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Clouds in a warmer climate

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Shallow cumulus and stratocumulus clouds over open ocean surfaces play a crucial role in Earth's energy and radiation budget. These clouds are highly reflective and strongly influence the planet's temperature. While stratocumulus clouds generally exert a cooling effect by reflecting solar radiation, their response to a warming climate is complex. Some studies suggest that stratocumulus cloud cover may decrease with warming, potentially amplifying climate change rather than mitigating it. Shallow cumulus clouds also interact with climate processes in ways that introduce significant uncertainties in climate projections.

Understanding cloud-climate interactions remains a challenge due to the multiscale nature of cloud processes, which range from micrometer-scale droplet interactions to cloud formations extending over thousands of kilometers. Small-scale cloud processes are not explicitly resolved in climate models and require parameterization, while large-scale atmospheric dynamics strongly influence cloud evolution and behavior.

In this presentation, we focus on shallow cumulus clouds over subtropical and Arctic oceans. Using observational data, we construct idealized vertical profiles adapted to warmer climate scenarios. These profiles serve as a basis to investigate cloud microphysics, structural changes, and potential feedback mechanisms in a warming climate, using the nonhydrostatic, convection-resolving Cloud Model 1.

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cloud modeling

Keyword-2

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Keyword-3

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