McIDAS-X GOES-R Tutorial
November 2016 (software version 2016.2)

In existence since 1973, McIDAS (Man computer Interactive Data Access System) is a suite of sophisticated software packages that perform a wide variety of functions with satellite imagery, observational reports, numerical forecasts, and other geophysical data. Those functions include displaying, analyzing, interpreting, acquiring and managing the data.

McIDAS-X is supported for the current GOES GVAR and upcoming GOES-R satellite series (currently estimated as being in service until 2036), with no end date in sight.

In this McIDAS-X tutorial, some exercises will be completed using different methods of data access: local data files and real-time access to default remote servers. If you have access to your own real-time ADDE servers, you may also use those, but be aware that different server configurations may make the explanations in this document not quite applicable to all data that you may load.

This tutorial assumes that you have McIDAS-X installed on your machine, and that you know how to start McIDAS-X.

The data herein is test data only, and the Government is furnishing the data in **as-is** condition. The user bears all responsibility for inspecting such data prior to use, and for the manner in which it utilizes the data. The Government makes no warranty of any kind with respect to this data.

ABI Background

Advanced Baseline Imager

The ABI : a **game-changing** instrument, scanning more wavelengths faster and with better spatial resolution

ABI Data Volume

Current GOES Data Volume

5X
Faster coverage (5-minute full disk vs. 25-minute)

4X
Improved spatial resolution (2 km IR vs. 4 km)

3X
More spectral bands (16 on ABI vs. 5 on current imager)

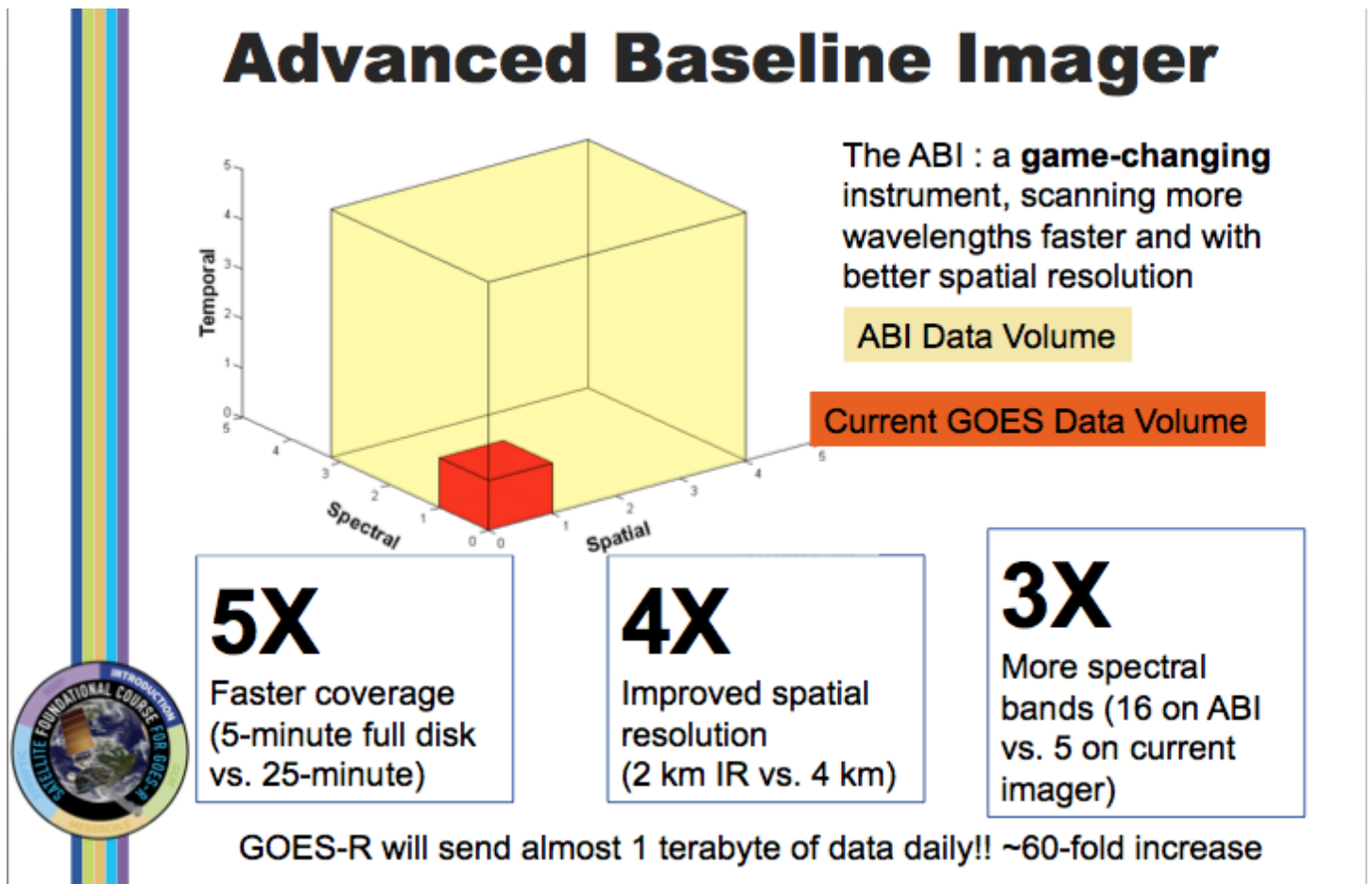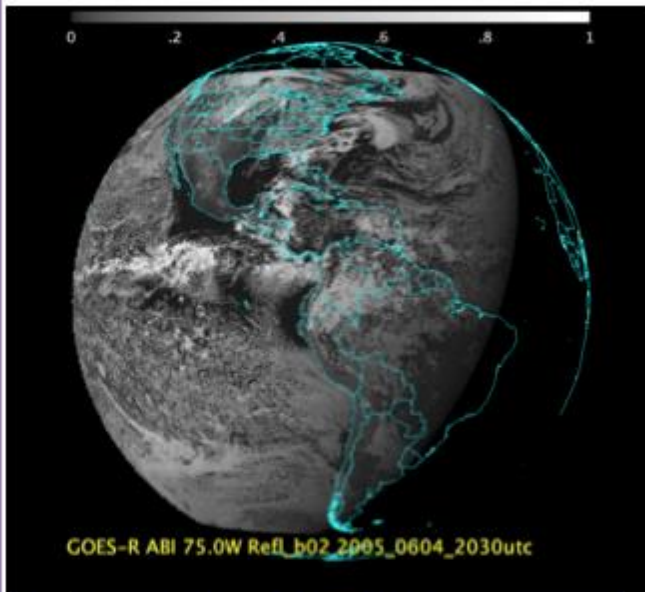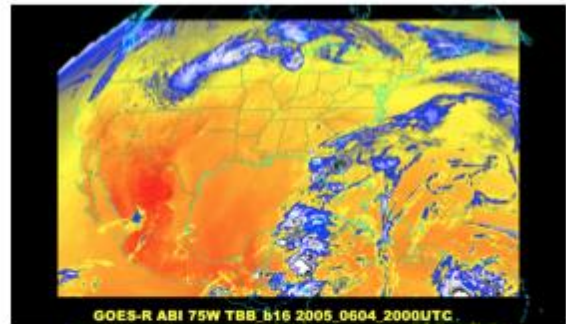GOES-R will send almost 1 terabyte of data daily!! ~60-fold increase

Image from J. Gerth, CIMSS.

There will be a 60-fold increase in the amount of data sent by the ABI compared to GOES-13 through -15. The ABI on GOES-R acquires a full-disk image 5 times faster than the imager on GOES-13 through GOES-15. The spatial resolution on the ABI compared to present GOES increases by a factor of 2 in both horizontal directions. There are about 3x more spectral bands on GOES-R. The cubes represent the data volumes from present GOES, in dark orange, and GOES-R, in beige.   The combination of increased resolutions means a 60-fold increase in data; about a terabyte of data will flow daily from GOES-R!
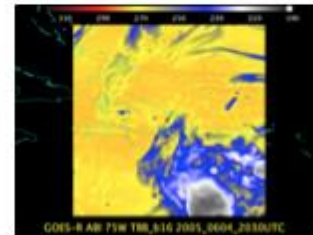
Image from Tim Schmit, Mat Gunshor and Scott Lindstrom (Satellite Foundational Course – GOES-R)

There are two main scanning modes for GOES-R, Mode 3 and Mode 4. The most likely default mode is Mode 3, where one FD image is scanned, 3 CONUS sectors are scanned, and 30 30-second mesoscale sectors are scanned in each 15 minutes. Those 2 mesoscale sectors could be split in two locations so you'd get 2 separate views with 1-minute imagery during the 15 minutes.

Mode 4 is the highest data rate for GOES-R's ABI and results in a full disk every 5 minutes. This might be used if multiple high-impact weather/volcanic events are happening, say a volcano in Chile, strong hurricanes over the Atlantic or Pacific basins, and high-impact severe weather over the central United States.

The Advanced Baseline Imager: ABI

	ABI	Heritage
Spectral Coverage	16 bands	5 bands
Spatial resolution		
0.64 μm Visible	0.5 km	~1 km
Other Visible/near-IR	1.0 km	n/a
Bands (>2 μm)	2 km	~4 km
Spatial coverage		
Full disk	4 per hour	Scheduled (3 hrly)
CONUS	12 per hour	~4 per hour
Mesoscale	Every 30 sec	n/a
Visible (reflective bands)		
On-orbit calibration	Yes	No

Image from Tim Schmit, Mat Gunshor and Scott Lindstrom (Satellite Foundational Course – GOES-R)

This comparison table shows the improvements in spectral, spatial and temporal coverage that GOES-R has over its predecessors.

GOES-R ABI Band List

```
McIDAS-X 2016.2: rcarp@eugene.ssec.wisc.edu
IMGLIST ABIL1B/CONUS FORM=BAND
Image file directory listing for:ABIL1B/CONUS
 Pos Satellite/            Date        Time       Center      Res (km)    Image_Size
     sensor                                      Lat  Lon    Lat   Lon
 --- ------------    ------------  ---------     ---- ----   ----- -----  -----------
  15  G-16 IMG          3 AUG 16216  03:57:16     29   91
    Band: 1      0.47 um VIS aerosol-over-land            1.00  1.00   3000 x 5000
    Band: 2      0.64 um VIS clouds fog, insol, winds     0.50  0.50   6000 x10000
    Band: 3      0.86 um Near IR veg/burn scar,aerosol, w 1.00  1.00   3000 x 5000
    Band: 4      1.38 um Near IR cirrus cloud             2.00  2.00   1500 x 2500
    Band: 5      1.61 um Near IR cloud phase, snow        1.00  1.00   3000 x 5000
    Band: 6      2.25 um Near IR land/cloud, vege, snow   2.00  2.00   1500 x 2500
    Band: 7      3.90 um IR Sfc, cloud, fog, fire, winds  2.00  2.00   1500 x 2500
    Band: 8      6.19 um IR High-level WV, winds, rainfal 2.00  2.00   1500 x 2500
    Band: 9      6.95 um IR Mid-level WV, winds, rainfall 2.00  2.00   1500 x 2500
    Band: 10     7.34 um IR Lower-level WV, winds & SO2   2.00  2.00   1500 x 2500
    Band: 11     8.50 um IR Total WV cloud phase, dust    2.00  2.00   1500 x 2500
    Band: 12     9.61 um IR Total ozone,turbulence,wind   2.00  2.00   1500 x 2500
    Band: 13     10.4 um IR Surface & cloud               2.00  2.00   1500 x 2500
    Band: 14     11.2 um IR Imagery,SST,clouds,rainfall   2.00  2.00   1500 x 2500
    Band: 15     12.3 um IR Total water, ash, and SST     2.00  2.00   1500 x 2500
    Band: 16     13.3 um IR Air temp, cloud hgt and amt   2.00  2.00   1500 x 2500
IMGLIST: done
    IMA GRA Bounds Switches                               Date        Time   T
     1   1   1-50                                03 Nov 2016308 18:11:07 0
```

Creating Local Datasets

You can access GOES-R Series netCDF format files with the IMG* commands by using DSSERVE to assign a dataset name to the files. When doing so, specify "ABIN" in the *format* parameter, TYPE=IMAGE, and the directory and file masks in the DIRFILE keyword. The files must be mission-standard Level 1b or Level 2 files in netCDF-4 format, like those from NOAA CLASS or from the GRB data stream after they've been decoded with CSPP Geo or other software. The names of files should look similar to ***ABI-L1b-RadC-M3C01_G16_s2015229195720.nc*** (current CSPP Geo naming convention) or ***OR_ABI-L1b-RadC-M4C16_G16_s20151702215532_e20151702220362_c20151702220394.nc*** (GOES-R Ground System naming convention).

1. Create a local dataset to access the ABI netCDF files on your local machine in the ***Data/ABI/NetCDF*** directory.

    OR_ABI-L1b-RadC-M3C02_G16_s20162491825085_e20162491827460_c20162491827483.nc
    OR_ABI-L1b-RadC-M3C14_G16_s20162491825085_e20162491827460_c20162491827489.nc
    OR_ABI-L2-TPWC-M3_G16_s20162152257163_e20162152259535_c20162152301341.nc

    a. Run the DSSERVE command to access the Level 1b netCDF imagery files.

        DSSERVE ADD ABI/CONUS ABIN TYPE=IMAGE DIRFILE= '*<local-path>*/Data/ABI/NetCDF/*RadC*'

b. Use the IMGLIST command to list the most recent image in the dataset.

IMGLIST ABI/CONUS

c. Datasets can be organized however the user chooses. Run DSSERVE to include all of the files in the data directory.

DSSERVE ADD ABI/DATA ABIN TYPE=IMAGE DIRFILE= '*<local-path>*/Data/ABI/NetCDF/*'

d. IMGLIST can list the image directory and band information with the FORM=ALL keyword. Your IMGLIST command should match the image.

IMGLIST ABI/DATA.ALL FORM=ALL

```
IMGLIST ABI/DATA.ALL FORM=ALL
Image file directory listing for:ABI/DATA
 Pos Satellite/        Date       Time      Center       Res (km)    Image_Size
     sensor                                 Lat  Lon     Lat   Lon
 --- ------------    ----------  --------   ----- ----   ----- -----  -------------
   1  G-16 PRD        2 AUG 16215  22:57:16    29   91    10.00 10.00   301 x  501
    Band: 13   L2: TPW  - Total Precipitable Water
     proj:     0 created: 2016215 225716   memo: GOES-R ConUS
     type:ABIN    cal type:RAW
     offsets:  data=    1280 navigation=  256 calibration=  768 auxiliary=     0
     doc length:   0   cal length:   0   lev length:   0 PREFIX=   0
     valcod:          0 zcor:  0 avg-smp: A
     lcor:     1  ecor:     1  bytes per pixel: 2  ss:187
     Resolution Factors (base=1):   Line=    20.0   Element=    20.0
   2  G-16 IMG        5 SEP 16249  18:25:08    29   91
    Band: 2    0.64 um VIS clouds fog, insol, winds     0.50  0.50  6000 x10000
    Band: 14   11.2 um IR Imagery,SST,clouds,rainfall   2.00  2.00  1500 x 2500
     proj:     0 created: 2016249 182508   memo: GOES-R ConUS
     type:ABIN    cal type:RAW
     offsets:  data=    1280 navigation=  256 calibration=  768 auxiliary=     0
     doc length:   0   cal length:   0   lev length:   0 PREFIX=   0
     valcod:          0 zcor:  0 avg-smp: A
     lcor:     1  ecor:     1  bytes per pixel: 2  ss:186
     Resolution Factors (base=1):   Line=     4.0   Element=     4.0
IMGLIST: done
```

e. Another IMGLIST keyword, FORM=BAND, lists the band and resolution without the file's expanded listing.

IMGLIST ABI/DATA.2 BAND=2 FORM=BAND

2. The data can be displayed and inspected with the IMGDISP and IMGPROBE commands.

    a. Run this series of commands to display BAND 2 of an ABI Level 1b file, display a navigated map over the image, place the cursor at the center of the image and run an IMGPROBE command to inspect the pixel values under the cursor.

        IMGDISP ABI/CONUS BAND=2 MAG= -16
        MAP X X LALO
        PC C
        IMGPROBE MODE=N
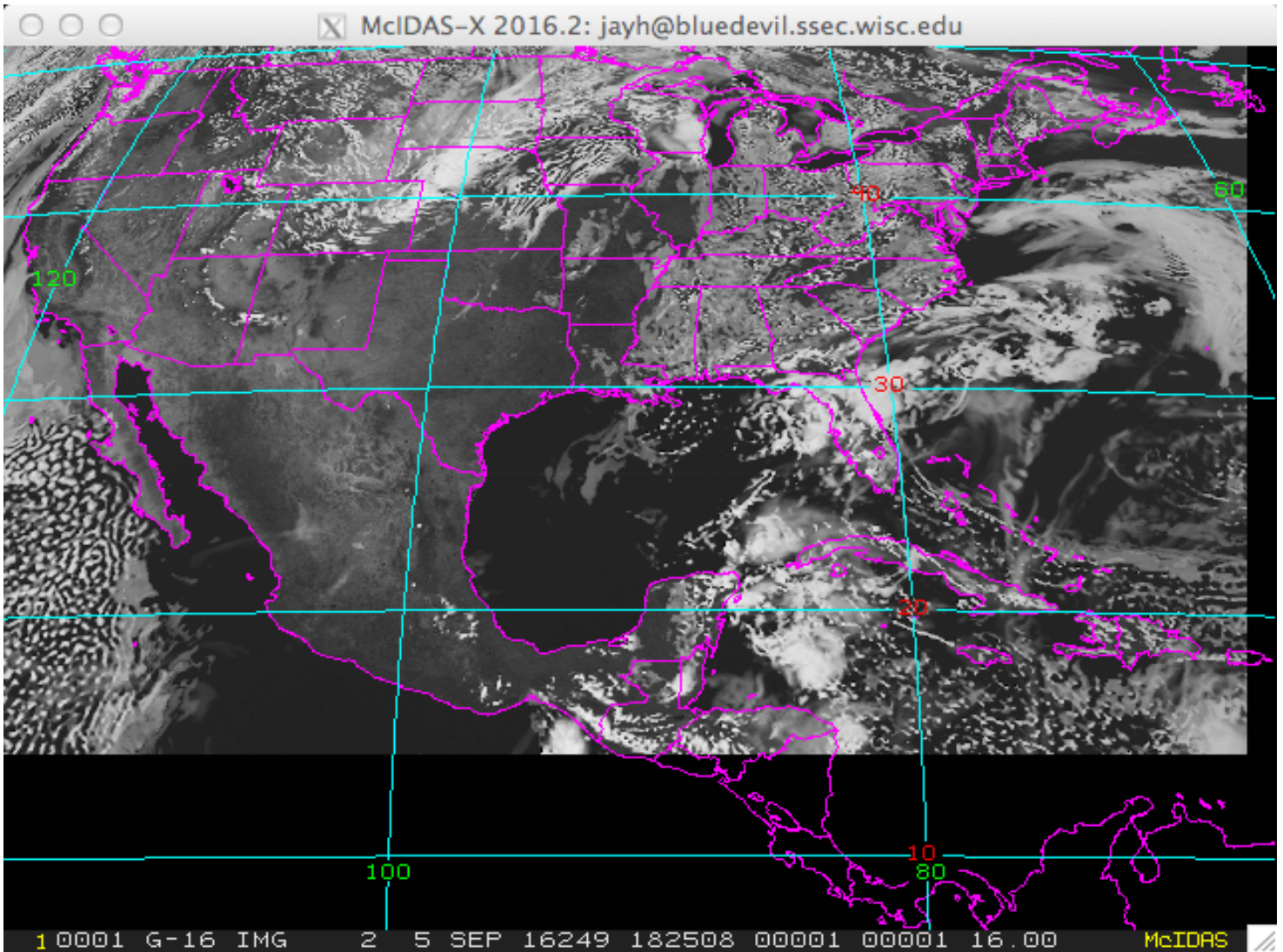
b. Display BAND 14 with a yellow map on a new frame which is automatically displayed with the SF=YES keyword. Move the cursor to a latitude/longitude point (29° N, 91° W), and list the statistics of the pixel values under the cursor.

IMGDISP ABI/CONUS 2 BAND=14 LATLON=29 91 SF=YES ; MAP X 3
PC E 29.4 90.7 ; IMGPROBE STAT BOX TEMP

Move the cursor around and press alt-g or the right mouse button over desired features. Be sure to quit each interactive IMGPROBE command with *Alt-Q* or by clicking the right and center mouse buttons.

c. Display the Total Precipitable Water Level 2 product file in the local dataset by specifying the absolute position number of the data. Plot a map and inspect the data in the middle of the frame with the IMGPROBE command.

IMGDISP ABI/DATA.1 3 SF=YES ; MAP
PC C ; IMGPROBE

Accessing Remote ADDE Datasets

3. To access a remote ADDE server with Level 1b ABI netCDF image files, follow these steps.

a. Modify your client routing table with the DATALOC command so that commands requesting data from a dataset in the group ABIL1B are routed to the SSEC remote server with the IP address PAPPY.SSEC.WISC.EDU.

DATALOC ADD ABIL1B PAPPY.SSEC.WISC.EDU

b. List all datasets available in the ABIL1B group with the DSINFO command.

DSINFO ALL ABIL1B

c. Run IMGLIST commands to see the available data in the datasets. Using a position number of .-2 will list the 3 most recent times in the dataset. Not specifying a position number will default to listing the most recent time.

IMGLIST ABIL1B/CONUS.-2 FORM=BAND
IMGLIST ABIL1B/FD FORM=ALL

d. Run the following list of commands to erase the frames and display a loop of 4 BAND 9 CONUS images centered on Madison with a map. Use the images in positions 5 through 8 and the REFRESH keyword to display a map on each frame. Then set the loop sequence with the LS command and animate the loop.

ERASE X 1 4
IMGDISP ABIL1B/CONUS.5 1 REP=4 BAND=9 STATION=KMSN SF=YES
      REFRESH='MAP GRA=(GRA) IMA=(IMA)'
LS 1-4
Alt-L (Press *Alt-L* again to stop the looping.)

e. Run the following list of commands to erase frames 1-4 and fill the frames with the four most recent BAND 2 times in the full disk dataset and a map. The LATLON= keyword centers the image at 20° N, 80° W. The MAG= -10 blows down the data by 10.

ERASE X 1 4
IMGDISP ABIL1B/FD 1 ALL=1 4 BAND=2 MAG= -10 LATLON=0 90
        REFRESH='MAP GRA=(GRA) IMA=(IMA)'
Alt-L (Press *Alt-L* again to stop the looping.)

4. To access a remote ADDE server with Level 2 ABI netCDF product data, follow these steps.

a. Add the group name to modify your client routing table with the ABIL2 group that exists on the server PAPPY.SSEC.WISC.EDU.

DATALOC ADD ABIL2 PAPPY.SSEC.WISC.EDU

b. Run DSINFO to find the available dataset names. In this example, use "I" instead of "ALL" to list only the image datasets available in the ABIL2 group.

DSINFO I ABIL2

```
X  McIDAS-X 2016.2: jayh@bluedevil.ssec.wisc.edu
DSINFO I ABIL2

        Dataset Names of Type: IMAGE in Group: ABIL2

Name              NumPos    Content
--------------    -------   ---------------------------------------------
ACHA              99999     DOE4 Cloud Top Height L2 product
ACHT              99999     DOE4 Cloud Top Temp L2 product
ACM               99999     DOE4 Cloud Mask L2 product
ACTP              99999     DOE4 Cloud Top Phase L2 product
ADP               99999     DOE4 Aerosol Detection L2 product
AOD               99999     DOE4 Aerosol Optical Depth L2 product
COD               99999     DOE4 Cloud Optical Depth L2 product
CPS               99999     DOE4 Cloud Particle Size L2 product
CTP               99999     DOE4 Cloud Top Pressure L2 product
DSI               99999     DOE4 Derived Stability Indices L2 product
FDC               99999     DOE4 Fire Detection L2 product
FSC               99999     DOE4 Fractional Snow Cover L2 product
LST               99999     DOE4 Land Sfc Temp L2 product
RRQPE             99999     DOE4 Rain Rate QPE L2 product
SST               99999     DOE4 Sea Sfc Temp L2 product
TPW               99999     DOE4 Total Precipitable Water L2 product
VAA               99999     DOE4 Volcanic Ash L2 product


DSINFO -- done
   IMA GRA Bounds Switches                         Date        Time     T
     1    1 random                          02 Nov 2016307 21:38:59  0
```

c. Run IMGLIST with FORM=ALL for the expanded image list for the Cloud Top Temperature product.

IMGLIST ABIL2/ACHT FORM=ALL

d. Display a loop of the Cloud Top Pressure product with a map.

ERASE X 1 4
IMGDISP ABIL2/CTP.4 1 REP=4 LAT=29 91 REFRESH='MAP GRA=(GRA) IMA=(IMA)'
Alt-L (Press Alt-L again to stop the looping.)

e. The DSI (Derived Stability Indices) product has multiple bands. List the bands and display BAND 9 which is the CAPE product (Convective Available Potential Energy). Use Alt-D to probe the data (Alt-D is a shortcut to execute IMGPROBE LIST POINT MODE=N).

IMGLIST ABIL2/DSI FORM=BAND
SF 5 ; IMGDISP ABIL2/DSI BAND=9 ; MAP
Alt-D

Using Other IMG* Commands with GOES-R Data

The ADDE ABIN server reads netCDF files directly to do IMGLIST and IMGDISP display commands. IMGCOPY uses the ADDE ABIN server to read the netCDF file and to outputs a McIDAS AREA file.

5. Use the ADDE commands to copy an ABI netCDF file to a McIDAS AREA file.
(The following exercises will overwrite AREA0001 through AREA0009 files on your local machine.)

a. Assign the MYDATA/TEST-IMAGES data to all of the AREA files on your local workstation.

DSSERVE ADD MYDATA/TEST-IMAGES AREA 1 9999 "ALL AREA FILES

b. Create the alias TI for the MYDATA/TEST-IMAGES dataset.

AKA ADD TI MYDATA/TEST-IMAGES

c. Copy the band 2 image from a local netCDF file to a local AREA file.

IMGCOPY ABI/DATA.2 TI.1 BAND=2 STATION=KMSN

d. Copy the band 14 image to a local AREA file at full resolution and list your new local AREA files.

IMGCOPY ABI/DATA.2 TI.2 BAND=14 SIZE=SAME

e. Copy a remote SST product file and list your new local AREA file.

IMGCOPY ABIL2/SST TI.3 LAT=0 89 SIZE=960 1280
IMGLIST TI.1 3 FORM=ALL

f. Display the AREA files.

IMGDISP TI.1 6 REFRESH='MAP GRA=(GRA) IMA=(IMA)'
IMGDISP TI.2 7 LAT=33 77 MAG=-2 REFRESH='MAP GRA=(GRA) IMA=(IMA)'
IMGDISP TI.3 8 MAG=-2 REFRESH='MAP X X LALO GRA=(GRA) IMA=(IMA)'

g. Use the SF command to show each frame and inspect the data with the IMGPROBE command. Be sure to quit each IMGPROBE command with *Alt-Q* or by clicking the right and center mouse buttons.

SF 6 ; IMGPROBE
IMGPROBE HIST BOX BRIT

h. Use the cursor size and IMGPROBE to inspect calibrated values on the IR and product images.

CUR 11 11
SF 7 ; IMGPROBE STAT BOX TEMP
SF 8 ; IMGPROBE HIST LINE SST OUTL=YES

6. Use IMGREMAP to read the local netCDF file and create a remapped product AREA file.

a. Create a rectilinear remapped product image at 4 km resolution.

IMGREMAP ABIL1B/CONUS.1 TI.4 PRO=RECT LAT=29 91 BAND=12 SIZE=480 640 RES=4

b. Display the new rectilinear AREA file.

IMGDISP TI.4 9 SF=YES ; MAP X X LALO

c. Use the PRO=DEST keyword in the IMGREMAP command to use an AREA file as the domain for a remapped product image.

IMGREMAP ABIL2/ACM TI.4 PRO=DEST

d. Now the cloud mask data will be in the product image AREA file.

IMGDISP TI.4 10 SF=YES ; MAP X X LALO

7. IMGOPER is used to perform mathematical operations on images. The domain of the source imagery must be the same for the operations to work correctly. The source imagery can reside on remote servers, local ABI netCDF files or local AREA files. Use IMGOPER to create a temperature difference image.

a. Create a temperature difference image from two Land Surface Temperature product files on an ADDE server. The output values are the product name DIFF and multiplied by 10. The product values from -50 to 50 are scaled from brightness 0 to 255.

IMGOPER ABIL2/LST.4 ABIL2/LST.9 TI.5 STA=KSTL SIZE=480 640 UNIT=LST
       FORM=ADD COEF=1 -1 SCALE=-50 50 0 255 MCON=10 PROD=DIFF

b. Display, draw a map, place the cursor, and probe the data with 4 concatenated commands.

IMGDISP TI.5 11 SF=YES ; MAP ; PC C ; D

c. Probe the data with the interactive IMGPROBE command and note the DIFF values in the image.

IMGPROBE

Problem Set

Create an Airmass RGB jpeg image with the IMGOPER, IMGDISP, COMBINE and FRMSAVE commands for the most recent image in the ABIL1B/RGB dataset.

EUMETSAT has created many different useful RGB composites for their SEVIRI instrument, and many can be applied to GOES-R. (http://oiswww.eumetsat.org/IPPS/html/MSG/RGB/)

Airmass is an RGB composite based upon data from infrared and water vapor channels. It is designed and tuned to monitor the evolution of cyclones, in particular rapid cyclogenesis, jet streaks and PV (potential vorticity) anomalies. Due to the incorporation of the water vapor and ozone channels, its usage at high satellite viewing angles is limited. The Airmass RGB can be composed from a scaled combination of GOES-R bands 8 (6.19 um high-level water vapor), 10 (7.34 um lower/mid-level water vapor), 12 (9.61 um ozone), and 14 (11.2 um longwave infrared).

From http://www.eumetrain.org/RGBguide/recipes/recipe_Airmass_RGB.pdf:

Color beam	Channel (difference)	Range [K]	
Red	WV6.2 – WV7.3	-25	0
Green	IR9.7 – IR10.8	-40	+5
Blue	WV6.2 inverted	243	208

Problem Set Solution

1. Run the following commands to create and display the scaled products for the RGB combination.

IMGOPER ABIL1B/RGB ABIL1B/RGB TI.6 BAND=8 10 COEF=1 -1 MAG= -10 LAT=0 89
   UNIT=TEMP MISS=NONE SCALE=-25 0 0 255
IMGOPER ABIL1B/RGB ABIL1B/RGB TI.7 BAND=12 14 COEF=1 -1 MAG= -10 LAT=0 89
   UNIT=TEMP MISS=NONE SCALE=-40 5 0 255
**IMGOPER ABIL1B/RGB TI.8 MAG= -10 BAND=8 LAT=0 89 UNIT=TEMP SCALE=243 208 0 255**
IMGDISP TI.6 12 REP=3 SF=YES

2. Use COMBINE to combine the displays in three frames into an RGB image in memory with the VIEW=NO keyword. FRMSAVE will convert the image into a jpeg file.

COMBINE 0 12 13 14 VIEW=NO
FRMSAVE 0 AIRMASS_RGB TYPE=COMBINE

FRMSAVE will list the output file path where the jpeg file is created. Go to that directory and display it with a jpeg viewing application.
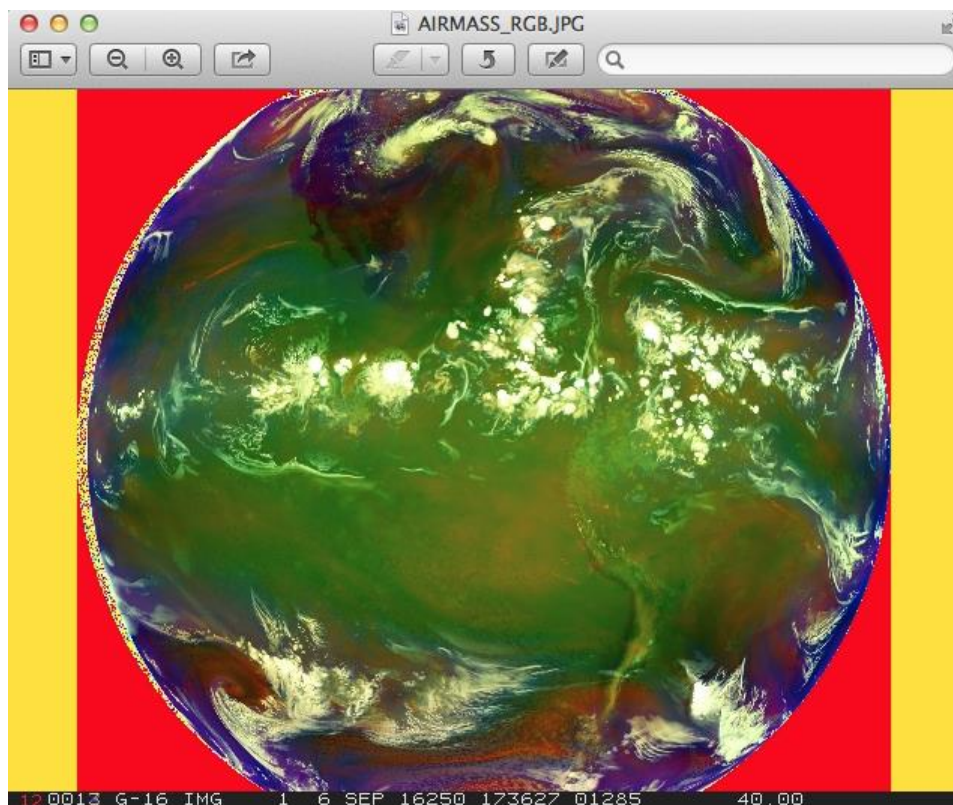
Note the following in the image:
- Dry sinking air masses appear red in the Airmass RGB image.
- In tropical and subtropical regions the RGB depicts hot and dry air masses in red-orange tones.
- High reaching opaque clouds appear white in the image. Lower clouds turn into red, green or blue depending on the air mass they lay within.
- Polar air masses appear blue in the image.
- The blue color can also come from the so-called "limb cooling effect" at the edge of the image.

McIDAS-V Tutorial
Using Simulated ABI Data
Created November 2016 (software version 1.6)

McIDAS-V is a free, open source, visualization and data analysis software package that is the next generation in SSEC's 40-year history of sophisticated McIDAS software packages. McIDAS-V displays weather satellite (including hyperspectral) and other geophysical data in 2- and 3-dimensions. McIDAS-V can also analyze and manipulate data with its powerful mathematical functions. McIDAS-V is built on SSEC's VisAD and Unidata's IDV libraries. The functionality of SSEC's HYDRA software package is also being integrated into McIDAS-V for viewing and analyzing hyperspectral satellite data.

More training materials are available on the McIDAS-V webpage and in the Getting Started chapter of the McIDAS-V User's Guide, which is available from the Help menu within McIDAS-V. You will be notified at the startup of McIDAS-V when new versions are available on the McIDAS-V webpage - http://www.ssec.wisc.edu/mcidas/software/v/.

If you encounter an error or would like to request an enhancement, please post it to the McIDAS-V Support Forums - http://www.ssec.wisc.edu/mcidas/forums/. The forums also provide the opportunity to share information with other users.

This tutorial assumes that you have McIDAS-V installed on your machine, and that you know how to start McIDAS-V. If you cannot start McIDAS-V on your machine, you should follow the instructions in the document entitled *McIDAS-V Tutorial – Installation and Introduction*.

Terminology

There are two windows displayed when McIDAS-V first starts, the **McIDAS-V Main Display** (hereafter **Main Display**) and the **McIDAS-V Data Explorer** (hereafter **Data Explorer**).

The **Data Explorer** contains three tabs that appear in bold italics throughout this document: ***Data Sources***, ***Field Selector***, and ***Layer Controls***. Data is selected in the ***Data Sources*** tab, loaded into the ***Field Selector***, displayed in the **Main Display**, and output is formatted in the ***Layer Controls***.

Menu trees will be listed as a series (e.g. ***Edit -> Remove -> All Layers and Data Sources***).

Mouse clicks will be listed as combinations (e.g. *Shift+Left Click+Drag*).

Introduction

McIDAS-V currently supports ABI DOE-4 netCDF data through remote servers as well as through the local file chooser on all platforms. Local servers for ABI DOE-4 data are currently available on OS X and Linux platforms. This tutorial will cover how to access this data through remote servers and the local file chooser, and different ways that the data can be displayed and interrogated in McIDAS-V.

Accessing ABI DOE-4 Data from a Remote Server – 1 Timestep

1. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

2. Create a remote ADDE dataset pointing towards one of the SSEC testing servers.

   a. From the **Main Display**, select the *Tools -> Manage ADDE Datasets* menu item. In the **ADDE Data Manager** window, navigate to the *Remote Data* tab and click the **Add New Dataset** button (or use the *File -> New Remote Dataset* menu item).

   b. In the **Add Remote Dataset** window, enter the following:
      i. **Server:** *pappy.ssec.wisc.edu*
      ii. **Dataset:** *ABIL1B*

   c. Click the **Verify and Add Server** button. This will verify that ABIL1B is an Imagery dataset and allows it to be accessed in the *Satellite -> Imagery* server. Click **Ok** to close the window.

3. In the *Data Sources* tab of the **Data Explorer**, navigate to the *Satellite -> Imagery* chooser. Select *pappy.ssec.wisc.edu* as the **Server** and *ABIL1B* as the **Dataset**. Click **Connect**.

4. Select *ALL – All ABIN test DOE4 netcdf files* as the **Image Type**.

5. In the **Times** panel, select the *Absolute* tab. This lists out all of the dates/times included in this dataset. Choose the *2016-08-03 18:00:34* time and click **Add Source**.

6. Display band 1 brightness data.

   a. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *0.47 um VIS aerosol-over-land -> Brightness* field.

   b. From the **Displays** panel, select the *Imagery -> Image Display* display type.

   c. Select the *Region* tab to see a low-resolution preview image of the data. Note that there is a green box drawn around the preview image. This is the bounding box showing which data will be displayed.

   d. Select the *Advanced* tab to see information about the band and calibration selected. These values match the domain of the data selected in the *Region* tab, so it covers the entire domain of the data. Notice that the **Image Size** is only *986 x 988* when the raw size of the data is *10848 x 10848*. The magnification if the data is set to *-11, -11*. This reduction in resolution is the default to allow for an efficient display of the data. Modify this *Advanced* tab to display full resolution data over Wisconsin and Illinois.
      i. **Coordinate Type:** *Latitude/Longitude*
      ii. **Location:** *Center*
      iii. **Lat:** *42*; **Lon:** *-89.6*
      iv. **Image Size:** *900 x 900*
      v. **Magnification:** *1 x 1*

   e. Click **Create Display**.

7. Investigate the display.

   a. In the **Main Display** window, practice navigating around in the display. To do this, use *Control+Right-Click+Drag* to translate the display. This shifts the data left/right and up/down without rotating the display. Zoom in on the display by scrolling down on the mouse wheel. As an alternative, select a region in the **Main Display** by using *Shift+Left-Click+Drag* to zoom in on a specific domain.

   b. Probe individual pixel values by holding down the middle mouse button over the display. This will print out probe values at the bottom of the display. Notice that latitude, longitude, and brightness values are included in the probe output.

8. Add a data transect to the display.

   a. From the *Field Selector* tab of the **Data Explorer**, select the *Data Transect* display type and click **Create Display**.

   b. In the **Main Display** window, there is a red line that is referred to as the data transect. The values along this transect line are output in the *Layer Controls* tab of the **Data Explorer**. The two end points of the transect can be moved around by *Left-Clicking+Dragging* them, or by entering new Lat/Lon values at the bottom of the *Display* tab in the *Layer Controls*. The transect line as a whole can be moved by *Left-Clicking+Dragging* the triangle in the middle of the transect line.

9. Create a histogram display.

   a. From the *Field Selector* tab of the **Data Explorer**, select the *Histogram* display type and click **Create Display**.

   b. Navigate to the *Layer Controls* tab of the **Data Explorer** to see a histogram of band 1 brightness values.

10. Create a display of the 10.4 micron temperatures so only values of 273K and less are plotted.

    a. Add a new two-paneled map display by selecting *File -> New Display Tab -> Map Display -> Two Panels* menu item.

    b. *Left-Click* in the left panel to make this panel active. The active panel has a blue frame around it, and this is the panel any displays will be added to.

    c. In the *Field Selector* tab of the **Data Explorer**, select the *10.4 um IR Surface & cloud -> Temperature* field. Choose the *Imagery -> Image Display* display type and click **Create Display**.

    d. Create the cloud mask display.

       i. *Left-Click* in the right panel to make this panel active. The active panel has a blue frame around it, and this is the panel any displays will be added to.

       ii. In the *Field Selector* tab of the **Data Explorer** select **Formulas**.

    iii. Select the *Imagery -> Mask Value* formula, the *Imagery -> Image Display* display type and click **Create Display**.

    iv. In the **Select input** window, enter the following and then click **OK**:

1. **comparison:** *<*
2. **cutoff:** *273*
3. **useNaN:** *1*
   Notes: The comparison is set to < or 'less then' since the goal is to display values less than 273, which was set as the cutoff value. Setting useNaN to 1 makes it so that if the pixels were probed outside of the masked range (where values are greater than 273) they wouldn't show a value. useNaN can be set to 0 as well, and in this case pixel values greater than 273 would probe as 0. Note that if these pixel values are set to 0, then these 0 values will be included in any calculations with the data that may be done later.

    v. In the new **Field Selector** window, for **inputFieldForMask**, select *ABIN * -> 10.4 um IR Surface & cloud -> Temperature*. This is the field that is being masked.

    vi. For **displayFieldToBeMasked**, select *ABIN * -> 10.4 um IR Surface & cloud -> Temperature*. This is the field that will be displayed where the **inputFieldForMask** is less than 273 degrees. In this case, we are displaying the same field that is being masked.

    vii. Click **OK**.

e. Investigate the display. Note that as one of the panels is navigated, the other will be navigated in the same way. This is because by default panels in the same window are set to share views. This setting can be disabled in a panel by unchecking *Projections -> Share Views*.

11. Create a display of a subtraction of two bands.

    a. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item, or by clicking the **Add new tab** (⬚) button in the **Main Toolbar**.

    b. In the *Field Selector* tab of the **Data Explorer** select **Formulas**.

    c. Select the *Miscellaneous -> Simple difference a-b* formula, the *Imagery -> Image Display* display type and click **Create Display**.

    d. In the new **Field Selector** window, for **a**, select the *8.50 um IR Total WV cloud phase, dust -> Temperature* field. For field **b**, select the *7.34 um IR Low-level WV, winds & SO2-> Temperature* field.

    e. Click **OK** in the **Field Selector** window to display the band subtracted data.

    f. *Right-Click* on the colorbar of the ABIN layer in the **Legend** and select the *System -> Inverse Gray Scale* enhancement.

g.   Add latitude and longitude labels to the display.

  i.   Click on the blue text for the *Default Background Maps* layer in the **Legend** to get to the *Layer Controls* tab of the **Data Explorer** for the layer.

  ii.   From the *Lat/Lon* tab of the *Layer Controls*, set the following:

    1.   Check the visibility checkboxes for **Lines** and **Labels** to plot them in the display.
    2.   **Lines**: **Interval**: *5.0*
    3.   **Labels**: **Interval**: *5.0*; **At Longitudes**: *-90.0*, **At Latitudes**: *40.0*, **Color**: *light blue*
    4.   **Font**: *Arial*; *Bold*; *14*
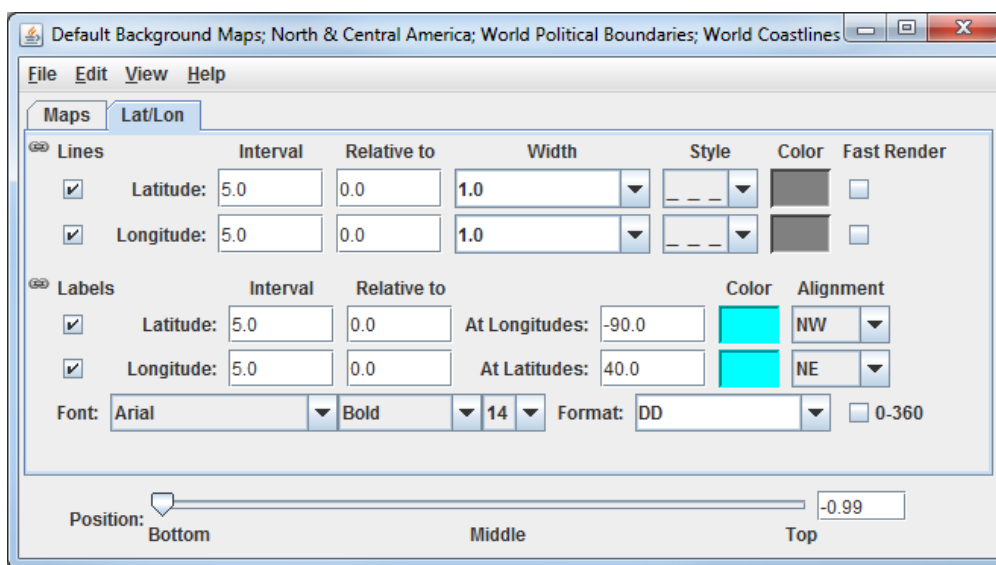
h.   Investigate the display to see the latitude and longitude lines and labels. Probe the data to see the temperature difference between the two bands.

12. Capture an image of the display.

  a.   From the **Main Display**, select the *View -> Capture -> Image* menu item.

  b.   In the **Save As** text field, enter the name to give your image, for example: *band_subtraction.gif*.

  c.   Use the dropdown below **Save As** to select the directory to save your image to.

  d.   Under **Capture What**, select *Current View*. This will capture an image of the display without including any other components of the **Main Display** such as menu items and the Legend.

  e.   Click **Save**.

  f.   View your saved image to verify the image was captured correctly.

Accessing ABI DOE-4 Data from a Remote Server – 5 Timesteps

13. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

14. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item. Close any previously-existing tabs.

15. In the *Data Sources* tab of the **Data Explorer**, navigate to the *Satellite -> Imagery* chooser. In the *Relative* tab of the **Times** panel, choose *5 most recent* and click **Add Source**.

16. Display a loop of 10.4um Temperature data over Wisconsin and Illinois.

    a. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *10.4 um IR Surface & cloud -> Temperature* field.

    b. From the **Displays** panel, select the *Imagery -> Image Display* display type.

    c. Navigate to the *Advanced* tab, and enter the following information:
        i. **Coordinate Type:** *Latitude/Longitude*
       ii. **Location:** *Center*
      iii. **Lat:** *42*; **Lon:** *-89.6*
       iv. **Image Size:** *450 x 450*
        v. **Magnification:** *1 x 1*

    d. Click **Create Display**.

17. Investigate the display.

    a. The **Main Display** now has a loop of the 5 most recent times of data in the ABIN dataset. As done in step 8 earlier, navigate around and zoom in/out of the display. Probe the display by holding down the middle mouse button over the data.

   b. Use the Time Animation Widget at the top of the display panel to play through a loop of the data.

    c. Click the **Properties** button ( ) in the Time Animation Widget to modify settings of the animation including the dwell rate (the time spent on each frame in the animation). As an example, set the **Forward**, **First**, and **Last** dwell rates to 0.2 and click **OK**. This reduced dwell rate allows the display to loop faster.

18. Change the enhancement used in the display.

   a. Stop the animation by clicking the **Stop Animation** button in the Time Animation Widget (▮▮).

   b. *Right-Click* on the colorbar of the ABIN layer in the **Legend** and select the *Satellite -> Longwave Infrared Deep Convection* enhancement.

   c. Notice that the rainbow part of the enhancement is used to color the higher temperature values as can be observed by looking at the enhancement range values in the **Legend**. Invert the enhancement so that the colder temperatures (the clouds) are colored by the rainbow part of the enhancement.

      i. *Right-Click* on the color bar of the ALL - All ABIN layer in the **Legend** and select *Edit Color Table*.

      ii. In the **Color Table Editor** window, *Right-Click* on the colorbar and choose *Invert Color Table*.

      iii. Click **OK**.

      iv. Investigate the display once again to see how the display has changed.

19. Add a color scale to the display.

   a. *Right-Click* on the ALL – All ABIN layer in the **Legend** and select *Edit -> Properties*.

   b. In the **Properties** window, navigate to the *Color Scale* tab and set the following:
      i. **Visible**: Check this option to add the color scale to the display.
      ii. **Position**: *Top*. This will position the color scale at the top of the display.
      iii. **Labels -> Visible**: Check this option to add numerical labels to the color scale.
      iv. **Labels -> Show Unit**: Check this to add the display unit to the color scale labels.
      v. **Labels -> Font**: Set the size to *32*.
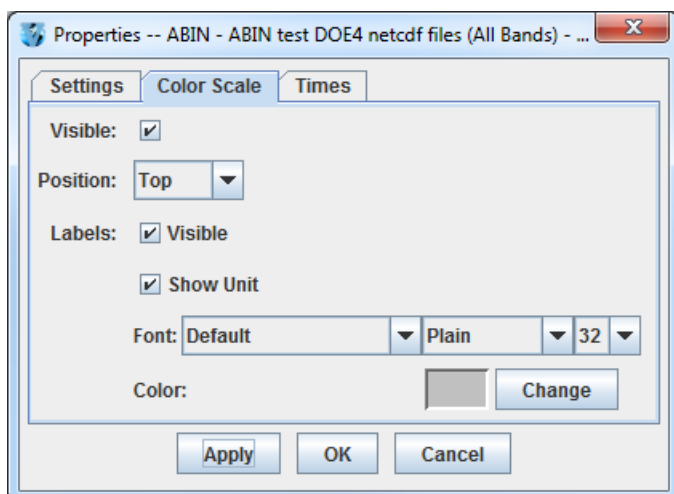
   c. Click **Apply**.

20. Create a Data Probe/Time Series display of band 13 temperature data. This display type allows for plotting how temperature values at a specific location change through time throughout the loop.

   a. In the *Field Selector* tab of the **Data Explorer**, select the *Data Probe/Time Series* display type and click **Create Display**.

   b. The *Layer Controls* tab of the **Data Explorer** now shows a time series display of temperature values at the location of the probe in the **Main Display**. Change the range of the y-axis (temperature values) to match the range of the data.

      i. At the bottom of the *Layer Controls* tab, *Double-Click* on the *186-Band13_TEMP* parameter to open the **Properties** window.

      ii. In the **Properties** window, change the **Range** text boxes to a **Min** of *180* and a **Max** of *320* to match the range of the enhancement in the **Main Display**.

      iii. Click **OK** to apply the new range in the *Layer Controls* and close the **Properties** window.

   c. Move the data probe in the **Main Display** around with *Left-Click+Drag*. The time series display in the *Layer Controls* automatically updates itself as the probe's location changes.

   d. The data probe in the **Main Display** can also be set to a specific latitude/longitude value by using the **Lat** and **Lon** text boxes at the bottom of the *Layer Controls*. For example, enter values of *38.6* for **Lat** and *-88.1* for **Lon**. Note that you must press *Enter* in each text field for latitude/longitude to update the location of the data probe.

Accessing ABI DOE-4 Data from a Remote Server through Scripting

Both of the previous sections of this tutorial can be replicated through scripting. This section covers creating a loop of ABI data and applying an enhancement to the display.

21. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

22. From the **Main Display**, select *Tools -> Formulas -> Jython Shell* to open the **Jython Shell**.

23. The **Jython Shell** defaults to single-line input mode, where only one line of code can be executed at a time. This script is more than one line long, so it requires multi-line input. To switch to multi-line input, click the double-down blue arrow button (⏬) to the right of the text entry box.

24. In a text editor, open the *Data/ABI/abiLoop.py* file. Copy this text and paste it into the **Jython Shell**.

25. To evaluate this code, click the **Evaluate** button, or use *Shift+Enter*. In-line documentation of what the script is doing can be found in the script (lines that begin with '#' are comments). More information about McIDAS-V scripting can be found in the User's Guide as well as the *Scripting* and *User Functions* tutorials.

26. After you are done analyzing the display created with the script, close the new display window.

Accessing ABI DOE-4 Data from the Local File Chooser

27. Remove all layers and data sources from any previous displays via the *Edit -> Remove -> All Layers and Data Sources* menu item from the **Main Display**.

28. In the *Data Sources* tab of the **Data Explorer**, navigate to the *General -> Files/Directories* chooser. In the **Files** panel, navigate to the *Data/ABI/NetCDF* directory and select the *OR_ABI-L1b-RadC-M3C14_G16_s20162491825085_e20162491827460_c20162491827489.nc* file. Click **Add Source**. This is a Level 1b DOE-4 netCDF CONUS band 14 file.

29. Display the band 14 radiance data over Illinois.

    a. Create a new one-panel map display and removed any previously-existing tabs.

    b. In the **Main Display**, zoom in and center the display over Illinois.

    c. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *2D grid -> ABI L 1b Radiances* field.

    d. In the **Displays** panel, select *Plan Views -> Color-Shaded Plan View*.

    e. In the *Region* tab, use the dropdown menu to select *Match Display Region*. This will display data only over the domain visible in the active display, which was set to Illinois above. Another way of doing this is to use the dropdown menu and choose *Select A Region* and draw a bounding box over Illinois.

    f. Click **Create Display**.

30. Inspect the display, and modify the enhancement so the clouds are white and land is darker.

    a. As the display is zoomed in on, individual blocks of data will be visible. These boxes can be shaded together to create a smoother image. To do this, go to the *Layer Controls* tab of the **Data Explorer** and click the **Shade Colors** checkbox.

    b. To make the clouds white, *Right-Click* on the colorbar in the **Legend** and select *System -> Inverse Gray Scale*.

    c. Zoom out of the display to notice that only data necessary to fill the geographical domain visible in the display was drawn. This saves time in creating the display by not displaying data that the user might not be interested in.

31. Display Level 2 total precipitable water ABI data.

    a. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item.

    b. In the *Data Sources* tab of the **Data Explorer**, navigate to the *General -> Files/Directories* chooser. In the **Files** panel, navigate to the *Data/ABI/NetCDF* directory and select the *OR_ABI-L2-TPWC-M3_G16_s20162152257163_ e20162152259535_c20162152301341.nc* file. Click **Add Source**.

    c. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *2D grid -> ABI L2 + Total Precipitable Water* field.

    d. In the **Displays** panel, select *Plan Views -> Color-Shaded Plan View*.

    e. Click **Create Display**.

32. Investigate the display and change the unit used to display the data.

    a. Probe the data to see that precipitable water is displayed with units of 'mm' for millimeters.

    b. Change the display unit to 'in' (inches).

       i. *Right-Click* on the blue text of the OR_ABI-L2* layer and choose *Edit -> Change Display Unit*. Note that this is the same as going to the *Layer Controls* tab for the layer and going to *Edit -> Change Display Unit*.

       ii. In the **Change unit** window, use the dropdown menu to select *in*.

       iii. Click **OK**.

    c. Probe the display to see units of 'in'. Also, notice that the colorbar range automatically adjusted itself for the numerical values for the new unit of inches.

Using Adaptive Resolution with ABI DOE-4 Data from the Local File Chooser

Adaptive resolution is a feature that is still under development in McIDAS-V. Adaptive resolution is a feature designed to load high resolution data efficiently by obtaining and loading only the minimum amount of data needed to display all of the observable features in the given display size and geographic domain. If the domain is subsequently changed by using either Shift+left-click+drag or the Projections menu, adaptive resolution automatically reloads the data at a higher resolution (if available) if the user zoomed in to a more detailed view, or reloads the data at a lower resolution (sampled) if the user zoomed out to a wider view.

33. Adaptive resolution is disabled by default. Enable adaptive resolution.

    a. From the **Main Display**, select the *Edit -> Preferences* menu item to open the **User Preferences** window.

    b. In the **User Preferences** window, navigate to the *Display Window* tab.

    c. Under **Panel Configuration**, enable the bottom option for **Enable Adaptive Resolution**.

    d. Click **OK**.

34. Add a new one-paneled map display by selecting *File -> New Display Tab -> Map Display -> One Panel* menu item.

35. Display local band 2 ABI data using adaptive resolution. This band 2 data is 0.5 km resolution.

   a. In the *Data Sources* tab of the **Data Explorer**, navigate to the *General -> Files/Directories* chooser. In the **Files** panel, navigate to the *Data/ABI/NetCDF* directory and select the *OR_ABI-L1b-RadC-OR_ABI-L1b-RadC-M3C02_G16_s20162491825085_e20162491827460_c20162491827483.nc* file.

   b. Click **Add Source**.

   c. Navigate to the *Field Selector* tab of the **Data Explorer** to see a listing of each band included with the data. Select the *2D grid -> ABI L1b Radiances* field.

   d. In the **Displays** panel, select *Plan Views -> Color-Shaded Plan View*.

   e. Click **Create Display**.

36. Investigate the display.

   a. Notice that a Data Sampling value is written out in the **Legend** for the layer that was just displayed. McIDAS-V took into account the size of the window at the time of the display's creation, and only displayed the highest resolution that can be viewed in the display's current state. This sampling value informs the user the resolution that the data was displayed at as far as x and y sampling values. For example only every 17th by 13th grid point may be displayed.

   b. Zoom in on the display with the mouse wheel. This does not cause the display to be re-sampled, so the resolution remains at what it was when the data was originally displayed. The display will become blocky, and it is no longer at full resolution.

   c. Sample the display by using *Shift+Left-Click+Drag* over a domain, such as Wisconsin. Notice two things:

      i. The display resolution has now improved, as noted by the Data Sampling values in the **Legend**.

      ii. Zoom out with the mouse wheel, and you will note that no data outside of this current domain is displayed. This data can be re-obtained by doing *Shift+Left-Click+Drag* over a different area (for example, over Texas).

   d. Sample the display by changing the projection.

      i. From the **Main Display**, select the *Projections -> Predefined -> US States -> N-Z -> Pennsylvania* menu item.

      ii. Notice that the data was re-sampled over this new domain.

37. Disable adaptive resolution to return it to the default setting. Follow the first step in this section to accomplish this, but disable the **Enable Adaptive Resolution** setting instead of enabling it.

Problem Set

The previous examples were intended to give you a general knowledge of how to load and display ABI data. The problem set below is intended to introduce you to a new topic related to the data, as well as challenge your knowledge of McIDAS-V. We recommend that you attempt to complete each problem set before looking at the solutions, which are provided below the problem set.

1. Use the data in *pappy.ssec.wisc.edu/ABIL1B/AREAS* to create an airmass RGB display. Use only the *2016-09-06 17:36:27Z* time. There are three bands in this data which aren't actually native bands of ABI data, but rather band subtractions that were scaled and generated in McIDAS-X for the ease of this tutorial. Use the *Three Color (RGB) Image (Auto-scale)* formula to generate the RGB display with the following:

   Red: **Band 1 -> Brightness**
   Green: **Band 2 -> Brightness**
   Blue: **Band 3 -> Brightness**

   As a reference, here is how the AREA files were created in McIDAS-X:

   Band 1:
   IMGOPER ABIL1B/FD ABIL1B/FD TI.6 BAND=8 10 COEF=1 -1 MAG= -10
   **   LAT=0 89 UNIT=TEMP MISS=NONE SCALE=-25 0 0 255**

   Band 2:
   IMGOPER ABIL1B/FD ABIL1B/FD TI.7 BAND=12 14 COEF=1 -1 MAG= -10
   **   LAT=0 89 UNIT=TEMP MISS=NONE SCALE=-40 5 0 255**
   IMGCHA A/A.7 BAND=2

   Band 3:
   IMGOPER ABIL1B/FD TI.8 MAG=-10 BAND=8
   **   LAT=0 89 UNIT=TEMP SCALE=243 208 0 255**
   IMGCHA A/A.8 BAND=3

Problem Set #1 – Solution

Use the data in *pappy.ssec.wisc.edu/ABIL1B/AREAS* to create an airmass RGB display. Use only the *2016-09-06 17:36:27Z* time. There are three bands in this data which aren't actually native bands of ABI data, but rather band subtractions that were scaled and generated in McIDAS-X for the ease of this tutorial. Use the *Three Color (RGB) Image (Auto-scale)* formula to generate the RGB display with the following:

Red: ***Band 1 -> Brightness***
Green: ***Band 2 -> Brightness***
Blue: ***Band 3 -> Brightness***

1. Remove all layers and data sources and create a new tab.

2. Load the ABI AREA data into the ***Field Selector***.

    a. From the ***Data Sources*** tab of the **Data Explorer**, navigate to the ***Satellite -> Imagery*** chooser.

    b. Select *pappy.ssec.wisc.edu* as the **Server** and *ABIL1B* as the **Dataset**. Click **Connect**.

    c. Select *AREAS – IMGOPER AREA files for Airmass RGB* as the **Image Type**.

    d. In the **Times** panel, select the *Absolute* tab. This lists out all of the dates/times included in this dataset. Choose the *2016-09-06 19:21:42* time and click **Add Source**.

3. From the ***Field Selector***, create the airmass RGB display.

    a. Under **Data Sources**, select **Formulas**.

    b. In the **Fields** panel of the ***Field Selector***, select the ***Imagery -> Three Color (RGB) Image (Auto-scale)*** formula and the ***RGB Composite*** display type.

    c. Click **Create Display**.

    d. In the **Field Selector** window, select the following:

        i. **red:** *AREAS -> Band 1 -> Brightness*

        ii. **green:** *AREAS -> Band 2 -> Brightness*

        iii. **blue:** *AREAS -> Band 3 -> Brightness*

    e. Click **OK** to display the data.

Zooming, Panning, and Rotating Controls

Zooming	Panning	Rotating
Mouse		
Shift-Left Drag: Select a region by pressing the *Shift* key and dragging the left mouse button. **Shift-Right Drag:** Hold *Shift* key and drag the right mouse button. Moving up zooms in, moving down zooms out.	**Control-Right Mouse Drag:** Hold *Control* key and drag right mouse to pan.	**Right Mouse Drag:** Drag right mouse to rotate.
Scroll Wheel		
Scroll Wheel-Up: Zoom Out. **Scroll Wheel-Down:** Zoom In.		**Control-Scroll Wheel-Up/Down:** Rotate clockwise/counter clockwise. **Shift-Scroll Wheel-Up/Down:** Rotate forward/backward clockwise.
Arrow Keys		
Shift-Up: Zoom In. **Shift-Down:** Zoom Out.	**Control-Up arrow:** Pan Down. **Control-Down arrow:** Pan Up. **Control-Right arrow:** Pan Left. **Control-Left arrow**: Pan Right.	**Left/Right arrow:** Rotate around vertical axis. **Up/Down arrow:** Rotate around horizontal axis. **Shift-Left/Right arrow:** Rotate Clockwise/Counterclockwise.

File Used in this Tutorial

abiLoop.py
```python
# Python dictionary to pass through loadADDEImage().
# For more information on the keywords and values
# that can be passed through loadADDEImage(), consult
# the documentation (available through Help > User's
# Guide in the Main Display window).
addeParms = dict(
    server = 'pappy.ssec.wisc.edu',
    dataset = 'ABIL1B',
    descriptor = 'ALL',
    band = 13,
    unit = 'TEMP',
    coordinateSystem = LATLON,
    location = (42,-89.6),
    place = CENTER,
    size = (450,450),
    )

# Loop through positions -4 through 0 (most recent)
# and append them to a list defined as abiLoop. In python,
# the last value in the loop is not used, so only values
# -4 through 0 are used, as the default skip value is 1.
abiLoop = []
for pos in range(-4,1):
    data = loadADDEImage(position=pos,**addeParms)
    abiLoop.append(data)

# Build a window referenced as abiPanel
abiPanel = buildWindow(height=600,width=800)

# Display the data, reference this layer as abiLayer.
# The window contains a list of panels for future support
# of working with multi-panelled displays in scripting.
# For now, specify [0] in the window name to use the one
# panel in the abiPanel window.
abiLayer = abiPanel[0].createLayer('Image Sequence Display',abiLoop)

# Add a temperature enhancement to the display
abiLayer.setEnhancement('Longwave Infrared Deep Convection',range=(320,180))

# Add a color scale to the display
abiLayer.setColorScale(size=32,showUnit=True)
```