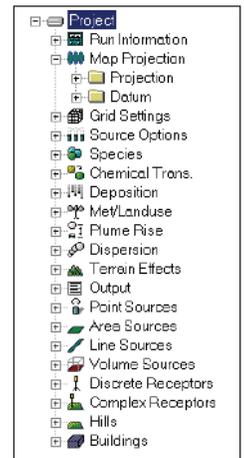# CALPUFF

*BREEZE*® CALPUFF is a Windows®-based advanced air quality modeling system used for common regulatory permitting applications, particularly those involving long-range pollutant transport or complex terrain. CALPUFF, an approved U.S. EPA model in its *Guideline on Air Quality Models*, is a non-steady state Lagrangian puff model that allows for refined representation of long-range phenomena such as visibility, regional haze, and acid deposition through the use of advanced meteorological data inputs. The *BREEZE* CALPUFF system includes CALMET, a distinct geophysical data processing system that compiles numerous data in various formats and time resolutions into a single file, through the use of several integrated preprocessors.

CALPUFF contains algorithms for minimum averaging periods of 1 hour for:

- Near-source effects
  - Building downwash
  - Partial plume penetration
  - Transitional plume rise
  - Subgrid scale terrain interactions
- Long range effects
  - Dry and wet deposition pollutant removal
  - Chemical transformation
  - Vertical wind shear
  - Overwater transport

- Temporally and/or spatially varying flow fields
  - Complex terrain: mountain-valley wind reversals, anabatic winds, katabatic winds
  - Coastal effects
  - Stagnation conditions
  - Non-uniform land use patterns
- Visibility assessments and pristine area impact studies
- Criteria pollutant modeling, including application to State Implementation Plan (SIP) development
- Buoyant area and line sources



BREEZE *CALPUFF features intuitive data organization.*

## CALPUFF - The Model

Originally developed for the California Air Resources Board by Sigma Research, CALPUFF contains algorithms for near-source effects such as building downwash, partial plume penetration, transitional plume rise, and subgrid scale terrain interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear, and overwater transport. Effective May 15, 2003, CALPUFF became an EPA recommended model for assessing the impact of pollutants on Federal Class I areas and on a case-by-case basis for specific near-field applications involving complex meteorological conditions. Furthermore, it is recommended for sulfur dioxide ($SO_2$) and particulate matter (PM) compliance assessments.
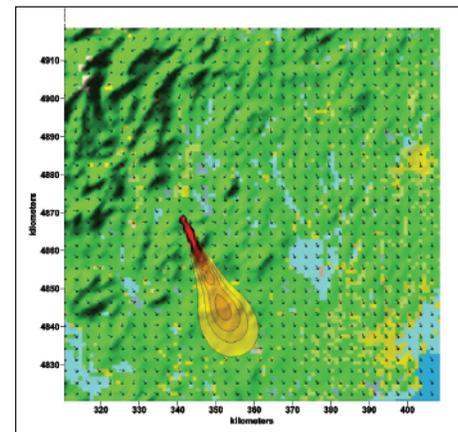


*CALPUFF supports easy overlaying of terrain, landuse, wind vectors, and concentration.*

## CALMET – The Model

CALMET, the meteorological preprocessor for CALPUFF, includes a diagnostic wind field generator containing objective analysis and parameterized treatments of slope flows, kinematic terrain effects, terrain blocking effects, and a divergence minimization procedure. It produces gridded fields of surface friction velocity, convective velocity scale, MO length, mixing height, PGT stability class, air temperature, and precipitation rate.

### Source Types
Point (constant or variable emissions)
Line (constant emissions)
Volume (constant or variable emissions with 1-hour
    time constraint)
Area (constant or variable emissions)

### Plume Rise
Partial penetration
Buoyant and momentum rise
Stack tip effects
Vertical wind shear
Building downwash effects

### Vertical Wind Shear
Puff splitting
Differential advection and dispersion

### Inputs
CALMET geophysical and meteorological data (required)
Emission parameters and rates
Hourly ozone concentration
Deposition velocity data
Chemical transformation data
Hill data and hill receptors
Coastline data

### Outputs
Unformatted data files containing gridded fields of
    time –averaged concentrations
Time-averaged dry deposition fluxes
Time-averaged wet deposition fluxes

## Benefits

The *BREEZE* CALPUFF system includes standard *BREEZE* productivity features and several enhancements that result in seamless, time-efficient modeling runs.

***CALMET:*** Meteorological preprocessor for CALPUFF, comprising:

- **Combined Pre-processors:** Two fully functional pre-processors for input to CALMET resulting in a streamlined, automated process, including MAKEGEO: TERREL and CTGPROC; and PMERGE: PXTRACT

- **SMERGE:** Surface meteorological preprocessor that processes and reformats hourly surface observations and creates formatted or unformatted files

- **READ62:** Preprocesses upper air data for CALMET

**BREEZE *Graphics:*** Provides a seamless interface between CALMET and Surfer®. GRAPHICS can be used with CALMET to create effective 2-D and 3-D graphics.

**BREEZE *Animator:*** Captures several images and produces an animated version allowing the user to visualize plot changes over time.

***Snapshot Array:*** Automates the production of report-ready plots.

***User-friendly Interface:*** Intuitive icons and a streamlined design help users easily navigate throughout *BREEZE* CALPUFF.

***Building Profile Input Program (BPIP):*** Calculates building heights and projected building widths for simple, multi-tiered, and groups of structures.

***Coordinate Conversion:*** Input projections can be converted to other systems, such as latitude/longitude coordinates to UTM or Lambert Conformal coordinates.

***Object Visualization:*** Results and objects are easily visualized using the latest Windows-based technology.

***Multi-window View:*** View up to 4 windows simultaneously to compare graphical and text-based results.

***Data Explorer:*** View model object groupings in two ways. Split screen displays allow for simple identification and editing of data parameters.

***Data Downloads:*** Link to databases containing met, terrain, and land use data.
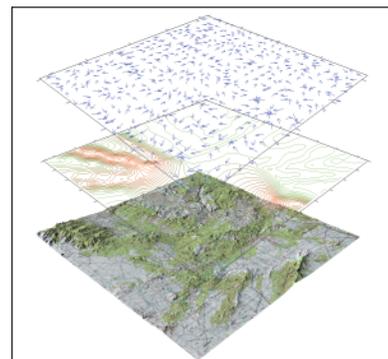
*CALMET and CALPUFF output can be easily combined to produce high quality graphics for your modeling report.*

**breeze**

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