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**Title**: A temporally and spatially varying environmental lapse-rate for temperature downscaling

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**Abstract:** (max 2000 characters)
Temperature near the surface varies with altitude accordingly to the environmental lapse-rate (ELR). The ELR depends on the overlying air masses, large-scale situation and local effects. The characterization of the ELR has several applications, in particular to downscale global/regional numerical weather predictions, and reanalysis in complex terrain regions. From an observational point of view, complex terrain regions also constitute a challenging environment due to the difficulties associated with the installation and maintenance of observational networks. In this study we propose the derivation of the ELR from the reanalysis lower troposphere vertical profiles of temperature. This creates a temporally and spatially varying ELR, that can be used to downscale near-surface air temperature from the reanalysis resolution to higher resolutions. This approach could replace the commonly used global constant ELR of 6.5 K km-1 by an ELR based on local meteorological conditions. The ELR estimates based on ERA5 and ERA-Interim were compared with observationally based ELR over the U.S. using the GHCN temperature data, showing a good agreement. The method is used to downscale ERA5 to about 9 km globally and validated against in-situ temperature observations and compared with simulations without any topographic correction and with a constant ELR. The results suggest some benefits of using this new ELR over complex terrain regions, when compared with a constant value, and suggest that this new methodology could be used as a default for downscaling temperature from reanalysis on the global/regional scale where local in-situ observations are scarce and computational resources limit dynamical downscaling.