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D9.6 Software tool which allows the propagation of uncertainties to dose assessment models (in collaboration with Subtask 9.1.3)

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Abstract

This report presents the software tool which allows the propagation of uncertainties to dose assessment models. The results of the uncertainty propagation through a terrestrial food chain and dose model from Subtask 1 within Task 1.3 of Work package 1 (WP1) within the CONFIDENCE project and their analysis are presented in CONFIDENCE deliverable D9.5.

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Introduction

The task of Subtask 1 within Task 1.3 of Work package 1 (WP1) within the CONFIDENCE project is to analyse the propagation of uncertainties from ensemble dispersion simulations through a terrestrial food chain and dose model. Ensemble atmospheric dispersion calculations were performed in Task 1.2 of WP1. The scenarios as well as methods and results of the ensemble calculations are described in detail in CONFIDENCE deliverable 9.3 (De Vries et al., 2019). In Subtask 1 (Task 1.3) the uncertainties of the atmospheric dispersion calculations were propagated through a model chain including the FDMT module (Food Chain and Dose Module for Terrestrial Pathways) which allows an assessment of the resulting dose.

Model setup

The principle of the model chain is illustrated in Figure 1. Atmospheric dispersion calculations based on meteorological data and source term information on the release are performed to calculate the atmospheric transport of the released radionuclides. The deposition of the airborne radionuclides on different surfaces is modelled in the next step. The transport within the human food chain is modelled according to the model parameter settings. Subsequently, organ doses and effective dose to the population are modelled using the available pathways of cloud shine, ground shine, inhalation, and ingestion.

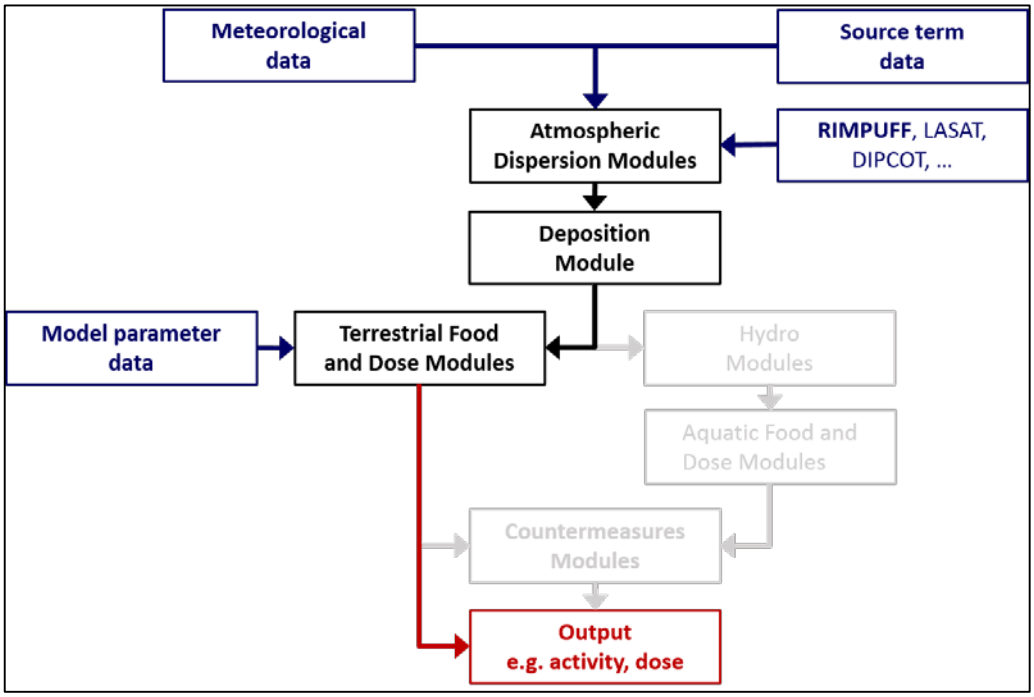

Figure 1 Setup of model chain and input parameter for the calculation of activity concentrations and dose resulting from a release of radionuclides. Blue: input data, black: used model chain, red: results, grey: available but not used model chain.

The different tools and modules used in the study to propagate the uncertainties from dispersion calculation through the food chain and to the dose are briefly described below.

Decision support system JRODOS

The Real-time Online Decision Support System (RODOS) is operated at BfS - as well as in numerous other European countries - in order to perform dispersion and dose calculations in the event of a nuclear accident or other radionuclide releases into the environment and to assess the potential consequences. RODOS was developed after the Chernobyl accident and supported by the European

Commission's Research and Technological Development Framework Programmes (Ehrhardt, 1997; Raskob et al., 2012). The resent development of the Java-based RODOS version is named JRODOS.

The JRODOS program serves as a framework for several models for data processing, physical modelling and user interactions. The model tasks include the processing of meteorological input data, the calculation of the dispersion in the atmosphere, the simulation of the transfer of radionuclides within the human food chain, and the estimation of radiation exposure experienced by the population.

Terrestrial Food Chain and Dose Module (FDMT)

The FDMT (Food Chain and Dose Module for Terrestrial Pathways) is the module in the JRODOS system to simulate the transfer of radioactive material in food chains, and to assess the doses to the population via all relevant exposure pathways - internal exposure via inhalation and ingestion, external exposure from cloud and ground shine (Gering and Müller, 2004; Müller et al., 2004). The main input parameters for FDMT are derived from the atmospheric dispersion calculations. They comprise the near ground activity concentration in air, the deposited activity concentration on the ground, the amount of precipitation and the date, i.e. season, of deposition. The different transfer steps of radionuclides through the food chain are shown in Figure 2.

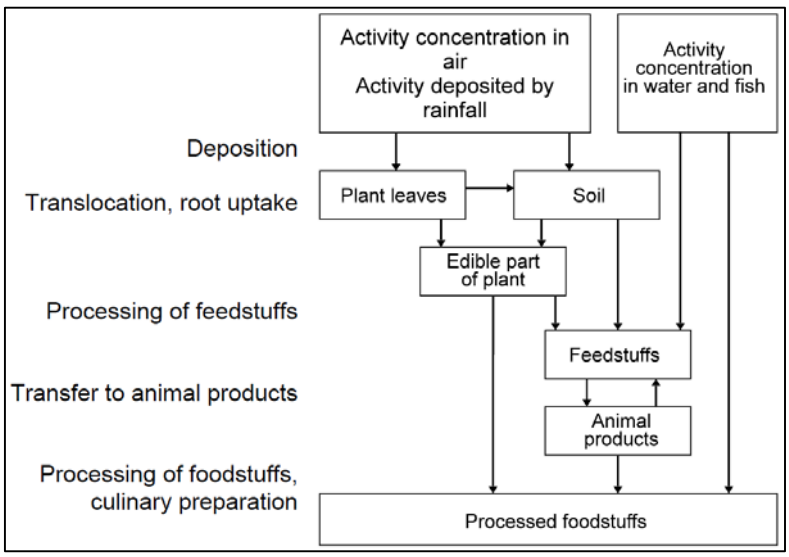

Figure 2 Steps of food chain transfer calculations (from Müller et al. (2004)).

Ensemble setup

Subtask 1 within Task 1.3 of Work package 1 (WP1) makes use of the ability of JRODOS to manage the model chain in an automatic mode which is launched by XML-documents. The XML-documents contain the settings of each ensemble member such as the meteorological input, the source term, and the parameter settings for FDMT. The output of each ensemble member is saved as statistic output to ASCII files which can then be subsequently analysed.

The total number of ensemble member was limited to 50 in the project to avoid a too large number of resulting ensemble members and to optimize model run-time and post-processing. Each one of the 50 representations of the FDMT model parameter from the model setup was randomly assigned to one of 50 representations of the dispersion calculations. Hence the total number of ensemble results remained at 50 ensemble members (Figure 3). However, any number of ensemble member is possible and only limited by the available computational resources.

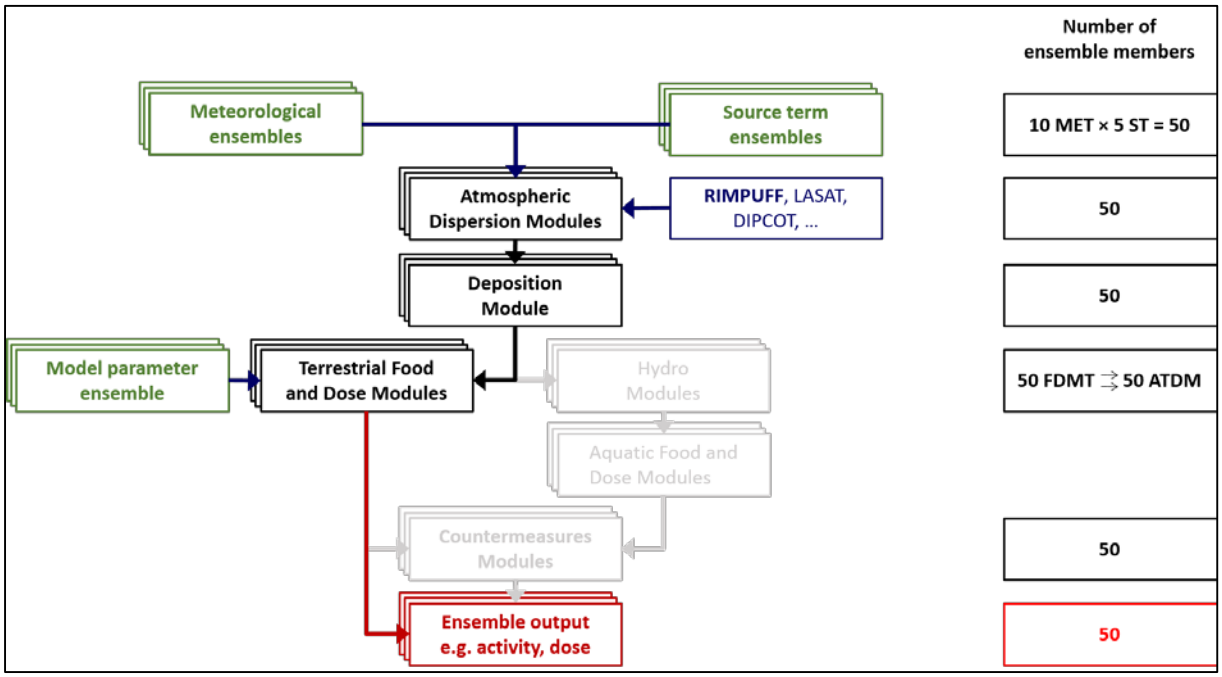

Figure 3 Model setup for propagation of meteorological, source term and FDMT uncertainties.

JRODOS XML-input

For each one of the ensemble member one separate XML-input file has to be prepared. In Subtask 1 within Task 1.3 this was achieved by preparing one XML-template for the ensemble run which was then automatically edited for each ensemble member using the Python lxml library (Richter et al., 2019). The XML-templates can be set up and saved from within the JRODOS-Lite user interface using JRodos Emergency runs.

Source term

For each representation of a source term ensemble member the XML-elements `<sourcetermInfo>`, `<sourcetermData>`, `<sourceterms>` have to be adapted respectively. Hereby, parameter like location, release time, release height, release amount, and nuclide vector can be set.

```
<sourcetermInfo active="true">
  <sourcetermInputType>userDefinedHand</sourcetermInputType>
  <startOfRelease>YYYY:mm:dd:HH:MM:SS</startOfRelease>
  <delayBeforeRelease>float</delayBeforeRelease>
  <nuclideNames>string of nuclides</nuclideNames>
  <blockName>string</blockName>
  <thermalPower>float</thermalPower>
  <operationTime>integer</operationTime>
  <inventory>string</inventory>
  <stackHeight>float</stackHeight>
  <longitude>float</longitude>
  <latitude>float</latitude>
</sourcetermInfo>
```

```
<sourcetermData inputType="integer">
  <label>UserDefined</label>
  <reactorType>Undefined</reactorType>
  <associatedSites />
  <comment />
  <endOfReaction>float</endOfReaction>
  <releaseTimeInterval start="float" end="float">
    <releaseAttribute height="float" thermalEnergy="float"
       volumeFlux="float" ventArea="float" />
    <relativeIodineFraction elemIod="float" orgBoIod="float"
       aerosolIod="float" />
    <nuclide name="string" value="float" />
      ...
  </releaseTimeInterval>
</sourcetermData>

<sourceterms>
  <nuclideNames>string of nuclides</nuclideNames>
  <releaseStart>YYYY:mm:dd:HH:MM:SS</releaseStart>
  <sourceterm index="0">
    <sourcetermInfo active="true">
      <sourcetermInputType>userDefinedHand</sourcetermInputType>
      <startOfRelease>YYYY:mm:dd:HH:MM:SS0</startOfRelease>
      <delayBeforeRelease>float</delayBeforeRelease>
      <nuclideNames>string of nuclides</nuclideNames>
      <blockName>string</blockName>
      <thermalPower>float</thermalPower>
      <operationTime>integer</operationTime>
      <inventory>string</inventory>
      <stackHeight>float</stackHeight>
      <longitude>float</longitude>
      <latitude>float</latitude>
    </sourcetermInfo>
    <sourcetermData inputType="6">
      <label>UserDefined</label>
      <reactorType>Undefined</reactorType>
      <associatedSites />
      <comment />
      <endOfReaction>float</endOfReaction>
      <releaseTimeInterval start="float" end="float">
        <releaseAttribute height="float" thermalEnergy="float"
           volumeFlux="float" ventArea="float" />
        <relativeIodineFraction elemIod="float" orgBoIod="float"
           aerosolIod="float" />
        <nuclide name="string" value="float" />
          ...
      </releaseTimeInterval>
    </sourcetermData>
  </sourceterm>
</sourceterms>
```

Meteorological data

The meteorological input can be set in XML-element <weatherInfo>. Here the required meteorological data provider has to be set for each ensemble member in <meteoProvider> as it is registered in JRODOS.

```
<weatherInfo active="true">
  <weatherInputType>meteoOnline</weatherInputType>
  <meteoTimeStamp>YYmmddHHMMSS</meteoTimeStamp>
  <meteoProvider>string</meteoProvider>
  <meteoAdaptTime>bool</meteoAdaptTime>
  <weatherNumericType>newestData</weatherNumericType>
  <meteoSettingType>Prognosis</meteoSettingType>
  <durationOfPrognosis>float</durationOfPrognosis>
  <initialPlumeBroadening>consider</initialPlumeBroadening>
  <buildingWidth>float</buildingWidth>
  <buildingHeight>float</buildingHeight>
  <turbulenceParameter>string</turbulenceParameter>
  <landUseData>string</landUseData>
  <dispersionModel>string</dispersionModel>
  <timeStepOfPrognosis>integer</timeStepOfPrognosis>
  <duration10minSteps>integer</duration10minSteps>
  <duration30minSteps>integer</duration30minSteps>
</weatherInfo>
```

FDMT data

The ensemble specific input data for FDMT are stored in ASCII files. The ASCII-files contain the distribution type and the distribution parameter. The values used in Subtask 1 within Task 1.3 are listed in the tables in Appendix A. The location of the FDMT parameter file can be set in XML-element

```
<jrodos>
  <uncertainty>
    <fdmt>/path/to/FDMT/parameter/file.txt</fdmt>
  </uncertainty>
</jrodos>
```

JRODOS statistical output

The statistical output is also defined within the <jrodos> element. It includes the location of the output definition file, i.e. an ASCII file containing the requested output, and the folder location, where the output should be written. The XML-element <expired> contains the information, how long the JRODOS-project itself should be saved. To save disk space this value is set very low as the required output is saved separately. An example of a statistic output definition file can be found in Appendix B Table 15.

```
<jrodos>
  <statisticOutput active="true"
    input="/path/to/statisticOutputDefinition">
    /path/to/statistic/output/folder/</statisticOutput>
  <expired>integer</expired>
</jrodos>
```

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Appendix A

Table 1 Retention coefficient of plants (mm)
Normal distribution

Plant type	Cs		I		Sr	
	Median	SD	Median	SD	Median	SD
Grass (int.)	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Grass (ext.)	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Maize	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Maize bulbs	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Potatoes	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Beets	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Beet leaves	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Winter barley	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Spring barley	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Winter wheat	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Spring wheat	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Rye	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Oats	2.00E-01	2.00E-01	1.00E-01	1.00E-01	4.00E-01	4.00E-01
Leafy veg.	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Root veg.	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Fruit veg.	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Fruits	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01
Berries	3.00E-01	3.00E-01	1.50E-01	1.50E-01	6.00E-01	6.00E-01

Table 2 Weathering rate describing exponential decrease of activity on plants due to wind, rain etc. (1/d)
Log-normal distribution

Element	Median	SD
Cs	5.00E-02	1.90E-02
I	7.50E-02	2.90E-02
Sr	5.00E-02	1.90E-02

Table 3 Transfer factor soil/plant (kg soil/kg fresh plant), all soil types
Log-normal distribution

Plant type	Cs		I		Sr	
	Median	SD	Median	SD	Median	SD
Grass (int.)	1.21E-01	1.80E-01	9.90E-02	3.10E-02	3.74E-01	2.64E-01
Grass (ext.)	2.42E-02	2.64E-02	9.90E-02	3.10E-02	3.74E-01	2.64E-01
Maize	3.00E-02	2.75E-02	2.75E-02	4.50E-02	2.48E-01	1.90E-01
Maize bulbs	1.05E-02	1.08E-02	2.66E-04	5.32E-04	1.12E-01	1.16E-02
Potatoes	2.10E-02	2.52E-02	2.10E-02	2.52E-02	5.04E-02	4.62E-02
Beets	1.20E-02	1.76E-02	2.08E-03	1.92E-01	2.40E-01	2.24E-01
Beet leaves	1.09E-02	1.92E-02	2.08E-03	1.92E-03	2.40E-01	2.24E-01
Winter barley	6.61E-02	1.31E-01	1.22E-04	2.44E-03	1.57E-01	1.65E-01
Spring barley	6.61E-02	1.31E-01	1.22E-04	2.44E-03	1.57E-01	1.65E-01
Winter wheat	6.69E-02	1.32E-01	1.23E-04	2.46E-03	1.58E-01	1.67E-01
Spring wheat	6.69E-02	1.32E-01	1.23E-04	2.46E-03	1.58E-01	1.67E-01
Rye	6.61E-02	1.31E-01	1.22E-04	2.44E-03	1.57E-01	1.65E-01
Oats	6.61E-02	1.31E-01	1.33E-04	2.44E-03	1.57E-01	1.65E-01
Leafy veg.	1.70E-02	2.10E-02	1.60E-03	2.90E-03	1.90E-01	1.80E-01
Root veg.	1.20E-02	1.76E-02	2.08E-03	1.92E-03	2.40E-01	2.24E-01
Fruit veg.	3.50E-03	7.50E-03	3.50E-03	7.50E-03	4.90E-02	9.00E-02
Fruits	2.25E-03	3.30E-03	1.80E-03	1.80E-03	3.75E-03	2.85E-03
Berries	2.90E-03	3.30E-03	2.90E-03	3.30E-03	5.50E-02	6.90E-02

Table 4 Begin and end of harvest of plants (Julian days)
Triangular distribution

Plant type	Begin			End		
	Min	MPV	Max	Min	MPV	Max
Grass (int.)	83	115	126	153	168	283
Hay (int.)	98	122	136	167	197	306
Grass (ext.)	83	115	126	153	168	283
Hay (ext.)	98	122	136	167	197	306
Maize	218	234	245	266	297	322
Maize bulbs	217	251	273	296	322	346
Potatoes	146	154	166	271	297	303
Beets	190	211	230	331	337	355
Beet leaves	190	211	230	331	337	355
Winter barley	146	170	185	208	233	276
Spring barley	121	185	194	232	266	280
Winter wheat	156	191	203	228	251	301
Spring wheat	177	193	200	258	270	288
Rye	160	185	181	195	264	292
Oats	167	192	206	232	265	293
Leafy veg.	106	121	136	289	304	319
Root veg.	167	182	197	304	319	334
Fruit veg.	177	185	189	264	276	289
Fruits	124	144	158	241	293	333
Berries	127	149	161	195	214	295

Table 5 End of first harvesting period (Julian days)
Triangular distribution

Plant type	Min	MPV	Max
Grass (int.)	127	140	152
Hay (int.)	137	152	166
Grass (ext.)	127	140	152
Hay (ext.)	137	152	166
Maize	246	256	265
Maize bulbs	274	285	295
Potatoes	167	219	270
Beets	231	281	330
Beet leaves	231	281	330
Winter barley	186	197	207
Spring barley	195	213	231
Winter wheat	204	216	227
Spring wheat	201	229	257
Rye	182	188	194
Oats	207	219	231
Leafy veg.	137	213	288
Root veg.	198	251	303
Fruit veg.	190	227	263
Fruits	159	200	240
Berries	162	178	194

Table 6 Yield of plants (kg/m^2)
Triangular distribution

Plant type	Min	MPV	Max
Grass (int.)	7.30E-01	8.60E-01	9.30E-01
Hay (int.)	7.30E-01	8.60E-01	9.30E-01
Grass (ext.)	7.30E-01	8.60E-01	9.30E-01
Hay (ext.)	7.30E-01	8.60E-01	9.30E-01
Maize	3.94E+00	4.38E+00	4.56E+00
Maize bulbs	7.10E-01	8.50E-01	9.50E-01
Potatoes	3.02E+00	3.87E+00	4.38E+00
Beets	5.01E+00	7.56E+00	1.02E+01
Beet leaves	2.00E+00	3.00E+00	4.00E+00
Winter barley	5.60E-01	6.20E-01	7.00E-01
Spring barley	4.30E-01	4.80E-01	5.20E-01
Winter wheat	6.50E-01	7.20E-01	7.90E-01
Spring wheat	5.10E-01	5.40E-01	5.90E-01
Rye	4.00E-01	5.10E-01	5.80E-01
Oats	4.20E-01	4.60E-01	5.10E-01
Leafy veg.	2.80E-01	2.51E+00	4.37E+00
Root veg.	8.90E-01	2.63E+00	3.00E+00
Fruit veg.	4.30E-01	1.70E+00	3.29E+00
Fruits	5.50E-01	1.03E+00	2.86E+00
Berries	4.10E-01	4.50E-01	4.60E-01

Table 7 Time grid for feeding rates (Julian days)
Triangular distribution

Animal product	Feed. time #1			Feed. time #2			Feed. time #3			Feed. time #4		
	Min	MPV	Max	Min	MPV	Max	Min	MPV	Max	Min	MPV	Max
Cow milk	101	111	121	121	131	141	284	294	304	304	314	324
Sheep milk	101	111	121	121	131	141	284	294	304	304	314	324
Goats milk	101	111	121	121	131	141	284	294	304	304	314	324
Cow beef	101	111	121	121	131	141	284	294	304	304	314	324
Lamb	101	111	121	121	131	141	284	294	304	304	314	324

Table 8 Transfer factor feed / animal product (d/kg)
Log-normal distribution

Animal product	Cs		I		Sr	
	Median	SD	Median	SD	Median	SD
Cow milk	6.10E-03	6.30E-03	9.10E-03	7.00E-03	1.50E-03	8.10E-04
Cow beef	3.00E-02	2.30E-02	1.20E-02	1.50E-02	2.10E-03	2.20E-03
Lamb	8.67E-01	3.85E-01	7.78E-02	6.49E-02	2.58E-03	1.08E-03

Table 9 Feeding rates for animals (kg/d), grass (int.)
Uniform distribution

Animal product	Feed. time #1			Feed. time #2			Feed. time #3			Feed. time #4			Feed. time #5		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Cow milk				4.90E+01	7.00E+01	9.10E+01	4.90E+01	7.00E+01	9.10E+01						
Sheep milk				6.00E+00	9.00E+00	1.20E+01	6.00E+00	9.00E+00	1.20E+01						
Goats milk				9.00E+00	1.30E+01	1.70E+01	9.00E+00	1.30E+01	1.70E+01						
Cow beef				6.00E+01	7.00E+01	8.00E+01	6.00E+01	7.00E+01	8.00E+01						
Bull beef	2.50E+01	2.80E+01	3.10E+01												
Veal	2.30E+00	2.90E+00	3.50E+00												
Pork	2.40E+00	3.00E+00	3.60E+00												
Lamb				4.00E+00	5.00E+00	6.00E+00	4.00E+00	5.00E+00	6.00E+00						
Chicken	8.00E-02	9.00E-02	1.00E-01												
Eggs	8.00E-02	9.00E-02	1.00E-01												

Table 10 Feeding rates for animals (kg/d), hay (int.)
Uniform distribution

Animal product	Feed. time #1			Feed. time #2			Feed. time #3			Feed. time #4			Feed. time #5		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Cow milk	1.00E+01	1.40E+01	1.80E+01							1.00E+01	1.40E+01	1.80E+01	1.00E+01	1.40E+01	1.80E+01
Sheep milk	1.20E+00	1.80E+00	2.40E+00							1.20E+00	1.80E+00	2.40E+00	1.20E+00	1.80E+00	2.40E+00
Goats milk	1.80E+00	2.60E+00	3.40E+00							1.80E+00	2.60E+00	3.40E+00	1.80E+00	2.60E+00	3.40E+00
Cow beef	1.20E+01	1.40E+01	1.60E+01							1.20E+01	1.40E+01	1.60E+01	1.20E+01	1.40E+01	1.60E+01
Bull beef	3.60E+01	4.00E+01	4.40E+01												
Veal	8.00E+00	1.00E+01	1.20E+01												
Pork	6.40E+00	8.00E+00	9.60E+00												
Lamb	8.00E-01	1.00E+00	1.20E+00							8.00E-01	1.00E+00	1.20E+00	8.00E-01	1.00E+00	1.20E+00
Chicken	1.80E-01	2.00E-01	2.20E-01												
Eggs	1.80E-01	2.00E-01	2.20E-01												

Table 11 Feeding rates for animals (kg/d), grass (ext.)
Uniform distribution

Animal product	Feed. time #1			Feed. time #2			Feed. time #3			Feed. time #4			Feed. time #5		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Cow milk	5.00E+01	7.50E+01	1.00E+02	5.00E+01	7.50E+01	1.00E+02	5.00E+01	7.50E+01	1.00E+02	5.00E+01	7.50E+01	1.00E+02	5.00E+01	7.50E+01	1.00E+02
Sheep milk	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00
Goats milk	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00	4.00E+00	6.00E+00	8.00E+00
Cow beef	6.40E+01	7.50E+01	8.60E+01	6.40E+01	7.50E+01	8.60E+01	6.40E+01	7.50E+01	8.60E+01	6.40E+01	7.50E+01	8.60E+01	6.40E+01	7.50E+01	8.60E+01
Bull beef															
Veal															
Pork															
Lamb	3.20E+00	4.00E+00	4.80E+00	3.20E+00	4.00E+00	4.80E+00	3.20E+00	4.00E+00	4.80E+00	3.20E+00	4.00E+00	4.80E+00	3.20E+00	4.00E+00	4.80E+00
Chicken															
Eggs															

Table 12 Biological halflifes for animal products (d), compartment #1
Uniform distribution

Animal product	Cs			I			Sr		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Cow milk	1.00E+00	1.50E+00	2.00E+00	4.00E-01	7.00E-01	1.00E+00	2.00E+00	3.00E+00	4.00E+00
Sheep milk	1.00E+00	1.50E+00	2.00E+00	4.00E-01	7.00E-01	1.00E+00	2.00E+00	3.00E+00	4.00E+00
Goats milk	1.00E+00	1.50E+00	2.00E+00	4.00E-01	7.00E-01	1.00E+00	2.00E+00	3.00E+00	4.00E+00
Cow beef	2.50E+01	3.00E+01	3.50E+01	5.00E+01	1.00E+02	1.50E+02	5.00E+00	1.00E+01	1.50E+01
Bull beef	4.00E+01	5.00E+01	6.00E+01	5.00E+01	1.00E+02	1.50E+02	5.00E+00	1.00E+01	1.50E+01
Veal	2.50E+01	3.00E+01	3.50E+01	5.00E+01	1.00E+02	1.50E+02	5.00E+00	1.00E+01	1.50E+01
Pork	3.00E+01	3.50E+01	4.00E+01	5.00E+01	1.00E+02	1.50E+02	5.00E+00	1.00E+01	1.50E+01
Lamb	1.50E+01	2.00E+01	2.50E+01	5.00E+01	1.00E+02	1.50E+02	5.00E+00	1.00E+01	1.50E+01
Chicken	1.50E+01	2.00E+01	2.50E+01	5.00E+01	1.00E+02	1.50E+02	2.00E+00	3.00E+00	4.00E+00
Eggs	2.00E+00	3.00E+00	4.00E+00	4.00E-01	7.00E-01	1.00E+00	1.50E+00	2.00E+00	2.50E+00

Table 13 Biological halflifes for animal products (d), compartment #2
Uniform distribution

Animal product	Cs			I			Sr		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Cow milk	1.00E+01	1.50E+01	2.00E+01				5.00E+01	1.00E+02	1.50E+02
Sheep milk	1.00E+01	1.50E+01	2.00E+01				5.00E+01	1.00E+02	1.50E+02
Goats milk	1.00E+01	1.50E+01	2.00E+01				5.00E+01	1.00E+02	1.50E+02
Cow beef							5.00E+01	1.00E+02	1.50E+02
Bull beef							5.00E+01	1.00E+02	1.50E+02
Veal							5.00E+01	1.00E+02	1.50E+02
Pork							5.00E+01	1.00E+02	1.50E+02
Lamb							5.00E+01	1.00E+02	1.50E+02
Chicken							5.00E+01	1.00E+02	1.50E+02
Eggs							1.50E+01	2.00E+01	2.50E+01

Table 14 Food consumption rates of average humans (g/d)
Triangular distribution

Foodstuff	Age 1			Age 5			Age 10			Age 15			Age Adults		
	Min	MPV	Max	Min	MPV	Max	Min	MPV	Max	Min	MPV	Max	Min	MPV	Max
Winter wheat flour	34	45	56	128	170	213	131	174	217	124	164	205	124	165	206
Rye flour	11	15	18	42	56	70	43	57	72	41	54	68	41	55	68
Oats	3	4	6	13	17	22	13	18	22	13	17	21	13	17	21
Potatoes	17	23	30	51	67	87	60	78	101	72	95	123	62	81	105
Leafy vegs.	56	73	88	59	76	91	59	77	93	62	81	98	91	119	143
Root vegs.	20	27	32	21	27	32	21	27	33	22	29	34	32	42	50
Fruit vegs.	12	15	18	29	38	46	30	39	46	31	41	49	46	59	71
Fruits	80	200	313	60	150	235	61	154	240	60	151	235	64	160	250
Berries	0	0	0	20	28	36	17	24	30	9	13	16	10	14	18
Fresh milk	187	314	562	122	204	365	124	208	372	99	165	296	77	129	231
Beef cow	1	1	2	7	13	21	8	15	25	9	17	29	10	18	30
Beef bull	1	2	3	14	26	44	17	31	52	19	35	58	20	36	61
Veal	0	0	0	1	1	2	1	1	2	1	1	2	1	1	2
Pork	1	3	4	28	51	85	33	60	101	38	68	115	39	71	120
Eggs	0	0	0	9	12	16	10	14	19	9	12	17	14	19	26
Beer	0	0	0	0	0	0	0	1	2	6	25	55	34	142	313

Appendix B

Table 15 Example for a statistic output definition file

```
# activity concentration in feedstuff (maximum)
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fgriTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_gras_int_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fgriTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_gras_int_I
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fgriTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_gras_int_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fhyiTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_hay_int_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fhyiTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_hay_int_I
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fhyiTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_hay_int_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fmaiTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_corn_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fmaiTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_corn_I
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fmaiTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_corn_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fbetTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_beet_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fbetTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_beet_I
Output=;=Prognostic Results=;=Activity concentrations=;=Feedstuff
activities=;=Maps=;=Tree.fbetTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_beet_Sr

# activity concentration in foodstuff (maximum)
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fvelTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_leafy_veg_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fvelTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_leafy_veg_I
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fvelTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_leafy_veg_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fmilTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_milk_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fmilTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_milk_I
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fmilTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_milk_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fpotTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_potatoes_Cs
```

```
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fpotTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_potatoes_I
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fpotTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_potatoes_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fbecTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_beef_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fbecTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_beef_I
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fbecTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_beef_Sr
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fwwhTree._Tree.vrawTree._Tree.ncesTree._Tree.epotTree._Tree.tmax * conc_max_winter_wheat_Cs
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fwwhTree._Tree.vrawTree._Tree.niodTree._Tree.epotTree._Tree.tmax * conc_max_winter_wheat_I
Output=;=Prognostic Results=;=Activity concentrations=;=Foodstuff
activities=;=Maps=;=Tree.fwwhTree._Tree.vrawTree._Tree.nstrTree._Tree.epotTree._Tree.tmax * conc_max_winter_wheat_Sr

# ingestion dose
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.t01y * eff_dose_ing_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.tlif * eff_dose_ing_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.t01y * eff_dose_ing_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.tlif * eff_dose_ing_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.t01y * eff_dose_ing_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.oeffTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.tlif * eff_dose_ing_adu_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.t01y * rbm_dose_ing_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.tlif * rbm_dose_ing_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.t01y * rbm_dose_ing_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.tlif * rbm_dose_ing_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.t01y * rbm_dose_ing_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.orbmTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.tlif * rbm_dose_ing_adu_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.t01y * thy_dose_ing_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.tlif * thy_dose_ing_05y_lif
```

```
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.t01y * thy_dose_ing_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.tlif * thy_dose_ing_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.t01y * thy_dose_ing_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Ingestion
dose=;=Maps=;=Tree.othrTree._Tree.vproTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.tlif * thy_dose_ing_adu_lif

# inhalation dose
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tadd * eff_dose_inh_05y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tadd * eff_dose_inh_10y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tadd * eff_dose_inh_adu
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tadd * rbm_dose_inh_05y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tadd * rbm_dose_inh_10y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tadd * rbm_dose_inh_adu
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tadd * thy_dose_inh_05y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tadd * thy_dose_inh_10y
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tadd * thy_dose_inh_adu

# all pathways
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.t01y * eff_dose_all_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.tlif * eff_dose_all_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.t01y * eff_dose_all_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.tlif * eff_dose_all_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.t01y * eff_dose_all_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.oeffTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.tlif * eff_dose_all_adu_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.t01y * rbm_dose_all_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.tlif * rbm_dose_all_05y_lif
```

```
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.t01y * rbm_dose_all_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.tlif * rbm_dose_all_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.t01y * rbm_dose_all_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.orbmTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.tlif * rbm_dose_all_adu_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.t01y * thy_dose_all_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.ac05Tree._Tree.epotTree._Tree.tlif * thy_dose_all_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.t01y * thy_dose_all_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.ac10Tree._Tree.epotTree._Tree.tlif * thy_dose_all_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.t01y * thy_dose_all_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all
pathways=;=Maps=;=Tree.othrTree._Tree.fsumTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.tlif * thy_dose_all_adu_lif

# all pathways except ingestion
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.t01y * eff_dose_woi_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tlif * eff_dose_woi_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.t01y * eff_dose_woi_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tlif * eff_dose_woi_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.t01y * eff_dose_woi_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tlif * eff_dose_woi_adu_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.t01y * rbm_dose_woi_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tlif * rbm_dose_woi_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.t01y * rbm_dose_woi_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tlif * rbm_dose_woi_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.t01y * rbm_dose_woi_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.orbmTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tlif * rbm_dose_woi_adu_lif
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Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.t01y * thy_dose_woi_05y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac05Tree._Tree.eexpTree._Tree.tlif * thy_dose_woi_05y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.t01y * thy_dose_woi_10y_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.ac10Tree._Tree.eexpTree._Tree.tlif * thy_dose_woi_10y_lif
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.t01y * thy_dose_woi_adu_01y
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.othrTree._Tree.nsumTree._Tree.aaduTree._Tree.eexpTree._Tree.tlif * thy_dose_woi_adu_lif

# dose for counter measures
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.othrTree._Tree.niodTree._Tree.ac01Tree._Tree.epotTree._Tree.t07d * thy_dose_inh_01y_07d
Output=;=Prognostic Results=;=Longer term doses=;=Inhalation dose
FDMT=;=Maps=;=Tree.othrTree._Tree.niodTree._Tree.aaduTree._Tree.epotTree._Tree.t07d * thy_dose_inh_adu_07d
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.ac01Tree._Tree.epotTree._Tree.t07d * eff_dose_woi_01y_07d
Output=;=Prognostic Results=;=Longer term doses=;=Total dose from all exposure except
ingestion=;=Maps=;=Tree.oeffTree._Tree.nsumTree._Tree.aaduTree._Tree.epotTree._Tree.t07d * eff_dose_woi_adu_07d

# gamma dose rate
Output=;=Prognostic Results=;=Dose rates=;=Total gamma dose rate * total_dose_rate

# deposition
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=I -131 * depo_I-131
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=I -132 * depo_I-132
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Te-132 * depo_T-132
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Xe-133 * depo_Xe-133
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Cs-134 * depo_Cs-134
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Cs-136 * depo_Cs-136
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Cs-137 * depo_Cs-137
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Ba-137m * depo_Ba-137m
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination dry+wet=;=Sr- 90 * depo_Sr-90

# wet deposition
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=I -131 * depo_wet_I-131
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=I -132 * depo_wet_I-132
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Te-132 * depo_wet_T-132
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Xe-133 * depo_wet_Xe-133
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Cs-134 * depo_wet_Cs-134
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Cs-136 * depo_wet_Cs-136
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Cs-137 * depo_wet_Cs-137
Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Ba-137m * depo_wet_Ba-137m
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Output=;=Prognostic Results=;=Activity concentrations=;=Ground contamination wet=;=Sr- 90 * depo_wet_Sr-90

# activity concentration
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=I -131 * air_conc_I-131
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=I -132 * air_conc_I-132
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Te-132 * air_conc_T-132
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Xe-133 * air_conc_Xe-133
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Cs-134 * air_conc_Cs-134
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Cs-136 * air_conc_Cs-136
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Cs-137 * air_conc_Cs-137
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Ba-137m * air_conc_Ba-137m
Output=;=Prognostic Results=;=Activity concentrations=;=Instantaneous concentration in air=;=Sr- 90 * air_conc_Sr-90

# grid
Output=;=Computational grid * grid
```