Towards a uniform crustal thermal model of the continental US: a Monte Carlo approach

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Crustal thermal structure provides fundamental information to interpret seismic structures and to constrain other crustal properties such as density, rheology, and seismic attenuation, and in aggregate, parameters that impact earthquake source properties, ground motions, and seismic hazard. Crustal temperature estimates, however, suffer from high uncertainties, partially since they can be constrained by different geophysical and geological methods (e.g., Boyd, 2019). To construct a uniform thermal model of the continental US crust, we integrate multiple data sets via a Monte-Carlo algorithm. These data sets include direct, in-situ thermal observables —surface temperature, geothermal heat flux, and near-surface heat conductivity and heat generation—and indirectly constrained ones—Moho temperature from Pn tomography (e.g., Perry 2006, Schutt et al., 2018), Curie depth from geomagnetic data, and crustal heat generation estimated from the latest compositional model derived from the USArray (Sui et al., 2021). Using a simple model parameterization, we produce a vertically smoothed 3-D thermal model compatible with these geologically- and geophysically-determined constraints. The resulting model presented here helps better constrain crustal density and rheology models for the continental US and helps better calibrate and improve future compositional models.

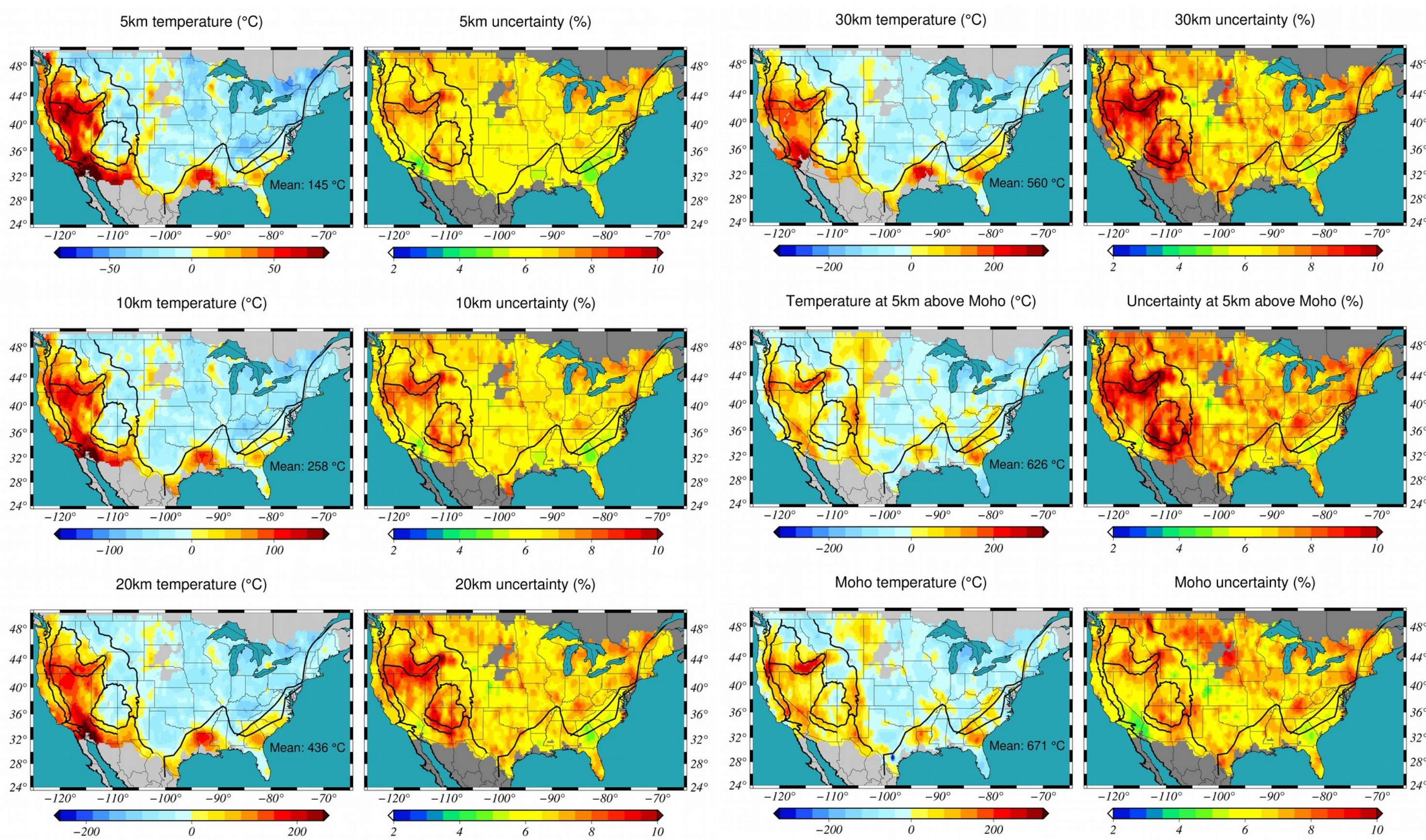

Figure 1. Map views of temperature and uncertainties of the continental US at different depths. The first and third columns show the relative temperature compared to the mean temperature (labeled). The second and fourth columns show the temperature uncertainty percentages.