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METEOROLOGISKA INSTITUTET
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Closure study of aerosol-stratocumulus interactions with UCLALES-SALSA

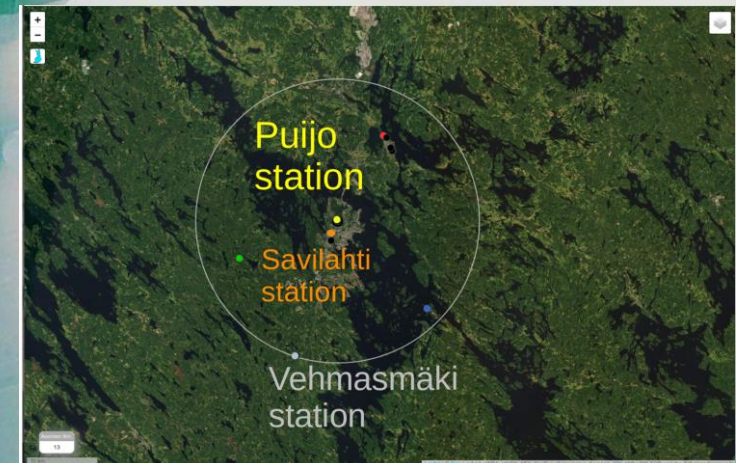
Silvia M. Calderón, Juha Tonttila, Angela Buchholz, Jorma Joutsensaari, Mika Komppula, Ari Leskinen, Hao Liqing, Dmitri Moisseev, Petri Tiitta, Annele Virtanen, Harri Kokkola, and Sami Romakkaniemi

AS3.2 EDI Clouds, Aerosols,
Radiation and Precipitation

EGU22-8212

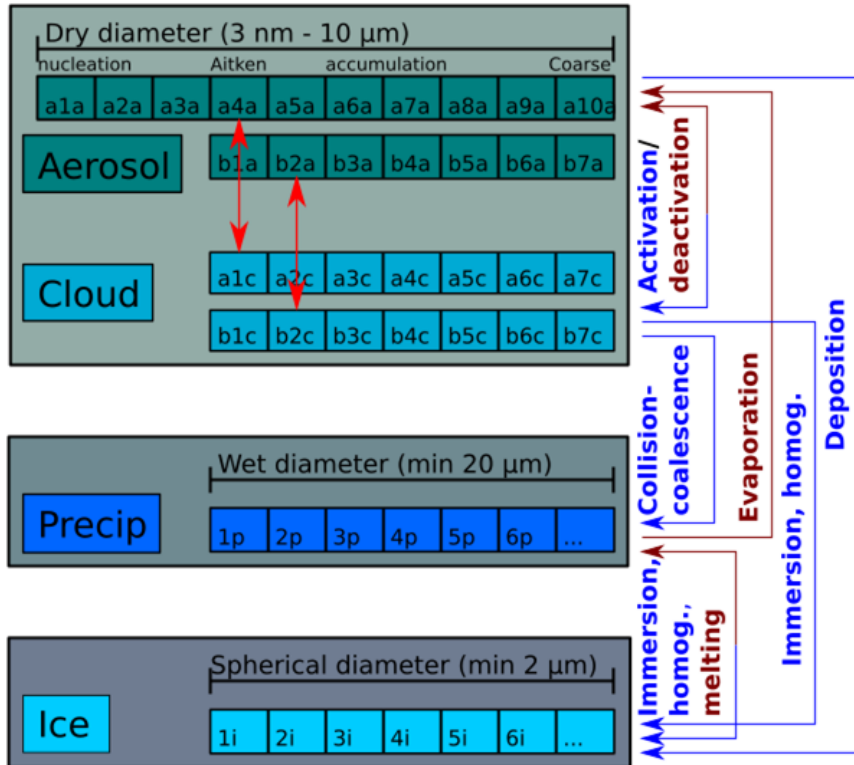
EGU General Assembly

May, 26, 2022

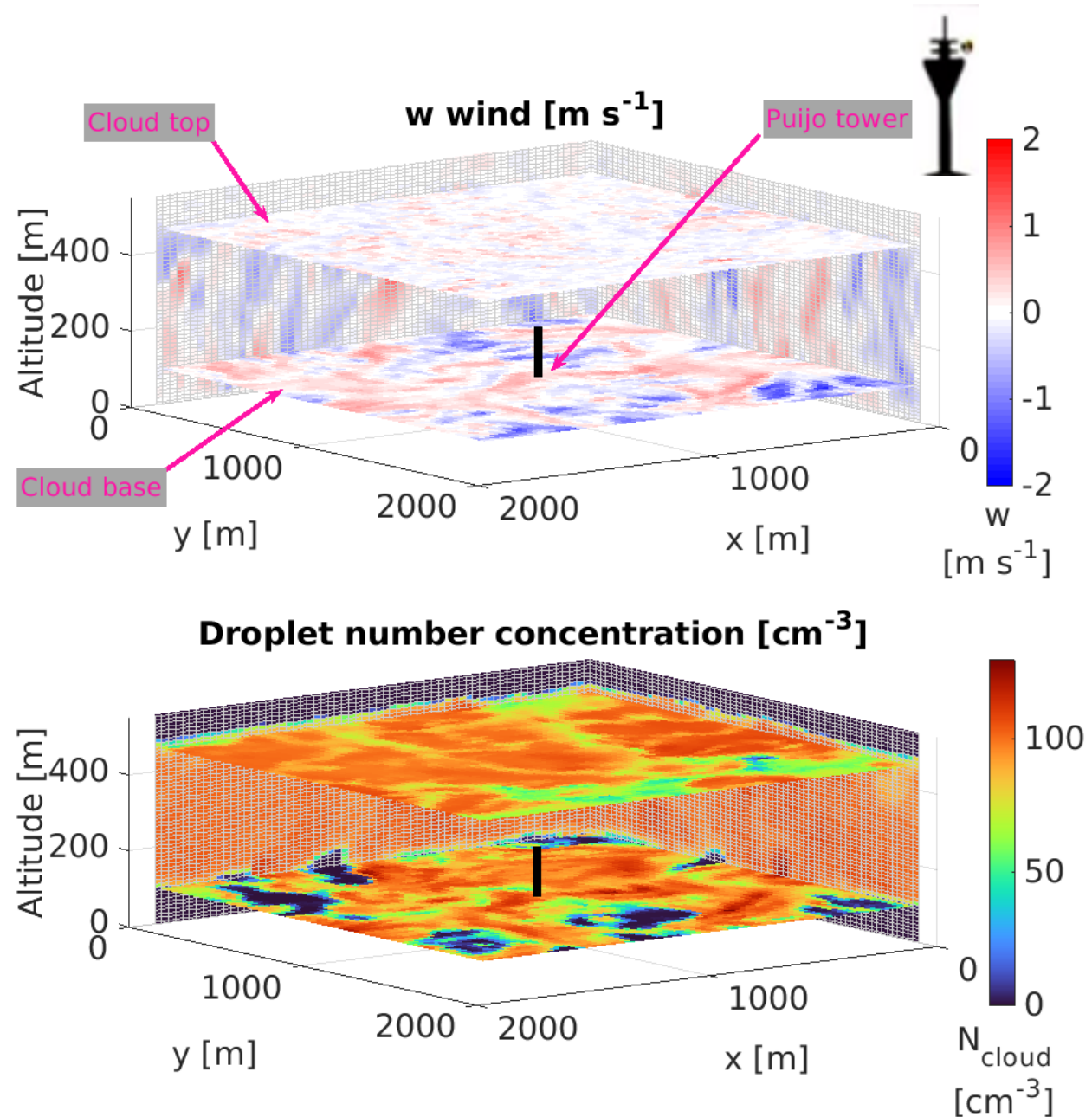


UCLALES-SALSA

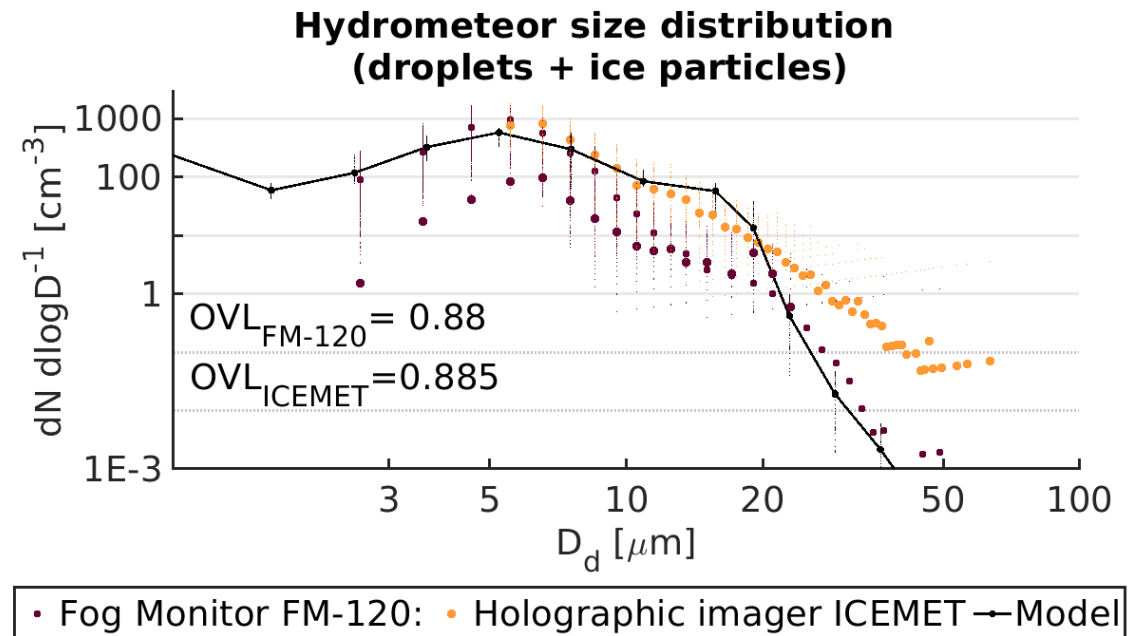
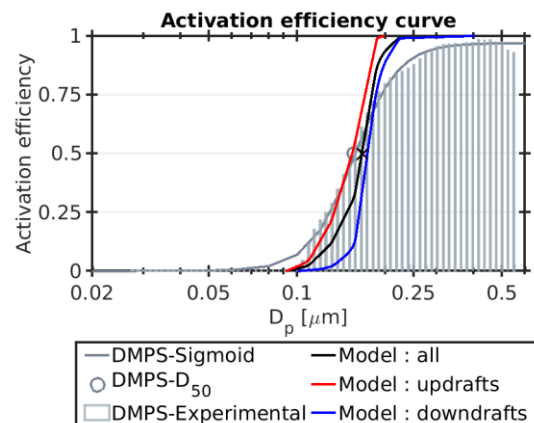
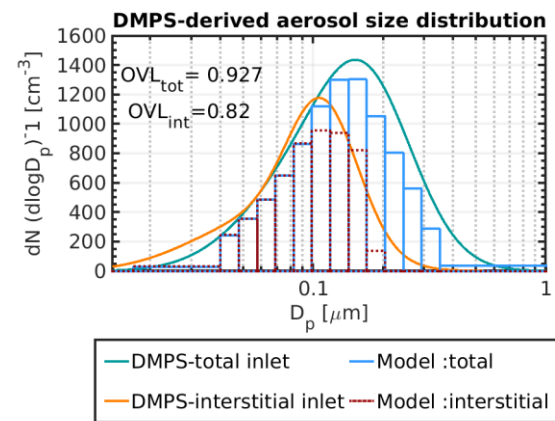
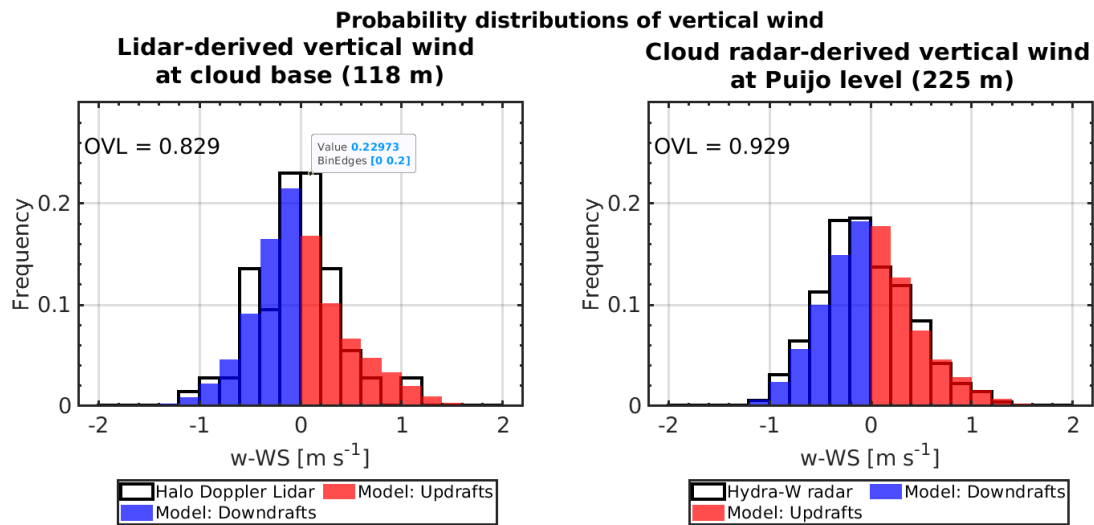
Large-Eddy-Simulation model with sectional representation of aerosol-hydrometeor interactions



Tonttila, J., Afzalifar, A., Kokkola, H., Raatikainen, T., Korhonen, H., & Romakkaniemi, S. (2021). Atmospheric Chemistry and Physics, 21(2), 1035–1048.



Example of a snapshot of model outputs

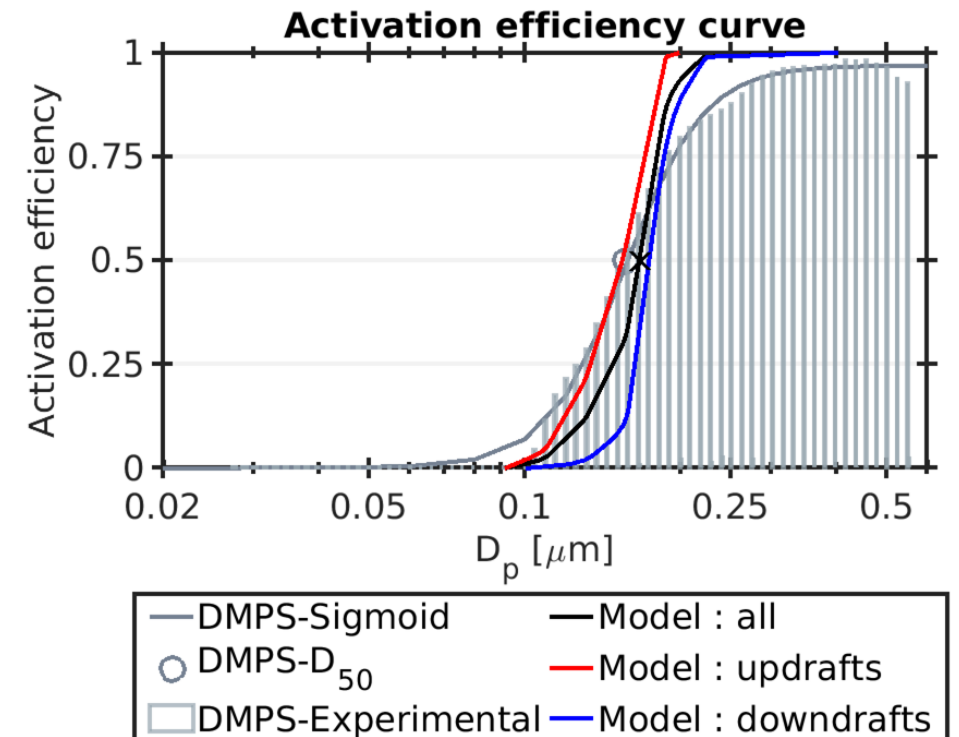
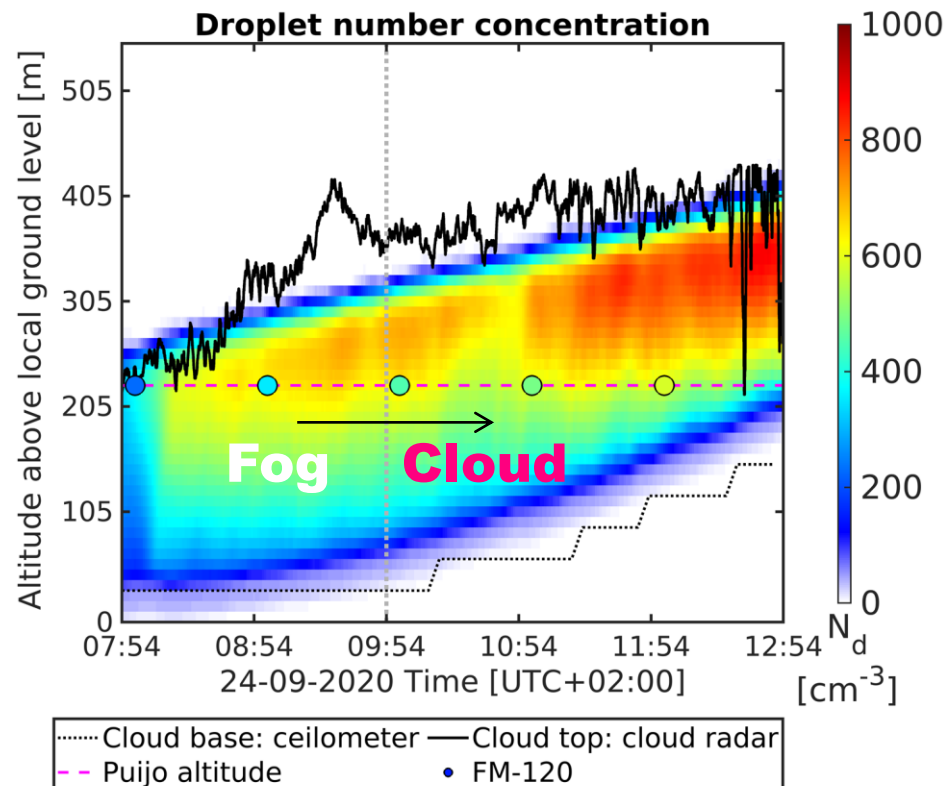


Aerosol-cloud-turbulence interactions ...

Diurnal cloud in
atmospheric
polluted
conditions

Aerosol loading:
 $2200 \text{ cm}^{-3} \rightarrow 1900 \text{ cm}^{-3}$
Aerosol composition:
Organic carbon / SO_4
[75 / 25] % v/v
Approx. constant

..enhance droplet activation and
evaporation in downdrafts leading to
smaller droplet sizes and altitude-
dependent droplet concentrations



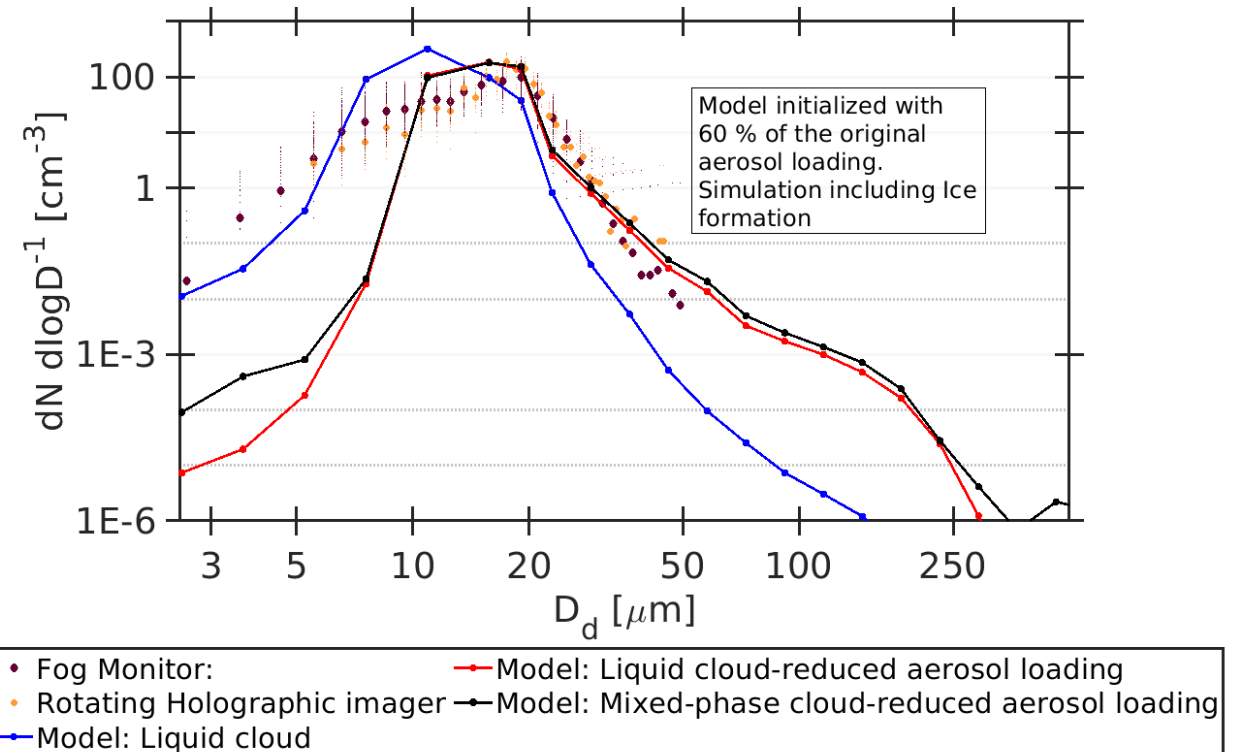
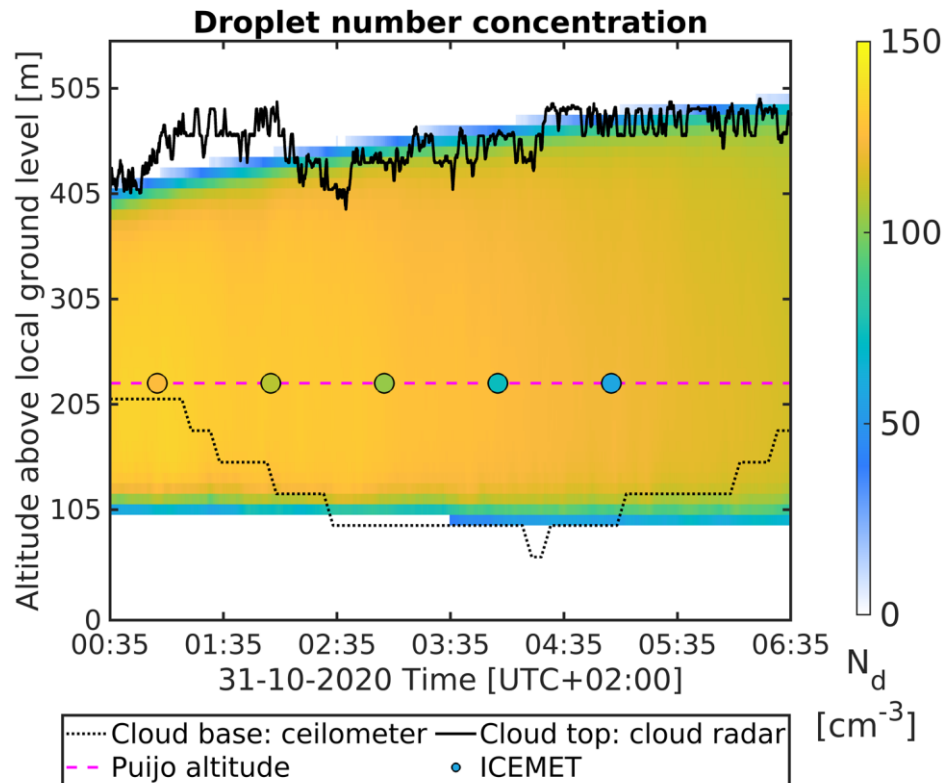
Aerosol-cloud-turbulence interactions ...

Nocturnal cloud in
“clean”
atmospheric
conditions

Aerosol loading:
 $550 \text{ cm}^{-3} \rightarrow 70 \text{ cm}^{-3}$

Aerosol composition:
Organic carbon / SO_4
[88 / 12] % v/v
Variable

..enhance the collision-coalescence process
leading to rapid hydrometeor growth.
If ice formation is possible, even at very low
concentrations (e.g. $N_{\text{ice}} \sim 1 \text{ \# m}^{-3}$) growth
speeds up.



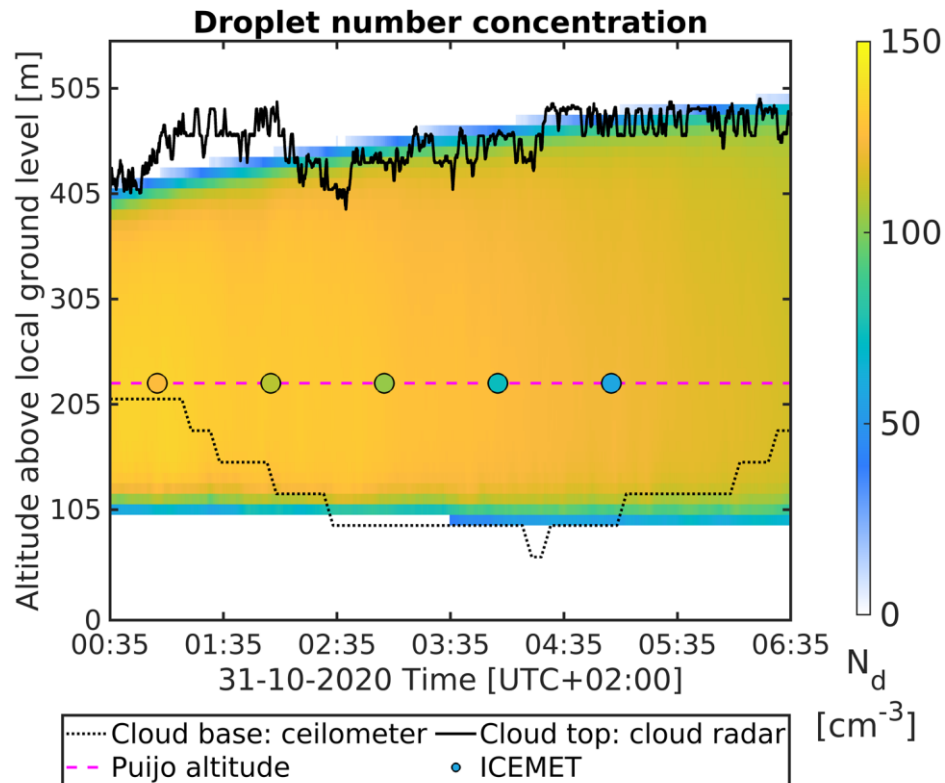
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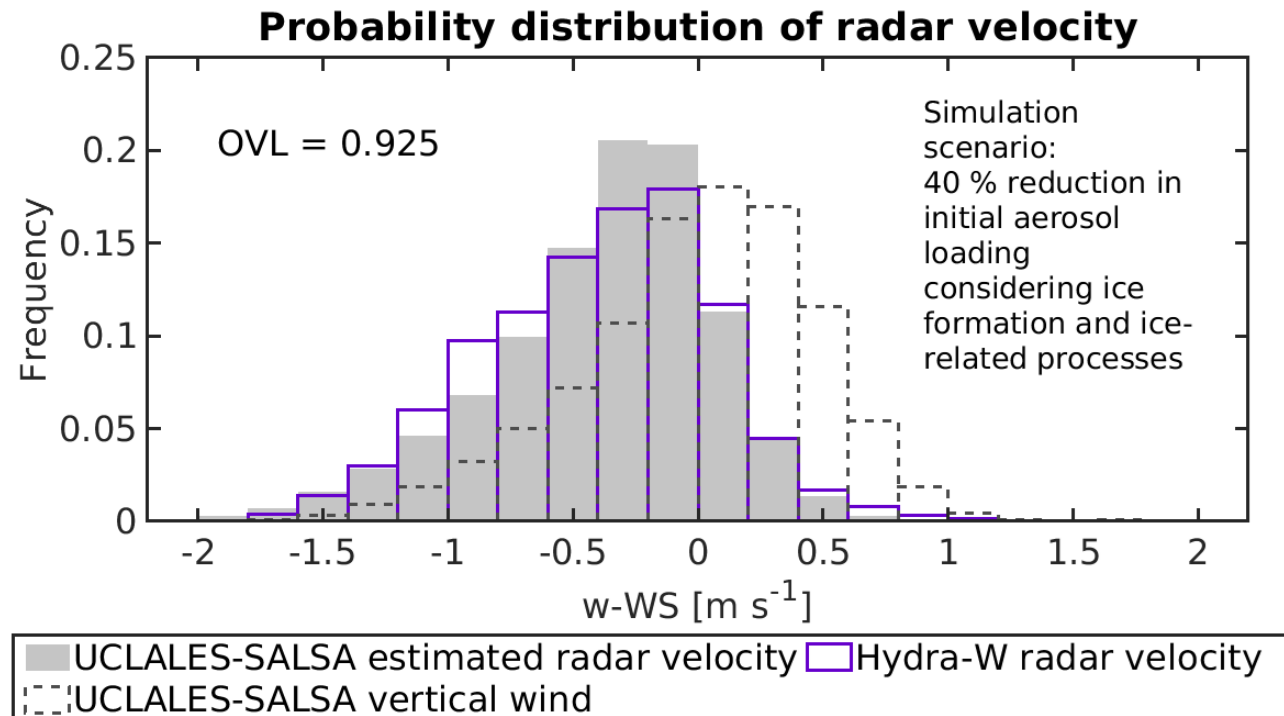
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If the Overlapping index (OVL) $\rightarrow 1$ two distributions are equivalent





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Aerosol-stratocumulus interactions: Towards a better process understanding using closures between observations and large eddy simulations

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Lessons learned ...

Observations of in-cloud properties

are needed to reduce the model

uncertainties related to aerosol-

cloud-turbulent interactions

especially in mixed-phase clouds.



**[https://acp.copernicus.org/
preprints/acp-2022-273/](https://acp.copernicus.org/preprints/acp-2022-273/)**