ID: Type: **Poster**

meta-model based localization of infrasound events in multivariate atmospheres

The International Data Center operates in real time, performing network processing to localize events. In this context, the relevance of full-wave modeling is unclear for two reasons. First, atmospheric specifications are necessarily statistical in nature, whereas sound propagates through a particular atmospheric state, which is indeed not known. While a current trend is to undertake the impact of atmospheric uncertainty on the waveforms using Monte Carlo simulation, such an approach, however, drastically increases the number of model runs. Second, many thousands of detections are recorded per day and thus, the problem of calculating plausible waveforms for subsets of detections often leads to computational demands that exceed available resources. In this work, we propose a new approach of the localization problem, using stochastic full-wave modeling and non-intrusive generalized Polynomial Chaos (gPC). The main difference with the standard Monte Carlo method is the fact that the sampling is carried out over the gPC metamodel, which is calibrated over a few realizations of atmospheric fluctuations. The performance of the method is demonstrated through reanalysis of the meteor explosion over the Bering sea, on Dec. 18, 2018, using as many meta-models as there are IMS stations that have presumably recorded the bolide.

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Track Classification: Sources and Scientific applications