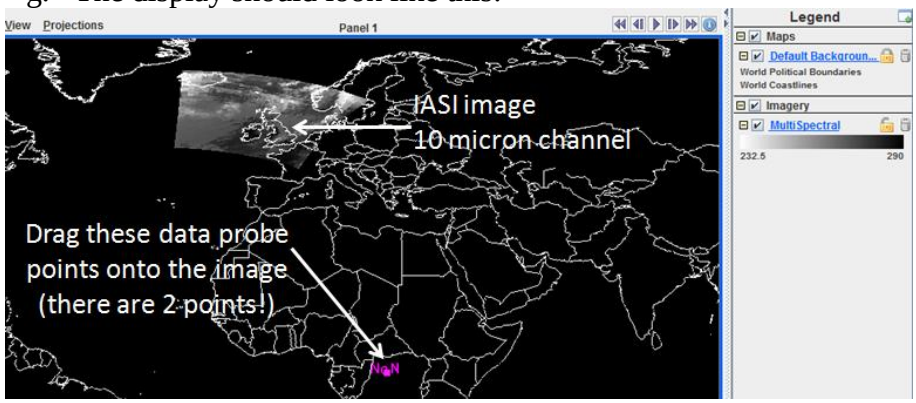
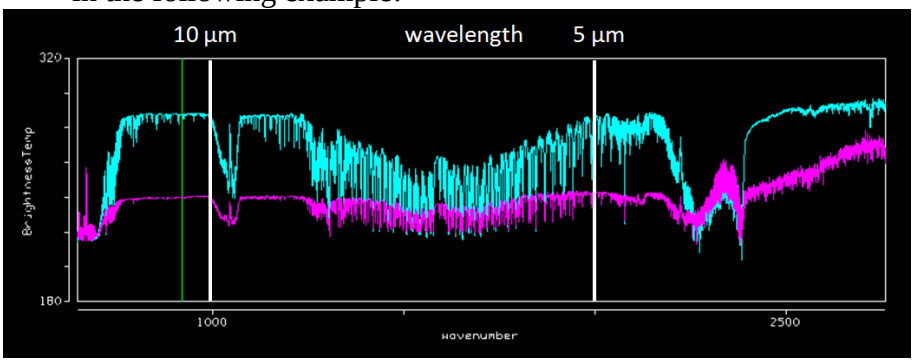
LAB 6 – Detection of thin ash and ice clouds

Here are step-by-step instructions for this lab (key questions are in yellow):

1. Open McIDAS-V
2. Load a file containing MetOp-A IASI data (HDF-5 format, 5-minute granule of an orbit):
    a. Click the **Data Sources** tab in the **Data Explorer** window
    b. Click the arrow next to **Satellite,** then click **HYDRA**
    c. Browse to **Data** → **IASI** folder and select the file '**IASI_xxx_1C_M02_20100415104754Z_20100415105249Z_N_O_20140520183535Z.h5**'
    d. Click **Add Source**
    e. In the **Displays** panel, select **Imagery** →**MultiSpectral Display**
    f. Click **Create Display** (to display default IASI IR channel)
    g. The display should look like this:

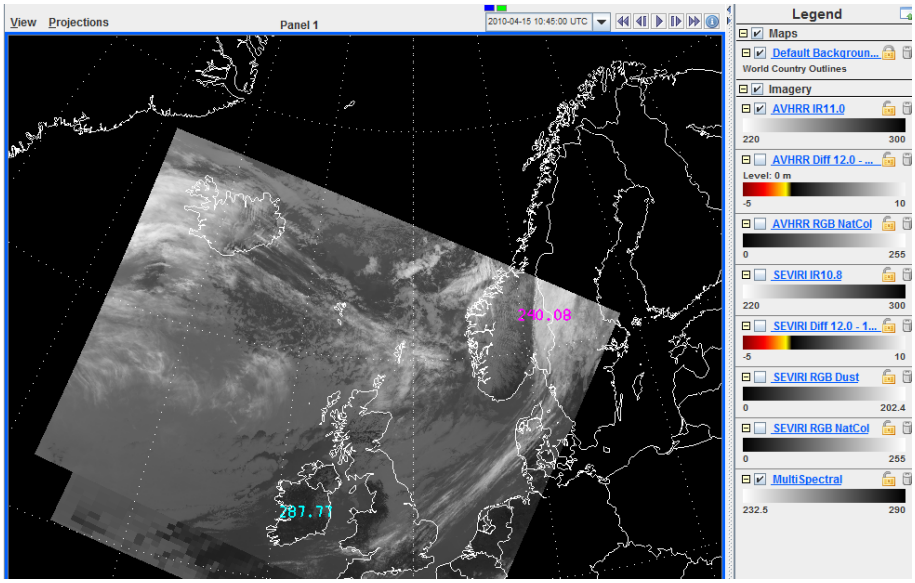


    h. Drag the two data probe points onto the image
    i. In the **Data Explorer** window, click the **Layer Controls** tab, then click the **Display** tab. You should see spectra corresponding to each of the data probes you just dragged onto the image, like in the following example:



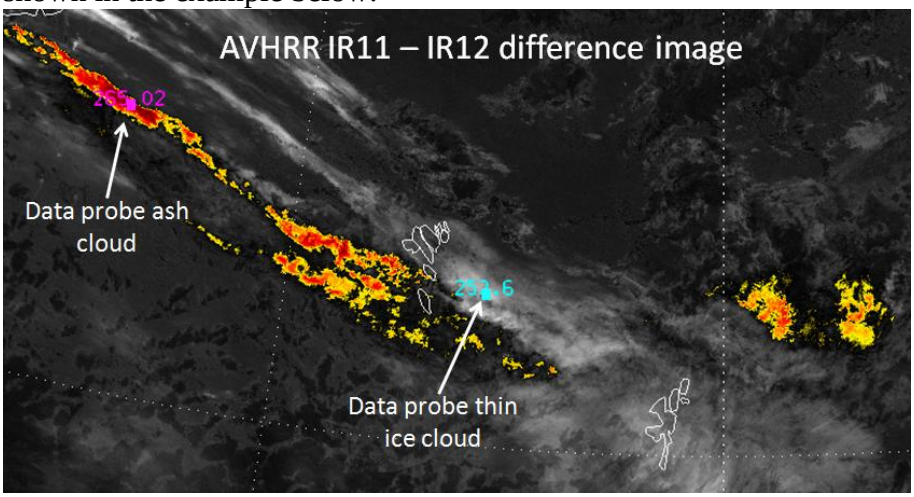
    j. Try moving one of the data probes and watch the spectra change accordingly.
    k. Remember: on the spectra plot, you should also see a vertical green line. You can drag this line to whichever wavenumber you want to see, and the IASI plot will change automatically on the map (Wavenumber 1000 = Wavelength 10 microns).

3. Open MSG SEVIRI and Metop AVHRR images for the same case
    a. In the map window, click **File** → **Open File**
    b. Locate a bundle "**iceland.mcvz**" under the directories **Data** → **Bundles** and click **Open (big file, takes a long time to open)!**
    c. Click **OK** (merge with active tabs), wait
    d. In the **Select Input** windows (2 times), type minrefl **0** and maxrefl **50**
    e. You should see many new layers in the McIDAS display window, with the AVHRR IR11.0 image as top one (see example below)



f. The images have been taken a few hours after the start of the volcanic eruption in Iceland in April 2010: can you see an ash cloud in the displayed AVHRR IR image?
g. Switch to the solar channels (AVHRR Natural Colour RGB): can you see the ash cloud in this image? If yes, what colour does it have?
h. Switch to the AVHRR IR11.0 – IR12.0 difference image (sorry: called AVHRR Diff 12.0 – 11.0): the coloured pixels indicate an ash cloud. Read the BTD values – what max values do you get for the ash cloud? Have a look at the colour table (right mouse click on colour bar of this image, **Edit Colour Table**): how has it been constructed, which breakpoints are used?
i. Now that you have seen the ash cloud: what is the white cloud in the AVHRR IR11 – IR12 difference image (values close to +10 K)?
j. Now, let us move on to the MSG SEVIRI images
k. Compare the SEVIRI BTD image to the AVHRR BTD image: what differences do you see?
l. Look at SEVIRI Dust RGB image: the ash cloud has a reddish colour (strong red component) and the thin ice cloud appears with black colour. What can you tell about the heights of these clouds? Which one is higher?

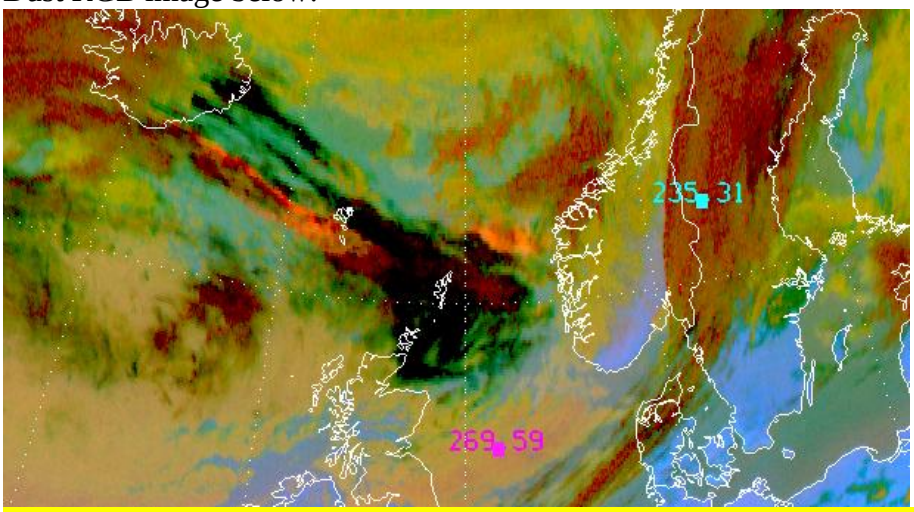
4. Look at IASI spectra for different scenes (clouds)
   a. Untick all images, except the IASI multispectral display
   b. You see the same data probes on the image, but you cannot move them around anymore. Therefore, you have to zoom out (to the world map), so that you can see the two data probe points (2 small squares outside the area) and drag them back to the IASI image
   c. Move one of the data probes to the ash cloud and the other one to the thin ice cloud (wave cloud)
   d. You may use the AVHRR IR11 – IR12 difference image to identify appropriate points, like shown in the example below:



   e. Click on the legend name of the IASI image 'Multispectral**',** to see the **Layer Controls, Display** of the spectra
   f. The two spectra should be quite different, especially in the 10-12 micron IR window region.

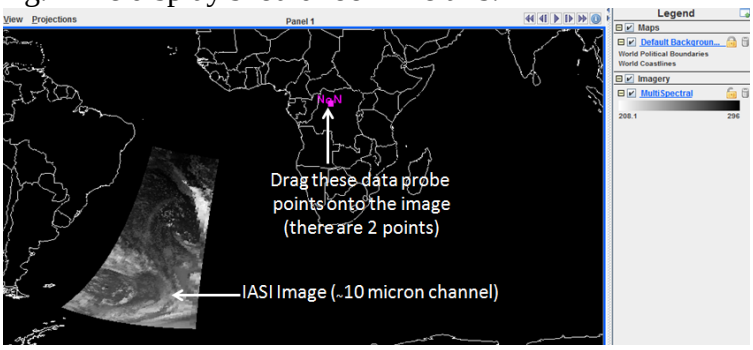
What differences do you see?

g. Save the two spectra (screenshots), so that you can compare them later to other cases
h. Also, analyse some spectra of thick water/ice clouds, for example the ones shown in the SEVIRI Dust RGB image below:

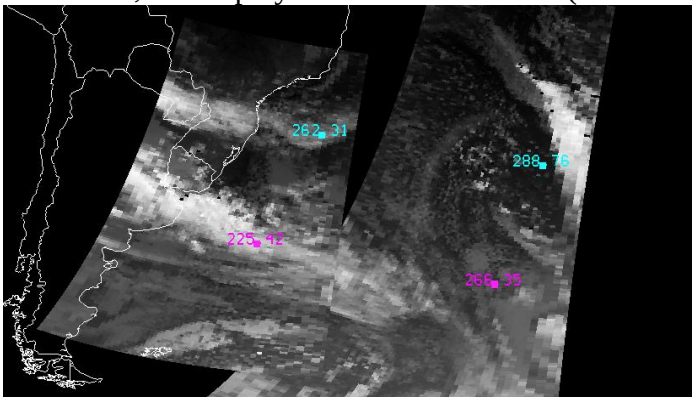


i. What Brightness Temperature Differences (BTD) IR11 – IR12 do you get for thick clouds?

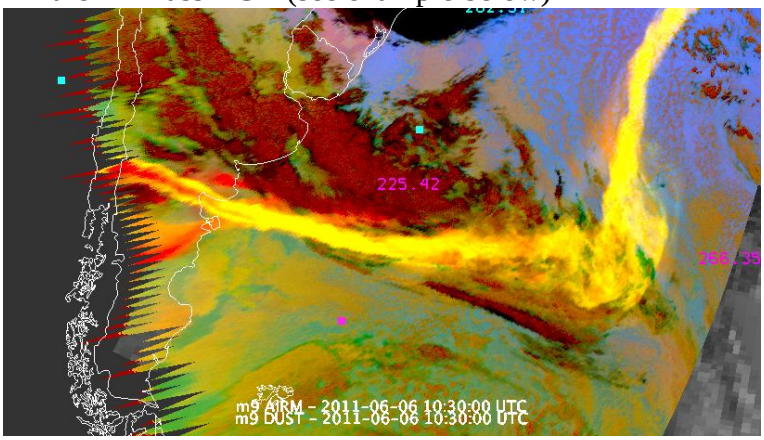
5. Close and Re-open McIDAS-V (we move to another case)
6. Load two files containing MetOp-A IASI data (HDF-5 format); the files are from 2 consecutive orbits of Metop-A:
   a. Click the **Data Sources** tab in the **Data Explorer** window
   b. Click the arrow next to **Satellite,** then click **HYDRA**
   c. Browse to **Data → IASI** folder and select the file '**IASI_xxx_1C_M02_20110606104100Z_20110606105507Z_N_O_20110807155039Z.h5**'
   d. Click **Add Source**
   e. In the **Displays** panel, select **Imagery →MultiSpectral Display**
   f. Click **Create Display** (to display default IASI IR channel)
   g. The display should look like this:



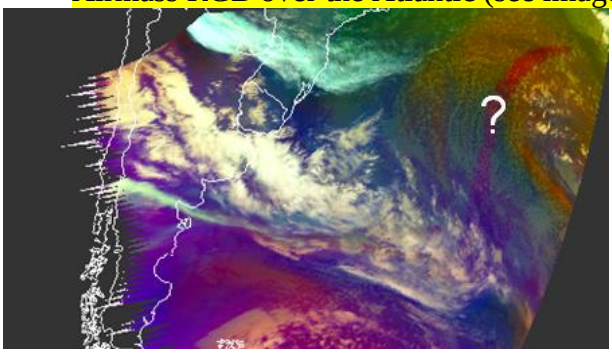
   h. Drag the two data probe points onto the image
   i. Open the another IASI file in the same way. File name: '**IASI_xxx_1C_M02_20110606122348Z_20110606123339Z_N_O_20140521203844Z.h5**'
   j. Again, drag the two data probe points onto the image
   k. Now, the display should look like this (with 2 IASI images and 4 probes):



7. Open the corresponding MSG SEVIRI image (Airmass RGB and Dust RGB) for the same case
   a. In the map window, click **File → Open File**
   b. Locate a bundle "**south_atlantic.mcvz**" under the directories **Data → Bundles** and click **Open**
   c. Click **OK** two times (merge with active tabs), wait
   d. You should now see two new layers in the McIDAS display window: the Dust RGB (on top) and the Airmass RGB (see example below)

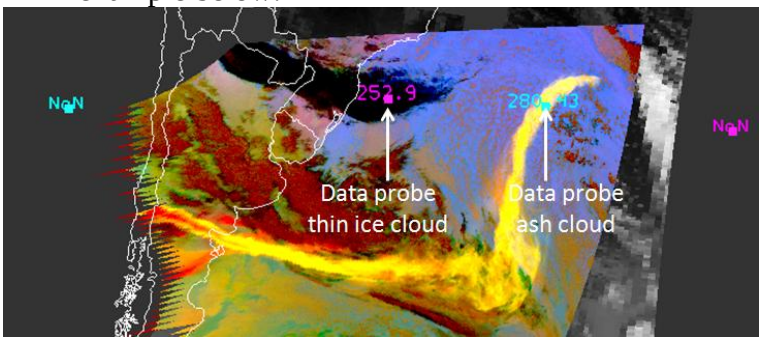


   e. If needed, zoom out to see the full SEVIRI images
   f. Toggle the 2 RGB images: which features can you recognize? What is the reddish stripe in the Airmass RGB over the Atlantic (see image below)?



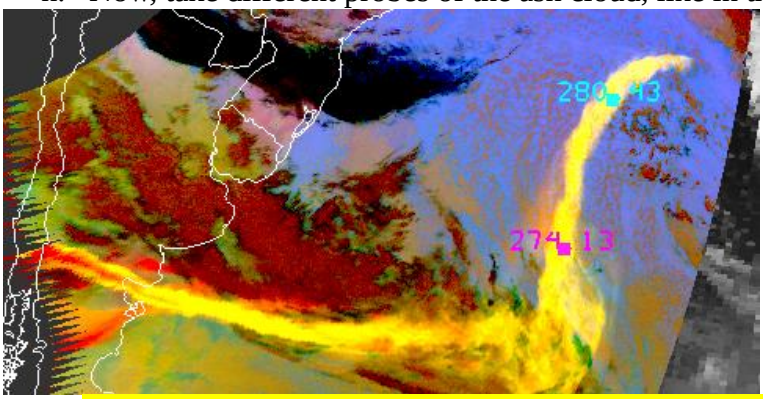
   g. Generate the SEVIRI IR10.8 – IR12.0 difference image: (**Field Selector**: **Formulas → Miscellaneous → Simple difference**)
   h. Change the colour table to use the same range (-5 K to +10 K) and the same colour table as in the Iceland case (Edit colour table: **Colour Table → System → Ash**)
   i. Is this colour table appropriate for this case? Or do you have to modify it? Read the values of the BTD of the ash and the thin ice cloud. What can you tell about the height of the clouds?

8. Look at IASI spectra for different scenes (clouds)
   a. Untick all images, except the two IASI multispectral displays
   b. Drag the data probes back to the image again
   c. Move one of the data probes to the ash cloud and the other one to the thin ice cloud (wave cloud)
   d. You may use the SEVIRI Dust RGB image to identify appropriate points, like shown in the example below:

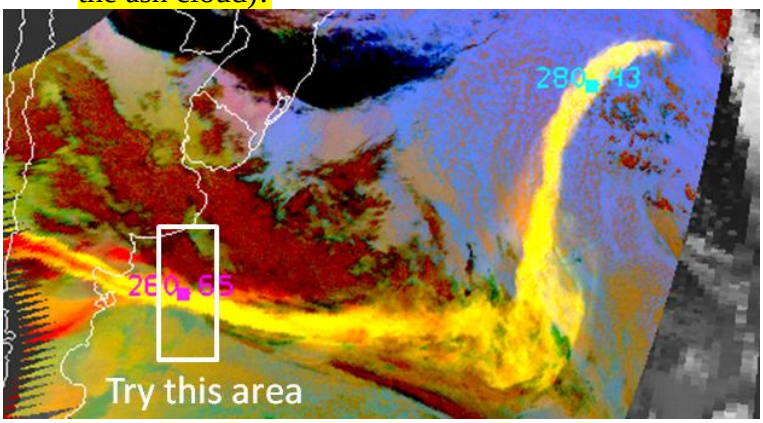


   e. Click on the legend name of the IASI image 'Multispectral**',** to see the **Layer Controls, Display** of the spectra

f. The two spectra should be quite different, especially in the 10-12 micron IR window region. What differences to you see?
g. Compare the spectrum of the Iceland and the Chile ash clouds!
h. Now, take different probes of the ash cloud, like in the example below. What do you see?



i. And if we look even further upstream (see area below), what do you observe (in the IASI spectra of the ash cloud)?



Extra LAB: Eruption of Calbuco Volcano, Chile

Close and Re-open McIDAS-V

Load file containing IASI data (HDF-5 format):

a. Click the **Data Sources** tab in the **Data Explorer** window
b. Click the arrow next to **Satellite,** then click **HYDRA**
c. Browse to **Data → IASI** folder and select the file '**IASI_xxx_1C_M02_20150423134610Z_20150423135929Z_N_O_20150505131229Z.h5**'
d. Click **Add Source**
e. In the **Displays** panel, select **Imagery →MultiSpectral Display**
f. Click **Create Display** (to display default IASI IR channel)
g. Drag the two data probe points onto the image

Load the Metop AVHRR image from 23 April 2015, 13:51 UTC (local data)

a. Display the AVHRR Natural Colour RGB. Can you see the ash cloud?
b. Display IR difference image (IR10.8 – IR12.0) and read/compare ash values
c. Look at different IASI spectra of the ash cloud