



Evaluation of the radiation budget with a regional climate model over Europe and inspection of dimming and brightening

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Shortwave (SW) and longwave (LW) components of the radiation budget at the surface and top of the atmosphere (TOA) are evaluated in the RegCM4 regional climate model driven by European Centre for Medium-Range Weather Forecasts (ECMWF) Reanalysis (ERA-Interim) over Europe. The simulated radiative components were evaluated with those from satellite-based products and reanalysis. At the surface the model overestimated the absorbed solar radiation but was compensated by a greater loss of thermal energy while both SW and LW TOA net fluxes were underestimated representing too little solar energy absorbed and too little outgoing thermal energy. Averaged biases in radiative parameters were generally within 25 Wm^{-2} and were dependent on differences by as much as 0.2 in cloud fraction, surface and planetary albedo, and less dependent on surface temperature associated with the surface longwave parameters and are in line with other studies. Clear-sky fluxes showed better results when cloud cover differences had no influence. We also found a clear distinction between land versus water with smaller biases over land at the surface and over water at the TOA due to differences in cloud fraction and albedo. Finally, we inspected dimming and brightening for the period 1979-2010 with an indication for dimming early in the time series (i.e. 1979-1987) and brightening after, which agrees with surface-based observations. After 2000, however, a decrease in the brightening by more than one order of magnitude was evident which is in contrast to the continued brightening found in surface records and satellite-derived estimates.