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BIOMASS: THE INTERNATIONAL ATOMIC ENERGY AGENCY PROGRAMME ON BIOSPHERE MODELLING AND ASSESSMENT

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This sixth Newsletter provides a summary of the main developments and progress in the BIOMASS Programme since July 1998. In October 1998 a very successful Plenary meeting was held in Vienna, 84 participants from 24 countries attended the meeting. The Working Groups Programmes were



The BIOMASS Theme 1 prepared the draft of the first Reference Biosphere Example for Long-term Safety Assessment of Waste Disposal Facilities

reviewed and updated and activities for 1999 were identified and planned.

The BIOMASS Co-ordinating Committee at its meeting during the October Plenary meeting, expressed general satisfaction on the way the project is going and on the new Plenary Meeting arrangements. All the BIOMASS sponsors reported to the Co-ordinating Committee meeting that their Working Groups intend to finish technical work by October 2000.

The BIOMASS Co-ordinating Committee and the Secretariat would like to take this opportunity to wish you a happy new year.

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Please note in your diaries: BIOMASS 1999 Plenary Meeting will be held in the week 4-8 October, at the IAEA in Vienna.

1.- THEME 1: RADIOACTIVE WASTE DISPOSAL (Reference Biosphere)

General Theme 1 Developments. Since the last Newsletter, a Theme 1 meeting of 17 participants was held in August, in Henley-on-Thames, UK, to progress development of Example Reference Biospheres (ERBs). These were then further developed at the BIOMASS Plenary Meeting in October in Vienna. A total of 53 participants with interest in Theme 1 attended the Plenary Meeting, representing regulators, operators and research organisations from 21 countries.

Progress with the methodological activities leading to production of the ERBs is referred to below, together with the outline programme for work in 1999.

The Theme 1 Working Document (WD2) issued during the summer discusses example **assessment contexts** and these are being used as part of the primary input to the development of the ERBs. A series of progressively complex ERBs is in development, corresponding to increasingly comprehensive requirements arising from the series of example assessment contexts. These example contexts reflect requirements of the repository performance assessments. However, such requirements change with time, for example as regulatory requirements evolve. Thus it is anticipated that further documentation of the contexts and how they apply to the ERBs will be needed. Comments on WD2 are invited, to be taken into account in final BIOMASS Theme 1 documentation. In the mean time, those interested are recommended to use or refer to WD2 (and other Theme 1 WDs) as appropriate.

The **application of data** to assessment models is a key issue. A WD describing a data protocol is being developed, with examples for important parameters such as soil/water distribution coefficients. The WD is due to be completed in May 1999, taking account of feedback and further discussion, and work is in progress to provide data for application to the ERBs.

An important aspect of ERB development concerns the assumptions for hypothetical **critical and other exposure groups**. Since this is such an especially difficult issue, a WD on the subject has been drafted and widely distributed for comment. Comments were discussed at the Plenary Meeting

in October and a further revision is due for circulation among participants early in the new year. A final WD is then due to be completed and distributed by the end of February 1999. The guidance offered in the WD is being applied to the definition of exposure group assumptions in the ERBs.

Biosphere system identification and justification for ERBs can be problematic, though the level of difficulty may depend on the assessment context. A draft WD on this subject has been produced and widely distributed for comment, and a final version is due for completion by the end of May 1999 taking account of feedback and further discussion. Work on system identification and justification for the ERBs is in progress using the identification and justification procedure described in the WD.

The next level of analysis concerns the production of **Biosphere System Descriptions** based on the assessment context and other inputs referred to above. Among the key issues to resolve is identifying when elements of a system description can be omitted. Decisions regarding relevance should be based as far as possible on scientific understanding. Some degree of iteration can clearly be helpful, and the recording of decisions within iterations is also important for transparency. A procedure for managing the treatment of information to describe biosphere systems has been drafted and is being trialed in the development of ERBs. This is due to be extended into a draft WD by the end of March 1999. Comments will be reviewed and discussed at a meeting in May, leading to production of a final version of the WD during the summer.

Taking account of the above inputs, the main focus of Theme 1 activities is now **the development of the ERBs**. A series of increasingly complex examples has been proposed with the aims of: demonstrating how to meet different performance assessment objectives; and providing practical examples relevant to different circumstances found to be important within different solid waste disposal programmes. ERB 1 concerns the annual individual dose arising from consumption of water taken from a contaminated well. The exposure modelling for this case is relatively straightforward. However, because of uncertainties with the boundary between the geosphere and biosphere models, ERB 1 is split into two cases, 1A where the radionuclide concentrations in the

well water are provided by the geosphere model, and 1B where concentrations in the well are determined from consideration of processes in a near surface aquifer, assumed to be part of the biosphere model domain. This latter consideration is not trivial. Significant draft material for ERB 1 has been prepared and a WD should be completed in the first few months of 1999.

The other ERBs are focused as follows. ERB 2 considers a wide range of transfer and exposure pathways associated with an agrarian society in a temperate environment making use of contaminated water taken from a well (2A) or from a contaminated surface water body (2B). Apart from the many extra pathways, consideration has to be given to the interface between the geosphere model and the release of radionuclides into surface waters. ERB 3 is similar to ERB 2, but consideration has also to be given the potential for environmental change. ERB 4 extends the analysis to include a wider range of radiological endpoints, i.e. not just annual individual doses, but also the distribution of doses among different exposure groups, radionuclide concentrations in relevant environmental media, and radionuclide fluxes across relevant boundaries in the system.

Outline Programme for 1999. A series of workshop type meetings is planned to progress methodological and ERB developments, to discuss draft material produced by participants, and to decide on comments received from the wider community:

Week beginning 22 February 1999, Henley-on-Thames, UK;

Week beginning 17 May 1999, Madrid, Spain, hosted by Ciemat;

Week beginning 30 August 1999, Washington DC, USA, hosted by NRC (to be confirmed).

Comments, questions or information on any of the above Theme 1 activities should be addressed to the Scientific Secretary:

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2.- THEME 2: ENVIRONMENTAL RELEASES

Dose Reconstruction Working Group.

The Dose Reconstruction Working Group spent most of its time at the Vienna meeting discussing the Iput River Scenario. This modelling scenario deals with ^{137}Cs contamination of a catchment basin and agricultural region in the Bryansk Region of Russia, which received substantial contamination from the Chernobyl accident. Modelling endpoints include ^{137}Cs concentrations in food, animal feed, and animal products, human whole body concentrations, and average internal and external doses to residents of the region. Most of the discussion centered around clarification and correct interpretation of the scenario description, particularly of the countermeasures that were applied in the region, such as extra plowing, fertilization, or removal of land from agricultural use. Initial modelling approaches and predictions were presented by four participants.

New model predictions for the Iput River Scenario (terrestrial endpoints) are requested by 15 May 1999. Documentation of the models (structure, parameter values, etc.) is also due at this time. At the next working group meeting (June 1999), the model predictions will be compared to measured values (test data) for the test endpoints. Preliminary predictions for aquatic endpoints (water, sediment, fish) are requested by 15 April 1999. Comparison of these endpoints with test data will take place at the October 1999 meeting.

A draft final report for the Hanford Scenario was distributed to working group participants at the Vienna meeting. This is the last opportunity for working group participants to check individual model descriptions and predictions; all revisions or comments due by 30 November 1998. The report is scheduled to be distributed as a Working Document in January 1999.

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Remediation Assessment Working

Group. In the Remediation Assessment Working Group the Olen case is considered. The case deals with the remediation of a radium contaminated area of approximately 100 ha. There are two scenarios. Olen Scenario Type A in which the influence of a past remedial action on the radium contamination of cow milk during the period 1971 - 1972 has to be assessed and compared with post remediation measurements.

Olen scenario Type B in which the effectiveness of potentially feasible remedial actions has to be assessed and intercomparisons of the modelling results are made. It has been agreed that two remedial actions would be considered. The first is the removal of surface soil down to 1 m in the most contaminated areas, the second one is covering the contaminated area with a layer of clean soil.

The Olen scenario Type A report is in a final stage. The second version of the draft report was discussed at the meeting and a timetable for completing the working document by the end of February 1999 was made.

Four modellers presented preliminary results for the Olen scenario Type B. Discussion of the results revealed that there were still some aspects in the scenario description that needed more clarification. A refined version of the scenario description will be sent to the participants by mid November. The deadline for submitting deterministic modelling results together with the model description is 14 May 1999. Results of the deterministic calculations and assumptions to be used for the uncertainty analysis will be discussed at the next meeting.

It is still possible to join the modelling of Olen scenario Type B. If you are interested, please contact either the Working Group Leaders:

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The next meetings of the Dose Reconstruction and Remediation Assessment Working Groups will be held 7-11 June 1999 in Vienna.

3.- THEME 3: BIOSPHERE PROCESSES

Tritium Working Group. The Tritium Working Group (TWG) met from 7 to 9 October 1998 in Vienna during the BIOMASS Plenary Meeting. Technical discussions were centred around the following meeting objectives:

- Analysis of calculations for the first model-model intercomparison scenario (Scenario version 1.3) and agreement on refinements to the hydrological part of the scenario description in the light of the results.
- Analysis of results for the second model-model intercomparison scenario (Scenario version 2.2) and agreement of modifications to the scenario description.
- Examination of the first results for the model-data scenario based on information from the AECL Chalk River site.
- Finalisation of the requirements for a second model-data scenario based on data collated by colleagues from RNFC-VNIIEF.
- Discussion of preliminary experimental work concerning wet and dry deposition of tritium and re-emission from the soil carried out by colleagues from CEA/DASE.
- Agreement of the future work plan, time schedule, agreed actions and arrangements for the Spring 1999 TWG meeting.

Scenario 1: Model-Model Intercomparison.

Scenario 1.3 description was distributed after the Spring '98 TWG meeting and concerns an assumed long-term atmospheric source of HTO and HT. The main modification in the scenario description was the provision of a given flux of tritium to the surface of the watertable in order to begin to isolate the consequences of different modelling assumptions for the contamination of groundwater.

For the assumed HTO release with a uniform windrose, results for concentrations in atmospheric water, soil water and plant tissue water (Bq/l) were generally in agreement within a factor of 3 for

distances of 0.3 km to 10 km from the source. At the close in distances of up to 0.3 km, results were more divergent because of assumptions about the effects of rain scavenging, building wakes and the heterogeneous nature of the ground surface (e.g. presence/absence of soil, concrete or plants). The results for distances beyond 0.3 km fell into two groups according to whether wet or wet plus dry deposition is included in the model. The importance of including only wet deposition as opposed to wet plus dry deposition is being investigated in on-going field sampling at a site in France.

For the assumed HT release, there was a factor of 5 or more difference in results for the terrestrial endpoints. A number of reasons could account for these differences such as different assumptions about deposition rates of HT, accumulation in soil, or the discretisation of the soil surface into areas for the calculation of re-emission. Modellers will provide this information with their model descriptions.

Scenario 2: Model-Model Intercomparison.

Scenario 2.2 was produced following the Spring '98 TWG meeting and concerns a sub-surface long-term aquatic source of tritium. The main modification at that time was the provision of the van Genuchten equation with defined parameter values taken from Brooks-Corey data for a sandy loam soil. Results presented at the Plenary Meeting this October showed that there were still wide differences in modelling results despite starting from a common approach to water retention in the soil. One participant had been in contact with van Genuchten and it became clear that the Brooks-Corey data were not suitable for use with the van Genuchten equation. So in order to more fully investigate why modelling results were so divergent, it was agreed to further refine the scenario and version 2.3 will be distributed in November.

Scenario 3: Model-Data Test. The third scenario being used by modellers to test their models has been developed by Dr Phil Davis (AECL). It is based on information about long-term atmospheric releases of tritium from three different locations on the Chalk River Laboratories site in Canada. The scenario description was distributed earlier this year and the first set of results were presented at this meeting. Endpoint

calculations are predicted concentrations of tritium in rainwater, soil water and vegetation (TFWT and OBT) at the three locations and for specified sampling dates. So far four modellers have participated but several other modellers have indicated that they will do calculations ready for discussion at the next meeting.

New Scenarios. Colleagues at RFNC-VNIIEF have undertaken a lot of work to extract relevant data from historical records of long-term atmospheric releases from a tritium facility in the Russian Federation. A map of the general locality where data had been collected was provided together with information on the routine releases, ground cover (mainly forest), soil type and other categories of data which have been gathered for the model-data validation scenario. For example, data have been collated for annual relative release amounts over a twenty year period, meteorological conditions, and tritium concentrations in soil and vegetation samples. The scenario description is almost finalised; only a few additional points of clarification requested by the modellers need to be added before the scenario is distributed.

It was announced at the meeting that colleagues from CEA/DAM/DASE are in the process of collating data for the basis of a new model-data test scenario. The scenario will be based on historic and field data aimed at clarifying some of modelling approaches to assessment of the impacts of long-term releases of tritium. Further information will be provided at the next, Spring '99 TWG meeting.

Experimental Work. Colleagues at CEA/DAM/DASE have been undertaking two sets of experiments to collate field data to provide essential information for clarifying modelling approaches concerning the importance of:

1. wet and dry deposition of tritium to the consequent concentrations of HTO in soil water; and
2. re-emission of HTO from soil following deposition.

Monitoring stations have been set up at selected points around a stack emitting tritium in France. Wind and rain roses are being correlated. Rain and soil core samples are being taken and analysed so that the effects of wet or dry deposition on soil concentrations of tritium can be determined. The

first few data were presented at the meeting. The overall objective is to undertake a full year of sampling and analysis.

The experimental set up that has been devised to monitor and measure soil re-emission was explained. Calibration of the equipment is being conducted and actual sampling will begin in mid-November. The first data will be presented next year.

Spring '99 TWG Meeting and Work Plan with Time Schedule. It is planned that the Spring '99 TWG meeting should be held at Sarov, Russia from Monday 24 to Thursday 27 May 1999. Should it not be possible to meet in Sarov for some reason, contingency plans for a meeting to be held elsewhere will be made. Possible alternative locations are Nyköping, Sweden or Henley-on-Thames, UK. Participants will be kept fully informed.

Information on any aspect of the work programme, details of scenarios or arrangements for future meetings can be obtained from:

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Fruits Working Group. The scope of the Fruits Working Group is to improve understanding of the uptake and transfer of radionuclides, both anthropogenic and natural, to fruit. Several different activities were carried on by the group during the first year of work (October 1997-September 1998).

- Two questionnaires were designed and circulated. The aim was to identify supporting information for the review and data requirements, to find unpublished data and to identify persons that would like to participate in model intercomparison study.
- "A Critical Review of Experimental, Field and Modelling Information on the Transfer of

Radionuclides to Fruit" was done on the following topics: the role of fruit in the diet, phenological development of fruit bearing species, significant radionuclides and speciation aerial pathways, post deposition transport processes soil to fruit transfer, role of microorganisms in leaf and root uptake, storage and processing, models and data requirements. The chapters, after circulation for comment to the reviewers, have been collated and edited into a draft document.

- The UIR database on parameters for dynamic models for the transfer of radionuclides in soil plant systems was presented, as well as the proforma for submitting contributions to the database. The intention is to collate model parameters and to incorporate them into the existing database, extending the domain of application of that which already exists.
- Results of recent experimental and modelling studies were presented and discussed during the two meetings. Proposed experimental studies were also reviewed and discussed.
- A hypothetical scenario for a model intercomparison study was drafted and circulated to potential participants. It simulates a continuous atmospheric release. The radionuclides of interest are ^{137}Cs , ^{90}Sr , ^{129}I and ^{35}S . Fruits to be modelled are strawberry, blackcurrant and apple growing on a temperate loam soil.
- Datasets for model validation were discussed, taking into account the answers to the questionnaire. Additional data were received after circulation of the second questionnaire.
- A proposal to develop a Fruit Conceptual Model was made.

Third meeting. The third meeting of the Fruits Working Group was held in Vienna, 5-7 October 1998, within the framework of the IAEA BIOMASS annual plenary meeting. The following progress was made at the meeting:

1. **Results from new experimental work.** New experimental results were presented and discussed:
 - ^{134}Cs and ^{85}Sr in fruit plants following wet aerial deposition (F. Carini)
 - Time dependent evolution of ^{137}Cs and ^{90}Sr deposited as aerosols on vine (C. Murlon)
 - Deposition and translocation of COS and CH_3I to crops (C.D. Collins)
2. **Model intercomparisons.** Results from the

first intercomparison were discussed. Results were from SPADE (N. Mitchell) and FORESTPATH (I. Linkov), designed to simulate continuous releases and from CHECOSYS (T. Riesen), which was adapted from spiked to continuous releases. It was suggested that a list of assumptions and parameter values be prepared, as well as results for the midpoints for discussion. After having noted that very few models are designed to simulate a continuous source, the group decided to also simulate a spike source.

The spike source scenario is based on the following:

Source term: Spike atmospheric release Radionuclides, Cs-137 and Sr-90 (both as sub-micron diameter particulates), I-129 as methyl iodide (vapour).

Deposition times: At blossoming, 1 month before harvest, at harvest

Fruit: Strawberries, blackcurrant and apples

Soil type: Temperate loam

3. Model validation. Datasets on apples, blackcurrant and strawberries have been identified and will be collected by circulating a format for data request. Scenarios for model validation will be prepared during the next meeting.

4. Requirements of the Fruits WG. Priorities for models and data on fruits were presented by N. Mitchell and discussed. Simple models need to be derived from consideration of the processes. Data requirements are very model specific. In general there is a need for composite datasets: source/deposition, distribution in plant-soil system and in its components, change in distribution with time.

5. Fruit conceptual model. The approach used is to develop a list of Features, Events and Processes (FEP) for fruits, as a precursor to develop an interaction matrix as already developed in BIOMOVIS II. An inventory has been prepared of the processes in the fruit system and an interaction matrix has been discussed from the qualitative point of view. Participants are asked to define parameters and diagrams, to improve and score processes. Results will be discussed during the next meeting.

6. Review Document. The draft of the review has been discussed. This document will be the first Working Document of the group and is going to be

published as a Special Issue by the Journal of Environmental Radioactivity. An executive summary of the review will be included in the final IAEA TECDOC of the Fruits WG.

Next Meeting. Next meeting will be hosted by Prof. M. Antonopoulos Domis in "Demokritos", Greece, 10-13 May 1999.

Purpose of the meeting:

- Presentation of a chapter of the review: "Role of microorganisms"
- Final discussion of the Review
- Presentation of new experimental results
- Discussion of model intercomparison results
- Discussion of the datasets for model validation
- Formalise scenarios and work programme for validation
- Discussion of the Fruit conceptual model

Request for contribution

Those who desire to contribute to the fruit database can request the proforma and associated helpfile for submitting data from the dedicated database address: radflux@mouchel.com or directly to the Radflux Database chairman N. Mitchell.

Persons interested in participating in the model intercomparison study can request detailed scenarios from the Technical Secretariat.

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Forest Working Group. The first full meeting of the IAEA BIOMASS Theme 3 Forest Working Group was held in Vienna (7-9 October 1998) within the framework of the IAEA BIOMASS annual plenary meeting (5-9 October 1998). The Forest Working Group meeting was opened by F Gera (IAEA, Scientific Secretary). G Shaw (Working Group Leader) gave a summary of

the background and objectives of the Forest Working Group, followed by an overview of the working group activities, and the expected deliverables.

Background. Forests are an important component of the total ecosystem and in many environmental conditions play a significant role in determining the radiological impacts of acute or chronic releases of radionuclides. Doses can be incurred *in situ* or *ex situ* through a variety of routes, but long-term assessments must be based on validated radioecological models. These have been lacking until recently.

Due to limited available time, the Forest Working Group plans to focus on model testing and not on data collection. Participants from other existing forest modelling/measurement programmes have been and are invited to join the BIOMASS Forest Working Group.

Working Group Objectives

- To improve our ability to assess the radiological impacts of contaminated forests.
- To improve our ability to model the migration and accumulation of radionuclides in forest ecosystems.
- To test available forest radioecology models using model-model and model-data intercomparisons.

Working Group Deliverables

- Reports on
 - model-model intercomparison study
 - model-data intercomparison study.
- Review of forest processes.
- List of Features, Events and Processes (FEPs) for forests, as well as an interaction matrix for forests.
- Final IAEA report (or refereed publication in a suitable journal) summarising the project as a whole.
- Six-monthly summaries of work progress for publication in the BIOMASS Newsletter.

The following aspects were discussed at the meeting:

- Results from the model-model intercomparison study.
- Second model-model intercomparison study.
- Data set for model validation.

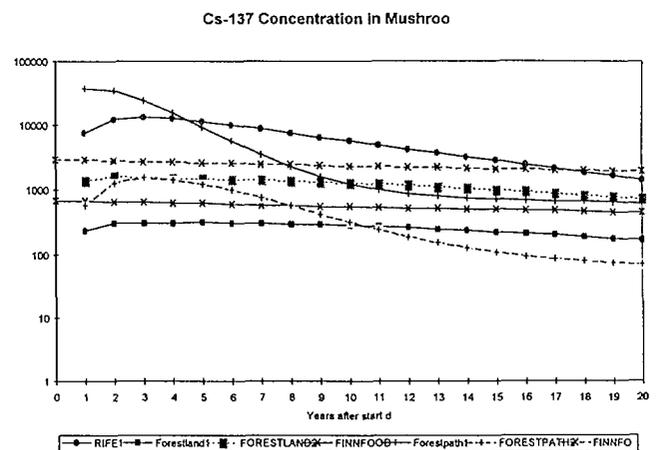
- Scenario for model validation.
- Review of forest processes.
- ‘RES’ matrix concept as applied to forest ecosystems.
- Future work programme and arrangements for next meeting.

Model - Model Intercomparison Study

Discussion of results. The first model-model intercomparison scenario was based on simulation of ¹³⁷Cs contamination from a single pulse atmospheric deposition event in a boreal forest. Participants were asked to report on the following endpoints: Bole wood (Bq/kg), Total wood (i.e. trunk plus branches - Bq/kg), Needles (annual average - Bq/kg), Other parts of tree (especially bark - Bq/kg), Soil profile (including litter - Bq/kg), Animals (annual average for moose and red deer - Bq/kg), Vegetation (mushrooms, berries, shrubs and grass - Bq/kg).

Results were received from the following modellers: George Shaw (United Kingdom), Sergei Fesenko (Russian Federation) and Rodolfo Avila (Sweden), Alexander Dvornik (Belarus), Ronny Bergman (Sweden), Igor Linkov (USA), Mauro Scimone (Italy), Sergey Mamihkin (Russian Federation), Aino Rantavaara (Denmark).

In brief, the degree of comparison between results was surprisingly consistent for most simulation endpoints. The results for mushrooms showed the greatest variability, with differences of up to 2 orders of magnitude, as shown below. The issue of predicting ¹³⁷Cs activity concentrations in mushrooms will form a specific focus in future model intercomparisons to be carried out by the Forest Working Group.



Conclusions from first model-model intercomparison study

- To facilitate model comparison, accurate model descriptions are needed. These should include a definition/diagram of compartments, the modeller's interpretation of the prescribed endpoints and a description of the mathematical approach taken as well as the solution algorithms. Parameter values (including the modeller's interpretation of the source term) should also be listed.

- Results should be reported with and without physical decay. The % distribution, or fractional distribution, between the major components of the forest ecosystem, as defined by the prescribed endpoints and/or the model structure, should also be reported.

- Calculated T_{agg} values should be reported and variability between models should be compared with variability between data and variability in T_{agg} values.

- Consideration should be made of whether models consider tree growth and age adequately.

- Sensitivity analysis should be undertaken (as part of the interaction matrix / FEP list, see Section 6).

- A table of fresh to dry weight ratios for forest components needs to be compiled.

- There is a particular need to understand more about foliar absorption (parallels exist here between the Forest and the Fruits Working Groups)

- There was a good degree of consistency between predicted berry results in spite of different approaches/species

- Mushroom results showed the highest degree of variability, even when considering results for individual species.

- Expert opinion should be solicited on selection of one or two species of mushroom to model in an attempt to reduce uncertainty in input parameters for models.

- Are the current modelling approaches sufficient for modelling the observed variability in the activity concentrations of ^{137}Cs in mushrooms - would probabilistic modelling give better results?

These issues will be addressed in the draft report on the first model-model intercomparison study.

Second Model-Model Intercomparison Study. Participants agreed to undertake a second model-model intercomparison study, based on a

continuous terrestrial source term. The reasons for choosing a continuous terrestrial source term are:

a) no international model intercomparison studies based on a continuous terrestrial source term have been undertaken previously, thus such a study will be a particularly valuable contribution in the field of forest modelling;

b) most forest models have been formulated post-Chernobyl and have been designed to simulate the fate of radionuclides following a single pulse atmospheric source term, therefore modelling of a continuous terrestrial source term will be a real challenge to the modellers; and

c) the results of the intercomparison should be of value to Theme 1 participants who are concerned with waste disposal.

Data Set And Scenario For Model Validation.

A data set that may be suitable for a model validation study (based on an atmospheric source term) was identified. The custodian of the data will be contacted to obtain all the necessary information and to arrange a data quality assurance exercise prior to the use of the data for any modelling. Suitable analytical reference materials for this purpose will be obtained from the IAEA laboratory in Seibersdorf. Once all the necessary information has been obtained, a scenario will be drafted and distributed to participants.

Review of Forest Processes. A short review of forest processes was presented by Y Thiry (SCK/CEN, Belgium). The following issues of importance to the modelling of radionuclides in forest ecosystems were identified:

- Representation of biological recycling is a key criterion for the development of realistic forest models.

- Soil properties (humus type, mineralogy) strongly controls bioavailability. This is important in both the temporal and spatial contexts.

- The depth of actively absorbing roots is a key factor in controlling the behaviour of ^{137}Cs within the forest ecosystem.

- The primary function of a forest is to produce biomass in the form of tree tissues, therefore tree growth effects are of special importance. Interaction with forest growth modellers may be beneficial to the BIOMASS Forest Working Group and, accordingly, forest scientists with appropriate expertise will be invited to the forthcoming Forest Working Group meeting in the Spring of 1999.

The Interaction ('Res') Matrix Concept as Applied to Forest Ecosystems. A presentation on the Interaction ('RES') Matrix Concept as applied to forest ecosystems was given by R Avila. (SSI, Sweden - a copy of the paper is available from the Technical Secretariat). Participants agreed to draft an interaction matrix for forests for discussion at the next meeting. Such a matrix could serve as a standard against which all the models that participated in the model intercomparison studies could be evaluated.

Arrangements for Next Meeting. The next meeting will be hosted by SSI in Stockholm, Sweden, on 19-21 April 1999.

Purpose of meeting

- a) Discuss draft report on the first model-model intercomparison study.
- b) Discuss results from model-data validation study
- c) Discuss second model-model intercomparison scenario
- d) Further review of forest processes
- e) Presentation on growth modelling
- f) Future work programme and arrangements for next meeting

It is also envisaged that a field trip will be arranged.

Enquiries about the BIOMASS Forest Programme should be directed to :

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4. EDITORIAL NOTE

Kirsti-Liisa Sjoebloom, Scientific Secretary of Theme 2, is going back to Finland at the end of January 1999. She has been responsible for the Dischargeable Waste Unit of the IAEA's Department of Nuclear Safety since it was created. The BIOMASS Co-ordinating Committee and the Secretariat would like to transmit a message of appreciation and gratitude to her and to wish the best for her and her family.

The Dischargeable Waste Unit's main function is the establishment of safety standards for the control of radioactive releases to the environment. The Unit is also engaged in providing advice and guidance on procedures and methods for environmental assessment, modelling and monitoring (The BIOMASS Programme is part of this activity). The Unit is establishing databases on world-wide discharges of radionuclides to the environment and an inventory of past waste disposals at sea. The Unit is the focal point for the Agency's interactions with international conventions and treaties concerned with radioactive waste and the environment.

The Agency has recently announced three vacancies in the Dischargeable Waste Unit: Environmental Assessment Specialist, Environmental Discharges Specialist and Unit Head

Deadline for application 19 February 1999.

More information is available at:

<http://www.iaea.org/worldatom/vacancies/98p067.html>