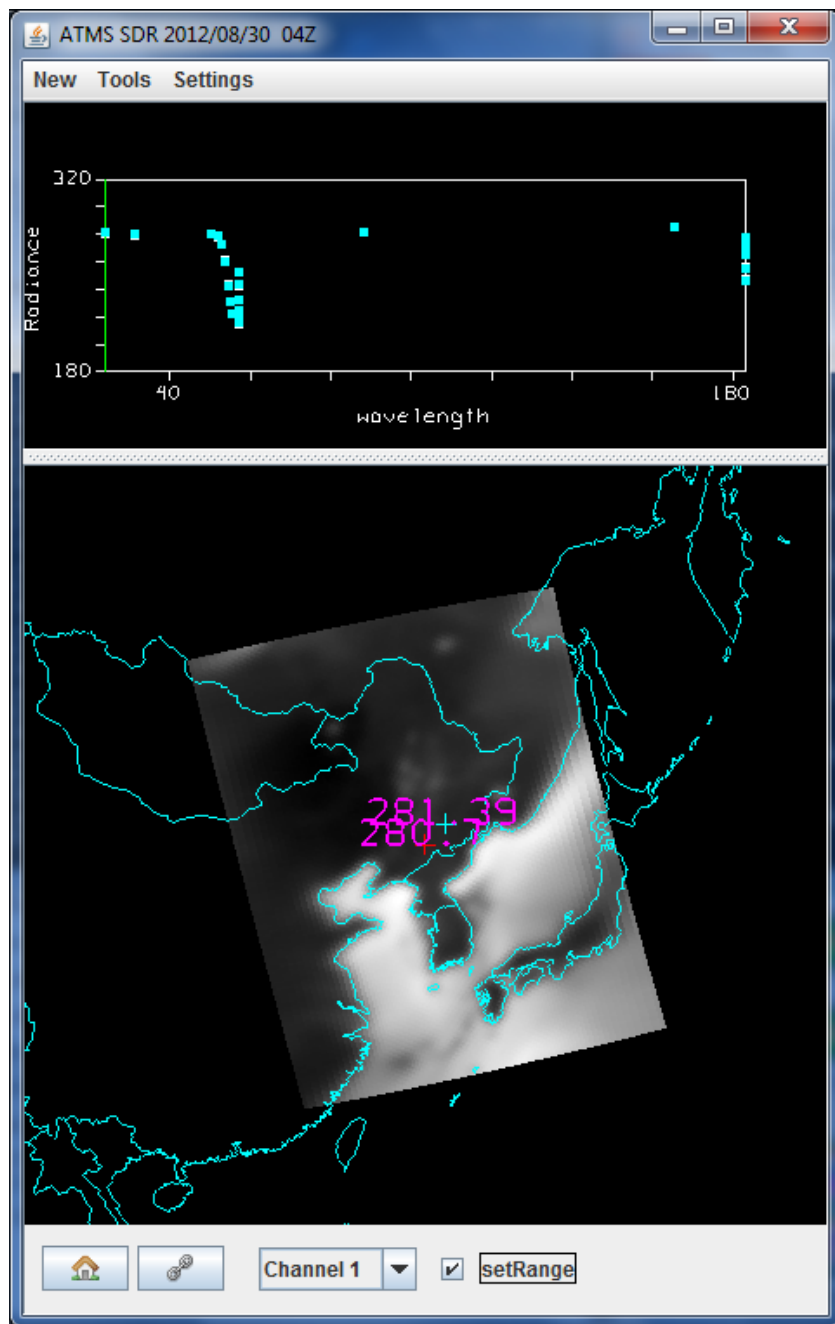


Figure 2: ATMS spectral channel 1.

Lab 3c - Exploring low level moisture in VIIRS, CrIS, and ATMS split windows

7. Plot a transect of the ATMS split windows (Band 1 minus Band 2) in the Sea of Japan matching that from the CrIS split window and note the BT difference.
8. Now open the collocated VIIRS data (HYDRA, File, VIIRS Directory). Find the same cloud free region over the Sea of Japan. Plot the transect of Band M15 minus Band M16. Compare the temperature difference in the three split windows. Which instrument is most sensitive to low level moisture?