The influence of atmospheric variability on ice formation in the mesosphere

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LIMA (Leibniz Institute Middle Atmosphere Model) is a new model which nicely reproduces the mean conditions of the summer mesopause region at middle and polar latitudes. It includes all relevant atmospheric processes such as dynamics, radiation, and chemistry from the ground to the lower thermosphere. In the lower atmosphere LIMA assimilates ECMWF ERA-40 data and thereby introduces natural variability. We have run an ice particle model in the mesosphere using the background conditions from LIMA which vary with season and height. The ice model is interactively coupled to water vapor and thereby includes the redistribution of H_2O by the so called 'freeze drying' effect. In this paper we discuss the importance of natural variability on the geographical and seasonal distribution of ice layers known as noctilucent clouds (NLC) and polar mesosphere summer echoes (PMSE). We will present a detailed comparison of the LIMA/ice model results with lidar and radar measurements at our three stations, namely Kühlungsborn (54°N), ALOMAR (69°N), and Longyearbyen (78°N). The average layer characteristics in the model, such as mean NLC altitude and brightness agree nicely with observations. There is a close correlation between the occurrence of ice layers and cold and wet periods in the upper mesosphere. We will also compare LIMA/ice results with satellite borne observations of ice clouds known as polar mesospheric clouds (PMC). Despite mixing by atmospheric waves and mean circulation we find a substantial modification of the background conditions (in particular the water vapor distribution) by ice particles.