University of Wisconsin SSEC Datacenter Satellite Data Services

Jerrold Robaidek

Satellite Data Services Program Manager

SSEC Satellite Data Services Update

- SDS Status
- SDS Projects

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SSEC SDS

Staffed M-F , 7:30 AM - 11:00 pm Central time.

- 2 FTE ~100% time
  - Computer Operator (1st shift)
  - Computer Operator (1st shift)
- 5 FTE ~portions of their time
  - Program Manager
  - System Programmer
  - DataBase/Web Programmer
  - Research Specialist (PM assistant)
  - Antenna/Communication technician
- 4 Student QC assistants/programmers (2nd shift)

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SSEC SDS

Staffed M-F , 7:30 AM - 11:00 pm Central time.

- Ops, QC, Programing
  - Rosie Spangler, Douglas Ratcliff
- QC, Ops, Inventory/Archive, Contracts
  - Nancy Troxel-Hoehn
- Programmer, UI, DataBase
  - Clayton Suplinski
- Programing, Product Generation, AMQP
  - Rick Kohrs
- System Programing, Ingestors
  - Dan Forrest
- Antennas
  - Istvan Bocsi

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Data Center Facilities

- Over 2100 ft.
- The Data Center's disk storage exceed 12-18 PBs.
- The entire room is on four 72 KW UPSs, of which, about 200+ KW are in use. Non UPS power usage is ~17 KW. An additional 72 KW UPS for a smaller 5th floor computer room
- Cooling provided by campus chilled water and outside air in the winter. Racks are cooled by 16 in row APC coolers.
- Gigabit and 10 Gigabit network (also 100 MB admin network, 40 Gigabit InfiniBand).

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Antennas @ SSEC

- C-Band
  - 11 meter heated (87° West - SES-2, POES Wallops Relay, MSG)
  - 6.3 meter heated (101° West - SES-1, POES Fairbanks Relay)
  - 4.5 meter (101° West - SES-1, Noaaport)
  - 3.7 meter GEONETcast (58° West INTELSAT 21)
- L-Band
  - 7.3 meter (75° West -GOES-East Primary/GOES-16)
  - 7.3 meter (89.5° West -GOES-West Primary/GOES-17)
  - 4.6 meter (135° West -GOES-West Primary)
  - 4.5 meter (135° West -GOES-East auto tracking)
- X-Band
  - 4.4 meter (Tracking - EOS)
- X/L Band
  - 2.4 meter (Tracking - Suomi NPP, EOS, Metop A&B, NOAA-18, 19 and FY3)

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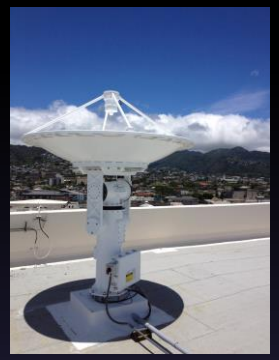
UW SSEC SDS
Antennas Remotely Managed



- X/L Band
  - Honolulu Community College
  - Atlantic Oceanographic & Met Lab , Miami, FL
  - University of Puerto Rico
  - Guam

  All are 2.4 m used for Tracking - Aqua, Terra, Suomi NPP, EOS, Metop A&B, NOAA-18, 19, NOAA-20 and FY3
  - Supports
    - NOAA NWS NCEP
    - Eumetcast
    - GTS

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Data Distribution

- Realtime
  - McIDAS ADDE (Abstract Data Distribution Environment)
  - ftp
  - http
  - Ldm
  - Direct access via mount
  - WMS (Web map service)
- Archive
  - ADDE
  - Direct Access (in-house only)
  - WMS (experimental)
  - McFETCH
  - THREDDS

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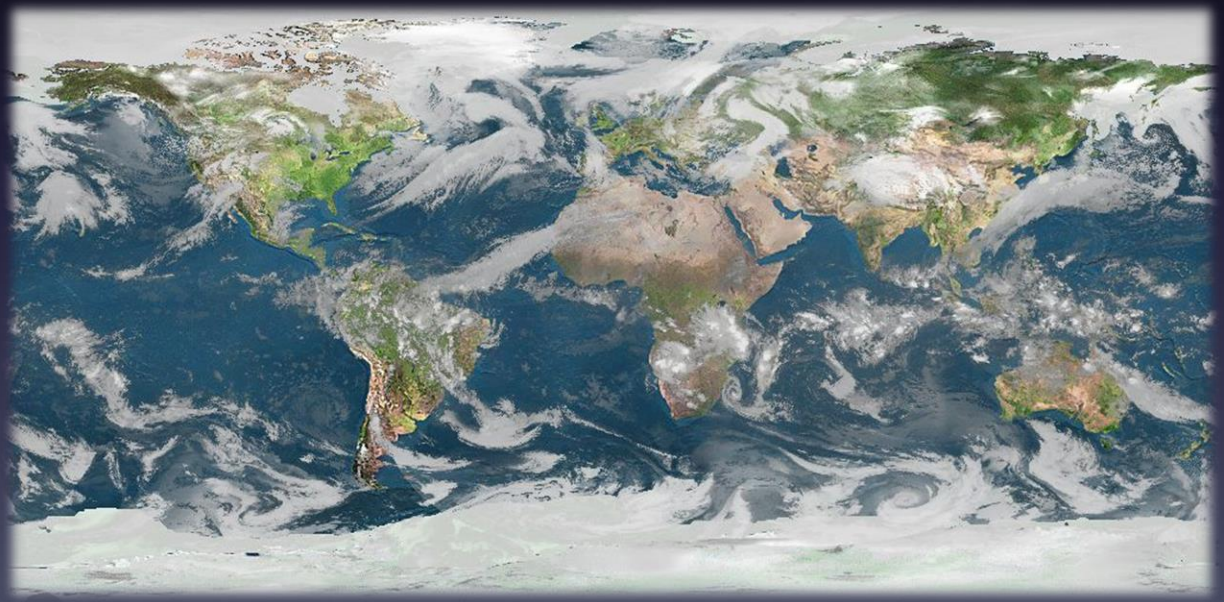
Real-time Data

The SSEC Data Center receives data from 9-12 different geostationary satellites and 12 different polar orbiting satellites. Most data are available in near real-time via ADDE. Other methods of data access are available upon request.



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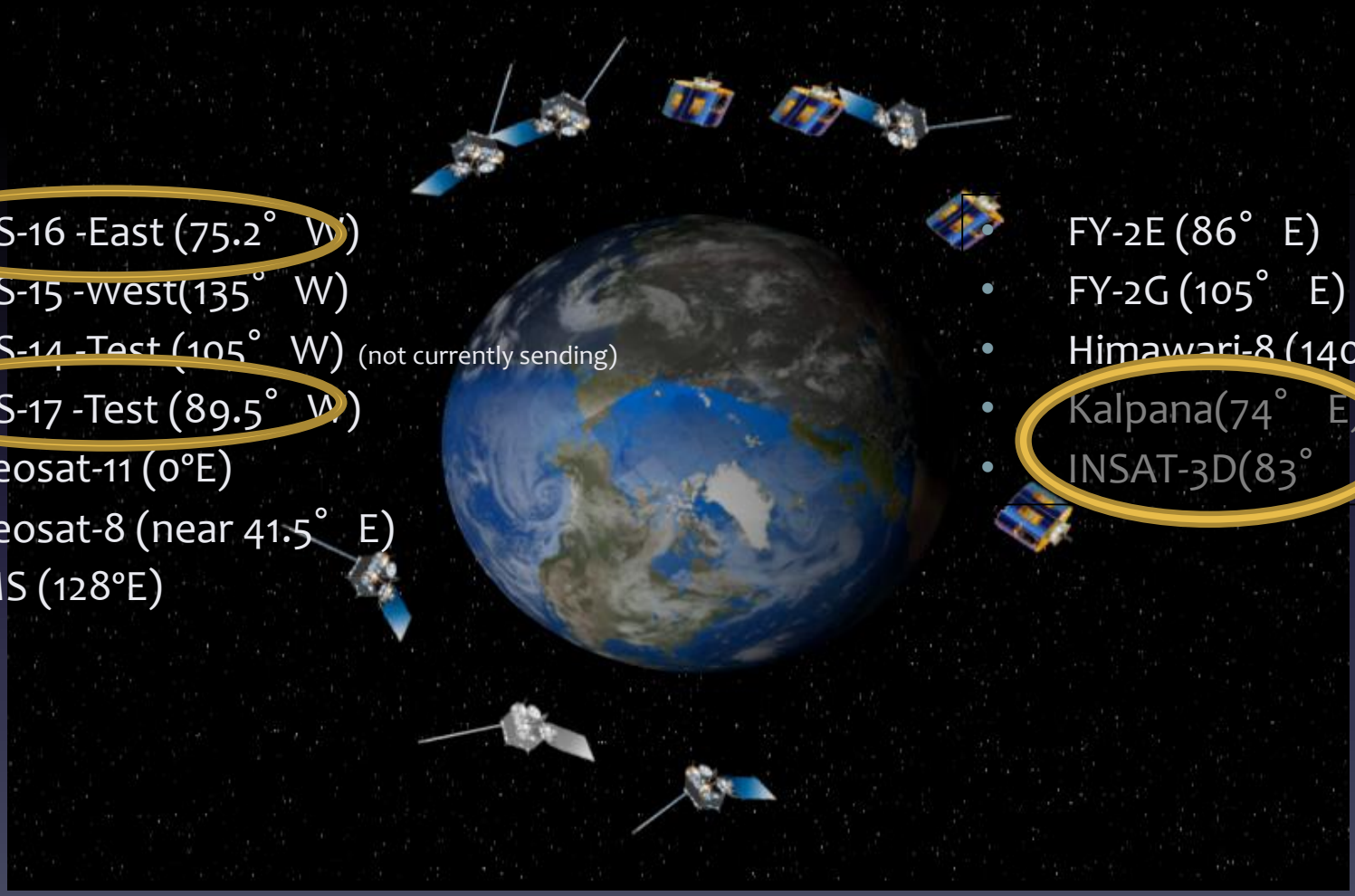
Geostationary Satellites received



- GOES-16 -East (75.2° W)
- GOES-15 -West(135° W)
- GOES-14 -Test (105° W) (not currently sending)
- GOES-17 -Test (89.5° W)
- Meteosat-11 (0°E)
- Meteosat-8 (near 41.5° E)
- COMS (128°E)
- FY-2E (86° E)
- FY-2G (105° E)
- Himawari-8 (140° E)
- Kalpana(74° E)
- INSAT-3D(83° E)

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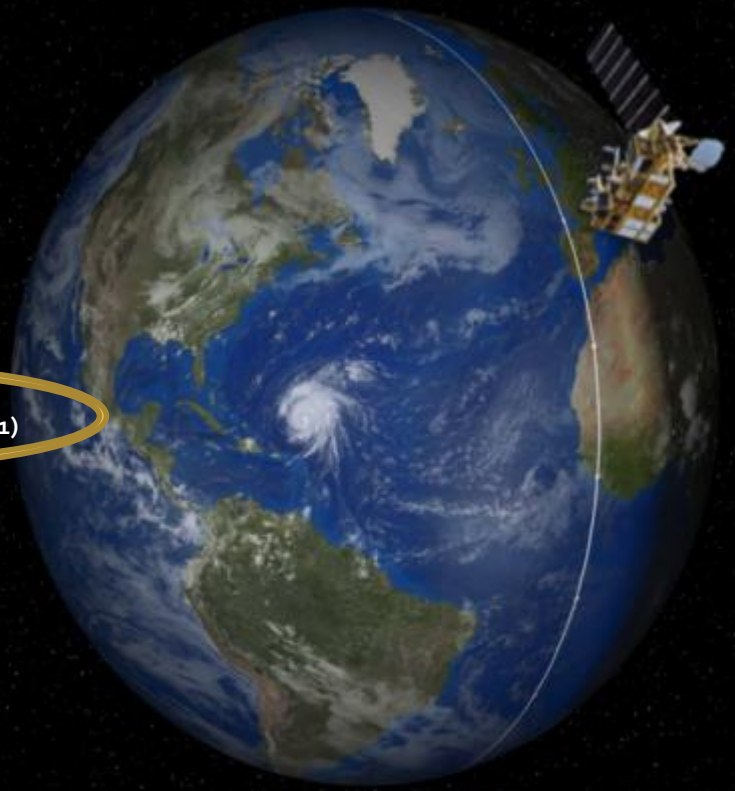
Geostationary Satellites Received at UW SSEC in 2016

	Sub-Point	Reception Method	Source	Latency	Daily Volume
GOES-16	75.2° West	L-Band	DB	<10 seconds	130-400 GB
GOES-14	105° West	L-Band	DB	<2 minutes	23 GB
GOES-15	135° West	L-Band	DB	<2 minutes	23 GB
GOES-17	89.5°West	L-Band	DB	<10 seconds via DB	130-400 GB
Meteosat-11	0° East	C-Band Relay	DB Relay	<15 minutes	24 GB
Meteosat-8	41.5° East	Network Relay	NOAA STAR	~30 minutes	24 GB
Himawari-8	140° East	Network Relay	NOAA STAR	~ 10 minutes	300 GB
Himawari-8	140° East	Himawari Cast Network Relay	Hawaii NWS	~ 10 minutes	62 GB
Kalpana	74° East	Network Relay	ISRO	45-120 minutes	1.4 GB
Insat-3D	83° East	Network Relay	ISRO	45-180 min	19 GB
FY2E	86° East	Network Relay	ABOM	15-30 minutes	4.7 GB
FY2G	105° East	Network Relay	ABOM	15-30 minutes	4.7 GB
COMS	128° East	Network Relay	KMA	9-24 minutes	11 GB

Polar Satellites received

- NOAA-15
- NOAA-18
- NOAA-19
- NOAA-20 (JPSS-1)
- METOP-A
- METOP-B



- Aqua
- Terra
- Suomi-NPP
- Landsat-8 (RE only)
- FY-3B
- FY-3C
- GCOM-W1

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Polar Satellites Received at UW SSEC in 2018

	Reception Method	Domain	ADDE Latency	Instruments	Access
NOAA-15	C-Band relay, NOAA-STAR	DB CONUS Global	DB <1 minutes after pass	AVHRR, AMSU, DCS->level-1	**ADDE**
				All other instruments Level-0	NA
NOAA-18	DB L-Band, C-Band relay, NOAA STAR	DB CONUS Global	DB <1 minutes after pass	AVHRR->level-1	**ADDE**
				All other instruments Level-0	NA
NOAA-19	DB L-Band, C-Band relay, NOAA STAR	DB CONUS Global	DB <1 minutes after pass	AVHRR->level-1	**ADDE**
				All other instruments Level-0	NA
NOAA-20	DB XL-Band, NOAA STAR, CLASS	DB CONUS Global	DB <1 minutes after pass	VIIRS>level-1	ADDE
				VIIRS,ATMS, CrIS	DB ftp (sips)
Metop-A	DB L-Band, NOAA STAR Relay	DB CONUS Global	CONUS <15 minutes after pass	AVHRR ->level-1	**ADDE**
				AVHRR, IASI	DB ftp (sips)
Metop-B	DB L-Band, NOAA STAR Relay	DB CONUS Global	CONUS <15 minutes after pass	AVHRR ->level-1	**ADDE**
				AVHRR,IASI	DB ftp (sips)
Suomi-NPP	DB X/L Band, NOAA STAR, CLASS	DB CONUS Global	CONUS <15 minutes after pass	VIIRS	**ADDE**
				VIIRS,ATMS, CrIS	DB ftp (sips)
Aqua	DB X-Band, NASA Relay	DB CONUS Global	DB <15 minutes after pass	AIRS, MODIS -> Level-1	**ADDE**
				AIRS, MODIS	DB ftp (sips)
Terra	DB X-Band, NASA Relay	DB CONUS Global	DB <15 minutes after pass	MODIS -> Level-1	**ADDE**
				MODIS	DB ftp (sips)
Landsat-8	Network Relay (USGS)	CONUS	<24 hours	Level-1	ADDE, WMS
Shizuku GCOM-W1	DB X-Band	CONUS	DB <1 min after pass	Level-0	SSEC ftp
FY-3B/C	DB X/L Band	CONUS	DB <1 min after pass	Level-0	SSEC ftp

Non-Satellite data

- NOAAport
  - Text/Point
  - Model Grids
  - Radar

Archive Data

As of May 2018, over 1,400 TBs online.

Grows approximately about ~350+ TB/year

US Geostationary Satellites

- GOES-8 through GOES-17 ***(1994-Present)*** (East, West , South America and test)
- GOES-1 through GOES-7 ***(1978-1996)***
- SMS-1&2 *(1978-1981)*

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Archive Data

International Geostationary Satellites

- GMS/MTSAT ***(1998-2015)***
- Meteosat/Meteosat IODC ***(1998-Present)***
- Meteosat-1 FGGE (1978-1979)
- FY2 (2004-Present)
- Kalpana ***(2005-2017)***
- Insat-3D ***(June 2014-2017)***
- COMS (June 2012 – Present)
- Himawari-8 (March 2015 – Present)

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Archive Data

NOAAPORT/Conventional Data

- Model Output ***(1996-Present)****
- In situ Point Observations ***(1976-Present)***

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Other SDS Projects

McFETCH Satellite Data Server

Dave Parker, Dave Santek, Bill Bellon, Clayton Suplinski, Rick Kohrs, Jerry Robaidek

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McFETCH Satellite Data Server

Multi-format client-agnostic File Extraction Through Contextual HTTP

- Allows access to ADDE archive servers
- Heavily dependent on McIDAS-X
- Outputs all formats McIDAS-X can plus others

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- Output formats:

AREA	Flat Binary
NetCDF	Gif
Geotiff	JPEG
Flat text	PNG

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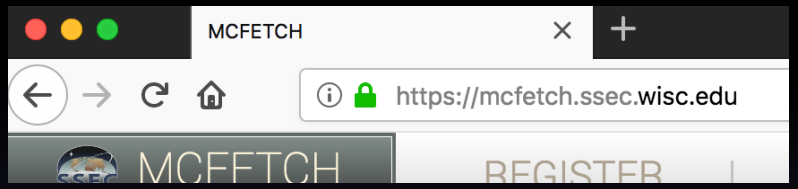
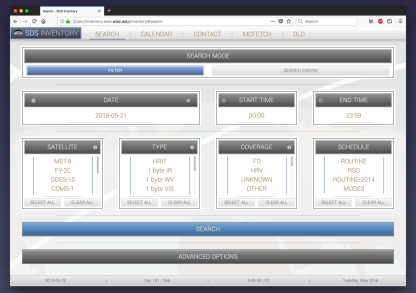


- Access via HTTPS
- Any client that can request a URL, can access, subset, and remap satellite data from an ADDE server
- Integrated with inventory



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McFETCH Satellite Data Server

- Must register for a unique data key
- 1 GB daily limit
- 1000 transaction per day daily limit
- Data must be 180 days or older (30 Days or older for Unidata Community)

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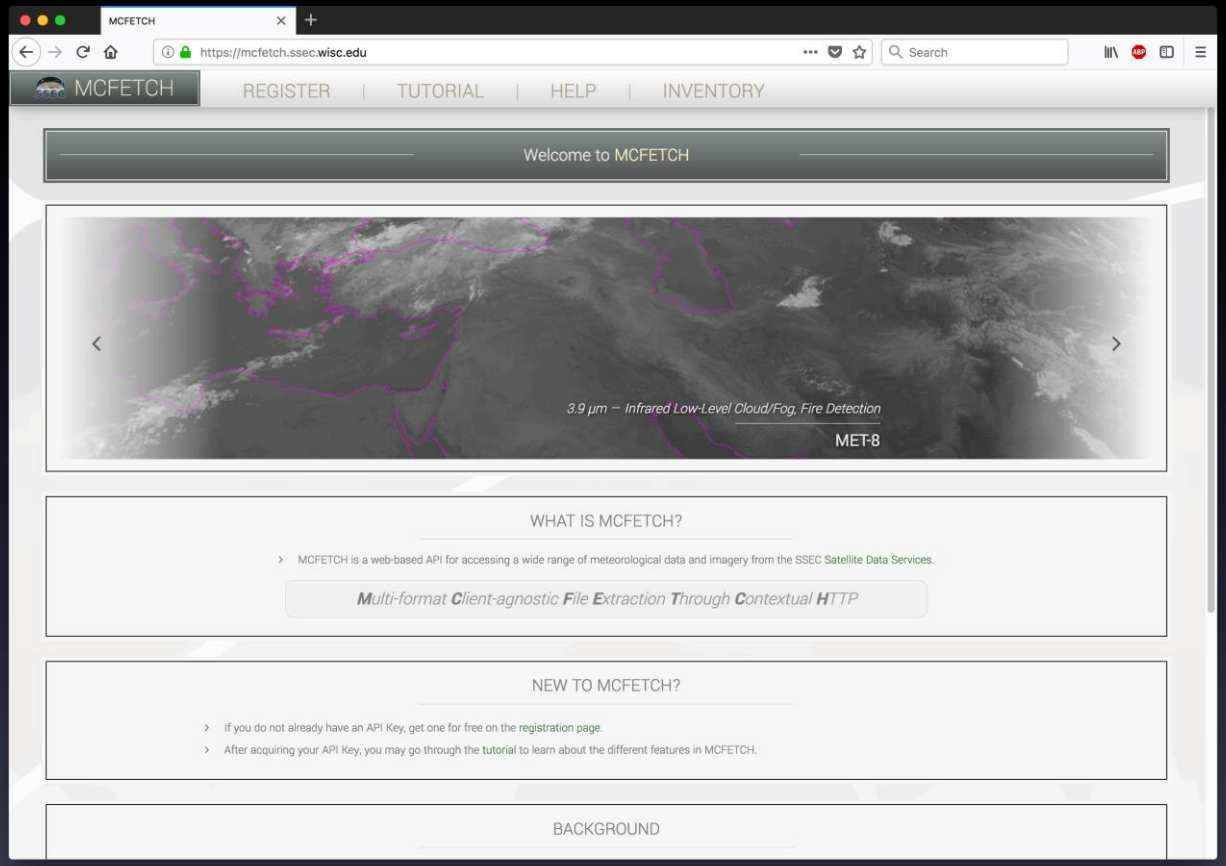

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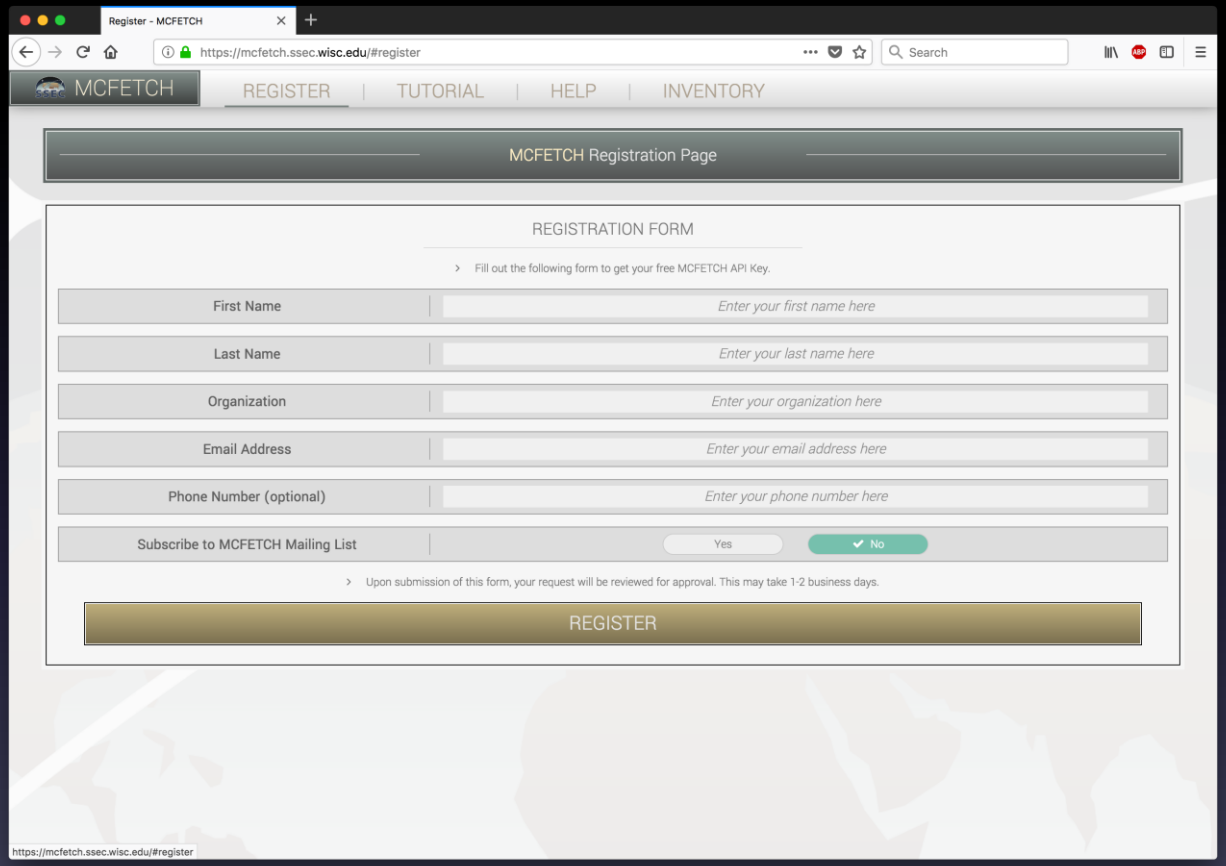

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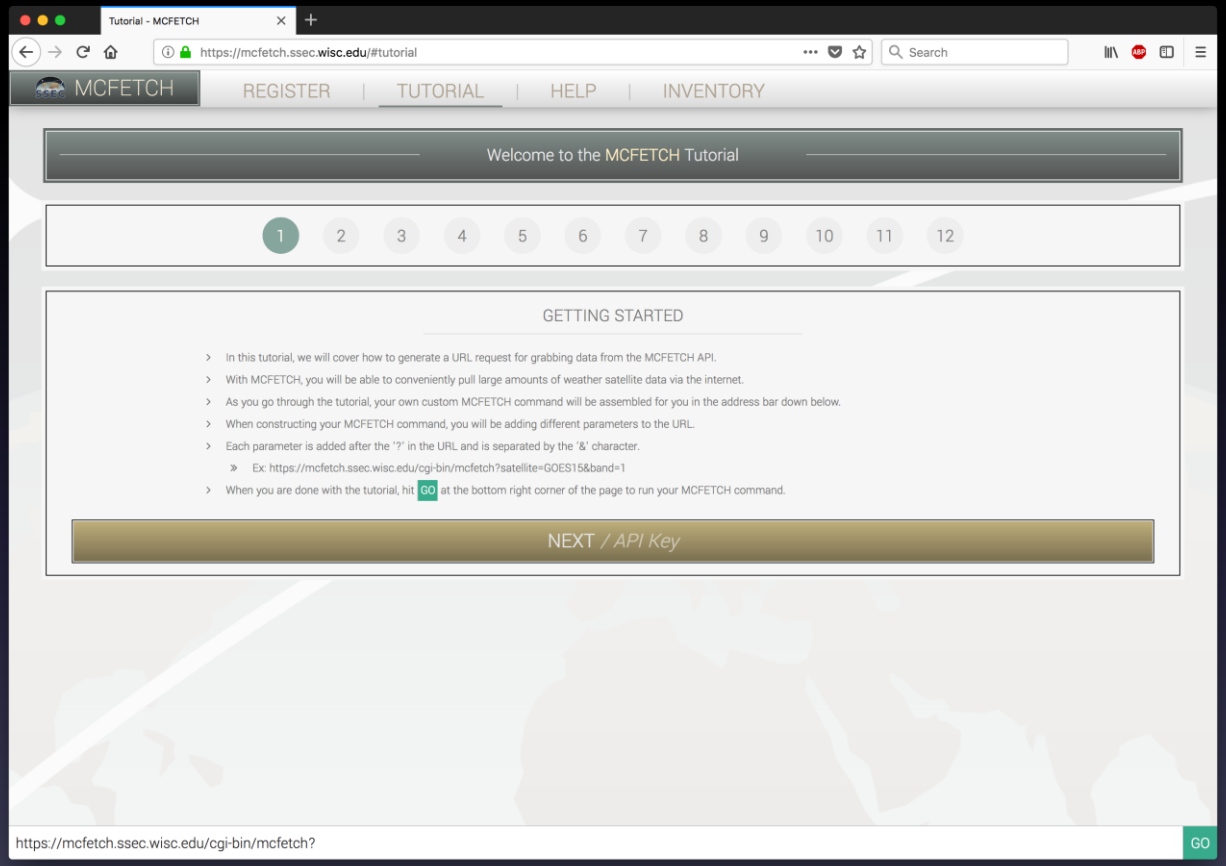

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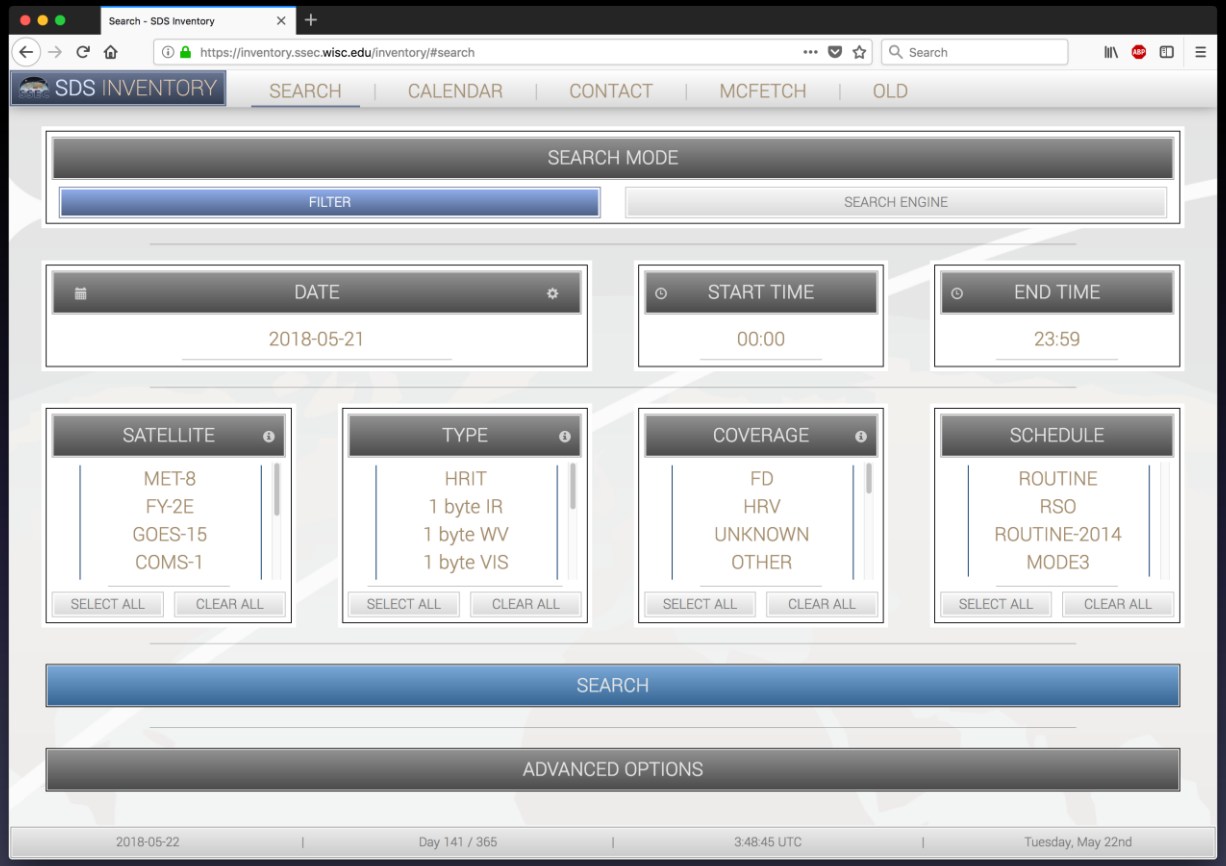

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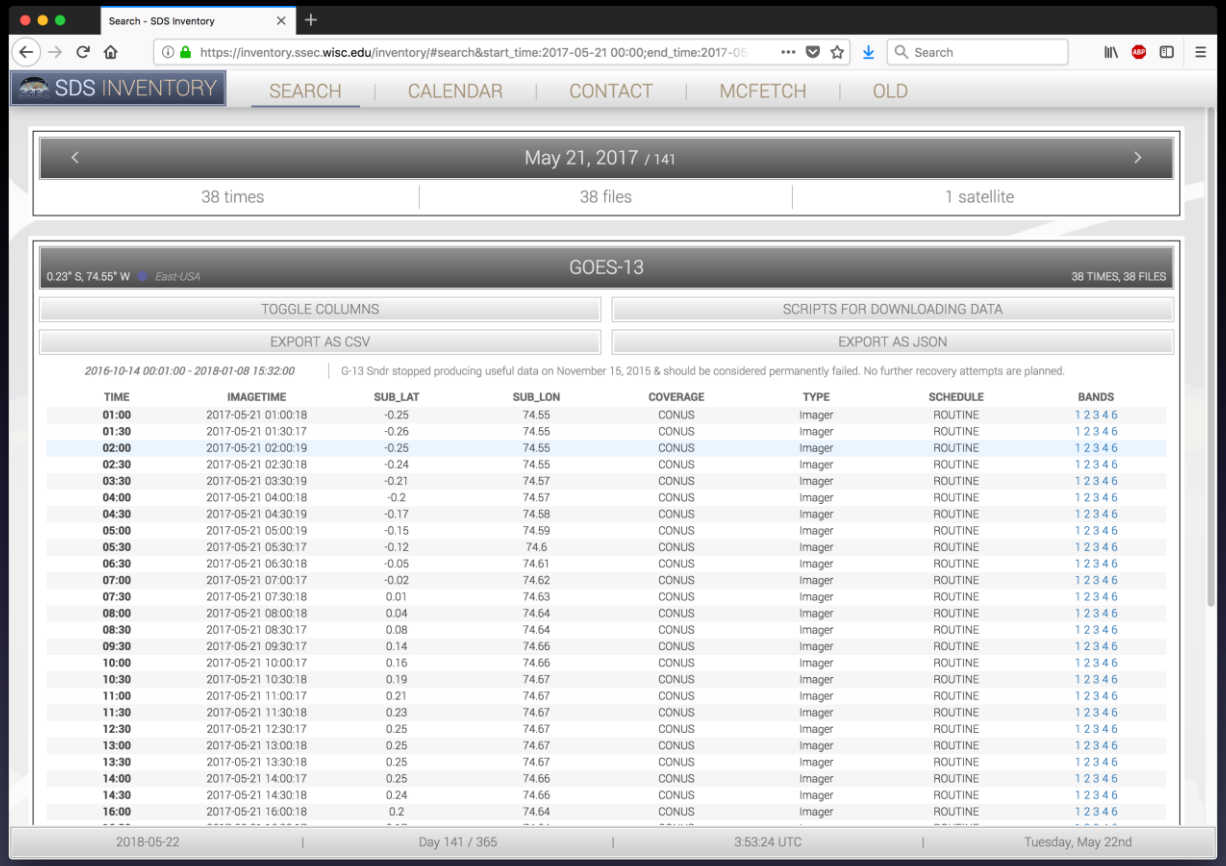
McFETCH Satellite Data Server



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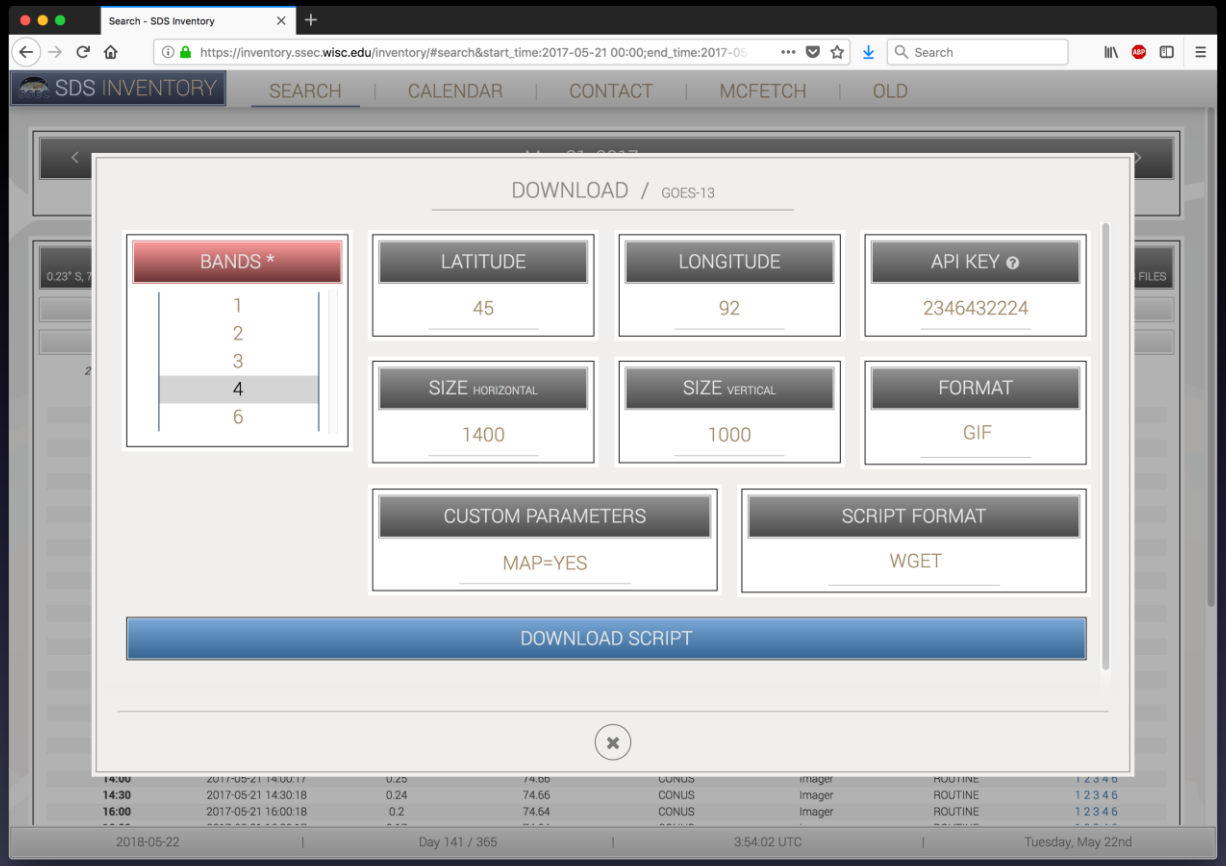

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McFETCH Satellite Data Server


```
#!/bin/bash

################################################################################
#
# Title       : GOES13_d20170521t010018_d20170521t233018.sh
# Description : This script will download the specified GOES-13 data from
#               the MCFETCH API.
# Author      : SSEC Satellite Data Services
# Date        : 2018-05-22 03:53 UTC
# Usage       : bash GOES13_d20170521t010018_d20170521t233018.sh
# Notes       : Run this script from the directory in which you want the data.
#               This script must be made executable in order to run.
#                 On linux and mac machines:
#                   chmod a+x GOES13_d20170521t010018_d20170521t233018.sh
#
# For obtaining a free MCFETCH API key, please refer to the following link:
# https://mcfetch.ssec.wisc.edu/#register
#
# Search URL:
# https://inventory.ssec.wisc.edu/inventory/#search&start_time:2017-05-21%2000:00;end_time:2017-05-21%2023:59;satellite:GOES-13;type:Imager;coverage:CONUS;
#
# DISCLAIMER: BY USING THIS SCRIPT, YOU WILL BE MAKING DATA REQUESTS TO THE
# MCFETCH SERVER THAT MAY IMPACT THE DATA QUOTA OF YOUR ACCOUNT. IF YOU EXCEED
# THIS QUOTA, YOUR ACCOUNT MAY BECOME LIMITED IN TERMS OF DATA REQUESTS AND
# YOU MIGHT LOSE THE ABILITY TO DOWNLOAD DATA FROM THIS SERVER.
#
# THIS SOFTWARE IS PROVIDED BY THE AUTHOR "AS IS" AND ANY EXPRESS OR IMPLIED
# WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF
# MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED.  IN NO
# EVENT SHALL THE AUTHOR BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL,
# SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
# PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS;
# OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY,
# WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR
# OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF
# ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
#
################################################################################

KEY="2346432224"

HTTP="http://mcfetch.ssec.wisc.edu/cgi-bin/mcfetch?dkey=${KEY}&satellite=GOES13&output=GIF&lat=45:92&size=1000:1400&MAP=YES"

COMMANDS=(
"date=20170521&time=01:00:18&coverage=CONUS&band=4"
"date=20170521&time=01:30:17&coverage=CONUS&band=4"
"date=20170521&time=02:00:19&coverage=CONUS&band=4"
"date=20170521&time=02:30:18&coverage=CONUS&band=4"
"date=20170521&time=03:30:19&coverage=CONUS&band=4"
"date=20170521&time=04:00:18&coverage=CONUS&band=4"
"date=20170521&time=04:30:19&coverage=CONUS&band=4"
"date=20170521&time=05:00:19&coverage=CONUS&band=4"
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"date=20170521&time=11:30:18&coverage=CONUS&band=4"
"date=20170521&time=12:30:17&coverage=CONUS&band=4"
"date=20170521&time=13:00:18&coverage=CONUS&band=4"
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"date=20170521&time=19:30:19&coverage=CONUS&band=4"
"date=20170521&time=20:00:19&coverage=CONUS&band=4"
"date=20170521&time=20:30:18&coverage=CONUS&band=4"
"date=20170521&time=21:30:19&coverage=CONUS&band=4"
"date=20170521&time=22:00:18&coverage=CONUS&band=4"
"date=20170521&time=22:30:19&coverage=CONUS&band=4"
"date=20170521&time=23:00:19&coverage=CONUS&band=4"
"date=20170521&time=23:30:18&coverage=CONUS&band=4"
)

FILENAMES=(
"GOES13_d20170521_t010018_b04"
"GOES13_d20170521_t013017_b04"
"GOES13_d20170521_t020019_b04"
"GOES13_d20170521_t023018_b04"
```

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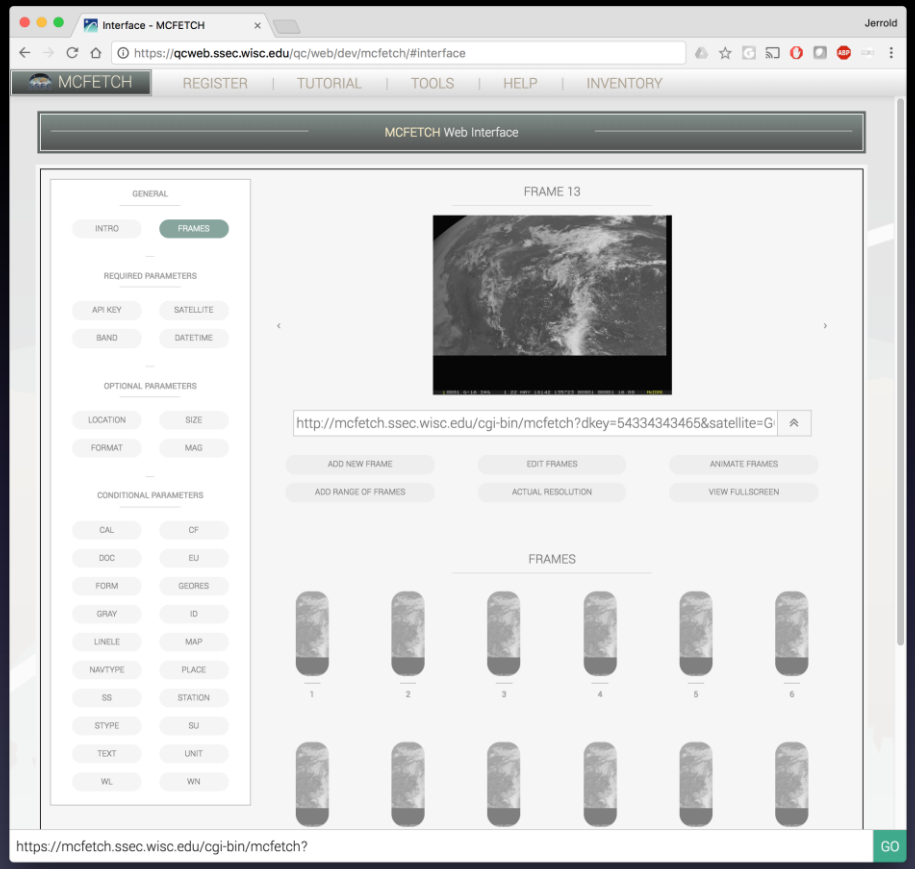
McFETCH Web Interface



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McFETCH Users

As of May 21, 2018

- 276 Users
- 29 users in last 30 days
- 52,750 transactions in last 30 days

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McFETCH Satellite Data Server

Upcoming updates (summer 2018)

- Improved performance for archive requests
- Original "archived" format data output

McFETCH Satellite Data Server

To get a data access key:

Go to https://mcfetch.ssec.wisc.edu

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McIDAS in Python

- Uses code developed by Kevin Hallock and Jon Beavers
- New McIDAS scripts in Python
- Available in McIDAS 2017.1 XRD

+

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AMQP

RabbitMQ

- AMQP -> **Advanced Message Queuing Protocol**
- **RabbitMQ**
- **amqpfind**
- **Himawari**
- **GOES-16/17**
- **Expand to other GEOs and Polar**

GRB Fanout server

Developed by Dan Forrest

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GRB Fanout Server

The Problem:

Quorum GRB-200 Demodulator

- Quorum Demodulator
  - Single UDP stream
  - Multicast broadcast
- Multiple Ingestors needed GRB stream
- Not all Co-located
- Multicast through router data loss
- Development planned in 2015

Only SDS/Datacenter funds were used for this.

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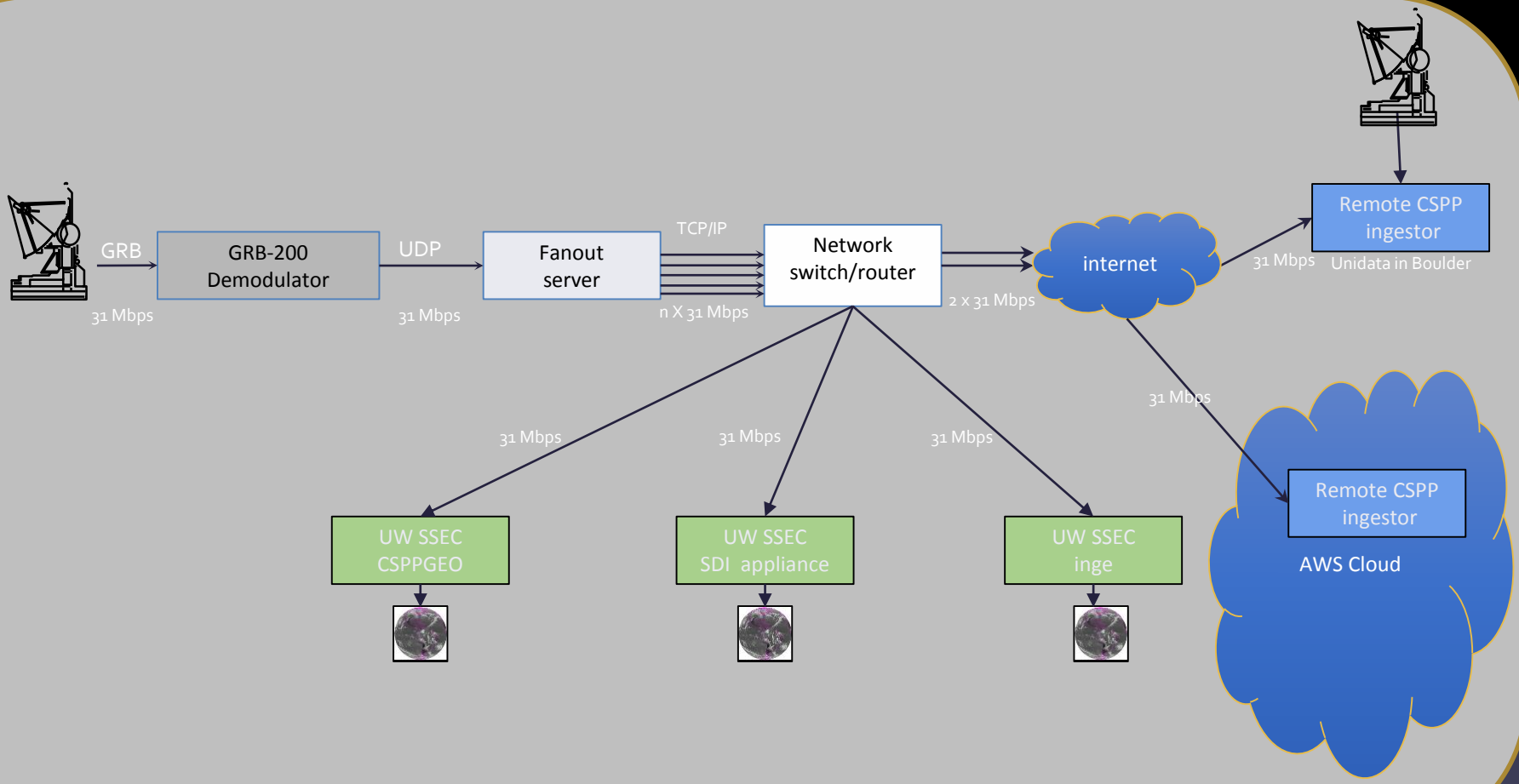
GRB Fanout Server



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Fanout server hardware specs

- Dell PE R430
- Single Intel Xeon 2.4GHz 6 core processor
- 8GB RAM
- 2TB disk (2 x 200GB & 1 x 1.6TB)
- $3,600 USD

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GRB Fanout Server

- Compatible with CSPP-GEO, SDI GRB Appliance
- Still in "ALPHA"
- Need additional resources to move to mature distribution

GRB Fanout switching

- Sometimes you need to switch to a different fanout server due to:
  - Swapping Antennas
  - Swapping demodulators
  - Antenna down time (planned or unplanned)
  - Local RFI (E.g. Solar RFI)

GRB Mixer

Developed by Dan Forrest

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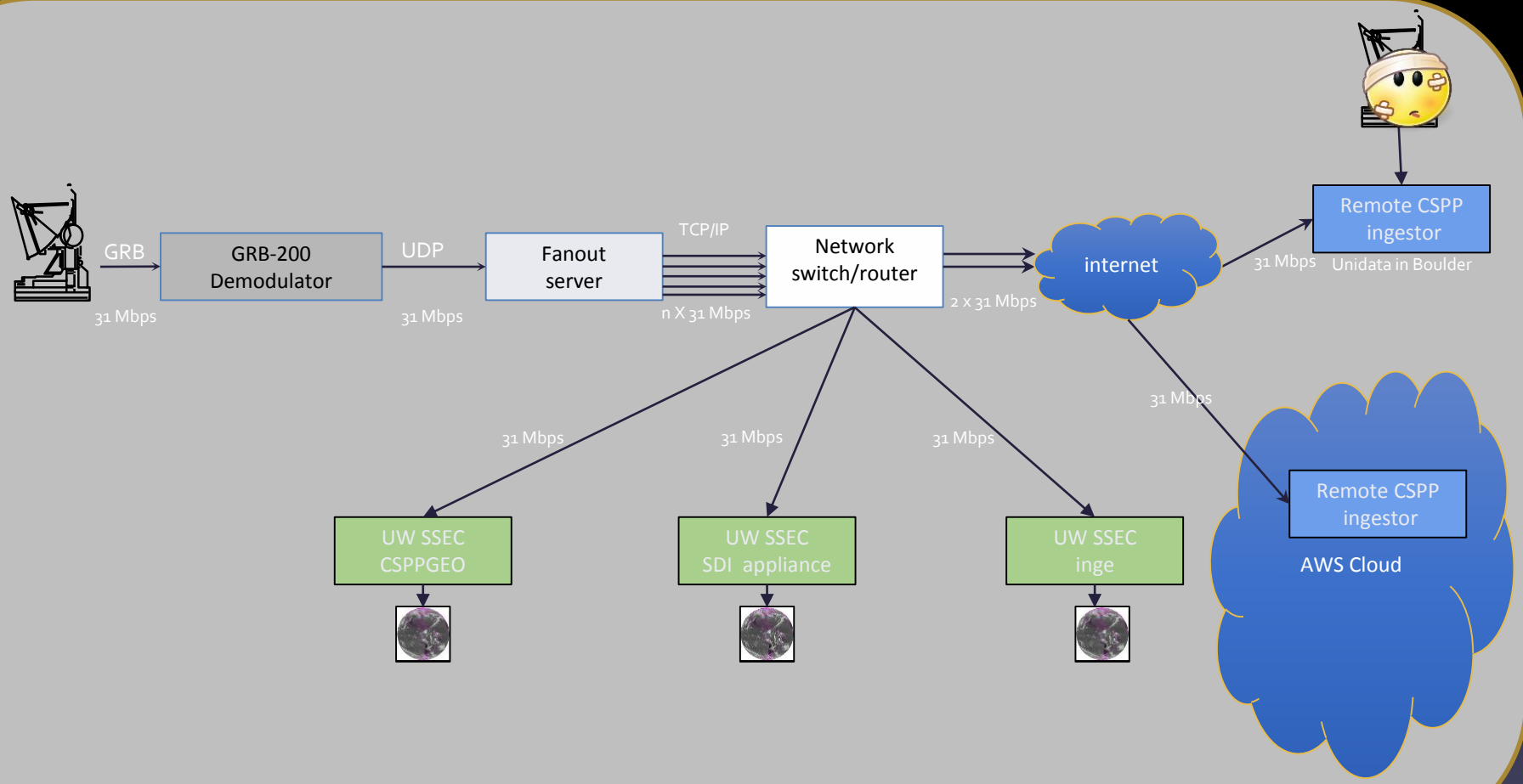
GRB Mixer

- Allows mixing of 1 or more fanout feeds …. automatically
- Mix feeds at the "CADU" level
- Great solution for local Radio Frequency Interference mitigation

GRB Fanout Server with Mixer



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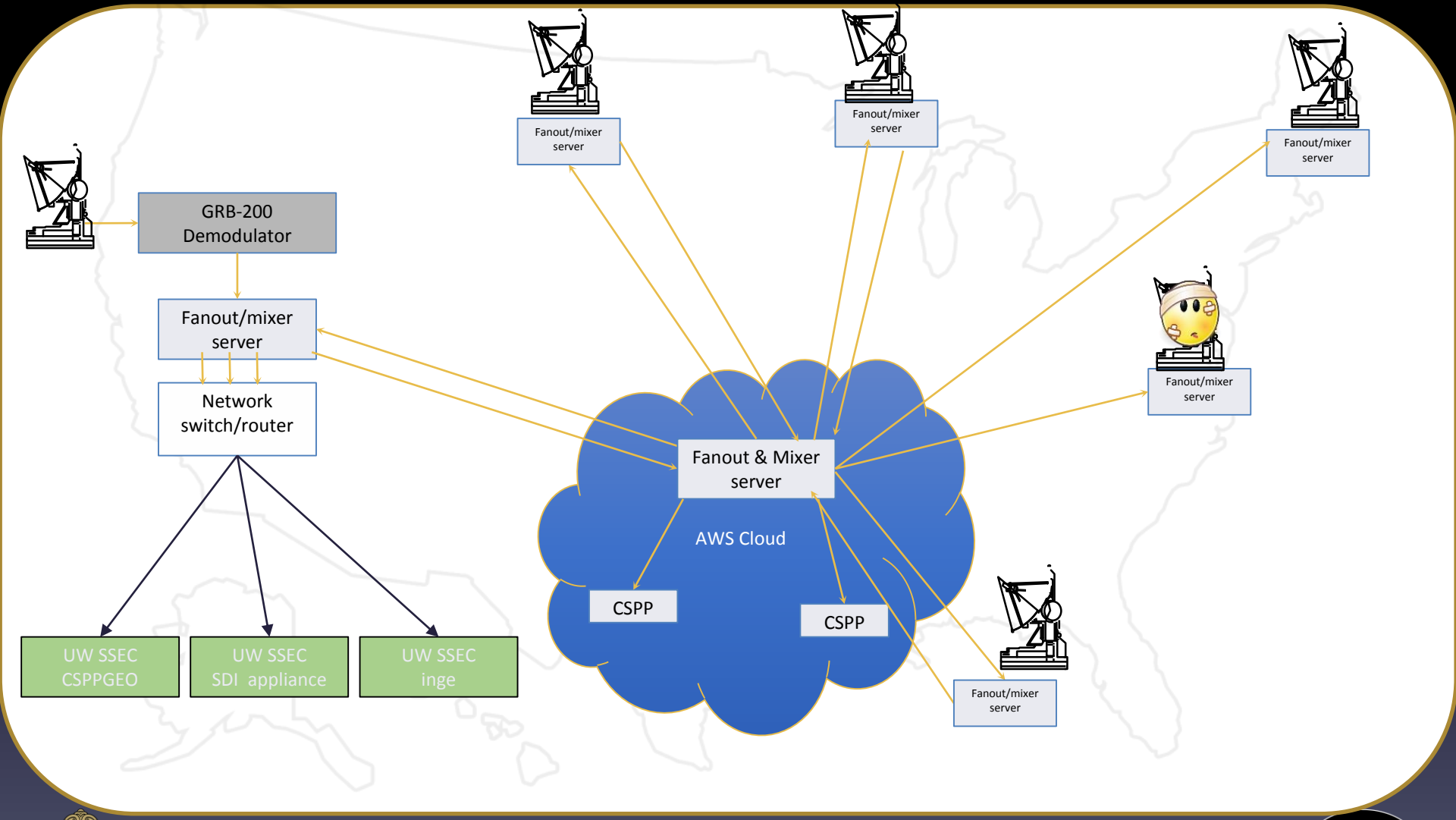
Fanout and Mixer in the Cloud



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GRB Mixer

Great for RFI!

Some RFI Sources

- Solar (annually near equinox)
- Local terrestrial … Powerlines, stray RF
- Lightning

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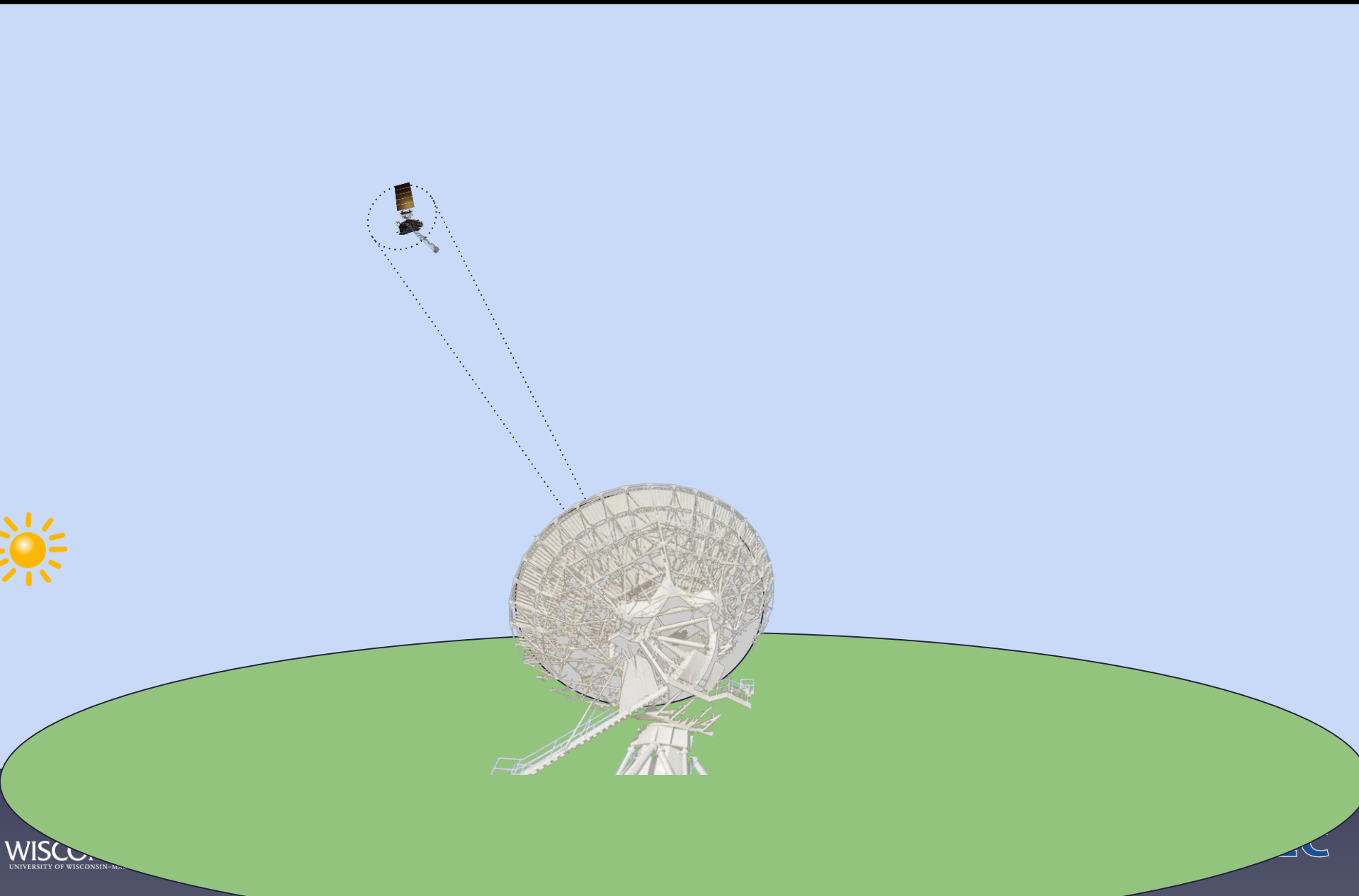
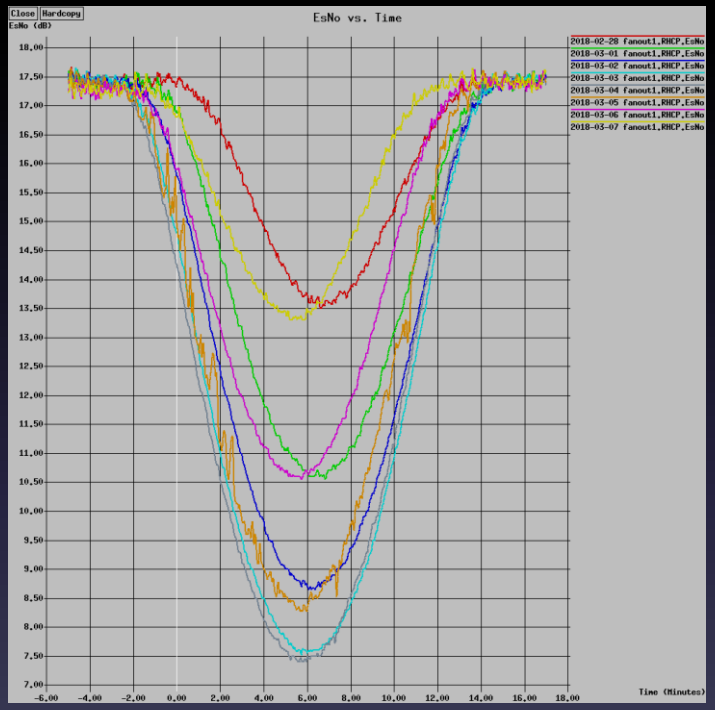
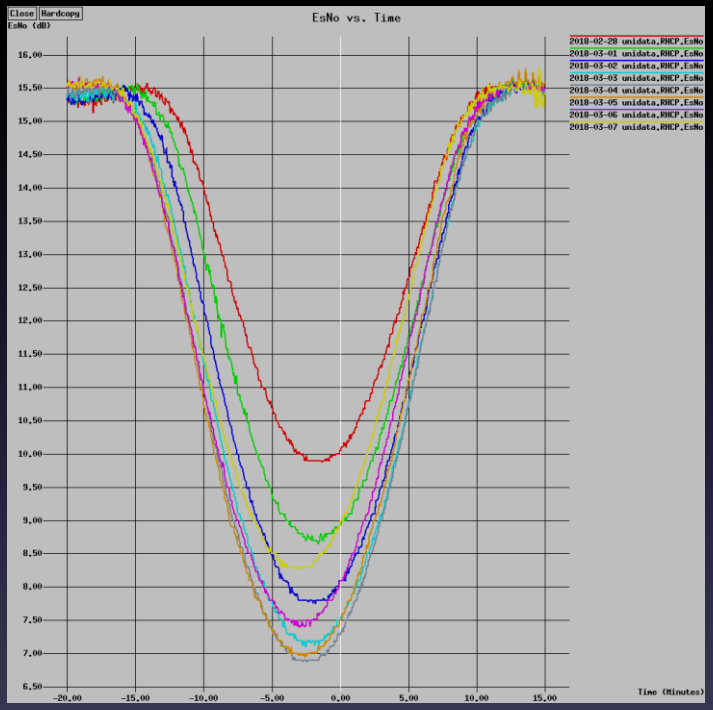


Solar RFI Graphs





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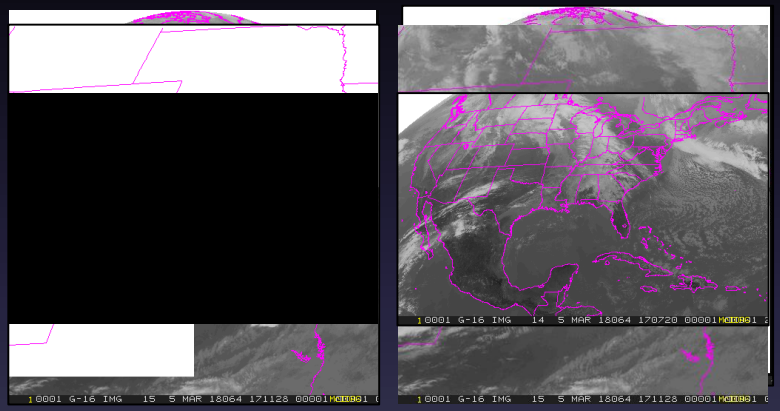
Solar RFI at PDA ground station March 5, 2018

- 03/05/2018 17:06:38 - 17:15:57 UTC
- Affected 7 Meso-scale sectors
  - 5 entire images lost
  - 2 partial images
- Affected 1 Full Disk
  - 8 Channels partial loss
  - 8 channels No loss
- Affected 1 CONUS (all 16 channels lost)



PDA SSEC

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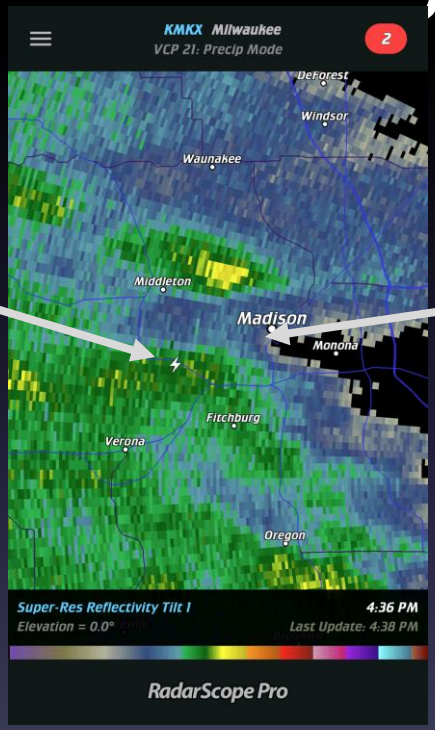
RFI due to Lightning

Lightning Flash 4.3 Miles away



SSEC Antenna Location

Lightning Flash occurred at 22:36:36Z on March 5, 2018

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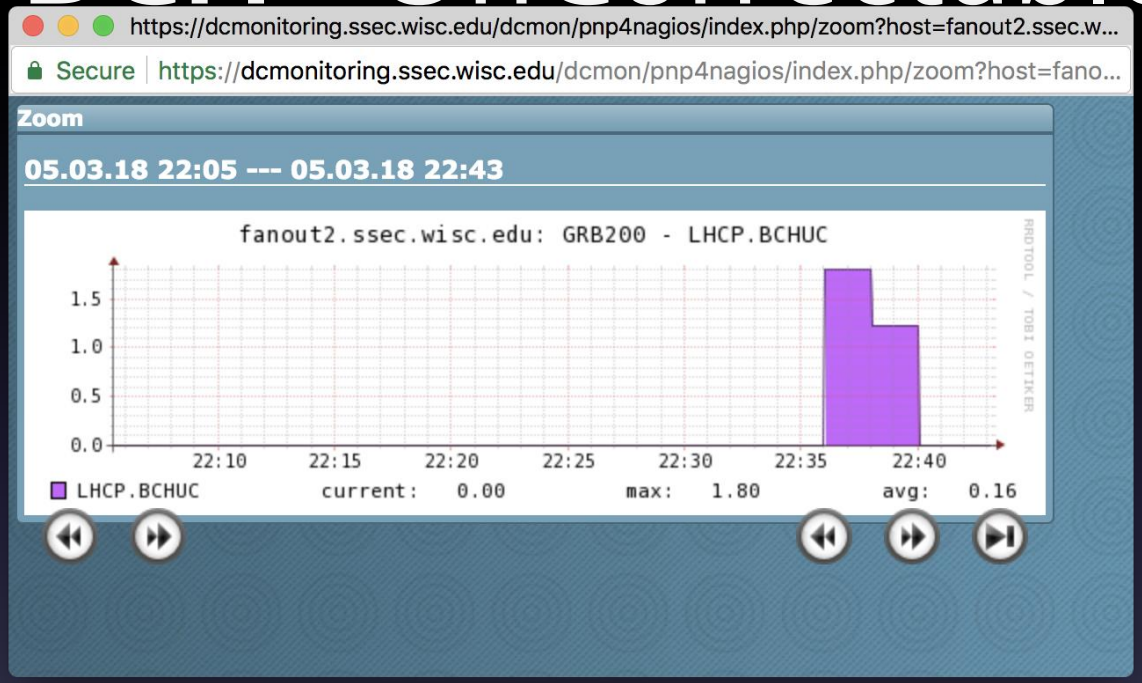
BCH* UnCorrectable



*Bose–Chaudhuri–Hocquenghem

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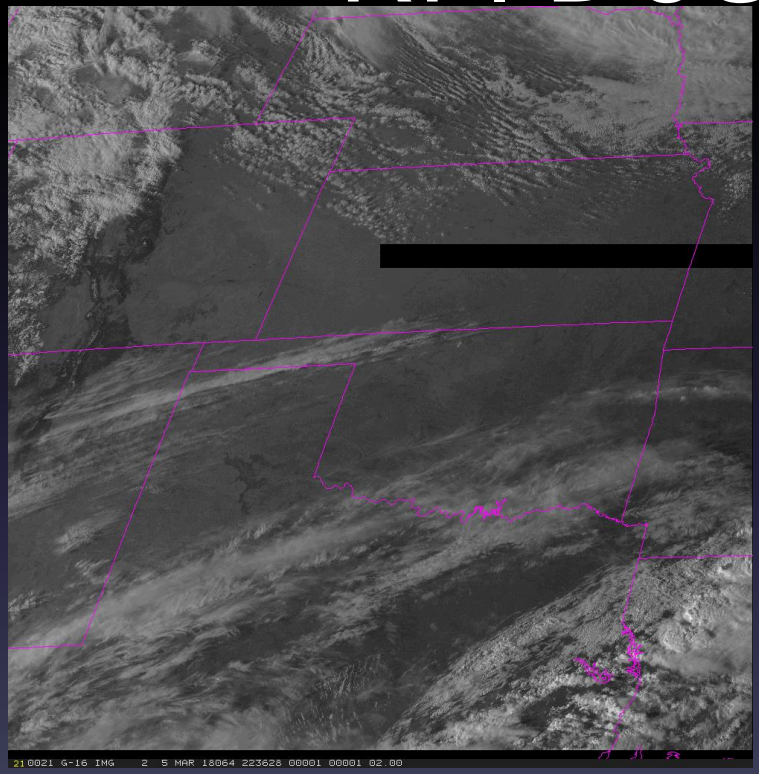
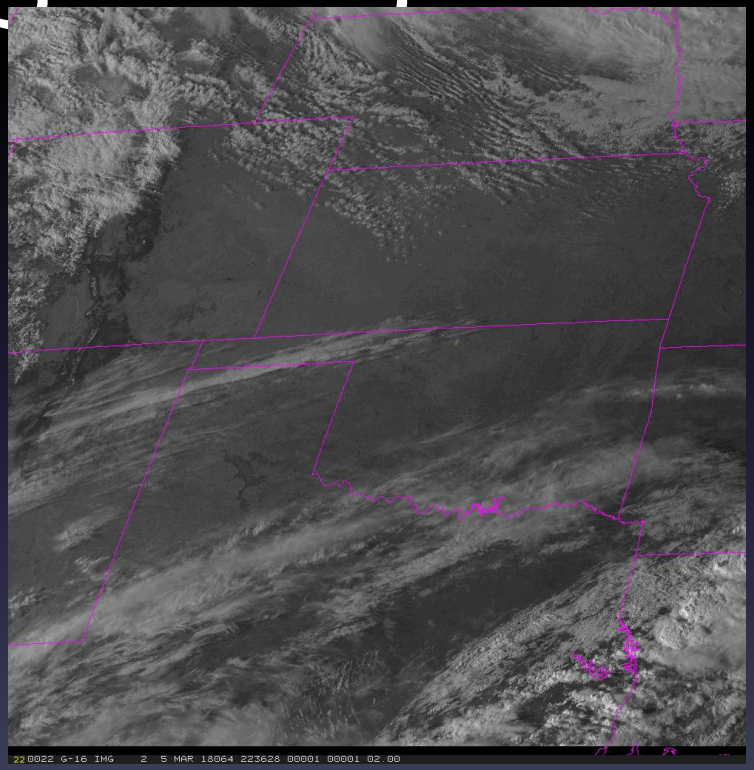
RFI Due to Lightning





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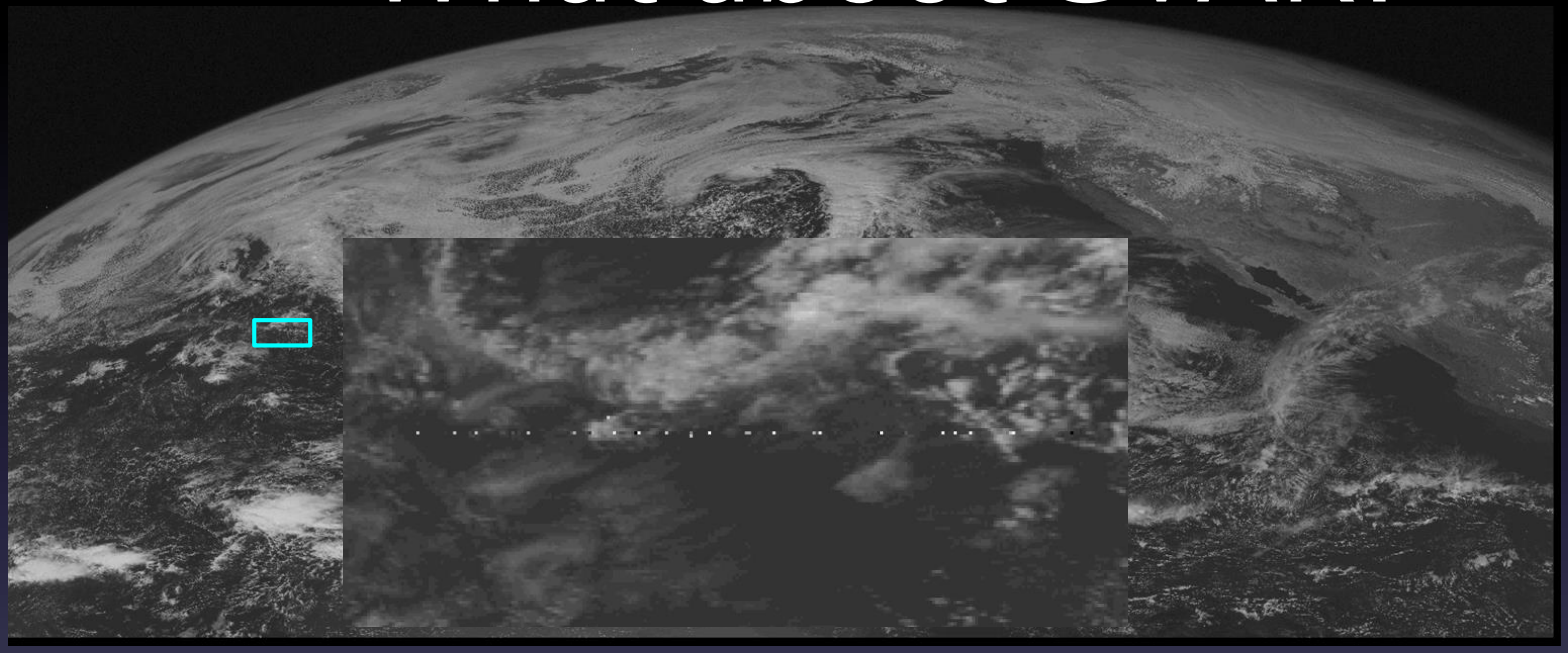
What about GVAR?



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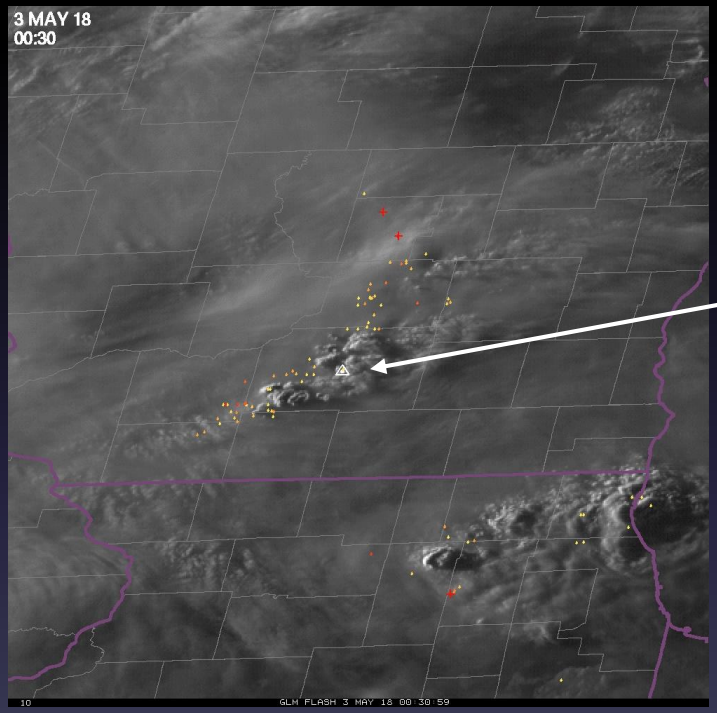
RFI due to Lightning (May 3, 2018 00:37 UTC)



SSEC Antenna Location

Lightning event at 00:35 - 00:40Z on May 3, 2018

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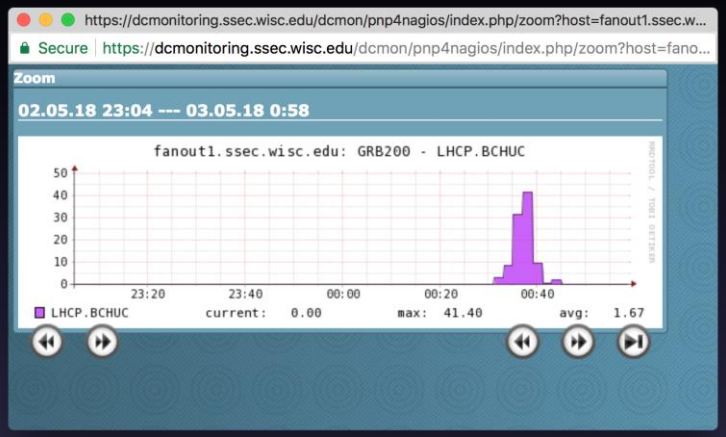
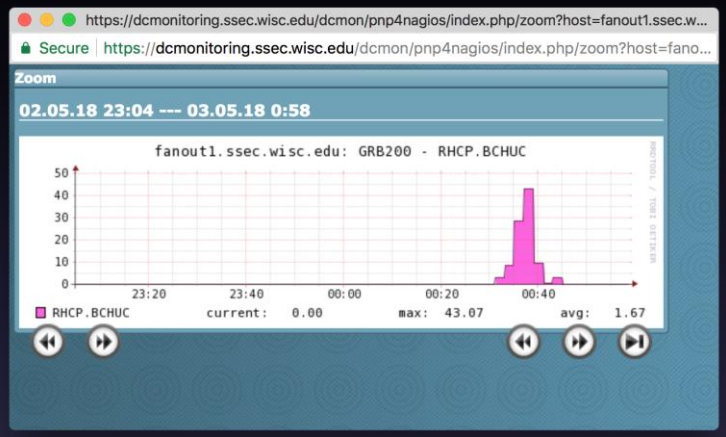
BCH* UnCorrectable



Left Hand Circular Polarized (LHCP)



Right Hand Circular Polarized (RHCP)

*Bose–Chaudhuri–Hocquenghem

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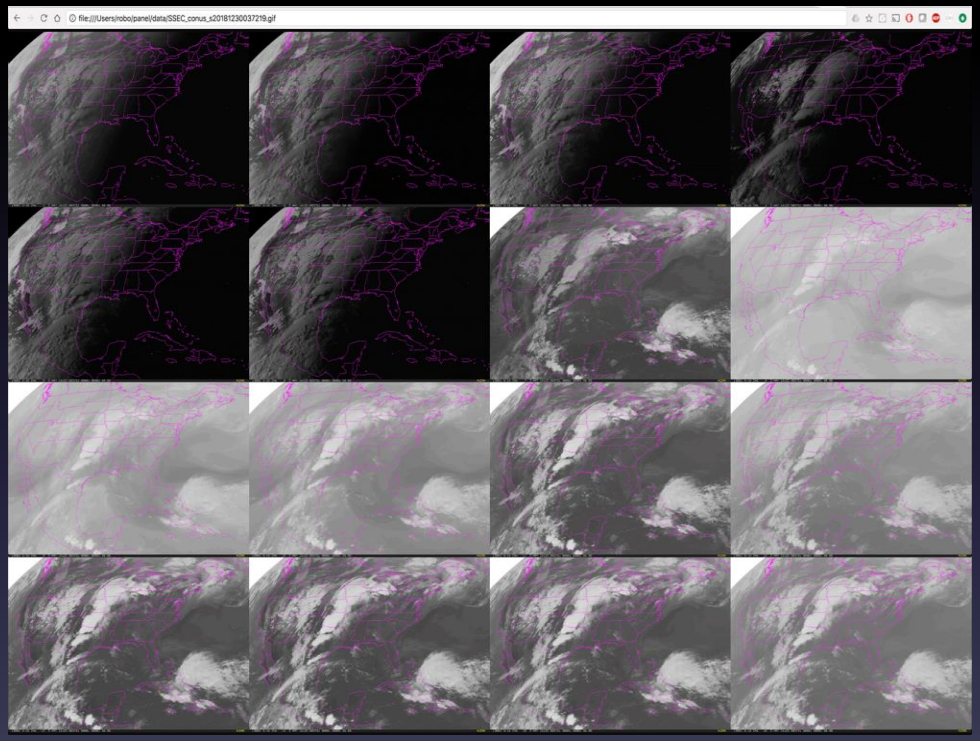
RFI Due to Lightning



CONUS
May 3, 2018
00:37:22 UTC

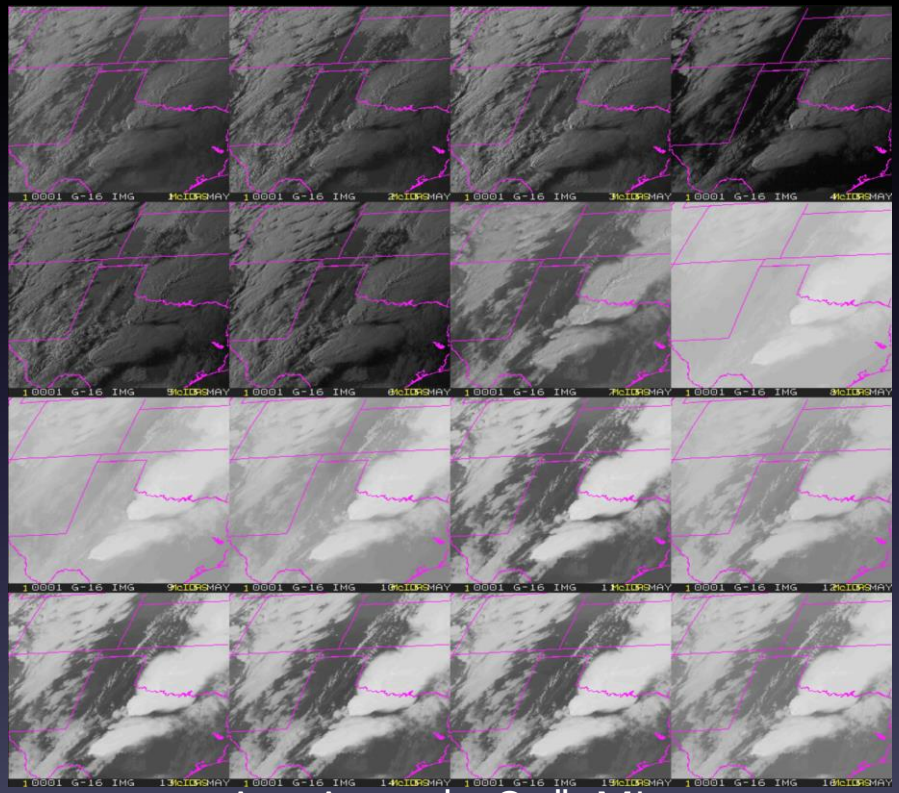
2 Antennas Only

Antenna Only

Mixer

RFI Due to Lightning

Meso 1
May 3, 2018
00:38:30 UTC



2 Antenna Only

Antenna Only

Mixer

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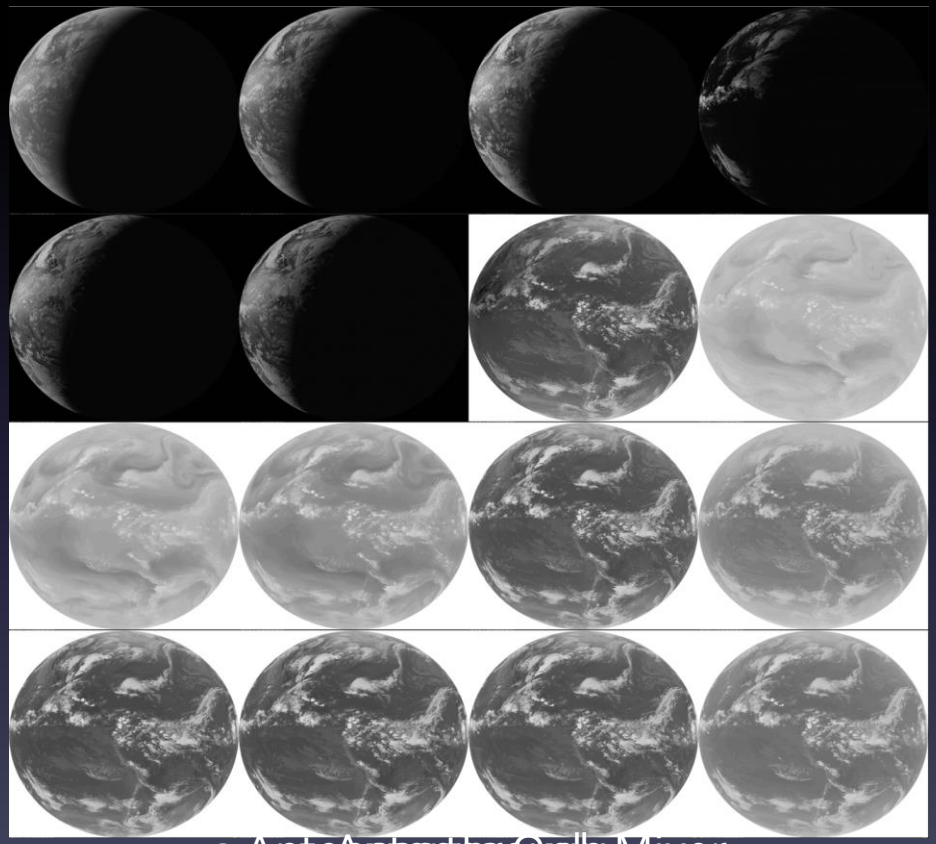
RFI Due to Lightning

Full Disk
May 3, 2018
00:30:41 UTC



2 Antenna Only

Antenna Only

Mixer

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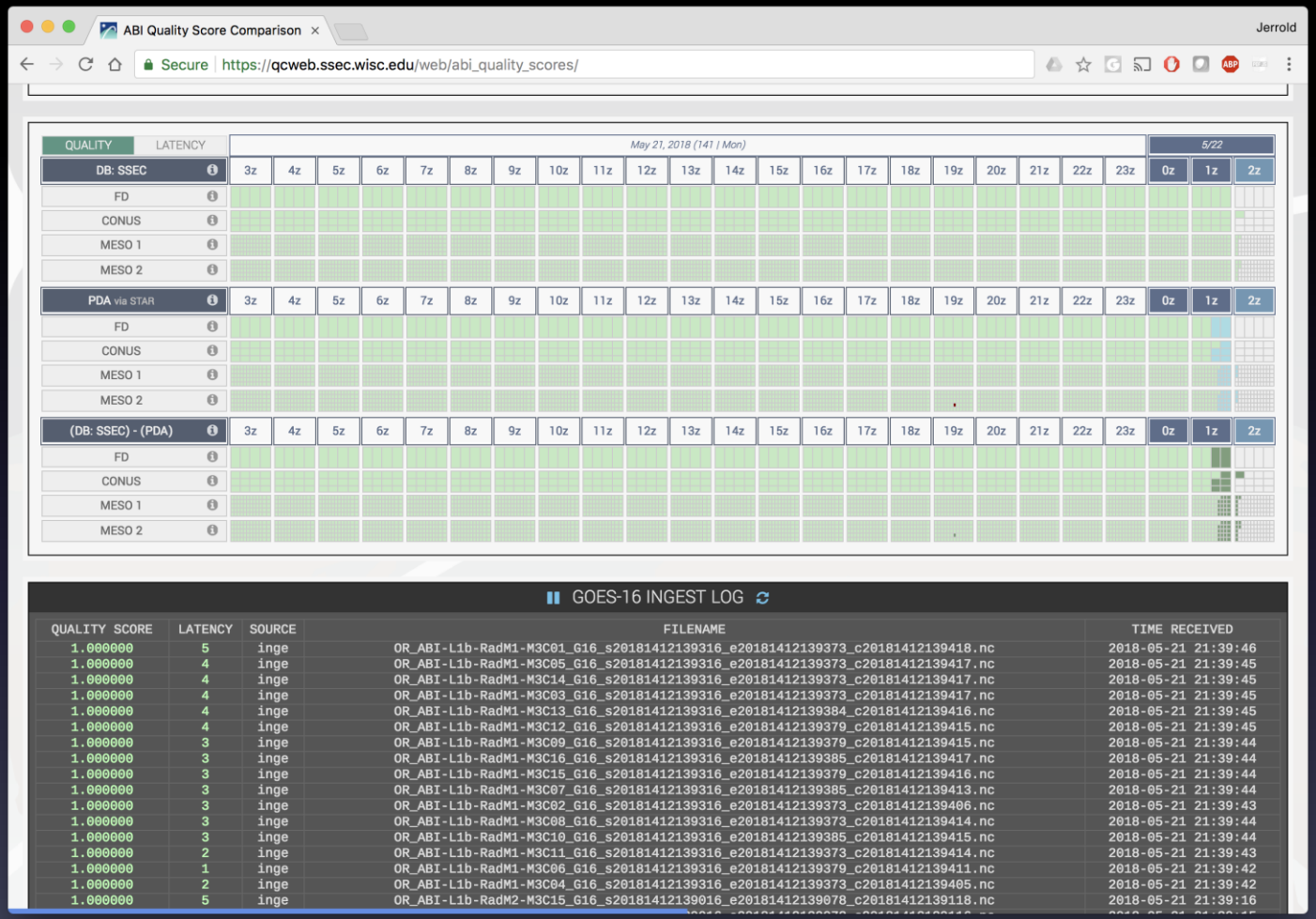
GRB Mixer

- Compatible with CSPP-GEO, SDI GRB Appliance
- Still in "ALPHA"
- Need additional resources to move to mature distribution

ABI Monitor



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1.000000	4	inge	OR_ABI-L1b-RadM1-M3C05_G16_s20181412139316_e20181412139373_c20181412139417.nc	2018-05-21 21:39:45
1.000000	4	inge	OR_ABI-L1b-RadM1-M3C14_G16_s20181412139316_e20181412139373_c20181412139417.nc	2018-05-21 21:39:45
1.000000	4	inge	OR_ABI-L1b-RadM1-M3C03_G16_s20181412139316_e20181412139373_c20181412139417.nc	2018-05-21 21:39:45
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1.000000	4	inge	OR_ABI-L1b-RadM1-M3C12_G16_s20181412139316_e20181412139379_c20181412139415.nc	2018-05-21 21:39:45
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1.000000	2	inge	OR_ABI-L1b-RadM1-M3C11_G16_s20181412139316_e20181412139373_c20181412139414.nc	2018-05-21 21:39:43
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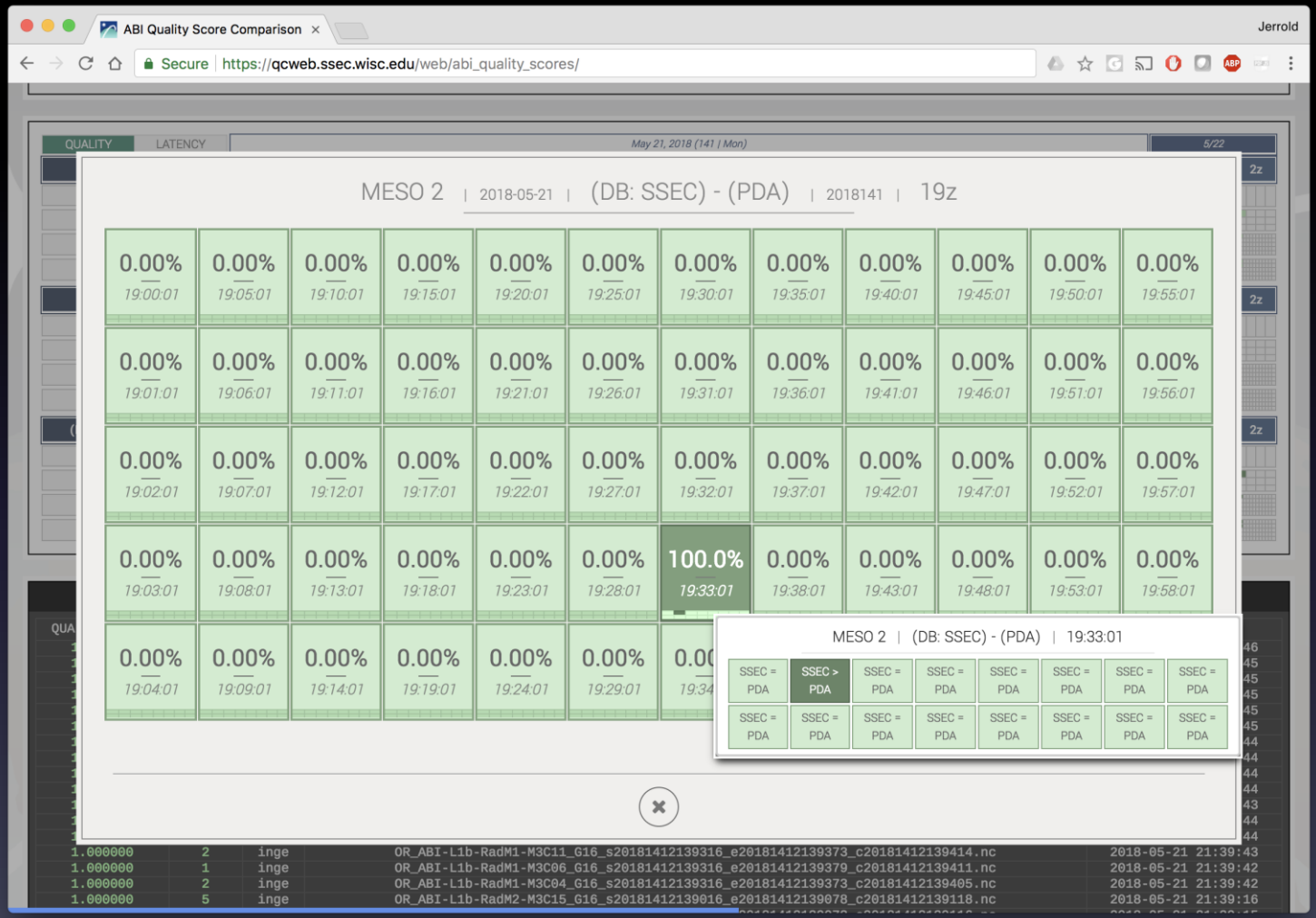
ABI Monitor



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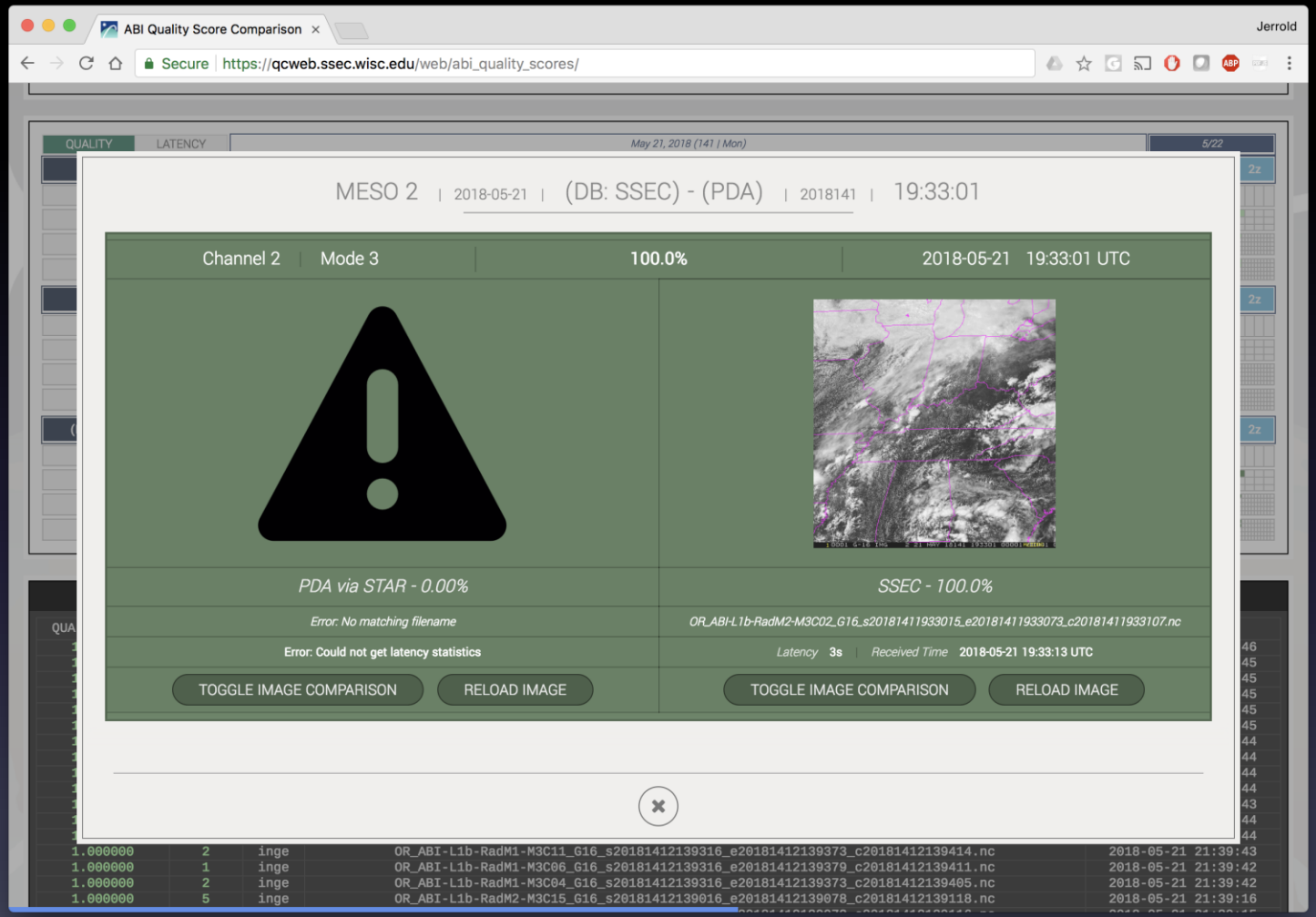
ABI Monitor



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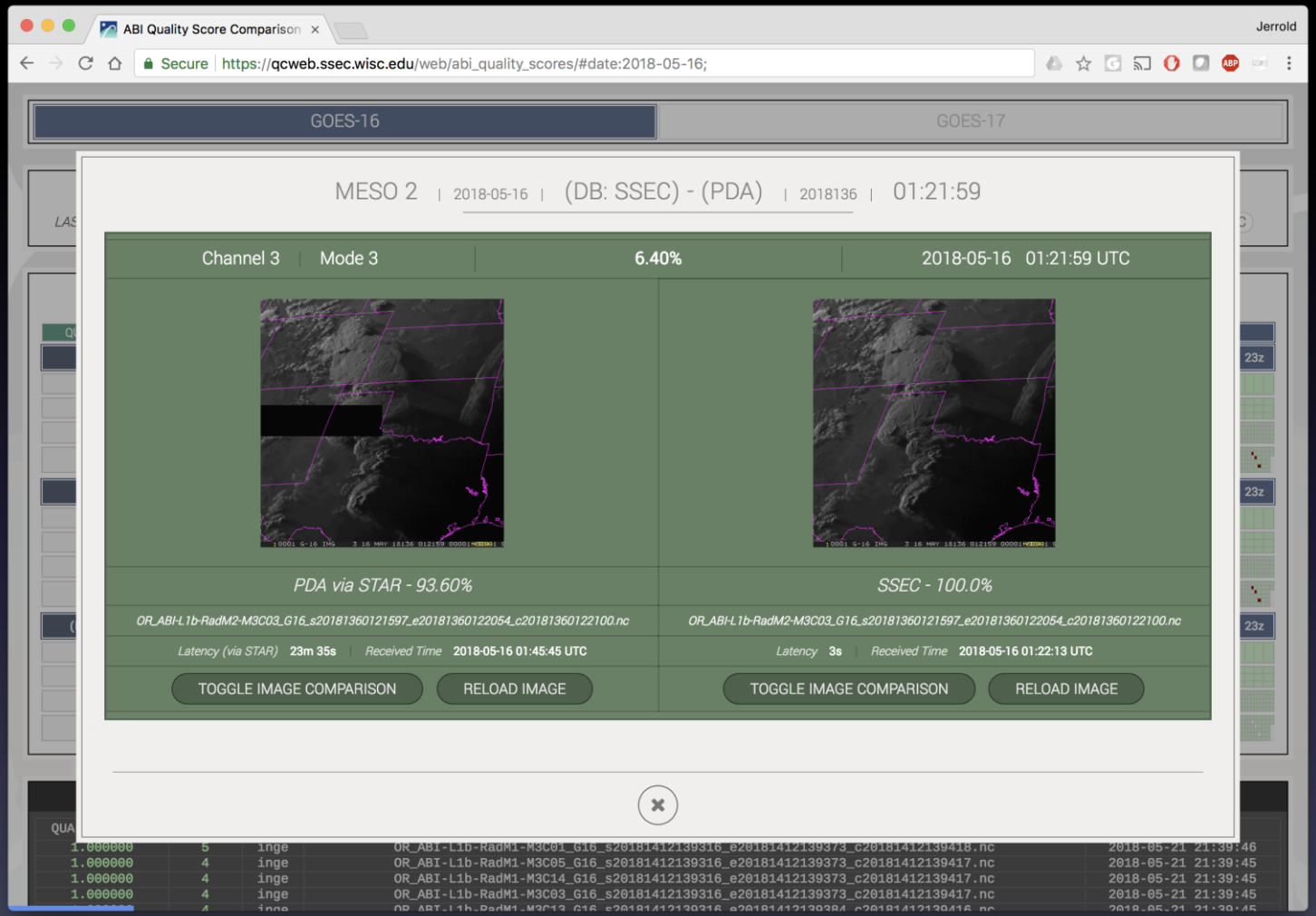
ABI Monitor



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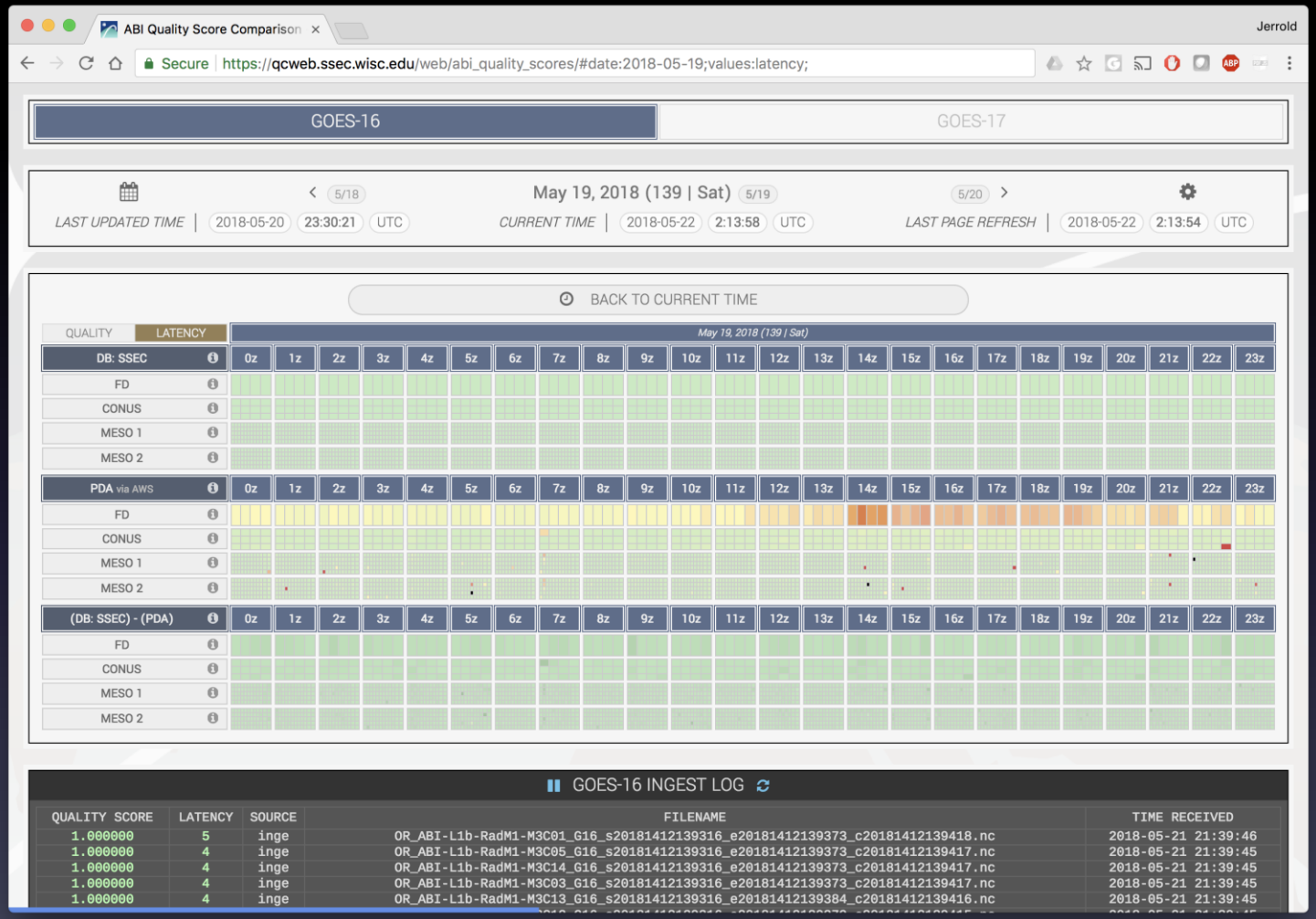
ABI Monitor



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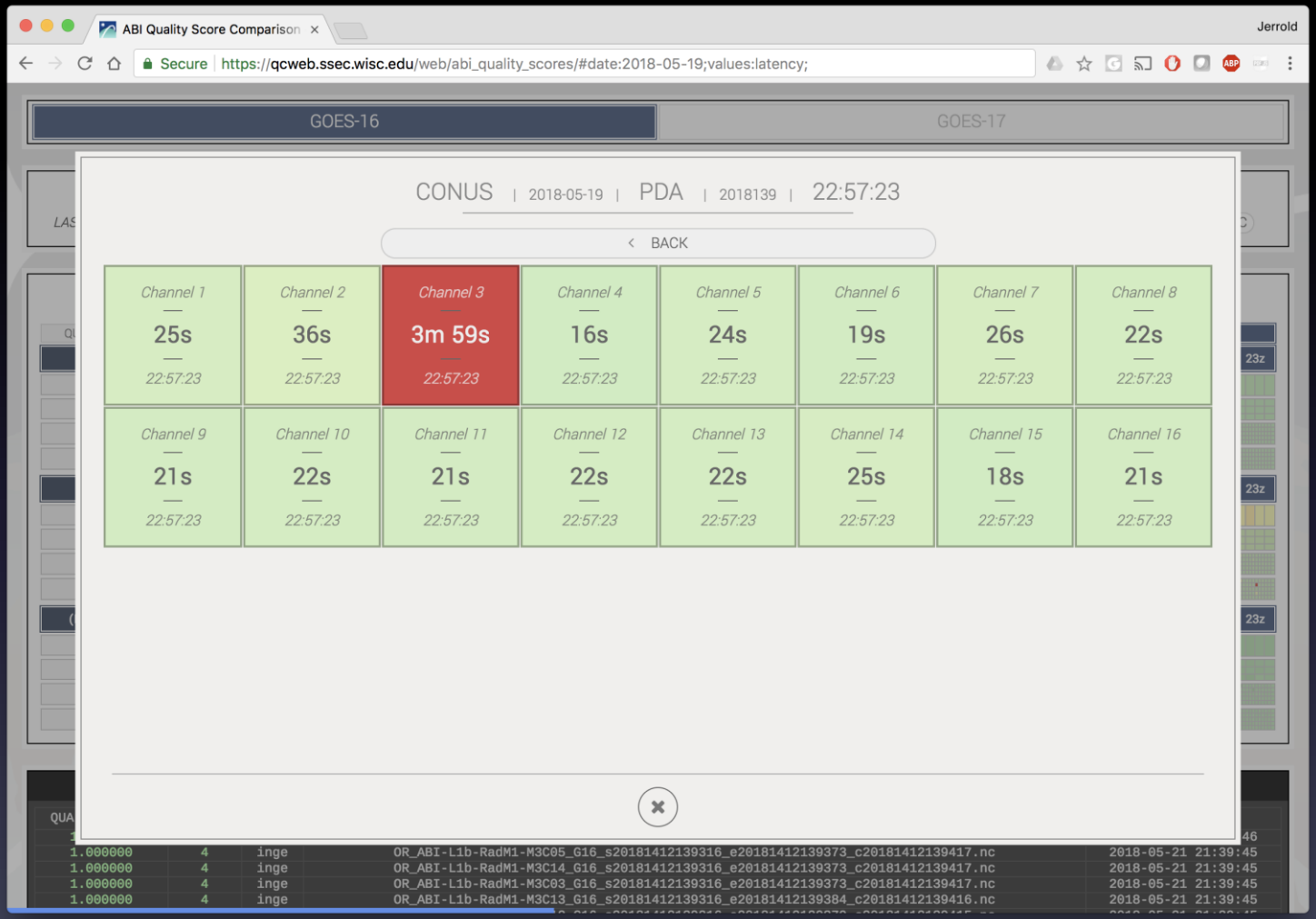
ABI Monitor



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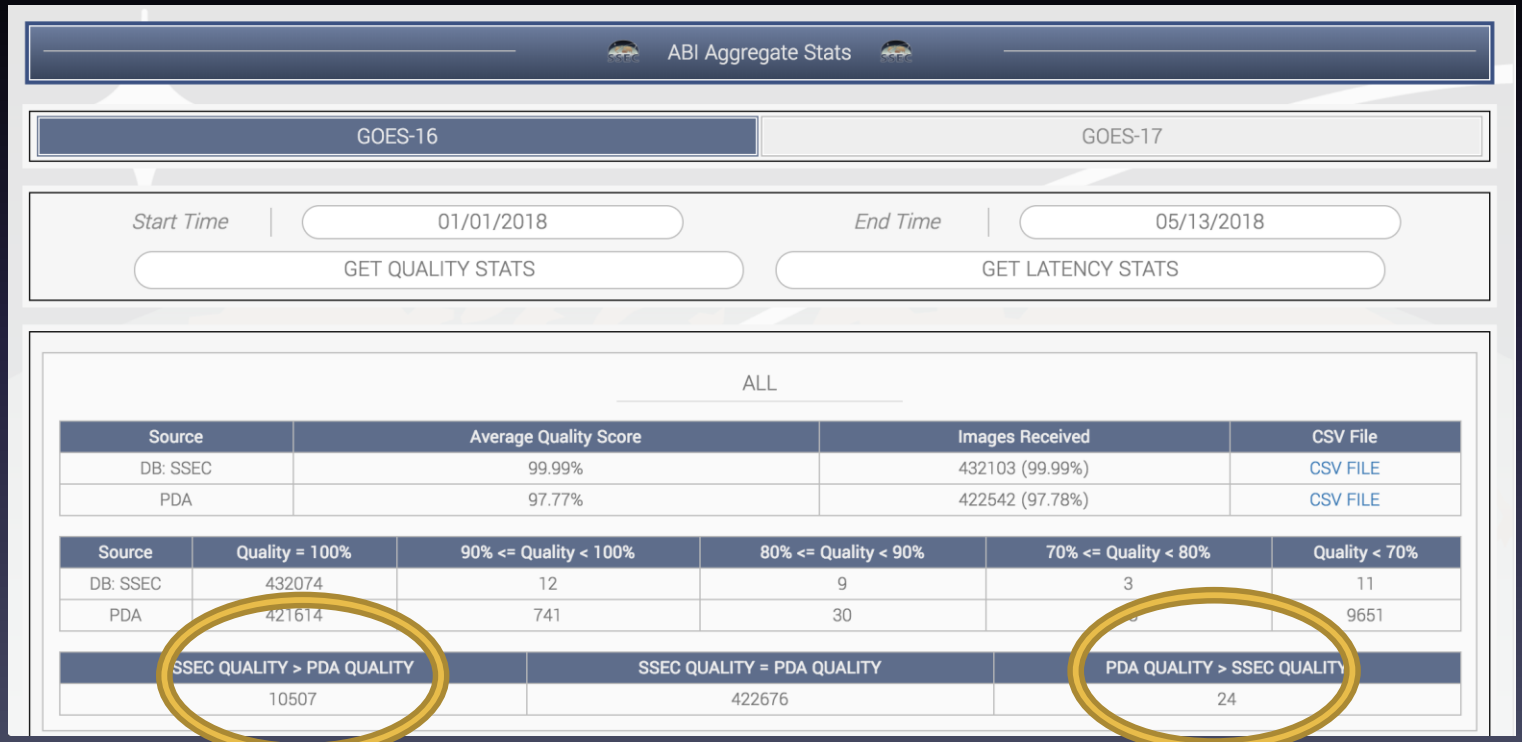
ABI Monitor

Statistics

- January 1 through May 13, 2018.



ABI Aggregate Stats

GOES-16 | GOES-17

Start Time: 01/01/2018 | End Time: 05/13/2018

GET QUALITY STATS | GET LATENCY STATS

ALL

Source	Average Quality Score	Images Received	CSV File
DB: SSEC	99.99%	432103 (99.99%)	CSV FILE
PDA	97.77%	422542 (97.78%)	CSV FILE

Source	Quality = 100%	90% <= Quality < 100%	80% <= Quality < 90%	70% <= Quality < 80%	Quality < 70%
DB: SSEC	432074	12	9	3	11
PDA	421614	741	30	[illegible]	9651

SSEC QUALITY > PDA QUALITY	SSEC QUALITY = PDA QUALITY	PDA QUALITY > SSEC QUALITY
10507	422676	24

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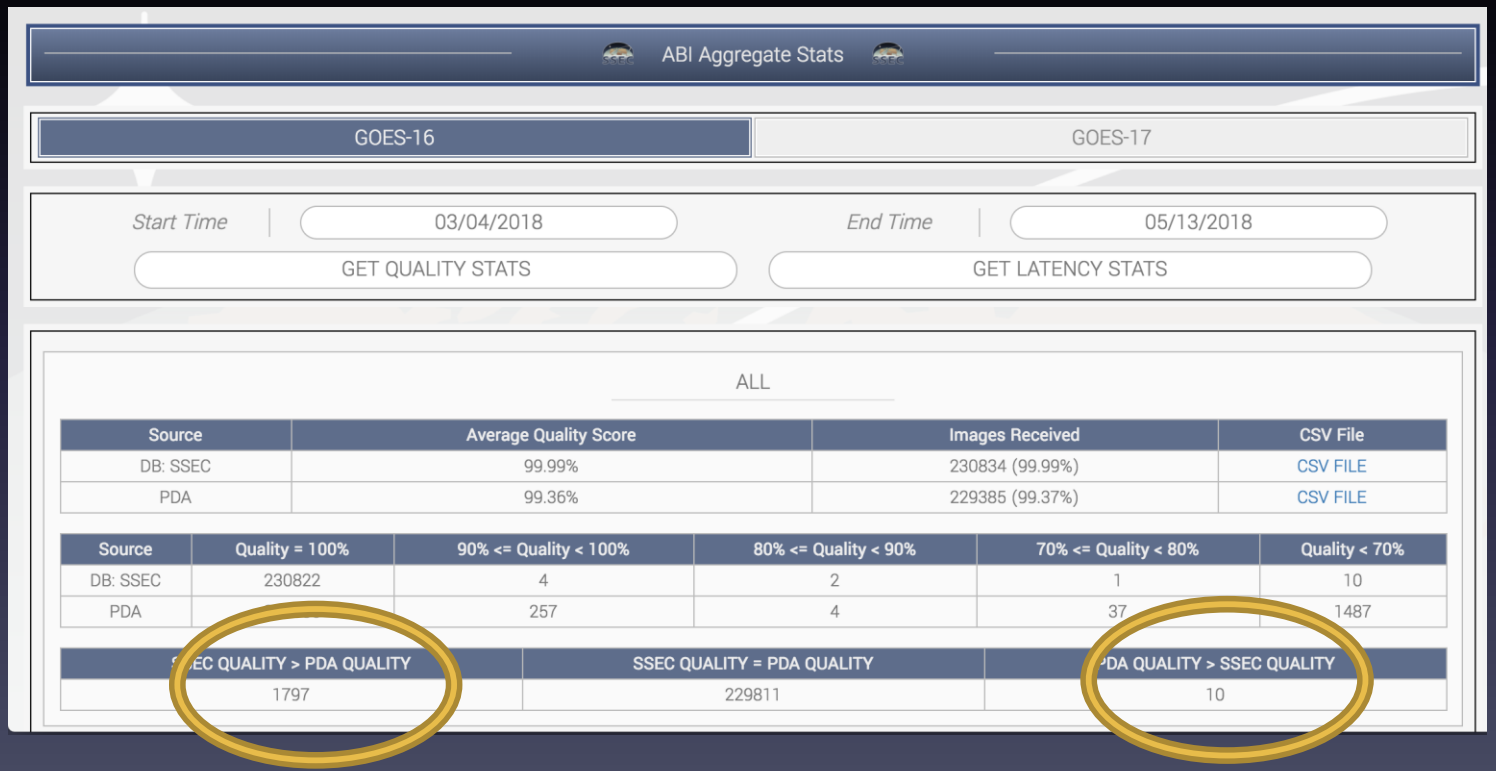
ABI Monitor

Statistics

- March 4 through May 13, 2018.



ABI Aggregate Stats

GOES-16 | GOES-17

Start Time: 03/04/2018 | End Time: 05/13/2018

GET QUALITY STATS | GET LATENCY STATS

ALL

Source	Average Quality Score	Images Received	CSV File
DB: SSEC	99.99%	230834 (99.99%)	CSV FILE
PDA	99.36%	229385 (99.37%)	CSV FILE

Source	Quality = 100%	90% <= Quality < 100%	80% <= Quality < 90%	70% <= Quality < 80%	Quality < 70%
DB: SSEC	230822	4	2	1	10
PDA		257	4	37	1487

EC QUALITY > PDA QUALITY	SSEC QUALITY = PDA QUALITY	DA QUALITY > SSEC QUALITY
1797	229811	10

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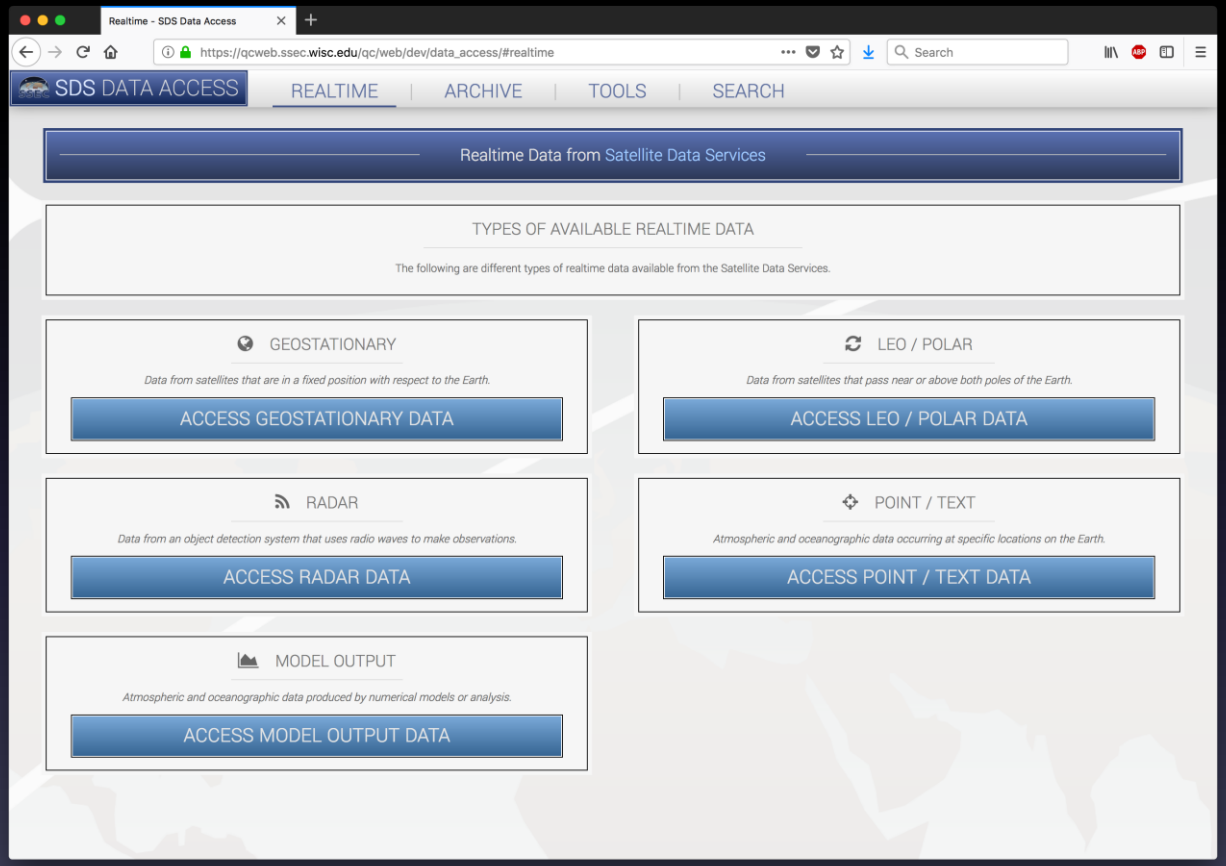
ABI Monitor

- Uses McFETCH
- Generic image QC code
- All GEOs planned to be added to a QC monitor

Data Access Page



Real-time Data

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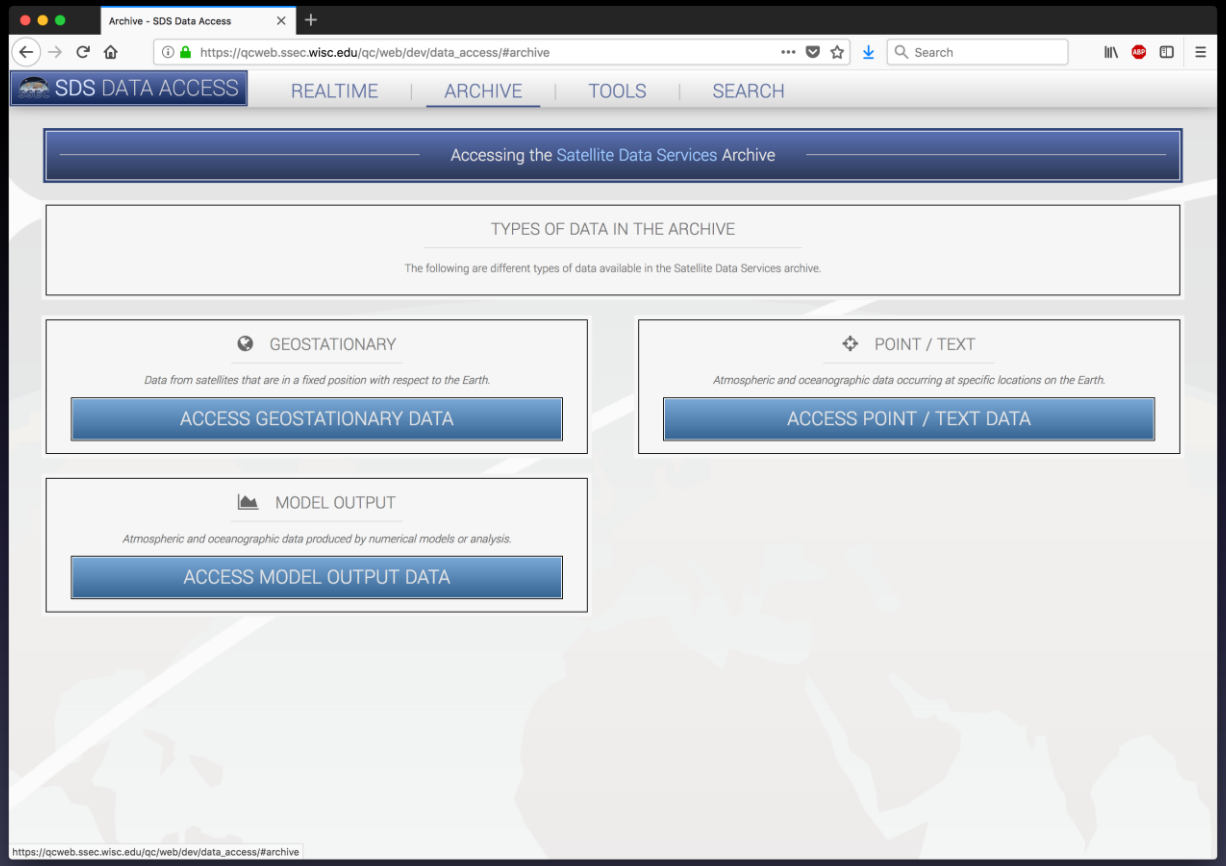
Data Access Page



Archive Data

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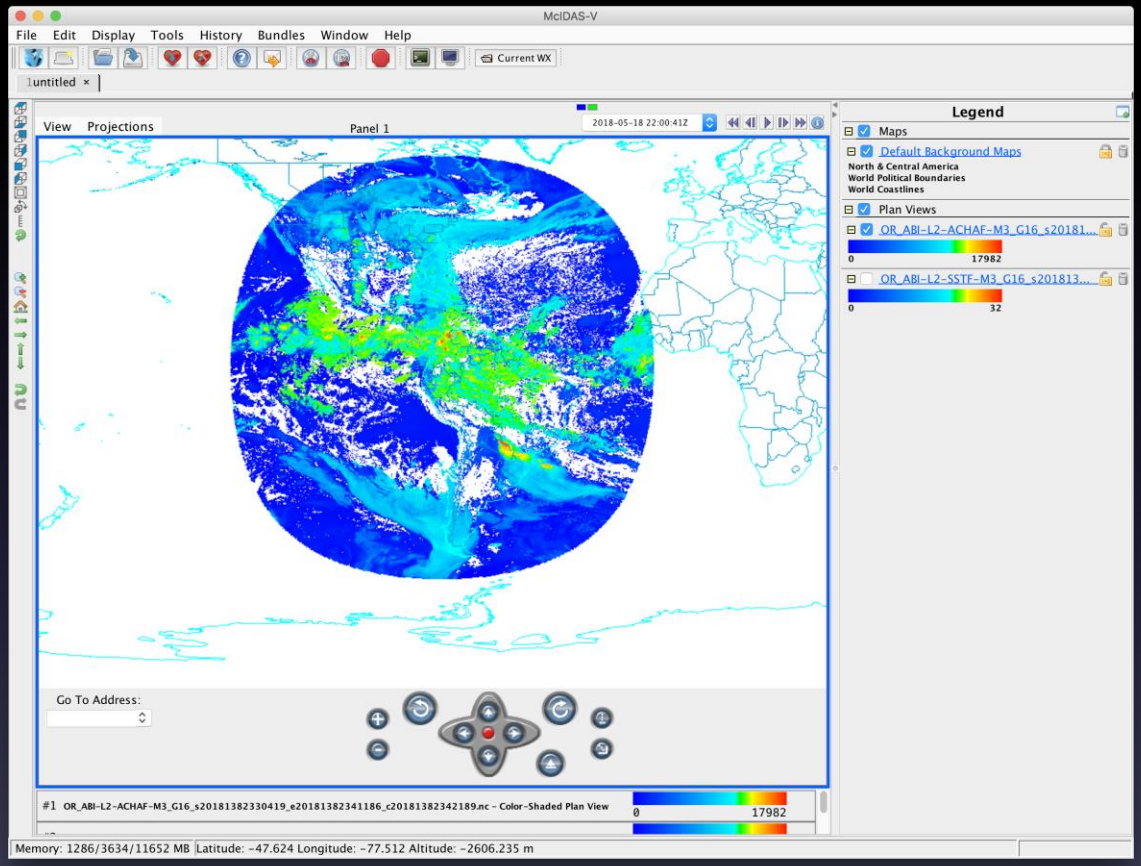
GEONETcast

- Used to monitor polar data uplinks

GEONETcast



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Cloud initiatives

- McIDAS client container
- McIDAS ADDE server container
- Fanout server container

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Questions?