Does the Indian monsoon impacts stratospheric background aerosol in the Arctic?

JT Jülich: Bärbel Vogel, Ines Tritschler - CLaMS model (Chemical Lagrangian Model of the Stratosphere)
AWI: Sandra Graßl, myself - Lidar

Driven by winds from ERA5 1°x 1°
Release of artificial tracers: B. Vogel et al ACP 2015

Maybe. But is is subtle.
…
And work in progress

Here:
Lidar data 2021 (homogeneous, quiet?)
1h / 150m
Large difference summer / winter
Careful with bound. condition
LR355 > LR532?

Recalculating the range resolution in lidar

Suppose you have $P(z_i)$ given and want to calcuate $P(z_j)$, $\Delta z_j > \Delta z_i$

$$\left(\quad \right) = \quad \frac{1}{2} \quad \left(\quad \right) \qquad \left(-2 \int_{0} \quad \left(\frown \right) \quad \frown \right) +$$

P depends non-linearly on z

You needed to know β(z), α(z) recalculate P

$$\left(\quad \right) = \quad _2 \quad \left(\quad \right) \qquad \left(\quad \right)$$

If BSR(z) is constant => $\beta(z) \propto \rho(z)$

$$\left(\quad \right) \coloneqq \frac{\left(\quad \right)^2}{\left(\quad \right)}$$

has a <u>much</u> weaker gradient of z

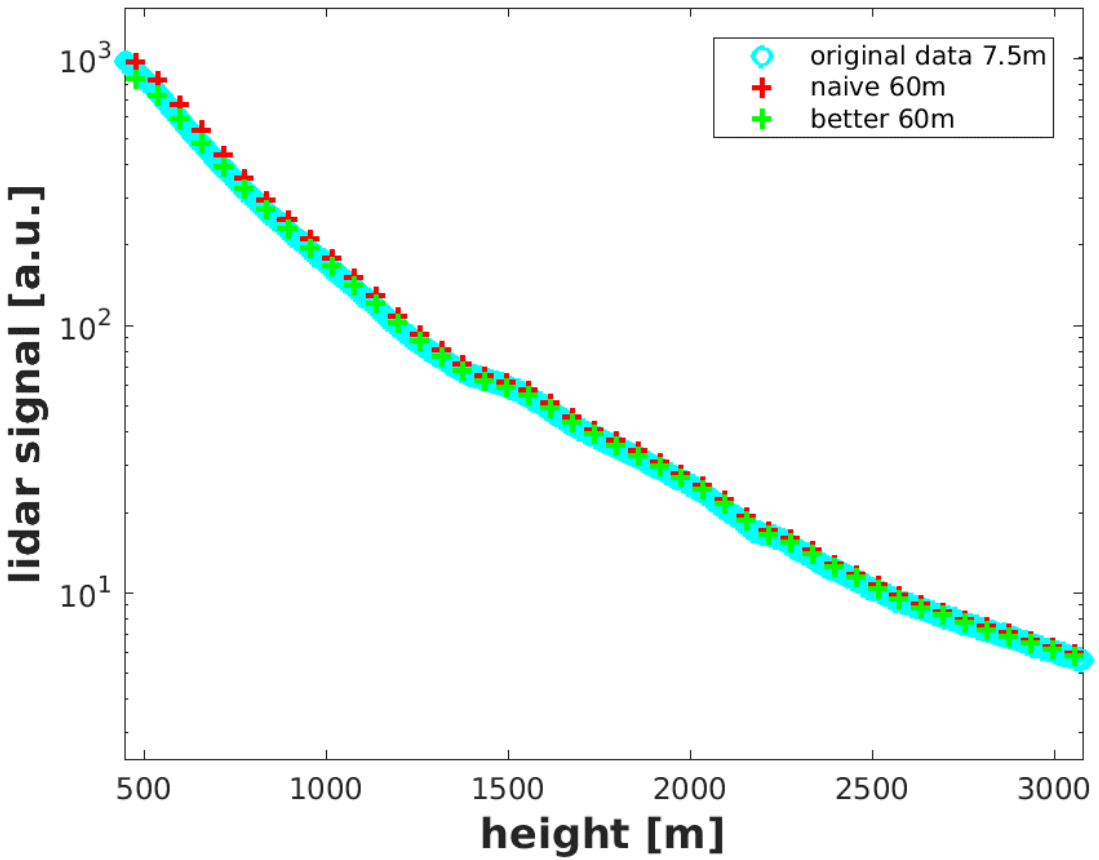
„E“ = „essence“ of the lidar signal

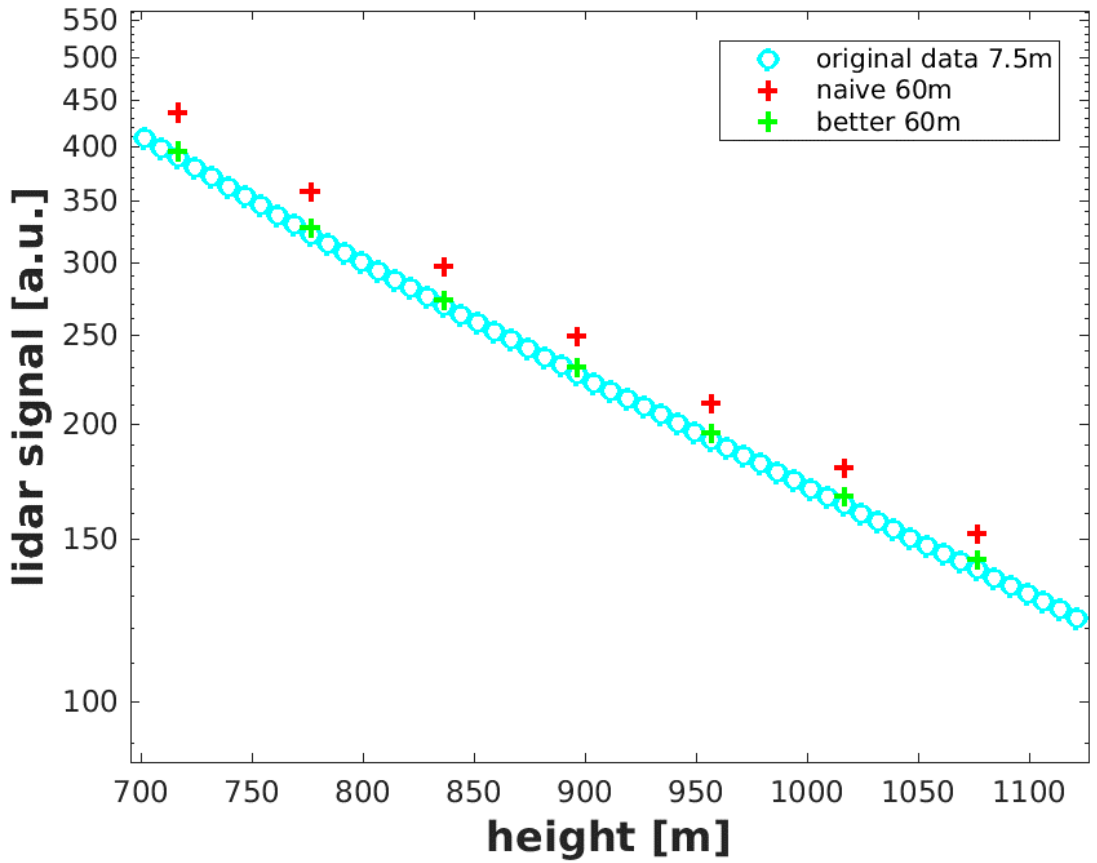
E may linearly interpolated to new grid z_j

For axtinction I do not rescale any more….

Cyan: original (P(7.5m steps)
Red: lineraly interpolated to P(60m) wrong gradient
Green: Pz^2 linearly interpolated to 60m
So steps:

1) Background correct signal
2) Calculate Pz^2
3) Interpolate 2) to new grid
4) Calculate 3) back to P
5) (Add the background from 1) – if needed)

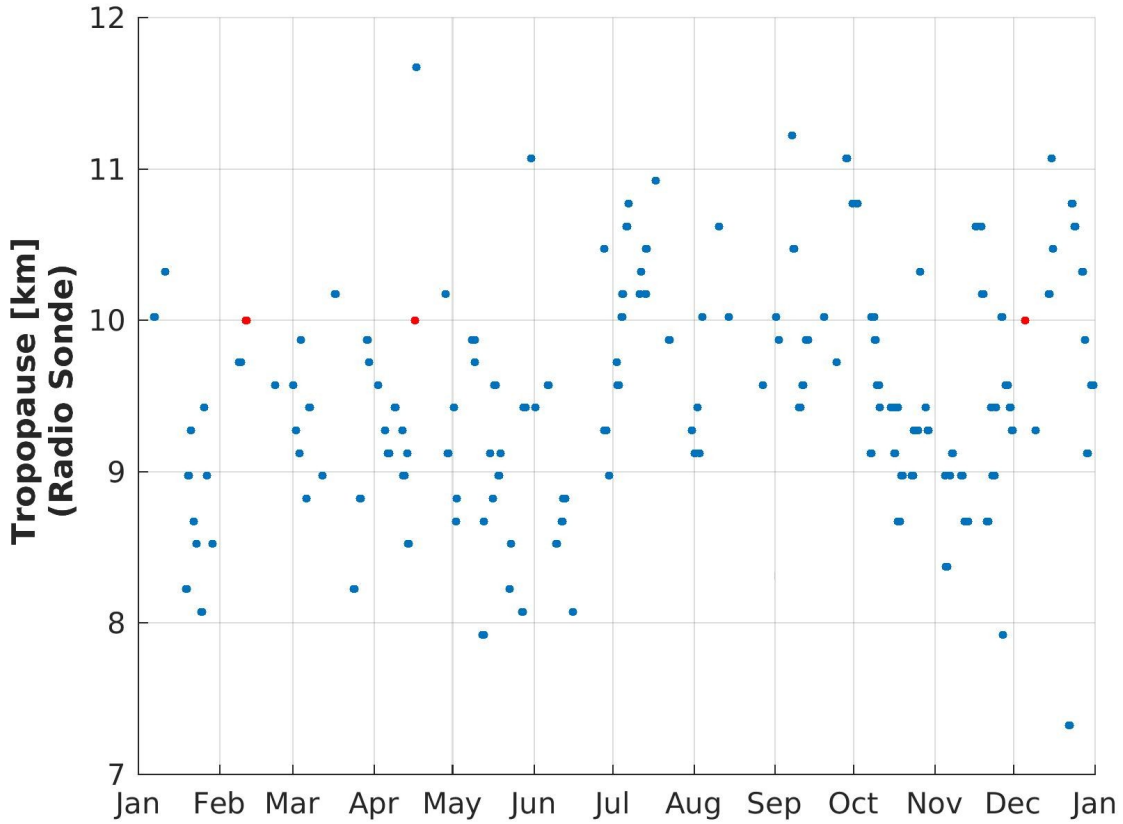


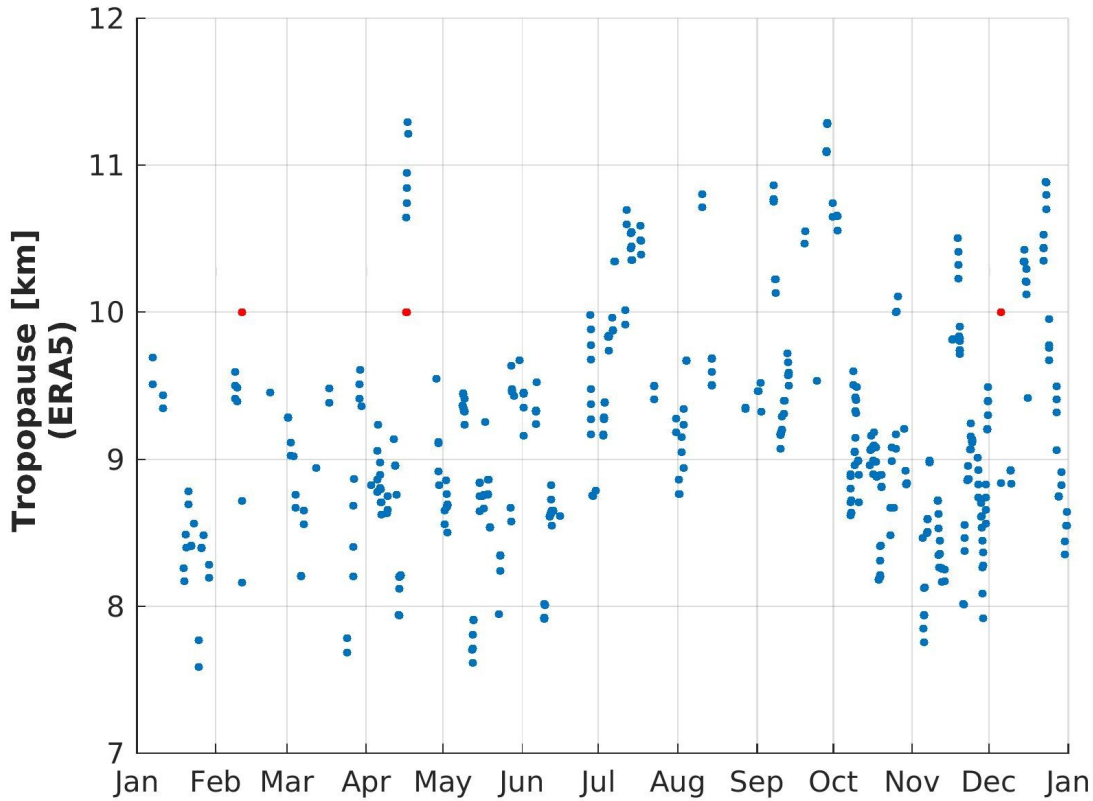


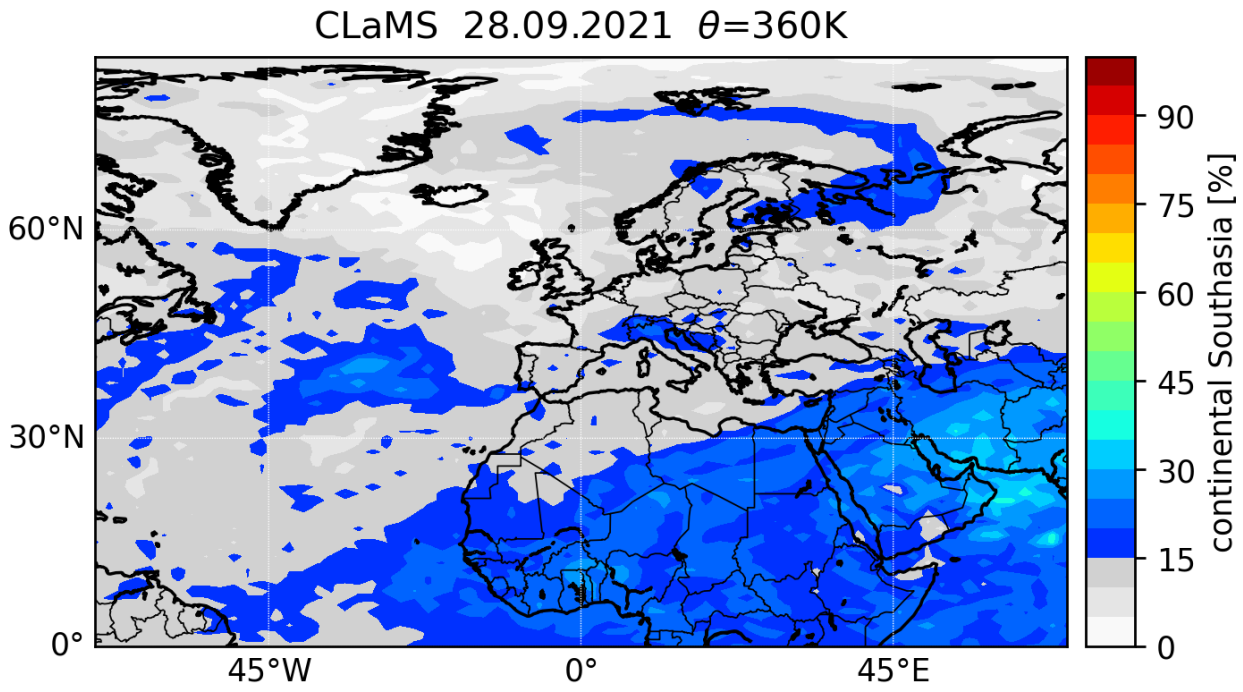
When is the „stratosphere“ the stratosphere?

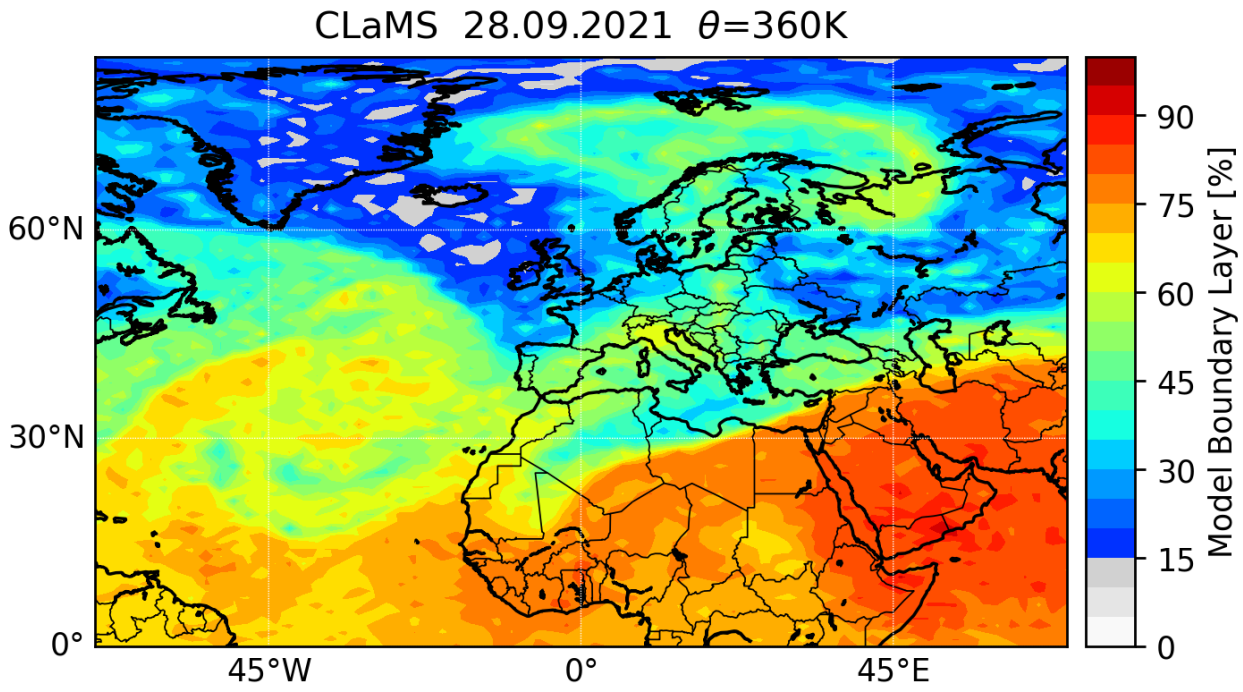
If the tropopause does not show pronounced T_min aerosol may distribute vertically
Arctic: winter!!!

So where does the (aerosol) stratosphere start?
Local radiosounding vs. model





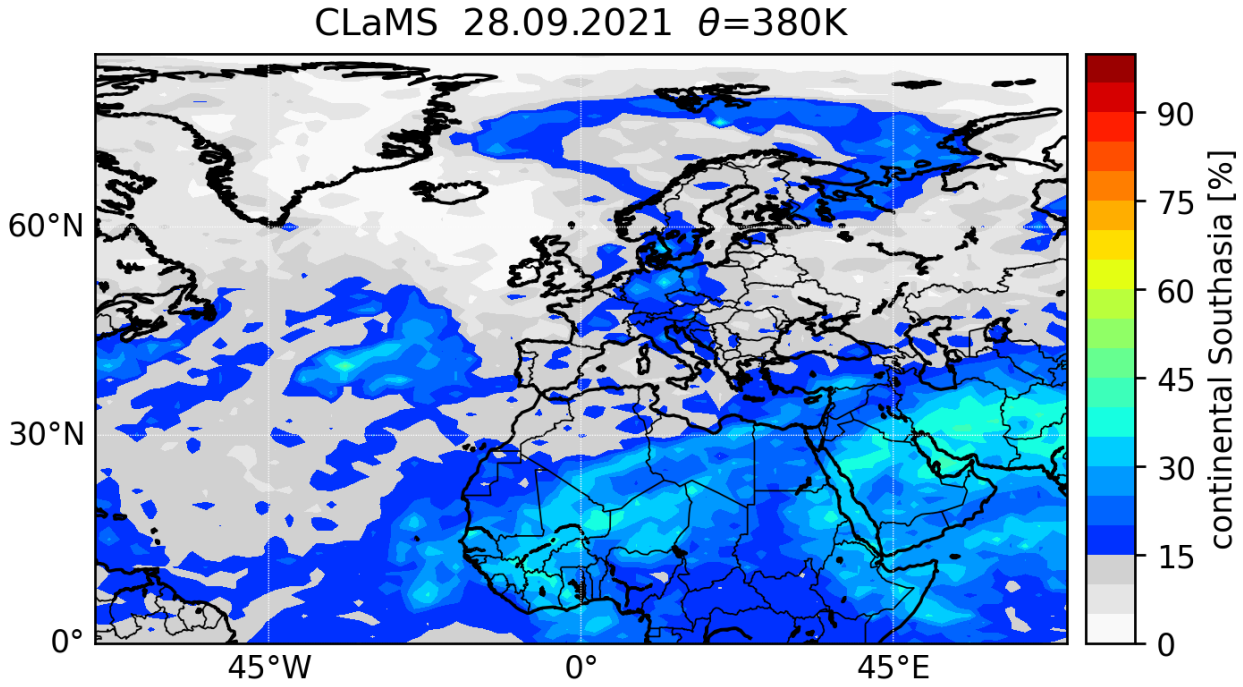


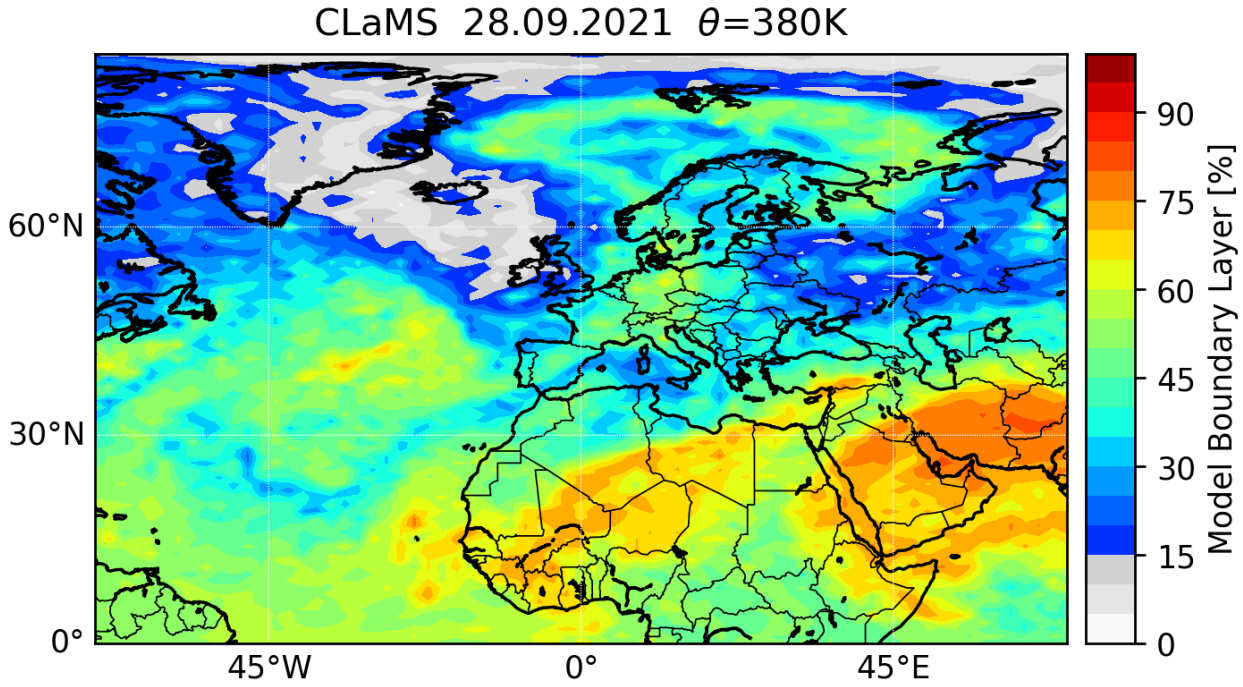


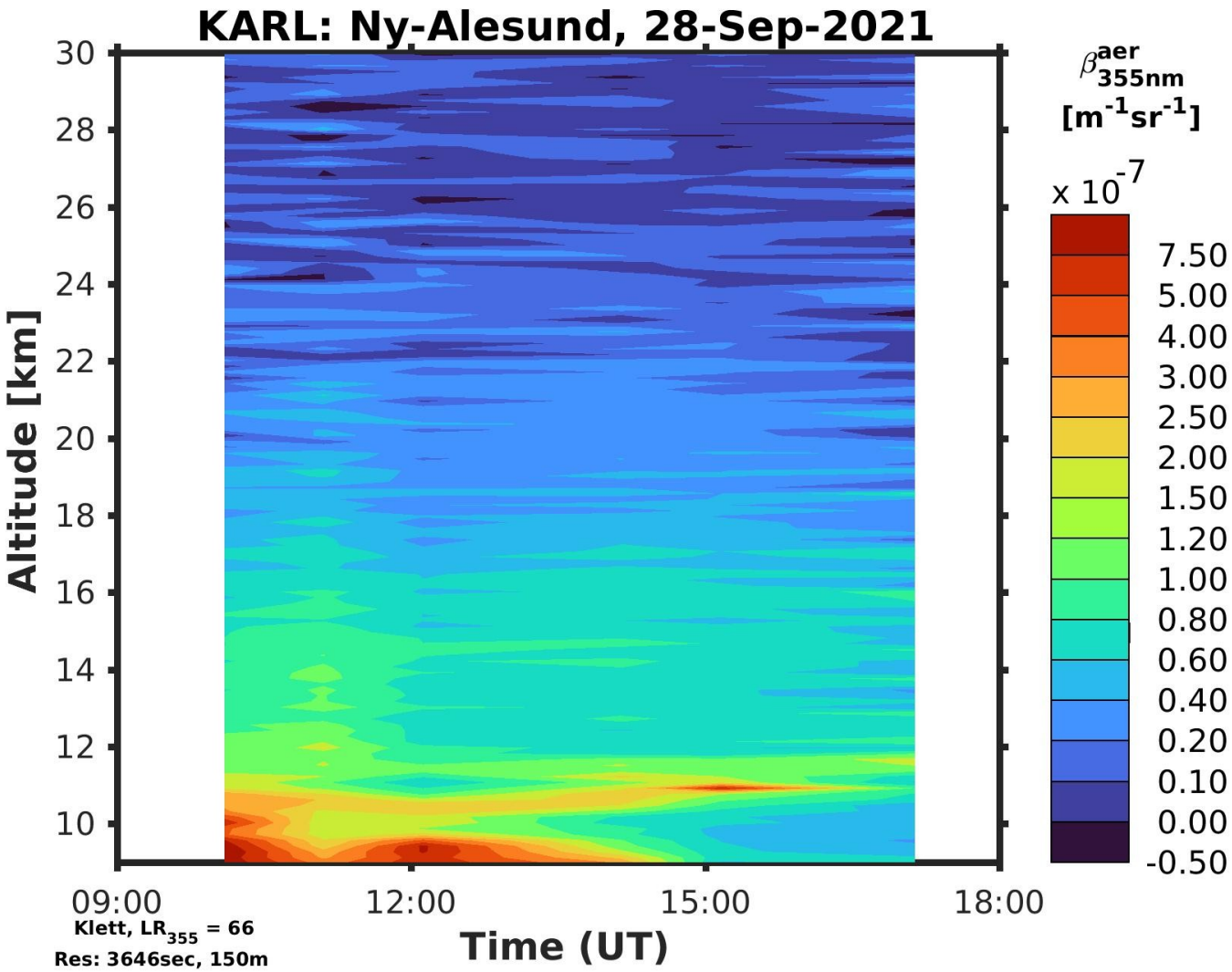
One nice case 28 Sep 360K to 380K Θ

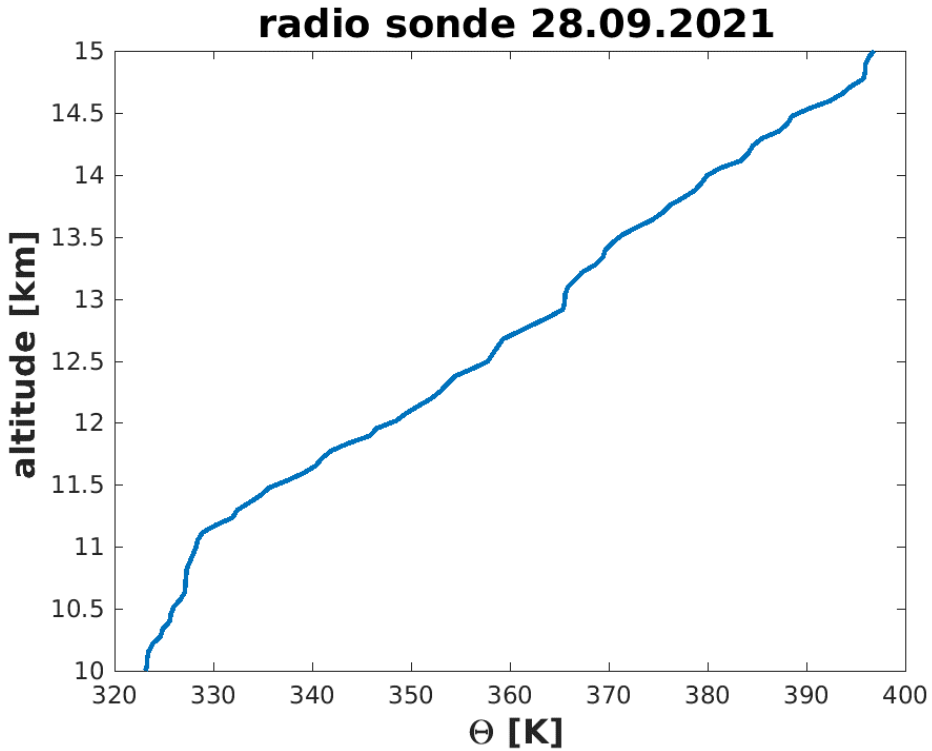
Plume: more air from S Asia
More air from boundary layer

What does this means in terms of aerosol concentration?


CLaMS 28.09.2021 θ=380K
60°N
30°N
0°
45°W
0°
45°E
90
75
60
45
30
15
0
continental Southasia [%]


CLaMS 28.09.2021 θ=380K
60°N
30°N
0°
45°W
0°
45°E
90
75
60
45
30
15
0
Model Boundary Layer [%]

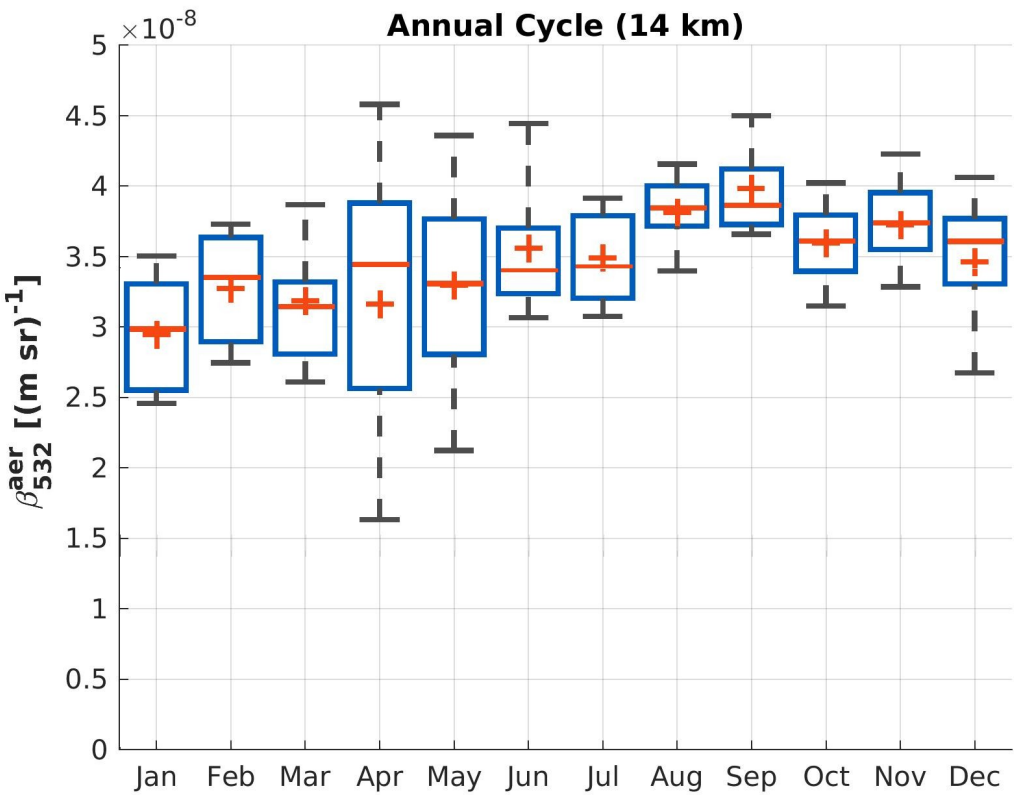


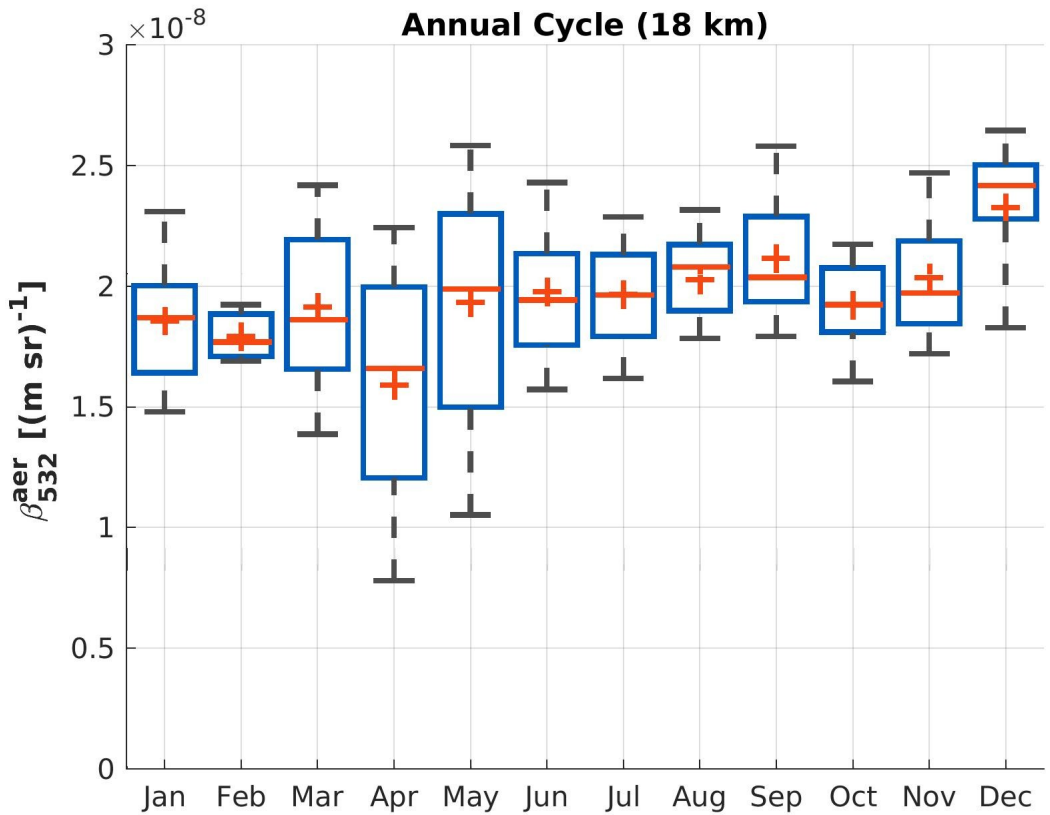


Model: aerosol 12.7 – 13.8km

Annual cycle: subtle in 532nm

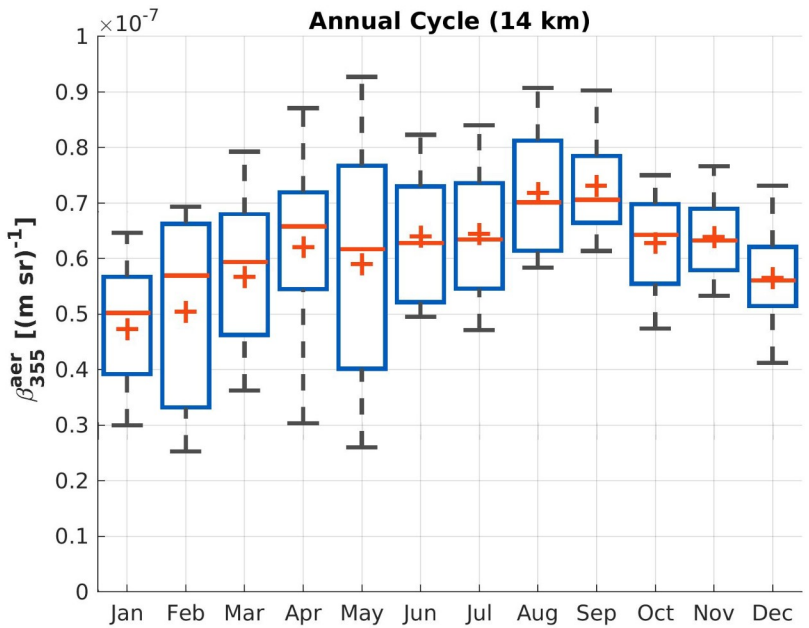
+: average line: median box: 25 and 75th percentile outside marks: 10 and 90 th percentile

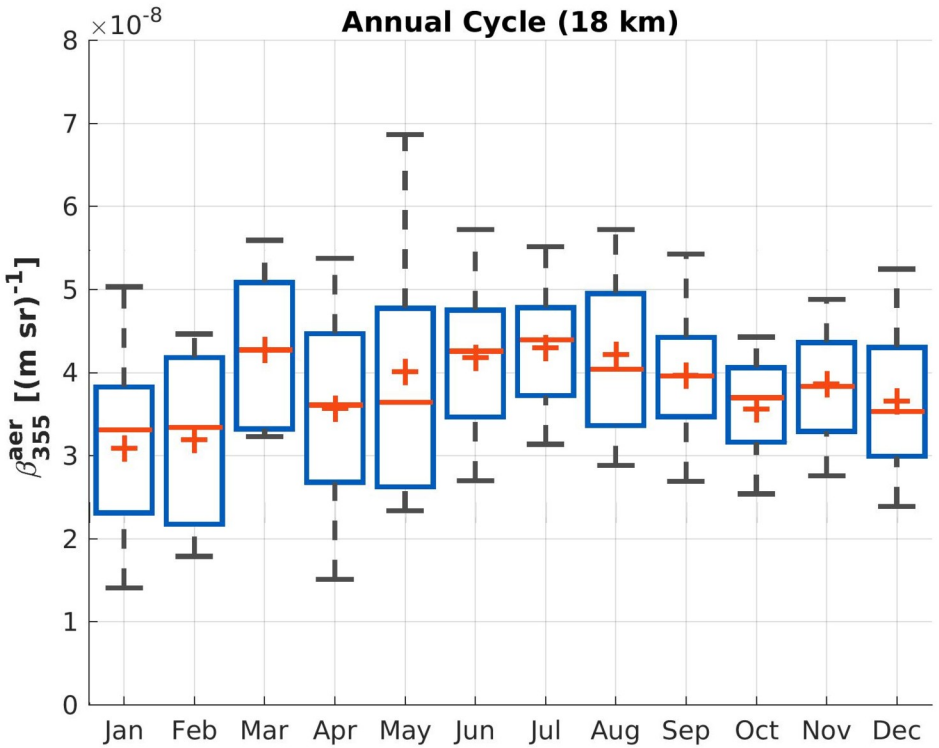




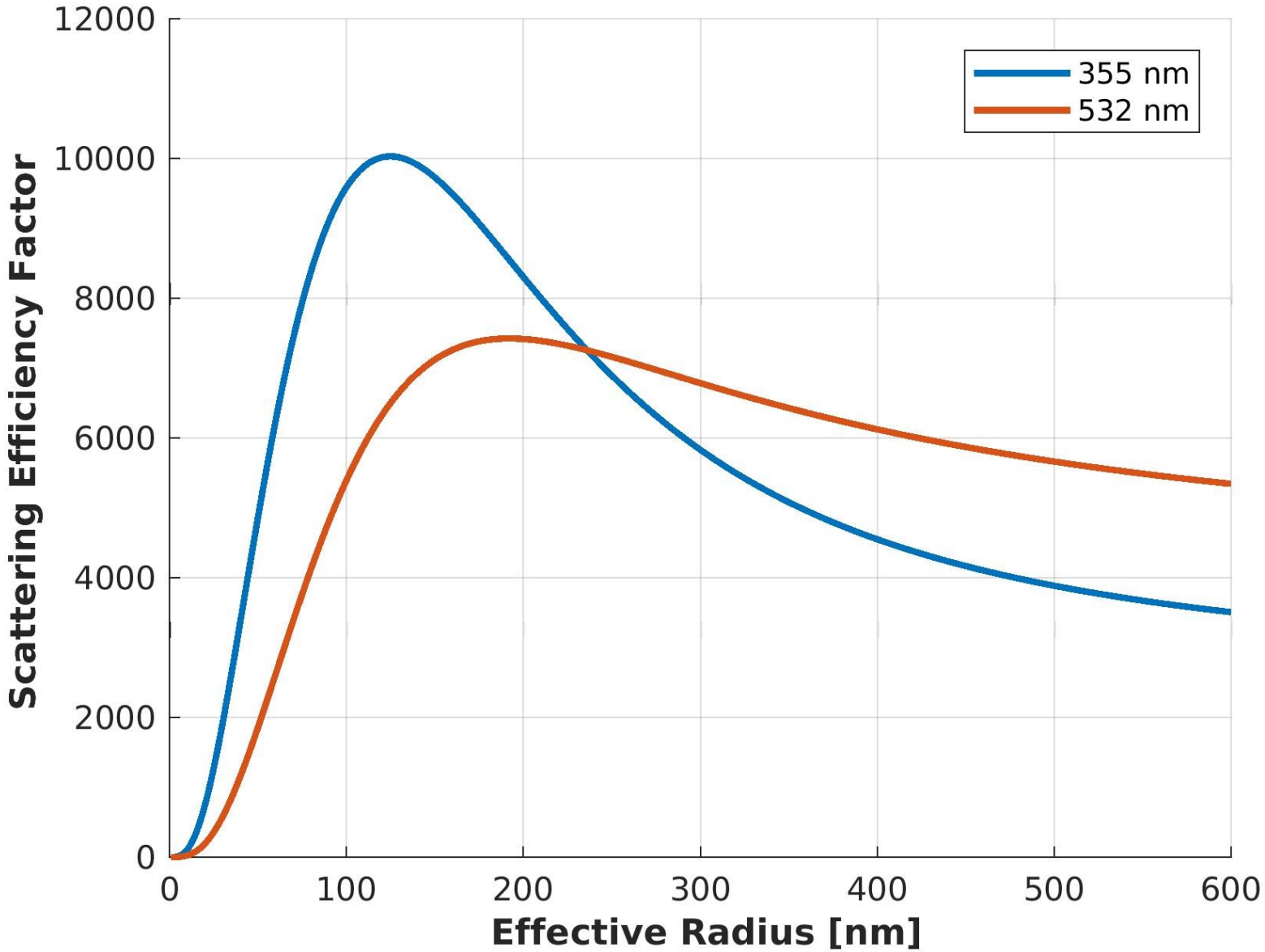
And slightly more pronounced in 355:

But recall the annual cycle in BL altitude over poles….





Sizes?



Suppose:
Mie theory (ok)
CRI = 1.41+i 10^{-4} (sulphate)
Log-normal 1 mode with
σ=1.5 geom. width

Then:

Color ratio	reff [nm]
2	97
2.25	82
2.5	70
2.75	59

Conclusions

Weak annual cycle espec. at 355nm
Some days the agreement to CLaMS and observations is not too good … work in progress

What if aerosol move only with 0.99*v_wind?

Or model / emission is not too convincing … real emission map needed