

Streaming Sensor Data from Space: Acquiring and Managing Direct Broadcast Satellite Data for Sites of the Long Term Ecological Research Network

John Vande Castle and Mark Servilla
Long Term Ecological Research Network Office,
Department of Biology, University of New Mexico
MSC03 2020, Albuquerque, NM 87131-0001

jvc@lternet.edu mservilla@lternet.edu



CREATE 

Center for Rapid Environmental Assessment & Terrain Evaluation

The University of New Mexico



THE UNIVERSITY *of*
NEW MEXICO

CREATE Hardware & Facilities

Receiving station: UNM Research Park:

- 4.5 meter X-Band automated 3-axis satellite tracking antenna (MODIS)
- 1.5 meter L-Band automated satellite tracking antenna (AVHRR)
- X-band and L-band automated acquisition processors, raw data backup storage (30 days)





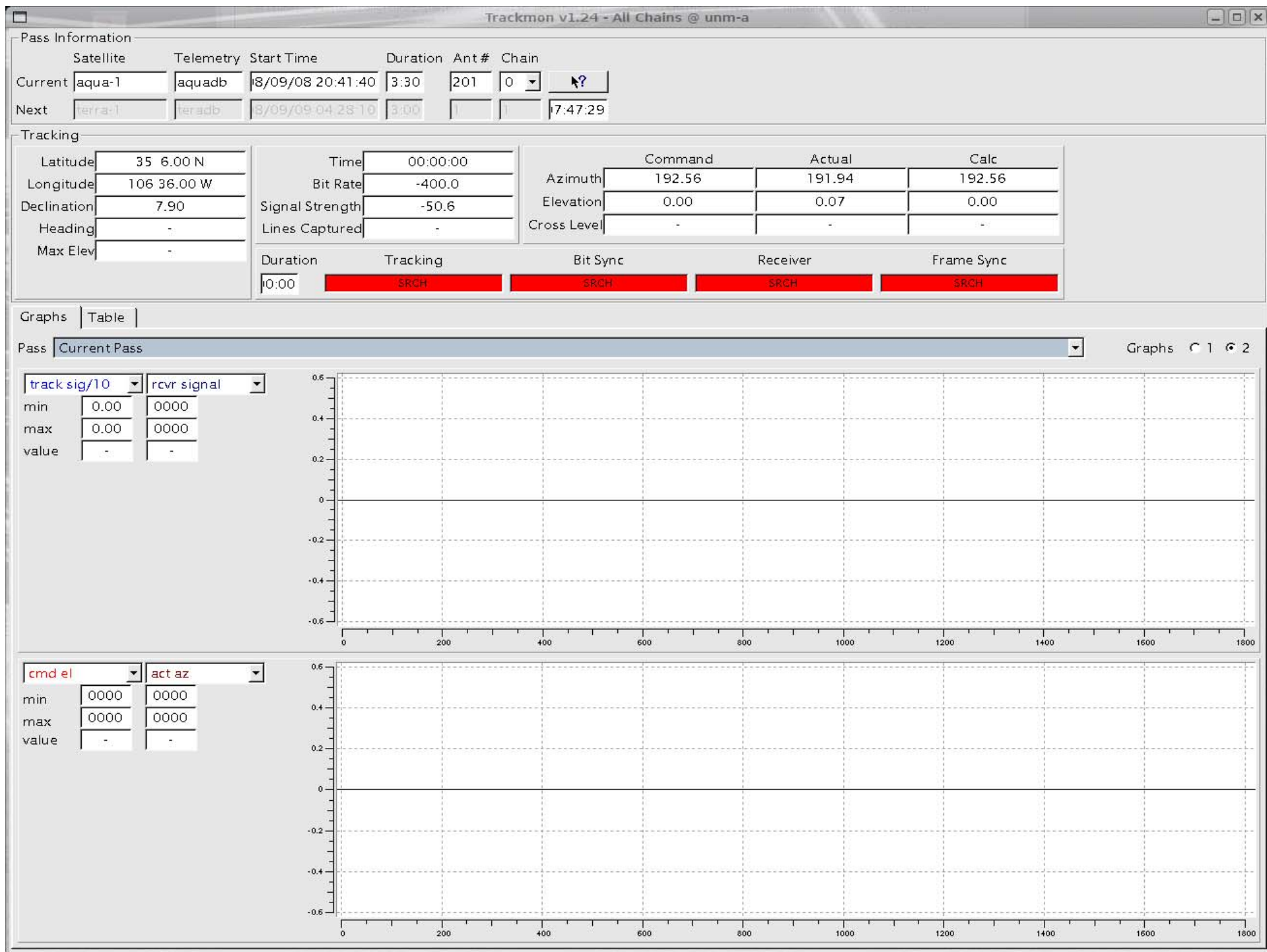
TV Guide

Watch

Live

Telemetry	Satellite	Date	Time	Duration	Lines
aquadb	aqua-1	2008/09/08	20:38:52	00:16:18	0





Pass Information

	Satellite	Telemetry	Start Time	Duration	Ant #	Chain
Current	aqua-1	aquadb	8/09/08 20:41:40	3:30	201	0
Next	terra-1	teradb	8/09/09 04:28:10	3:00	1	1

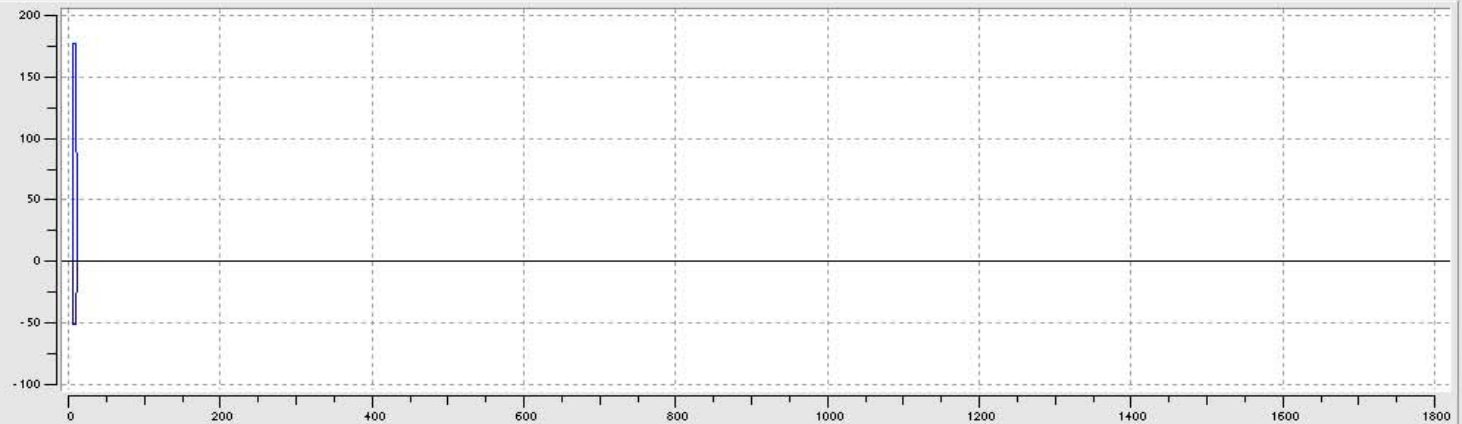
Tracking

Latitude	35 6.00 N	Time	00:00:05	Command	Actual	Calc
Longitude	106 36.00 W	Bit Rate	-400.0	Azimuth	192.66	192.61
Declination	7.90	Signal Strength	-50.5	Elevation	0.00	0.19
Heading	-	Lines Captured	-	Cross Level	-	-
Max Elev	-					
Duration	00:05	Tracking	SRCH	Bit Sync	SRCH	Receiver
					SRCH	Frame Sync
						SRCH

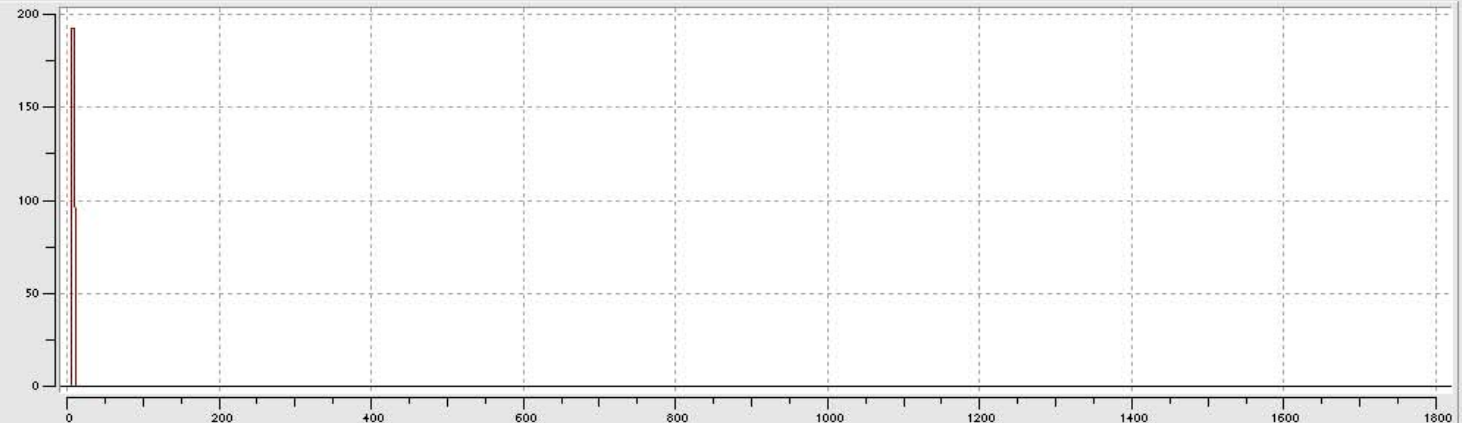
Graphs | Table

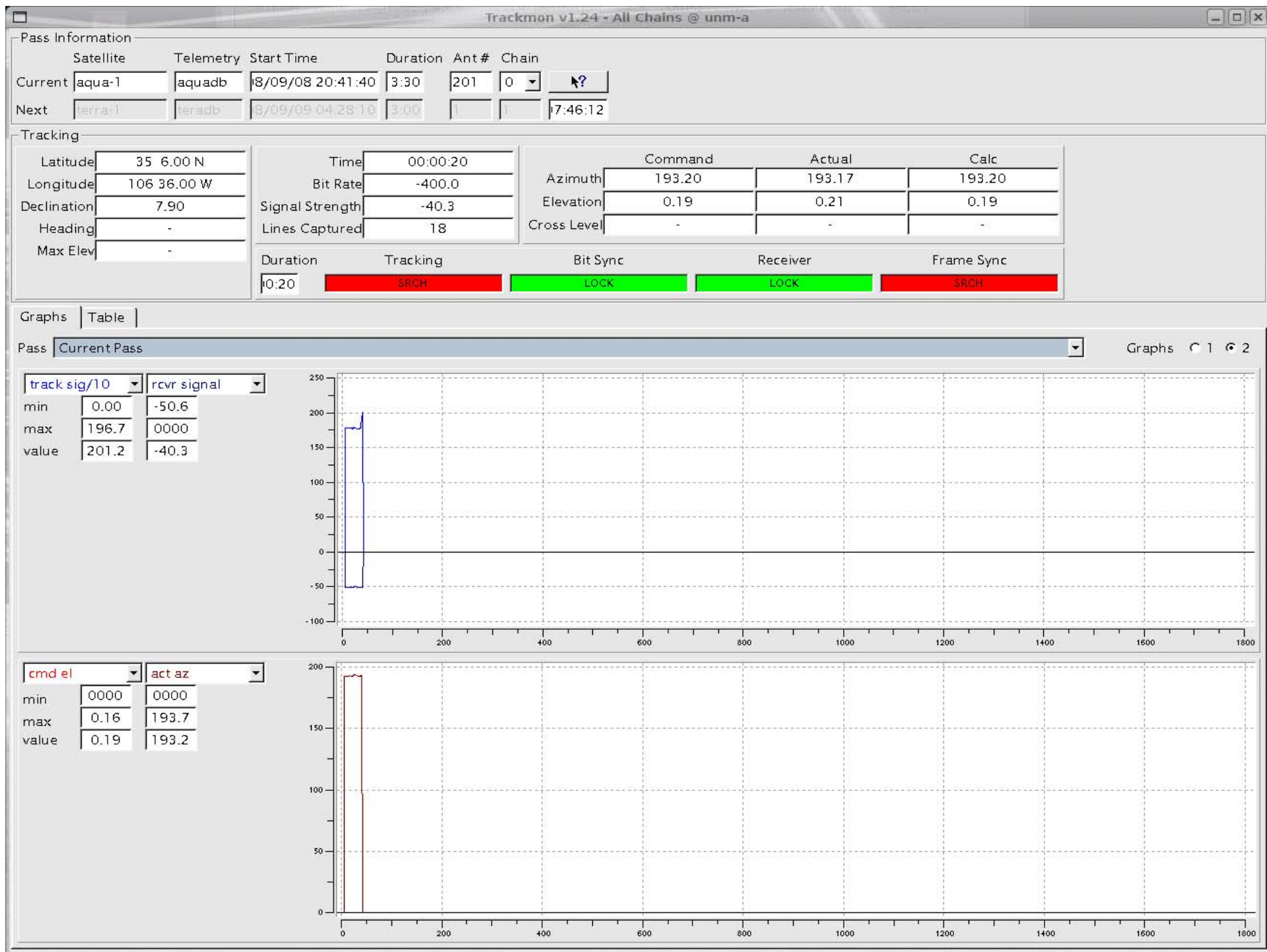
Pass Current PassGraphs 1 2

track sig/10	rcvr signal
min	0.00 -50.6
max	177.6 0000
value	177.5 -50.5



cmd el	act az
min	0000 0000
max	0000 192.6
value	- 192.6





Pass Information

	Satellite	Telemetry	Start Time	Duration	Ant #	Chain
Current	aqua-1	aquadb	8/09/08 20:41:40	3:30	201	0
Next	terra-1	teradb	8/09/09 04:28:10	3:00	1	1

Tracking

Latitude	35 6.00 N
Longitude	106 36.00 W
Declination	7.90
Heading	-
Max Elev	-

Time	00:00:30
Bit Rate	-400.0
Signal Strength	-30.1
Lines Captured	106

	Command	Actual	Calc
Azimuth	193.56	193.45	193.56
Elevation	0.79	0.21	0.79
Cross Level	-	-	-

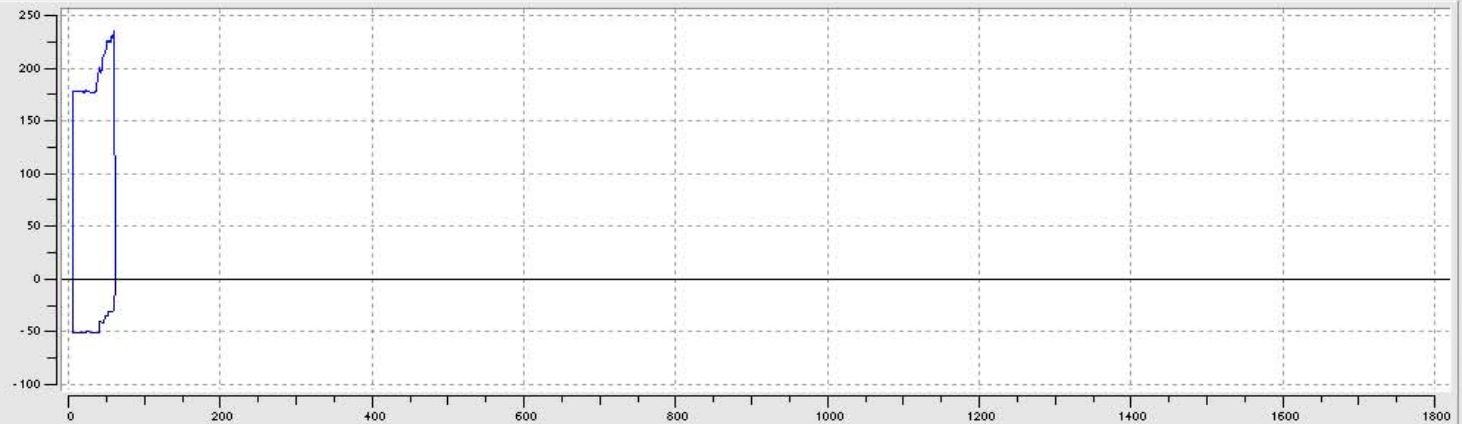
Duration	Tracking	Bit Sync	Receiver	Frame Sync
10:30	SRCH	LOCK	LOCK	SRCH

Graphs | Table

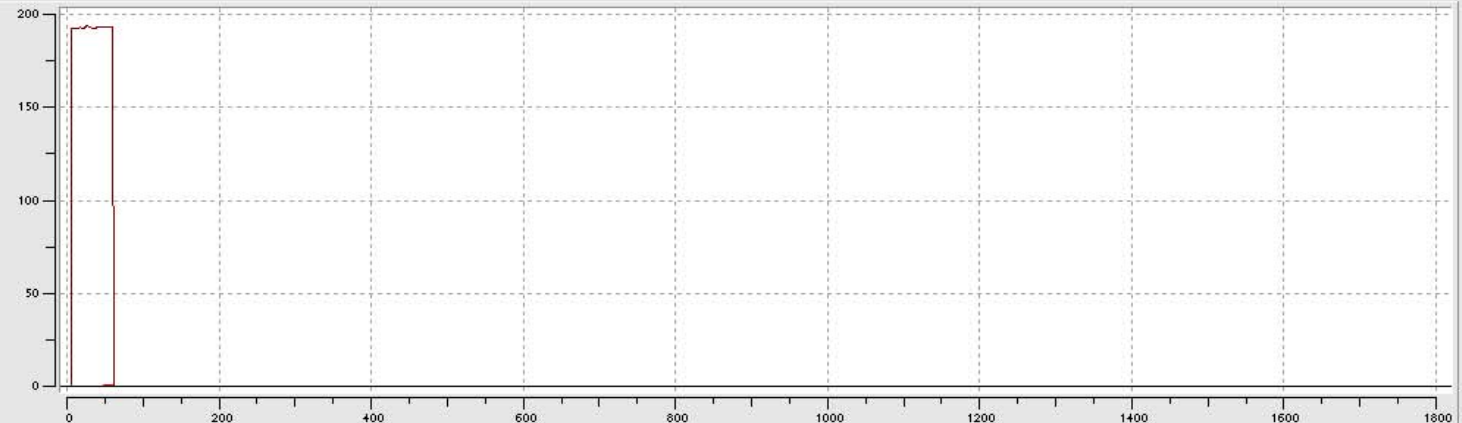
Pass Current Pass

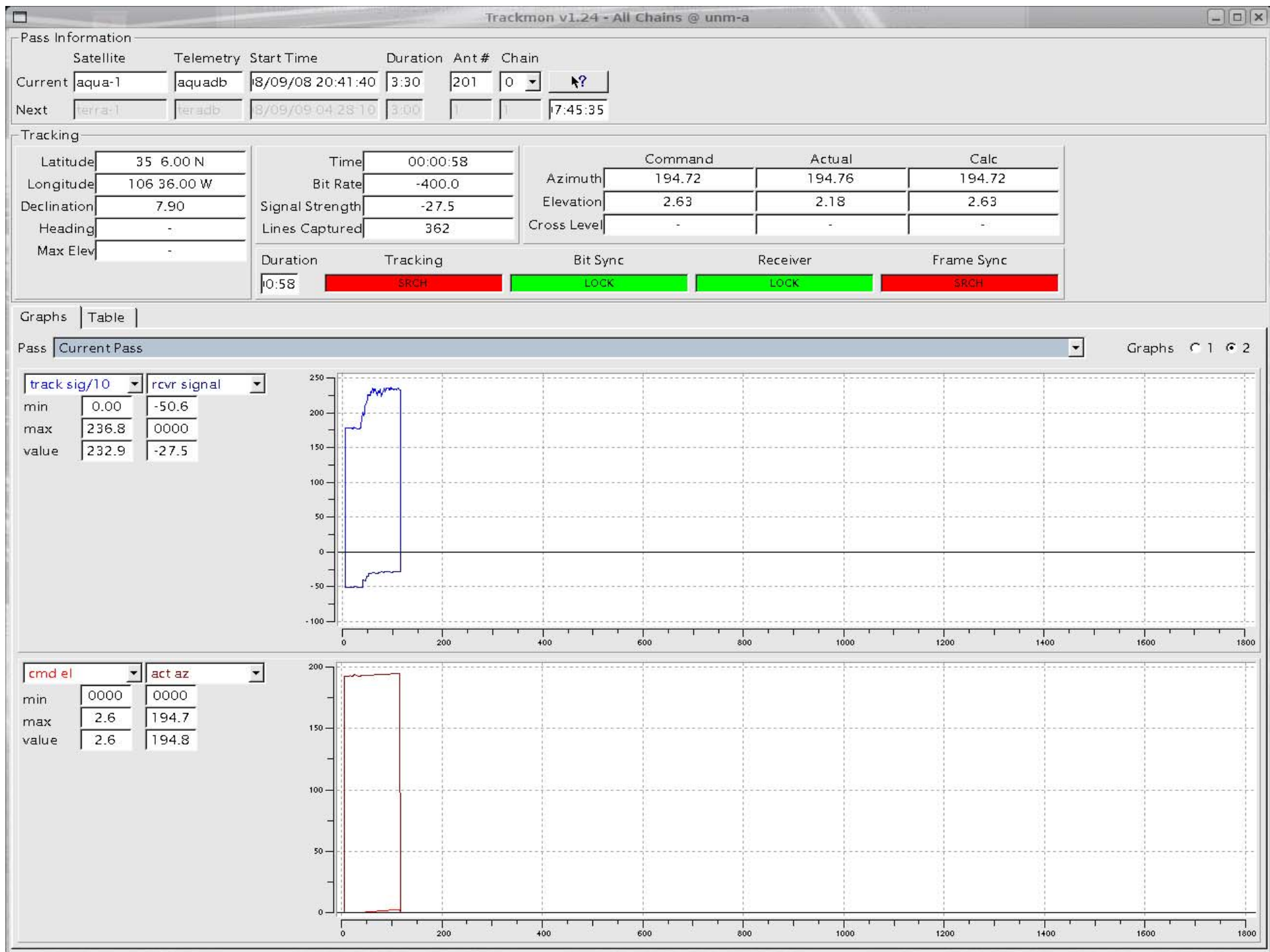
Graphs 1 2

track sig/10	rcvr signal
min	0.00 -50.6
max	230.5 0000
value	235.6 -30.1



cmd el	act az
min	0000 0000
max	0.75 193.7
value	0.79 193.4





Pass Information

	Satellite	Telemetry	Start Time	Duration	Ant #	Chain
Current	aqua-1	aquadb	8/09/08 20:41:40	3:30	201	0
Next	terra-1	teradb	8/09/09 04:28:10	3:00	1	1

Tracking

Latitude	35 6.00 N
Longitude	106 36.00 W
Declination	7.90
Heading	-
Max Elev	-

Time	00:01:37
Bit Rate	-400.0
Signal Strength	-26.8
Lines Captured	722

	Command	Actual	Calc
Azimuth	196.65	196.70	196.63
Elevation	5.47	4.93	5.43
Cross Level	-	-	-

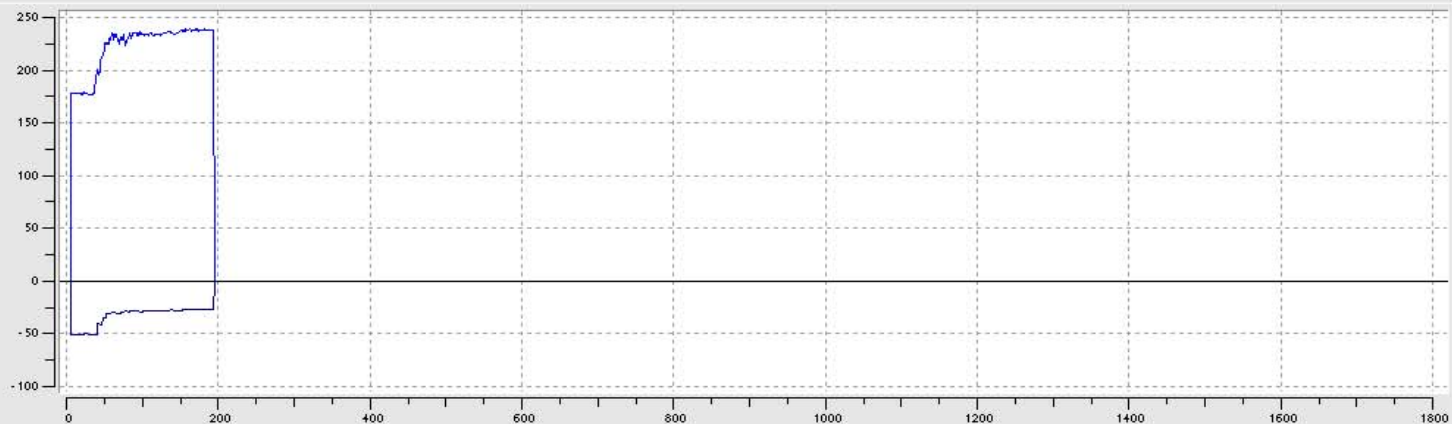
Duration	Tracking	Bit Sync	Receiver	Frame Sync
1:37	SRCH	LOCK	LOCK	SRCH

Graphs | Table

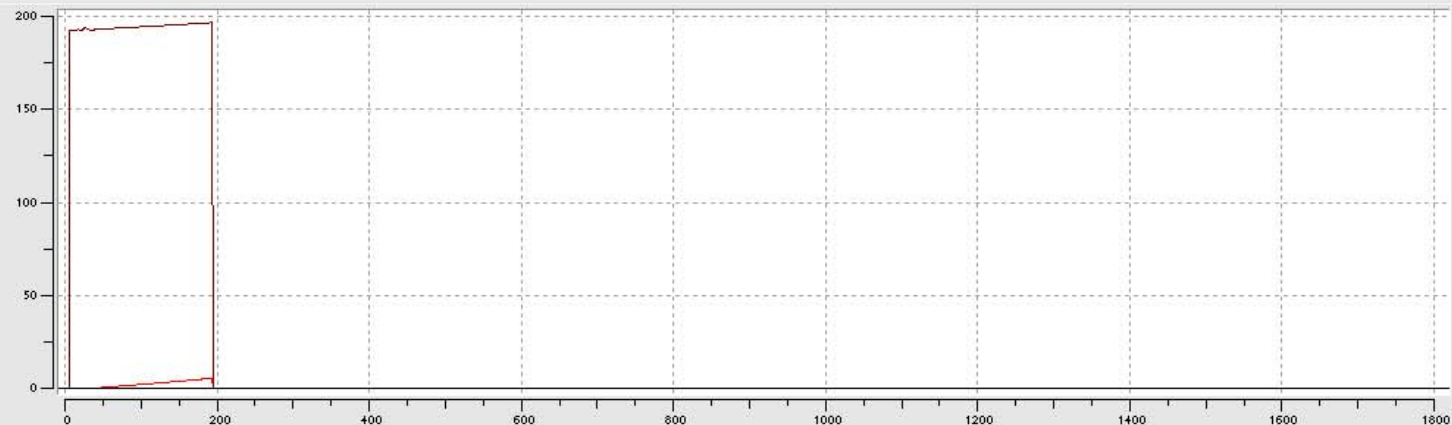
Pass Current Pass

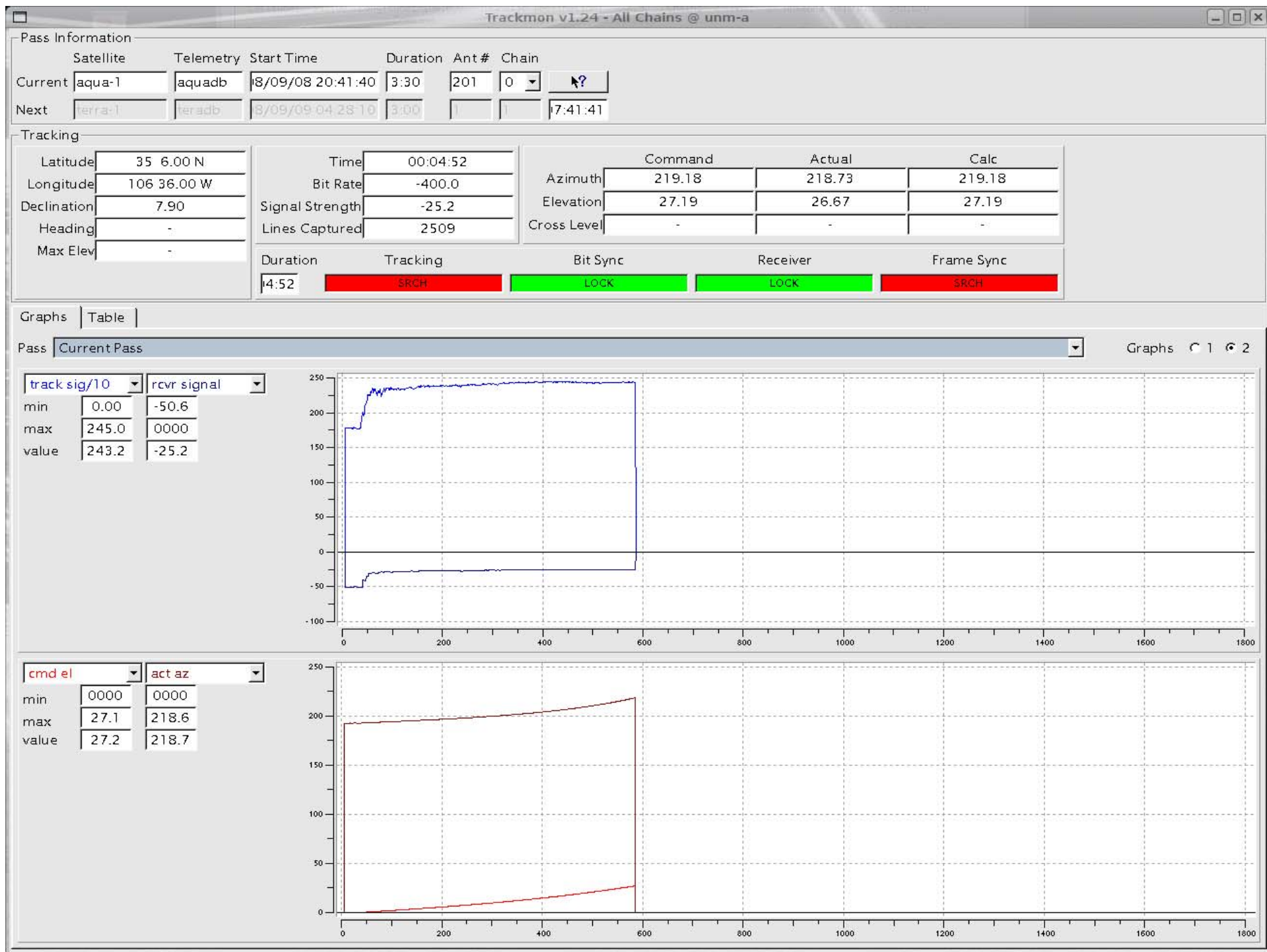
Graphs 1 2

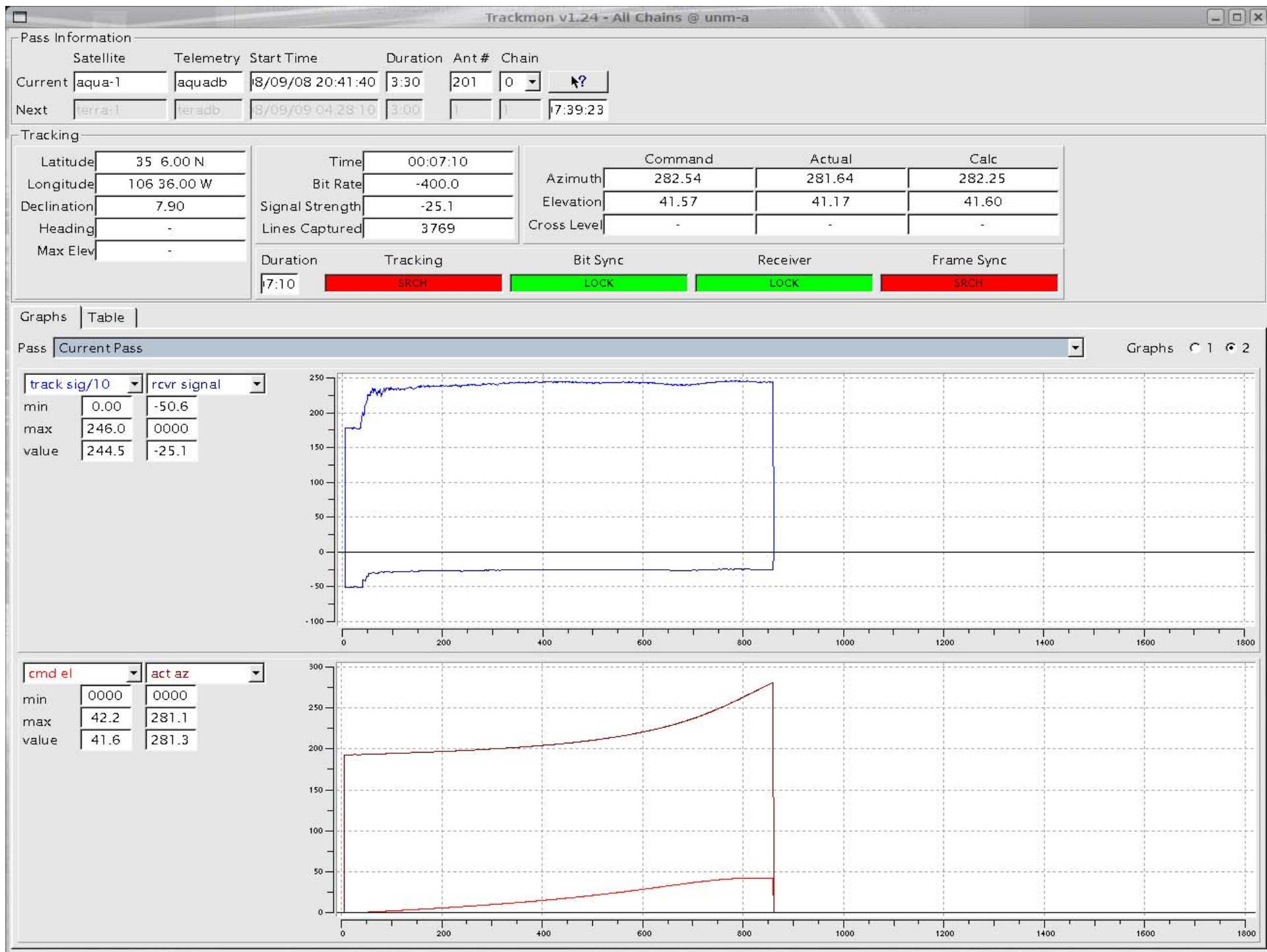
track sig/10	rcvr signal
min	0.00 -50.6
max	239.1 0000
value	238.3 -26.8

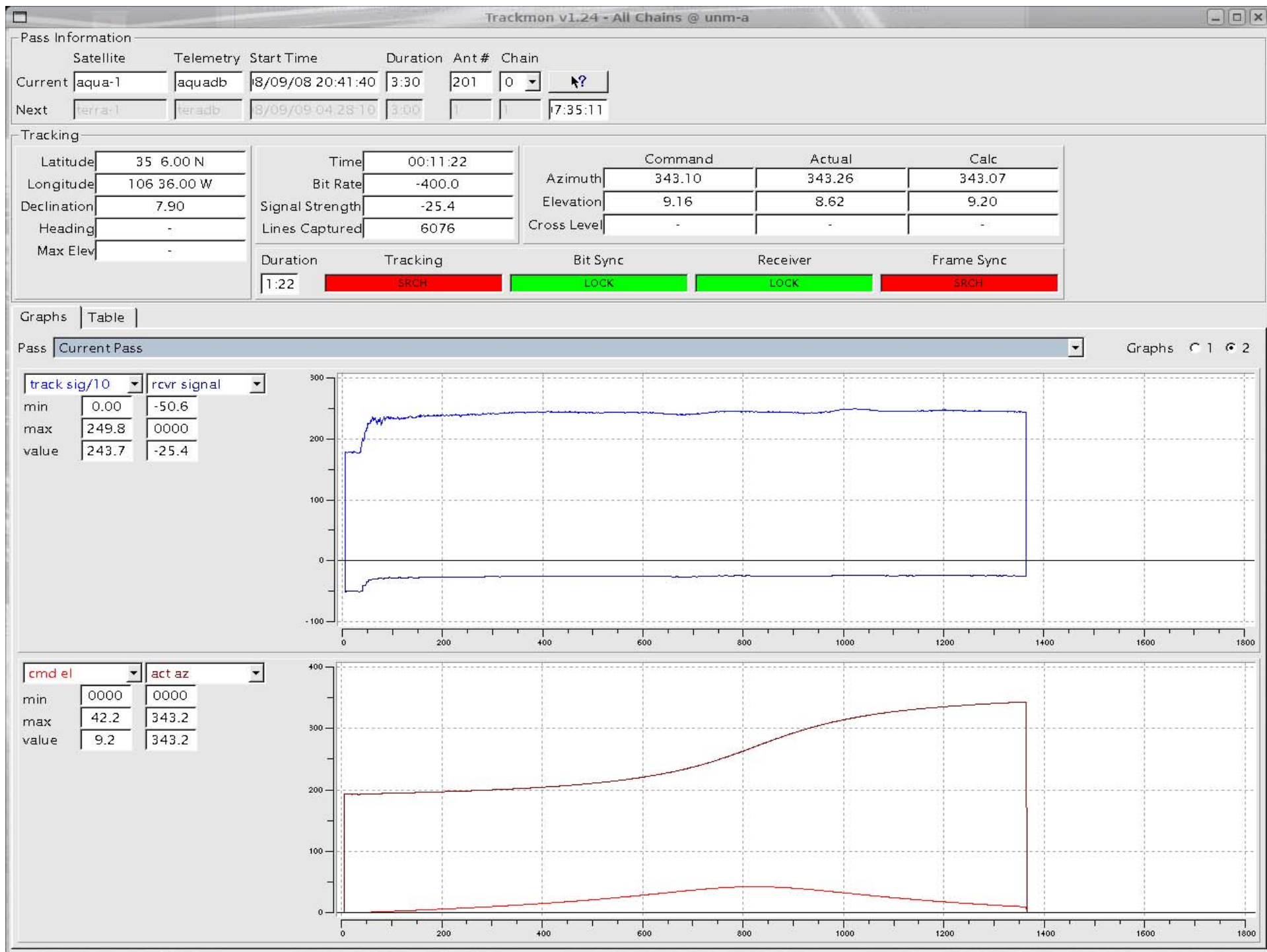


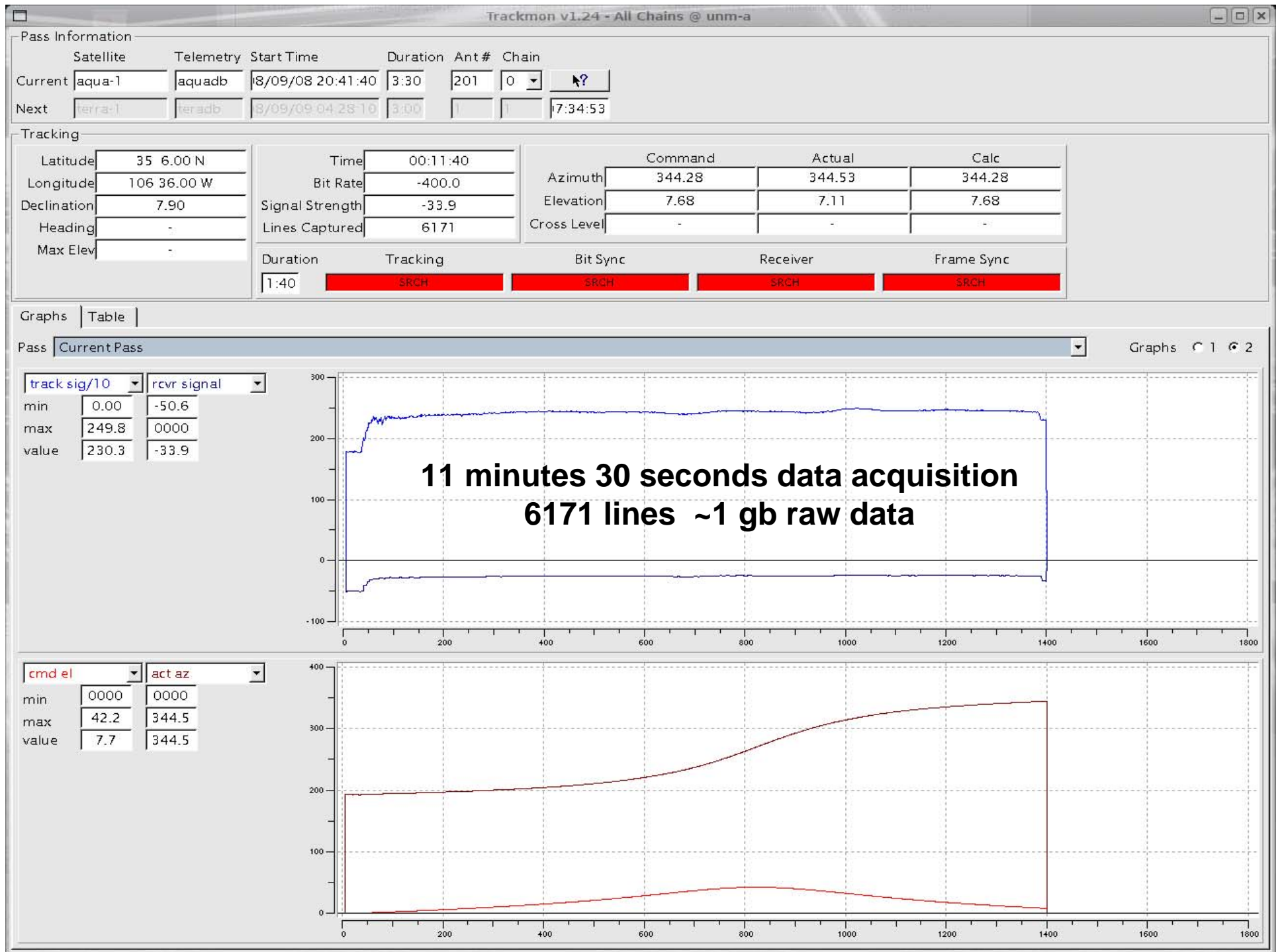
cmd el	act az
min	0000 0000
max	5.4 196.7
value	5.4 196.7











CREATE Hardware & Facilities

CREATE at the UNM Center for High Performance Computing (HPC):

- High speed data transfer from UNM research park
- 5 Node (2CPU) Terascan Linux processing cluster, 20 Tb of storage
- Dual quad-core 32gb Linux NASA IPOPP processing server 4/7 Tb storage
- Linux data distribution server (create.hpc.unm.edu): 7 Tb of storage
- Create processing and research laboratory: Linux, MAC, Windows processing servers, image processing software



CREATE Research Lab

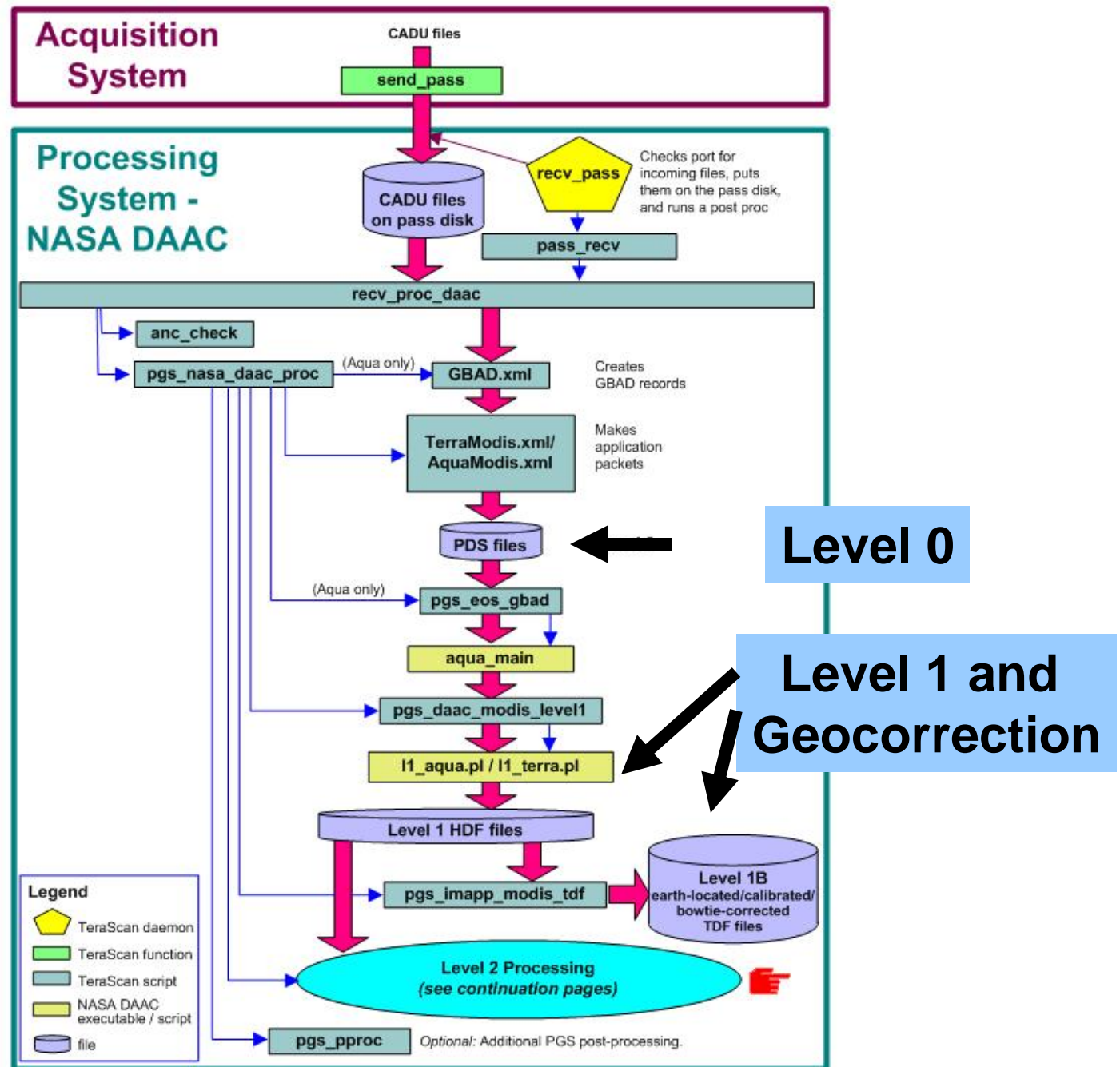


**Processing
and
Distribution
Servers**

Automated processing cluster

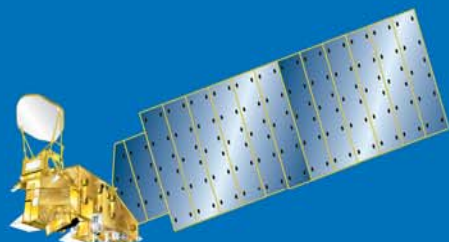


TeraScan MODIS ("NASA DAAC") Processing Flow

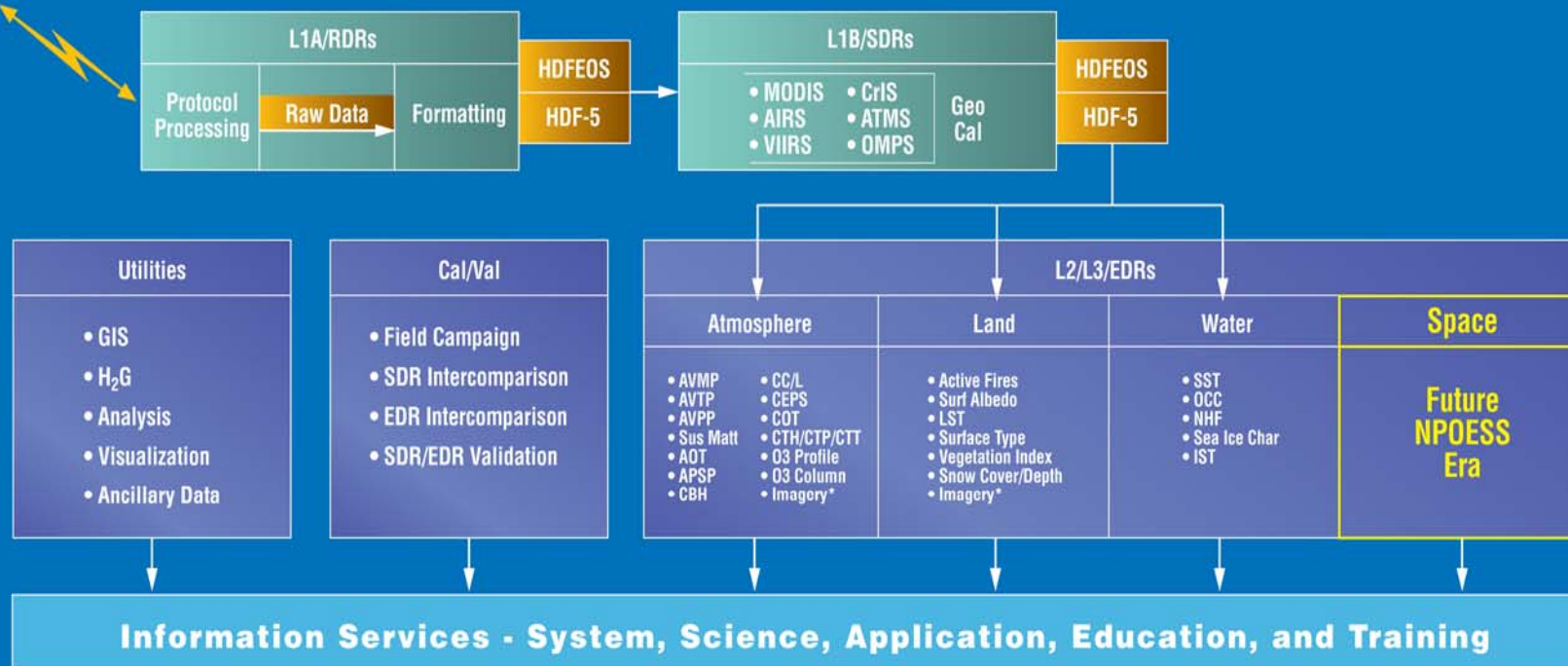




International Polar Orbiter Processing Package (IPOPP) Elements for Terra, Aqua, and NPP



IPOPP is the primary processing package that will enable the Direct Broadcast (DB) community to process, visualize, and evaluate NPP Sensor and Environmental Data Records—which is a necessity for the DB community during the transition from the Earth Observing System Era to the NPOESS Era.



CREATE - Alpha Test Site Transition MODIS → VIIRS



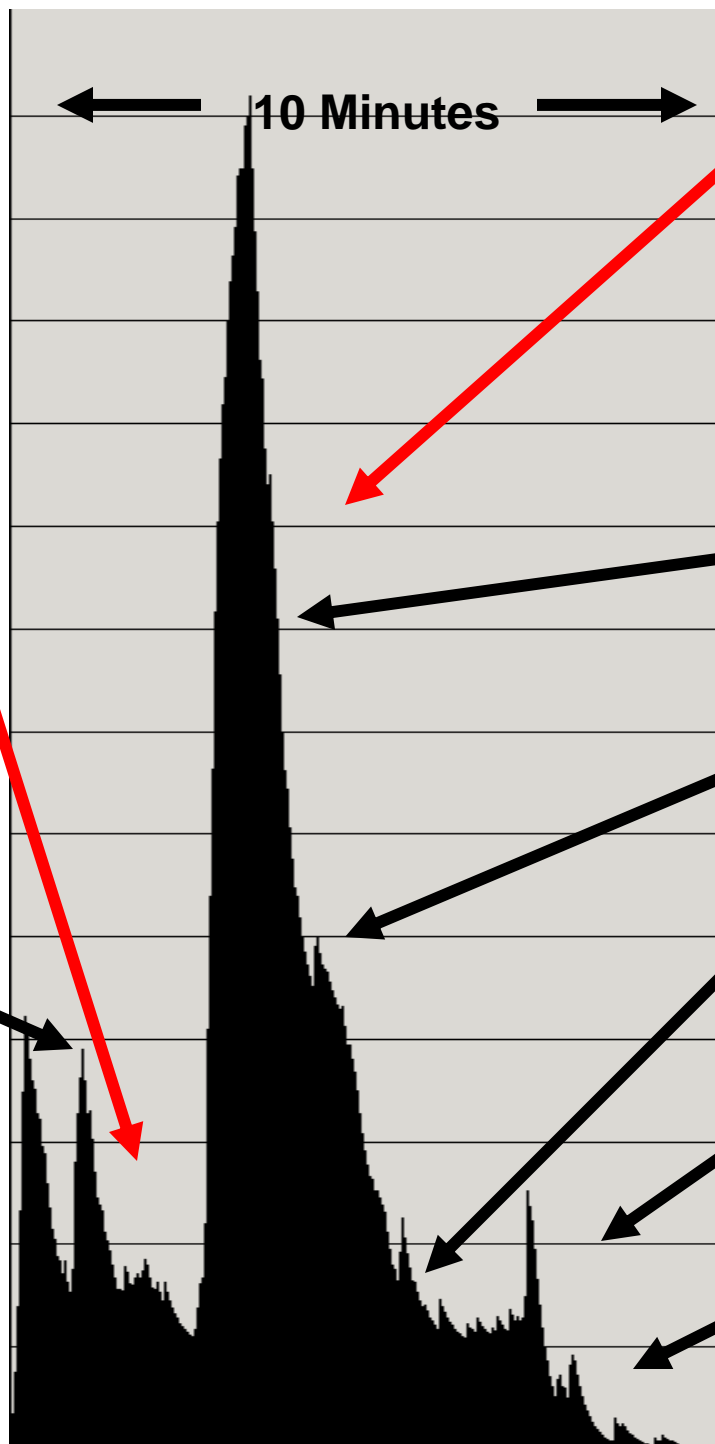
MODIS DATA Processing

**System
Process-bound
-waiting for single
large product
generation**

Generation of
Level 1 Data
(1km, hkm, qkm
radiance data
products etc.)

Generation of
MODIS Level 0 PDS
Data, secondary
transfer to RAID
archive

Data transfer to
processing sever



**System
Processor-bound
-queue waiting for
large number of
individual product
generation**

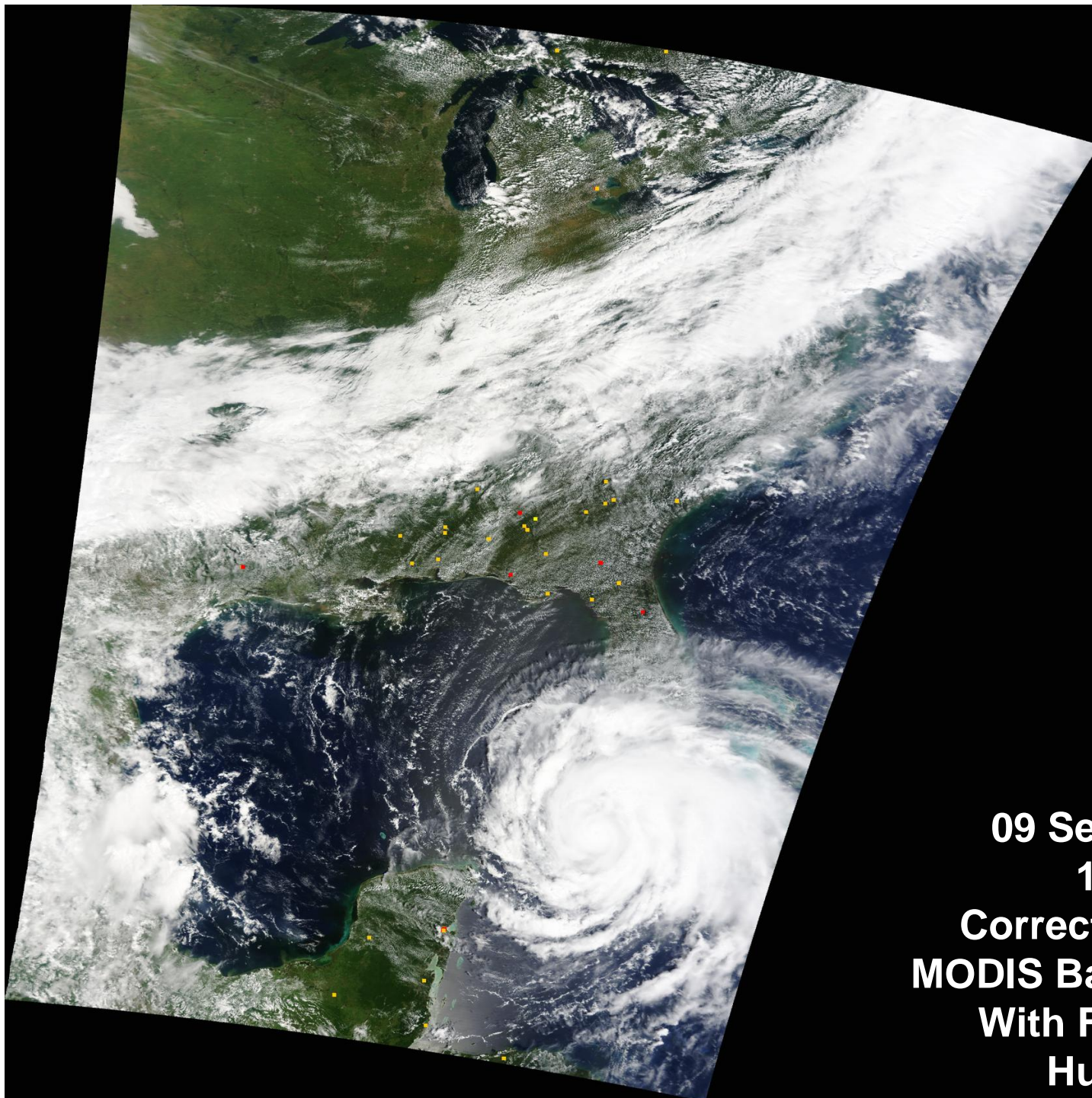
Generation of Level 2
data - hdf, (tdf) and
GeoTiff data products

NDVI/EVI Data
Processing

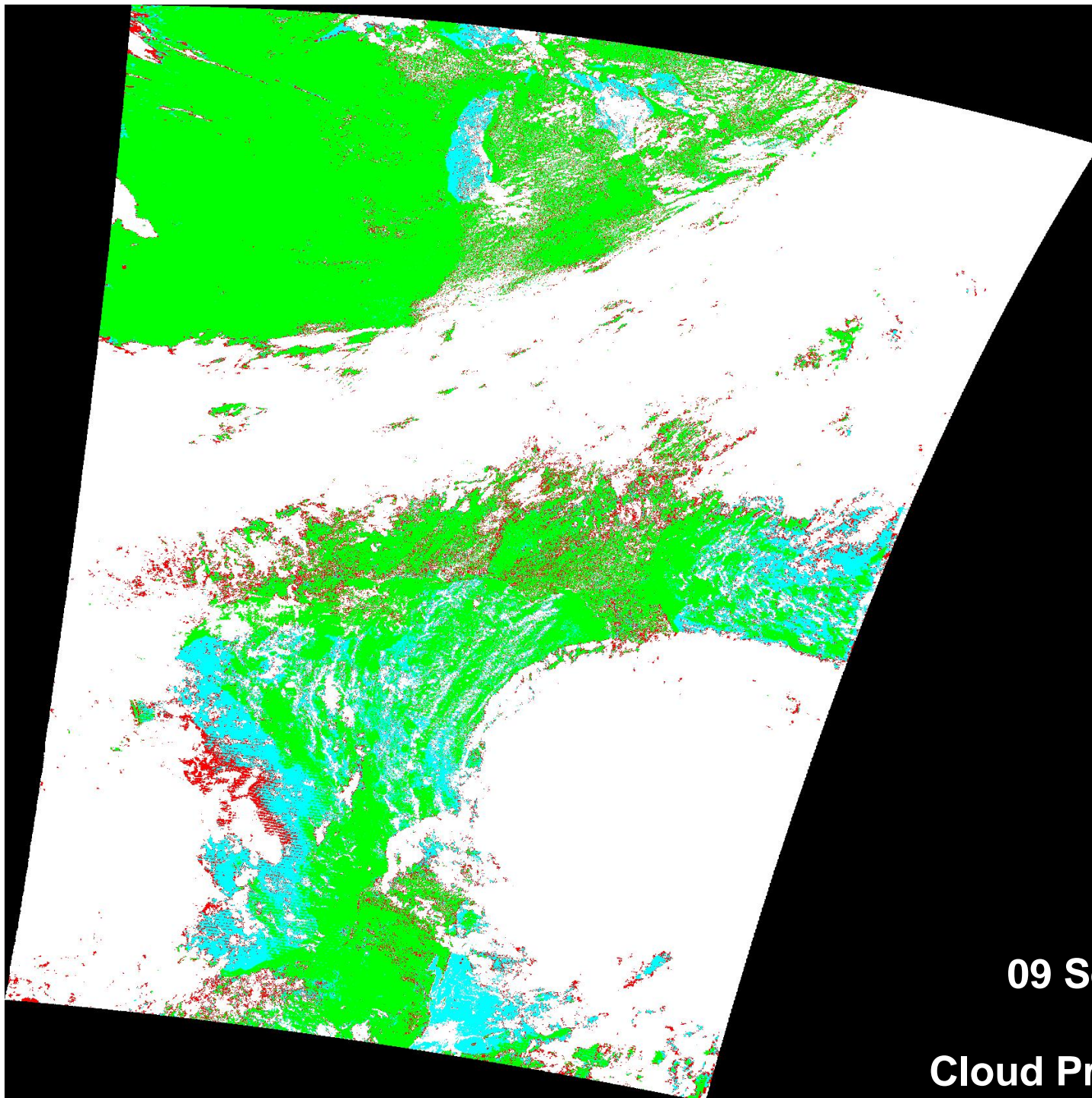
Generation of
secondary cloud
products

Data clean-up,
transfer and archive

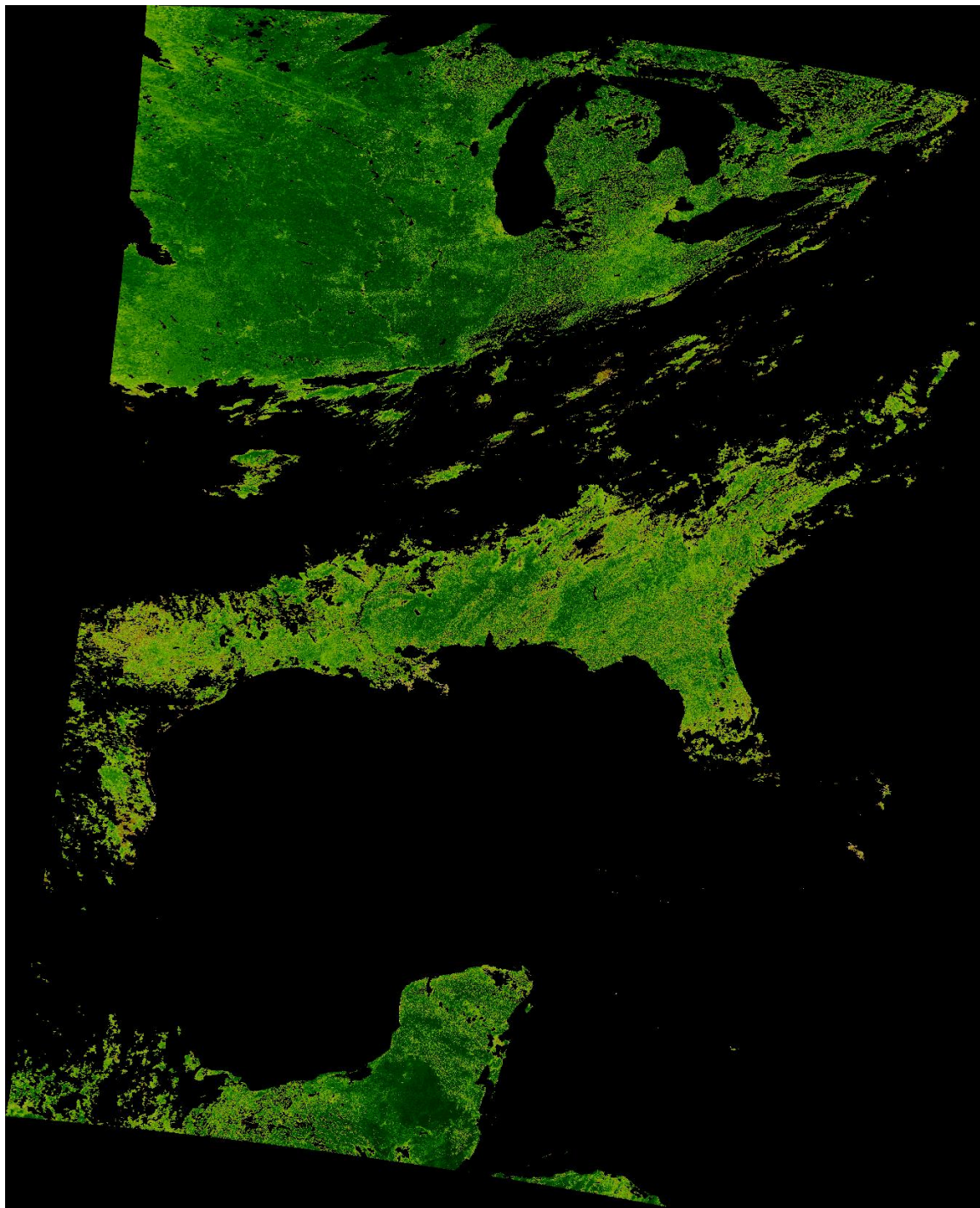
Retrieval of ancillary
data from GSFC,
SSEC etc.



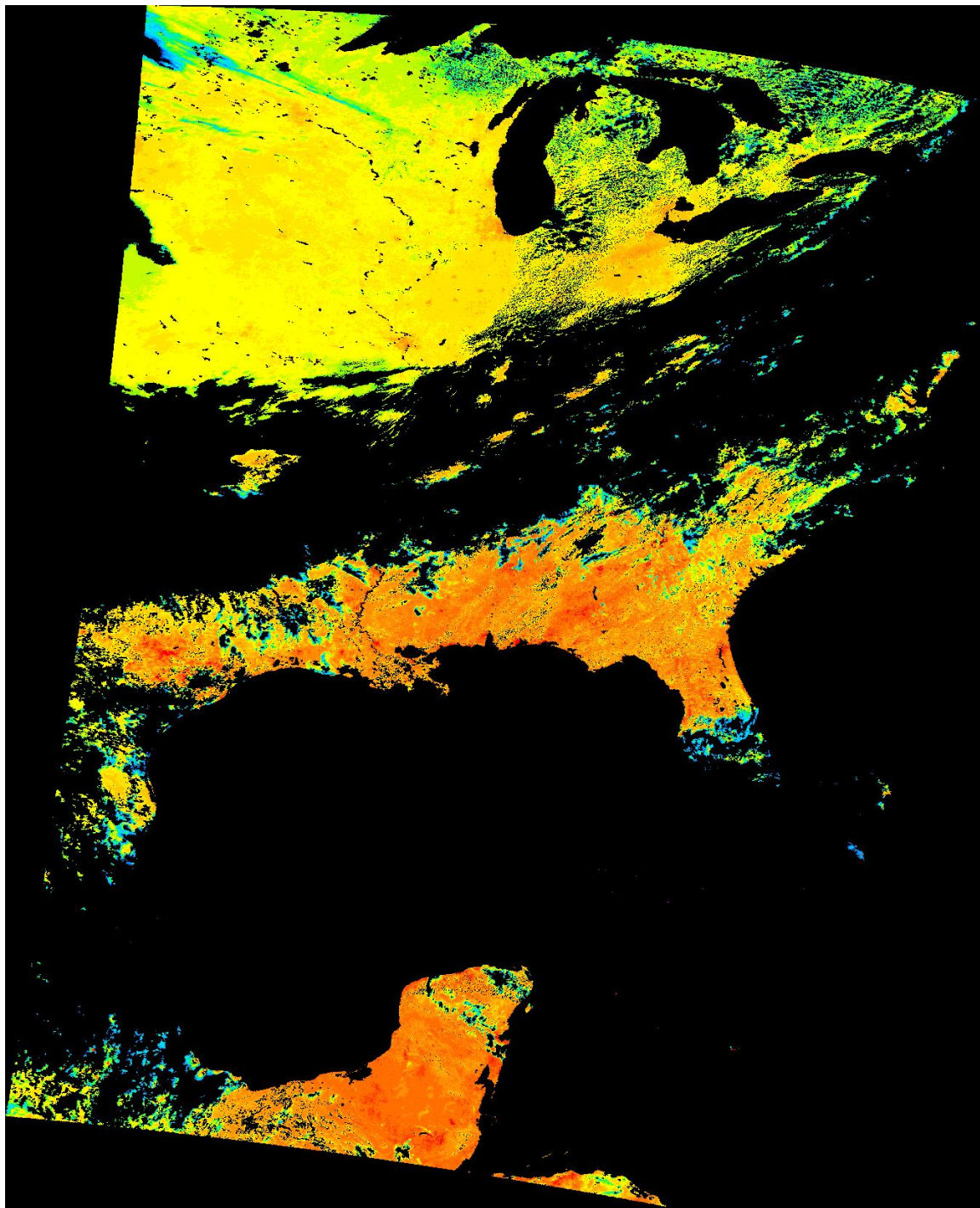
**09 September 2008
16:32 UTC
Corrected Reflectance
MODIS Bands 1,4,3 = R,G,B
With Fire Probability
Hurricane Ike**



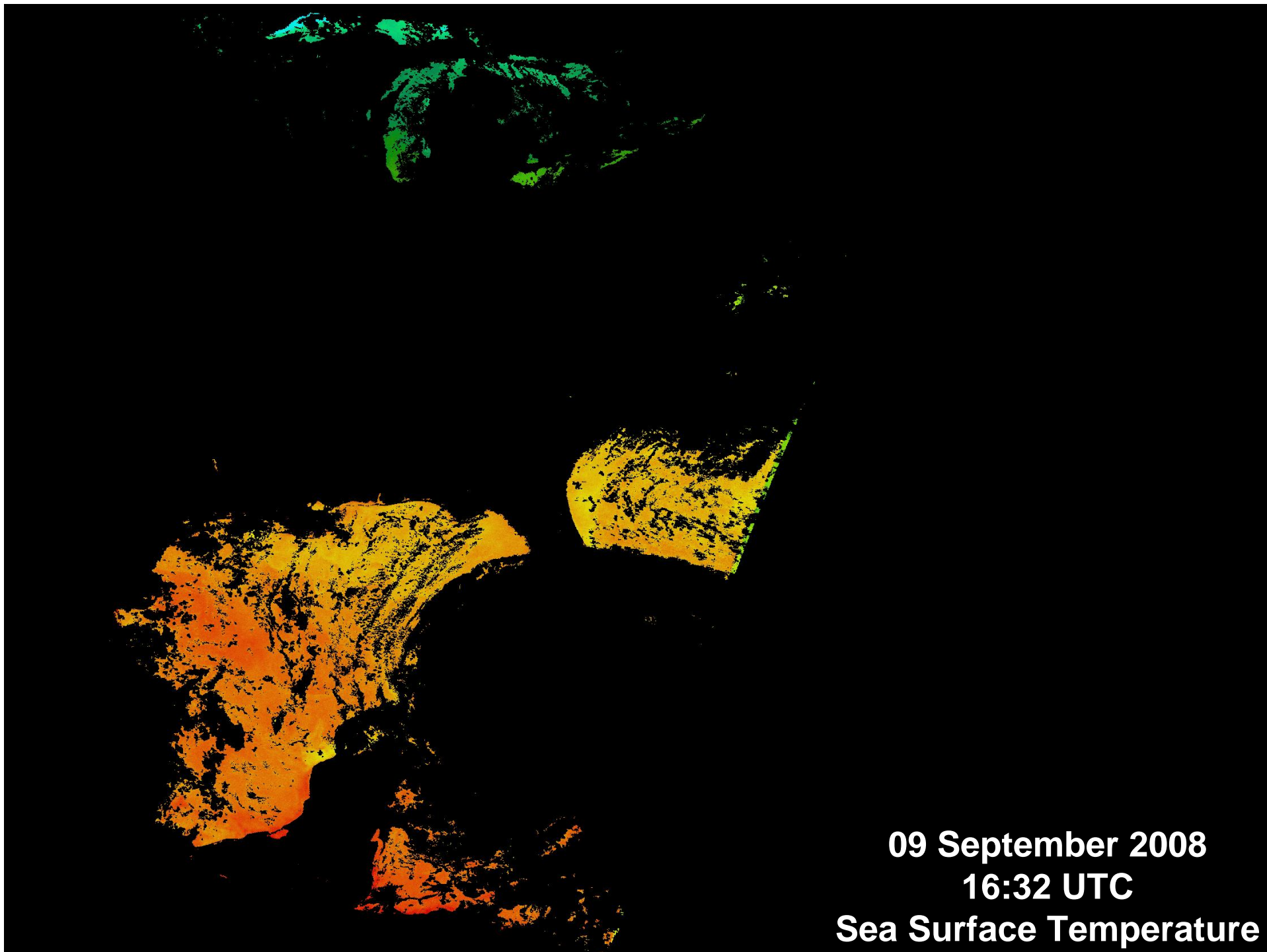
09 September 2008
16:32 UTC
Cloud Properties and Mask



**09 September 2008 Day
16:32 UTC
Normalized Difference
Vegetation Index
(NDVI)**



09 September 2008
16:32 UTC
Land Surface Temperature



09 September 2008
16:32 UTC
Sea Surface Temperature

Real-time data
for NSF LTER
research sites



CREATE - Mozilla Firefox

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http://create.hpc.unm.edu/create/lter.php

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CREATE
Center for Rapid Environmental Assessment & Terrain Evaluation
The University of New Mexico

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LTER

MODIS data for LTER sites produced at CREATE

The Center for Rapid Environmental Assessment and Terrain Evaluation (CREATE), has installed automated scripts into its processing system to extract MODIS data from its processing stream for regions encompassing sites of the Long Term Ecological Research Network (LTER) <http://www.lternet.edu/>

The input for the products are DIRECT READOUT MODIS data acquired real-time by the CREATE acquisition and processing system.

The area currently extracted is a 128km by 128km region centered each LTER sites. Depending on the MODIS data product, the resolution varies from 250 meter for MODIS bands 1 and 2 and related products, 500 meters for MODIS bands 3-7 and related products and 1km resolution for other MODIS data.

The first step in the processing is to generate simple browse images as the data are acquired. The primary purpose of the browse images are simple to view various data products - as simple jpeg image files. Once a suitable data set is noted, the primary GEOTIFF data products can be access as input to standard GIS and image processing software such as ENVI, or Erdas/Imagine.



Example browse image as MODIS bands 2,1,1=RGB , Niwot Ridge LTER scene, November 3, 2007, 18:01GMT

250m resolution, 128x128km

[Access LTER Browse Images](#)

[Access LTER GEOTIFF DATA Products](#)

Done

[Remap]

active: yes

function: eos_remap

output_files: Remap

batch_queue: small

cover_area: lter_and

cover_percent: 40

interpolate: nn

scrub_age_hours: 960

{

[lter_and-CREFL]

input_directory: products/hdf/modis/ndvi

input_files: CREFL*hdf

remap_variables: CorrRef1_*

geo_directory: products/hdf/modis/level1

output_template: %yyyy.%mdd.%hhmm.%satel.CREFL

save_directory: products/tdf/lter/and/modis/ndvi

save_files: 20??.*.CREFL

[lter_and-MOD021KM]

input_directory: products/hdf/modis/level1

input_files: MOD021KM.*.hdf

remap_variables: modis_ch*

remap_night_vars: modis_ch2[0-5] modis_ch2[7-9] modis_ch3*

min_day_sun_elev: 5

geo_directory: products/hdf/modis/level1

output_template: %yyyy.%mdd.%hhmm.%satel.MOD021KM

save_directory: products/tdf/lter/and/modis/level1

save_files: 20??.*.MOD021KM

[lter_and-MOD02HKM]

input_directory: products/hdf/modis/level1

input_files: MOD02HKM.*.hdf

remap_variables: modis_ch*

geo_directory: products/hdf/modis/level1

output_template: %yyyy.%mdd.%hhmm.%satel.MOD02HKM

save_directory: products/tdf/lter/and/modis/level1

save_files: 20??.*.MOD02HKM

[lter_and-MOD02QKM]

input_directory: products/hdf/modis/level1

input_files: MOD02QKM.*.hdf

remap_variables: modis_ch*

geo_directory: products/hdf/modis/level1

output_template: %yyyy.%mdd.%hhmm.%satel.MOD02QKM

save_directory: products/tdf/lter/and/modis/level1

save_files: 20??.*.MOD02QKM

[lter_and-MOD03]

input_directory: products/hdf/modis/level1

input_files: MOD03.*.hdf

remap_variables: height *zenith *azimuth range land_mask

teradb.lter_and

H.J Andrews LTER Parameter file (boundary, projection

Ignore script if < 40% data

Remove all files aged 40 days

Wait for input data here

Output name template

Store data in
consistent
place

2008.0907.1958.aqua-1.level1.ch2ch1ch1.jpg

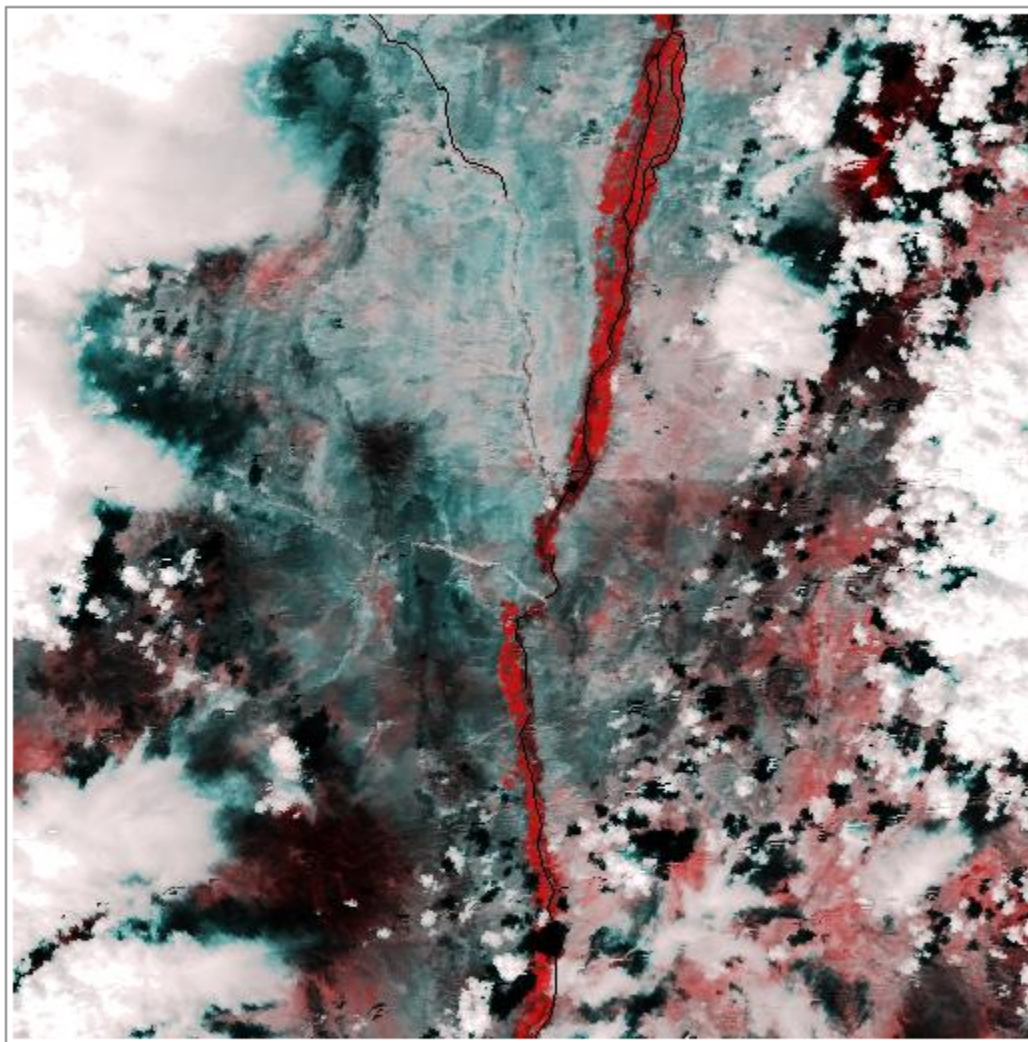
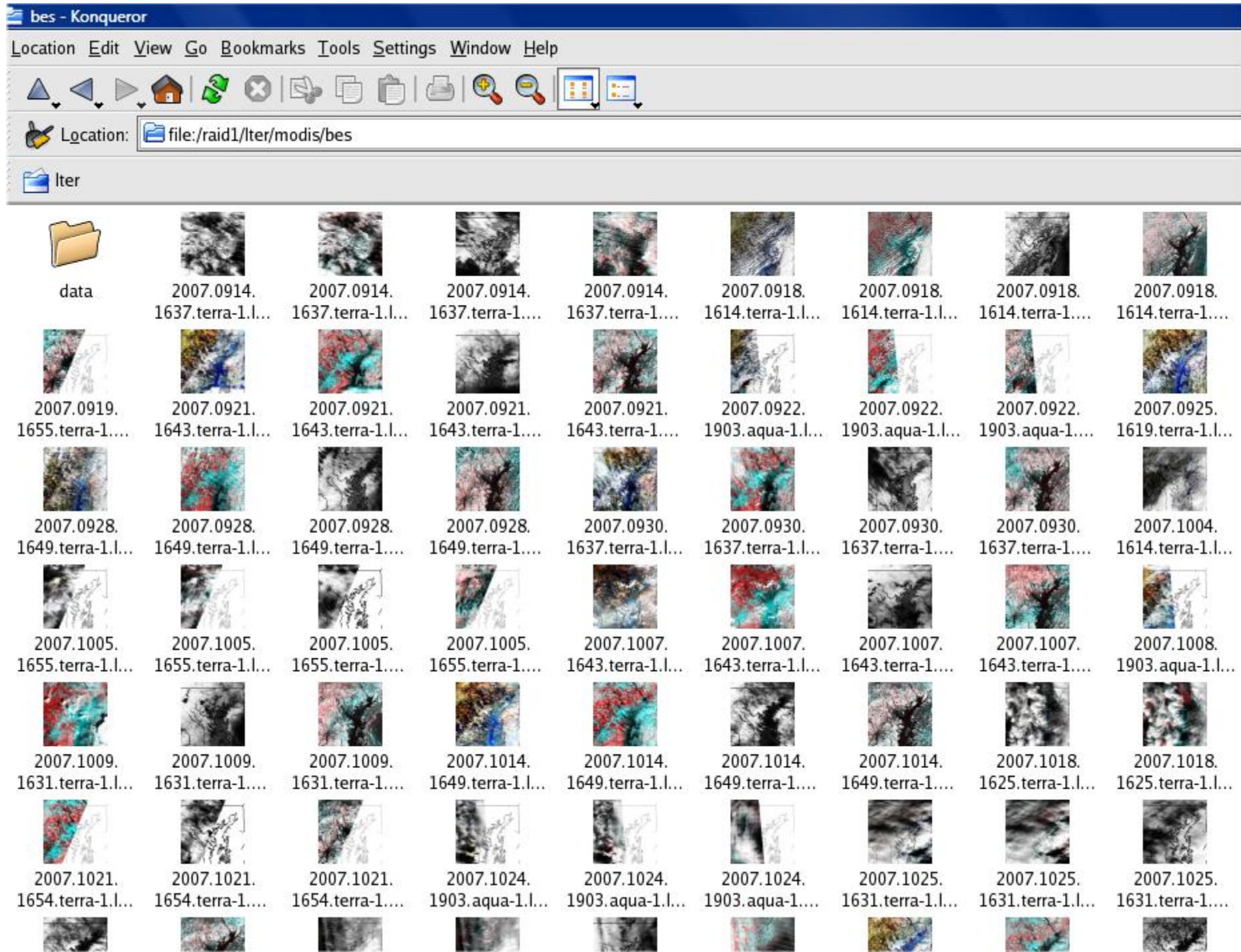


Image Description: No Description

Last Modified: September 07 2008 21:11:28.

[Back](#)




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LTER DATA

LTER data links:

- </lter/modis/and/data>
- </lter/modis/bes/data>
- </lter/modis/cap/data>
- </lter/modis/cce/data>
- </lter/modis/cdr/data>
- </lter/modis/cwt/data>
- </lter/modis/fce/data>
- </lter/modis/gce/data>
- </lter/modis/hbr/data>
- </lter/modis/hfr/data>
- </lter/modis/jrn/data>
- </lter/modis/kbs/data>

Index of /Images//sev/data - Mozilla Firefox

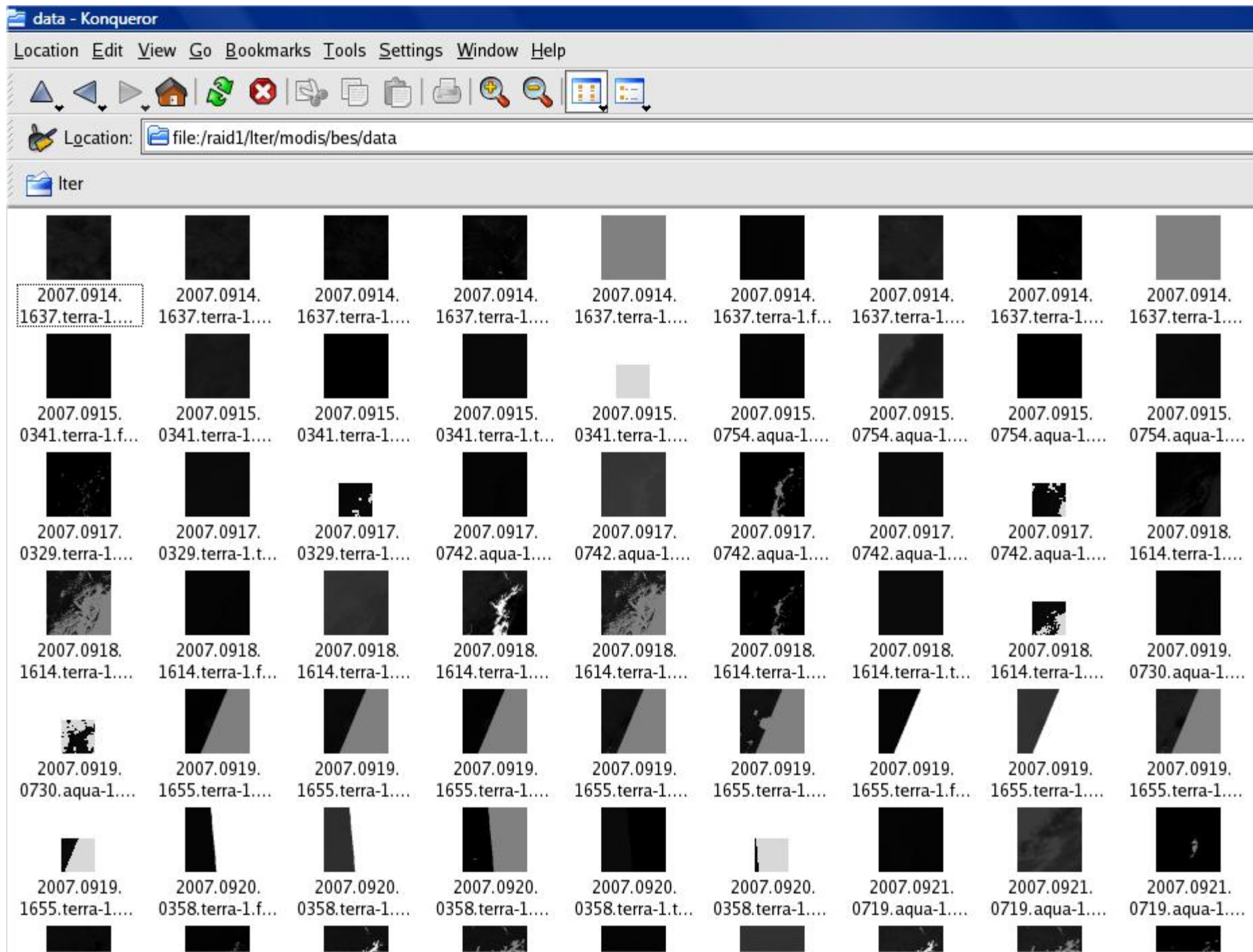
File Edit View History Bookmarks Tools Help

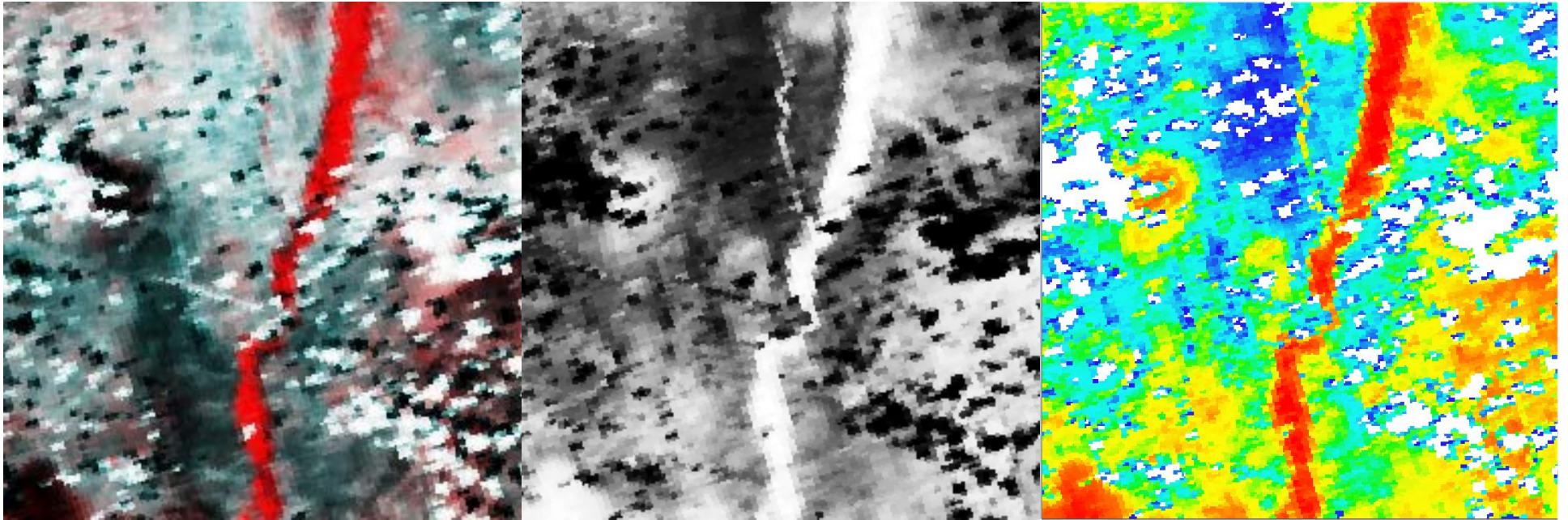
http://create.hpc.unm.edu/Images//sev/data/

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Index of /Images//sev/data

Name	Last modified	Size	Description
 Parent Directory		-	
 2007.0716.0824.aqua-1.fire.tiff	03-Aug-2007 16:41	17K	
 2007.0719.1820.terra-1.evi.tiff	23-Jul-2007 17:03	129K	
 2007.0719.1820.terra-1.evix.tiff	23-Jul-2007 17:03	129K	
 2007.0719.1820.terra-1.fire.tiff	23-Jul-2007 17:03	4.6K	
 2007.0719.1820.terra-1.ndvi.tiff	23-Jul-2007 17:03	129K	
 2007.0719.1820.terra-1.ndvix.tiff	23-Jul-2007 17:03	129K	
 2007.0720.1725.terra-1.evi.tiff	24-Jul-2007 15:38	129K	
 2007.0720.1725.terra-1.evix.tiff	24-Jul-2007 15:38	129K	
 2007.0720.1725.terra-1.fire.tiff	24-Jul-2007 15:38	4.6K	
 2007.0720.1725.terra-1.ndvi.tiff	24-Jul-2007 15:38	129K	
 2007.0720.1725.terra-1.ndvix.tiff	24-Jul-2007 15:38	129K	
 2007.0720.2039.aqua-1.evi.tiff	24-Jul-2007 15:38	129K	
 2007.0720.2039.aqua-1.evix.tiff	24-Jul-2007 15:38	129K	
 2007.0720.2039.aqua-1.fire.tiff	24-Jul-2007 15:38	4.6K	
 2007.0720.2039.aqua-1.ndvi.tiff	24-Jul-2007 15:38	129K	
 2007.0720.2039.aqua-1.ndvix.tiff	24-Jul-2007 15:38	129K	



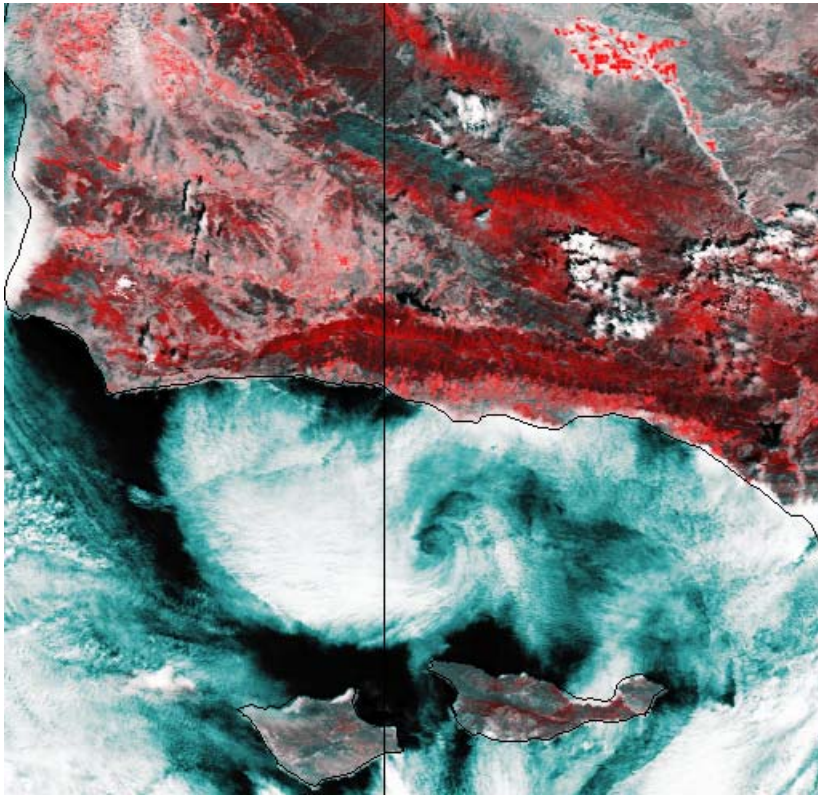


False Color

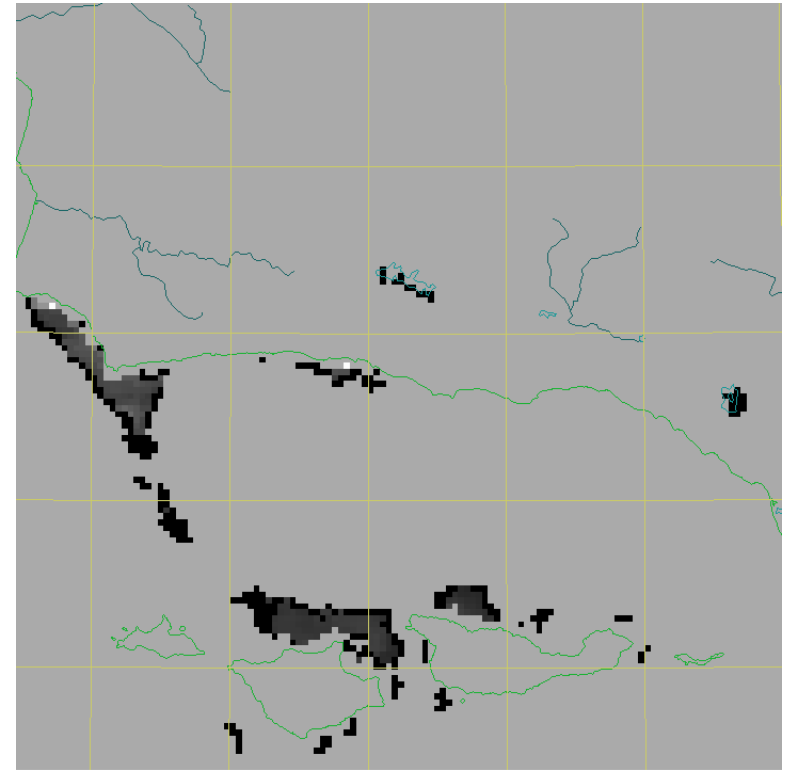
Raw NDVI

**Processed NDVI
with Cloud Mask**

**July 23, 2007 AQUA MODIS
128 x 128km x 250m centered on Seville LTER**



False-Color



Validated SST

SBC - July 24, 2007 18:53GMT


```
Driver: GTiff/GeoTIFF
Size is 4101, 4764
Coordinate System is:
GEOGCS["WGS 84",
    DATUM["Not_specified_based_on_WGS_84_ellipsoid",
        SPHEROID["WGS 84",6378137,298.2572235630016,
            AUTHORITY["EPSG","7030"]],
        AUTHORITY["EPSG","6030"]],
    PRIMEM["Greenwich",0],
    UNIT["degree",0.0174532925199433],
    AUTHORITY["EPSG","4326"]]
Origin = (-114.436676025390625,57.375228881835938)
Pixel Size = (0.010002411633003,-0.010002407135644)
Metadata:
  AREA_OR_POINT=Area
  TIFFTAG_XRESOLUTION=1
  TIFFTAG_YRESOLUTION=1
  TIFFTAG_RESOLUTIONUNIT=1 (unitless)
Corner Coordinates:
Upper Left  (-114.4366760,  57.3752289) (114d26'12.03"W, 57d22'30.82"N)
Lower Left  (-114.4366760,   9.7237613) (114d26'12.03"W,  9d43'25.54"N)
Upper Right  (-73.4167859,  57.3752289) ( 73d25'0.43"W, 57d22'30.82"N)
Lower Right  (-73.4167859,   9.7237613) ( 73d25'0.43"W,  9d43'25.54"N)
Center       (-93.9267310,  33.5494951) ( 93d55'36.23"W, 33d32'58.18"N)
Band 1 Block=4101x8 Type=Byte, ColorInterp=Palette
  Color Table (RGB with 256 entries)
    0: 0,0,0,255
    1: 227,217,193,255
    2: 227,217,193,255
    3: 227,217,193,255
    4: 227,217,193,255
    5: 227,217,193,255
    6: 227,217,193,255
    7: 227,217,193,255
    8: 227,217,193,255
    9: 227,217,193,255
   10: 227,217,193,255
   11: 227,217,193,255
   12: 227,217,193,255
   13: 227,217,193,255
   14: 227,217,193,255
   ..: .....
```



The US Long Term Ecological Research Network

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Welcome to the LTER Data Catalog

Data are one of the most valuable products of the LTER program. The LTER Network seeks to inform the LTER and broader scientific community by creating well designed and well documented databases and to provide fast, effective, and open access to LTER data via a network-wide information system designed to facilitate data exchange and integration. Currently, the LTER Data Catalog contains entries for over 4000 ecological datasets from 26 LTER Network research sites, and thousands of additional datasets from numerous other ecological field stations and research institutions.

Data Catalog

You may search the data catalog without being [logged in](#) to your account, but you will have access only to *public* data.

Search
Term:

[Advanced
Search](#)

☐ Include non-LTER data

LTER Data Policies

The [LTER data policy](#) includes three specific sections designed to express shared network policies regarding the release of LTER data products, user registration for accessing data, and the licensing agreements specifying the conditions for data use.

Other Databases

Additional information is available through these value-added data products:

- [LTER/USFS Climate / Hydrology Data](#)
- [Annual Net Primary Productivity Data](#)

New Mexico Department of Health: Tracking

Health outcome data:

State employee absenteeism, asthma,
heat related ER visits, mortalities

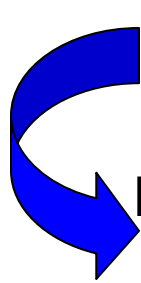
Air quality data:

pollen counts, ozone, temperature

Satellite data:

NDVI, Land surface temperature

linkage



linkage



Prototype NM Health Tracking Website

To Link Environmental Data with Indices of Lost Work Days, Asthma Occurrence and Hospitalizations

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**Building a Healthy New Mexico**

NM DOH Environmental Health Epidemiology Bureau | doh-ehb@state.nm.us | 1-888-878-8992

New Mexico Tracking Tools | National Tracking Network

Welcome to the New Mexico Environmental Public Health Tracking (EPHT) Program

The Centers for Disease Control and Prevention (CDC) National Center for Environmental Health (NCEH) is building an integrated environmental and public health information system through the National Environmental Public Health Tracking (EPHT) Program. New Mexico is one of seventeen CDC Grantees funded to implement an EPHT Network that links environmental and health data at the state, city, and national levels.

The CDC Environmental Public Health Tracking Program is a multidisciplinary collaboration involving ongoing collection, integration, analysis, interpretation, and dissemination of data from environmental hazard monitoring, human exposure surveillance, and health effects surveillance.

[Learn More About EPHT:](#) [New Mexico Tracking](#) [CDC National Tracking](#)

Environmental Exposure

What are Environmental Exposures?

Environmental Data

- Air
- Fish
- Water

Exposure Data - Biomonitoring (Hair, Blood, Urine)

Exposure Assessment

[More...](#)

Health Effects

How do Environmental Exposures affect Health?

Health and Environment

- Linkage Studies

Health Data

- Birth
- Cancer
- Cardiovascular (Heart Attack)
- Respiratory (Asthma)

[More...](#)

New Mexico Mapping

Discover and Map Data

Application opens in a new window.

City/County/Tribe Information, Maps

Select Area: (drop-down menu)

State Maps

- Wildfires
- Pollen, Vegetation Greenness
- Land Temperature
- Dust Forecast

[More...](#)

[Environmental Health News:](#) [Wildfires](#) [Drinking Water Advisories](#) [Dust Storms](#)

N.M. Wildfire Smoke Map

Current Map opens in a new window.

U.S. Wildfire Smoke Map

Current Map opens in a new window.

N.M. Ozone Pollution Map

Current Map opens in a new window.

U.S. Ozone Pollution Map

Current Map opens in a new window.

U.S. Particle Pollution Map

Current Map opens in a new window.

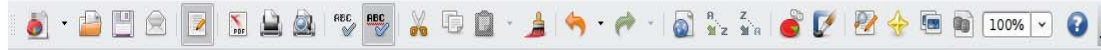
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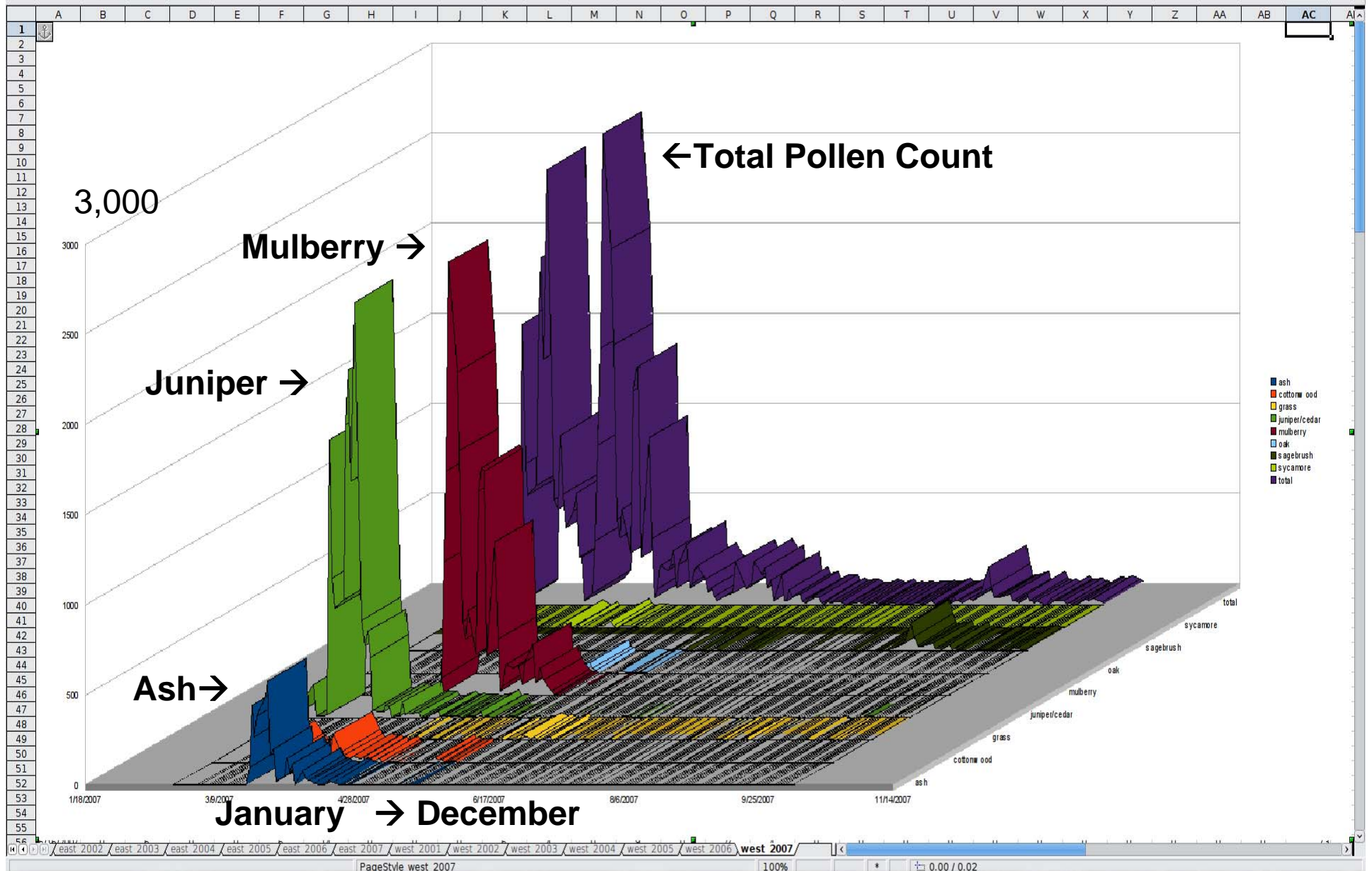
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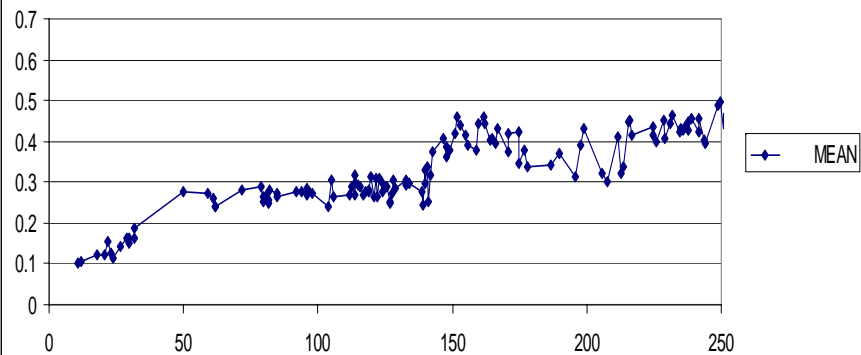


AC1 f(x) Σ = total

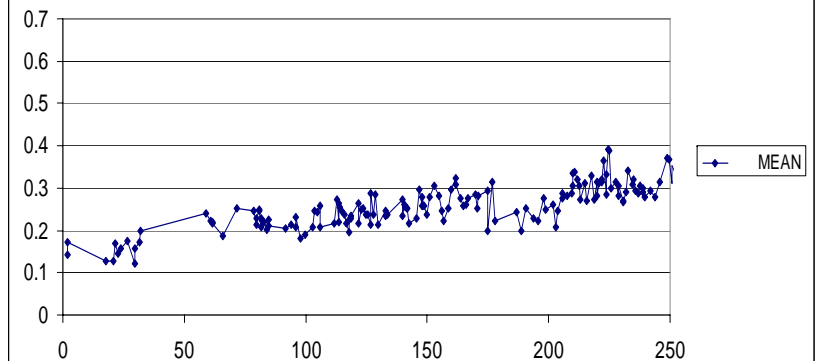


Comparison of Urban and Reference Regions

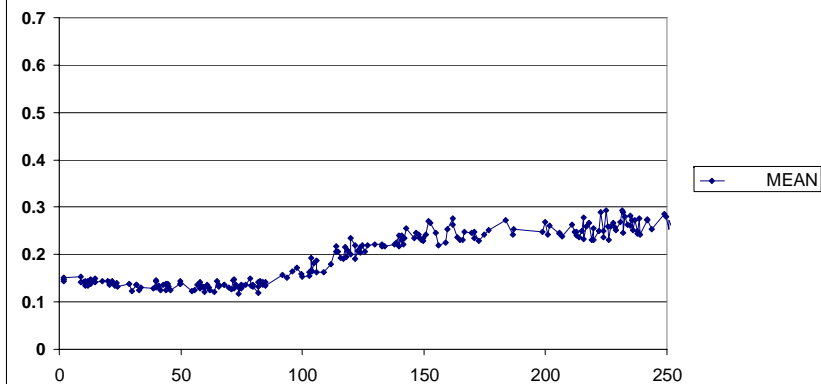
Los Alamos NDVI



Santa Fe NDVI

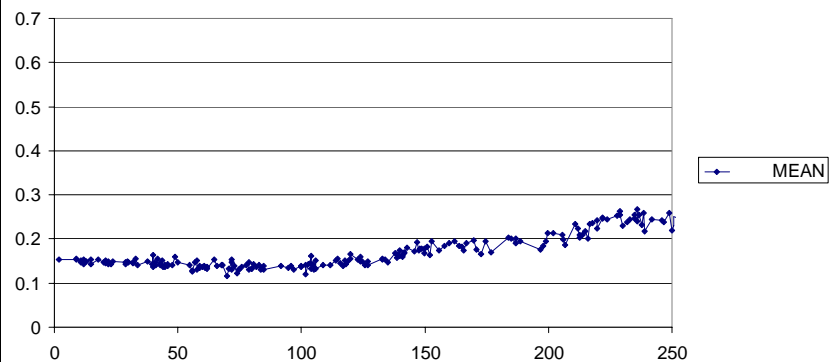


Albuquerque NDVI

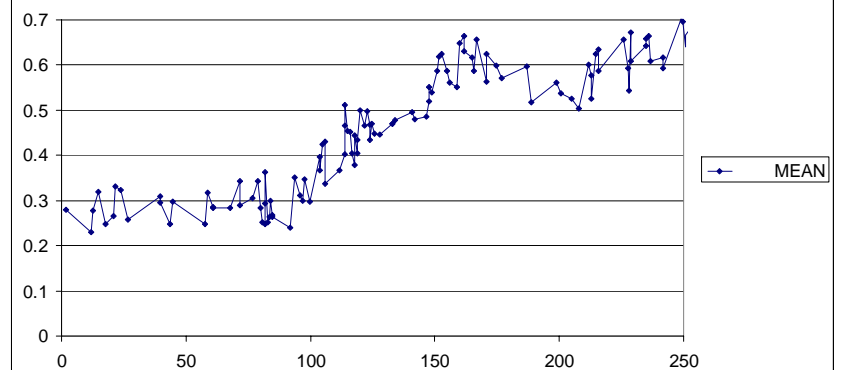


Daily MODIS NDVI Estimates

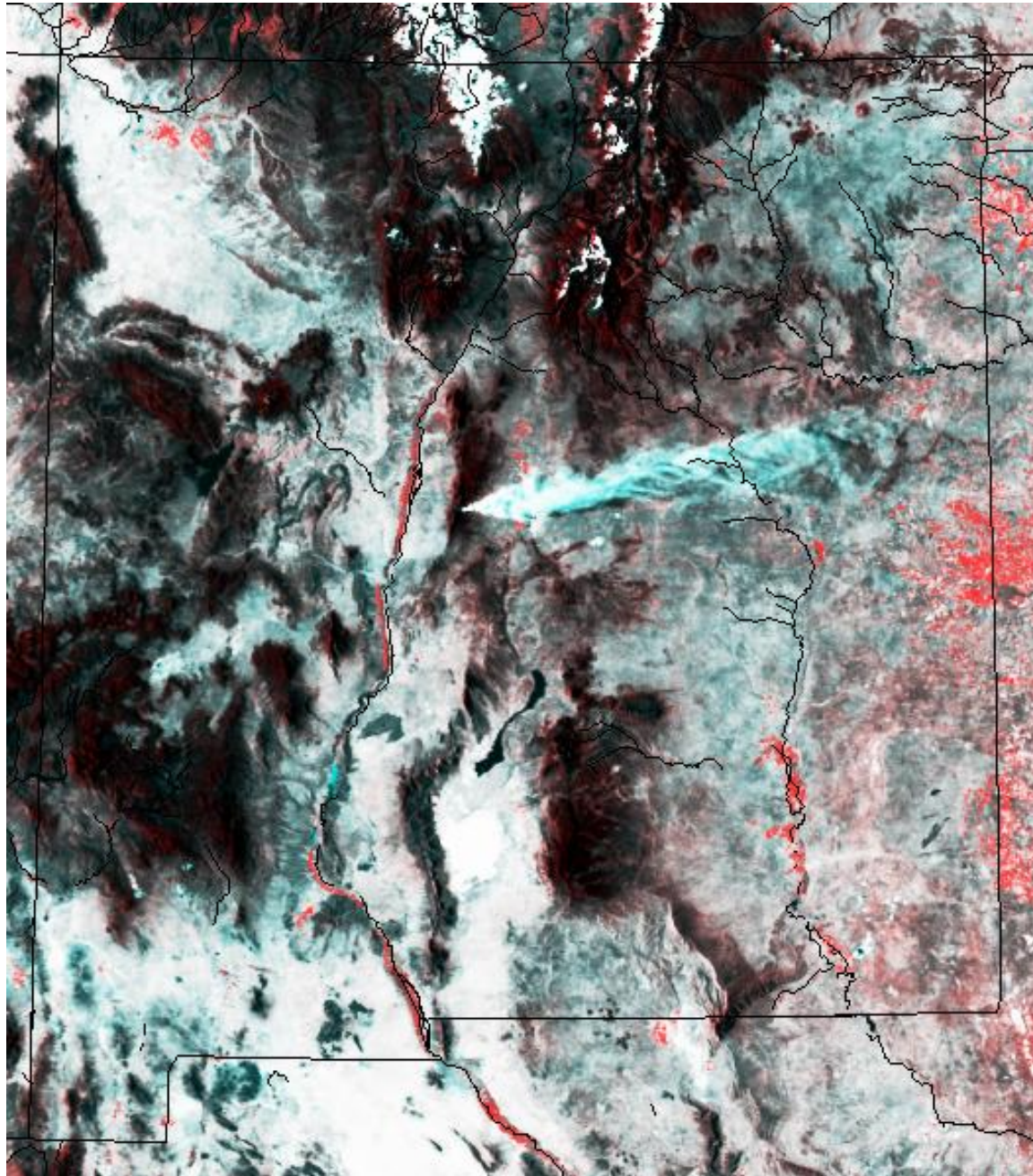
Sevilleta NDVI

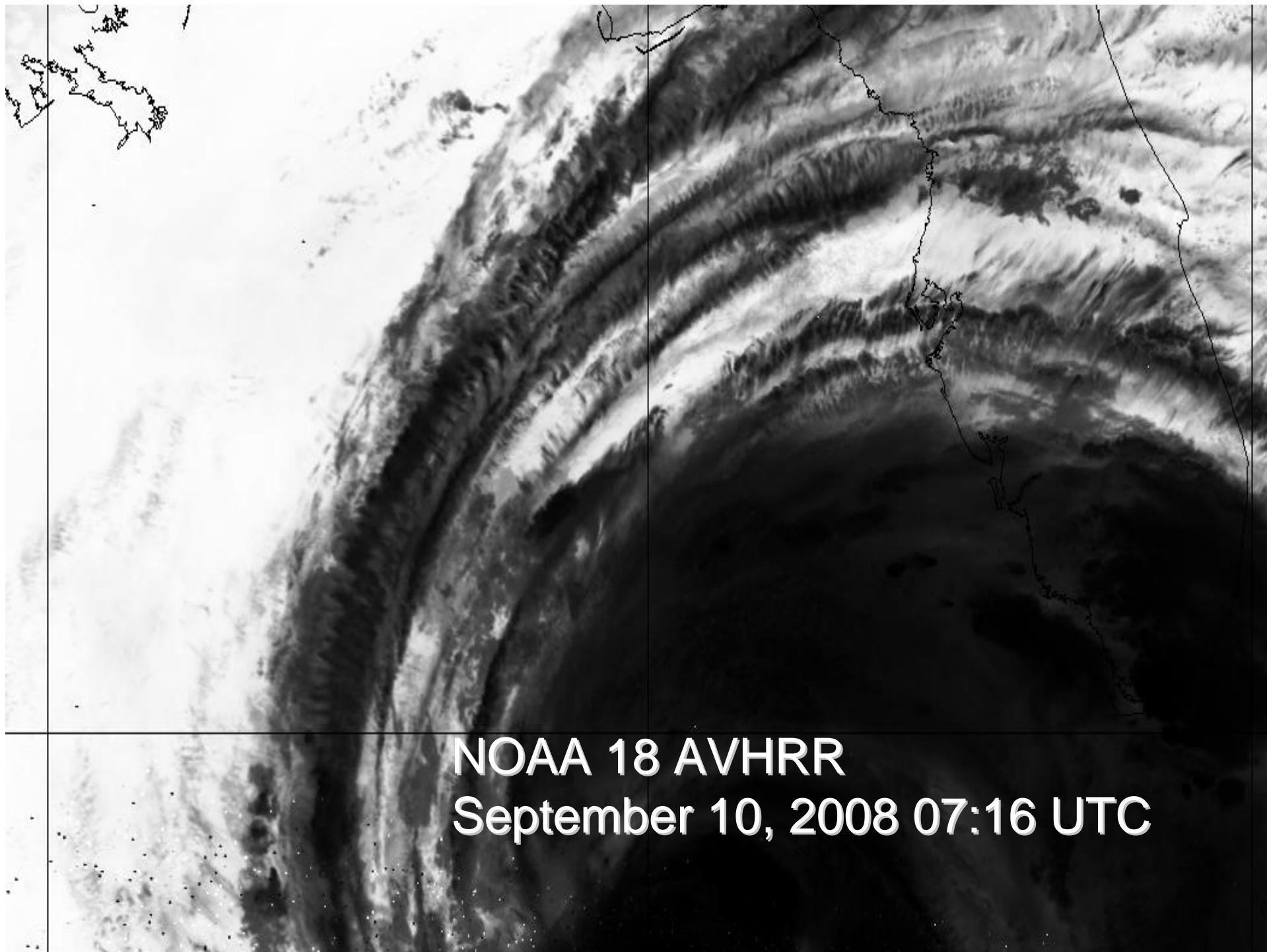


Valles Caldera NDVI



New Mexico Wildfire Smoke Plume





NOAA 18 AVHRR
September 10, 2008 07:16 UTC



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