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Temperature monitoring in mountain regions using reanalyses: Lessons from the Alps

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The monitoring of near-surface temperature is a fundamental task of climatology that remains especially challenging in mountain regions. Here we assess the regional monitoring capabilities of modern reanalysis products in the well-monitored northern Swiss Alps during the last 20 to almost 60 years. Monthly and seasonal 2 m air temperature (T2m) anomalies of the global ERA5 and the three regional reanalysis products HARMONIE, MESCAN-SURFEX and COSMO-REA6 are evaluated against high quality in situ observational data for a low elevation (foothills) mean, and a high elevation (Alpine) mean. All reanalysis products show a good year-round performance for the foothills with the global reanalysis ERA5 showing the best overall performance. The high-resolution regional reanalysis COSMO-REA6 clearly performs best for the Alpine mean, especially in winter. Most reanalysis data sets show deficiencies at high elevations in winter and considerably overestimate recent T2m trends in winter. This stresses the fact that even in the most recent decades utmost care is required when using reanalysis data for near-surface temperature trend assessments in mountain regions. Our results indicate that a high-resolution model topography is an important prerequisite for an adequate monitoring of winter T2m using reanalysis data at high elevations in the Alps. Assimilating T2m remains challenging in highly complex terrain. The remaining shortcomings of modern reanalyses also highlight the continued need for a reliable and dense in situ observational monitoring network in mountain regions.