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USArray recordings of infrasound generated by the Chelyabinsk Meteor and other, smaller bolides

Catherine de Groot-Hedlin and Michael Hedlin
UCSD, Scripps Institution of Oceanography, La Jolla, CA, United States (chedlin@ucsd.edu)

A small asteroid that entered Earth's atmosphere near the city of Chelyabinsk, Russia, generated infrasound signals that were recorded by USArray barometers at distances from 6000-10000 km from the source. The infrasound recordings made of this event by these arrays are unprecedented, due to rarity of this type of event and the high density and spatial extent of the recording network. Signal characteristics vary across the network; infrasound arrivals recorded in Alaska and along the U.S. northwest coast had higher velocities and higher frequency content than those recorded in the eastern part of the network. The recorded pressure amplitudes at Alaska sites were significantly larger than for the remaining stations. Atmospheric specifications of global wind and sound speeds indicate the presence of a stratospheric duct for propagation to Alaska and stations along the northwest coast; however, most USarray stations lie within a thermospheric duct. Raytrace modeling confirms that, at stations in Alaska and the northwest U.S., the arrival times and durations of stratospherically ducted rays are consistent with observed arrivals at frequencies above the microbarom band. At lower frequencies, arrival times are consistent with thermospheric ducting at stations across the network.

Estimates of infrasound attenuation from the Chelyabisk meteor to the recording sites were made using an attenuation formula derived from parabolic equation simulations. The results suggest that, under the assumption that infrasound was radiated isotropically from the Chelyabinsk meteor, thermospheric returns have higher than expected amplitudes as compared to stratospheric returns at the same frequencies. We examine in greater detail our assumption of isotropic infrasound radiation from a bolide explosion using a number of much smaller fireball events observed at seismic and infrasound sensors at the USArray.