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learning surrogate model for near real-time estimation of ground-level infrasound transmission losses

Accurate modelling of infrasound transmission losses is essential for evaluating the performance of the International Monitoring System (IMS) infrasound network. The parabolic equation method provides accurate loss modeling but is computationally expensive for operational monitoring applications. To address this, a previous study trained a Convolutional Neural Network on regionally simulated wind speed fields, predicting ground losses nearly instantaneously with a mean squared error of 5 dB. However, it relies on interpolated atmospheric data, which can lead to an incomplete representation of the medium, and only considers wind values, which is not adapted for long-range modelling. In this contribution, we address this by using globally simulated range- dependent wind speed and temperature fields up to 130 km altitude and by optimizing the network. Recurrent layers capture sequential atmospheric dynamics, improving performances. The model achieves an error of 4 dB and provides epistemic and data-relate uncertainty estimates. Validation on reference events (Tonga-Hunga eruption, Hukkakero explosions, etc.) demonstrates the model's generalization capabilities. Predicted attenuation are compared with the one obtained by an alternative version of the model, specialized on a regional scale using fine-tuning. The method also adapts to new frequencies, marking a significant step towards near-real-time evaluation of IMS detection threshold.

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