Severe convection over Germany seen in SEVIRI, MODIS, CloudSat and VIIRS

New McIDAS-V skills:

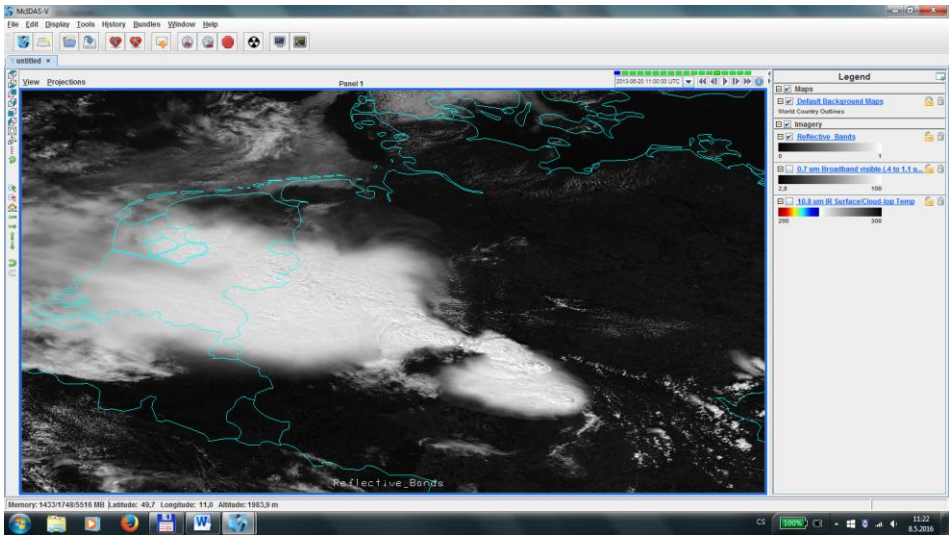
a. Opening MODIS bands and comparison with SEVIRI
b. Opening CloudSat data and comparison with MODIS
c. Opening VIIRS Image bands (under development)

Step-by-step instructions for this case (key questions are in yellow):

1. Open McIDAS-V.
2. Open MSG/SEVIRI data (both HRV and IR10.8) – follow exactly the same procedure as in LAB 13 (2. and 3.), but use only data at 11:00 to 11:10 UTC (5 images) and 12:20 to 12:30 UTC (5 images), the **Region** of Germany, Benelux and the Alps.

3. Open Aqua MODIS 0.6 µm image (band 1). Instead of using the local ADDE server, we display the MODIS image with HYDRA. Unfortunately, the storm in our focus is split into two granules of data, but McIDAS-V can merge them together.

a. Click the **Data Sources** tab in the **Data Explorer** window
b. Click the arrow next to **Satellite** (left column), then click **HYDRA**
c. Browse to **Data → modis250m** folder and select the files "MYD02QKM.A2013171.1220.005.2013176201414.hdf" and "MYD02QKM.A2013171.1225.005.2013176202145.hdf" (these files include data with the resolution of 250 m = ¼ km = QKM)
d. Click **Add Source**
e. In the **Field Selector** tab in the middle column select **MultiSpectral → Reflective_Bands**
f. **Display → Image display**
g. In the **Channels** tab select **Band 1**
h. In the **Region** tab shift-click and drag on the preview image the region around the convective storms over Germany and Benelux (to get the finest resolution)
i. Click **Create Display**
j. The resulting image should look like this:



Toggle the MODIS Band 1 image and the SEVIRI HRV image. Choose the most accurate SEVIRI image considering the shape of the cloud-tops and the estimation, that the south-eastern storm was measured by MODIS approximately at 12:26 UTC (located at the beginning of the granule starting at 12:25 UTC). Keep in mind the method of scanning of MSG and Aqua satellites! Which image has a higher resolution? Why is the storm in the MODIS image further to the south? Try to change the projection of the images.

4. Open Aqua MODIS 11.0 μm image (band 31). Follow the same steps as before (3. a. – i.), but in:

c. Browse to **Data** → **modis** folder and select files "MYD021KM.A2013171.1220.005.2013176201414.hdf" and "MYD021KM.A2013171.1225.005.2013176202145.hdf" with resolution of 1 km

e. choose **Emissive_Bands** (instead of Reflective_Bands)

g. In the **Channels** tab select **Band 31**

h. In the **Region** tab select the same region as before

j. to distinguish the coldest pixels change the scale to "Setvak scale" and change the range to the same range as SEVIRI IR 10.8 (200 to 300 K)

5. Compare the values of the coldest pixels (minimum BT in IR images) and check the displacement.

a. Use the closest time of SEVIRI measurement to the MODIS image, which you have already found.

b. Zoom strongly on the coldest part of the storms over Germany

c. Hold down the mouse wheel to read brightness temperature (BT) values

d. The lat/lon and BT (for both IR images) information appears on the bottom of the display window

e. Move mouse cursor across the image and find the coldest pixel of the MODIS and SEVIRI images

Which BT value is lower and why? Where it is located? Discuss the possible reason(s) for the difference between the MODIS and the SEVIRI BTs.

6. Create a sandwich product of MODIS channels (band 1 and band 31)

a. Change the projection: in the map window **Projections** → **Predefined** → **EuropePS-10E**

b. If it is not, put the MODIS IR on top: right-click on IR image (text, not the colour bar), **View** → **Bring to Front**

c. Change the transparency of the IR-BT layer (the upper one) to create a sandwich product: right-click on the colour scale and choose **Transparency** → **40%** (or others, try what you like the most)

d. Right-click on the colour bar of the IR image, **Edit Colour Table** and the new window (**Color Table Editor**) will pop up

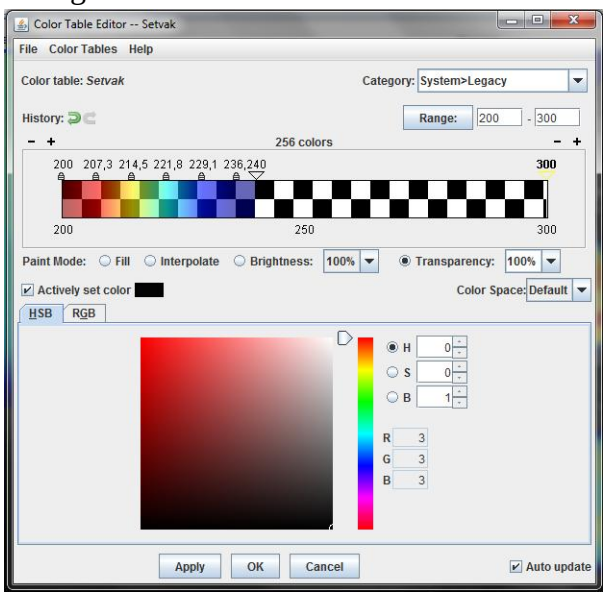
e. Select the 300 breakpoint (left-click)

f. Click the **Transparency** button and set the value to 100 %

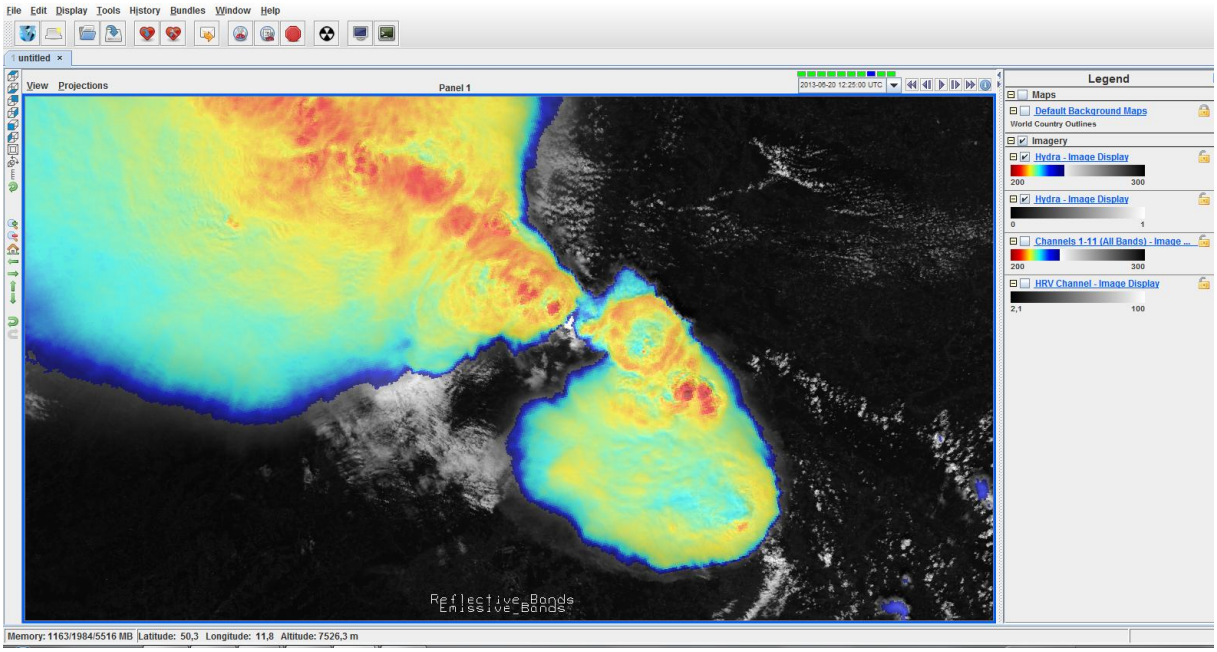
g. Do the same for the 240 breakpoint

h. Interpolate between these breakpoints: right-click on the 300 breakpoint and select from the drop down list **Edit Colours → Transparency (100%) → Interpolate → Left**.

The colour table should change like this:



i. Check the result: you should now see both, the VIS image and the IR image overlaid (for the cold clouds with BT below 240 K)



Study the cloud-tops carefully (toggle the MODIS sandwich IR and the MODIS VIS0.6 images). What features can you see? Where are the coldest IR-BT pixels located? Is every overshooting top cold?

7. Plot the CloudSat measurements (data from space-born cloud radar)

a. Go to **Data Sources** tab in the **Data Explorer** window

b. In the left column click the arrow next to **General** and select **Files/Directories**

c. Navigate to the file '**2013171112439_38015_CS_2B-GEOPROF_GRANULE_P_R04_E06.hdf**' in the folders **Data → cloudsat**

d. Select 'HYDRA data source' under **Data Type**

e. Click **Add Source**

f. In the **Field Selector** tab, select the filename under the **Data Sources** panel (left)

g. In the Fields panel, select **ProfileAlongTrack → 2B-GEOPROF/Data_Fields/Radar_Reflectivity**

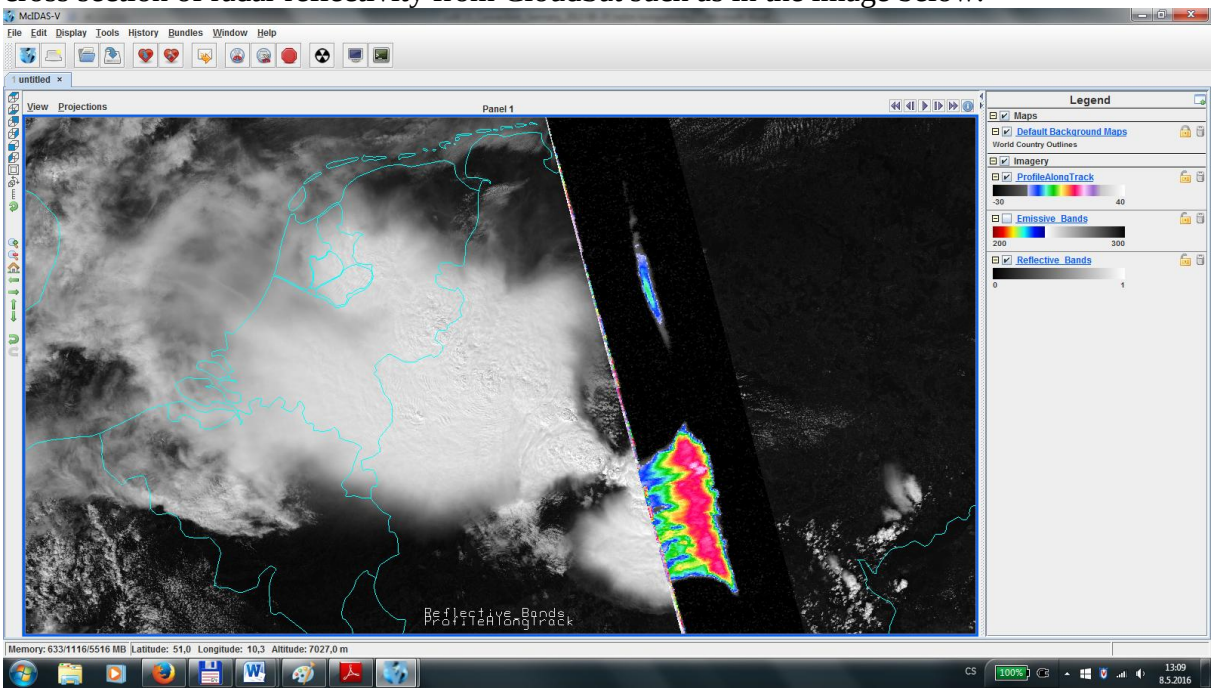
h. Select **ProfileAlongTrack Display** in the **Displays** panel

i. In the **Track** tab, change both **Track stride** and **Vertical stride** to **1**

j. Hold **Shift + left-click + drag** to draw a green box around the portion of the orbit over Europe

k. Click **Create Display**

We have plotted data that utilizes the 3-dimensional capabilities of McIDAS-V. You must use **Ctrl + right-click** to rotate the display. You will need to rotate the display to see the vertical cross section of radar reflectivity from CloudSat such as in the image below.



Take a while to look at the CloudSat observations in connection with MODIS data. Feel free to explore the scene as you wish. What features can you observe?

Note: On the left side of your map window, you will see six cubes. If you get disoriented, you can always click the topmost of these cubes to reset to a top-down viewpoint.

8. Open Suomi-NPP VIIRS images for this case, it overpassed the storms around 11:05 UTC:

a. In the **Data Explorer** window, folder **Data Sources**, on the left column **Under Development → Imagery – Suomi NPP**

b. Browse to the folder **Data → viirs** and open the file ´ GIMGO-SVI01_npp_d20130620_t1105285_e1111089_b08528_c20140716215602993049_noaa_ops.h5´ and **Add Source**

c. In the **Field Selector** tab in the **Fields** select **IMAGE → VIIRS-I1-SDR_All/Reflectance**

d. In the **Displays → Image Display**

e. Choose the **Region** of western Germany and Benelux, but be careful – if you draw over the displayed region or too close to its edge, an error will occur

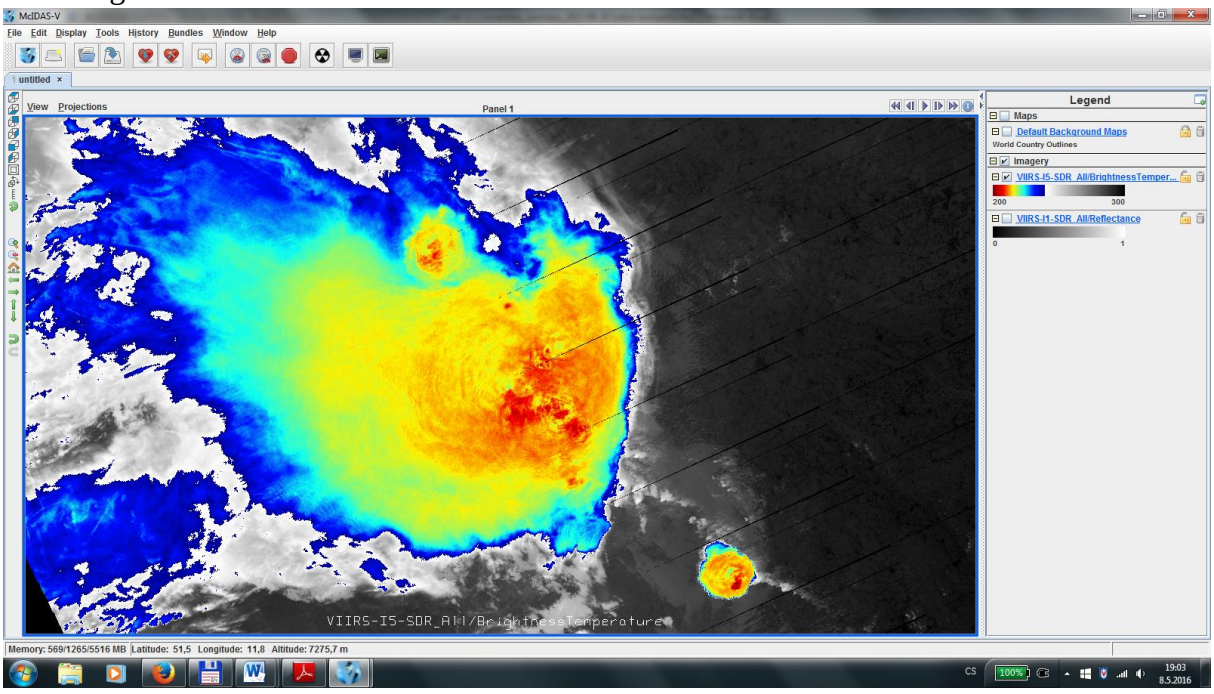
f. Click **Create Display**

There are strange stripes on the VIIRS image. Do you know, what is the cause?

g. Do the same steps to open IR image: repeat a. – f., but in b. open ´GIMGO-SVI05_npp_d20130620_t1105285_e1111089_b08528_c20140716215722960882_noaa_ops.h5´ and in c. select **VIIRS-I5-SDR_All/BrightnessTemperature**

h. Set the Range of the IR image to 200 to 300 K (same as for SEVIRI image) and load the "Setvak" colour table (right-click the colour bar of the IR image and select **System → Legacy → Setvak**).

The image should look like this:



Compare the VIIRS VIS and IR image to the SEVIRI images. What is the main difference? Can you see some interesting features on the VIIRS image?

9. Measure and compare the coldest pixels in IR-BT

a. Use the closest image of the SEVIRI measurement to the VIIRS image

b. Zoom strongly on the cold-ring shaped storm on the south-east

c. Follow the steps in 5 c. – d. with VIIRS and SEVIRI instruments

Which BT value is lower and why? Where is it located? Discuss the possible reason(s) for the difference between the VIIRS and the SEVIRI BTs.

BONUS:

1. We can use also I3 (1.61 micron) to distinguish ice and water particles or try to create RGB product in the resolution of 375 m☺

2. Measure the height of the cloud. There is a shadow casted by the cloud evolving over Central Germany… If we know the exact position of the Sun and satellite…