

Aerosol and Cloud Classification and Comparison Based on Chinese and European Spaceborne High Spectral Resolution Lidar: ACDL/DQ-1 and ATLID/EarthCARE



Wenrui Long¹, Guangyao Dai¹, Songhua Wu¹, Ulla Wandinger², Holger Baars², Kangwen Sun¹, Weibiao Chen³, Jiqiao Liu³

¹Ocean University of China, China, China, People's Republic of; ²Leibniz Institute for Tropospheric Research, Germany; ³Shanghai Institute of Optics and Fine Mechanics, China

*Corresponding Author e-mail: wenrui_long@foxmail.com



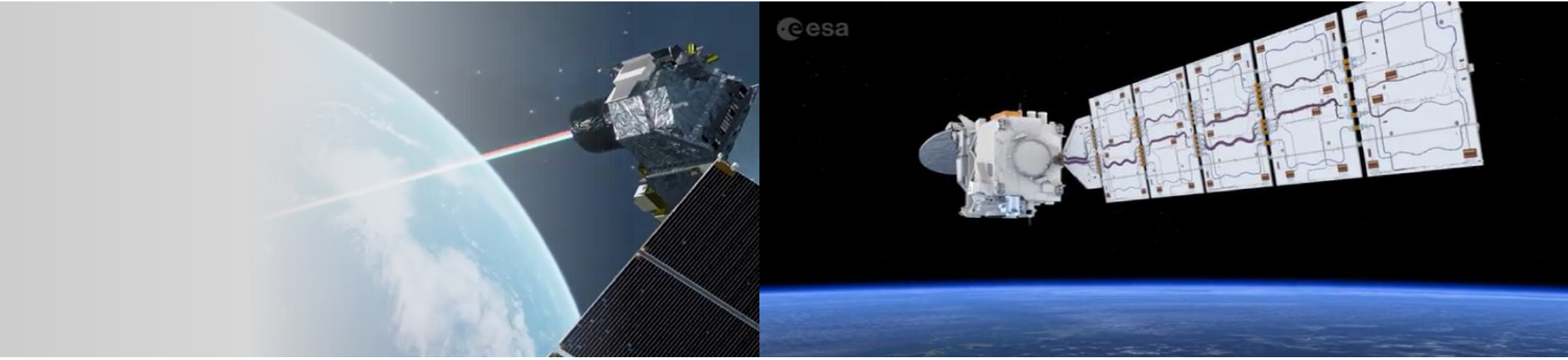
Abstract

With the continuous development of satellite technology, spaceborne remote sensing is gradually playing an important role in atmospheric observation, and high spectral resolution lidar (HSRL) is an important instrument for achieving high-precision and high-resolution global comprehensive monitoring of aerosols and clouds. Aerosol and Carbon Detection Lidar (ACDL) is a high spectral resolution lidar (HSRL) with two-wavelength polarization detection, that can be utilized to derive the aerosol optical properties. And the latest version of the Baseline05 processing algorithm has been developed for ACDL. And the HSRL payload ATLID also provide vertical profiles of aerosols and thin clouds. In this research, the cross-validation results will be investigated and presented, including both profiles comparison and statistical results.

Introduction

China's Daqi-1 (DQ-1) satellite carries:
Aerosol and Carbon Detection Lidar (ACDL)
High-spectral-resolution & polarization lidar @532 nm
Mie lidar @ 1064 nm

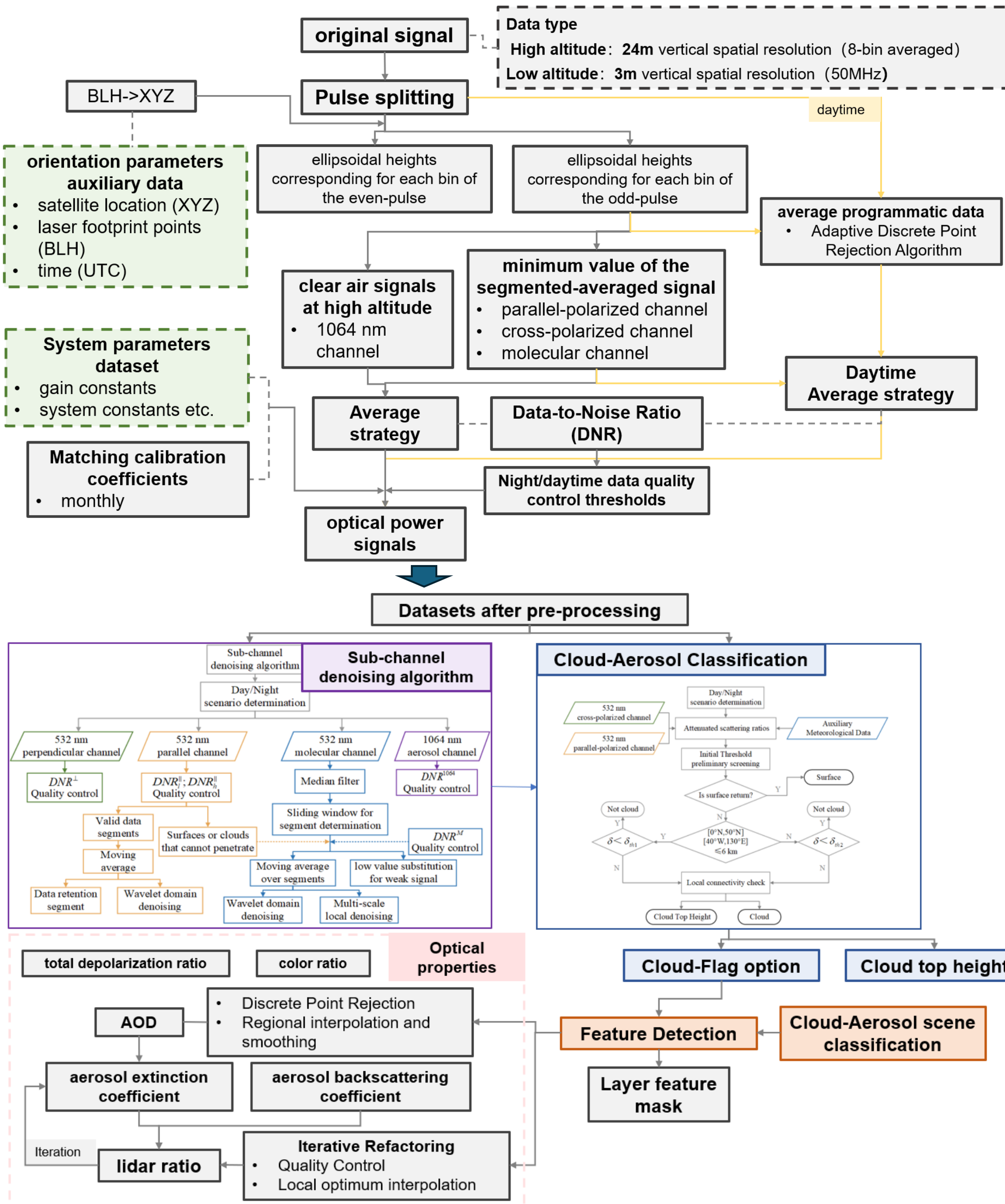
ESA's EarthCARE satellite carries:
the Atmospheric Lidar (ATLID)
High-spectral-resolution & polarization lidar @355 nm



To guarantee the data quality and refine the retrieval algorithms, CAL/VAL campaigns for ACDL and ATLID products needs to be implemented.

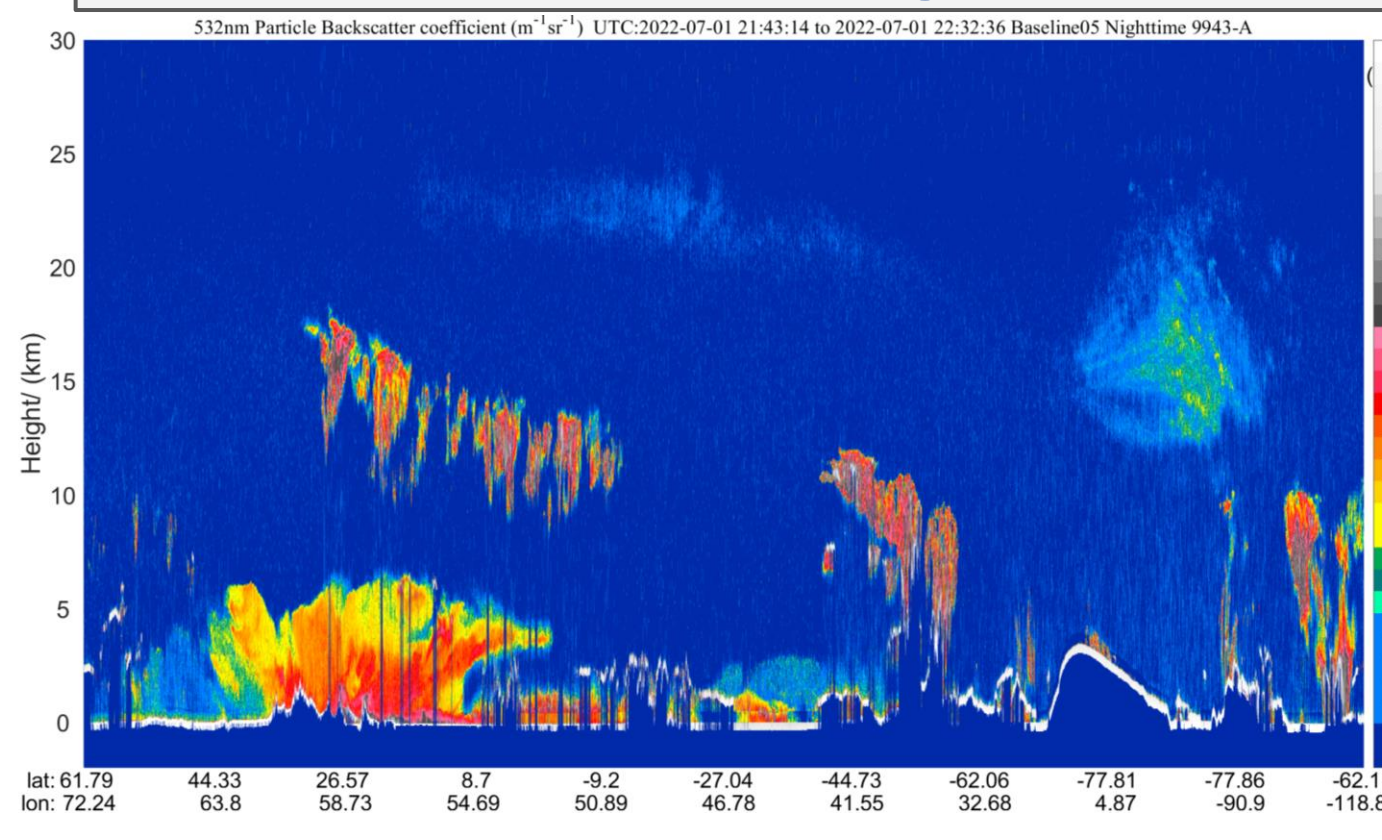
Baseline05 - ACDL

Development of a series of data processing algorithms for the characteristics of spaceborne high-spectral-resolution lidar (HSRL) data.

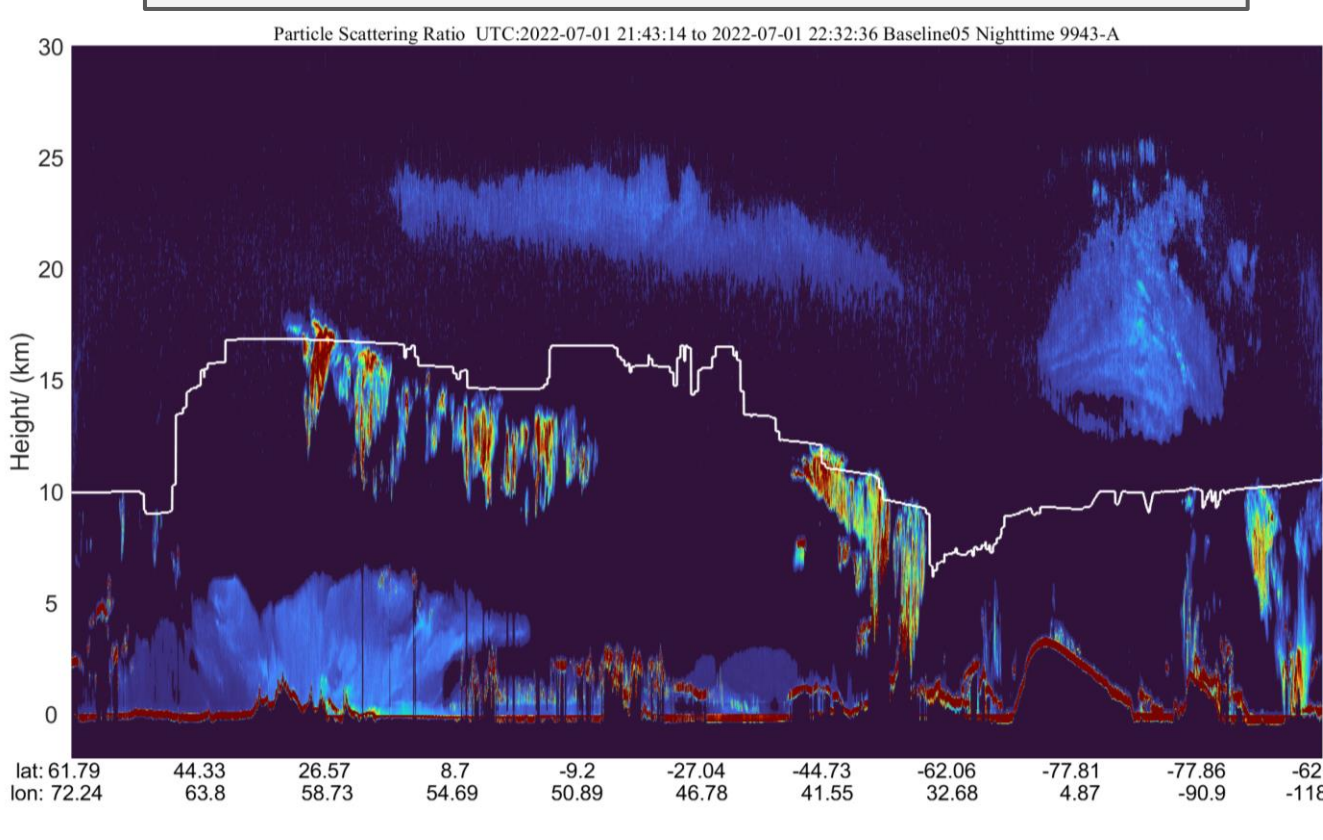


Acknowledgement: This work was conducted as part of the Dragon 6 cooperation programme between the European Space Agency (ESA) and the Ministry of Science and Technology (MOST) of China. The authors acknowledge the support and coordination provided by the Dragon Programme Office.

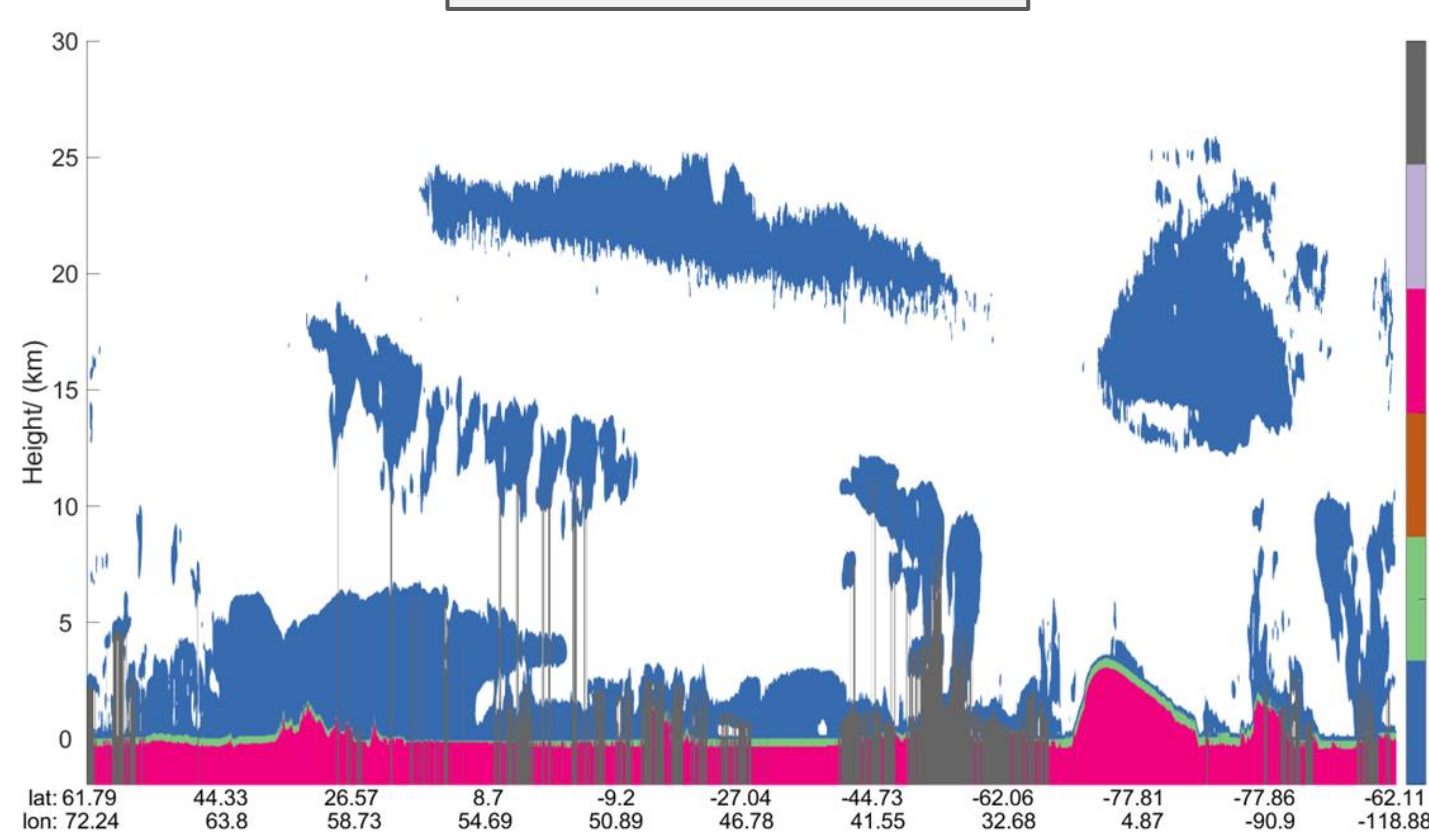
Aerosol backscattering coefficient



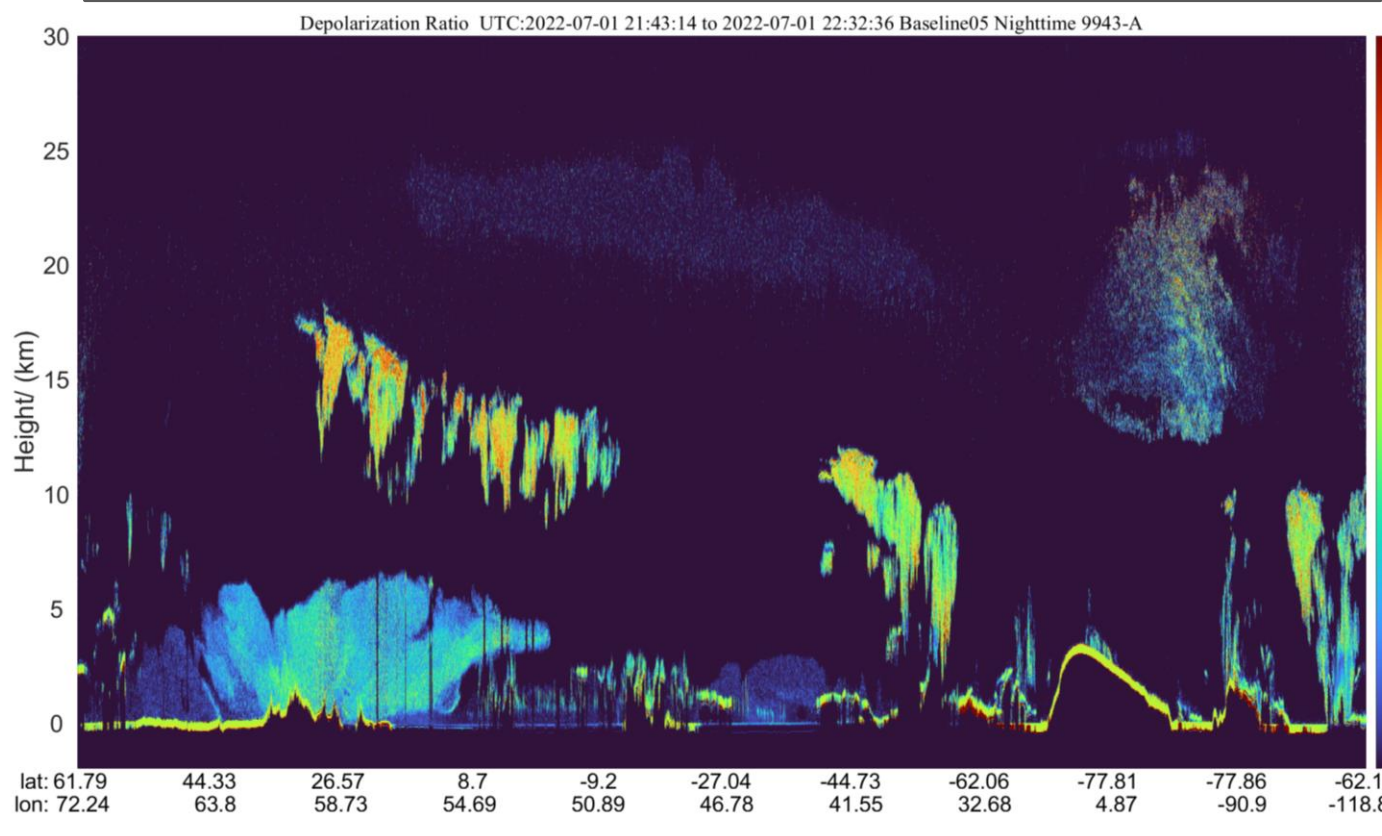
Aerosol backscattering ratio



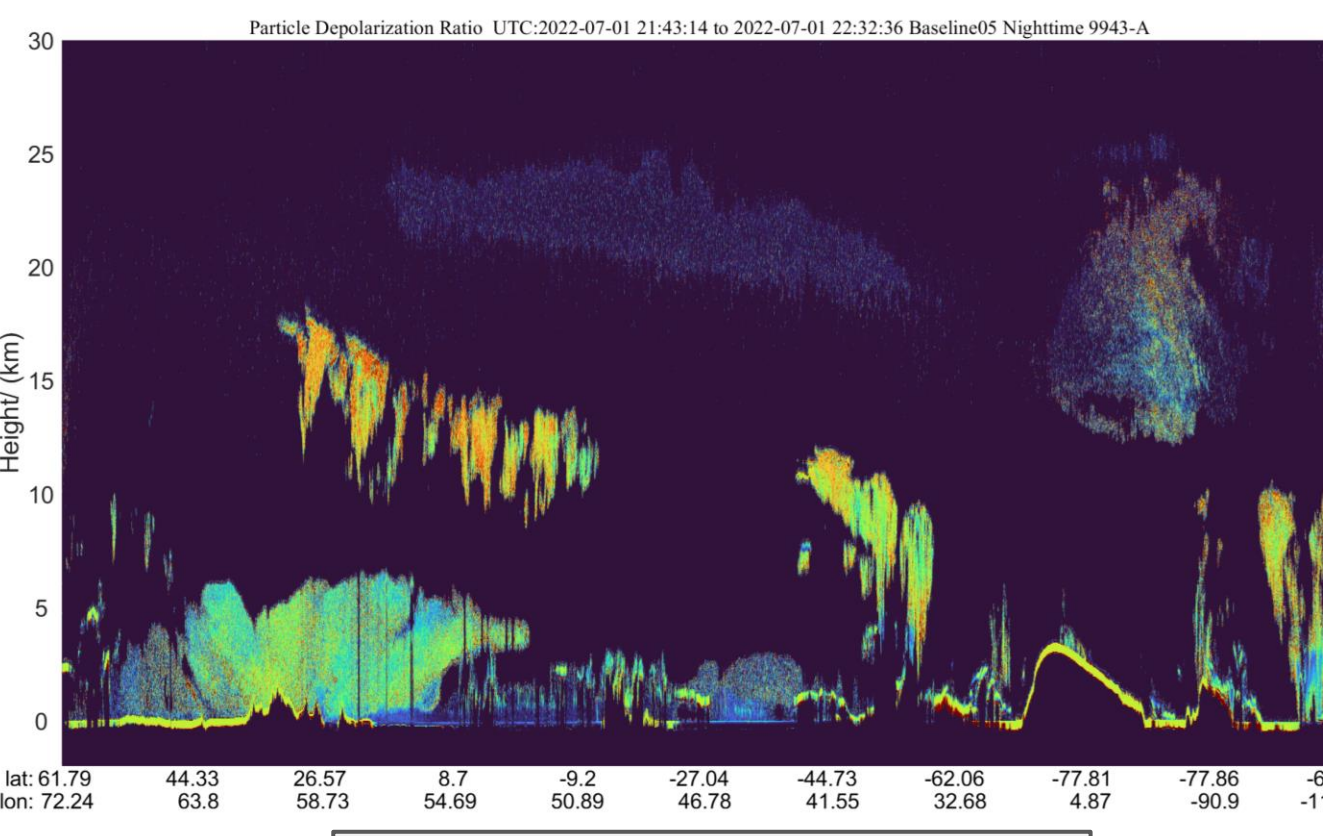
Feature-mask



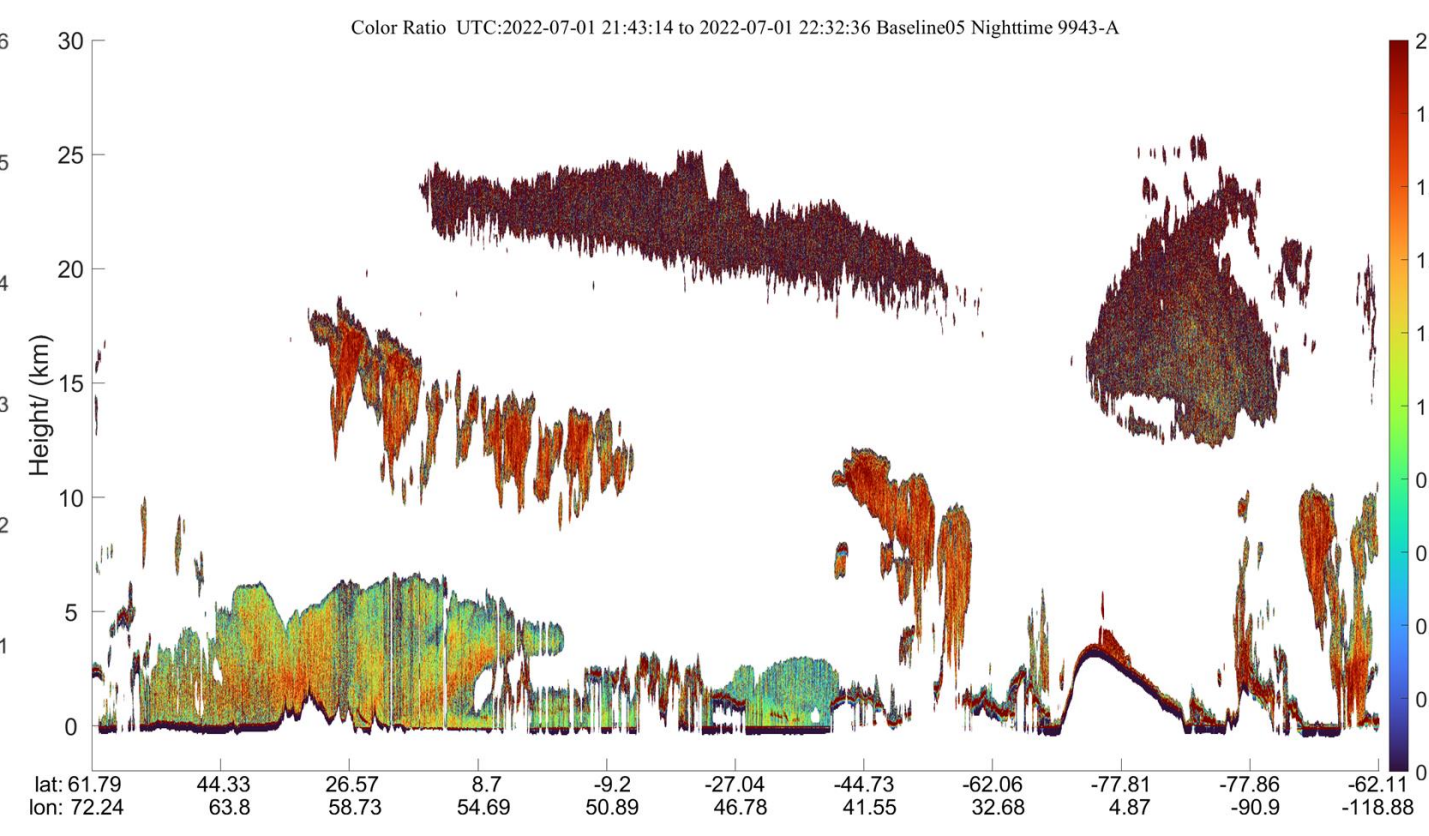
Total linear depolarization ratio



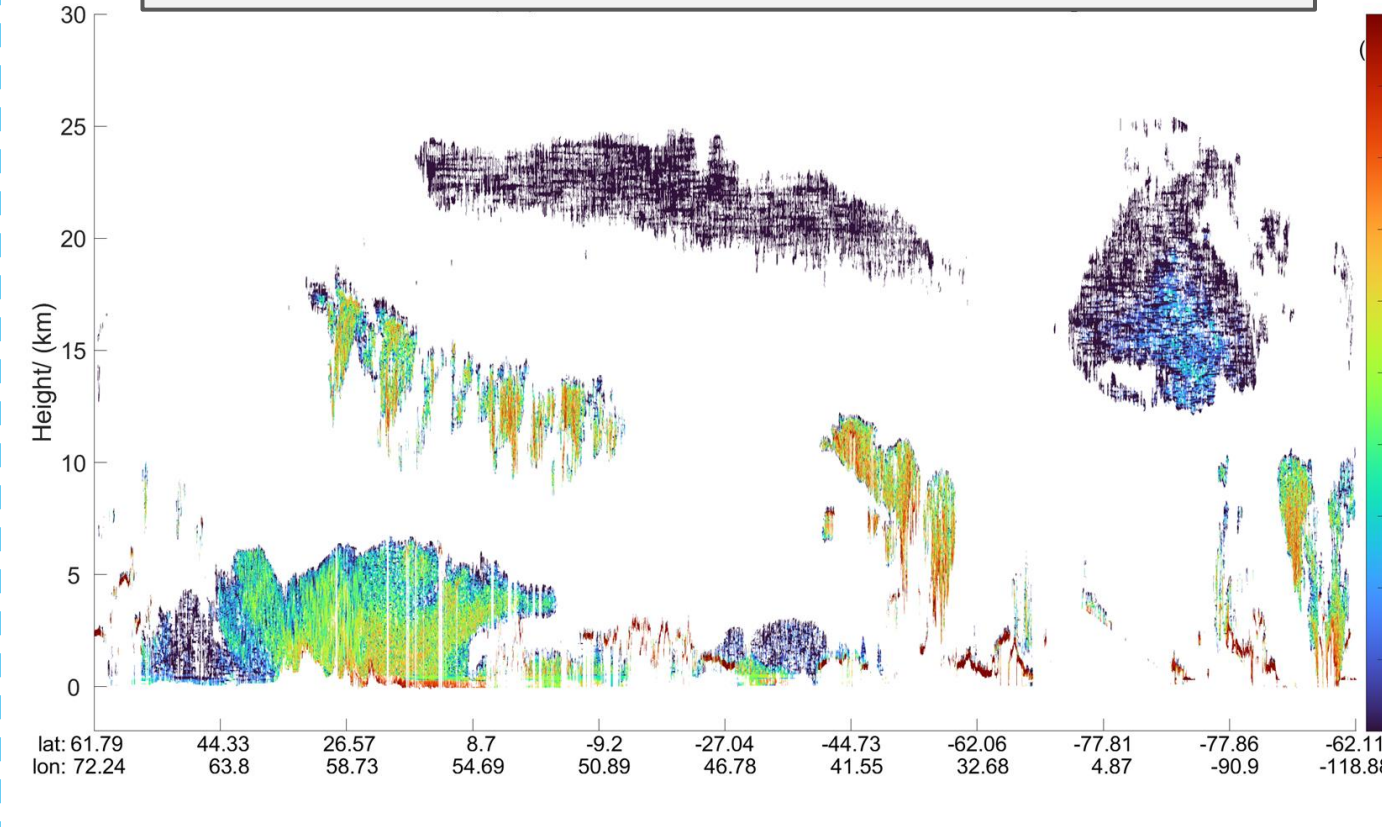
Particle depolarization ratio



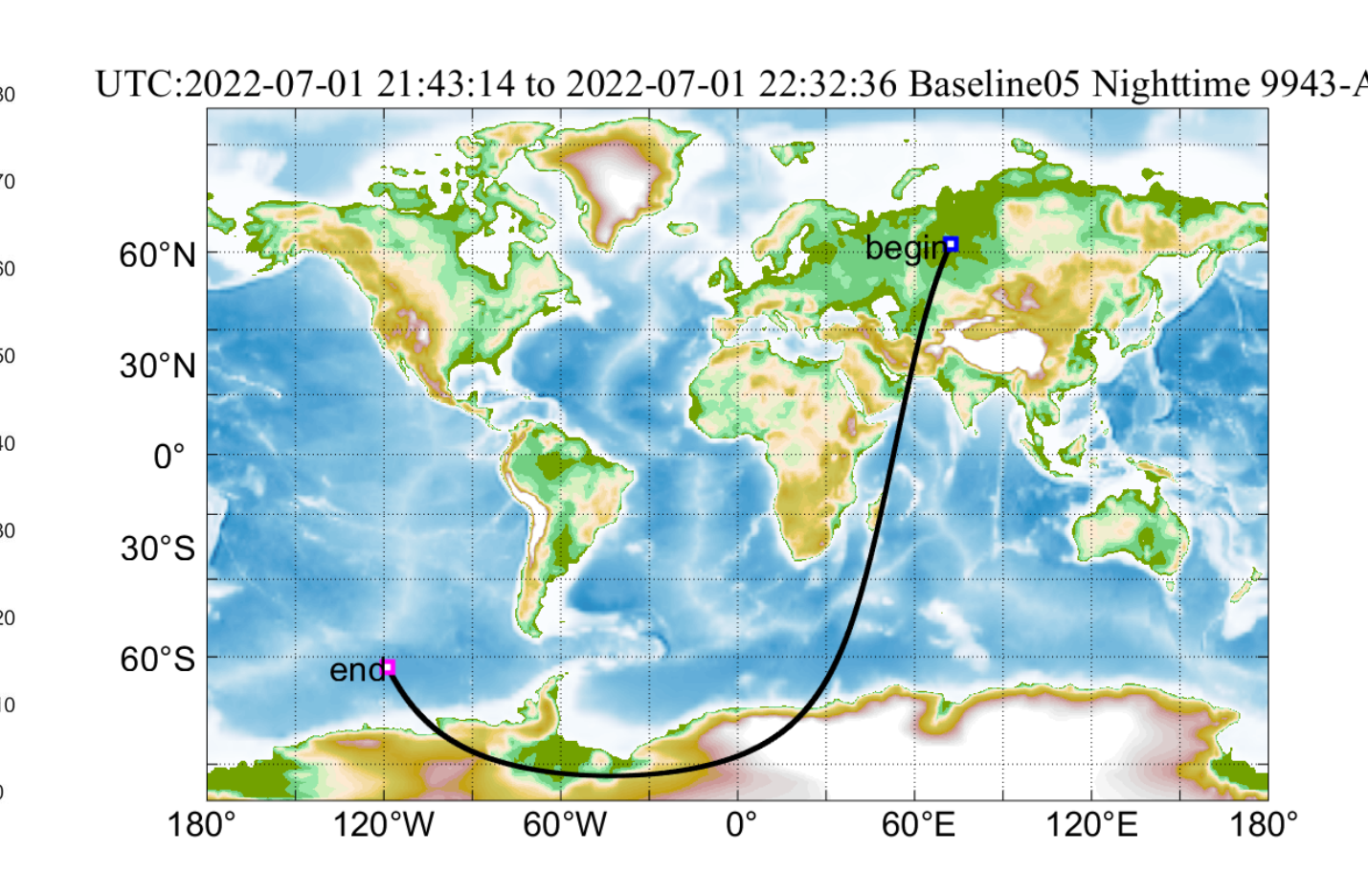
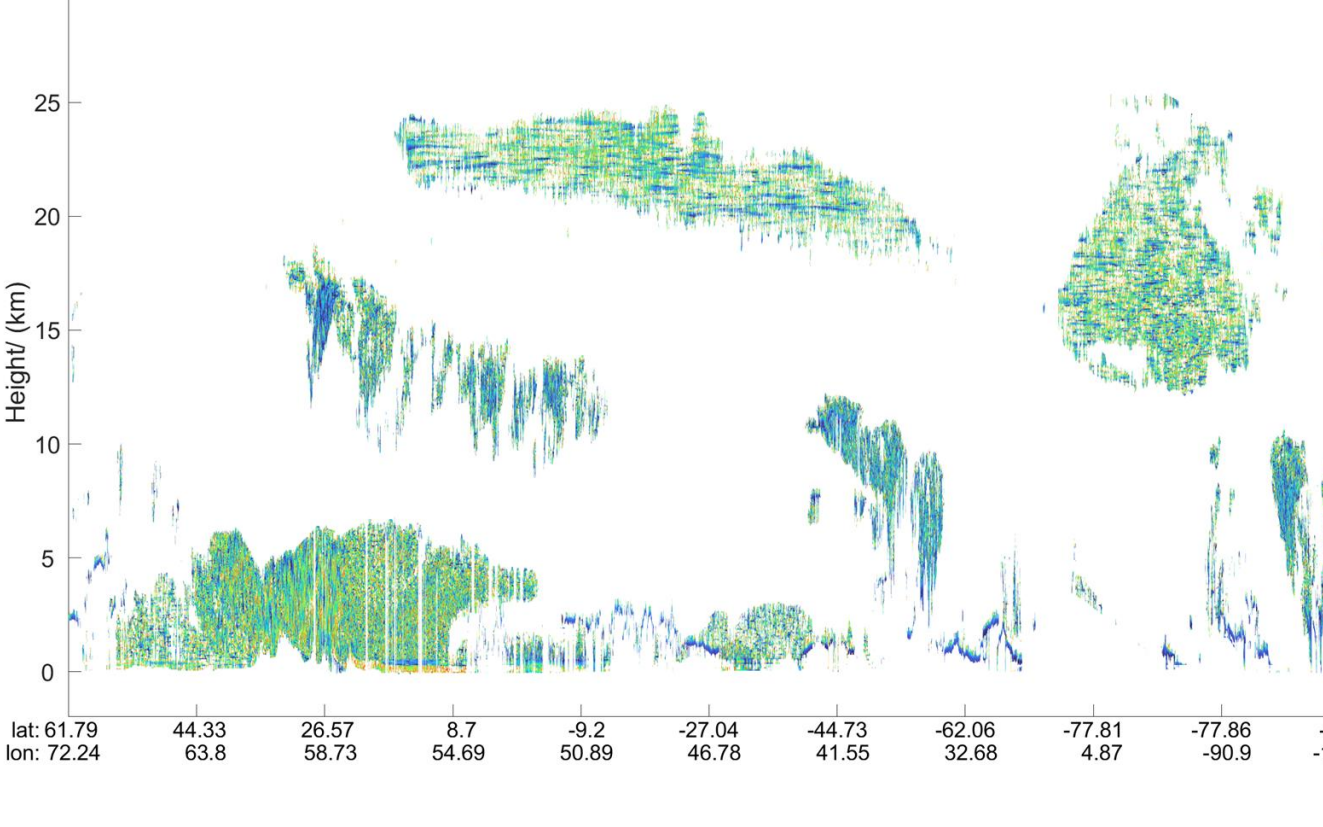
Attenuated color ratio



Aerosol extinction coefficient

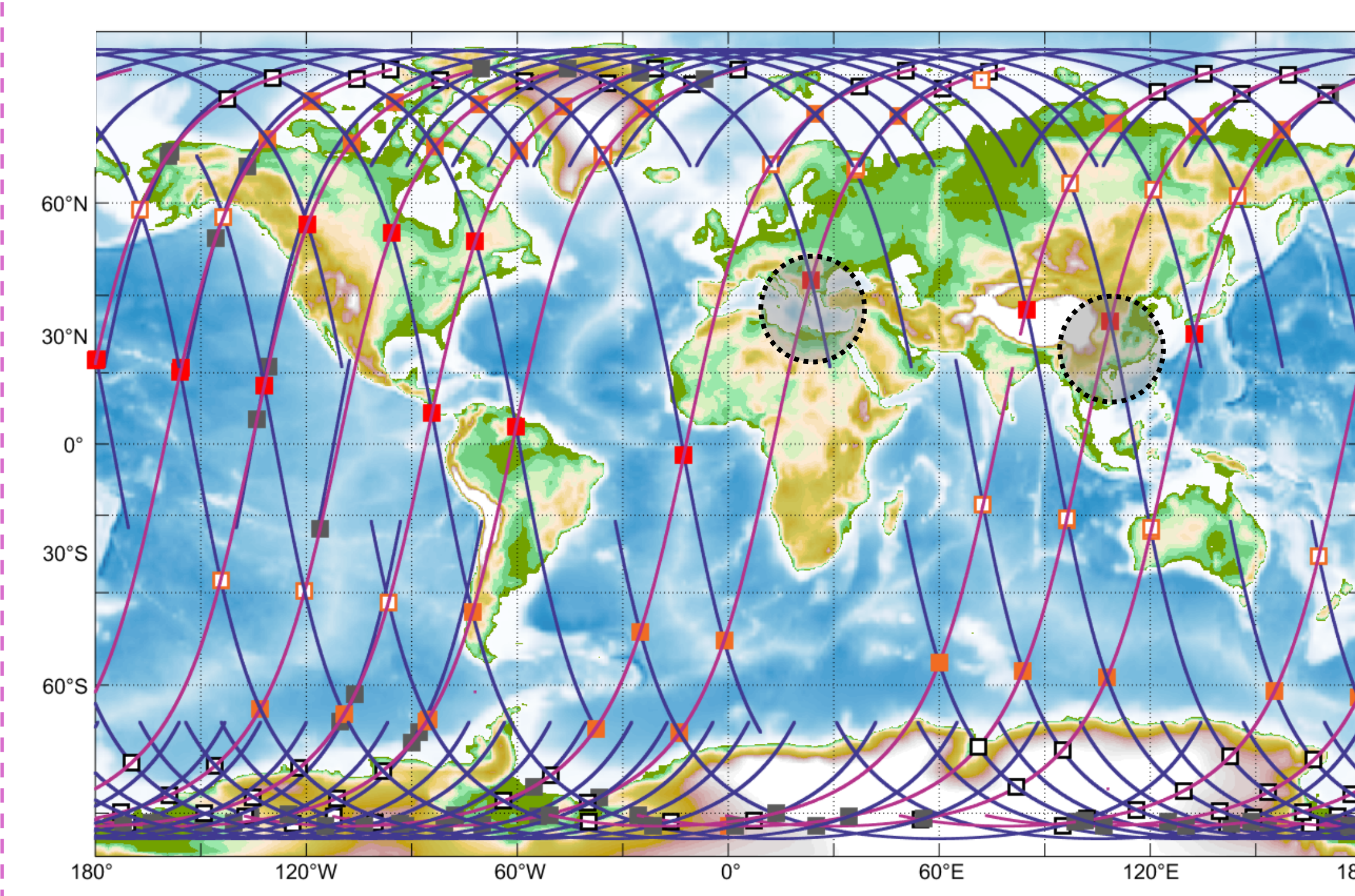


Aerosol lidar ratio



The inter-comparison of ACDL and ATLID

Night-time track matching in one day (2025/03/24)

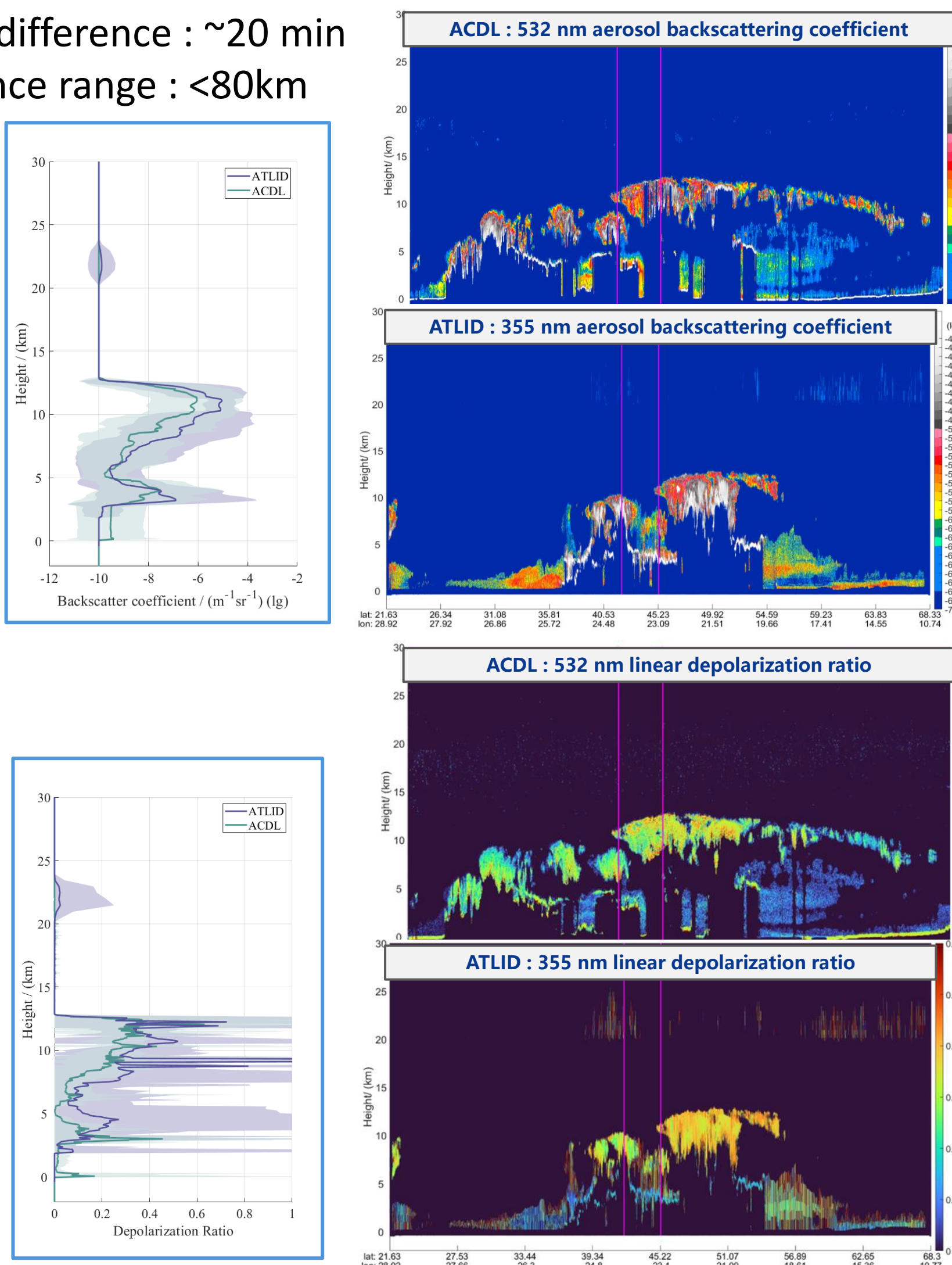


- The inter-comparison and cross-validation between ACDL/DQ-1 and ATLID/EarthCARE.
- The orbital design makes ACDL and ATLID well suited for combined observation (ATLID at 355 nm, ACDL at 532 nm and 1064 nm):

- >8h
- 4~8h
- 2~4h
- 1~2h
- <1h

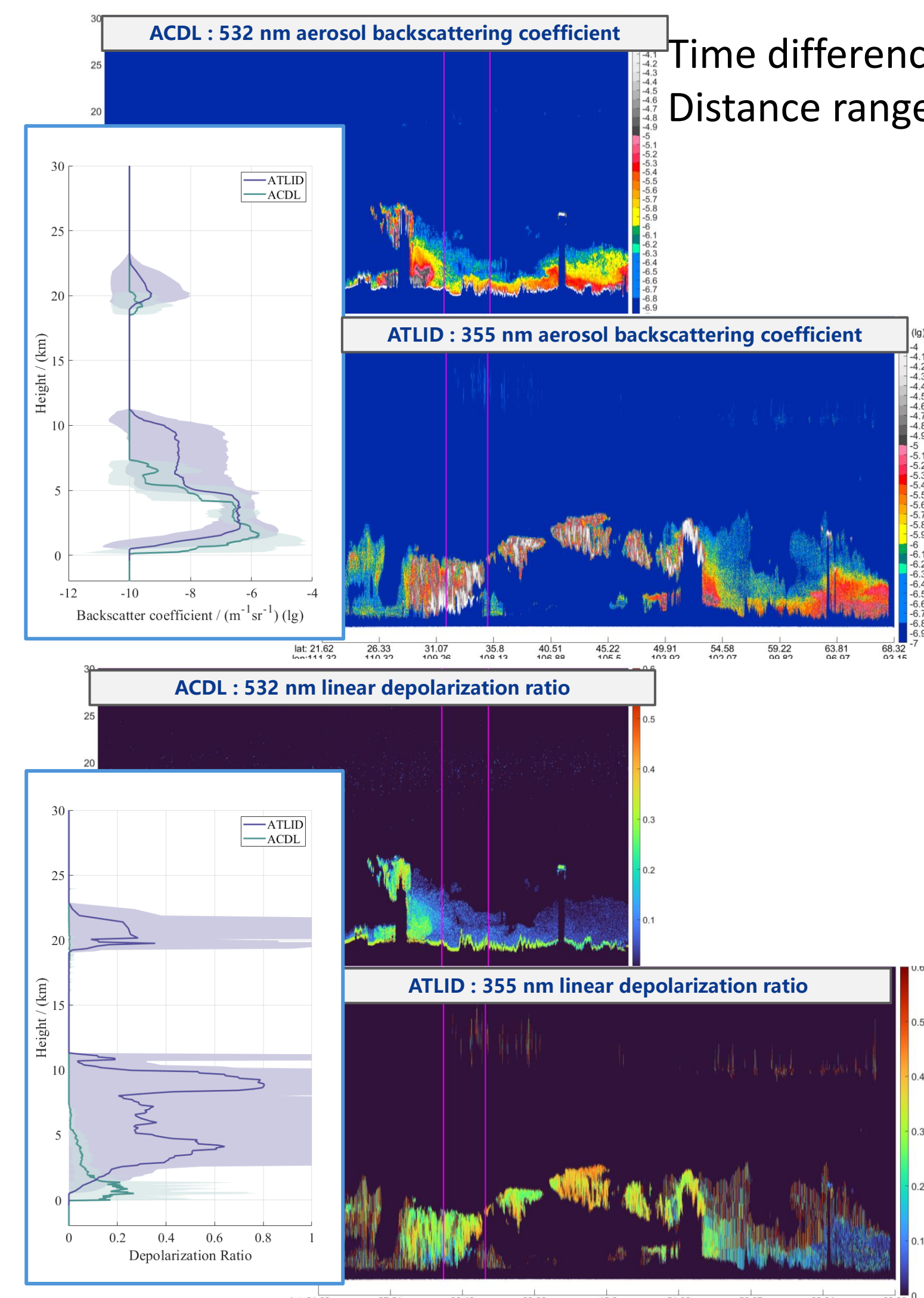
European case

Time difference : ~20 min
Distance range : <80km



China case

Time difference : <3 min
Distance range : <80 km



- The observation capability and data accuracy of the spaceborne high spectral resolution lidar are verified, and iterative optimization directions are provided for the calibration program and data processing algorithms.
- Based on the comparison results, the application capability of dual-wavelength HSRL detection in aerosol scene classification and cloud phases identification will be discussed in the subsequent study.