LAB 4 – Investigate a tropical depression with MODIS and AMSR in addition to AIRS

We will continue to explore the tropical depression case from the weighting function lab, but will use data from the AMSR-E sensor and focus on interpretation of microwave imagery.

Goals for this lab:

1. Learn how to create MODIS true-color RGB images
2. Learn how to create a local ADDE dataset (this will likely be a useful skill if you ever try to use your own data with McIDAS-V)
3. Plot several microwave channels from the AMSR-E (Advanced Microwave Scanning Radiometer for the Earth Observing System) sensor and learn to interpret the differences between them

Instructions for this lab (key questions are in **bold)**:

1. Open McIDAS-V
2. In the map display window, click **View → Properties**, and confirm that the **Auto-set projection** option is **unchecked**. Click **OK**.
3. We'll start by creating a true color MODIS RGB image so you can remind yourself how things look.
    a. Click the **Data Sources** tab in the **Data Explorer** window
    b. Click the arrow next to **Satellite**, then click **HYDRA**
    c. Navigate to the MODIS file "**MYD021KM.A2011244.1905.005.2011245153109.hdf**" in the folders **Data → MODIS**
    d. Click on the file and click **Add Source**
    e. In the **Field Selector** tab, click **Formulas**
    f. In the **Fields** display click the arrow next to **Imagery and s**elect **Three Color (RGB) Image (Auto-scale)**
    g. Select **RGB Composite** under the **Displays** panel
    h. Click **Create Display**
    i. A new window will open. For each color *(RGB = Red, Green, Blue)*, select **Hydra → MultiSpectral → Reflective Bands**, and select the appropriate band under the **Channels** tab:
        i. Red: Band 1 (0.67 microns)
        ii. Green: Band 4 (0.565 microns)
        iii. Blue: Band 3 (0.479 microns)
    j. Click **OK** and wait.
    k. Brighten the image by lowering the Gamma value in the **Layer Controls** tab - 0.5 works well. You only need to change the value in the **Common Gamma** box at the bottom and click **Apply to All Gamma Fields**.
    l. Now you have a true-color image of the scene that you can compare to the microwave channels we will plot in the following steps.
4. Now you will add the AMSR-E data to explore the scene using various microwave channels.
    a. First, we need to add a local ADDE dataset in McIDAS-V.
        i. In the map window click **Tools → Manage ADDE Datasets**
        ii. Click **Add New Dataset** and fill in the required information
        iii. **Dataset**: "MW_LAB"
        iv. **Image Type**: "AMSRE"
        v. **Format**: "AMSR-E L 1b"
        vi. **Directory**: browse to the folder **Data → AMSR**. You need to select the directory itself, not the file inside it.
        vii. Click **Add Dataset** and **OK**
    b. Add this as data source
        i. Go to **Data Sources** tab in the **Data Explorer** window
        ii. Click the arrow next to **Satellite** and select **Imagery**

iii. Select **Server**: <LOCAL-DATA>
iv. Select the **Dataset** you've just created: MW_LAB
v. Click **Connect**
vi. Select **Image Type**: AMSRE
vii. Go to the **Absolute** tab and select the image at **2011-09-01 18:30:52 UTC**
viii. Click **Add Source**

c. Now you can create displays for as many AMSR channels as you wish. For example, here are step-by-step instructions to create a display of 6 GHz vertically polarized brightness temperatures:
   i. In the **Field Selector** tab, click **AMSR (All Bands)** in the **Data Sources** panel
   ii. Under the **Fields** panel, click the arrow next to **6 GHz-V Brightness Temperature** and select **Temperature**. Note: H stands for Horizontal Polarization, but V- for Vertical Polarization.
   iii. Select **Imagery → Image Display** under the **Displays** panel
   iv. Click the **Advanced** tab, and click the button with 4 green arrows - this is to make sure you get a full-resolution image
   v. Click **Create Display**
   vi. We'll be adding several channels, therefore rename this display so you keep track of all your channels:
      1. In the **Layer Controls** tab, click **AMSR (All Bands)**
      2. Select **Edit → Properties**, and change the **Legend Label** to something like "6V"
   vii. Play around with different enhancement tables and data ranges to get you plot to display nicely. A good color table choice for microwave brightness temperatures is **System → Temperature**.

d. Now you can keep plotting AMSR channels using the instructions from the previous step (Definitely plot at least 6H, 10H, 37V, 89V-B). You should be able to skip the "*Click the Advanced tab…*" step from now on. Here are some important questions to consider as you explore these channels:
   i. Which channel sees most of the surface? Why?
   ii. Which channel sees least surface signal? Why?
   iii. Focus on the deep convective clouds over the Gulf of Mexico.
      1. At 37 GHz, precipitating areas are warmer than the ocean surface.
      2. However, at 89 GHz, precipitating areas are colder than the ocean surface.
      3. Why?
   iv. Now focus on the clouds over Florida.
      1. Now you see that the tall clouds are colder than the land surface at both 37 and 89 GHz.
      2. Why?
   v. Can you identify any strange features over land that look like artifacts (hint: focus on 6 and 10 GHz)? If so, what do you think is causing them? Why aren't they present at higher frequencies?