HEM-3

Screening Tool for Human Exposure Modeling

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Purpose

- Provide a screening tool to evaluate emissions of toxic air pollutants
  - Cancer risks
  - Noncancer risks
  - Population exposures
- Evaluate sources with complex configurations and multiple pollutants

Changes from Earlier Versions

- Updated dispersion algorithm
- Updated treatment of Census blocks
- New platform – easier to use

General Specifications

- Uses ISCST3 dispersion model
- Analyzes risks at Census blocks
- Estimates cancer risks, noncancer hazard indices & population exposures
- Evaluates long term (5-year) and short term (down to 1-hour) concentrations
- Analyzes multiple pollutants concurrently

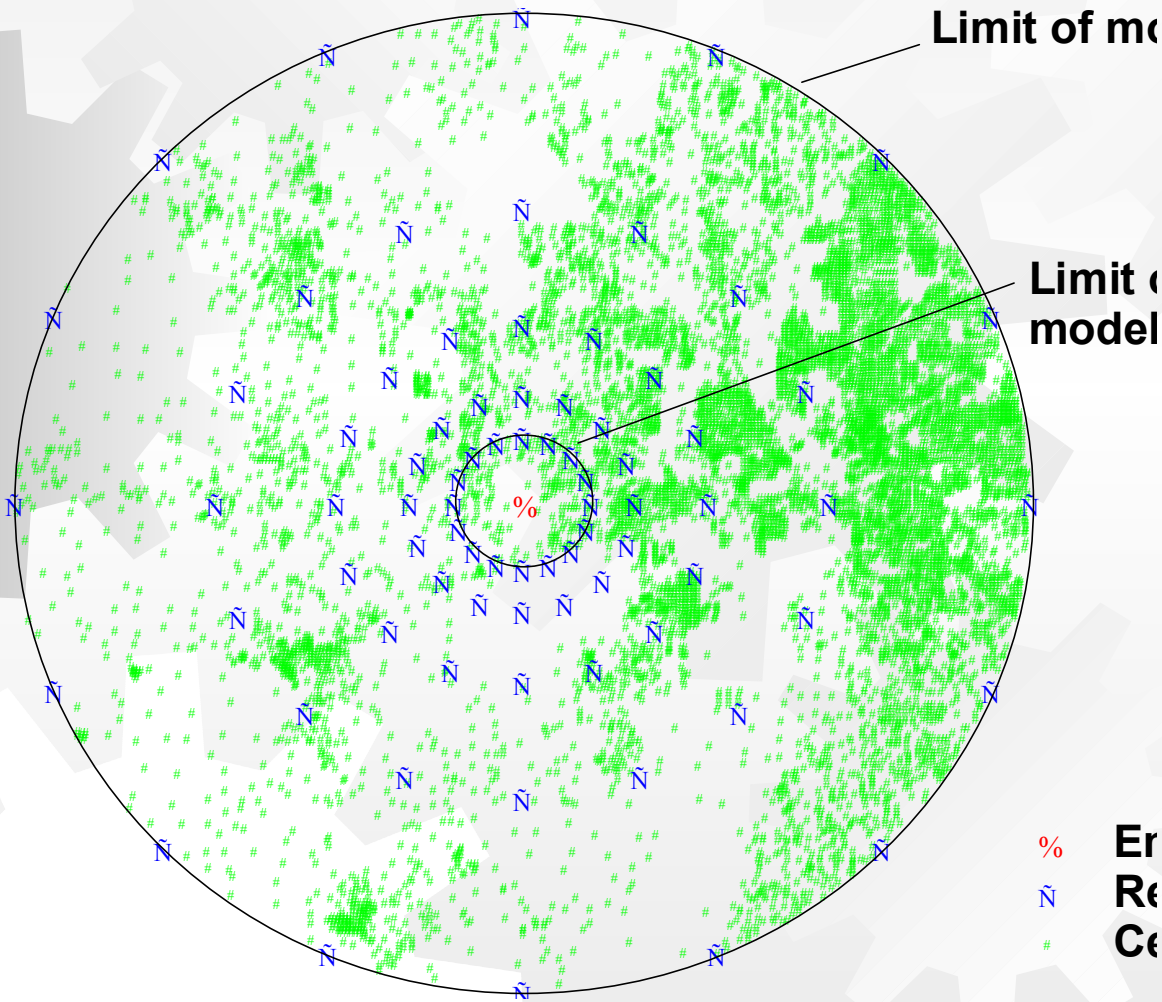
Optional Features

- Terrain elevation (available at the Census block level)
- Pollutant deposition and depletion

Modeling Domain Specification

- User defines model domain
  - Radius of overall domain
  - Transition from discrete modeling to interpolation
  - Specification of polar receptor network
- Modeling of blocks
  - Nearby blocks are modeled separately
  - Beyond the transition point, concentrations are interpolated based on the polar receptor network
  - Block locations (geographic centers) based on 2000 Census

Example Modeling Domain



Other User Inputs

- Most inputs are read from standardized spreadsheets
  - Source locations and configuration
  - Pollutant emissions
  - Particle size distribution and scavenging factors
  - Additional discrete receptors, such as nearby houses or schools
- User also selects meteorological data or provides source-specific data

Sample Source Location File

Source ID	Type	Longitude or UTM East (m)	Latitude or UTM North (m)	UTM zone	Length in x direction (m)	Length in y direction (m)	Angle	Elevation (m)	Stack height (m)	Initial release height (m)	Initial plume height (m)	Stack diameter (m)	Exit velocity (m/s)	Exit tempera-ture (K)
06C00ROT	U	559966.0000000	4400652.0000000	16				244	50.3			2.82	21	322
06C01RMA	U	559940.0000000	4400645.0000000	16				244	18.3			1.14	18	308
06C02RVN	U	559937.0000000	4400649.0000000	16				244	18.3			1.14	18	308
06C03RVN	U	559934.0000000	4400653.0000000	16				244	18.3			1.14	18	308
06C04RVN	U	559933.0000000	4400657.0000000	16				244	18.3			1.14	18	308
06C05RVN	U	559931.0000000	4400661.0000000	16				244	18.3			1.14	18	308
06C06RSL	U	559926.0000000	4400664.5000000	16				244	18.3			1.14	17	316
06C07RRS	U	559925.0000000	4400667.0000000	16				244	18.3			1.14	18	310
06C08RSF	U	559923.5000000	4400670.0000000	16				244	18.3			1.14	18	315
06C09RRS	U	559922.0000000	4400674.0000000	16				244	18.3			1.14	22	308
06P11RSF	U	559959.0000000	4400670.0000000	16				244	30.5			1.22	23	322
06FARRFN	U	559880.0000000	4400565.0000000	16	130	120	0	244		2.0				

Sample Emission File

Source ID	Pollutant	CAS number	Emissions (tons/year)	Standard deviation (tons/year)	Fraction emitted as particulate matter (%)
06C00ROT	Lead compounds	7439-92-1	0.915250150693187	0.732200120554533	100.0
06C00ROT	Antimony compounds	7440-36-0	0.118429308694064	0.094743446955263	100.0
06C00ROT	Arsenic compounds	7440-38-2	0.118029454995201	0.094423563996165	100.0
06C00ROT	Cadmium compounds	7440-43-9	0.095154031786815	0.076123225429444	100.0
06C00ROT	Chromium (III) compounds	7440-47-3	0.031823062461603	0.025458449969270	100.0
06C00ROT	Chromium (VI) compounds	18540-29-9	0.000318230624615	0.000254584499700	100.0
06C00ROT	Manganese compounds	7439-96-5	0.002964297178072	0.002371437742447	100.0
06C00ROT	Mercury (elemental)	7439-97-6	0.042198572335968	0.033758857868774	50.0
06C00ROT	Nickel compounds	7440-02-0	0.020700475371613	0.016560380297295	100.0
06C00ROT	Selenium compounds	7782-49-2	0.066887952547614	0.053510362038102	100.0
06C00ROT	Acetaldehyde	75-07-0	1.013220123793560	0.810576099034845	0.0
06C00ROT	Acetophenone	98-86-2	0.206961590825826	0.165569272660651	0.0
06C00ROT	Acrolein	107-02-8	0.440204018581920	0.352163214865552	0.0
06C00ROT	Acrylonitrile	107-13-1	0.022585094236943	0.018068075389546	0.0
06C00ROT	Benzene	71-43-2	6.945649760141130	5.556519808112900	0.0
06C00ROT	Biphenyl	92-52-4	1.109896059644180	0.887916847715354	0.0
06C00ROT	Bis(2-ethylhexyl)phthalate	117-81-7	2.327731270966220	1.862185016772960	6.5
06C00ROT	1,3-Butadiene	106-99-0	17.974215257662600	14.379372206130000	0.0
06C00ROT	Carbon disulfide	75-15-0	26.257371897290300	21.005897517832300	0.0
06C00ROT	Chlorobenzene	108-90-7	0.192999896206624	0.154399916965300	0.0
06C00ROT	Chloroform	67-66-3	0.026839304715029	0.021471443772020	0.0
06C00ROT	Cumene	98-82-8	0.030504542865483	0.024403634292375	0.0
06C00ROT	Dibenzofuran	132-64-9	0.105123347721054	0.084098678176828	90.0
06C00ROT	Dibutylphthalate	84-74-2	0.010770450134810	0.008616360107833	0.0
06C00ROT	1,3-dichloropropene	542-75-6	0.071099049909553	0.056879239927659	0.0
06C00ROT	Ethyl benzene	100-41-4	0.651154665013232	0.520923732010574	0.0
06C00ROT	Ethyl chloride	75-00-3	0.473055064744749	0.378444051795813	0.0
06C00ROT	Formaldehyde	50-00-0	0.054743921927057	0.043795137541644	0.0
06C00ROT	n-Hexane	110-54-3	0.643176553802259	0.514541243041797	0.0
06C00ROT	Methyl bromide	74-83-9	0.242159140285999	0.193727312228798	0.0
06C00ROT	Methyl chloride	74-87-3	8.987107628831280	7.189686103065020	0.0
06C00ROT	Methyl ethyl ketone	78-93-3	0.271490431502814	0.217192345202265	0.0
06C00ROT	Methyl iodide	74-88-4	0.111928207283355	0.089542565826697	0.0
06C00ROT	Methyl isobutyl ketone	108-10-1	0.212155206523650	0.169724165218929	0.0

QA Checks for Model Inputs

- Standard checks
  - Linkage of emissions to sources
  - Linkage of pollutants to pollutant library
  - Spatial overlap between sources and receptors
- Additional QA tools
  - Web-based GIS link for checking overall source location
  - Map for checking source configuration and nearby receptors

Outputs

- Maximum estimated risk levels (for populated and unpopulated sites)
- Location of highest-risk receptors
- Pollutant-specific and source-specific contributions to maximum risk levels
- Domain-wide exposures

Planned Additions

- Link to EPA's Indirect Exposure Model (IEM) for multimedia exposures
- Ecological screening
- Monte Carlo analysis of model predictions

Current Status

- Under development (pre-Beta test)
- Expected completion of test model – September 30, 2003