Air Resources Laboratory
HYSPLIT Modeling System

Protecting the public by modeling the transport and dispersion of harmful atmospheric materials

The release of hazardous materials to the atmosphere (smoke, dust, and volcanic ash, chemical, biological or nuclear agents) can have significant health, safety, economic, and national security implications. The Air Resources Laboratory's (ARL) HYSPLIT model produces simulations that are critical to understanding how, where, and when substances are transported, dispersed, and deposited over local to global scales; answering the fundamental questions, _where did it come from_, _where is it going_, and _where is it hazardous?_

HYSPLIT is a state-of-the-art analytical tool initially developed by ARL over 30 years ago to produce operational and research-grade dispersion products. Thanks to continued development and enhancements, HYSPLIT remains one of the most widely used models for atmospheric trajectory and dispersion calculations. Publicly available via ARL's Real-time Environmental Applications and Display sYstem (READY) web server (http://www.ready.noaa.gov), thousands of users worldwide access and display meteorological data and create trajectory and dispersion model products for activities such as student experiments, research, and climatological studies. The number of HYSPLIT simulations produced on the READY server has steadily increased since usage tabulations began in 2009, exceeding one million simulations each of the last two years.

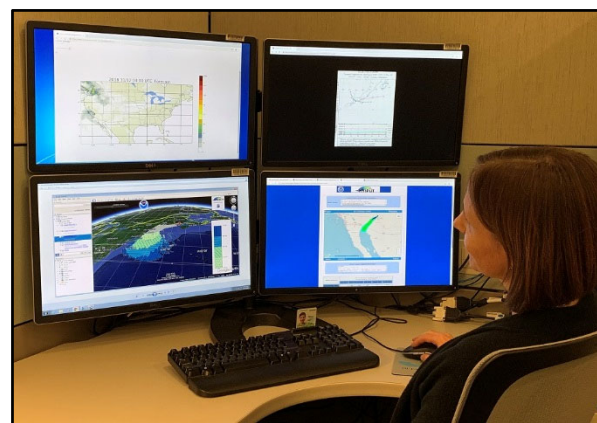### Looking to HYSPLIT for Potentially Life-Saving Answers

Since NOAA's National Weather Service (NWS) is the primary operational user of HYSPLIT, the model is accessible 24x7x365 via dedicated servers. NWS's nationwide network of 120+ Weather Forecast Offices (WFOs) use HYSPLIT's dispersion and trajectory guidance products on a daily basis to aid decision making in their local communities. HYSPLIT is also run by NWS's National Centers for Environmental Prediction per international agreements. HYSPLIT's applications range from simple allergens and common pollutants, to flight planning (aircraft and manned balloons), to hazardous plumes in emergency situations; providing invaluable assistance to emergency planners and first responders charged with protecting life and property and mitigating environmental damage.

An example of HYSPLIT's offerings (clockwise from top left): Ensemble for smoke from fires, hypothetical trajectories for volcano eruptions, time of arrival plots using Google Earth, and WFO exercise results.

HYSPLIT as a Preparatory Tool

In the interest of national security, emergency management partners in major cities frequently utilize contingency plume forecasts from HYSPLIT to prepare for large civic events. HYSPLIT runs are created at regular intervals and kept on hand in the event that something occurs, enabling critical decisions to begin at a moment's notice. Immediately knowing where to look significantly improves response time, which can mean the difference in lives saved. HYSPLIT has supported New Year's Eve festivities in Times Square, the Papal visit (2015), Presidential inaugurations, and numerous high-visibility sporting events including: the Boston Marathon, NBA All Star game and NCAA Final Four, NFL Super Bowl and Pro Bowl, MLB World Series, and NASCAR Daytona 500.

Real Life Examples Highlighting HYSPLIT's Diverse Usage

Across the U.S., HYSPLIT is used on a daily basis to prepare for, and/or react to, numerous different occurrences. These include, but are not limited to:

- Controlled burns, wildfires, scrapyard or refinery fires
- Chemical leaks and spills (industrial locations, well blowouts, train derailments, tanker turnovers, etc.)
- Major nuclear accidents (Fukushima-Daiichi disaster, 2011)
- Deliberate attacks (September 11 attacks, New York City, 2001)
- Natural disasters such as volcanic eruptions (Kilauea, 2018)

The Impact of Ongoing Research

HYSPLIT developers credit decades of national and international collaboration for the model's ever-strengthening capabilities. Regular, ongoing, interactions within the scientific community help to promote the exchange of ideas related to solving atmospheric dispersion problems, and differing perspectives and operational objectives continually inform decision making regarding enhancements. HYSPLIT is used operationally to address volcanic ash, supporting U.S. Volcanic Ash Advisory Centers covering all of North and Central America. A special variation of the model, HYSPLIT-Hg, was developed to better address Mercury; providing an unprecedented ability to assess the relative impacts of local-to-global emissions on Hg levels in fish. Non-traditional, unplanned uses of HYSPLIT are coming to light in recent months and years as well, including tracking the transport of air masses from the Gulf of Mexico into the U.S. to model moisture and possible flooding and also the transport of bugs (meaning both communicable diseases and actual insects that can be transported by wind and destroy crops). One thing is certain, ARL's scientists can be counted on for continued HYSPLIT enhancements that will protect public health and safety and address economic and ecological concerns.

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