Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 5391-5400, 2007
www.atmos-chem-phys.net/7/5391/2007/

Towards a better representation of the solar cycle in general circulation models

K. M. Nissen[1], K. Matthes[1], U. Langematz[1], and B. Mayer[2]
[1] Institut für Meteorologie, Freie Universität Berlin, Carl-Heinrich-Becker-Weg 6–10, 12165 Berlin, Germany
[2] Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen, Germany

Abstract. We introduce the improved Freie Universität Berlin (FUB) high-resolution radiation scheme FUBRad and compare it to the 4-band standard ECHAM5 SW radiation scheme of Fouquart and Bonnel (FB). Both schemes are validated against the detailed radiative transfer model libRadtran. FUBRad produces realistic heating rate variations during the solar cycle. The SW heating rate response with the FB scheme is about 20 times smaller than with FUBRad and cannot produce the observed temperature signal. A reduction of the spectral resolution to 6 bands for solar irradiance and ozone absorption cross sections leads to a degradation (reduction) of the solar SW heating rate signal by about 20%.

The simulated temperature response agrees qualitatively well with observations in the summer upper stratosphere and mesosphere where irradiance variations dominate the signal.

Comparison of the total short-wave heating rates under solar minimum conditions shows good agreement between FUBRad, FB and libRadtran up to the middle mesosphere (60–70 km) indicating that both parameterizations are well suited for climate integrations that do not take solar variability into account.

The FUBRad scheme has been implemented as a sub-submodel of the Modular Earth Submodel System (MESSy).

Final Revised Paper (PDF, 456 KB) Supplement (9 KB) Discussion Paper (ACPD)

Citation: Nissen, K. M., Matthes, K., Langematz, U., and Mayer, B.: Towards a better representation of the solar cycle in general circulation models, Atmos. Chem. Phys., 7, 5391-5400, 2007. Bibtex EndNote Reference Manager