HARP
(Hotspots Analysis and Reporting Program)

Presented to:

USEPA Region 5

July 17, 2003

Presented by:

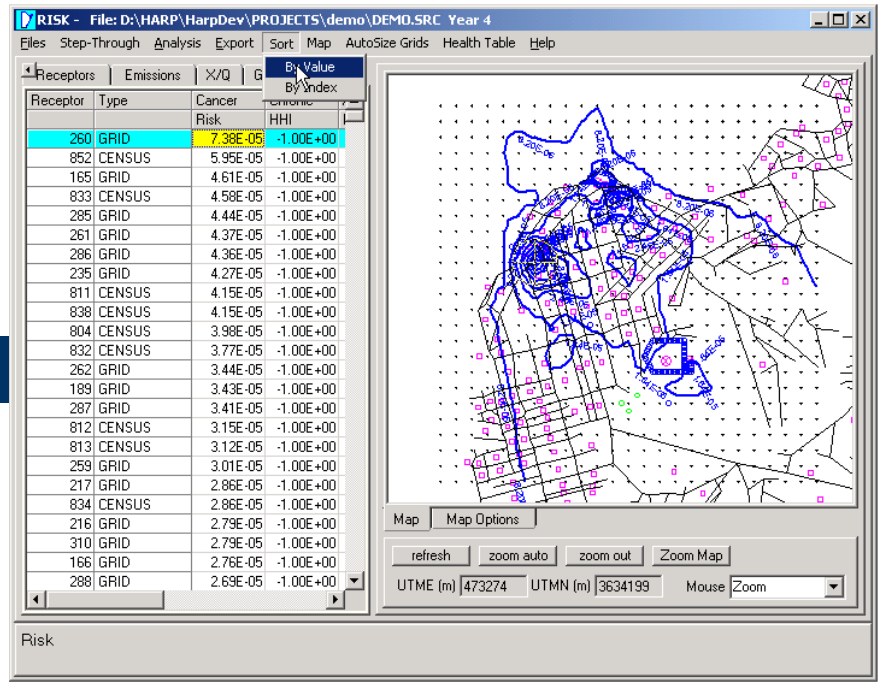
Jeff Dillingham, Ph.D.

Dillingham Software Engineering, Inc.

La Jolla, CA

858-551-8526

Email: Jeff@DillinghamSoftware.net



Agenda

- Background
- Program Organization
- Data Entry and Management
- Reporting
- Dispersion Analysis
- Risk Analysis

Background

What is HARP?

"Hot Spots Analysis and Reporting Program"

HARP integrates all of the data management, dispersion and risk analysis functions required for statewide air quality management into a single windows-based program.

Background

- Project initiation
  - Initiated in July 1995 in support of Assembly Bill 2588, Air Toxics “Hot Spots” Information and Assessment Act
- Release schedule
  - **Database management module** completed and deployed in June 1996
  - **Risk analysis module** developed (1999-present) in parallel with development of risk analysis guidelines by Office of Environmental Health Hazard Assessment (OEHHA)
  - **Public release** expected summer of 2003
- Funding/Sponsor
  - Funded by California Air Resources Board (CARB)
- Contractor
  - Software designed and written by Dillingham Software Engineering, Inc. (DSE)
- Deployment
  - Expected summer of 2003

Project Objectives

- Uniform data reporting
  - Standardize reporting of emissions data state-wide
- Electronic data exhange
  - Transmit emissions data to/from CARB and districts
- Compatibility with CEIDARS database
  - Wimilar to RAPIDS and NEI
- Standardize analysis
  - Standardize emission inventory, dispersion and risk analysis by integration into one program
  - Strict compliance with OEHHA guidelines for risk analysis methodology (similar to HHRAP)
- Royalty-free distribution
  - Software will be available at little or no cost, including public domain street maps, census data and terrain elevation data
- Turn-key system
  - Includes everything for data reporting, dispersion analysis, risk analysis, GIS. No third-party software required.

HARP Program Organization

Four Flavors of HARP

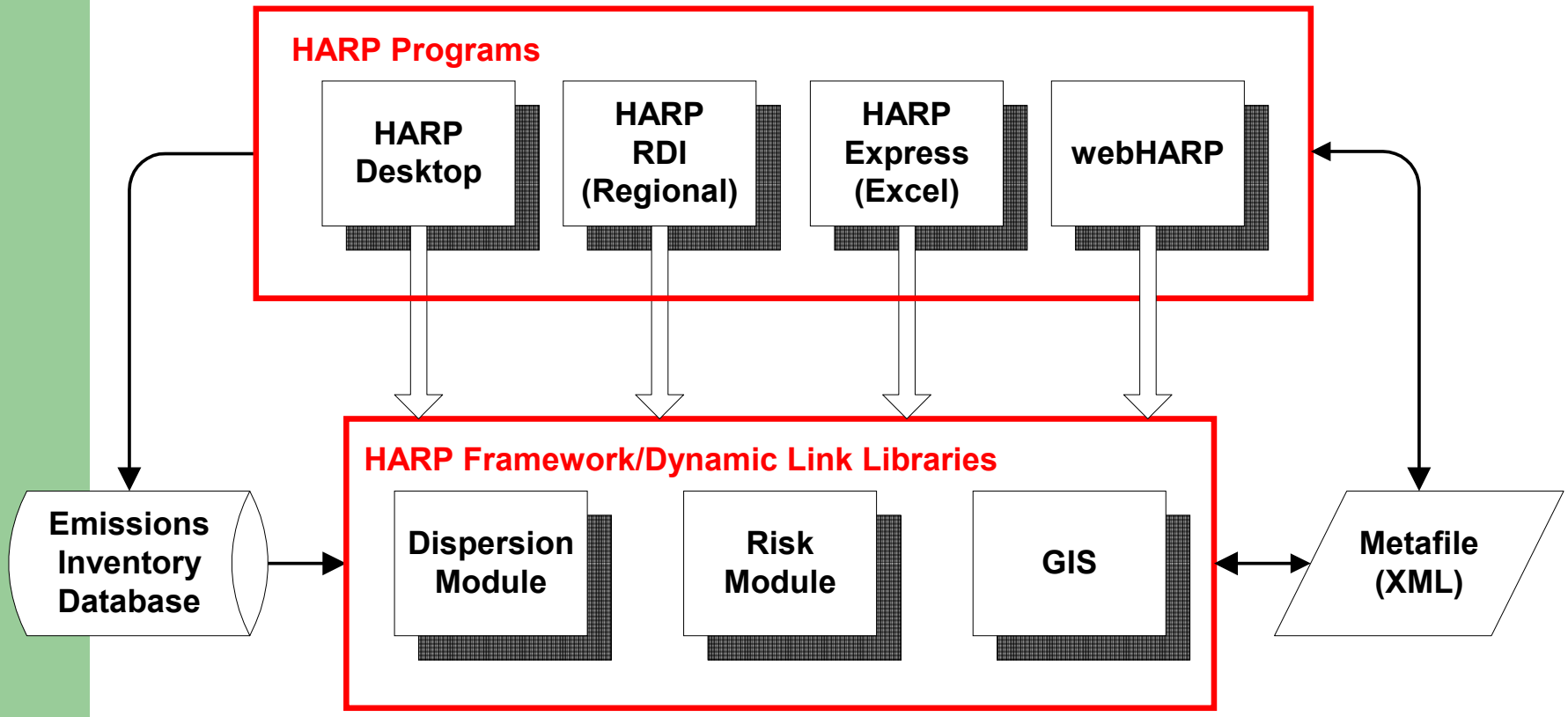
HARP Desktop/Framework
emissions inventory database, dispersion analysis, risk analysis, integrated GIS; framework libraries

webHARP
Web-based interface to HARP analysis functions

HARP Regional Data Integrator
batch processing of dispersion and risk on a large scale

HARP Express
Spreadsheet for streamlined input of data. Run HARP dispersion and risk analysis from Excel

HARP Framework

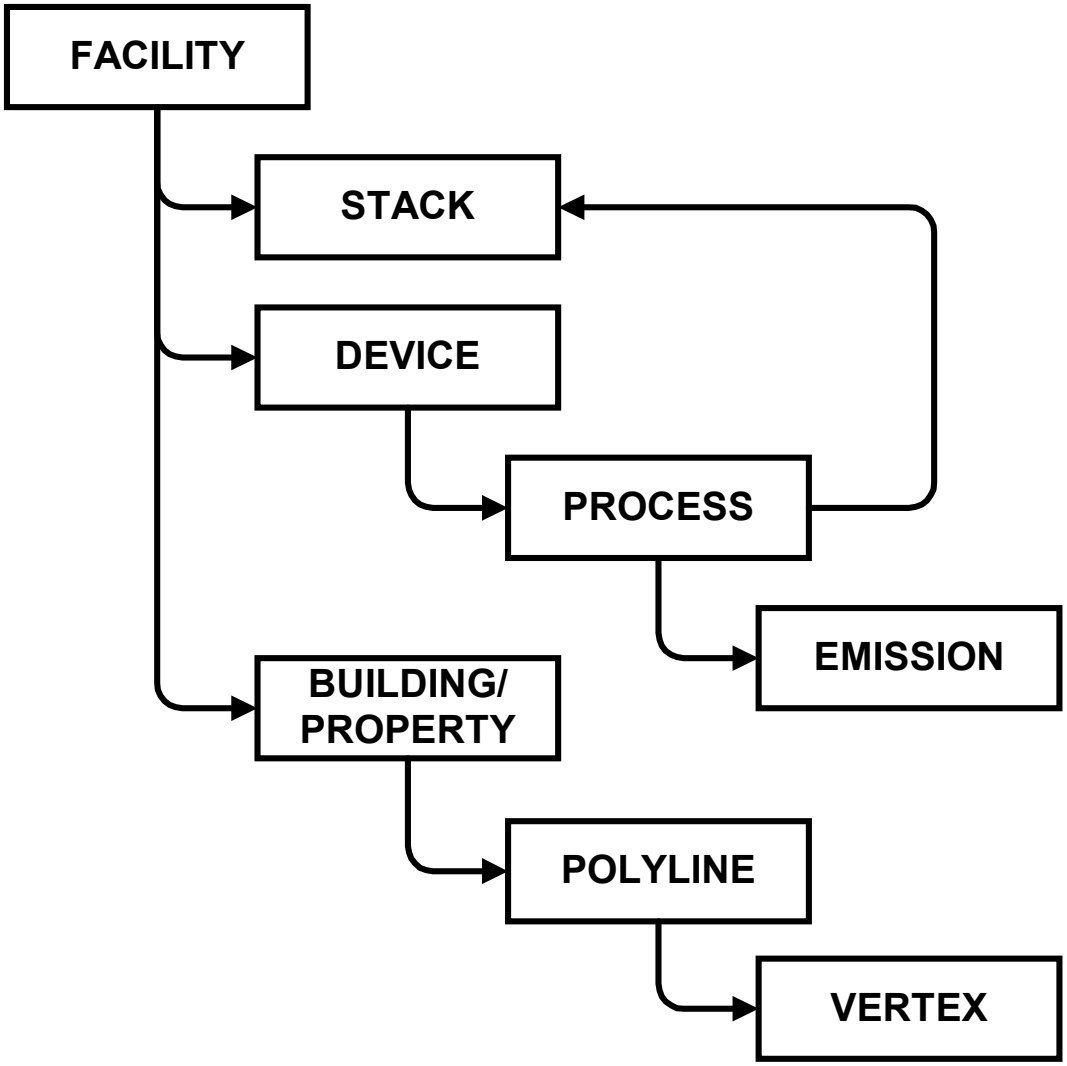


Data Entry and Management

HARP Data Management

- Interactive Data entry
  - Facility, device, process, emissions, stacks, buildings, property boundaries
  - Error checking/validation
  - Pick-lists for pollutants, SCC, SIC, etc.
  - Conversion of facility and stack locations between coordinate systems and datums
- Reporting
  - Emission inventory standard reporting forms
  - Emission summary by facility and process
  - Q/A reports
  - Prioritization (ranks facilities based on California rules)
- Read/write transaction files
  - Allows exchange of data between consultants, facilities, districts, and state

Database Organization



HARP - Reporting Year 1998

Facility Data - Inventory Year 1998

Device Data - Inventory Year 1998

Process Data - Inventory Year 1998

Emissions Data - Inventory Year 1998

Stack Data - Inventory Year 1998

Add Duplicate Delete Save List Undo Next Previous Goto Help Exit

STACK INFORMATION

Page 1 | Page 2

Identification (1)

	Name:	ID:
Facility	PROSPECT OIL	1001
Stack Name	PROSPECT STK 1	1

Release Parameters

Elevation (ft)	75	Temp (F)	200	
Release Ht. (ft)	30	Rate (acfm)	753.9822	Calculate Rate
Stack Diam. (ft)	4	Vel. (fpm)	60	Calculate Vel.

Location

East	474.55	Datum	NAD27	Change coordinate system
North	3634.406	Coord. System	UTM	
Units	km	Zone	11	
		Spheroid	CLARKE1866	Locating Method

Release Type

Release Type: Point Volume Area Open Pit

Is default N

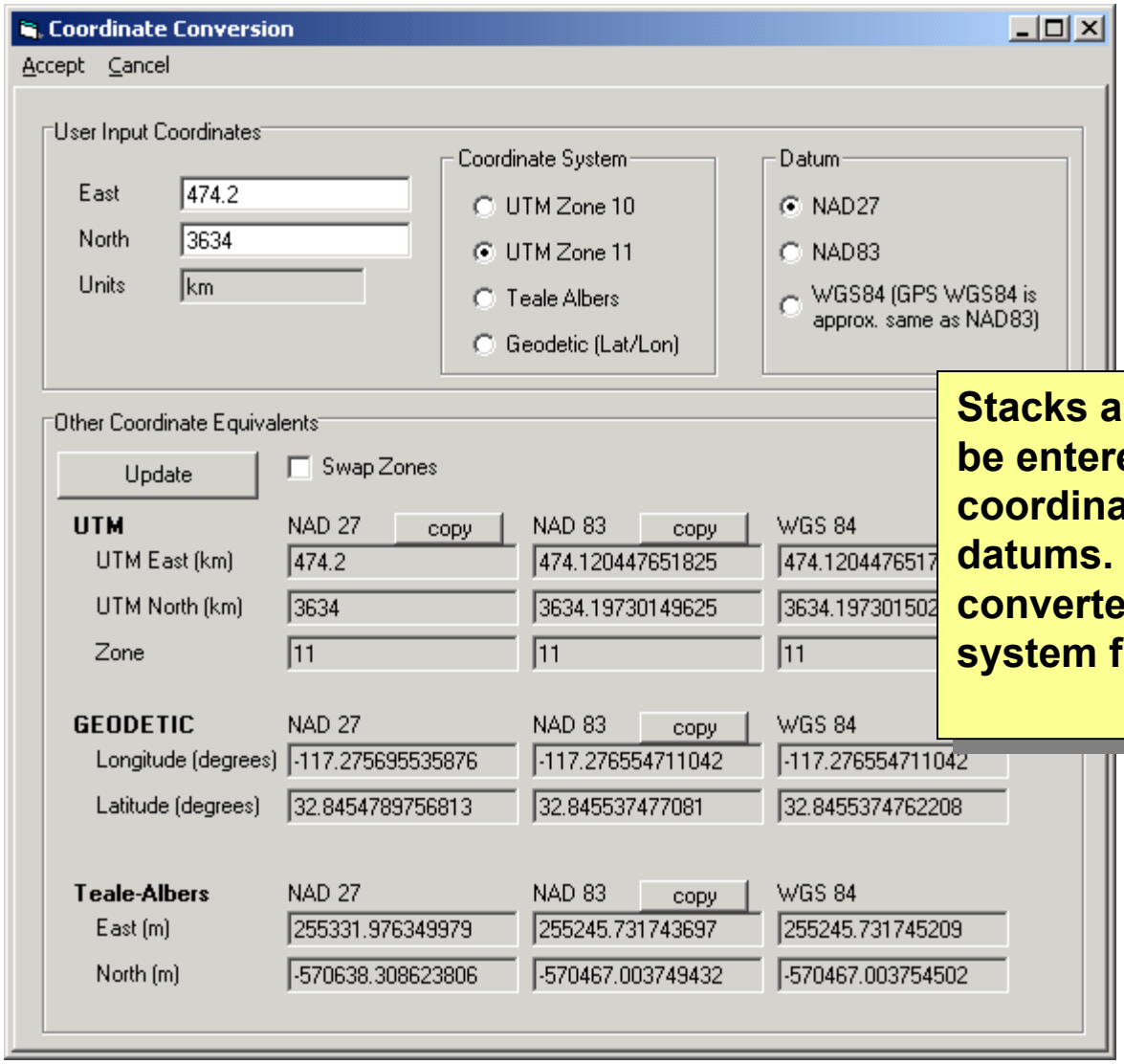
Data editing windows.

Stack parameters

Press button to change coordinate systems

Release type

Coordinate System Conversions



Stacks and facilities can be entered in several coordinate systems and datums. All are converted to common system for analysis.

HARP - Reporting Year 1998

Facility Data - Inventory Year 1998

Building Geomety

Save Add Delete List Next Previous Edit Points Redraw Zoom Options Help Exit

Facility ID	1002	Building ID	0
Facility	ACME ARSENIC CORP.	Description	LAB
County	SAN DIEGO	Height (m)	41
Air Basin	SAN DIEGO	Elevation (ft)	220
District	SAN DIEGO COUNTY APC	Tier	1
Is default	N		

Rel. East (m)	136.09	UTM East (m)	475056.54
Rel. North (m)	112.64	UTM North (m)	3633609.94

Edit Buildings

Edit Property

Calculate Help Exit

Building Boundary Points

Add Delete Sort Redraw Help Exit

Building 0 Tier 1

Plot Order	East Location (m)	North Location (m)
1	-10	0
2	40	0
3	40	50
4	-10	50
5	-20	25

Edit building and property parameters.

Stack location

Building tiers

Property boundary

Building vertex locations

Reporting

Q/A Reports

Q/A Reports

Print Exit

Facilities

All Facilities

Selected CO/AB/DIS

County

Air Basin

District

Select CO/AB/DIS

UTM Range

North East

Min.

Max.

Zone

User Defined Facility List

Facilities List File

D:\HARP\HarpDev\CODE\HarpMain\facility.fac

Q/A Reports

1 Facilities without emissions

2 Stacks without emissions

3 Devices without emissions

4 Processes without emissions

5 Stacks without processes

6 EMissions data Q/A

7 Stack data Q/A

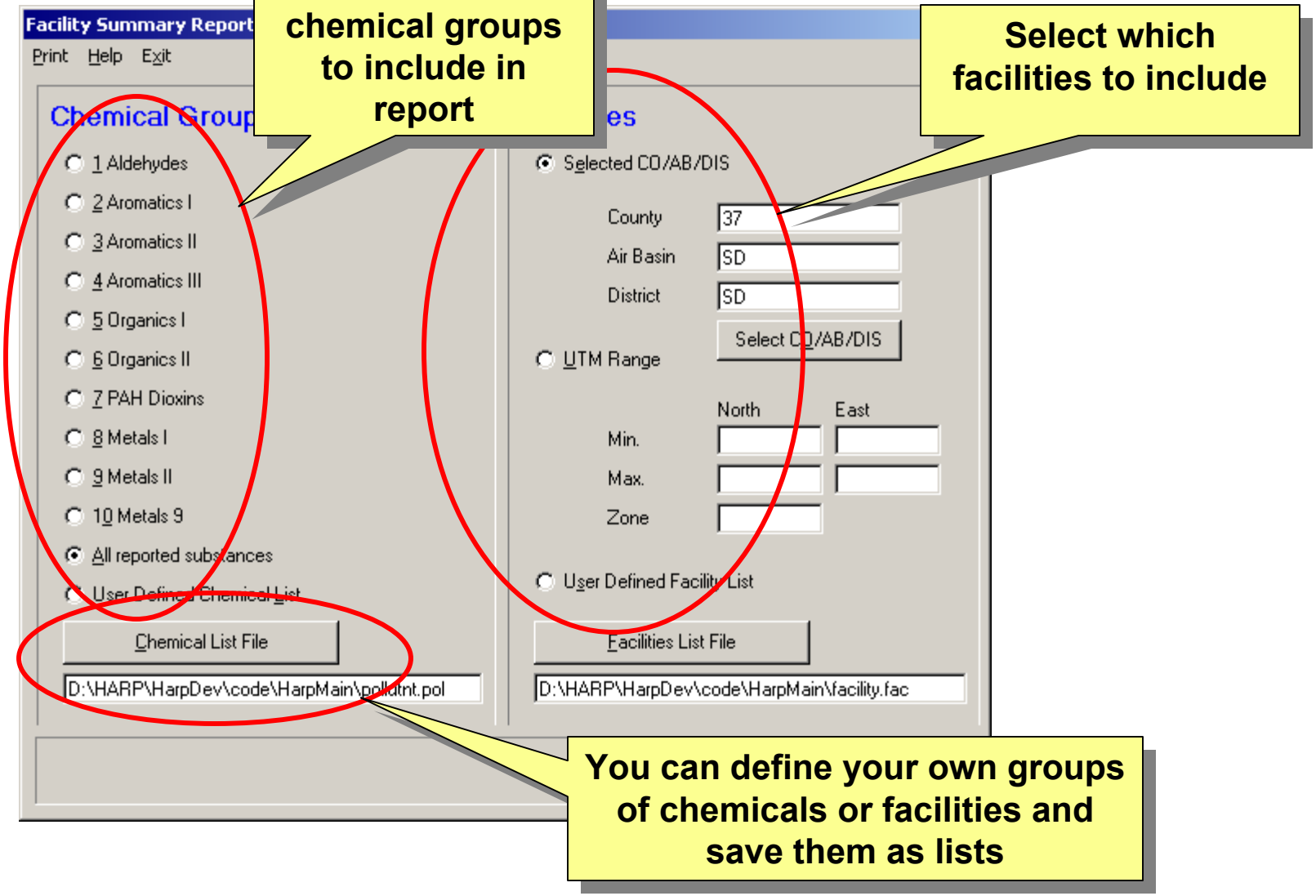
8 Process and temporal data Q/A

Info

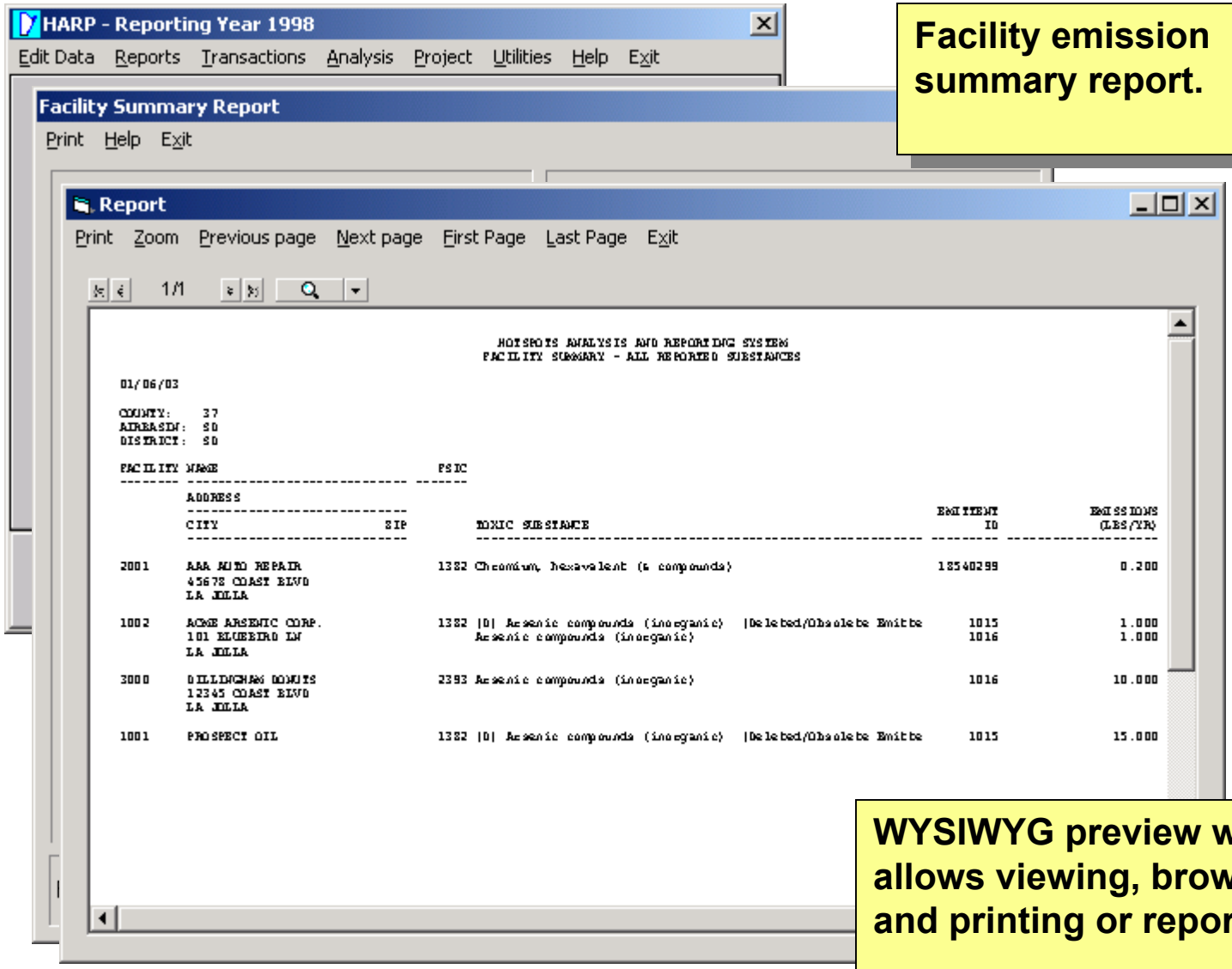
Select types of reports

Select which facilities

Emissions Reports



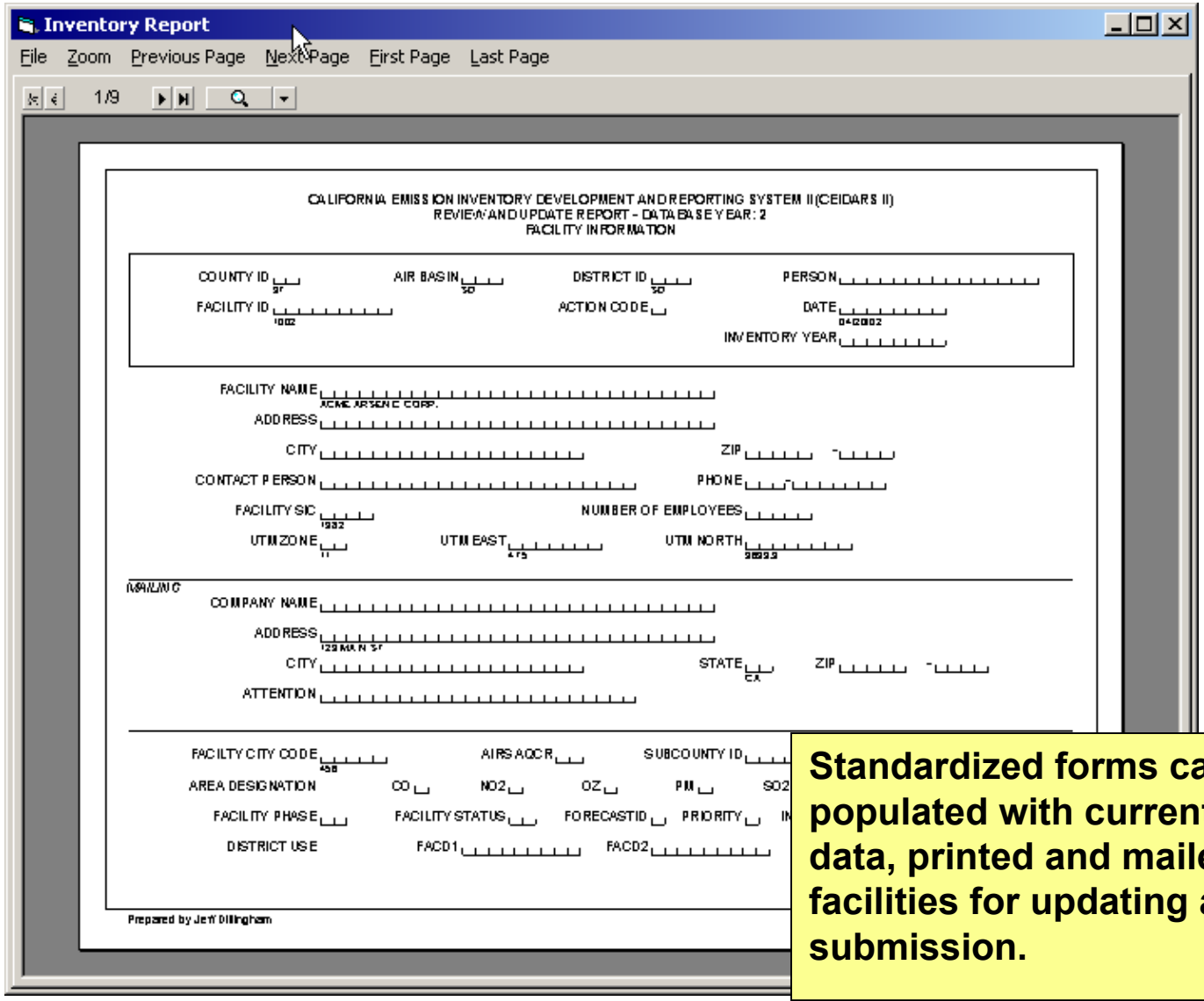
Emission Reports



Facility emission summary report.

WYSIWYG preview window allows viewing, browsing and printing or reports.

Inventory Reporting Forms



Standardized forms can be populated with current facility data, printed and mailed to facilities for updating and submission.

Dispersion Analysis

Dispersion Analysis

- Graphical User Interface
  - Spreadsheet-like interface similar to Excel
- Integrated
  - Communicates with data management and risk analysis modules
- Builds source input for ISC
  - Extracts data from emissions inventory database
- Builds receptor input for ISC
  - Grids
  - Property boundaries
  - Sensitive receptors
  - Census blocks
  - Pathway receptors
- Cumulative risk
  - Handles multiple sources for cumulative risk
  - Assumes unit emission rate and computes GLC by post-processing

Dispersion Analysis

- Building downwash
  - Automatic building downwash calculation using BPIP
  - BPIP has been converted into a DLL for speed
- Elevation lookup
  - Automatically determines elevations of sources and receptors from DEM data
  - DEM data is public domain
- Census block receptors
  - Public domain Census 2000 data is included
  - HARP automatically adds census block receptors to ISC input file for a user-specified geographic range

Dispersion/Sources

Grab a facility from the database and add all of its stacks to the dispersion run.

Dispersion - D:\HARP\HarpDev\PROJECTS\demo\DEMO.ISC

File Analysis Sources Options Utilities Help

Insert Entire Facility
Insert Sources Using Selection Filter
Insert Row(s)
Delete Row(s)
Delete All Sources
Auto-generate Source IDs
Fill in elevations

ISC Fil
Contr
Sourc
Grid Rece
Prop. Boundary
Sensitive Recs.
Census Blocks
Pathway Rec.
Meteorology
Output
Emission Rates
Deposition and

FEET

Selection Filter
Range (m) 3000 County
from
UTME 474000
UTMN 3634000
UTM Zone 11

Sources

Source ID	Facility ID	Facility Name	County	Air Basin	District	St	k ID	Stack Name
S001	1001	PROSPEC	37	SD	SD		1	PROSPEC
S002	1002	ACME AR	37	SD	SD		1	ACME STI
S003	1002	ACME AR	37	SD	SD			SECOND S
S004	2001	AAA AUTC	37	SD	SD			IRST STA
S005	3000	DILLINGHA	37	SD	SD			RST STA

PitVol (ft^3)
PARAMETER NAME: soPitvol
Volume of OPENPIT source. Not used fo
ALLOWABLE VALUES: real, > 0, <= 1000

Dispersion analysis window, source sheet

You specify a central location and range. HARP will add all of the stacks in that area to the analysis.

Stacks to be included in the dispersion analysis appear in this list. Stack parameters can be edited here.

Dispersion/Control Parameters

Set ISC run control parameters

DISPERSION - C:\HARP\PROJECTS\DEMO\Demo.isc Year 4

File Analysis Control Options Utilities Help

ISC Files
Control
Sources
Grid Receptors
Prop. Boundary
Sensitive Recs.
Census Blocks
Pathway Rec.
Meteorology
Output
Emission Rates
Deposition and Depletion

Pollutant

Pollutant ID	Other
Half Life	-1

Model Options

Use regulatory default	YES
Rural or Urban	RURAL
Gradual Plume Rise	NO
Stack top downwash	YES
Buoyancy induced dispersion	YES
Calms processing	YES
Missing data processing	NO

Building Downwash

Include building downwash?	YES
Lowbound Option?	NO

Terrain

Terrain model	SIMPLE
Elevated Receptors	Y
Terrain Elevation Units	FEET

Averaging times

1-Hour	YES
3-Hour	NO
8-Hour	NO
24-Hour	NO
Monthly	NO
Period	YES
Annual	NO

NO
PARAMETER NAME: LowBoundOption
Enter 'Y' to use the non-regulatory LowBound option for building downwash. This option only applies if 'Include building downwash?" is set to 'Y', otherwise it is ignored.

As you cursor around the worksheet, the help line describes the input parameter and cross-references the ISC manual.

Dispersion/Grid Receptors

Specify grid receptors

DISPERSION - D:\HARP\HarpDev\PROJECTS\demo\STARTUP.ISC

File Analysis Grid receptors Options Utilities Help

ISC Files
Control
Sources
Grid Receptors
Prop. Boundary
Sensitive Recs.
Census Blocks
Pathway Rec.
Meteorology
Output
Emission Rates
Deposition and Depletion

Include Grid? (Y/N) YES Flagpole Height (m) 0

Origin of Receptor Grid

Facility Name	ACME ARSENIC CORP.		
Facility ID	1002	Origin UTM East (m)	474920.45
County	37	Origin UTM North (m)	3633497.3
Air Basin	SD	Origin UTM Zone	11
District	SD	Elevation Units	FEET

Grid Generation Parameters

	Min.	Max.	Increment	Npts
Rel. East (m)	-1200	1200	100	25
Rel. North (m)	-1200	1200	100	25

Receptor Locations and Elevations

UTM East

UTM North	-1200	-1100	-1000	-900	-800	-700	-600	-500	-400
1200	0	0	0	0	0	0	[illegible]	29.5	26.2
1100	0	0	0	0	0	40.5	[illegible]	70.3	102.8
1000	0	0	0	0	33.5	56.9	[illegible]	103.9	110.4
900	0	0	19.7	28.4	50.3	[illegible]	99.5	107.1	114.8
800	0	0	20.8	45.9	72.9	[illegible]	105.3	113.7	120.3
700	0	0	24.1	59	87.1	101.7	107.5	114.8	124.6
600	0	0	42.6	83.1	94	101.7	109.3	114.8	124.6
500	2.2	36.8	67.8	87.5	101.7	103.9	105.7	113	120.3
400	21.9	43.4	80.9	89.7	93.7	96.2	99.5	106.1	112.6
300	28.4	59	82	85.3	82	91.8	96.2	98.4	111.5
200	32.8	64.5	77.6	77.3	85.3	95.1	102	108.2	115.9
100	40.8	48.1	65.6	79.8	90.7	101.7	110.4	119.2	126.8

Elevations at grid coordinates are filled in by HARP using public domain DEM data

Select buttons to edit other receptors, meteorology, etc.

Dispersion/Pathway Receptors

DISPERSION - D:\HARP\HarpDev\PROJECTS\demo\pala.ISC Year 2

File Analysis Pathway Receptors Options Utilities Help test

ISC Files
Control
Sources
Grid Receptors
Prop. Boundary
Sensitive Recs.
Census Blocks
Pathway Rec.
Meteorology
Output
Emission Rates
Deposition and Depletion

Pathway Receptors

Receptor ID	Receptor Name	UTM East (m)	UTM North (m)	Elevation (ft)	UTM Zone	Include?
WATER	WATER SOURCE	490600	3690000	1232.5	11	YES
PASTURE	PASTURE	490700	3690100	1149.9	11	YES
FISH	FISH	490800	3690200	1091.5	11	YES

Flagpole Ht. (m) 0

YES
PARAMETER NAME: pastureInclude
RESERVED FOR FUTURE USE.
Enter Y to include pasture pathway receptor. Enter N if you do not inten

Multipathway analysis defines three possible pathway receptors

The locations of pathway receptors determine the ground level concentrations at the places where the food, drinking water and fish are impacted. Some pathways, such as dermal, inhalation and home grown produce are only affected by the GLC at the target receptor.

Risk Analysis

Risk Analysis

- Multi-pathway
  - Model follows OEHHA Guidelines; calculates cancer, chronic and acute risk
- Point estimate or stochastic analysis
  - Monte Carlo simulation
- Optional “derived” risk
  - Using dominant pathway approach (according to California rules)
- Cumulative risk
  - Risk from multiple sources and chemicals
- Simplified or refined acute risk
  - “Simplified” (concurrent max. approximation) acute risk is conservative and much quicker to calculate
- Fully integrated
  - Information flows transparently between database, dispersion analysis and risk analysis

Risk Analysis

- "What-if" analysis
  - User can modify chemical emissions and recalculate risk without rerunning dispersion model
- Chemical coefficients
  - Access database contains chemical-specific coefficients, pathways and toxicological endpoints. Chemical coefficients database developed and maintained by CARB and OEHHA.
- Adaptable network model architecture
  - User can inspect and/or modify any parameter or uptake distribution interactively. All equations and uptake factors are stored in external data files
- Averaging times
  - Automatically calculates averages, max. and hourly time-varying ground level concentrations at receptors for all chemicals from dispersion results and emission inventory. Five averaging times required for acute analysis.
- Cancer burden and population exposure

  Census data is provided with HARP

Risk Analysis

- PMI Report
  - Point of Maximum Impact
- Risk report options
  - Report by by chemical, pathway, source and toxicological endpoint
- Contours
  - Calculates isopleths of cancer, chronic and acute risk and displays them on street map
- Street maps
  - Uses public-domain Tiger data
  - Tiger maps are converted to binary for speed and reduced storage

Site Parameters

Site Parameters (D:\HarpProjects\demo\project.sit)

File Report Hide

Drinking Water | Fish | Pasture | Home Grown | Deposition

Pasture pathway enabled

Pasture water source

Area (m^2) 1000

Volume (kg) 1.E7

Volume changes per year 1

Fraction of consumed beef from contaminated source 1.0

Fraction of consumed dairy products from contaminated source 1.0

Fraction of beef cow drinking water from pasture water source 1.0

Fraction of dairy cow drinking water from pasture water source 1.0

Fraction of cows feed from grazing 1.0

Site parameters are required to define pollutant uptakes for multipathway analysis.

For example, these parameters define the geometry of the water body where the cows get drinking water.

Risk Analysis Options

Exposure duration, analysis method, health effect and site parameters define a "risk configuration"

Reports can be broken down by source, receptor, pathway and chemical

Risk Reports

Exposure Duration
- 70 year (adult resident)
- 30 year (adult resident)
- 9 year (child resident)
- 46 years (adult worker)
- Standard work schedule (12.5% of 70 years)
- User-specified years (adult worker) 10

Analysis Method
- Average Point Estimate
- High-end Point Estimate
- Derived
- Average, High-end and Derived

Health Effect
- Cancer Risk
- Chronic HHI
- Acute HHI (Screening)

Output file name: Report.txt

Receptors
- All receptors
- Single receptor, enter number-> 5

Sources
- All sources
- Single source, enter nun

Chemicals
- All chemicals
- Single chemical, enter number

Report Content
- Report by source
- Report by receptor
- Include breakdown by chemical
- Include doses by pathway
- Include site-specific parameter report
- Include UTMs

Calculate | View Report | PMI/MEI | Site Parameters | Hide

Done. Report written to D:\HarpProjects\demo\Report.txt

Risk Window

Dilution factors, GLC and risk are displayed in tables

RISK - File: D:\HARP\HarpDev\PROJECTS\demo\DEMO.SRC Year 2

Files Step-Through Analysis Export/Import Sort Map AutoSi... Table Options Help

Receptors | Emissions | X/Q | GLC | Risk

Receptor	Type	Cancer Risk	Chronic HI	Acute Simple HI
829	CENSUS	2.40E-04	8.16E-01	5.35E+00
705	SENSITIVE	2.30E-04	7.82E-01	3.92E+00
132	GRID	2.28E-04	7.77E-01	3.91E+00
853	CENSUS	[illegible]E-04	6.92E-01	4.69E+00
157	GRID	[illegible]7E-04	6.35E-01	5.71E+00
158	GRID	[illegible]8E-04	5.29E-01	3.14E+00
798	CENSUS	[illegible]08E-04	3.64E-01	1.55E+01
63	GRID	[illegible]31E-05	3.12E-01	1.58E+01
831	CENSU[illegible]	[illegible]19E-05	3.02E-01	3.15E+00
800	CENS[illegible]	[illegible].94E-05	2.98E-01	2.23E+01
184	GRI[illegible]	[illegible].64E-05	2.48E-01	3.37E+00
832	CE[illegible]	[illegible]7.43E-05	2.30E-01	3.54E+00
182	G[illegible]	[illegible]7.30E-05	2.42E-01	3.29E+00
159	[illegible]	[illegible]7.23E-05	2.02E-01	3.40E+00
[illegible]	[illegible]	[illegible]	2.32E-01	1.29E+01
[illegible]	[illegible]	[illegible]	2.28E-01	3.43E+00
[illegible]	[illegible]	[illegible]	2.21E-01	3.51E+00
[illegible]	[illegible]	[illegible]	1.93E-01	3.57E+00
[illegible]	[illegible]	[illegible]	1.96E-01	6.17E+00
[illegible]	[illegible]	[illegible]	1.66E-01	6.65E+00
[illegible]	[illegible]	[illegible]	1.86E-01	1.13E+01
[illegible]	[illegible]	[illegible]	1.69E-01	7.04E+00
[illegible]	[illegible]	[illegible]	1.76E-01	4.95E[illegible]
[illegible]	[illegible]	[illegible]	1.55E-01	[illegible]
[illegible]	[illegible]	[illegible]	1.70E[illegible]	[illegible]
108	GRID	5.03E-05	[illegible]	[illegible]+00
88	GRID	4.94E[illegible]	[illegible]	[illegible]7E+00

Click on the map to get information about a source or receptor. The selected item is highlighted in the table at left.

Map shows streets, census blocks, cancer risk contours, building and property boundaries, grid receptors

Map | Map Options

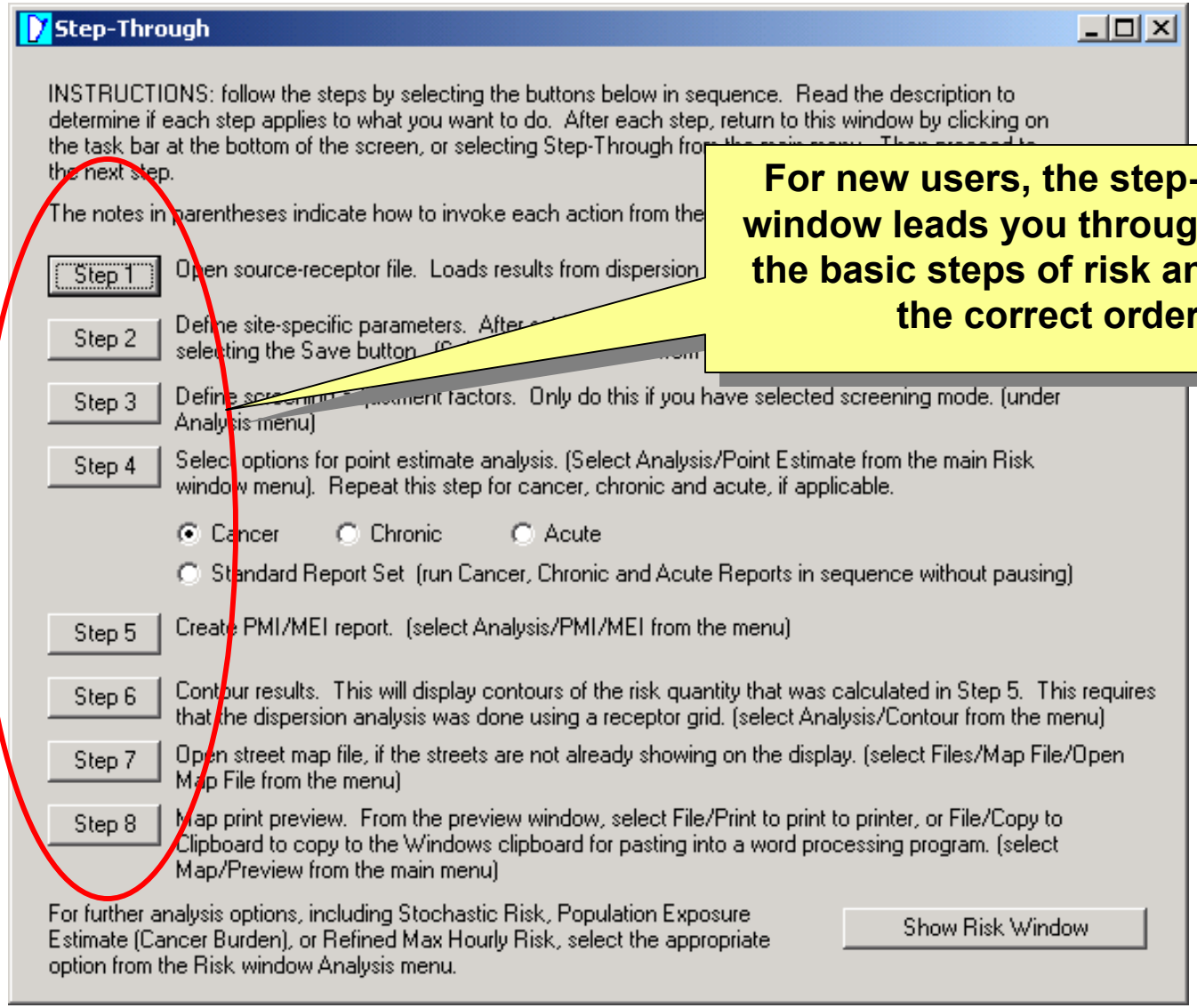
refresh | zoom auto | zoom out | Zoom Map

UTME (m) 474024 UTMN (m) 3634187 Mouse Zoom

Click on a source or receptor in the tables. The selected item is highlighted on the map.

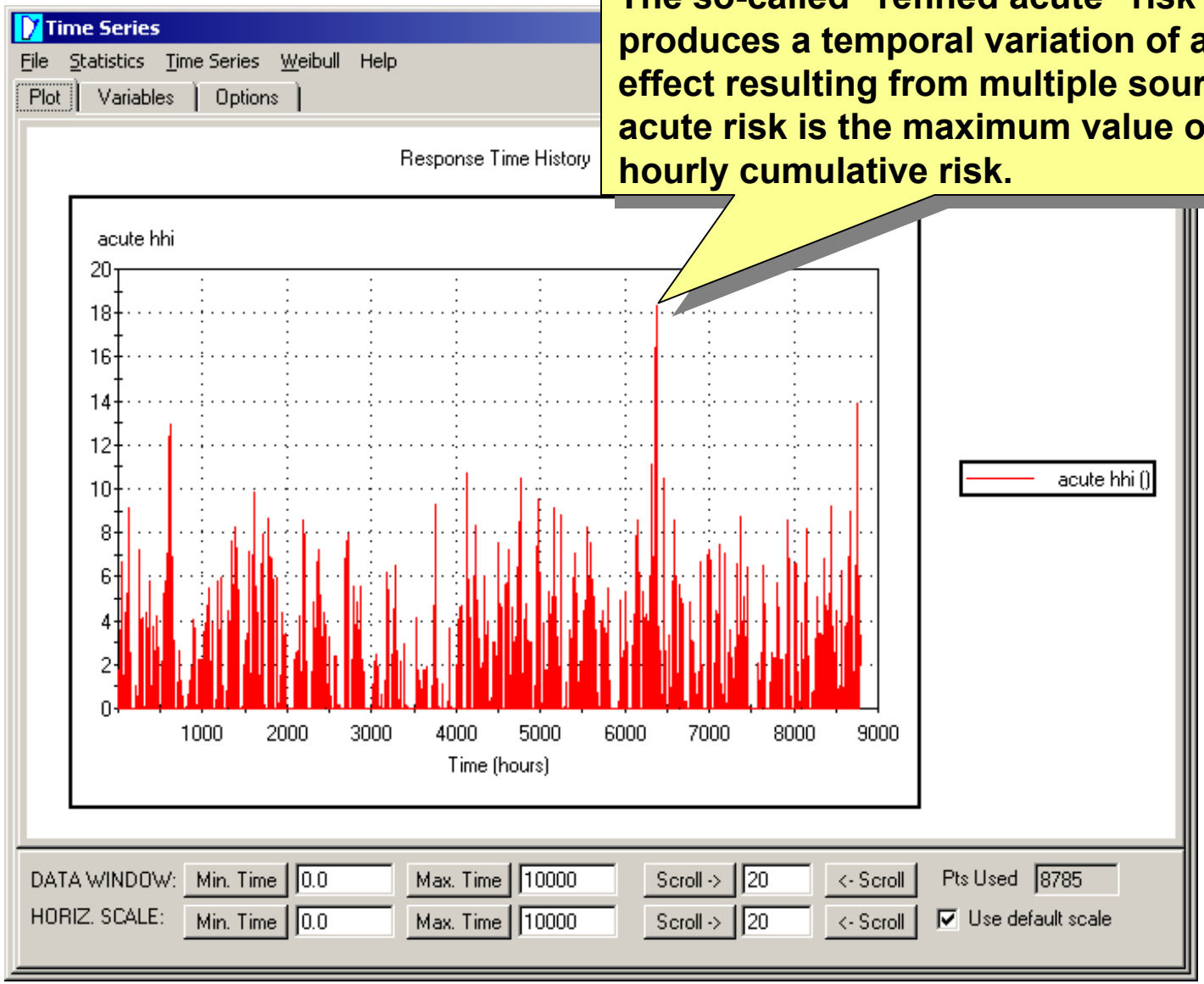
Map can be printed or copied to Windows clipboard and pasted into a Word document

Risk Analysis Step-Through



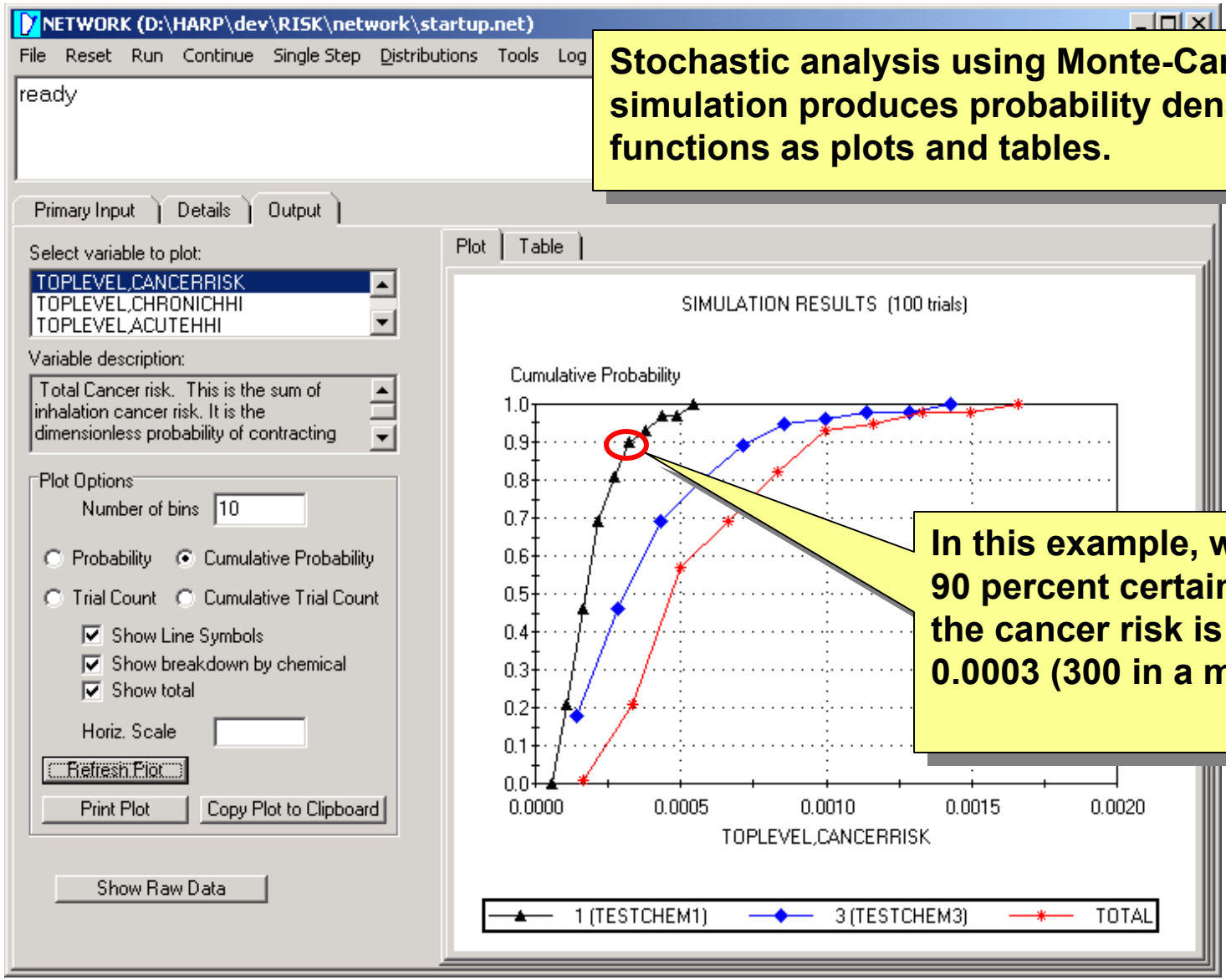
For new users, the step-through window leads you through each of the basic steps of risk analysis in the correct order.

Temporal Variation of Acute Risk



The so-called "refined acute" risk analysis produces a temporal variation of acute effect resulting from multiple sources. The acute risk is the maximum value of the hourly cumulative risk.

Multipathway Stochastic Analysis



Stochastic analysis using Monte-Carlo simulation produces probability density functions as plots and tables.

In this example, we are 90 percent certain that the cancer risk is below 0.0003 (300 in a million)

Manual Override of Emission Rates

RISK - File: D:\HarpProjects\demo\DEMO.SRC Year 2

Files Site Parameters Export Analysis Sort Map AutoSize Grids Health Table Admin Stop

Sources | Receptors | Emissions | X/Q | GLC | Risk

Add Chem | Refresh emissions rates from database

Delete Chem | Refresh all chemicals and emissions from database

Save As | Open | Print

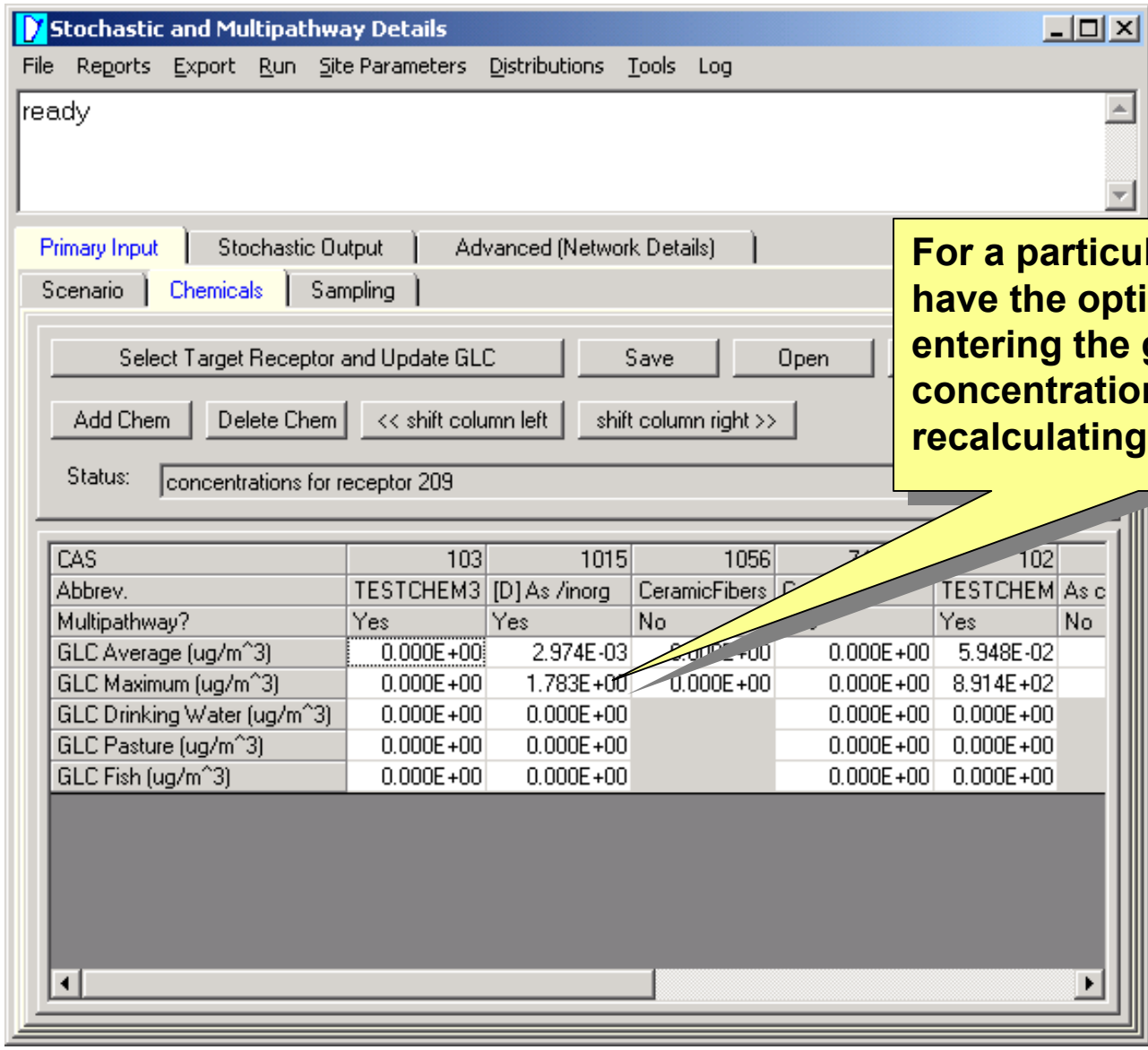
Average EMS | Max EMS

	fac	dev	pro	stk	Mult				
CAS						103	1015	1056	7
Abbrev.						TESTCHEM3	[D] As /inorg	CeramicFibers	C
Background (ug/m^3)						0	0	0	
Multiplier						1	1	1	
SRC 1 EMS (lbs/yr)	1001	1	1	1	1	20	15	MISSING	
SRC 1 EMS (lbs/yr)	1001	1	2	1	1	*	*	*	
SRC 2 EMS (lbs/yr)	1002	1	1	1	1	*	1	*	
SRC 3 EMS (lbs/yr)	1002	1	2	2	1	*	*	*	
SRC 4 EMS (lbs/yr)	2001	*	*	1	1	*	*		
SRC 5 EMS (lbs/yr)	3000	1	1	1	1	*	*		

Emissions data

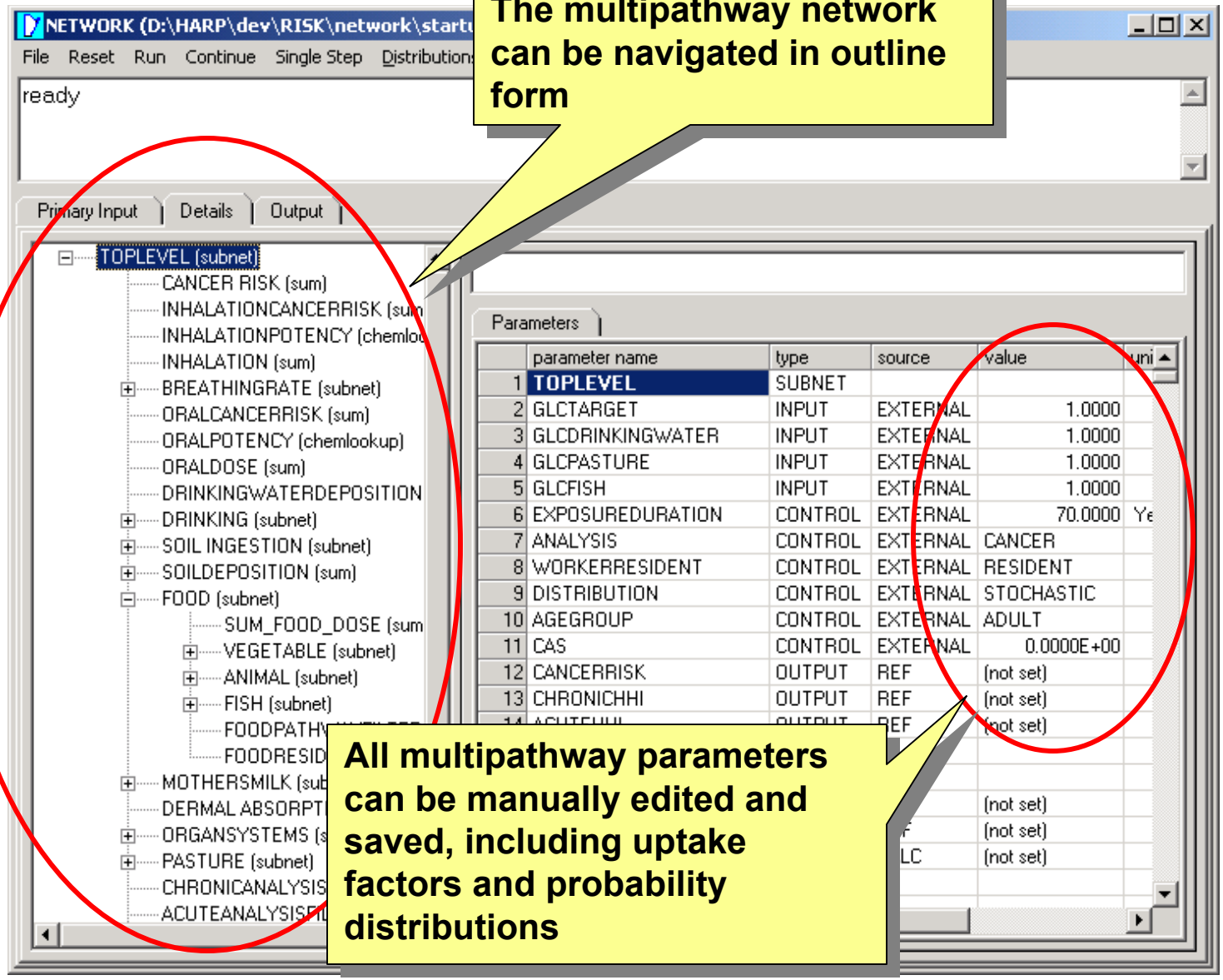
For "what-if" analysis, you can edit or scale the emission rates for any source or chemical and recalculate risk without rerunning dispersion.

Manual Override of GLCs



For a particular receptor, you have the option of manually entering the ground level concentration and recalculating risk.

Multipathway Network Details



The multipathway network can be navigated in outline form

All multipathway parameters can be manually edited and saved, including uptake factors and probability distributions

PMI Report

Preview

Print Zoom Previous page Next page First Page Last Page Exit

1/1

FILE: D:\HARP\HarpDev\PROJECTS\demo\Rep_PMI.txt

RECEPTORS WITH HIGHEST CANCER RISK

REC	TYPE	CANCER	CHRONIC	ACUTE	UTME	UTMN
165	GRID	8.32E-05	2.41E-01	1.51E+01	474650	3634300
811	CENSUS	7.72E-05	2.23E-01	1.54E+01	474684	3634323
260	GRID	7.07E-05	2.17E-01	1.69E+00	474150	3633900
804	CENSUS	6.39E-05	1.85E-01	1.31E+01	474544	3634279
833	CENSUS	6.36E-05	1.93E-01	1.89E+00	474262	3633825
261	GRID	6.30E-05	1.87E-01	2.03E+00	474250	3633900
812	CENSUS	6.17E-05	1.77E-01	1.34E+01	474714	3634249
286	GRID	5.83E-05	1.76E-01	1.79E+00	474250	3633800
166	GRID	5.35E-05	1.53E-01	8.45E+00	474750	3634300
287	GRID	5.11E-05	1.42E-01	1.69E+00	474350	3633800

RECEPTORS WITH HIGHEST CHRONIC HHI

REC	TYPE	CANCER	CHRONIC	ACUTE	UTME	UTMN	ZONE
165	GRID	8.32E-05	2.41E-01	1.51E+01	474650	3634300	11
811	CENSUS	7.72E-05	2.23E-01	1.54E+01	474684	3634323	11
260	GRID	7.07E-05	2.17E-01	1.69E+00	474150	3633900	11
833	CENSUS	6.36E-05	1.93E-01	1.89E+00	474262	3633825	11
261	GRID	6.30E-05	1.87E-01	2.03E+00	474250	3633900	11
804	CENSUS	6.39E-05	1.85E-01	1.31E+01	474544	3634279	11
812	CENSUS	6.17E-05	1.77E-01	1.34E+01	474714	3634249	11
286	GRID	5.83E-05	1.76E-01	1.79E+00	474250	3633800	11
166	GRID	5.35E-05	1.53E-01	8.45E+00	474750	3634300	11
191	GRID	5.03E-05	1.44E-01	1.12E+01	474750	3634200	11

RECEPTORS WITH HIGHEST ACUTE HHI

REC	TYPE	CANCER	CHRONIC	ACUTE	UTME	UTMN	ZONE
811	CENSUS	7.72E-05	2.23E-01	1.54E+01	474684	3634323	11
165	GRID	8.32E-05	2.41E-01	1.51E+01	474650	3634300	11
812	CENSUS	6.17E-05	1.77E-01	1.34E+01	474714	3634249	11
804	CENSUS	6.39E-05	1.85E-01	1.31E+01	474544	3634279	11
191	GRID	5.03E-05	1.44E-01	1.12E+01	474750	3634200	11
189	GRID	4.82E-05	1.36E-01	1.01E+01	474550	3634200	11
820	CENSUS	3.79E-05	1.06E-01	1.01E+01	474591	3634107	11
89	GRID	3.24E-05	9.09E-02	9.63E+00	474550	3634600	11
192	GRID	4.19E-05	1.19E-01	9.54E+00	474850	3634200	11
813	CENSUS	3.99E-05	1.13E-01	9.49E+00	474793	3634130	11

Point of Maximum Impact report. Receptors are sorted in descending order of cancer, chronic and acute risk.

Risk Report

Preview

Print Zoom Previous page Next page First Page Last Page Exit

2/5

CHEMICAL CROSS-REFERENCE TABLE

CHEM	CAS	ABBREVIATION	POLLUTANT NAME
0001	103	TESTCHEM3	TESTCHEM3
0002	1015	[D] As /inorg	[D] Arsenic compounds (inorganic) [Deleted/Obsolete Emittent ID]
0003	1056	CeramicFibers	Ceramic fibers (man-made)
0004	7440439	Cadmium	Cadmium
0005	102	TESTCHEM2	TESTCHEM2
0006	1017	As cmpd(org)	Arsenic compounds (other than i
0007	101	TESTCHEM1	TESTCHEM1
0008	1016	As cmpd(inorg)	Arsenic compounds (inorganic)
0009	18540299	Cr(VI)	Chromium, hexavalent (& compour
0010	42401	SOX	Oxides of sulfur

CANCER RISK REPORT

RECEPTOR 165

SOURCE 1 DOSES BY PATHWAY (mg/kg)

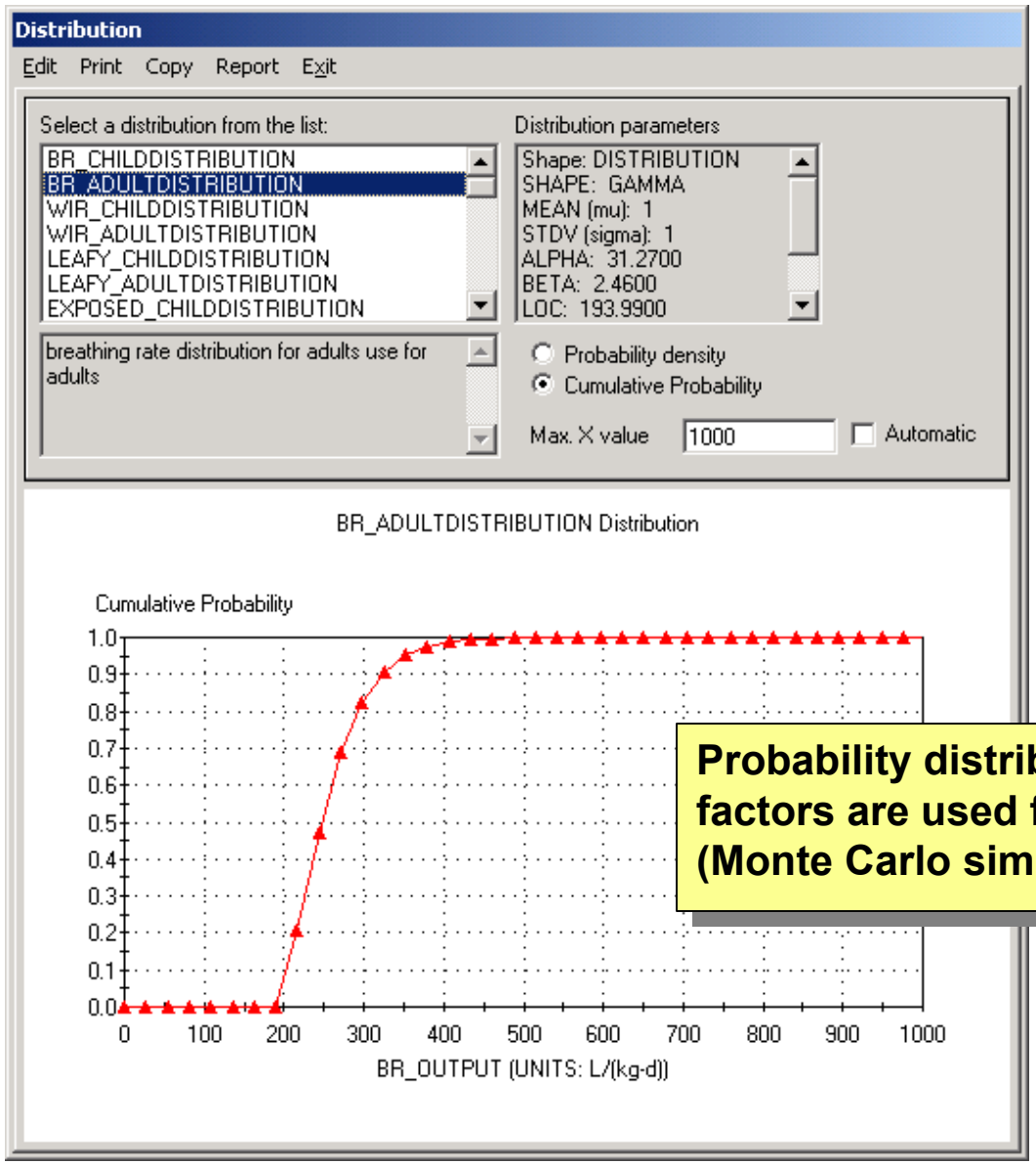
CHEM	INHAL	DERM	SOIL	MOTHER	FISH	WATER	VEG	DAIRY	BEEF	CHICK	PIG	EGG
0001	9.57E-07	4.51E-09	1.40E-08	3.04E-08	1.04E-08	8.72E-07	1.10E-05	1.62E-08	1.08E-07	2.80E-10	1.06E-08	3.45E-10
0002	7.17E-07	2.17E-08	1.87E-07	0.00E+00	7.79E-09	6.54E-07	9.20E-06	1.35E-08	9.00E-08	8.28E-10	3.15E-08	1.02E-09
0003	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0004	4.78E-10	3.62E-13	1.25E-10	0.00E+00	4.75E-10	4.36E-10	6.41E-09	1.47E-10	1.67E-11	1.53E-13	5.81E-12	1.89E-13
0005	1.43E-06	6.77E-09	1.86E-08	4.11E-08	1.56E-08	1.31E-06	1.47E-05	2.17E-08	1.45E-07	3.85E-10	1.45E-08	4.75E-10
0006	7.17E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0007	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0009	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0010	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SOURCE 1 RISK BY PATHWAY

CHEM	INHAL	DERM	SOIL	MOTHER	FISH	WATER	VEG	DAIRY	BEEF	CHICK	PIG	EGG	ME
0001	9.57E-08	4.51E-10	1.40E-09	3.04E-09	1.04E-09	8.72E-08	1.10E-06	1.62E-09	1.08E-08	2.80E-11	1.06E-09	3.45E-11	1.19E-
0002	8.61E-06	3.26E-08	2.80E-07	0.00E+00	1.17E-08	9.81E-07	1.38E-05	2.03E-08	1.35E-07	1.24E-09	4.72E-08	1.53E-09	1.85E-
0003	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0004	7.17E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0005	1.43E-07	6.77E-10	1.86E-09	4.11E-09	1.56E-09	1.31E-07	1.47E-06	2.17E-09	1.45E-08	3.85E-11	1.45E-09	4.75E-11	1.60E-
0006	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0007	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0008	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0009	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
0010	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+
SUM	8.86E-06	3.37E-08	2.83E-07	7.15E-09	1.43E-08	1.20E-06	1.64E-05	2.41E-08	1.60E-07	1.31E-09	4.97E-08	1.61E-09	2.13E-

This example report shows risk broken down by pathway, chemical and source for a single receptor.

Programmed Distributions



Probability distributions of uptake factors are used for stochastic analysis (Monte Carlo simulation)