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Using MODIS land surface temperatures and the Crocus snow model to understand the warm bias of ERA-Interim reanalyses at the surface in Antarctica

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MODIS land surface temperatures in Antarctica were processed in order to produce a gridded data set at 25 km resolution, spanning the period 2000-2011 at an hourly time-step. The AQUA and TERRA orbits and MODIS swath width, combined with frequent clear-sky conditions, lead to very high availability of quality-controlled observations : on average, hourly data are available 14 hours per day at the grid points around the South Pole and more than 9 over a large area of the Antarctic Plateau. Processed MODIS land surface temperatures were compared with in situ hourly measurements of surface temperature collected over the entire year 2009 by 7 stations from the BSRN and AWS networks. In spite of occasional failures in the detection of clouds, MODIS land surface temperature exhibit a good performance, with a bias ranging from -2.0 to 1.2°C and errors ranging from 2.7 to 4.8°C root mean square at the 5 stations located on the Plateau. Thus, MODIS land surface temperature can be used as a precise and accurate reference to evaluate other surface data sets. We assessed the performance of surface temperature in the ERA-Interim reanalysis. During conditions detected as a cloud-free by MODIS, ERA-Interim shows a widespread warm bias in Antarctica in every season, ranging from -3 to +6°C on the Plateau. A comparison with in situ surface temperature shows that this bias is not strickly limited to clear-sky conditions. A detailed comparison with stand-alone simulations by the Crocus snowpack model, forced by ERA-Interim, and with the ERA-Interim/land simulations, shows that the warm bias may be due primarily to an overstimation of the surface turbulent fluxes in very stable conditions.