Geophysical Research Abstracts
Vol. 14, EGU2012-11335, 2012
EGU General Assembly 2012

On the impact of short-term solar variability on the polar summer mesopause and noctilucent clouds

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The Earth's middle atmosphere is affected by short-term solar variability in a variety of ways. This contribution deals with two different short-term solar effects on the polar summer mesopause region and on noctilucent clouds (NLCs) in particular. First, the effect of solar proton events (SPEs) on the thermal conditions near the polar summer mesopause and subsequently on NLCs is discussed. A proposed physical mechanism to explain a dynamically induced warming at the polar summer mesopause during and after SPEs is investigated using model simulations with the Kühlungsborn Mechanistic General Circulation Model (KMCM). A second aspect related to the effect of SPEs on NLCs is on the SPE-induced ion-chemical conversion of H_2O to HO_x, leading to a possible sublimation of NLCs. However, detailed model simulations of the ion chemistry and its effect on NLC particles demonstrate that this effect is of minor importance compared to the dynamically induced temperature effect.

Second, the recently discovered 27-day solar cycle signature in NLCs will be discussed, which was identified in SCIAMACHY as well as SBUV satellite observations of NLCs using cross-correlation analysis and the superposed epoch method. NLC occurrence rate and albedo anomalies are anti-correlated with Lyman-α anomalies with a time-lag of 1 day at most. The sensitivities of the NLC albedo anomalies to Lyman-α forcing in terms of the 27-day and the 11-year solar cycle were found to agree within their uncertainties. This finding suggests that the same underlying physical mechanism drives the 27-day as well as the 11-year solar cycle signature in NLCs. The exact mechanism is still unknown, however.