Solar cycle and long term variations of mesospheric ice layers

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Ice layers in the summer mesosphere at middle and polar latitudes, frequently called 'noctilucent clouds' (NLC) or 'polar mesosphere clouds'(PMC), are considered to be sensitive indicators of long term changes in the middle atmosphere. We present a summary of long term observations from the ground and from satellites and compare with results from the LIMA model (Leibniz Institute Middle Atmosphere Model). LIMA nicely reproduces mean conditions of the summer mesopause region and also mean characteristics of ice layers. LIMA nudges to ECMWF data in the troposphere and lower stratosphere which influences the background conditions in the mesosphere and thereby the morphology of ice clouds. A strong correlation between temperatures and PMC altitudes is observed. Applied to historical measurements this give s negligible temperature trends at PMC altitudes (approximately 0.01-0.02 K/y). Trace gas concentrations are kept constant in LIMA except for water vapor which is modified by variable solar radiation. Still, long term trends in temperatures and ice layer parameters are observed, consistent with observations. As will be shown, these trends originate in the stratosphere. Solar cycle effects are expected in ice layers due to variations in background temperatures and water paper. We will present results from LIMA regarding solar cycle variations and compare with NLC observations at our lidar stations in Kühlungsborn (54°N) and ALOMAR (69°N), and also with satellite measurements.