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Infrasound ray tracing models for real events

Gil Averbuch (1), David Applbaum (1), Colin Price (1), and Yochai Ben Horin (2)
(1) Tel Aviv University, Geosciences, Tel Aviv, Israel (gil.averbuch@gmail.com), (2) Soreq Nuclear Center, Israel

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C. Price1, G. Averbuch1, D. Applbaum1, Y. Ben Horin2
(1) Department of Geosciences, Tel Aviv University, Israel
(2) Soreq Nuclear Research Center, Yavne, Israel
Ray tracing models for infrasound propagation require two atmospheric parameters: the speed of sound profile and the wind profile. The usage of global atmospheric models for the speed of sound and wind profiles raises a fundamental question: can these models provide accurate results for modeling real events that have been detected by the infrasound arrays? Moreover, can these models provide accurate results for events that occurred during extreme weather conditions?
We use 2D and 3D ray tracing models based on a modified Hamiltonian for a moving medium. Radiosonde measurements enable us to update the first 20 km of both speed of sound and wind profiles. The 2009 and 2011 Sayarim calibration experiments in Israel served us as a test for the models. In order to answer the question regarding the accuracy of the model during extreme weather conditions, we simulate infrasound sprite signals that were detected by the infrasound array in Mt. Meron, Israel.
The results from modeling the Sayarim experiment provided us sufficient insight to conclude that ray tracing modeling can provide accurate results for real events that occurred during fair weather conditions. We conclude that the time delay in the model of the 2009 experiment is due to lack of accuracy in the wind and speed of sound profiles. Perturbed profiles provide accurate results. Earlier arrivals in 2011 are a result of the assumption that the earth is flat (no topography) and the use of local radiosonde measurements for the entire model. Using local radiosonde measurements only for part of the model and neglecting them on other parts prevents the early arrivals.
We were able to determine which sprite is the one that got detected in the infrasound array as well as providing a height range for the sprite's height or the sprite's most energetic part. Even though atmospheric wind has a strong influence on infrasound wave propagation, our estimation is that for high altitude sources, extreme weather in the troposphere below has low impact on the trajectories of the waves.