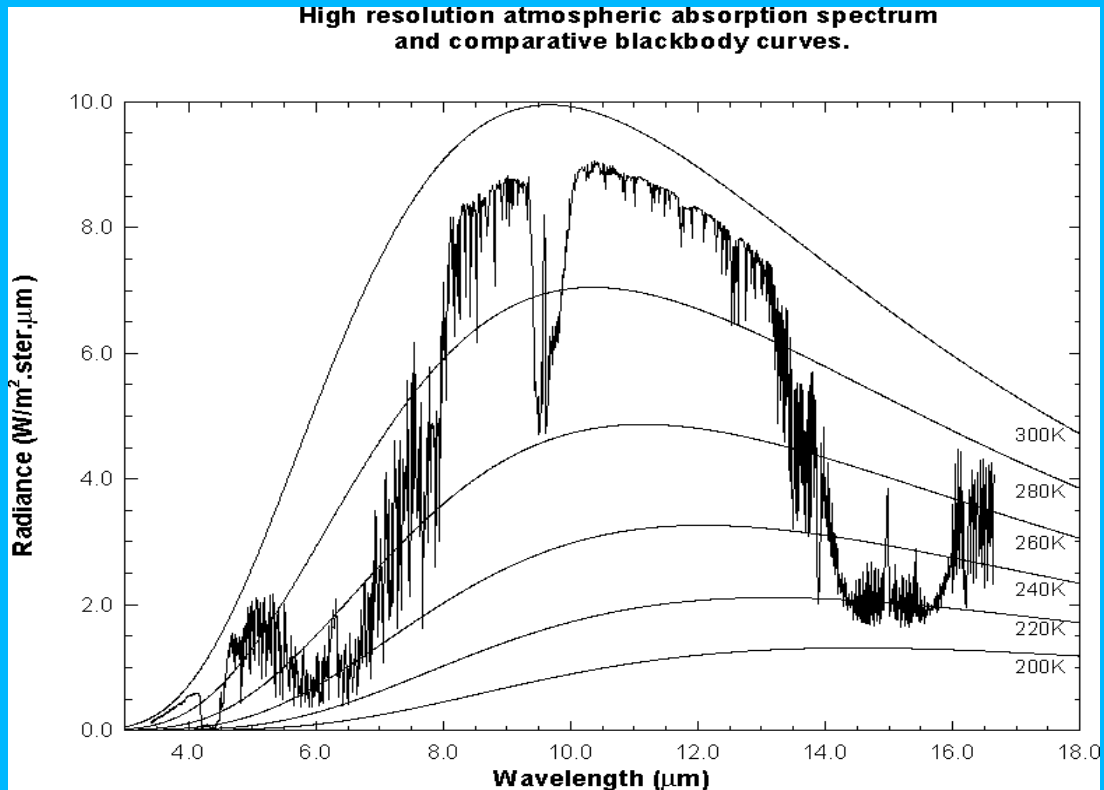


Lab 2a – High spectral resolution infrared data



Exercise 1

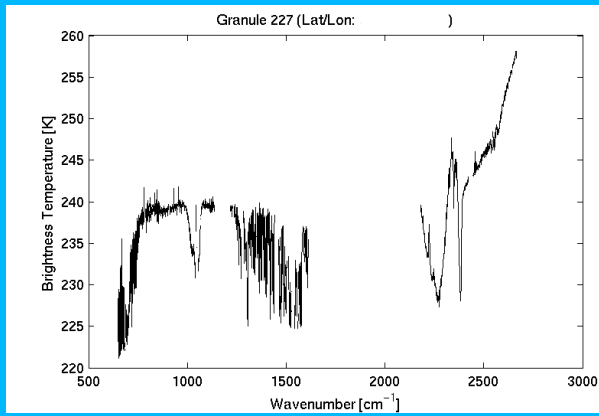
Open Matlab and load the file *Exercise1*. Type *whos* from prompt. The *lines* structure contains the line by line calculations for 6 different absorption gases (H_2O , O_3 , CO_2 , CH_4 , N_2O , water vapor continuum) in units of $\text{mW}/\text{ster}/\text{cm}^{-1}/\text{m}^2$. The *case1* and *case2* structures contain observed high spectral resolution spectra (in $\text{mW}/\text{ster}/\text{cm}^{-1}/\text{m}^2$) and the corresponding wavenumber scale (in cm^{-1}).

1. Plot the spectrum *case1* [type from prompt: `plotSpectrum(case1)`] and, by over imposing the line by line calculations [type from prompt: `help addLines; addLines(lines,1)`], identify the spectral regions where each absorption gas is active.
2. Try also to identify lines that are not due to any of those 5 molecular species.
3. Look at the observed spectrum. What is the temperature difference for on-line off-line spectra at 735 cm^{-1} for this scene? 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 scene? What does this imply about the 720 cm^{-1} weighting function with respect to the 735 cm^{-1} weighting function?

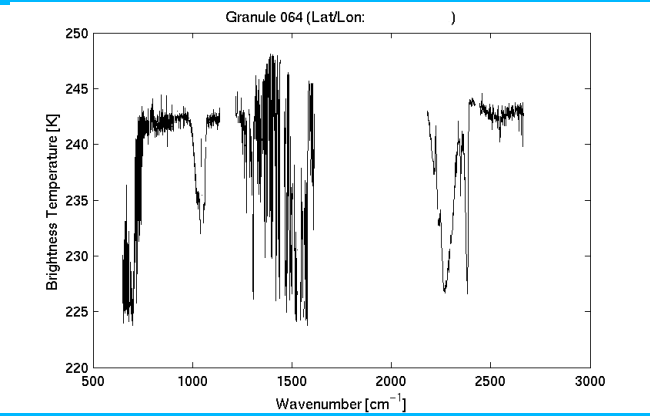
4. Redo 1 to 4 for the case2 spectrum. Is there any difference in your results? If yes, could you guess what those differences are due to?

Exercise 2

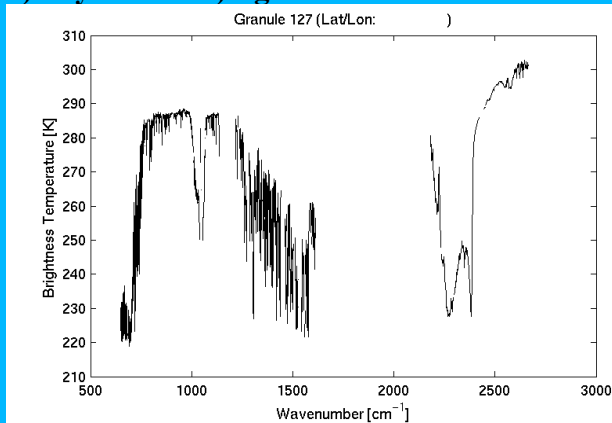
5. Look at the following spectra, verify if one or more of the multiple choices are correct, and explain why.



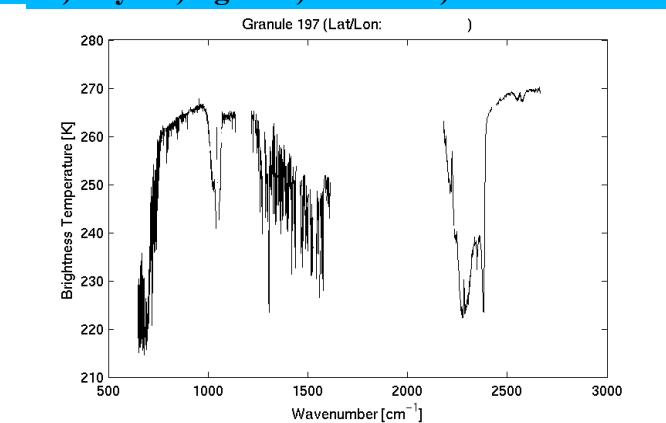
a) day b) night



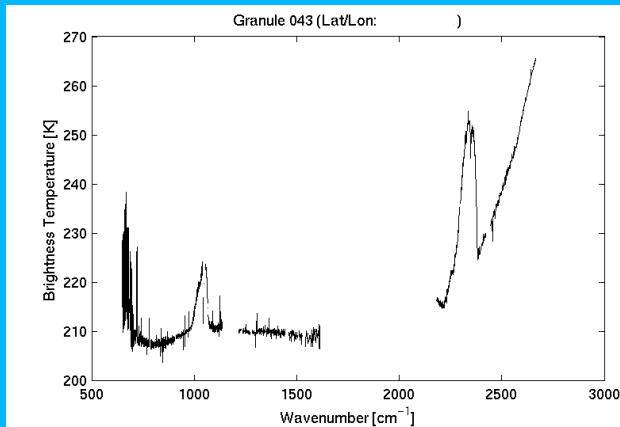
a) day b) night c) desert d) ice/snow



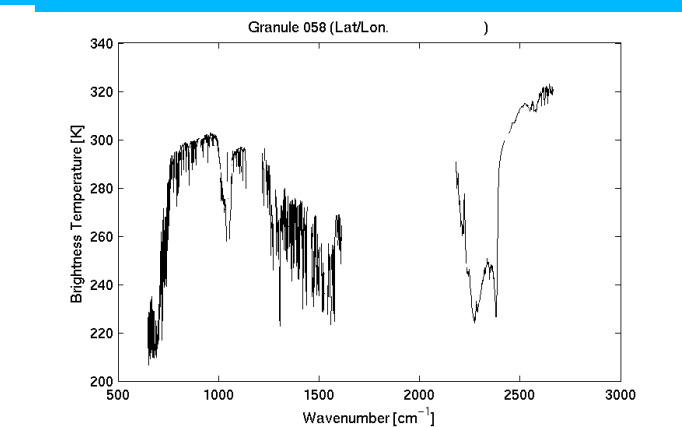
a) day b) night



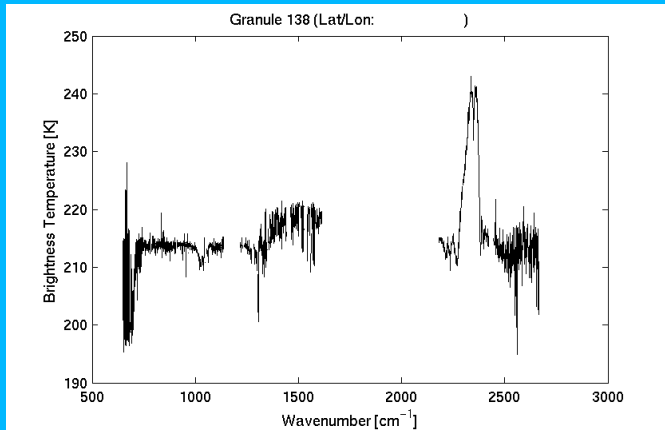
a) land b) ocean



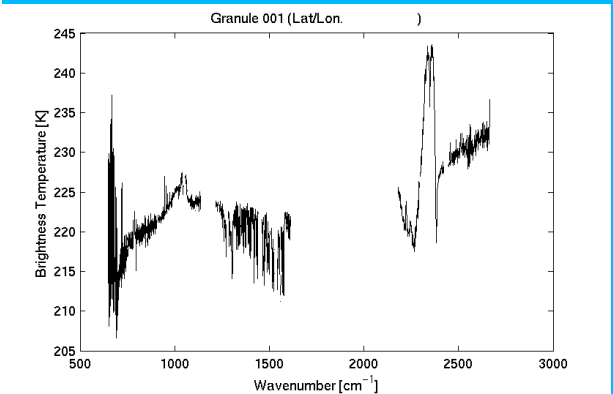
a) desert b) ocean c) cloudy



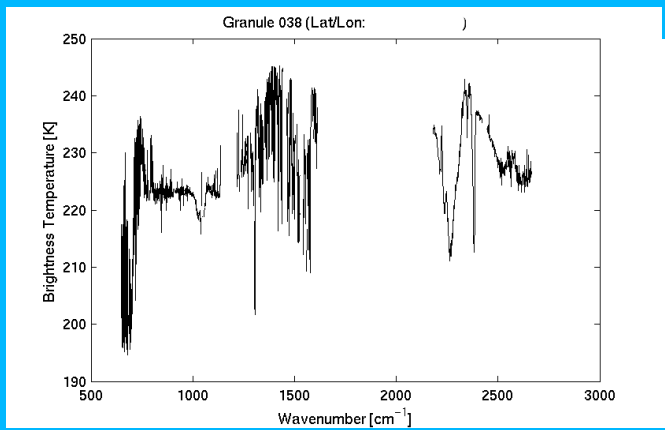
a) day b) night c) desert d) ocean



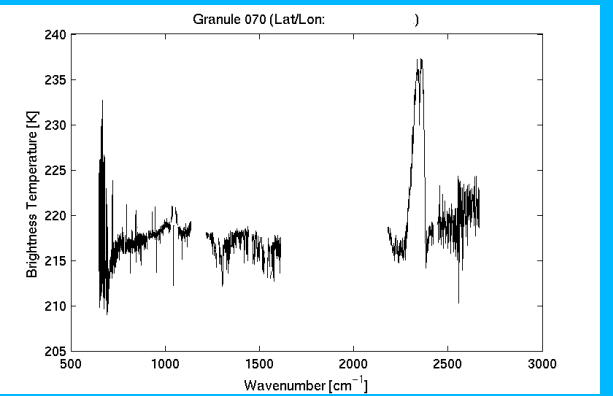
a) ocean b) cloudy c) snow/ice d) desert



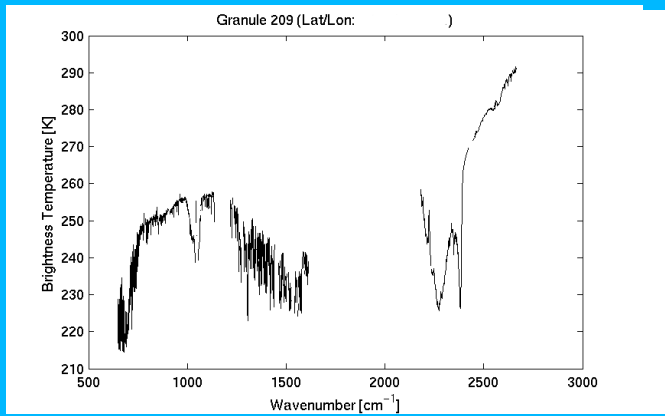
a) day b) night c) desert d) cloudy



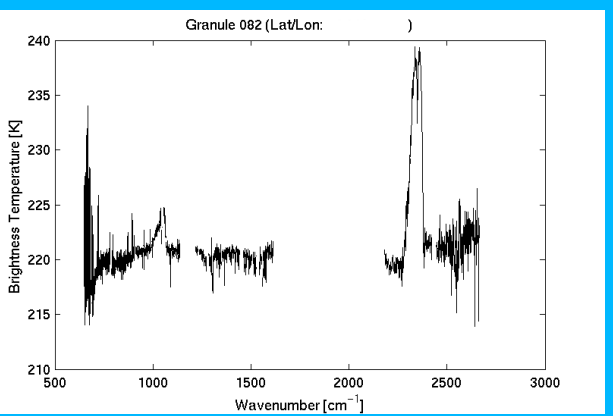
a) cloudy b) desert c) ocean d) ice/snow



a) land b) desert c) ice/snow d) ocean

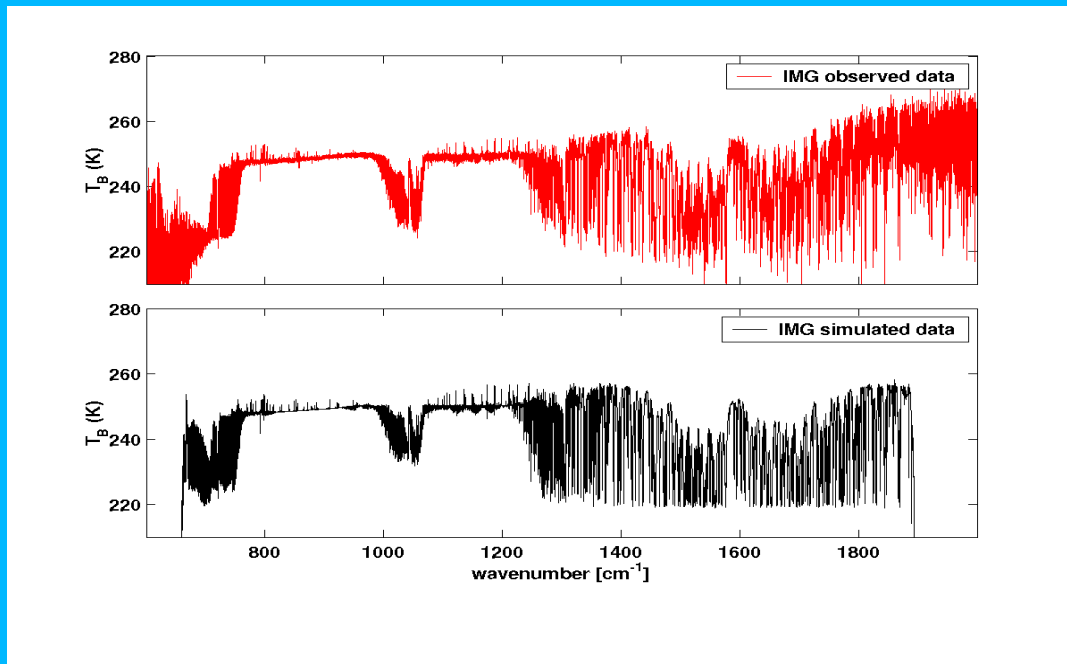


a) day b) night c) low clouds d) high cirrus



a) day b) night c) ocean d) cloudy

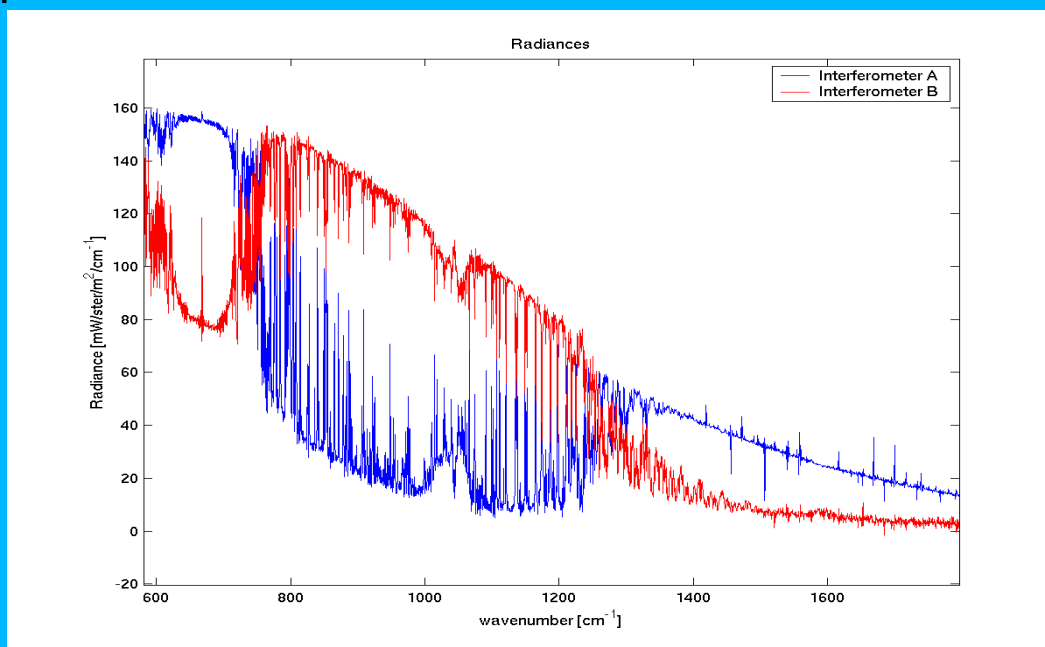
Exercise 3



6. The observations in the top panel of this figure were collected by IMG over Alaska. The spectrum in the lower panel was simulated from a radiosonde launched in proximity of the observed FOV. The spectra show a clear signature of an atmospheric inversion, can you identify the signature? Can you explain why the inversion causes this unique signature in the spectrum?

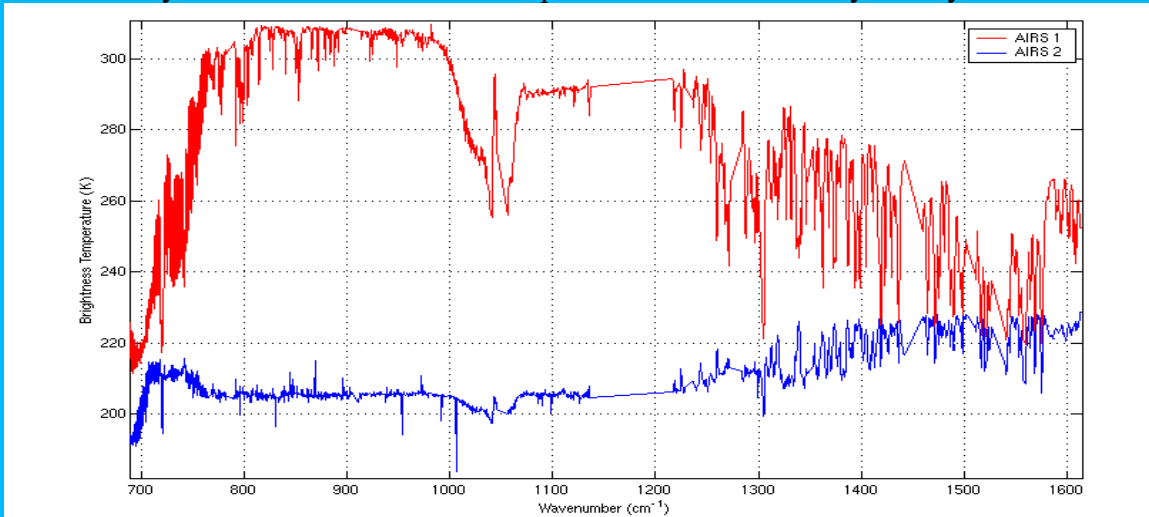
7. From the matlab prompt descend in the directory Ex3 and run `exercise3.m`. This matlab script will plot the IMG data at a resolution of 0.1 cm^{-1} , and it will allow you to calculate and display the same data at different spectral resolutions. At which resolution does the inversion signature disappear? Would have Modis been able to detect the inversion?

Exercise 4



8. The observations in this figure were collected by two different interferometers looking at the same atmospheric column at the same time. Could you explain why they differ?

9. Is there any evidence of a low-level temperature inversion? Why or why not?



10. The observations in this figure have been collected by the AIRS in different days and at different times. Could explain the they look so different?

11. There is any evidence of temperature inversion in the observations?

12. One of the observations shows a large difference between 8 and 12 microns, might that be related to any surface properties? If yes which one?

Exercise 5

Open Matlab and from the directoru Ex5 run the *Exercise5* application. This programs allows you to visualize the weighting function for each spectral channel. Convince yourself that moving in the wavenumber scale actually corresponds to a vertical scanning of the atmosphere.