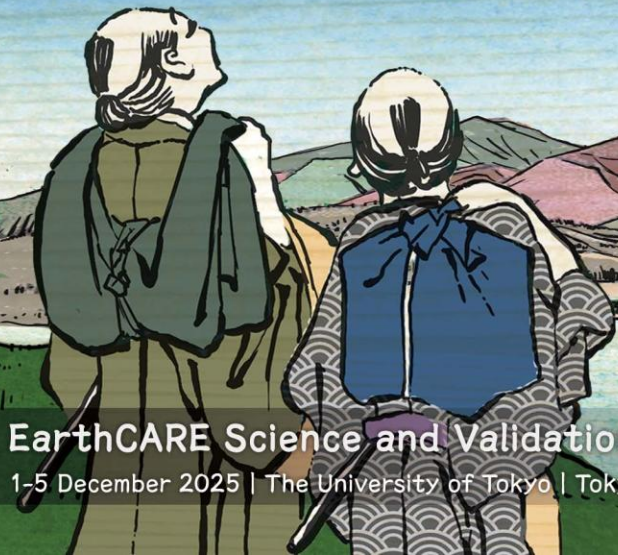
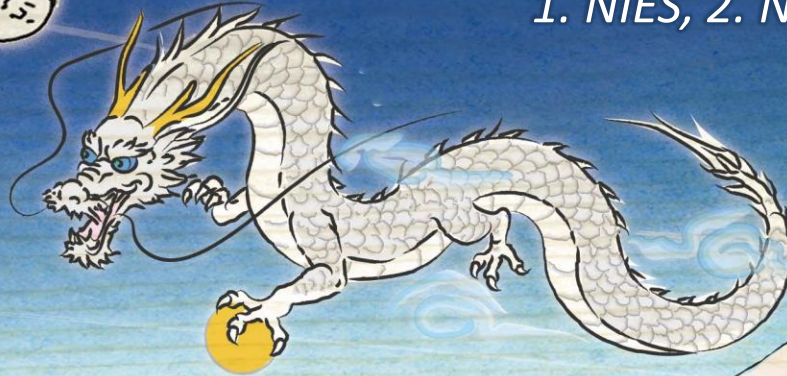
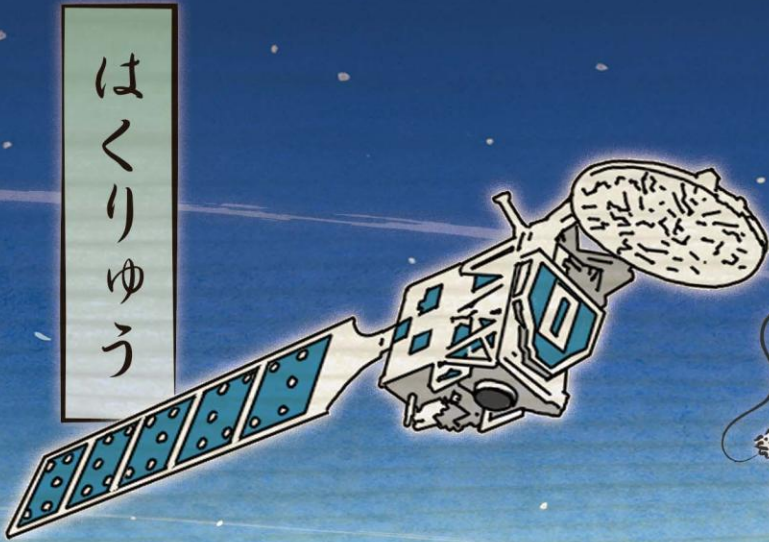


Validation of ATLID aerosol products using ground-based observation in East Asia

Y. Jin¹, T. Nishizawa¹, A. Shimizu¹, N. Sugimoto¹, A. Higurashi¹,
H. Iwai², M. Aoki², S. Papandrea³, H. Okamoto⁴, K. Yumimoto⁴,
H. Irie⁵, R. Kudo⁶, T. Sakai⁶, K. Yasunaga⁷, and M. Katsumata⁸

1. NIES, 2. NICT, 3. SMN, 4. Kyushu Univ., 5. Chiba Univ.,
6. MRI/JMA, 7. Univ. Toyama, 8. JAMSTEC



EarthCARE Science and Validation Workshop 2025

1-5 December 2025 | The University of Tokyo | Tokyo, Japan

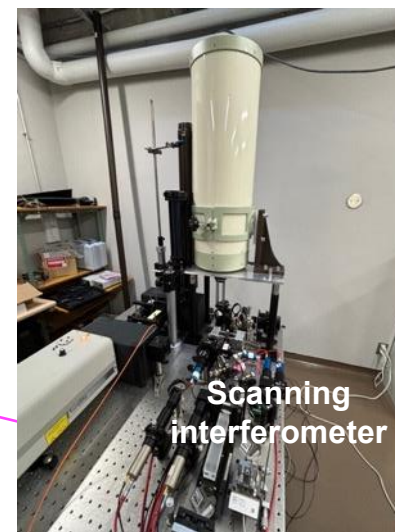
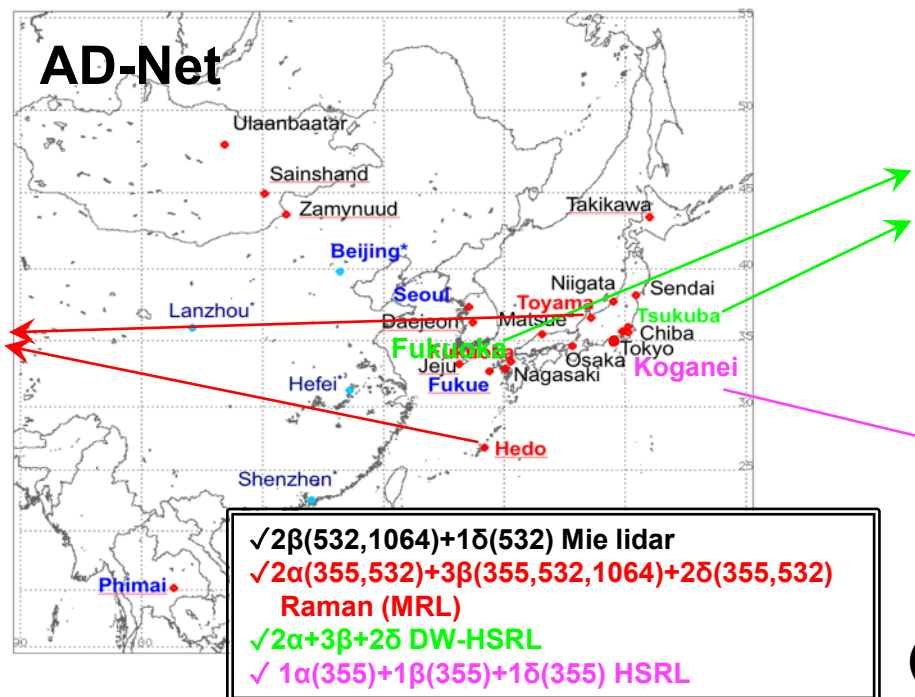


Validation of ATLID products using AD-Net lidars

- Asian dust and aerosol lidar observation network (AD-Net) is one of the important lidar networks to validate ATLID products
- AD-Net several sites (Koganei, Tsukuba, Fukuoka, Toyama, and Hedo) employ multi-wavelength HSRL and Raman lidars, which are useful for direct comparison of extinction and backscatter
- In this study, JAXA ATLID L2a products are evaluated using AD-Net data



MRL
(Toyama, Hedo)



DW-HSRL
(Tsukuba, 2024.08.15~)

355nm HSRL
(Koganei)



Target data and validation method



【Target data and period】

- ◆ JAXA ATLID L2a product (ATL_CLA **yCb (ver 2.1)**) algorithm using ATLID L1b baseline **BA**
- ◆ Period: 2024.09.01 – 2025.08.31 (1-year)

【Validation method】

- ◆ Direct comparison with ground-based HSRL and Raman lidars
- ◆ Average ATLID data within a 50 km radius of ground-based lidar site
- ◆ This report will mainly focus on aerosol cases, since suitable cloud cases for direct comparison are not available

【Ground-based lidar sites and number of match-up frames】

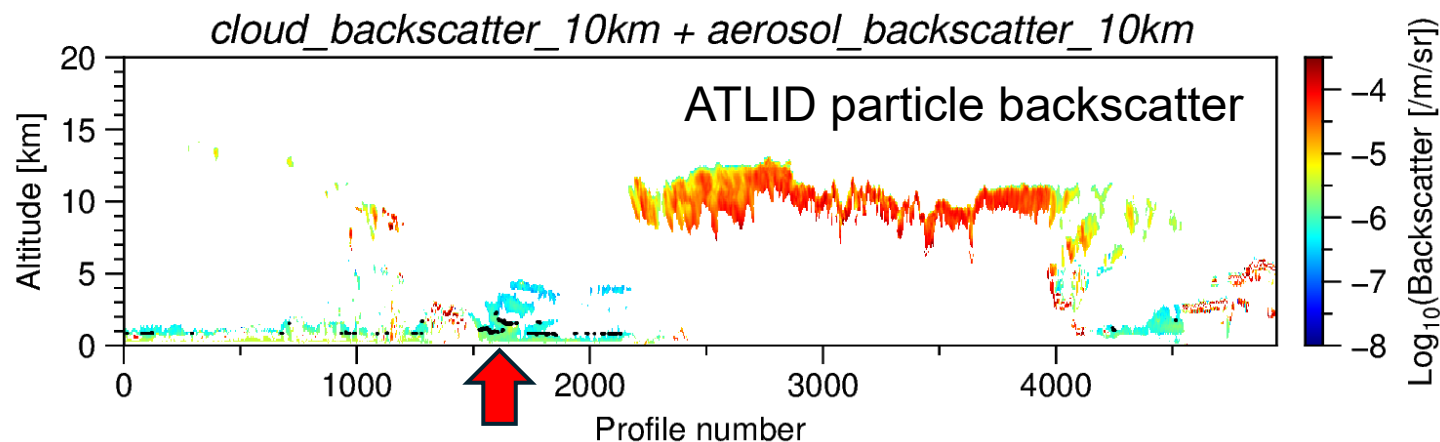
Koganei	Tsukuba	Fukuoka	Toyama	Hedo
29(24)	31(31)	30(29)	34(15)	32(10)

() ground-based lidar data available

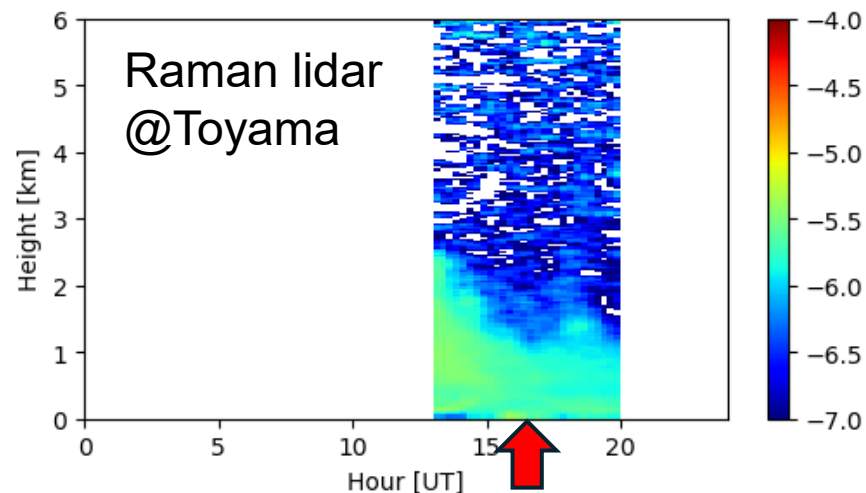
Comparison of ATLID with ground-based lidar



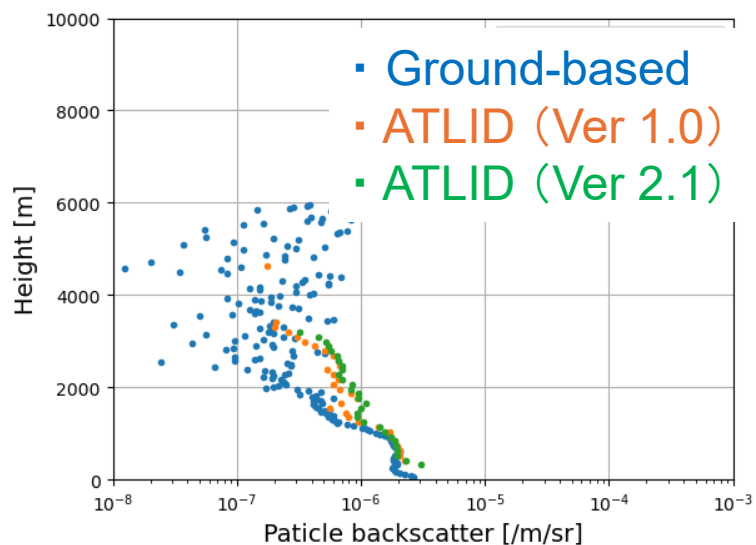
- ◆ Very good agreement with ground-based lidar observation



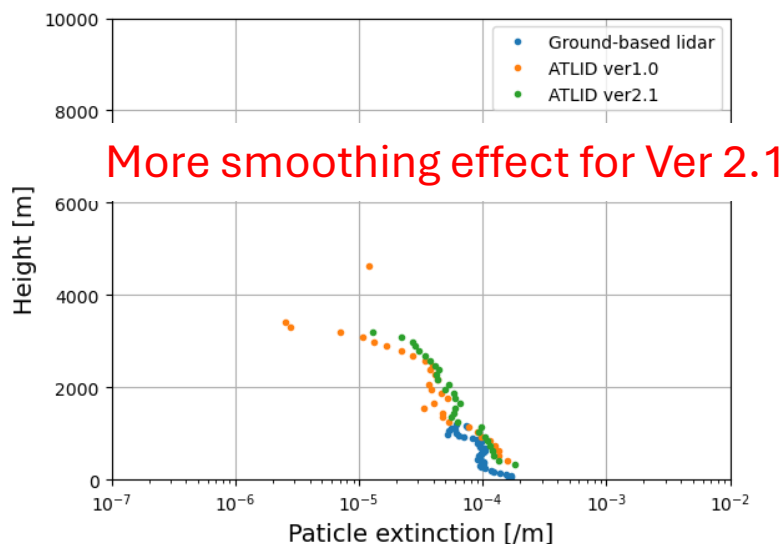
Particle Backscatter 2024.09.09



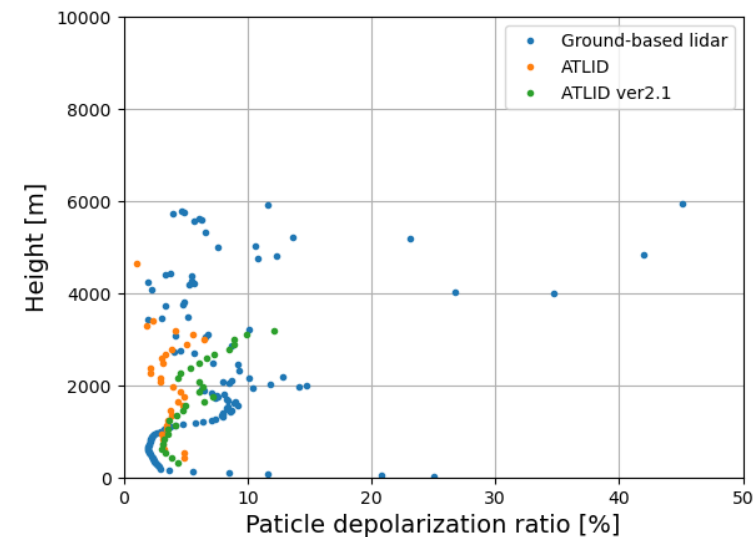
Particle backscatter [m/sr]



Particle extinction [m]



Particle dep. ratio [%]



Validation of ATLID JAXA L2a optical properties

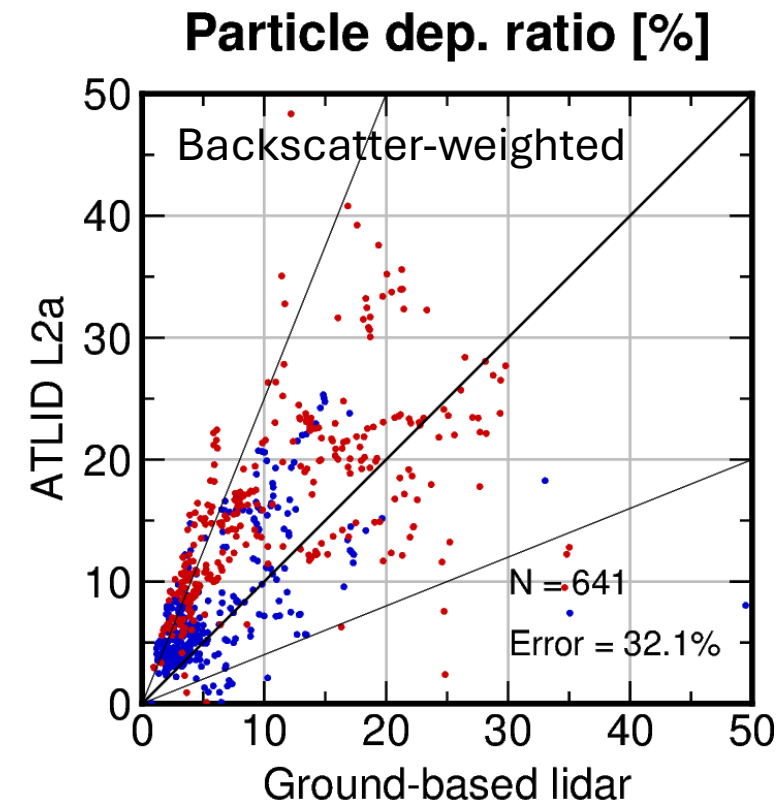
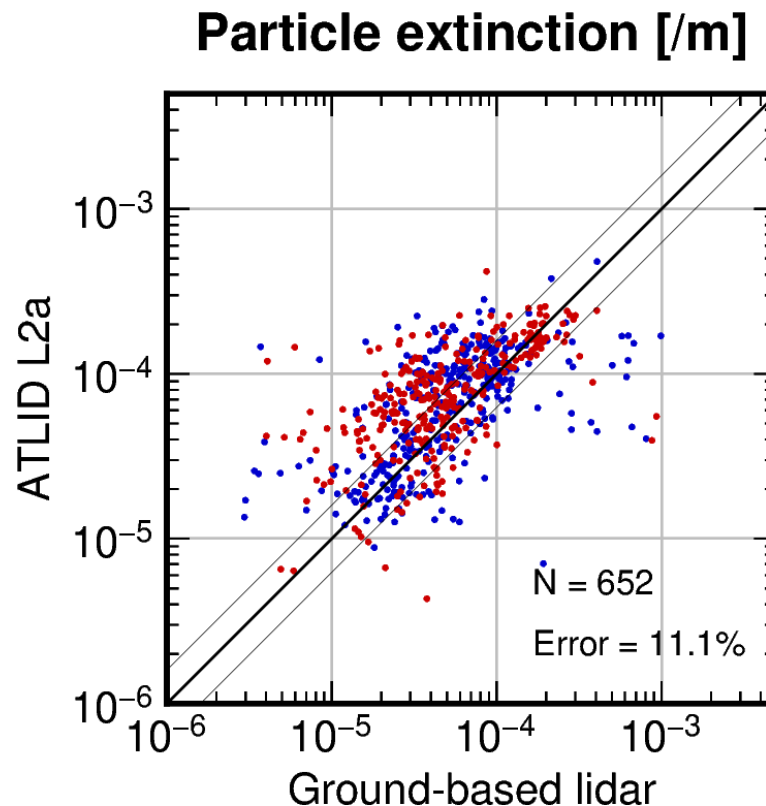
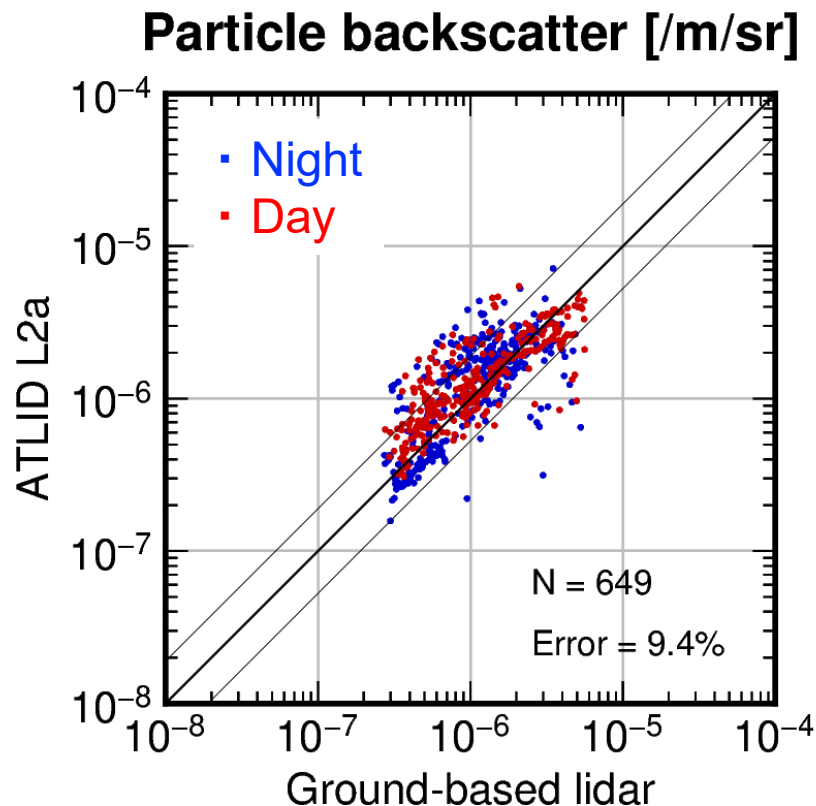
- ◆ Achieved release accuracy target for all optical properties

	Backscatter	Extinction	Dep. ratio
Error [%]	9.4%	11.1%	32.1%
Target [%]	± 90%	± 60%	± 150%

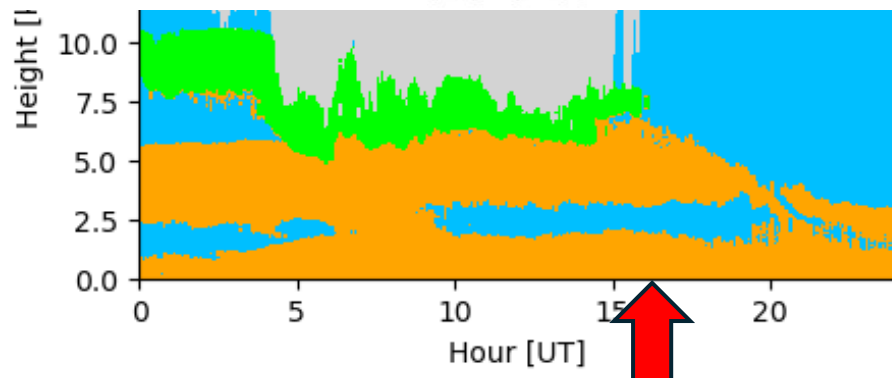
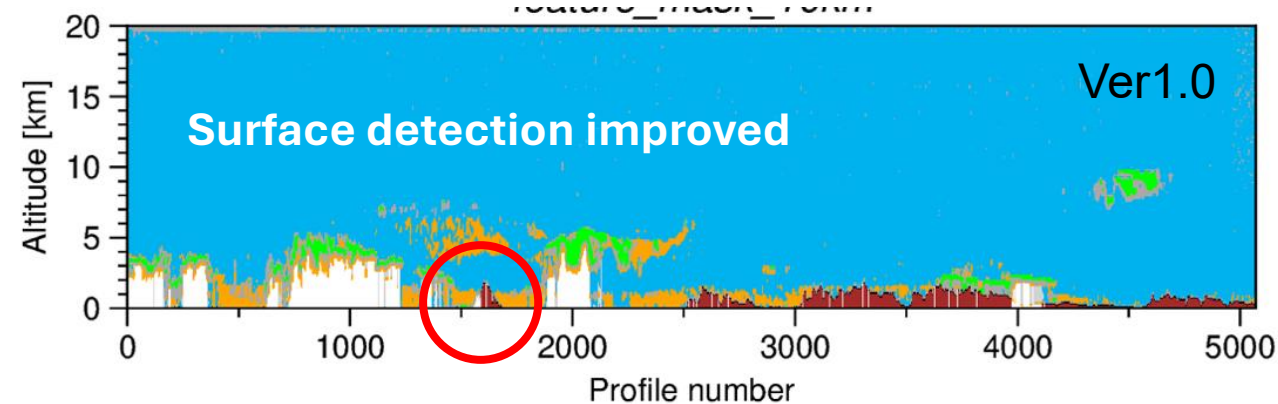
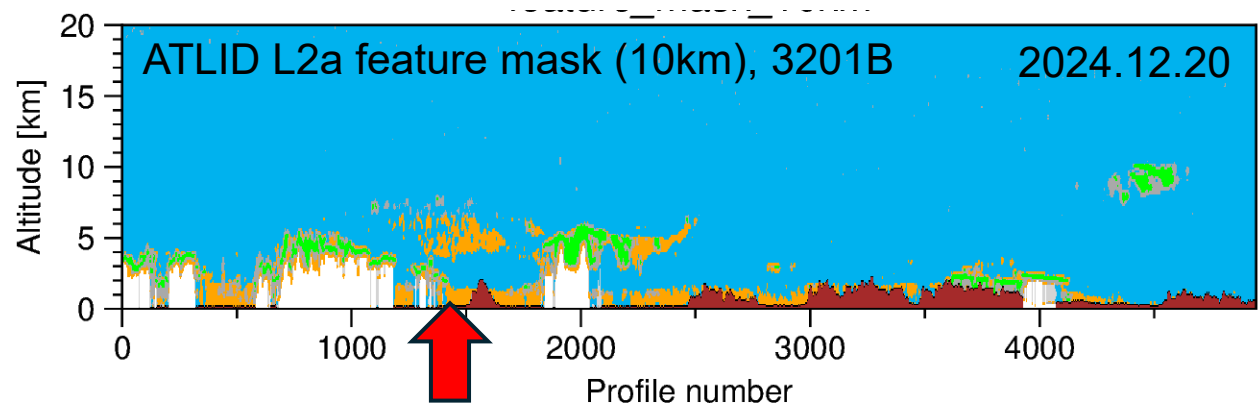
$$\text{Estimated error} = \left(\frac{1}{N} \sum_i (E_i - T_i) \right) / \left(\frac{1}{N} \sum_i T_i \right)$$

(Quoted from JAXA validation plan document)

E_i : ATLID, T_i : Ground-based lidar



Validation of ATLID L2a feature mask



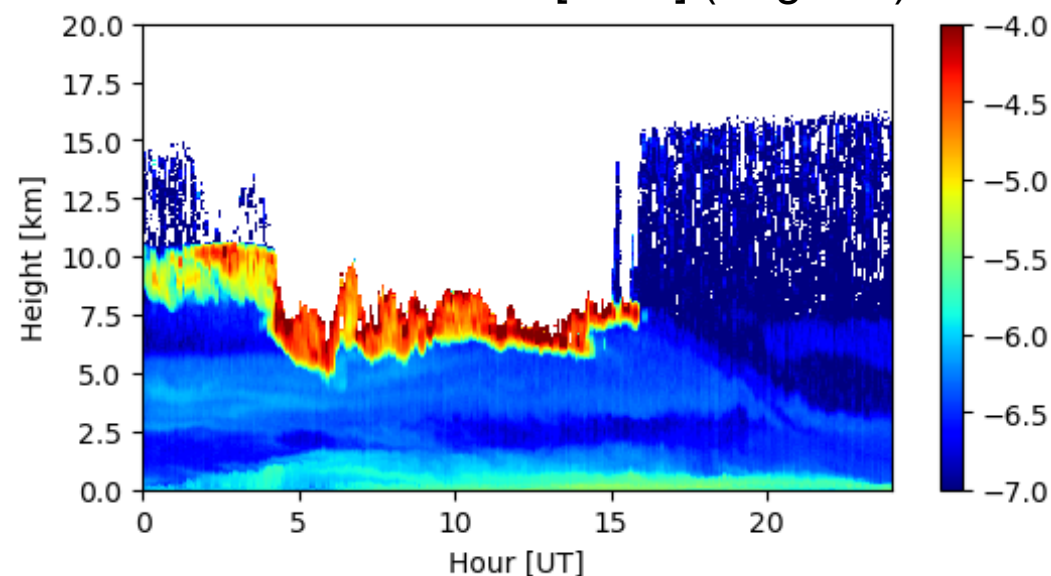
False detection ratio = $\frac{FP + FN = 394}{TP = 3225} = \sim 12\%$
 (Only clear and aerosol cases) (Target: 100%)

Ground-based lidar

	Existence	Non-existence
Existence	TP	FP
Non-Existence	FN	TN

ATLID

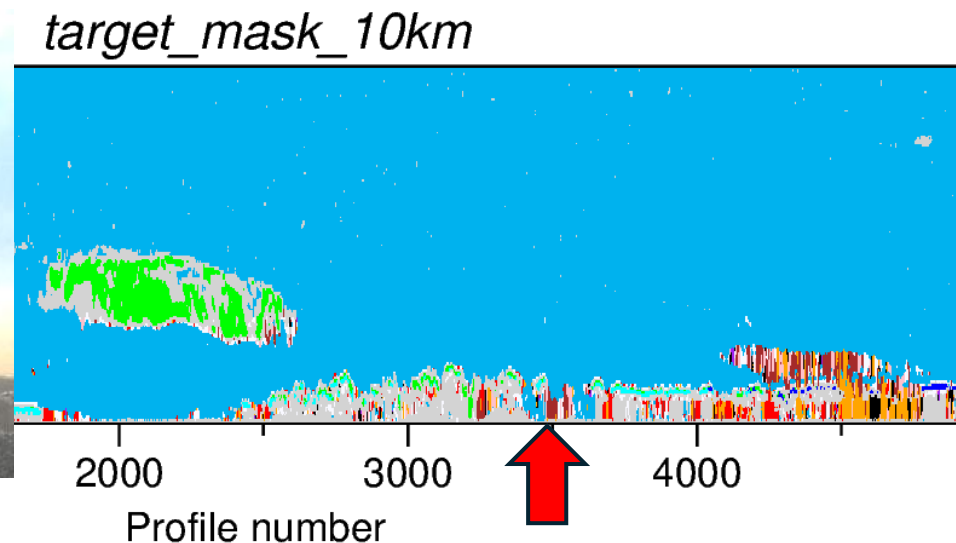
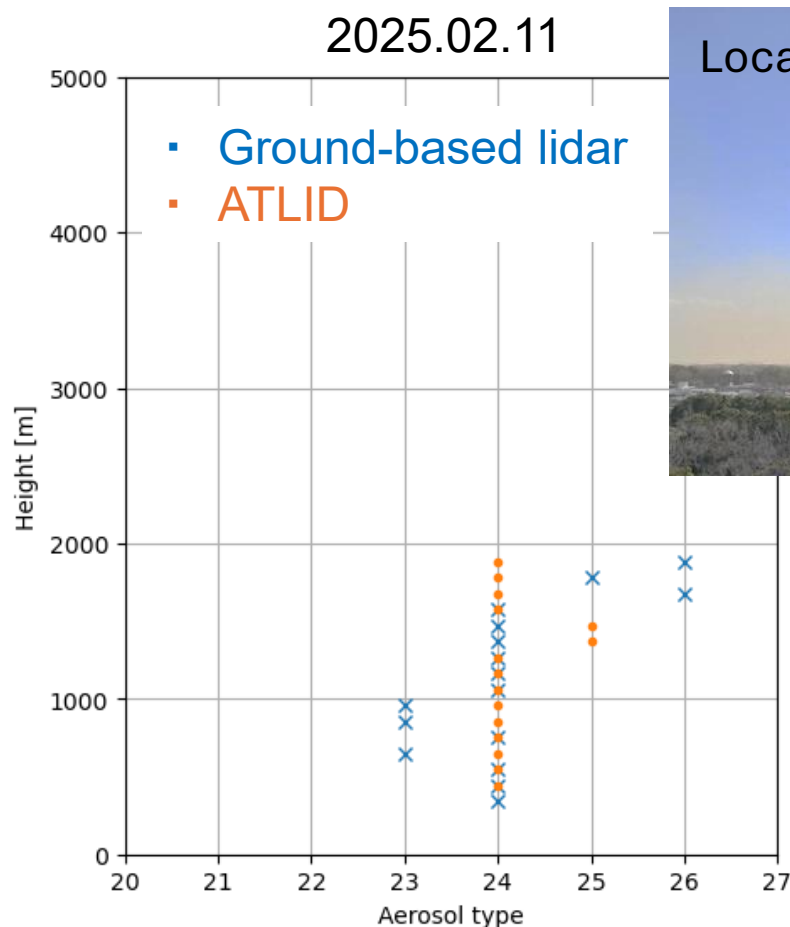
Particle backscatter [/m/sr] (Koganei)



Validation of ATLID target mask (aerosol typing)

- ◆ Target mask errors were >100%
- ◆ Homogeneous & high load aerosol layers are acceptable, but still challenging for thin aerosol layers

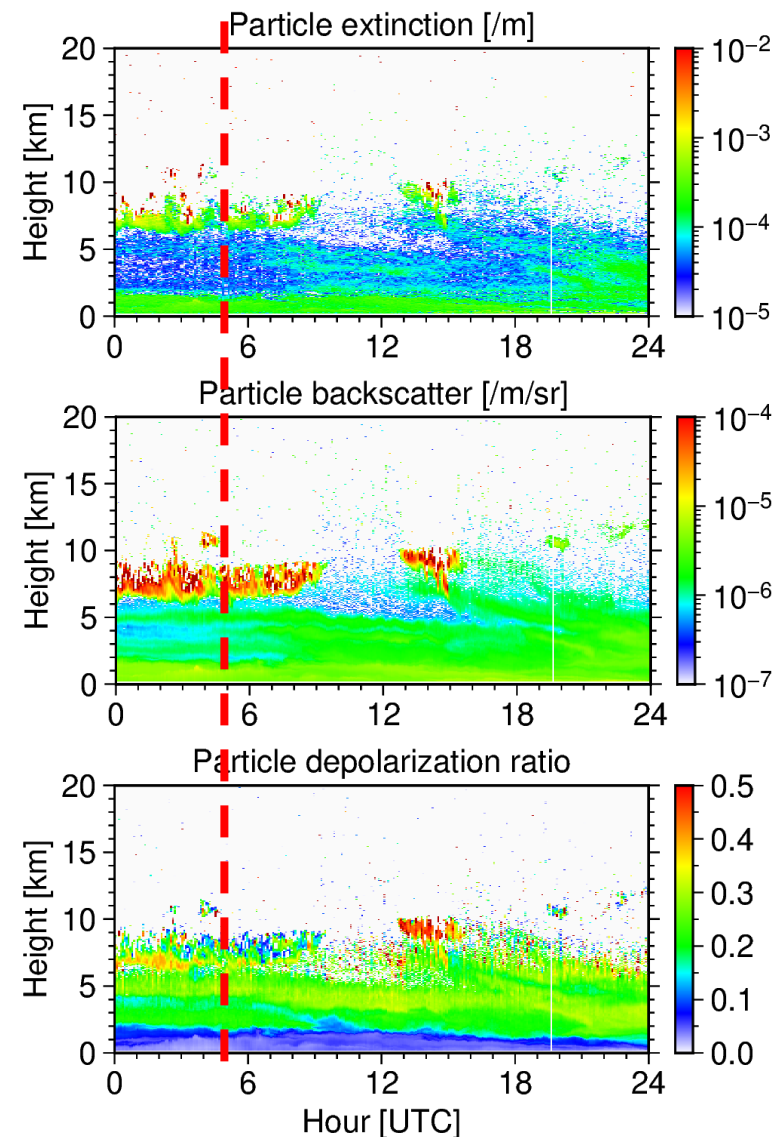
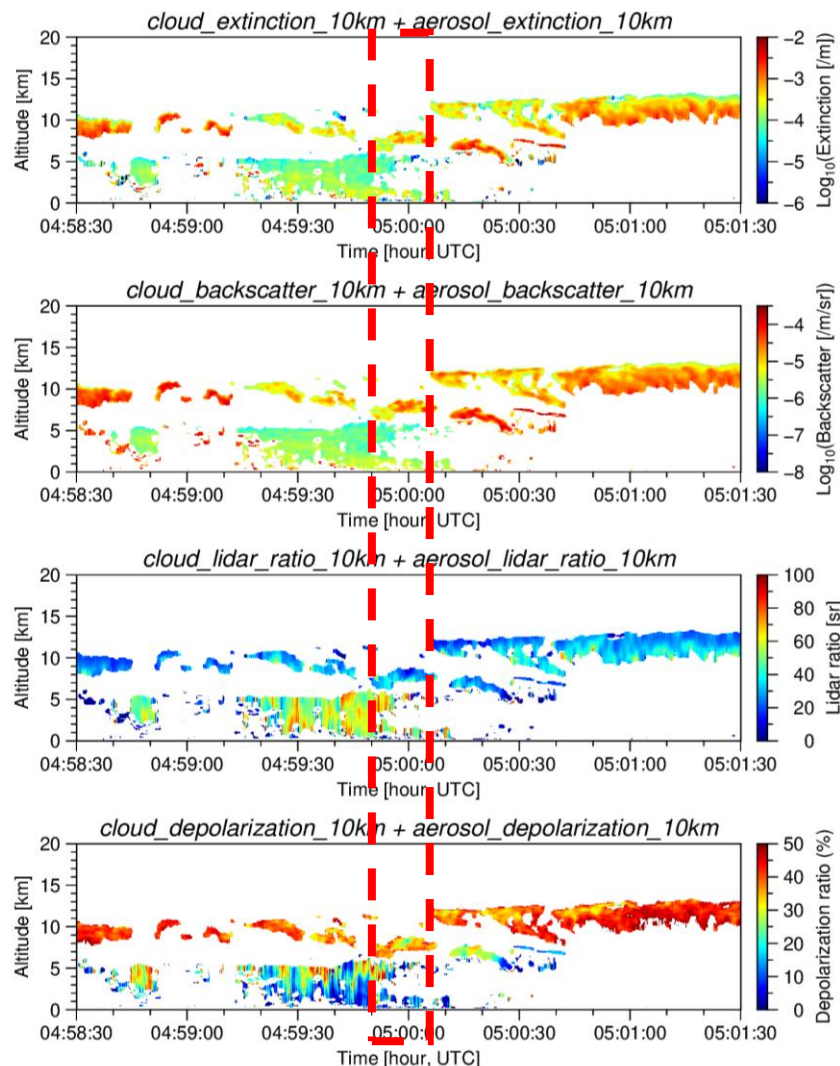
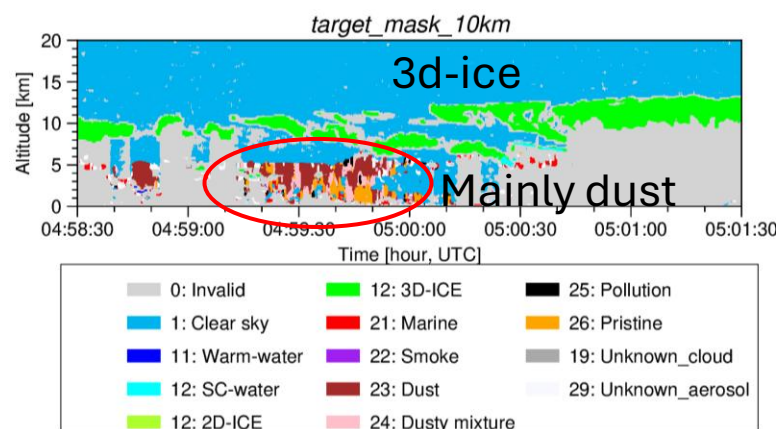
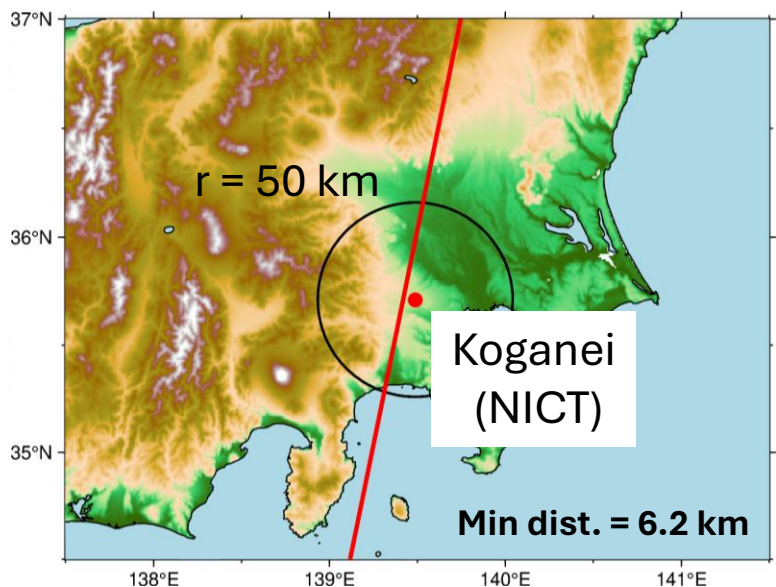
$$\text{False detection ratio} = \frac{\text{FP} + \text{FN} = 473}{\text{TP} = 168}$$



0: Invalid	12: 3D-ICE	25: Pollution
1: Clear sky	21: Marine	26: Pristine
11: Warm-water	22: Smoke	19: Unknown_cloud
12: SC-water	23: Dust	29: Unknown_aerosol
12: 2D-ICE	24: Dusty mixture	

Comparison analysis (Asian dust and ice cloud)

2025.04.18 (daytime)

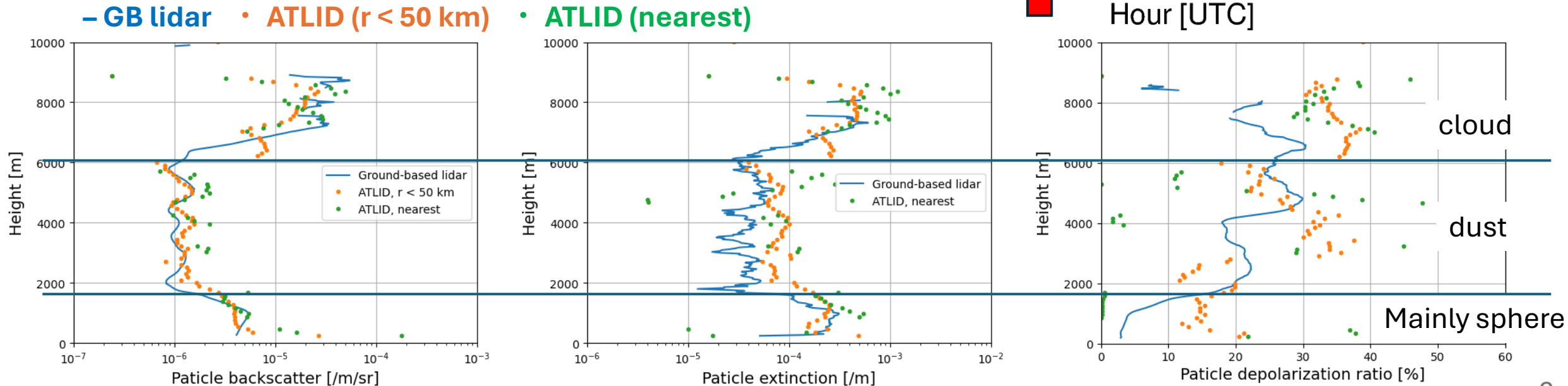
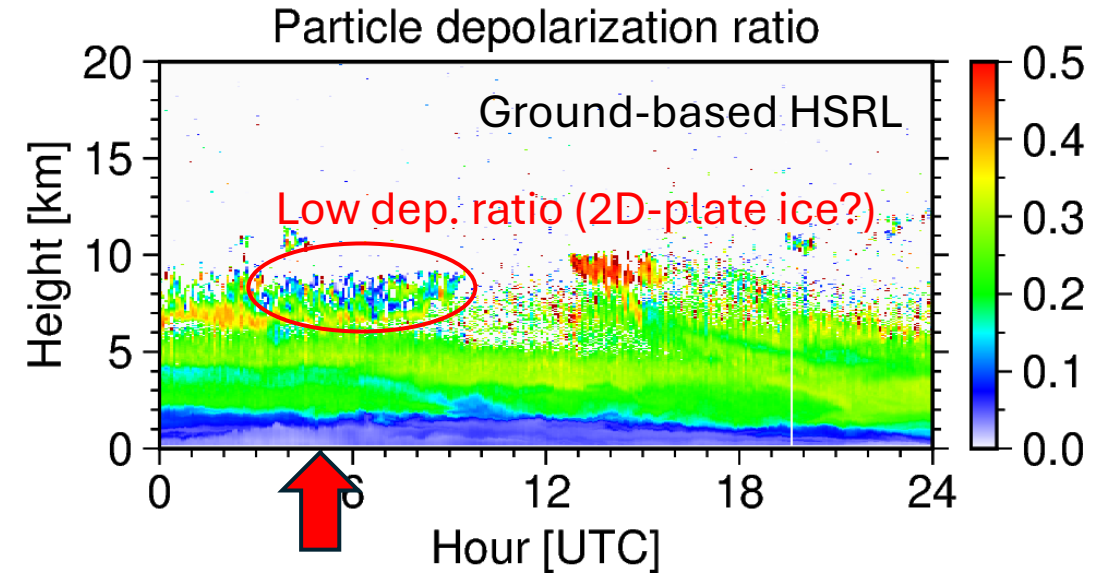


Ice clouds over dust were observed by ATLID and GB lidar

Comparison analysis (Asian dust and ice cloud)



- ◆ Backscatter and extinction have good agreements for aerosols
 - ◆ ATLID has lower backscatter and higher dep. ratio for ice clouds
- => Dep. ratio of ground-based lidar may be affected by 2D-plate ice (because of zenith angle pointing)





- ◆ Validation of ATLID JAXA L2a products using ground-based HSRL/Raman lidars for 1-year

	Feature mask	Aerosol backscatter	Aerosol extinction	Aerosol dep. ratio	Target mask	PBL height
Estimated error	~12%	~10%	~11%	~32%	N/A	~110m

- ◆ Very good agreement with ground-based lidar, but dep. ratio may be overestimated and target mask is still challenging for thin aerosol layers due to noisy data
- ◆ Influence of horizontally-oriented (2D-plate) ice on the comparison

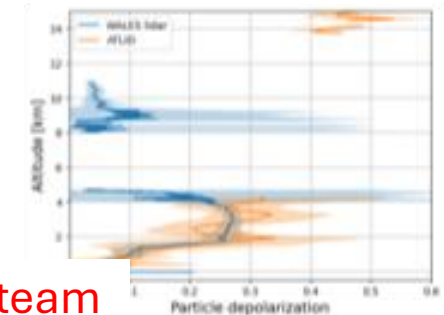
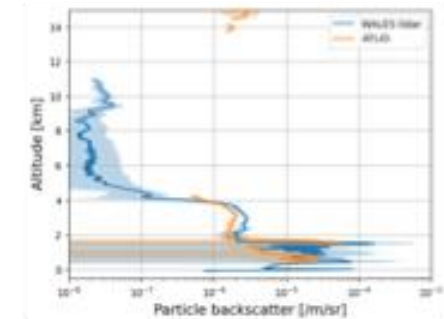
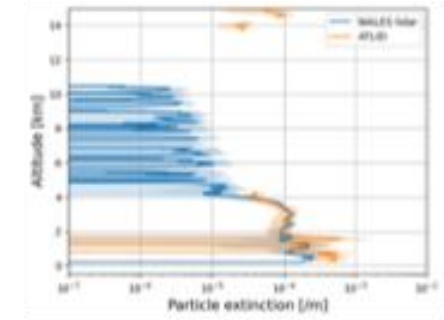
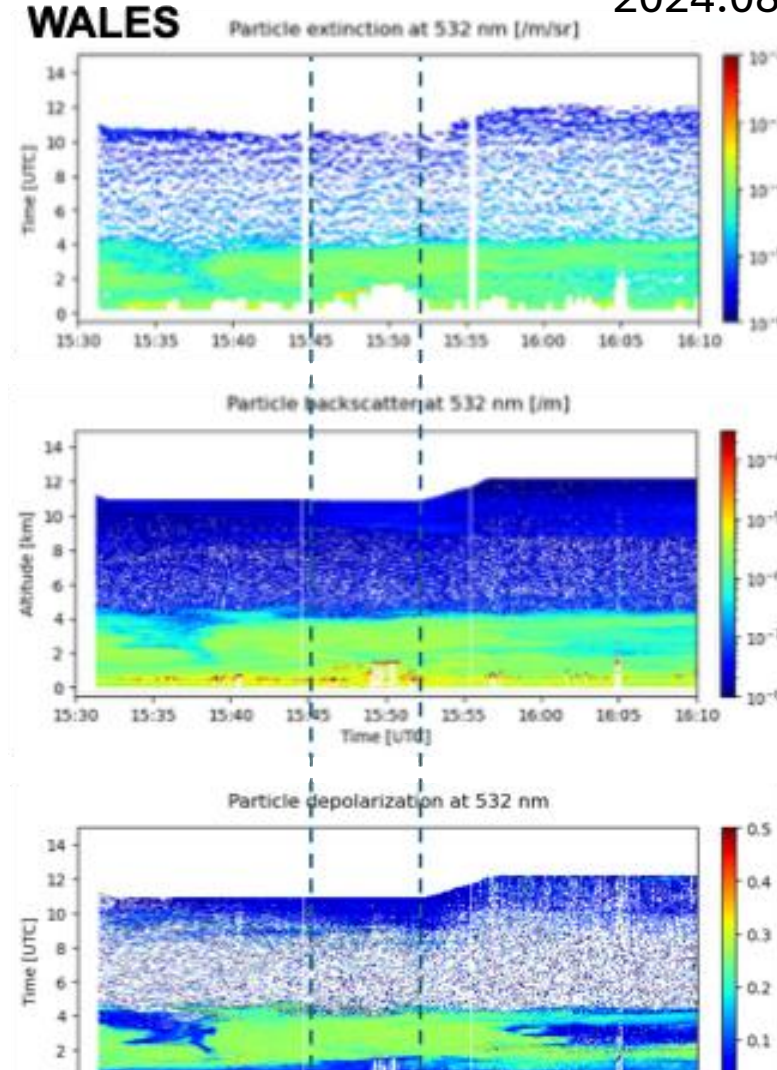
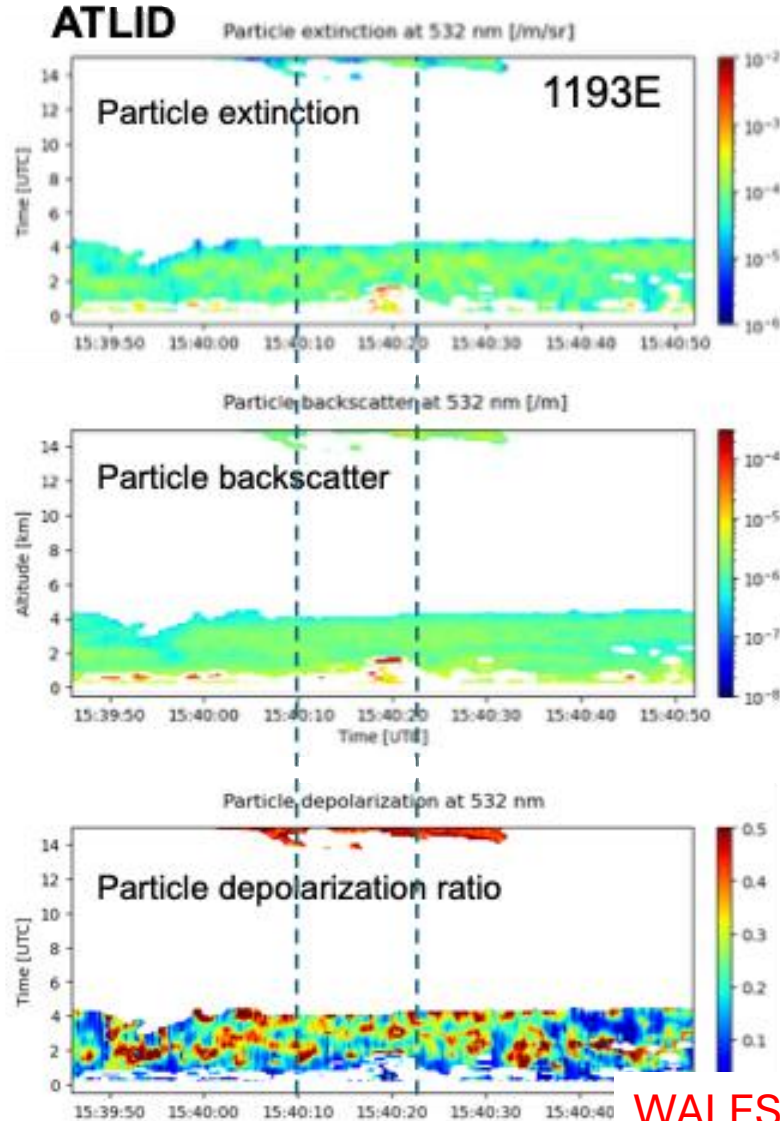
Ongoing study

- ◆ Validation of MSI AOT and Ångström exponent using SKYNET data
- ◆ Validation of ATLID JAXA L2a aerosols and clouds products using HALO/WALES lidar

Comparison of ATLID JAXA L2a with WALES lidar



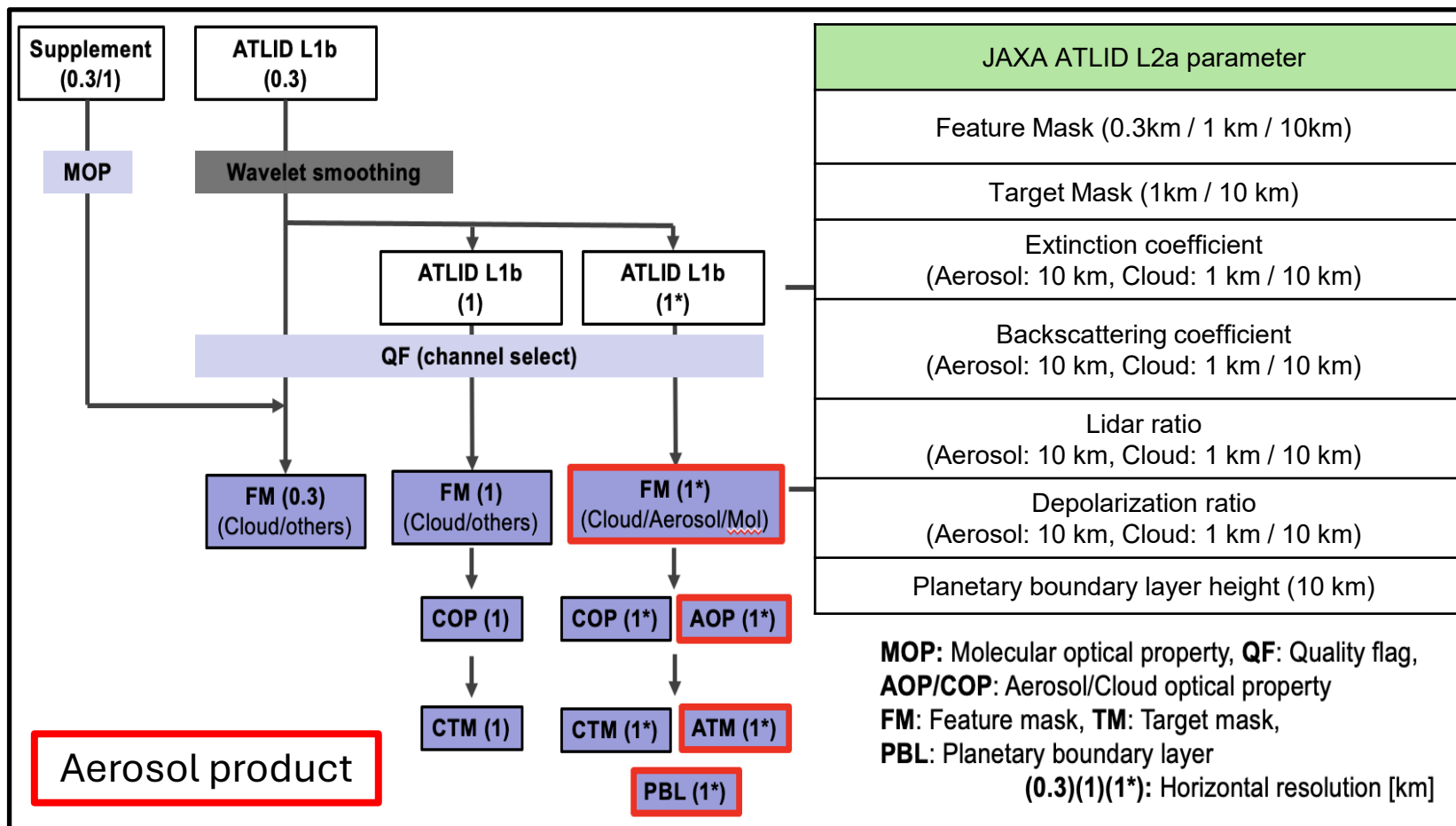
2024.08.13 (SAL case, preliminary results)



WALES lidar data was provided by the WALES lidar team



◆ Evaluation of standard L2a product (10-km horizontal resolution)



Validation site (HSRL & Raman lidars)



Obs. site	Lat Lon	Instrument	Parameter
Koganei*1 (Urban)	35.7N 139.48E	355 HSRL (2019~) 355MFMSPL 355DWL	α , β , δ , S: 355 (Day & Night) Attenuated backscatter: 355 (Day & Night) Attenuated backscatter: 355 (Day & Night) (Multiple scatter) Vertical wind
Tsukuba (Rural)	36.05N 140.12E	MRHSRL (NIES)	α , β , δ , S: 355 (Night) α , β , δ , S: 532 (Day & Night) Attenuated backscatter: 355/532/1064 (Day & Night)
		ML (MRI)	β , δ : 532 (Day & Night) Attenuated backscatter: 532 (Day & Night)
Fukuoka*2 (Rural-Urban)	33.52N 130.48E	MRL =>MRHSRL (2021~)	α , β , δ , S: 355 (Night) α , β , δ , S: 532 (Day & Night) *2021~ Attenuated backscatter: (Day & Night)
Hedo (Maritime)	26.87N 128.25E	MRL	α , β , δ , S: 355/532 (Night) Attenuated backscatter: 355/532/1064 (Day & Night)
Toyama*3 (Rural)	36.7N 137.1E	MRL	α , β , δ , S: 355/532 (Night) Attenuated backscatter: 355/532/1064 (Day & Night)
RV Mirai*4 (Maritime)	Ocean	MRL	α , β , δ , S: 355/532 (Night) Attenuated backscatter: 355/532/1064 (Day & Night)

*1 Collaboration with Kyushu Univ., NICT, and Tokyo Metropolitan Univ. *2 Collaboration with Kyushu Univ.

*3 Collaboration with Univ. of Toyama *4 Collaboration with JAMSTEC and Univ. of Toyama

Validation of ATLID JAXA L2a PBL height

◆ Estimated errors are ~110 m (Target: $\pm 500\text{m}$)

