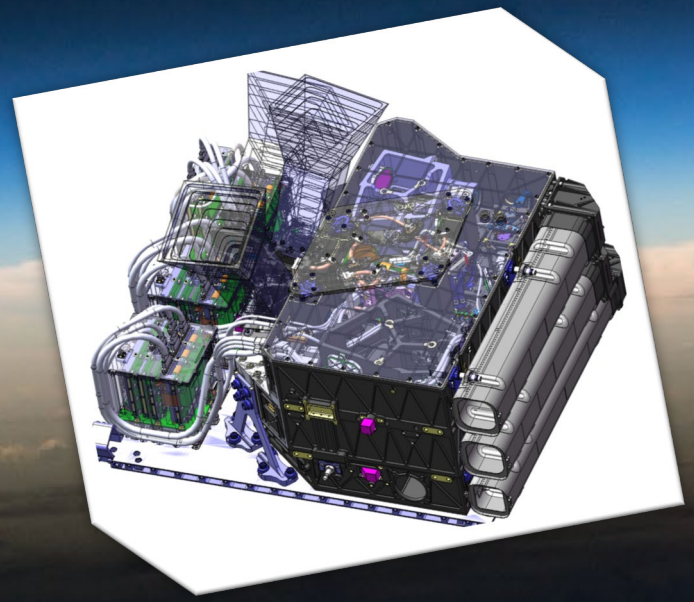


ALTIUS

Atmospheric Limb Tracker for the Investigation of the Upcoming Stratosphere

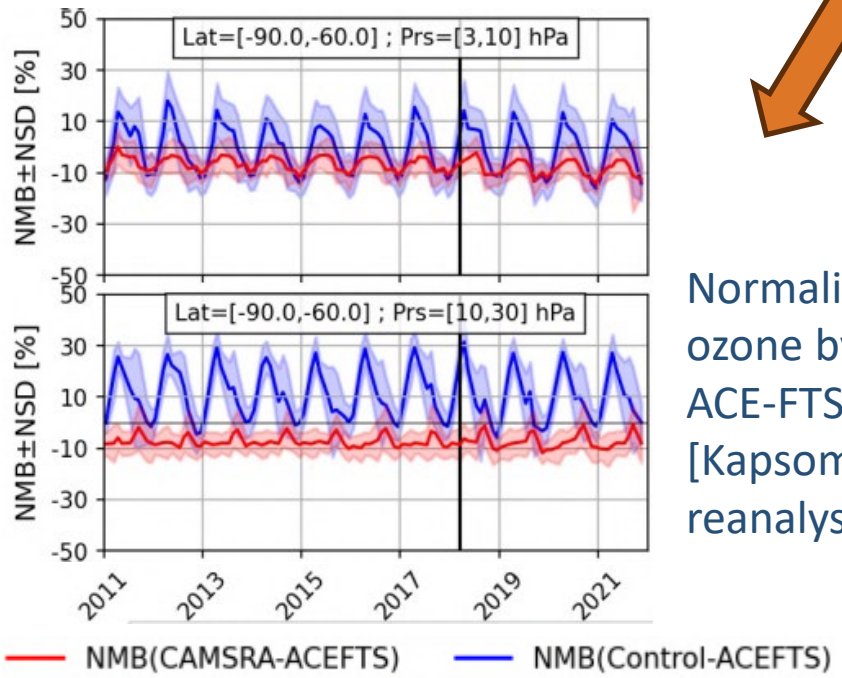
E. Dekemper, N. Baker, A. Berthelot, P. Demoulin, G. Franssens, D. Fussen, P. Gramme, N. Mateshvili, D. Pieroux, S. Sotiriadis
BIRA-IASB, Brussels, Belgium

OIP Space Instruments REDWIRE SPACEBEL UNIVERSITY OF SASKATCHEWAN belspo BIRA-IASB

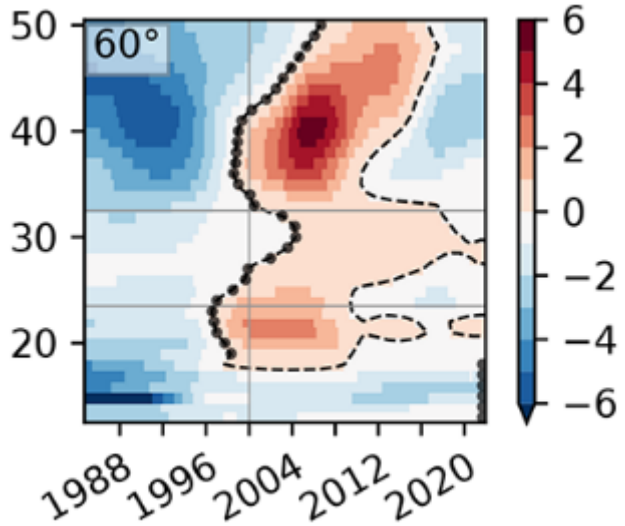
Scientific objectives

Primary objective

The primary objectives of ALTIUS are to observe the global distribution of stratospheric ozone at high vertical resolution in support of operational services in near-real time and to contribute to stratospheric ozone long term monitoring.



Normalized mean bias in monthly mean ozone by CAMS reanalysis compared to ACE-FTS.
[Kapsomenakis et al., CAMS global reanalysis validation report, 2003-2021]



O_3 recovery trend (%/decade) as a function of altitude and time at latitude 60°.
[Bognar et al., ACP, 2022]

Scientific objectives

Secondary objectives

The secondary objective of ALTIUS is to provide profiles of mesospheric ozone and of other trace gases and particles in the middle atmosphere for scientific studies related to ozone chemistry, climate change and atmospheric dynamics.

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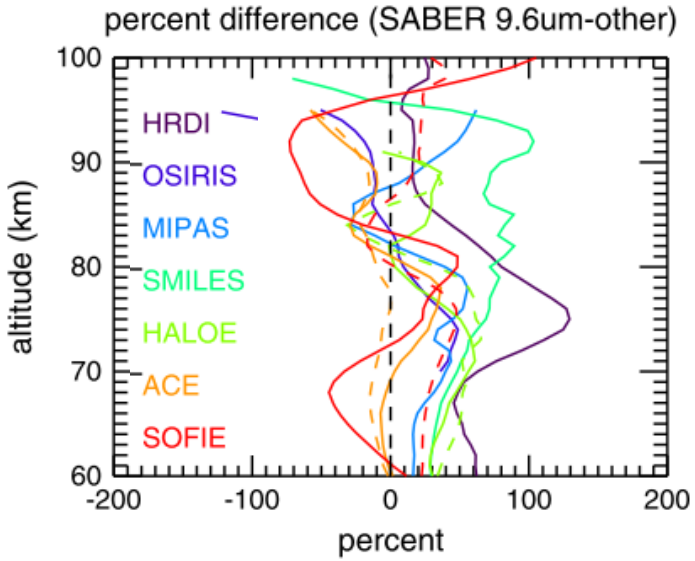
Target	Alt. range [km]	Target uncertainty [%]	Target vert. resolution [km]
mesospheric O_3	45-100	10	1



[Smith, JGR, 2013]

Scientific objectives

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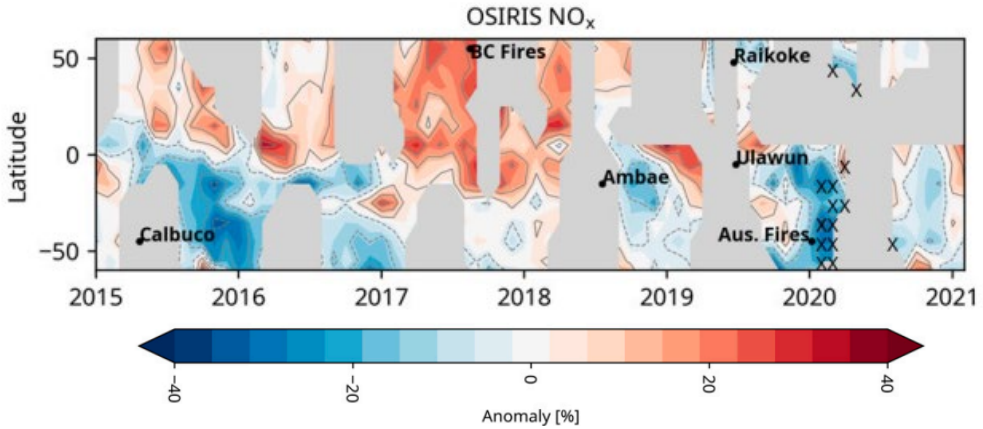
mesospheric O_3	45-100	10	1
NO_2	15-45	15	1



[Solomon, PNAS, 2022]

Scientific objectives

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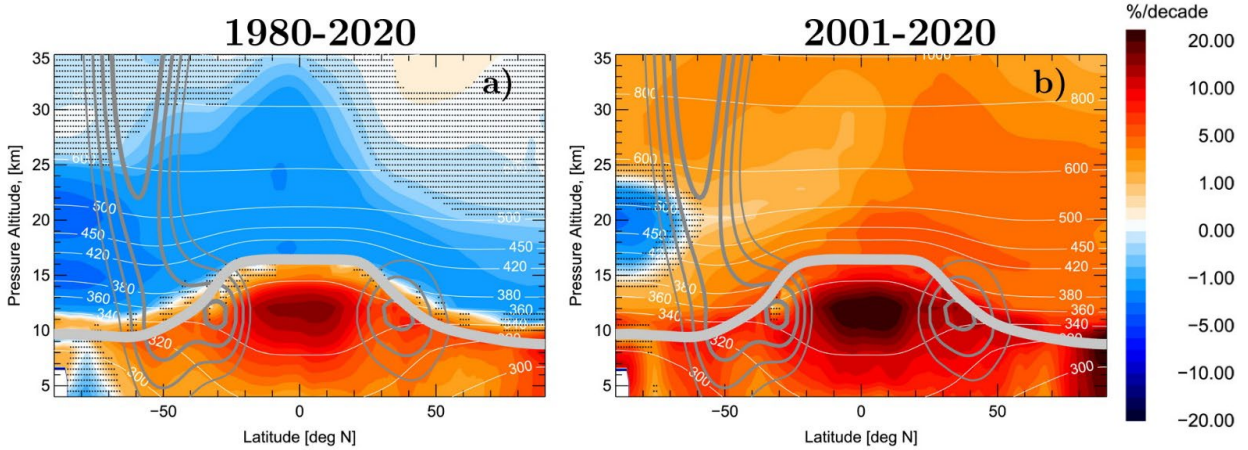
NO_2	15-45	15	1
H_2O	15-30	5	1



[Konopka, GRL, 2022]

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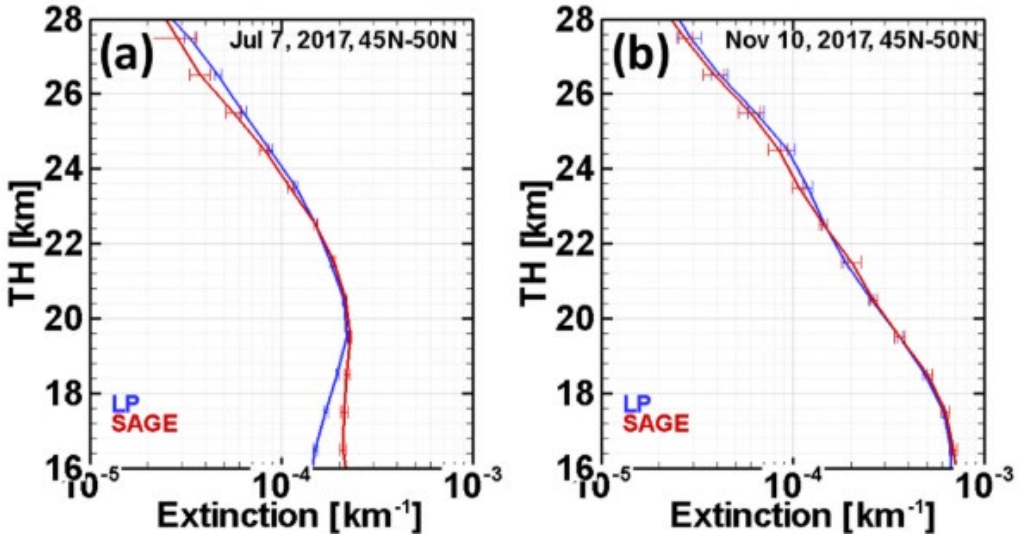

Detection of wildfire smokes
[Chen, AMT, 2020]

Scientific objectives

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OClO	15-50	20	2
BrO	15-30	5	2

Scientific objectives

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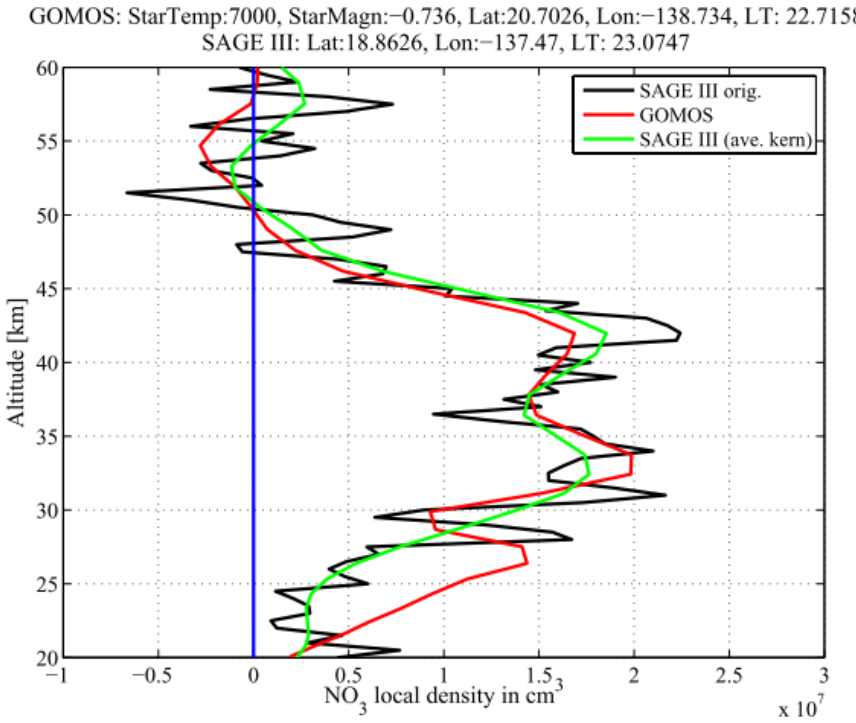

[Hakkarainen, AMT, 2012]

Scientific objectives

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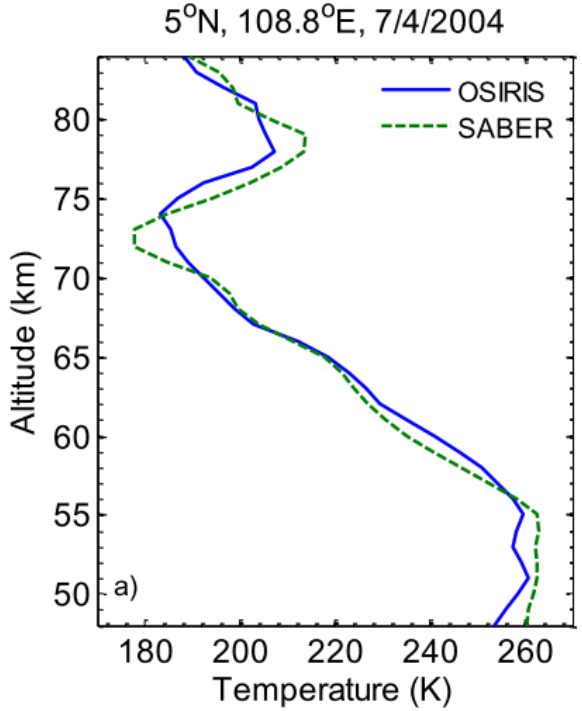
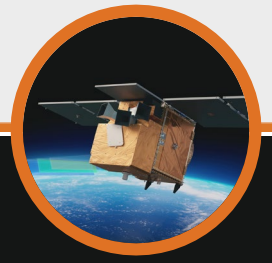
BrO	15-30	5	2
NO_3	20-45	15	1
Temperature	15-100	1	2



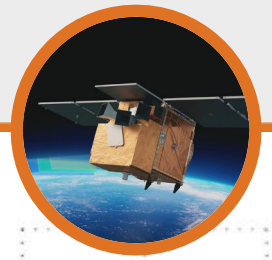
[Sheese, AMT, 2012]



ALTIUS mission

altius

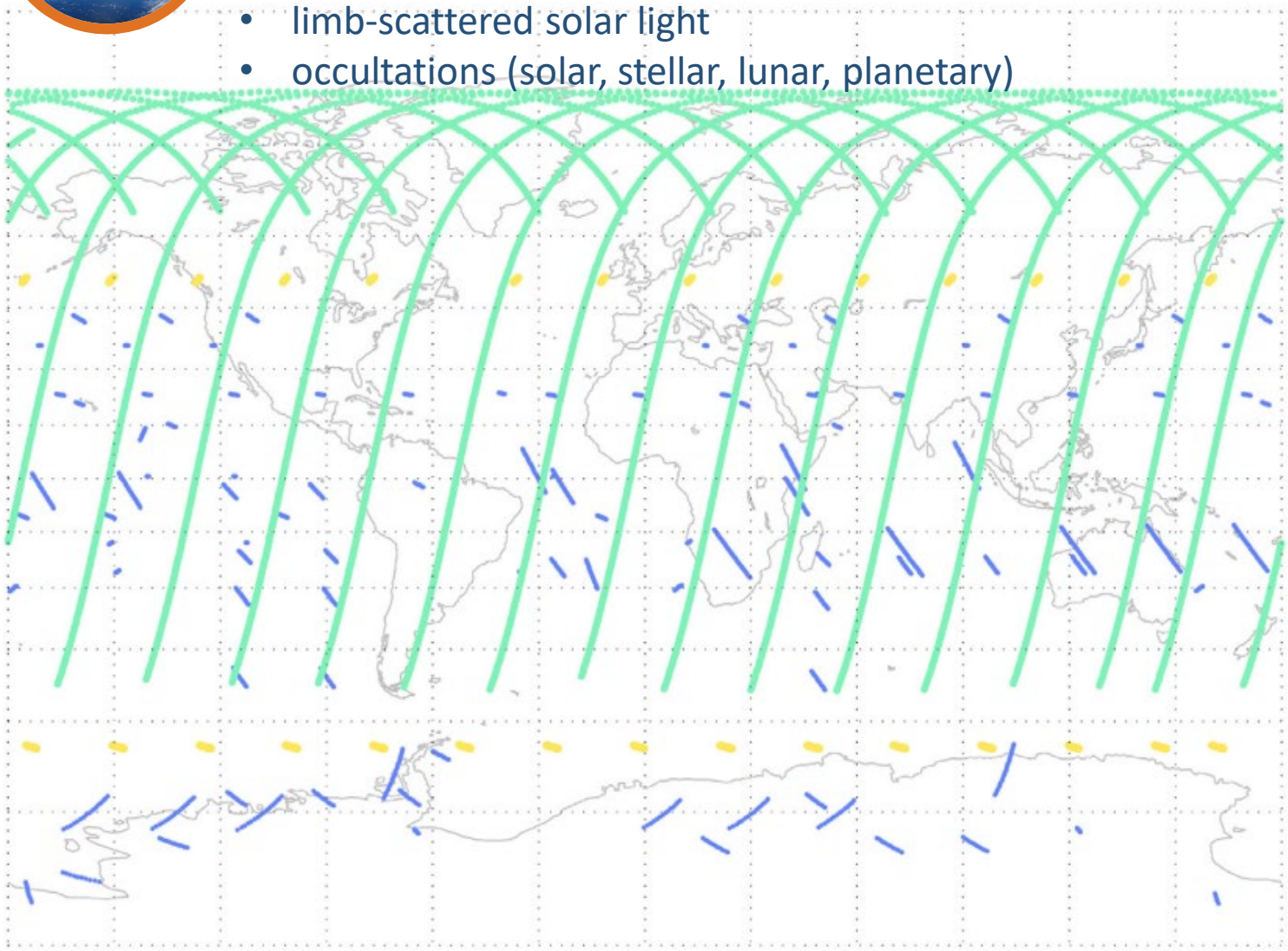
ESA'S OZONE MISSION

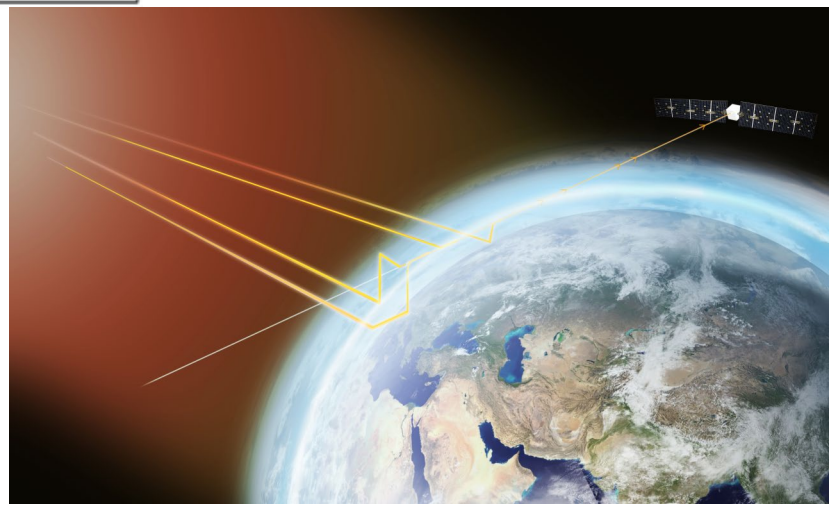


ALTIUS mission

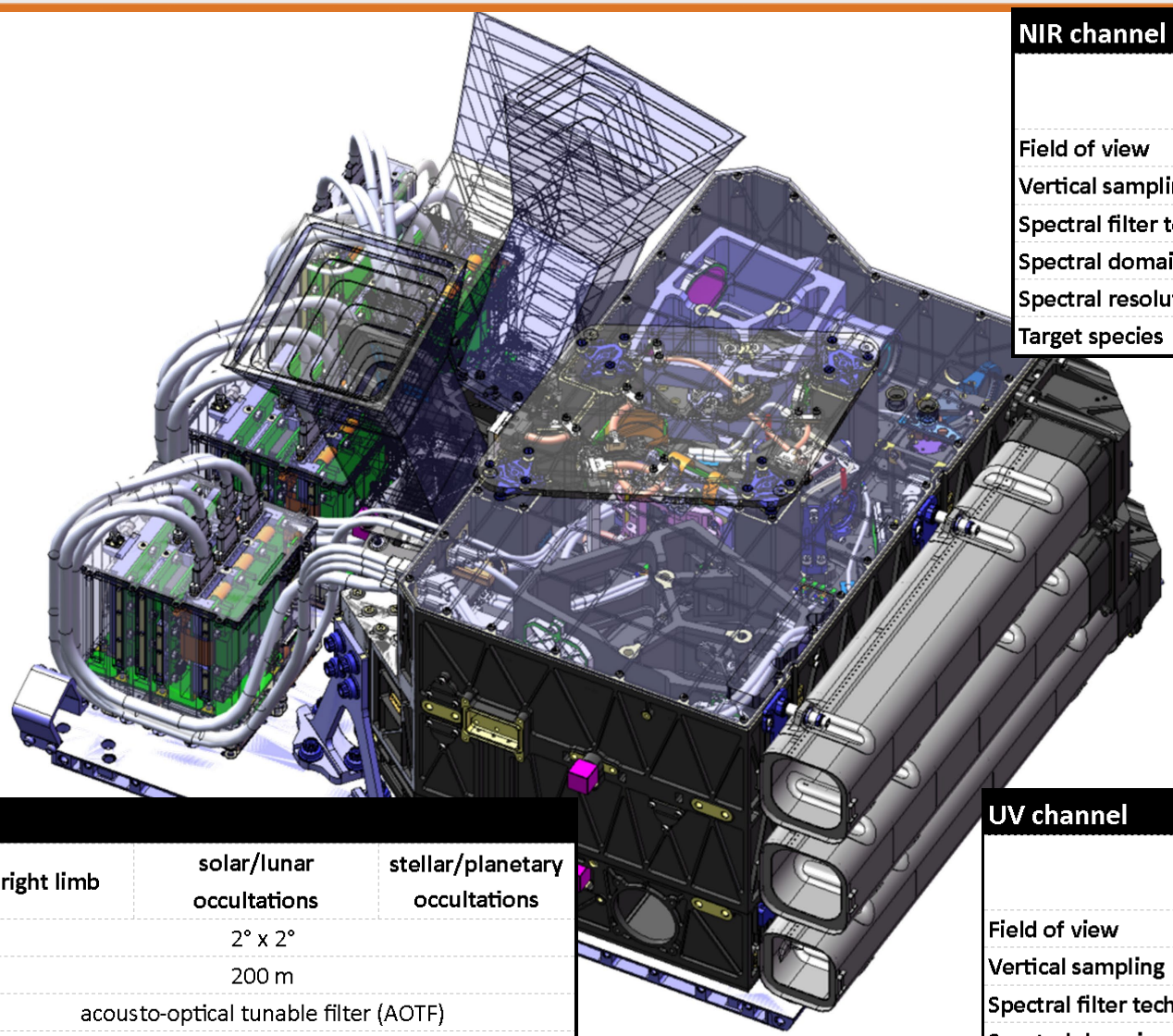
Baseline observation modes:

- limb-scattered solar light
- occultations (solar, stellar, lunar, planetary)





ALTIUS mission



NIR channel

	bright limb	solar/lunar occultations	stellar/planetary occultations
Field of view	2° x 2°		
Vertical sampling	400 m		
Spectral filter technology	acousto-optical tunable filter (AOTF)		
Spectral domain	600-1020 nm		
Spectral resolution	2-10 nm		
Target species	aerosols	aerosols, H_2O	aerosols

VIS channel

	bright limb	solar/lunar occultations	stellar/planetary occultations
Field of view	2° x 2°		
Vertical sampling	200 m		
Spectral filter technology	acousto-optical tunable filter (AOTF)		
Spectral domain	440-675 nm		
Spectral resolution	2-10 nm		
Target species	O_3, NO_2, aerosols	O_3, NO_2, aerosols, NO_3,	O_3, aerosols

UV channel

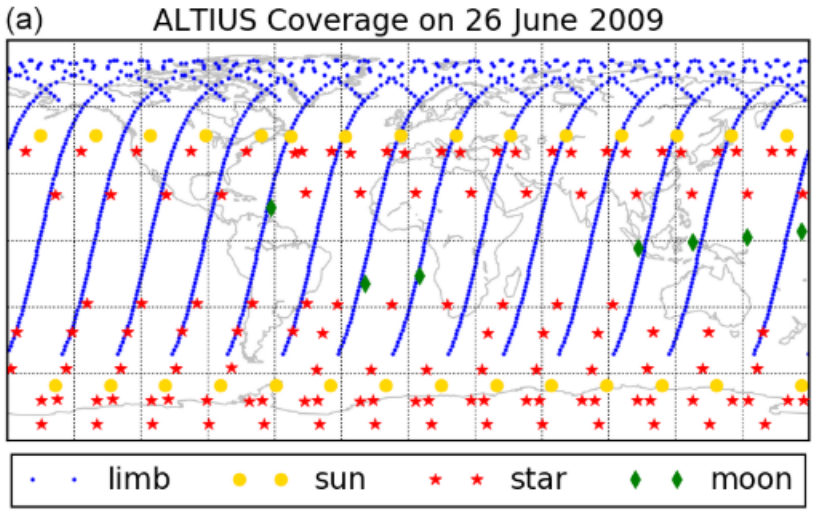
	bright limb	solar/lunar occultations	stellar/planetary occultations
Field of view	2° x 2°	2° x 2°	0.2° x 0.2°
Vertical sampling	600 m	600 m	60 m
Spectral filter technology	stack of 4 Fabry-Pérot interferometers		
Spectral domain	250-355 nm		
Spectral resolution	2-3 nm		
Target species	O_3, T°	O_3, BrO, OClO, T°	O_3

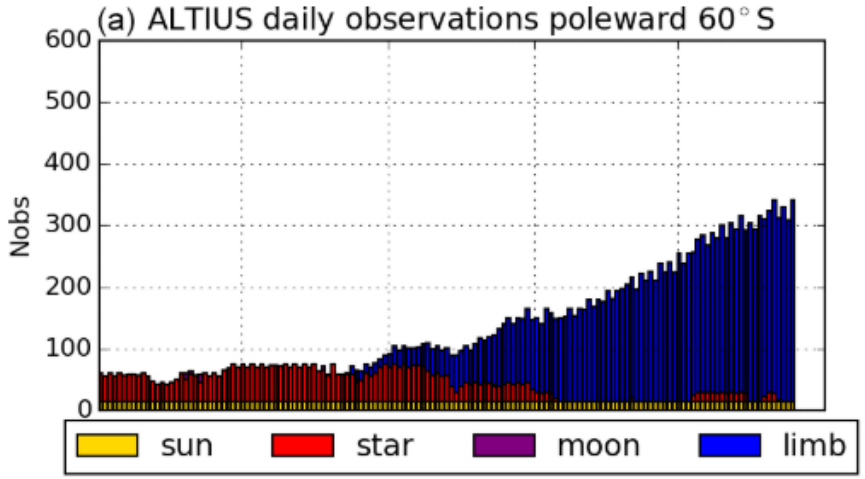
ALTIUS mission

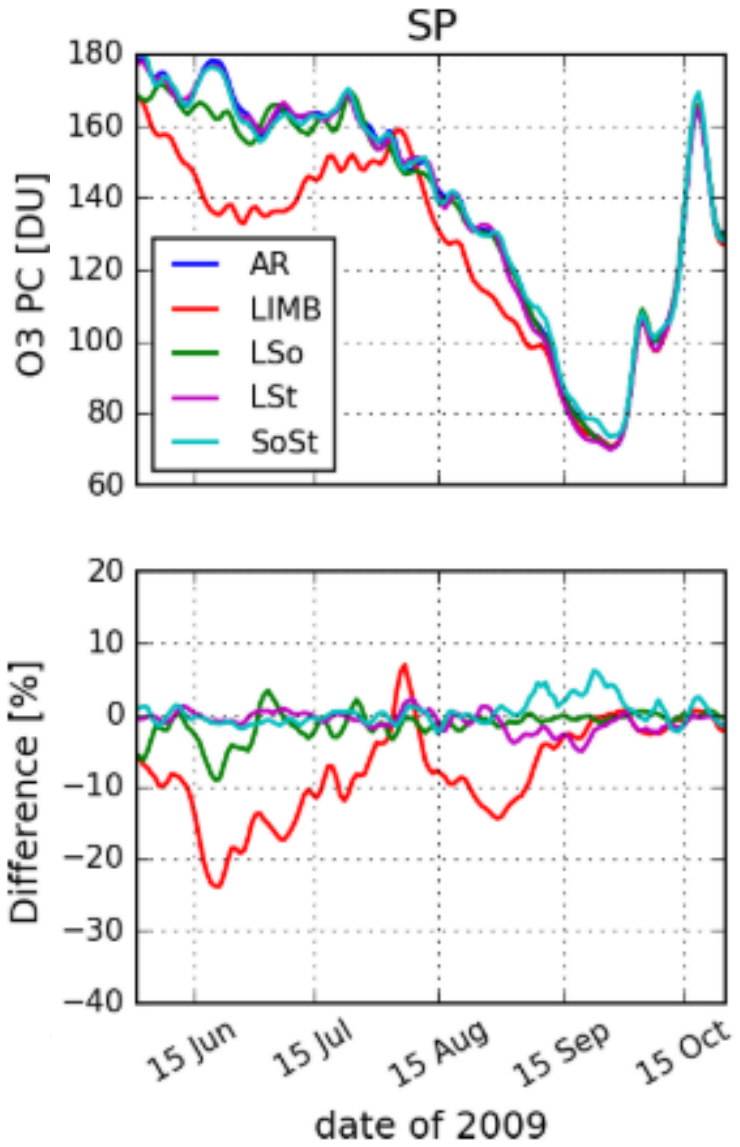
On the importance of occultations

Each orbit, ALTIUS will follow
- 2 solar occultations
- 2-5 stellar/lunar/planetary occultations

When limited or no bright limb observations are available, these occultations, though limited in number, are valuable in an assimilation scheme (Errera et al., AMT 2021).

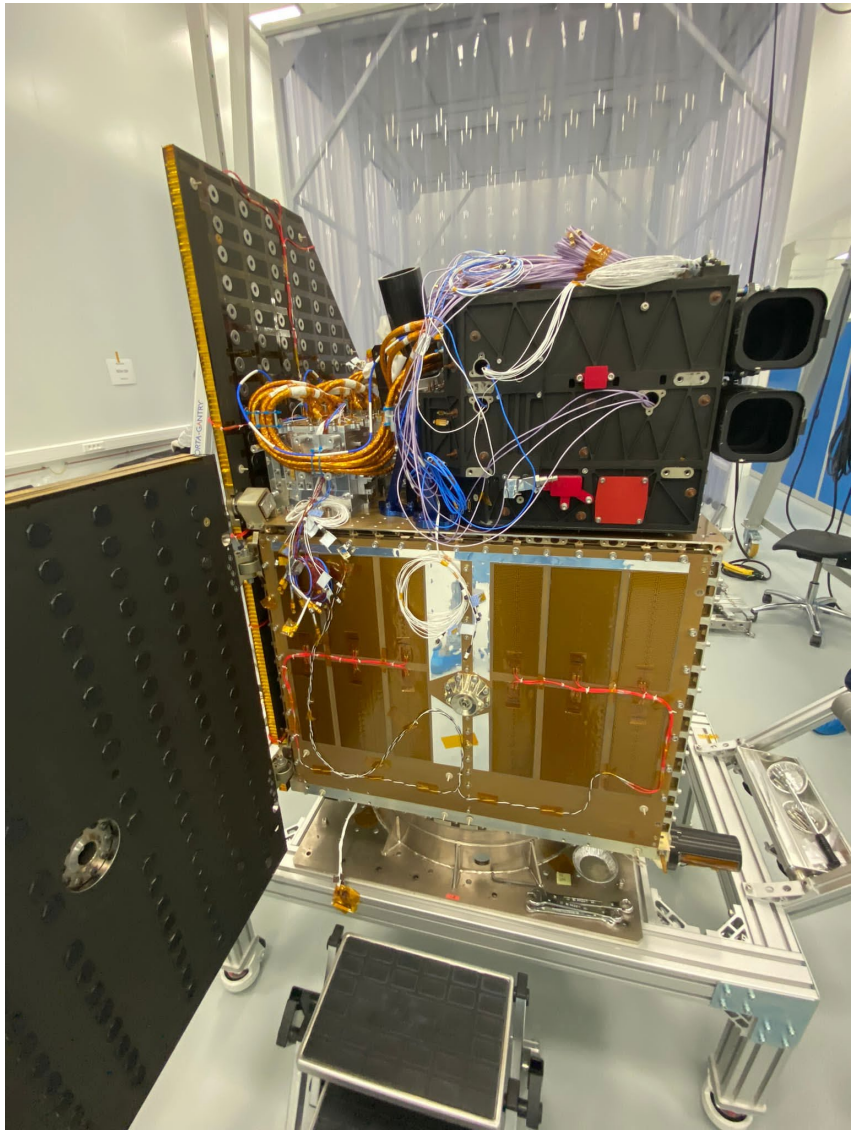






Development status

Space segment now entering CDR.
Ground segment will enter CDR in Q1 2024.
Launch foreseen on Vega-C (dual launch with FLEX) in Q2-2026.
Phase E1 duration: 3 months
Phase E2 duration: > 5 years



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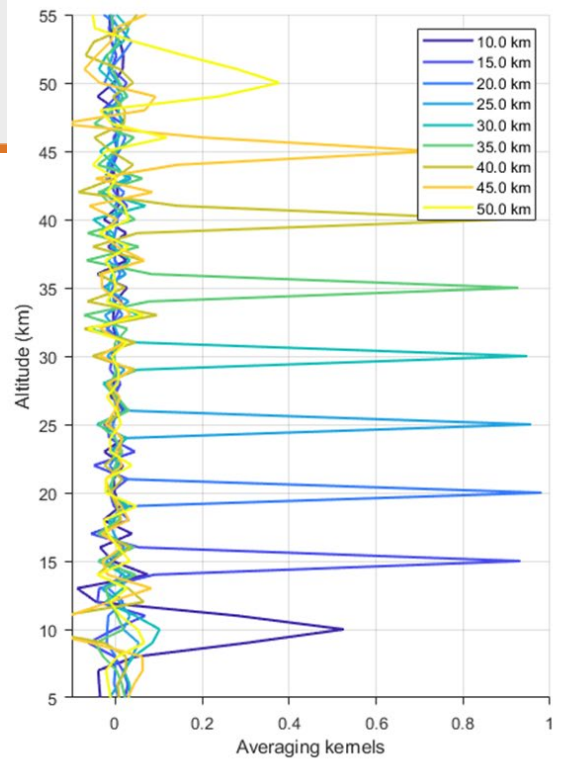
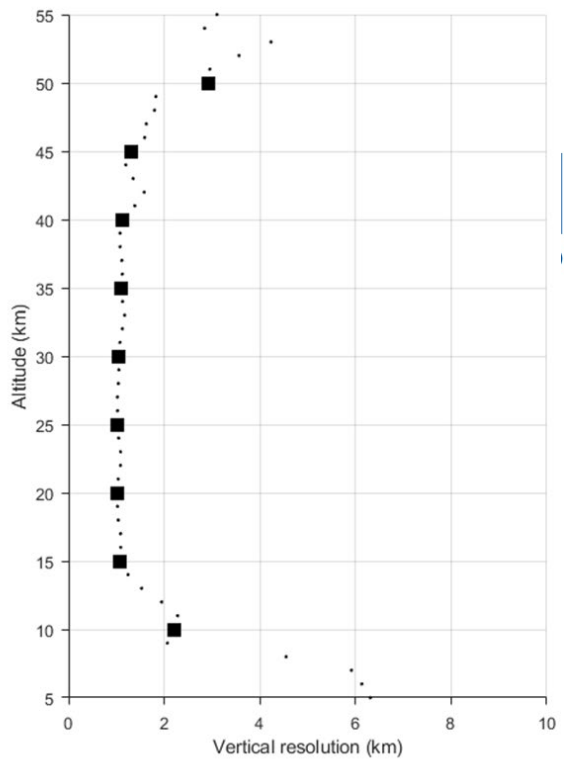
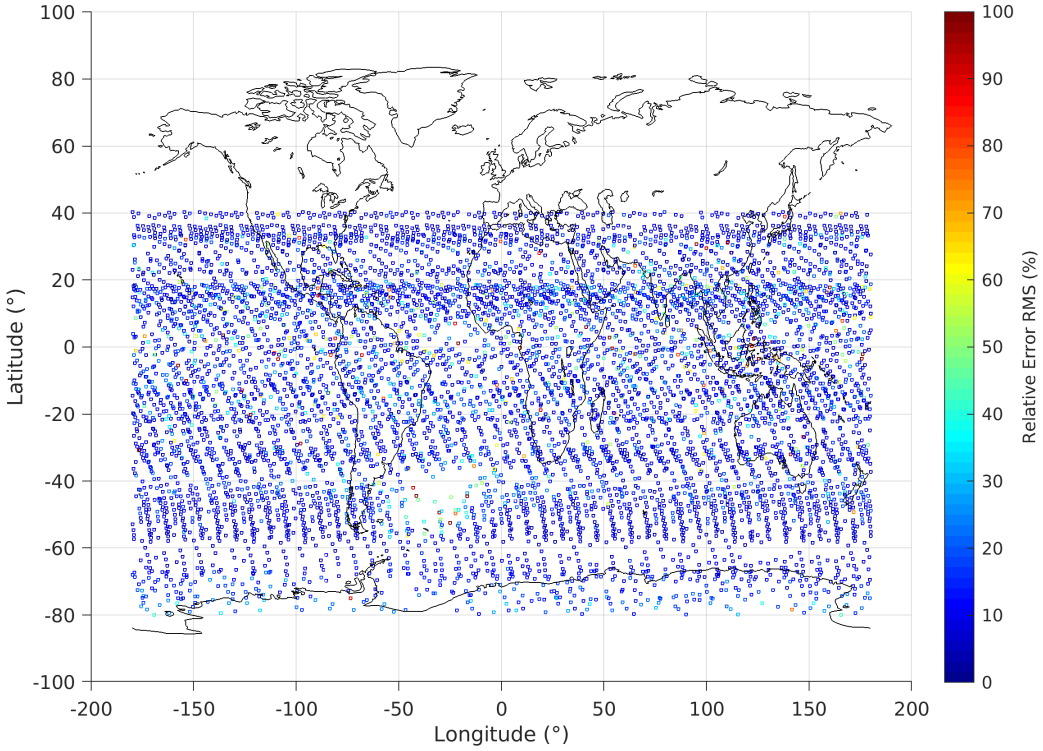
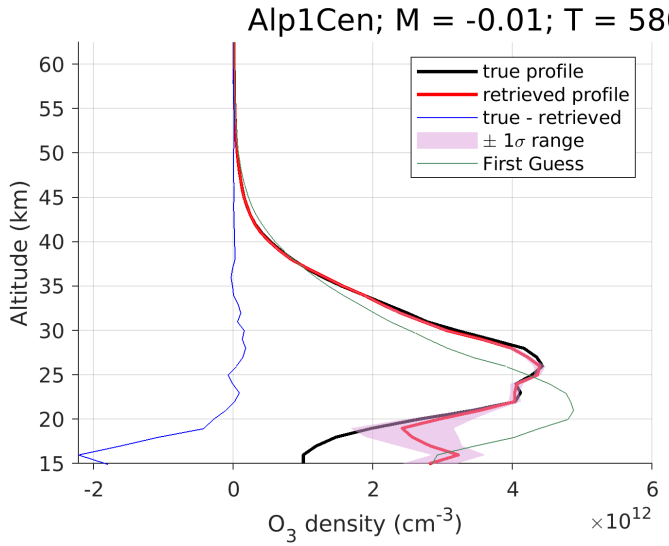
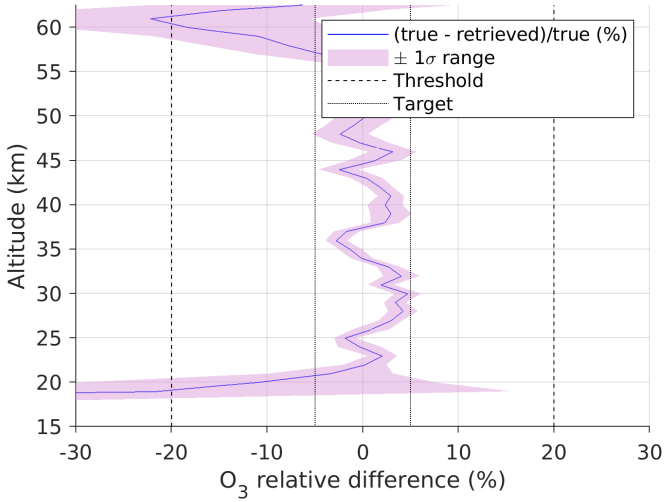
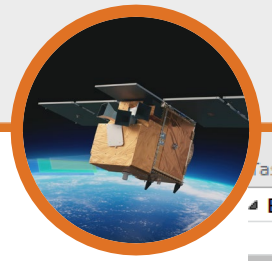










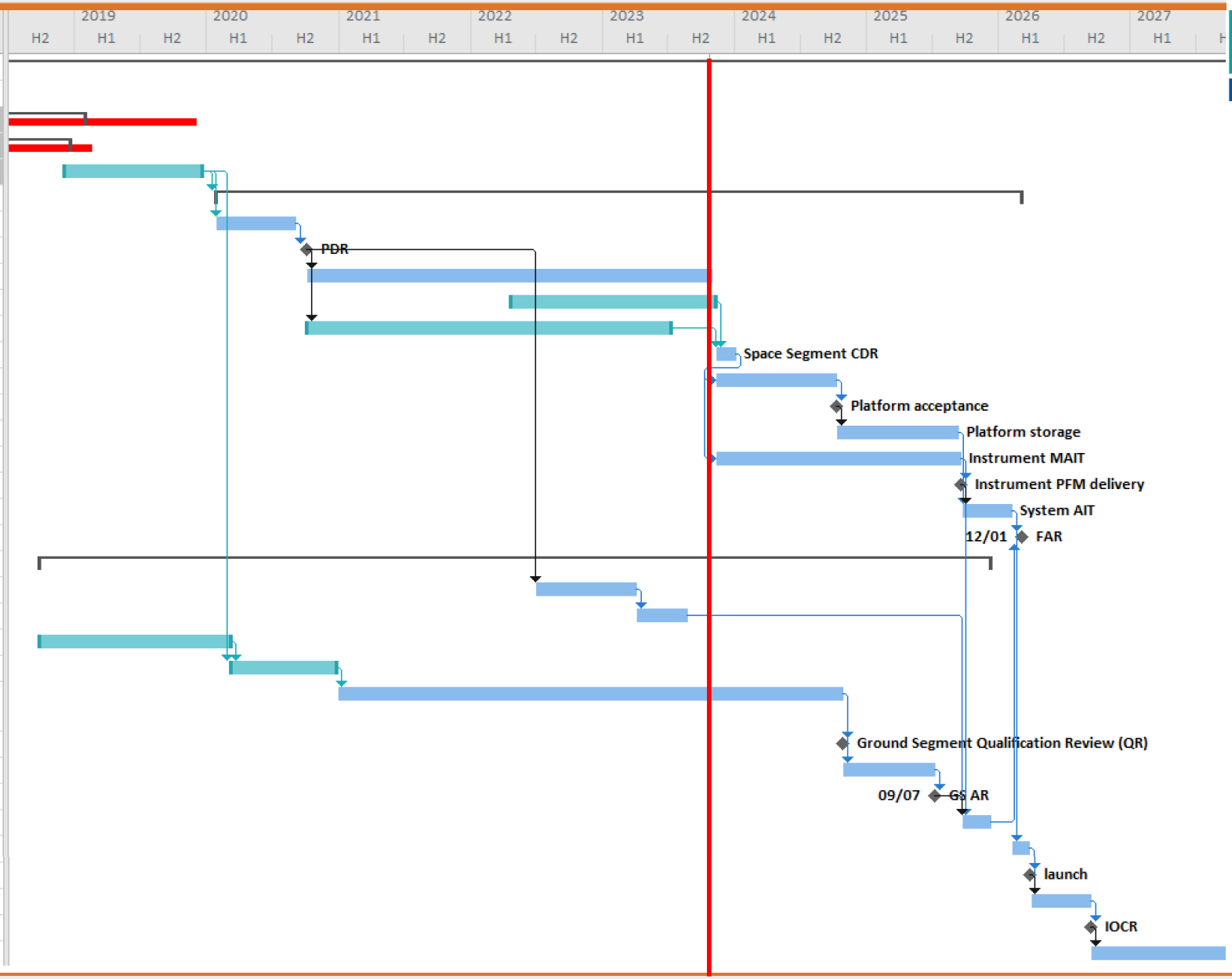


Development status

Space segment

Ground segment

Task Name
Earth Watch - ALTIUS Element
Instrument Pre-Development Phase
Space Segment System Consolidation Phase
Phase B2/C/D Procurement Process
Space Segment Implementation Phases
Preliminary System Design
Preliminary Design Review (PDR)
Phase C Instrument
Instrument STM and ELM AIT flow
Phase C Platform
Space Segment CDR
Platform PFM Integration
Platform acceptance
Platform storage
Instrument MAIT
Instrument PFM delivery
System AIT
Flight Acceptance Review
Ground Segment Development
FOS and Operations Phase C/D development
FOS Installation
Ground Segment Preparatory Activities
Ground Segment (PDGS) Procurement Process
Ground Segment (PDGS) Phase B2/C/D development
Ground Segment Qualification Review (QR)
PDGS Installation, validation and acceptance
Ground Segment Acceptance Review (AR)
System Validation Tests
Launch Campaign
launch
In Orbit Commissioning (Phase E1)
IOCR
Phase E



Conclusions

ALTIUS will be an **operational ozone monitoring mission** AND an **ozone + other trace gases science mission**.

The L2 products will be high vertical resolution concentration profiles of:

Target	Observation mode		
	Bright limb	**Stellar Occ**	**Solar Occ**
stratospheric O_3	x	x	x
mesospheric O_3		x (only planets)	x
NO_2	x	x	x
H_2O	x		x
Aerosols	x (USASK)	x	x
PSC		x	x
PMC			x
OClO			x (lunar occ.)
BrO			x
NO_3		x (only planets)	x (lunar occ.)
Temperature	x		x

All the secondary species will be the subject of announcement of opportunities (AO calls) for participation to the L2 product validation.

- AO calls to be issued in 2024 -