# LAB 11 – Looking at low clouds

Here are the <u>goals of this lab</u>:

1. New McIDAS-V skills:
    a. Opening RGB images
    b. Fine tuning of RGB products
    c. Further enhancements for IR and VIS images

2. Key concepts:
    a. Identification of cloud free areas
    b. Concepts of SST and LST
    c. Differences between IR3.9 and IR10.8 at night-time
    d. IR3.9 : noise and artefacts
    e. Fog detection: night and day-time
    f. Problems with thin radiation fog
    g. Other applications of Night/24h Microphysics RGB
    h. Preparation for MTG (with MODIS example)

Here are <u>step-by-step instructions</u> for this lab (key questions are in <mark>yellow</mark>):

1. Open MSG SEVIRI IR images

    a. Open McIDAS-V
    b. In the **Data Explorer** window, load the **SEVIRI IR10.8** (temperature) data from:
        2014-07-13 21:00:00 UTC for a large African area from 15 deg North to 50 deg South (do not forget to put magnification to 1 (full resolution)).
    c. Change the range of the displayed IR image to **250 to 300 K.**
    d. You can easily identify some big Cb clusters over the DRC (see image below). These clouds are "over-enhanced" (totally white), because in this lab we want to concentrate on surface features and low/mid level clouds.
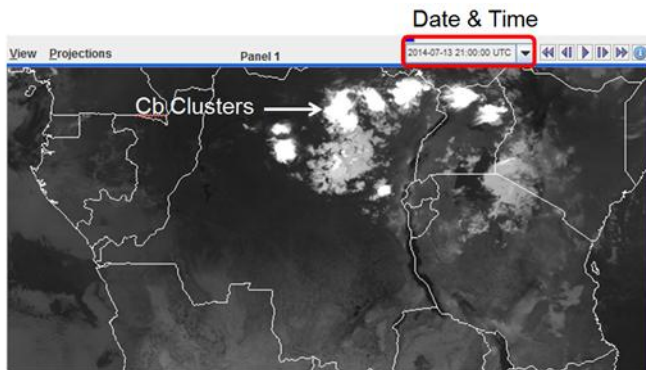

    e. <mark>From this simple IR10.8 black/white image, can you identify areas with low and mid level clouds?</mark>
    f. <mark>Focus on Lake Victoria: is it cloud free? If yes, can you read some IR values to estimate the Lake temperature</mark> (as done in the online activity).
    g. <mark>Focus on the area of South Africa (see image below): is the area cloud free? If yes, read the IR10.8 brightness temperature values. Are there places with temperatures below 0°C? What is the coldest place?</mark> For this, try to create a colour table that colour-enhances the pixels below 0 deg C.
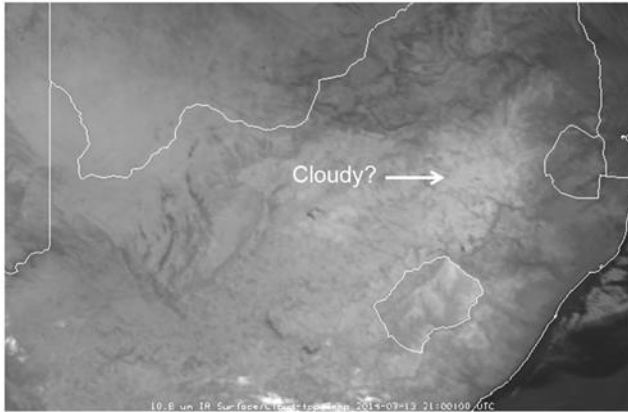
h.   Now add (load) the IR3.9 (temperature) image for the same area and the same range (250 to 300 K)
i.   <mark>Does the IR3.9 image help you to find low and mid level clouds?</mark>
j.   This is a night-time situation: <mark>try to explore the differences between IR3.9 and IR10.8 for different scenes (land, water, fires, low clouds, thin high clouds).</mark>
k.   <mark>Like in the previous lab, can you identify some hot spots (fires) in the IR3.9 image? Where? Which is the hottest pixel?</mark> For this, you may have to change the temperature range of the IR3.9 image.
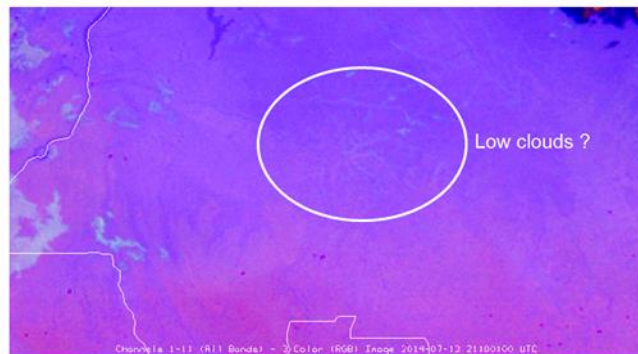

2.   Open MSG SEVIRI RGB images

a.   In the **Data Explorer** window, **Field Selector**, load the **SEVIRI RGB → NCMP** (for info: this is the Night Microphysics RGB) for the same area (is already selected). This RGB product should help to identify low clouds.
b.   Also load the **SEVIRI RGB → ACMP** (for info: this is the 24h Microphysics RGB) for the same area (is already selected). This RGB is very similar to the Dust RGB, but tuned for the detection of low clouds.
c.   <mark>Look again at the areas of step 1 (Africa sub-equator, Lake Victoria, South Africa) and identify cloud free areas, low clouds and mid-level clouds.</mark>
d.   Low cloud detection in Sub-tropics: Focus on South Africa and Swaziland (see image below): <mark>toggle the two RGB products. Which one gives better contrast for the detection of low clouds?</mark>
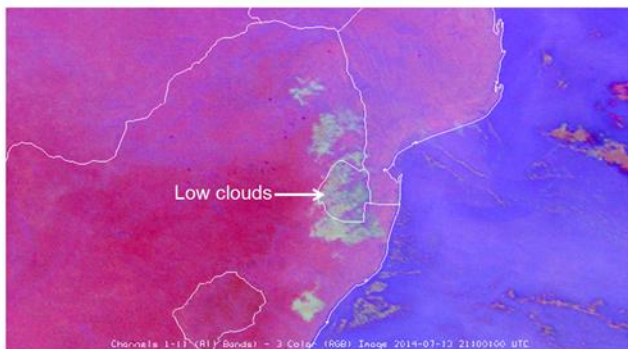

e.   Low cloud detection in Tropics: Focus on Gabon – Congo coastal area (see image below): <mark>toggle the two RGB products. Which one gives better contrast for the detection of low clouds?</mark>
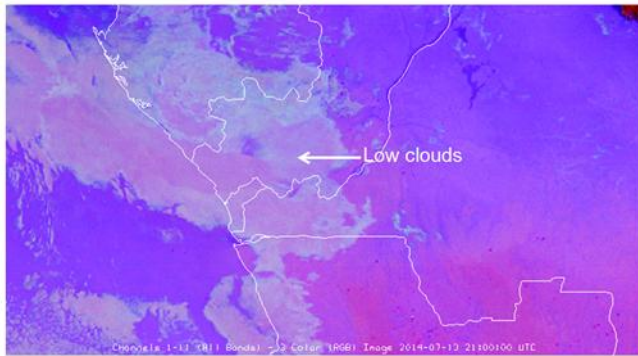
f. In the DRC, river valley fog frequently develops in the night-time and quickly dissolves in the morning hours. So, let us focus on the central part of the DRC (the Kasai and the Sankuru rivers and their tributaries, in the area of Kasai Occidental, see image below): toggle the two RGB products. <mark>Can you see areas with river valley fog?</mark>

g. River valley fog can be very difficult to see at night-time (small areas (sub-pixel), thin radiation fog). So, let us try to enhance the Night Microphysics RGB a bit (for this particular case).

h. In the **Data Explorer** window, **Field Selector**, **Formulas** load the **SEVIRI RGB → GNCM** (for info: this is Generic Night Microphysics RGB where you can tune and play yourself

i.) for the same area (is already selected). The formula allows us to change the ranges of the RGB product (to fine tune the product for low cloud detection).

j. Click **Create Display**, a new window pops up

k. For **Field IR3.9** select **Channels 1-11 → 3.9 um → Temperature**, wait

l. For **Field IR10.8** select **Channels 1-11 → 10.8 um → Temperature**, wait

m. For **Field IR12.0** select **Channels 1-11 → 12.0 um → Temperature**, wait

n. Click **OK**

o. A new image is displayed (very magenta colour) and the **Layer Controls** is shown in the **Data Explorer** window

p. Select the following ranges: **Red range: -4 to +2 K; Green range: 0 to +5 K (normal range is 0 to +10 K); Blue range: 273 to 300 K**.

q. Click **Apply** (repeat and click Enter if nothing happens). The result should look like this:
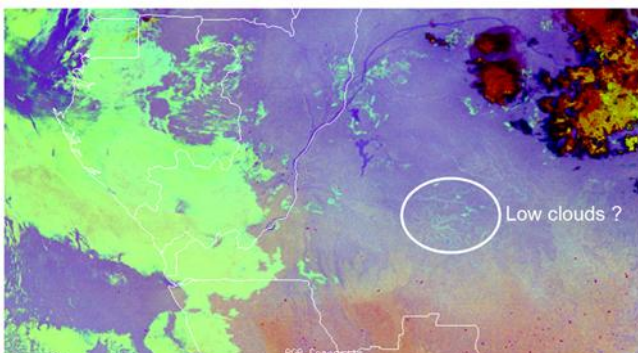
r. <mark>Toggle this fine-tuned Night Microphysics RGB with the "normal" (standard) Night Microphysics RGB: has the contrast for low clouds improved? Can you detect river valley fog?</mark>

3.   Other applications of the RGB Products

a.   In addition to fog (low cloud) detection, the RGB Products (Night Microphysics and 24h Microphysics) have a number of other applications, like thin Cirrus detection, dust detection, ash detection, moisture detection … Let us briefly explore two of these applications.

b.   First, focus on the area of the southern Mozambique Channel and analyze the colour of the RGB products in this area over the Ocean (see images below)
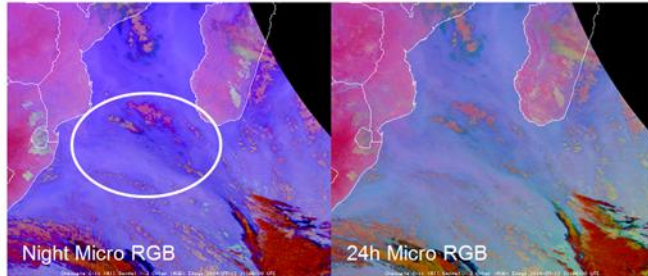
c.   Can you see a colour boundary running across the image? What is the synoptic situation over the Mozambique Channel? Are there any fronts?

d.   Now, let us focus on the hot spot (IR3.9 image) in eastern DRC, close to Lake Kivu. Strongly zoom on this hot spot (see image below).
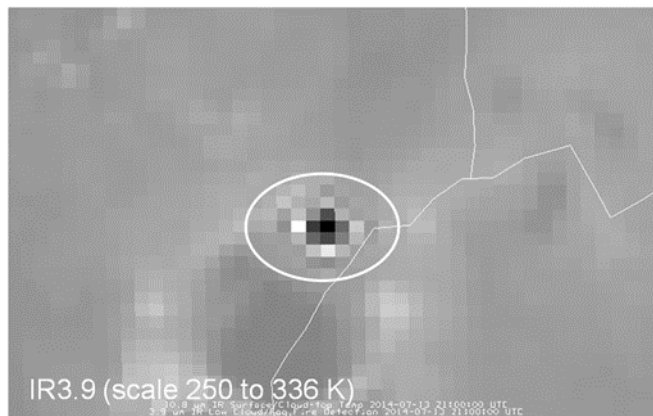
e.   Why does this hot spot look so strange, with white (cold) pixels next to the hot spot?

f.   What do you think has caused this hot spot? A fire?

g.   Now, look at the 24 h Microphysics RGB. What extra feature do you see (green colour)? Can you outline the extent of this feature?

4.   MODIS image

a.   To prepare for MTG (Meteosat Third Generation), let us look at the same scene (DRC, 13 July 2014) with high-resolution (1 km) MODIS data

b.   In the **Data Explorer** window, load the MODIS data from: **2014-07-13 21:10:00 UTC**

c.   In the **Field Selector**, **Formulas** load the **SEVIRI RGB → GNCM** (for info: this is Generic Night Microphysics RGB where you can tune and play yourself)

d.   Click **Create Display**, a new window pops up

e.   For **Field IR3.9** select **Level 1B Data → 3.7882 um → Temperature**, wait

f.   For **Field IR10.8** select **Level 1B Data → 11.0186 um → Temperature**, wait
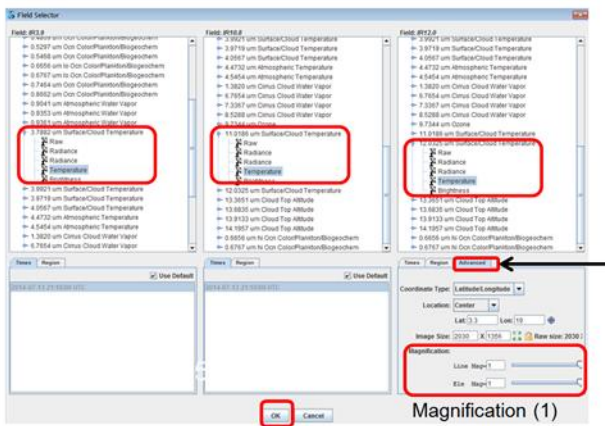
g.   For **Field IR12.0** select **Level 1B Data → 12.0325 um → Temperature**, wait (**do not click OK**)

h.   Increase the size of the window (to see the advanced options)
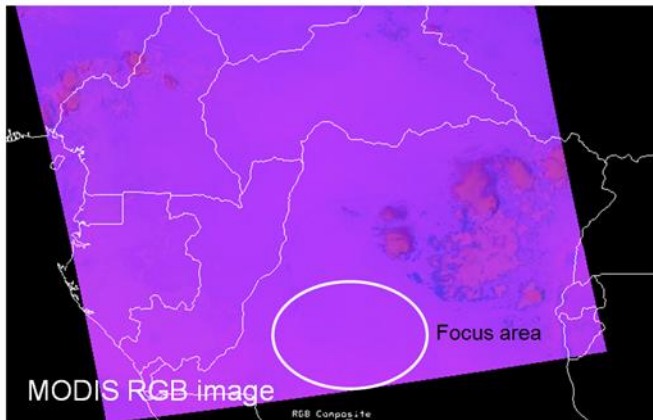
i.   In the **Advanced tab** of the Field IR12.0: put **Magnification** to 1 (full resolution, see screenshot below)

j. In the **Region tab** check that the full MODIS granule is selected

Magnification (1)

k. Finally, Click **OK**
l. A new image is displayed (very magenta colour, see image below) and the **Layer Controls** is shown in the **Data Explorer** window

MODIS RGB image

Focus area

m. Select the following ranges: **Red range: -4 to +2 K; Green range: -3 to 2 K; Blue range: 273 to 300 K**.
n. Extra Question: why do we select a different green range for the fine-tuned MODIS Night Microphysics RGB: -3 to +2 K (instead of 0 to +5 K for SEVIRI)?
o. Click **Apply** (repeat and click Enter if nothing happens). The result should look like this:

Focus area
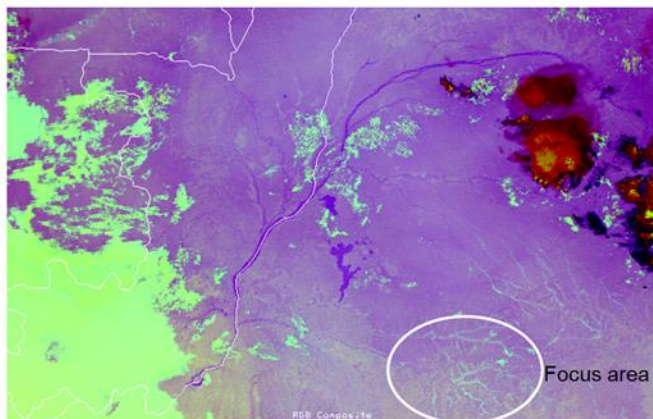
p. Focus again on the central part of the DRC. Compare the MODIS RGB to the SEVIRI RGB: which one is better for the detection of river valley fog? Why?
q. Last but not least, let us look at cold, high clouds in this fine-tuned SEVIRI Night Microphysics RGB. Why do very cold clouds (e.g. in Chad, see screenshot below) have such a funny red-yellow structure? Hint: it helps to look at the IR3.9 channel.
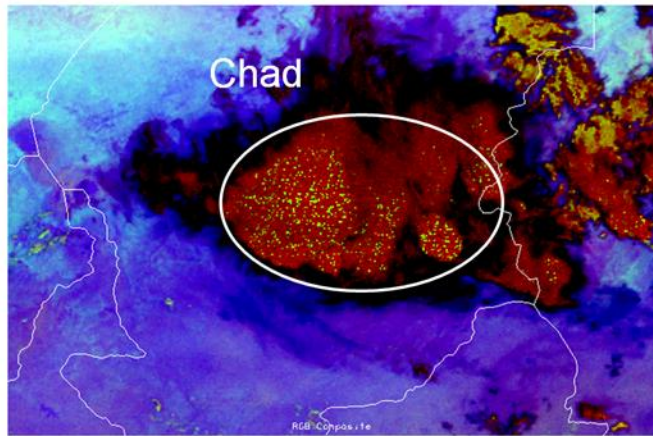
5. Daytime (early morning) situation at 06:00 UTC (following day)

    a. In the **Data Explorer** window, **Data Sources** tab, add the local data source **MSG** from: **2014-07-14 06:00:00 UTC**

    b. Load the **SEVIRI RGB → NCOL** for the DRC – Lake Victoria area (do not forget to put magnification to 1 (full resolution)).

    c. Select **minrefl** 0 and **maxrefl** 20 (early morning, low reflectivities)

    d. Click **Create Display**

    e. Zoom on the central DRC area, the image should look like this:

    f. Can you please analyze the fog situation in DRC at 6 UTC? Has it changed compared to the 21 UTC situation?

    g. What is the cyan feature in the eastern part of the DRC? Hint: load the **SEVIRI RGB → ACMP image**

    h. Now, let us compare the Natural Colour RGB to the high resolution HRV image

    i. In the **Data Explorer** window, **Data Sources** tab, add the local data source **MSGHRV** from: **2014-07-14 06:00:00 UTC**

    j. Load the **0.7 um Broadband → Reflectivity** for the DRC area (do not forget to put magnification to 1 (full resolution))

    k. Enhance the HRV image by changing the range (try to find an appropriate range to get a good contrast of the river valley fog)

    l. Compare the Natural Colours RGB and the enhanced HRV image (for river valley fog)

If you want to read more: Early morning river valley fog in the Democratic Republic of the Congo