Ask Dr. ALOHA: How is ALOHA Different than the Green Book?

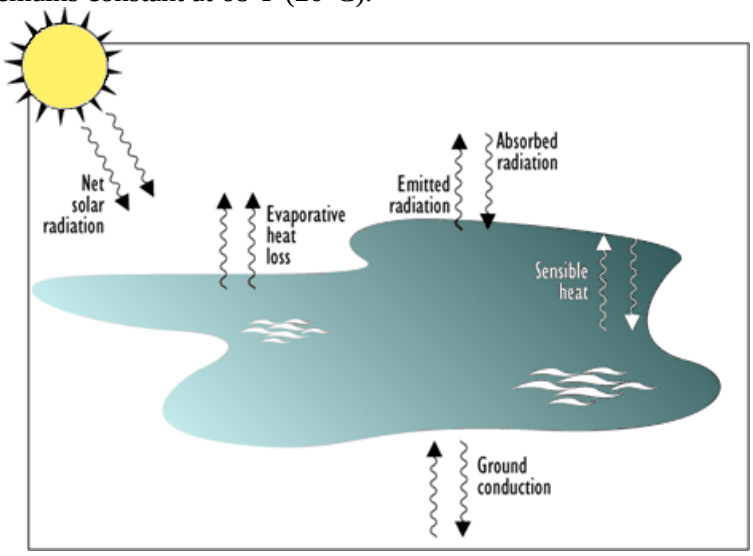
The "**Green Book**" provides a method that planners can use to quickly determine the relative hazards of chemicals stored in a community, as required by the Emergency Planning and Community Right-to-Know Act (EPCRA). The Green Book method uses simple calculations to provide an initial assessment of the hazards based on just a few pieces of information about the stored chemicals. (**CAMEO's** Screening & Scenarios module implements the Green Book procedures.) Once the worst hazards are identified, planners may analyze those locations more thoroughly using a hazard model like **ALOHA**.

Note: Published in 1987, the Green Book is more properly known as ***Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances***.

For a given release scenario, if you compare the Green Book estimate for vulnerable zone distance and the ALOHA estimate for threat zone length, you will find that they are often quite different. The primary reason for this is because the ALOHA model uses more complex equations to give you better estimates of the area affected by a chemical release. (To use ALOHA, you need to specify more information about the potential release than you do in the Green Book procedures.) This article discusses several reasons why ALOHA's calculations differ from the Green Book recommendations.

Liquid Evaporation

For any puddle evaporation scenario, you're likely to see significant differences in your results for two reasons. First, ALOHA uses a more complex method to model evaporation, taking into account many factors that affect evaporation. For example, ALOHA considers the heat exchanged between a puddle and its environment (as seen below), calculating changes in the puddle temperature over time and how this affects the evaporation rate. The Green Book method does not account for these factors and assumes the puddle temperature remains constant at 68°F (20°C).



Some factors that influence ALOHA's evaporation rate estimates.

Second, the Green Book and ALOHA make different assumptions about the size of the puddle formed by a spilled chemical. This is significant because the larger a puddle's area, the greater its evaporation rate. ALOHA expects a puddle of spilled liquid to spread out until its depth averages 0.5 centimeter (the puddle will then become thinner as it evaporates). In contrast, the Green Book assumes that an evaporating puddle will spread to a depth of 1.0 centimeter. So, given the same mass of spilled liquid, ALOHA expects the area of an evaporating puddle to be twice as large.

Atmospheric Dispersion

The toxic threat from any chemical—whether it is released as a gas or evaporates from a puddle—will depend on how the chemical disperses as it travels downwind. A cloud that is heavier than air will disperse differently than one that is neutrally buoyant (that is, about the same density as air).

The Green Book method assumes that all chemicals are neutrally buoyant and dispersed passively by wind and atmospheric turbulence. In addition to modeling neutrally buoyant gases, ALOHA also models heavy gases—and ALOHA will determine the appropriate model to use based on the chemical and the release conditions. However, even for neutrally buoyant gases, there are still some cases where the predictions from ALOHA and the Green Book will differ.

For neutrally buoyant gases, both ALOHA and the Green Book use Gaussian formulas to estimate downwind distance to a specific concentration—but there are some differences:

- The Green Book method uses tables that are based on a Gaussian model where the release is constant and continuous. The Gaussian model that's incorporated in ALOHA is more complex than the Green Book one. ALOHA includes equations to account for release rates that change over time and for dispersion in the along-wind direction that is caused by processes such as wind shear.
- For urban areas, ALOHA uses a different set of Briggs dispersion coefficients (numbers which describe the vertical and crosswind extent of a dispersing gas cloud). So, ALOHA's threat zone estimates can be much longer than those in the Green Book's urban vulnerable zone tables.

Cut-off Limits and Chemicals with Very Low Volatility

Here are two final examples of the differences between ALOHA and the Green Book procedures:

- ALOHA has a 6 mile (10 kilometer) cut-off limit: long threat zones are truncated at that point and ALOHA will not estimate downwind concentrations at distances beyond the limit. The Green Book uses a different cut-off distance: 10 miles (16 kilometers).
- ALOHA's chemical library does not contain chemicals with very low vapor pressures, because these substances are not expected to be volatile enough to be air dispersion hazards. In contrast, the Green Book describes how to estimate dispersion of any substance that has been designated an Extremely Hazardous Substance—even if they have very low volatility (including liquids such as sulfuric acid and solids such as cobalt and lindane).

For More Information

- ALOHA: http://response.restoration.noaa.gov/aloha
- ALOHA Tools: http://response.restoration.noaa.gov/alohatools
- Ask Dr. ALOHA Articles: http://www.response.restoration.noaa.gov/ADA/overview
- Ask Dr. ALOHA - Using CAMEO tools for RMP and EPCRA Hazard Analyses: http://response.restoration.noaa.gov/ADA/RMP_EPCRA
- CAMEO: http://response.restoration.noaa.gov/cameo
- Green Book (PDF): http://www.epa.gov/emergencies/docs/chem/tech.pdf