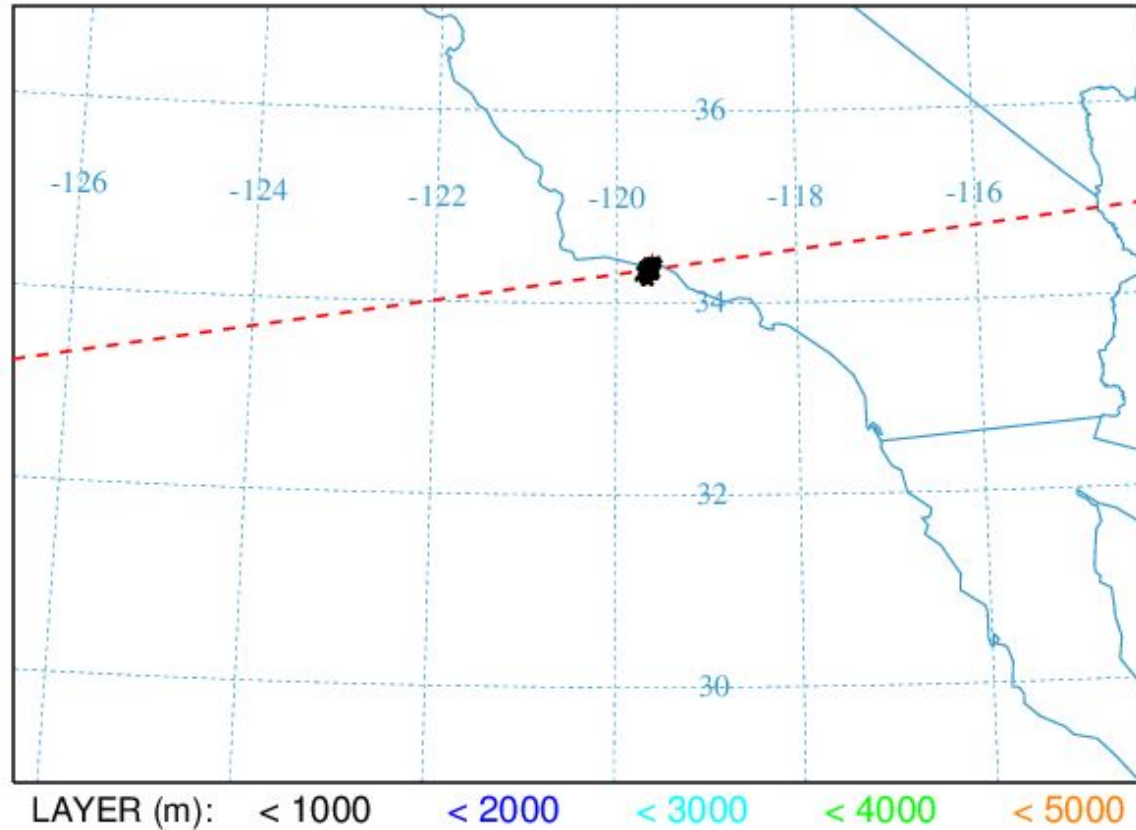# HYSPLIT

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ATMS 748

What is HYSPLIT?

- Hybrid Single-Particle Lagrangian Integrated Transport model
  - Lagrangian frame of reference: specific air parcels are followed through time
- Air parcel trajectories and complex transport, dispersion, chemical deposition and transformation
- Backwards or forwards trajectory calculations
- Variety of particles (PM2.5, radioactive particles, volcanic ash, ozone, dust)

History

- 1949: back trajectory sourcing of radioactive particles from Soviet atomic testing detected by aircraft.
  - All calculations done by hand using winds from twice daily weather balloon data
  - Remarkably accurate
- 1960s: MESODIFF model in response to safety concerns about radioactive material release at Idaho's National Reactor Testing Station.
  - Gaussian puff model using gridded data to account for spatial variability of horizontal wind flow near the surface
- 1970s: Gaussian puff model and trajectory calculations combined to compute long-range concentration models of specific particles
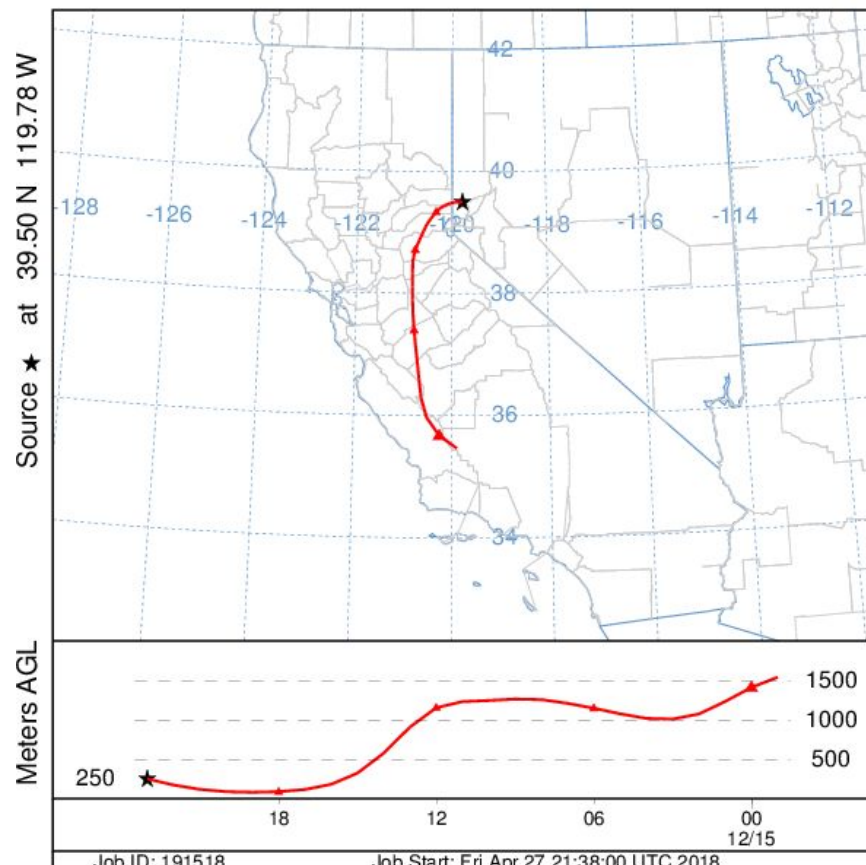- 1980s: the first version of HYSPLIT as we know it

Particle Cross Section Example
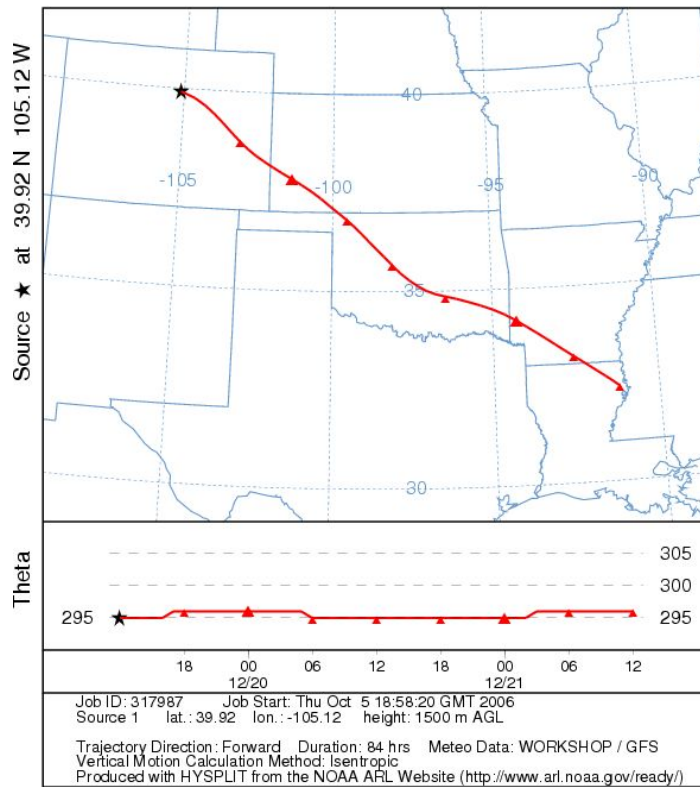
Particle Concentration Example
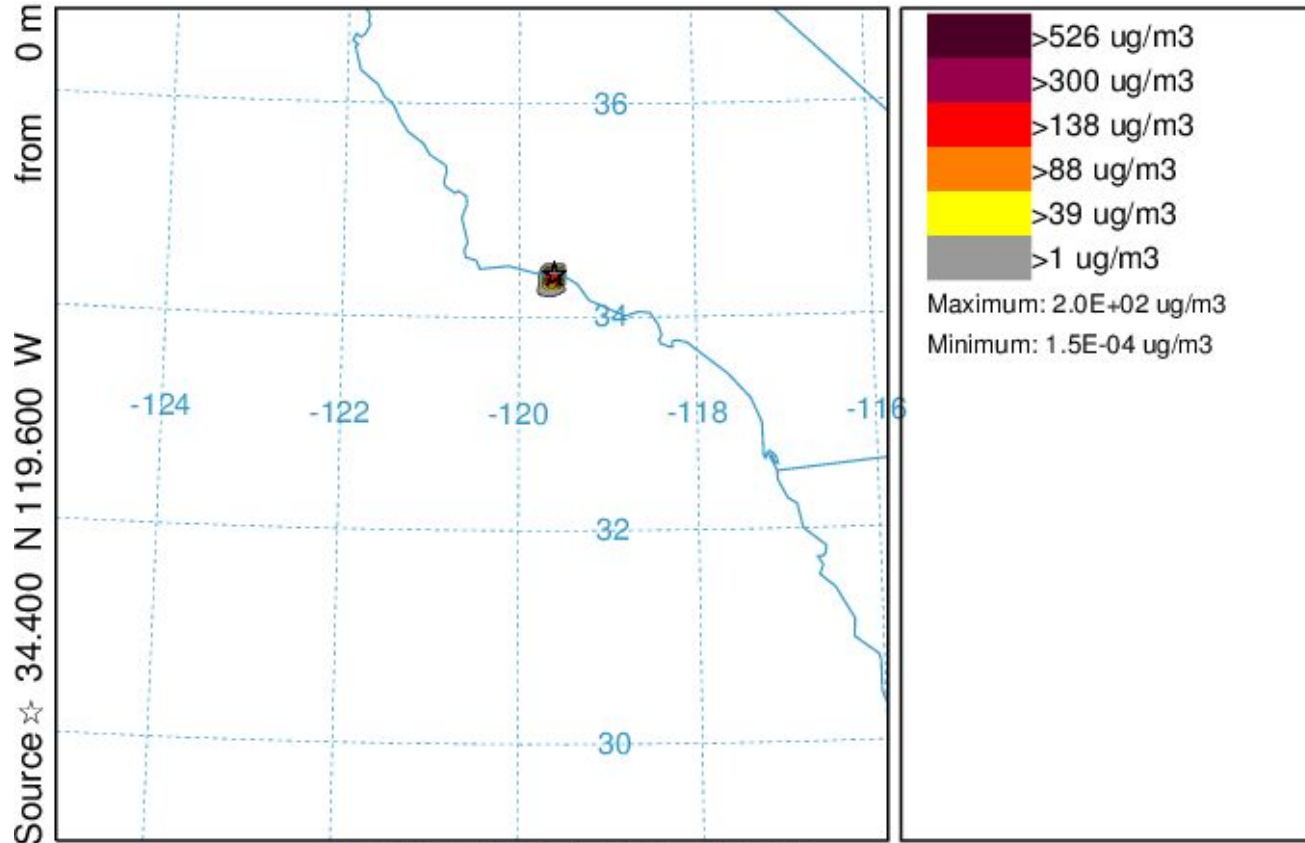
Back Trajectory Example

Forward Trajectory Example

NOAA HYSPLIT MODEL
Forward trajectories starting at 12 UTC 19 Dec 05
12 UTC 19 Dec   NAM Forecast Initialization

Source ★ at multiple locations

-80   -70   -60   -50   -40

-40

40

hPa

600
650
700

Job ID: 318106   Job Start: Fri Oct 6 14:28:27 GMT 2006
Source 1   lat.: 42.0   lon.: -72.0   height: 2500 m AGL

Trajectory Direction: Forward   Duration: 24 hrs   Meteo Data: WORKSHOP / GFS
Vertical Motion Calculation Method: Isobaric
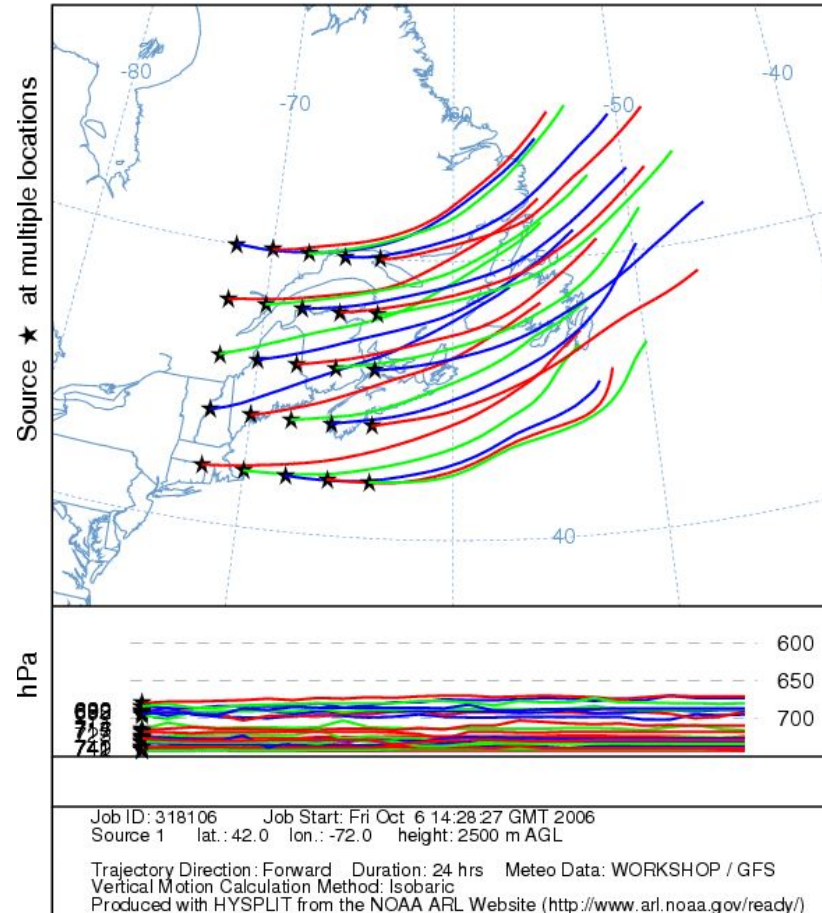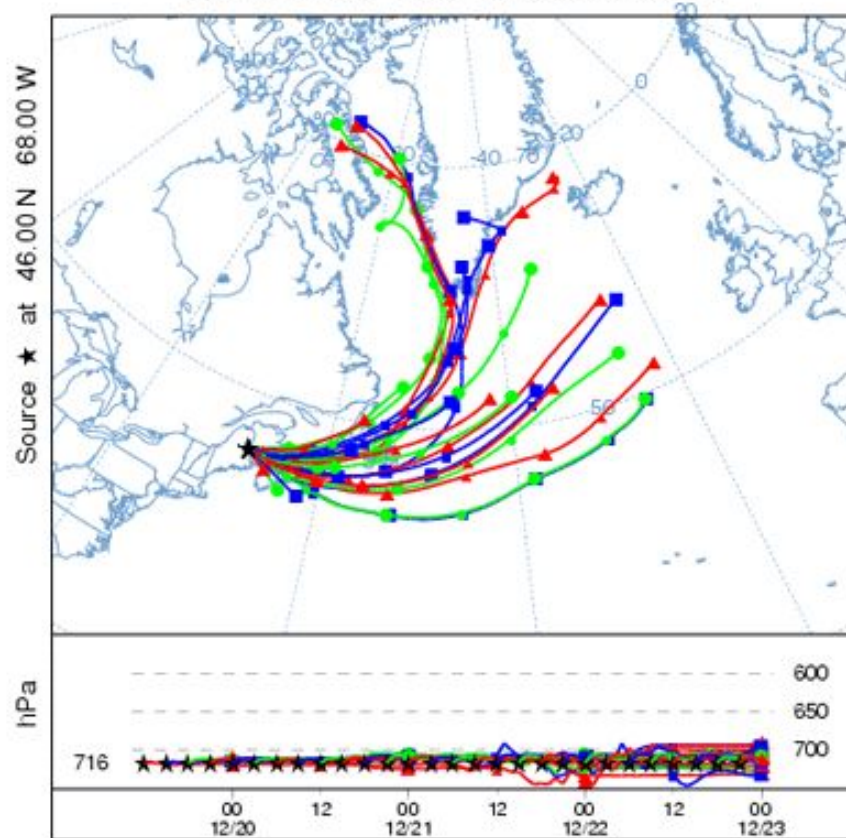Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

NOAA HYSPLIT MODEL
Forward trajectories starting at 12 UTC 19 Dec 05
12 UTC 19 Dec   NAM Forecast Initialization

(a) NOAA HYSPLIT MODEL
Backward trajectories ending at 00:00 UTC 24 May 16
GDAS Meteorological Data

(b) NOAA HYSPLIT MODEL
Forward trajectories starting at 20:00 UTC 17 May 16
GDAS Meteorological Data

Job ID: 135235   Job Start: Tue Aug 9 15:03:56 UTC 2016
Source 1   lat.: 52.000000   lon.: -4.500000   height: 11000 m AGL

Trajectory Direction: Backward   Duration: 170 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 22 May 2016 - GDAS1

Job ID: 126148   Job Start: Tue Aug 9 14:36:46 UTC 2016
Source 1   lat.: 56.000000   lon.: -112.000000   height: 11000 m AGL

Trajectory Direction: Forward   Duration: 170 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 15 May 2016 - GDAS1

References

- https://ready.arl.noaa.gov/HYSPLIT.php
- https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-14-00110.1
- https://en.wikipedia.org/wiki/Lagrangian_and_Eulerian_specification_of_the_flow_field
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