Sensitivity of Arctic mixed-phase cloud simulations to ice microphysical modifications in the WDM6 scheme of WRF (v4.3.1)

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Introduction

This supplement provides additional figures supporting the analysis presented in the main text. Figure S1 shows the three-dimensional flight track of the UND Citation aircraft during the M-PACE campaign, with the specific analysis segment highlighted.

Figure S2 presents the spatial distribution of low-level cloud fraction across all five model configurations, illustrating the systematic increase in cloud coverage from ice-dominated to liquid-dominated configurations.

Figure S3 compares vertical profiles of water vapor mixing ratio from radiosonde observations, ERA5 reanalysis, and the WDM6 and WDM6_ICE simulations, demonstrating the dry bias in ERA5 boundary conditions within the cloud layer.

Figure S4 shows the vertical profiles of liquid and ice water content simulated with the Shin and Hong (2015) PBL scheme, confirming that the microphysical sensitivities identified in the main text are robust to the choice of boundary-layer parameterization.

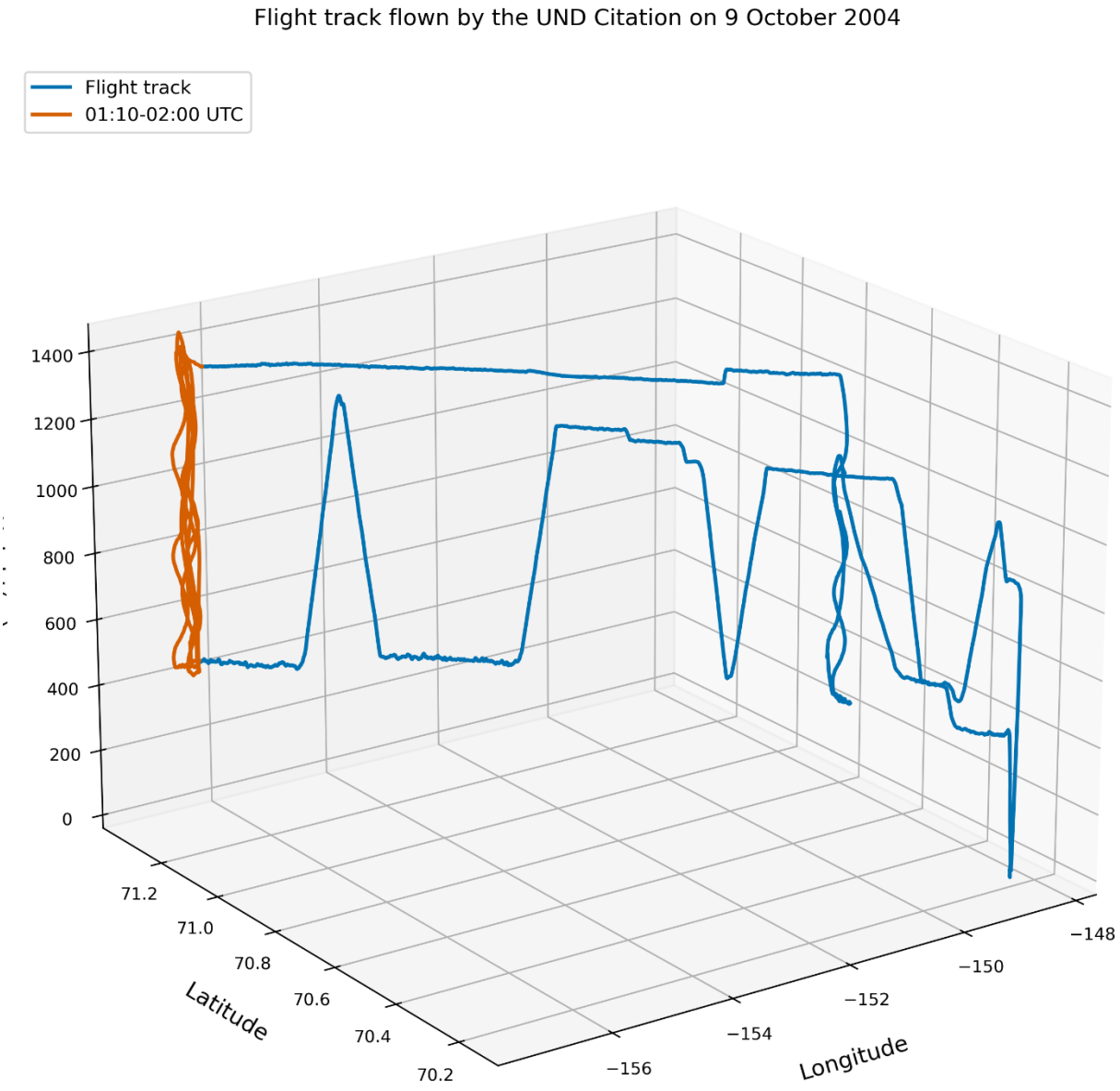
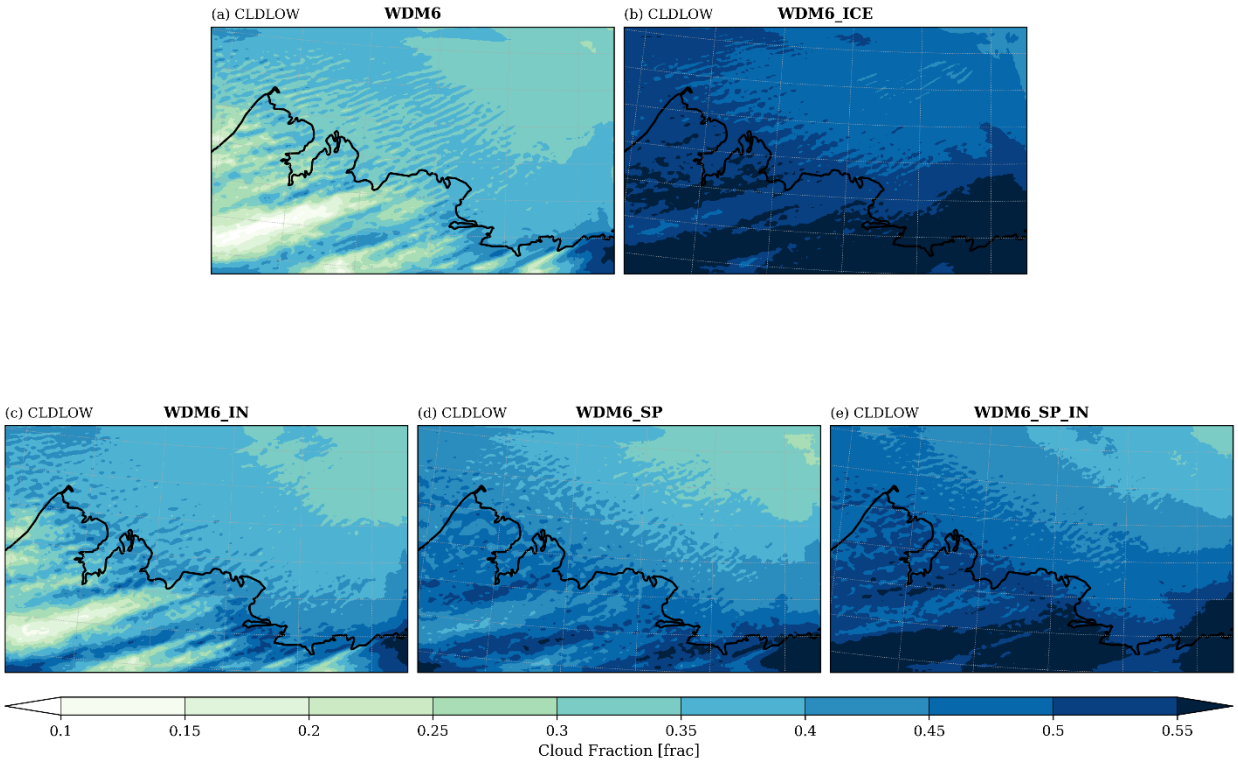


Figure S1: 3D flight track of the UND Citation aircraft on 9 October 2004. The vermillion segment indicates the specific analysis period (01:10–02:00 UTC).



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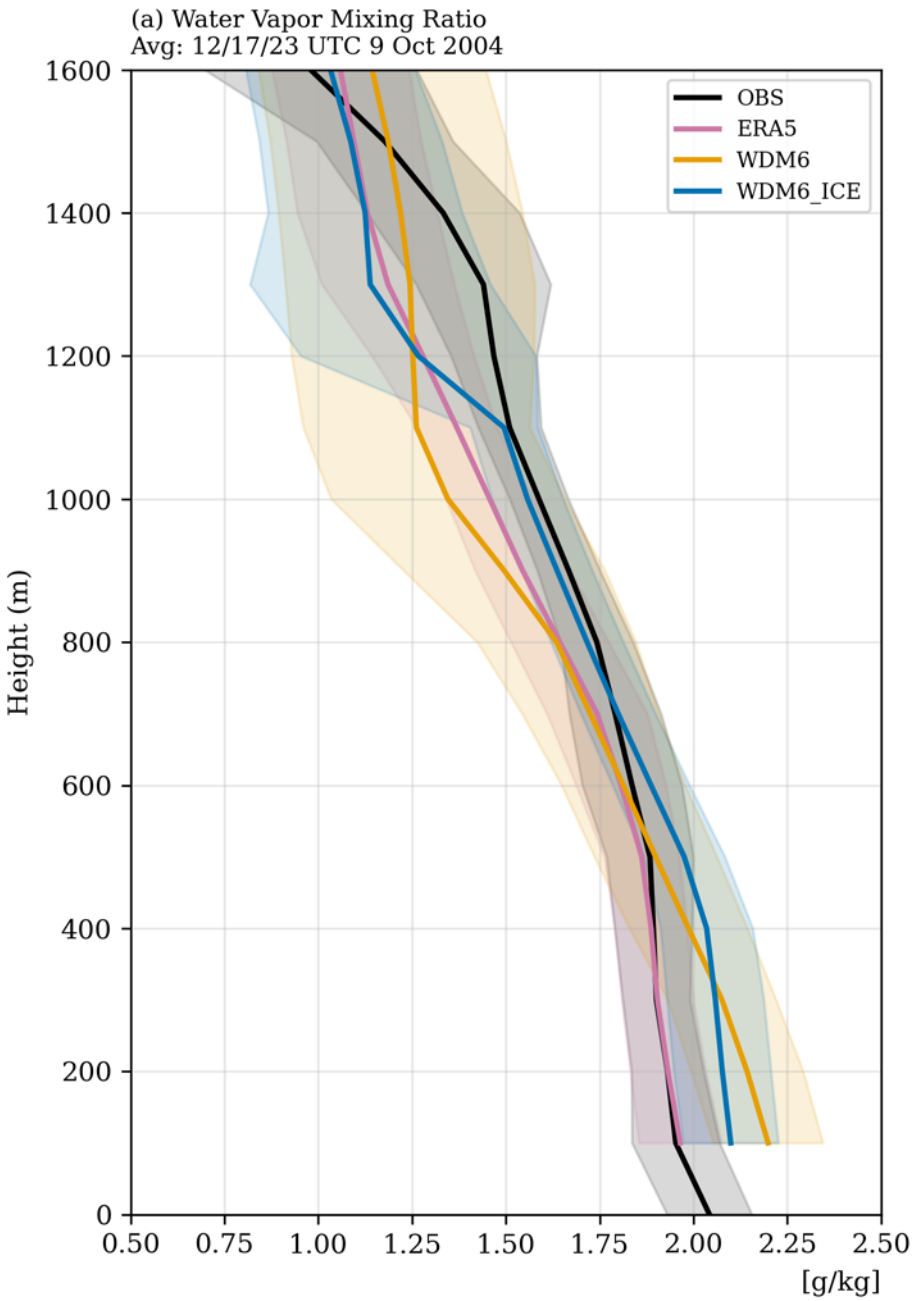
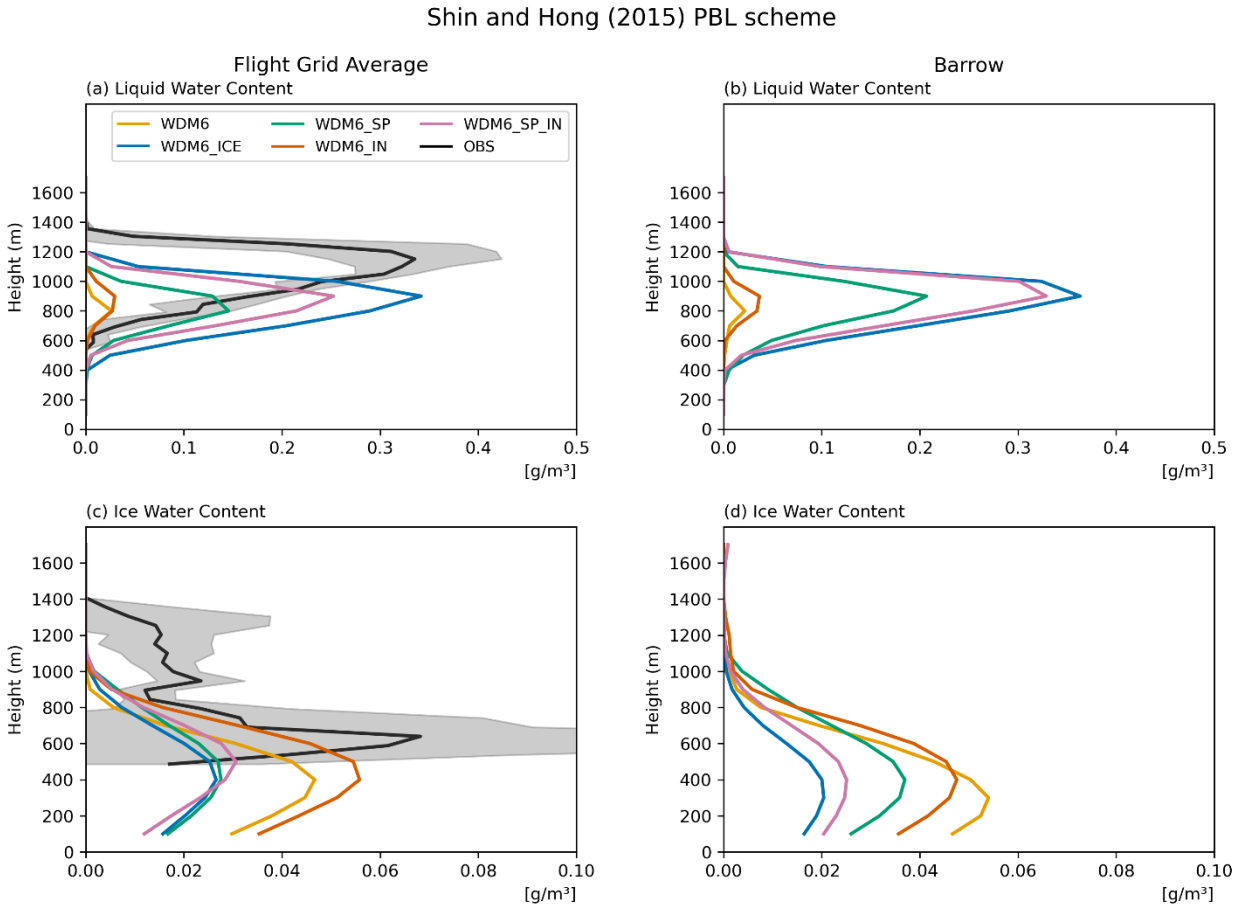


Figure S3: Vertical profiles of water vapor mixing ratio (g kg^{-1}) at BAR, averaged over 12:00, 17:00, and 23:00 UTC 9 October 2004. Black solid line: radiosonde observations; purple line: ERA5 reanalysis; orange line: WDM6; blue line: WDM6_ICE. Shading indicates ±1 standard deviation.



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