Lab: RSA case 16 April 2013

Key learning:

a. Low-level moisture detection through BTD 12.0-10.8 and Dust RGB
b. Drawing and understanding the data transect
c. Overlaying NWP data over the satellite data
d. Displaying and comparing high-resolution LEO imager data (MODIS)

1. Set local ADDE servers (**skip this step(!),** unless you can not load the data)

- McIDAS-V window, Tools <**Manage ADDE datasets**>
- Select <**Local Data**
- Select <**MSG**> Dataset
- Click <**Edit Dataset**>
- Directory: Browse to **data/seviri folder**
- Click <**Open**>
- Click <**Save Changes**>
- **Click <Ok>**

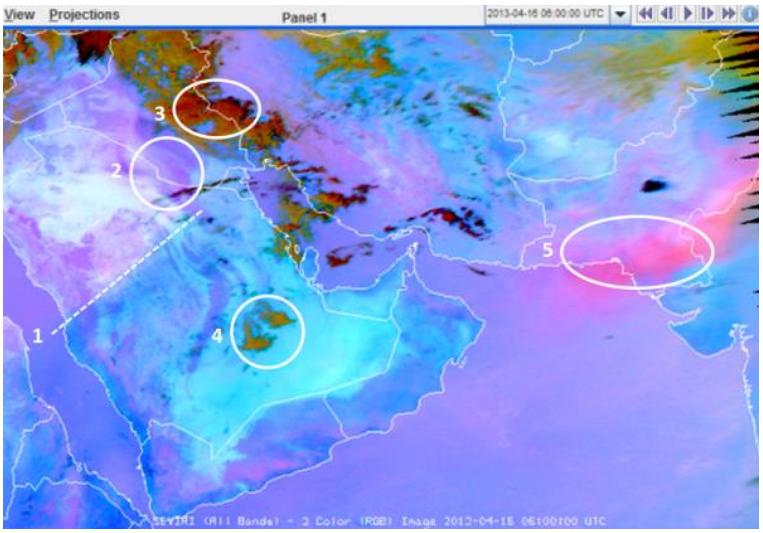
We will also set up a local ADDE server for MODIS data

- Select <**TERRA**> Dataset
- Click <**Edit Dataset**>
- Directory: Browse to **data/modis folder**
- Click <**Open**>
- Click <**Save Changes**>
- **Click <Ok>**

2. Open MSG SEVIRI Dust RGB and Natural Colour RGB images

- McIDAS-V Data Explorer window, <**Data Sources**> tag
- **Satellite Imagery** should be highlighted
- Server: select <**Local Data**>
- Dataset: select <**MSG**>
- Click <**Connect**>, wait
- Image Type: select <**SEVIRI**>
- Times: select <**Absolute**>, you will see two images (06:00 and 14:00 UTC) in the list; select the 06:00 UTC image
- Click: <**Add Source**>**, wait**
- Fields Selector window: select <**SEVIRI RGB**>**,** <**DUST**>, wait
- Displays window: select <**Advanced**> tag
- Put <**Magnification**> slider to maximum (1)
- Select <**Region**> tag
- Select region that includes the Middle East up to the limb (eastern edge) of the MSG image by pressing shift key and dragging the area with the left mouse button
- Click <**Create Display**>, wait

- Zoom on the Middle East. The image should look like this:



Question: Can you identify the features 1 to 5?

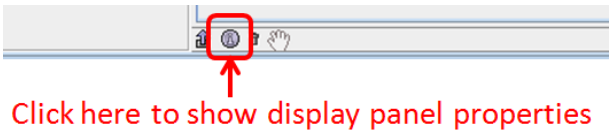
- Go to the Data Explorer window
- Fields Selector window: select **<SEVIRI RGB>, <NCOL>**, wait
- Click **<Create Display>**, wait
- A new window pops up to select the range for the Natural Colour RGB: put minrefl=0 and maxrefl=60, clock **<OK>**

Toggle the 2 RGB images. Question: Are all 5 features visible in the Dust RGB also visible in the Natural Colour RGB?

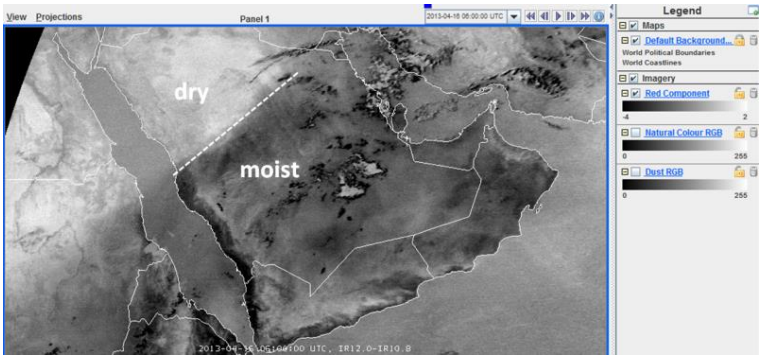
3. Generate the Red component of the Dust RGB image (IR12.0 – IR10.8)

- To better understand the Dust RGB, let us generate the red component of the RGB product
- Go to the Data Explorer window
- In the Field Selector window select data source: **<Formulas>**
- As field select **<Miscellaneous>, <Simple difference a-b>**
- As Display select **<Image Display>**
- Click **<Create Display>**
- A new window pops up
- for Field a select SEVIRI, 12.0 um IR, Temperature, wait
- for Field b select SEVIRI, 10.8 um IR, Temperature, wait
- Click <OK>
- The Difference IR12.0 – IR10.8 (the red component of the Dust RGB) is now displayed with a greyscale colour table
- Change the range to [-4, +2]
- Click **<Apply>**
- If the result is ok, click **<OK>**
- It is useful to change the label of displayed image
- Left click on the text of this layer to display the Layer Controls

- Click on the Info button (see below)



- Change the **<Legend Label>** to "Red Component"
- Change the **<Layer Label>** to "%timestamp%, IR12.0 – IR10.8"
- Click **<OK>**
- Now, the difference image should look like this:



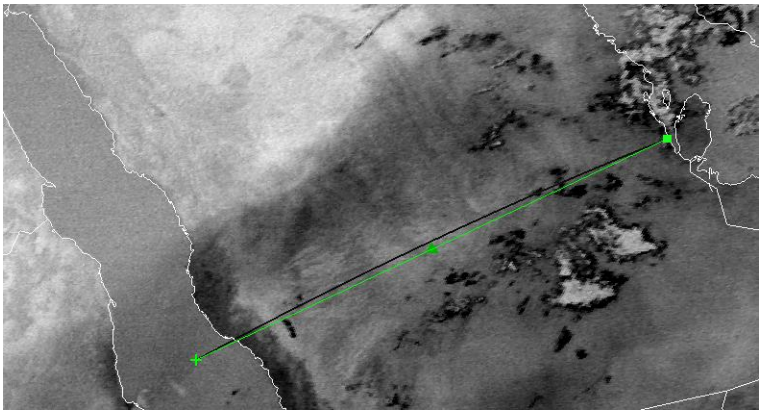
There is a moisture boundary running across Saudi Arabia. Please, read some typical values of the IR12.0 – IR10.8 difference for the dry and the moist area!

- To do this, click and keep pressed middle mouse button
- The lat/lon and BT information appears on the bottom of the display window (keep out of Full screen view, to notice values at the bottom!)
- Move mouse cursor across the image
- Read and note the BTD (brightness temperature difference) values of the Red Component

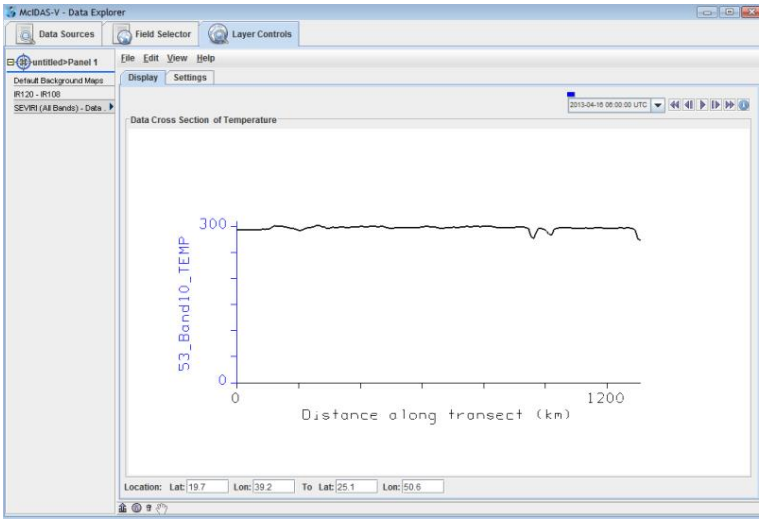
Question: What is the largest (negative) value that you get in the moist (cloud-free) area? And what are the values in the dry area? (read also the values over the Red Sea)

4. Plot a data transect for the IR12.0 channel from dry to moist airmass

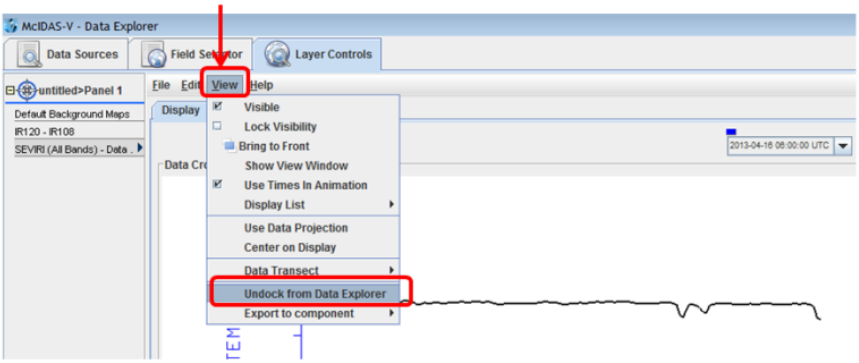
- Go to the Data Explorer window
- In the Field Selector, select **<12.0 um>, <Temperature>**
- In the Displays window, select **<Data Transect>**
- Click **<Create Display>**
- A cross-section indicator appears in the McIDAS window (see below)



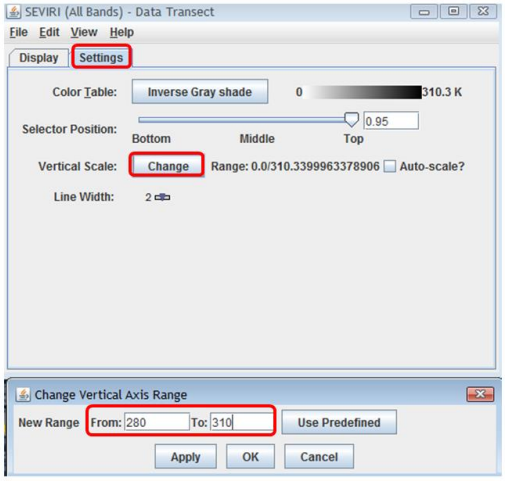
- And the values of the cross-section appear in the Data Explorer window (Layer Controls, see below)



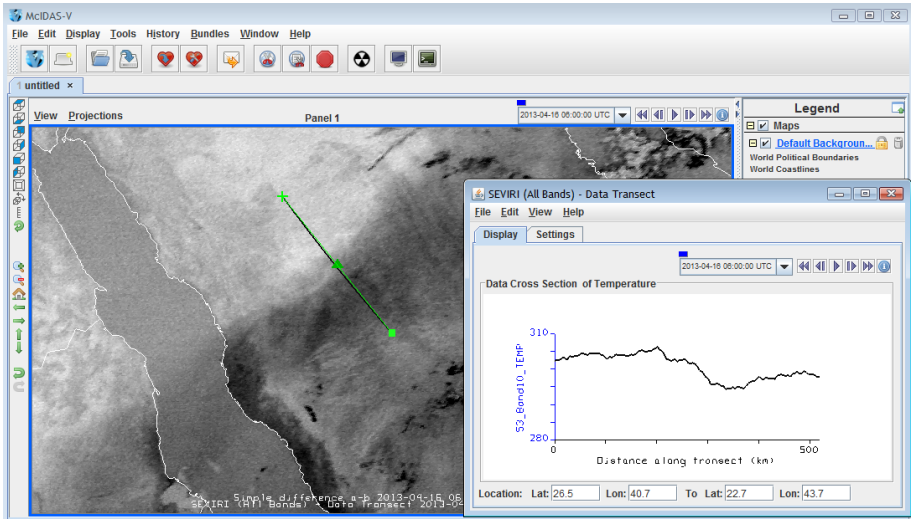
- To get a separate window for the cross-section data, select the **<View>** menu and select **<Undock from Data Explorer>** (see below)



- And change the vertical scale as indicated below (280 to 310 K):



- Last but not least, drag the endpoints of the cross-section to the desired positions (from dry- to moist airmass, see example below), and have a look at the result



Question: This display shows the cross-section of the IR12.0 brightness temperature. Why does it drop by several K when moving from the dry to the moist airmass? And what does this tell us about the vertical stratification (temperature profile) of the lower atmosphere? Do we have a temperature inversion?

Extra lab: you may also create a cross section for the IR12.0 – IR10.8 difference

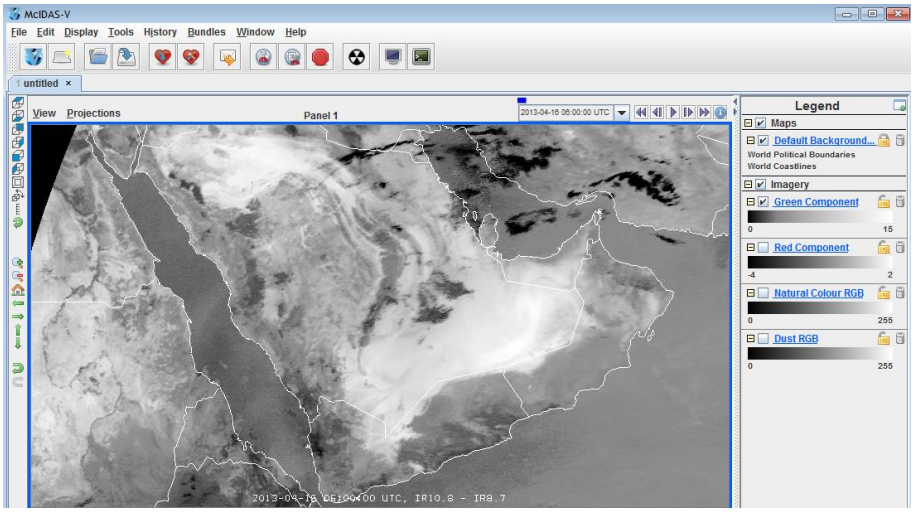
- Before we continue, remove the display of the cross-section

5. Generate the Green component of the Dust RGB image

- Go to the Data Explorer window
- In the Field Selector window select data source: <**Formulas**>
- As field select <**Miscellaneous**>, <**Simple difference a-b**>
- As Display select <**Image Display**>
- Click <**Create Display**>
- A new window pops up

- for Field a select SEVIRI, 10.8 um IR, Temperature, wait
- for Field b select SEVIRI, 8.7 um IR, Temperature, wait
- In the <**Advanced**> tag make sure that <**Magnification**> is set to maximum (1)
- In the <**Region**> tag make sure that the same region is selected
- Click <OK>
- The Difference IR10.8 – IR8.7 (the green component of the Dust RGB) is now displayed with a coloured colour table (not so useful in our case)

- We will again change the range and select a black/white colour table
- Right click on the colour bar of this layer and select <**Edit Colour Table**>
- From the "Colour Tables" drop down menu, select <**Satellite**>, <**Group1**>, <**GAM25**>. This colour table is black/white with a Gamma enhancement of 2.5.
- Change the range to [0, +15]
- Click <**Apply**>
- If the result is ok, click <**OK**>
- It is useful to change the label of displayed image
- Left click on the text of this layer to display the Layer Controls
- Click on the Info button
- Change the <**Legend Label**> to "Green Component"
- Change the <**Layer Label**> to "%timestamp%, IR10.8 – IR8.7"
- Click <**OK**>
- Now, the difference image should look like this:



Question: Can you see the moisture boundary in this difference image? Why are sandy desert surfaces so bright (white) in this image? Why are ice clouds black? Toggle this difference image and the IR12.0 – IR10.8 difference image (and the Dust RGB).

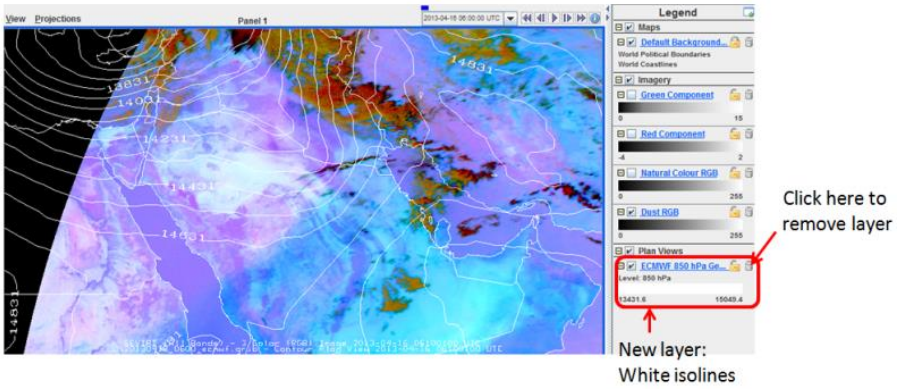
6. <u>Analyze the synoptic situation with the satellite image & NWP fields</u>

- Let's open the ECMWF 6 UTC analysis for this case (GRIB data)
- McIDAS-V window, **<File> <Open File>**
- Browse to **data\ecmwf**
- Change **<Files of Type> to <All Files>**
- Select 20130416_0600_ecmwf.grib

- Click **<Open>, wait**
- Go to McIDAS-V Data Explorer window
- Select the **<Field Selector>** tag
- Select **<3D grid>, <Geopotential>**, wait
- In the Displays window select Level, 850 hPa
- Click: **<Create Display>, wait**

You should see the 850 hPa Geopotential field (coloured lines).

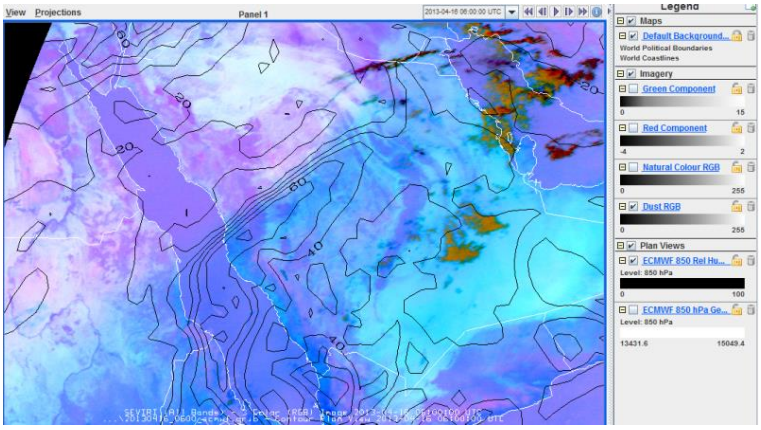
- Change the colour table to **<System>, <Solid Colours>, <White>**
- Let us change the interval of the isolines
- Left click on the name of the 850 hPa field layer
- In the Layer Controls click Contour **<Change>**
- Change **<Contour Interval>** to 100
- Clock **<OK>**
- Change the text label of the displayed 850 hPa field to "850 hPa Geopotential"
- The display window should look like this (Dust RGB background):



Question: What is the synoptic situation in the Middle East? Where is the upper-level trough? Where is the cold front? Is there any post-frontal dust visible in the dust RGB? What is the convective situation in the Middle East (consider that this case is 6 UTC in April!)? If you want, you can also display other NWP fields, like the 300 hPa Geopotential or the 300 hPa Potential Vorticity or the 500 hPa relative Vorticity. For each field, select a different colour.

7. Compare Dust RGB (and IR12.0 – IR10.8 BTD) image to model moisture fields

- Let us try if we can see the moisture boundary also in NWP fields (let us do a model verification)
- Go to McIDAS-V Data Explorer window
- Select the **<Field Selector>** tag
- Select **<3D grid>, <Relative Humidity>**, wait
- In the Displays window select Level, 850 hPa
- Click: **<Create Display>, wait**
- Change the colour of the isolines to Black; the display should look like this:

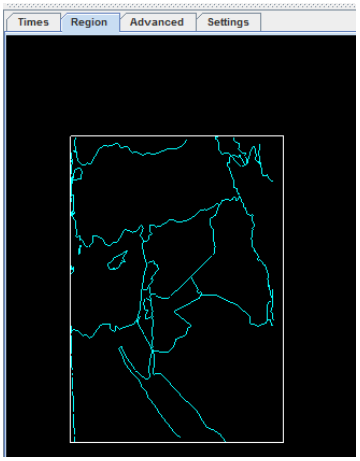


Question: Why did we choose the 850 humidity and not the 1000 hPa humidity or the surface humidity? Does the model field (rel. humidity) match the satellite info? Are there small discrepancies, where?

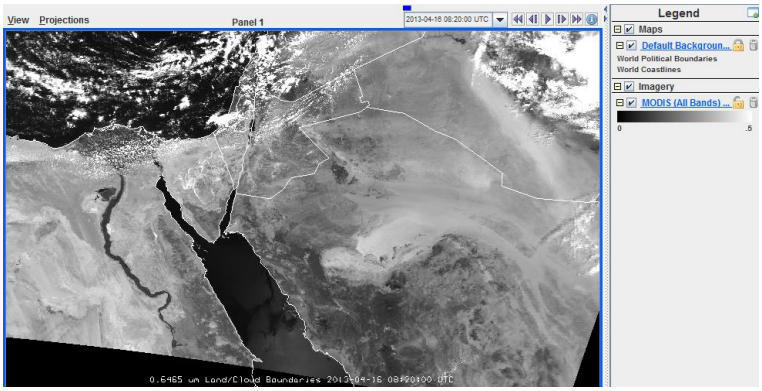
Now that you know a bit more about the synoptic situation and the moisture distribution, can you please make a forecast for a) the convective situation over Saudi Arabia and b) the dust situation over the Middle East in the next 6-8 hours.

8. Terra MODIS image at 8:20 UTC

- McIDAS-V Data Explorer window, **<Data Sources>** tag
- Satellite Imagery should be highlighted
- Server: select **<Local Data>**
- Dataset: select **<MODIS>**
- Click **<Connect>**, wait
- Image Type: select **<L1b calibrated>**
- Times: select **<Absolute>**, you will see two images in the list: select 16 April 2013 (08:20 UTC)
- Click: **<Add Source>**
- Fields Selector window: select **<0.6465 um>**, **<Reflectance>**, wait
- Displays window: select **<Advanced>** tag
- Put **<Magnification>** slider to maximum (1)
- Select **<Region>** tag
- Select the entire region (see example below) by pressing shift key and dragging the area with the left mouse button

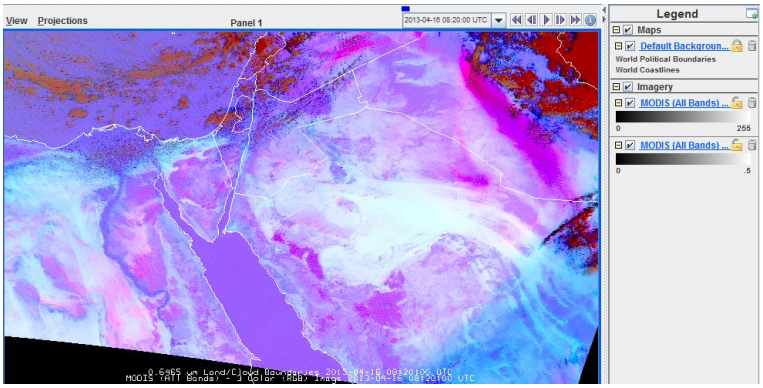


- Click <**Create Display**>, wait
- Zoom on Saudi Arabia
- Change the range to 0.0 to 0.5
- The resulting image should look like this:



Question: can you see the moisture boundary in this 0.6 micron MODIS image? Can you see dust clouds? Where?

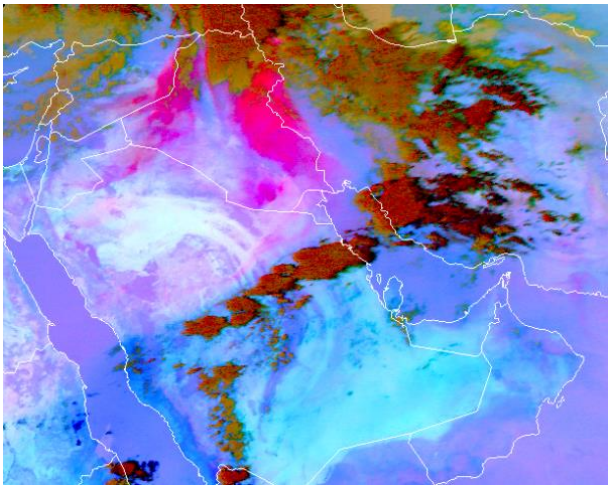
- Now, let us create the Dust RGB
- Fields Selector window: in <**Data Sources**> select <**Formulas**>
- Select <SEVIRI RGB>, <DUST>
- Click: <**Create Display**>, wait
- A new window pops up (Field selector)
- Left: Field IR8.7, select <**MODIS 8.5288 um**>, <**Temperature**>, wait
- Middle: IR10.8, select <**MODIS 11.0186 um**>, <**Temperature**>, wait
- Right: IR12.0, select <**MODIS 12.0325 um**>, <**Temperature**>, wait
- Do not click Ok!!!
- Resize the Field Selector window – make it bigger so that you can see the Times, Region and Advanced tags of the 3rd Field
- Make sure that <**Magnification**> is set to maximum (1)
- Make sure that <**Region**> is the full region (if not already set)
- Click <**Ok**>, wait…
- The result should look like this:



Toggle the 2 images (dust RGB and VIS image). Question: what extra info do you get from the IR-based Dust RGB image? Is the dust over Iraq thick or thin? Has convection along the moisture boundary over Saudi Arabia started (zoom on the moisture boundary)?

9. Situation at 14:00 UTC

- McIDAS-V Data Explorer window, <**Data Sources**> tag
- Satellite Imagery should be highlighted
- Server: select <**Local Data**>
- Dataset: select <**MSG**>
- Click <**Connect**>, wait
- Image Type: select <**Channels 1-11**>
- Times: select <**Absolute**>, you will see two images (06:00 and 14:00 UTC) in the list; select the 14:00 UTC image
- Click: <**Add Source**>**, wait**
- Fields Selector window: select <**SEVIRI RGB**>**,** <**DUST**>, wait
- Displays window: select <**Advanced**> tag
- Put <**Magnification**> slider to maximum (1)
- Select <**Region**> tag
- Select region that includes the Middle East up to the limb (eastern edge) of the MSG image by pressing shift key and dragging the area with the left mouse button
- Click <**Create Display**>, wait
- Zoom on the Middle East
- To see some city locations, go to the McIDAS-V window, <**Display**>**,** <**Plot Location Labels**>**,** <**World**>**,** <**Middle East**>
- If you want, you can change the symbol and the colour of the plotted locations (left mouse click on the text of the locations layer). White is usually the best colour (on RGB background images).
- The situation at 14:00 UTC should look like this:



Toggle the 06 UTC and the 14 UTC Dust RGB images. Convective storms develop close to the Moisture Boundary (Dry Line). Convective storms also develop over Yemen (orographic convection, sea breezes). Post-frontal dust (Shamal) can be seen over Iraq. As the low-level winds are nearly parallel to the Dry Line, the cold front and the dust do not move far south.