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Acoustic resonances of atmospheric oscillations

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ABSTRACT

Atmosphere responds in a resonant way to broad-band excitation by earthquakes, volcano eruptions, and convective storms. Energetic oscillations, known as acoustic resonances, occur at frequencies of 3.5–4.5 MHz and involve infrasound propagation between lower thermosphere and either the ocean or the solid earth. Several approaches have been proposed in the literature to determine the conditions of the acoustic resonances occurrence, predict their frequencies, and relate the frequencies to thermal structure of the atmosphere. This paper presents an asymptotic theory of atmospheric resonances. Contributions to the resonance condition of the Berry phase of infrasonic waves as well as phase shifts at turning points and at reflection from the ground surface are discussed. Unlike low and middle latitudes, acoustic resonances are predicted to be a seasonal phenomenon in polar regions. Excitation of atmospheric resonances by plane-wave vertical displacements of the ground surface and by finite sources is considered. Asymptotic predictions are compared to results of numerical simulations. Infrasound tunneling between turning points via evanescent waves is shown to play a critical role in ionospheric manifestations of the acoustic resonances. [Work supported in part by NSF.]