HAZMAT Operations: What NOAA Can Provide

TDEM Conference

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Overview

- Plume Modeling available from NOAA
- Interagency Modeling and Atmospheric Assessment Center (IMAAC)
  - Scientific Support for HAZMAT events from NOAA Agencies
  - Exercise Support for HAZMAT events
    - Oil Spill Support
  - Preliminary Damage Path Tool
Plume Modeling Overview
Small Scale Releases

- For small scale (0-10 km), short duration (less than one hour) releases:
  - ALOHA (part of the Computer-Aided Management of Emergency Operations (CAMEO) software suite) is used to forecast the dispersion
  - ALOHA contains a database of hundreds of chemical agents, and is designed to work in concert with CAMEO and Mapping Application for Response, Planning, and Local Operational Tasks (MARPLOT), a companion mapping program
- The NWS typically does not run ALOHA
- But we can help with a site-specific observation or estimate
  - Usually a wind vector, but may include other factors such as stability class or relative humidity.
When NOAA Can Help

- Large atmospheric release
  - Horizontal extent usually >10 km
  - Lasting more than an hour
- Some chemical, biological or radioactive contaminant
NOAA’s Air Resources Laboratory:
- Develops and improves atmospheric dispersion and air chemistry models
- Collects research-grade atmospheric and deposition measurements of select air chemistry parameters;
- Studies the atmospheric boundary layer by collecting and analyzing essential data of surface and near surface weather and climate conditions
- Provides high quality, reference-grade measurements of critical climate parameters.

Most known tool by ARL is the HYSPLIT modeling system
- Designed to support a wide range of simulations related to the atmospheric transport and dispersion of pollutants and hazardous materials, as well as the deposition of these materials to the Earth’s surface.
- Some of the applications include tracking and forecasting the release of radioactive material, volcanic ash, wildfire smoke, and hazardous chemicals.
NOAA’s HYSPLIT Program

- HYSPLIT = Hybrid Single Particle Langrangian Integrated Trajectory Model
- Used to compute air parcel trajectories and dispersion or deposition of atmospheric pollutants
- Can also be used for a back trajectory analysis to determine the origin of air masses and establish source-receptor relationships.

A complete description of all the equations and model calculation methods for trajectories and air concentrations has been published and is available on-line at the following web site: https://www.arl.noaa.gov/hysplit/hysplit/.
NOAA’s HYSPLIT Program

- HYSPLIT runs can be initiated by contacting your local NWS Weather Forecast Office
  - Can be run locally or through requests directly off the NOAA supercomputer
- There are also points across the nation where dispersion forecasts are run continuously
  - Points can be added for special events, ongoing wildfires, large public events, etc
- All runs are calculated using the best meteorological forecast data; there are multiple options and the choice of which model is best likely changes on a day to day basis (forecaster will assess and determine which one is most accurate)
- A public, web-based version of HYSPLIT has been successfully running in a non-operational environment at ARL since the late 1990s.
  - Although a dispersion forecast is still restricted to registered users affiliated with atmospheric science, trajectories and dispersion runs using archived meteorological data are available to anyone. This system, referred to as READY (Real-time Environmental Applications and Display sYstem)
READY (Real-time Environmental Applications and Display System) has been developed to allow users to access and display meteorological data products and to run the HYSPLIT transport and dispersion model on the NOAA Air Resources Laboratory's (ARL) web server. READY brings together dispersion models, meteorological display programs and textual weather forecast programs generated over many years at ARL into a form that is easy to use by anyone. Its primary user group, however, is atmospheric scientists.

A research paper providing an overview of READY titled "Real-time Environmental Applications and Display System: READY" is now available. Any research papers published using READY products should include a reference to this paper.
READY Tools and Products

- HYSPLIT Model
- Volcanic Ash
- Current & Forecast Meteorology
- Wildfire Smoke Forecasting
- Archived Meteorology
- Air Quality Products
- Emergency Assistance
- DATEM Tracer Verification
When to Use HYSPLIT

- To address problems with source-to-receptor distances greater than 1/4 the resolution of the meteorological data driving the model simulation.
- To estimate source strengths based upon the ratio of the air concentration measurement to the model's unit emission air concentration prediction.
- To model the transport and dispersion of neutrally-buoyant materials, or buoyant plumes after stabilization.
- To estimate air concentration or exposure over time at specific locations or areas downwind when temporal and/or spatial variations in meteorological conditions are expected and when estimates of dry and/or wet deposition of the pollutant are required.
- To obtain a forecast of plume position using the most recent NWS/NCEP forecast meteorological data.
When HYSPLIT isn’t Appropriate

- Plume height changes due to non-meteorological factors (i.e., plume rise from the heat of a large fire).
- Transport or dispersion at distances less than 1 km (~1/2 mile) from the source.
- Emissions containing dense gases, especially very near the source (flow controlled by gravity, not meteorology).
- Emissions involving any chemical reactions more complex than radioactive decay if quantitative concentration estimates are required. The model can be run for all situations to infer plume transport directions and plume width estimates.
- Cases where the plume may be diverted due to local topographic features and effects such as sea breezes, unless the local topography and effects are well represented by the meteorological model used to run HYSPLIT. Plume transport within HYSPLIT is driven only by the input meteorological data.
If you are calling an NWS office to request a HYSPLIT run, we need:

– Location and time of release (start and end, if known)
– Rate of release
– Source term characteristics (if known)
– Size and/or height of release
– Who (and how) to contact with the results.

\[
C' = \frac{Q \cdot f}{u} \cdot \frac{g_1 + g_2 + g_3}{\sigma_y \sqrt{2\pi} \cdot \sigma_z \sqrt{2\pi}}
\]

• Remember that HYSPLIT output cannot be released to the public without the consent of the coordinating agency.

• Model results from the web-based version of HYSPLIT will usually be available to the user within a few minutes of submitting the model run.
The NOAA Smoke Forecasting System integrates:

- NOAA National Environmental Satellite, Data and Information Service’s satellite information on the location of wildfires.
- NOAA National Weather Service weather inputs from the North American Mesoscale model.
- Smoke dispersion simulations from the NOAA ARL HYSPLIT model.

It produces a daily 48-hour prediction of smoke transport and concentration.

The model also incorporates U.S. Forest Service estimates for wildfire smoke emissions based on vegetation cover.

This system is intended as guidance to air quality forecasters and the public for fine particulate matter emitted from large wildfires and agricultural burning which can elevate particulate concentrations to unhealthful levels.
• Marsh fire in St. Bernard Parish
• Concern with smoke plume moving into tourist district
• Hysplit modeling saved the city tens of thousands of dollars

Plume Modeling for Super Bowl XLVII
Hysplit
WHO IS IMAAC?

IMAAC IS A PARTNERSHIP
IMAAC TECHNICAL OPERATIONS HUB

- Managed by the Defense Threat Reduction Agency (DTRA).

- The IMAAC Technical Operations Hub, coordinates the production and dissemination of IMAAC plume modeling products.

- Capabilities
  - Staffed 24/7 by CBRNE subject matter experts
  - Turn around requests quickly
  - Numerous decision support tools to assist Interagency customers
UNCLASSIFIED

IMAAC: OPERATIONAL CONCEPT
UNCLASSIFIED

IMAAC MODELING TOOLS

DoD/DTRA
- HPAC
- CAMEO/ALOHA
- NOAA
- CAMEO/ALOHA
- HYSPLIT

HHS
- Population modeling

DoD/DTRA
- HPAC

DOE/NNSA
- National Atmospheric Release Advisory Center - NARAC

DoD/DTRA
- HPAC
- EPA
- NOAA
- NRC
- RASCAL

DoD/DTRA
- HPAC
- VAPO
IMAAC MODELING TOOLS, cont.

Chem/Bio

Rad/Nuc

Explosion

Cascading Effects

Waterborne Hazards
HOW TO ACTIVATE THE IMAAC

- The IMAAC is activated for current or potential real-world emergencies involving significant hazardous atmospheric releases.

- ANY Federal, State, Tribal Territorial, and Local official can request the activation of IMAAC.

To activate IMAAC or request assistance, please call (703) 767-2003.
The IMAAC Emergency Request form describes the type of information required for modeling:

- When (incident time)
- Where (address, intersection, coordinates, etc.)
- What (hazard, amount, dispersal method; any details you know)
- Contact information

Phone call is best to ensure rapid response:
- Form can be filled out and sent later to confirm details
IMAAC ACTIVATION SEQUENCE

1. IMAAC Activated
2. Initial IMAAC Products Distributed
3. IMAAC Coordination Teleconference
4. IMAAC Deactivated
IMAAC PRODUCTS

- **Types**
  - Descriptive plume products (PowerPoint/PDF)
  - GIS shapefiles

- **Access**
  - The primary method of product distribution is the Homeland Security Information Network (HSIN) IMAAC page at: [https://hsin.dhs.gov/collab/IMAAC](https://hsin.dhs.gov/collab/IMAAC)
  - Products may be distributed through email upon request
  - If you require an IMAAC account, please send an email to imaacinquiries@fema.dhs.gov.
EXERCISE SUPPORT & TRAINING

- To request IMAAC support for an exercise or training session, please send your request to IMAACINQUIRIES@FEMA.DHS.GOV.

- Optional, in-classroom technical training to use the HPAC model is available to all federal employees at no cost. For information, please contact the DTRA Training Manager at (703) 767-3419 or dtra.belvoir.J9.mbx.reachback-training@mail.mil.
For Emergencies

IMAAC Operations: (703) 767-2003
Email: IMAAC@FEMA.DHS.GOV

For general inquiries and exercise support requests, please send an email to
IMAACINQUIRIES@FEMA.DHS.GOV

Public website: https://www.dhs.gov/imaac
Delegated National Response Team and Regional Response Team representatives for Department of Commerce

Ocean Science, Living Marine Resource Management, Coastal Resiliency, Weather Forecasting & Observation
Response (24 hours)

Emergency Response Division (ERD)

Assessment & Restoration Division (ARD)

Restoration - Recovery (Years to Decades)
Home Team (SST) located in Seattle

Oceanographers
Biologists
Chemists
Information/Data Management
• On Command Staff, Works Closely with Environmental Unit

• Responsibilities
  – Seek consensus on scientific issues
  – Provide trajectory, resources at risk, and product hazard information
  – Assess environmental tradeoffs associated with cleanup methods and endpoints
  – Facilitate Endangered Species Act (ESA) consultations and National Resource Damage Assessment (NRDA) activities
Analytical Framework
SST in the Response

- Trajectory Specialist
- Resources at Risk Specialist
- Shoreline Cleanup and Assessment Technique (SCAT) Coordinator
- Oil Spill Aerial Observer
Oil Spill Response Tools (Models)

** GNOME (Trajectory)**

** ADIOS (Oil Fate)**

** CAMEO (Chemical Hazard Evaluation)**
Preparedness & Planning

• Planning
  – Participate in Area Committees (ACs) and Regional Response Teams (RRT)
  – GRPs, ERAs

• Drill Support – Planners and Players

• Guidelines
OR&R Contacts

In Coastal Texas and Louisiana:
Paige  206-549-7819  paige.doelling@noaa.gov
Brandi  504-376-3213  brandi.todd@noaa.gov
Steve  206-556-1604  steven.j.wall@noaa.gov

HAZMAT 24-Hour Emergency  206-526-4911
HAZMAT Support – Spot Forecasts

• NOT a model forecast
• Point-specific weather forecast created/edited by local NWS office
• Can help with timing of wind shifts, expected onset of showers/storms
• Primarily useful for determining potential weather hazards that may impact responders/response
National Weather Service On-Site Support

- Can provide in-person briefings and weather expertise specific to the local area
- Available to answer questions
- Can provide heads up notification for any weather hazards that may impact the response/responders
• NWS River Forecast Centers (namely West Gulf RFC in Fort Worth) can do timing and routing times for a spill moving downstream
• Does not measure dispersion and dilution as it moves downstream, just done for routing purposes
Other Tool for Assessing HAZMAT Risk

NWS Preliminary Damage Path Tool

- May 2011 – Tool developed internally
- April 13th, 2012 – First test in the city of Norman
Preliminary Path vs Damage Survey
May 20th, 2013 Moore Tornado
Preliminary Path vs Damage Survey
May 31st, 2013 El Reno Tornado
Getting Messages to the Public

- NWS can help with disseminating messages to the public

**B.4.10 Hazardous Materials Warning (HMW)**

A warning of the release of a non-radioactive hazardous material (such as a flammable gas, toxic chemical or biological agent) that may recommend evacuation (for an explosion, fire or oil spill hazard) or shelter-in-place (for a toxic fume hazard).

**B.4.17 Shelter in Place Warning (SPW)**

A warning of an event where the public is recommended to shelter in place (go inside, close doors and windows, turn off air conditioning or heating systems, and turn on the radio or TV for more information). Examples include the release of hazardous materials where toxic fumes or radioactivity may affect designated areas.

**B.4.6 Civil Emergency Message (CEM)**

An emergency message regarding an in-progress or imminent significant threat(s) to public safety and/or property. The CEM is a higher priority message than the Local Area Emergency (LAE), but the hazard is less specific than the Civil Danger Warning (CDW).
Note:

- WFOs may relay the message over NWS dissemination systems at the request of the alerting authority.
- For security reasons and to minimize the possibility of false or inappropriate releases of a NWEM by NWS, WFOs will develop and institute strict authentication procedures with alerting authorities.
- Since NWS is not authorized to transmit NWEMs to IPAWS, and IPAWS is the sole conduit to Wireless Emergency Alerts (WEAs), NWS cannot activate WEA for NWEMs. All NWEMs relayed by NWS on behalf of non-NWS alerting authorities will only be disseminated across NWS systems and the Emergency Alert System (EAS).
Questions?