



## **On the ability of RegCM4 to simulate surface solar radiation patterns over Europe: An assessment using satellite-based observations**

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We assess here the ability of RegCM4 to simulate the surface solar radiation (SSR) patterns over the European domain. For the needs of this work, a decadal (1999-2009) simulation was implemented at a horizontal resolution of 50km using the first year as a spin-up. The model is driven by emissions from CMIP5 while ERA-interim data were used as lateral boundary conditions. The RegCM4 SSR fields were validated against satellite-based SSR observations from Meteosat First Generation (MFG) and Meteosat Second Generation (MSG) sensors (CM SAF SIS product). The RegCM4 simulations slightly overestimate SSR compared to CM SAF over Europe with the bias being +1.54% in case of MFG (2000-2005) and +3.34% in case of MSG (2006-2009). SSR from RegCM4 is much closer to SSR from CM SAF over land (bias of -1.59% for MFG and +0.66% for MSG) than over ocean (bias of +7.20% for MFG and 8.07% for MSG). In order to understand the reasons of this bias, we proceeded to a detailed assessment of various parameters that define the SSR levels (cloud fractional cover - CFC, cloud optical thickness - COT, cloud droplet effective radius -  $R_e$ , aerosol optical thickness - AOD, asymmetry factor - ASY, single scattering albedo - SSA, water vapor - WV and surface albedo - ALB). We validated the simulated CFC, COT and  $R_e$  from RegCM4 against satellite-based observations from MSG and we found that RegCM4 significantly underestimates CFC and  $R_e$ , and overestimates COT over Europe. The aerosol-related parameters from RegCM4 were compared with values from the aerosol climatology taken into account within CM SAF SSR estimates. AOD is significantly underestimated in our simulations which leads to a positive SSR bias. The RegCM4 WV and ALB were compared with WV values from ERA-interim and ALB climatological observations from CERES which are also taken into account within CM SAF SSR estimates. Finally, with the use of a radiative transfer model (SBDART) we manage to quantify the relative contribution of each of the above mentioned parameters to the total bias appearing between RegCM4 and CM SAF SSR.

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