



EarthCARE 2026 Science and Validation workshop

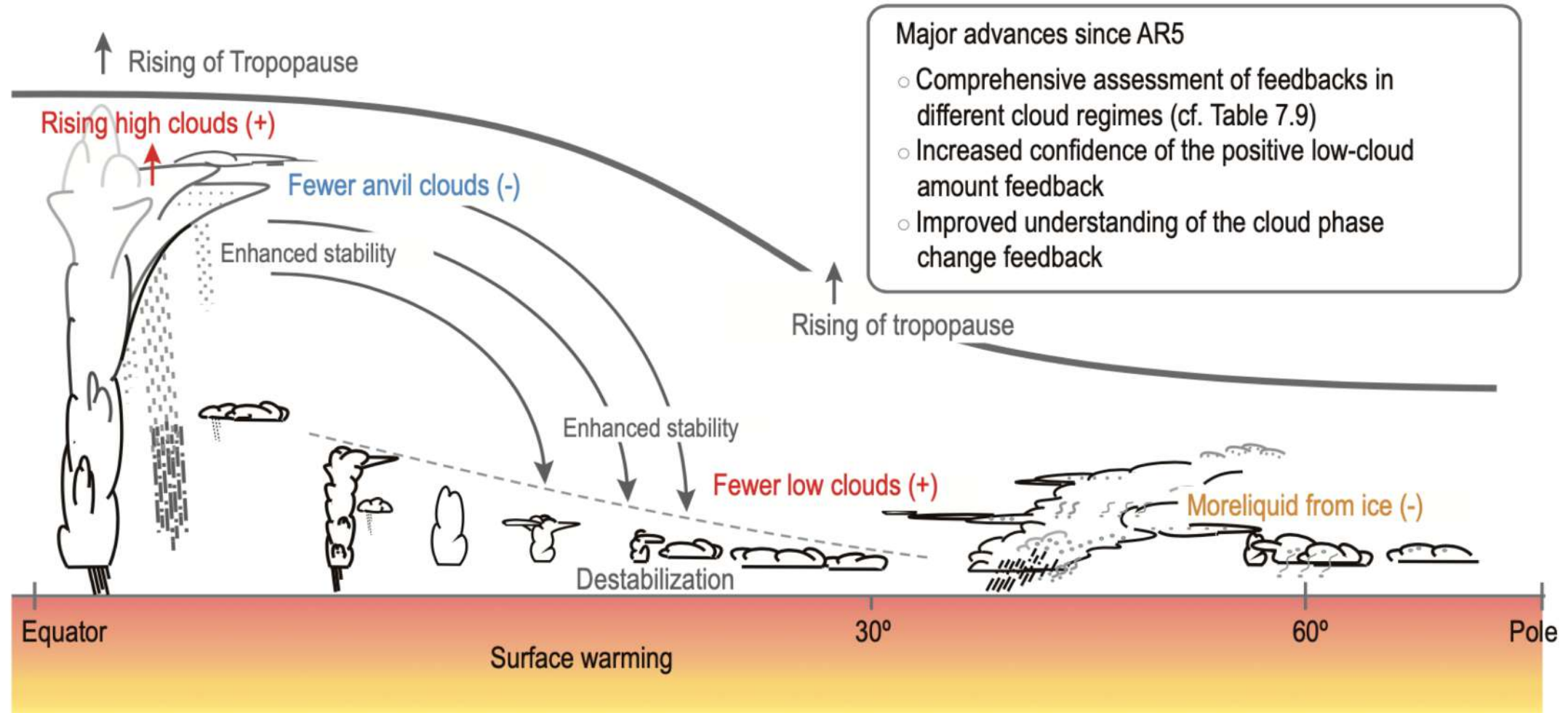
8–12 June 2026 | Rhodes House | Oxford, UK

Multi-lidar cloud climate record

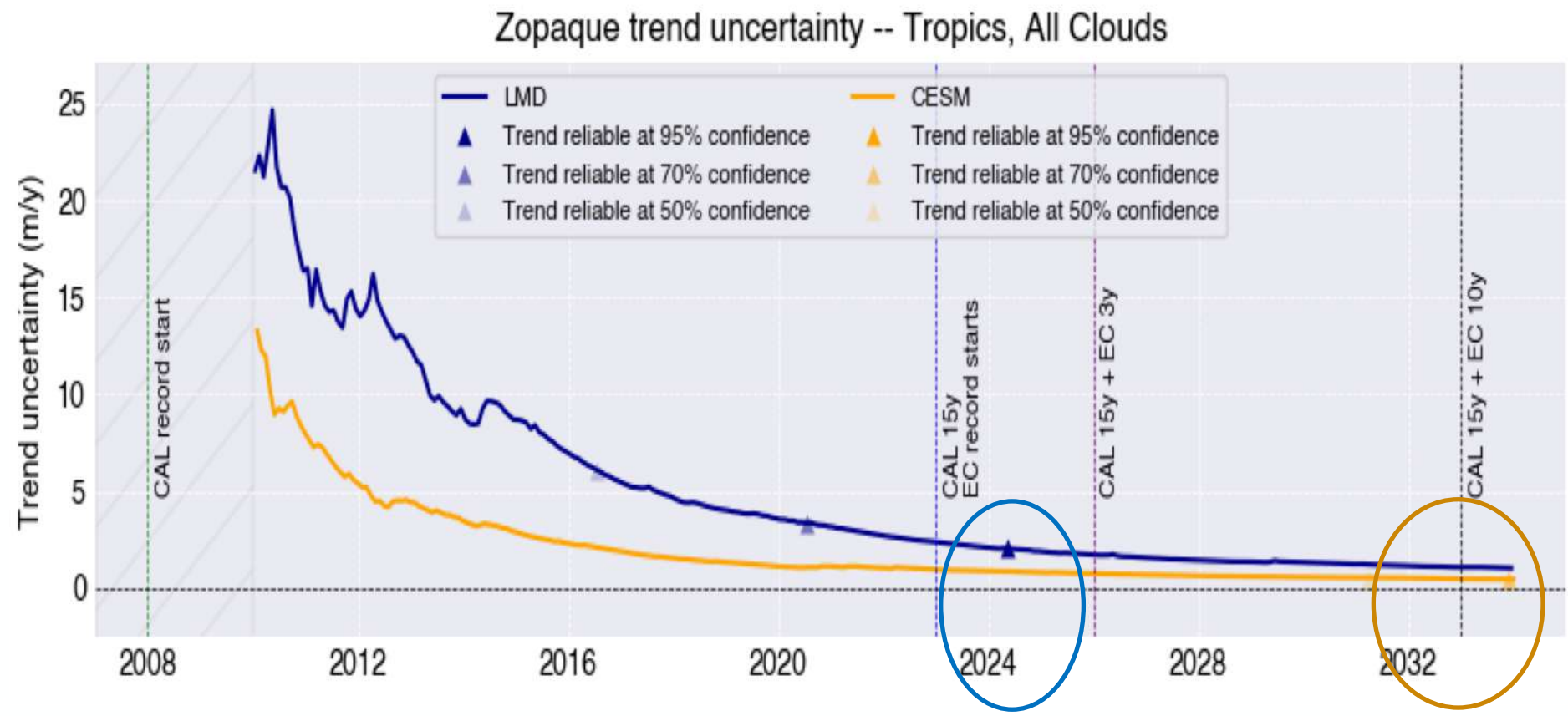
H. Chepfer, M. Dahuron, O. Chomette, V. Noël, D. Winker, A. Feofilov
Sorbonne Université, CNRS, Paris

Projected cloud changes as climate warms

IPCC, AR6



climate model simulations + COSP/lidar simulator



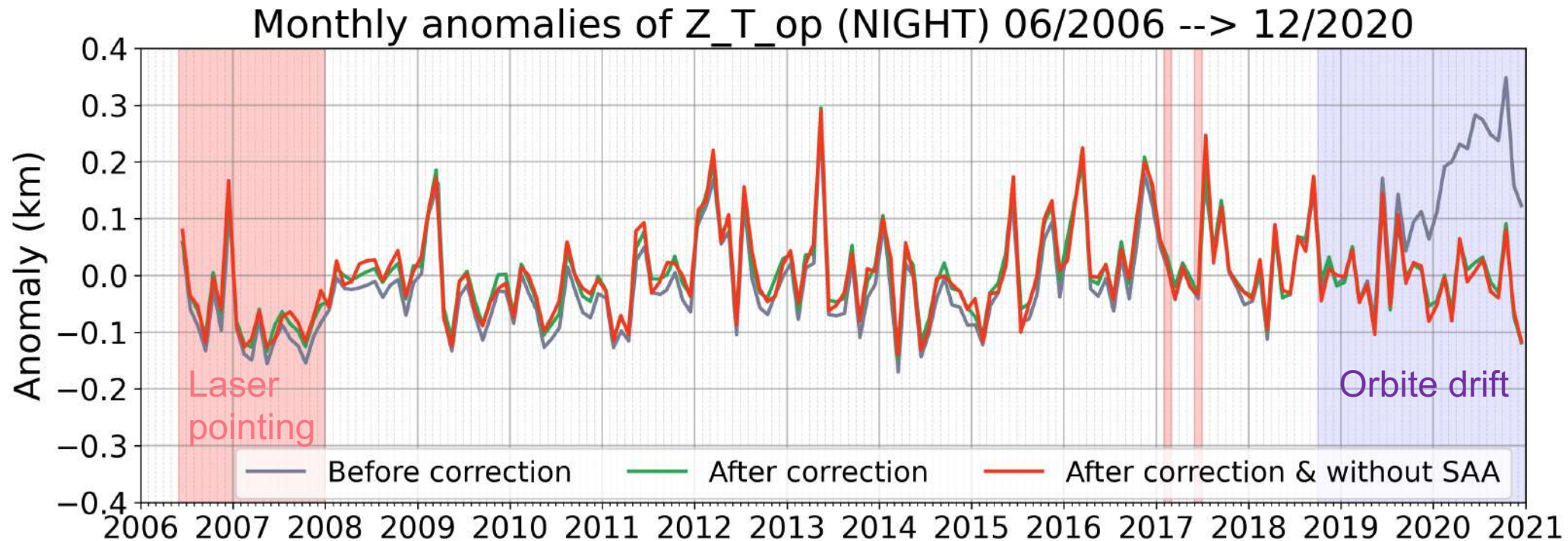
Chepfer et al. 2014, 2018
Winker et al. 2017
Takahashi et al., 2018
Feofilov et al. 2023

Do we detect the projected cloud changes in the 17 years CALIPSO record ?



Chepfer H., O. Chomette, A. Arouf, V. Noël, D. Winker, A. Feofilov, A. Balava-Balzado, 2025: Variability and trends in cloud properties over 17 years from CALIPSO space lidar observations, J. Geophys. Res. <https://doi.org/10.1029/2025JD043764>

CALIPSO cloud record: remove data contaminated by mission artefacts



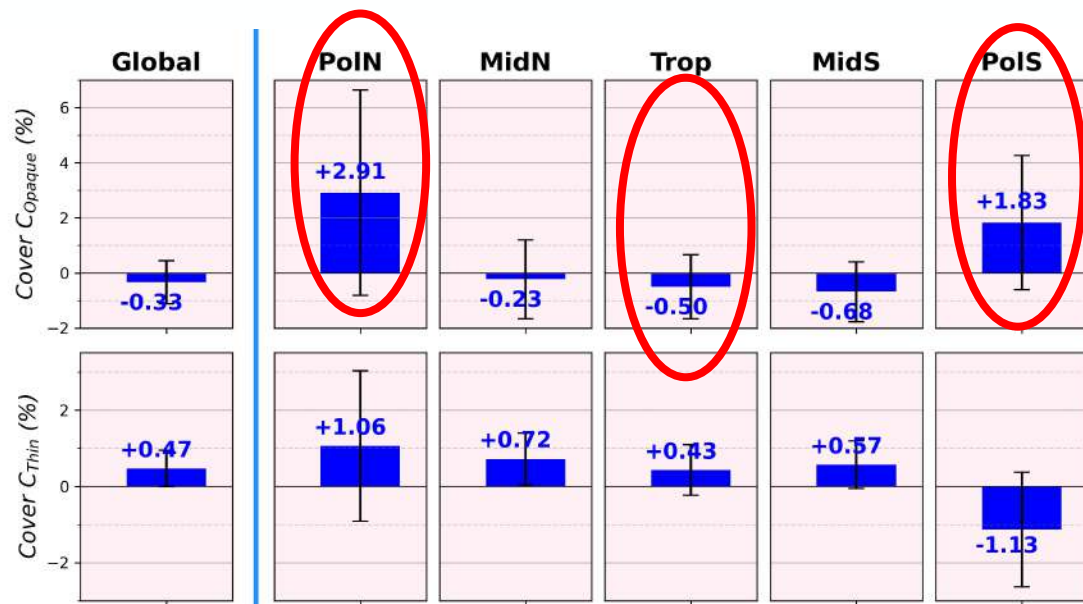
Method:

Calipso data contaminated by low laser energy shots, laser pointing, orbit drift, SAA, etc...
are removed from the record before estimating cloud trends => shorten the CALIPSO record

CALIPSO trends over ocean



Cloud covers

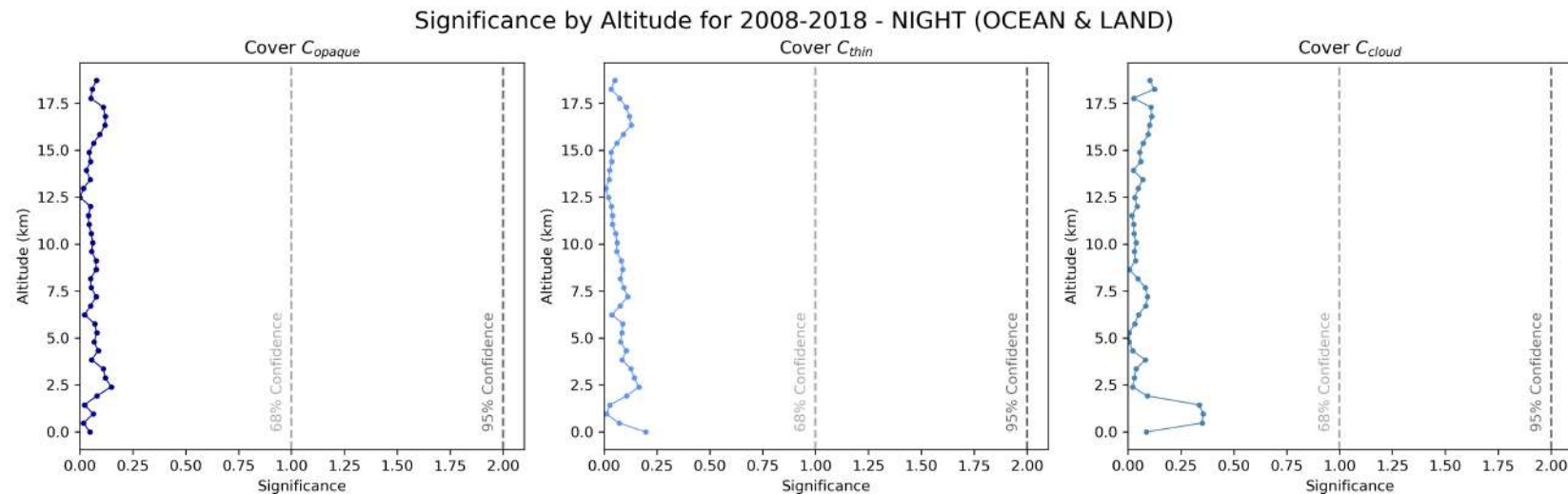
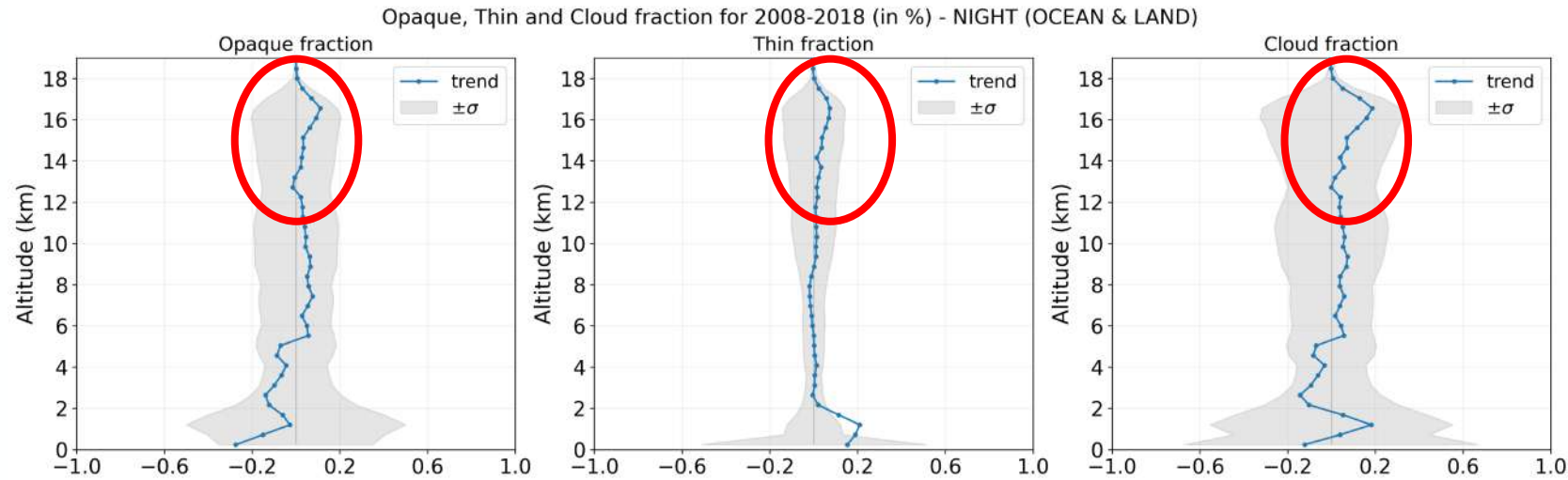


The signs of the observed trends are consistent with climate model projections **but** none of the observed trends are statistically significant

Cloud altitudes



CALIPSO trends Vertical profiles - global



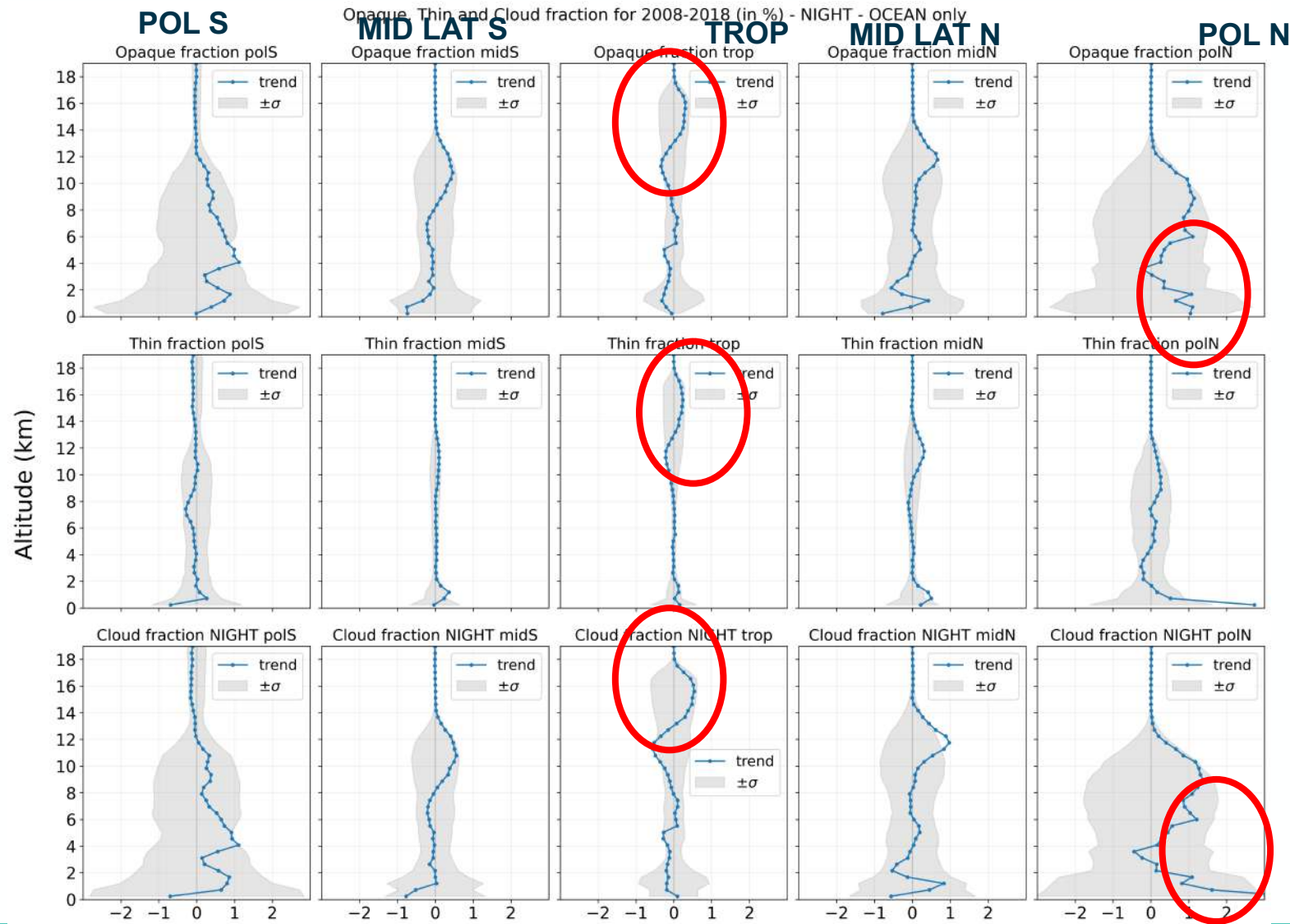
CALIPSO trends Vertical profiles



Opaque clouds

Thin clouds

All clouds



Extend the CALIPSO record with ATLID



Build ATLID clouds fully consistent with CALIPSO



CALIPSO (2006-2023)

LID_L1.v4.10

Attenuated Total Backscatter @ 532nm
Attenuated Molecular Backscatter @532nm
Single profile full resolution.



Attenuated Total Backscatter @ 532nm
Attenuated Molecular Backscatter @532nm
Single profile resolution.H 330m and V 480m



GCM Oriented CALIPSO Cloud Product Algorithm (e.g. Chepfer et al. 2010, Cesana et al. 2013, Guzman et al. 2017, ...)



CALIPSO-GOCCP (2006-2023)
cloud mask and cloud climatology

ATLID (2024-2026)

ATL_NOM_1B_BA

Attenuated Particulate Backscatter @ 355nm
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equivalent



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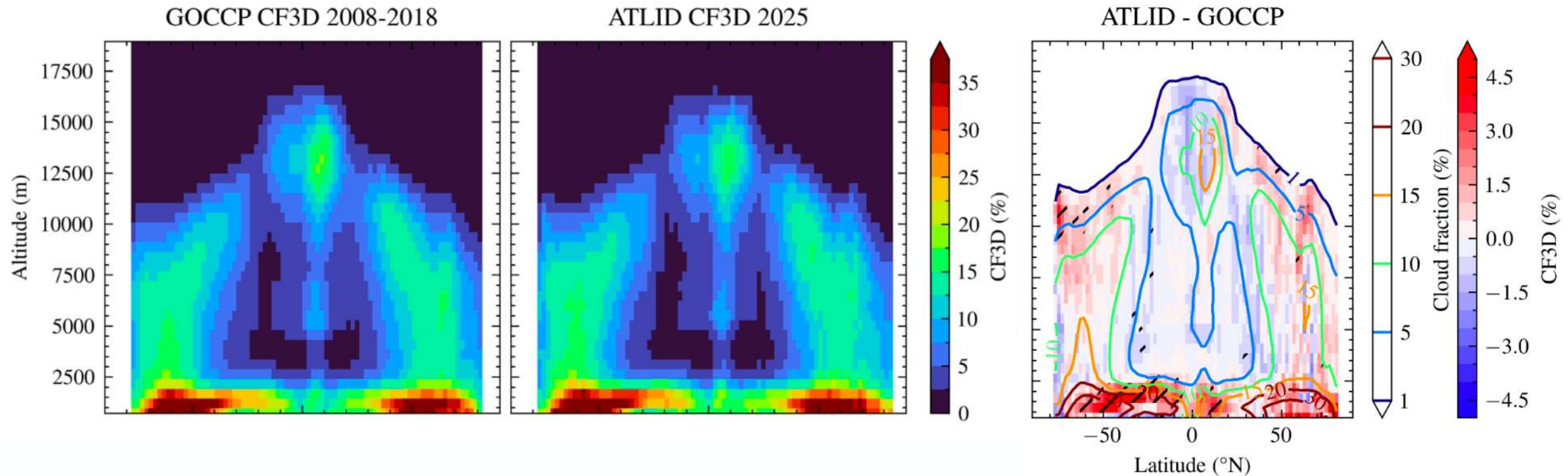


consistent
can be merged



ATLID-GOCCP or CLIMP (2024-2026)
cloud mask and cloud climatology

CALIPSO-GOCCP vs ATLID-GOCCP (CLIMP)



Poster Marius Dahuron

Is it good enough to be merged ?
more work needed

Conclusion



CALIPSO record alone does not exhibit statistically significant cloud trends (after discarding all CALIPSO profiles contaminated by mission artefacts)

The signs of CALIPSO non-significant trends are in agreement with cloud changes projected by climate models (Chepfer et al. 2025, JGR)

ATLID can extend the length of the CALIPSO cloud record

For that purpose **ATLID needs to remain stable as long as possible (laser power, orbit, pointing, SAA, hot pixels ...)**

First attempt to build fully consistent ATLID and CALIPSO cloud dataset to be merged to extend the cloud record:

- More work needed including assessment with independent observations

- ATLID+CALIPSO record will be useful for cloud trends and cloud interannual variability

- ATLID+CALIPSO record is directly comparable to COSP outputs (model evaluation)

ACDL data can fill the gap between CALIPSO and ATLID

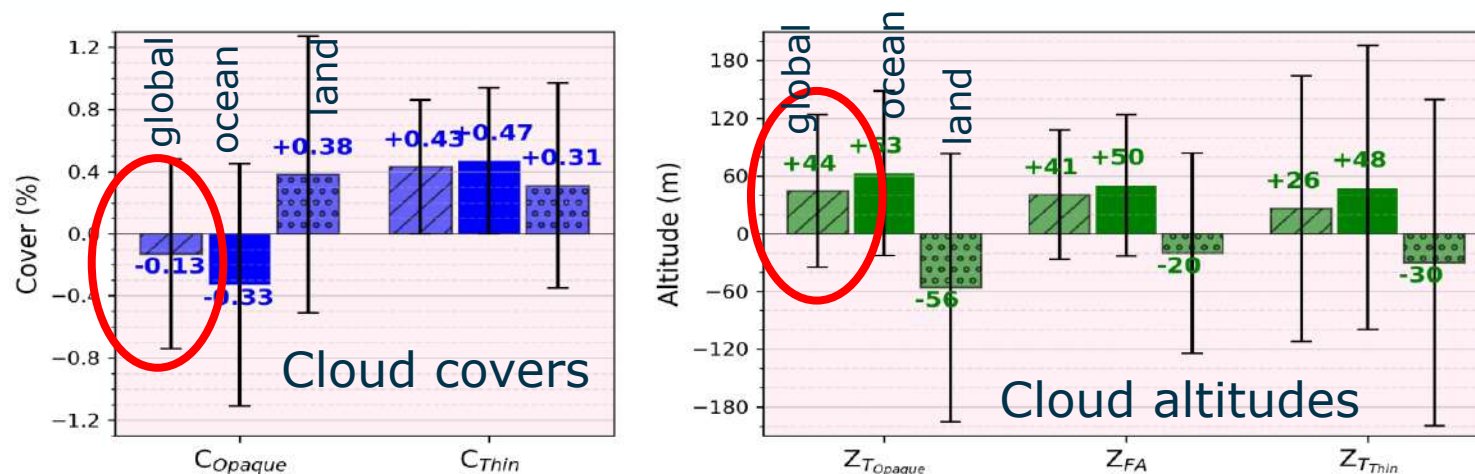
CALIPSO trends at global scale



Signs of the observed trends consistent with model projections

BUT

None of the observed trends are statistically significant



2008-2018 - NIGHT (OCEAN)

