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# of atmospheric entry angle on uncertainties in the observed infrasound signal back-azimuths

Infrasound sensing is essential for the global detection and precise geolocation of bolide events. However, discrepancies often arise between observed back-azimuths — the arrival direction of infrasound signals — and theoretical predictions based on the bolide's peak brightness location, especially for shallow angle entries. Shallow entry angles result in complex, extended acoustic signals along the atmospheric path, with various trajectory segments detected by infrasound stations, causing significant variability in back azimuth residuals (differences between observed and theoretical values). This study investigates how the bolide entry angle influences azimuth variability up to 15 000 km. We developed a model to quantify the impact of entry angles on back-azimuths, showing that shallow entry bolides can lead to substantial deviations, challenging accurate geolocation over long distances. In contrast, steeper entry angles produce more consistent azimuth measurements, reducing uncertainty beyond certain ranges. These findings stress the importance of accounting for trajectory geometry in infrasound analysis to refine bolide detection and characterization, advancing geolocation accuracy and contributing to planetary defense efforts. This framework can also aid in interpreting high energy atmospheric events, such as spacecraft re-entries, where precise geolocation is critical.
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