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Lossy propagation of the Gulfstream Quiet Spike

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The Gulfstream Quiet Spike is a telescoping nose extension with multiple segments of decreasing diameter intended to reduce the outdoor loudness of a sonic boom. This work examines the influence of the atmosphere on a propagated sonic boom signature for this device. First, atmospheric data, averaged by season, has been collected as a function of latitude to reasonably bound the range of meteorological conditions. These atmospheric profiles are subsequently input to nonlinear, lossy propagation code that computes the primary sonic boom carpet for a supersonic aircraft in steady, level flight. This code is an augmented implementation of the KZK model equation for one-dimensional propagation. The confluence of shocks generated by the Quiet Spike remains distinct and do not coalesce, as intended per the design. The amplitudes, rise times and spacing of the shocks from the individual spike segments are strongly governed by dispersion and attenuation. Loudness levels calculated from the resulting ground signatures show an observable change of over 4 dB at certain azimuths due to the various atmospheric conditions. Based on these results, minor design changes are recommended to improve the acoustic performance of the Gulfstream Quiet Spike.