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

Topic	Investigate the long-term characteristics of fog optical properties from the satellite and evaluate a selected fog event with a high-resolution model.
Release Date	01.12.2023
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Description:	Fogs are the variant of a cloud that has formed close to the earth's surface. The large impact of fog on visibility can be a major hazard for traffic, especially air traffic (Gultepe et al., 2015). Similar to the clouds, fog/cloud condensation nuclei changes have a crucial role in the occurrence, formation and dissipation of fog and its optical properties. Vautard et al., 2009 have reported that the probability of occurrence in Europe has decreased significantly over the last two decades. However, the observation of fog optical properties is discrete and mostly relies on in-situ observations, which is attributed to the poor spatial and temporal resolution of the fog data. Although satellite observation provides long-term observation of clouds globally, the low-temperature difference between the fog (low cloud) top and the surrounding land/sea makes it difficult to identify from the satellite. However, combining the geostationary and polar orbiting satellite information can be used to retrieve daytime fog optical properties. Furthermore, fog is very poorly represented in atmospheric models (Boutle et al., 2018). The new ICON-Large Eddy model (Heinze et al., 2017), with its resolution of up to 156 m even over large simulation areas, now offers the new possibility to study fog and its modification with aerosol.

	The proposed master thesis will first identify the daytime fog occurrence using the SEVERI satellite, and this fog flag will be used to retrieve fog optical properties from the MODIS satellite if there are no overlying clouds. The second part of the thesis will evaluate fog simulated by the ICON-LEM model using observational data from in-situ data and satellite remote sensing. It will then explore the extent to which fog changes when aerosol concentrations are reset to high loads in 1985. The work can then draw conclusions about the relevance of this process to climate and society.
Literature:	Aitken, J., On dust, fogs, and clouds, Proceed. Roy. Soc. Edinburgh, Session 1880-81, 14–18, doi:10.1017/S0370164600046666, 1880. Boutle, I., Price, J., Kudzotsa, I., Kokkola, H., and Romakkaniemi, S.: Aerosol–fog in- teraction and the transition to well-mixed radiation fog, Atmos. Chem. Phys., 18, 7827-7840, https://doi.org/10.5194/acp-18-7827-2018, 2018. Gultepe, I., B. Zhou, J. Milbrandt, A. Bott, Y. Li, A. Heymsfield, B. Ferrier, R. Ware, M. Pavolonis, T. Kuhn, J. Gurka, P. Liu, and J. Cermak, A review on ice fog measure-ments and modeling, Atmos. Res., 151, 2–19, doi:10.1016/j.atmosres.2014.04.014, 2015. Heinze, R., et al., Large-eddy simulations over Germany using ICON: A comprehensive evaluation, Quart. J. Roy. Meteorol. Soc., 143, 69-100, doi:10.1002/qj.2947, 2017. Vautard, R., A. Colette, E. van Meijgaard, F. Meleux, G. Jan van Oldenborgh, F. Otto, I. Tobin, and P. Yiou, Attribution of wintertime anticyclonic stagnation contributing to air pollution in western Europe, Bull. Amer. Meteorol. Soc., 99(1), S70–S75, doi:10.1175/BAMS-D-17-0113.1, 2018. Pauli, E., Cermak, J. & Andersen, H.(2022) A satellite-based climatology of fog and low stratus formation and dissipation times in central Europe. *Q J R Meteorol Soc*, 148(744), 1439–1454. Available from: **https://doi.org/10.1002/qj.4272**