



EarthCARE and Himawari-8 Aerosol Products

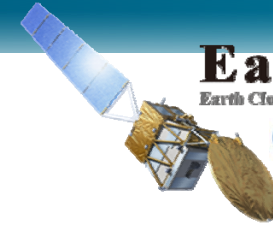
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M. Eisinger and T. Wehr (ESA/ESTEC),

EarthCARE project members and Himawari-8 group members

14th July 2016

Contact: kikuchi.maki@jaxa.jp

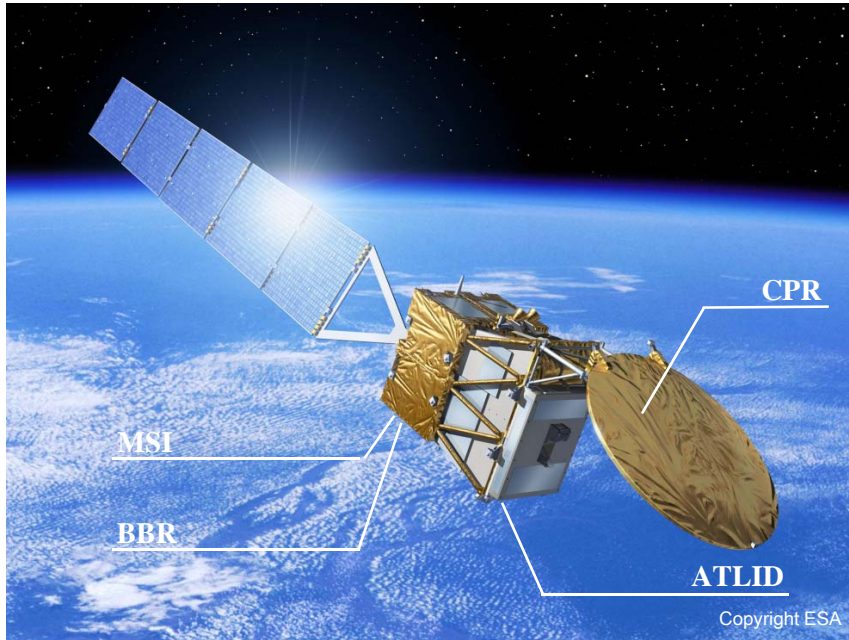
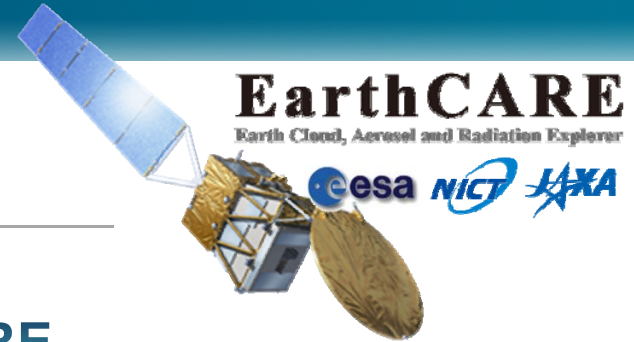


EarthCARE
Earth Cloud, Aerosol and Radiation Explorer



EarthCARE

EarthCARE Satellite



EarthCARE

Earth Clouds, Aerosol and Radiation Explorer

Observation Instruments on EarthCARE

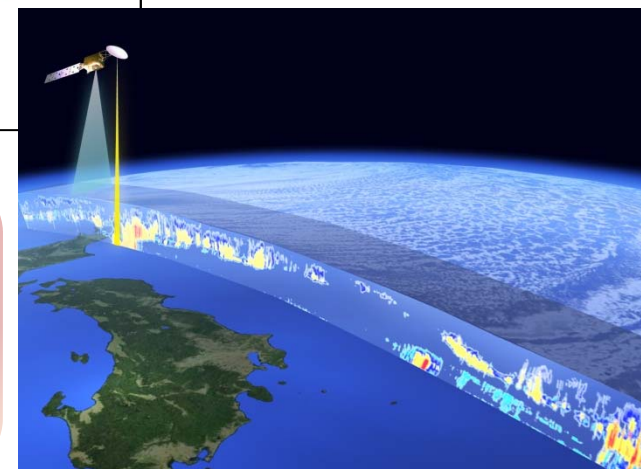
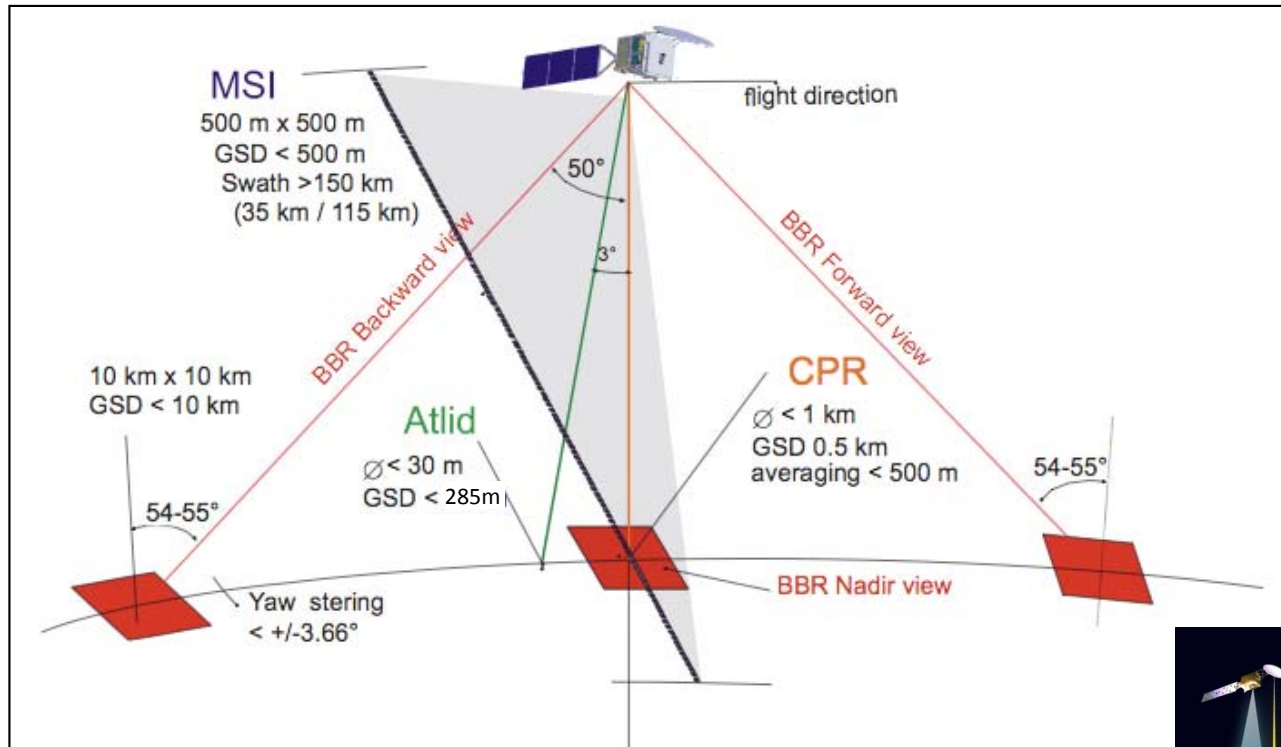
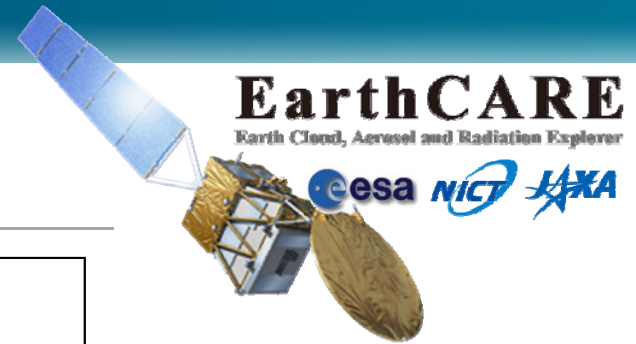
- CPR** Cloud Profiling Radar
- ATLID** Atmospheric Lidar
- MSI** Multi-Spectral Imager
- BBR** Broadband Radiometer



Synergetic Observation by 4 sensors

Institutions	European Space Agency (ESA) / National Institute of Information and Communications Technology (NICT) / Japan Aerospace Exploration Agency (JAXA)
Launch	2018 using Soyuz or Zenit (by ESA)
Mission Duration	3-years
Mass	Approx. 2200kg
Orbit	Sun-synchronous sub-recurrent orbit Altitude: approx. 400km Mean Local Solar Time (Descending): 14:00
Repeat Cycle	25 days
Orbit Period	5552.7 seconds
Semi Major Axis	6771.28 km
Eccentricity	0.001283
Inclination	97.050°

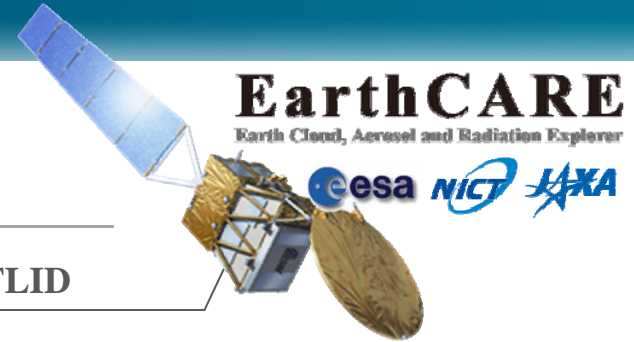
Strategy



Synergetic Observation by 4 Sensors on Global Scale

- 3-dimensional structure of aerosol and cloud including vertical motion
- Radiation flux at top of atmosphere
- Aerosol – cloud – radiation interactions

Sensors



ATLID Atmospheric Lidar

Instrument	355nm High Spectral Resolution Lidar (HSRL)
Channel	<ul style="list-style-type: none"> - Rayleigh Channel - Mie Channel (Cross-polarization) - Mie Channel (Co-polarization)
Sampling	Horizontal : 285m / Vertical : 103m
Observation Direction	3° Off Nadir (TBD)

ATLID

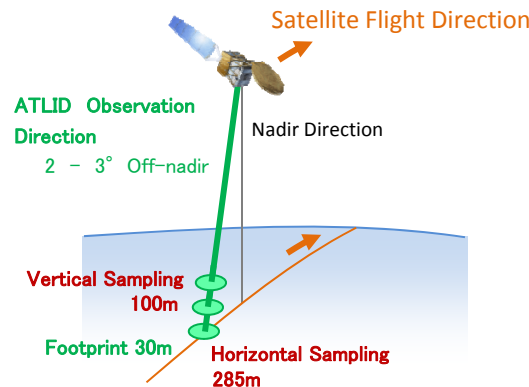
Global Observation of Cloud and Aerosol Vertical Profile and Optical Properties

ATLID is a High Spectral Resolution Lidar (HSRL) developed by European Space Agency.

Different from the traditional Mie lidar, it has the capability to separate Rayleigh scattering signal (originate from atmospheric molecules) and Mie scattering signal (originate from aerosol and cloud) by high spectral resolution filter. Thus, it has the potential to independently retrieve **backscattering coefficient** and **extinction coefficient** of atmospheric particles.

Derived Parameters

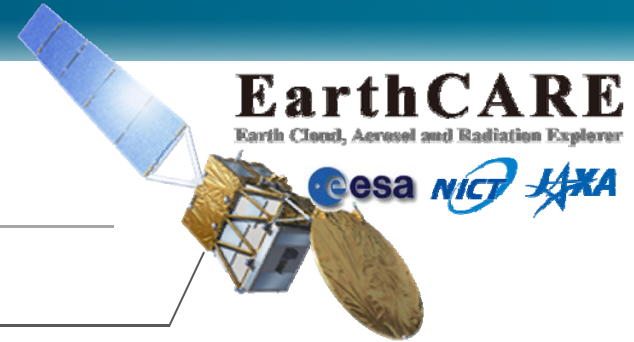
- Backscattering Coefficient
- Target Mask
- Feature Mask
- Extinction Coefficient
- Depolarization Ratio
- Lidar Ratio



Observation of Fine Particles within the Atmosphere

By 355nm (UV) wavelength, ATLID has the capability to **detect fine particles, such as thin cloud and aerosol, that were difficult to be observed by radars**. In addition, it also has the capability to achieve information of **particle shapes** by polarization observation.

Sensors



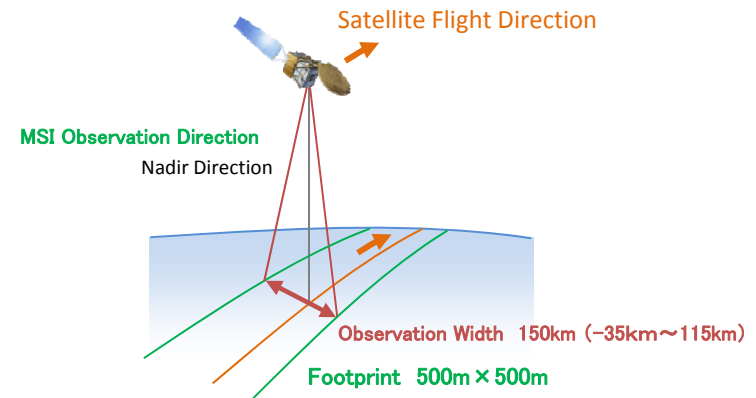
MSI

MSI

Multi-Spectral Imager

Instrument	Pushbroom Imager
Wavelength Band (Visible / Near-Infrared / Shortwave Infrared)	0.670 μm , 0.865 μm , 1.65 μm , and 2.21 μm
Wavelength Band (Thermal Infrared)	8.80 μm , 10.80 μm , and 12.00 μm
Observation Width	150 km (-35 km to +115 km)*
Footprint	500 m x 500 m

*This asymmetry is intended to reduce the influence of sunglint



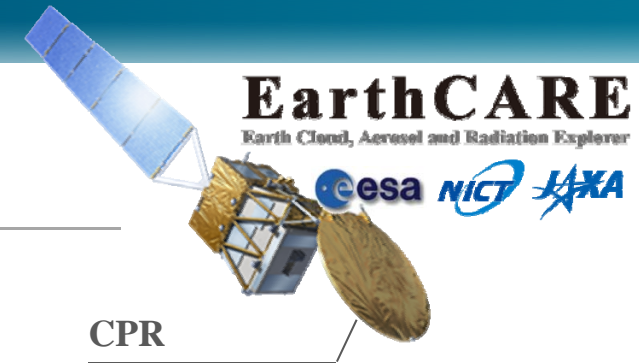
Derived Parameters

- Cloud Flag / Cloud Phase
- Liquid Optical Thickness
- Liquid Effective Radius (1.6 μm)
- Liquid Effective Radius (2.2 μm)
- Cloud Top Height
- Cloud Top Pressure
- Cloud Top Temperature

Measurement of Cloud by Multiband

MSI is an optical sensor with 7 channels from visible to thermal infrared, which measures the **cloud distribution** and cloud physical properties including **cloud effective radius** and **optical thickness**.

Sensors



CPR

Cloud Profiling Radar

Instrument	94 GHz (W-band) Doppler Radar
Center Frequency	94.05 GHz
Sampling	Horizontal : 500 m Vertical : 500m (Oversampling 100m)
Footprint	800m (Horizontal)
Pulse Repetition Frequency	6100 ~ 7500 Hz (Variable PRF)
Observation Height Range	Surface to 20km (low latitude), 16km, 12km (high latitude)

The World's First Satellite-borne Doppler Cloud Radar

CPR is a **94 GHz (W-band) Doppler Radar** jointly developed by Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT).

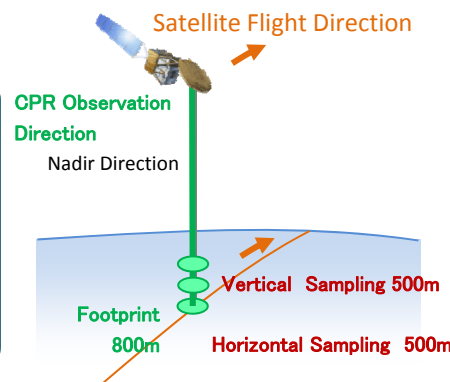
From its millimeter radar signal, it has the capability to observe **3-dimensional distribution** and **physical characteristics** of **cloud** and **drizzle**.

In addition, information on the **in-cloud vertical motion** by **Doppler measurement function** has the potential to contribute to the understanding of cloud and precipitation process.

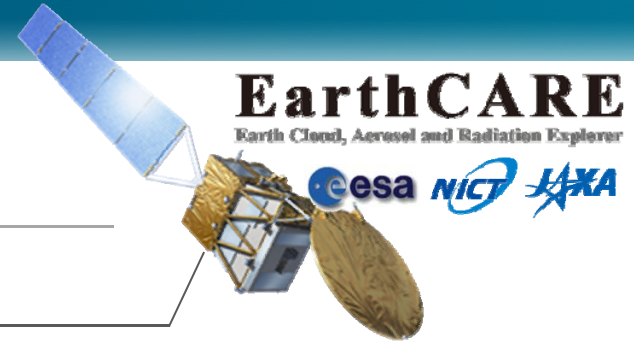
EarthCARE CPR has approximately **6 times higher sensitivity** compared to CloudSat CPR onboard in the A-Train Constellation.

Derived Parameters

Radar Reflectivity	Liquid Water Content
Doppler Velocity	Ice Water Content
Cloud Mask	Liquid Effective Radius
Cloud Particle Type	Ice Effective Radius
	Optical Thickness



Sensors



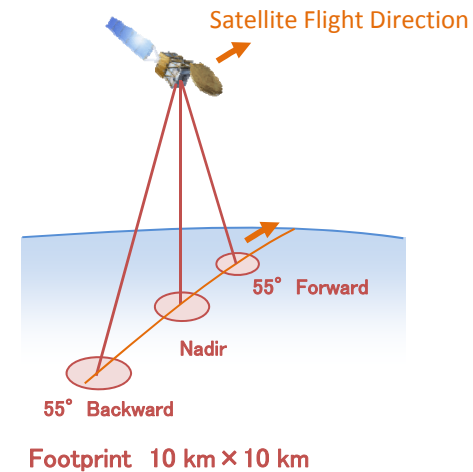
BBR

BBR

Broadband Radiometer

Wavelength Range	- Short wave : 0.2 – 4.0 μm - Long wave : 4.0 – 50 μm^*
Dynamic Range	- Short wave: 0 – 450 $\text{W}/\text{m}^2/\text{str}$ - Long wave: 0 – 130 $\text{W}/\text{m}^2/\text{str}$
Observation Direction	nadir, forward (55 deg), backward (-55 deg)
Footprint	10 km x 10 km

*The spectral radiance in Long-wave channel is calculated from Short-wave and Total-wave (0.2- 50 μm) observations. (based on MRD)



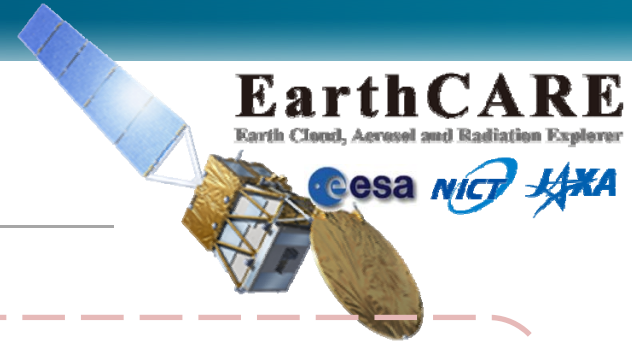
Measurement of Radiation Flux at Top of Atmosphere

BBR has the sensitivity to shortwave and totalwave broadband radiances from which **shortwave and longwave radiation flux** at the top of atmosphere can be retrieved.

Derived Parameters

Radiation (Longwave / Shortwave)
Radiation Flux(Longwave / Shortwave)

JAXA EarthCARE Products



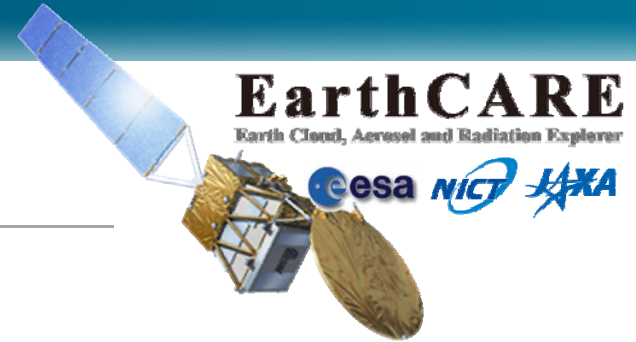
Standard Product

- strongly promoted to be developed and released
- processed and released from JAXA/MOS (Mission Operation System)
- all data will be able to be sent to ESA operationally when produced

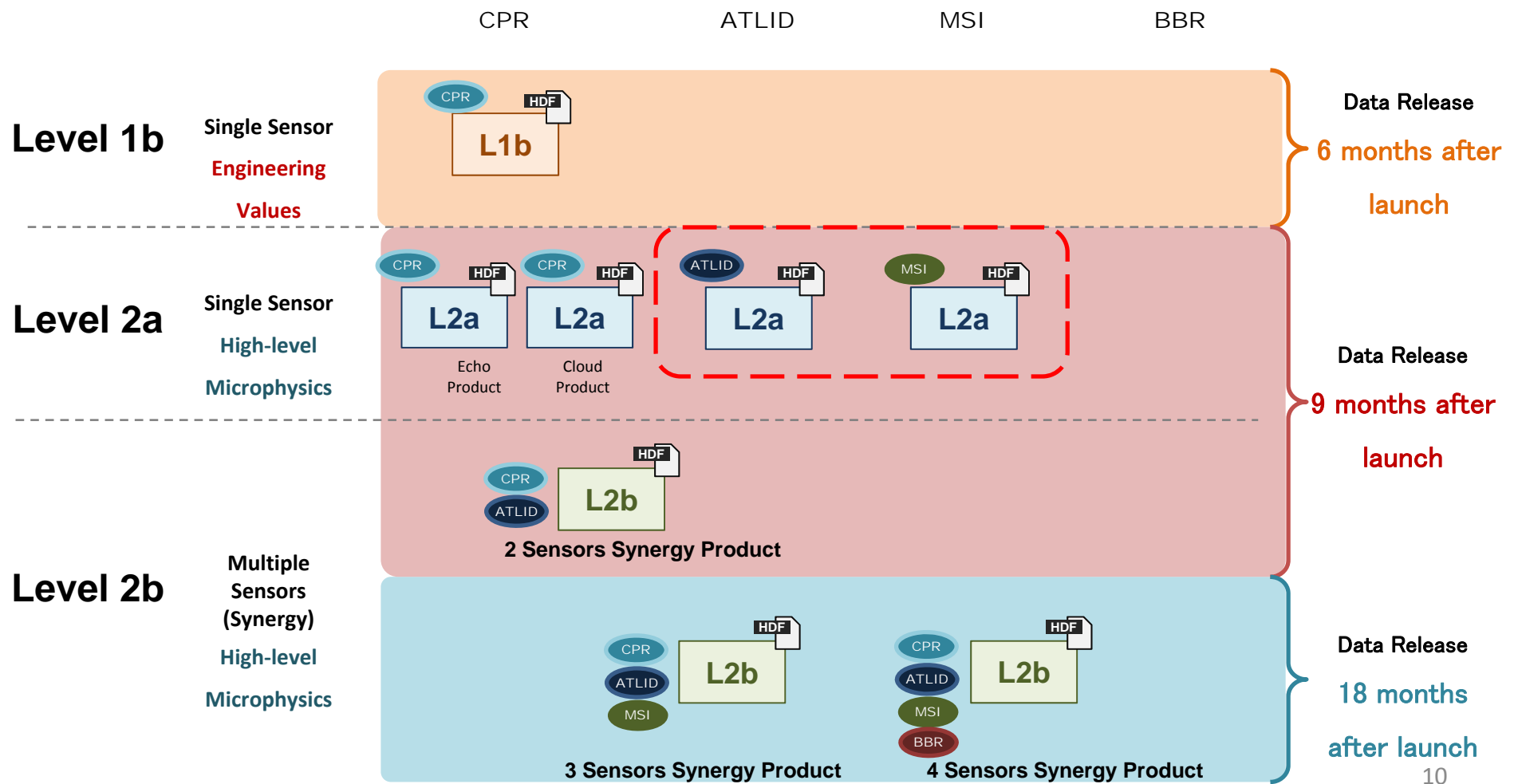
Research Product

- promoted to be developed and released
- some are planned to be upgraded to standard products
- further divided into two groups;
 - EORC Research Products (ER)
 - processed and released from JAXA/EORC
 - Laboratory Research Products (LR)
 - from cooperating Japanese Laboratories

Product Release Timing

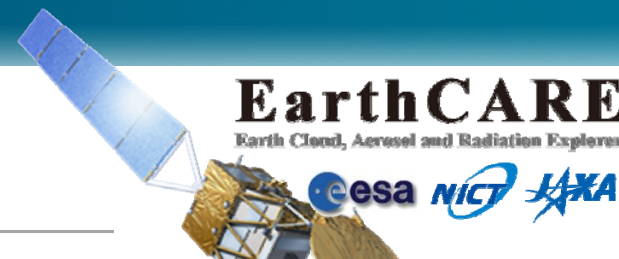


JAXA Standard Product and its Release Timing



EarthCARE Products

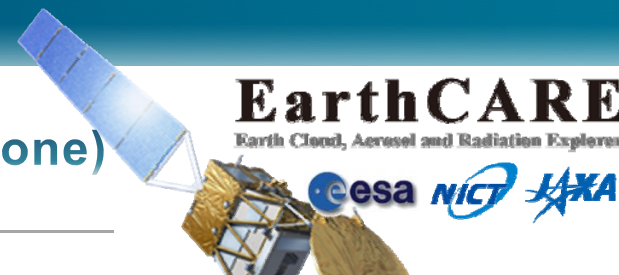
JAXA & ESA Product (L1b/c:Stand-alone)



Sensor(s)	Processing Level	Product Name (Product ID for ESA)	Primary Parameter	Grid Spacing		File Unit File Format	Data Volume per day*
				Horizontal	Vertical		
CPR	L1b	CPR One-Sensor Received Power and Doppler Product	Received Echo Power / Radar Reflectivity Factor / Doppler Velocity / Pulse Pair Covariance / Spectrum Width	0.5 km	0.1 km	1/8 orbit HDF	51.3GB
			Surface Radar Cross Section	0.5 km	-		
ATLID	L1b	A-NOM	Rayleigh and Mie Backscattering coefficient * Mie component has horizontal and vertical depolarization component	0.285 km	0.103 km	1/8 orbit netCDF	91.6GB
MSI	L1b	M-NOM	Radiation Intensity * Visible(0.67μm), Near IR(0.865μm), SW IR(1.65μm, 2.21μm), LW IR(8.80μm, 10.80μm, 12.00μm)	0.5 km	-	1/8 orbit netCDF	83.9GB
BBR	L1b	B-NOM	SW and LW Radiation (Forward, Nadir, Backward)	10 km	-	1/8 orbit netCDF	2.3GB
Sensor(s)	Processing Level	Product Name (Product ID for ESA)	Primary Parameter	Grid Spacing		File Unit File Format	Data Volume per day*
				Horizontal	Vertical		
MSI	L1c	M-NOM	L1b Radiation Intensity (interpolated to the location of a reference band)	0.5 km	-	1/8 orbit netCDF	18.3GB

* 125 files per day is assumed without compression. ATLID, MSI, BBR is ESA product.

JAXA Standard Products (L2a:Stand-alone)



Sensor(s)	Processing Level	Product Name	Primary Parameter (Red: Spatial-integrated values will be also generated)	Grid Spacing		File Unit File Format	Data Volume per day*
				Horizontal	Vertical		
CPR	L2a	CPR One-sensor Echo Products	Integrated Radar Reflectivity Factor Integrated Doppler Velocity Gas Correction Factor	1 km	0.1 km	1/8 orbit HDF	116.0GB
CPR	L2a	CPR One-sensor Cloud Products	Cloud Mask / Cloud Particle Type / Liquid Water Content / Ice Water Content / Effective Radius of Liquid Water Cloud / Effective Radius of Ice Water Cloud	1 km	0.1 km	1/8 orbit HDF	131.8GB
			Optical Thickness	1 km	-		
ATLID	L2a	ATLID One-sensor Cloud and Aerosol Products	Feature Mask	0.2 km	0.1 km	1/8 orbit HDF	70.8GB
			Target Mask	1 km	0.1 km		
			Aerosol Extinction Coeff. / Aerosol Backscat. Coeff. / Aerosol Lidar Ratio / Aerosol Depolarization Ratio	10km	0.1 km		
			Cloud Extinction Coeff. / Cloud Backscat. Coeff. / Cloud Backscat. Coeff. / Cloud Depolarization Ratio	1 km	0.1 km		
			Cloud Depolarization Ratio	1 km	0.1 km		
MSI	L2a	MSI One-sensor Cloud Products	Cloud Flag including Cloud Phase / Optical Thickness of Liquid Water Cloud / Effective Radius of Liquid (1.6 μ m) / Effective Radius of Liquid (2.2 μ m) / Cloud Top Temperature / Cloud Top Pressure / Cloud Top Height	0.5 km	-	1/8 orbit HDF	163.6GB

* 125 files per day is assumed without compression.

JAXA Research Products (L2a:Stand-alone)



Sensor(s)	Processing Level	Status	Product Name	Primary Parameter (Red: Spatial-integrated values will be also generated)	Grid Spacing		File Unit File Format
					Horizontal	Vertical	
CPR	L2a	Red R	CPR One-sensor Doppler Products	Doppler velocity correction value (considering inhomogeneity) / Doppler velocity unfolding Value / Radar Reflective Factor with Attenuation	1 km	0.1 km	1/8 orbit HDF
		ER	CPR One-sensor Rain and Snow Products	Rain Water Content / Snow Water Content / Rain Rate / Snow Rate	1 km	0.1 km	1/8 orbit HDF
		ER	CPR One-sensor Vertical Velocity Products	Vertical Air Motion / Sedimentation Velocity	1 km	0.1 km	1/8 orbit HDF
ATLID	L2a	ER	ATLID One-sensor Aerosol Extinction Products	Aerosol Extinction Coefficient (Water Soluble) / Aerosol Extinction Coefficient (Dust) / Aerosol Extinction Coefficient (Sea Salt) / Aerosol Extinction Coefficient (Black Carbon)	1 km	0.1 km	1/8 orbit HDF
MSI	L2a	ER	MSI One-sensor Ice Cloud Products	Optical Thickness of Ice Cloud with Reflection method / Effective Radius of Ice Cloud (1.6 μ m) / Effective Radius of Ice Cloud (2.2 μ m) / Ice Cloud Top Temperature / Ice Cloud Top Pressure / Ice Cloud Top Height	0.5 km	-	1/8 orbit HDF
		ER	MSI One-sensor Aerosol Products	Aerosol Optical Thickness (Ocean) / Aerosol Optical Thickness(Land) / Angstrom Exponent (Ocean)	0.5 km	-	1/8 orbit HDF

“Red R” = Research product, would be processed in JAXA EORC Research and Application System, and to be upgraded to standard after one year or later when the release accuracy is approved.
 “ER” = Research product, would be processed in JAXA EORC Research and Application System. “LR” = Research product, would be processed in Japanese Laboratories

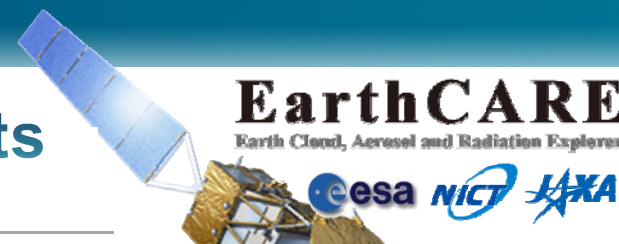
JAXA Research Products (L2a:Synergy)



Sensor(s)	Processing Level	Status	Product Name	Primary Parameter (Red: Spatial-integrated values will be also generated)	Grid Spacing		File Unit File Format
					Horizontal	Vertical	
CPR + ATLID	L2a	Red R	CPR-ATLID Synergy Particle Mass Ratio Products	Mass Ratio (2D_Ice/IWC)	1 km	-	1/8 orbit HDF
		ER	CPR-ATLID Synergy Rain & Snow Products	Rain Water Content / Snow Water Content / Rain Rate / Snow Rate	1 km	0.1 km	1/8 orbit HDF
		ER	CPR-ATLID Synergy Vertical Velocity Products	Vertical Air Motion / Sedimentation Velocity	1 km	0.1 km	1/8 orbit HDF
ATLID + MSI	L2a	ER	ATLID-MSI synergy Aerosol Components Products	Aerosol Extinction Coefficient (Water Soluble) / Aerosol Extinction Coefficient (Dust) / Aerosol Extinction Coefficient (Sea Salt) / Aerosol Extinction Coefficient (Black Carbon) / Mode Radius	10 km	0.1 km	1/8 orbit HDF
CPR + ATLID + MSI	L2a	LR	CPR-ATLID-MSI Synergy Cloud Doppler Products	Cloud Mask / Cloud Particle Type / Liquid Water Content / Ice Water Content / Effective Radius of Liquid Water Cloud / Effective Radius of Ice Water Cloud (with Doppler)	1 km	0.1 km	1/8 orbit HDF
				Optical Thickness / Liquid Water Path / Ice Water Path (with Doppler)	1 km	-	1/8 orbit HDF
		LR	CPR-ATLID-MSI Synergy Rain and Snow Products	Rain Water Content / Snow Water Content / Rain Rate / Snow Rate	1 km	0.1 km	1/8 orbit HDF
		LR	CPR-ATLID-MSI Synergy Vertical Velocity Products	Vertical Air Motion / Sedimentation Velocity	1 km	0.1 km	1/8 orbit HDF
		LR	CPR-ATLID-MSI Synergy Emission Method Products	Effective Radius of Ice Cloud derived from Emission Method / Optical Thickness of Ice Cloud derived from Emission	0.5 km	-	1/8 orbit HDF

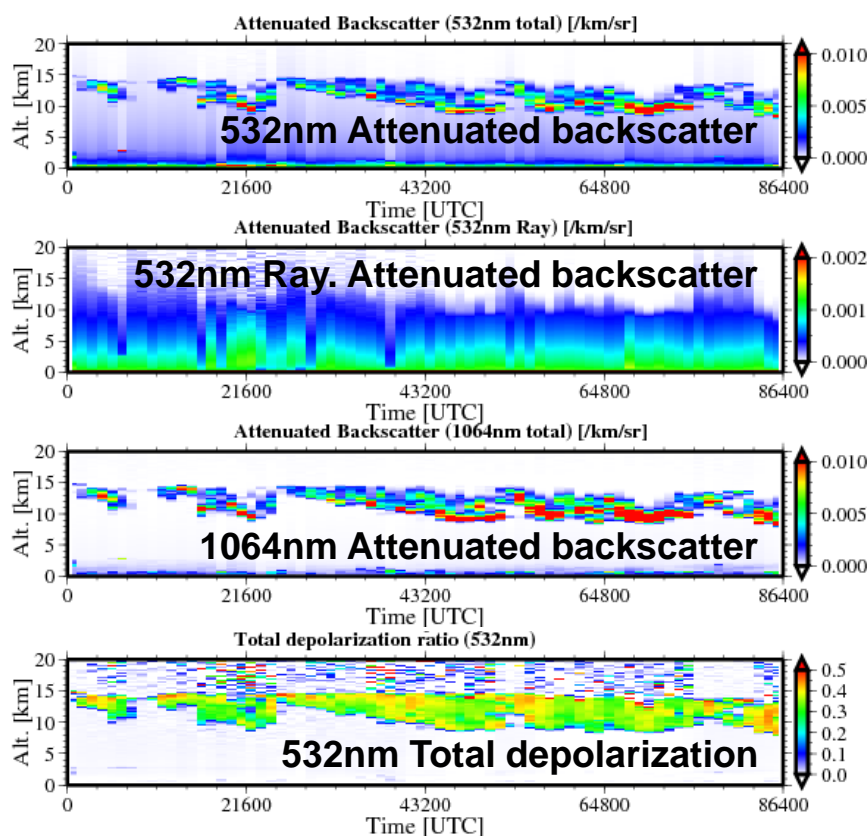
“Red R” = Research product, would be processed in Japanese Laboratories Research and Application System, and to be upgraded to standard after one year or later when the release accuracy is approved.
 “ER” = Research product, would be processed in Japanese Laboratories Research and Application System.
 “LR” = Research product, would be processed in Japanese Laboratories

An example of expected Lidar Products - Demonstration using CALIOP data -

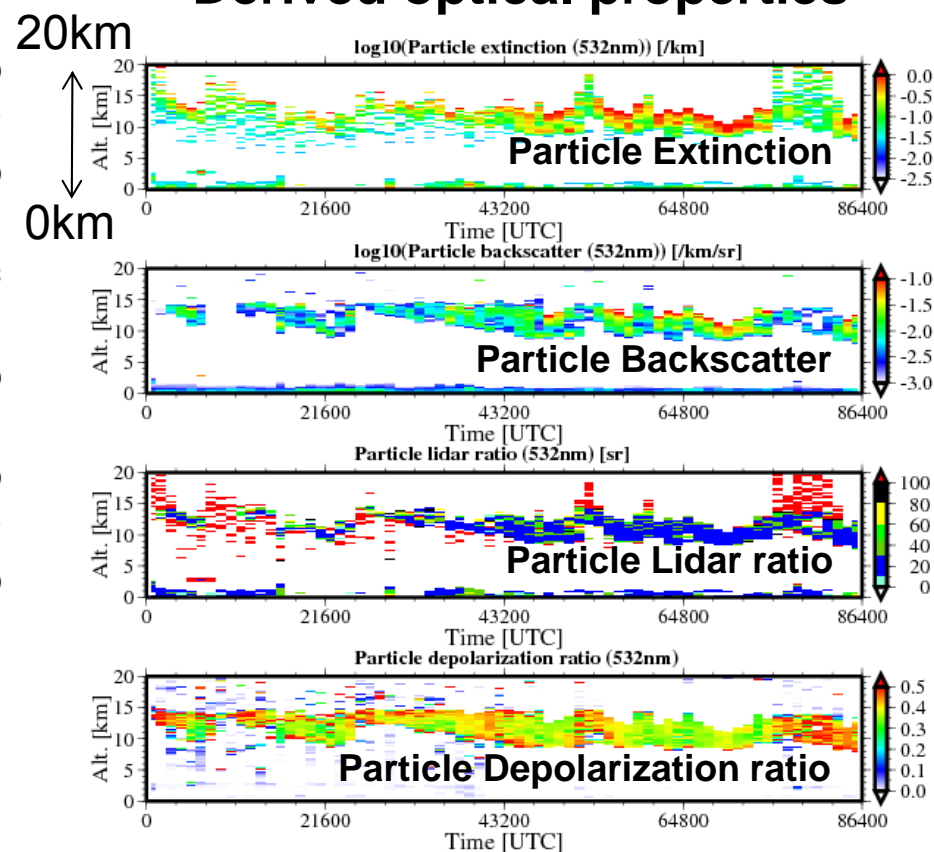


→ detailed information presented by Dr. Sugimoto (NIES)

Measured signals



Derived optical properties



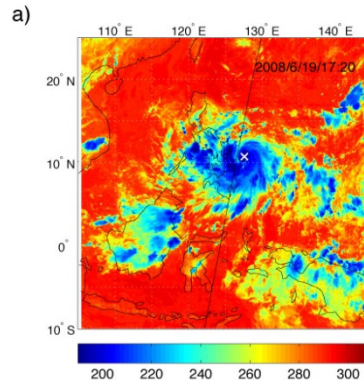
$\Delta Z = 90 \text{ m}$
 $\Delta T = 20 \text{ min}$

Evaluation of numerical models

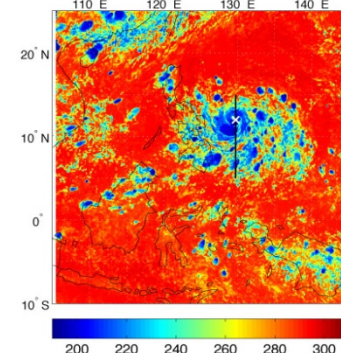


Infrared (10.8 mm) T_b

Observation

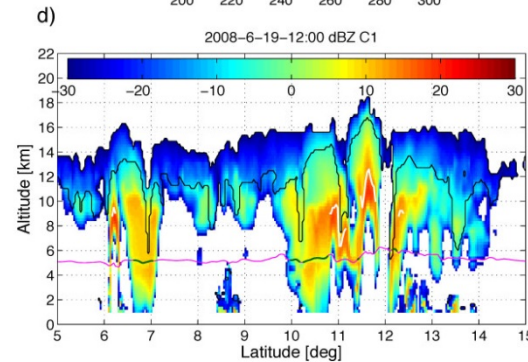
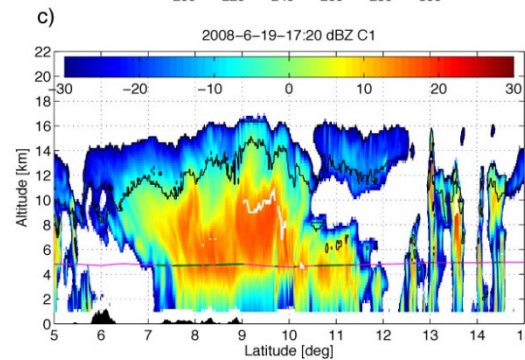


Simulation
(NICAM & Joint-Simulator)

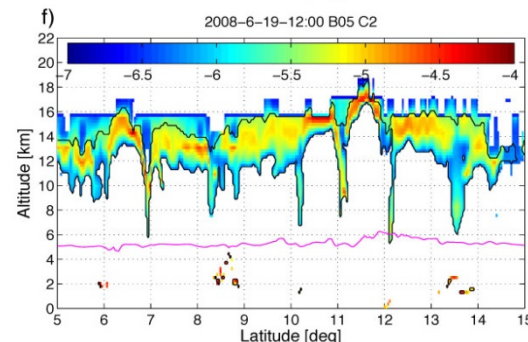
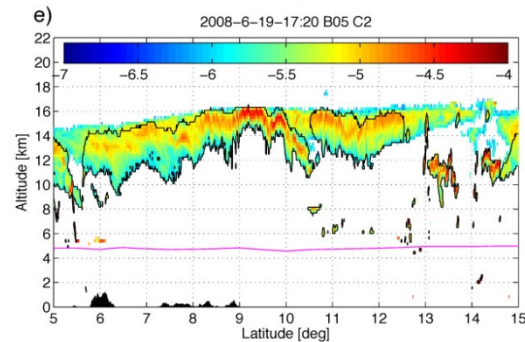


(This analysis uses NICAM data. It also can be used for WRF and JMA-NHM)

95 GHz radar reflectivity
(CloudSat/CPR)



532 nm backscattering coefficient
(CALIPSO)



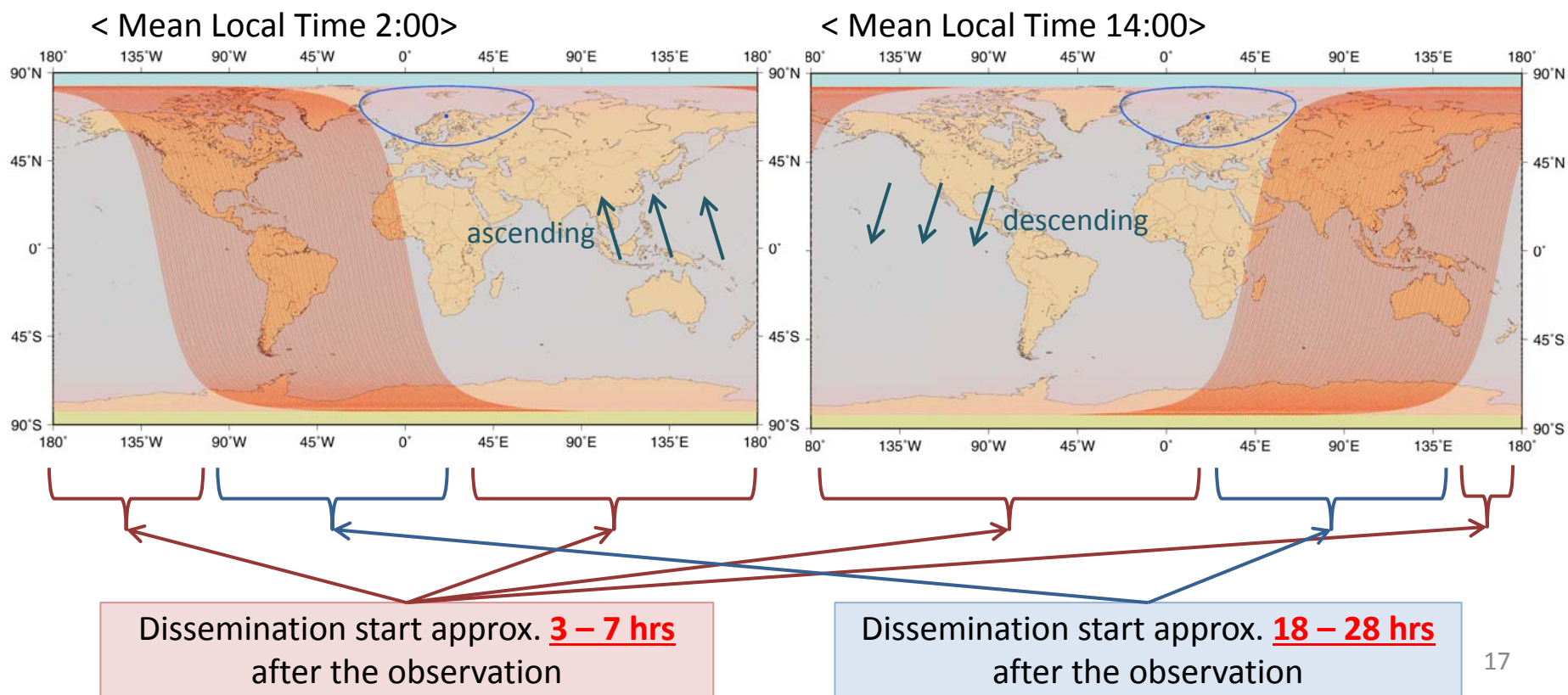
(Hashino et al. 2013)₁₆

Data Latency



60-65% of the data products are able to be disseminated a few hours after the observation where the EarthCARE satellite passes over relatively close to the ground station.

However, 35-40% of the data product dissemination will delay to some extent where the satellite is on the blind orbit and the station cannot downlink the data.



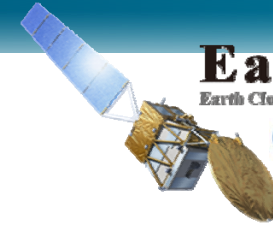
EarthCARE Data Dissemination Timing

JAXA(Standard) & ESA Products (L1b/c: Stand-alone)



Sensor	Level	Product Name (Product Identifier for ESA)	Nominal (60–65%)	Worst (35–40%)
CPR	L1b	CPR One-Sensor Received Power and Doppler Product		
ATLID	L1b	A-NOM	3.1 hours	18 hours
MSI	L1b	M-NOM		
BBR	L1b	B-NOM		
MSI	L1c	M-NOM	3.6 hours	20 hours
CPR	L2a	CPR One-sensor Echo Product	5.4 hours	23 hours
CPR	L2a	CPR One-sensor Cloud Product		
ATLID	L2a	ATLID One-sensor Cloud Aerosol Product	4.4 hours	23 hours
MSI	L2a	MSI One-sensor Cloud Product		
CPR ATLID	L2b	CPR-ATLID Synergy Cloud Product	6.1 hours	26 hours
CPR ATLID MSI	L2b	CPR-ATLID-MSI Synergy Cloud Product		
4Sensors	L2b	4 Sensor Synergy Radiation Budget Product		

※ ATLID, BBR, MSI products are ESA product. Primary parameters are TBD. ※ Hours are time after observations ※ All information are TBD⁵



EarthCARE

Earth Cloud, Aerosol and Radiation Explorer



Himawari-8

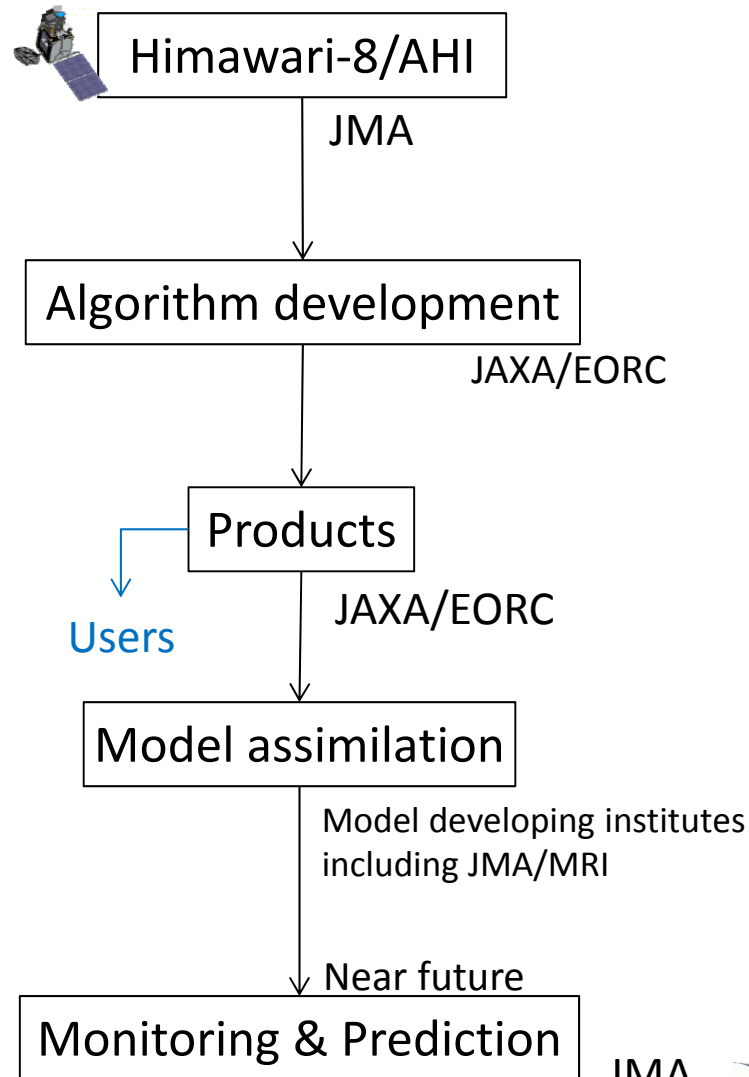
Japanese Geostationary Satellite “*Himawari-8*”

- 7th October 2014 : Launched from Tanegashima Space Center
- 7th July 2015 : Official Operation Started
- Loads a multiwavelength imager called Advanced Himawari Imager (AHI)
- 16 band in visibal to infrared wavelength range (5 bands in previous Himawari 6/7)
- Spatial Resolution increased 2 times (e.g. from 1km to 0.5 km in visible band)
- Observation frequency of full-disk also increased from 30 minutes interval to 10 minutes interval



Center Wavelength of Himawari-8/AHI					
Band	Wavelength (μm)	Resolution (km)	Band	Wavelength (μm)	Resolution (km)
1	0.47	1	9	6.9	2
2	0.51		10	7.3	
3	0.64	0.5	11	8.6	
4	0.86	1	12	9.6	
5	1.6	2	13	10.4	
6	2.3		14	11.2	
7	3.9		15	12.4	
8	6.2		16	13.3	

Collaboration with external organizations



JAXA Himawari Monitor

Image from yesterday

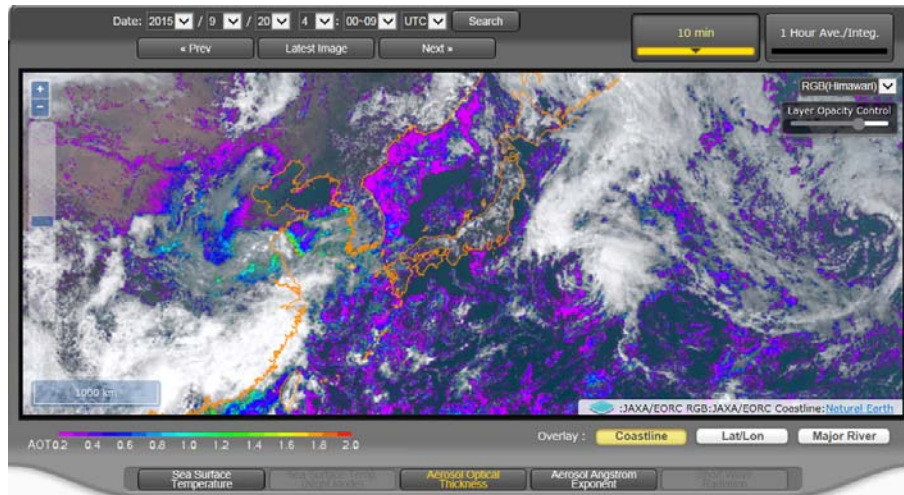
http://www.eorc.jaxa.jp/ptree/index_j.html

- Opened the webpage on 31st August
- Registration: 348 people (on 4th July)
- Shows images on the Webpage
- Disseminates Himawari Standard data and geophysical data via FTP
- Data can be achieved with simple user registration

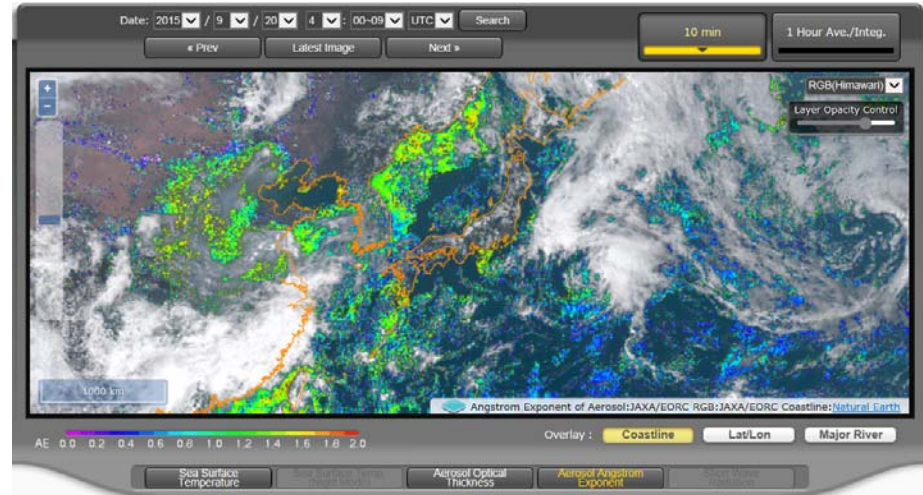
The screenshot shows the JAXA Himawari Monitor interface. At the top, it displays the title 'JAXA Himawari Monitor' and 'P-Tree System'. Below this, there are navigation options for language (日本語) and a search bar. The main content area features a satellite image of Earth with various data overlays, including a color-coded AOT (Aerosol Optical Thickness) scale from 0.2 to 2.0. Below the image, there are buttons for different data layers: Sea Surface Temperature, Sea Surface Temp. (Night Mode), Aerosol Optical Thickness, Aerosol Angstrom Exponent, Short Wave Radiation, and Chlorophyll-a. A 'What's New' section is visible, dated Apr/08/16, mentioning system maintenance. At the bottom, there is a 'User Registration' button with a right-pointing arrow, which is highlighted with a large orange arrow pointing to a larger 'User Registration' button in a separate box at the bottom of the slide.

Example of JAXA Himawari Products

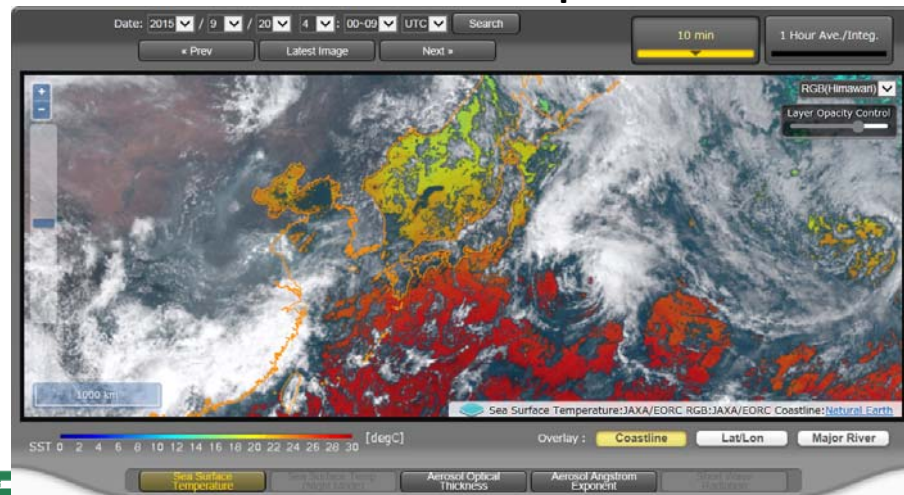
Aerosol Optical Thickness at 04:00Z Sep. 20



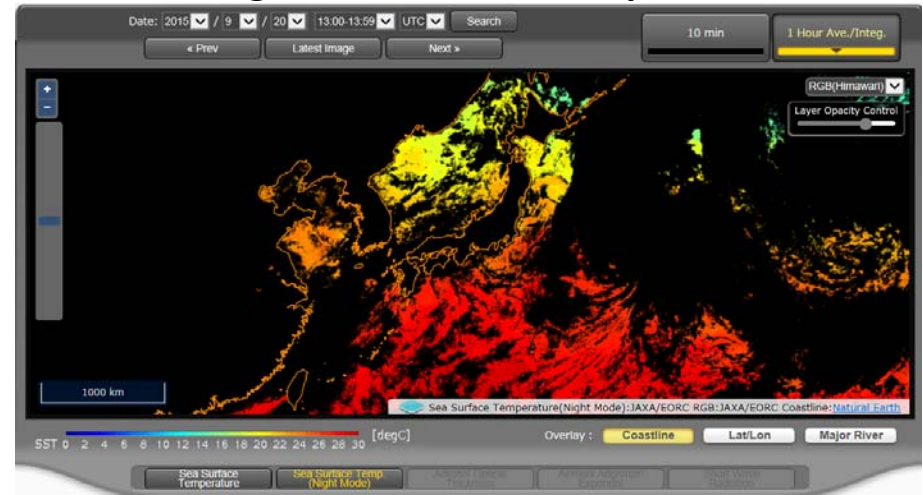
Aerosol Angstrom Exponent at 04:00Z Sep. 20



SST at 04:00Z Sep. 20



Nighttime SST at 13Z Sep. 20



Products to be released from JAXA/EORC

JAXA Himawari-8 products (planned)				
Level	Product name		Grid size	Format
L1	Reflectance (6 bands) Brightness temperature (10 bands)		Himawari Standard Format (NetCDF4**)	
L2	Atmosphere	Aerosol properties Cloud properties**	0.02°-0.05° Equal lat-lon grid (Full disk)	NetCDF4
	Ocean	Sea surface temperature Ocean color		
	Land	Vegetation index* Snow cover*		
	Radiation	Photosynthetically active radiation Fire Detection**		

*Research products (Ocean color (TSM, chlorophyll-a conc..), Snow cover..) are under investigation

**Planned to be released in the Autumn this year.

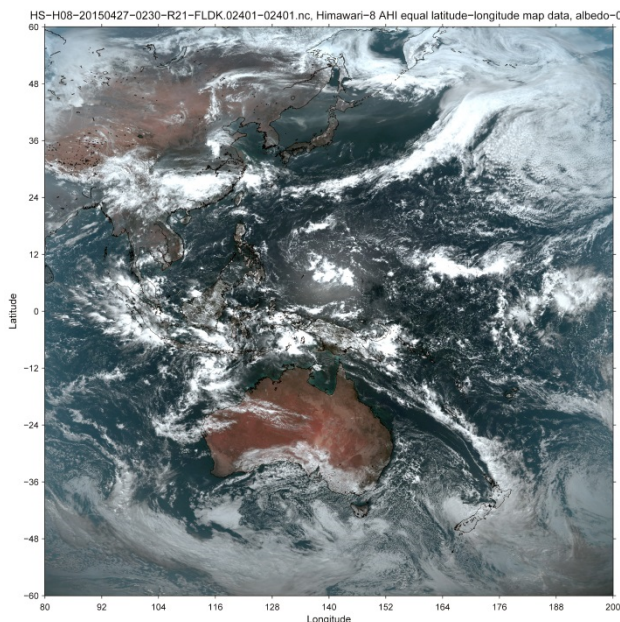
L1 data (NetCDF4)

Examples in 27 April 2015

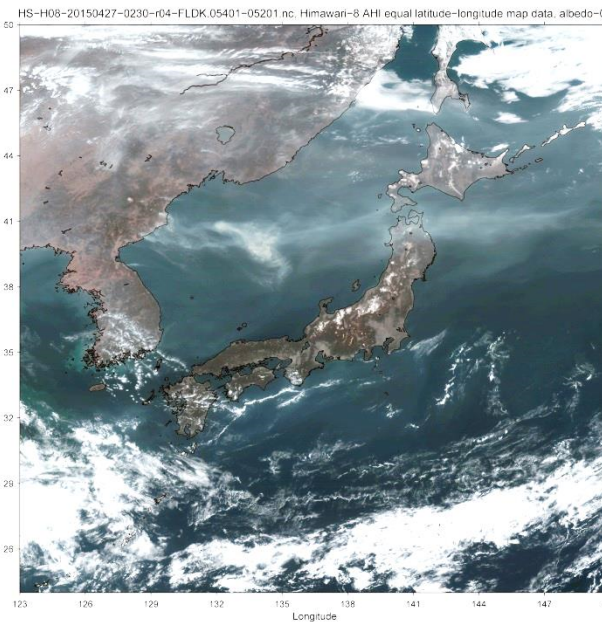
Planned to release NetCDF product
in the Autumn this year



Himawari standard projection
(4-pixel interval, jointed to a
full-disk data)



Equal lat-lon grid data
(0.05-deg, and 0.02-deg)



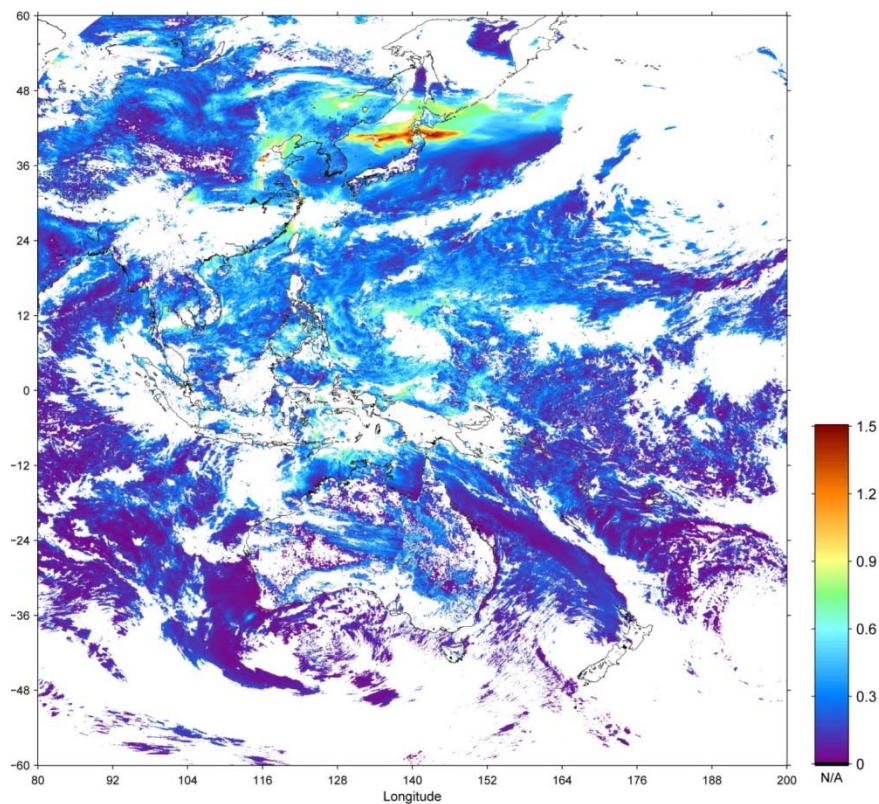
Equal lat-lon around Japan
(0.01-deg, VIS-SWIR(6)+TIR(3))

L1 data contents:

- Reflectance (6 bands)
- Brightness temperature (10 bands)
- Satellite zenith, azimuth, solar zenith, azimuth, and observation hours

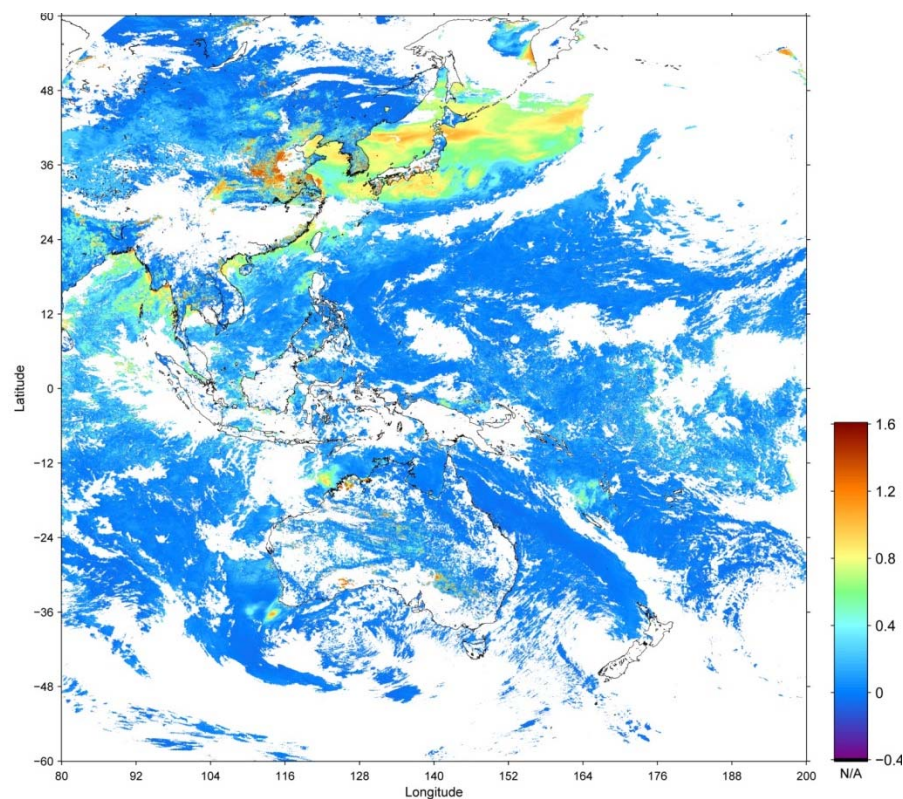
Aerosols: Examples in 27 April 2015

Aerosol Optical Thickness



※ 昼間平均

Aerosol Angstrom Exponent



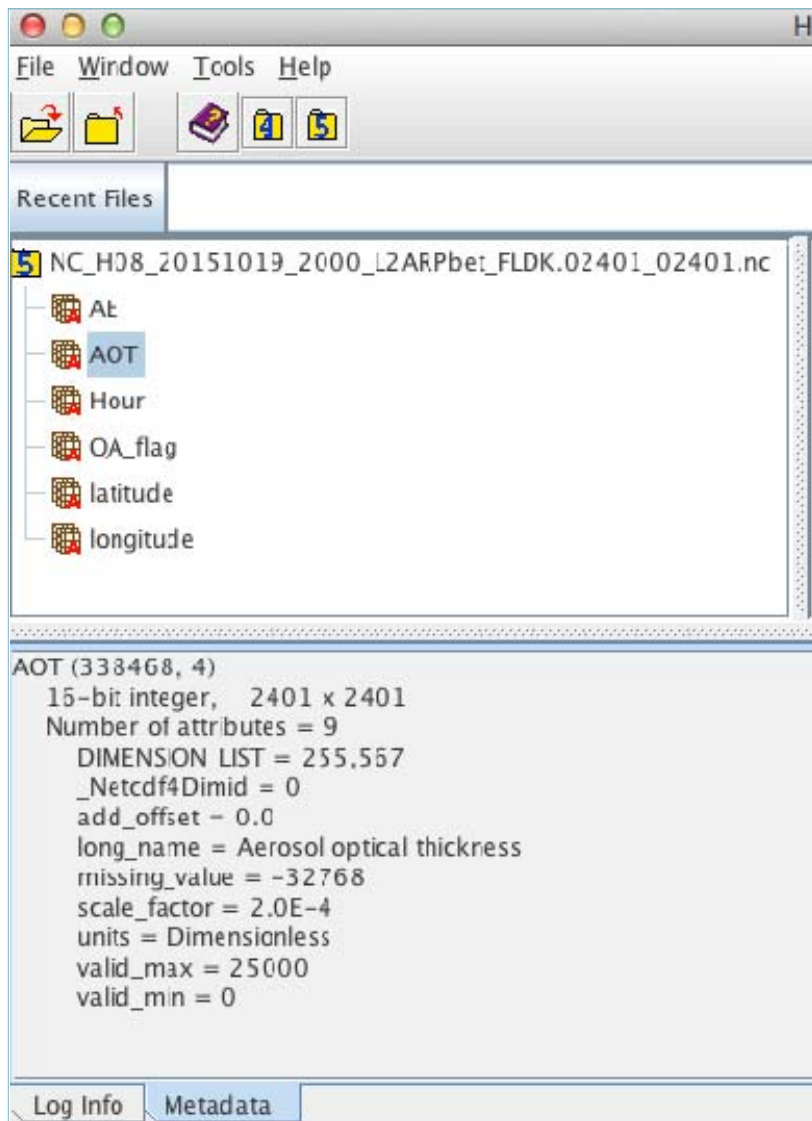
※ 昼間平均

(Courtesy to Dr. Higurashi for retrieval algorithm over land)

Himawari Aerosol Product

- Two aerosol products:
 - L2 Aerosol Properties (Snapshot)
 - Already Released. Major Update in Autumn this year.
 - NetCDF4 format, 0.05° Equal lat-lon grid, full disk, processed every 10 minutes
 - L3 Aerosol Properties (Hourly Combined)
 - Planned to be released in Autumn this year.
 - NetCDF4 format, 0.05° Equal lat-lon grid, full disk, processed every 1 hour (possible to process every 10 minutes if requested from users)
- Disseminated within 1 hour after observation (approx. 40 minutes in average for L2 aerosol snapshot)
- Both L2 and L3 products will be (re-)processed from 7th July 2015 (start of Himawari-8 official operation)

L2 Aerosol Product (Snapshot)



1. Geometry, Observation time
 - **latitude, longitude**
 - **Hour**
2. Retrieval
 - **AOT**: Aerosol optical thickness at 500nm
 - **AE** : Aerosol Angstrom exponent
3. Quality
 - **QA_flag** : Quality assurance flag(in bit field)
 - Data availability / Retrieval Status
 - Land / Water flag
 - Cloud flag / Additional cloud test
 - AOT/AE confidence
 - Solar/Satellite zenith angle > 70

✘ latitude, longitude are in 1-dimension, others in 2-dimensions

Quality Assurance Flag

- Consistent with Himawari-8 and GCOM-C/SGLI product

Bit Field	Description key	Result	Detail	Group
0 (LSB)	Data availability	0 = available / 1 = no data	1 if radiance was missing	Common
1	Land / Water flag	0 = land / 1 = water	Original data from MODIS Land Water Mask (MOD44W)	
2	Cloud flag	0 = clear / 1 = cloud	Cloud Screening (CLAUDIA) Result	
3	Retrieval status	0 = successful / 1 = failed	1 if retrieval failed	
4 – 5	AOT confidence	00 = very good 01 = good (not used) 10 = marginal (not used) 11 = no confidence (or no retrieval)	Only registered 00 and 11 in current version 11 if AOT_uncertainty > 1.0	Retrieval confidence
6 – 7	AE confidence	00 = very good 01 = good (not used) 10 = marginal (not used) 11 = no confidence (or no retrieval)	Only registered 00 and 11 in current version In principle, the AE accuracy is low where AOT is low 11 if AOT < 0.1	
8	Additional cloud test	0 = clear / 1 = cloud	Additional cloud screening result for aerosol : • Near-by-cloud test (1 if cloud existed within 3x3 pixel)	Source of Uncertainty
9	Sunglint	0 = not sunglint / 1 = sunglit	1 if ocean and cone angle < 30.0	
10	Solz > 70, Satz > 70	0 = no / 1 = yes	1 if solar zenith angle > 70 or satellite zenith angle > 70	
11	Stray light correction	0 = no / 1 = yes	Not be implemented	
12 – 13	Aerosol type	TBD	Not be implemented	Additional information
14	Hot spot flag	TBD	Not be implemented	
15(MSB)	-	-	-	

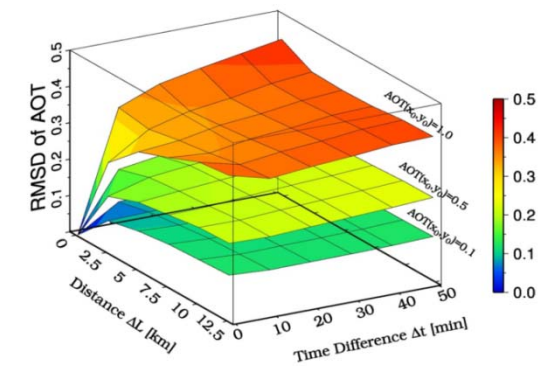
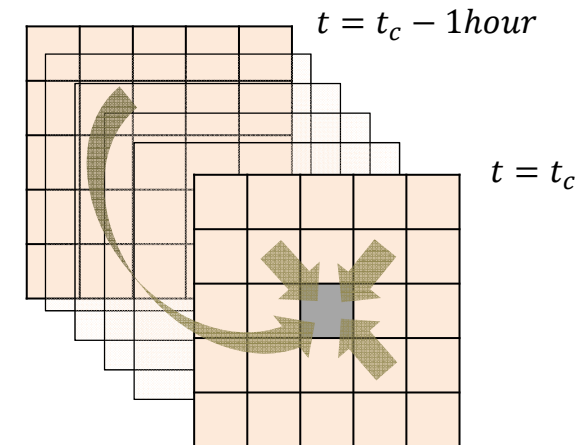
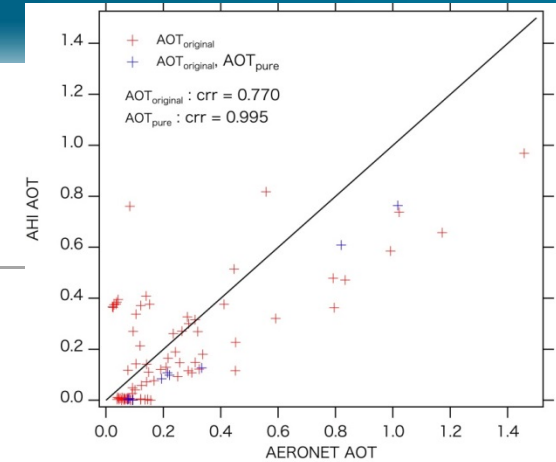
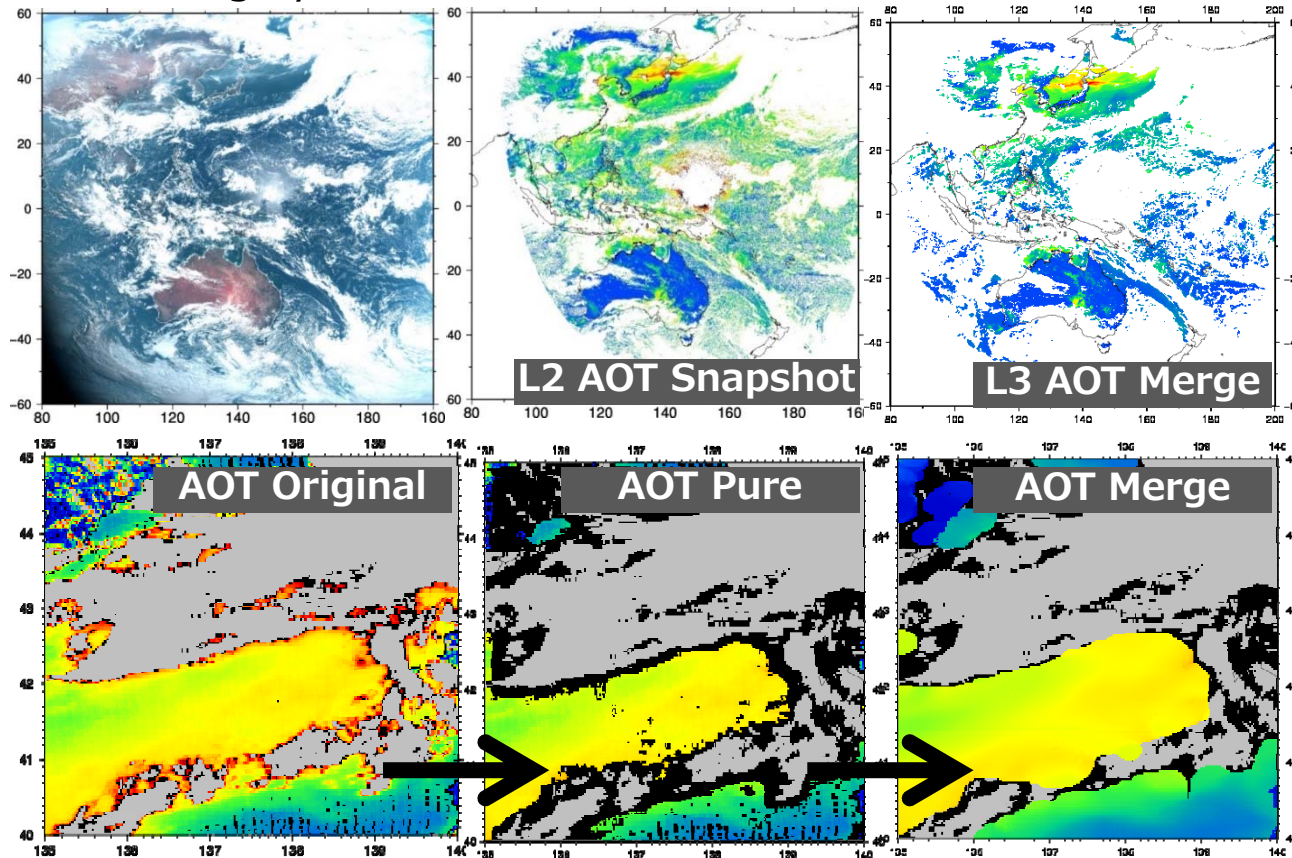
Aerosol Retrieval algorithm (L2 snapshot)

- Consistent algorithm with that of JAXA Earth observation satellites (GCOM-C/SGLI, GOSAT-2/CAI-2, EarthCARE/MSI)

- Version Beta (currently released)
 - (1) Cloud/Clear Discrimination : *CLAUDIA* (Ishida & Nakajima, 2009)
 - (2) Surface Reflectance : Rmin + NDVI-Kaufman Method (Fukuda *et al.*, 2013)
 - (3.1) Retrieval Algorithm over land :
 - Fukuda *et al.*, 2013; Band 1, 2, 3 (460, 510, 640nm);
 - (3.2) Retrieval Algorithm over ocean :
 - *REAP* (Higurashi & Nakajima, 1999); Band 3, 4 (640, 860nm);
 - Ocean surface reflectance considered, water leaving radiance neglected

Aerosol Retrieval algorithm (L3 hourly combined)

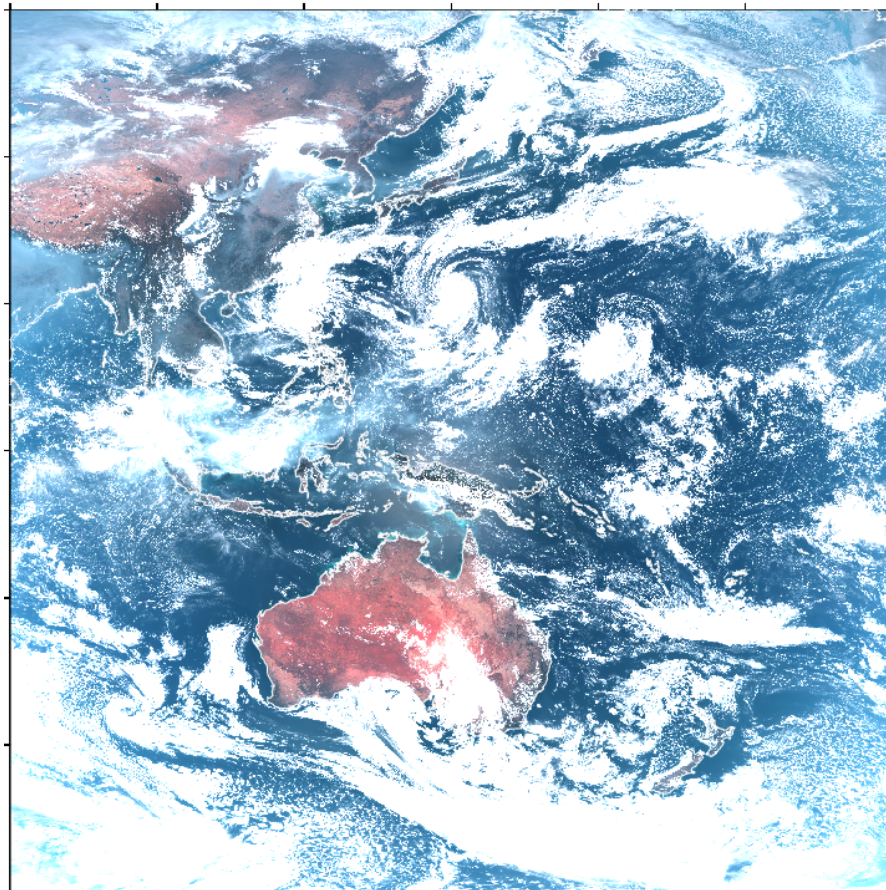
Evaluate spatiotemporal variability characteristic of aerosol using surrounding 12.5km and past 1 hour data. Use the characteristic to eliminate cloud contaminated pixels and derive highly accurate aerosol dataset



Himawari Images on 19-20th Oct. 2015

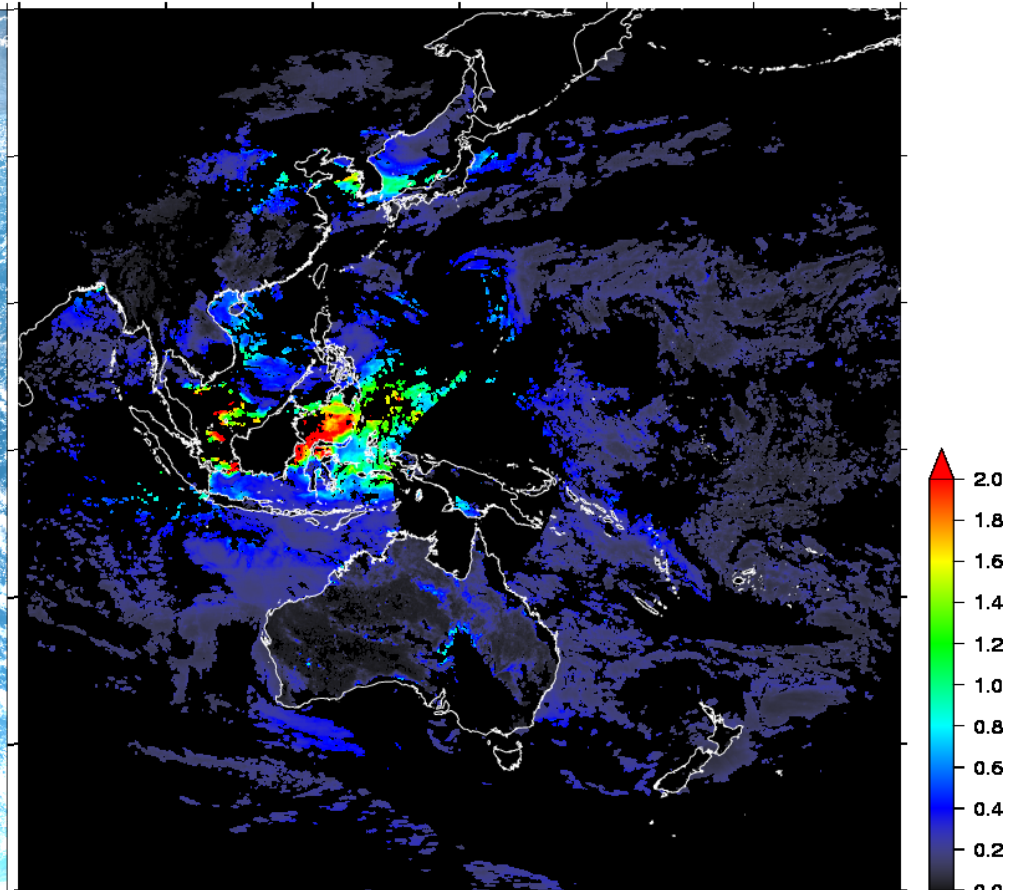
RGB Image

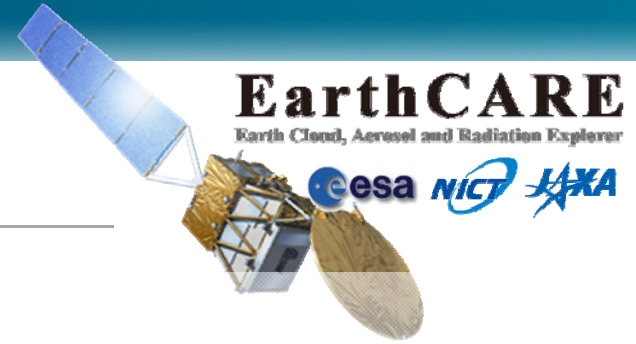
NC_H08_20151020_0230_R21_FLDK.02401_02401.nc



Aerosol Optical Thickness
(L3 Hourly Combined)

AOT1H H08_20151020_0230_1H_ARPbet_FLDK.02401_02401.nc





Any Questions?