



# Introduction to HDFLook\_MODIS

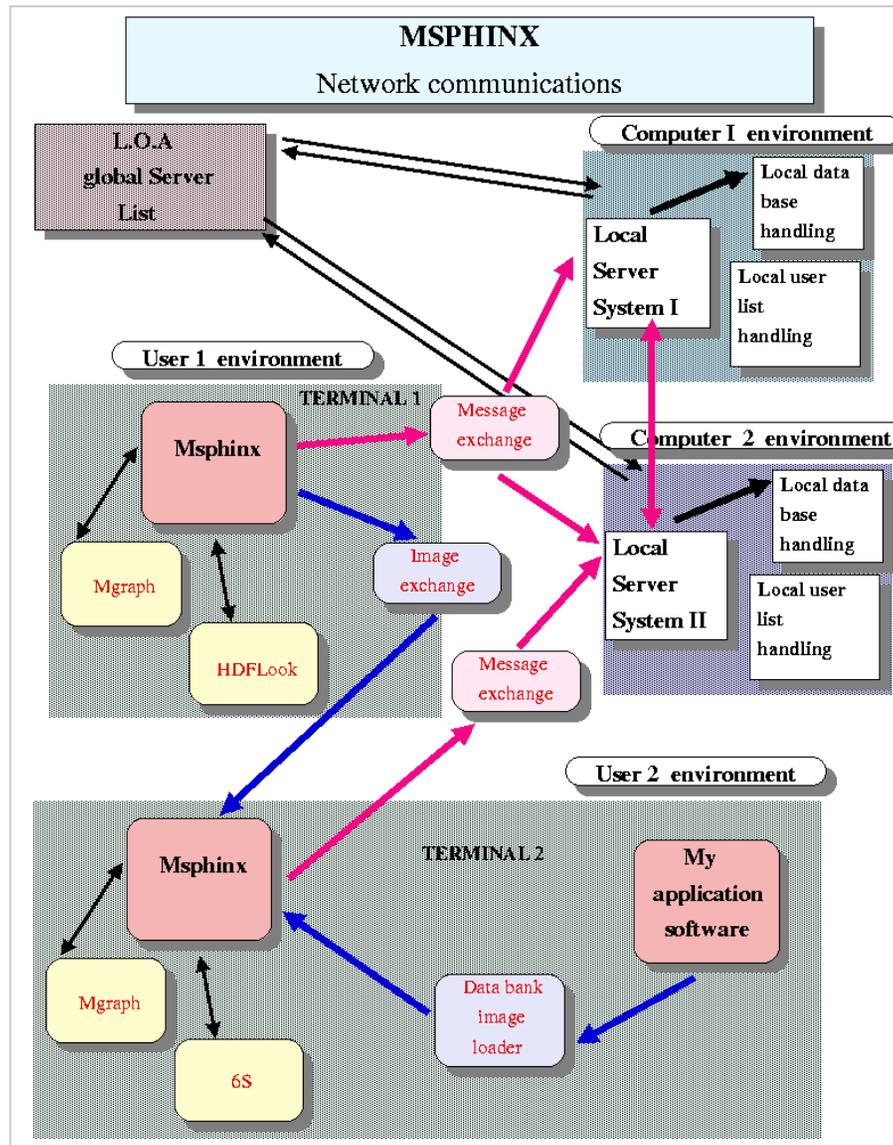
**Louis Gonzalez<sup>2</sup> and Dimitar Ouzounov<sup>1</sup>**

**<sup>1</sup> NASA GSFC, Goddard Earth Sciences DAAC, Greenbelt, MD**

**<sup>2</sup>Laboratoire d'Optique Atmospherique, University of Science and Technology  
Lille, France**



**MSPHINX/HDFLook philosophy**



In 2002-2003, together GES DAAC and LOA- UL, France distributed more than 3000 copies of the new HDFLook\_MODIS around the world.



# What is HDFLook

- What is HDFLook - Is a X-Motif based reader and viewer of NCSA HDF v.4.x and HDF-EOS 2.x science datasets
- HDFLook-MODIS is a result of joint collaboration between LOA USTL, France, and GES DAAC
- Main HDFLook developers are Louis Gonzalez and Christine Deroo, Laboratoire d'Optique Atmosphérique, USTL, France
- Main HDFLook science and data support: D.Ouzounov, S.Ahmad, J.Li (GES DAAC), E.Vermote (University of Maryland / MODLAND) , N.Saleous and R.Wolfe (LTP/GSFC )



## HDFLook\_MODIS Overview

HDFLook-MODIS is a result of joint collaboration between LOA USTL, France, and GES DAAC and is based on the very popular MSPHINX (Motif satellite Process Handling Images uNder XWindows) tool philosophy ([http://www-loa.univ-lille1.fr/Msphinx/Msphinx\\_gb.html](http://www-loa.univ-lille1.fr/Msphinx/Msphinx_gb.html)). Created as a flexible modular tool, is easy to update, add new features, and is free to users obtaining it from the GES DAAC

**HDF-EOS Visualization – MODIS:** L1B, Land L2,L3; Atmospheric L2, L3,L4; Ocean L2,L3,L4 mapped, Ocean L3, L4;

**Mapping and projections** - Geo-projection conversion utility.L2, L3, and L4 products.  
LINEAR.GOODE'S,MOLLWEIDE,HAMMER, AZIMUTHAL, LAMBERT, MILLER, MOLLWEIDE, ORTHOGRAPHIC, SINUSOIDAL, VAN DER GRINTEN,WAGNER 7, ISIN, POLDER

**Subsetting** - Channel, Parameter, Spatial; Subsampling

**Multi granule processing** - Mosaic and Stitch

**Data Conversion-** HDF-EOS to ASCII, Binary, JPEG, GeoTIFF

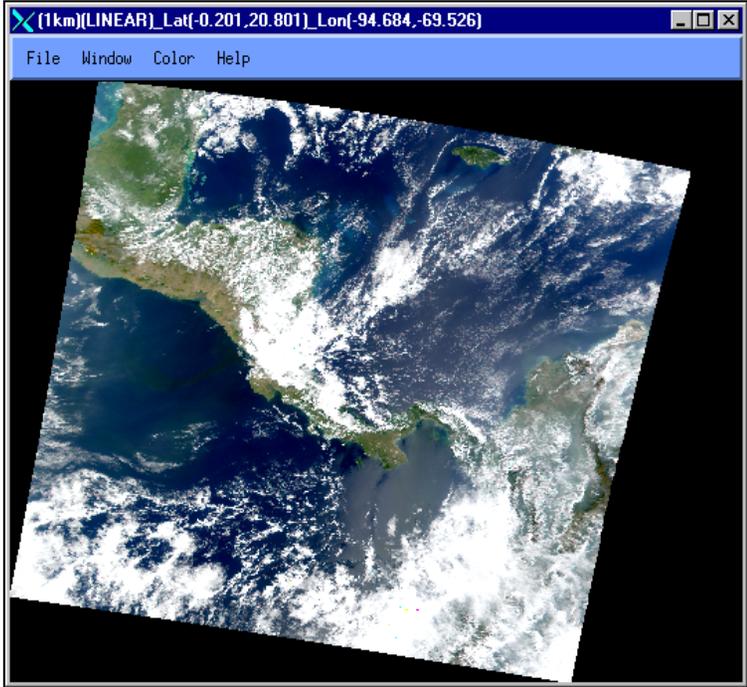
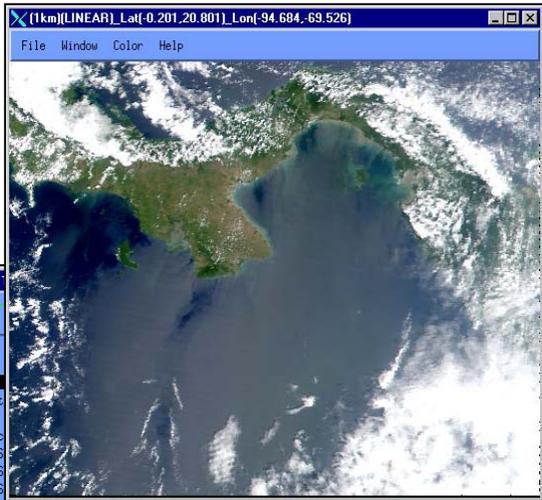
**AERONET data bank accesses** - Aerosol and other ancillary data is available from the ground based sun photometer measurements (AERONET data bank).

**Running modes** - All current capabilities are available in interactive, operational and command line modes

**XWindows CE** – SGI, HP, IBM-AIX, DEC, SUN, Linux, Macintosh and MS Windows (via Cygwin)



Mapping and projections



SDS list

- 1: ( 406 x 271 ) Latitude
- 2: ( 406 x 271 ) Longitude
- 3: ( 15 x 2030 x 1354 ) EV\_1KM\_RefSB
- 4: ( 15 x 2030 x 1354 ) EV\_1KM\_RefSB\_Uncert
- 5: ( 16 x 2030 x 1354 ) EV\_1KM\_Emissive
- 6: ( 16 x 2030 x 1354 ) EV\_1KM\_Emissive\_Unc
- 7: ( 2 x 2030 x 1354 ) EV\_250\_Aggr1km\_RefSB
- 8: ( 2 x 2030 x 1354 ) EV\_250\_Aggr1km\_RefSB
- 9: ( 2 x 2030 x 1354 ) EV\_250\_Aggr1km\_RefSB
- 10: ( 5 x 2030 x 1354 ) EV\_500\_Aggr1km\_RefSB
- 11: ( 5 x 2030 x 1354 ) EV\_500\_Aggr1km\_RefSB\_Uncert\_Indexes
- 12: ( 5 x 2030 x 1354 ) EV\_500\_Aggr1km\_RefSB\_Samples\_Used

SDS selection

3: ( 15 x 2030 x 1354 ) EV\_1KM\_RefSB Show attributes

Multidimensional SDS: layer selection (layer index, or \* for all)

\*  Height  Width

Width  Height

(LINEAR) Lat(-0.201,20.801) Lon(-94.684,-69.526)

Set RGB mode to log  Set reprojection geometry...

No predefined scaling

Automatic mask detection

Set preview  Standard

Show SDS as values

Show SDS as a plot

AERONET (Optical thickness)

(\*Day\*): 2001: 1:15 ( 15 ) 16h15

Quick send to Mspinx...  Dump a selected SDS on file...

Show SDS as an image  Show (RGB) image

Close

Type of Mapping:

- Level1B RGB standard atmospheric corrected image or a single plane.
- Level1B RGB thermal anomalies corrected image .
- Level1B RGB thermal image.
- Mod09 RGB standard atmospheric corrected image or single plane.
- Other products (with latitude, longitude SDS records) a single plane.
- Other products (reprojected SDS records) a single plane.



Subsetting - parameter, band and spatial

Linear  
 GOODE'S Homolosine  
 MOLLWEIDE Equal-Area  
 HAMMER  
 Azimuthal Equidistant  
 LAMBERT Azimuthal equal area  
 MILLER Cylindrical  
 MOLLWEIDE

Orthographic

**/L2\_atm/MOD07\_L2.A2001013.1625.002.2001026070928.hdf**

SDS list

- 1: ( 408 x 270 ) Scan\_Start\_Time
- 2: ( 408 x 270 ) Latitude
- 3: ( 408 x 270 ) Longitude
- 4: ( 408 x 270 ) Solar\_Zenith
- 5: ( 408 x 270 ) Solar\_Azimuth
- 6: ( 408 x 270 ) Sensor\_Zenith
- 7: ( 408 x 270 ) Sensor\_Azimuth
- 8: ( 12 x 408 x 270 ) Brightness\_Temperature
- 9: ( 408 x 270 ) Cloud\_Mask
- 10: ( 408 x 270 ) Surface\_Temperature**
- 11: ( 408 x 270 ) Surface\_Pressure
- 12: ( 408 x 270 ) Surface\_Elevation

SDS selection

10: ( 408 x 270 ) Surface\_Temperature Show attributes

Multidimensional SDS; layer selection (layer index, or \* for all)

Height  Width

Width

Height

(LAMBERT Azimuthal equal area) Lat(0,653,29,669) Lon(-95,991,-70,117)

Enhance RGB image... Set reprojection geometry...

Apply  $y = a * (x - b)$

Automatic mask detection

Set preview Standard

Show SDS as values

Show SDS as a plot

AERONET (Optical thickness)

("Day": 2001: 1:13 ( 13 ) 16h25)

Dump a selected SDS on file...

**HDF\_projections**

Output image geometry and reprojection selection  
 For MODIS HDF data files format

**HDF\_attributes(10: Surface\_Temperature)**

Set no 9; Rank: 2, 408 x 270  
 Data set name: 'Surface\_Temperature'  
 Data type: 16-bit integer

SDS attributes

Number of attributes: 10  
 valid\_range: 0, 20000  
 FillValue: -32768  
 long\_name: Surface Temperature  
 units: K  
 scale\_factor: 0,01  
 add\_offset: -15000  
 Parameter\_Type: Non MODIS Input  
 Cell\_Along\_Swath\_Sampling: 3, 2028, 5  
 Cell\_Across\_Swath\_Sampling: 3, 1348, 5

Close

**HDF\_projections**

Output image geometry and reprojection selection  
 For MODIS HDF data files format

**HDF\_projections**

Output image geometry and reprojection selection  
 For MODIS HDF data files format

Output image size (lines,columns)  
 360 (360) Width 180 (180) Height

Output image geometry (Latitude,Longitude)  
 (in degrees)

90,00000 Latitude maximum  
 -180,00000 Longitude minimum  
 -90,00000 Latitude minimum  
 longitude maximum

X shift First standard paralle  
 Y shift Second standard parall  
 Major axis Center latitude  
 Minor axis Center longitude

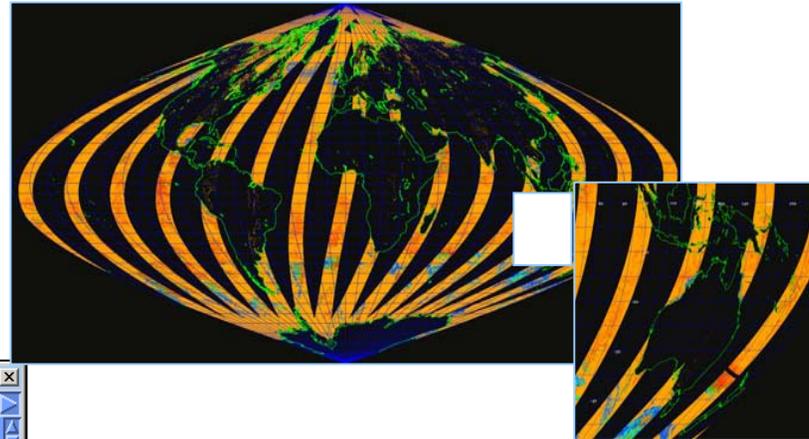
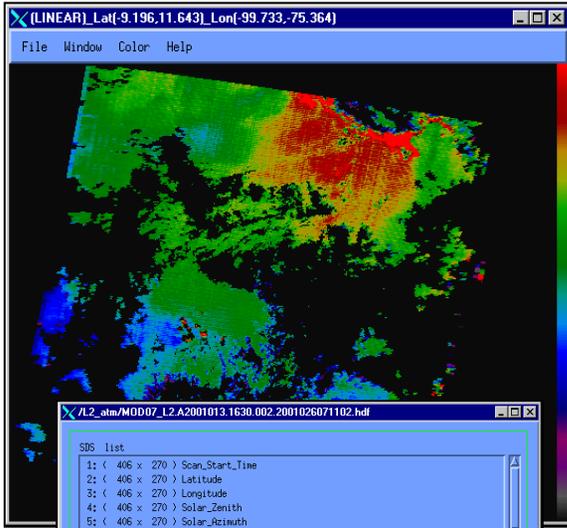
GOODE'S Homolosine

Show (Image area in the output projection geometry)



Mapping and projections L2 and L3

Mapping L3 Ocean mapped 4KM DailyProduct (Mean) Calcite concentration day 25, 2001



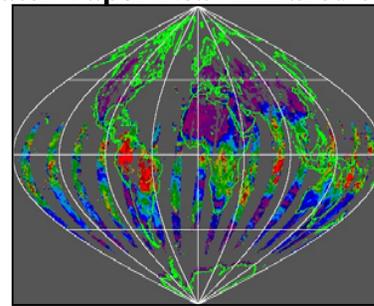
Mapping Atmospheric Daily Global L3 gridded (1x1 degree grid mean)

```
SIS list
1: ( 406 x 270 ) Scan_Start_Time
2: ( 406 x 270 ) Latitude
3: ( 406 x 270 ) Longitude
4: ( 406 x 270 ) Solar_Zenith
5: ( 406 x 270 ) Solar_Azimuth
6: ( 406 x 270 ) Sensor_Zenith
7: ( 406 x 270 ) Sensor_Azimuth
8: ( 12 x 406 x 270 ) Brightness_Temperature
9: ( 406 x 270 ) Cloud_Mask
10: ( 406 x 270 ) Surface_Temperature
11: ( 406 x 270 ) Surface_Pressure
12: ( 406 x 270 ) Surface_Elevation
```

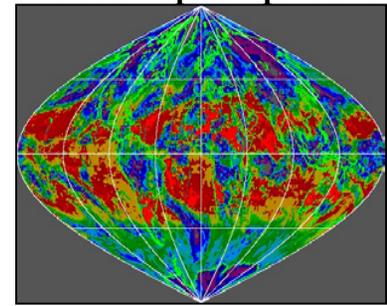
HDF\_show\_values[10: Surface\_Temperature]

File size	270x408	Show size	95 -> 145	X	265 -> 315				
01-	95:	01-	96:	01-	97:	01-	98:	01-	99:
01-	265:	298,29	298,43	297,97	298,2	298,1			
01-	266:	298,05	297,91	297,79	298,04	298,04			
01-	267:	298,35	298,22	298,2	298,47	298,4			
01-	268:	297,54	297,78	297,55	297,96	297,9			
01-	269:	298,36	298,2	297,89	298,3	298,3			
01-	270:	298,39	298,29	297,88	297,96	298,2			
01-	271:	298,81	298,72	298,31	298,57	298,6			
01-	272:	297,97	298,13	297,79	298,01	298,1			
01-	273:	298,23	298,39	298,13	298,48	298,4			
01-	274:	298,09	297,98	297,77	298,23	298,0			
01-	275:	298,63	298,43	298,09	298,43	298,7			
01-	276:	298,07	297,84	297,64	297,48	297,9			
01-	277:	298,28	297,99	297,63	298,18	298,0			
01-	278:	298,08	297,69	297,66	297,96	298,			
01-	279:	298,26	298,15	297,85	298,18	298,.			
01-	280:	297,61	297,68	297,53	297,73	297,5			
01-	281:	298,02	298,06	297,83	298,12	297,9			
01-	282:	297,87	297,78	297,68	297,96	297,7			
01-	283:	298,37	298,27	298,02	298,37	298,.			
01-	284:	297,69	297,75	297,52	297,71	297,6			
01-	285:	298,05	298,01	297,79	297,96	298,1			
01-	286:	297,86	297,65	297,47	297,72	297,1			
01-	287:	298,21	298,07	297,85	298,22	298,2			
01-	288:	297,48	297,15	296,82	296,54	296,1			

Water Vapor Near Infrared clear



Cloud Top Temperature





AERONET data base

Data type menu

Select the data which you want to subset:

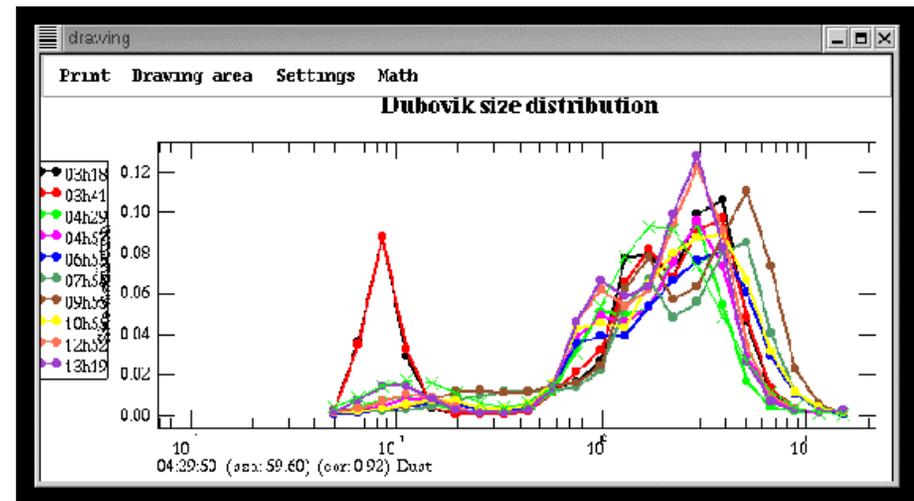
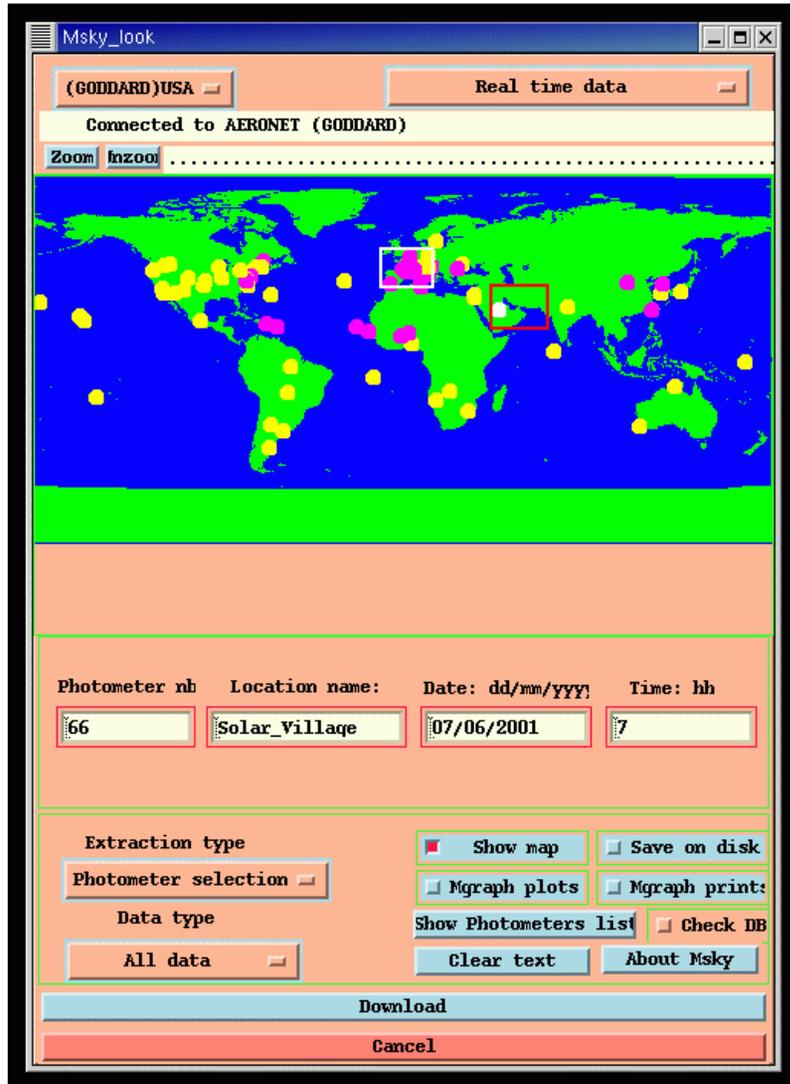
Optical thickness

Size distribution

Refraction index

Polarization

All data



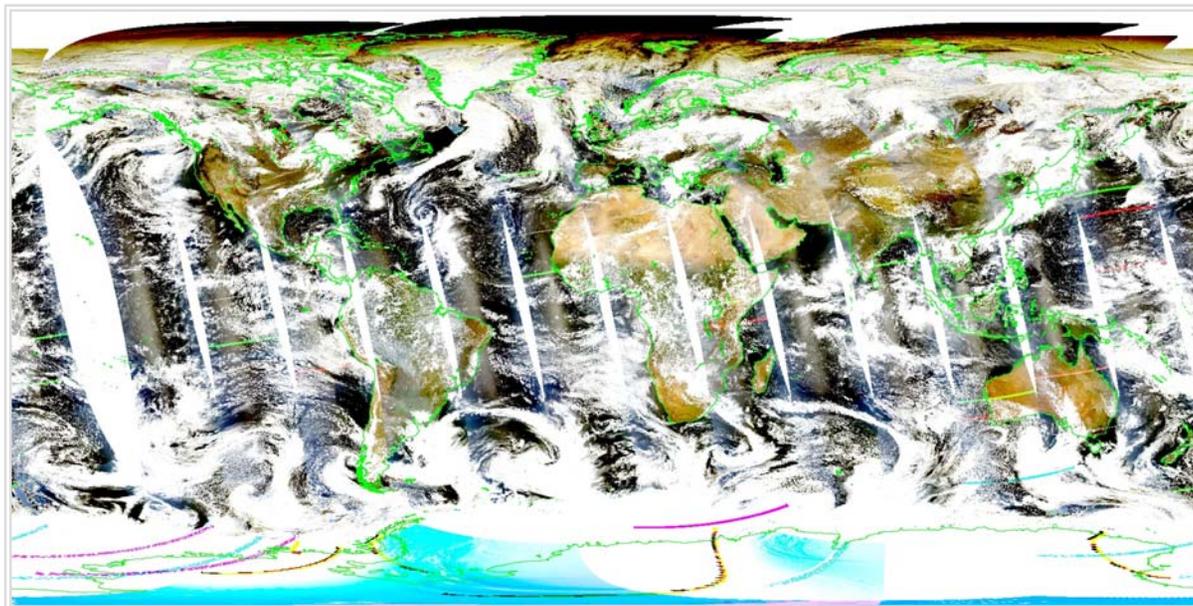


Interactive, operational and batch mode

Multi granule processing -Mosaic and Stitch

```
verbose
clear_data
set_home_directory /var/scratch
set_tmp_directory /var/scratch
set_map_directory /usr/modis/HDFLOOK/Maps
set_output_directory /var/scratch/dimitar/test
set_input_directory /ftp/datapool/OPS/user/MOGA/MYD021KM.003/2002.10.06
set_projection_to_geometry ProjectionTo="LINEAR" WidthTo=2000 HeightTo=1000 \
    LatitudeMinTo=-90. LatitudeMaxTo=90.0 LongitudeMinTo=-180. LongitudeMaxTo=180.0
set_image_background color=White
add_maps Coastlines=yes CoastlineColor=Green
set_misc_options OnlyDay=Yes
#set_image_RGB_composite THERMAL
set_image_RGB_composite VISIBLE
#add_grids color=Red LatitudeMin=-90 LatitudeMax=90 LatitudeStep=5 \
# LongitudeMin=-180 LongitudeMax=180 LongitudeStep=40
set_input_hdf_file /ftp/datapool/OPS/user/MOGA/MYD021KM.003/2002.10.06/MYD021KM*.hdf
create_MODIS_RGB_Mosaic FileName="MYD021KM_day_aqua_2002.10.06" RGBMode="Log" CreateJPEG=yes
```

**MODIS/Aqua Day-time 5km Global RGB Browse 10.06.2002**





## The Global MODIS/Terra and Aqua Browse



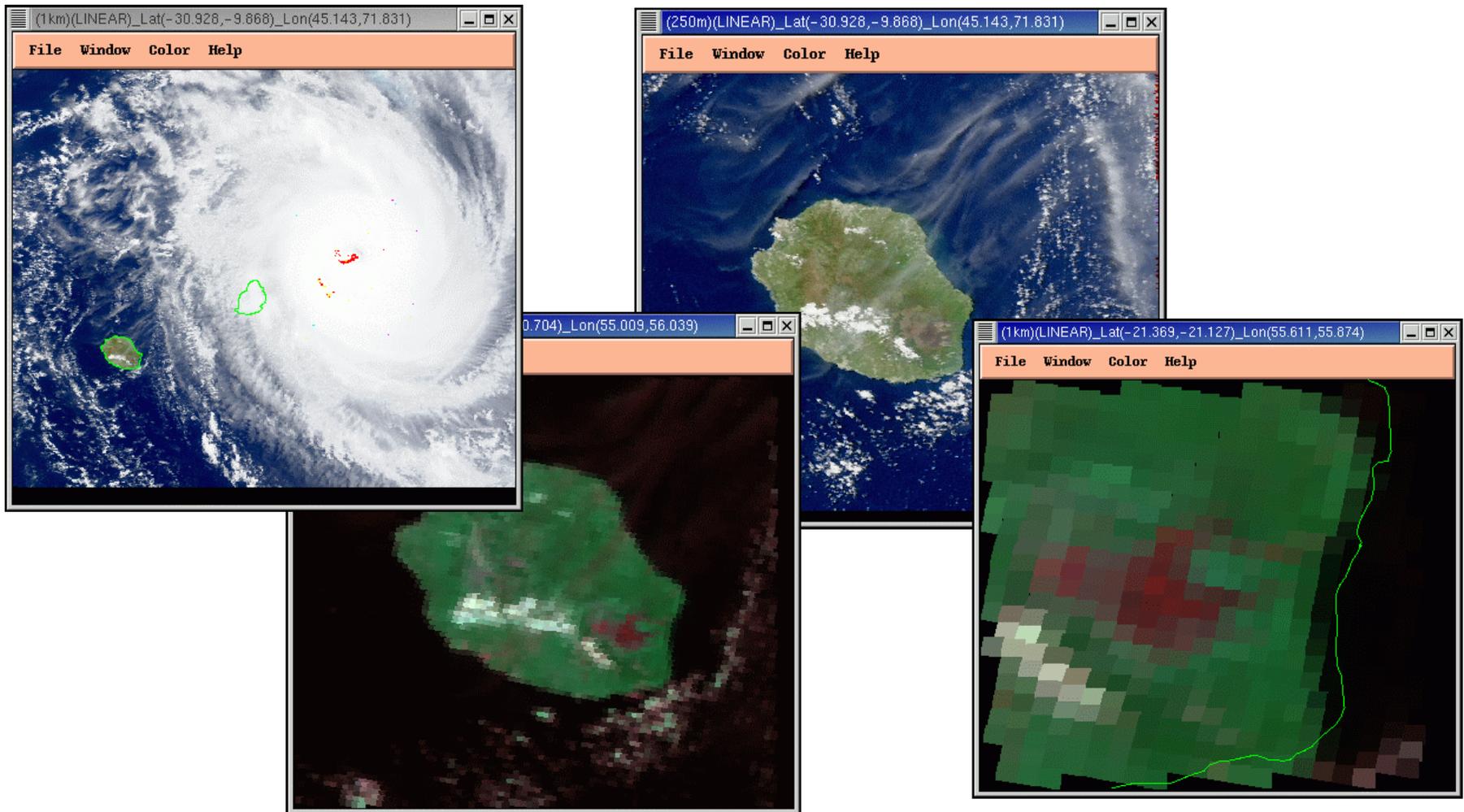
*HDFLook*

The Global Browse 5 km pixel resolution image in the foreground (with polar regions omitted) was generated with MODIS/Terra daytime data over MODIS/Aqua daytime data using visible bands 1, 4 and 3. This is the first time the MODIS Data Support Team (MDST) has generated combined images with data from the Terra and Aqua satellites. The background image, also the first of its kind, was generated with MODIS/Terra nighttime data using infrared bands 31, 29 and 20. These images are generated with HDFLook from MODIS/Terra and MODIS/Aqua data that was acquired on September 16, 2002. Images courtesy of the MDST at the GES DAAC.



## HDFLook on the fly

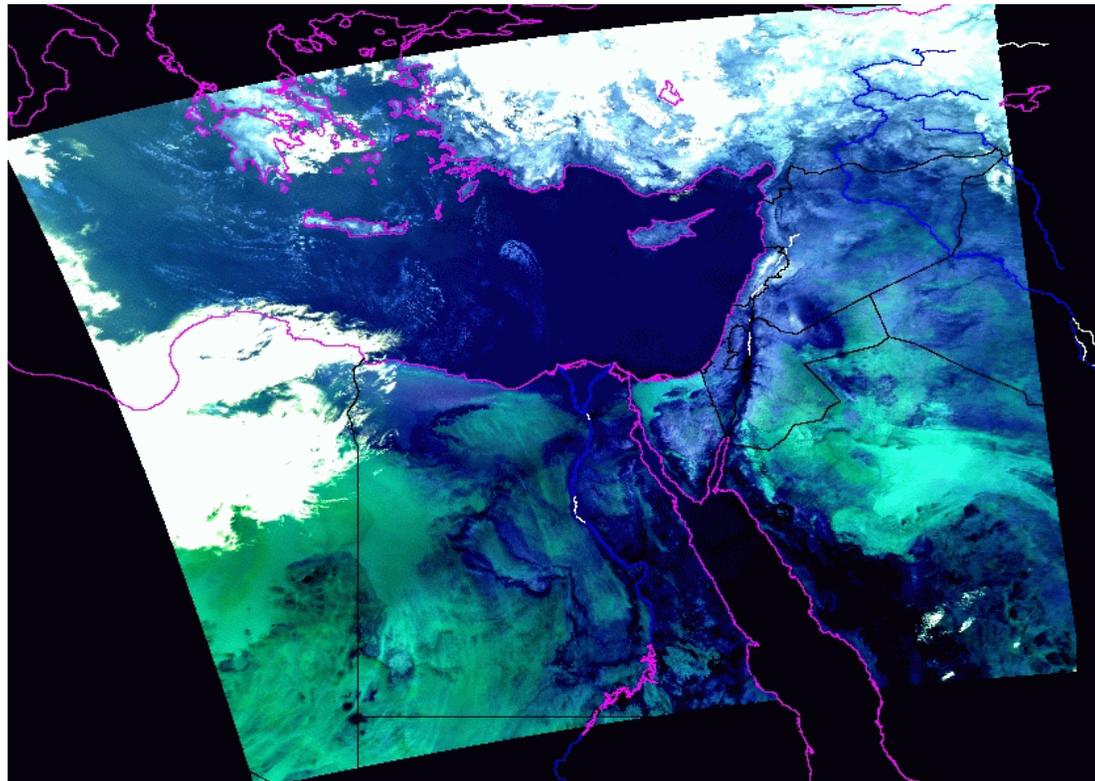
### Level1B visible and thermal anomalies over la Reunion





## Night time Thermal composite

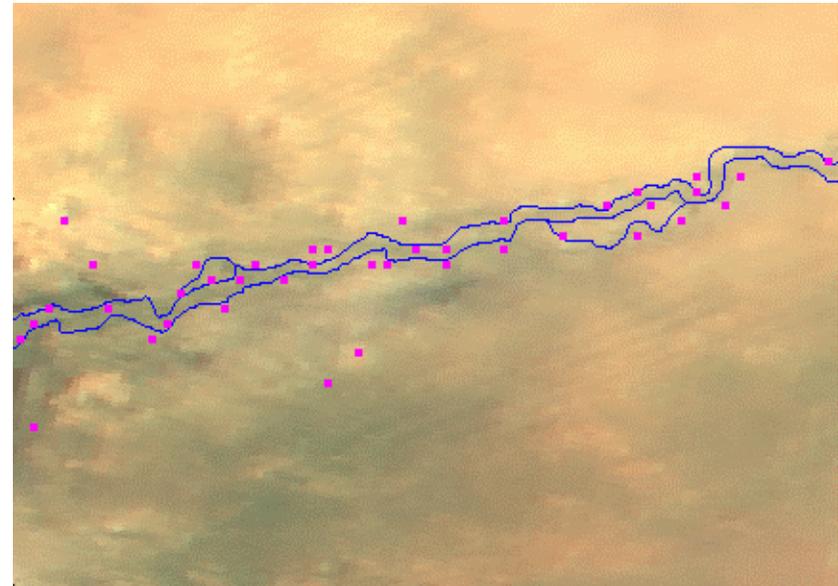
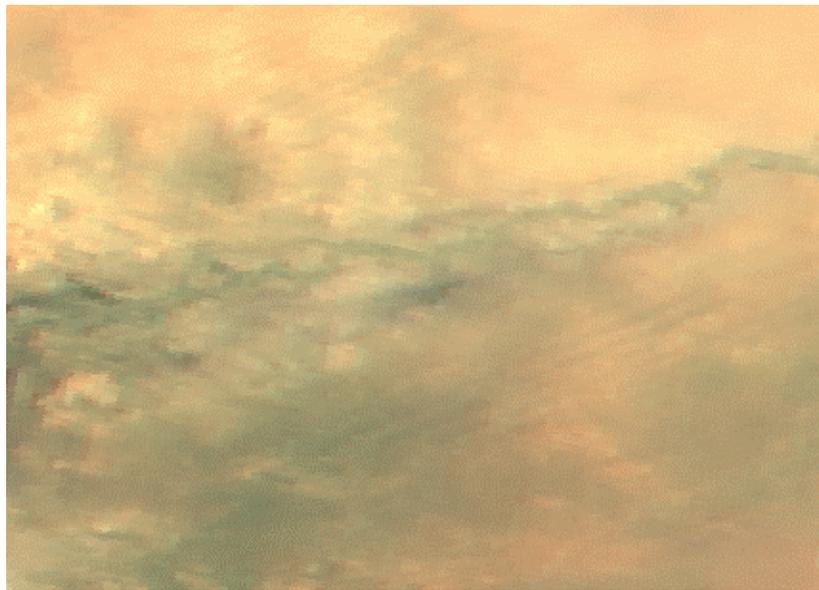
These are thermal RGB images acquired during nighttime 2002 141 (Brazil, Nile Delta) using these settings: band 31 Red 290K-275K, band 29 Green 280K-270K, band 20 B 300K-285K. the clouds which appear white (note the scale is reversed, the highest temperature is the lowest intensity and the lowest temperature is the highest intensity). The water appears very dark as the thermal inertia of water is so big that the warmest objects in the night data are the water bodies. [ Petitcolin F. and Vermote E. F. 2002]





## Human activities

### Desert Mali (Along the river)



Composite surface reflectance (MOD09) 250m



# Operational use and system integration of HDFLook

- It is a main programs to routinely generate Level 1B browse images (true-color for daytime, and brightness temperature for nighttime) for MODIS data from the Terra and Aqua satellites.(GES DAAC)
- Spatial on-the-fly subsetting of MODIS Level 3 Ocean products from the Data Pool (GES DAAC)
- On-demand parameter subsetting of MODIS Ocean Level 2 products (GES DAAC)
- Operational Terra Modis preprocessing system (Yasuoka Lab, Institute of Industrial Science, University of Tokyo)



## *HDFLook* SUMMARY

- ❑ Accessing and visualization of all swath (level-1, and 2) and gridded (level-3 and 4) MODIS radiometric and geolocation, atmosphere, land, and ocean products, AIRS L1B and CERES data.
- ❑ Re-mapping of swath data to world map
- ❑ Reprojection from one projection to a different one
- ❑ Interactive, operational and batch mode capabilities
- ❑ Subsetting features - availability of parameter, band, and spatial subsetting
- ❑ Multi-granule processing - Mosaic and stitch capabilities
- ❑ Displays ancillary/data attributes
- ❑ Data conversion- from scaled quantities to physical units
- ❑ Format conversion- HDF-EOS to ASCII, Binary, JPEG, and Geo Tiff

Where to get HDFLook :GES DAAC [daac.gsfc.nasa.gov/MODIS/HDFlook](http://daac.gsfc.nasa.gov/MODIS/HDFlook)

LOA, UL, France [www-loa.univ-lille1.fr/Hdflook/hdflook\\_gb.html](http://www-loa.univ-lille1.fr/Hdflook/hdflook_gb.html)

This presentation described methods and tools implemented or planned for the Goddard DAAC that are intended to optimize access to MODIS data for the Earth Science community.