Geophysical Research Abstracts
Vol. 14, EGU2012-2964, 2012
EGU General Assembly 2012

Intercomparison of aerosol climatologies for use in a regional climate model over Europe

E. M. Zubler, U. Lohmann, D. Lüthi, and C. Schär

ETH Zurich, Institute for Atmospheric and Climate Science, Department of Environmental System Sciences, Zurich, Switzerland (elias.zubler@env.ethz.ch)

Many regional climate models (RCM) and numerical weather prediction (NWP) models use out-dated aerosol data sets to calculate the direct aerosol radiative effect. In this study, three multi-year simulations with the regional climate model COSMO-CLM using different aerosol climatologies and a simulation with monthly mean aerosol optical properties, stemming from a COSMO-CLM simulation with coupled aerosol microphysics and transport, are evaluated.

The climatologies of Tegen et al. (1997), the AEROCOM-climatology for present-day conditions, and the monthly mean optical properties from Zubler et al. (2011), that show realistic patterns of aerosol optical depth (AOD), lead to an increase of annual mean downward surface shortwave radiation (SSR) of 35 W m^{-2} (20%) in the Mediterranean region in comparison with the climatology of Tanré et al. (1984) (TAN84). The former is known to strongly overestimate AOD over Europe owing to an unrealistic representation of desert dust. The associated bias in SSR exceeds the observed variations of the recent decades by up to a factor 5. Despite an annual mean temperature increase of more than 0.5 K above Southern European land surfaces owing to the enhanced SSR, the newer climatologies yield colder temperatures in the mid-troposphere because of a reduction of the shortwave absorption by desert dust.

Consequently, the reduced tropospheric heating, in combination with the surface warming, destabilizes the atmosphere relative to the simulation with TAN84, amplifying cloud formation and precipitation in these simulations. In the Northern part of Europe, the cloud fraction increases by roughly 2.5% in the annual mean. Over Scandinavia, this effect is even stronger than the increase in SSR due to reduced AOD, such that colder temperatures result in comparison with TAN84. Locally, the annual mean precipitation increases by up to 15%. It is thus recommended that the RCM community uses updated aerosol information for radiative transfer calculations.