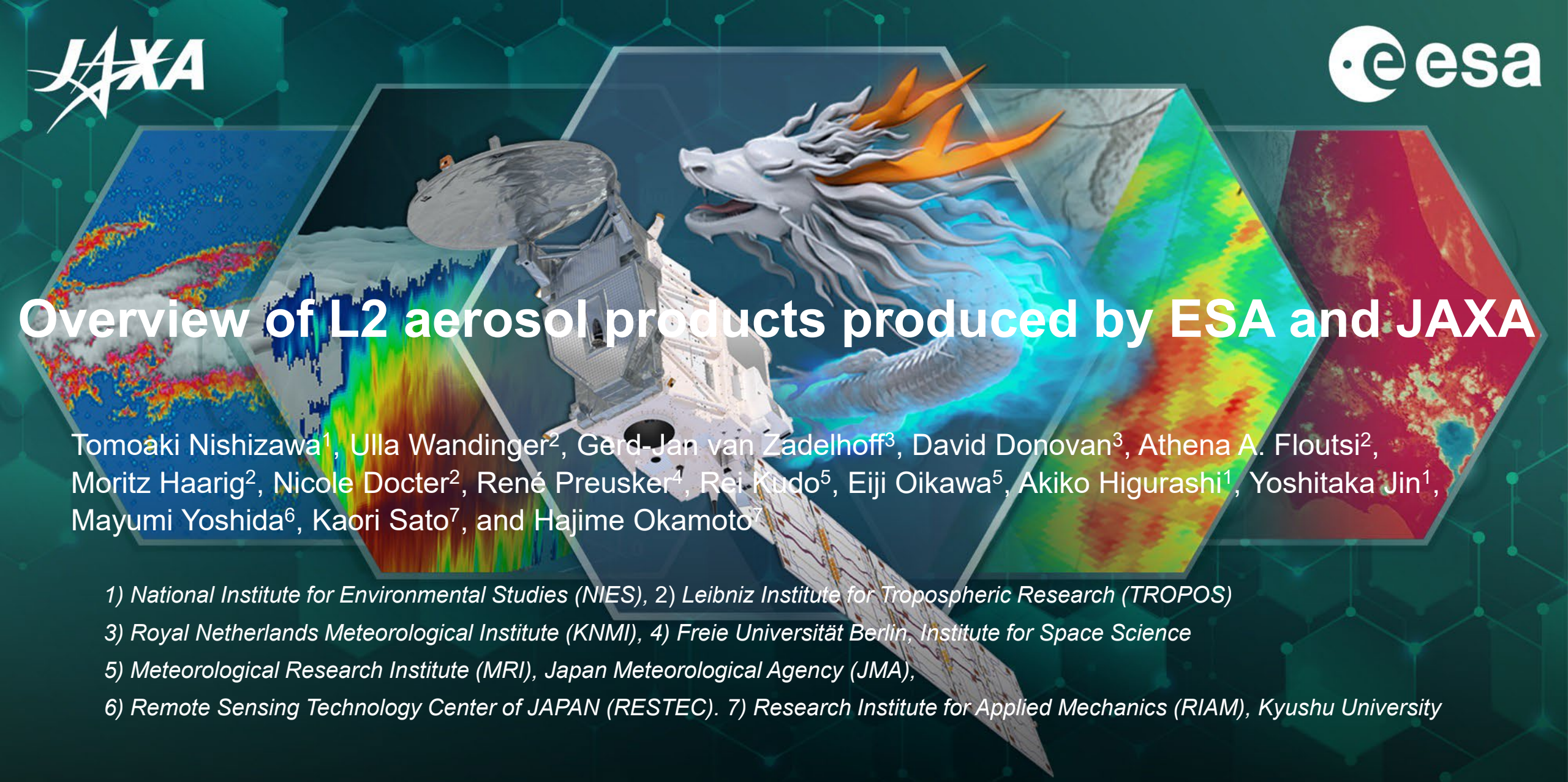

Overview of L2 aerosol products produced by ESA and JAXA

Tomoaki Nishizawa[1], Ulla Wandinger[2], Gerd-Jan van Zadelhoff[3], David Donovan[3], Athena A. Floutsi[2], Moritz Haarig[2], Nicole Docter[2], René Preusker[4], Rei Kudo[5], Eiji Oikawa[5], Akiko Higurashi[1], Yoshitaka Jin[1], Mayumi Yoshida[6], Kaori Sato[7], and Hajime Okamoto[7]

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3) Royal Netherlands Meteorological Institute (KNMI), 4) Freie Universität Berlin, Institute for Space Science

5) Meteorological Research Institute (MRI), Japan Meteorological Agency (JMA),

6) Remote Sensing Technology Center of JAPAN (RESTEC). 7) Research Institute for Applied Mechanics (RIAM), Kyushu University

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop

17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

EarthCARE
(Earth Clouds, Aerosols and Radiation Explorer)

✓ Joint Japanese (JAXA)-European (ESA) satellite mission
✓ Improve the understanding of cloud-aerosol-radiation interactions
✓ Four sensors:

ATLID (Atmospheric Lidar: 355nm HSRL with dep. Measurement function)
MSI (Multi-spectral imager: 0.66, 0.865, 1.61, 2.2, 8.8, 10.8, 12.0 um)
CPR (Cloud Profiling Radar: 94GHz)
BBR (Broad-band radiometer: SW (0.2-4um), Total (0.2-50um)

=> Observe Global / 3D distribution of Aerosols, Clouds, and Radiation
=> Provide information on Aerosol and Cloud effects on atmospheric radiation

Aerosols

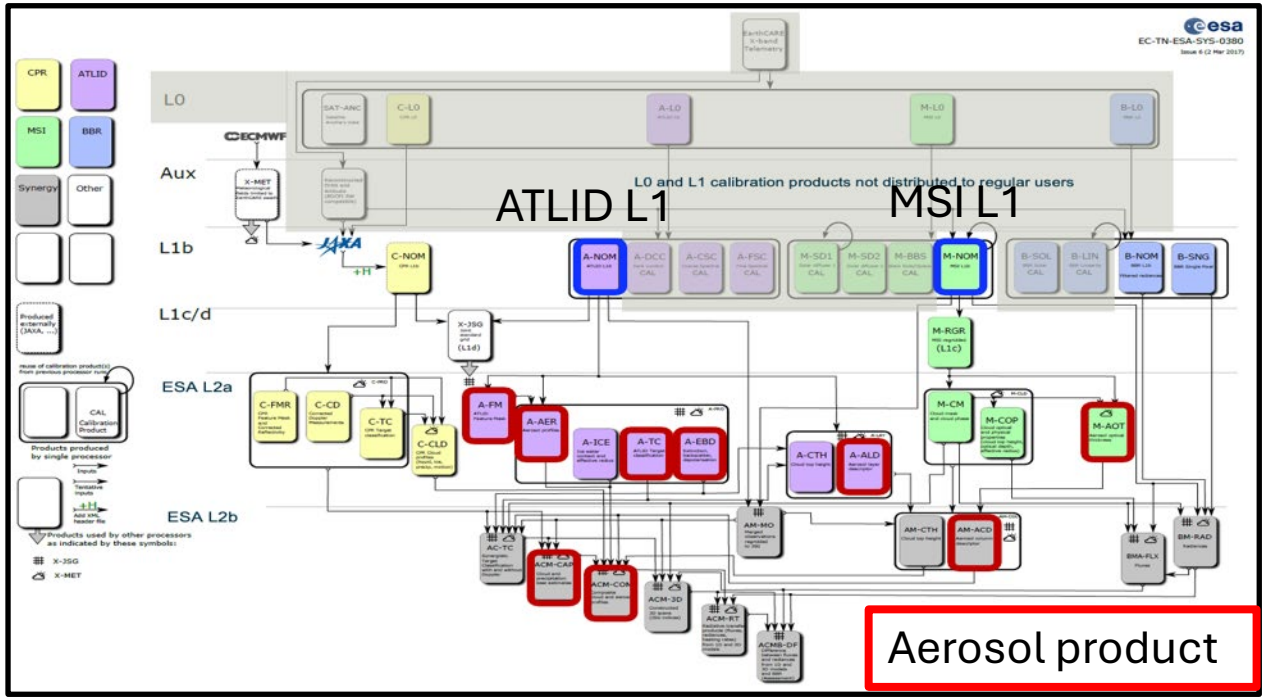
- Vertical / Layer / Columnar Optical/Microphysical/Radiative properties: extinction, depolarization, AOT ….
- Aerosol type: Dust, Smoke, Continental Pollution, Sea-salt ….
- Aerosol component: Sea-salt, Carbonaceous (Light-absorbing), Water soluble, Dust

✓ L1 products are generated by each sensor development organization (JAXA for CPR and ESA for others)
✓ **L2 products** are generated by different algorithms by JAXA or ESA, respectively.

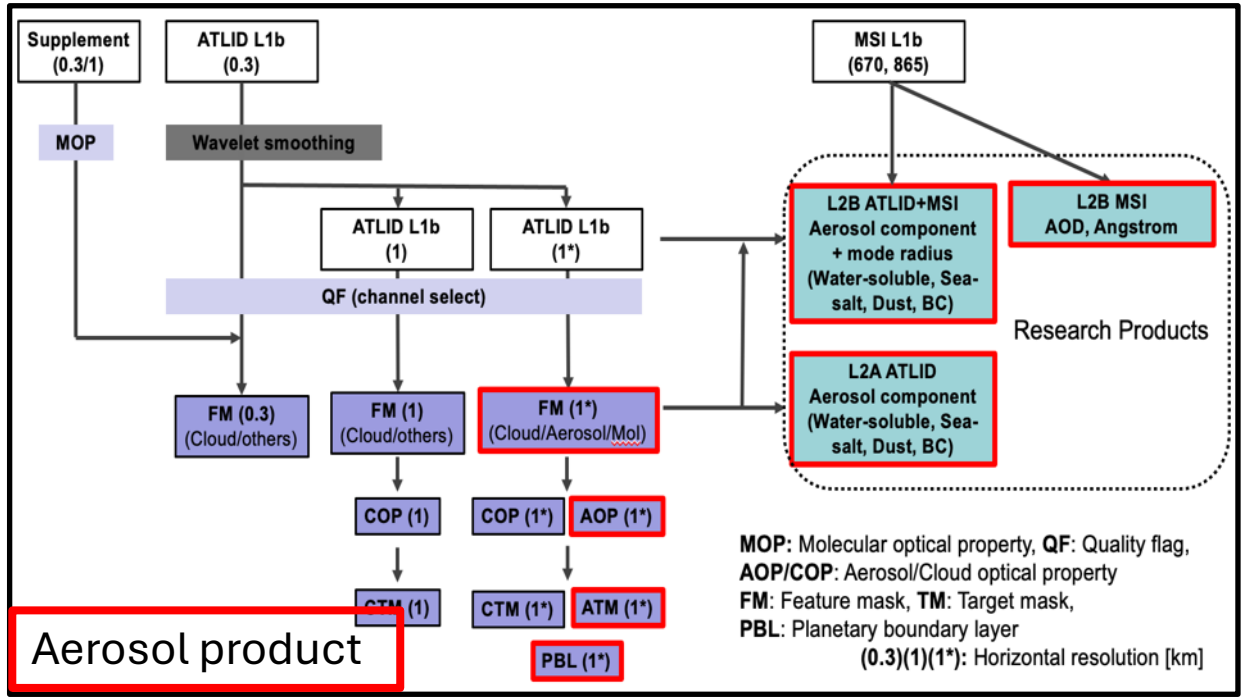
=> We attempt to summarize the L2 products briefly, contrasting the ESA and JAXA L2 products, here.

Aerosol products (1)

ESA processing chain for all products



JAXA processing chain for Aerosol products

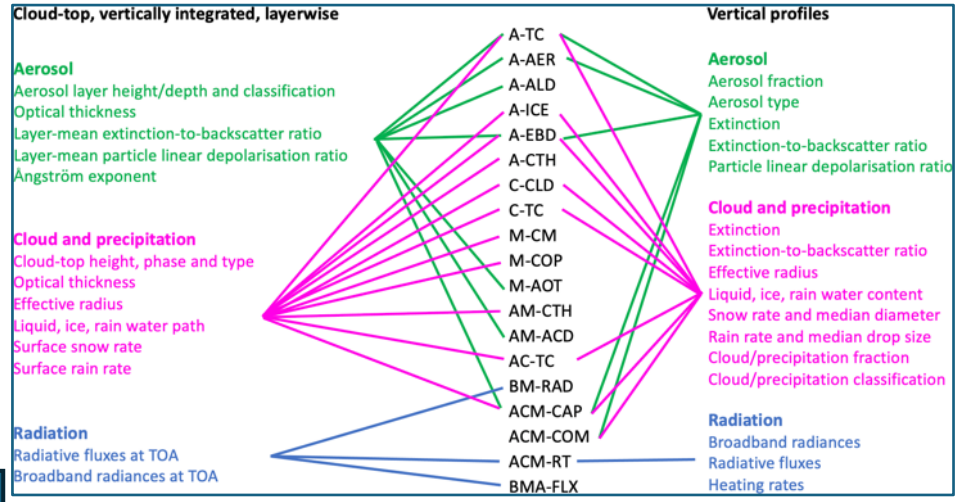


- ✓ Aerosol products are basically created using ATLID L1 and MSI L1.
- ✓ There are standalone (ATLID or MSI) and synergy (ATLID-MSI) products.
- ✓ There are similar products at ESA and JAXA, as well as unique products at both.
- ✓ The aerosol products created lead to atmospheric radiation assessments in the processing chain.

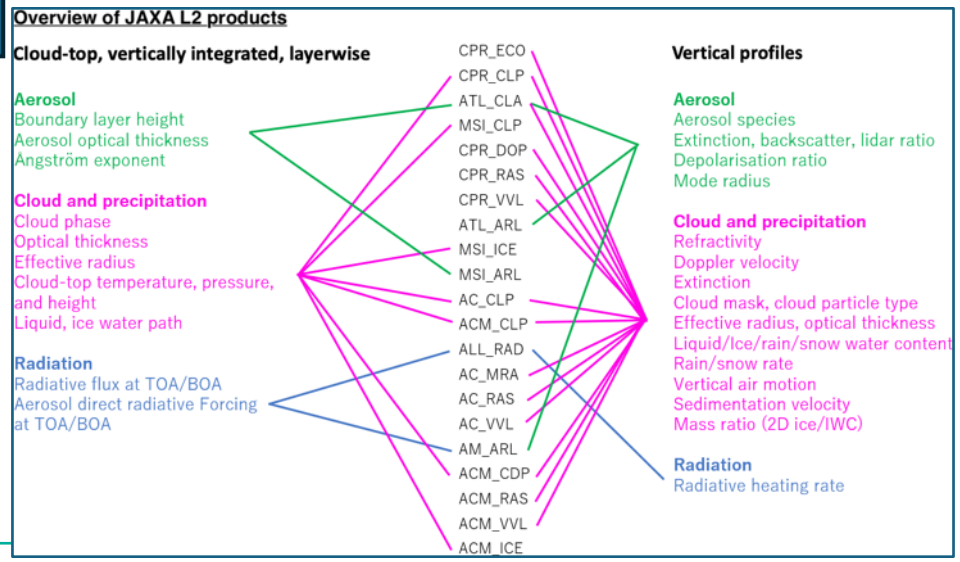
Aerosol products (2)

Product	ESA	JAXA
Vertical profiles		
Feature mask	✓	✓
Extinction/Backscatter/Lidar ratio/Depolarization	✓	✓
Particle type	✓	✓
Aerosol fraction	✓	
Aerosol component		✓
Vertically integrated, Columnar		
Extinction/Backscatter/Lidar ratio/Depolarization	✓	
Particle type	✓	
Layer height	✓	
AOT / Angstrom	✓	✓
PBL height	✓	✓

Overview of ESA L2 products

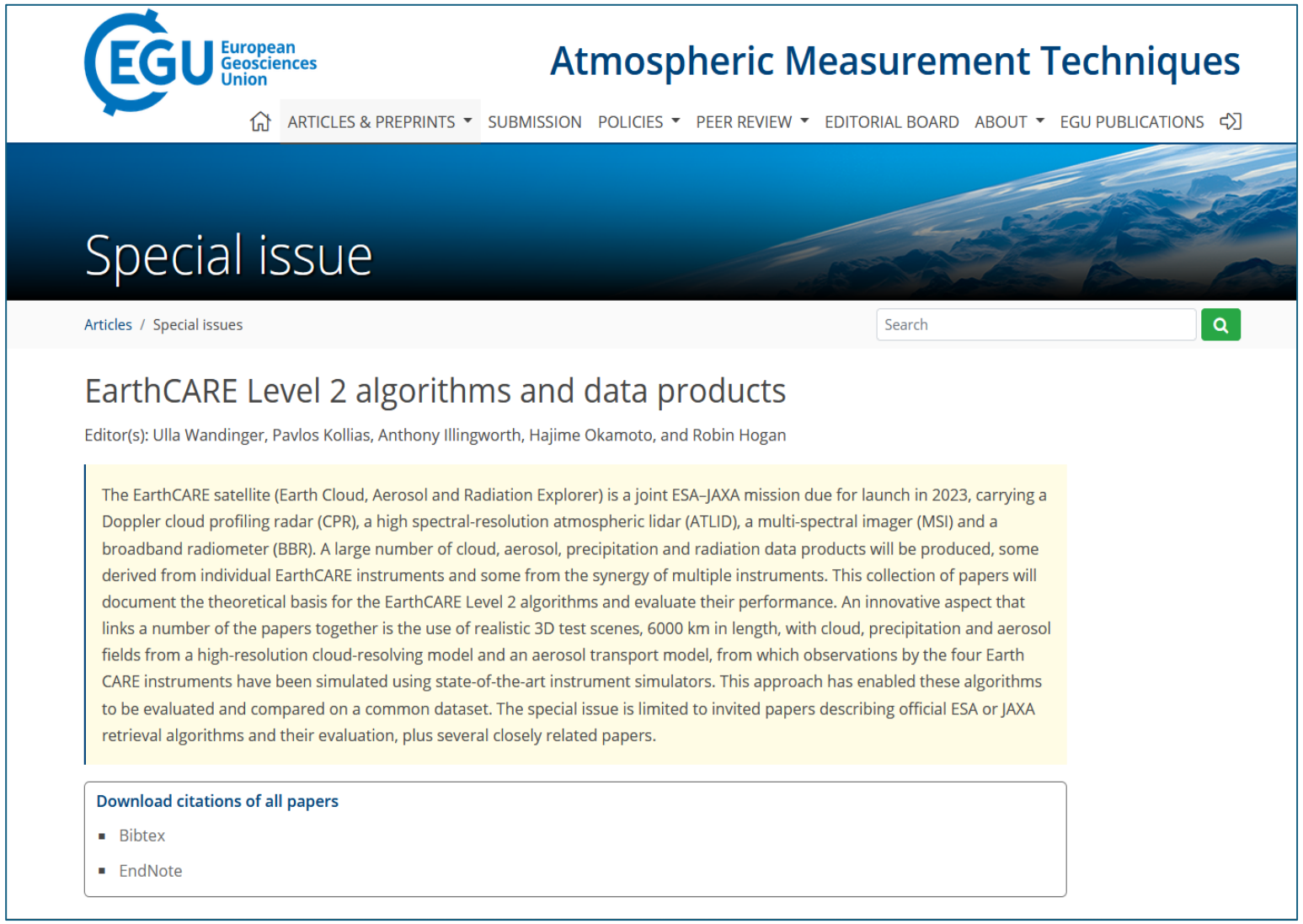


Overview of ESA L2 products



Wehr et al. AMT, 2023

Algorithms (AMT Special Issue …)



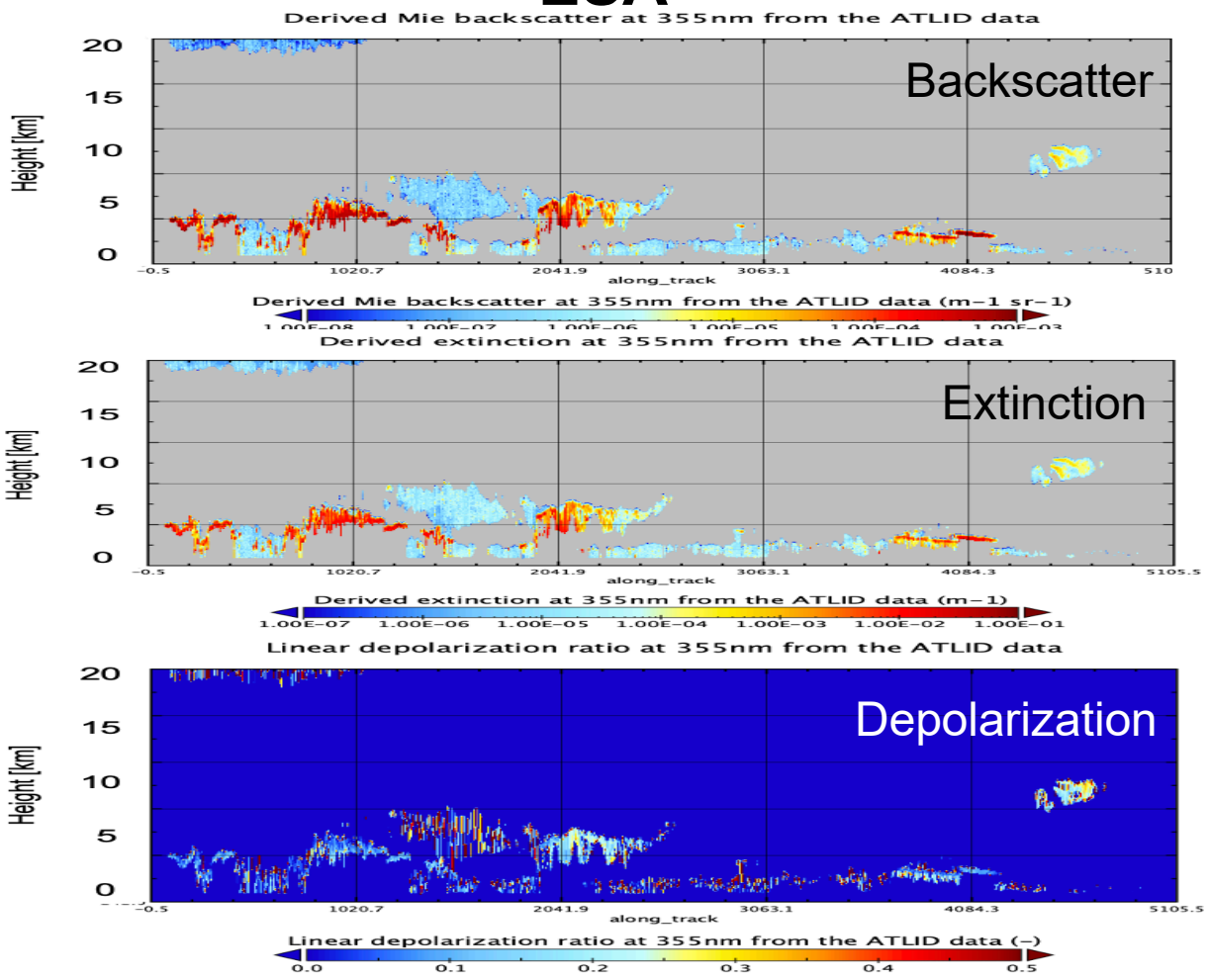
✓Contains all product and algorithm descriptions

✓ Note that the algorithms on JAXA research products are described in the JAXA ATBD: https://www.eorc.jaxa.jp/EARTHCARE/document/doc_index_e.html.

✓ Note that, even if they are similar parameters, the algorithms for signal processing (averaging and smoothing), numerical solution methods, and thhresholds differ between the two algorithms (see AMT special issue and ATBD).

Particle Extinction / Backscatter / Depolarization
(Example of ESA/JAXA Common parameter)

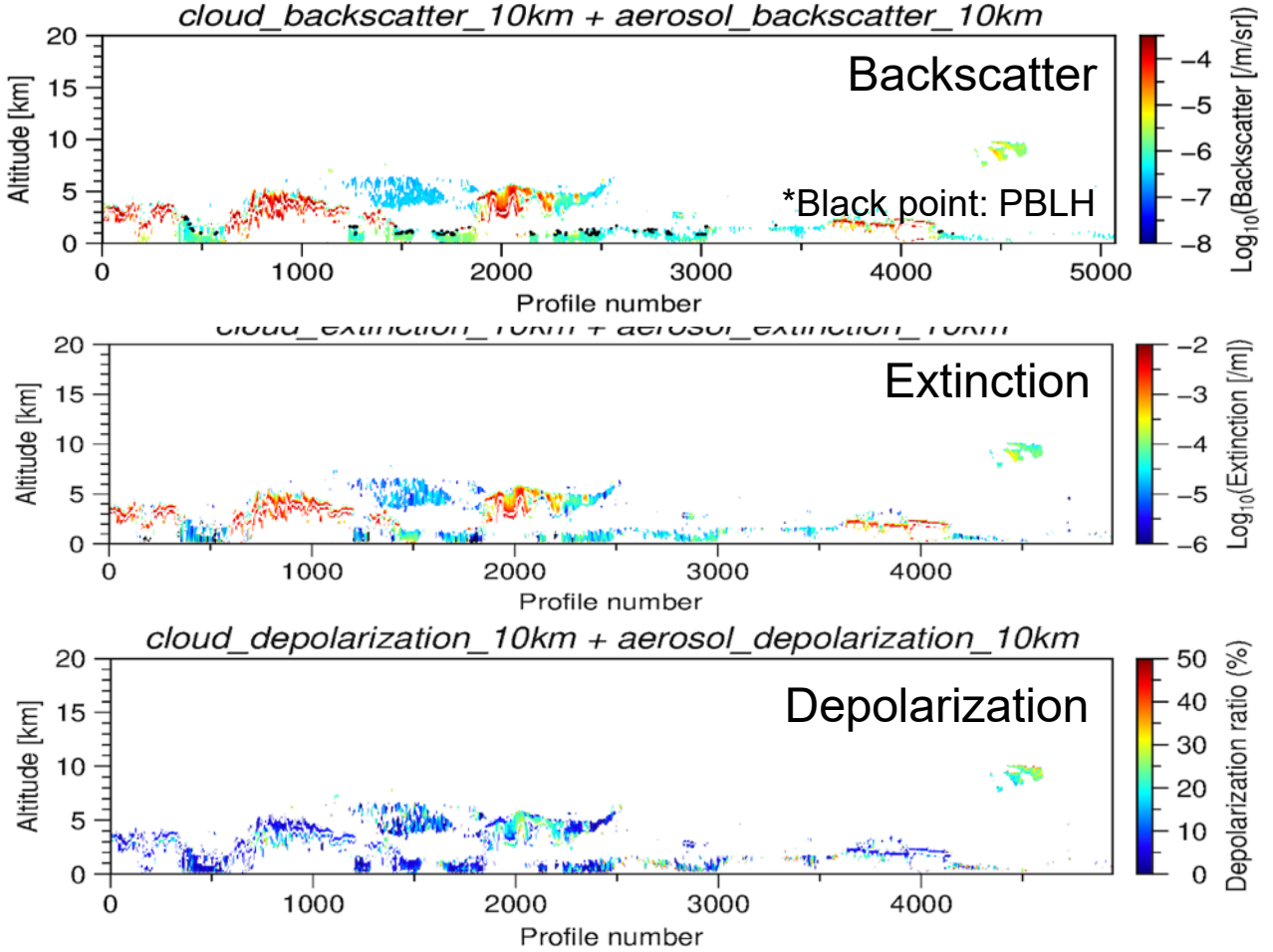
ESA



*A-AER/EBD :Variable spatial resolution (Low/Middle/High)
presented by Donovan et al. on Tuesday

ECA_EXAC_ATL_EBD_2A_20241220T161753Z_20241220T214544Z_03201B.h5

JAXA

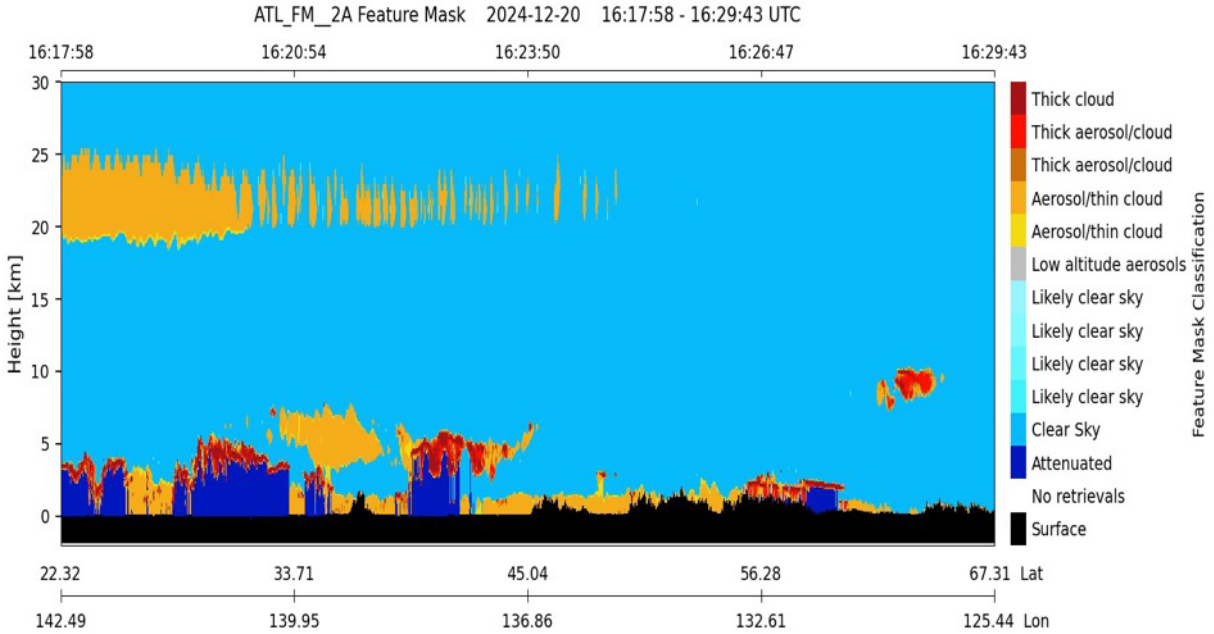


* Fixed resolution : 10km/100m horizontal/vertical resolution for Aerosol product. Note that wavelet analysis is used for denoising L1 data to improve L2 quality.

ECA_J_ATL_CLA_2AS_20241220T1617_20241220T1629_03201B_vAa

Feature mask
(Example of ESA/JAXA Common parameter)

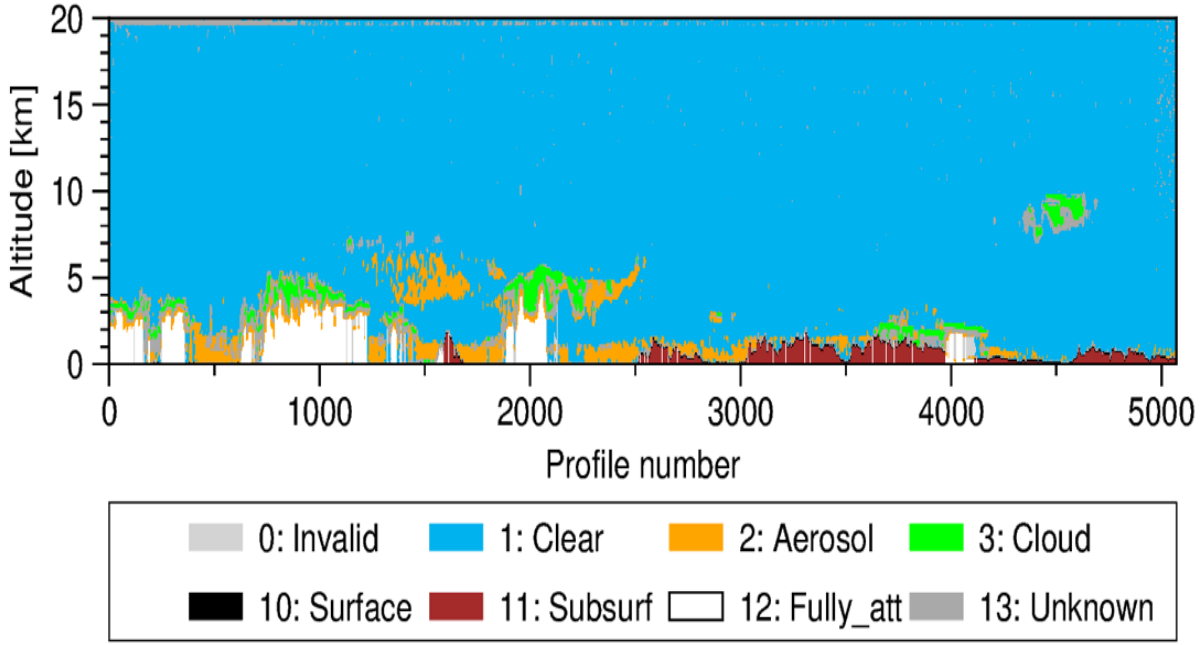
ESA



Feature types:

Cloud (Thick / Thin), Aerosol (Thick / Thin)
Low altitude aerosol
Clear-sky (five levels)
Attenuated, No retrieval, Surface
*Simple classification products are also provided

JAXA



Feature types:

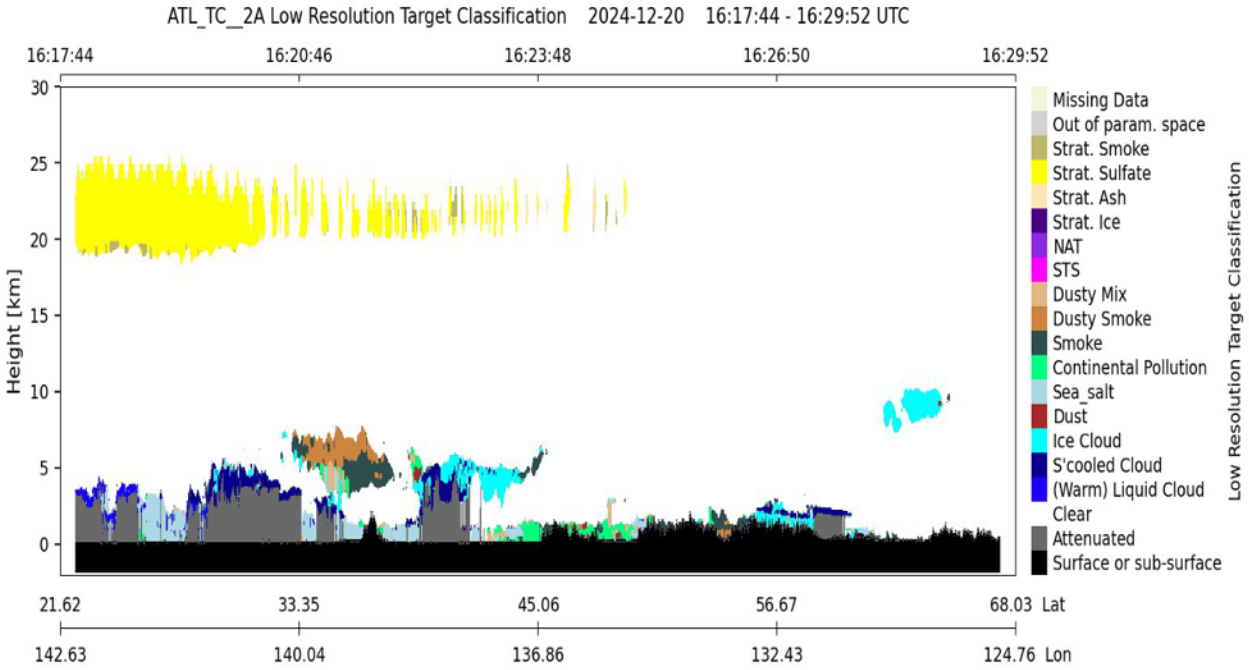
Cloud
Aerosol
Clear-sky
Attenuated, Invalid (No retrieval), Surface, Subsurface

ECA_EXAC_ATL_FM_2A_20241220T161753Z_20241220T212643Z_03201B

ECA_J_ATL_CLA_2AS_20241220T1617_20241220T1629_03201B_vAa

Particle type
(Example of ESA/JAXA Common parameter)

ESA

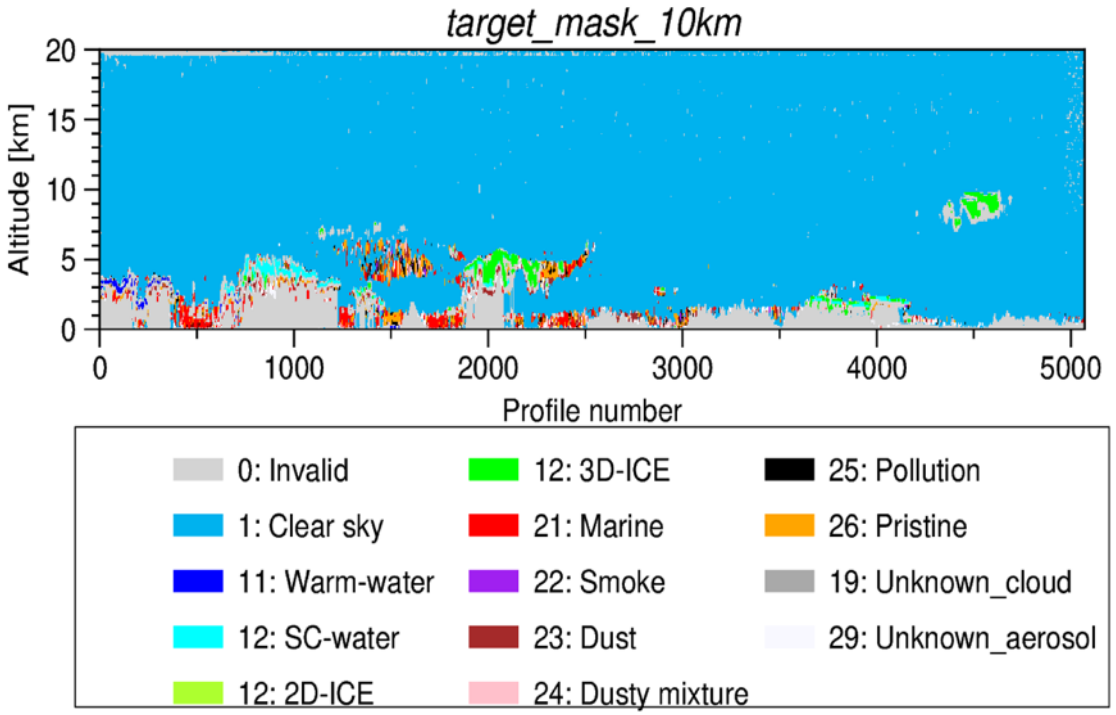


Aerosol types (9 types):

- Dust, Dusty mix
- Smoke, Dusty smoke
- Continental Pollution
- Sea salt
- Stratosphere Smoke / Sulfate / Ash

ECA_EXAC_ATL_TC_2A_20241220T161753Z_20241220T214544Z_03201B

JAXA



Aerosol types (6 types):

- Dust, Dusty mix
- Smoke
- Pollution
- Pristine
- Marine

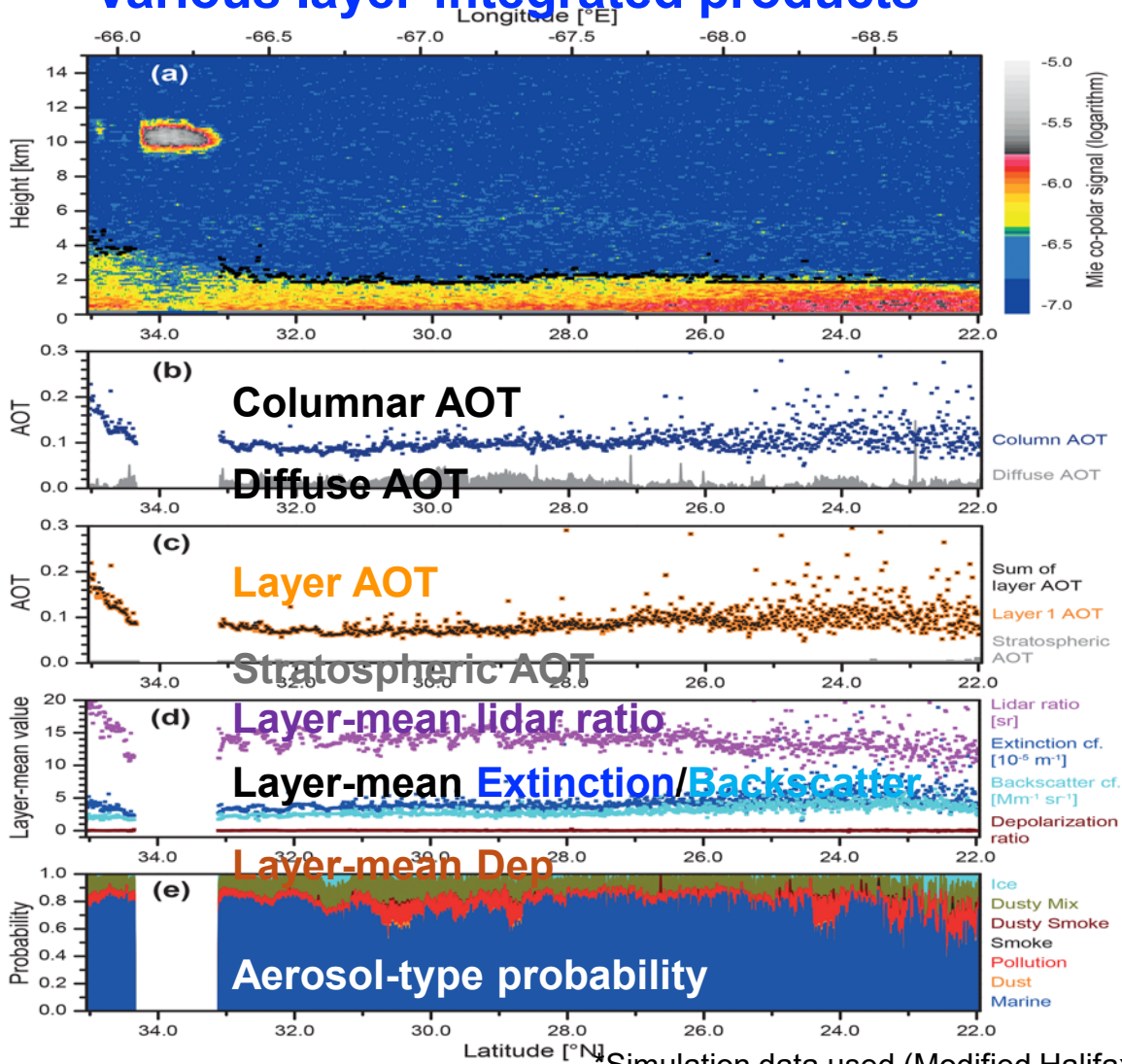
ECA_J_ATL_CLA_2AS_20241220T1617_20241220T1629_03201B_vAa

Different parameter at ESA / JAXA

(For example …)

ESA

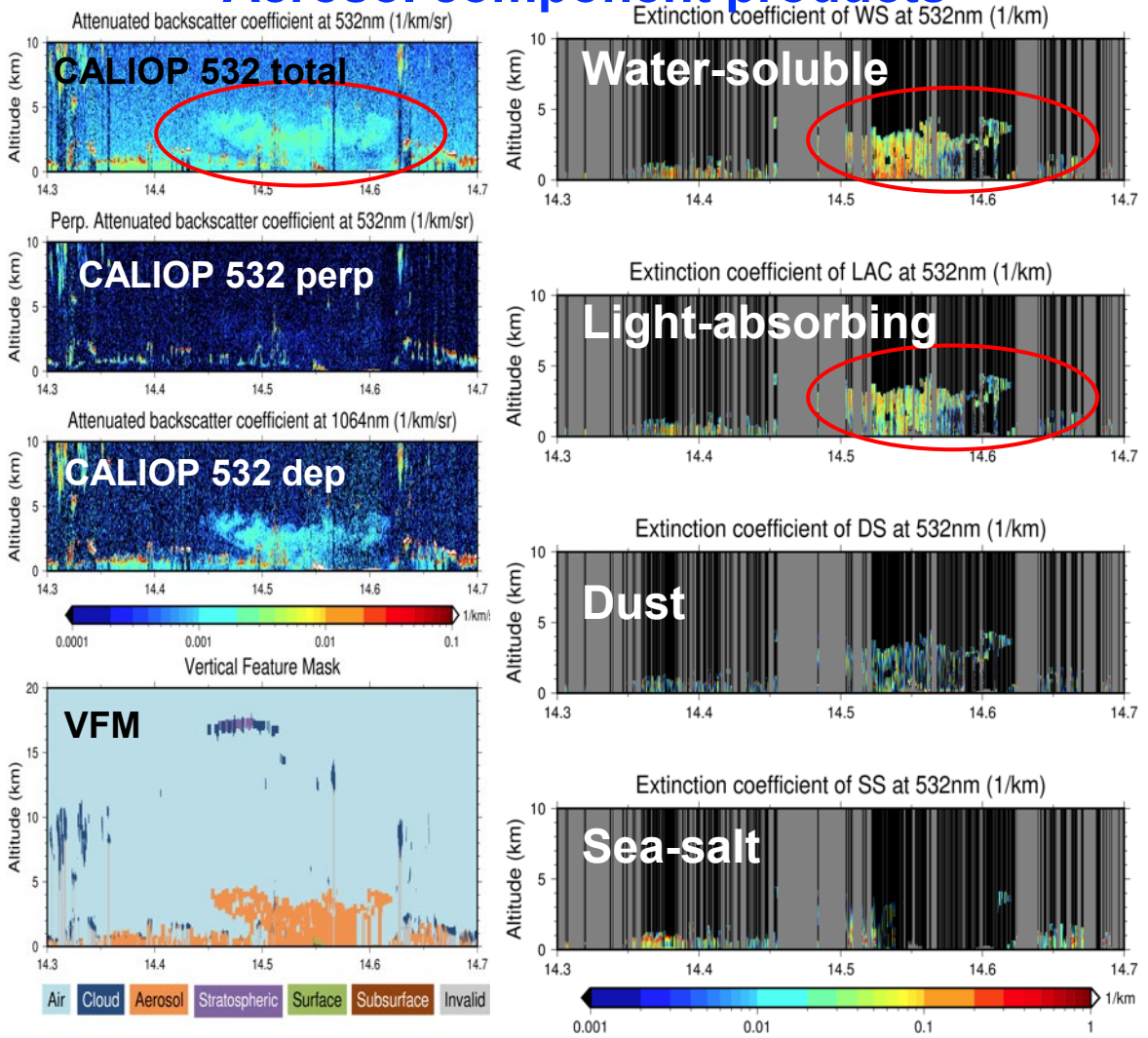
Various layer-integrated products



*Simulation data used (Modified Halifax)

JAXA

Aerosol component products



*CALIOP/MODIS L1 data used

Summary

We have briefly summarized the L2 aerosol products provided by ESA JAXA at the present time.

Aerosol products are basically created using ATLID L1 and MSI L1, there are standalone (ATLID or MSI) and synergy (ATLID-MSI) products.

There are similar products for ESA and JAXA (e.g., Feature mask, extinction/backscatter/depolarization, Aerosol type, AOT/Angstrom …), as well as unique products at both (e.g., various layer-integrated products for ESA; Aerosol component product for JAXA). It should be noted even if they are similar parameters, the algorithms for signal processing (averaging and smoothing), numerical solution methods, and thresholds differ between the two algorithms (see AMT special issue and ATBD).

ESA/JAXA product (algorithm) cross-comparisons are being carried out, and initial results are presented in the following (presented by Wandinger et al.)