Announcement of a topic for:
Master Theses (please mark one or more)

Topic	Exploring the sensitivity of cloud droplet number concentration to the liquid water path with cloud tracking method using high-resolution model simulation.
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Description:	Aerosol–cloud interactions, referred to as aerosol perturbation, could modify the cloud droplet number concentration (Nd), which enhances the cloud albedo and modifies the cloud liquid water path (LWP). It is commonly referred to as the radiative forcing due to aerosol-cloud interactions (Bellouin et al., 2020; Forster et al., 2021), which remain one of the largest sources of uncertainty in future climate projections (Boucher et al., 2013). Recent studies reported the numerous mechanisms explaining aerosol-cloud interactions with Nd-LWP sensitivity (Gryspeerdt et al., 2019). Satellite observations play a crucial role in understanding and quantifying the radiative forcing due to aerosol-cloud interactions. However, a discrepancy exists when comparing the satellite-derived aerosol-cloud interactions, for instance, the Nd-LWP sensitivity with the model or in-situ observations because of the adiabatic assumptions used to retrieve Nd from the satellite (Dipu et al., 2022). The proposed master thesis will investigate the sensitivity of Nd-LWP using the cloud tracking method. The cloud track method would identify the cloud clusters with different lifetimes from the high-resolution ICON-LEM (ICOsahedral Non-hydrostatic Large Eddy Model). This will allow documenting the Nd-LWP sensitivity during the cloud lifetime.

Literature:	1. Boucher, O., Randall, D., Artaxo, P., Bretherton, C., Feingold, G., Forster, P., Kerminen, V.-M., Kondo, Y., Liao, H., Lohmann, U., et al.: Clouds and aerosols, in: Climate change 2013: the physi- cal science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 571–657, Cambridge University Press, 2013. 2. Dipu, S, Schwarz, M, Ekman, AML, Gryspeerdt, E, Goren, T, Sourdeval, O, Mülmenstädt, J and Quaas, J. 2022. Exploring Satellite- Derived Relationships between Cloud Droplet Number Concentration and Liquid Water Path Using a Large- Domain Large-Eddy Simulation. Tellus B: Chemical and Physical Meteorology,74(2022):176–188. DOI: https://doi.org/10.16993/tellusb.27 3. Gryspeerdt, E, Goren, T, Sourdeval, O, Quaas, J, Mülmenstädt, J, Dipu, S, Unglaub, C, Gettelman, A and Christensen, M. 2019. Constraining the aerosol influence on cloud liquid water path. Atmos. Chem. Phys., 19(8): 5331–5347. DOI: https://doi.org/10.5194/acp-19-5331-2019 4. Bellouin, N, Quaas, J, Gryspeerdt, E, Kinne, S, Stier, P, Watson-Parris, D, Boucher, O, Carslaw, K, Christensen, M, Daniau, A-L, Dufresne, J-L, Feingold, G, Fiedler, S, Forster, P, Gettelman, A, Haywood, JM, Lohmann, U, Malavelle, F, Mauritsen, T, McCoy, D, Myhre, G, Mülmenstädt, J, Neubauer, D, Possner, A, Rugenstein, M, Sato, Y, Schulz, M, Schwartz, SE, Sourdeval, O, Storelvmo, T, Toll, V, Winker, D and Stevens, B. 2020. Bounding global aerosol radiative forcing of climate change. Rev. Geophys., 58: e2019RG000660. DOI: https://doi. org/10.1029/2019RG000660 5. AForster, P, Storelvmo, T, Armour, K, Collins, W, Dufresne, J-L, Frame, D, Lunt, D, Mauritsen, T, Palmera, M, Watanabea, M, Wild, M and Zhang, H. 2021. The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Masson-Delmotte, V, Zhai, P, Pirani, A, Connors, SL, Péan, C, Berger, S, Caud, N, Chen, Y, Goldfarb, L, Gomis, MI, Huang, M, Leitzell, K, Lonnoy, E, Matthews, JBR, Maycock, TK, Waterfield, T, Yelekçi, O, Yu, R and Zhou, B (eds.), Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (Chapter 7). Cambridge University Press. In Press.