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Upper-air temperature trends above Switzerland 1959-2011

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This study summarizes 53 years of radiosonde measurements at the MeteoSwiss aerological station of Payerne, Switzerland. The temperature time-series is the result of a careful reassessment of the original data, mainly based on the internal station documentation. In the lower troposphere, we compare radiosonde measurement trends to independently-homogenized surface trends measured at lowland and Alpine stations up to 3'580 m. We find an average difference among trends below 0.03 K/dec (7-8%), showing consistency between upper-air and surface temperature measurements. Upper-air data show the 0 °C isotherm to rise by about 70 m/dec on average over the whole period, which is consistent with the 60 m/dec trend found using surface measurements. A similar change has also been measured for the tropopause height, which rose by 57 m/dec over the last five decades. Analysis of the phase and amplitude of the diurnal temperature cycle shows a strongly decreasing amplitude with height from about 3 K at the surface to 0.2 K at 700 hPa. The diurnal cycle peaks at about 15 UTC at the surface and shifts to later hours with height, reaching almost midnight at 400 hPa. In the stratosphere diurnal temperature again peaks at around 15 UTC, but with low amplitude. Annual temperature cycle amplitude is in the order of 15 K and fairly constant with height. The peak temperature however, shifts from July-August in the troposphere to June-July in the stratosphere. Temperature trends in the troposphere exhibits a clear warming trend since the 1980s, which decreases with height and changes to a cooling trend in the stratosphere, with no trend or minor warming since the end of the 1990s. The warming in the troposphere is found to be larger during summer months, whereas the cooling in the stratosphere is larger during winter months.