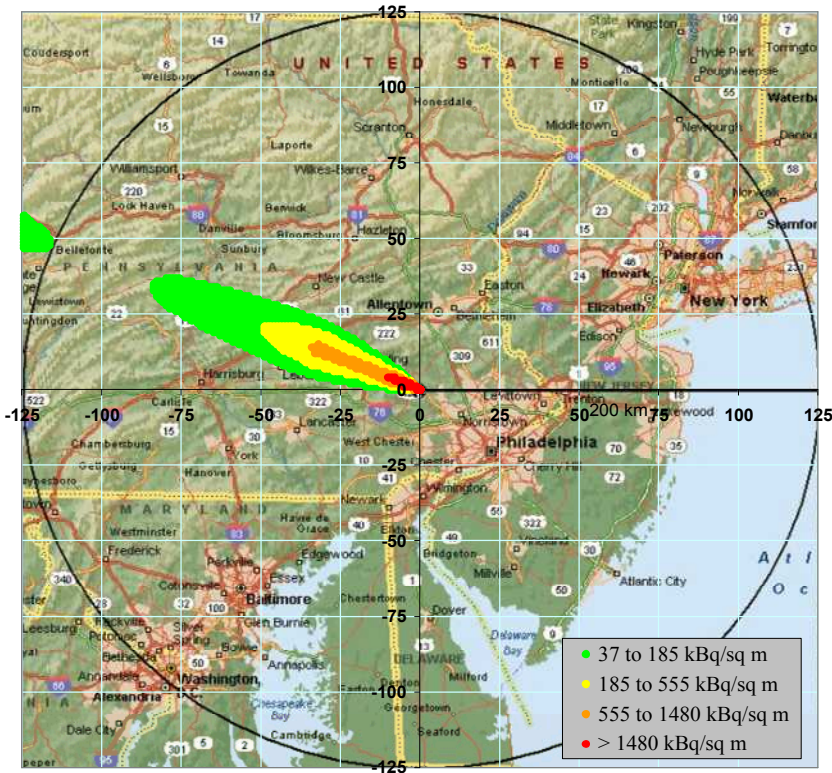


Exceptional service in the national interest



Brief Review of ATMOS Inputs

Nate Bixler

Sandia National Laboratories

26 – 29 January, 2016

Kyiv, Ukraine

Objectives

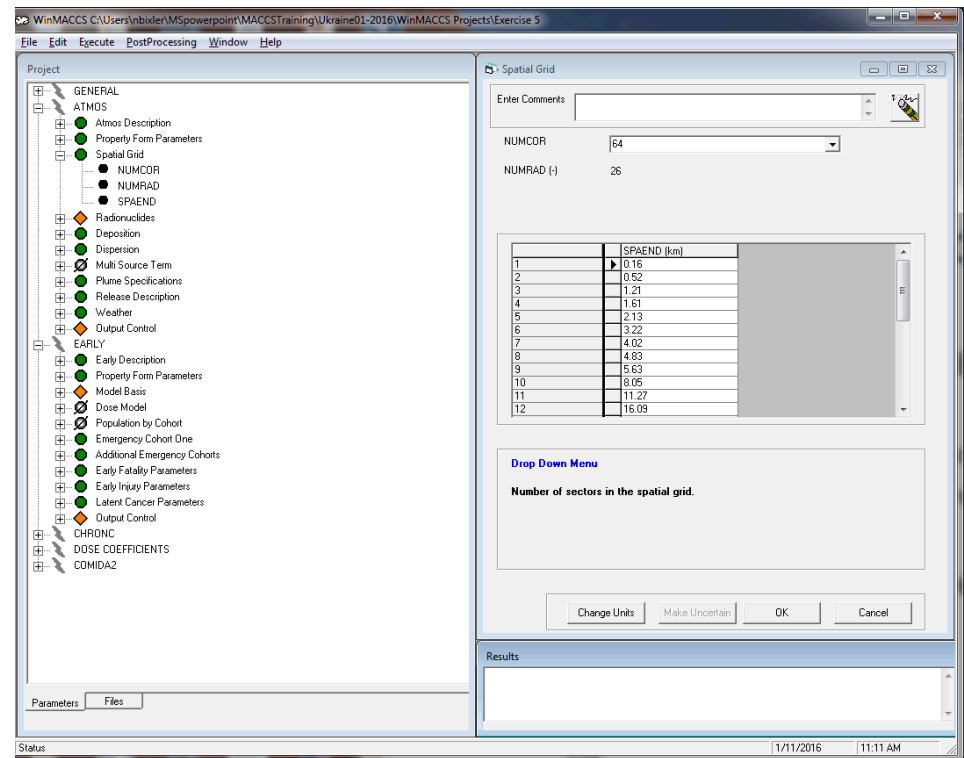
- Review the categories of information required for the ATMOS module of MACCS
- Differentiate the portions of the inputs that site or accident specific and those that are not

Current Functions of ATMOS

- Grid definition – often depends on site
- Choice of radionuclides to be modeled – depends on type of facility
- Atmospheric transport and deposition model options – usually independent of site or accident scenario
- Description of source term – highly dependent on facility and accident scenario being modeled
- Weather sampling definition – depends on location of facility

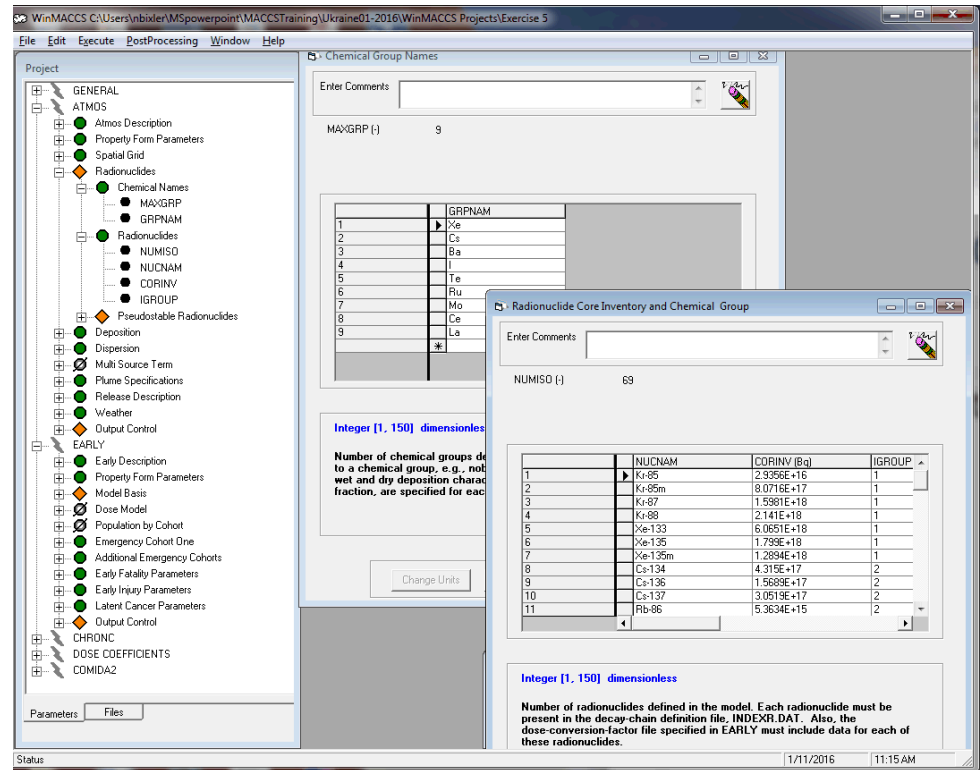
Grid Definition

- Up to 35 radial rings and 64 azimuthal sectors
- Considerations
 - Site exclusion boundary
 - Boundaries required for licensing
 - Ect.
- Grid definitions are usually mostly consistent between sites



Choice of Radionuclides

- Definition of chemical groups (classes)
- Definition of radionuclides and their inventories belonging to each group
- Specification of decay chain terminators
- Consideration: ensure that important decay products are included in radionuclides list (e.g., Ba-137m)
- Radionuclide data depend mainly on type of facility



The screenshot displays the WinMACCS software interface, specifically the 'Chemical Group Names' and 'Radionuclide Core Inventory and Chemical Group' windows.

Chemical Group Names Window:

- Enter Comments: [Text Field]
- MAXGRP (-) 9
- Table with 2 columns: GRPNAM, IGROUP

	GRPNAM	IGROUP
1	Xe	
2	Cs	
3	Ba	
4	I	
5	Te	
6	Ru	
7	Mo	
8	Ce	
9	La	
	*	

Radionuclide Core Inventory and Chemical Group Window:

- Enter Comments: [Text Field]
- NUMISO (-) 69
- Integer [1, 150] dimensionless
- Number of chemical groups defined to a chemical group, e.g., not wet and dry deposition fraction, are specified for each
- Change Units button
- Table with 4 columns: NUCNAM, CORINV (Bq), IGROUP

	NUCNAM	CORINV (Bq)	IGROUP
1	Kr-85	2.9356E+16	1
2	Kr-85m	8.0716E+17	1
3	Kr-87	1.5981E+18	1
4	Kr-88	2.141E+18	1
5	Xe-133	6.0651E+18	1
6	Xe-135	1.799E+18	1
7	Xe-135m	1.2894E+18	1
8	Cs-134	4.315E+17	2
9	Cs-136	1.5689E+17	2
10	Cs-137	3.0519E+17	2
11	Rb-86	5.3634E+15	2

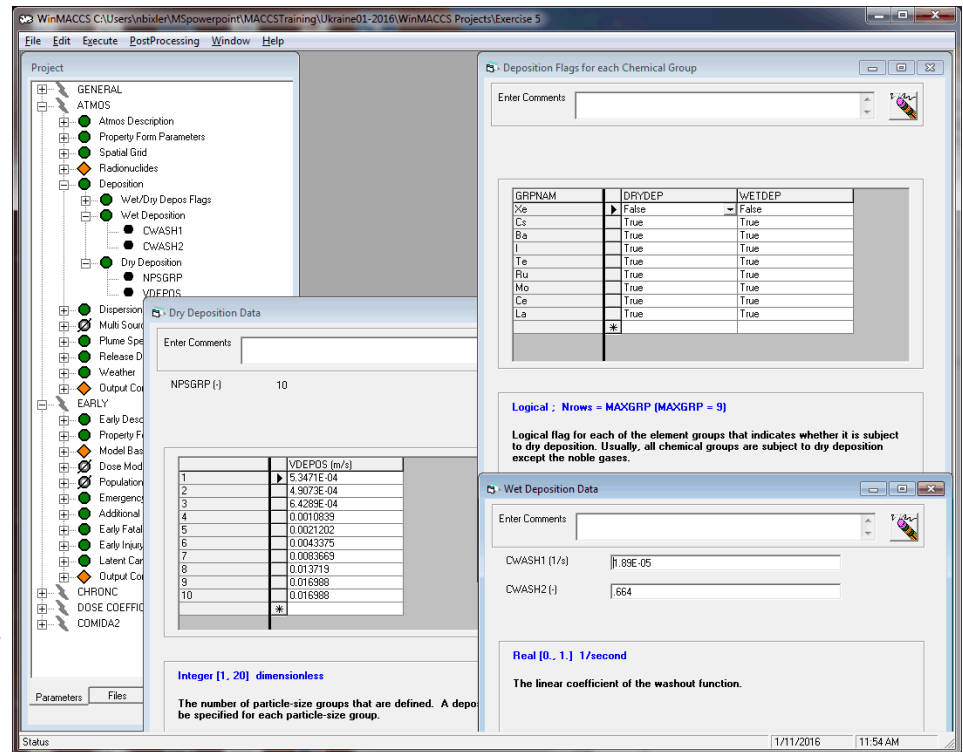
Radionuclide Core Inventory and Chemical Group Window (continued):

- Integer [1, 150] dimensionless
- Number of radionuclides defined in the model. Each radionuclide must be present in the decay chain definition file, INDEXR.DAT. Also, the dose-conversion-factor file specified in EARLY must include data for each of these radionuclides.

Status: 1/11/2016 11:15 AM

Deposition

- Definition of which aerosols are affected by wet and dry deposition
- Definition of wet deposition parameters
- Determination of dry deposition velocities
- Dry deposition depends on surface roughness of site; wet deposition is site independent



The screenshot shows the WinMACCS software interface with the 'Deposition' section selected in the project tree. The 'Dry Deposition Data' window is open, displaying a table of deposition velocities (VDEPOS) for various particle size groups. The 'Deposition Flags for each Chemical Group' window is also open, showing a table of flags for wet and dry deposition for various chemical groups.

Deposition Flags for each Chemical Group

GRPNAM	DRYDEP	WETDEP
Xe	False	False
Cs	True	True
Ba	True	True
I	True	True
Te	True	True
Ru	True	True
Mo	True	True
Ce	True	True
La	True	True

Logical: Nrows = MAXGRP (MAXGRP = 9)

Logical flag for each of the element groups that indicates whether it is subject to dry deposition. Usually, all chemical groups are subject to dry deposition except the noble gases.

Wet Deposition Data

Enter Comments

CWASH1 (1/s) 1.89E-05

CWASH2 (-) .564

Real [0., 1.] 1/second

The linear coefficient of the washout function.

Dry Deposition Data

Enter Comments

NPSGRP (-) 10

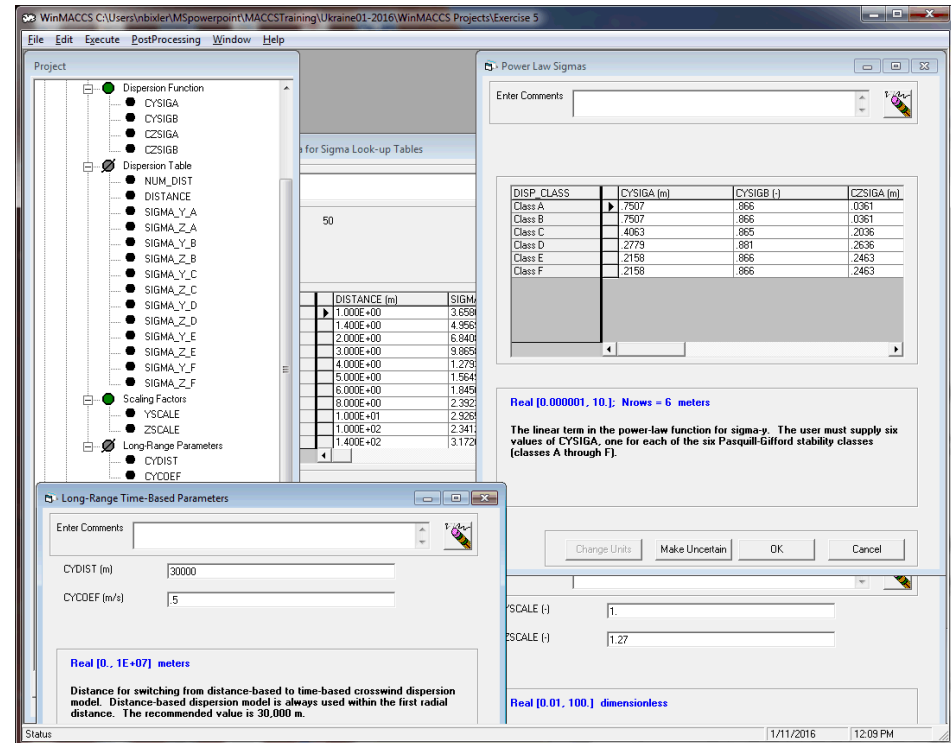
	VDEPOS (m/s)
1	5.3471E-04
2	4.3073E-04
3	6.4289E-04
4	0.0010839
5	0.0021202
6	0.0043375
7	0.0083663
8	0.013719
9	0.016988
10	0.016988

Integer [1, 20] dimensionless

The number of particle-size groups that are defined. A deposition velocity must be specified for each particle-size group.

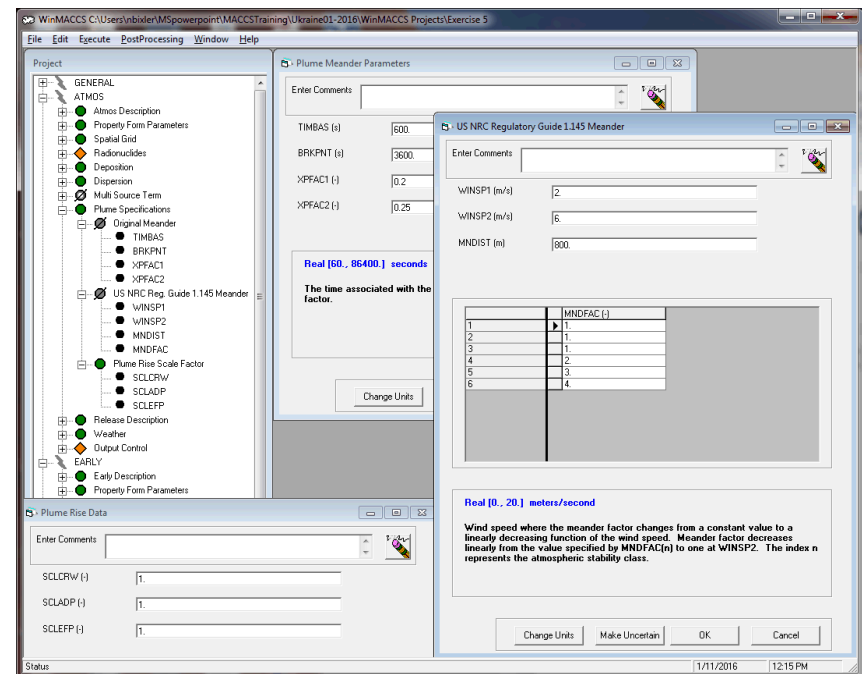
Atmospheric Dispersion

- Basic model choices
 - Power-law function
 - Lookup table
 - Time-based function beyond specified distance
- YSCALE used to account for surface roughness
- Only surface roughness is site dependent



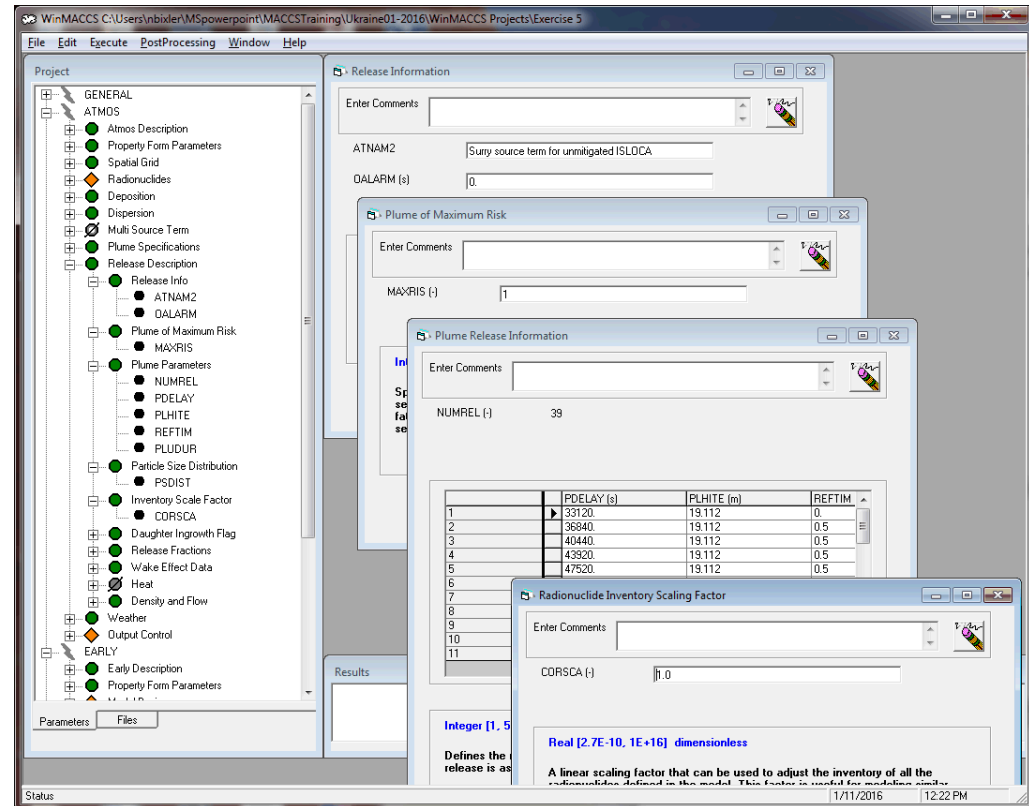
Plume Meander and Rise

- Plume meander options
 - Original meander model
 - Reg. Guide 1.145 model
 - No meander
- Plume rise scale factors
- Parameters are independent of site and accident scenario



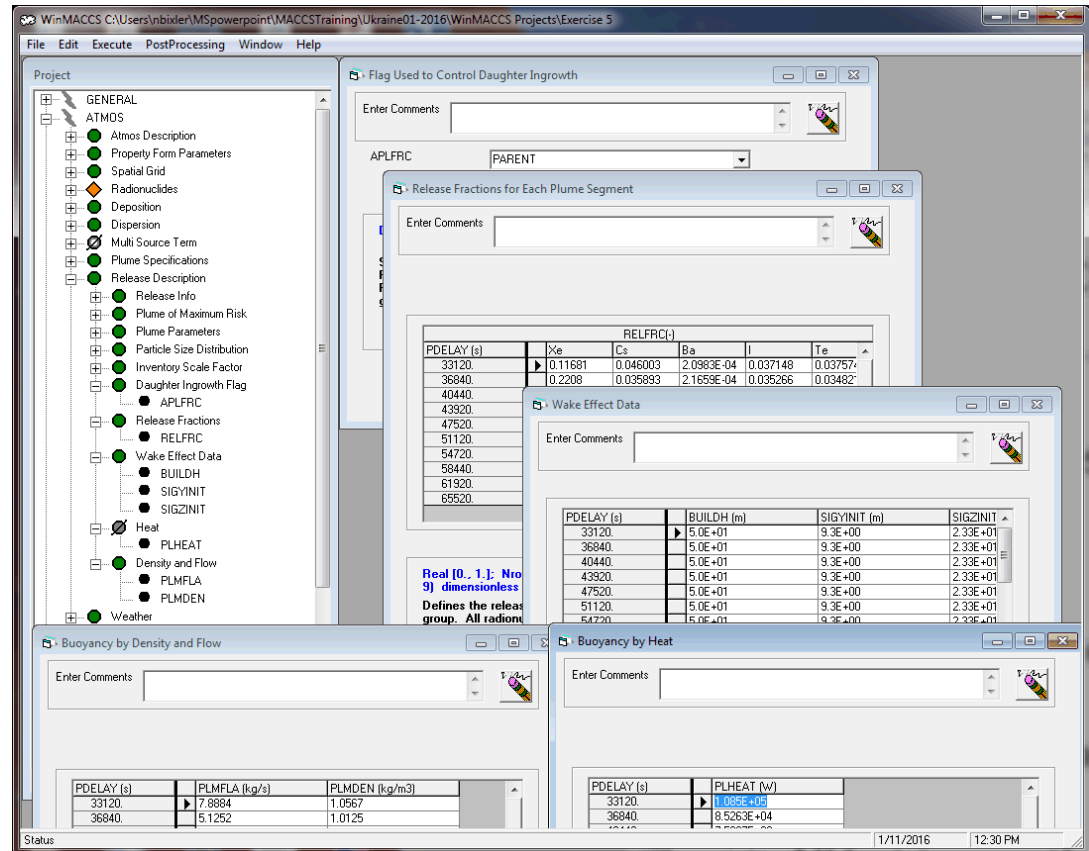
Release Description - I

- Alarm time – affects evacuation timing
- Maximum risk plume segment – affects alignment of release and weather
- Particle Size Distribution
- Inventory scale factor
- All of these choices depend on facility or accident scenario



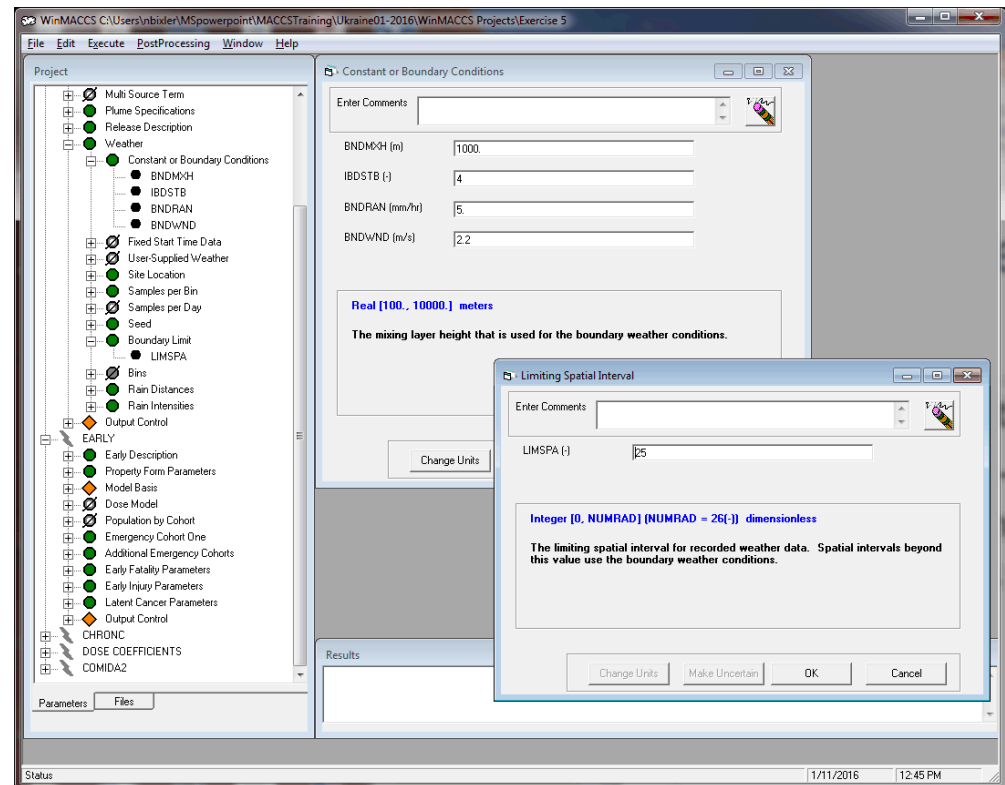
Release Description - II

- Ingrowth flag
- Release fractions
- Wake effects
- Buoyancy data
 - Rate of release of sensible heat
 - Plume density and flow rate
- All but ingrowth flag depend on facility or accident scenario



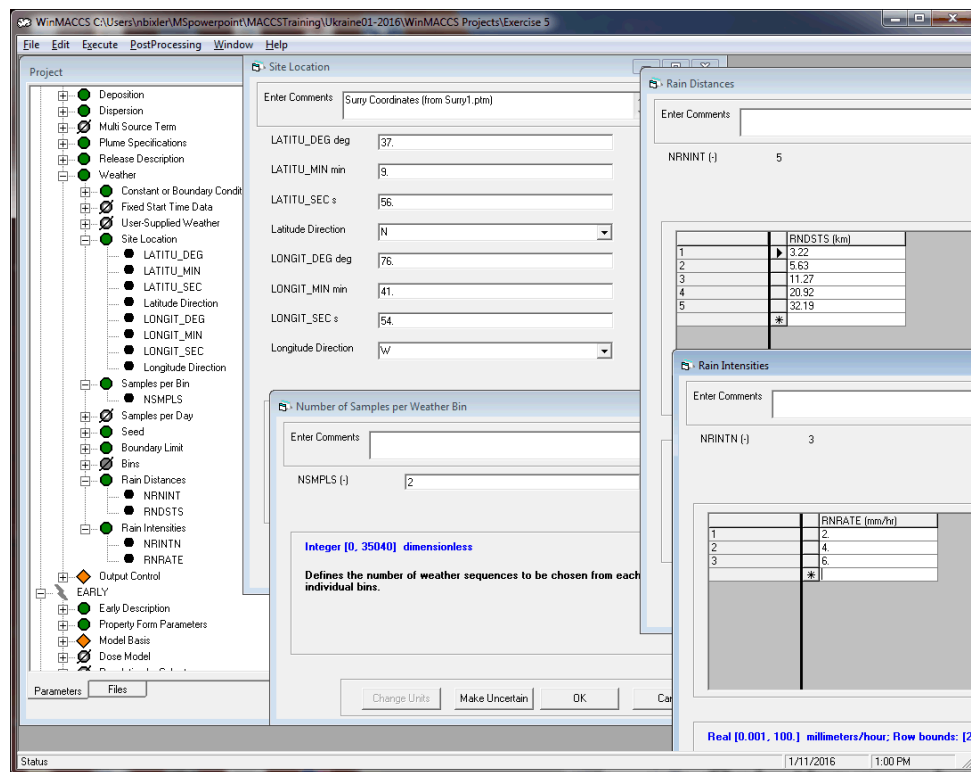
Boundary Weather

- Boundary conditions – constant weather used in outermost rings
- Boundary limit
 - Last ring where recorded weather data applies
 - Beyond this ring boundary weather applies



Weather Sampling

- Type of sampling method – recommend weather bin sampling
- Samples per bin – recommend maximum of 12 or 10%
- Rain distances
- Rain intensities
- All but the sampling method should be reevaluated per site



The screenshot shows the WinMACCS software interface with several dialog boxes open. The 'Site Location' dialog box contains the following fields:

Field	Value
Enter Comments	Sunny Coordinates (from Sunny1.ptm)
LATITU_DEG deg	37.
LATITU_MIN min	3.
LATITU_SEC s	56.
Latitude Direction	N
LONGIT_DEG deg	76.
LONGIT_MIN min	41.
LONGIT_SEC s	54.
Longitude Direction	W

The 'Number of Samples per Weather Bin' dialog box contains the following fields:

Field	Value
Enter Comments	
NSMPLS (-)	2

The 'Rain Distances' dialog box contains the following fields:

Field	Value										
Enter Comments											
NRNINT (-)	5										
RINDSTS (km)	<table border="1"> <tbody> <tr><td>1</td><td>3.22</td></tr> <tr><td>2</td><td>5.63</td></tr> <tr><td>3</td><td>11.27</td></tr> <tr><td>4</td><td>20.32</td></tr> <tr><td>5</td><td>32.19</td></tr> </tbody> </table>	1	3.22	2	5.63	3	11.27	4	20.32	5	32.19
1	3.22										
2	5.63										
3	11.27										
4	20.32										
5	32.19										

The 'Rain Intensities' dialog box contains the following fields:

Field	Value						
Enter Comments							
NRNINT (-)	3						
RNRATE (mm/hr)	<table border="1"> <tbody> <tr><td>1</td><td>2</td></tr> <tr><td>2</td><td>4</td></tr> <tr><td>3</td><td>6</td></tr> </tbody> </table>	1	2	2	4	3	6
1	2						
2	4						
3	6						

The status bar at the bottom indicates: Real [0.001, 100.] millimeters/hour; Row bounds: [2] 1/11/2016 1:00 PM

Weather File

- A formatted (text) weather file is required for weather sampling
 - Weather data can be averaged over 1-hour, 30-minute, or 15-minute time periods
 - Wind direction, wind speed, atmospheric stability class, and precipitation rate must be supplied for each time period in a 365-day year (e.g., an hourly data point for 8760 hours)
 - The last line of the file must contain seasonal day and night mixing heights

Recent and Future Development

- An alternative atmospheric transport and deposition model using Lagrangian particle tracking is being developed
- A multi-unit model has recently been developed and is supported in MACCS 3.10
- MelMACCS can be used to extract source-term data from MELCOR plot files
- A recent version of MelMACCS (2.0) supports multi-unit releases

Summary

- ATMOS models atmospheric release, dispersion, and deposition of radionuclides.
- Many of the ATMOS input parameters are facility (site) or accident-scenario dependent.
- Some of the ATMOS input parameters are insensitive to site and accident scenario.