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Detailed modeling of mountain wave PSCs

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Abstract. Polar stratospheric clouds (PSCs) play a key role in polar ozone depletion. In the Arctic, PSCs can occur on the mesoscale due to orographically induced gravity waves. Here we present a detailed study of a mountain wave PSC event on 25-27 January 2000 over Scandinavia. The mountain wave PSCs were intensively observed by in-situ and remote-sensing techniques during the second phase of the SOLVE/THESEO-2000 Arctic campaign. We use these excellent data of PSC observations on 3 successive days to analyze the PSCs and to perform a detailed comparison with modeled clouds. We simulated the 3-dimensional PSC structure on all 3 days with a mesoscale numerical weather prediction (NWP) model and a microphysical box model (using best available nucleation rates for ice and nitric acid trihydrate particles). We show that the combined mesoscale/microphysical model is capable of reproducing the PSC measurements within the uncertainty of data interpretation with respect to spatial dimensions, temporal development and microphysical properties, without manipulating temperatures or using other tuning parameters. In contrast, microphysical modeling based upon coarser scale global NWP data, e.g. current ECMWF analysis data, cannot reproduce observations, in particular the occurrence of ice and nitric acid trihydrate clouds. Combined mesoscale/microphysical modeling may be used for detailed a posteriori PSC analysis and for future Arctic campaign flight and mission planning. The fact that remote sensing alone cannot further constrain model results due to uncertainities in the interpretation of measurements, underlines the need for synchronous in-situ PSC observations in campaigns.

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