EGU23-9597, updated on 27 Mar 2023
https://doi.org/10.5194/egusphere-egu23-9597
EGU General Assembly 2023

Increasing the sampling density of 3D GPR data using multiple-point geostatistics

James Irving[1], Chongmin Zhang[1], Mathieu Gravey[3], and Grégoire Mariéthoz[2]
[1]Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland
[2]Institute of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland
[3]Department of Physical Geography, Utrecht University, Utrecht, Netherlands

3D GPR data, where measurements are acquired along a series of parallel survey lines, offer much potential for gaining important information about complex subsurface environments. Such data are, however, extremely time consuming to collect, and a typical trade-off is that the survey line spacing is set to be significantly larger than the trace spacing along the lines. This introduces a strong resolution bias in the 3D dataset, and spatial aliasing is commonly present in the across-line direction. Although simple interpolation methods may be considered to address this problem, they generally lead to overly smoothed and unrealistic results.

Here, we present a means of overcoming this issue via multiple-point geostatistics (MPS) simulation. Considering that we have a limited number of sparsely distributed 2D GPR profiles to begin with, we reconstruct the densely spaced 3D GPR data set using a series of separate 2D simulations in both the along-line and across-line directions. Training images, which are necessary for the application of MPS, come from the existing GPR profiles. To deal with the discontinuities in 3D spatial structures caused by performing independent 2D simulations, target profiles are selected randomly but simulations are performed alternately in both directions. Test results show that this methodology provides significantly better reconstructions than standard interpolation, in particular as the spacing between the GPR survey lines increases.