**AALM Inputs and Outputs:**

AALM inputs and outputs are controlled and recorded in the *INPUT&OUTPUT.xlsm* workbook. This workbook has several functions:

1. Allows setting of input parameter values for AALM simulations
2. Macros in this workbook are used to pass data to and from acslX
3. Allows plotting of AALM output data
4. Provides a complete record of input values and results of each AALM simulation

Input data are entered into the yellow highlighted cells of each worksheet in *INPUT&OUTPUT.xlsm*. Do not edit cells that are highlighted in grey, or add or delete or columns to any worksheets, as this will result in errors in model simulations. The only exception to this is the PLOT worksheet, which can be modified as needed to produce plots of interest.

Worksheets in*INPUT&OUTPUT.xlsm* allow the user to set exposure scenarios for Pb in air (*Air*), surface dust, (*Dust*), drinking water (*Water*), food (*Food*) and/or other ingestion intakes (*Other*). The AALM uses inputs from all exposure media when it creates biokinetics simulations. This allows construction of complex multi-pathway exposure scenarios. Exposure media that are to be excluded from the simulation must be set to zero. The easiest way to accomplished this is to set *Baseline Pb* and *Pulse Pb* to zero and *f\_Pulse Pb* to 1, for each excluded exposure medium (see further explanation below). *Air*, *Dust* and *Water* exposures are constructed by setting values for Pb concentration and rates of intake of each exposure medium. *Food* and *Other* exposures are constructed by setting values for the daily rate of Pb intake (µg/day).

Worksheets in*INPUT&OUTPUT.xlsm* also allow the user to set values for parameters that control Pb absorption and relative bioavailability in each medium (*RBA*), and biokinetics (*Lung*, *Systemic*, *Sex*). Caution should be exercised in making any revisions to any of the biokinetics parameter values without having a complete understanding of the underlying biokinetics models.

A more detailed description of the various worksheets in *INPUT&OUTPUT.xlsm* is provided below.

**AALM-LG *INPUT&OUTPUT.xlsm* Worksheets:**

***Summary*:**

1. Displays a selection of input settings that control and/or define the exposure scenario and simulation (Col E).
2. Displays the output variables available to the user (Col R) and that are displayed in the *Output* worksheet.

***Simulation Control:***

1. Allows access to macros for exporting data to AALM.acsl, importing output data from AALM.acsl, and clearing data from the Output worksheet. The macros are activated by clicking on the macro buttons.
2. Allows input of the name and address of the *INPUT&OUTPUT.xlsm* file (and associated AALM.acsl data input and output files), which are required for operation of *Export* and *Import* macros.
3. Allows input of the age-span of simulation (*TSTOP*). The simulation always begins at day 0 (birth). A setting 18250 days means the simulation runs from birth to age 18250 days (approximately 50 years).
4. Allows input of the communication interval for AALM.acsl output (*CINT*). A setting of 1 day means that AALM.acsl will report values of all output variables for each day of the simulation. In general, the communication interval should be set to a value that is small enough to display dynamics in the output variable of interest. For example, if want to see the predicted daily changes in blood Pb during an intermittent exposure, then you must set the communication interval to 1 day.

***Air:***

1. Allows input of 3 time (*Age*) series of discrete air Pb concentrations (*Air\_1*, *Air\_2*, *Air\_3*; µg/m3) and the proportion of total daily exposure contributed by each series (*f\_Air\_1*, etc). The time-averaged air Pb for each discrete exposure is used in the simulation (e.g., *Air\_1* ◦ *f\_Air\_1* + *Air\_2* ◦ *f\_Air\_2* ◦*Air\_3* x *f\_Air\_3*). Ages serve as breakpoints in the time series at which the air Pb concentration and/or proportional contribution to each source changes. Values between breakpoints are interpolated by AALM.acsl. For example, a 5-day period of elevated exposure (3 µg/m3) at age 2 years (age 730-735 days), over a baseline air Pb exposure (0.03 µg/m3) could be inputted as:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Age** | **Air\_1** | **f\_Air\_1** | **Air\_2** | **f\_Air\_2** | **Air\_3** |
| **day** | **ug/m3** | **f** | **ug/m3** | **f** | **ug/m3** |
|  |  |  |  |  |  |
| 3 | 4 | 5 | 6 | 7 | 8 |
| 0 | 0.03 | 0.04 | 0 | 0.96 | 0 |
| 90 | 0.03 | 0.04 | 0 | 0.96 | 0 |
| 365 | 0.03 | 0.08 | 0 | 0.92 | 0 |
| 729 | 0.03 | 0.12 | 0 | 0.88 | 0 |
| 730 | 0.03 | 0.16 | 3.0 | 0.84 | 0 |
| 735 | 0.03 | 0.16 | 3.0 | 0.84 | 0 |
| 736 | 0.03 | 0.16 | 0 | 0.84 | 0 |
| 1095 | 0.03 | 0.16 | 0 | 0.84 | 0 |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |

1. Allows input of a pulse train of exposure to air Pb (µg/m3) at fixed durations and frequencies (e.g., 2 days/week, 3 months/year). Both, the time-averaged air Pb for discrete exposures and the pulse train are used in the simulation. The proportion of total daily exposure contributed by discrete or pulsed air Pb concentration is set with the parameter *f\_Pulse Pb*, which can have any value between 0 and 1. For example, setting *f\_Pulse Pb* to 1 means that exposures occur only from the pulse train; a setting of zero means that exposures occur only from the discrete exposures; and a setting of 0.5 means that half of the exposure is contributed by the pulse train and half by the discrete exposures. The Pb concentration during each pulse is set with *Pulse Pb* (µg/m3). The Pb concentration between pulses is set with *Baseline Pb* (µg/m3). The age at which the pulse train begins and ends are set with *Pulse\_start* and *Pulse\_stop*, respectively. For example, a repeated interval of elevated exposure above a baseline that occurs for 2 days/week for 3 months per year, which begins at age 2 years (age 730 days) and ends at age 7 years (age 2555 days) could be inputted as:

|  |  |  |  |
| --- | --- | --- | --- |
| **Baseline Pb** | **ug/m3** | 1 | 0.03 |
| **Pulse Pb** | **ug/m3** | 2 | 3.0 |
| **f\_Pulse Pb** | **f** | 3 | 1 |
| **Pulse\_start** | **day** | 4 | 730 |
| **Pulse\_stop** | **day** | 5 | 2555 |
| **Pulse\_1 width** | **day** | 6 | 2 |
| **Pulse\_1 period** | **day** | 7 | 7 |
| **Pulse\_2 width** | **day** | 8 | 90 |
| **Pulse\_2 period** | **day** | 9 | 365 |

1. Allows setting of ventilation rates (*V,* m3/day). The values assigned to ventilation rate are based on the ICRP Human Respiratory Tract Model (HRTM), for the general population. These rates are intended to be used with particle deposition fractions provided in the *Lung* worksheet. If the ventilation rates are revised from the ICRP model defaults for the general population, the ICRP model default deposition fractions may also have to be revised.

***Dust:***

1. Allows input of 3 time (*Age*) series of discrete surface dust Pb (e.g. indoor dust, soil dust, etc.) concentrations (*Dust\_1*, *Dust\_2*, *Dust\_3*; µg/g) and proportion of total daily exposure contributed by each series (*f\_Dust\_1*, etc).
2. Allows input of a pulse train of exposure to surface dust Pb (µg/g) at fixed durations and frequencies (e.g., 2 days/week, 3 months/year).
3. Allows setting of surface dust ingestion rates (*IRD*, g/day).

See description of *Air* worksheet for examples of settings.

***Water:***

1. Allows input of 3 time (*Age*) series of discrete drinking water Pb concentrations (*Water\_1*, *Water\_2*, *Water\_3*; µg/L) and proportion of total daily exposure contributed by each series (*f\_Water\_1*, etc).
2. Allows input of a pulse train of exposure to drinking water Pb (µg/L) at fixed durations and frequencies (e.g., 2 days/week, 3 months/year).
3. Allows setting of surface dust ingestion rates (*IRW*, L/day).

See description of *Air* worksheet for examples of settings.

***Food:***

1. Allows input of 3 time (*Age*) series of discrete food Pb intakes (*Food\_1*, *Food\_2*, *Food\_3*, µg/day) and proportion of total daily intake contributed by each series (*f\_Food\_1*, etc). Intakes from all 3 series are summed.
2. Allows input of a pulse train of exposure to food Pb intakes (µg/day) at fixed durations and frequencies (e.g., 2 days/week, 3 months/year). Both, the time-averaged food Pb intakes for discrete exposures and the pulse train are used in the simulation. The proportion of total daily exposure contributed by discrete or pulsed food Pb intakes is set with the parameter *f\_Pulse Pb* (from 0 to 1). The Pb intake during each pulse is set with *Pulse Pb* (µg/day). The Pb intake between pulses is set with *Baseline Pb* (µg/day). The age at which the pulse train begins and ends are set with *Pulse\_start* and *Pulse\_stop*, respectively.

***Other:***

1. Allows input of 3 time (*Age*) series of discrete Pb intakes form miscellaneous exposure media (µg/day, *Other\_1*, *Other\_2*, *Other\_3*, µg/day) and proportion of total daily intake contributed by each series (*f\_Other\_1*, etc). Intakes from all 3 series are summed.
2. Allows input of a pulse train of exposure to other Pb intakes (µg/day) at fixed durations and frequencies (e.g., 2 days/week, 3 months/year).

***RBA:***

1. Allows setting of the gastrointestinal absorption fraction (*AF*) for Pb. These values are applied to all lead than enters the small intestine, regardless of the exposure medium.
2. Allows setting of the relative bioavailability (*RBA*) of Pb in each exposure medium (*Dust*, *Water*, *Food*, *Other*) and the RBA for inhaled lead particulate that enters the GI-tract as a result of mucociliary clearance from the respiratory tract. Absorption of Pb from the lung is controlled with parameter values in the *Lung* worksheet.

***Lung:***

1. Allows setting of parameter values that control absorption of lead from the lung. These settings are based on the ICRP HRTM absorption classes: *fast*, *moderate*, *slow*; these represent compounds having high, moderate or low water solubility, respectively. The ICRP recommended default for airborne Pb is moderate; however, slower absorption might be expected for highly low solubility lead oxides.
2. Allows setting of parameter values that control kinetics of transfer of Pb between respiratory tract compartments.
3. Allows setting of the particle size of inhaled Pb (*PS*, µm). Particle sizes must be selected from the list provided in cells Q24-Q33 and are based on the ICRP HRTM.
4. Allows setting of regional deposition fractions of inhaled Pb. The correct values that correspond to the selected particle size are automatically selected for use in the simulation. These values also correspond to the ICRP HRTM default values for ventilation rate (*V*, µ/day) for the general population that are the default values in the *Air* worksheet. Caution should be exercised in making any revisions to the deposition fractions without having a complete understanding of the underlying HRTM; and, in particular, relationships between ventilation rate, particle size and deposition.

***Systemic*:**

Allows setting of values for parameter constants and parameter age arrays that control the systemic biokinetics model.Caution should be exercised in making any revisions to the constants or age arrays without having a complete understanding of the underlying biokinetics model.

***Gender*:**

Allows setting of gender-specific parameter values that control growth and tissue masses and volumes. Setting cell C21 to *M* (male) or *F* (female) automatically sets values for male of female, respectively.

***Output***:

Displays values for AALM output values. These values are imported into *INPUT&OUTPUT.xlsm* when the *Import* macro is run. The output variables and the order of presentation in the *Output* worksheet are set in AALM.acsl and cannot be modified by revising *INPUT&OUTPUT.xlsm*. A glossary list of the output variables is provided in the *Summary* worksheet.

***Plot***:

Plots time series for selcted output variables in the *Output* worksheet and/or the *Comparison Data* worksheet. The user can add, delete or modify plots to explore specific interests. The *Plot* worksheet is set to overlay plots of data from the *Output* and *Comparison Data* worksheets. However, data from additional simulations can be inlcuded in the plots by adding supplemental *Comparison Data* e.g., *Comparison Dat*a 2) sheets to I*NPUT&OUTPUT.xlsm,* and using the *Select Data* function in Excel to include the data in the plots of interest.

***Comparison Data***:

Allows recording of output data from archived simulations. This is accomplished by copying data in the *Output* worksheet from a previous simulation (e.g., another *INPUT&OUTPUT.xlsm* file) into the data array in the *Comparison Data* worksheet. The complete output data array (including column headers) should be copied to cell A17. This ensures that the correct output variable names are retained in the *Comparison Data* data array (for example, for comparing AALM-LG with AALM-OF simulations which have different output variables). See *Plot* for description of how to overlay data from more than one *Comparison Data* worksheet.

***Export Data***:

Records settings for all input variables. These values are exported to AALM.acsl when the Export macro is run. Do not edit this worksheet. Changing the values or archtecture (i.e., rows, colums) in this worksheet will compromise function of the AALM, even though it may not prevent a simulation from being completed.