NOAA Near-Real Time Arctic GOES/POES Composite Satellite Imagery Products

Banghua Yan*

NOAA/NESDIS/OSPO

Matthew Lazzara[1,2] and Rick Kohrs[1]

[1]UW-Madison/CIMSS and [2]Madison College

*Other Contributors: David Mikolajczyk, J. Guo, C. Davenport, A. Irving, and J. Key

Outline

- **Significance**
- **Composite Methodology Briefing**
- **NOAA NRT Composite Imagery Product Briefing**
- **Product Access Information**

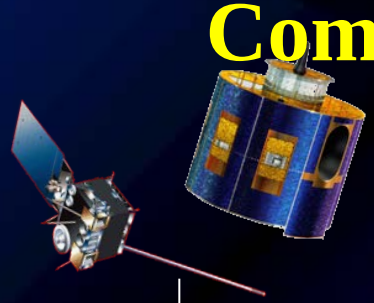
Significance of Arctic Composite Imagery Products

- Improves operational forecasting for the North Pacific and North Atlantic from 50°N to 90 °N in the following fields:
  - Climate (Climate Observations and Monitoring)
  - Weather and Water (Local Forecast and Warnings; Coasts, Estuaries & Oceans)
    - Understanding weather patterns and phenomena, ultimately improving forecasts, e.g., high-latitude atmospheric motion vectors from composite satellite data (Lazzara *et al*., 2013)
    - Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) project
  - Commerce and Transportation
    - Marine Transport Systems
    - Marine Weather
    - Surface Weather

Project Background

- The Arctic Satellite Composite Project, originally funded by National Science Foundation, was funded since 2012 by NOAA/NESDIS Satellite Product and Services Review Board (SPSRB) to generate near-real time (NRT) POES/GOES Arctic composite imagery products over Arctic polar region of the globe
  - The algorithm and code were developed by University of Wisconsin Space Science and Engineering Center (SSEC) (Atmospheric Research, Kohrs *et al*., 2014).
  - Non-operational Arctic composite images of various wavelengths over the Arctic polar region of the globe are also run at SSEC (*Lazzara et al.*, http://arctic.ssec.wisc.edu/).

Composite Algorithm Overview



Geostationary

Polar

Start time +/- 30 min Nominal Time

no

Unused Image

yes

Remap and Process Image

yes

Start time <= 105 min Nominal Time

no

Unused Image

Parallax Age Brightness

Unused Pixel

no

Pixel age +/- 30 min Nominal Time

yes

Multiple Co-located Pixels

yes

Multiple w/ Parallax Error < 15 km

yes

Weighted Average

no *(single pixel)*

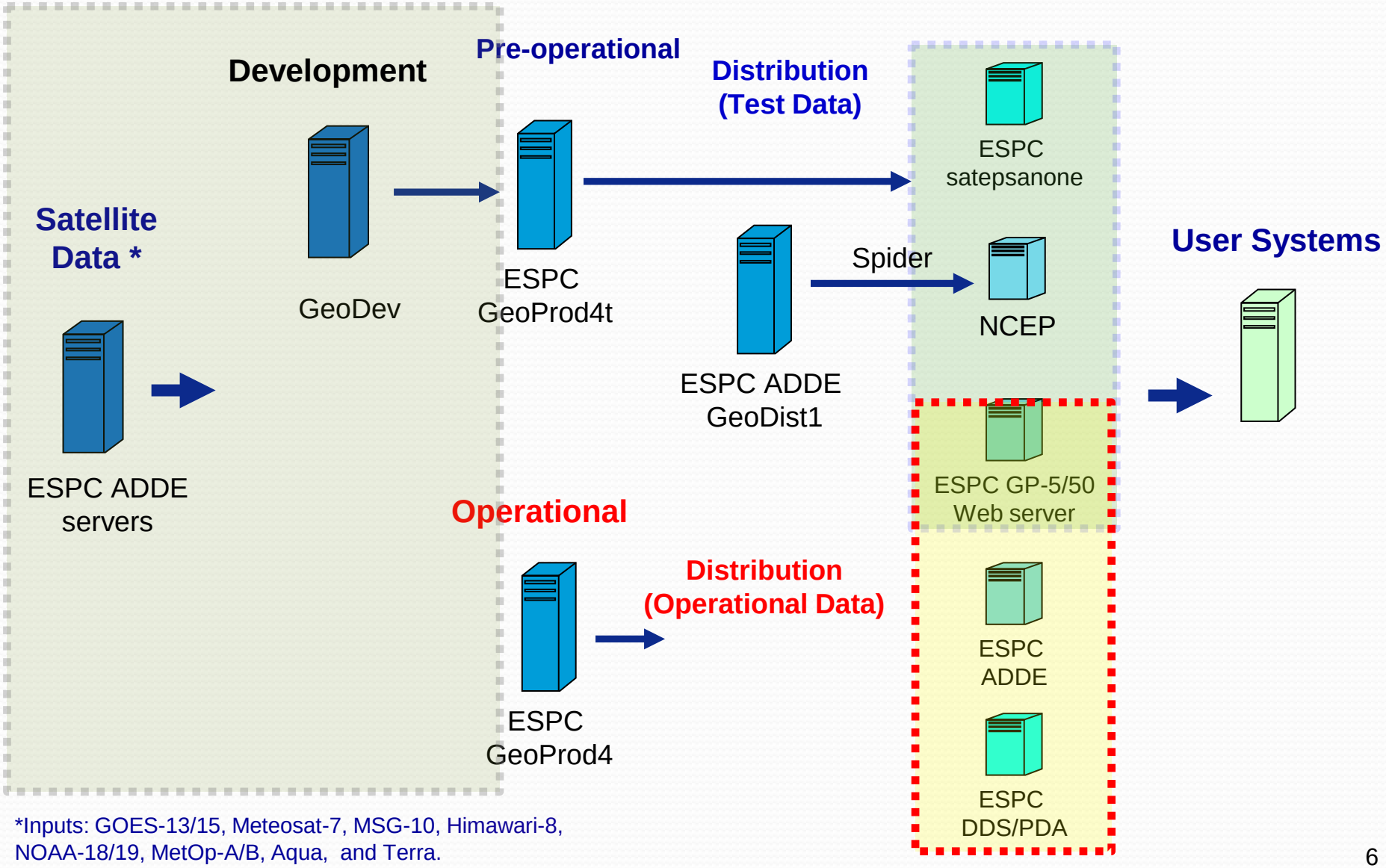
no *(use pixel with least error)*

Final Image

(Reference: Atmospheric Research, Kohrs *et al*., 2014)

5

OSPO Environment IT Architecture for Arctic Imagery Products



*Inputs: GOES-13/15, Meteosat-7, MSG-10, Himawari-8, NOAA-18/19, MetOp-A/B, Aqua, and Terra.

NRT Arctic GOES/POES Composite Imagery Operational Product Specifications

- **Products:**
  - Near-real time 4-km hourly Arctic GOES/POES composite imagery products.
- **Satellite Imagery Bands**
  - Visible (~0.65 µm): VIS
  - Shortwave Infrared (3.7 to 3.9): SW
  - Water vapor (~6.7 µm): WV
  - Infrared (~11.0 µm): IR
  - Longwave Infrared (~12.0 µm): LW
- **Timeliness and Latency**
  - Composites are made hourly, however for inclusion of as much satellite data as possible, they are made approximately 3 hours after the target image time
- **Formats:**
  - McIDAS Area, netcdf, and gif

Ingested GOES/POES Satellites Data

- Geostationary satellite imagery:
  - GOES-13 (East)
  - GOES-15 (West)
  - Meteosat-7
  - MSG-10
  - Himawari-8
- Polar orbiting satellite imagery:
  - NOAA-18
  - NOAA-19
  - Metop-A
  - Metop-B
  - Aqua
  - Terra

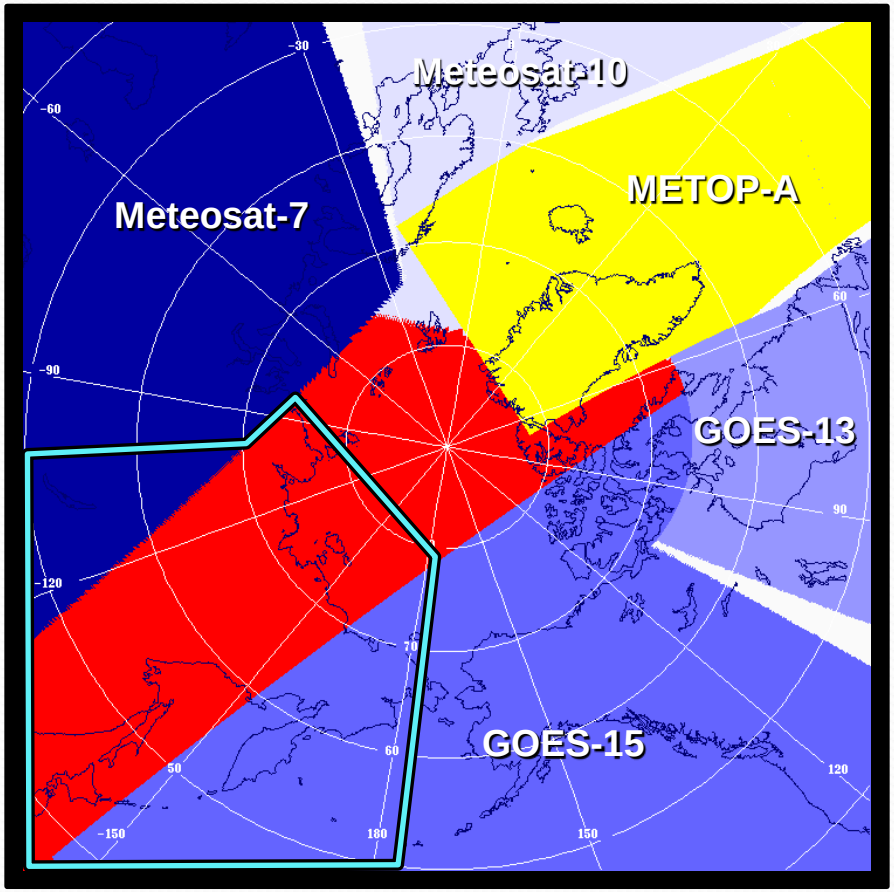
GOES Ingest Data Band Description

Satellite	Image Type	Band Number	Wavelength
GOES-East	Visible	1	0.65 µm
	Shortwave IR	2	3.90 µm
	Water Vapor	3	6.80 µm
	Infrared	4	10.7 µm
GOES-West	Visible	1	0.63 µm
	Shortwave IR	2	3.90 µm
	Water Vapor	3	6.70 µm
	Infrared	4	10.7 µm
Meteosat Second Generation	Visible	1	0.60 µm
	Shortwave IR	4	3.90 µm
	Water Vapor	6	7.30 µm
	Infrared	9	10.8 µm
	Longwave IR	10	12.0 µm
Meteosat First Generation (INODEX)	Visible	1	0.75 µm
	Infrared	8	11.5 µm
	Water Vapor	10	6.90 µm
Himawari-8	Visible	3	0.64 µm
	Shortwave IR	7	3.90 µm
	Water Vapor	9	6.90 µm
	Infrared	13	10.4 µm
	Longwave IR	15	12.4 µm

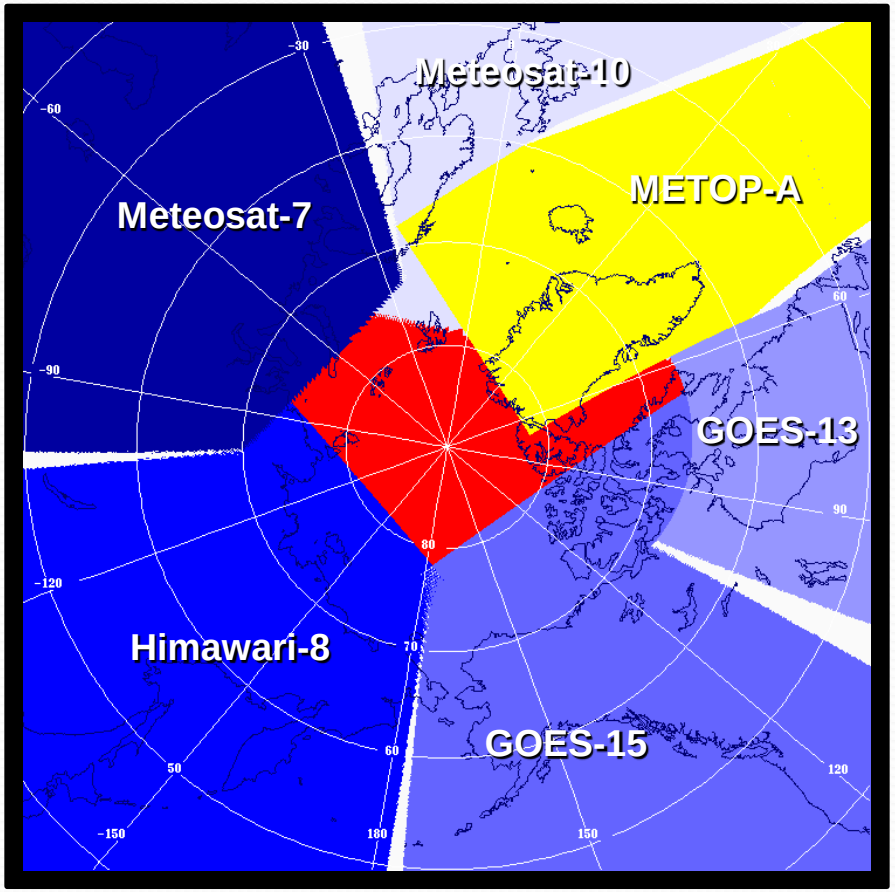
POES Ingest Data Band Description

Satellite	Image Type	Band Number	Wavelength
Terra MODIS	Visible	1	0.64 µm
	Shortwave IR	20	3.78 µm
	Water Vapor	27	6.76 µm
	Infrared	31	11.0 µm
	Longwave IR	32	12.0 µm
Aqua MODIS	Visible	1	0.64 µm
	Shortwave IR	20	3.78 µm
	Water Vapor	27	6.76 µm
	Infrared	31	11.0 µm
	Longwave IR	32	12.0 µm
NOAA-18	Visible	1	0.64 µm
	Shortwave IR	3	3.90 µm
	Infrared	4	10.4 µm
	Longwave IR	5	12.4 µm
NOAA-19	Visible	1	0.64 µm
	Shortwave IR	3	3.90 µm
	Infrared	4	10.4 µm
	Longwave IR	5	12.4 µm
METOP-A	Visible	1	0.63 µm
	Shortwave IR	3	3.74 µm
	Infrared	4	10.8 µm
	Longwave IR	5	12.0 µm
METOP-B	Visible	1	0.63 µm
	Shortwave IR	3	3.74 µm
	Infrared	4	10.8 µm
	Longwave IR	5	12.0 µm

Satellite Data Coverage Map: An Example



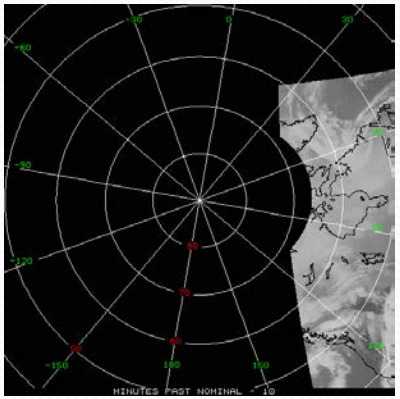
University of Wisconsin
(Himawari-8 Missing)



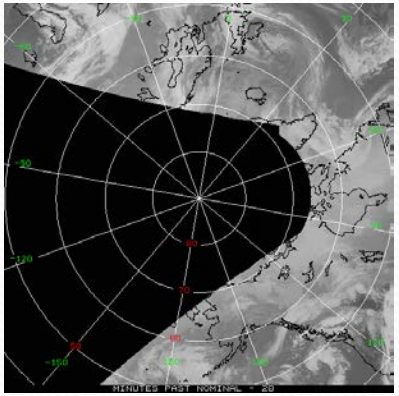
OSPO

No data coverage
Two or more satellites overlap

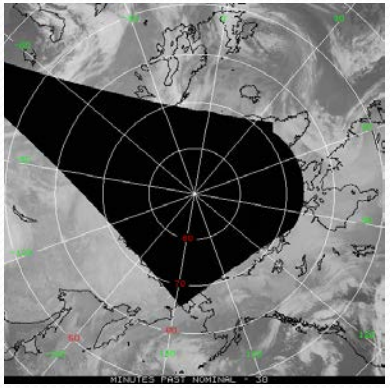
Merging Single Satellite Imagery into Composite Imagery: An Example



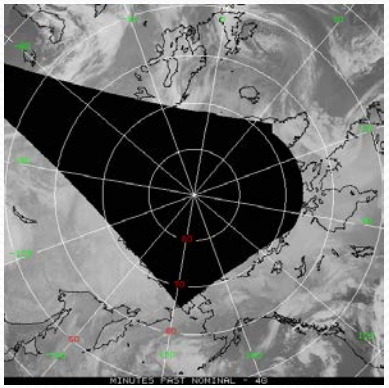
(a) minutes past nominal - 10



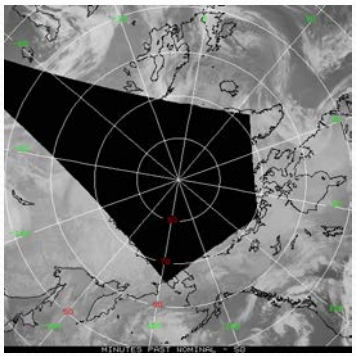
(b) minutes past nominal - 20



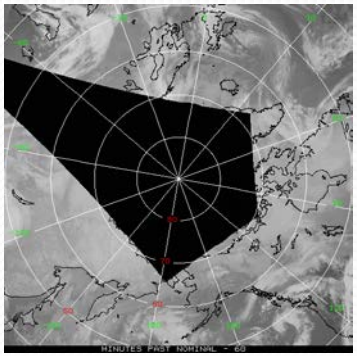
(c) minutes past nominal - 30



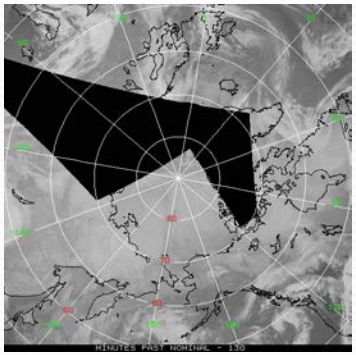
(d) minutes past nominal - 40



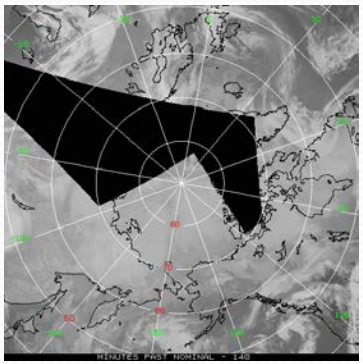
(e) minutes past nominal - 50



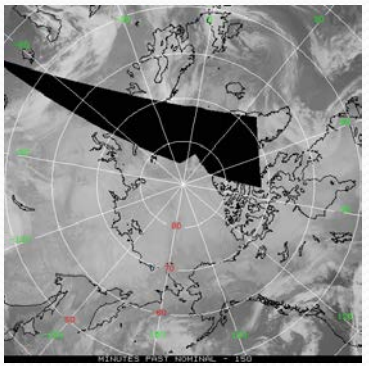
(f) minutes past nominal - 60



(g) minutes past nominal -130



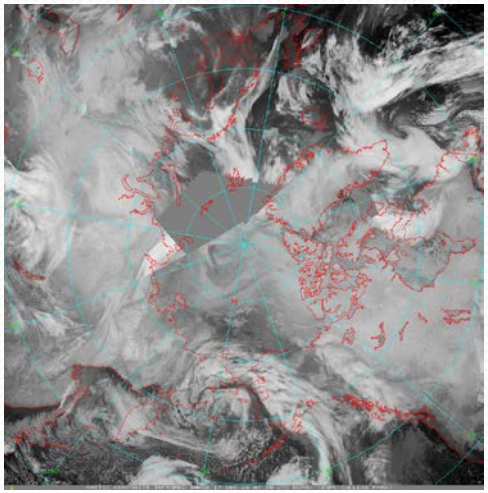
(h) minutes past nominal -140



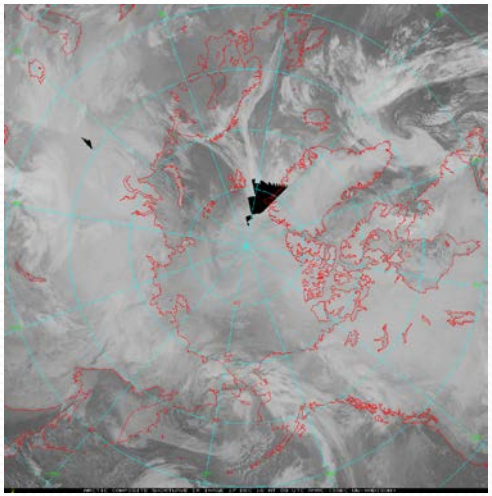
(i) minutes past nominal -150

NRT Arctic Composite Imagery Products: Animation Examples

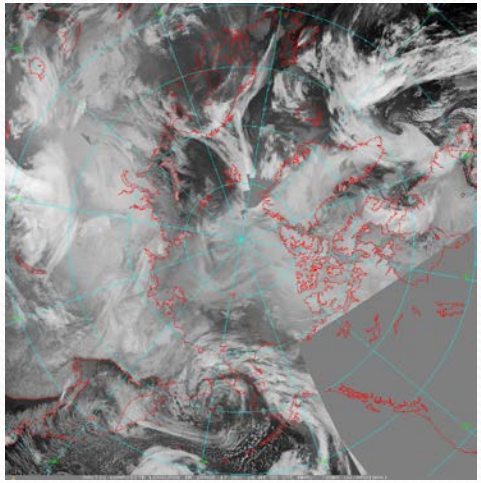
Infrared Band



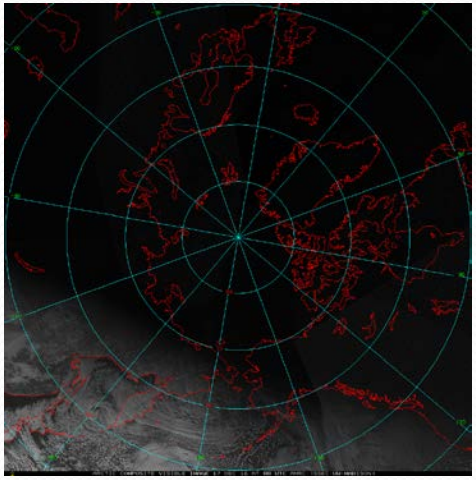
Shortwave Band



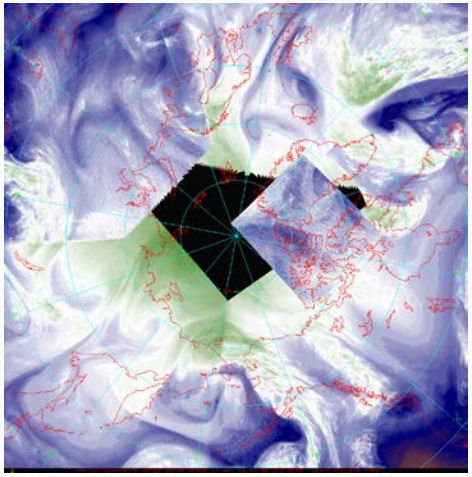
Longwave Band



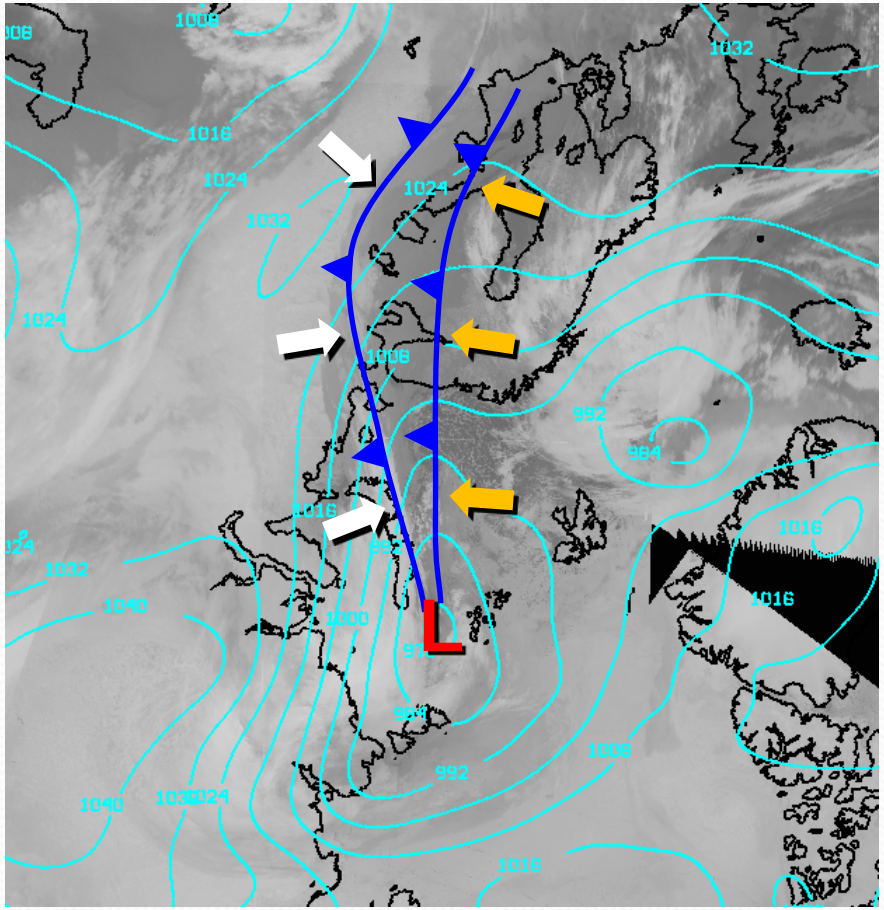
Visible Band



Water Vapor Band



Arctic Composite and GFS Model Data



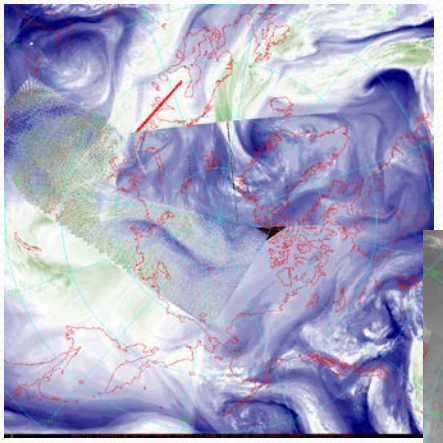
Infrared (10.7 um) 08-Jan-2017 00:00 UTC

Cold Front Analysis, GFS (Orange Arrows), Composite (White Arrows)

NRT Arctic Composite Imagery Products: OSPO Web-based QA Monitoring Tool

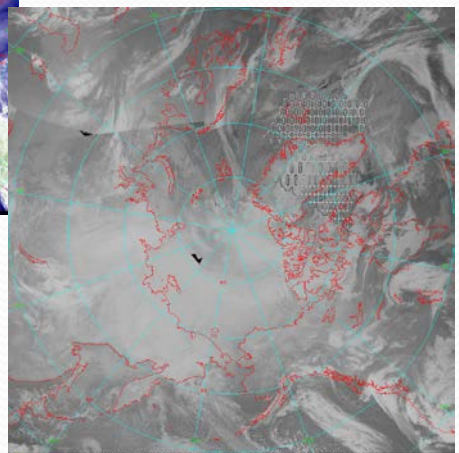
- Monitor in near real time hourly product imagery at five bands
- Monitor up to 7 days of product imagery
- Display current day animated imagery

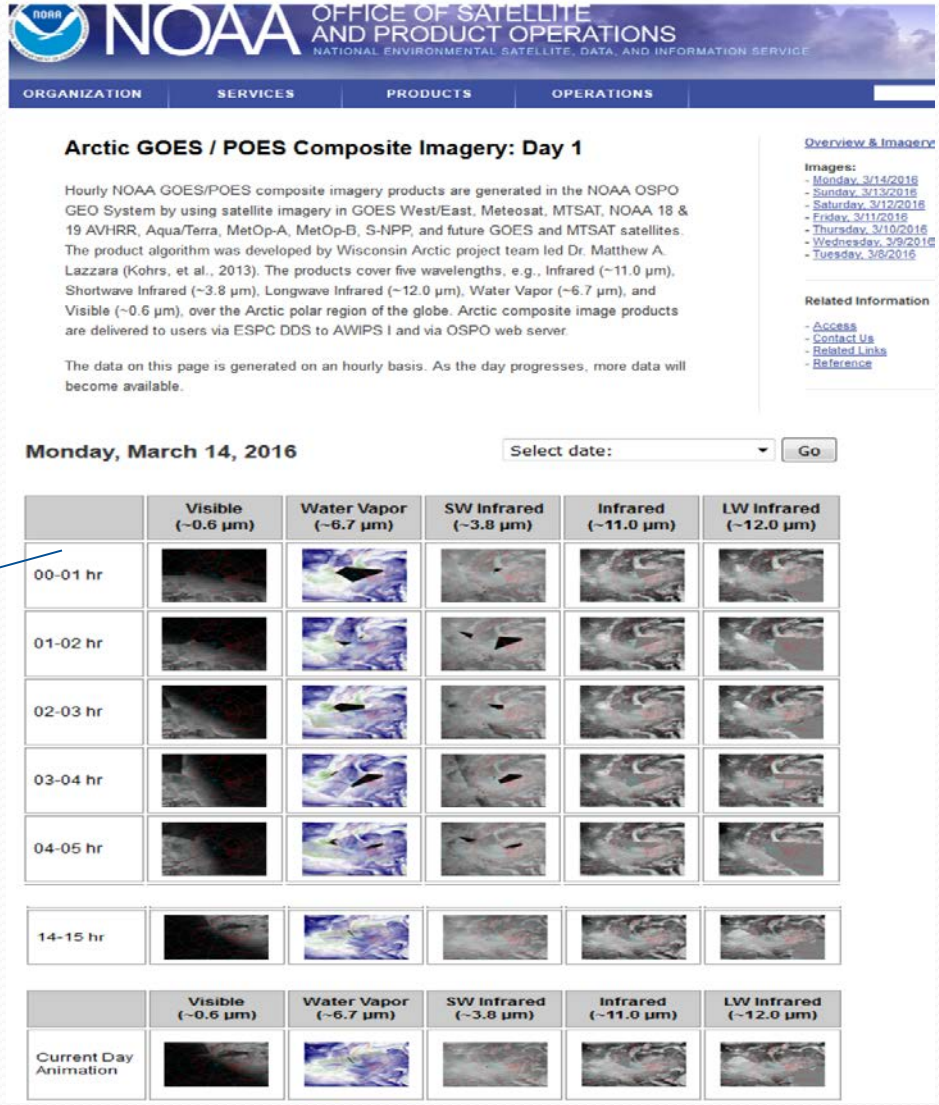
Examples:



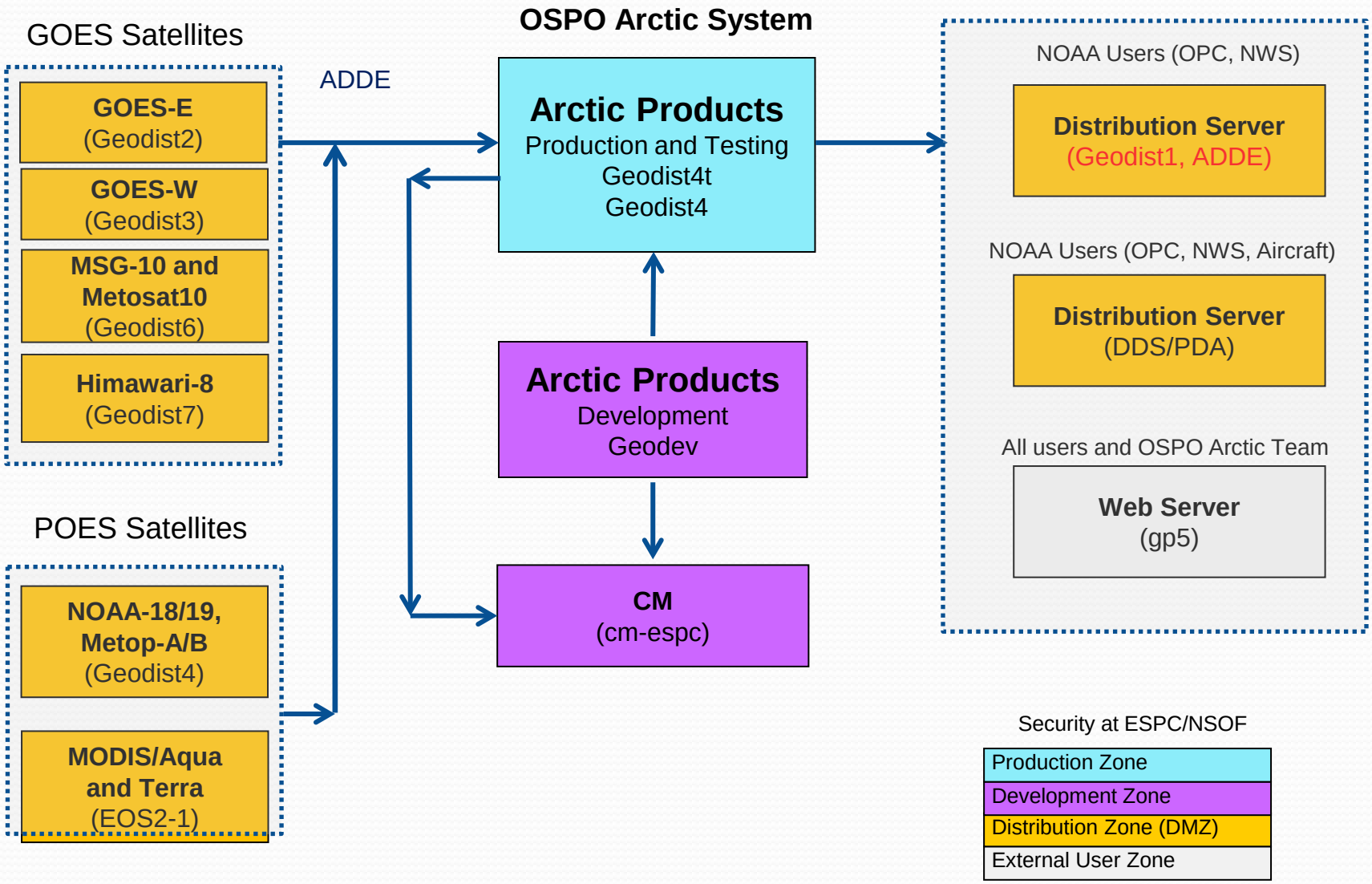
WV Band

SW Band





NRT Arctic GOES/POES Composite Operational Product Data Flow



NRT Arctic Imagery Product Access Information

- **DDS/PDA**
  - The Arctic GOES/POES composite imagery in NetCDF format
  - Submit a Data Access Request (DAR) form to nesdis.data.access@noaa.gov for approval
- **ADDE**
  - The GOES/POES composite imagery in McIDAS Area
- **ESPC satepsanone ftp site**
  - ftp://satepsanone.nesdis.noaa.gov/7day/arctic/

    (gif format only)
  - ftp://satepsanone.nesdis.noaa.gov/2day/arctic/

    (standard netcdf and McIDAS Area formats)