

Infrasound propagation in multiple-scale random media using surrogate models

Infrasound propagation in realistic environments is highly dependent on the information to specify the waveguide parameters. For real-world applications, there is considerable uncertainty regarding this information, and it is more realistic to consider the wind and temperature profiles as random functions, with associated probability distribution functions reflecting phenomena that are filtered out in the available data. Even though the numerical methods currently-in-use allow accurate results for a given atmosphere, high dimensionality of the random functions severely limits the ability to compute the random process representing the acoustic field, and some form of sampling reduction is necessary. In this work we use polynomial chaos (gPC)-based metamodels to represent the effect of large-scale atmospheric variability onto the acoustic normal modes. The impact of small-scale atmospheric structures is modelled using a perturbative approach of the coupling matrix. This multi-level approach allows to estimate the statistical influence of each mode as the frequency varies. An excellent agreement is obtained with the gPC-based propagation model, with a few realizations of the random process, when compared with the Monte Carlo approach, with its thousands of realizations. Further, the gPC framework allows computing easily the Sobol indices without supplementary cost, which is essential for sensitivity studies.

Primary author: MILLET, Christophe (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

Presenter: MILLET, Christophe (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

Track Classification: Theme 1. The Earth as a Complex System