Modeling the Atmospheric Fate and Transport of Dioxin Emitted During in-situ Burning of Oil from the Deepwater Horizon Spill

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Goal

Estimate the atmospheric deposition and ground-level air concentrations of dioxin resulting from the ocean-surface burning of oil from the Deepwater Horizon spill, to support a screening level assessment of health risks due to inhalation and due to consumption of dioxin contaminated seafood

Approaches

• DIO measured in DWH oil-burning plumes to estimate an emissions factor for in-situ oil burning
• ARL analyzed burn-by-burn data (relayed by NOAA ARL, 2010) to estimate dioxin emissions for the entire modeling period
• ARL modeled the regional fate and transport of dioxin (HYPLIT-SV) for the entire modeling period

Context

• As one of the methods to respond to the oil spill, 410 separate in-situ burns were carried out between April 28 and July 19, burning an estimated 22 (200-310,000 barrels of oil (~5% of the total amount of leaked oil)
• Polychlorinated dibenzo-p-dioxins and furans (referred to as PCDD/F or “dioxin”) are formed in trace amounts during combustion
• The presence of chlorine in the combustion environment is the most toxic and is one of the most potent carcinogenic compounds ever discovered

Accomplishments

• Ground-level air concentrations of PCDD/F were estimated throughout the region
• ARL modeled the regional fate and transport of semi-volatile pollutants such as dioxin (HYPLIT-SV)
• ARL used the atmospheric deposition results of the HYPLIT-SV model as input to a marine food chain model to estimate dioxin concentrations in fish and cancer risk to the general public from fish consumption

Indicators of Success

• The HYPLIT-SV model has been used successfully in the past, e.g., Cohen, Draxler, Artz, et al. (2002). Modeling the Atmospheric Transport and Deposition of Dioxin to the Great Lakes, Environ. Sci. Technol. 36, 4831
• Based on these previous successes and its ability to respond rapidly, NOAA-ARL was asked by the USEPA to assist in this important analysis
• ARL utilized these HYPLIT-SV results in their screening level risk assessment

The analysis underwent several independent peer reviews (both internal and external) and was recognized for doing

Future Directions*

• ARL will carry out sensitivity analyses to examine the influence of key uncertainties on model results
• ARL will extend the HYPLIT-SV model to simulate Polyaromatic Hydrocarbons (PAHs) and use this tool to assess exposure to PAHs as a result of oil burning activities
• ARL will evaluate the HYPLIT-SV model further by additional comparisons against ambient dioxin measurements
• ARL will continue technology transfer and collaboration with Mexican government and academic scientists
• ARL will use the Global Eulerian Model (GEM) capability of HYSPLIT (and HYSPLIT-SV) to simulate atmospheric dioxin in Mexico