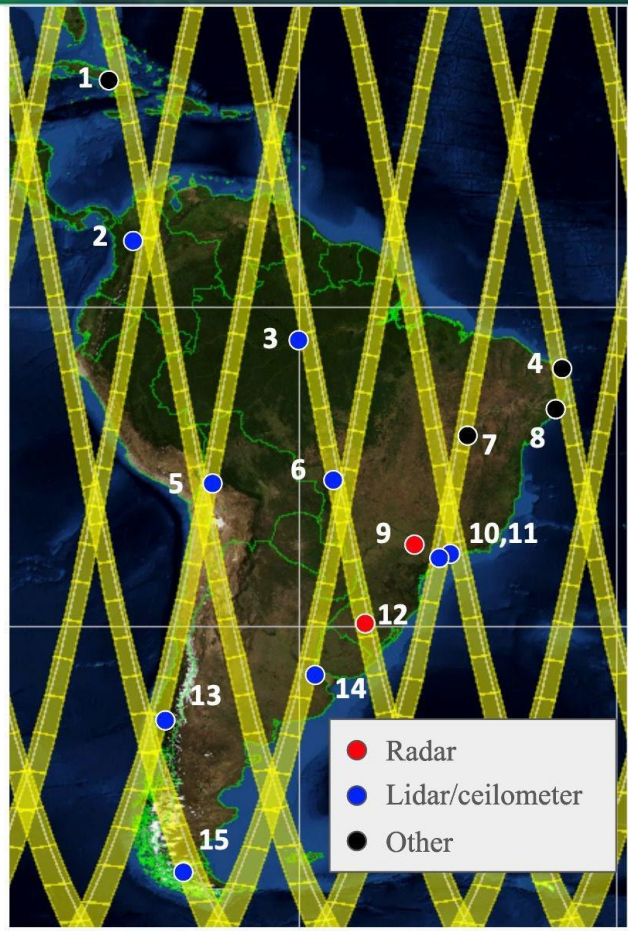
Progress of CAL/VAL activities for EarthCARE aerosol products at SPU Lidar Station, Brazil

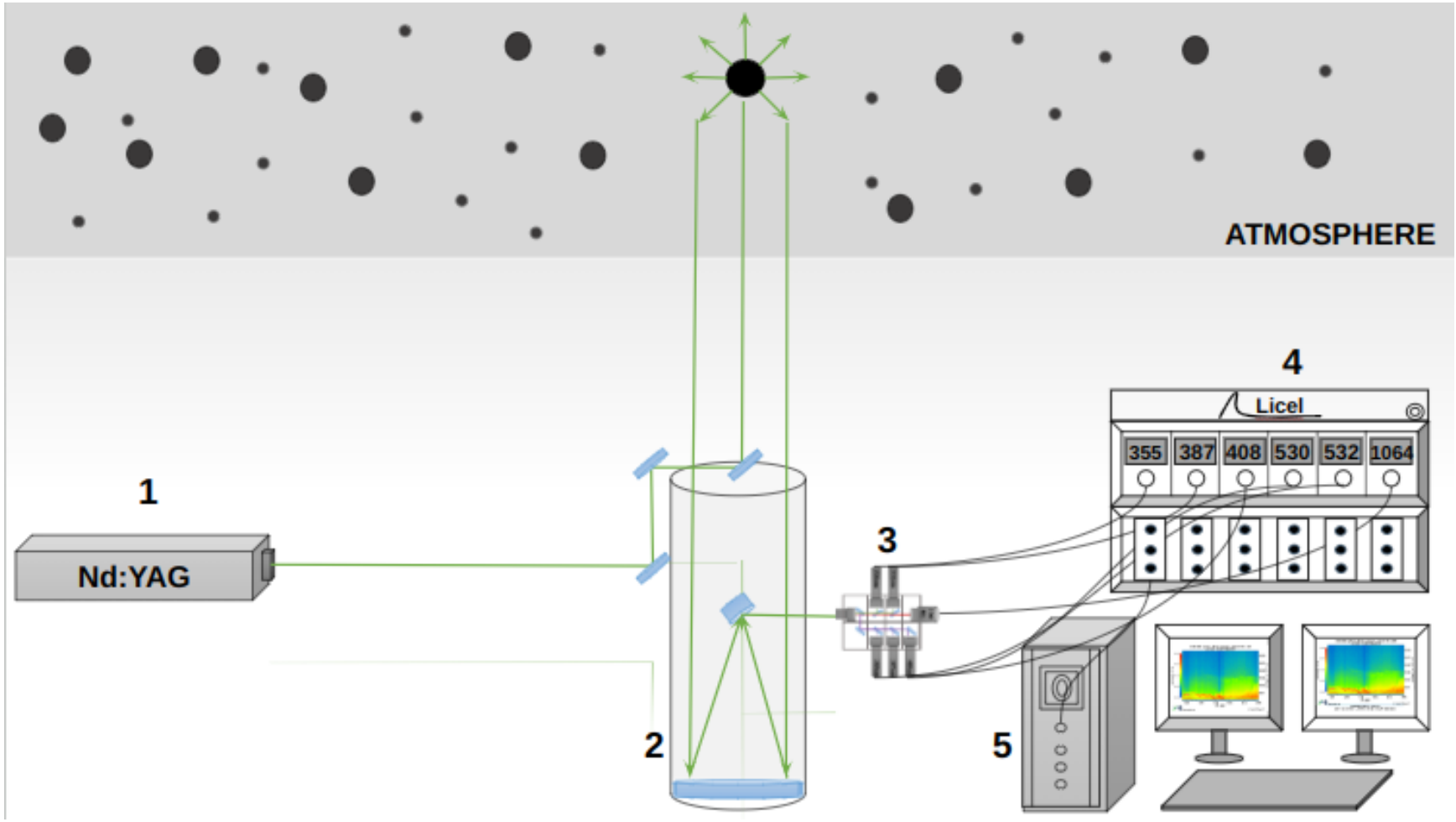
Silva, G.M., Oliveira, N.N., Lopes, F.J.S., Cacheffo, A., Correia, A.L., Yoshida, A.C., Souza, G., Barja, B., and Landulfo, E.

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop
17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy

LatAm Lidar Network

The Latin America Lidar Network is a Latin American coordinated lidar network measuring aerosol backscatter coefficient and aerosol extinction profiles for climatological studies of the aerosol distribution over Latin America. This federative lidar network aims to establish a consistent and statistically sound database for enhancement of the understanding of the aerosol distribution over the continent and its direct and indirect influence on climate.





Elastic Detection

1064 nm

355 nm

532 nm

Raman detection

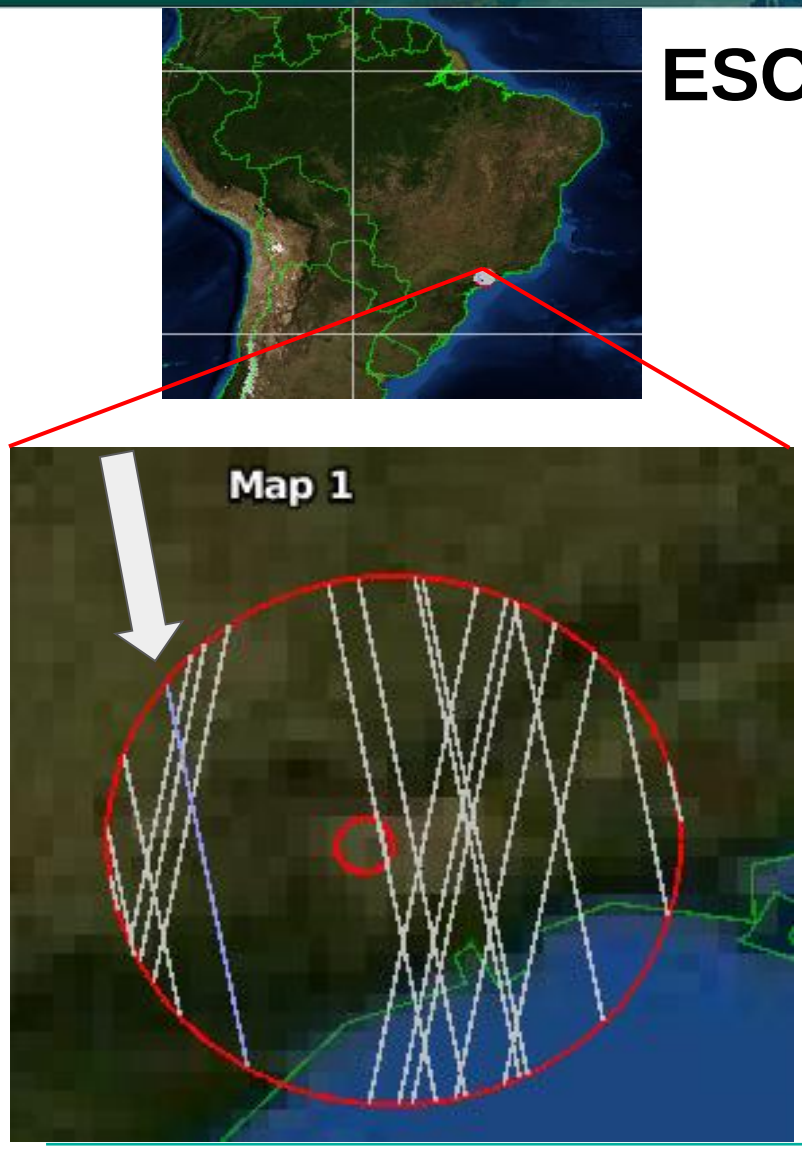
530 nm — $N_2 + O_2$ (VRR)

387 nm — N_2(VRR)

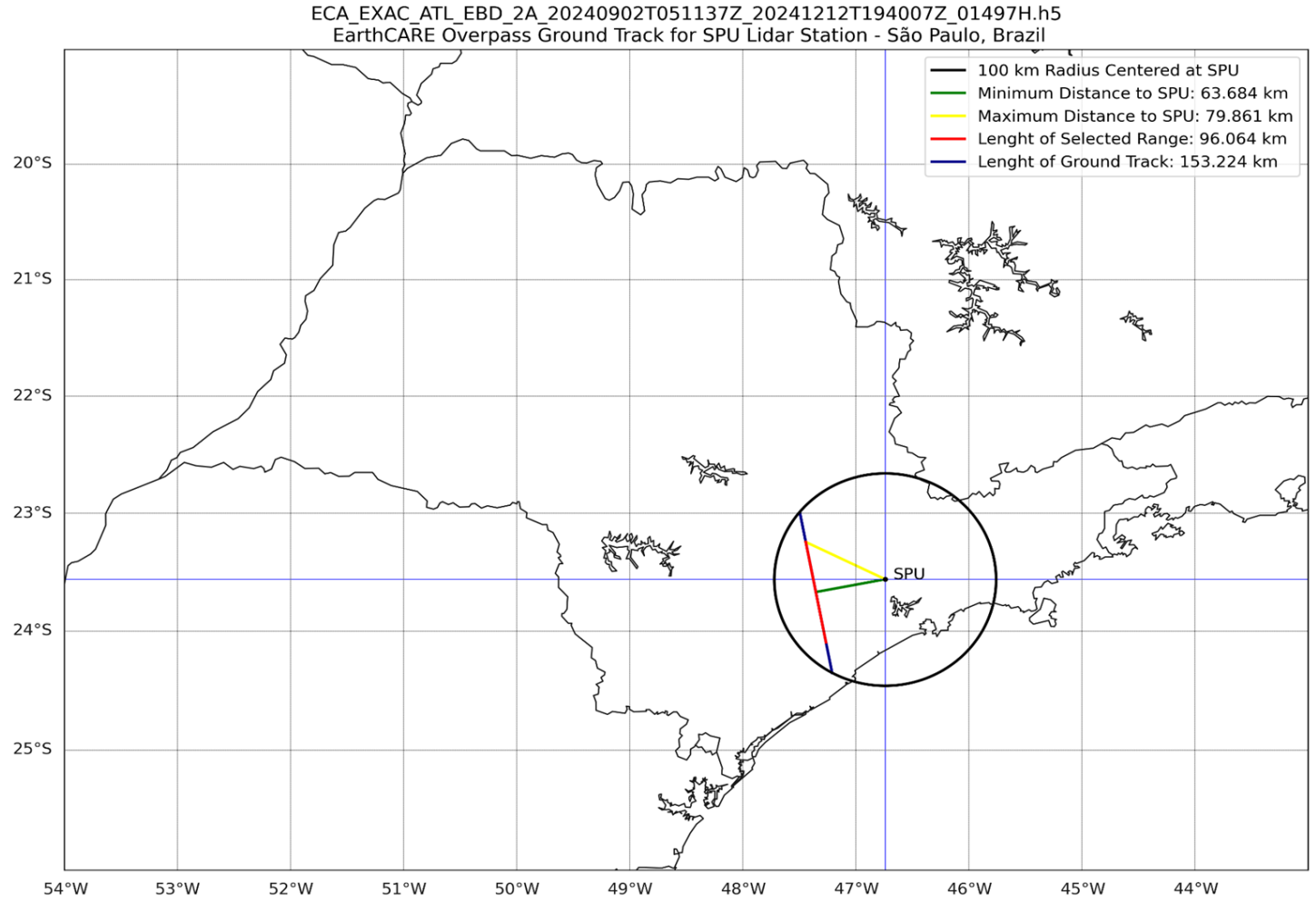
408 nm — H_2O

Backscatter	Extinction	Lidar Ratio	Angstrom Exponent	Aerosol layers

ESOV NG

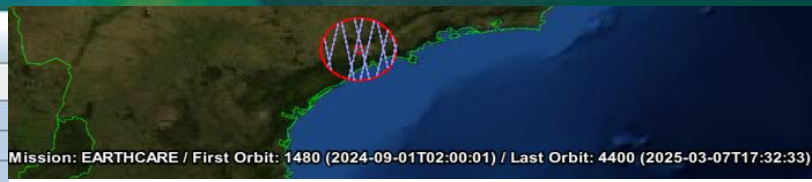


LALINET TRACKER



EARTHCARE / ATLID - Segments

Visible	Id	Color	Start Orbit	Start Sec	Start UTC	Stop Orbit	Stop Sec	Stop UTC ▲	Duration...	Zone
👁	0		1497	5177	2024-09-02T05:21:38	1497	5203	2024-09-02T05:22:04	26.0	São Paulo (SPU)
👁	2		1536	3138	2024-09-04T16:56:35	1536	3139	2024-09-04T16:56:37	2.0	IPEN_SPU
👁	1		1536	3125	2024-09-04T16:56:22	1536	3152	2024-09-04T16:56:50	27.0	São Paulo (SPU)
👁	3		1637	5184	2024-09-11T05:17:43	1637	5204	2024-09-11T05:18:04	21.0	São Paulo (SPU)
👁	4		1676	3131	2024-09-13T16:53:23	1676	3152	2024-09-13T16:53:45	21.0	São Paulo (SPU)
👁	5		1777	5191	2024-09-20T05:16:24	1777	5198	2024-09-20T05:16:31	7.0	São Paulo (SPU)
👁	6		1816	3137	2024-09-22T16:52:03	1816	3147	2024-09-22T16:52:13	9.0	São Paulo (SPU)
👁	7		1886	5182	2024-09-27T05:23:19	1886	5196	2024-09-27T05:23:34	15.0	São Paulo (SPU)
👁	8		1925	3127	2024-09-29T16:58:17	1925	3147	2024-09-29T16:58:37	19.0	São Paulo (SPU)
👁	15		2026	5191	2024-10-06T05:19:35	2026	5192	2024-10-06T05:19:36	2.0	IPEN_SPU
👁	9		2026	5178	2024-10-06T05:19:22	2026	5205	2024-10-06T05:19:49	27.0	São Paulo (SPU)
👁	10		2065	3126	2024-10-08T16:54:22	2065	3153	2024-10-08T16:54:49	27.0	São Paulo (SPU)
👁	11		2275	5182	2024-10-22T05:22:47	2275	5196	2024-10-22T05:23:01	15.0	São Paulo (SPU)
👁	12		2314	3127	2024-10-24T16:57:45	2314	3147	2024-10-24T16:58:04	19.0	São Paulo (SPU)
👁	16		2415	5191	2024-10-31T05:19:02	2415	5192	2024-10-31T05:19:04	2.0	IPEN_SPU
👁	13		2415	5178	2024-10-31T05:18:49	2415	5205	2024-10-31T05:19:17	27.0	São Paulo (SPU)
👁	14		2454	3126	2024-11-02T16:53:50	2454	3153	2024-11-02T16:54:16	27.0	São Paulo (SPU)
👁	17		2664	5182	2024-11-16T05:22:19	2664	5196	2024-11-16T05:22:33	15.0	São Paulo (SPU)
👁	18		2703	3127	2024-11-18T16:57:17	2703	3147	2024-11-18T16:57:36	19.0	São Paulo (SPU)
👁	29		2804	5191	2024-11-25T05:18:35	2804	5192	2024-11-25T05:18:37	2.0	IPEN_SPU
👁	19		2804	5178	2024-11-25T05:18:22	2804	5205	2024-11-25T05:18:50	27.0	São Paulo (SPU)
👁	20		2843	3126	2024-11-27T16:53:23	2843	3153	2024-11-27T16:53:50	27.0	São Paulo (SPU)
👁	21		3053	5182	2024-12-11T05:21:50	3053	5196	2024-12-11T05:22:04	15.0	São Paulo (SPU)
👁	22		3092	3127	2024-12-13T16:56:48	3092	3147	2024-12-13T16:57:07	19.0	São Paulo (SPU)
👁	30		3193	5191	2024-12-20T05:18:06	3193	5192	2024-12-20T05:18:08	2.0	IPEN_SPU
👁	23		3193	5178	2024-12-20T05:17:53	3193	5205	2024-12-20T05:18:21	27.0	São Paulo (SPU)
👁	24		3232	3126	2024-12-22T16:52:54	3232	3153	2024-12-22T16:53:21	27.0	São Paulo (SPU)
👁	25		3442	5182	2025-01-05T05:21:21	3442	5196	2025-01-05T05:21:36	15.0	São Paulo (SPU)
👁	26		3481	3127	2025-01-07T16:56:19	3481	3147	2025-01-07T16:56:39	19.0	São Paulo (SPU)
👁	31		3582	5191	2025-01-14T05:17:38	3582	5192	2025-01-14T05:17:39	2.0	IPEN_SPU
👁	27		3582	5178	2025-01-14T05:17:25	3582	5205	2025-01-14T05:17:52	27.0	São Paulo (SPU)
👁	28		3621	3126	2025-01-16T16:52:26	3621	3153	2025-01-16T16:52:52	27.0	São Paulo (SPU)
👁	32		3831	5182	2025-01-30T05:21:00	3831	5196	2025-01-30T05:21:15	15.0	São Paulo (SPU)
👁	33		3870	3127	2025-02-01T16:55:58	3870	3147	2025-02-01T16:56:18	19.0	São Paulo (SPU)
👁	40		3971	5191	2025-02-08T05:17:17	3971	5192	2025-02-08T05:17:19	2.0	IPEN_SPU

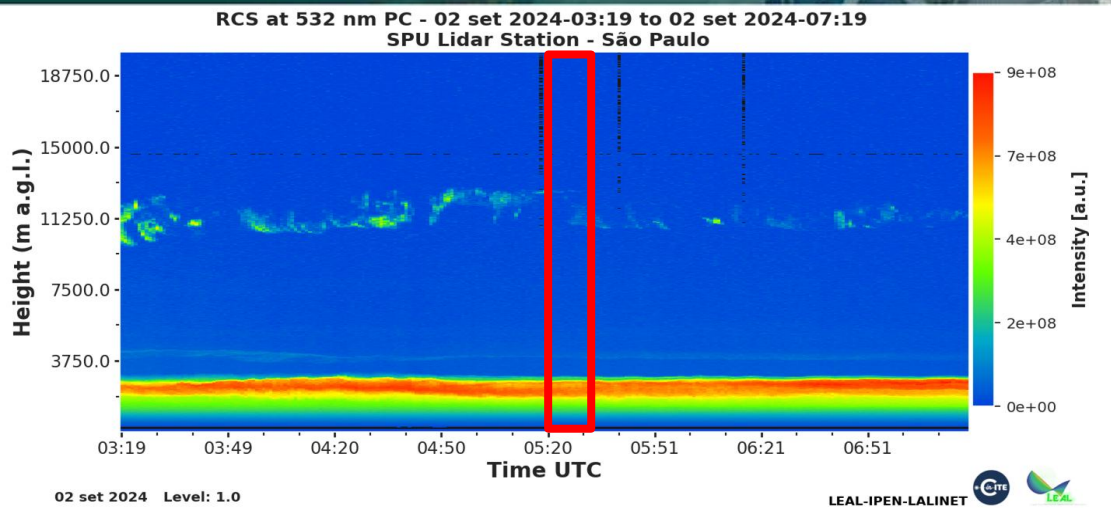


Overpass info page

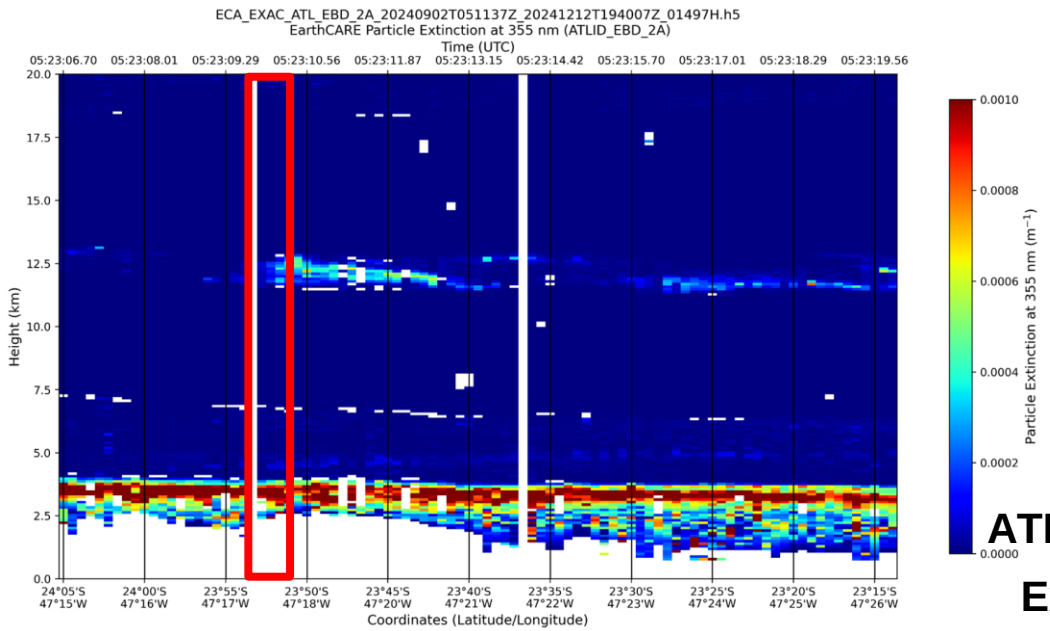
ECVT Confluence page:
Red Circle is the 100 km radius Inner Red Circle is a 10 km radius close to SPU-Station.

40 Overpasses

- **9 Measurements (22.5%)**
- **7 Partial measurements (17.5%)**



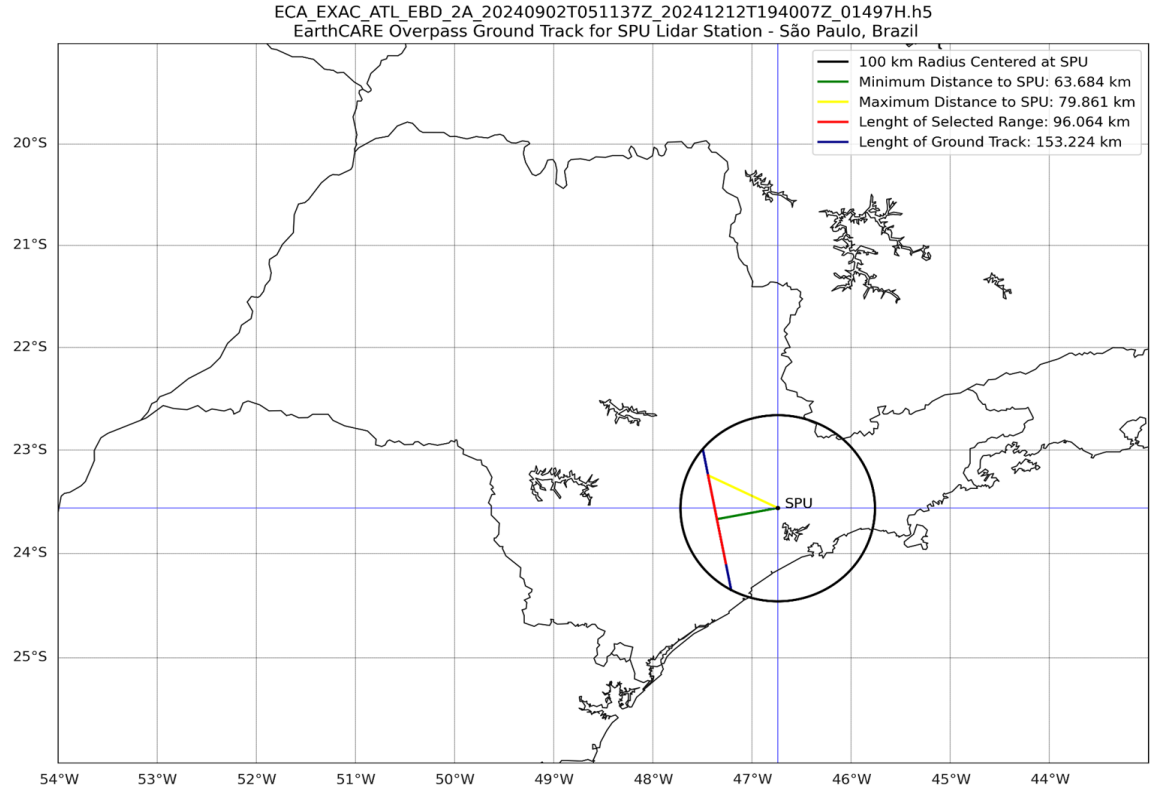
SPU

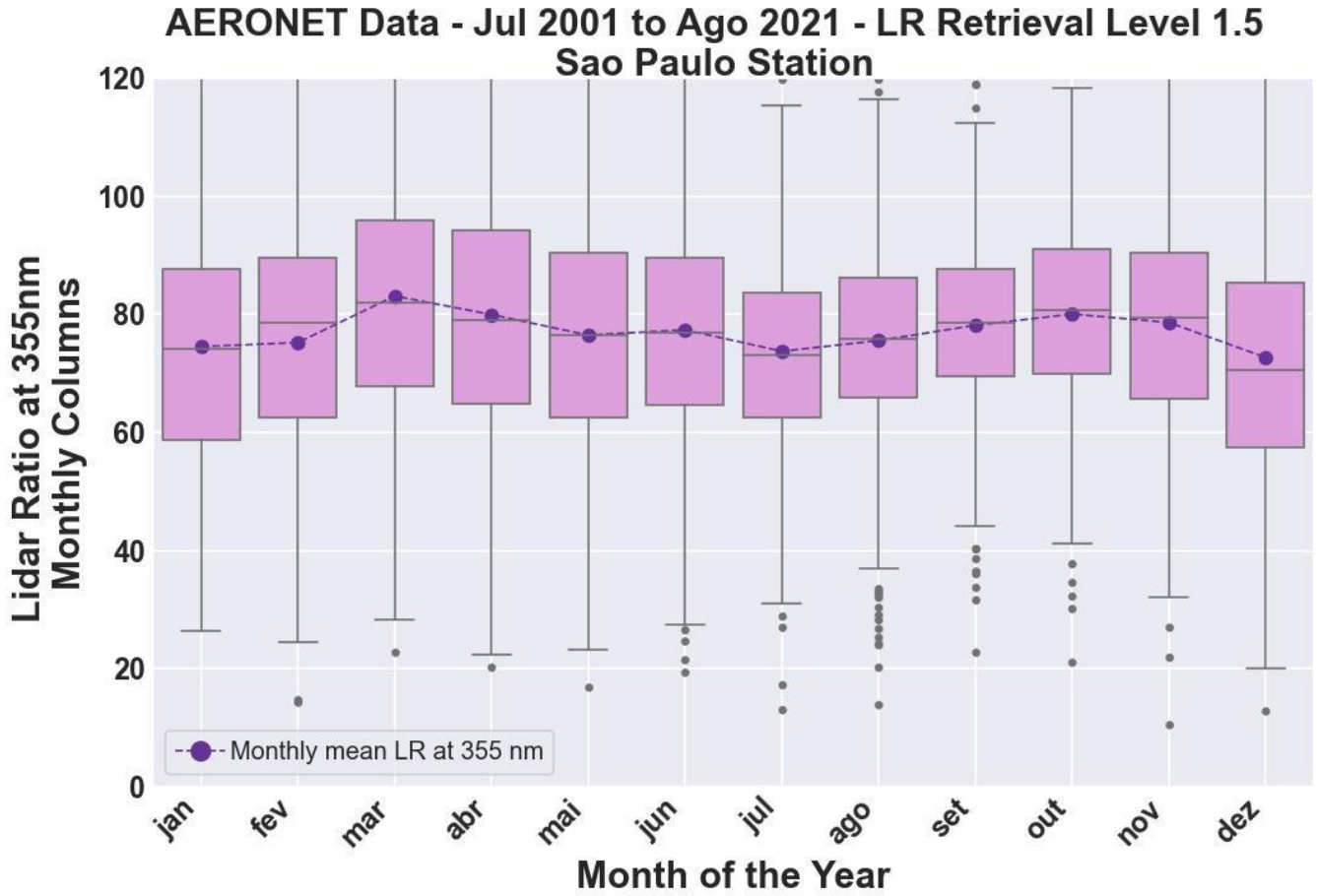


ATL_EBD_2A

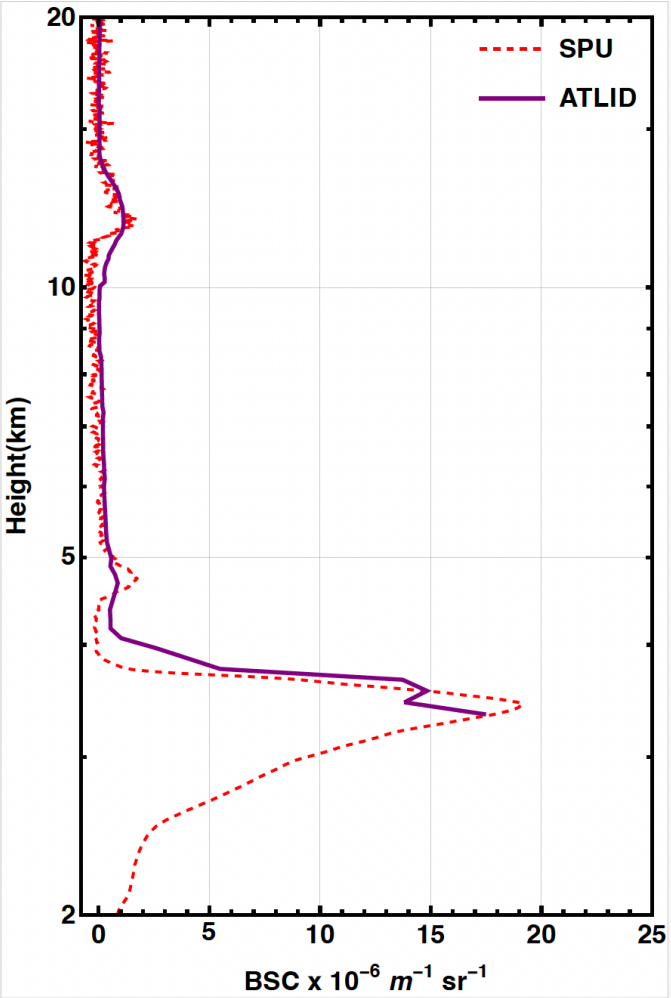
Extinction

02/09/2024 - Orbit 1497

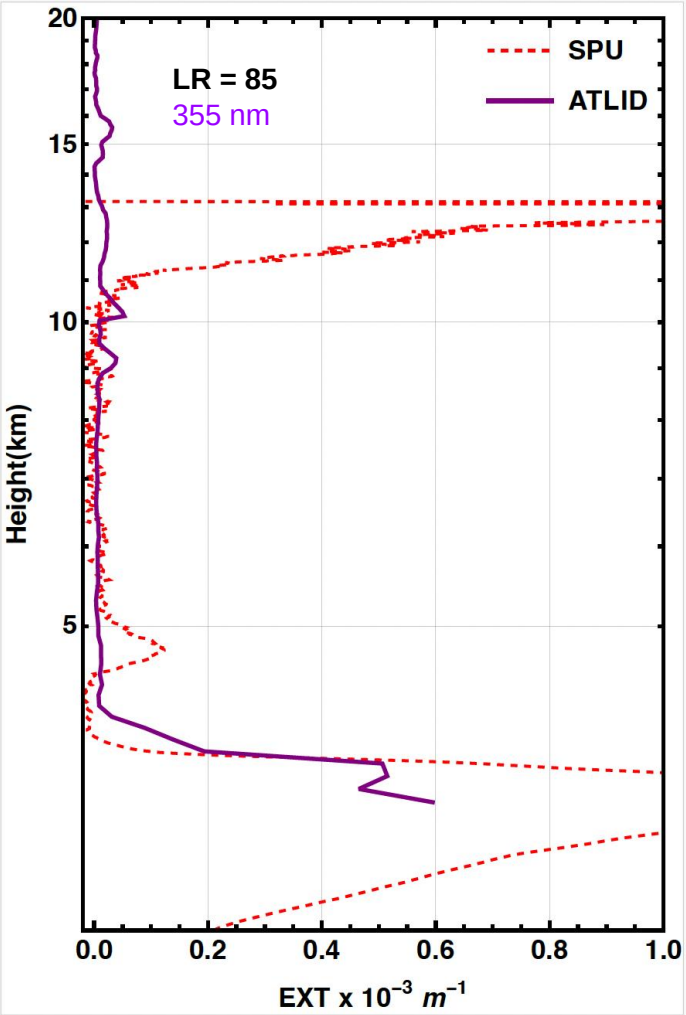


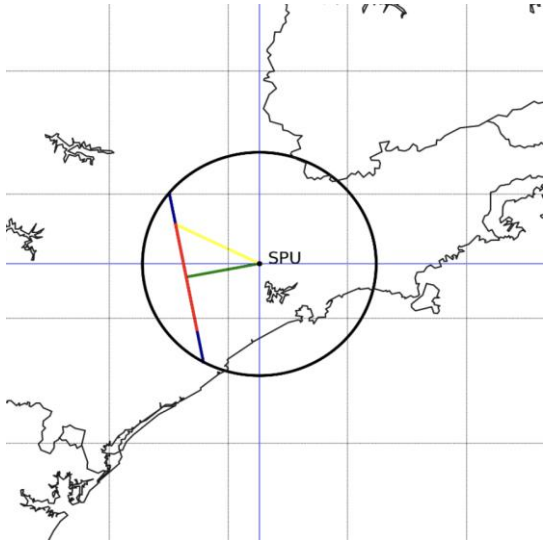

AERONET Data - Jul 2001 to Ago 2021 - LR Retrieval Level 1.5
Sao Paulo Station
Lidar Ratio at 355nm
Monthly Columns
120
100
80
60
40
20
0
Monthly mean LR at 355 nm
jan
fev
mar
abr
mai
jun
jul
ago
set
out
nov
dez
Month of the Year

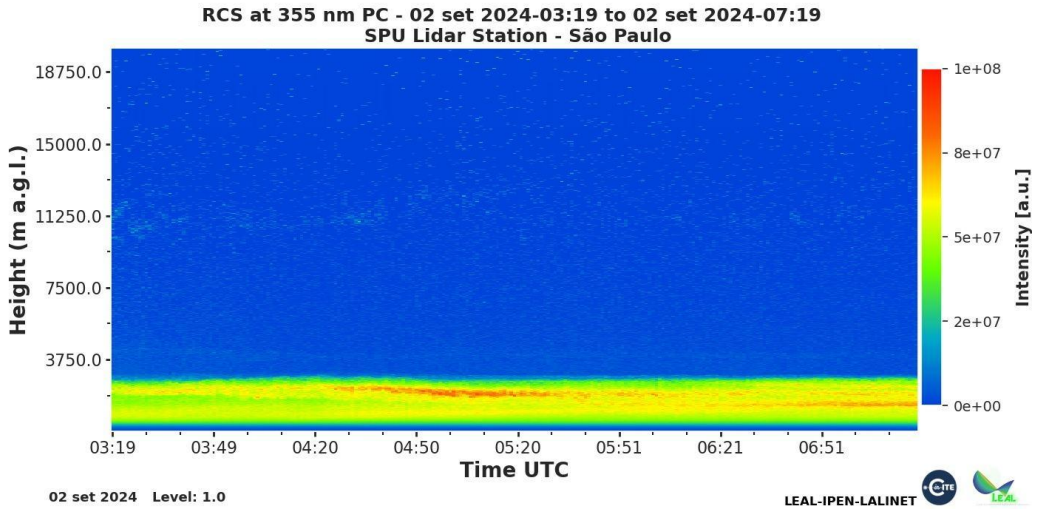
ATL_EBD_2A _Backscatter

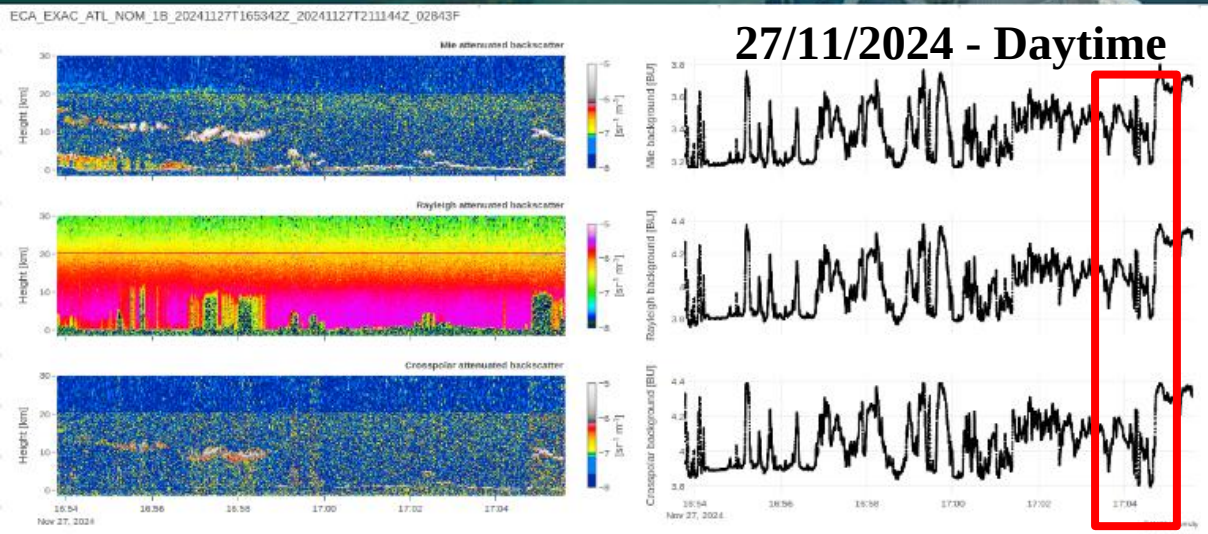


ATL_EBD_2A _Extinction

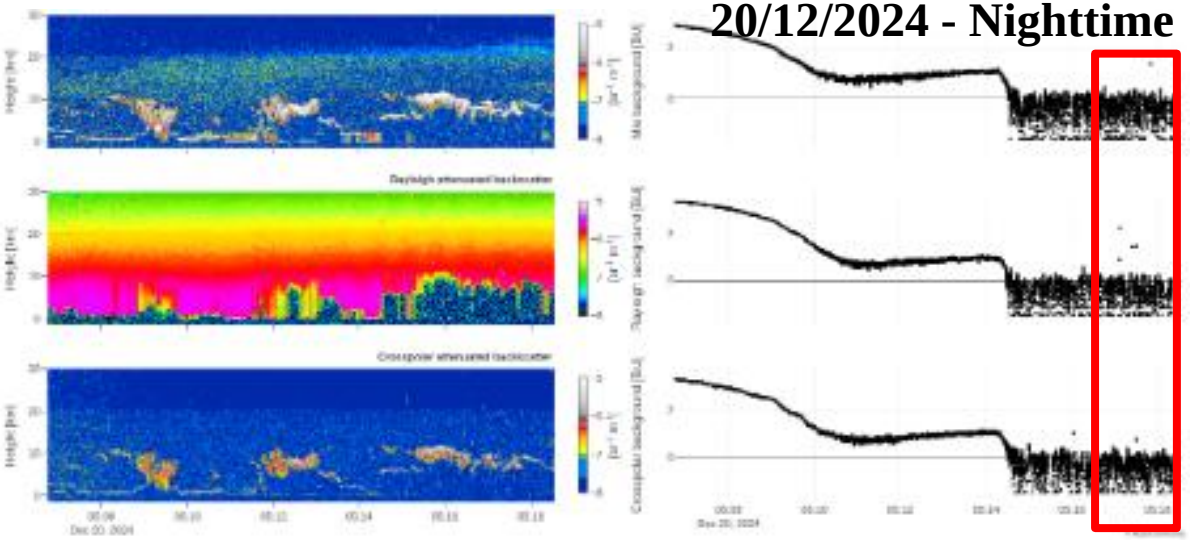






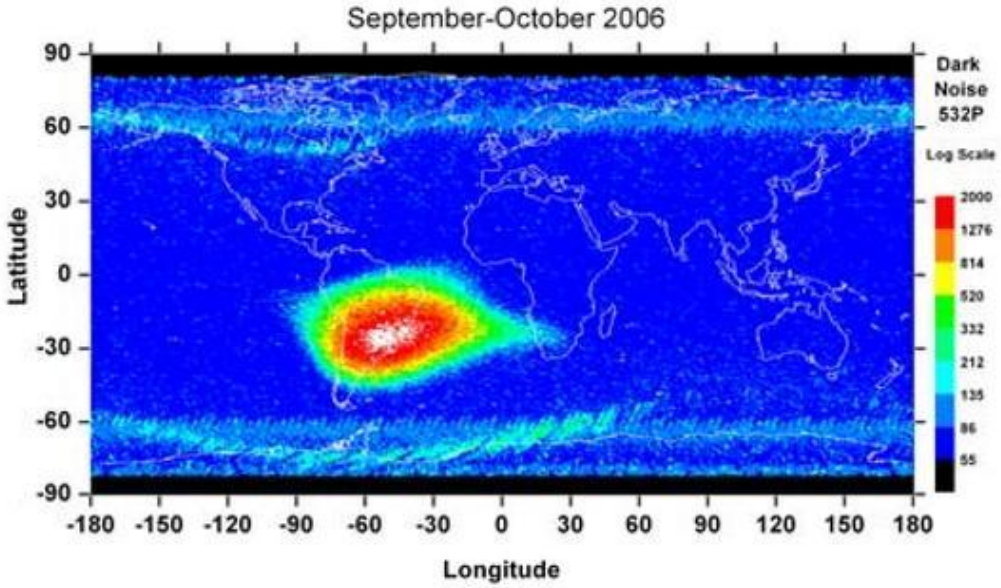


27/11/2024 - Daytime



20/12/2024 - Nighttime

When exposed to cosmic radiation, the photomultipliers can produce current pulses that are as much as two orders of magnitude larger than pulses due to single photoelectrons, resulting in increased noise levels and possible biases in the measured backscatter signals.

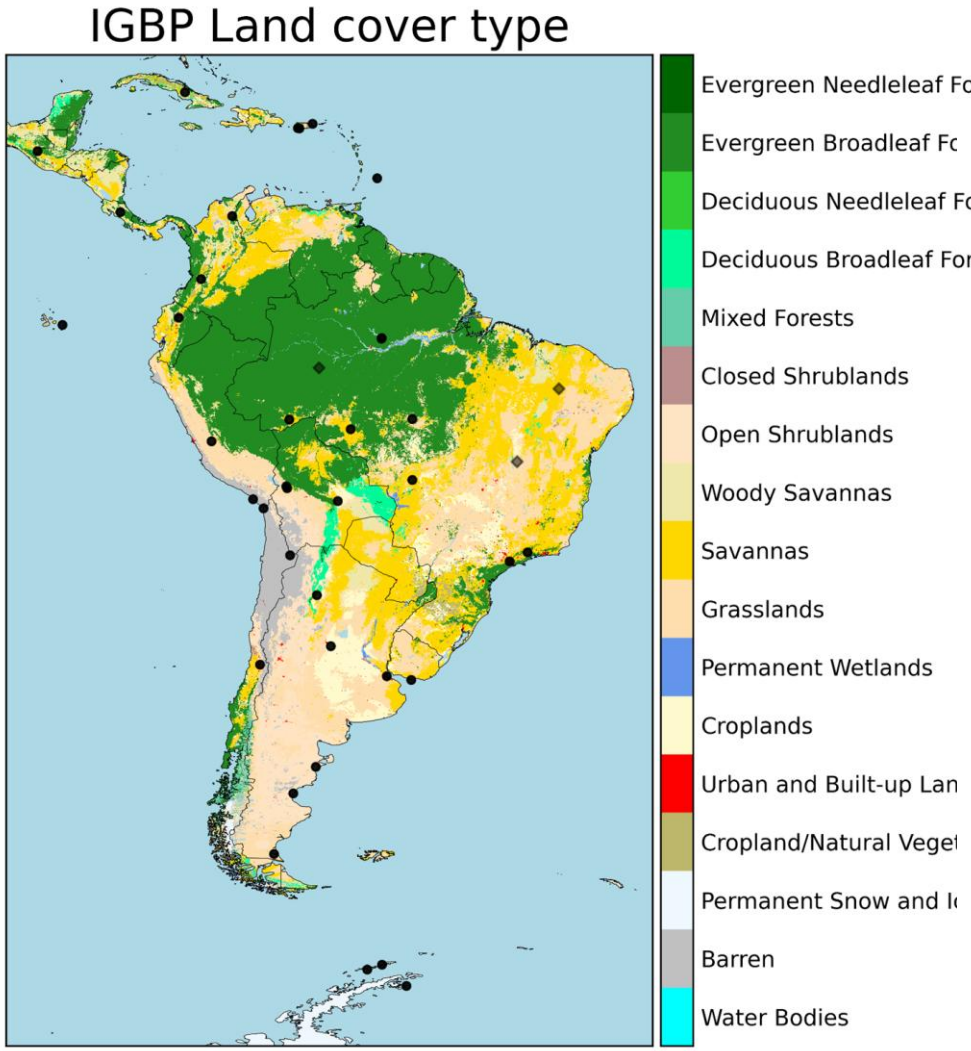


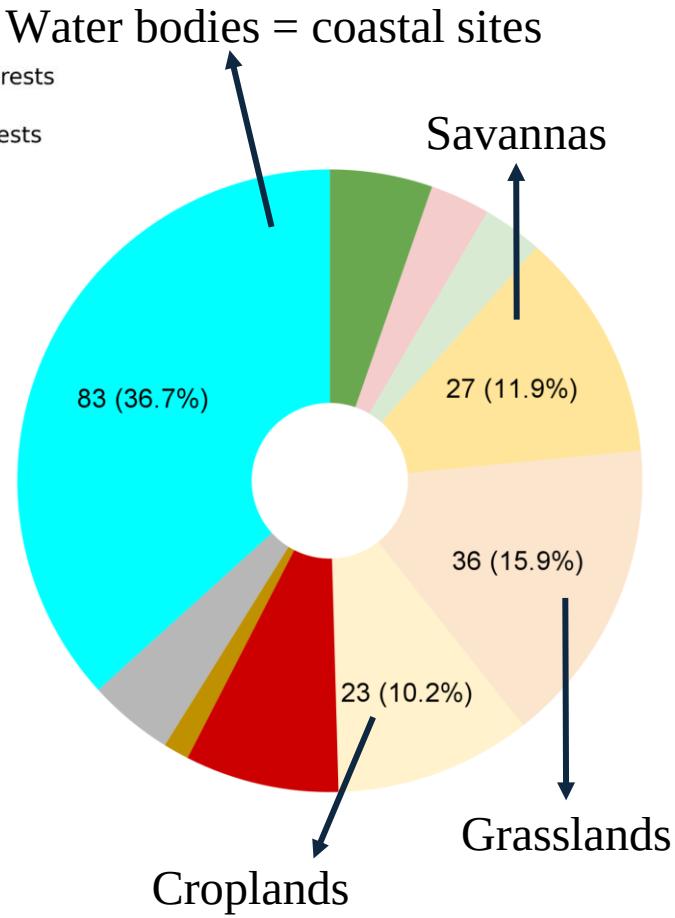
A framework for validating EarthCARE aerosol products over South America

Correia[1], A.L., Oliveira[2], N.N., Lopes[3], F.J.S., Cacheffo[4], A., Marques[2], J.B., Nobrega[1], T.F., Silva[5], G. M., Agostinho[1], B.S., Landulfo[5], E.

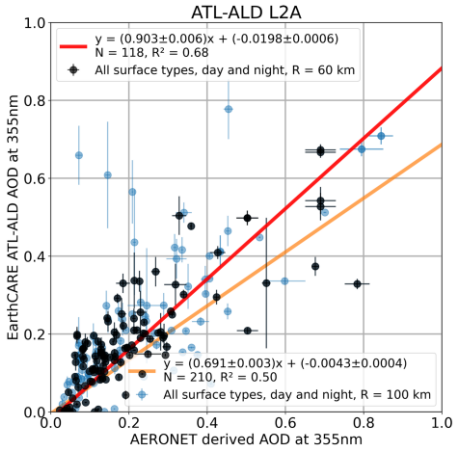
As part of the Latin America Lidar Network (LALINET) EarthCARE Cal/Val activities, we have been developing a framework for validating EarthCARE level 2 aerosol products from ATLID and MSI sensors. Here we show initial results across different land cover types in South America.

https://bit.ly/LA-EC-aerosol

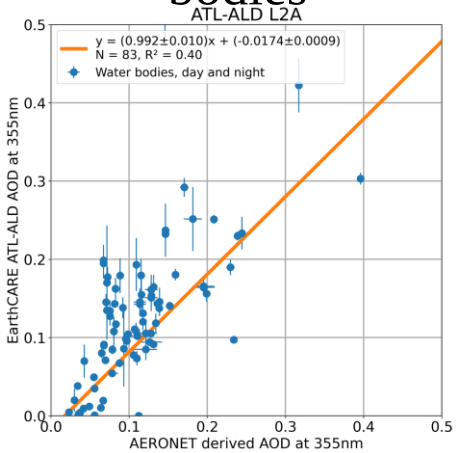




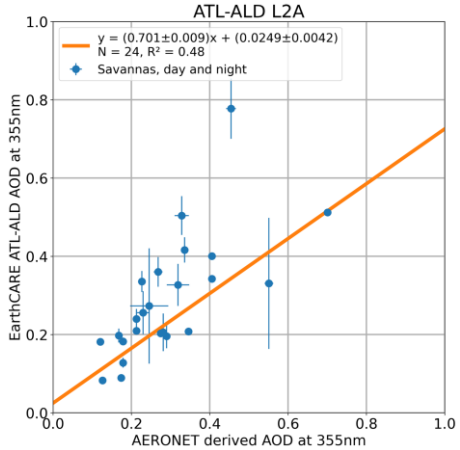
All surfaces

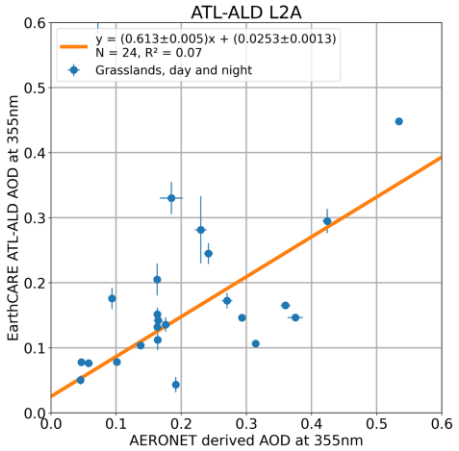


Water bodies

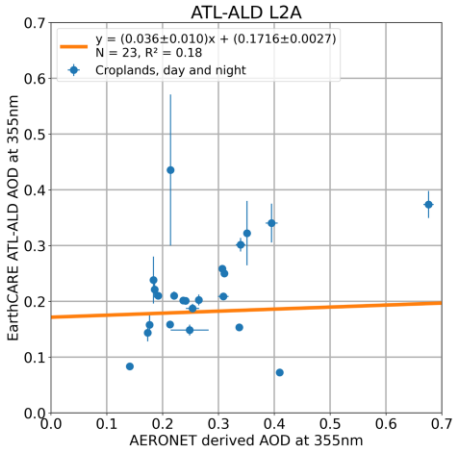


Savannas

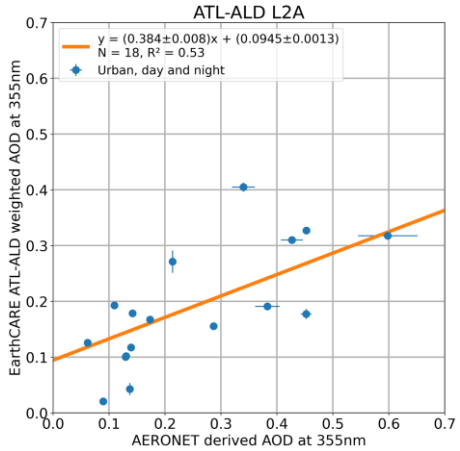




Grasslands



Croplands



Urban

Data sources

Temporal domain: 2024-08-10 to 2025-02-28

- 37 AERONET sites in South and Central America, Antarctica
- EC ATL-ALD Level 2A AOD at 355 nm
- EC MSI-AOT Level 2A AOD at 670, 865 nm

Preliminary results

- Surface type has a major impact over the quality of comparisons
- Limiting overpass radius to 60 km for “all surfaces” case results in slope closer to unity, increased correlation.

https://bit.ly/LA-EC-aerosol

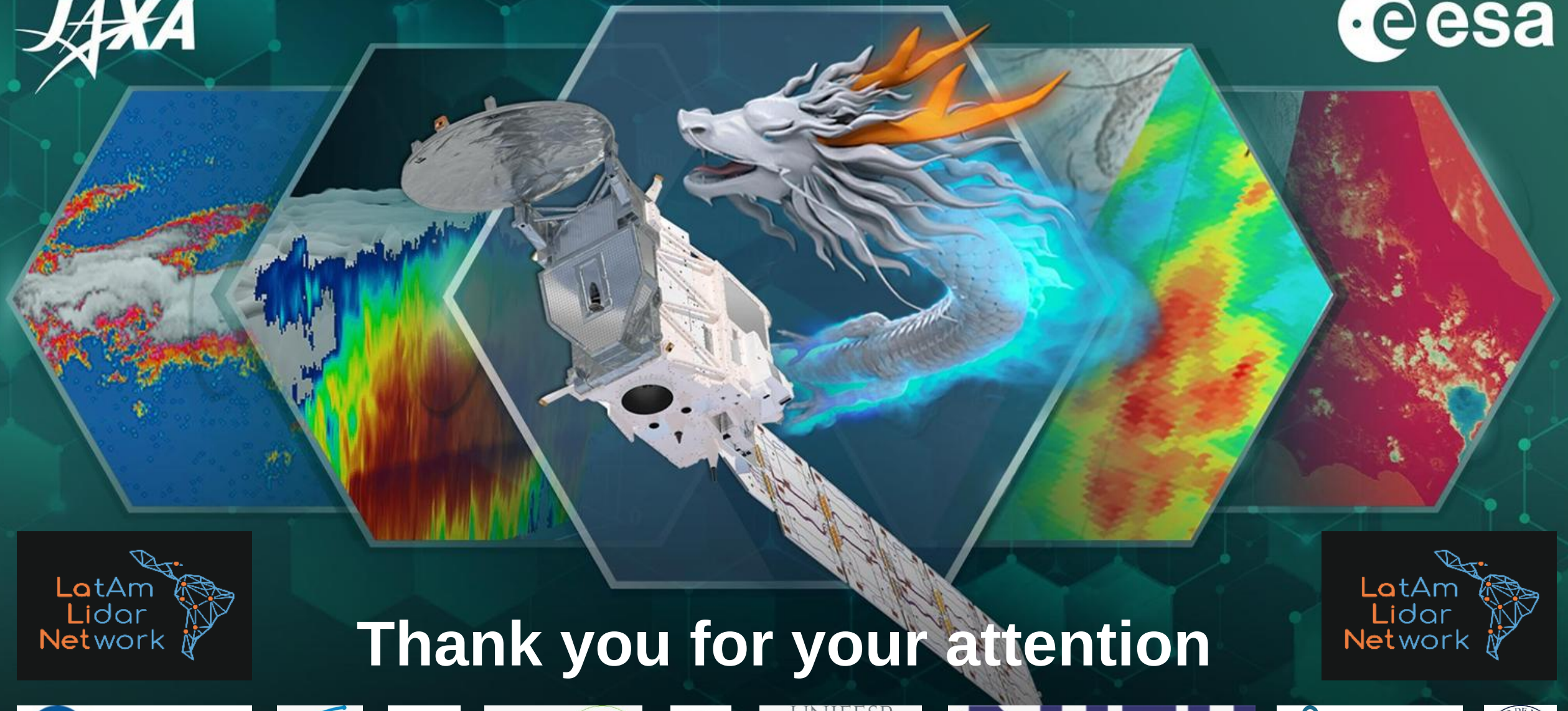
TRAINING AND OUTREACH

FABIO LOPES (UNIFESP) & ALEXANDRE CORREIA (USP)

ATMONEXT Training at

Next steps

- We should continue with correlative measurements to increase the comparative database
- Improve our analysis to derive the backscatter and extinction profiles independently (Raman Signal)
- Improve our analysis including the uncertainties on the backscatter and extinction profiles
- Investigate different distance ranges between EarthCARE overpasses and SPU Lidar station to improve comparisons
- For aerosol comparisons, we will analyze other factors such as precipitable water, solar/lunar zenith angle, aerosol single scattering albedo, asymmetry factor, Lidar ratio, and depolarization ratio.
- Prepare for campaign 2nd semester 2025 - LALINET
- Prepare for campaigns 2026 + 2027 - LALINET + OTHER NETWORKS*



Thank you for your attention

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop
17 – 20 March 2025 | ESA-ESRIN | Frascati (Rome), Italy