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A new model of mesospheric ice layers: first results and implications for coupling mechanisms

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A newly developed model of the atmosphere called LIMA (Leibniz Institute Middle Atmosphere Model) nicely reproduces the mean conditions of the summer mesopause region at middle and polar latitudes. LIMA includes natural variability through nudging techniques to ERA-40 data in the lower atmosphere. 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. The background variability has a major impact on the geographical distribution of ice clouds. This distribution is in agreement with the latitudinal distribution of ice particle related phenomena such as noctilucent clouds (NLC), polar mesospheric clouds (PMC), and polar mesosphere summer echoes (PMSE). For example, the occurrence rate of NLC observed at Kühlungsborn (54°N) is nicely reproduced in the model but only when the atmospheric background variability is taken into account. The average layer characteristics in the model, such as mean NLC altitude and brightness agree nicely with observations. LIMA/ice also reproduces the occasional depletion of ice particles at polar latitudes ('ice holes') which have been observed by satellite and ground based instruments. We present new results on the redistribution of water vapor by ice particle nucleation, transport, and sublimation. This freeze drying causes a depletion of water vapor in the polar upper mesosphere and large enhancements of H_2O at mid latitudes. The modification of water vapor abundance significantly affects photochemical coupling mechanisms.