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High-resolution modelling of marine biogenic aerosol precursors in the Arctic realm

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The presence of liquid or ice as cloud phase determines the climate radiative effect of Arctic clouds, and thus, their contribution to surface warming. Biogenic aerosols from phytoplankton production localized in leads or open water were shown to act as cloud condensation nuclei (liquid phase) or ice nuclei (ice phase) in remote regions. As extensive measurements of biogenic aerosol precursors are still scarce, we conduct a modelling study and use acidic polysaccharides (PCHO) and transparent exopolymer particles (TEP) as tracers. In this study, we integrate processes of algal PCHO excretion during phytoplankton growth or under nutrient limitation and processes of TEP formation, aggregation and also remineralization into the ecosystem model REcoM2. The biogeochemical processes are described by two functional phytoplankton and two zooplankton classes, along with sinking detritus and several (in)organic carbon and nutrient classes. REcoM2 is coupled to the finite-volume sea ice ocean circulation model FESOM2 with a high resolution of up to 4.5 km in the Arctic. We will present the first results of simulated TEP distribution and seasonality patterns at pan-Arctic scale over the last decades. We will elucidate drivers of the seasonal cycle and will identify regional hotspots of TEP production and its decay. We will also address possible impacts of global warming and Arctic amplification of the last decades in our evaluation, as we expect a strong effect of global warming on microbial metabolic rates, phytoplankton growth, and composition of phytoplankton functional types. The results will be evaluated by comparison to a set of in-situ measurements (PASCAL, FRAM, MOSAiC). It is further planned that an atmospheric aerosol-climate model will build on the modeled biogenic aerosol precursors as input to quantify the net aerosol radiative effects. This work is part of the DFG TR 172 Arctic Amplification.