

Labs in Bologna & Potenza Menzel

Lab 4 – Exploring low level moisture in AIRS, MODIS, and AMSU-A split windows

1. Open **Hydra** and load AIRS.2005.08.28.103.L1B.AIRS_Rad.v4.0.9.0.G05241172839.hdf. Under **Start** open the **MultiChannel Viewer** and the following should appear (see Figure 1).

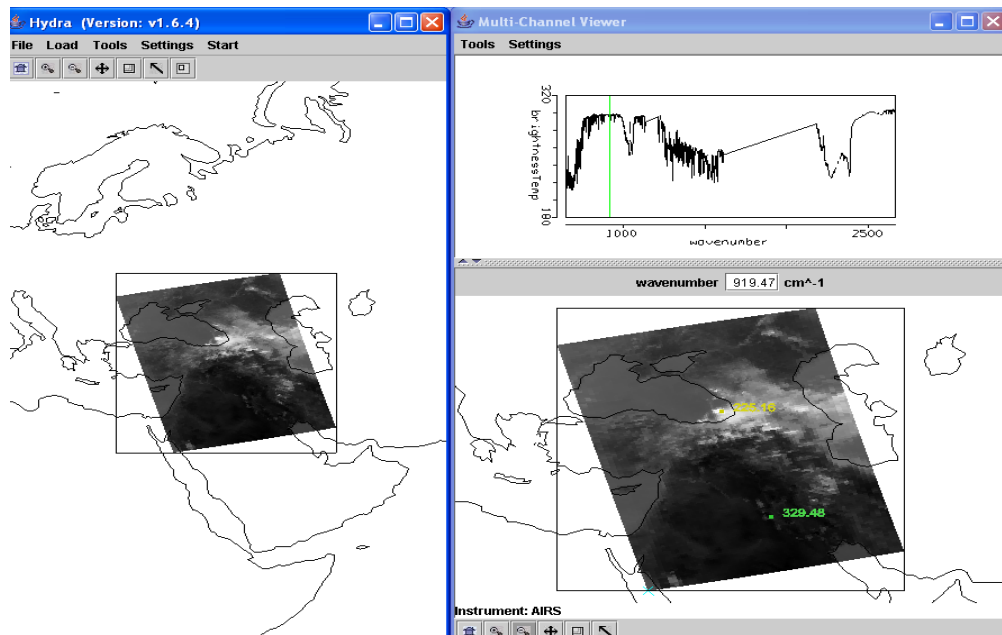


Figure 1: Hydra display of AIRS data showing BT spectra from warmest pixel and IRW image over the Black and Caspian Seas on 28 August 2005.

1a. Engage the reference spectrum icon (under **Tools** find **Reference Spectrum** and click on). Show spectra from the eastern and western parts of the Black Sea; zoom in on the spectra near 870 cm⁻¹ (see Figure 2).

1b. Using **Linear Combinations** create a pseudo image of the BT difference on and off a H₂O absorption line in the infrared window region (e.g. try 870.3 minus 871.3 cm⁻¹). Color display the difference image (see Figure 3). What is the range of values in the scene? Differences in the eastern Black Sea are smaller than differences further west; what does this tell you about low level moisture?

1c. Keep the **MultiChannel Viewer** with the reference spectrum open. Using Hydra again load the AIRS retrievals for this scene found in AIRS.2005.08.28.103.atm_prof_rtv_npc030.hdf (leave the Multichannel Viewer with the AIRS data open). Under **Variables** select **Water Vapor Profiles** and under **Tools** turn **Reference Profile** on. Inspect the moisture retrieval image for 900 hPa. The western Black Sea appears to have more low level moisture than the eastern part. In the Multi-Channel Viewer display two spectra, one for a FOV in the moister region and one in the drier region. Zoom in on the two spectra at 870 cm⁻¹ (click on the icon third from the right in the bottom tool and then click and drag over the appropriate part of the spectrum – repeat until full resolution of the absorption lines in the IR window are apparent). You should have something that looks like Figure 4. Does the on-line off-line brightness temperature difference in this part of the spectrum agree with the inference from the retrieval field? Explain?

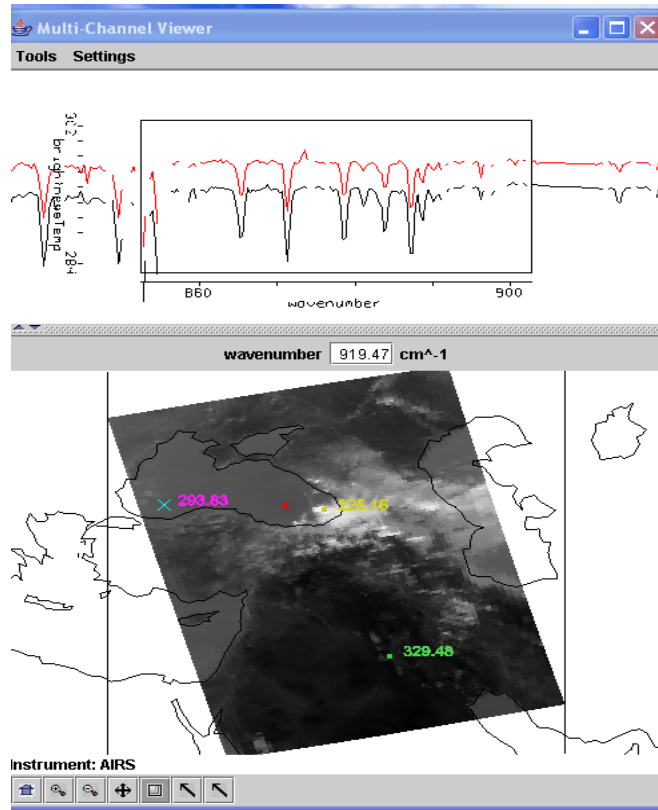


Figure 2. MultiChannel Viewer display with zoom in on IR window spectra near 870 cm⁻¹ over FOVs in eastern and western Black Sea.

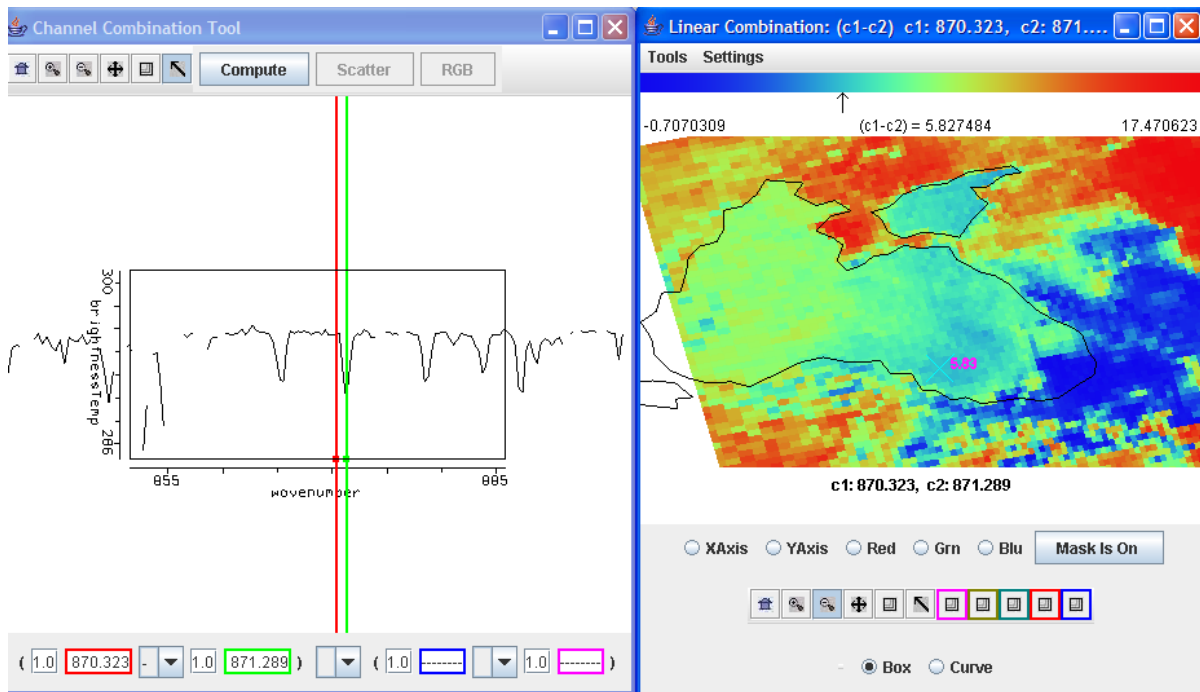


Figure 3. Micro-channel difference of 870.3 cm⁻¹ (off H₂O line) minus 871.3 cm⁻¹ (on H₂O line) indicating the low level water vapor concentrations over the Black Sea

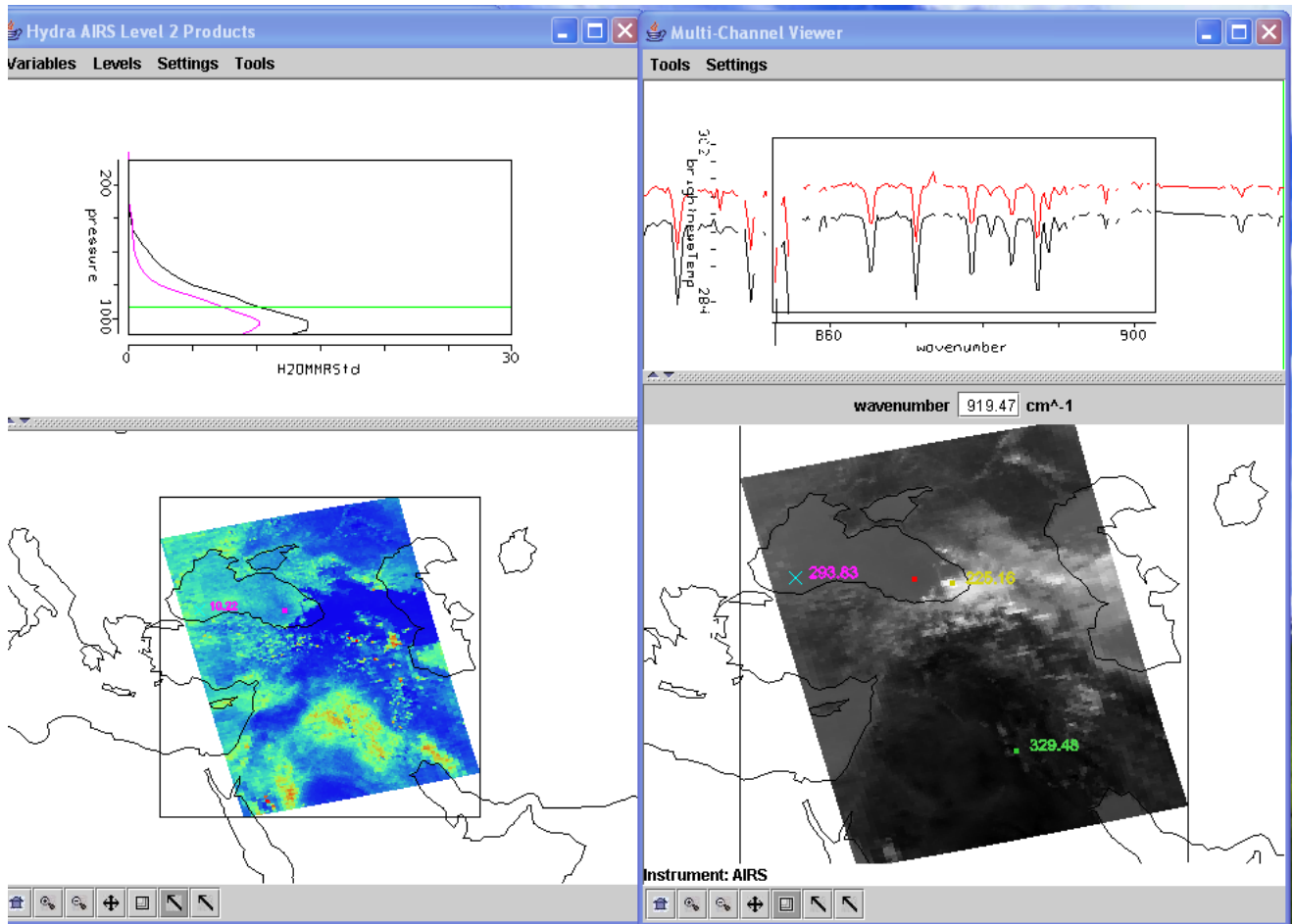
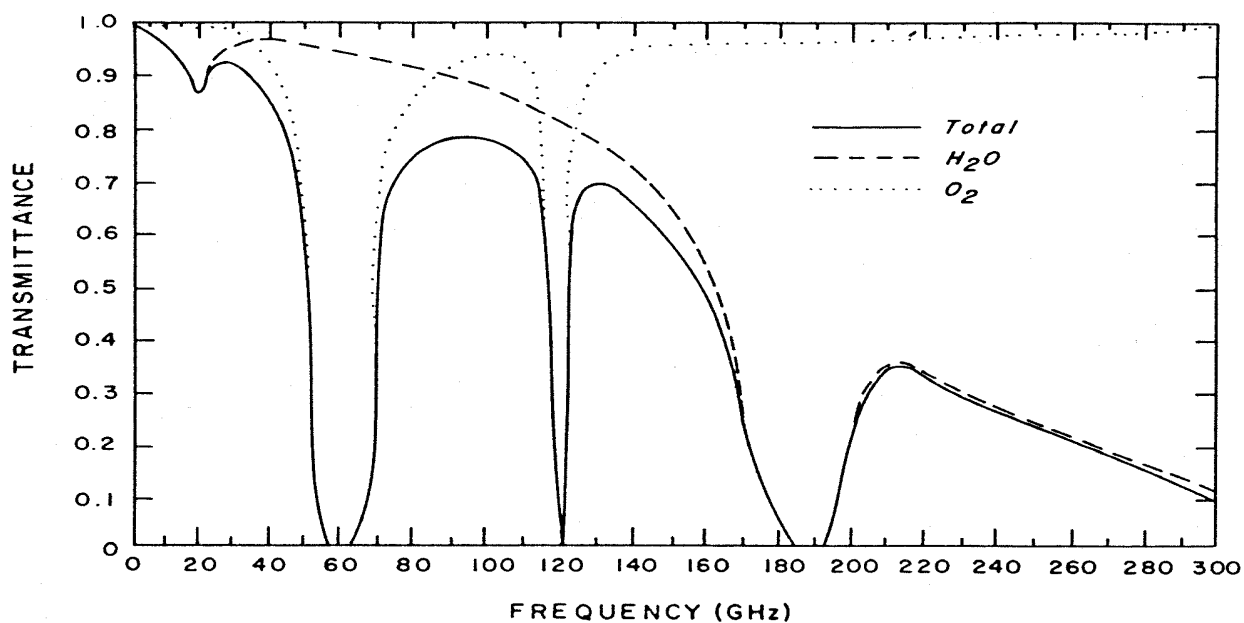


Figure 4. (right) MultiChannel Viewer display with zoom in on IR window spectra near 870 cm⁻¹ over FOVs in eastern and western Black Sea. (left) AIRS water vapor profile retrievals in the two selected FOVs and the 900 hPa water vapor retrieval field for the granule.

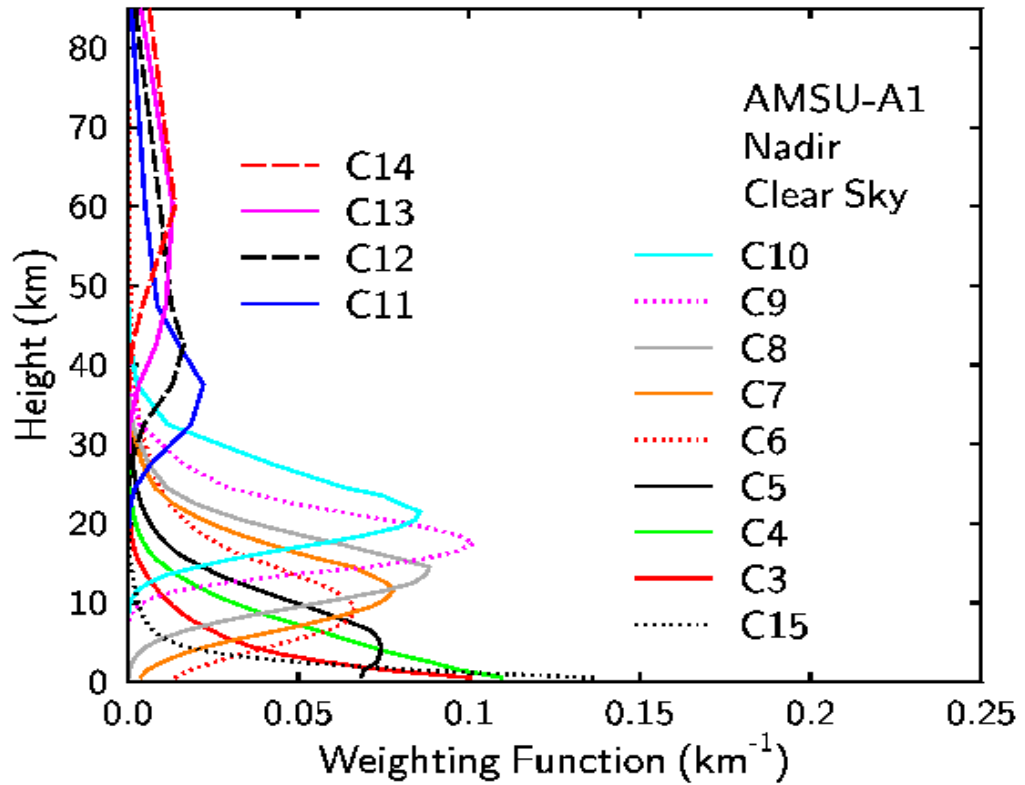
2. Use *Hydra* to load the collocated Aqua MODIS data found in MYD021KM.A2005240.1020.005.2005242062607.hdf. Open the *Multi-channel Viewer* and use *Linear Combinations* to create a pseudo image of the split window BT difference over the Black Sea (BT31-BT32). Compare the temperature differences in the MODIS split window to the AIRS micro-channel on-line off-line from 1b.
3. Explore the collocated microwave data collected with the Advanced Microwave Sounding Unit (AMSU-A).



AMSU-A Band

Frequency in GhZ

1	23,800
2	31,400
3	50,300
4	52,800
5	53596±115
6	54,400
7	54,940
8	55,500
9	$f_0=57,290.344$
10	$f_0\pm 217$
11	$f_0\pm 322.2\pm 48$
12	$f_0\pm 322.2\pm 22$
13	$f_0\pm 322.2\pm 10$
14	$f_0\pm 322.2\pm 4.5$
15	89,000



3a. Using **Hydra** load AIRS.2005.08.28.103.L1B.AMSU_Rad.v5.0.9.0.G07102220758.hdf. Under **Start** open the *MultiChannel Viewer* and the following should appear.

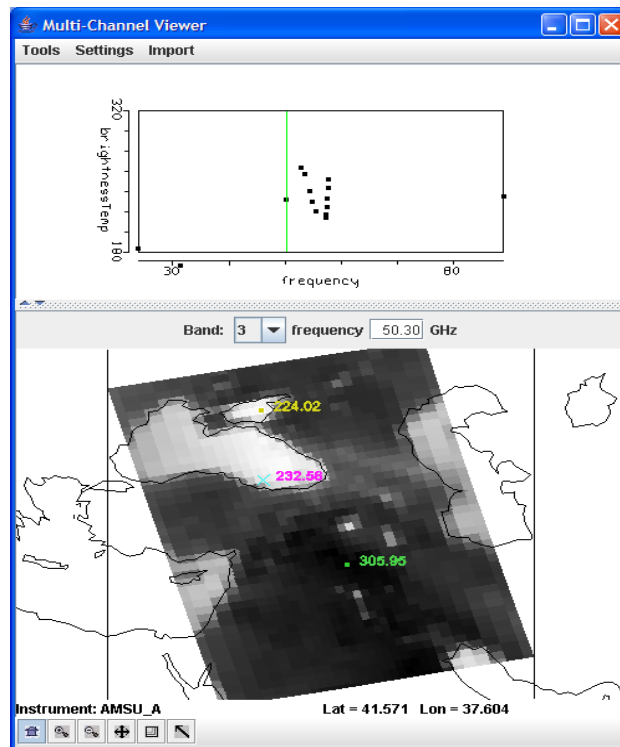


Figure 5. MultiChannel Viewer display of AMSU Band 3

Look at the spectral bands in sequence from Band 1 (23 GHz) to Band 15 (89 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 Black Sea in Band 13 than Band 12. Can you explain why?

3b. Use *Linear Combinations* to create a pseudo image of the brightness temperature difference Band 2 (31 GHz) minus Band 1 (23 GHz). How do these BT differences compare to AIRS micro-channel differences and MODIS split window differences? Note that Band 1 is more sensitive to low level moisture than Band 2.

3c. Capture all three (AIRS, MODIS, and AMSU) split window pseudo images on ppt. Compare transects in all three pseudo images. Compare the temperature difference in the three split windows. Which instrument is most sensitive to low level moisture?