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Amplified Warming Rates in High Elevation Regions

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We use ground-based and satellite-retrieved observations in conjunction with output from global climate model simulations from the Coupled Model Intercomparison Project Phase 5 (CMIP5) to determine whether warming rates in high elevation regions are significantly different than in their lower elevation surroundings. In addition, for regions where there is enhanced warming at higher elevations, we investigate several of the potential mechanisms that may contribute to this enhancement. For the mid-latitudes in the Northern Hemisphere, the multi-model ensemble indicates that warming rates during the 21^{st} century will be enhanced at high elevations relative to their lower elevation counterparts at the same latitude. This effect is most pronounced for daily minimum temperatures during the cold season in the Tibetan Plateau/Himalayan region. A neural network analysis is used to identify and quantify some of the potential mechanisms responsible for enhanced warming rates, including the effects of variables such as atmospheric water vapor, clouds, snow cover, and aerosols on the radiation and surface heat budgets. We also demonstrate that satellite retrievals can be used to expand the often sparse ground-based observations in such regions and that they provide the correct relationships between variables.

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