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## Using historical data to improve analysis of nuclear testing

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Films from historic nuclear testing enable new analysis of the shock propagation and buoyant cloud rise with material entrainment, furthering understanding of the time-evolution of the entrained mass. Many late cloud films were captured from at least two positions, enabling accurate characterization of the cloud development and trajectory. A generalized framework is developed to capture the similarity of nuclear debris cloud formation for detonations with similar scaled heights of burst. The nuclear debris cloud regimes are defined based on debris cloud behavior observed in a dry, dusty environment with loose, easily lofted surface material and can be used to improve dispersion models. As new information on how expected material entrainment and mixing is affected by the surrounding environment becomes available, adjustments to the regime height-of-burst ranges are easy to adopt. Both fast-running fallout codes and higher-fidelity cloud-rise and fallout codes need to be validated against existing test data. We present on the use of historical film to provide many types of data to validate and improve models of late cloud behavior. Combining such data with an understanding of buoyant cloud rise and cloud stabilization informs entrainment including the total mass of entrained materials.

### Promotional text

The historic test films inform a generalized framework to understand nuclear debris clouds. New analysis of film data furthers the source characterization of nuclear detonations and provides accurate validation data sets for predictive fallout models.

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