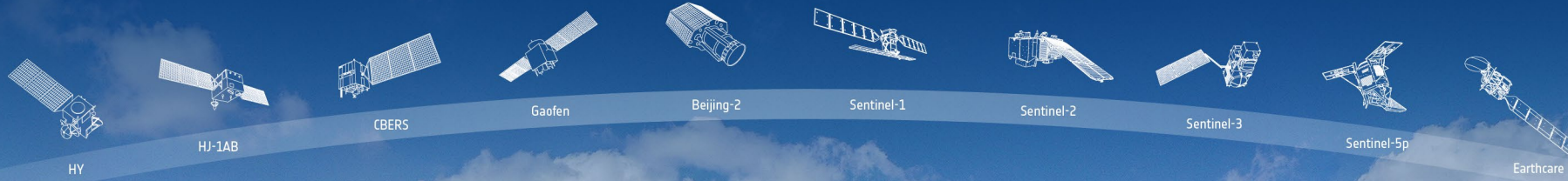




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2025 DRAGON 6 SYMPOSIUM

14-18 JULY 2025

PROJECT ID. 95395

TOWARDS UNDERSTANDING AEROSOL CLOUD RADIATION INTERACTIONS

USING 3D SATELLITE OBSERVATIONS (TACT)





<TUESDAY, 15 JULY 2025>

ID. 95395

**PROJECT TITLE: TOWARDS UNDERSTANDING AEROSOL CLOUD RADIATION INTERACTIONS
USING 3D SATELLITE OBSERVATIONS (TACT)**

PRINCIPAL INVESTIGATORS: [PING WANG, MINZHENG DUAN]

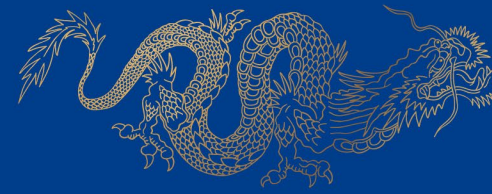
**CO-AUTHORS: [XUEMEI WANG, SIJIE CHEN, DAVE DONOVAN, GERD-JAN VAN ZADELHOFF, JOB WILTINK,
JAN FOKKE MEIRINK, HAILEI LIU, YING ZHOU, YONG HAN]**

PRESENTED BY: [PING WANG]



- **Inform on the project's objectives**
- **Detail the Copernicus Sentinels, ESA, Chinese and ESA Third Party Mission data utilised to achieve the project's objectives (complete slide 4)**
- Detail the in-situ data measurements and requirements
- Provide details on field data collection campaigns and periods in P.R. China or other study areas
- **Inform on the project's schedule, planning & contribution of the partners for the following year**
- **Report on the level and training of young scientists on the project achievements, including academic exchanges**
- **Brief overview on the European and Chinese young scientist's research (presented by the Ys, if attending the symposium)**

Project objectives

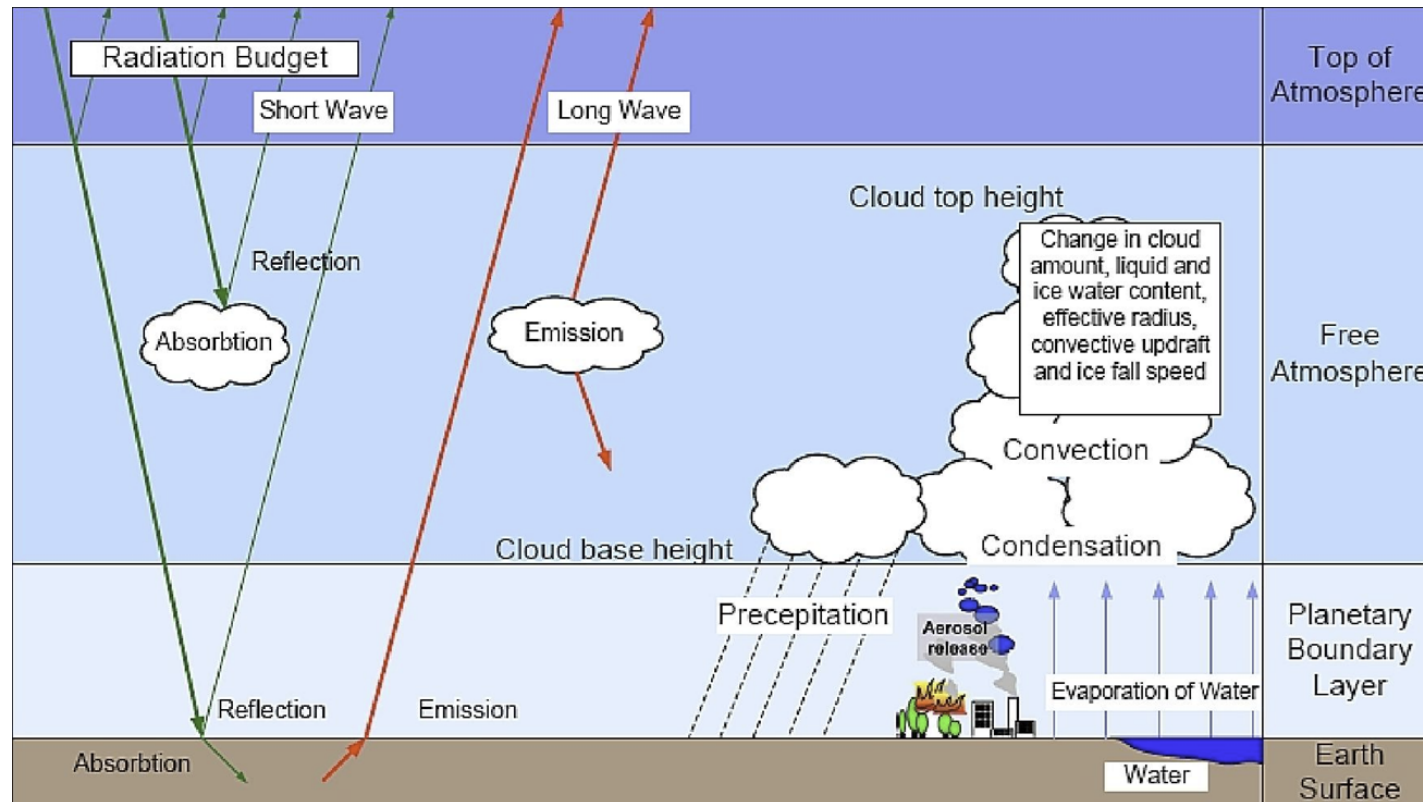


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Using EarthCARE, and geostationary data to study the aerosol, cloud radiation interaction for selected cases.



From ESA website

EarthCARE

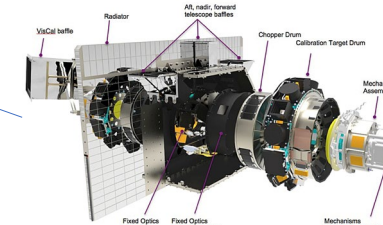
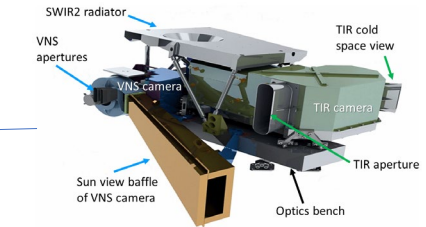
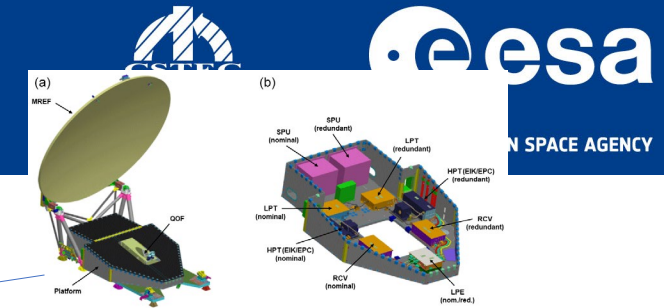
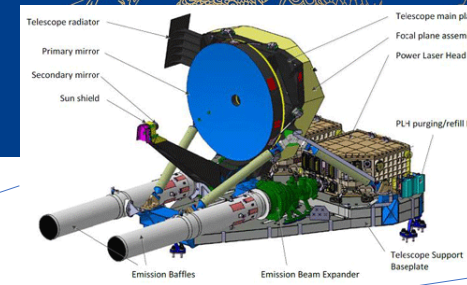
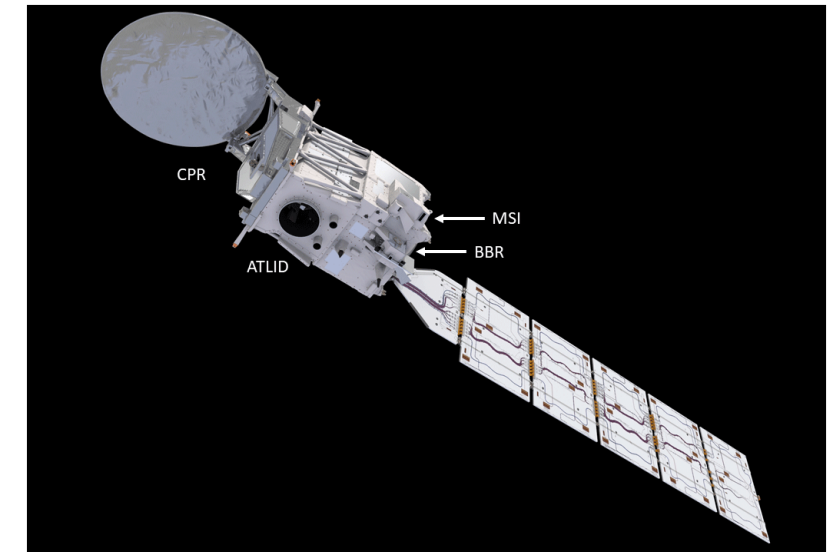
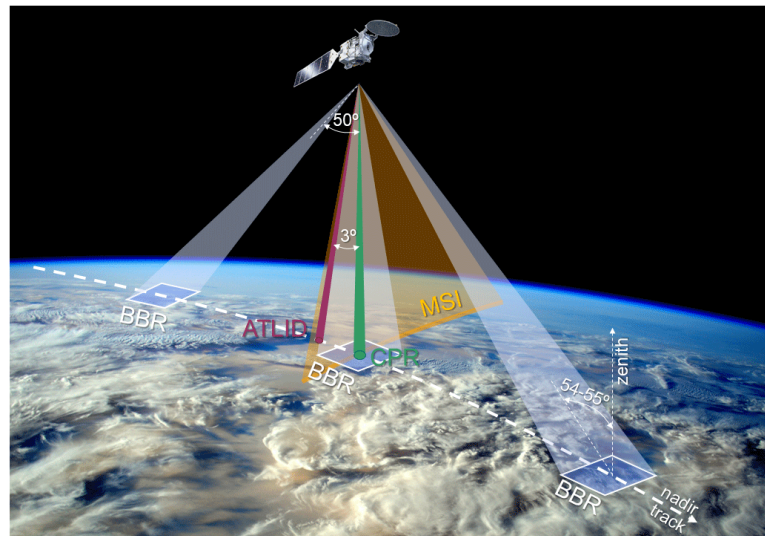
ESA/JAXA Cloud-Aerosol-Radiation process-study oriented mission.

Instruments

1. Cloud-Aerosol Lidar (ATLID) [355 nm, HSRL]
2. Cloud Profiling Radar (CPR) [94 GHz Doppler]
3. Multi-Spectral Imager (MSI) [670,865,1650,2210,8800,10800,12000 nm]
4. Three-view Broad-Band Radiometer (BBR) [SW, SW+LW channels]

Orbit

- Polar sun-synchronous orbit: 25 Day revisit cycle
- 14:00 descending node
- Approx. 400 km mean altitude
- Launch: 28 May 2025





of uncertainty in projections of the future climate, making them critical to improve numerical weather predictions and climate modelling.

The largest uncertainties are due to the diversity of cloud formation processes and the feedback mechanisms depending on cloud macrophysical and microphysical properties

EarthCARE is acquiring key observables needed to better understand the role of cloud, aerosol and radiation in climate.

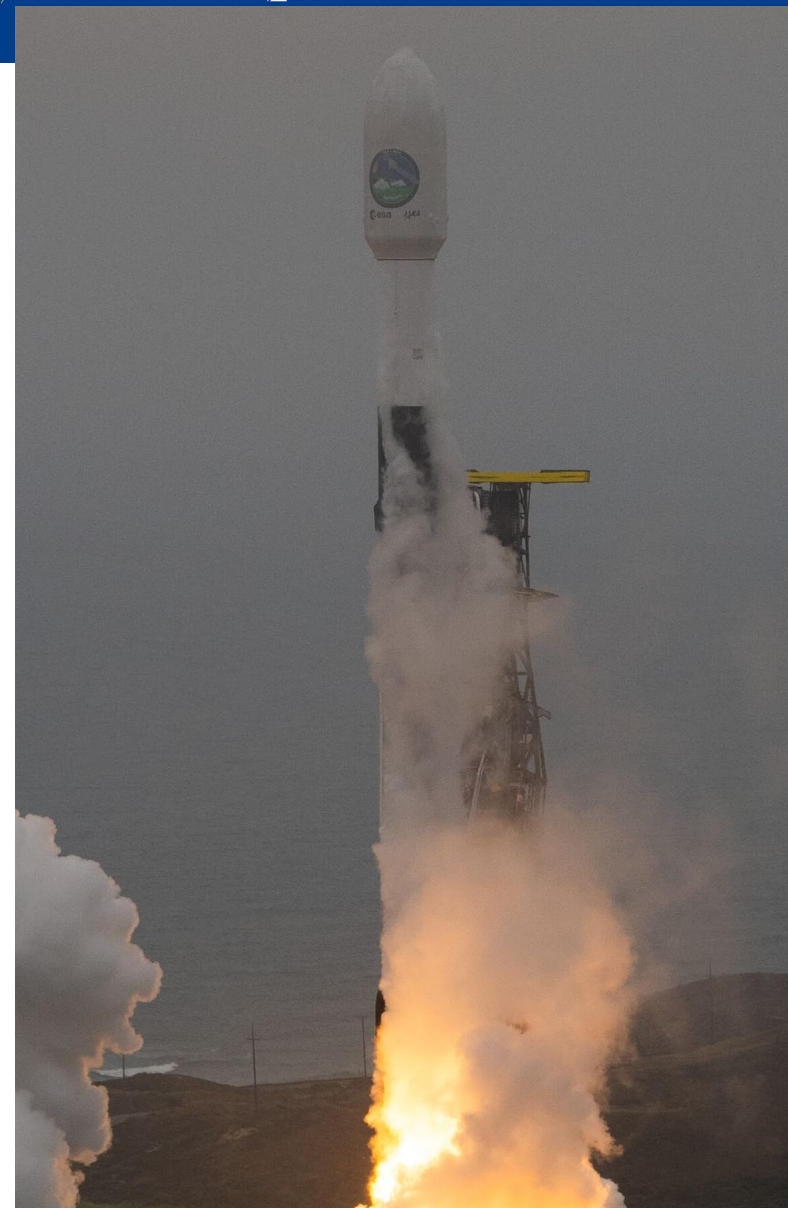
Satellite and Payload

EarthCARE is a joint venture between ESA and JAXA

The largest and most complex Earth Explorer to date,

Sun-sync. orbit @ 393 km, 14:00 hours descending node

Launched May 28th 2024.



Meteosat Third Generation



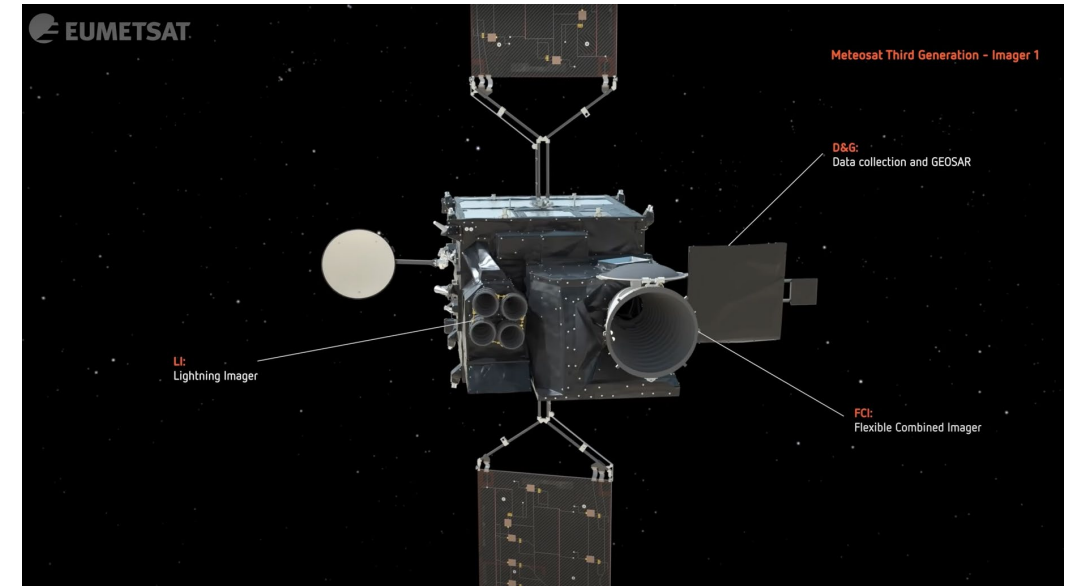
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Two platforms

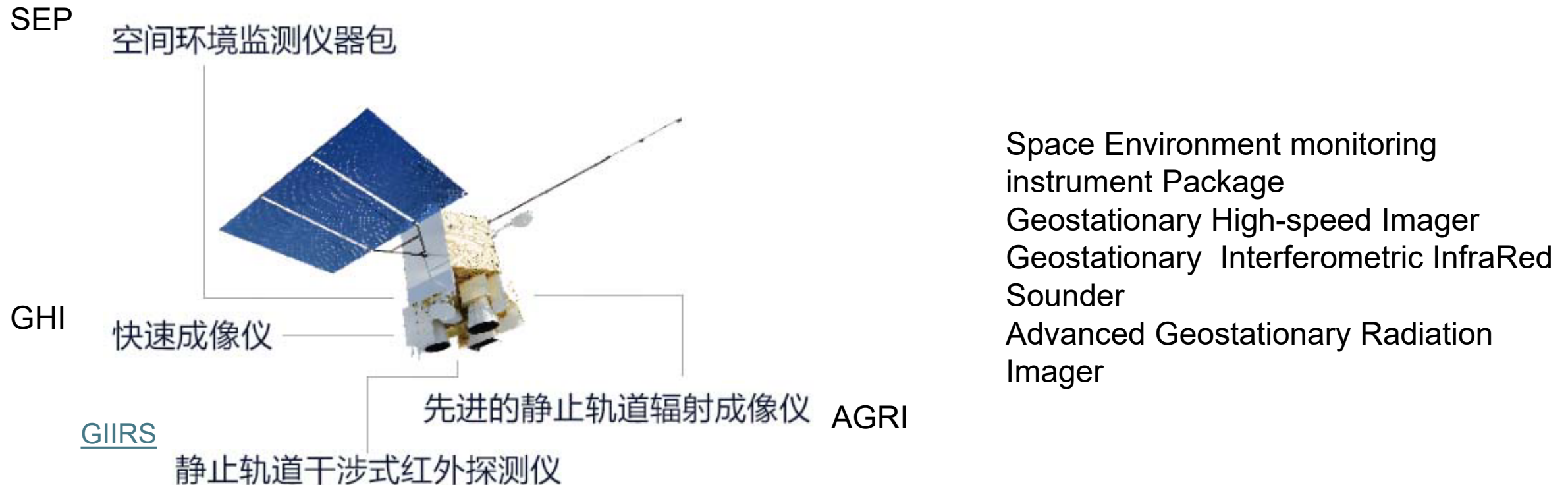
- Imager (MTG-I)
 - High-res multi-color photos
 - Lightning detection
 - Sounder (MTG-S)
 - Temperature/humidity profiles
 - Air pollution
-
- MTG-I launched on 13 Dec 2022
 - MTG-S launched on 1 July 2025





FY-4B launched on 3 June 2021

location 105°E after 2024-3-05



From nsmc website <http://nsmc.org.cn/nsmc/cn/satellite/FY4B.html>



- *Inform on the project's schedule, planning and contribution of the partners*

1 data evaluation (year 1)

1.1 evaluation of EarthCARE aerosol extinction over Europe

1.2 evaluation of EarthCARE aerosol extinction over China

2 data collection and preliminary analysis (year 2)

2.1 collect collocated EarthCARE and geostationary satellite data for golden cases

2.2 prepare extinction profile, effective radius, optical thickness, target classification, cloud optical thickness, effective radius, cloud number density

2.3 derive number density of CCN and INP if they are not available



3. quality control, preliminary analysis (year 3)

analyze the relation between aerosol and cloud properties for difference cases (regions)

3.1 dust aerosols

3.2 BBA

3.3 cities

4 detailed analysis (year 4)

Based on the results from 3, improve the analysis

Possible with addition of new data, meteorological data and radiative transfer model simulations.

The KNMI and IAP teams will work on similar topics but focus on different regions and cases.

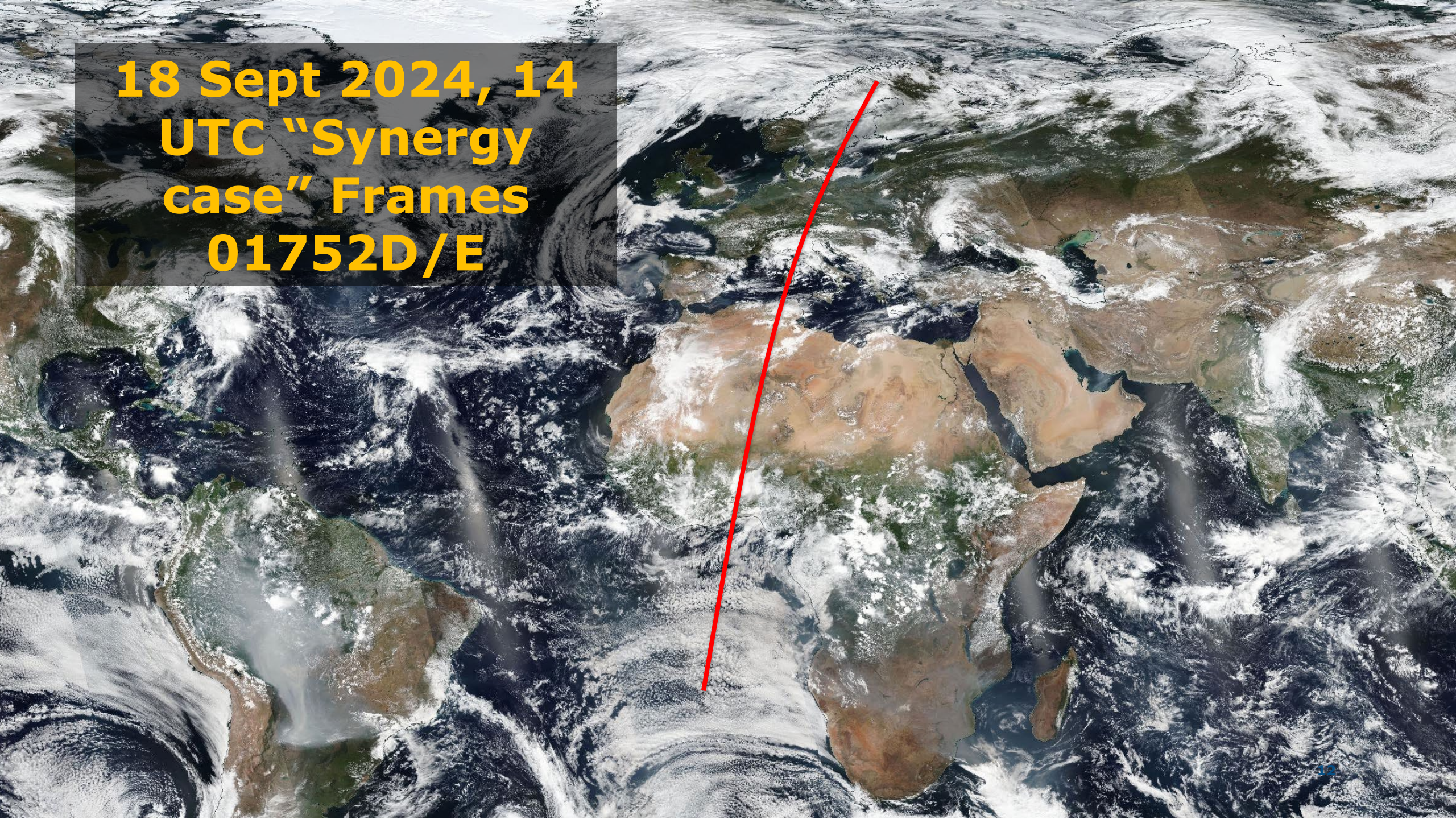
Dragon 6 EO Data Delivery

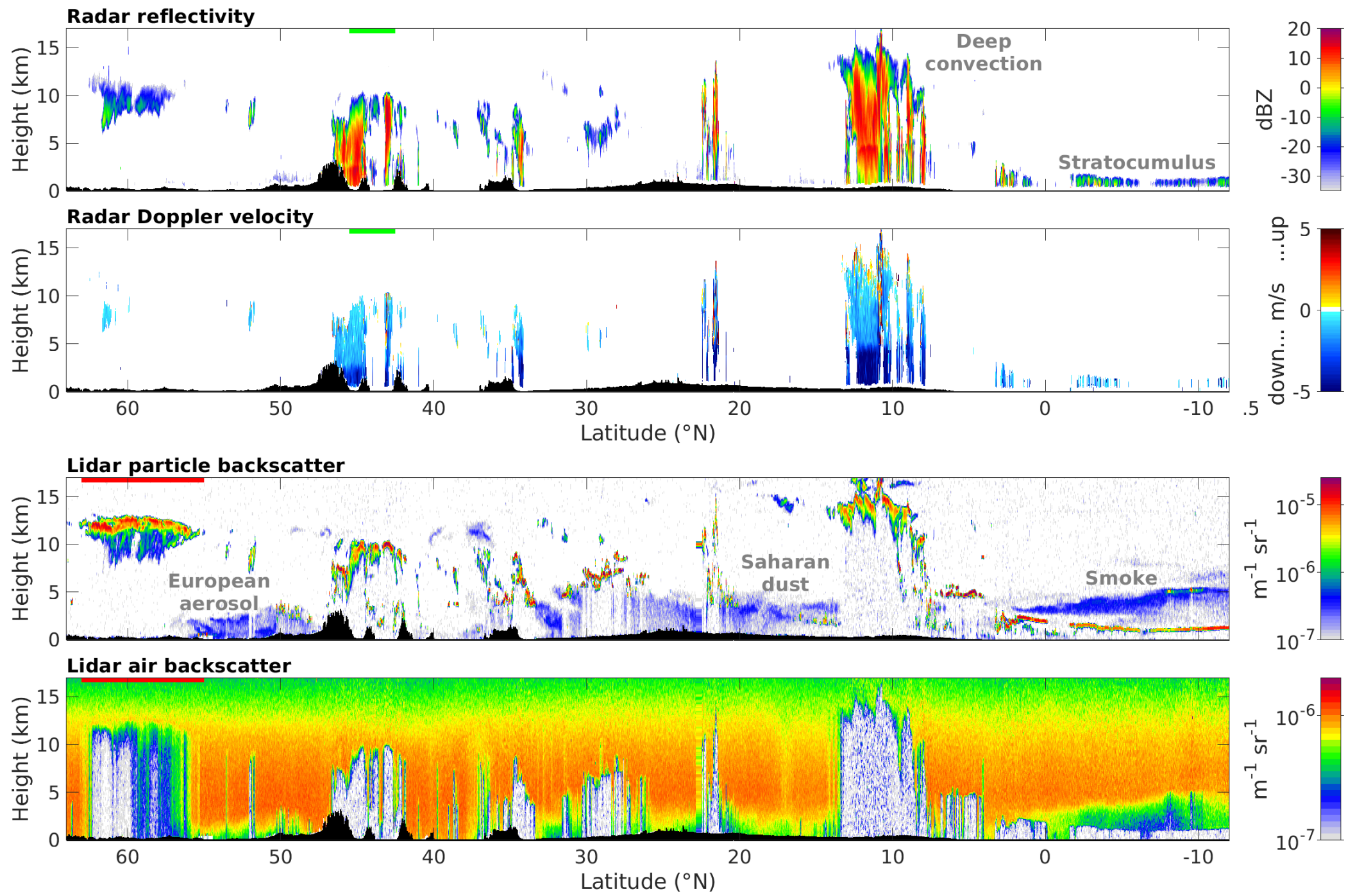


Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since June 2024) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert “ftp”

ESA /Copernicus Missions	No. Scenes	ESA Third Party Missions	No. Scenes	Chinese EO data	No. Scenes
1.EarthCARE	3 months	1. FCI	2 days	1. FY-3 MERSI	1 month
2.		2.		2.	
3.		3.		3.	
4.		4.		4.	
5.		5.		5.	
6.		6.		6.	
Total:		Total:		Total:	
Issues:		Issues:		Issues:	

**18 Sept 2024, 14
UTC "Synergy
case" Frames
01752D/E**

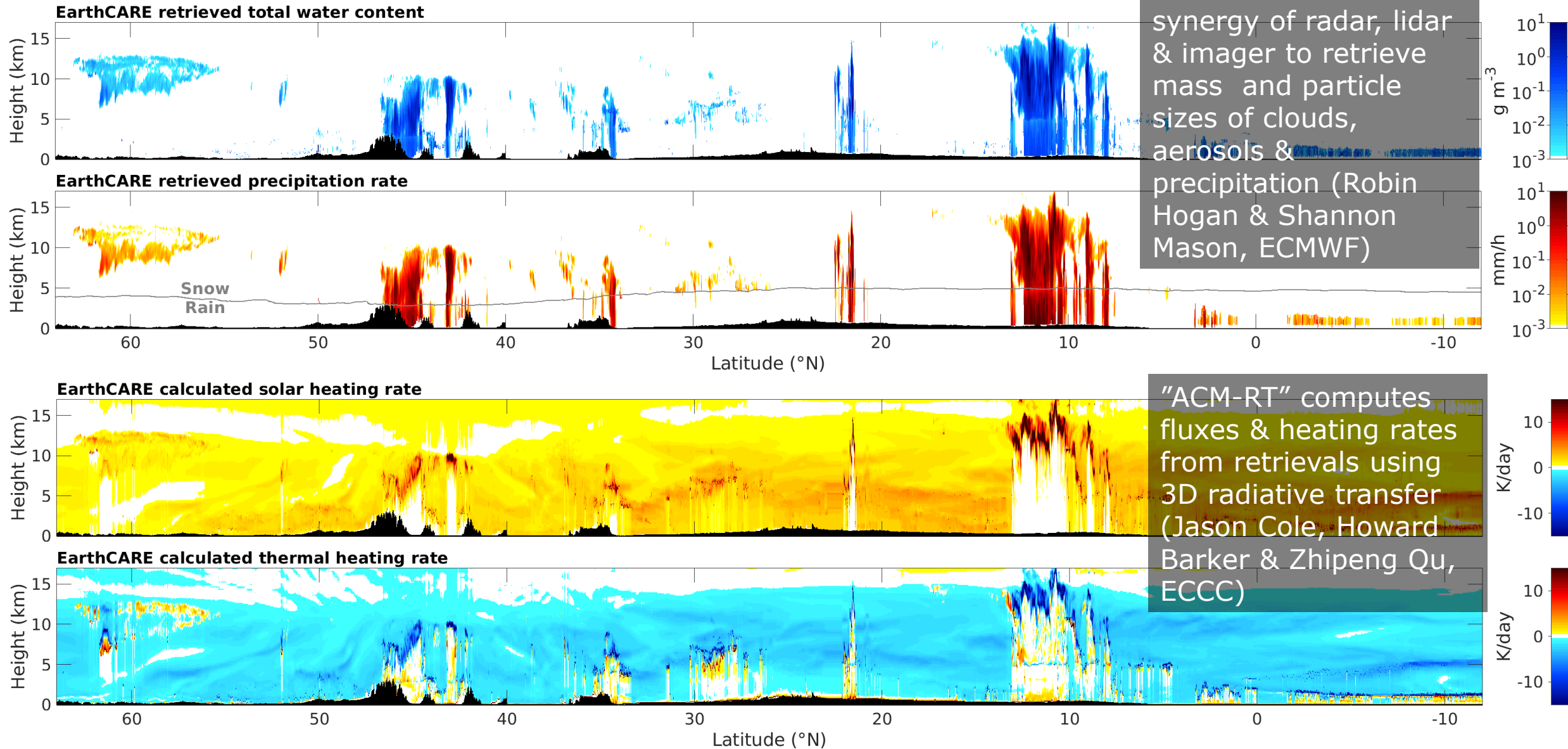




Cloud/precipitation retrievals (ACM-CAP) and heating rates (ACM-RT)



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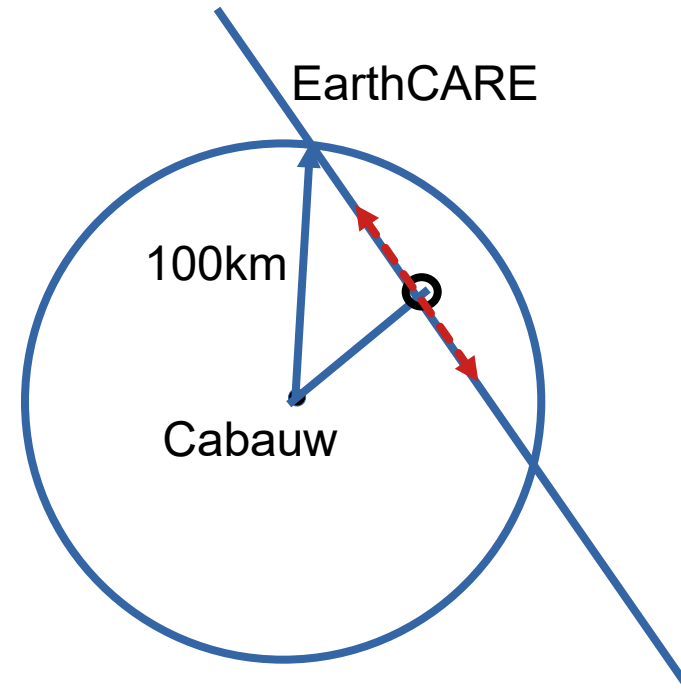
Evaluation of ATLID products using EARLINET data

<https://www.earlinet.org/>



Remove clouds before averaging using classification in ATL_AER_L2

Only select data with quality_status = 0 or 1 in AER, EBD



- 1) Select ATLID measurements within 100 km to Cabauw, time difference < 1.5 hour.
- 2) Select the measurement closest to Cabauw.
- 3) Average the measurements along track for 100 km around the closest point, can be less than 100 km if the orbit is far away.

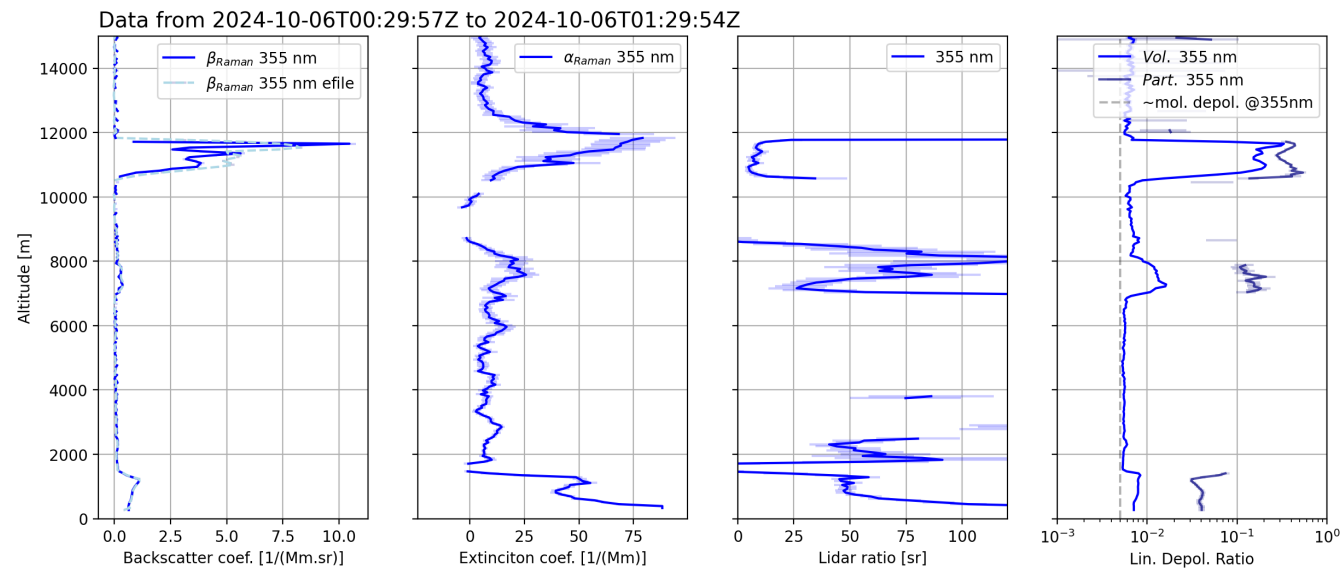
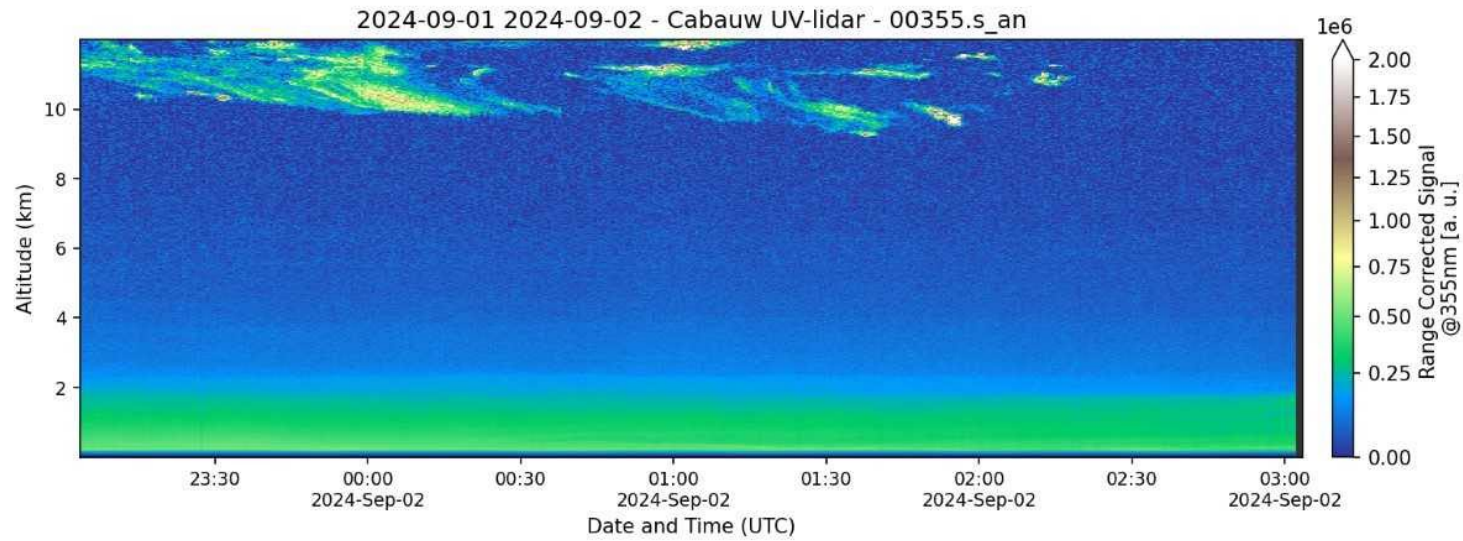
Cabauw UV lidar 20240902

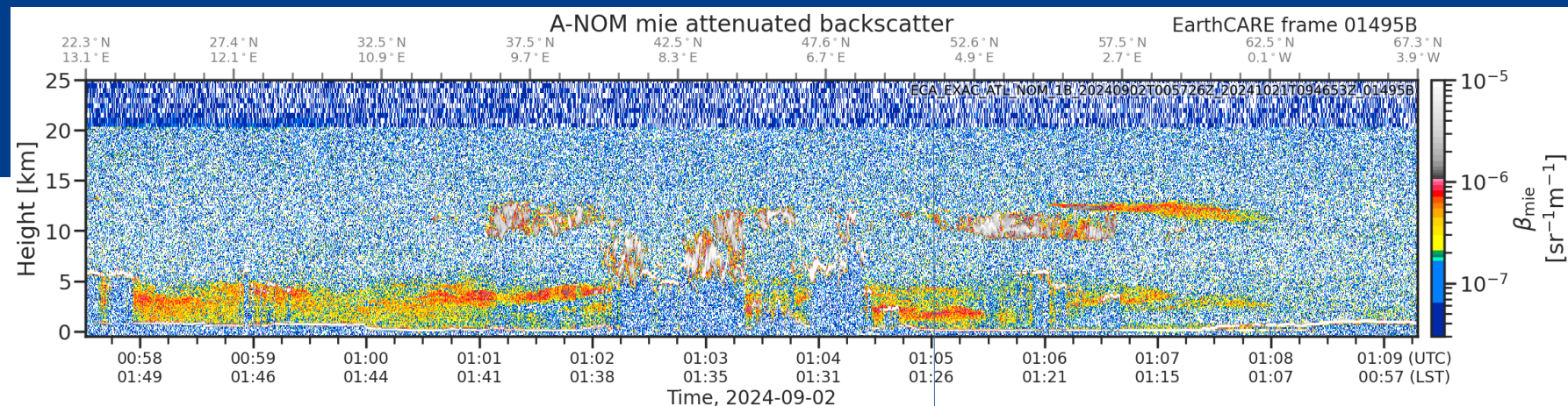


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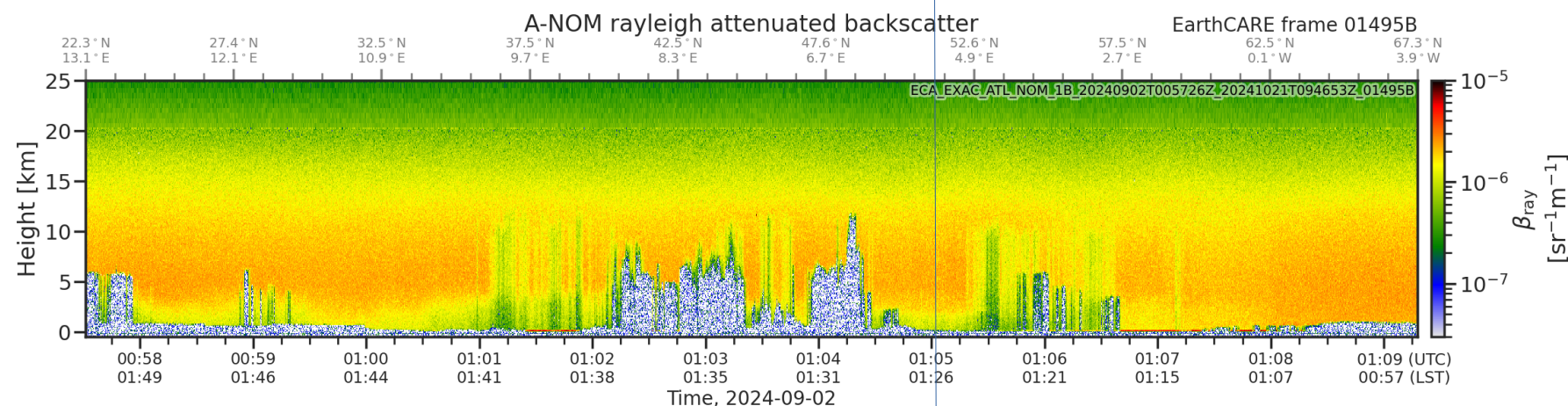


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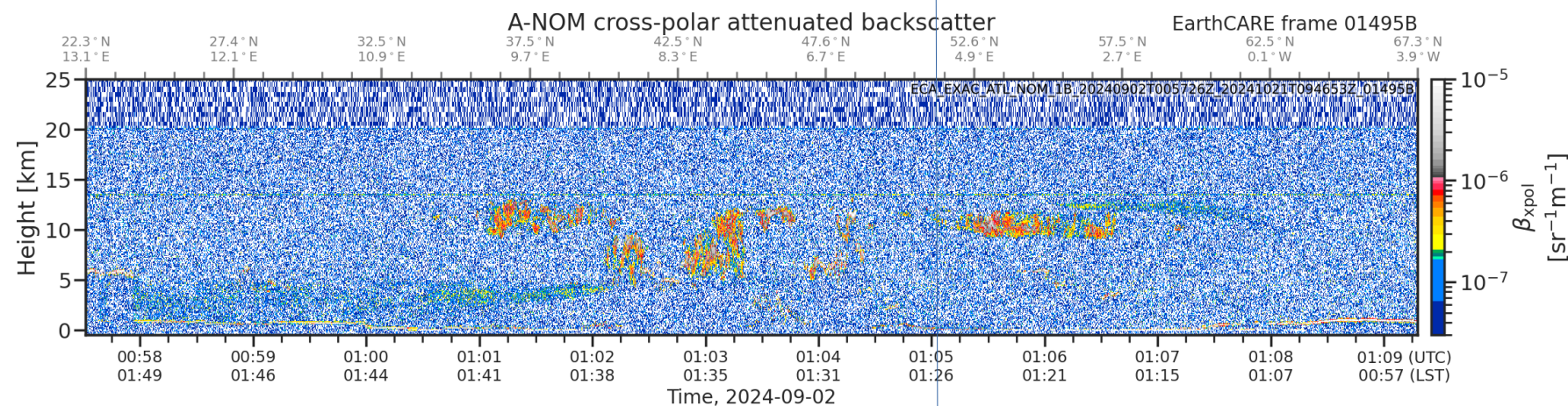




Mie co-polar
Attenuated
Backscatter



Rayleigh
Attenuated
Backscatter

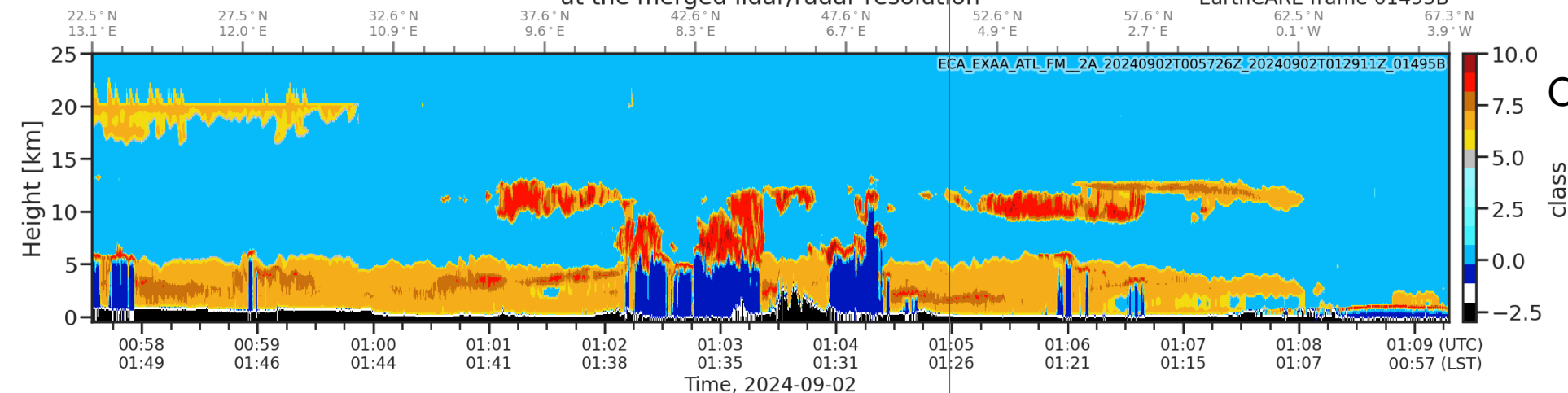


Cross polar
Attenuated
Backscatter



ATL-FM lidar feature mask
at the merged lidar/radar resolution

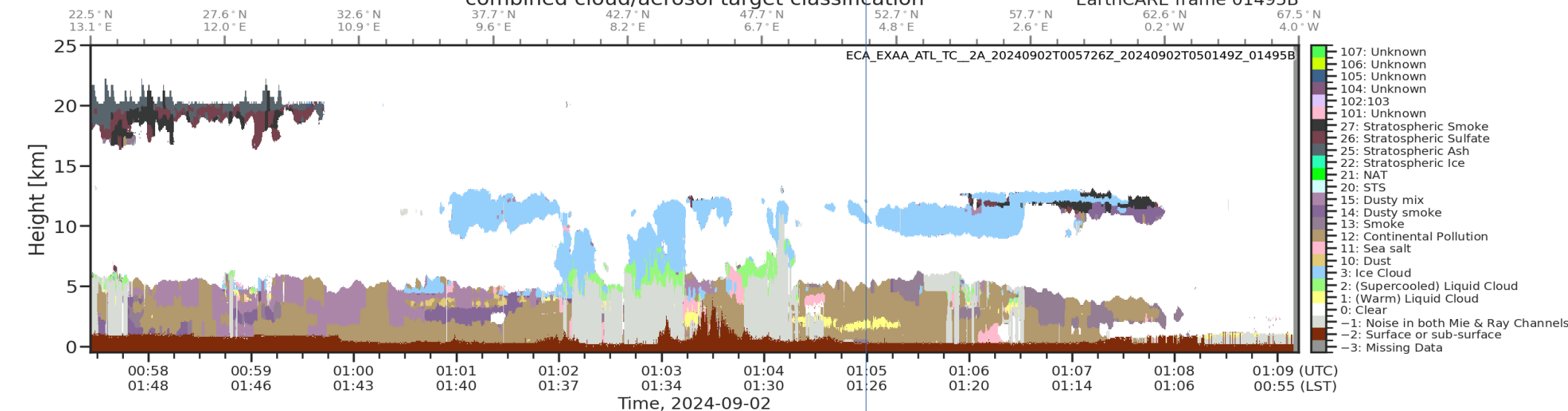
EarthCARE frame 01495B



Overpass at 01:05 UTC

ATL-TC low horizontal resolution
combined cloud/aerosol target classification

EarthCARE frame 01495B

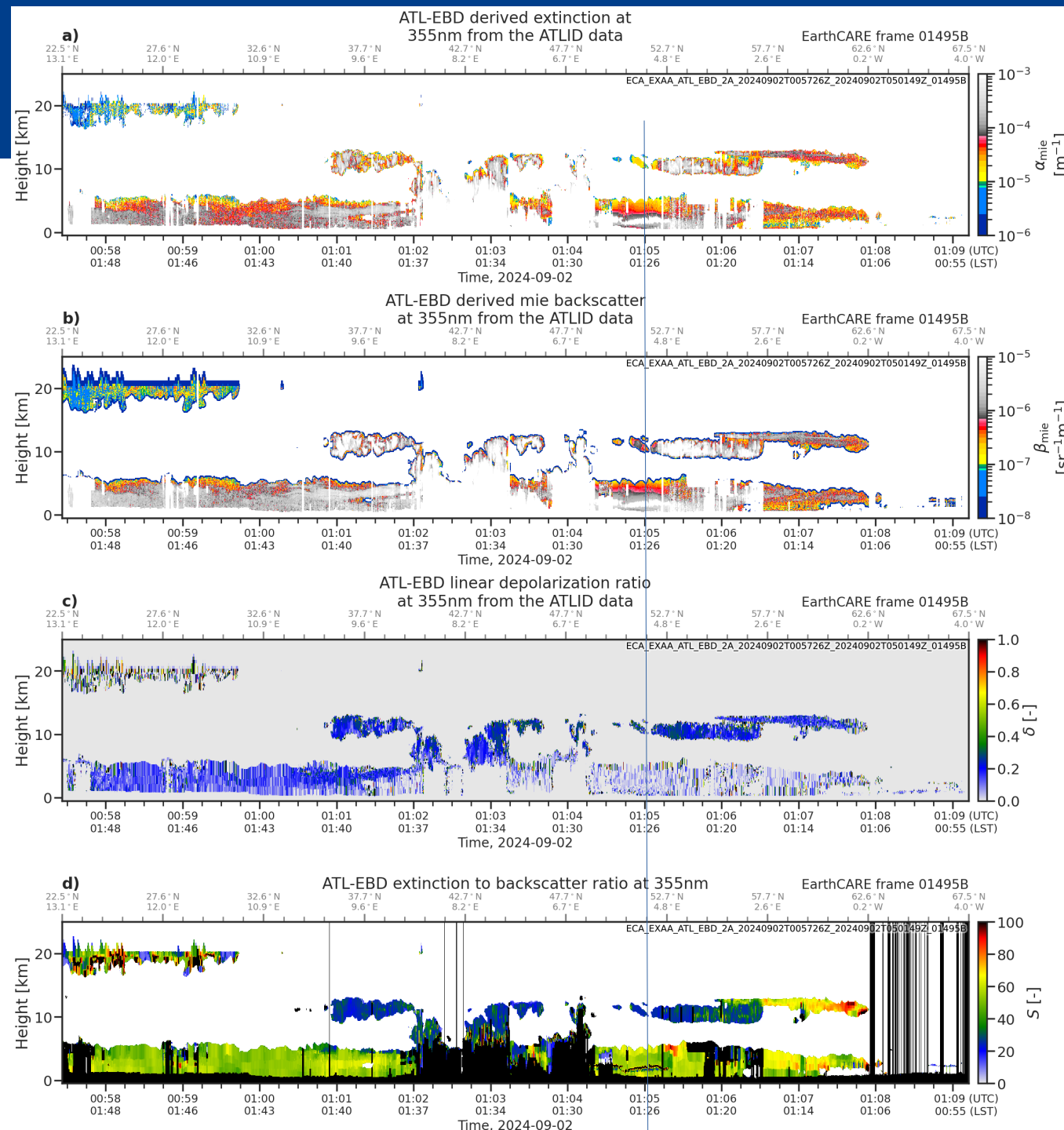




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EBD
particle extinction
coef.

particle backscatter
coef.

particle linear
depolarisation ratio

particle extinction
to backscatter ratio

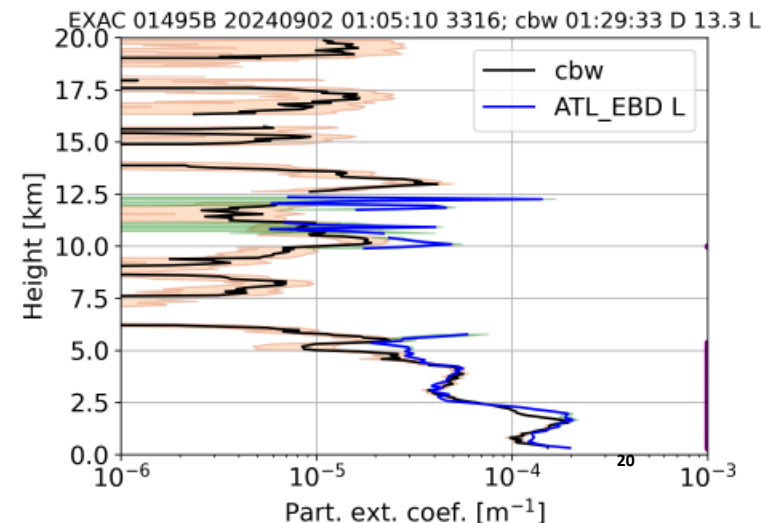
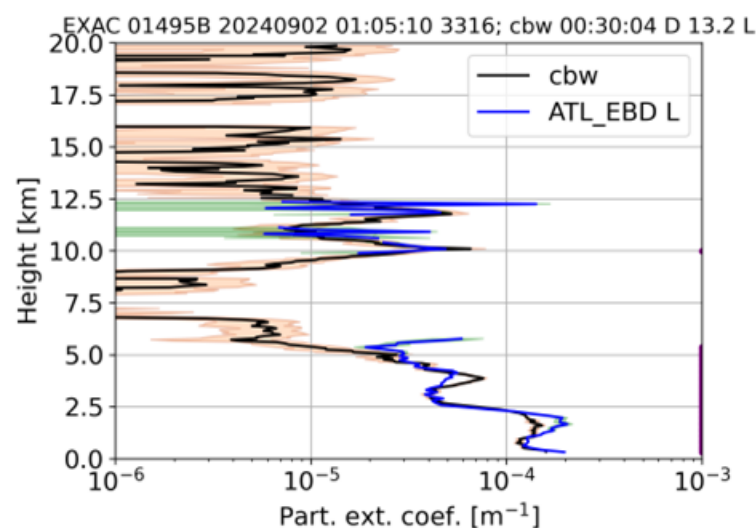
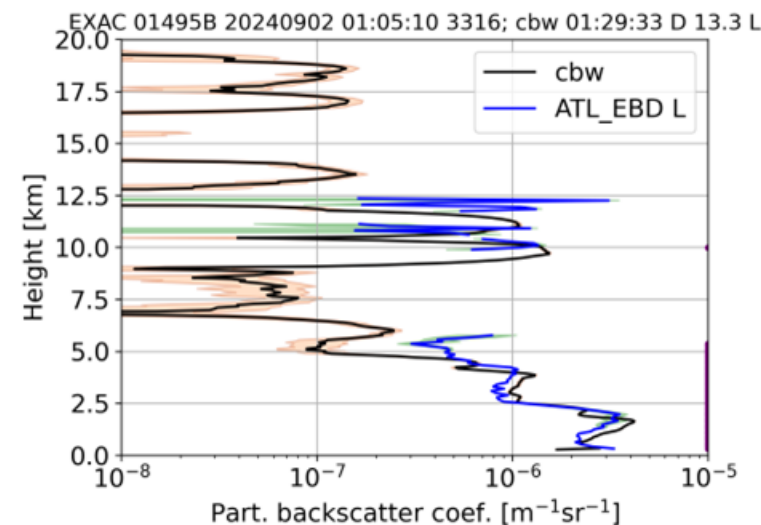
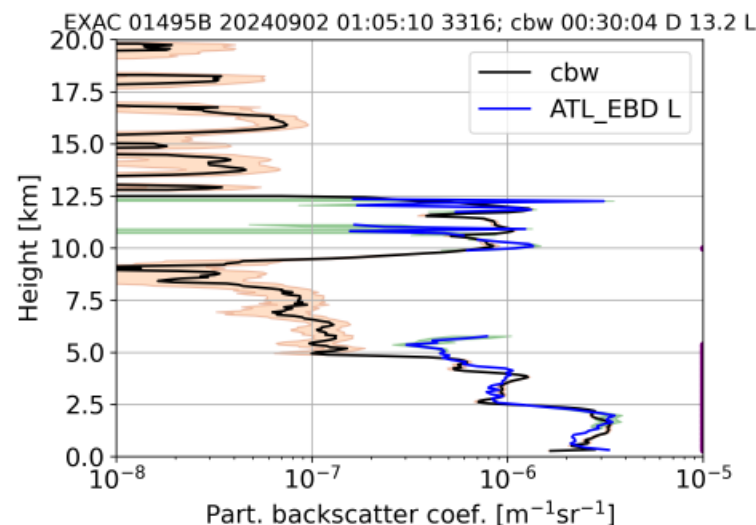
Lidar ratio

L2 Earlinet Example Comparison (using Cabauw 355 Raman data)

<https://www.earlinet.org/>



- 1) Select ATLID measurements within 100 km to Cabauw, time difference < 1.5 hour.
- 2) Select the measurement closest to Cabauw.
- 3) Average the measurements along track for 100 km around the closest point, can be less than 100 km if the orbit is far away.



EXAE 20250415 Cabauw case



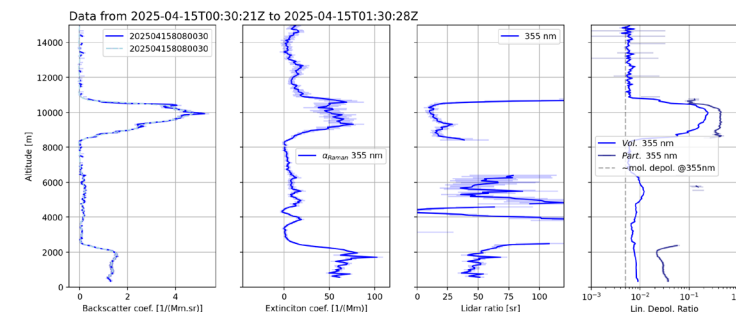
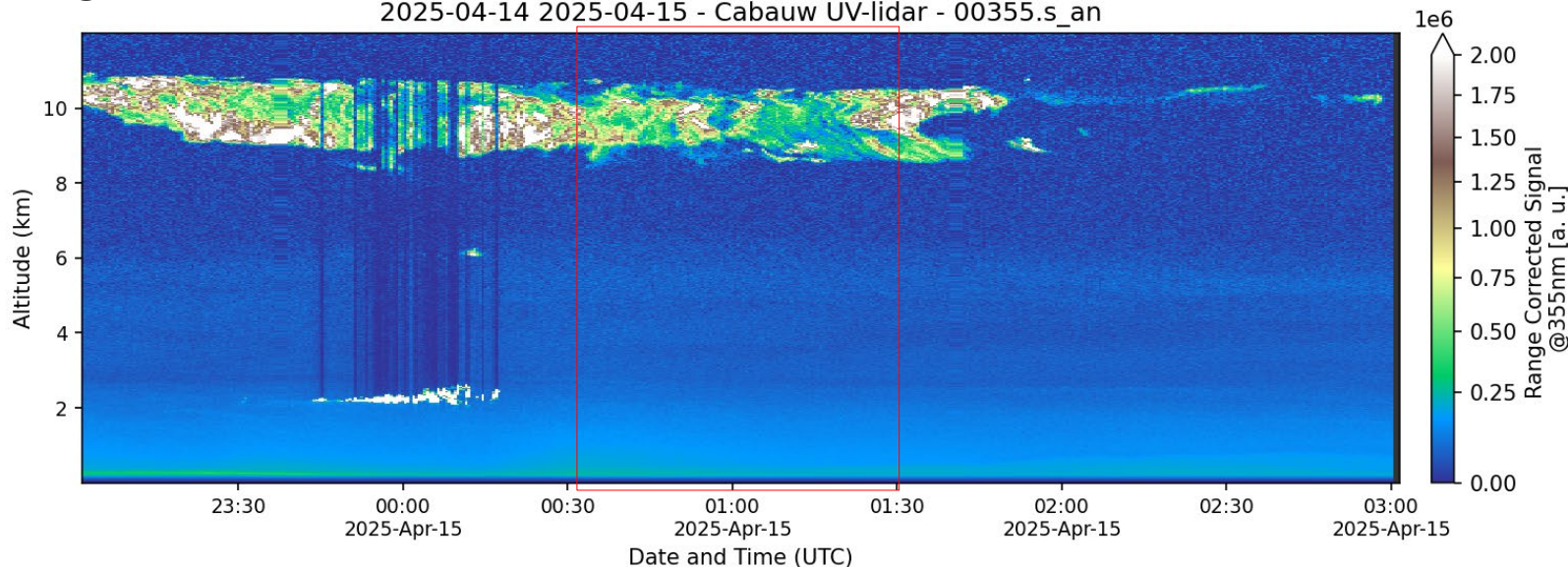
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UV-lidar

2025-04-14 2025-04-15 - Cabauw UV-lidar - 00355.s_an



Cirrus between 8-11 km
Aerosols at 0 – 2 km

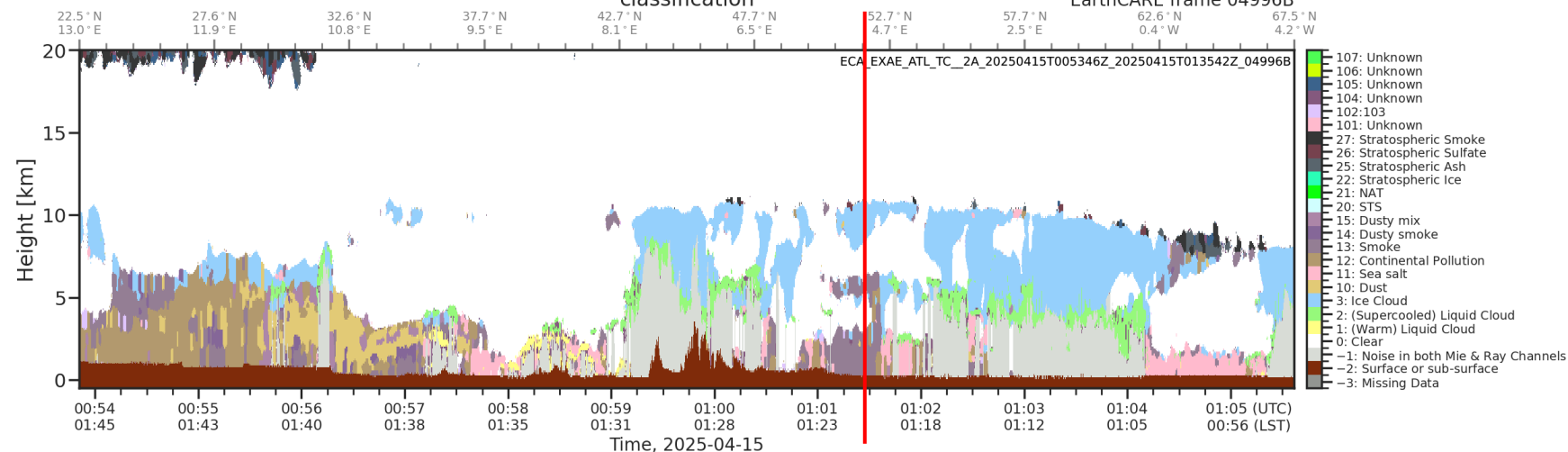
Cabauw UV-lidar
00:30:21--01:30:21

ATLID overpass
01:01:29

TC= 12, 13, (< 5 km)
14 (~5-6 km)
3 (~9-10 km)

ATL-TC combined cloud/aerosol target
classification

EarthCARE frame 04996B



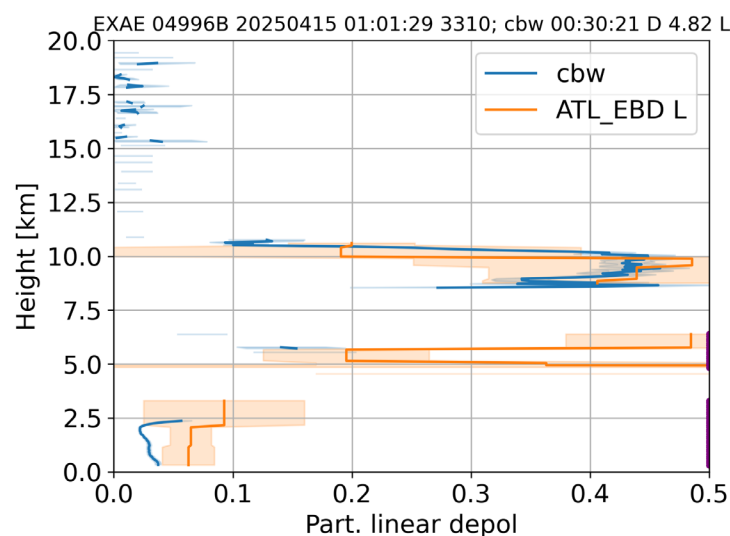
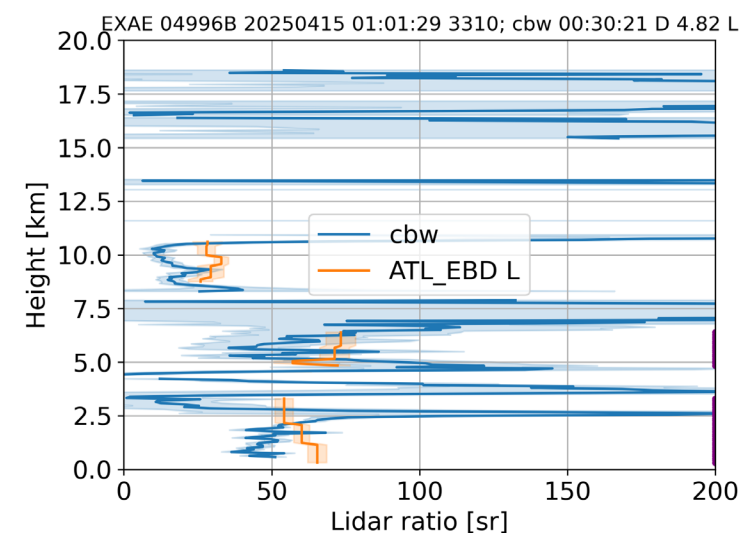
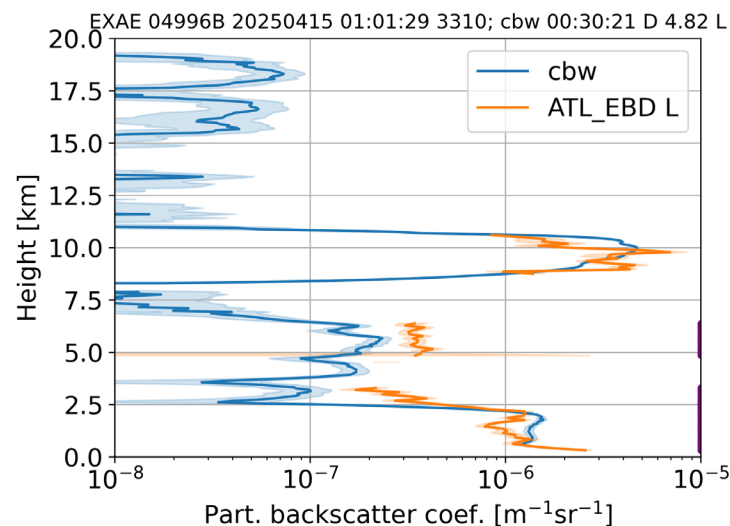
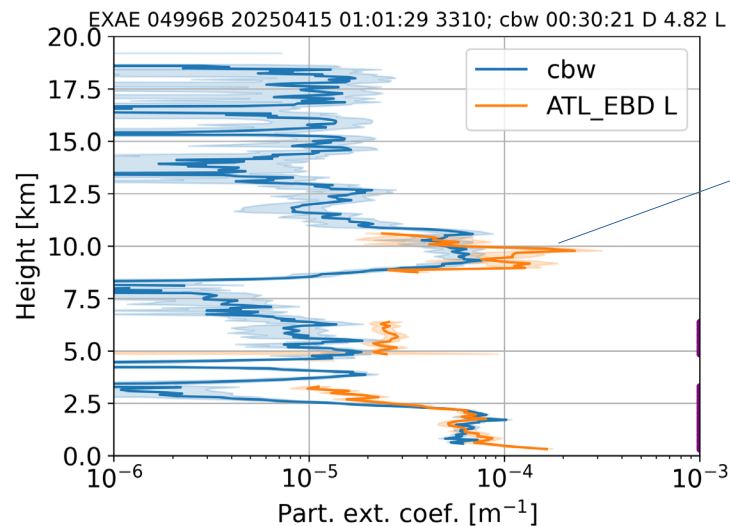
EXAE 20250415 ATL_EBD products



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Cirrus has small lidar ratio
Depol is about 0.4
Aerosols lidar ratio 50-60?
ATL_AER depol is also good for
aerosols

AER actual along track
resolution > 100 km

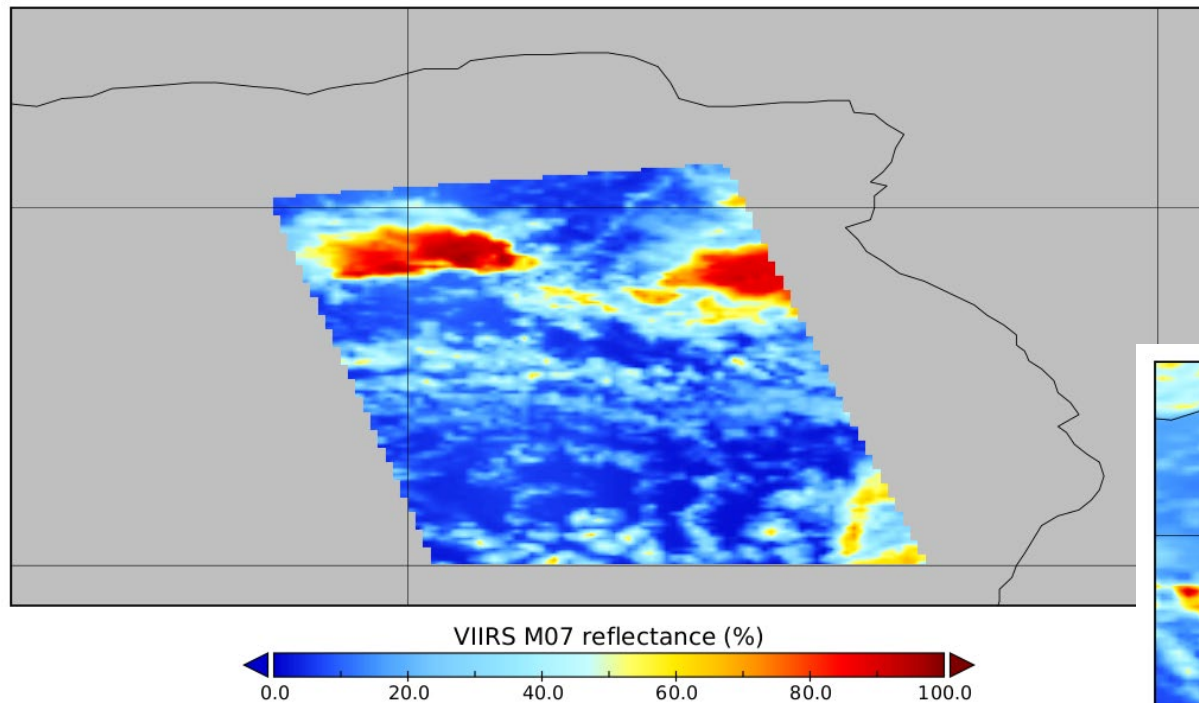
Compare FCI with VIIRS overpass



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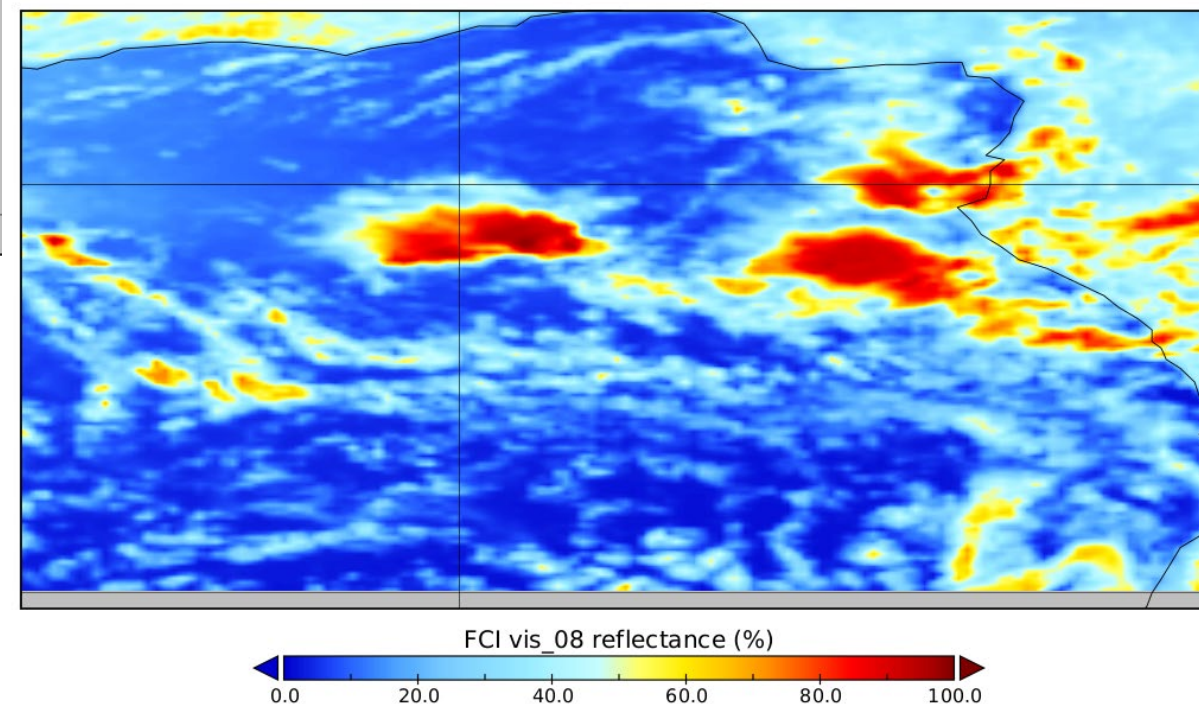
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SNPP VIIRS

5 April 2025, 13:10

MTG-I1 FCI



FCI cloud property products



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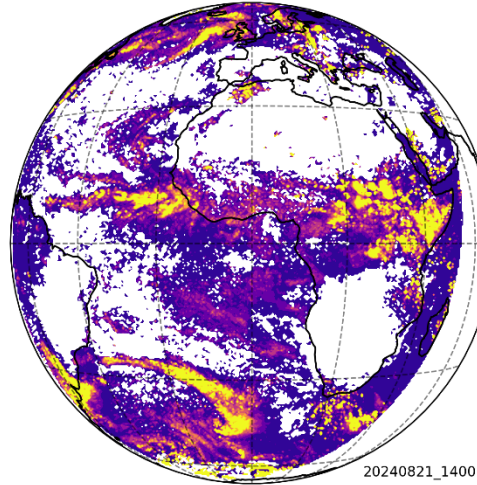


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Optical
thickness

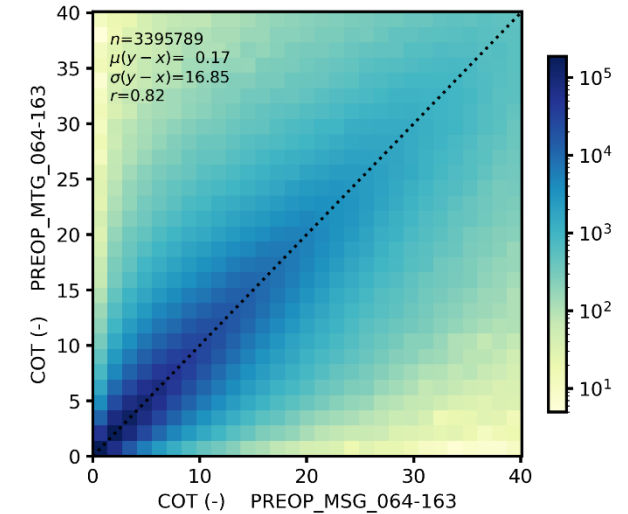
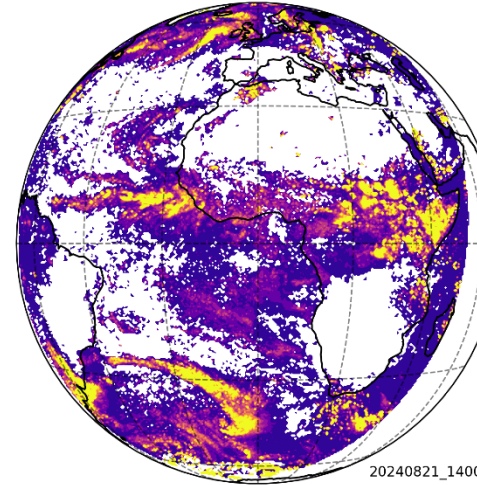
SEVIRI

COT (-) preop_msg_064-163



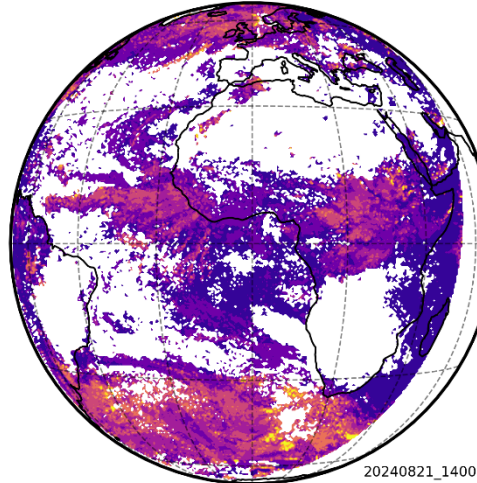
FCI

COT (-) preop_mtg_064-163

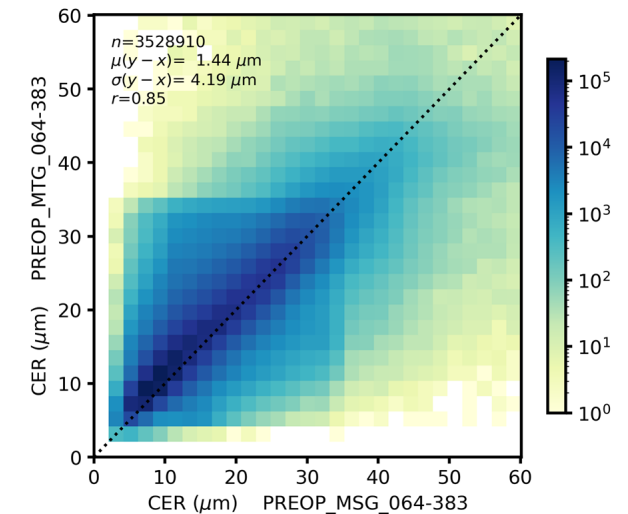
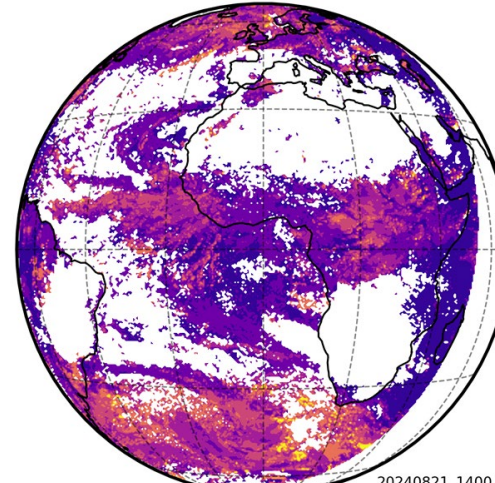


Effective
radius

CER (μm) preop_msg_064-383



CER (μm) preop_mtg_064-383



CPP cloud
algorithm

2025 Dragon 6 Symposium: project plans for year #2



- *Inform on the project's schedule, planning & contribution of the partners for the following year*

202507-202607

Compare ATLID data with ACDL because the EarthCARE reprocessed data will be available. (China)

Compare the FCI cloud products with EarthCARE cloud products. (Europe, YS)

Find good cases from MTG and EarthCARE to study interaction of clouds and aerosols (Europe, team work + YS).

Find good cases from FY-4 or FY-3 and ACDL and/or EarthCARE data to study interaction of clouds and aerosols (China).

European Young Scientists contributions in Dragon 6



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Name	Institution	Poster title	Contribution including period of research
Job Wiltink	KNMI	..	Evaluate FCI cloud property products, look for golden cases, 2026-
Xuemei Wang		Investigating aerosol optical properties using ATLID and CAMS forecast , Non official young scientist	Focus on comparison of CAMS model and EarthCARE products. Understand the aerosol, cloud, radiation interaction from model for selected cases.

Chinese Young Scientists contributions in Dragon 6



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Name	Institution	Poster title	Contribution including period of research
Ying Zhou	IAP		
Hailei Liu	Chengdu univeristy of information and technology	Retrieval of aerosol optical depth and vertical extinction profiles from the OCO-2 oxygen A-band observations over China	New extinction profile retrievals from OCO-2
Sije Chen	NSMC	Cloud Top Height from a Lidar Perspective: Cirrus, Multi-Layer Clouds, and other Complex Scenarios	Compared ACDL, EarthCARE, FY-3, FY-4, CALIPSO cloud top height, cloud fraction

Overview of European YSs research

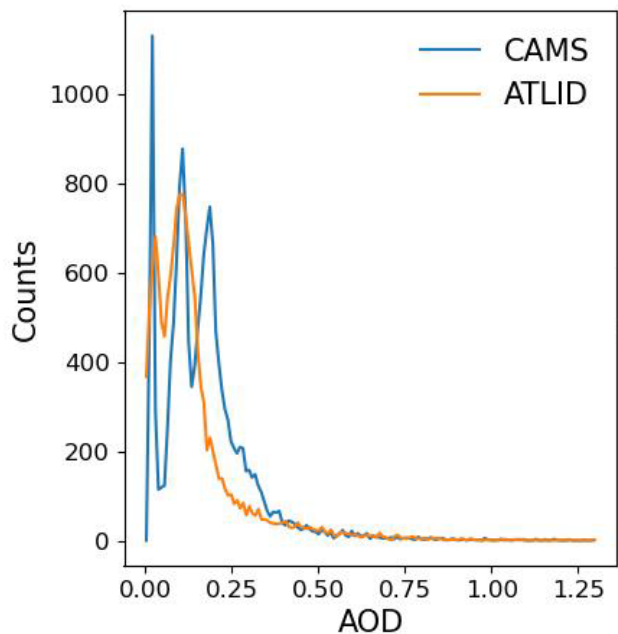


Overview of European YSs research

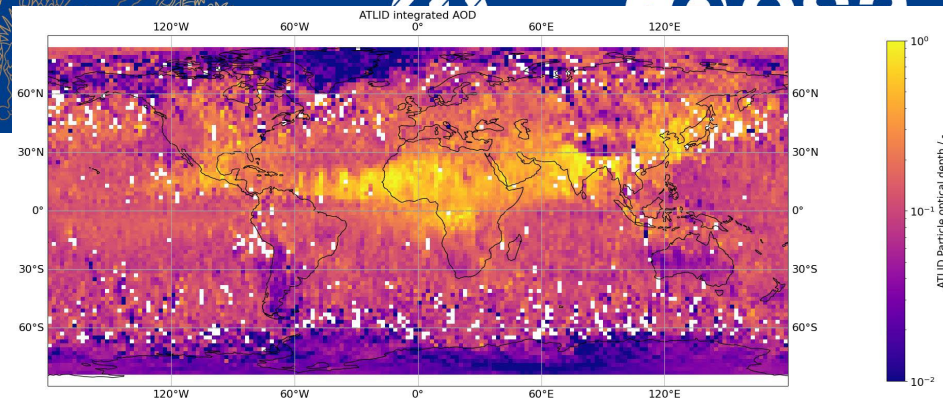
Wang et al., Investigating aerosoloptical properties using
ATLID and CAMS forecast, Non-official young scientist

May 2025 2 degree

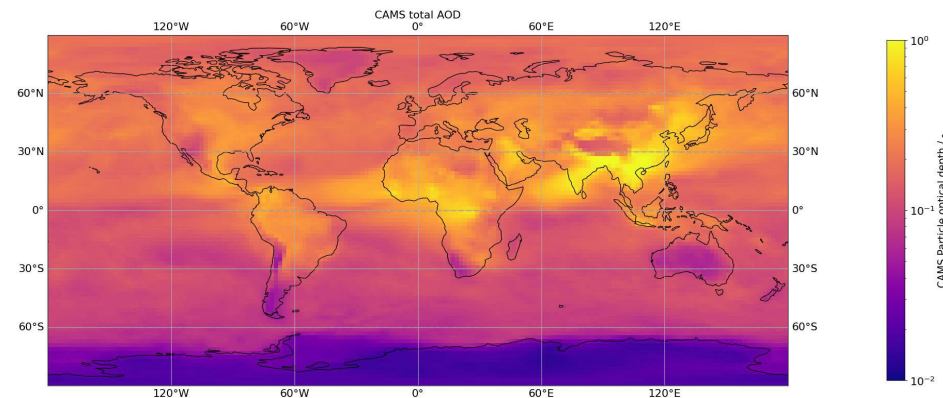
Xuemei Wang



ATLID AOD global mean = 0.14
Global land mean = 0.16
Global ocean mean = 0.13

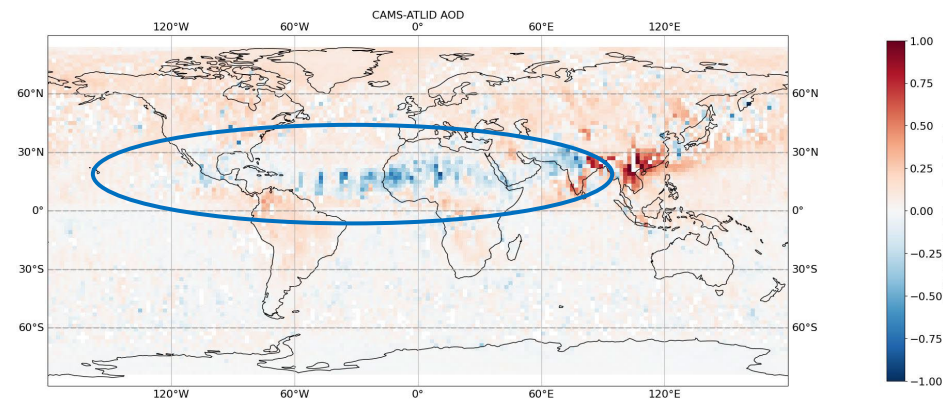


CAMS AOD global mean = 0.18
Global land mean = 0.2
Global ocean mean = 0.16



CAMS-ATLID global mean = 0.038

ATLID detected more optically thick aerosols than CAMS in the tropics in May.
The negative bias was not that clear in March or April (see slides 5 & 6).



Overview of Chinese YSs research



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Overview of Chinese YSs research



Sije Chen et al., Cloud Top Height from a Lidar Perspective: Cirrus, Multi-Layer Clouds, and other Complex Scenarios, see the poster presentation

	FY-3D	FY-3E	FY-3F	FY-3G	DQ-1	CALIPSO	EarthCARE
Altitude	836km	836km	836km	407±5km	705km	688km	393km
Inclina-tion	98.75°	98.75°	98.75°	50°±1°	98.2°	98.2°	97.05°
Period	101.5min	101.5min	101.5min	~93min	~90min	~90min	92.5min
Cycle	5.5天	5.5天	5.5天	70天	16天	16天	25天
Nodes	14:00 (A)	5:30 (D)	~10:10 (D)		13:30 (A)	13:30 (A)	14:00 (D)
Swath (MERSI)	2930km	2450km	2930km	1000km	-	-	-

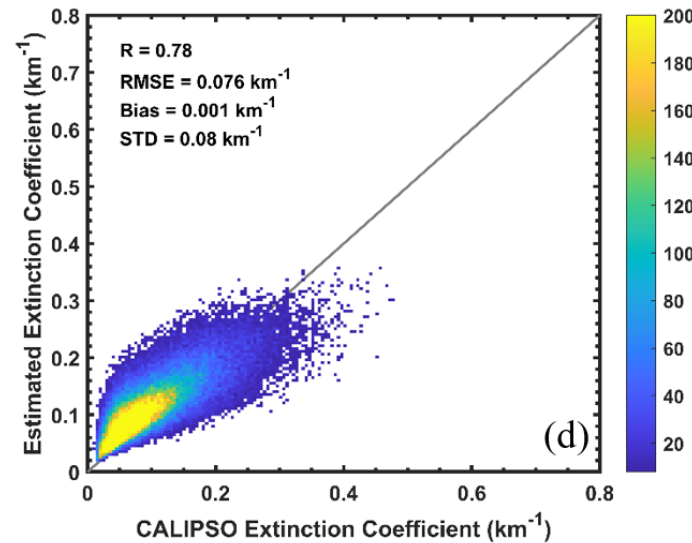
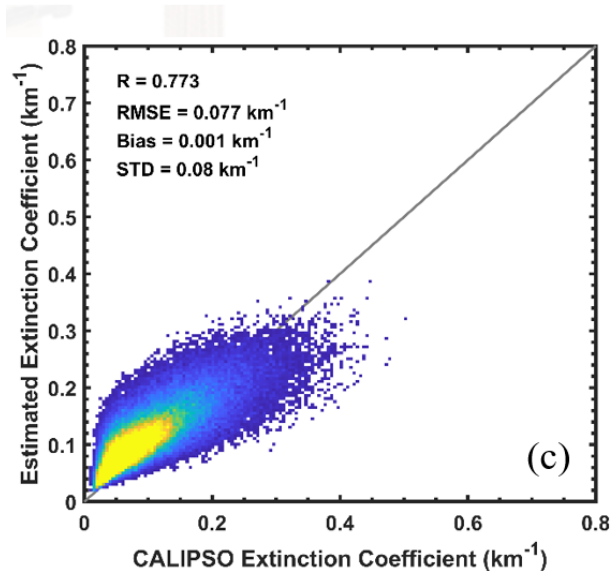
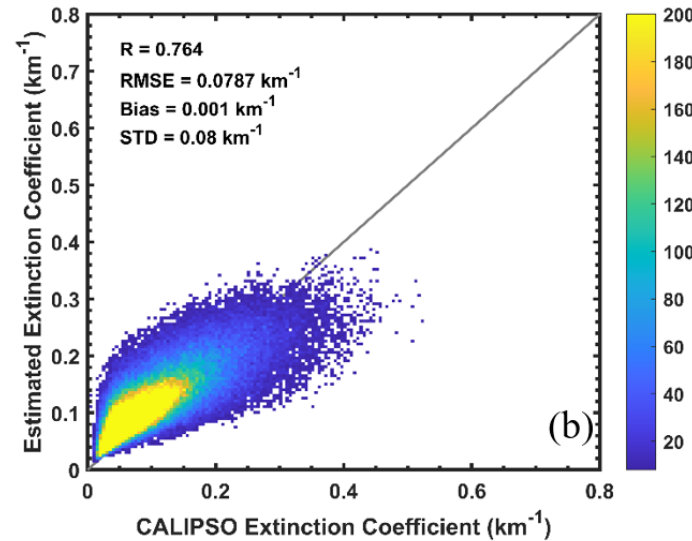
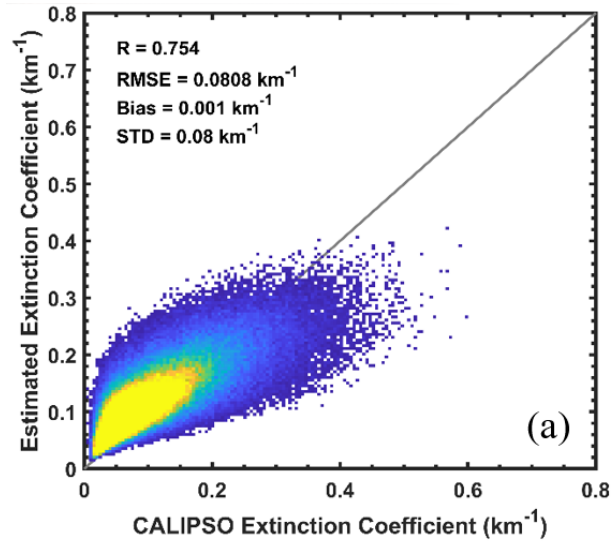
Overview of Chinese YSs research



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Liu et al.

YS poster

Retrieval of aerosol optical depth
and vertical extinction profiles
from the OCO-2 oxygen A-band
observations over China