



# University of Wisconsin SSEC Satellite Data Services Update

McIDAS Users Group Meeting

September 25-26, 2023



# SSEC SDS



## Current Staff



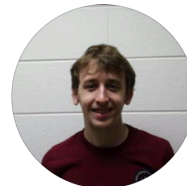
Jerrold Robaidek



Daniel Forrest



Richard Kohrs



Clayton Suplinski



Douglas Schumacher



Kaba Bah



Rob Lemke



Istvan Bocsi



Erik Olson

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



# Data Center Facilities

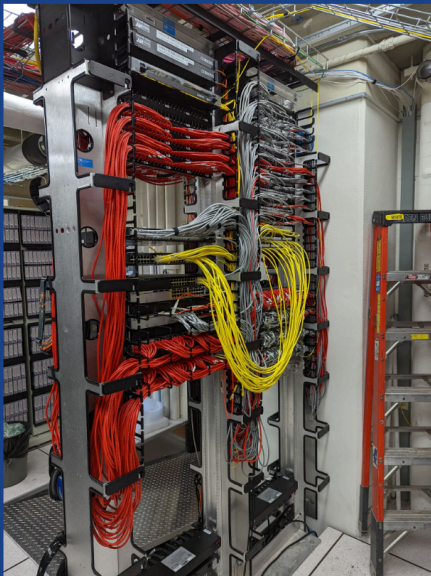
- 2100 sqft
- Backup power provides ~15 minutes uptime
- Campus Chilled water for cooling
- Greater than 20 PBs

Storage \* (storage numbers out of date)



# Data Center Facilities

Power, Cooling, and Network



1 & 10 GBit internal connections  
50 Gbit infiniband within HPCC



22 In-line coolers



5 - 72 KW UPS



# 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



## High Performance Compute Cluster (HPCC)

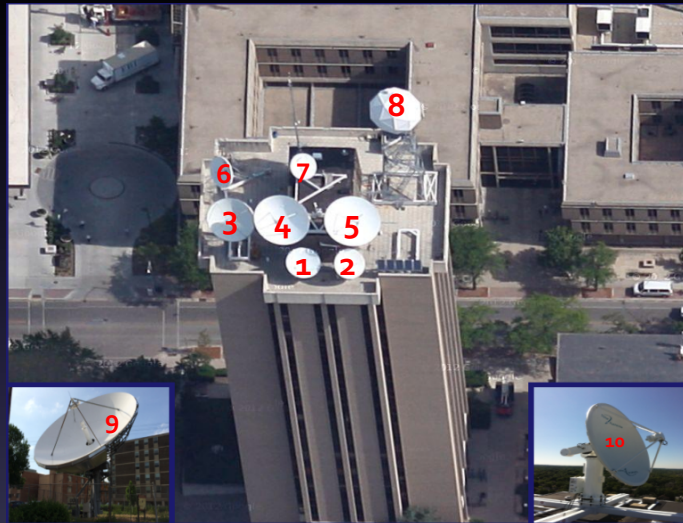
2018 Replaced original 2012 HPCC

- 2,560 cores
- 15.3 TB memory
- 4 PB of storage
- 54 Gbit FDR infiniband
- \$1.6 milion



# Antennas

## UW SSEC Antennas September 22, 2023



|    | Name                    | Type and Band  | Datasets  | Pointing location<br>Satellite  | Antenna<br>Diameter |
|----|-------------------------|--|---|---------------------------------|---------------------|
| 1  | Patriot 1               | DVB2 C-Band<br>4020MHz   | <a href="#">Noaaport</a><br><i>*note</i>          | Galaxy 31<br>121°W              | 4.5 m               |
| 2  | Patriot 2               | GRB/GVAR L-Band (dual feed)<br>GRB 1,686.6 MHz<br>GVAR 1685.7 MHz  | -GOES-West backup<br>-GOES-14 -GOES-T<br>checkout | Goes-W/Test<br>GOES-14<br>108°W | 4.5 m               |
| 3  | Patriot 3               | C-Band<br>EWS 4126.475MHz<br>Wallops 4117.065MHz 4120MHz<br>center | -EWS-G1<br>-Wallops Polar Relay                   | SES-2<br>87°W                   | 6.3 m               |
| 4  | West Harris             | GRB L-Band<br>GRB 1,686.6 MHz                                      | <a href="#">GOES-West</a>                         | GOES-West<br>137°W              | 7.3 m               |
| 5  | East Harris             | GRB L-Band<br>GRB 1,686.6 MHz                                      | <a href="#">GOES-East</a>                         | GOES-East75°W                   | 7.3 m               |
| 6  | Andrew                  | GVAR L-Band<br>GVAR 1685.7 MHz                                     | idle/backup                                       | 128°W                           | 4.6 m               |
| 7  | Little Andrew           | C-Band<br>4080 MHz   | <a href="#">Geonetcast</a>                        | 58°W                            | 3.7 m               |
| 8  | Modis                   | X-Band   | off-line  | tracking                        | 4.4 m               |
| 9  | Orchard St              | C-band<br>3960MHz<br>(center 3951.625MHz)                          | Gilmore Polar Relay                               | SES-1<br>101°W                  | 11 m                |
| 10 | Direct Broadcast<br>ERB | X/L Band<br>L-Band 1701.3 MHz                                      | LEO DB  | tracking                        | 2.4 m               |



# SSEC Antennas







# DB Antennas operated by CIMSS/SSEC



## SSEC antennas (5)

(Owned and operated by CIMSS/SSEC on behalf of NOAA)

(\*Locations part of the NWS PSAS project)

- Honolulu\*
- Madison
- Miami
- Mayaguez
- Guam\*



Madison, Wisconsin



Honolulu, Hawaii

All antennas are  
Orbital Systems  
X/L-band

## NOAA antennas (2)

(Owned and operated by UAF and NOAA NWS, respectively)

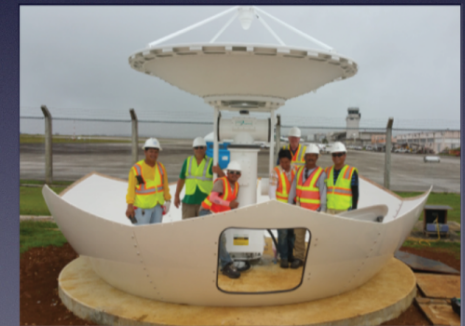
- Fairbanks\*
- Monterey



Miami, Florida



Mayaguez, Puerto Rico



Guam, Mariana Islands

## Partner antennas (15)

(Owned and operated by other groups)

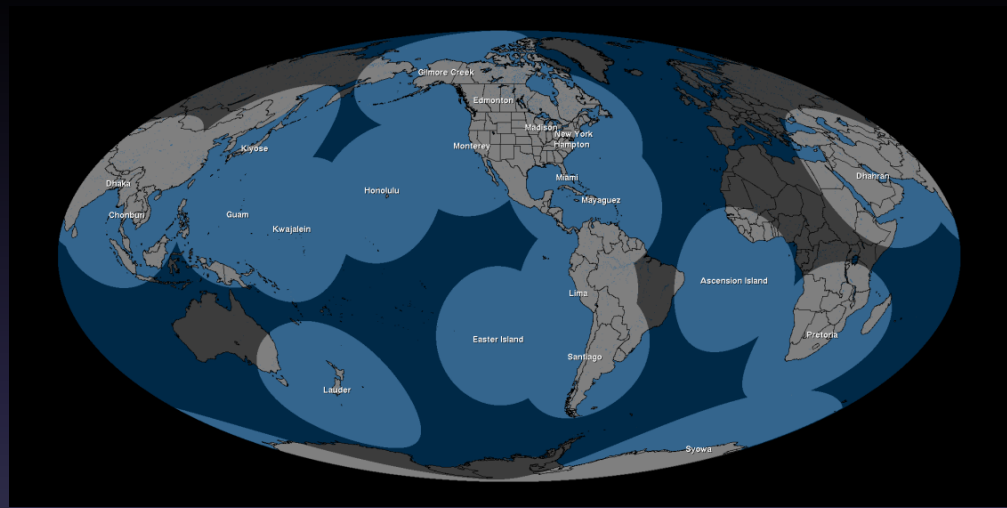
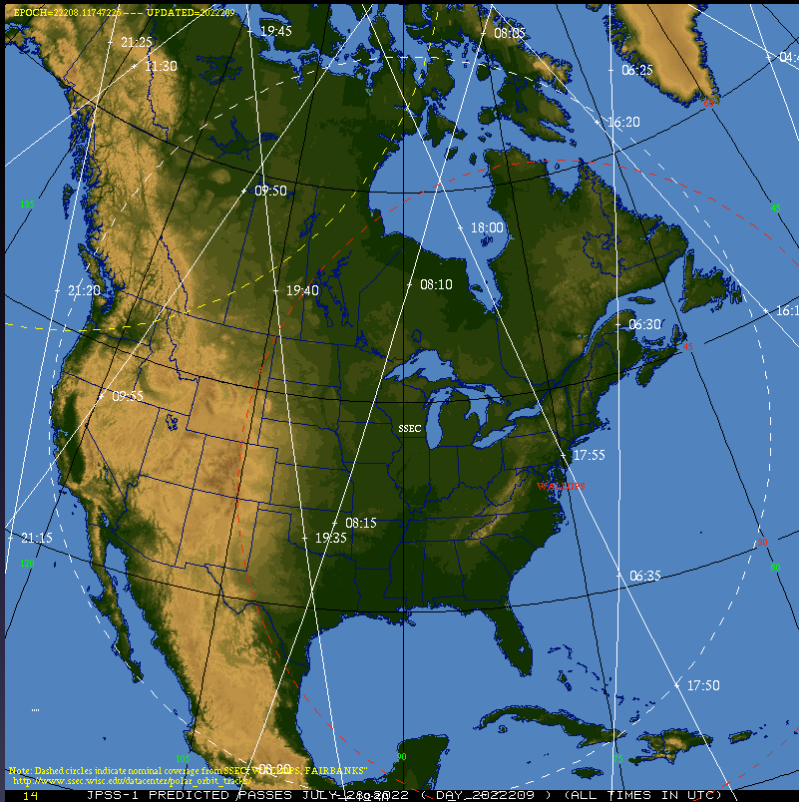
- JMA
- ECCC
- CLS/KINEIS
- CSIR
- GISTDA
- ATSC
- Hampton Univ.

Credit Liam Gumley

NOAA DBRTN DBNet



# Antenna Coverage of Direct Broadcast Antennas



# CIMSS & SSEC at the UW-Madison

## SSEC Data Center Incoming Data August, 2023

**1+ TB/day  
via Satellite**

(C-band, L-band, X-band)



**8+ TBs/day  
via Internet\***

(ftp, LDM, ADDE, http, rsync, AWS)

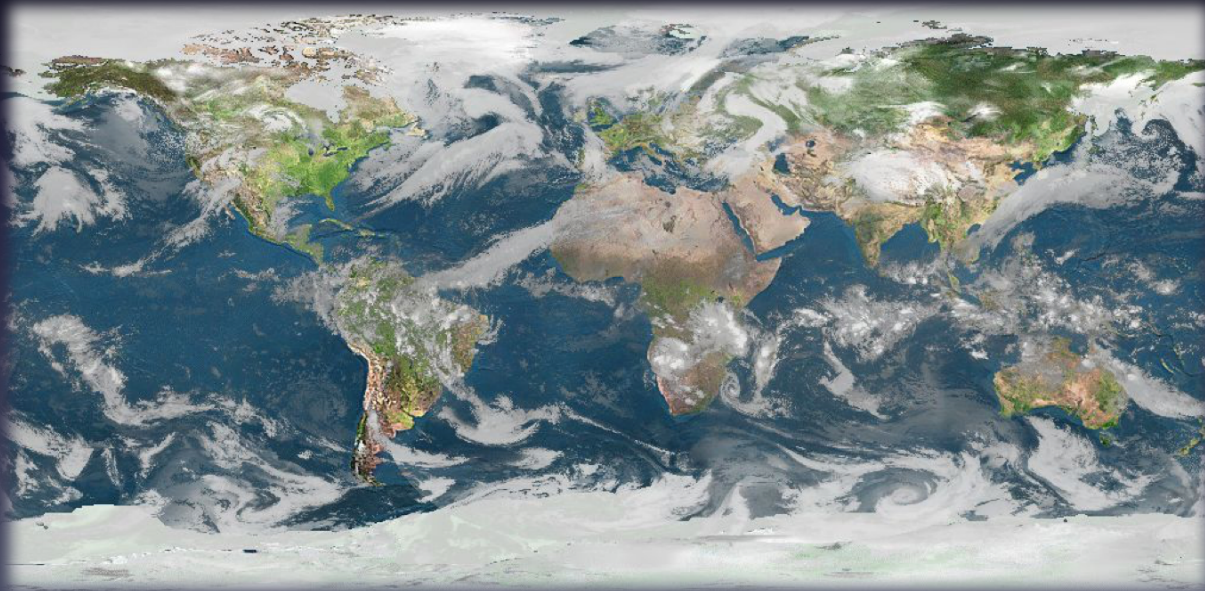
*CIMSS* = Cooperative Institute for Meteorological Satellite Studies

*SSEC* = Space Science & Engineering Center



# Real-time Data

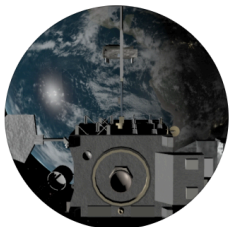
The SSEC Data Center receives data from 10+ different geostationary satellites and 13+ different polar orbiting satellites. Most data are available in near real-time via ADDE. Other methods of data access are available upon request.



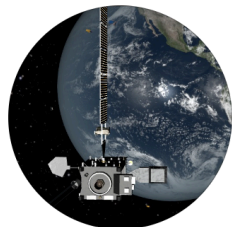


# Satellites Ingested

*12 geostationary satellites (varies from 8-12)*



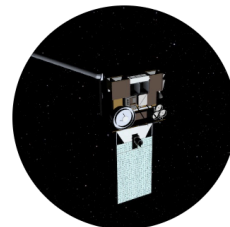
GOES-16



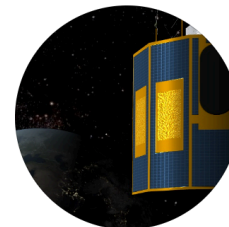
GOES-18



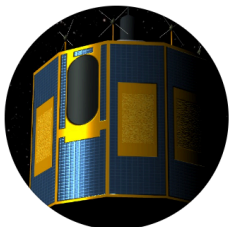
GOES-14



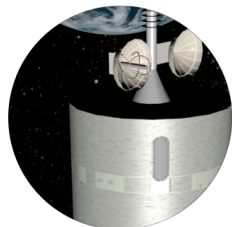
EWS-G1



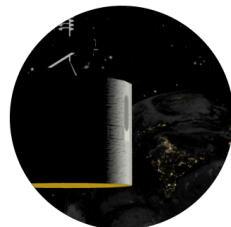
Meteosat-9



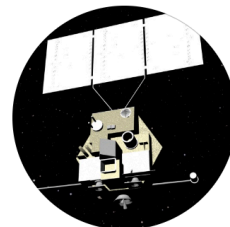
Meteosat-10



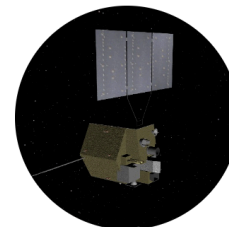
FY-2G



FY-2H



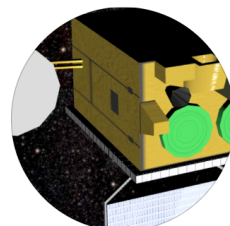
FY-4A



FY-4B



Himawari-9



GEO-KOMPSAT-2A



# Geostationary Satellites Received at UW SSEC in 2023



|   | Sub-Point                      | Reception Method               | Source   | Latency       | Daily Volume |
|---|--------------------------------|--------------------------------|--|---------------|--------------|
| GOES-16                                 | 75.2° West                     | L-Band                         | DB   | <10 seconds   | 130-400 GB   |
| GOES-14 (backup)                        | 104° West                      | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-13/EWS-G1                          | 61.5° East                     | C-Band & internet relay        | DB   | <2 minutes    | 23 GB        |
| GOES-15/EWS-G2                          | 103.3°E -Drifting to 61.5°East | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-17 (backup)                        | 104.7° West                    | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-18                                 | 137° West                      | L-Band                         | DB   | <10 seconds   | 130-400 GB   |
| Meteosat-10                             | 0° East                        | Network Relay                  | NOAA STAR<br><i>Terrestrial Eumetcast</i><br><i>Geonetcast</i> | ~30 minutes   | 24 GB        |
| Meteosat-9                              | 41.5° East                     | Network Relay                  | NOAA STAR  | ~30 minutes   | 24 GB        |
| Himawari-9                              | 140° East                      | Network Relay                  | NOAA STAR<br>AWS <small>(backup)</small>                       | ~ 10 minutes  | 300 GB       |
| Himawari-9                              | 140° East                      | Himawari Cast<br>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       |
| GK2A                                    | 128° East                      | Network Relay                  | KMA  | 9-24 minutes  | 11 GB        |
| FY-4A <small>(AGRI &amp; GIIRS)</small> | 105° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |
| FY-4B <small>(GIIRS only)</small>       | 133° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |

# Geostationary Satellites Received at UW SSEC in 2023



|                      | Sub-Point                      | Reception Method               | Source   | Latency       | Daily Volume |
|----------------------|--------------------------------|--------------------------------|--|---------------|--------------|
| GOES-16              | 75.2° West                     | L-Band                         | DB   | <10 seconds   | 130-400 GB   |
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| GOES-13/EWS-G1       | 61.5° East                     | C-Band & internet relay        | DB   | <2 minutes    | 23 GB        |
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| GOES-17 (backup)     | 104.7° West                    | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-18              | 137° West                      | L-Band                         | DB   | <10 seconds   | 130-400 GB   |
| Meteosat-10          | 0° East                        | Network Relay                  | NOAA STAR<br>Terrestrial Eumetcast<br>Geonetcast | ~30 minutes   | 24 GB        |
| Meteosat-9           | 41.5° East                     | Network Relay                  | NOAA STAR  | ~30 minutes   | 24 GB        |
| Himawari-9           | 140° East                      | Network Relay                  | NOAA STAR<br>AWS (backup)                        | ~ 10 minutes  | 300 GB       |
| Himawari-9           | 140° East                      | Himawari Cast<br>Network Relay | Hawaii NWS                                       | ~ 10 minutes  | 62 GB        |
| FY2H                 | 79° East                       | Network Relay                  | ABOM   | 15-30 minutes | 4.7 GB       |
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| FY-4A (AGRI & GIIRS) | 105° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |
| FY-4B (GIIRS only)   | 133° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |

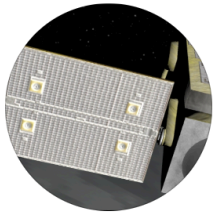
# Geostationary Satellites Received at UW SSEC in 2023



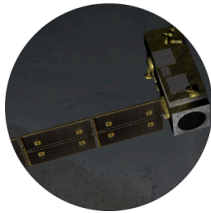
|   | Sub-Point                      | Reception Method               | Source   | Latency       | Daily Volume |
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| GOES-15/EWS-G2                          | 103.3°E -Drifting to 61.5°East | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-17 (backup)                        | 104.7° West                    | L-Band                         | DB   | <2 minutes    | 23 GB        |
| GOES-18                                 | 137° West                      | L-Band                         | DB   | <10 seconds   | 130-400 GB   |
| Meteosat-10                             | 0° East                        | Network Relay                  | NOAA STAR<br><i>Terrestrial Eumetcast</i><br><i>Geonetcast</i> | ~30 minutes   | 24 GB        |
| Meteosat-9                              | 41.5° East                     | Network Relay                  | NOAA STAR  | ~30 minutes   | 24 GB        |
| Himawari-9                              | 140° East                      | Network Relay                  | NOAA STAR<br>AWS <small>(backup)</small>                       | ~ 10 minutes  | 300 GB       |
| Himawari-9                              | 140° East                      | Himawari Cast<br>Network Relay | Hawaii NWS   | ~ 10 minutes  | 62 GB        |
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| FY-4A <small>(AGRI &amp; GIIRS)</small> | 105° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |
| FY-4B <small>(GIIRS only)</small>       | 133° East                      | Terrestrial Eumetcast          | Eumetsat   | 10-15 minutes | ~5 – 13 GB   |



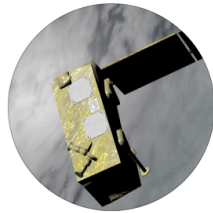
*18 polar satellites (varies from 11-18)*



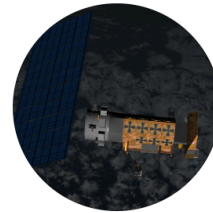
Suomi NPP



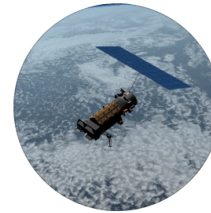
NOAA-21



NOAA-20



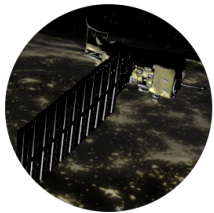
NOAA-19



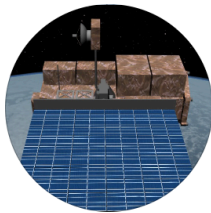
NOAA-18



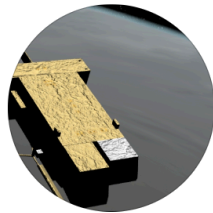
NOAA-15



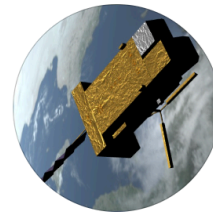
Aqua



Terra



MetOp-B



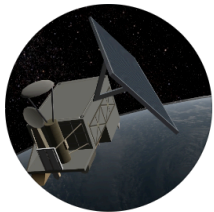
MetOp-C



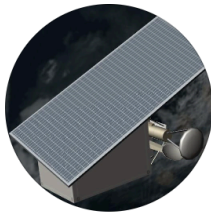
Sentinel-3A



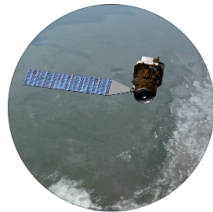
Sentinel-3B



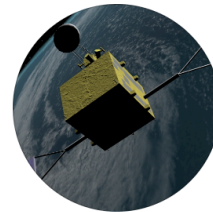
FY-3A



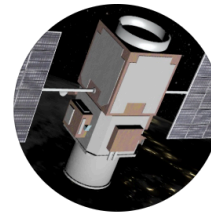
FY-3B



Landsat-8



GCOM-W1



Calipso



SARAL

# Polar Satellites Received at UW SSEC in 2023

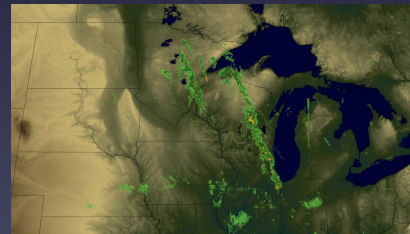
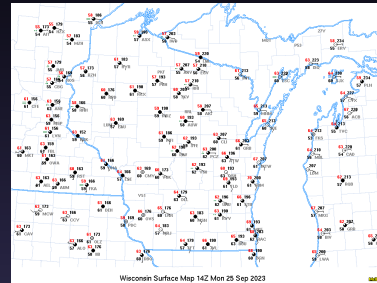
|  | Reception Method                   | Domain             | ADDE Latency   | Instruments                   | Access        |
|--|------------------------------------|--------------------|--|-------------------------------|---------------|
| NOAA-15  | C-Band relay, NOAA-STAR            | DB CONUS<br>Global | DB <1 minutes after pass                                     | AVHRR, AMSU, DCS->level-1     | <b>ADDE</b>   |
|  |                                    |                    |  | All other instruments Level-0 | NA            |
| NOAA-18  | DB L-Band, C-Band relay, NOAA STAR | DB CONUS<br>Global | DB <1 minutes after pass                                     | AVHRR->level-1                | <b>ADDE</b>   |
|  |                                    |                    |  | All other instruments Level-0 | NA            |
| NOAA-19  | DB L-Band, C-Band relay, NOAA STAR | DB CONUS<br>Global | DB <1 minutes after pass                                     | AVHRR->level-1                | <b>ADDE</b>   |
|  |                                    |                    |  | All other instruments Level-0 | NA            |
| NOAA-20  | DB XL-Band, NOAA STAR, CLASS       | DB CONUS<br>Global | DB <1 minutes after pass<br>Global network relay ~45 min     | VIIRS>level-1                 | <b>ADDE</b>   |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| Metop-B/C                                      | DB L-Band, NOAA STAR Relay         | DB CONUS<br>Global | CONUS <15 minutes after pass                                 | AVHRR ->level-1               | <b>ADDE</b>   |
|  |                                    |                    |  | AVHRR, IASI                   | DB ftp (sips) |
| Suomi-NPP                                      | DB X/L Band, NOAA STAR, CLASS      | DB CONUS<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | <b>ADDE</b>   |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| NOAA-20  | DB X/L Band, NOAA STAR, CLASS      | DB CONUS<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | <b>ADDE</b>   |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| NOAA-21  | DB X/L Band, NOAA STAR, CLASS      | DB CONUS<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | <b>ADDE</b>   |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| Aqua   | DB X-Band, NASA Relay              | DB CONUS<br>Global | DB <15 minutes after pass                                    | AIRS, MODIS -> Level-1        | <b>ADDE</b>   |
|  |                                    |                    |  | AIRS, MODIS                   | DB ftp (sips) |
| Terra  | DB X-Band, NASA Relay              | DB CONUS<br>Global | DB <15 minutes after pass                                    | MODIS -> Level-1              | <b>ADDE</b>   |
|  |                                    |                    |  | MODIS                         | DB ftp (sips) |
| Landsat-8                                      | Network Relay (USGS)               | CONUS              | <24 hours  | Level-1                       | WMS           |
| Shizuku<br>GCOM-W1, FY-<br>B/C, Calipso, Saral | DB X-Band                          | CONUS              | DB <1 min after pass   | Level-0                       | SSEC ftp      |

# Polar Satellites Received at UW SSEC in 2023

|  | Reception Method                   | Domain             | ADDE Latency   | Instruments                   | Access        |
|--|------------------------------------|--------------------|--|-------------------------------|---------------|
| NOAA-15  | C-Band relay, NOAA-STAR            | DB CONUS<br>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<br>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<br>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<br>Global | DB <1 minutes after pass<br>Global network relay ~45 min     | VIIRS>level-1                 | ADDE          |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| Metop-B/C                                      | DB L-Band, NOAA STAR Relay         | DB CONUS<br>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<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | ADDE          |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| NOAA-20  | DB X/L Band, NOAA STAR, CLASS      | DB CONUS<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | ADDE          |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| NOAA-21  | DB X/L Band, NOAA STAR, CLASS      | DB CONUS<br>Global | CONUS <15 minutes after pass<br>Global network relay ~45 min | VIIRS                         | ADDE          |
|  |                                    |                    |  | VIIRS,ATMS, CrIS              | DB ftp (sips) |
| Aqua   | DB X-Band, NASA Relay              | DB CONUS<br>Global | DB <15 minutes after pass                                    | AIRS, MODIS -> Level-1        | ADDE          |
|  |                                    |                    |  | AIRS, MODIS                   | DB ftp (sips) |
| Terra  | DB X-Band, NASA Relay              | DB CONUS<br>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<br>GCOM-W1, FY-<br>B/C, Calipso, Saral | DB X-Band                          | CONUS              | DB <1 min after pass   | Level-0                       | SSEC ftp      |

# Non-Satellite data

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



# Future ADDE real-time datasets

- GOES-U
- MTG
- GK<sub>2</sub>A (ADDE)
- FY-4A/B AGRI (ADDE)



# Data Distribution

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



# Archive



# Early SSEC Satellite Archive History (Before 1978)



7.3 Meter Antennas for  
SMS-1 and SMS-2  
1974



9 - Track tapes  
Before 1978





# National Archive 1979 - 2004



Routine Archiving Begins  
1978  
(FGGE)



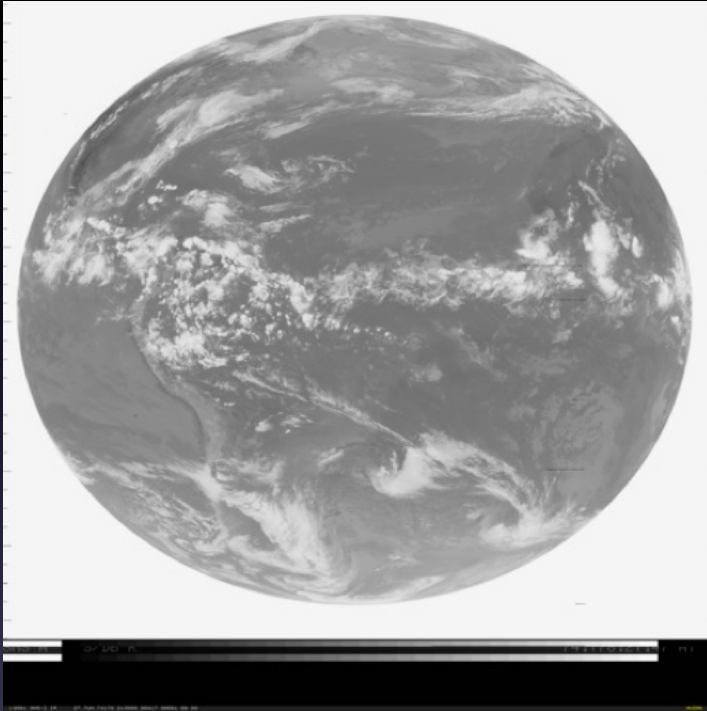
Umatic Tapes  
(3 tapes/day per/satellite)  
1978-1996



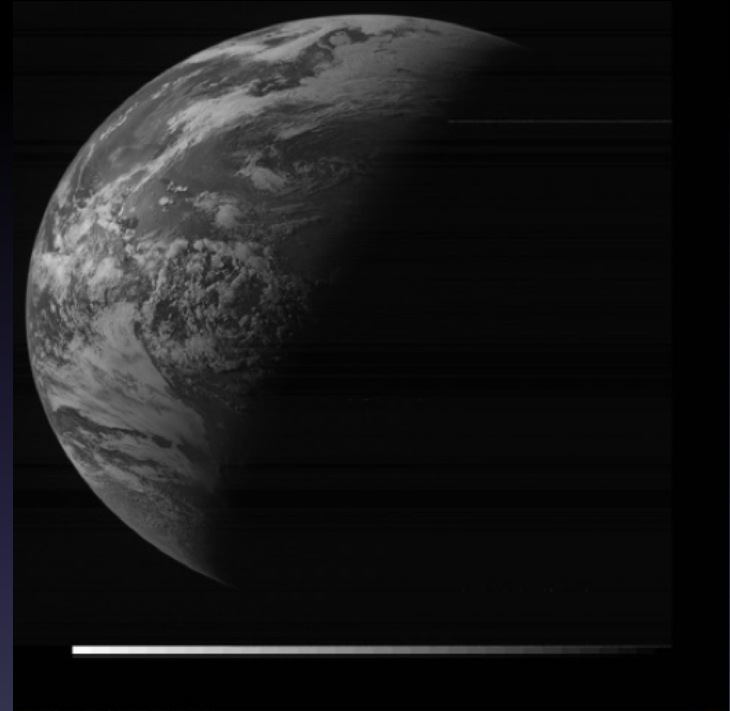
3590 Tapes  
(1 tape/day per/satellite)  
1996 - 2004



# First SMS/GOES Images in the Archive



Infrared



Visible

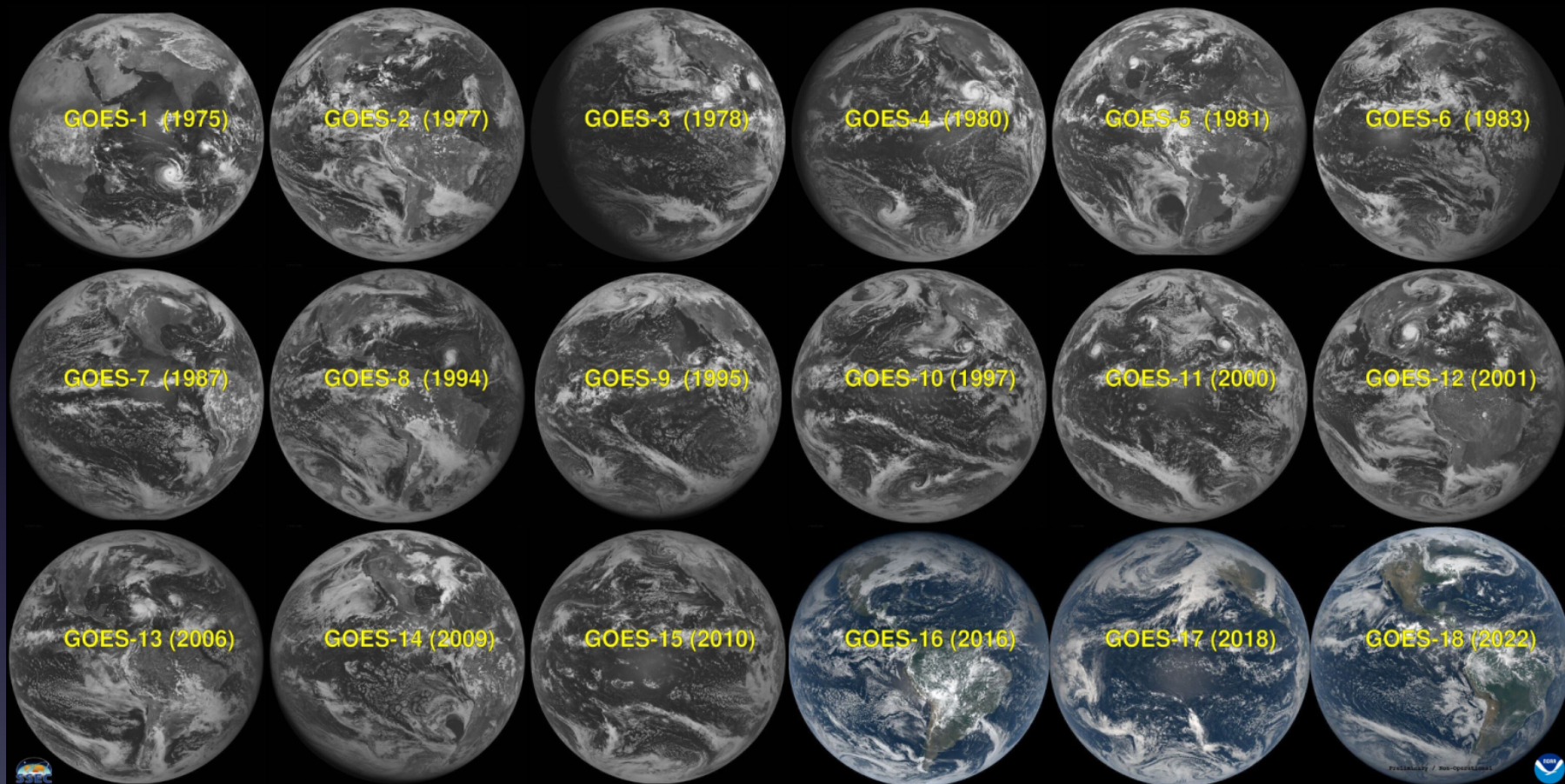
SMS-1

1974 - June 27

21:30 UTC



# GOES-1 through GOES-18



Credit Tim Schmit



# Online Archive

Currently over 3 PB in size!

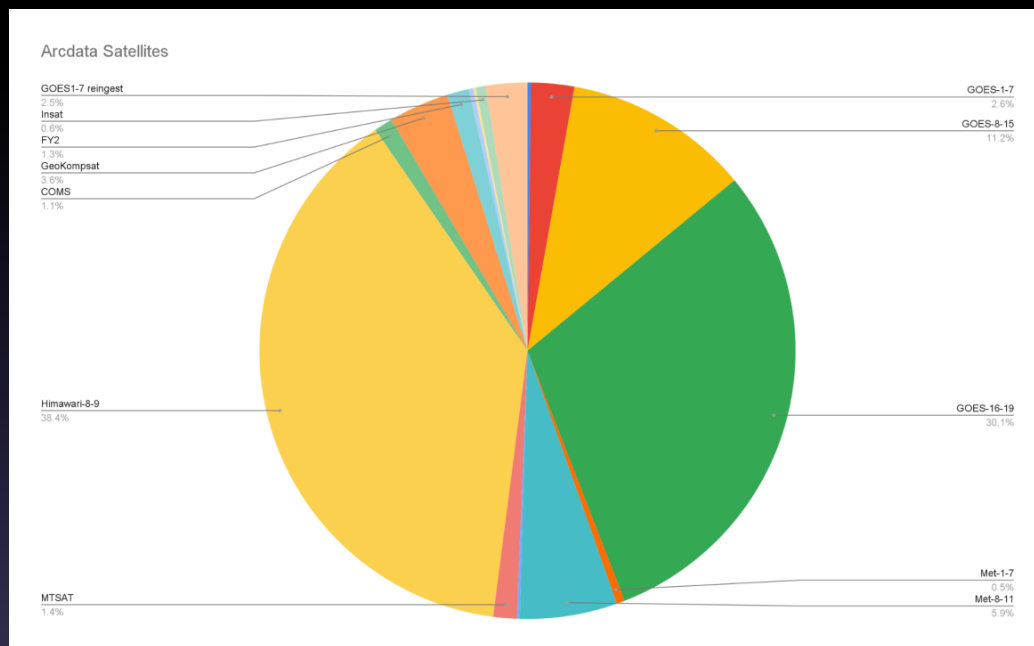


Online Archive Begins in 2005

(Funded by commercial data user)



Data backed up to LTO 5 (being moved to LTO-8)



Routine International  
Satellite Archive  
Begins in 1998



# Archive Data

As of Summer 2023, over 3 PBs online.

Grows approximately about ~350+ TB/year

## US Geostationary Satellites

- GOES-8 through GOES-18 (1994-Present) (East, West , South America and test)
  - G16 and G18 L1 ABI and L2 GLM in Netcdf
  - G16 and G18 CADUs (essential for SDS and CSPP-GEO debugging)
- GOES-1 through GOES-7 (1978-1996)
- SMS-1&2 (1974, 1978-1981)



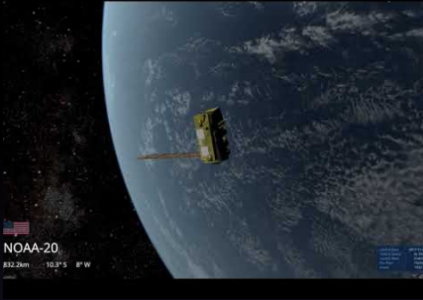
# Archive Data

## 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 – 2022) (not archiving GK2A)
- Himawari-8/9 (March 2015 – Present)



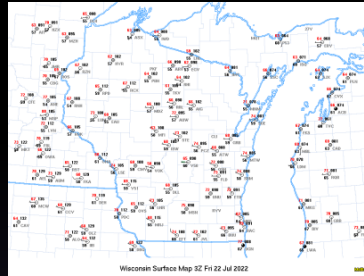
## Other Archives



### LEO Archive

1978 - Present

- NOAA-5 through NOAA-19
- METOP-A/B/C
- AVHRR
- HIRS



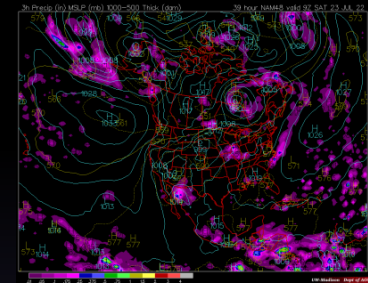
### Insitu data Archive

1976 - Present



### ATS-1 and 3

1966 - 1974



### Model Output Grids Archive

1996 - Present

66,000 images scanned  
to be available  
online in 2023



# SDS related initiatives

- AMQP Events
- Satellite QC API
- GRB Fanout/Mixer
- Local Noon
- ATS recovery
- SUVI
- AMRDC/WxSaTS development





# AMQP

← → C qcweb.ssec.wisc.edu/web/amqp\_monitor/#exchange:Satellite;

SDS AMQP Monitor Satellite

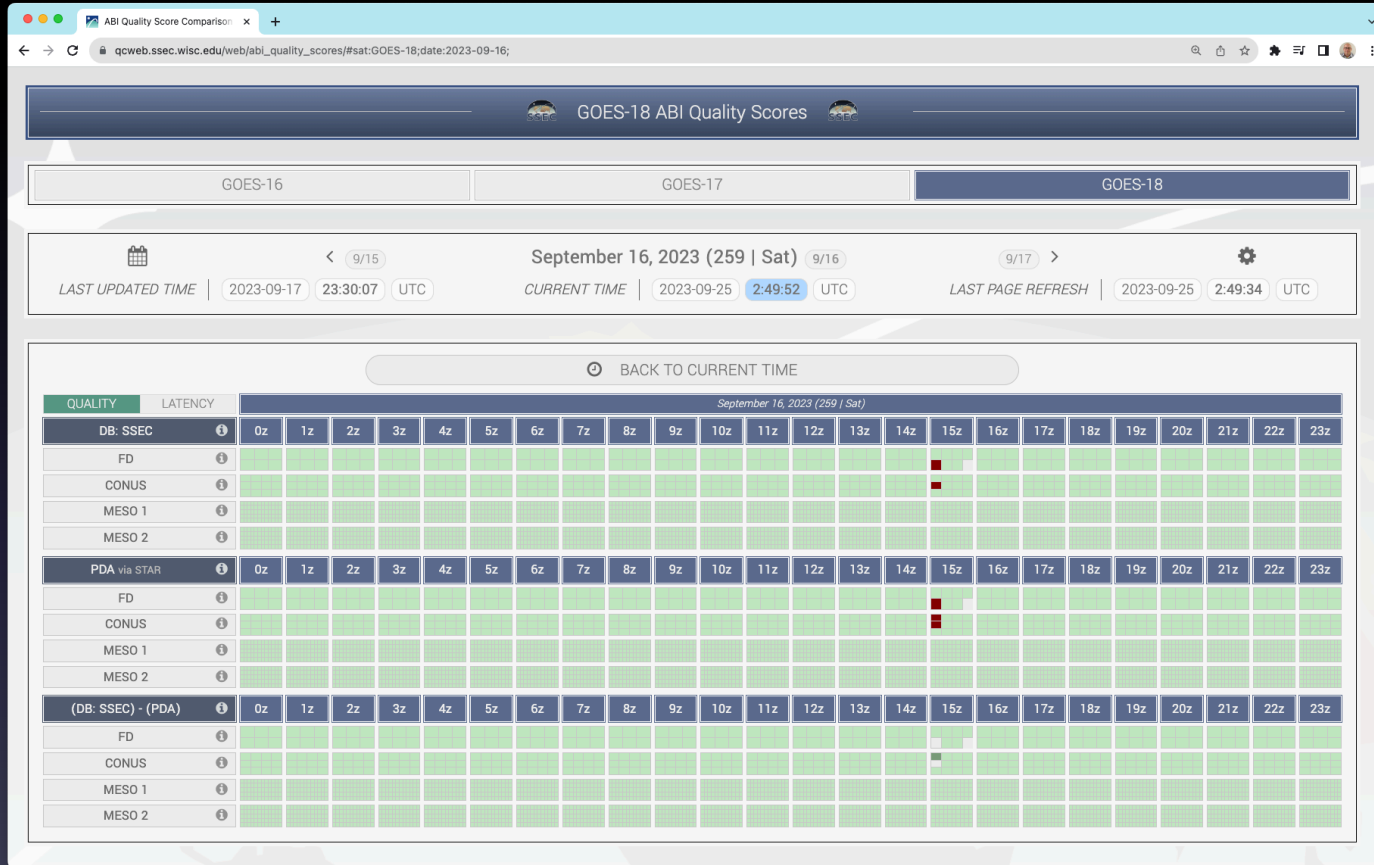
amqpfind -X satellite -C \*.\*.\*.\*.\*.\*.\*.\*.\*.\*

Settings Clear Filters

| Type | Family | ID   | Instrument | Medium   | Server Type                                  | Format   | Class                   | Status  | Host   | Topic  | Timestamp               | Age               | Past 3 Hours      |
|------|--------|------|------------|----------|--|--|-------------------------|---|--|--|-------------------------|-------------------|-------------------|
| ALL  | ALL    | ALL  | ALL        | ALL      | ALL  | ALL  | ALL                     | ALL   | ALL  | *.*.*.*.*.*.*.*.*.*                                  |                         |                   |                   |
| geo  | coms   | gA2a | ami        | file     | realtime                                     | hdf  | band                    | end   | mq1  | geo.coms.gA2a.ami.file.realtime.hdf.band.end         | 2023-09-25 01:05:34 UTC | 1h                | 1088 21 0         |
|      |        |      |            |          |  |  | image                   | complete  | mq1  | geo.coms.gA2a.ami.file.realtime.ncdf.image.complete  | 2023-09-25 00:59:58 UTC | 1h                | 69 0 0            |
|      | ews    | g1   | imager     | addc     | realtime                                     | gvar   | image                   | complete  | mq1  | geo.ews.g1.imager.addc.realtime.gvar.image.complete  | 2023-09-25 02:25:45 UTC | 21m               | 3 2 1             |
|      |        |      |            |          |  |  | start                   |   | mq1  | geo.ews.g1.imager.addc.realtime.gvar.image.start     | 2023-09-25 02:20:07 UTC | 27m               | 2 2 1             |
|      | fy     | 4a   | giirs      | file     | realtime                                     | hdf  | sector                  | complete  | mq1  | geo.fy.4a.giirs.file.realtime.hdf.sector.complete    | 2023-09-25 02:45:17 UTC | 1m                | 269 209 166       |
|      |        | 4b   | giirs      | file     | realtime                                     | hdf  | sector                  | complete  | mq1  | geo.fy.4b.giirs.file.realtime.hdf.sector.complete    | 2023-09-25 02:46:49 UTC | 21s               | 160 157 153       |
|      | goes   | g16  | abi        | addc     | realtime                                     | area   | product                 | complete  | mq1  | geo.goes.g16.abi.addc.realtime.area.product.complete | 2023-09-25 02:46:48 UTC | 22s               | 138 138 108       |
|      |        |      |            |          |  | ncdf   | band                    | complete  | mq1  | geo.goes.g16.abi.addc.realtime.ncdf.band.complete    | 2023-09-22 17:02:10 UTC | 2d                | 0 0 0             |
|      |        |      |            |          |  |  | end                     |   | mq1  | geo.goes.g16.abi.addc.realtime.ncdf.band.end         | 2023-09-25 02:46:52 UTC | 18s               | 11351 12326 10125 |
|      |        |      |            |          |  | image  | complete                | mq1   | geo.goes.g16.abi.addc.realtime.ncdf.image.complete   | 2023-09-25 02:46:52 UTC                              | 18s                     | 362 364 284       |                   |
|      |        |      |            |          |  | product  | complete                | mq1   | geo.goes.g16.abi.addc.realtime.ncdf.product.complete | 2023-09-25 02:46:59 UTC                              | 31s                     | 18634 18916 14717 |                   |
|      |        |      |            | file     | archive                                      | ncdf   | band                    | end   | mq1  | geo.goes.g16.abi.file.archive.ncdf.band.end          | 2023-09-25 02:46:42 UTC | 28s               | 2173 2274 1539    |
|      |        |      |            |          |  | image  | complete                | mq1   | geo.goes.g16.abi.file.archive.ncdf.image.complete    | 2023-09-25 02:45:51 UTC                              | 1m                      | 137 143 96        |                   |
|      |        |      |            | realtime | ncdf   | band   | end                     |   | mq1  | geo.goes.g16.abi.file.realtime.ncdf.band.end         | 2023-09-25 02:46:10 UTC | 1m                | 2521 2989 2567    |
|      |        |      |            |          |  | product  | complete                | mq1   | geo.goes.g16.abi.file.realtime.ncdf.product.complete | 2023-09-25 02:46:59 UTC                              | 31s                     | 4587 4628 3696    |                   |
|      | exis   | addc | realtime   | ncdf     | profile                                      | complete   | mq1                     | geo.goes.g16.exis.addc.realtime.ncdf.profile.complete   | 2023-09-25 02:46:22 UTC                              |  |                         | 180               | 372               |
|      |        | file | realtime   | ncdf     | profile                                      | complete   | mq1                     | geo.goes.g16.exis.file.realtime.ncdf.profile.complete   | 2023-09-25 02:46:21 UTC                              |  |                         | 140               | 186               |
|      | glm    | addc | realtime   | ncdf     | point  | complete   | mq1                     | geo.goes.g16.glm.addc.realtime.ncdf.point.complete      | 2023-09-25 02:46:52 UTC                              |  |                         | Good              | < 30m             |
|      |        | file | archive    | ncdf     | point  | complete   | mq1                     | geo.goes.g16.glm.file.archive.ncdf.point.complete       | 2023-09-25 02:34:59 UTC                              |  |                         | Bad               | ≥ 30m             |
|      | mag    | addc | realtime   | ncdf     | point  | end  | mq1                     | geo.goes.g16.mag.addc.realtime.ncdf.point.end           | 2023-09-25 02:46:52 UTC                              |  |                         | 90                | 122               |
|      |        | file | realtime   | ncdf     | point  | end  | mq1                     | geo.goes.g16.mag.file.realtime.ncdf.point.end           | 2023-09-25 02:46:52 UTC                              |  |                         | 30                | 94                |
|      | seis   | addc | realtime   | ncdf     | point  | complete   | mq1                     | geo.goes.g16.seis.addc.realtime.ncdf.point.complete     | 2023-09-25 02:46:22 UTC                              |  |                         | 48s               | 60 60 47          |
|      |        | file | realtime   | ncdf     | point  | complete   | mq1                     | geo.goes.g16.seis.file.realtime.ncdf.point.complete     | 2023-09-25 02:46:22 UTC                              |  |                         | 48s               | 624 624 486       |
|      | suvi   | addc | realtime   | ncdf     | image  | complete   | mq1                     | geo.goes.g16.suvi.addc.realtime.ncdf.image.complete     | 2023-09-25 01:42:22 UTC                              |  |                         | 48s               | 312 312 243       |
|      |        | file | realtime   | area     | product                                      | end  | mq1                     | geo.goes.g16.suvi.file.realtime.area.product.end        | 2023-09-25 01:42:22 UTC                              |  |                         | 1h                | 1328 628 0        |
|      |        | png  | product    | end      | mq1  | geo.goes.g16.suvi.addc.realtime.png.product.end      | 2023-09-26 01:42:21 UTC | 1h  | 720 504 0  |  |                         |                   |                   |
|      |        | area | product    | end      | mq1  | geo.goes.g16.suvi.file.realtime.area.product.end     | 2023-09-26 01:42:22 UTC | 1h  | 664 464 0  |  |                         |                   |                   |
|      |        | ncdf | image      | complete | mq1  | geo.goes.g16.suvi.file.realtime.ncdf.image.complete  | 2023-09-25 01:42:16 UTC | 1h  | 360 252 0  |  |                         |                   |                   |
|      |        | png  | product    | end      | mq1  | geo.goes.g16.suvi.file.realtime.png.product.end      | 2023-09-26 01:42:21 UTC | 1h  | 360 252 0  |  |                         |                   |                   |
|      |        | area | product    | complete | mq1  | geo.goes.g18.abi.addc.realtime.area.product.complete | 2023-09-25 02:46:51 UTC | 19s   | 138 138 108  |  |                         |                   |                   |
|      |        | ncdf | band       | end      | mq1  | geo.goes.g18.abi.addc.realtime.ncdf.band.end         | 2023-09-25 02:25:07 UTC | 22m   | 8886 5301 3057                                       |  |                         |                   |                   |
|      |        |      | band       | complete | mq1  | geo.goes.g18.abi.addc.realtime.ncdf.band.complete    | 2023-09-22 14:06:42 UTC | 2d  | 0 0 0  |  |                         |                   |                   |
|      |        |      | end        | mq1      | geo.goes.g18.abi.addc.realtime.ncdf.band.end | 2023-09-25 02:46:53 UTC                              | 17s                     | 11311 13074 8936  |  |  |                         |                   |                   |
|      |        |      | image      | complete | mq1  | geo.goes.g18.abi.addc.realtime.ncdf.image.complete   | 2023-09-25 02:46:52 UTC | 18s   | 340 361 266  |  |                         |                   |                   |
|      |        |      | product    | complete | mq1  | geo.goes.g18.abi.addc.realtime.ncdf.product.complete | 2023-09-25 02:46:45 UTC | 25s   | 28271 21478 14653                                    |  |                         |                   |                   |
|      |        |      | band       | end      | mq1  | geo.goes.g18.abi.file.archive.ncdf.band.end          | 2023-09-25 02:46:51 UTC | 19s   | 4355 4528 3244                                       |  |                         |                   |                   |
|      |        |      | image      | complete | mq1  | geo.goes.g18.abi.file.archive.ncdf.image.complete    | 2023-09-25 02:46:29 UTC | 41s   | 273 285 200  |  |                         |                   |                   |
|      |        |      | realtime   | ncdf     | band   | end  | mq1                     | geo.goes.g18.abi.file.realtime.ncdf.band.end            | 2023-09-25 02:25:07 UTC                              |  |                         | 22m               | 1 1 1             |
|      |        |      | band       | end      | mq1  | geo.goes.g18.abi.file.realtime.ncdf.band.end         | 2023-09-25 02:46:53 UTC | 17s   | 2540 3368 2041                                       |  |                         |                   |                   |
|      |        |      | product    | complete | mq1  | geo.goes.g18.abi.file.realtime.ncdf.product.complete | 2023-09-25 02:46:44 UTC | 26s   | 4707 4686 3695                                       |  |                         |                   |                   |
|      | exis   | addc | realtime   | ncdf     | profile                                      | complete   | mq1                     | geo.goes.g18.exis.addc.realtime.ncdf.profile.complete   | 2023-09-25 02:46:21 UTC                              |  |                         | 49s               | 480 480 372       |
|      |        | file | realtime   | ncdf     | profile                                      | complete   | mq1                     | geo.goes.g18.exis.file.realtime.ncdf.profile.complete   | 2023-09-25 02:46:21 UTC                              |  |                         | 49s               | 240 240 186       |
|      | glm    | addc | realtime   | ncdf     | point  | complete   | mq1                     | geo.goes.g18.glm.addc.realtime.ncdf.point.complete      | 2023-09-25 02:46:52 UTC                              |  |                         | 18s               | 581 592 454       |
|      |        | file | archive    | ncdf     | point  | complete   | mq1                     | geo.goes.g18.glm.file.archive.ncdf.point.complete       | 2023-09-25 02:46:50 UTC                              |  |                         | 20s               | 377 397 286       |
|      | mag    | addc | realtime   | ncdf     | point  | end  | mq1                     | geo.goes.g18.mag.addc.realtime.ncdf.point.end           | 2023-09-25 02:46:21 UTC                              |  |                         | 49s               | 120 120 94        |
|      |        | file | realtime   | ncdf     | point  | end  | mq1                     | geo.goes.g18.mag.file.realtime.ncdf.point.end           | 2023-09-25 02:46:21 UTC                              |  |                         | 49s               | 60 60 47          |
|      | misc   | addc | realtime   | ncdf     | ephemeris                                    | received   | mq1                     | geo.goes.g18.misc.addc.realtime.ncdf.ephemeris.received | 2023-09-25 02:20:26 UTC                              |  |                         | 26m               | 2 2 2             |
|      |        | file | realtime   | ncdf     | ephemeris                                    | received   | mq1                     | geo.goes.g18.misc.file.realtime.ncdf.ephemeris.received | 2023-09-25 02:20:26 UTC                              |  |                         | 26m               | 4 3 2             |
|      | seis   | addc | realtime   | ncdf     | point  | complete   | mq1                     | geo.goes.g18.seis.addc.realtime.ncdf.point.complete     | 2023-09-25 02:46:22 UTC                              |  |                         | 48s               | 624 624 486       |

Monday, September 25th 2023-09-25 Day 267 / 365 2:47:34 UTC

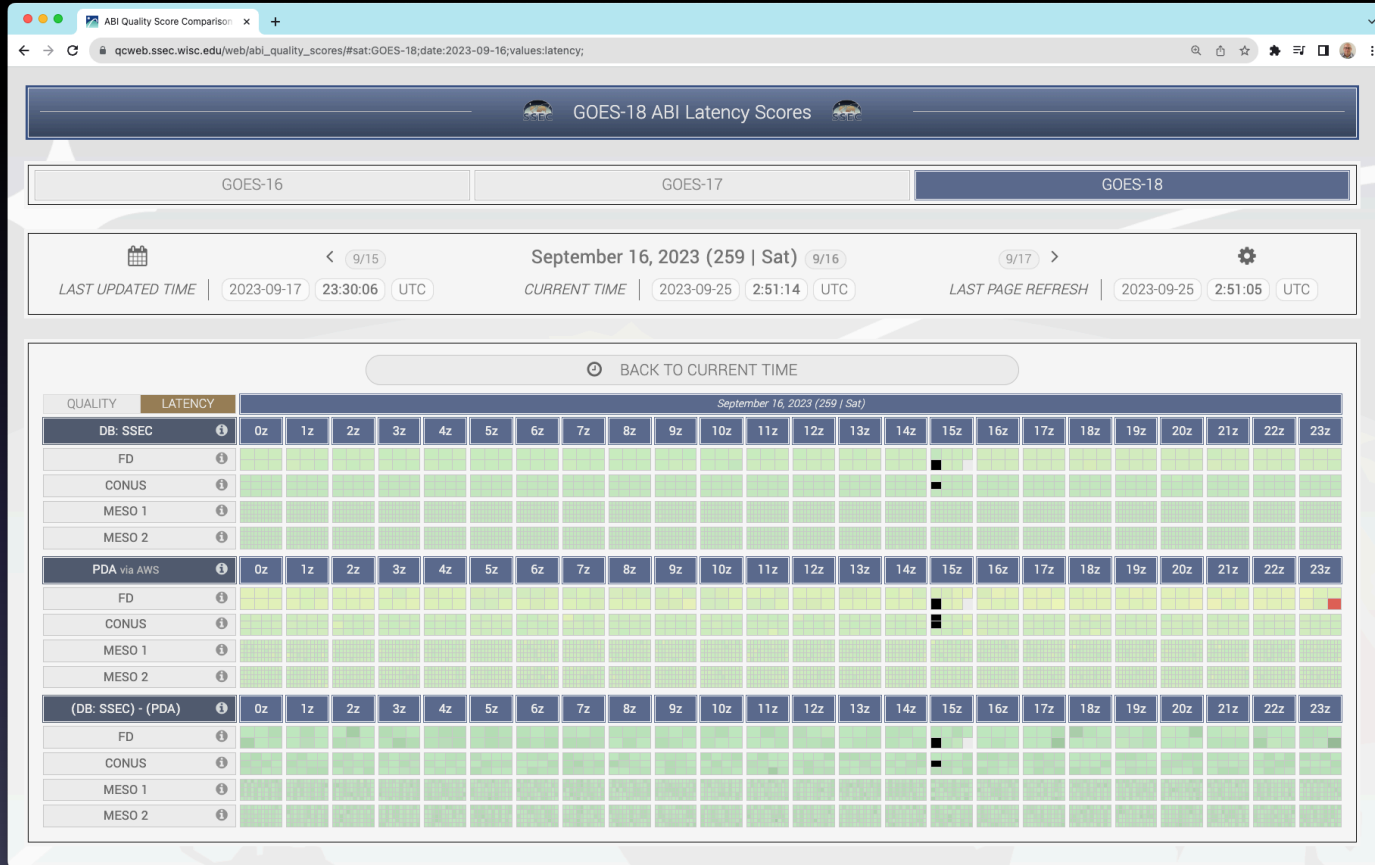
# Satellite QC API



[https://qcweb.ssec.wisc.edu/web/abi\\_quality\\_scores/](https://qcweb.ssec.wisc.edu/web/abi_quality_scores/)



# Satellite QC API



[https://qcweb.ssec.wisc.edu/web/abi\\_quality\\_scores/#values:latency;](https://qcweb.ssec.wisc.edu/web/abi_quality_scores/#values:latency;)



# Satellite QC API

The screenshot shows a web browser window titled "SDS Data Statuses" displaying the interface for HIMAWARI-8. The left sidebar contains a navigation menu with "Geo Satellites" and "Data Flows" sections. The main content area shows a date selector for "September 15, 2019 (258 | Sun)" and two "AH1" data tables. The top table is labeled "REAL-TIME" and the bottom one "ARCHIVE". Both tables have columns for time slots (5z to 22z) and rows for "FD", "Japan", and "Region3". The "USEFUL LINKS" section at the bottom includes "JMA - Image Viewer", "JMA - Notifications", "CIRA", and "ABoM".

**Geo Satellites**

- GOES-17
- GOES-16
- GOES-15
- COMS-1
- FY-2G
- FY-2H
- FY-4A
- HIMAWARI-8**
- MET-8
- MET-11

**Data Flows**

- COMS
- DIRECT BROADCAST
- FY-2G
- GOES-16
- HCAST
- HIMAWARI
- INVENTORY
- METEOSAT IODC
- METEOSAT PRIME
- METOP
- NOAAPORT
- SNPP
- STAR
- VIIRS

**Tools**

- Global Settings
- GOES-16
- GOES-17
- Geo Image Loops

**REAL-TIME AH1**

|         | 5z | 6z | 7z | 8z | 9z | 10z | 11z | 12z | 13z | 14z | 15z | 16z | 17z | 18z | 19z | 20z | 21z | 22z |
|---------|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ALL     |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FD      |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Japan   |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Region3 |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |

**ARCHIVE AH1**

|         | 5z | 6z | 7z | 8z | 9z | 10z | 11z | 12z | 13z | 14z | 15z | 16z | 17z | 18z | 19z | 20z | 21z | 22z |
|---------|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ALL     |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FD      |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Japan   |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Region3 |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |

**USEFUL LINKS**

- JMA - Image Viewer**  
[https://www.data.jma.go.jp/mscweb/data/himawari/sat\\_img.php](https://www.data.jma.go.jp/mscweb/data/himawari/sat_img.php)
- JMA - Notifications**  
[https://www.data.jma.go.jp/mscweb/en/operation/bulletin\\_list\\_1](https://www.data.jma.go.jp/mscweb/en/operation/bulletin_list_1)
- CIRA**  
<http://rammb-slides.cira.colostate.edu/?sat=himawari>
- ABoM**  
<http://satview.boom.gov.au/>

https://qcweb.ssec.wisc.edu/qc/web/dev/sds\_data\_statuses/#Geo Satellites;item:FY-4A; Sunday, September 15th 2019-09-15 Day 258 / 365 22:57:35 UTC



# Satellite QC API

SDS Data Statuses

- > Geo Satellites 10
- ▼ Polar Satellites 8
  - METOP-B
  - METOP-C
  - NOAA-15
  - NOAA-18
  - NOAA-19
  - NOAA-20
  - NOAA-21
  - Suomi NPP
- > Products 23
- > Machines 85
- > Projects 124
- > Data Flows 18
- ▼ Tools 7
  - Global Settings
  - Clock
  - Products Loop
  - Edit Data Flows
  - GOES-16 [↗](#)
  - GOES-17 [↗](#)
  - Geo Image Loops [↗](#)

Polar Satellites

| Polar Satellite | Source | Instrument | Storage   | 1 Hr | 6 Hrs | 24 Hrs | 48 Hrs | Last Updated            |
|-----------------|--------|------------|-----------|------|-------|--------|--------|-------------------------|
| METOP-B         | ALL    | AVHRR      | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:36 UTC |
|                 | ALL    | HIRS       | ARCHIVE   | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:36 UTC |
| METOP-C         | ALL    | AVHRR      | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:36 UTC |
|                 | ALL    | HIRS       | ARCHIVE   | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:36 UTC |
| NOAA-15         | ALL    | AVHRR      | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:36 UTC |
|                 | ALL    | HIRS       | ARCHIVE   | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:36 UTC |
| NOAA-18         | ALL    | AVHRR      | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:37 UTC |
|                 | ALL    | HIRS       | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:37 UTC |
| NOAA-19         | ALL    | AVHRR      | ARCHIVE   | ✓    | ✓     | ✓      | 1 ⚠    | 2023-09-25 14:04:37 UTC |
|                 | ALL    | HIRS       | ARCHIVE   | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:37 UTC |
| NOAA-20         | ALL    | VIIRS      | REAL-TIME | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:45 UTC |
| NOAA-21         | ALL    | VIIRS      | REAL-TIME | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:48 UTC |
| Suomi NPP       | ALL    | VIIRS      | REAL-TIME | ✓    | ✓     | ✓      | ✓      | 2023-09-25 14:04:55 UTC |

# Satellite QC API

The screenshot displays the SDS Data Statuses web application interface. The main content area is titled "NOAA-19" and shows data for "September 21, 2023 (264 | Thu)". The interface includes a navigation sidebar on the left with categories like "Geo Satellites", "Polar Satellites", "Products", "Machines", "Projects", "Data Flows", and "Tools". The main area features three data panels: "AVHRR" (with "GAC" data), "HIRS" (with "HIRX" data), and "USEFUL LINKS" (with "Projects - NOAA-19 Ingest"). A "LEGEND" at the bottom indicates data status: "Received" (green), "Warning" (yellow), and "Missing" (red). The data rows for AVHRR and HIRS show a timeline from 0z to 23z, with all cells in the "ALL" row highlighted in green, indicating received data.

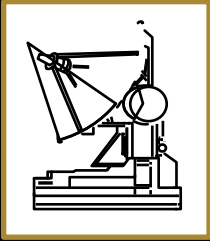


# Satellite QC API

- Integrated with inventory
- Public accessible interface



# Fanout/Mixer Server

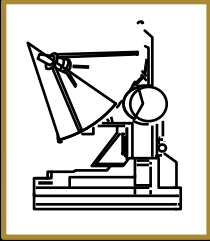


- Fanout allows:
  - Transmission of GRB CADU/CCSDS packets via TCP/IP
  - Distribution of GRB via internet
  - Feed multiple ingestors without using multicast





# 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



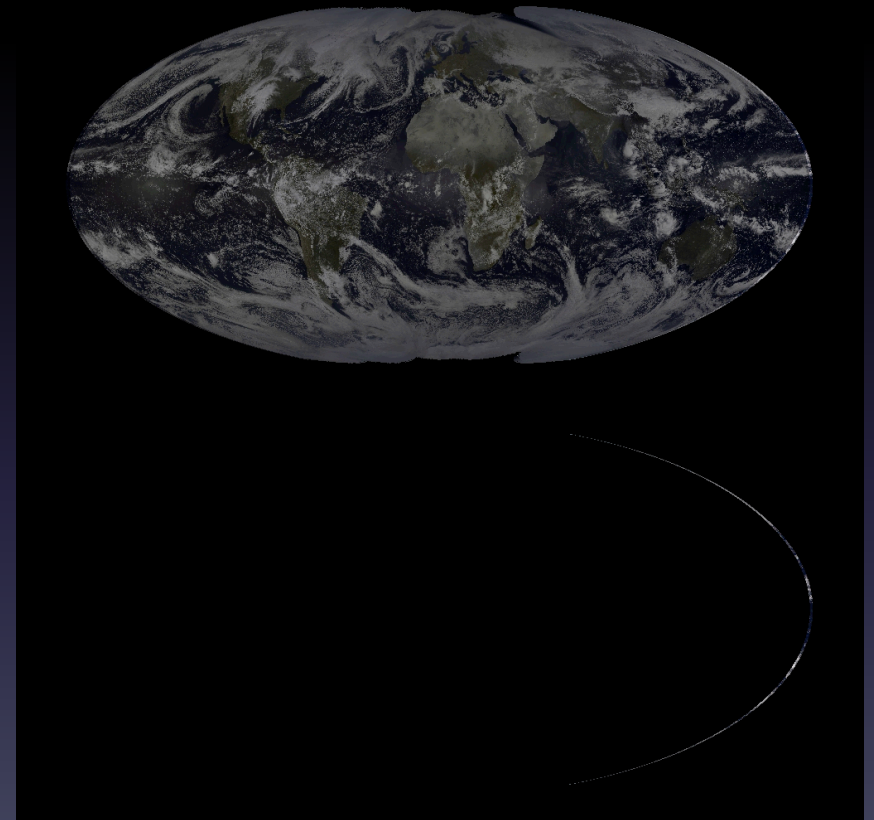
# Fanout Mixer

- Multiple Antennas used
- 3 local antennas
- 2 antennas at UCAR in Boulder



# Local Noon

- Created by Rick Kohrs
- Uses local noon visible pixels from global geostationary satellites



# ATS 1 & 3 Recovery

- Digitizing 66,000+ ATS1&3 images
- Jean Phillips, Dave Santek, Tim Schmit, Jerry Robaidek, Max Drexler, Sophia Reiner



# ATS 1 & 3 Recovery

- Determine dates, and times
- Navigate and register image navigation



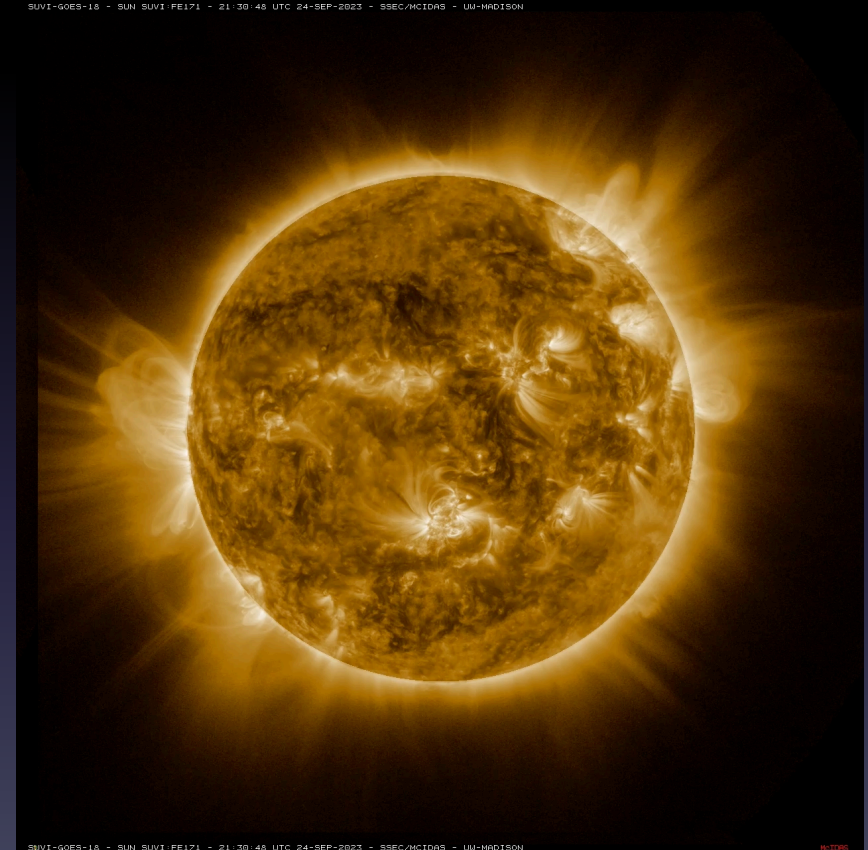
# ATS 1 & 3 Recovery

- Does not have a Y2K problem
- It has a “Y” problem
- Or a “just Y” problem
- Or “Just Why?!”



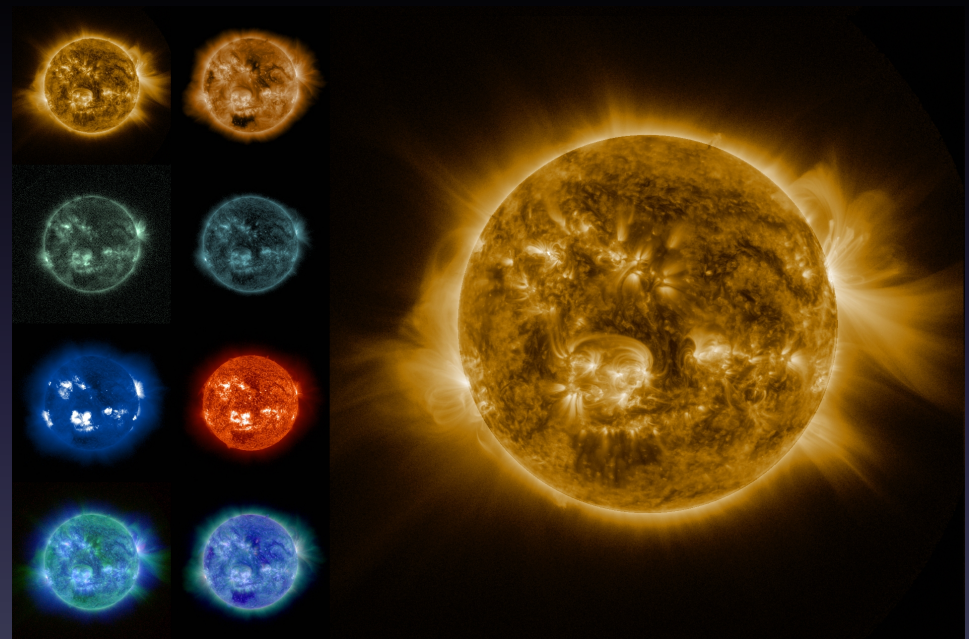
# GOES SUVI

- Thanks to Kaba Bah and Rick Kohrs
- Decoding into pngs, and then into AREAs
- Internally available as netcdf, png and AREAs
- Externally available via ADDE



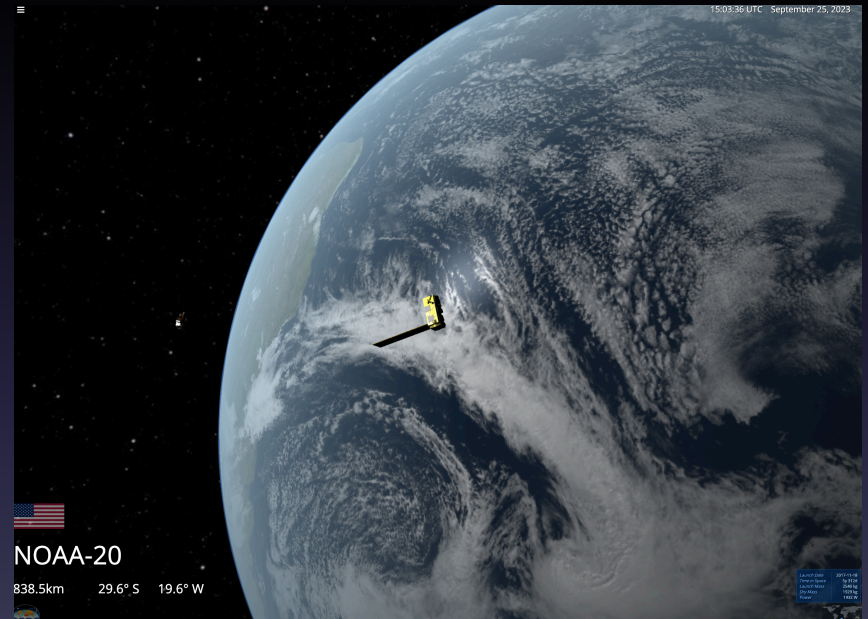
# GOES SUVI

- Thanks to Kaba Bah and Rick Kohrs
- Decoding into pngs, and then into AREAs
- Internally available as netcdf, png and AREAs
- Externally available via ADDE





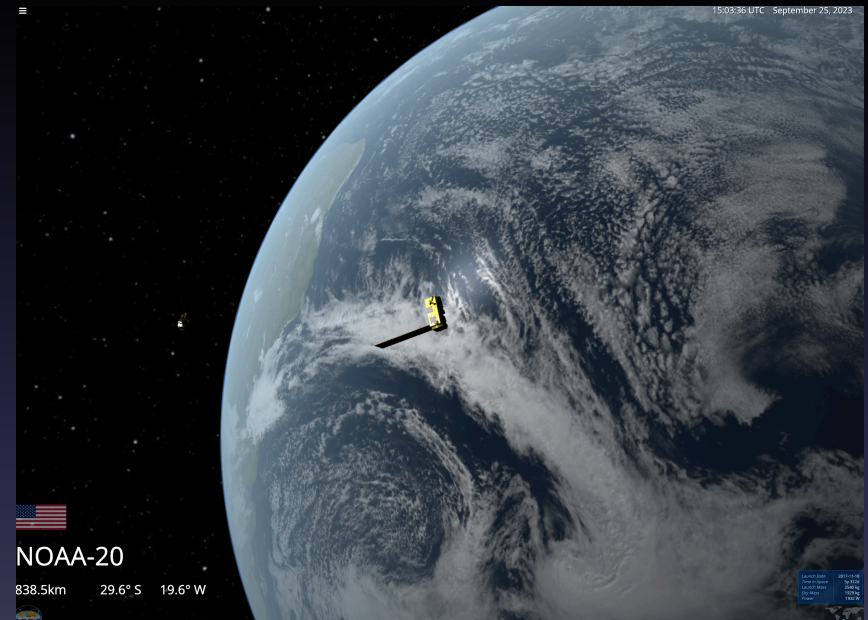
# WxSaTS



# WxSaTS

## Current Features

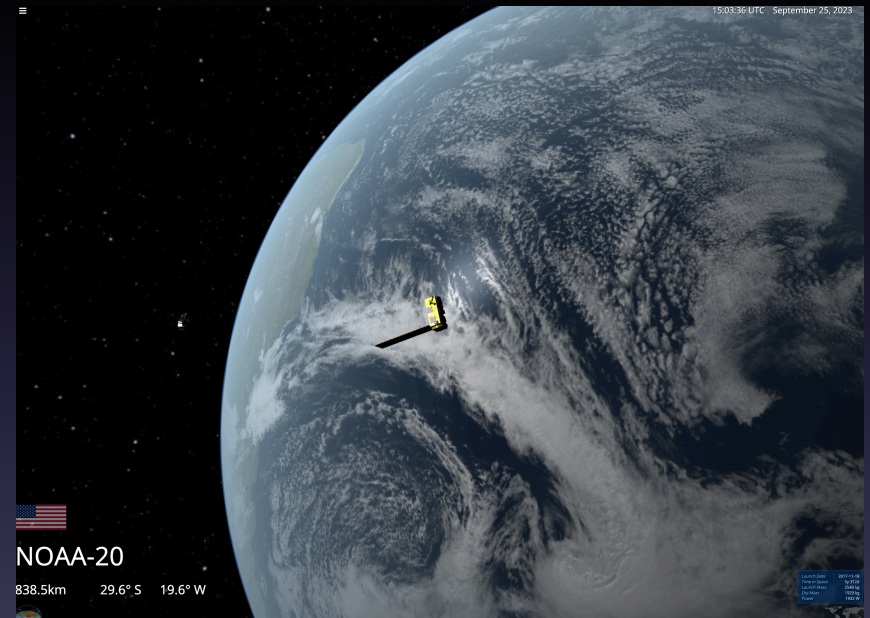
- Weather satellites we receive data from
- Earth with real-time clouds
- Able to display fields-of-vision for ground stations
- Paths, swaths, instrument labels for satellites
- Render cloud-top heights in 3D
- Wind vectors



# WxSaTS

## Current Features

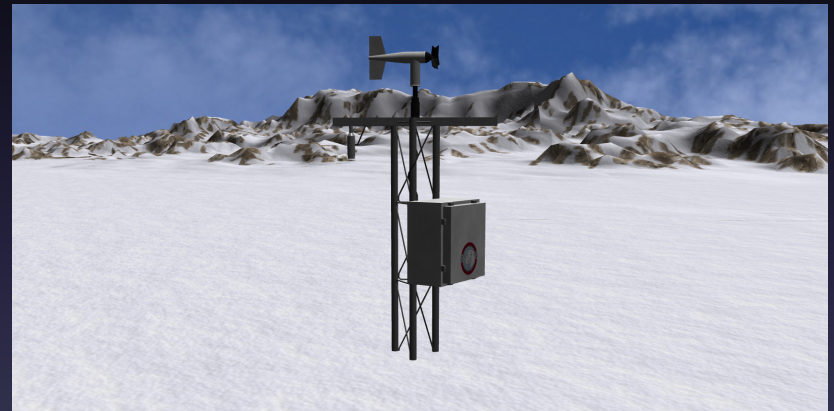
- Display data on a sphere
- All Satellites demo
- View satellites drawn to scale
- Rotating SSEC building with antenna labels
- Other planets / moons / asteroids / stars / exoplanets
- VR support (Meta Quest 1)



# WxSaTS

## AMRDC

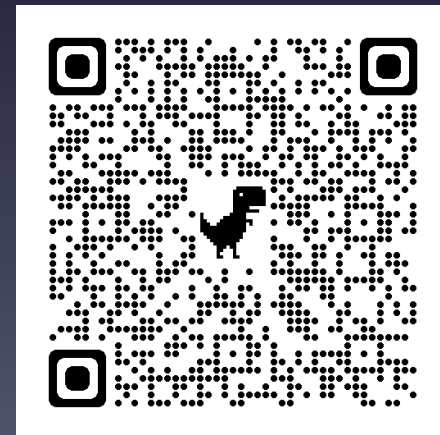
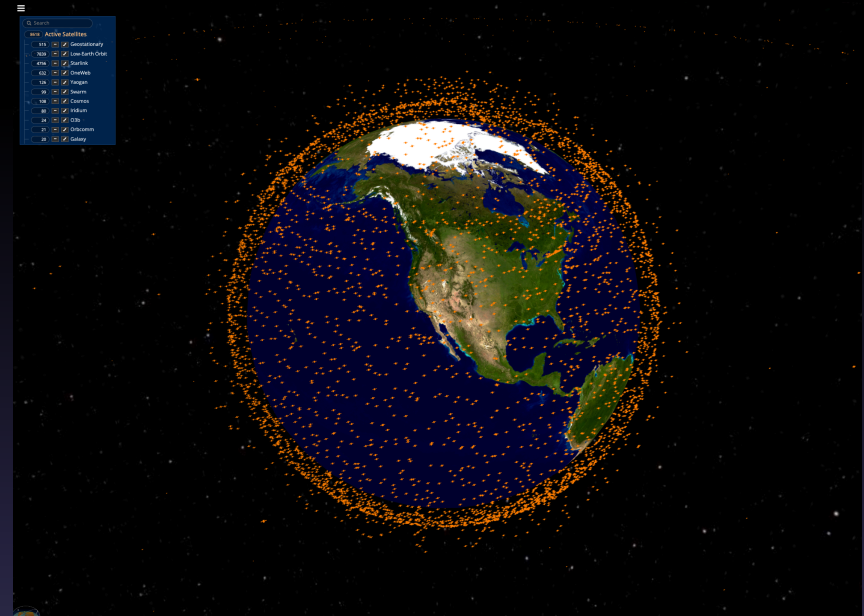
- Will test on:
  - Quest 3
  - Apple Vision Pro
- Turning a lot of the underlying code into a reusable series of libraries.
- Antarctic Simulation



# WxSaTS

## All Sats

- Displays all active satellites
- Interactive
- <https://qcweb.ssec.wisc.edu/web/wxsats/#environment:Environments,Custom,All%20Satellites;>



# Thanks!



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