ID: Type: **Poster**

Realistic Terrain Boundary Conditions into Numerical Infrasound Propagation Modelling

To accurately interpret infrasound arrivals at International Monitoring System (IMS) arrays requires understanding of low-frequency acoustic propagation in the atmosphere. This is often achieved using numerical acoustic propagation modeling. The Parabolic Wave Equation (PWE) uses an approximated Helmholtz equation, obtained for paraxial (i.e. near-horizontal) propagation, and has been extensively used for modeling wave propagation through ocean and atmospheric waveguides. The suitability of the PWE method for the accurate modeling of infrasound relies on its ability to satisfactorily account for the dominant atmospheric propagation effects: geometric spreading, refraction, reflection, diffraction, and scattering. Although the influence of the terrain topography has slowly gained importance among the atmospheric acoustics community, resulting in new PWE models, current global infrasound propagation studies neglect this effect. Here we derive Finite Difference and Split-Step Fourier PWE, in narrow- and wide-angle forms, and compare against Finite Element Simulations for 2D propagation over simple and realistic topographies. We apply the method to study wind turbine noise recorded at the Ascension Island IMS array. Results show that terrain when combined with refracting atmosphere conditions influences recorded infrasonic amplitudes, and that the PE is valid for slopes up to 20 degrees in narrow angle and 30 degrees in wide angle.

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Track Classification: 1. The Earth as a complex system