BenMAP, The Environmental Benefits Mapping and Analysis Program: A Tool for Estimating Health Benefits from Air Quality Improvements.

Davidson, K.F.[1]; Deck, L.[1]; Hallberg, A.[1]; Hubbell, B.[2]; McCubbin, D.R.[1]; Post, E.S.[1]

AIRNET
A Thematic Network on Air Pollution and Health

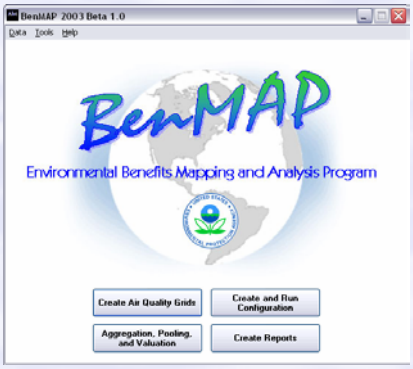
NERAM
Network for Environmental Risk Assessment and Management

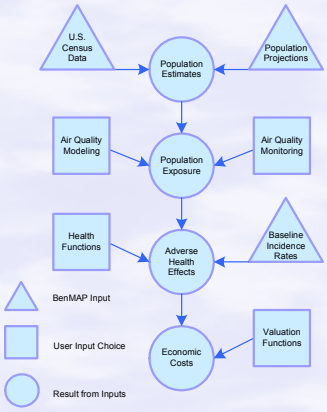
What is BenMAP?

Abt Associates Inc. and the United States Environmental Protection Agency's (US EPA) Office of Air and Radiation have developed a state-of-the-art air benefits model called BenMAP, the Environmental Benefits Mapping and Analysis Program. BenMAP is the US EPA's premier tool for estimating benefits associated with air pollution reduction strategies. BenMAP runs on a Windows© based computer, and is planned for public released by the US EPA after a successful peer review. BenMAP is a GIS-based modeling system that can:

- Create population-level air pollutant exposure surfaces;
- Estimate changes in incidence of a wide variety of health outcomes associated with changes in ambient air pollution;
- Value changes in incidence of health outcomes;
- Provide characterizations of uncertainty in incidence and valuation estimates; and,
- Document key modeling assumptions and analyst judgments through an exportable "audit trail."

BenMAP is designed for many types of users to examine the benefits of policy options for air quality management, including policy analysts, academics, and decisionmakers.

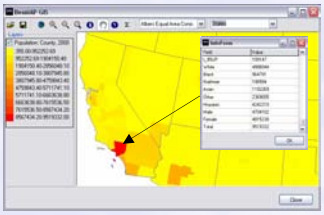




Key Features of BenMAP

BenMAP can handle data at many different levels of spatial aggregation. By overlaying grid-based data files over a geographical area of interest (e.g., the U.S.), BenMAP fits data into each user-specified grid cell. A "grid" can be regularly shaped or based on GIS shapefiles.

Population Estimates are built off of U.S. Census block data and aggregated to a user-specified grid. BenMAP can be easily adapted to accommodate population grids from other countries.



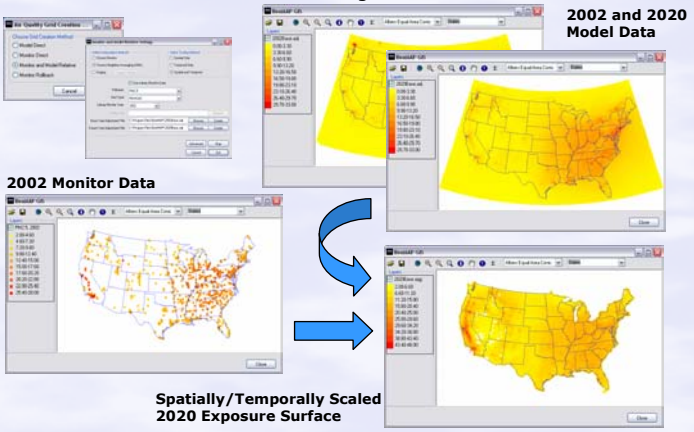
Air Quality Data – BenMAP is able to use a wide variety of air quality data, both monitored and modeled.

- *Model based data* is widely available in standard grid formats (REMSAD, CAMx, UAM-V). Other model formats can be imported by the user.
- *Monitor based data* – BenMAP contains an internal library of U.S. monitor data for multiple years and pollutants.

Key Features (Cont.)

Population Exposure Surfaces (grids) can be calculated in multiple ways, including direct use of monitor or model data, or use of model data with monitor data in a relative sense. Interpolation methods include *Closest Monitor, Voronoi Neighbor Averaging, and Kriging*.

- Users can also quickly assess **"What If?"** scenarios based on user-defined reductions in monitored air quality levels.
- BenMAP includes a powerful **Monitor Filtering** tool that can be used to restrict the monitors used in grid creation.

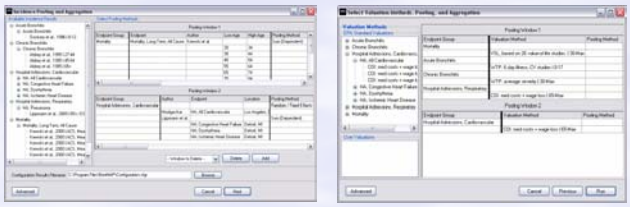


Adverse Health Effects – BenMAP is preloaded with hundreds of C-R functions to estimate adverse health effects. Users can easily add more with the full featured equation editor.

Pooling - BenMAP can also combine the results of multiple C-R functions that estimate the same pollutant-health endpoint combination in order to produce better estimates of the adverse health effect. BenMAP supports three pooling methods: *Subjective Weights, Fixed Effects, and Random/Fixed Effects*.

Valuation - BenMAP can estimate the economic value of avoided incidence based on hundreds of health effect-specific unit values.

Uncertainty - BenMAP characterizes uncertainty surrounding C-R relationships and uncertainty surrounding unit dollar values and total monetized benefits using Monte Carlo methods.



Future Directions for BenMAP

- **International BenMAP** – We are designing BenMAP to allow international researchers to enter their own population, health and air quality data.
- **Advanced Uncertainty Analysis** – BenMAP will be able to evaluate multiple uncertain elements within a given policy analysis, provide a more sophisticated treatment of correlation structures, and provide influence analyses.
- **Addition of Non-Air Impact Assessment** – BenMAP's grid-based modeling structure makes it transferable to assessments related to visibility, mercury deposition and water pollution.
- **Website** with all databases and configurations used in EPA analyses. Users may completely replicate analyses and develop own sensitivity analyses.

Notes

1. Abt Associates Inc., 4800 Montgomery Lane, Suite 600, Bethesda, MD 20814 USA
2. US EPA, Research Triangle Park, NC 27711 USA

Abt Associates Inc.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY