University of Wisconsin SSEC Satellite Data Services Update

McIDAS Users Group Meeting

September 16-17, 2019

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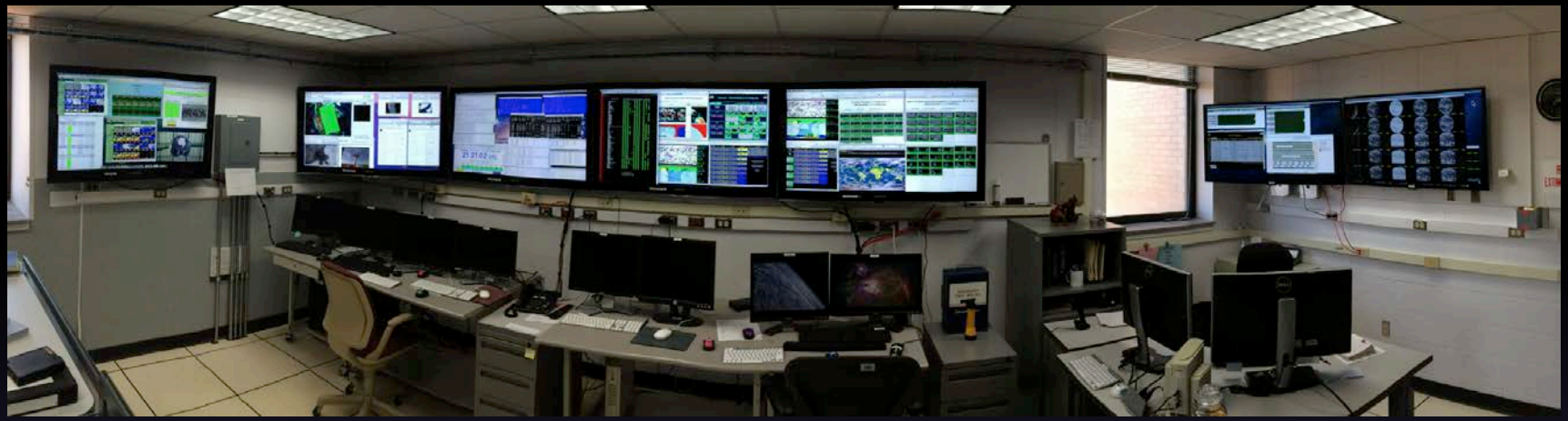
SSEC SDS



Staffed M-F , 8:30 AM - 5:00 pm Central time.

- SDS operations and QC lead
- Senior Systems Programmer
- Senior Research Application Programmer
- Visualization, Database, and Web programmer
- Research Intern
- Program manager
- Antenna/Communication technician
- 3 Student QC assistants/programmers

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Retirements

- Rosie Spangler (33 years)

- Nancy Troxel-Hoehn (30 years)

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Data Center Facilities

- Over 2100 ft.
- The Data Center's disk storage exceed 15-20 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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Data Center Facilities

UW Provisioned Off-site Data Center

- Tier 3, backup power, cooling
- Essential systems
- Ingest, Distribution
- On UW network
- Plans to expand for projects that demand high availability

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S4 Super Computer

- Funded in 2018 by NOAA
- 2,560 cores
  - 15 TB memory
  - 4 PBs of storage
  - Researching satellite data assimilation into operational NOAA models
  - This is the 3rd enhancement(2011, 2013)

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CIMSS & SSEC at the UW-Madison

SSEC Data Center Incoming Data

October, 2018

1,033+ GB/day via Satellite
(C-band. L-band, X-band)

7,330+ GB/day via Internet*
(ftp, LDM, ADDE, http)

GOES satellites	~690 GB/day
International Geo Satellites	~500+ GB/day
NOAA 15-19 Polar	~27 GB/day
Landsat-8	~50 GB/day
MODIS polar	~150 GB/day
SUOMI NPP (VIIRS CrIS ATMS)	3,400+ GB/day
Noaaport, GNC-A, misc*	3,700+ GB/day

* Some data are duplicates pulled from multiple sources

CIMSS = Cooperative Institute for Meteorological Satellite Studies

SSEC = Space Science &Engineering Center

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Antennas @ SSEC

- C-Band
  - 11 meter heated (101° West – SES-1, POES Fairbanks Relay)
  - 6.3 meter heated (87° West – SES-2, POES Wallops Relay)
  - 4.5 meter (101° West – SES-1, Noaaport)
  - 3.7 meter GEONETcast (58º West INTELSAT 21)
- L-Band
  - 7.3 meter (75° West –GOES-East Primary/GOES-16)
  - 7.3 meter (137° West –GOES-West Primary/GOES-17)
  - 4.6 meter (128° West –GOES-15)
  - 4.5 meter (60° West –GOES-13/GOES-14/GOES-15 backup)
- X-Band
  - 4.4 meter (Tracking – EOS)
- X/L Band
  - 2.4 meter (Tracking – Suomi NPP, EOS, Metop A&B, NOAA-18, 19, 20 and FY3)

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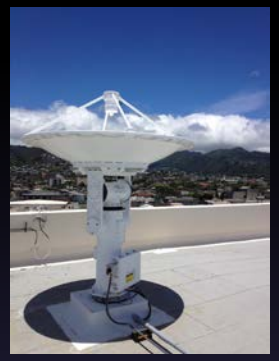
UW SSEC SDS
Antennas Remotely Managed



- 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&C, NOAA-18, 19, NOAA-20 and FY3
  - Supports
    - NOAA NWS NCEP
    - Eumetcast
    - GTS

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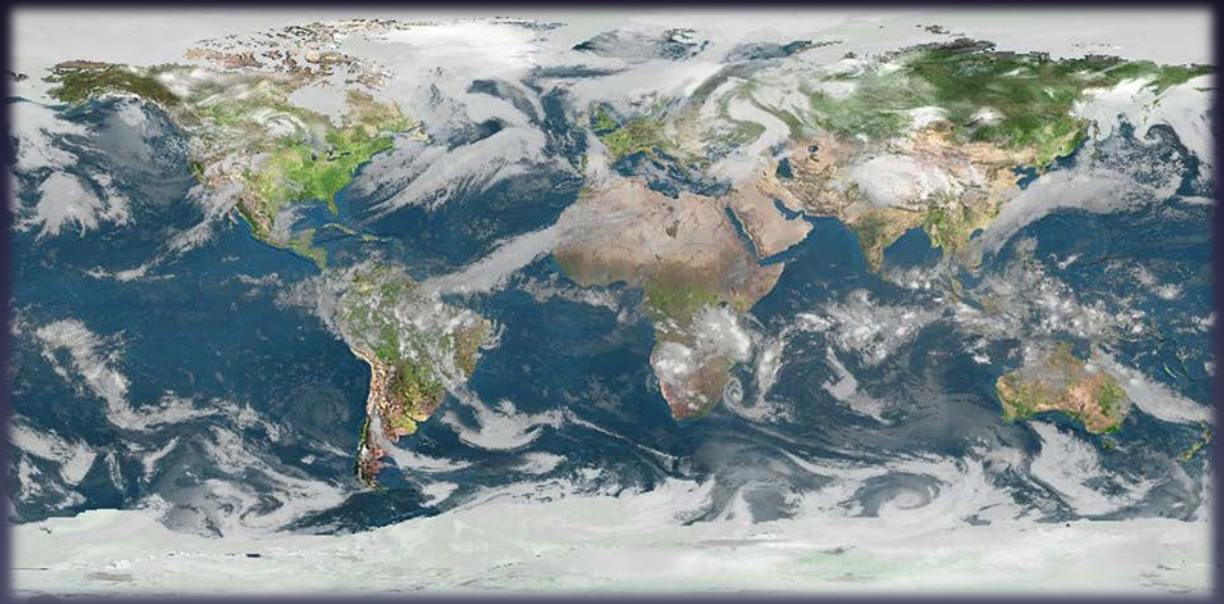
Real-time Data

The SSEC Data Center receives data from 10+ different geostationary satellites and 13+ 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(128° W)
- GOES-13/14 -Test (141°/104°W)
- GOES-17 -West(137° W)
- Meteosat-11 (0°E)
- Meteosat-8 (near 41.5° E)
- COMS (128°E) *

- FY-2H (79° E)
- FY-2G (99.5° E)
- Himawari-8 (140° E)
- FY-4A *GIIRS only*(105° E)
- INSAT-3D(83° E)

*GEO-KOMPSAT-2A being pursued

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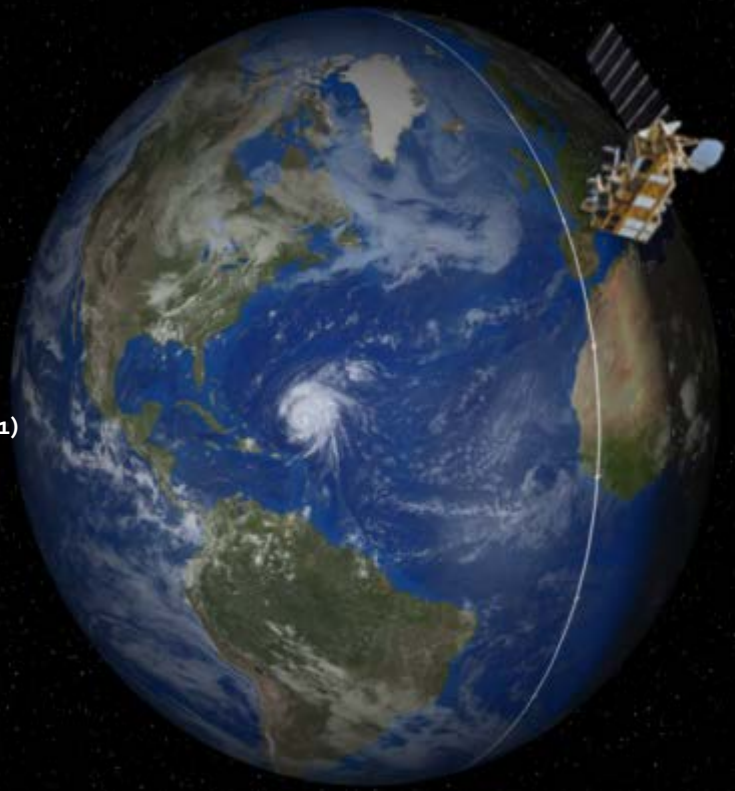
Geostationary Satellites Received at UW SSEC in 2019

	Sub-Point	Reception Method	Source	Latency	Daily Volume
GOES-16	75.2° West	L-Band	DB	<10 seconds	130-400 GB
GOES-13/14	141°/104° West	L-Band	DB	<2 minutes	23 GB
GOES-15	128.5° West	L-Band	DB	<2 minutes	23 GB
GOES-17	137°West	L-Band	DB	<10 seconds	130-400 GB
Meteosat-11	0° East	Network Relay	NOAA STAR	~30 minutes	24 GB
Meteosat-8	41.5° East	Network Relay	NOAA STAR	~30 minutes	24 GB
Himawari-8	140° East	Network Relay	NOAA STAR ABOM (backup)	~ 10 minutes	300 GB
Himawari-8	140° East	Himawari Cast Network Relay	Hawaii NWS	~ 10 minutes	62 GB
FY2H	79° East	Network Relay	ABOM	15-30 minutes	4.7 GB
FY2G	99.5° East	Network Relay	ABOM	15-30 minutes	4.7 GB
COMS	128° East	Network Relay	KMA	9-24 minutes	11 GB
FY-4A (GIIRS only)	105° East	Terrestrial Eumetcast	Eumetsat	10-15 minutes	~5 – 13 GB

Polar Satellites received

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



- 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 2019

	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 Global network relay ~45 min	VIIRS>level-1	**ADDE**
				VIIRS,ATMS, CrIS	DB ftp (sips)
Metop-A/B/C	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 Global network relay ~45 min	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	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

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Data Distribution

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

Non-Satellite data

- NOAAport (500+GB/day)
  - Text/Point
  - Model Grids
  - Radar

Archive Data

As of May 2019, over 1,700 TBs online.

Grows approximately about ~350+ TB/year

US Geostationary Satellites

- GOES-8 through GOES-17 ***(1994-Present)*** (East, West , South America and test)
  - *G16 and G17 L1 ABI and L2 GLM in Netcdf*
  - *G16 and G17 CADUs (essential for SDS and CSPP-GEO debugging)*
- 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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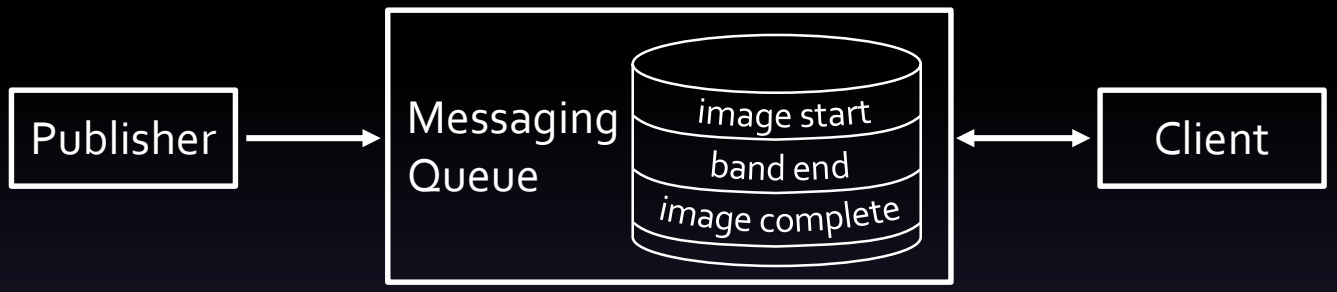
SDS related initiatives

- AMQP Events
- Satellite QC API
- GRB Fanout/Mixer
- Other projects

AMQP status



http://www.ssec.wisc.edu/datacenter/amqpfind

AMQP == Advanced Message Queuing Protocol

- **Provides end user notification of data events**
- **Python program amqpfind**
- **Allows end user better reliability, shorter latencies**
- **Will run both at SSEC and at remote Datacenter (eventually the cloud?)**
- **Will move to as many datasets as possible/practical**

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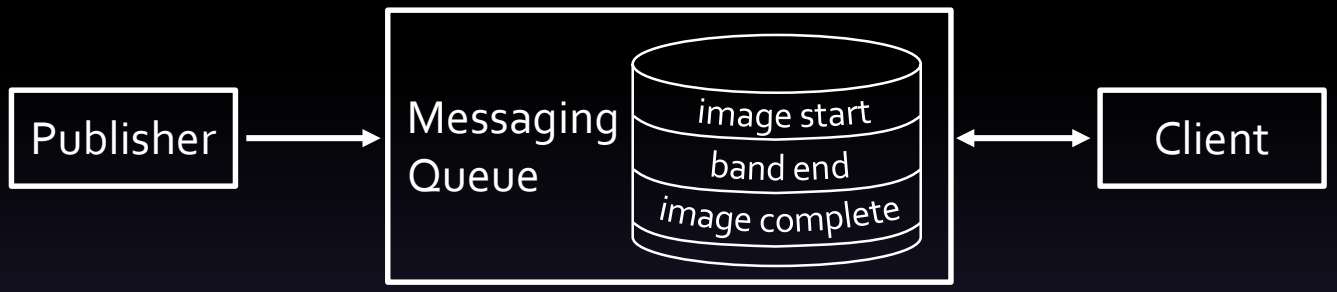
AMQP status



http://www.ssec.wisc.edu/datacenter/amqpfind

Satellites

- GOES-16/17
  - L1b - all instruments
  - GLM
  - L2 products
- Himawari (HDS)
- NOAA-20 (VIIRS only)
- SNPP (VIIRS only)

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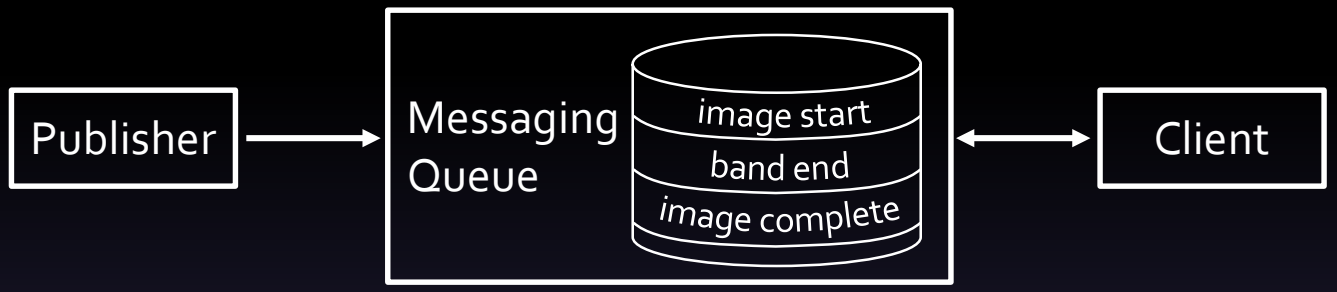
AMQP status



http://www.ssec.wisc.edu/datacenter/amqpfind

Python requirements

- Multi-server: Python 2.7 and greater
- Single Server: Python 2.6 and greater

Tested operating systems

- Redhat/CentOS 6 and 7
- OS X 10.0

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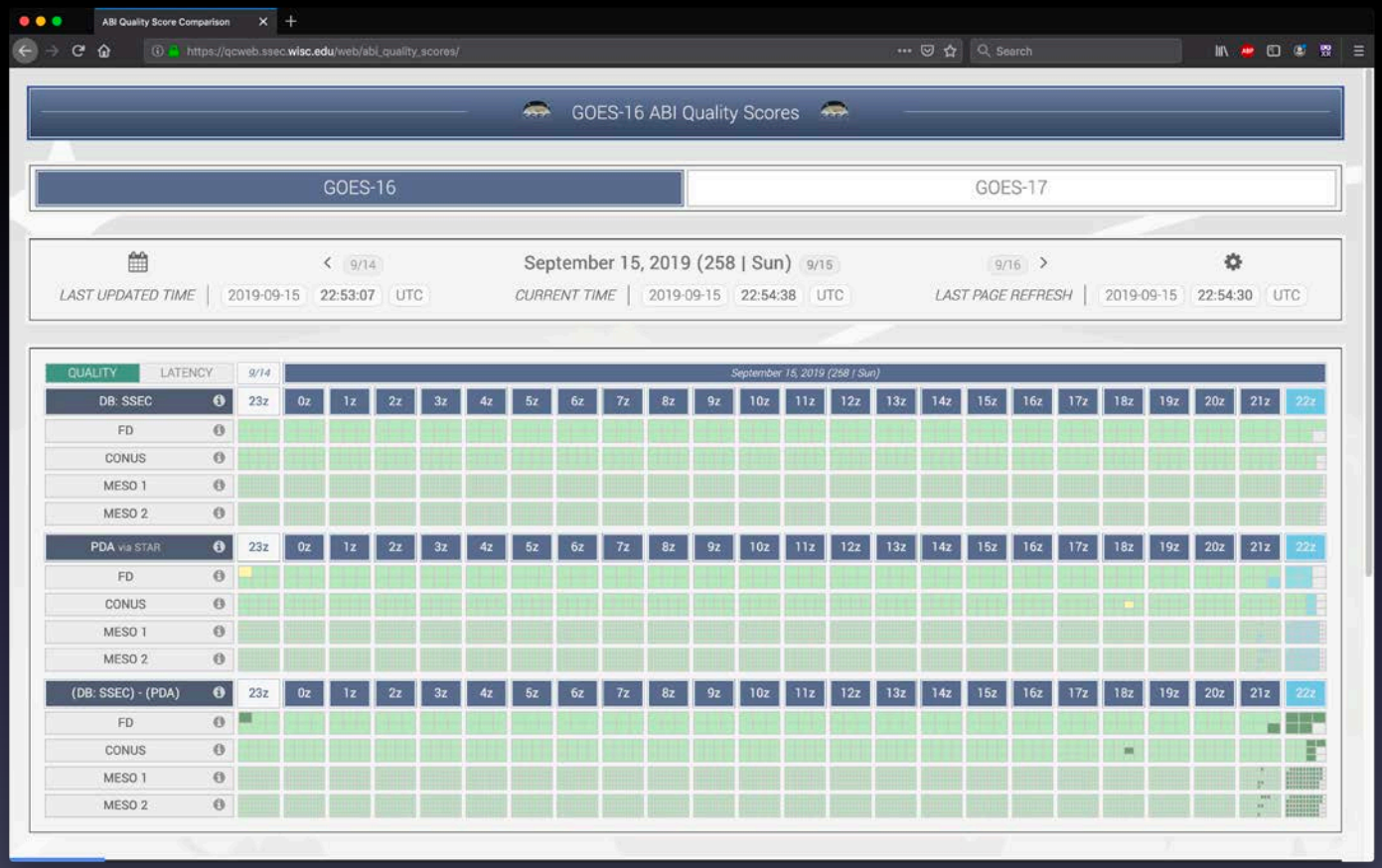
Satellite QC API



https://qcweb.ssec.wisc.edu/web/abi_quality_scores/

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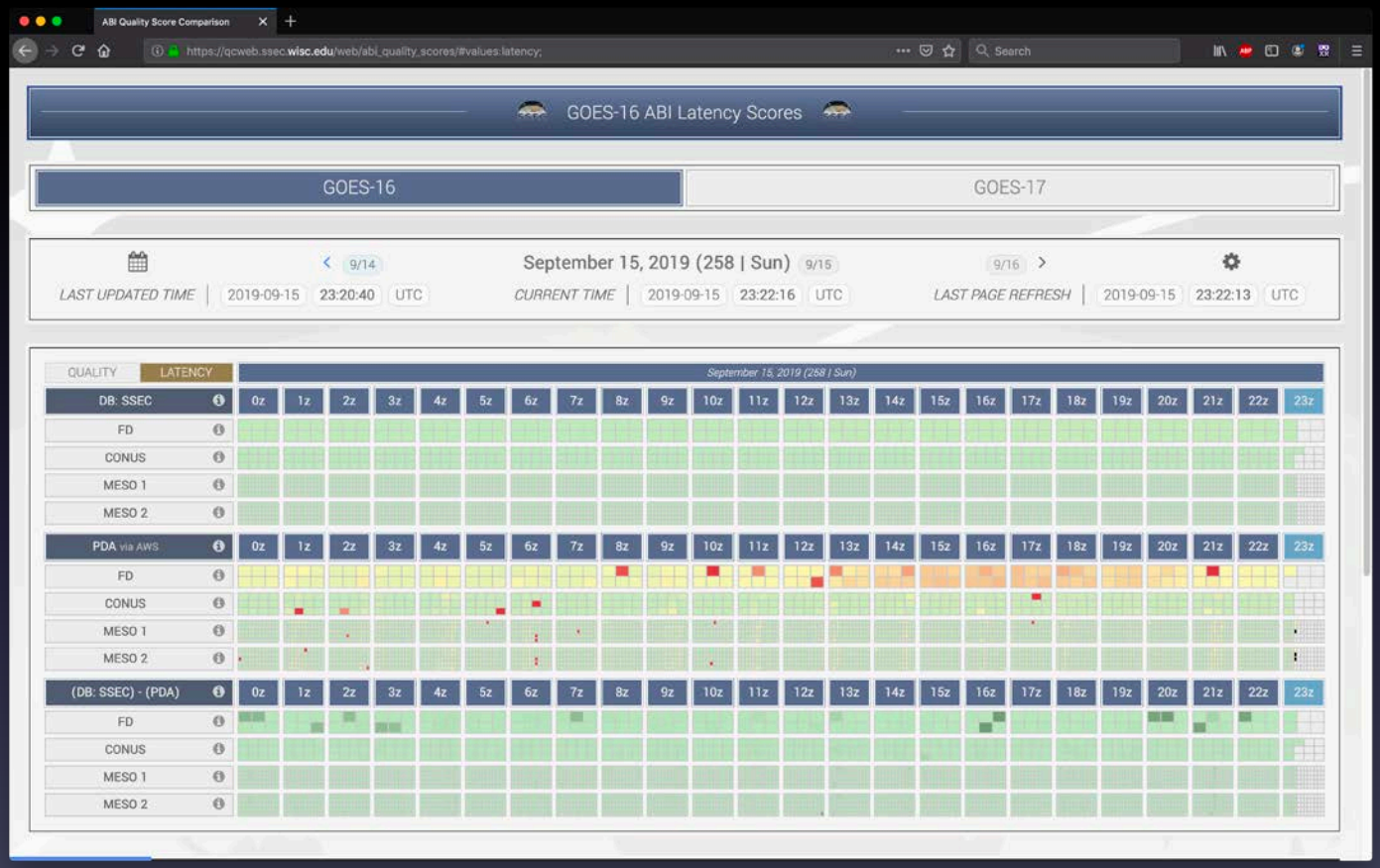
Satellite QC API



https://qcweb.ssec.wisc.edu/web/abi_quality_scores/#values:latency;

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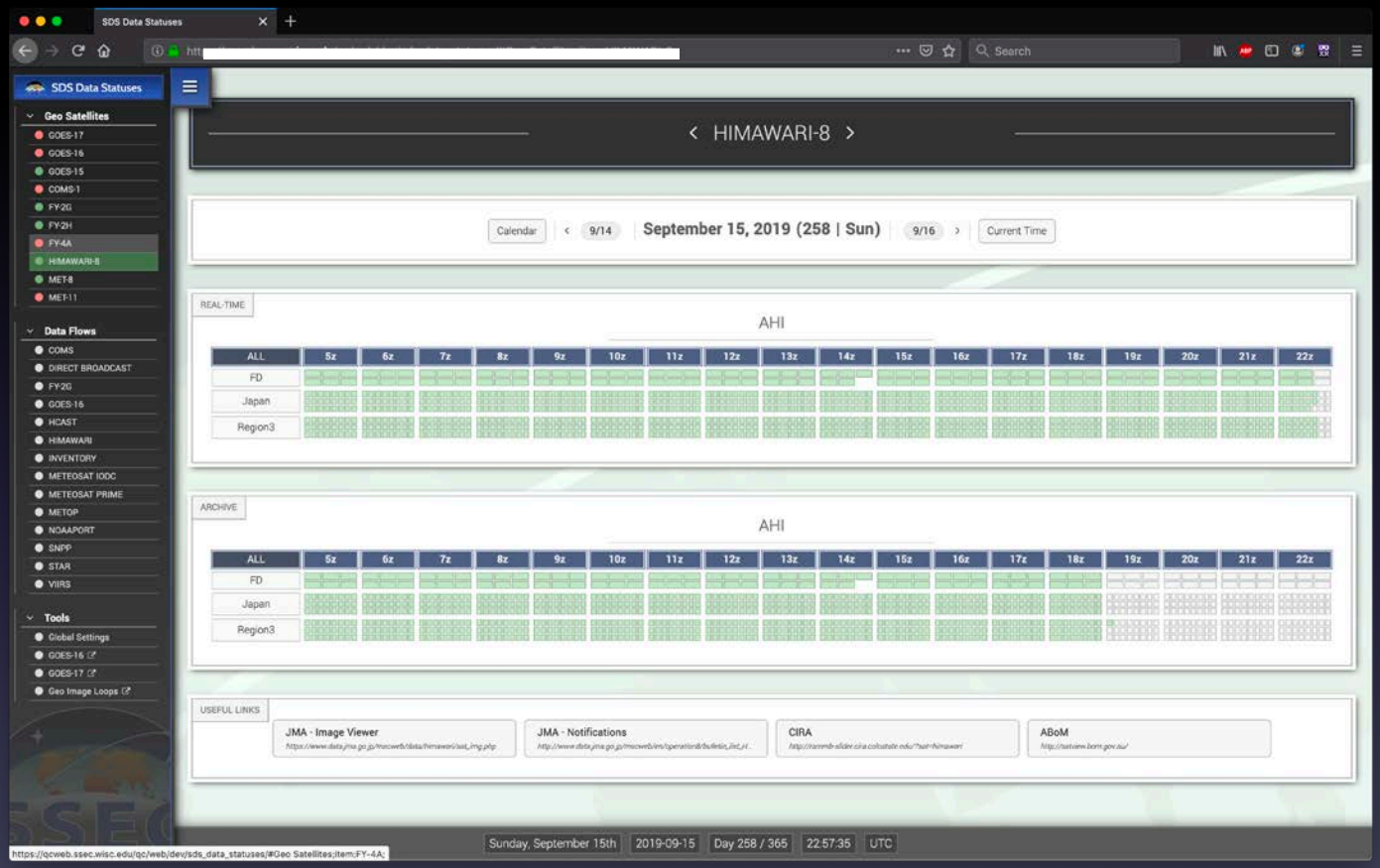
Satellite QC API



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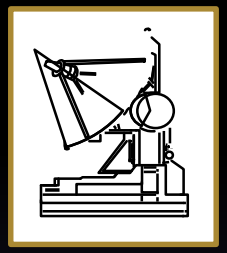
Satellite QC API

- Will migrate all GEOs to API first
- Integrated with inventory
- Will eventually add Non-GEOs
- Public accessible interface

Fanout/Mixer Server



- Fanout allows:
  - Transmission of GRB CADU/CCSDS packets via TCP/IP
  - Distribution of GRB via internet
  - Feed multiple ingestors without using multicast

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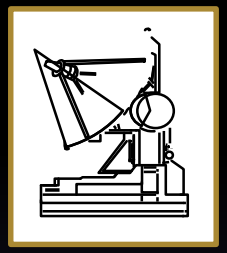
Fanout/Mixer Server



- Mixer allows:
  - Multiple antenna inputs
  - Mix feeds at the "CADU" level
  - Can allow selective data distribution
  - Great for RF interference mitigation
  - Automatic redundancy

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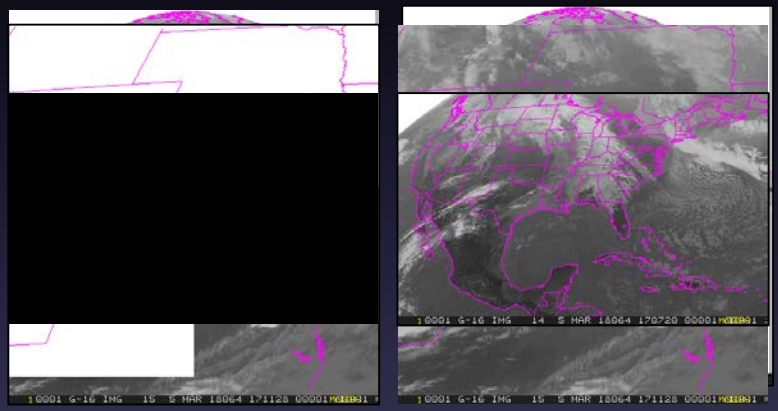
Solar RFI at PDA ground station March 5, 2018

- 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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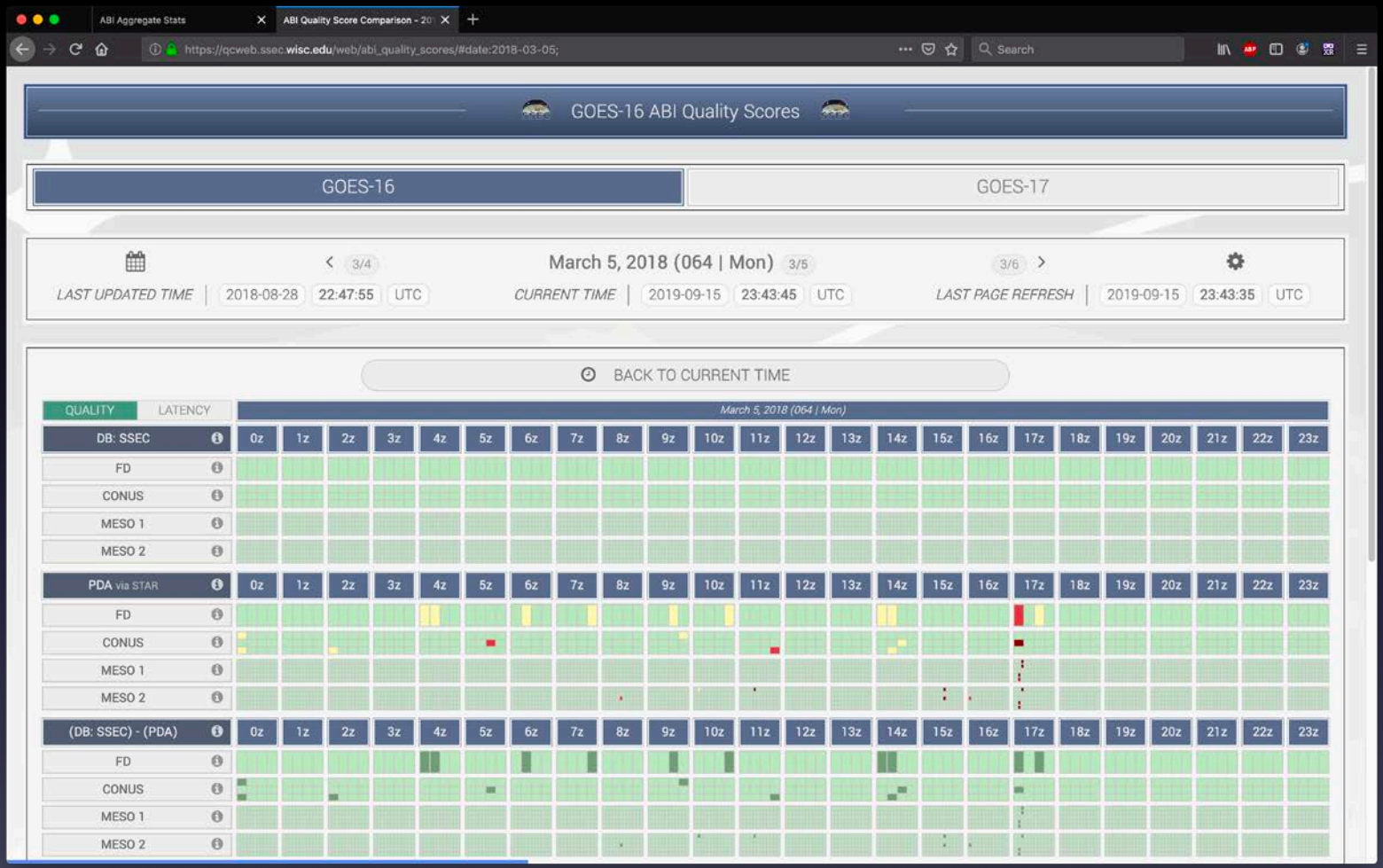
Fanout/Mixer Server



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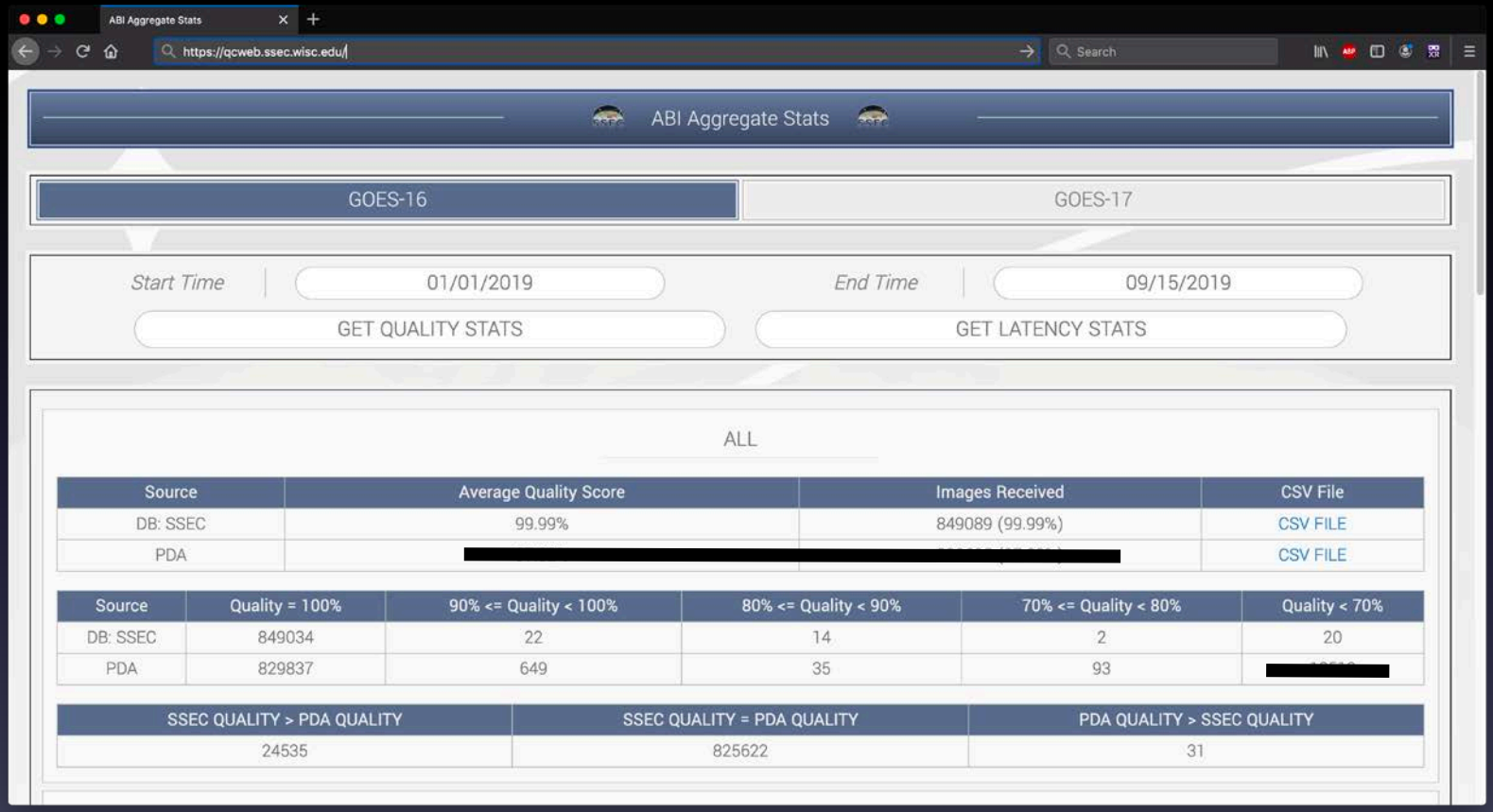
Fanout/Mixer Server



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Other projects

- GOES-17 detector cooling problem imagery mitigation (Fusion)
  - Mission-level netCDF are created experimentally
- FY-4A GIIRs checkout
- Outreach activities
  - Climate digest
  - Virtual Reality (VR) demos

Thanks!

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