Geophysical Research Abstracts, Vol. 9, 07069, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07069

FUBRad - a high resolution short wave radiation scheme for solar cycle studies

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Understanding solar variability effects on climate is an important topic in current studies with chemistry climate models. Most general circulation models use radiation schemes with only few spectral intervals to calculate short-wave heating rates. As variations in the total solar irradiance over the 11-year solar cycle are small this is not sufficient for studies of the effect of solar variability on climate. Changes in solar irradiance are wavelength dependent and increase towards shorter wavelengths. It is therefore essential to resolve the solar spectrum in more detail. At the Freie Universität Berlin we have developed the high resolution short wave radiation scheme (FUBRad) for solar cycle studies. It comprises 49 intervals in the UV and visible part of the spectrum (125-680 nm). In this paper we introduce the scheme and compare it against the detailed radiative transfer model libRadtran. We show that FUBRad produces realistic heating rate variations during the solar cycle and a temperature response that is in good agreement with observations. To demonstrate the importance of spectral resolution we have repeated the model experiments with the Fouquart and Bonnel radiation scheme using 1 band for the 240-680 nm interval. The comparison shows that short wave heating rate variations in the middle atmosphere are about 20 times weaker with the low resolution scheme which therefore cannot produce the observed temperature signal.