Progress report to EMRAS II WG3, subgroup 3

Ari Ikonen
team manager, biosphere assessment
Posiva Oy, Long-term performance & safety

Tasks due in October 2010

1. System description and initial description of methodology
   - *Overview based on available information from site descriptions (a few pages per site)*
     - Report available: Biosphere description 2009 (“BSD-2009”; POSIVA 2009-02)
     - More summaries in a number of other reports
   - *Description of methodology – initial, to be evaluated*
     - Main points of ecosystem characterisation strategy presented in previous meeting and in BSD-2009
     - Formulation of strategy for the repository construction stage on-going
2. Identify processes and parameters potentially affected by environmental change
   - *Sensitivity analysis of the model is used to identify the most important parameters*
     - Sensitivity analysis results from a 2007 assessment available, for the 2009 assessment being produced + the accumulated experience
     - Uncertainty cases in the 2009 assessment: whether a release location is terrestrial or aquatic does matter more than single parameter values
   - *Use knowledge from climate modelling to identify parameters potentially affected by climate change*
     - Climate data available over the last glacial cycle and for the next 120 000 years assuming a constant CO_2 level (i) 280 ii) 400 ppm): temperature, precipitation, …
     - Identification of the parameters overlaps with the task to be done in this meeting
- We do have a plenty of data but it needs to be agreed in which format all this is wanted to be reported (tomorrow’s work → plenary)

The system description and the data…

The biosphere: nearly 900 pages of the system description and input data to the safety assessment

…summarised in the main safety case level

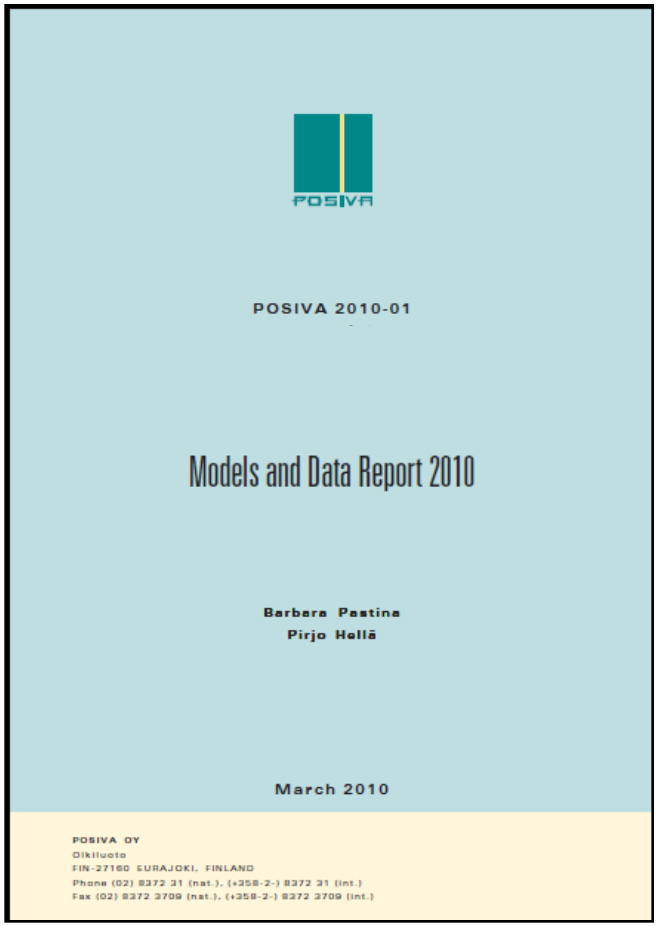


Table D-5. *Data specific to forest class (see Table 7-6) for modelling the radionuclide transport in the biosphere and the dose assessment. All these data are derived from site data, although in some cases also auxiliary literature data have been applied (Haapanen et al. 2009, Ikonen et al. 2010a). UNTAMO site classes 1-3 and 5. Class 4 is not used since such type is used as cropland (Haapanen et al. 2009).*

Parameter	Unit	Class 1 (Rocky)	Class 2 (Heath)	Class 3 (Herb-rich)	Class 5 (Mire)
Net primary production	$kg_C/m^2/y$	0.140	0.249	0.349	0.17 (a)
Vegetation height (b)	m	7.9	9.3	10.9	9.0
Above-ground biomass					
...of tree wood	kg_{dw}/m^2	1.7	4.6	6.4	4.4
...of tree foliage		0.90	2.5	3.4	2.4
...of understorey plants		0.25	0.11	0.12	0.16
Production					
...of tree wood		0.079	0.20	0.25	0.17

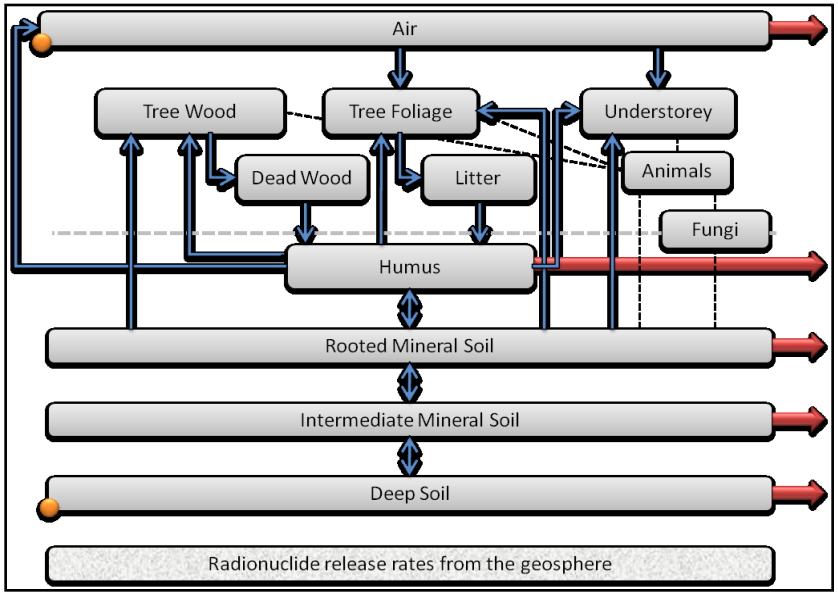
Table D-7. *Other data for modelling the radionuclide transport in the biosphere (compiled by Haapanen et al. 2009, Ikonen et al. 2010a). The types: S site or regional/national data, M mixture of site, regional/national and literature data, L literature data, E expert judgement based on regional conditions.*

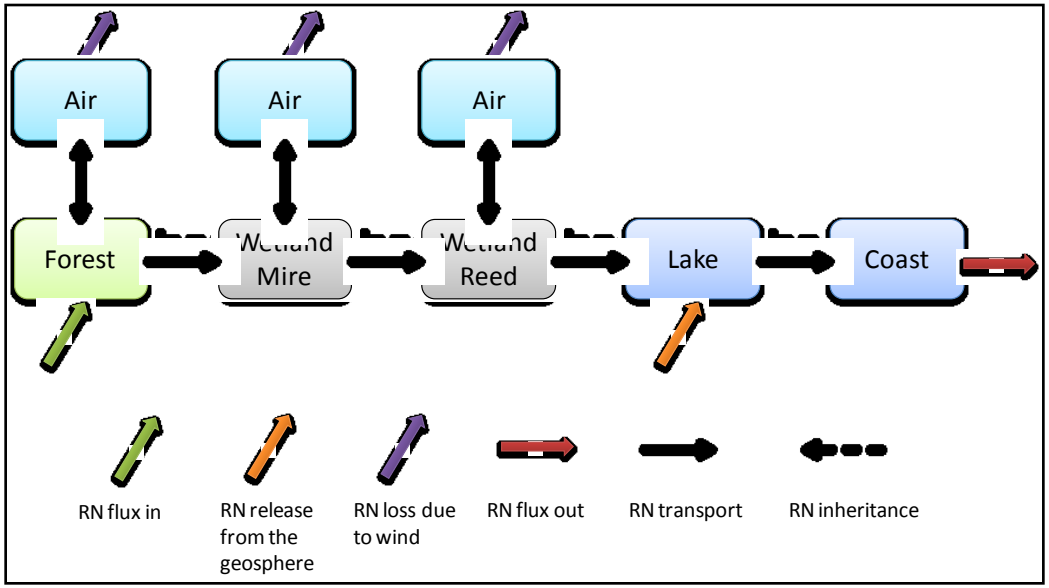
Parameter	Value	Unit	Type	Comments
Wind speed (average)	4.1	m/s	S	
Decomposition rate of exposed sediment	0.03	1/y	L	
Forests and wetlands				
Biomass of dead wood	0.158	kg_{dw}/m^2	M	Site data scaled with national data on dead wood density
Decomposition rate				
...of litter (forest class 1-3)	0.030	1/y	M	Modelled for Finnish conditions
...of acrotelm (mires)	0.015		S	
...of dead wood	0.054		M	Derived from field experiment
Rotation period of trees	100	y	-	Related to calculation of average biomass and production, see (Ikonen et al.

Models… to look like the site *(?)*

Atmo-sphere	Deposition, Rainfall, CO_2 uptake	Deposition, Rainfall, CO_2 uptake	Deposition, Rainfall, (CO_2 uptake)		(Inhalation)
Resusp-ension, Gas exchange	Terrestrial system	Runoff, Litterfall		(Infiltration)	Food source, (Other harvesting) (Drinking)
Gas exchange, (Sea spray)	Terres-trialisation, Irrigation	Shoreline system	Water exchange, Runoff, Flotation	(Infiltration)	(Food source), (Drinking), (Water use)
Gas exchange, (Sea spray)	Irrigation	Terres-trialisation, Water exchange, Flotation	Aquatic system	(Infiltration)	Food source, Drinking, (Water use)
	Ground-water discharge	Ground-water discharge	Ground-water discharge	Bedrock	
	Crop protection, Fertili-sation, (Planting)	(Dumping), (Effluents)	(Dumping), (Effluents)		Man

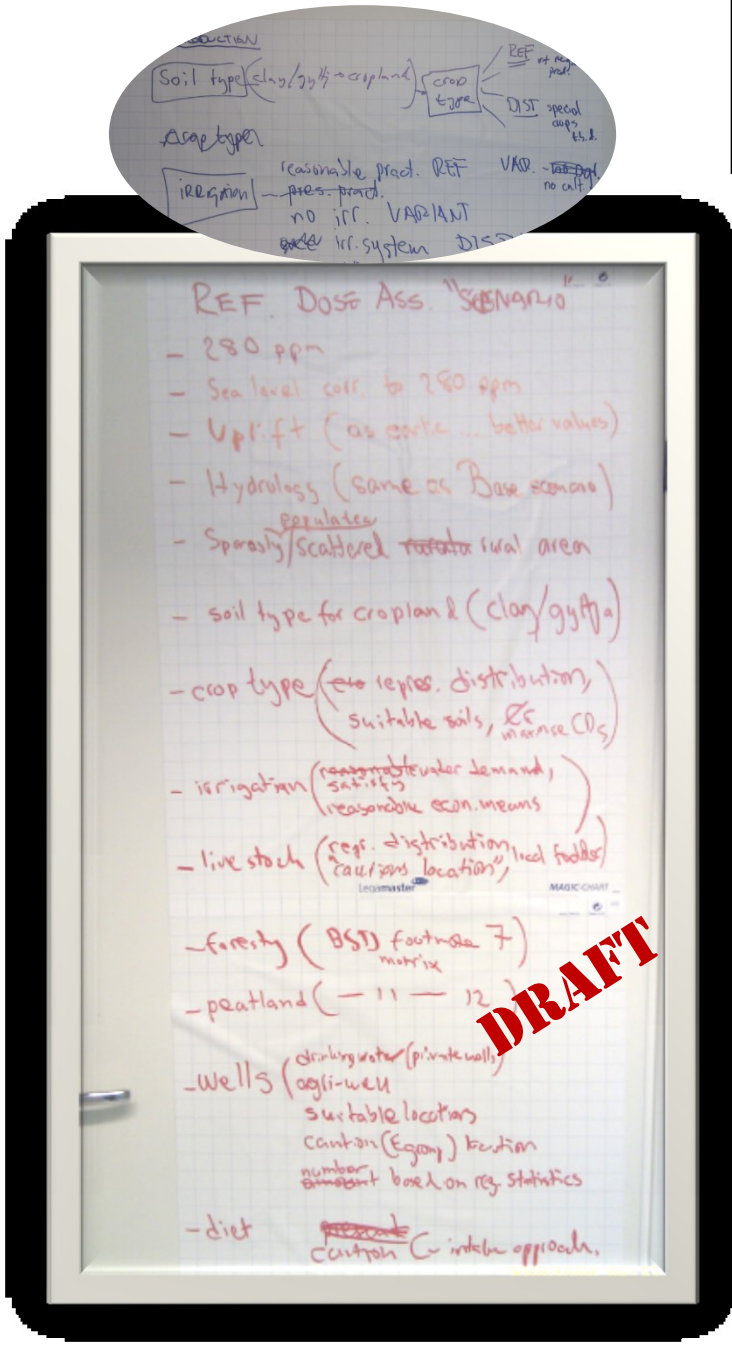
Plants	Litterfall	Throughfall, Root exuda-tion & channelling	Food source	Food source
	Litter	Bioturbation, Mineralisation, Leaching	Intake, (Inhalation)	(Ingestion)
Uptake	Bioturbation	Soil (solids and soil solution)	Intake, (Inhalation)	(Ingestion), (Inhalation)
	Excretion	Excretion	Decom-posers	Food source
	Excretion	Excretion	Food source	Animals





Scenarios…
according to the site context

- Repository scenarios * Dose assessment scenarios
- Main drivers:
  - Climate (under the general safety case specifications)
    - Post-glacial uplift, sea level change
    - Changes in surface and overburden hydrology
  - Land use (assuming present habits etc.)
    - Demography
    - Agricultural intensity (cultivated areas, crops, irrigation, livestock)
    - Forest and wetland management practise
- Rest of calculation cases essentially deal with modelling and data uncertainties



On the strategy…

- The model development, the assessment, the scenarios, the data… all are iteration of site characterisation/understanding and assessment activities
  - Models need to be representative to the site first, only then their input data can be truly site-specific
  - In practise, with any reasonable use of resources, this is strongly iterative
- At the present stage, all aspects have been at least once iterated with the site understanding (more or less formally)
  - FEPs → Dose assessment scenarios → Models → Sensitivity analysis → Data acquisition → New round
  - Still, there are lacks of data that need to be filled by using literature data → Data acceptance criteria & Statistical tools
    - The same goes also to ensuring adequate range (pdf) of values
    - Can one ever get totally rid of this?

Some more on the strategy…

- How rigorously site-specific (~realistic?) the assessment should be depends on the stage of the repository programme
  - ...and the assessment context
- How much to spend resources... the same applies
  - In the early phases gaining overall understanding of the system is more important than single parameter values
    - Understanding the development of the biosphere (spatial context) and the basic mass pools and fluxes (geological, hydrological, biological) appears to dominate also in the quantitative analysis
  - Scope of the assessment? ... e.g. in Finland, the scope of the construction license application is to show that there are no foreseeable show-stoppers to construct a safe repository
    - Not so much about the doses/exposures (as the concept is based on total isolation of the waste) but on the infiltration of groundwater to the bedrock

Climate scenario data available…

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Research material

- **global model simulations (CLIMBER-SICOPOLIS)**

  Ganopolski & al., 2009. Simulation of the last glacial cycle with a coupled climate ice-sheet model of intermediate complexity. Clim Past Discuss., 5, 2269-2309, 2009.

- **regional model simulations (RCA3)**

  SKB Technical Report TR-09-04

- **downscaling with a statistical model**

  Vrac M., Marbaix P., Paillard D., Naveau P., 2007. Non-linear statistical downscaling of present and LGM precipitation and temperature over Europe. Climate of the Past, 3, 669-682.

- **utilizing observations of the recent past climate (Climate Research Unit)**

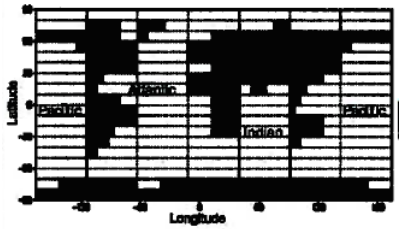
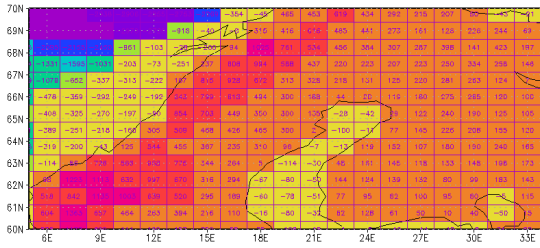


Fig. 1 Representation of the Earth's geography in the model. *Dashed lines* show atmospheric grid, *solid lines* separate ocean basins

CLIMBER: 51° x 10°
SICOPOLIS: 1.5° x 0.75°

Small ice sheet
over Fennoscandia



(Figures from different scenarios)

…and more

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Monthly precipitation in Olkiluoto in the future 280 ppm scenario in the next 100,000 years