McV LAB MTG-I – Exploring the NIR2.25 µm cloud phase channel

1. New McIDAS-V skills:

    a. Reflectivity range manipulation
    b. Constructing RGB composites

2. Key concepts:
    a. Test cloud phase sensitivity of the 2.25 µm channel
    b. Test cloud particle size sensitivity of the 2.25 µm channel
    c. Difference other channels (namely 1.6 µm, 0.8 µm VIS and IR window channels)
    d. Utilisation of the 2.25 µm channel in RGB products
    e. Relation to SEVIRI legacy and future of nowcasting

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

CASE I – Polar Air Mass, US, 06 September 2017

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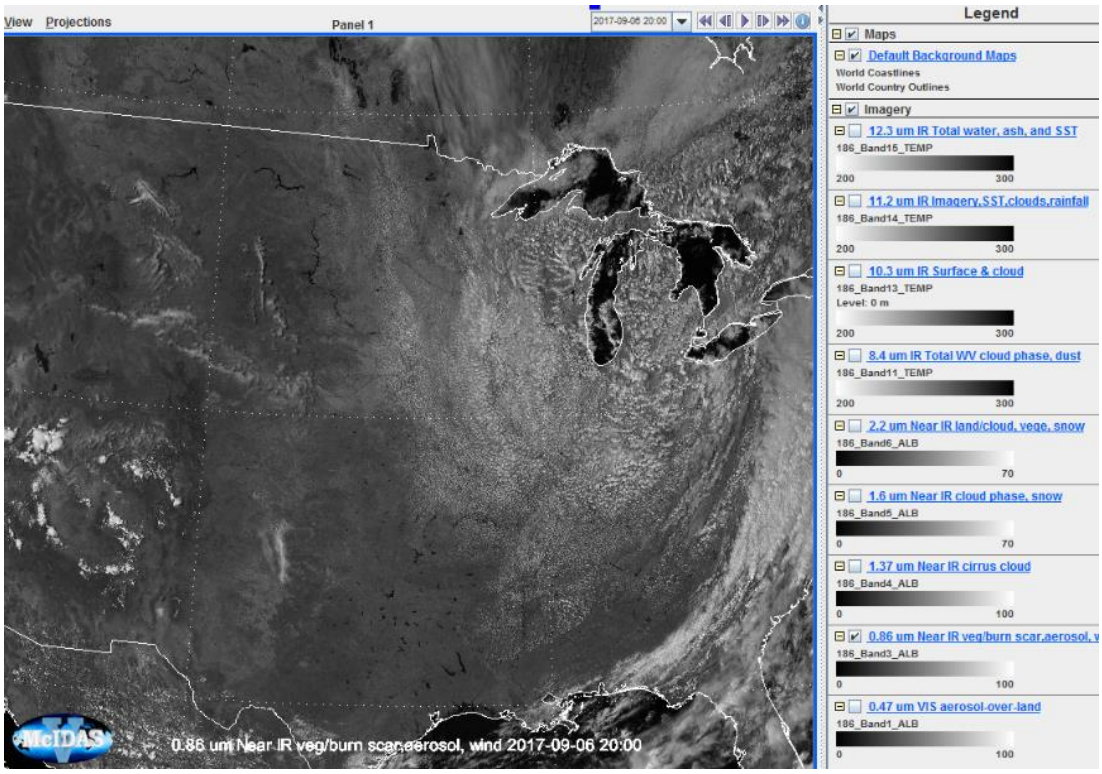
In this example we will explore clouds with different water phase, observed by ABI on 6 September 2017.

1. Display GOES-16 ABI imagery on 6 September 2017, 20:00 UTC (over "CONUS" area, USA)

    a. Open McIDAS-V (version 1.8)
    b. In the McIDAS-V window, go to **File → Open File**
    c. Open the bundle "abi_20170906_g16_vis_ir.mcvz" in the **Data → bundles** directory (wait!!)
    d. If asked, select **Merge with active tab(s)** (default option) and **Write to temporary directory** (default option)
    e. Wait until all frames are loaded, the display window should look like this (VIS0.8 image should be in front):



f. The following bands should be also displayed: VIS0.4 (band 1), VIS0.8 (band 3), NIR1.3 (band 4), NIR1.6 (band 5), NIR2.25 (band 6), IR8.4 (band 11), IR10.35 (band 13), IR11.2 (band 14) and IR12.4 (band 15), using standard ranges [0-100% for VIS bands, 0-70% for NIR bands and 200-300 K for IR bands].

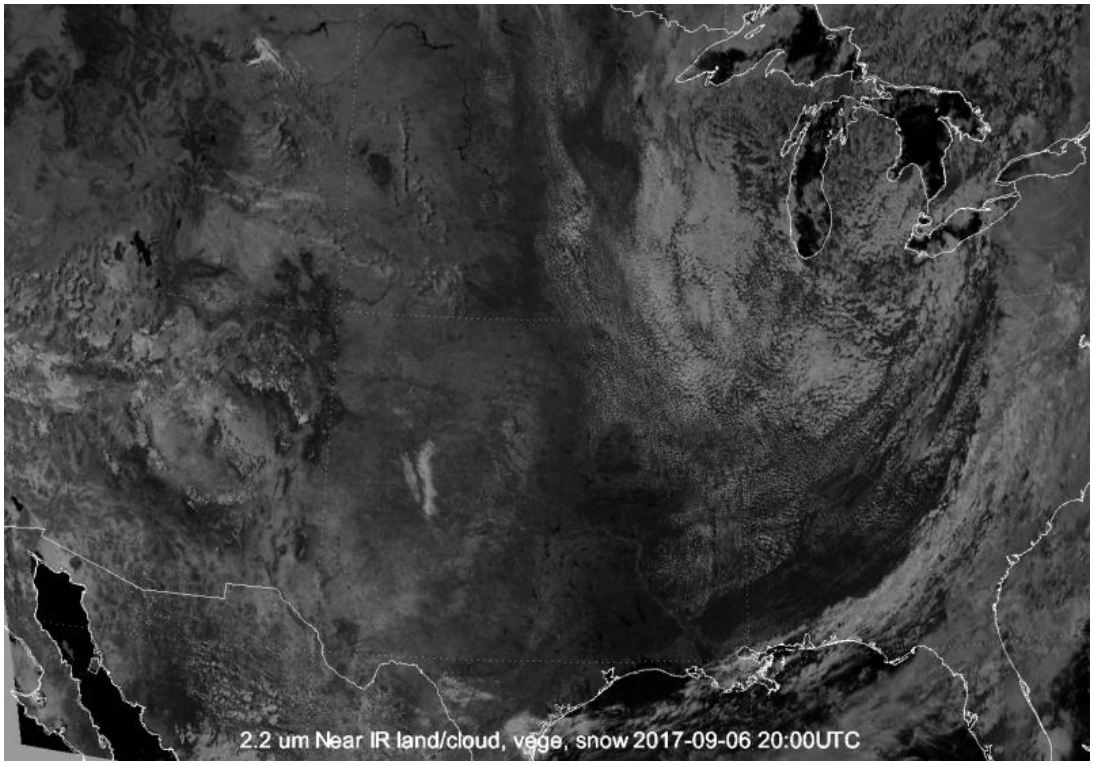
g. Note that ABI has no VIS0.5 band (this is why it is not displayed)

h. Note also that the VIS0.6 (band 2) is not displayed, as it has higher (500 m) resolution

i. Explore the scene by toggling the different bands. Which cloud types can you identify?

j. Can you asses the synoptic situation over the observed domain – do you see any frontal systems?

k. Compare now for instance the VIS0.4 (or VIS0.8) channel to NIR2.2 channel. Toggle between these two. Which channel you think better to distinguish clouds from the bare grounds, and why you think this is the case? Do you think this is anyhow dependent on the cloud type?



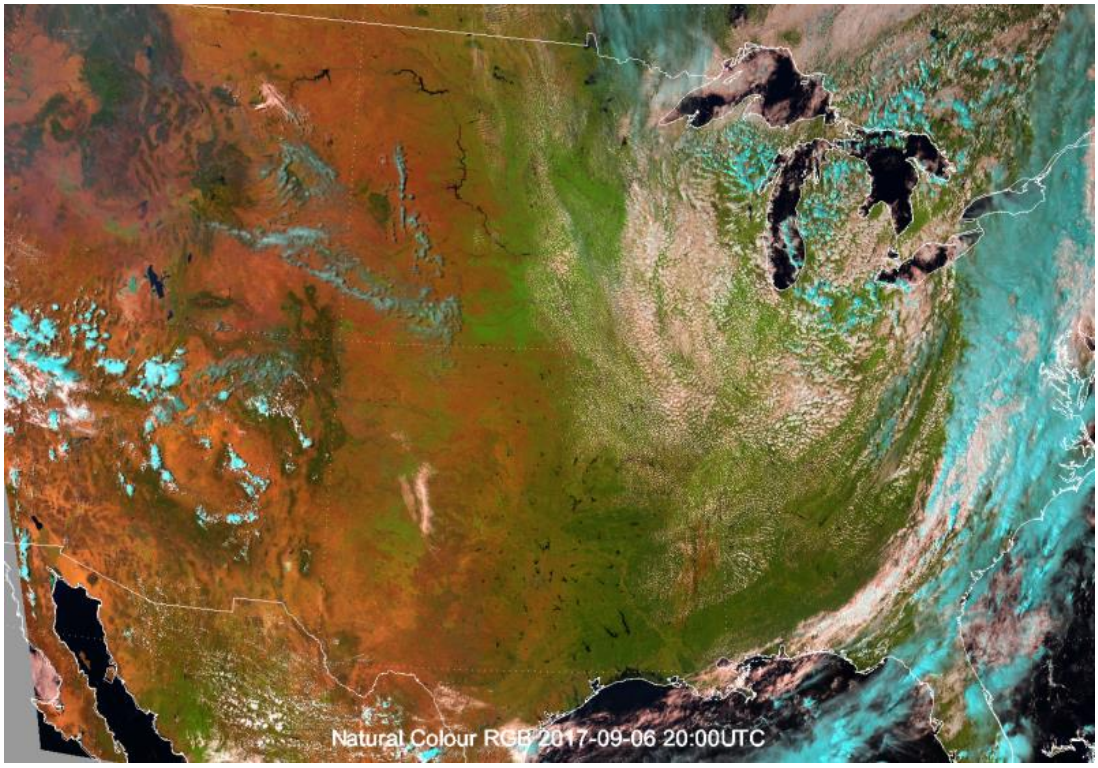
l. Now, let us create the Natural Colour RGB image: in the **Data Explorer** window, under the **Field Selector** tab, click on **Formulas**

m. Then in the Fields panel, click on the flag **Imagery**, and choose **Three Color RGB Image (Auto-scale)**

n. Select **RGB Composite** in the **Displays** panel and click **Create Display** at the bottom.

o. Then a separate window will appear and you can select the ABI bands that are displayed in the red, green and blue 'guns'. Under second flag '**FD – All GOES-16 Full Disk Images**' select the channels: 1.6 um for red, 0.8 um for green and 0.4 um for blue.

p. To get a good image, enhance the RGB image by changing the RGB ranges, in the **Data Explorer** window, **Layer Controls** choose 0-50% for red, 0-80% for green and 0-80% for blue. The RGB should look like this:



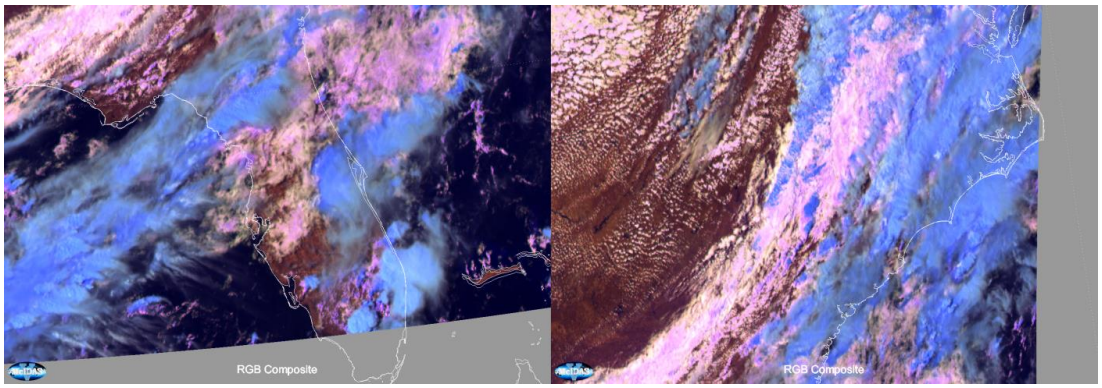
q. Can you better identify clouds in this area? Can you tell more on the type of the clouds, height and especially cloud microphysics/phase?

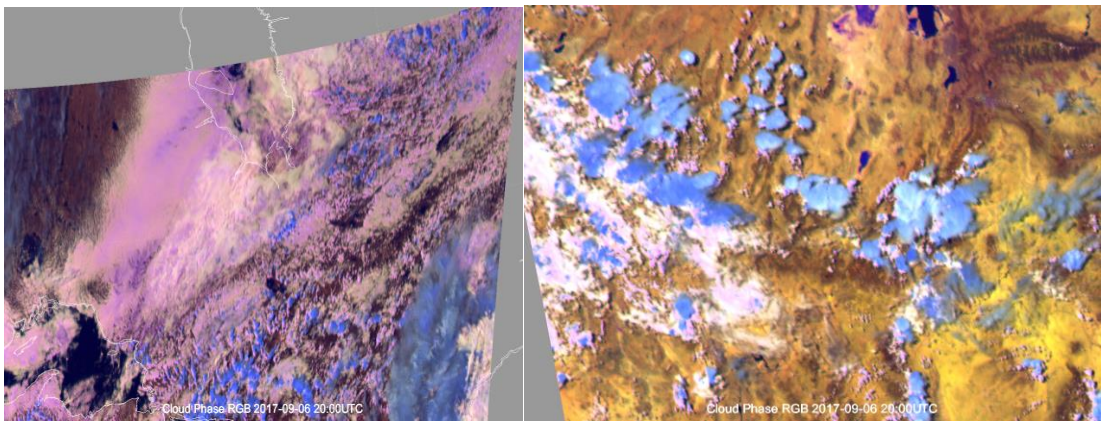
r. Toggle the Natural Colour RGB and the NIR2.2 channel and compare both images. Which clouds blend most with the background (cloud-free) area? What is the phase of these clouds?

s. Now toggle between NIR2.2 and NIR1.6 channel (latter one being used for red beam of Natural Colour RGB that you created). Which one you think reveals cloud phase better?

t. Last but not least, generate the Cloud Phase RGB with NIR1.6 on red (0-40%, Gamma = 1.0), NIR2.25 on green (0-40%, Gamma = 1.0), VIS0.4 on blue (0-60%, Gamma = 1.0)

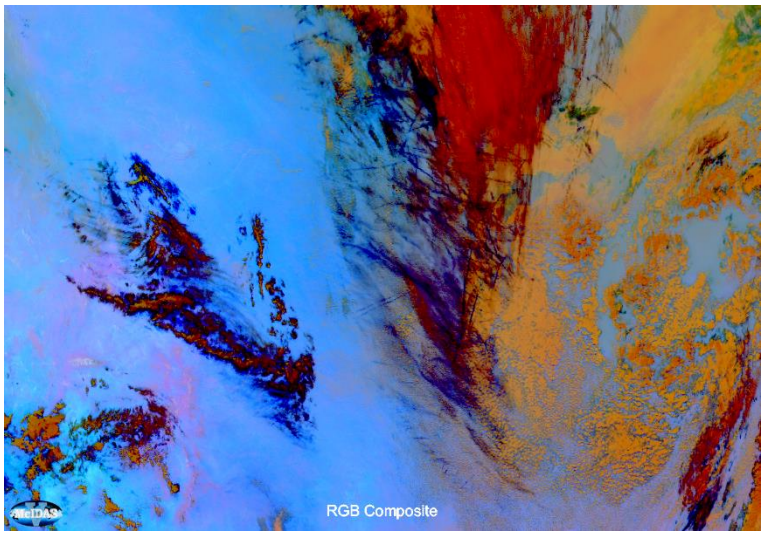
u. As the name says, this RGB uses both NIR channels to study the cloud phase. Zoom onto a) Florida, b) the frontal cloud band in the east of domain, c) cloud field in the NE edge of domain (north of Great Lakes) and d) SW USA (see below) and compare to the Natural Colour RGB.





v. Where do you find most notable differences between two RGB products?
w. Which one is better for cloud phase discrimination?
x. Can you determine particle size of the clouds with Cloud Phase RGB? For which type of clouds is that more important from forecaster's perspective?

2. Extra task: Have a closer look at GOES-16 ABI infrared images and related RGBs (Dust RGB) for the same case.
   a. Observe now the clouds in the domain with 4 available IR channels - IR8.4 (band 11), IR10.35 (band 13), IR11.2 (band 14) and IR12.4 (band 15) – can you say something about the cloud particle size or the phase only looking at the IR channels (is there difference between big and small particles, liquid or ice phase)? Hint: compare channels with the Natural Colour RGB or Cloud Phase RGB.
   b. Generate the tuned Dust RGB image for this case (the ranges for the red and blue beams are slightly different from the standard ranges for the Dust RGB)
   c. In the **Field Selector** tab in the **Data Explorer** window, highlight **Formulas** in the **Data Sources** panel
   d. Select **Imagery → Three Color (RGB) Image (Auto-scale)** in the Fields panel
   e. Select **RGB Image** in the Displays panel
   f. Select **Formulas → Miscellaneous → Simple difference a-b** (or 'Define a formula') for the red field
   g. Select **Formulas → Miscellaneous → Simple difference a-b** for the green field
   h. Select **FD – All GOES-16 → 10.3 um** for the blue field
   i. A new window pops up. Select 12.3 um for field a and 10.3 um for field b. Click **OK**
   j. A new window pops up. Select 11.2 um for field a and 8.4 um for field b. Click **OK**
   k. The Dust RGB for ABI is displayed, but we have to change the ranges and the Gammas in the Data Explorer Layer Controls window to get a better contrast
   l. For red select -8 to +2 K, for green 0 to +15 (Gamma = 0.4) and for blue 261 to 300 K.
   m. The RGB image should look like this:

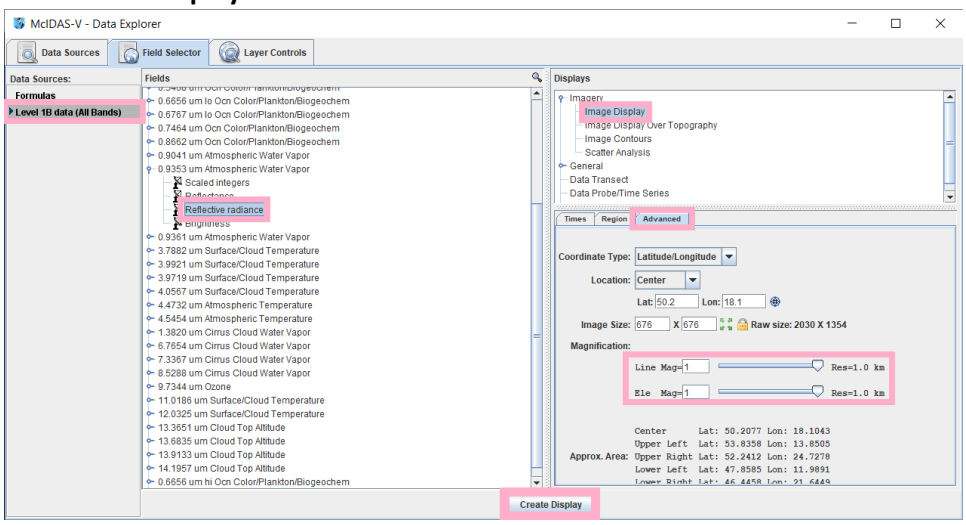


n. In the Dust RGB, thick ice clouds are dark red, thin ice clouds dark blue to black, and mid level water clouds brownish (ochre).
o. Compare the Dust RGB to the Cloud Phase RGB. Is there a good overlap between these two products when it comes to the cloud phase?

ANNEX I – VISUALIZE SINGLE CHANNELS AND CHANNEL DIFFERENCES

a. Under **Fields** window (inside **Data Explorer** window) expand the key node next to channel of interest and choose **Reflective radiance** in case selected channel is in the solar domain, for infrared channels choose **Temperature** option
b. Under **Displays** window expand the **Imagery** key and choose Image Display, go to **Advanced** tab below and click the **icon with four green arrows** to set the resolution to full (1km nominal)

c. Click **Create Display**



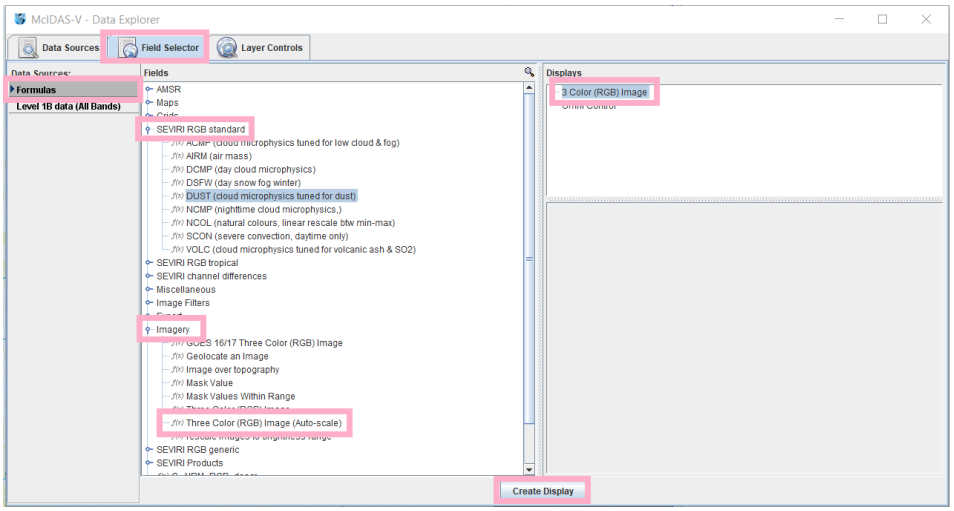
d. To produce a **channel difference**:

   i. In the **Field Selector** tab in the **Data Explorer** window, highlight **Formulas** in the **Data Sources** panel
   ii. Select **Miscellaneous → Define a formula → Image Display → Create Display**. In the **Select Input** window that opens write simple formula: **a-b**
   iii. A new window that pops up: select channel of interest for **field a** and second one for **field b**
   iv. Click **OK**

e. **Should you like to change name of the product** in the main window Legend – click on existing product title in the **Legend** → **Layer Controls** in the **Data Explorer** window will open – **click on the small 'i' symbol** at the foot of the window ('Show Display Control Properties') → Change **Legend Label** (label in the **Legend**) and **Layer Label** (label on the image itself) as you please.

ANNEX II – VISUALIZE RGB PRODUCTS (BOTH STANDARD AND GENERIC)

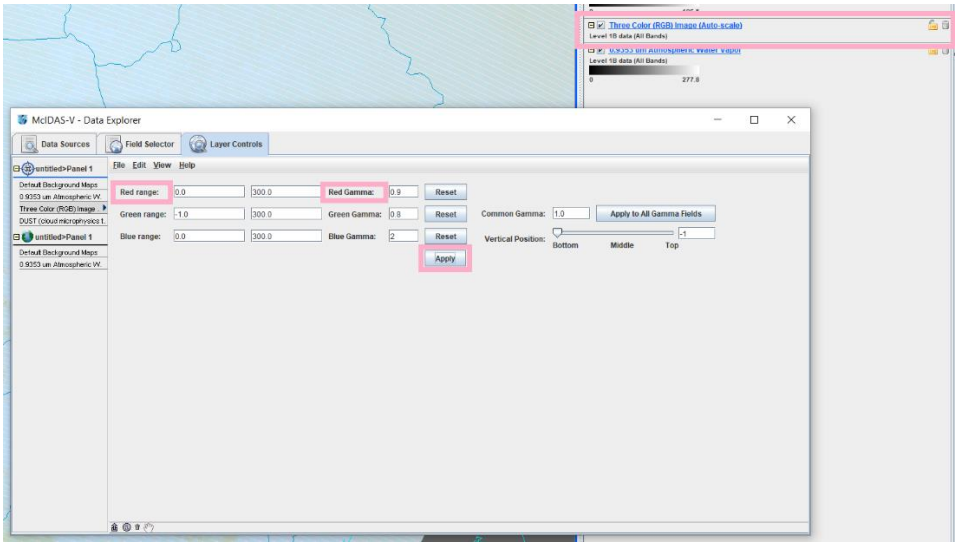
a. In the **Data Explorer**, under **Field Selector** choose **Formulas**
b. In the **Fields** window open the key next to **SEVIRI RGB standard** list and choose product of interest
c. In the **Displays** window choose **3 Color (RGB) Image** and hit **Create Display** on the bottom
d. In the **Field Selector** window that opened automatically, choose suggested channels from the available **Level 1B data (All Bands)** list**,** for each RGB component (closest possible band)
e. To explore the RGB products and applications you can consult the available RGB Quick Guides. And if you want to know more on how RGB recipes are build please consult the EUMeTrain RGB Recipes user manual.



f. **In order to create ANY combination of channels**, i.e. **self-tailored RGB product**, under **Fields** window you should open the key next to **Imagery** and then select **Three Colour (RGB) Image (Auto-scale)** – click **Create Display**

g. In the **Field Selector** window that opened automatically, select channels of your own choice from the available **Level 1B data (All Bands)** list, for each RGB component – after selection click **OK** button

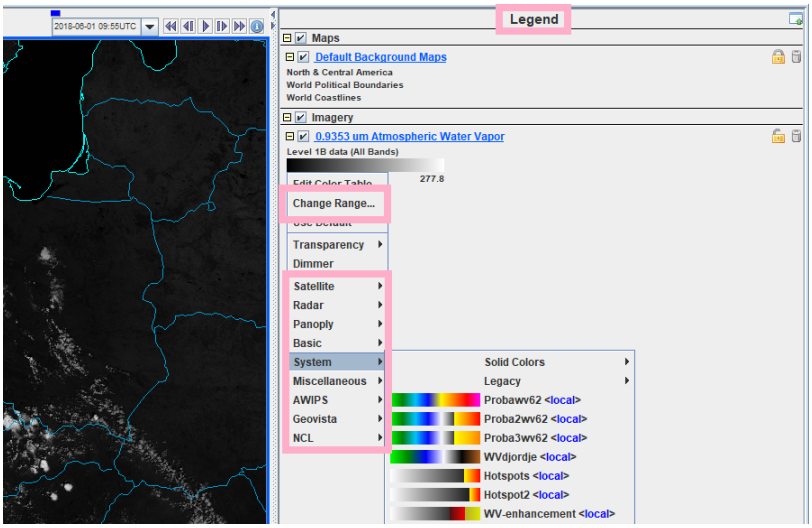
h. In the **main Mc-V window** if you click in on the newly created product name in the **Legend** bar, a **Layer Control** window will open automatically – there you can further **adjust ranges and gamma values** for individual RGB beams:



ANNEX III – CHANGE THE RANGE AND COLOUR SCHEME

a. Change channel temperature/reflectivity range: In main Mc-V window, **Legend** section – **right-click** on the corresponding colour bar and click **Change Range…**

b. Change the colour scheme of the visualised channel: In the main Mc-V window, **Legend** section – **right-click** on the corresponding colour bar and choose between number of pre-defined colour schemes at the **last section** of opened menu



ANNEX IV - SAVE CURRENT VIEW/IMAGE FROM THE MAIN WINDOW

a. In the main Mc-V window navigate to **View**, choose **Capture** and finally click on **Image** (see the image below)