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Tuning a multiscale prior with generalized cross validation for piecewise constant paleotemperature.

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The study of paleoclimate depends on a number of sophisticated paleotemperature proxies. Present borehole temperature measurements in depth provide the advantage of a "temperature to temperature" imprint of the local ground surface temperature history.

Unfortunately, the resolution in time is limited by the diffusive character of the forward problem, and the inverse problem requires careful regularization.

We consider a very general stochastic prior defined as the superposition of stochastic processes on *multiple time scales* from the scale of *minutes* and *hours* over *days* and *years* to *millennia* and *epochs*. This extreme wideband property, which is geoscientifically well established, turns out to make the inverse problem remarkably robust to careless discretization and differences in borehole depths and history scopes. In practice, only moderate adjustment of stochastic parameters should be required by the data or allowed by geoscientific common wisdom. This is tested by a generalized cross validation.

We propose the multiscale prior combined with generalized crossvalidation as an *attractive standard regularization* method which would provide *improved consistency between studies of paleotemperature* across timescales, borehole depths scales and groups of investigators.

MATLAB *computer code* for computation of the multiscale prior covariance matrices and associated parameter weight matrices *is available upon request*.