

University of Wisconsin SSEC Satellite Data Services Update

McIDAS Users Group Meeting

September 16-17, 2019





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





Retirements

Rosie Spangler (33 years)



• Nancy Troxel-Hoehn (30 years)







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).





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





S4 Super Computer

- Funded in 2018 by NOAA
- 2,560 cores
 - 15 TB memory
 - 4 PBs of storage



• This is the 3rd enhancement(2011,2013)





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
nternational Geo Satellites	~500+ GB/day
NOAA 15-19 Polar	~27 GB/day
_andsat-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 r	nultiple sources

CIMSS = Cooperative Institute for Meteorological Satellite Studies

SSEC = Space Science & Engineering Center





Antennas @ SSEC

• <u>C-Band</u>

- 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 (58° West INTELSAT 21)

• <u>L-Band</u>

- 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)
- <u>X-Band</u>
 - 4.4 meter (Tracking EOS)

X/L Band

- 2.4 meter (Tracking - Suomi NPP, EOS, Metop A&B, NOAA-18, 19, 20 and FY3)





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











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.







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) ۲
- 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°
- FY-4A GIIRS only(105°
- INSAT-3D(83°E)

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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	o° 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)	105º 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



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





Polar Satellites Received at UW SSEC in 2019

	Reception Method	Domain	ADDE Latency	Instruments	Access
NOAA-15	C-Band relay, NOAA-STAR	DB CONUS	DB <1 minutes after pass	AVHRR, AMSU, DCS->level-1	ADDE
		Global		All other instruments Level-0	NA
NOAA-18	DB L-Band, C-Band relay, NOAA	DB CONUS	DB <1 minutes after pass	AVHRR->level-1	ADDE
	STAR	Global		All other instruments Level-0	NA
NOAA-19	DB L-Band, C-Band relay, NOAA	DB CONUS	DB <1 minutes after pass	AVHRR->level-1	ADDE
	STAR	Global		All other instruments Level-0	NA
NOAA-20	DB XL-Band, NOAA STAR, CLASS	DB CONUS	DB <1 minutes after pass	VIIRS>level-1	ADDE
		Global	Global network relay ~45 min	VIIRS,ATMS, CrIS	DB ftp (sips)
Metop-A/B/C	DB L-Band, NOAA STAR Relay	DB CONUS	CONUS <15 minutes	AVHRR ->level-1	ADDE
		Global	after pass	AVHRR, IASI	DB ftp (sips)
Suomi-NPP	DB X/L Band, NOAA STAR, CLASS	DB CONUS	CONUS <15 minutes	VIIRS	ADDE
		Global	after pass Global network relay ~45 min	VIIRS,ATMS, CrIS	DB ftp (sips)
Aqua	DB X-Band, NASA Relay	DB CONUS	DB <15 minutes after	AIRS, MODIS -> Level-1	ADDE
		Global	pass	AIRS, MODIS	DB ftp (sips)
Terra	DB X-Band, NASA Relay	DB CONUS	DB <15 minutes after	MODIS -> Level-1	ADDE
		Global	pass	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





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)
 - <u>G16 and G17 L1 ABI and L2 GLM in Netcdf</u>
 - G16 and G17 CADUs (essential for SDS and CSPP-GEO debugging)
- GOES-1 through GOES-7 (1978-1996)
- SMS-1&2 <u>(</u>1978-1981<u>)</u>





Archive Data

International Geostationary Satellites

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







Archive Data



NOAAPORT/Conventional Data

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





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





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)





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





Satellite QC API

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Satellite OC API

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Satellite OC API







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





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





Solar RFI at PDA ground station March 5, 2018

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











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!



