American Meteorological Society
# Wright Memorial Chapter

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## Minutes from 31 March 2009 Meeting

Meeting of Chapter with Dr. Steve Fiorino, President.

BD's BBQ, Dayton, OH

Dr Fiorino introduced the evening's speaker, MAJ Buck O'Day, US Army, who recently graduated with a Master's Degree from the Air Force Institute of Technology (AFIT).

"ESTIMATION OF WEAPON YIELD FROM INVERSION OF DOSE RATE CONTOURS"

This research was partially funded by the Defense Threat Reduction Agency (DTRA) and MAJ O'Day thanked his colleagues who have visited this research ahead of him, particularly the work of AFIT graduates R.W. Chancellor (2005), K.D. Pace (2006) and C. P. Jones (2007).

Scientists and engineers interested in modeling local fallout from a nuclear detonation using modern programs are aware of difficulties associated with recreating an event that occurred fifty years ago. Several researchers and scientists have attempted to use the Hazard Prediction and Assessment Capability (HPAC) suite of programs to predict local fallout from a nuclear event. These researchers have not been able to effectively recreate the dose rate contours reported from historic events. Previous researchers attributed HPAC's inability to recreate historic dose rate contours to the program's failure to consider variation in wind speed with altitude.

MAJ O'Day's research focused on inversion of dose rate contours from nuclear fallout to determine if a minimum estimate of yield could be established. He developed a fallout deposition code (FDC) to transport and deposit fallout from a nuclear detonation. His model created an initial stabilized cloud of radioactive material using empirical fits to the Defense Land Fallout Interpretive Code Cloud Rise Module (DELFIC-CRM) created by AFIT researchers during the 1980s and then deposited the radioactive debris, in 81 equal activity particle size groups, using wind data obtained from balloon soundings for historic events for 2-3 hours and wind speeds taken from high resolution mesoscale reanalysis weather data thereafter.

MAJ O'Day recreated dose rate contours using HPAC and the FDC for five yields including and bracketing the reported weapon yield from six historic nuclear tests. He determined that the FDC better reproduced

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historic dose rate contours and used this program for the remainder of his research. After numerous recreations of dose rate contours for yields bracketing the historic yield, he determined that the Yield Estimation / Yield Approximation (YEYA) inversion technique was reliable to well within a factor of two of actual weapon yield with more than 90% confidence.

From a fallout modeling and deposition perspective, the major accomplishments of MAJ O'Day's research are that it provided a proof of concept for yield estimation from inversion of dose rate contours, validated the use of ground-zero and high resolution mesoscale reanalysis weather wind data to recreate historic dose rate contours, developed a single numerical figure of merit (FOM) to compare a series of dose rate contours against a reference dose rate contour, and created a relatively simple fallout deposition code that accounts for time and spatially variable winds.

From a meteorologists perspective, his most important findings were the a combination of ground zero balloon wind data and nested-grid reanalysis weather wind data allowed recreation of dose rate contours that more closely matched historic contours than previous modeling efforts. Further, his research improved on the Measure of Effectiveness and Normalized Absolute Difference analysis techniques by creating the FOM to provide a single numerical quantity to compare a series of predicted dose rate contours against a reference dose rate contour.

## Picture of the month

Photograph of rainbow in Waimea, HI (14 April 2009).

Shutterbugs – Submit your latest and greatest weather shots to our newsletter! Send them via e-mail to: mary.bedrick@wpafb.af.mil