Accessing Non-NOAA Data: Sentinel and Himawari

Frank Monaldo/Michael Soracco#*

NESDIS/STAR/SOCD/MECB

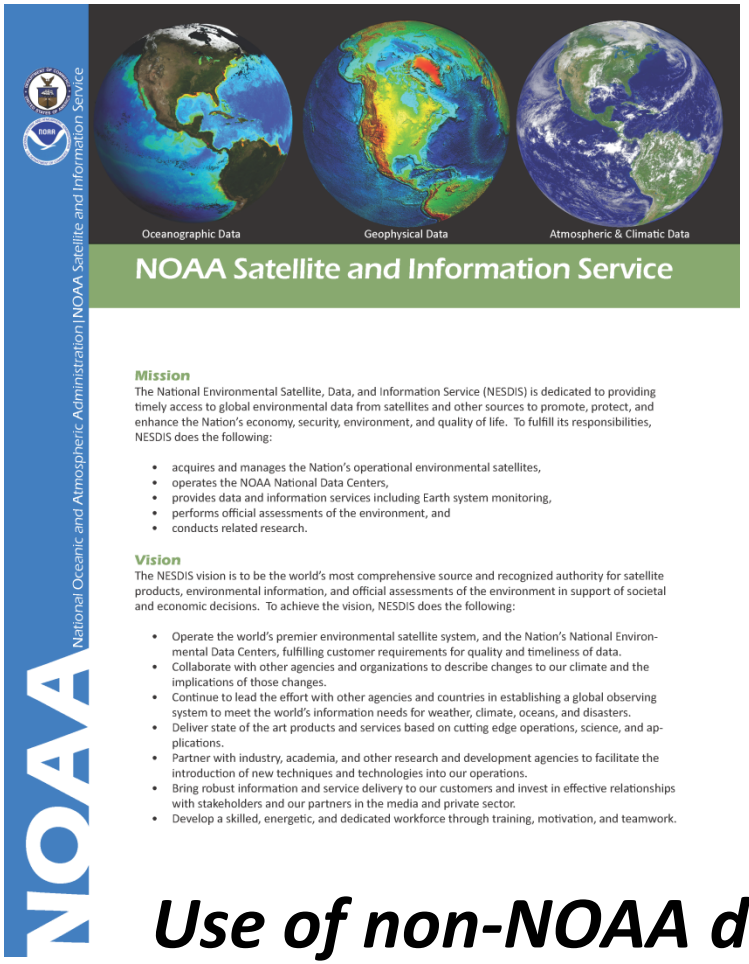
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**IPA from Johns Hopkins University APL*

 # DMT for NOAA/NESDIS/STAR/SOCD

NESDIS Mission Statement



"…NESDIS is dedicated to providing timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life."

"Continue to lead the effort with other agencies and countries in establishing a global observing system to meet the world's information needs for weather, climate, oceans, and disasters."

Use of non-NOAA data sources is consistent with and necessary to complete the NESDIS Mission.

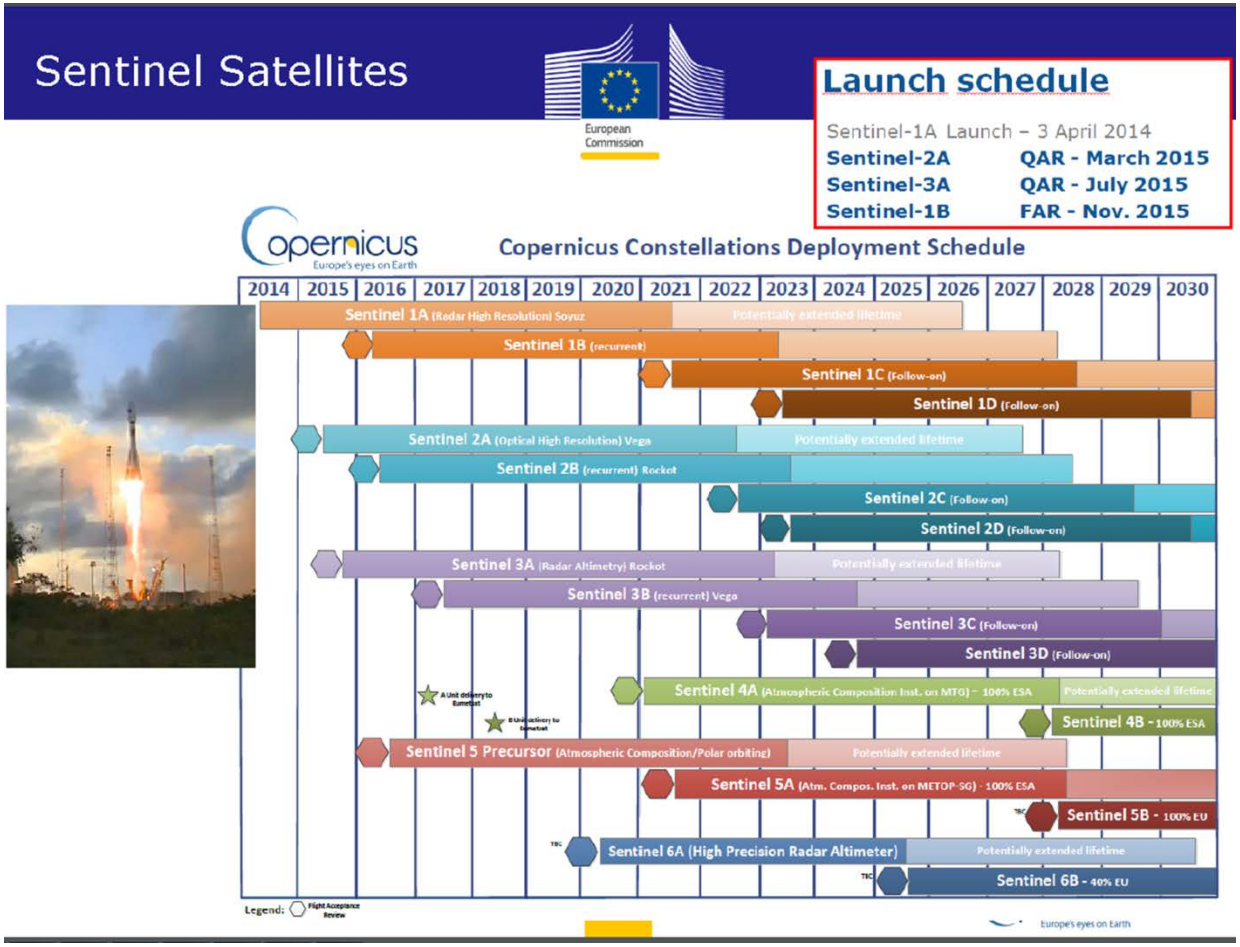
Non-NOAA Data

- NASA and other agencies.
- Other countries.
- Varying data policies.
- Differ degrees of relevance to NOAA.
- Here we focus of accessing Sentinel data from Europe and Himawari data from Japan.

Copernicus Program

- Europe's effort to provide necessary environmental data.
- Complements US efforts.
- Data is free and open.
- Long-term program, slated to spend $10 billion to 2020 and significantly more out to 2030.
- The US just needs to apply sufficient resources to say "Yes."

Copernicus Program



- **Sentinel-1:** SAR Imagery
- **Sentinel-2:** Multi-Spectral Imaging (Landsat)
- **Sentinel-3:** Ocean and global land monitoring (VIIRS/MODIS)
- **Sentinel-4:** GEO atmospheric composition
- **Sentinel-5:** LEO atmospheric composition
- **Sentinel-6:** LEO altimetry

2014-2017 Sentinel Data

- **Sentinel-1:**
  - C-band Synthetic Aperture Radar Imagery for wind speed, oil spill, ship detection, ocean wave spectra etc. (10-50 m resolution, 80-400 km swath)
  - 1A Launched April 2014
  - 1B Launch Early 2016
- **Sentinel-2:** Multi-Spectral Imaging (Landsat)
  - 13-channel multi-spectral imagery (443 – 2190 nm), 10-60 m resolution, 290 km swath
  - 2A Launched June 2015
  - 2B Launch Mid- 2016
- **Sentinel-3:** Ocean and global land monitoring (VIIRS/MODIS)
  - Instruments:
    - SLSTR (Sea and Land Surface Temperature Radiometer) , 0.5-1 km resolution, 1400 km swath.
    - OLCI (Ocean and Land Color Instrument.) 21 bands, 300 m resolution, 1270 km swath.
    - SRAL (SAR Altimeter).
  - 3A Launch Nov 2015
  - 3B Launch 18 months after 3A ~Early 2017

Data for International Partner

- Special portal for “International Partners.”
- Same interface as the open portal.
- NOAA, NASA and USGS are negotiating the high-level and technical arrangements. Expect conclusion in the fall.
- Data has lower latency than public portal.
- On Internet-2-Geant for higher bandwidth and less competition with general Internet traffic.
- EUMETSAT Level-2 Ocean Products through multicast

Open Sentinel Data Hub

https://scihub.esa.int/dhus/



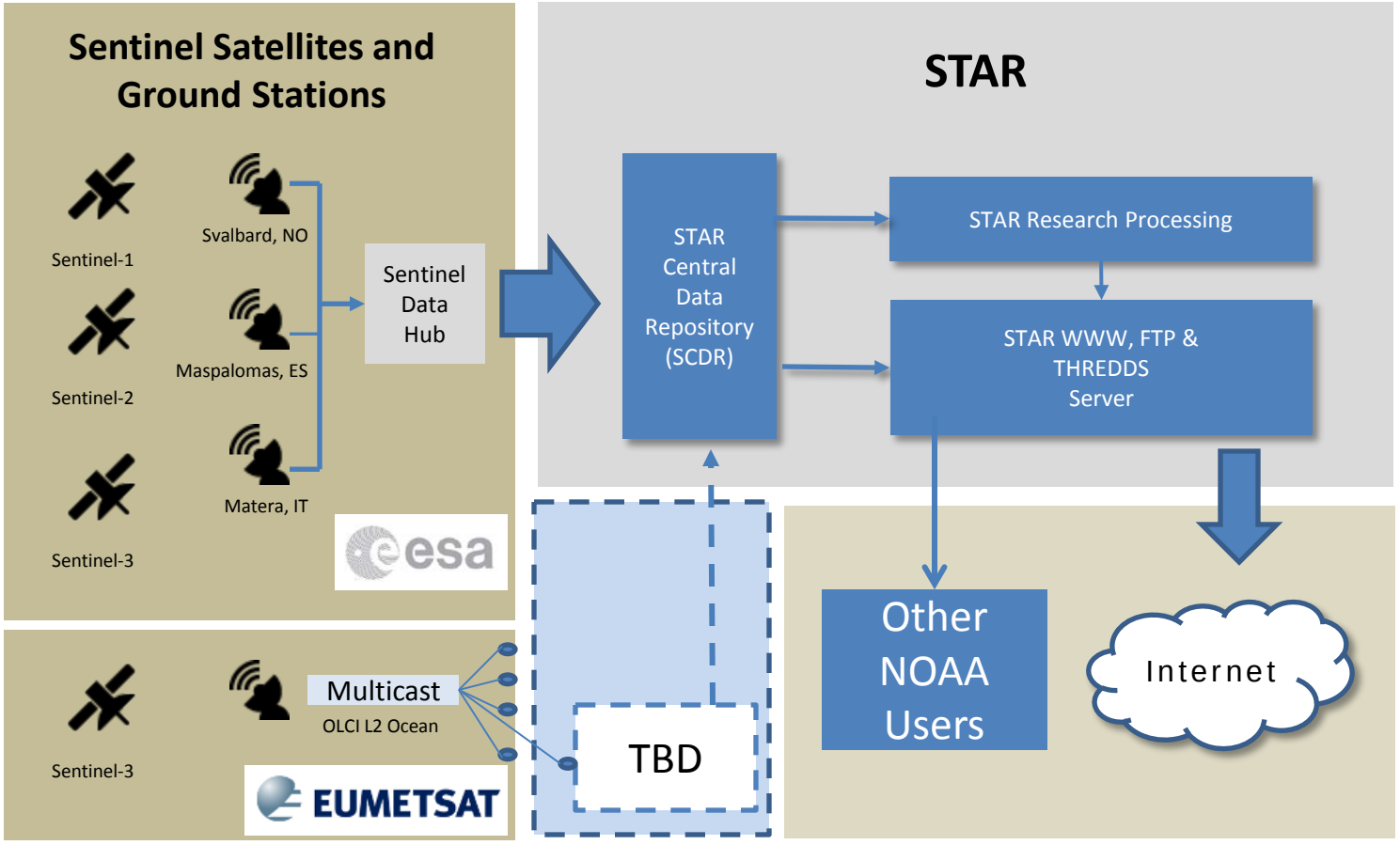
- Free and open data.
- Access to all Sentinel data.
- Interactive data selection.
- Scriptable calls using https to pull data within different time and location windows.

Sentinel Data Rates

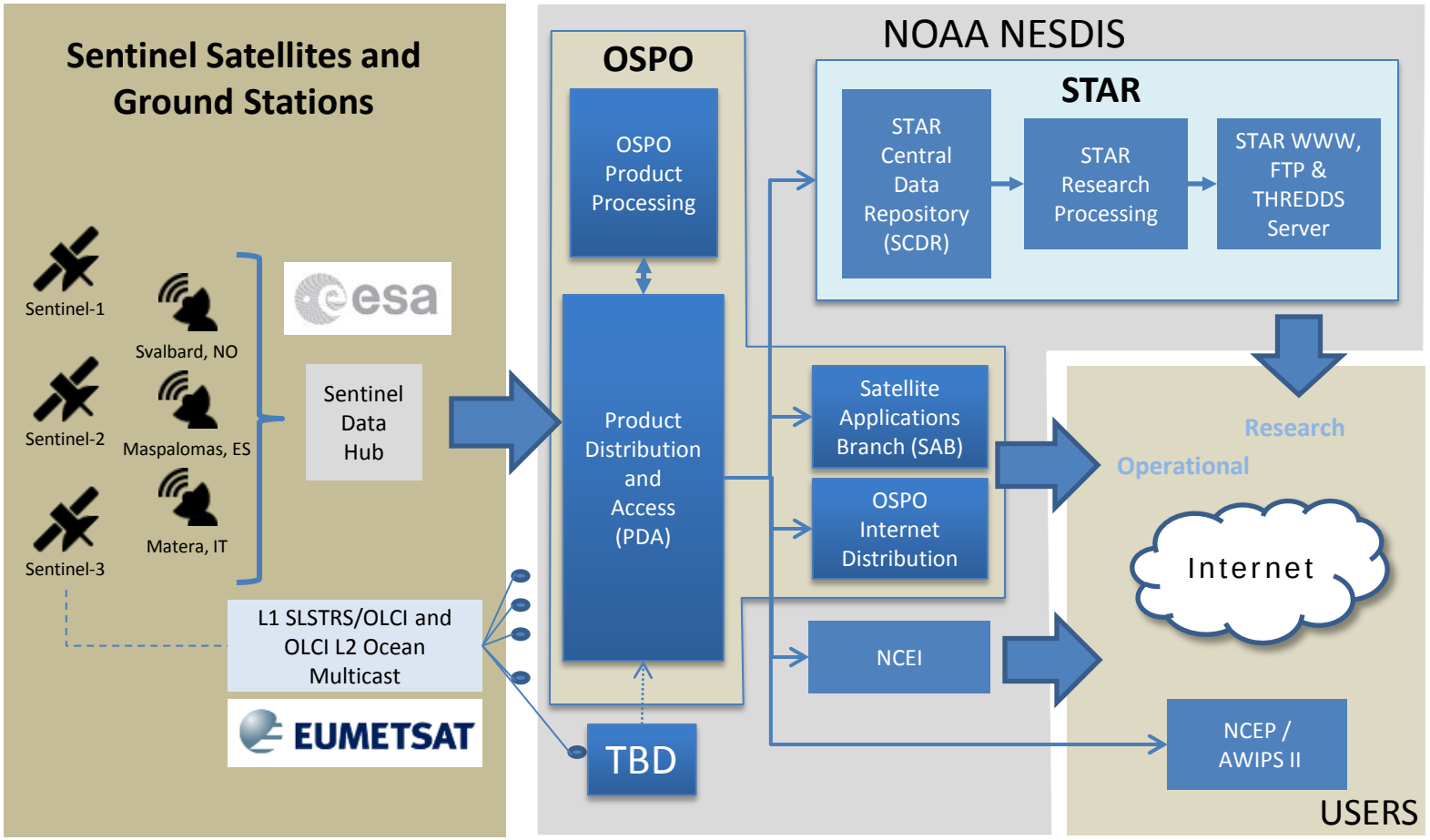
	Data rates (TB per day)	FY16	FY17
Sentinel-1A (Launched)	0.68*	0.68	0.68
Sentinel-1B (April2016)	0.68		0.68
Sentinel-2A (Launched)	1.66	1.66	1.66
Sentinel-3A (OCT2015)	2.62	2.62	2.62
Sentinel-2B(mid-2016)	1.66		1.66
Sentinel-3B (18 months after Sentinel-3A):	2.62		2.62
Total	9.92	4.96	9.92

* Currently pulling at medium resolution, approximately 300 GB/day. Only pulling polar regions and coasts of the US.

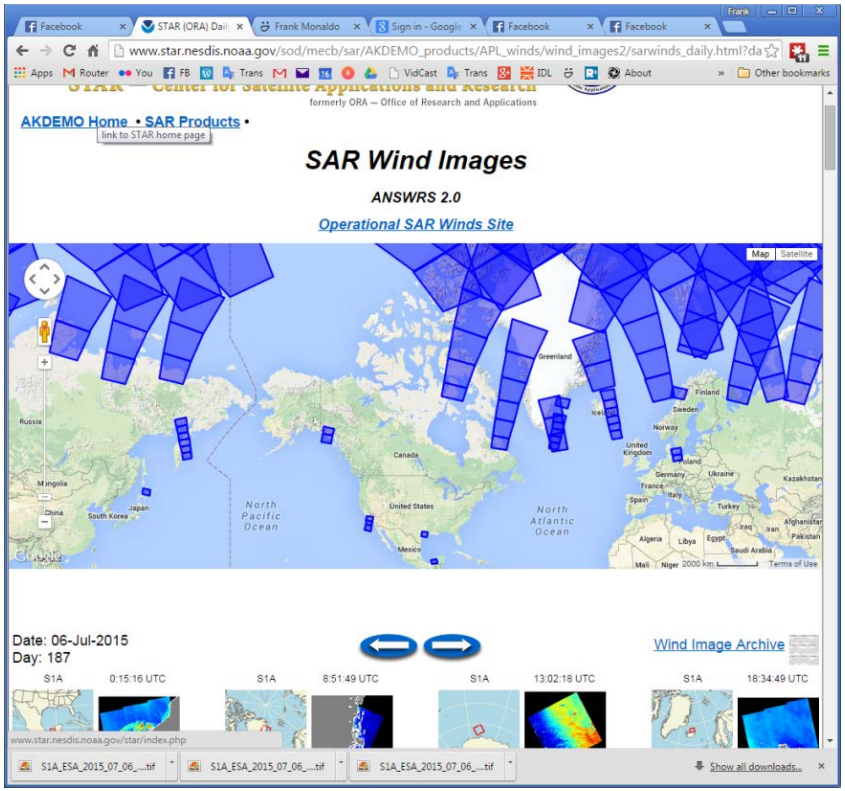
Nominal Data Flow For Sentinel Data in Pre-PDA Era

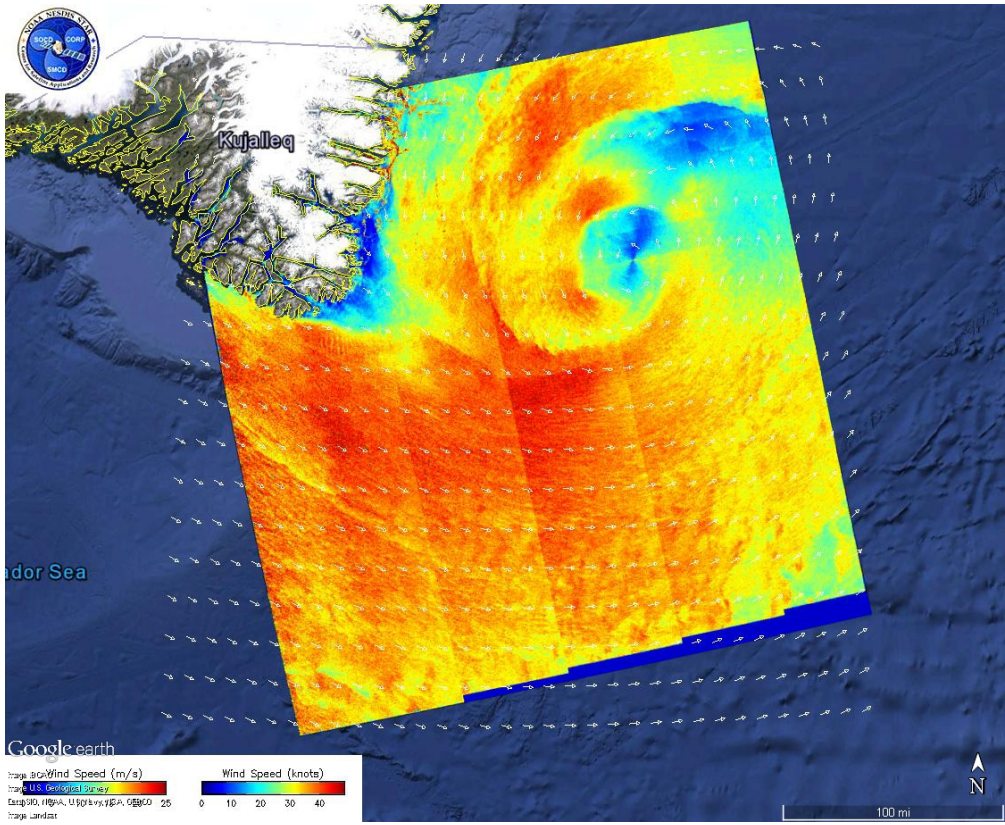


Nominal Data Flow For Sentinel Data PDA Era

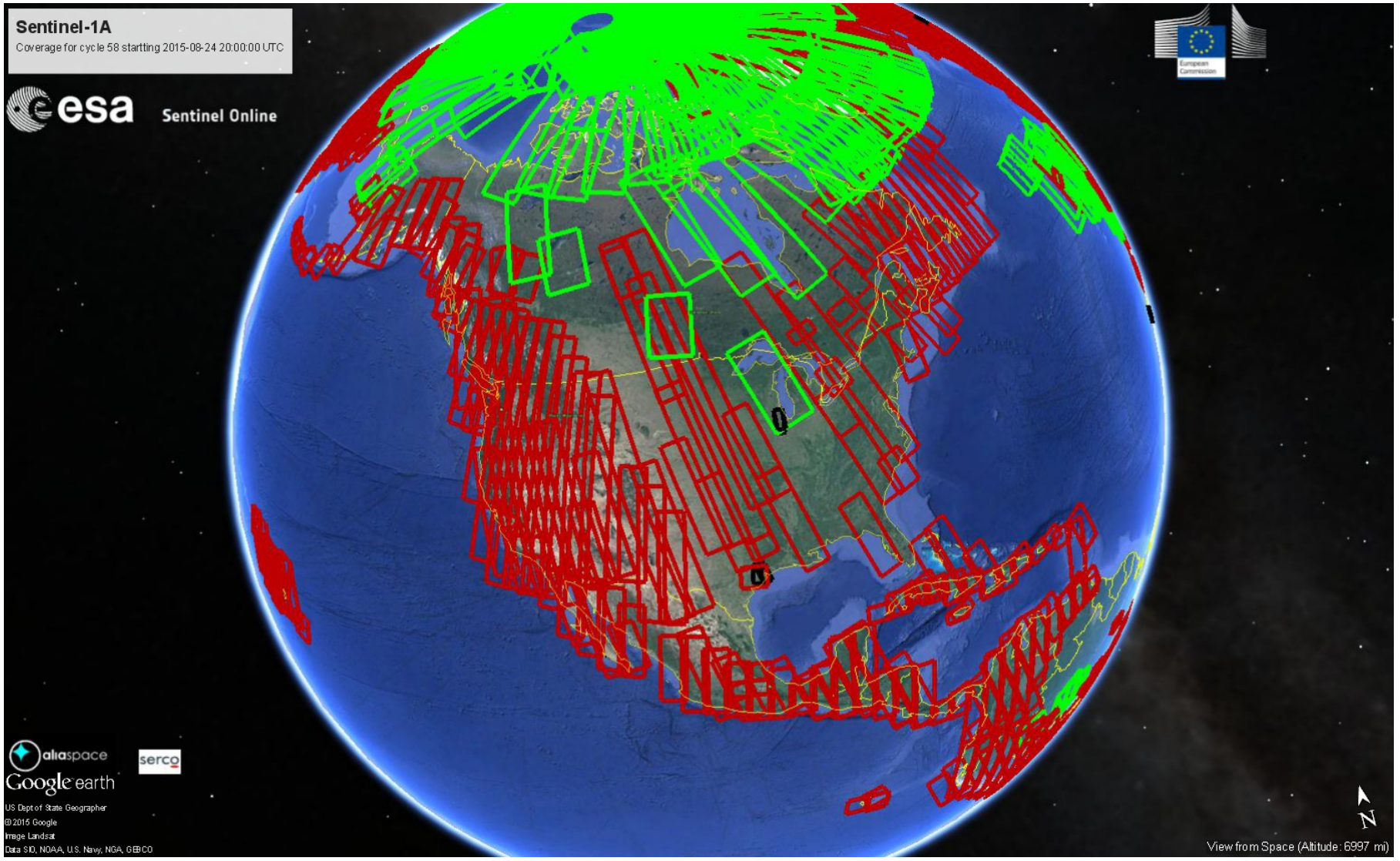


Sample Sentinel-1A Wind Retrieval



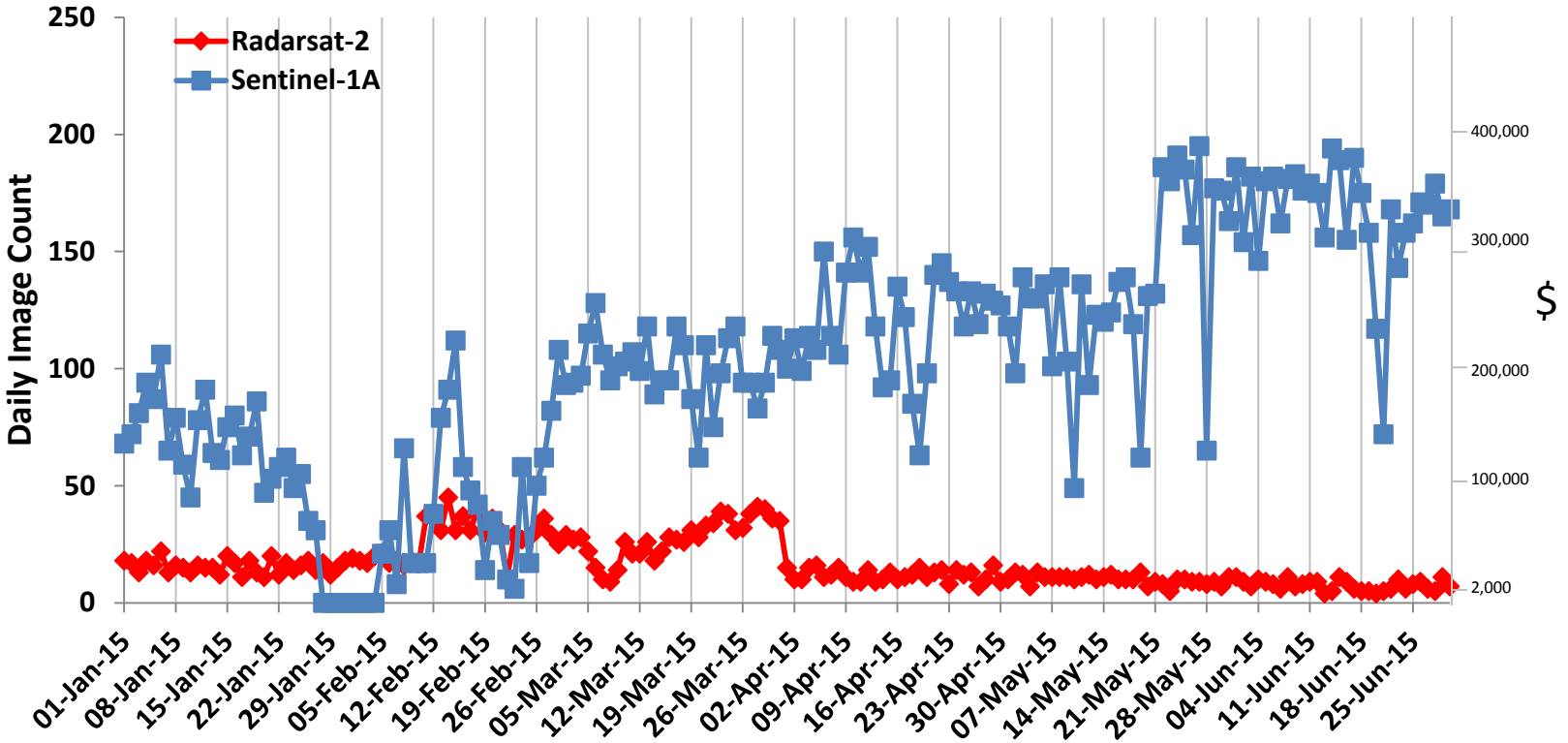


Sentinel-1A Coverage: 12 day cycle



Sample Cost Savings

Each Radarsat-2 image costs the US government $2K or $20K/day. At 100 images a day, Sentinel-1A represents $200K/day of data.



NOAA/NOS Great Lakes Forecast, Sentinel-3

NCCOS planning on Sentinel-3 OLCI for improved Lake Erie HAB Forecasting and water quality monitoring

- 300m spatial resolution
- Spectral bands for product generation
- Relieves single-point-of-failure

Himawari 8/9

- Advanced Himawari Imager (AHI)

Wave length (μm)	Himawari-8/9			MTSAT-1R/2	
	Band number				
0.47	1		1		
0.51	2		1		
0.64	3		0.5		1
0.86	4		1		
1.6	5		2		
2.3	6		2		
3.9	7		2		4
6.2	8		2		4
6.9	9		2		
7.3	10		2		
8.6	11		2		
9.6	12		2		
10.4	13		2		4
11.2	14		2		
12.4	15		2		4
13.3	16		2		

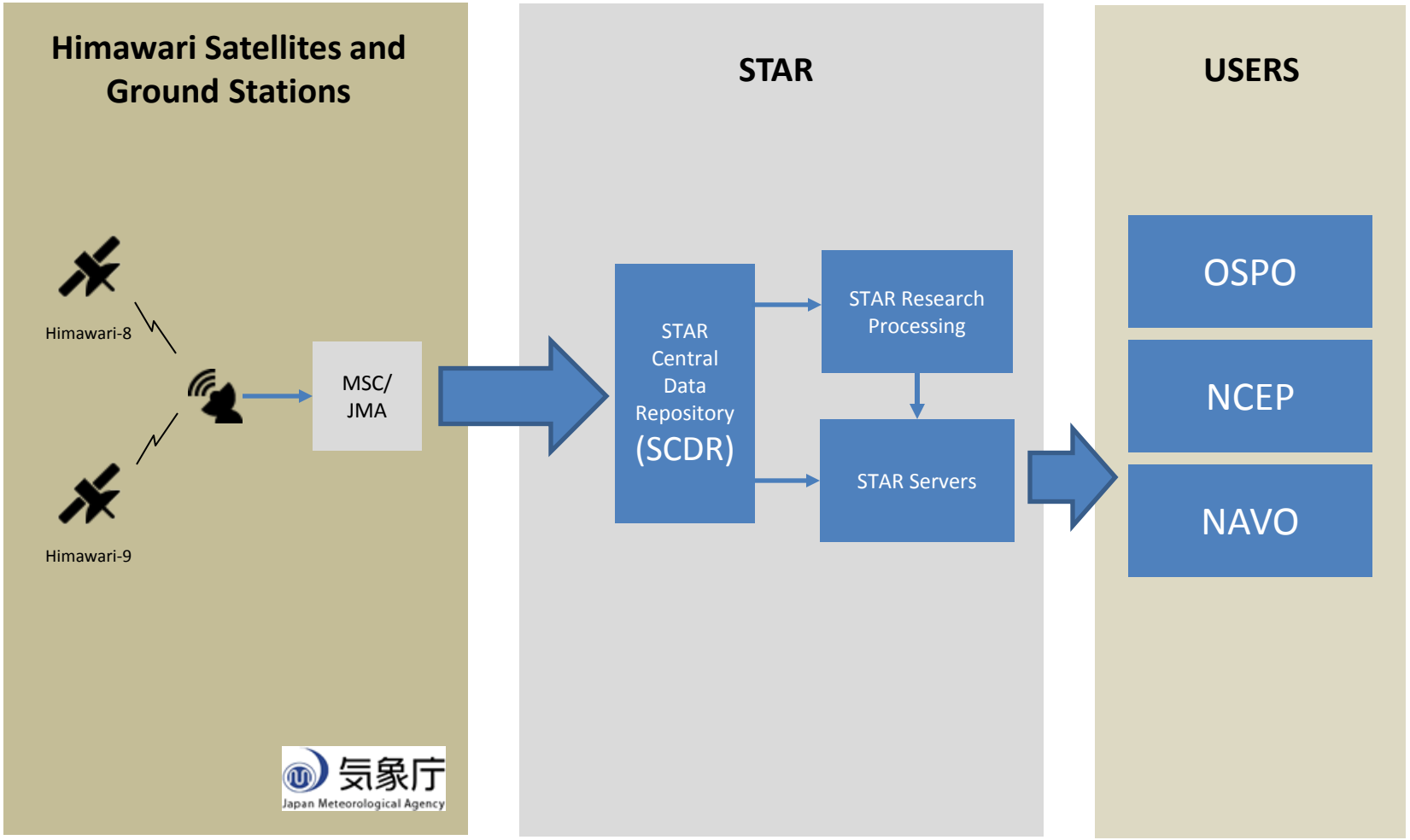
: the sensor has its observing band.
Number : horizontal resolution (in [km]) at sub-satellite point.



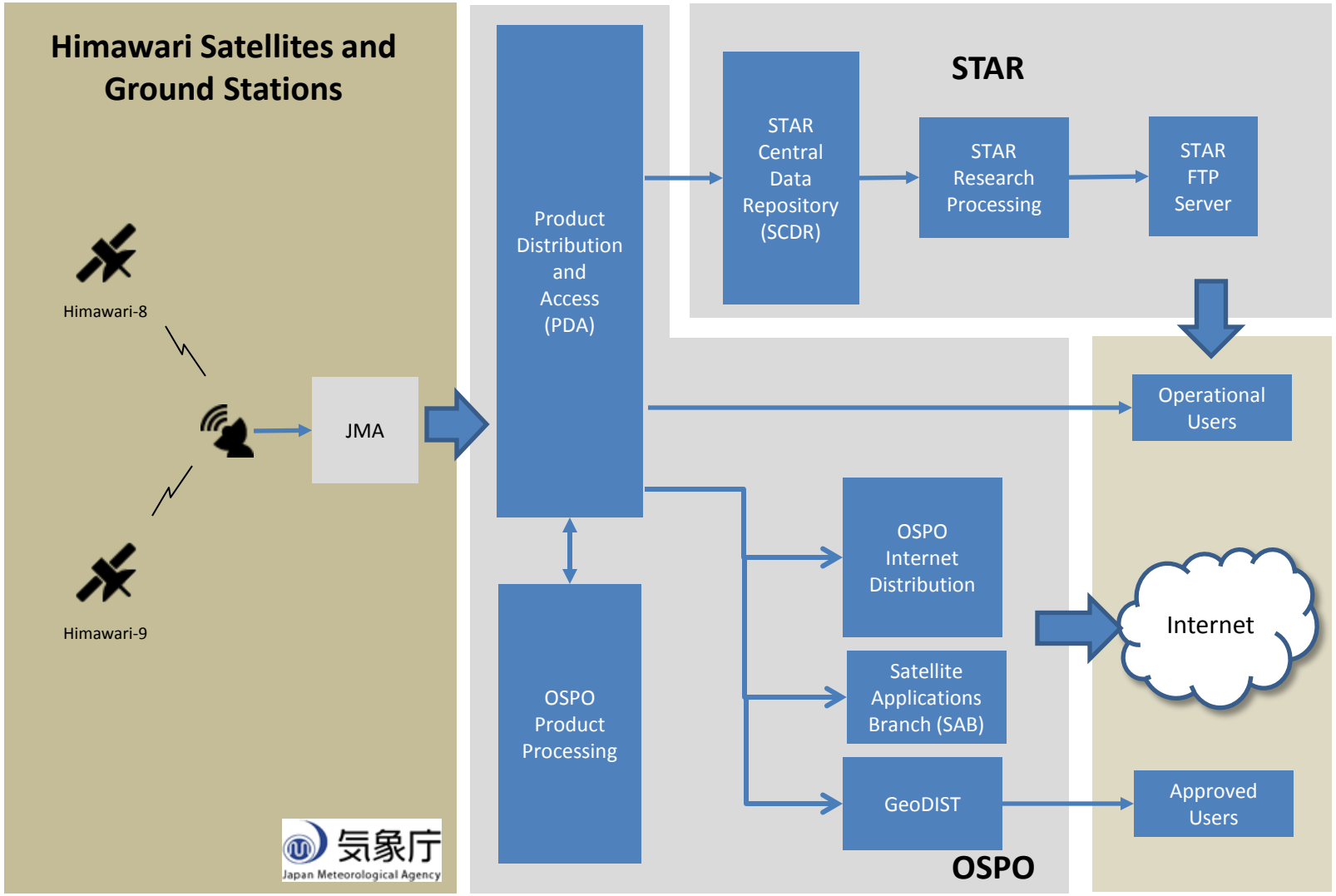
Himawari 8/9

- Present:
  - 350GB/Day all channels of AHI HSD data
  - Every full disk, 10 minutes
  - Users are NWS and NAVO.
- Planned:
  - NESDIS/OSPO to set up H-8 data in McIDAS at the current MTSAT temporal/spatial resolution and bands.
  - Replacement of MTSAT hoped to be in place by Dec 2015, but may be delayed due to other OSPO priorities.
  - Users approved for MTSAT on GEODist servers will be granted access to H-8 McIDAS.
  - Access to full resolution H-8 data (NetCDF) will only be through PDA (~2016). (Existing users will be contacted around Jan 2016 to re-validate access for PDA.)
  - Himawari-8 SST data from either STAR or from Australia BoM to replace MTSAT in our blended SST product.

Himawari 8/9 Data Flow Pre-PDA



Himawari 8/9 Data Flow PDA

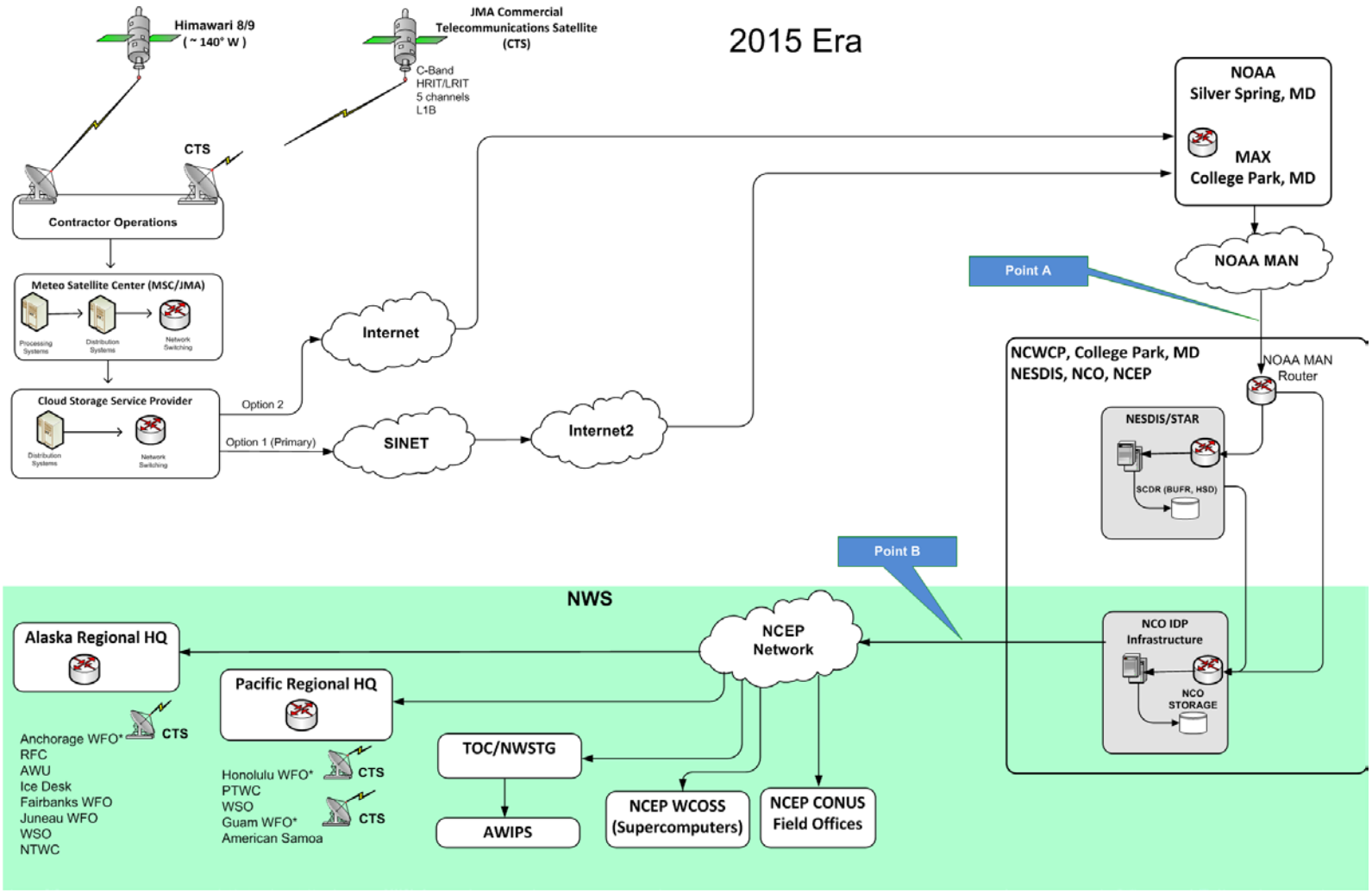


Conclusions

- Other countries are providing increasing volumes and quality of Earth environmental data.
- In many cases, these data complement NOAA polar-orbiting and geostationary data.
- NESDIS is beginning to deal with Sentinel and Himawari data.
- Need to keep these data in mind when planning for resource requirement for data acquisition, processing, and distribution.

Support slides

H-8 NWS Dissemination Architecture



Satellite Comparison for cyano

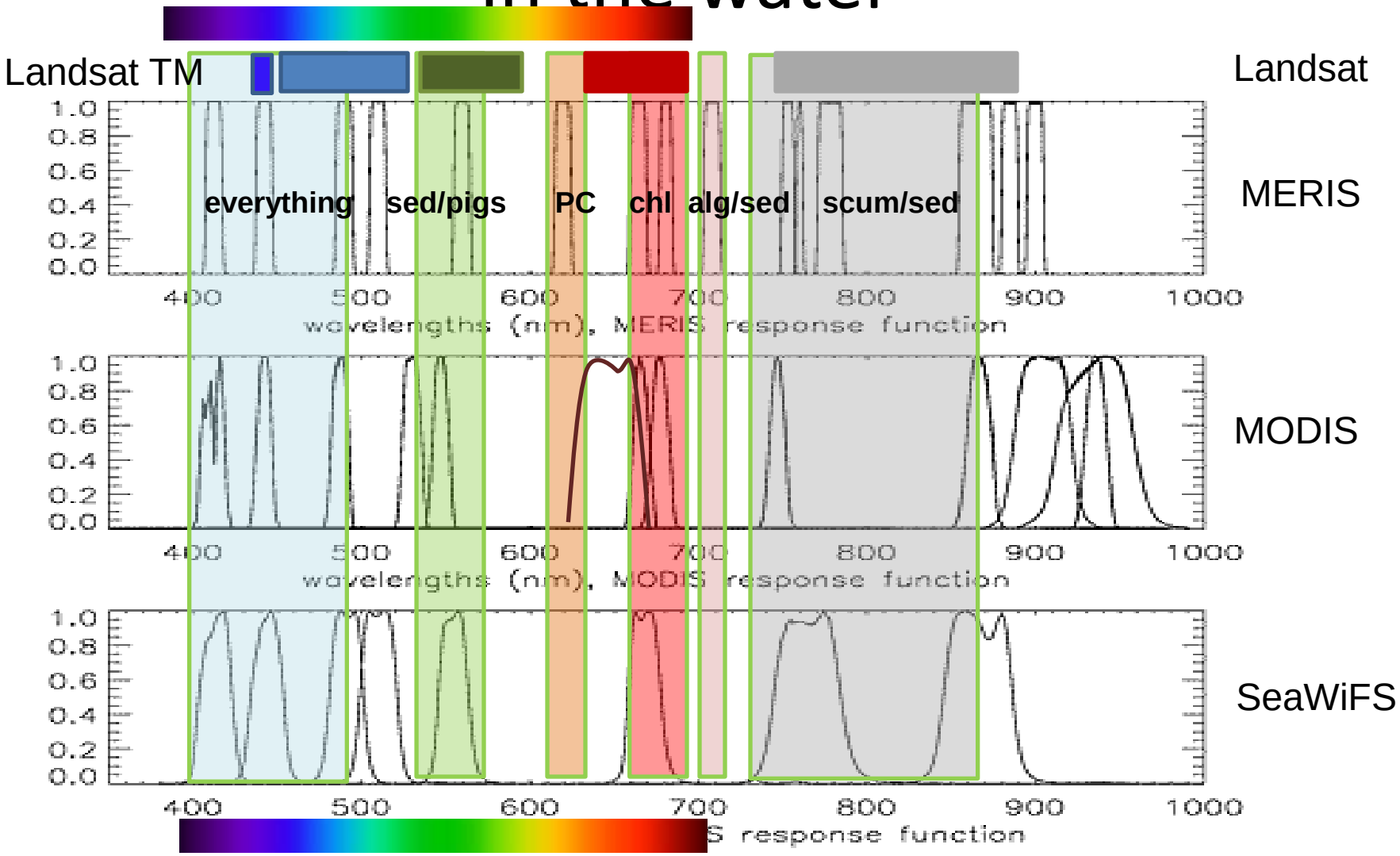
Satellite	Spatial	Temporal	Key Spectral
MERIS (2002-12) OLCI Sentinel-3 2015	300 m *OK*	2 day *good*	10 (5 on red edge) *good*
MODIS high res Terra 1999; Aqua 2002	250/500 m *OK*	1-2 day *good*	4 (1 red, 1 NIR) *marginal*
MODIS low res & SeaWiFS	1 km *poor*	1-2 day *good*	7-8 (2 in red edge) *OK*
Landsat	30 m *good*	8 or 16 day *poor*	4 (1 red, 1 NIR) *marginal*
Sentinel-2 (2015)	20 m *good*	10 day (5 day with 2nd satellite in 2017) *Potential with 2*	5 (1 red; 2 NIR, 1 in red edge) *potential*

Clouds take out 1/2 to 2/3 of imagery

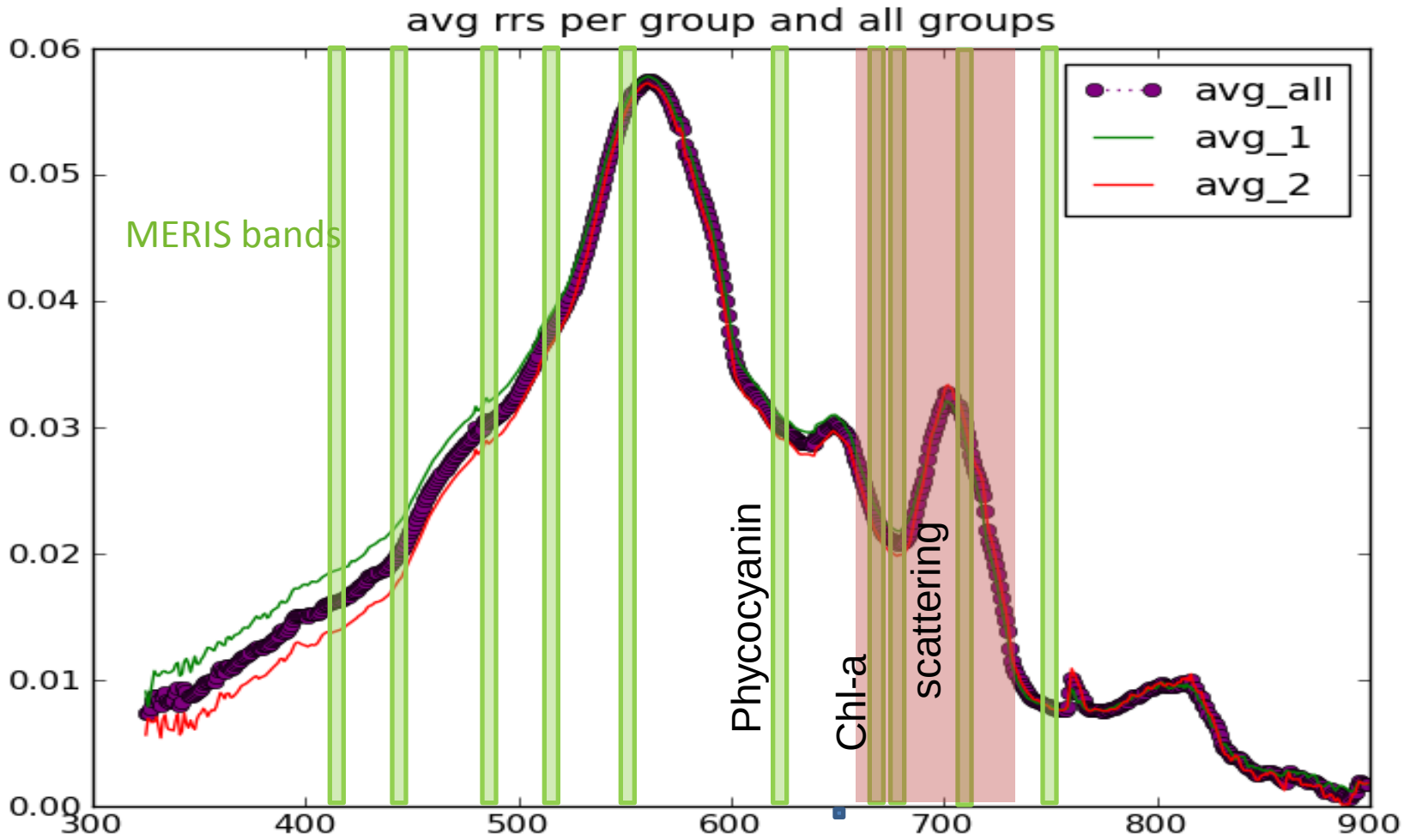
Some sunglint is not a problem for our algorithms

Minimum resolution, 3 pixels across (2 mixed land/water)

Satellite bands and sensitivity to materials in the water



Intense blooms in water, red/NIR bands provide discrimination



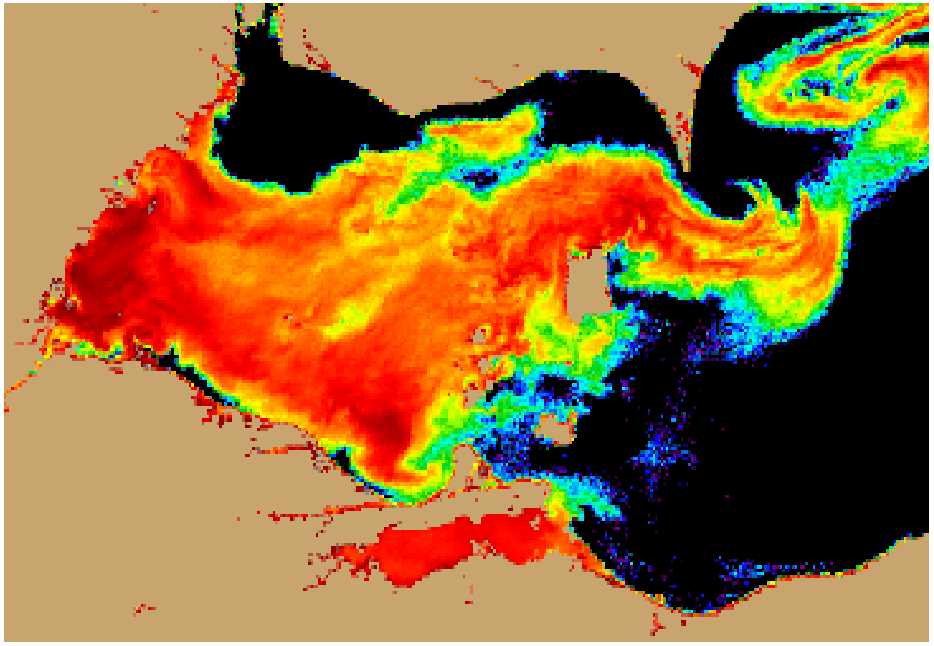
Extensive use of MERIS for monitoring

(Lake Erie example). Algorithm moved to 1 km MODIS in 2012.

Experimental
Lake Erie Harmful Algal Bloom Bulletin
2011-008
08 September 2011
National Ocean Service
Great Lakes Environmental Research Laboratory
Last bulletin: 22 July 2011

Experimental Lake Erie Harmful
National Centers for Coastal Ocean Science and Great Lak
24 August, 2015, Bulletin 13
The *Microcystis* cyanobacteria bloom continues across a large part of the western basi

MERIS 300 m



MODIS 1 km

