A Revisit to Trinity

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In the process of re-issuing "The Effects of Nuclear Weapons" (ENW) by Glasstone and Dolan, ARA was asked to confirm the labeling of the Trinity photo in figure 2.32. The previous edition (third) was published in 1977.

In response to comments about the Trinity photo in ENW, Dr. Stu Kelley (DTRA) asked ARA to make a "modern" hydrodynamic calculation of the Trinity event and compare the results with the photography. He also asked us to make our own approximations to the triple point path (Mach stem height) for the Trinity event.

A state of the art, two dimensional calculation, was completed using the SHAMRC CFD code. The resolution of the calculation was 5 cm in each direction. The grid covered a region 200 by 200 meters for a total of 16 million zones in two dimensions. The calculation included radiation cooling of the fireball, and a thermal layer model based on the thermal flux as a function of position and time. The radiation cooling and the thermal layer model used the same thermal flux as a function of time, so were compatible. A dust sweep-up model was used to calculate the rate of dust sweep up as a function of the surface level air momentum. The results of the calculation provide insight into the details of the flow behind the shocks and in the turbulent dust region. One of the primary objectives was to calculate the track of the formation and growth of the Mach stem. Agreement with experimental data for Mach stem height, and shock and fireball geometry is remarkable.

We also used the LAMB (Low Altitude Multi-Burst) model to determine an approximate triple point path using simple modeling and fits to data. The path, using the LAMB model, is consistent with the Trinity triple point even though the model required extrapolation beyond its data base.

The full CFD calculation showed that nearly 50% of the Trinity crater volume was the result of dust scouring, with only about half the volume caused by compaction. Earlier estimates had placed the scouring volume ratio at about 30%. (Henny, MABS-18)

This presentation includes comparisons of the SHAMRC code and highly resolved digitized frames from the original photographic film.

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