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GENII: Dose Estimation

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Estimating Radiation Dose to Individuals

- Primary components are radionuclides in:
  - Air
  - Water
  - Soil
  - Foods
- Level of human exposure to each

Converting Environmental Concentrations to Doses

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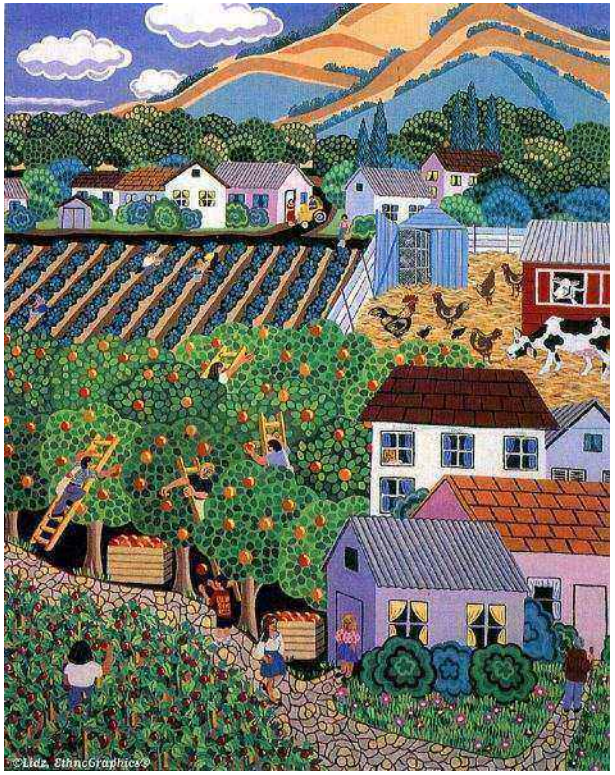


Doses

- Dose is a useful physical concept, but it is nearly impossible to measure for individuals
- Therefore, most dose estimates are made with non-individual-specific dose conversion factors, which are themselves the result of the application of a model

External Dosimetry

- Estimation of radiation doses to organs from sources outside the body
  - Submersion in contaminated air
  - Immersion in contaminated water
  - Exposure to contaminated ground, sediment, or surfaces

External Dose Rate Factors

- Anatomical representation of reference individuals of different age, sex, ethnicity
- Distribution of radionuclides in source
  - Uniform, infinite planes or slabs often used
- Radiation transport from source to body
  - Shielding may be considered here or a correction added later
- Radiation transport to specific organs
- Energy absorbed in specific organs

External Dose - Calculation

- External dose factors are used to estimate dose from simplified source configurations
- Usually a dose rate calculation
- Must consider buildup/decay of radionuclides, shielding, fraction of time exposed, etc., separately from dose rate factor

Internal Exposure

- Estimation of dose from intakes of radionuclides into the body
  - Inhalation
  - Ingestion
  - Dermal absorption (e.g. tritium)
- Must consider patterns of deposition in specific organs

Internal Dose Factors

- Anatomical representation of reference individuals of different ages, sexes, etc.
- Absorption of radionuclides into blood
  - Lung model
  - GI-Tract model
- Deposition/retention in different organs, accounting for biological elimination, decay
- Organ dosimetry

Metabolic Models

- "Metabolic" or "biokinetic" models are used to describe absorption, deposition, and retention
- Functions of age
- Generally empirical, fitting limited data
- Behavior of decay progeny is often treated idealistically

GENII V.2 Human Exposure

- Up to 6 age groups allowed, following ICRP-56,67,69

3 months	0-1 year
1 year	1-2 year
5 year	2-7 year
10 year	8-12 year
15 year	13-17 year
20 + year	17- 110 year

External Exposure - Doses

- Dose rate conversion factors from Federal Guidance Report 12, provided by Keith Eckerman, ORNL
  - Air Submersion
  - Water Immersion
  - Soil Plane
  - Soil Volume

Internal Exposure - Doses

- Effective dose equivalent: ICRP-30
  - Adult only
- Effective dose: ICRP-72
  - 6 age groups
  - 24 organs/tissues
  - Inhalation classes F, M, S

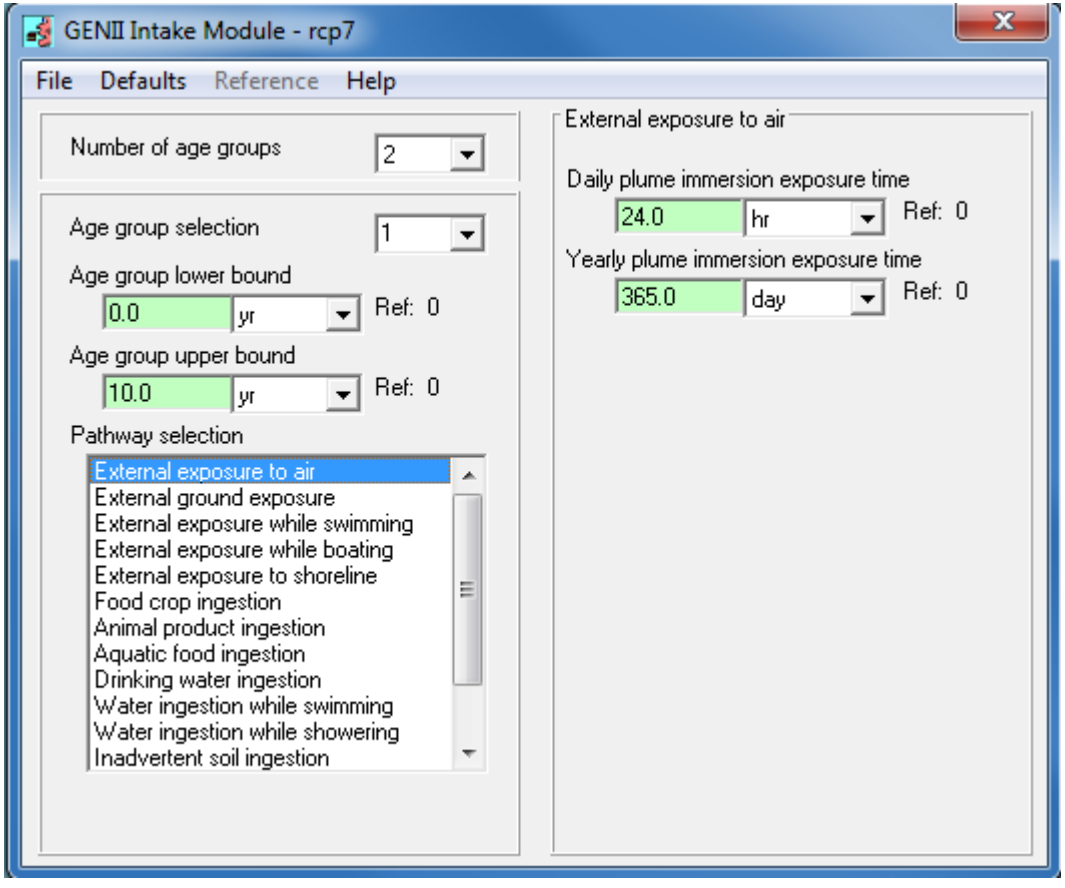
Risk Calculations - FGR 13

- US Federal Guidance Report 13 provides coefficients for 15 cancer sites
  - Inhalation (risk/Bq)
    - Inhalation classes F, M, S
  - Ingestion (risk/Bq)
    - Accounts for different consumption patterns with age
      - Drinking water
      - Food crops

GENII: Human Exposures

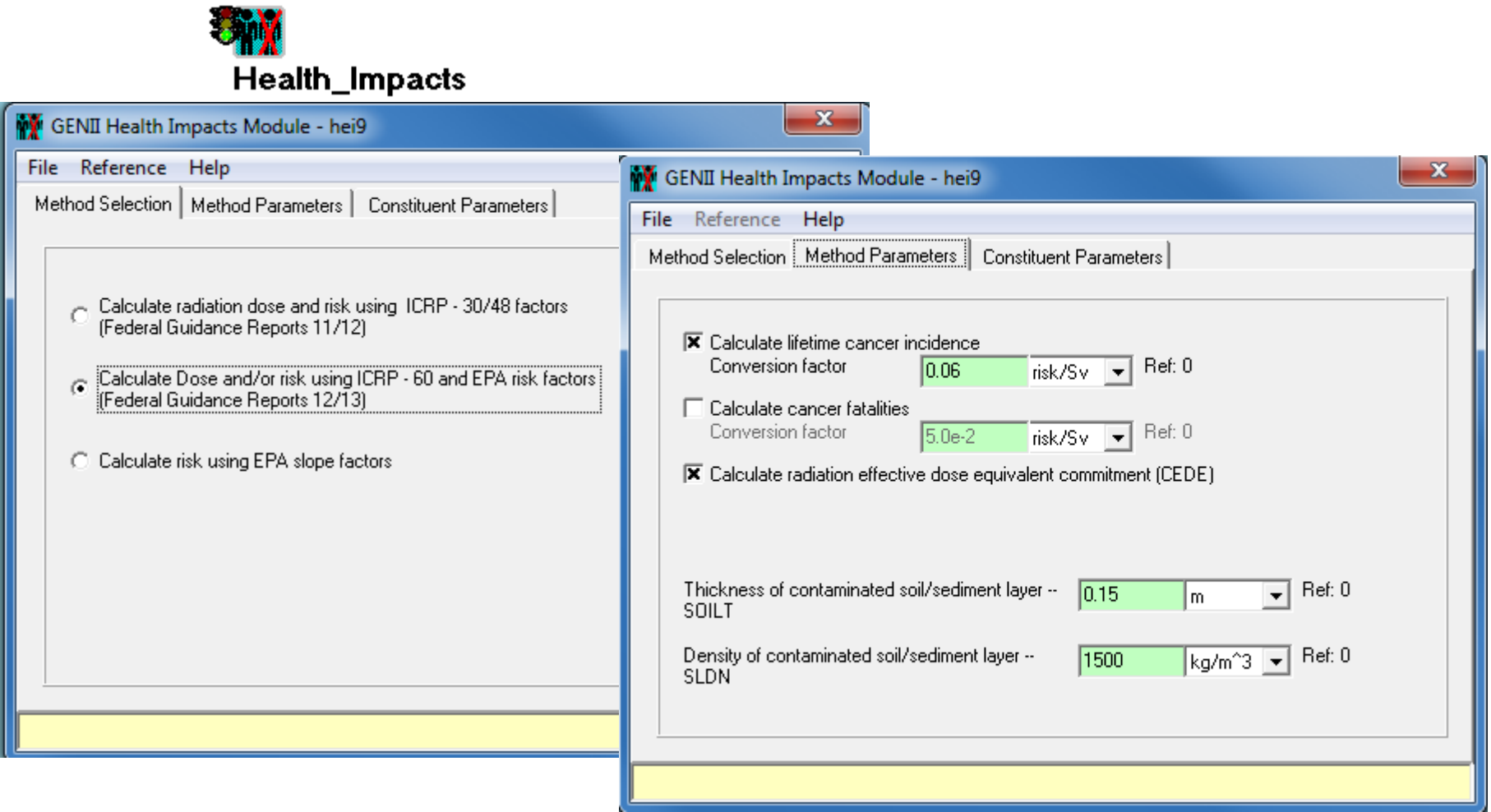
- Maximally-exposed individual (or population-average individual) intakes are determined in the Receptor Intakes Module

Receptor_Intakes



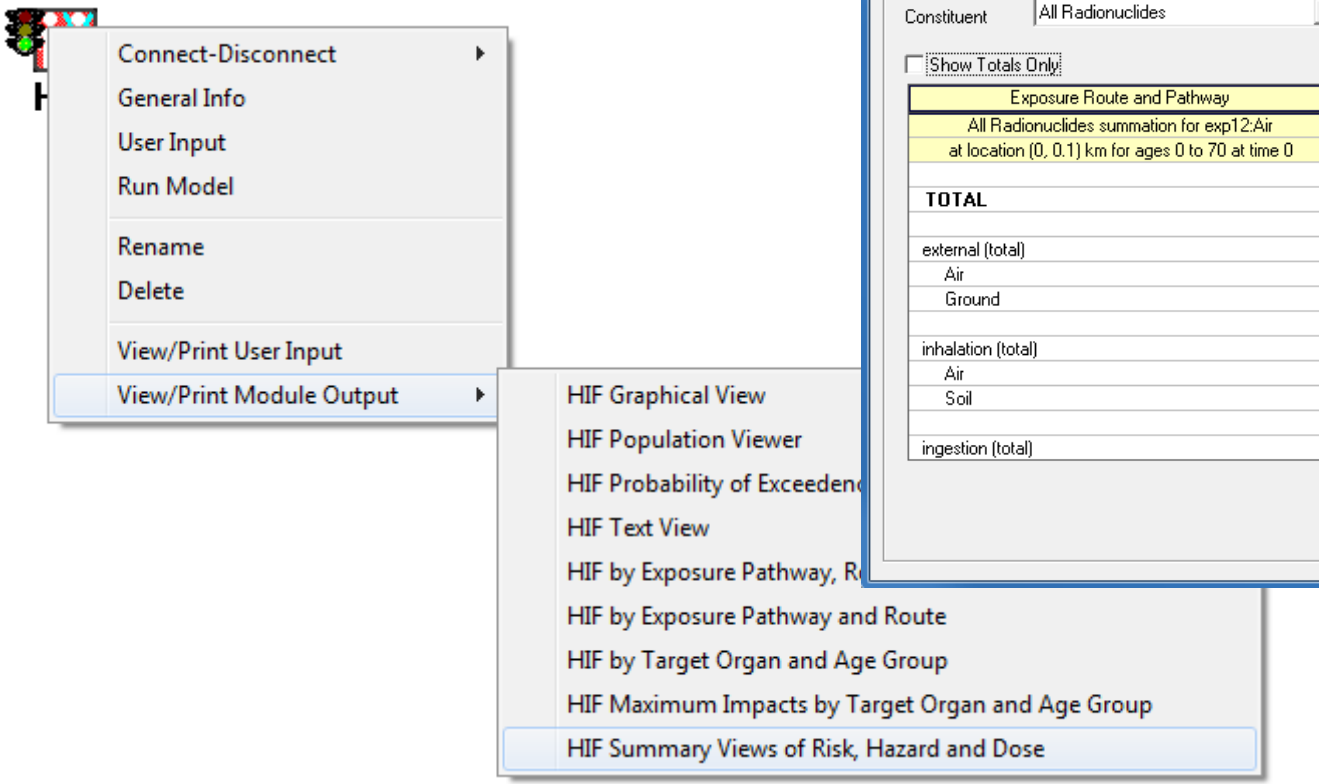
GENII: Dose and Risk Estimation

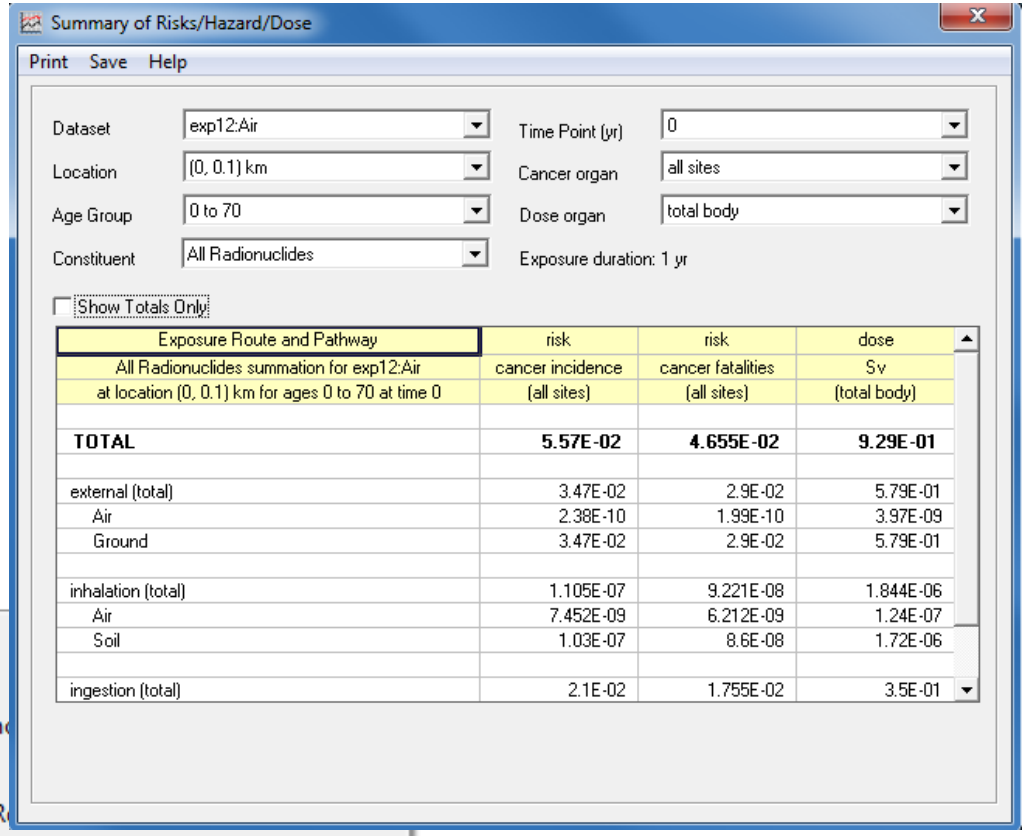
- Doses and risks are calculated in the Health Impacts Module



GENII: Looking at the Answer

- There are many ways to see the results
  - FRAMES-provided viewers
  - Air/Water Report Generators





Exposure Route and Pathway	risk	risk	dose
All Radionuclides summation for exp12:Air	cancer incidence	cancer fatalities	Sv
at location (0, 0.1) km for ages 0 to 70 at time 0	(all sites)	(all sites)	(total body)
TOTAL	**5.57E-02**	**4.655E-02**	**9.29E-01**
external (total)	3.47E-02	2.9E-02	5.79E-01
Air	2.38E-10	1.99E-10	3.97E-09
Ground	3.47E-02	2.9E-02	5.79E-01
inhalation (total)	1.105E-07	9.221E-08	1.844E-06
Air	7.452E-09	6.212E-09	1.24E-07
Soil	1.03E-07	8.6E-08	1.72E-06
ingestion (total)	2.1E-02	1.755E-02	3.5E-01

GENII: Report Generators

Report_Generator

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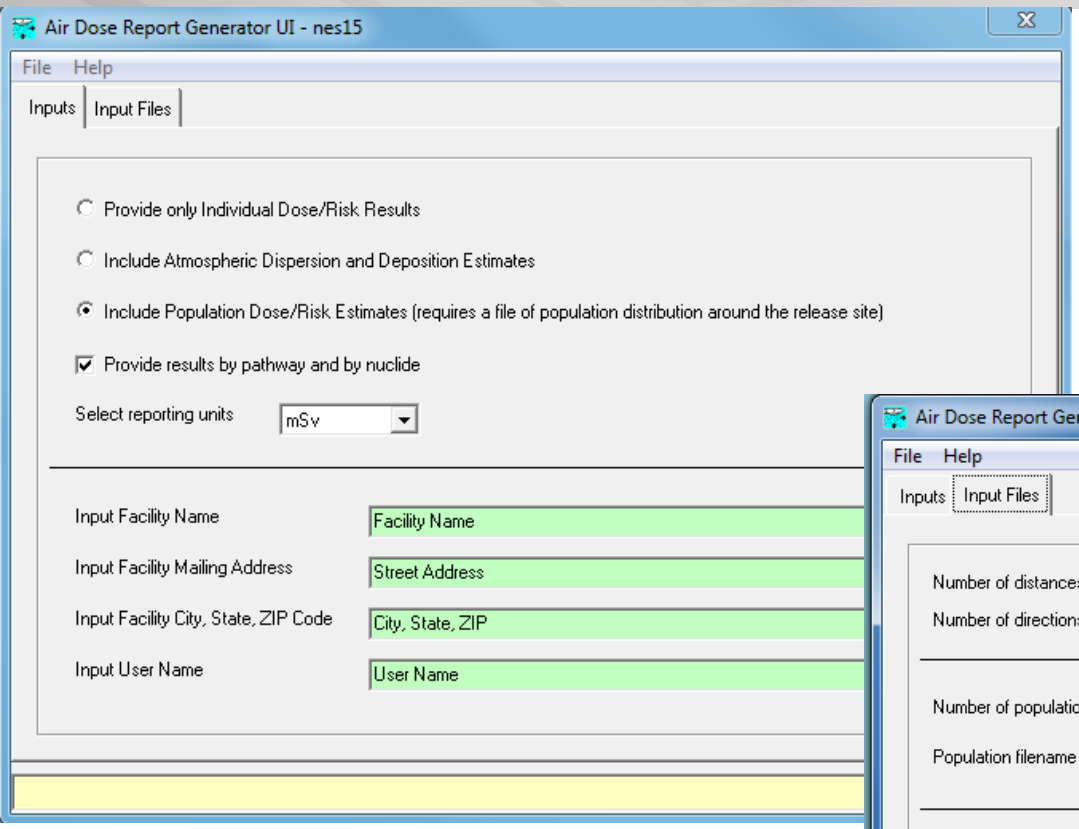

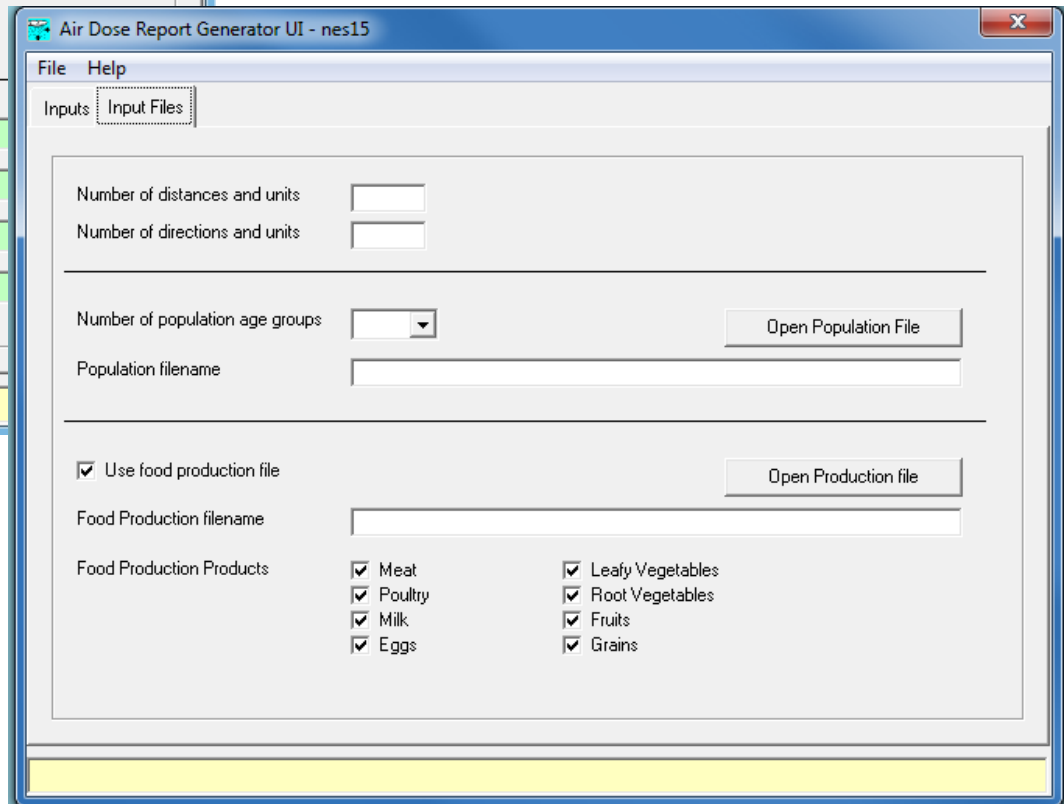

Collective dose calculations require additional information in a format that matches the remainder of the calculation