Confidence
Coping with uncertainty for improved modelling and decision making in nuclear emergencies

EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH
CONCERT

Human Foodchain Modelling – Reducing Uncertainties

Nick Beresford, Steve Lofts, Catherine Barnett, Justin Brown, Håvard Thørring, Ali Hosseini, Javier Guillien, Francisco Gómez Polo, Talal Al Mahaini, Lieve Sweeck, Danyl Perez, Deborah Oughton, Ole-Christian Lind & Keiko Tagami (scientific advisor – WP3)

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287

Radioecological modelling: fit for purpose - why?

Predictions made using radioecological models will be used in the early part of the transition phase to make longer-term decisions ……

……. models must be sufficiently robust and fit for purpose with uncertainties reduced

Radioecological modelling: fit for purpose

Activities of the WP are in three broad areas:

- ‘Improving models’
- ‘Process based models’
- ‘Hot particles’

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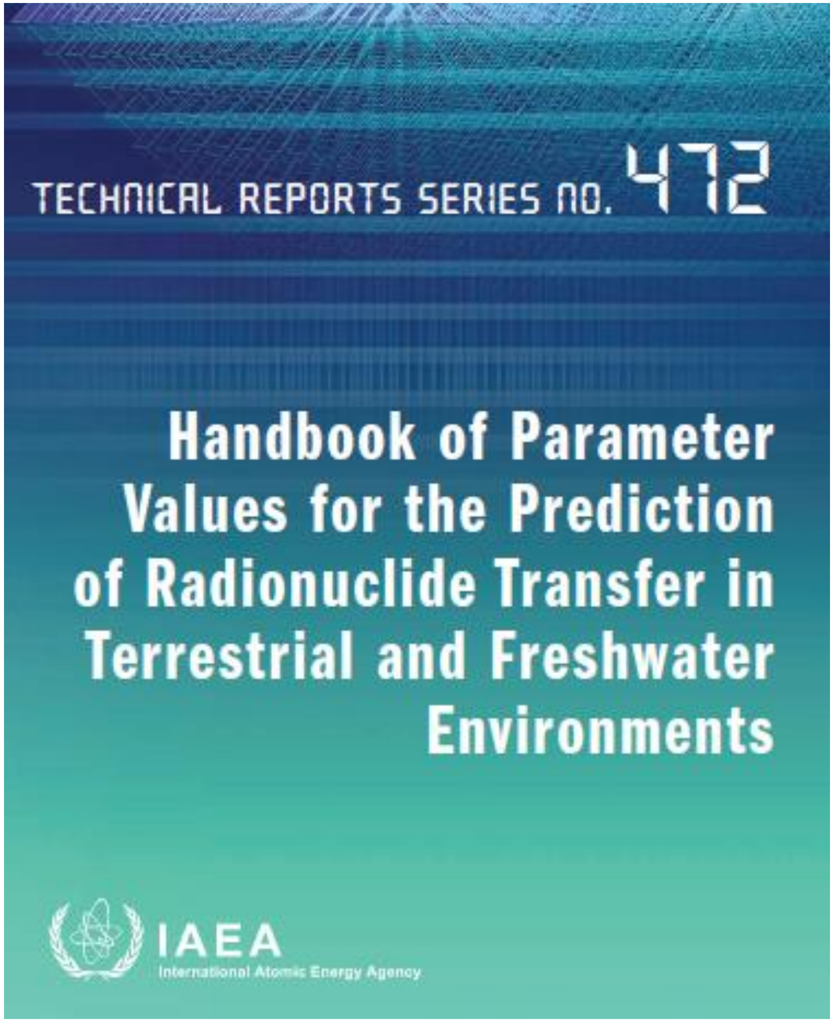
ALLIANCE Human Food Chain Roadmap

Improving models – FDMT JRodos

JRodos foodchain model (Ecosys-87) parameterisation predates IAEA TRS364 handbook [replaced by TRS472 in 2010]



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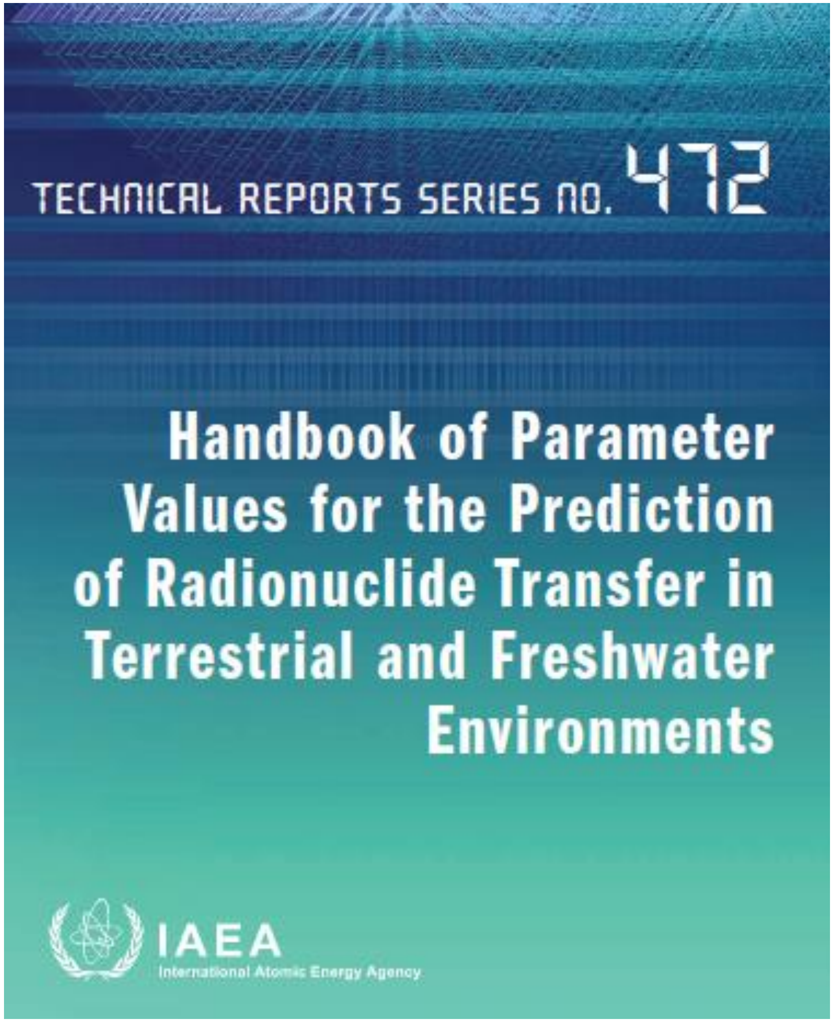
See poster comparing FDMT and TRS472 parameters



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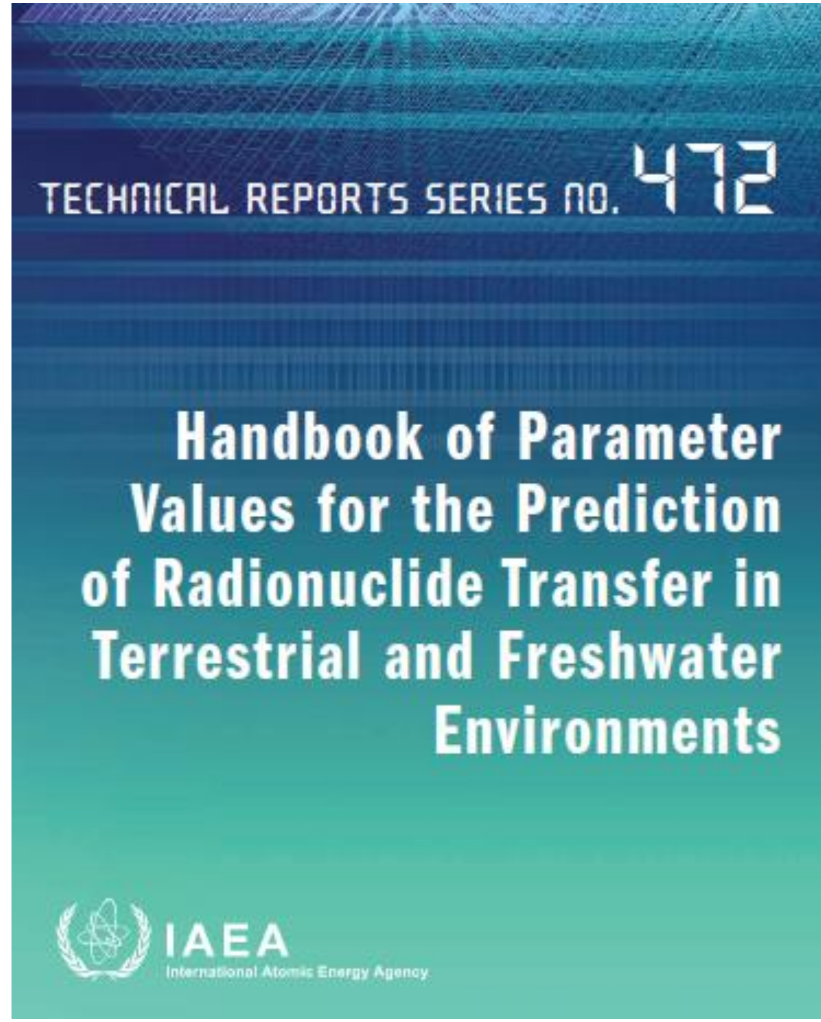
Improving models

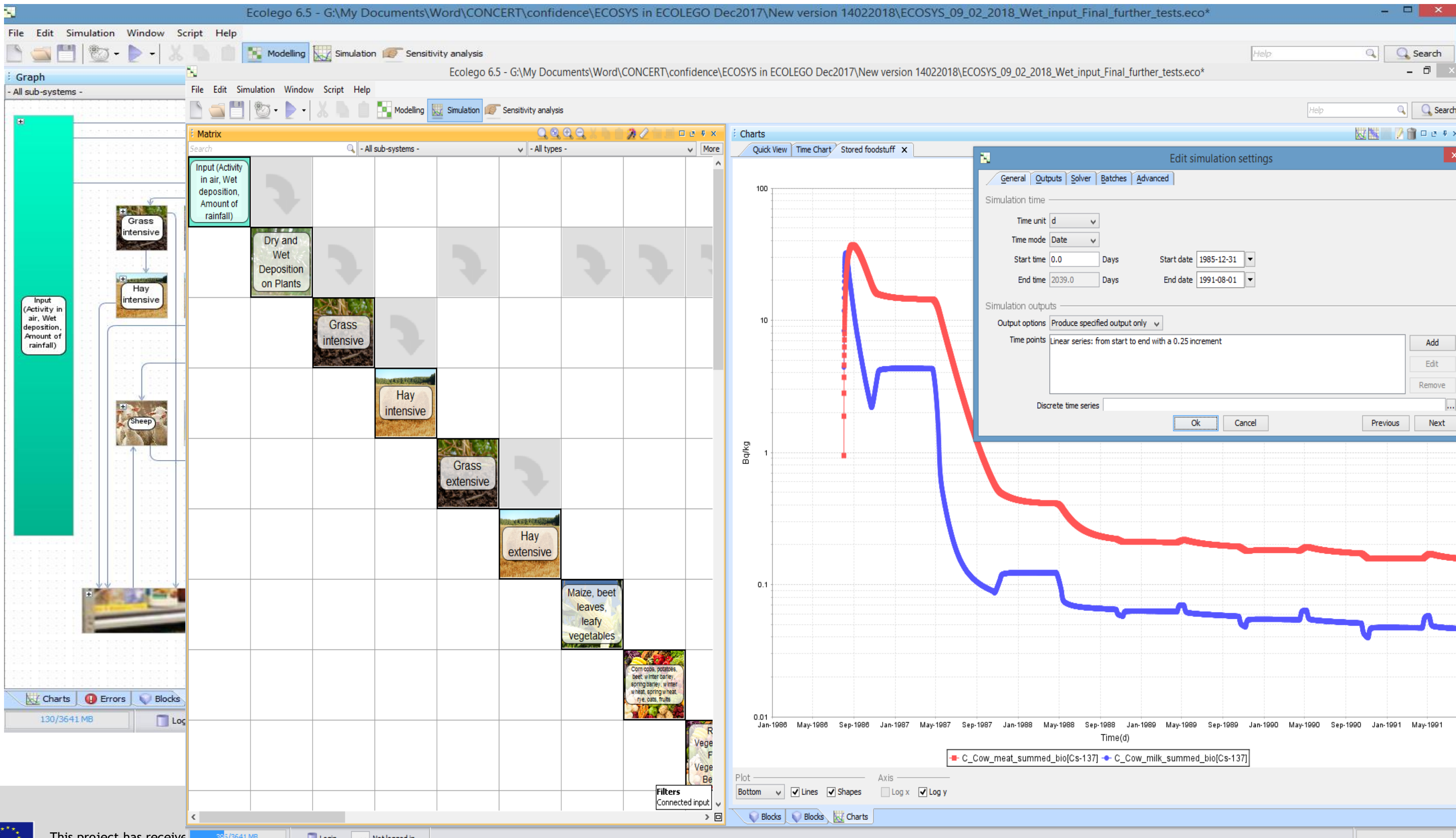
See poster on Mediterranean database

http://concert-h2020.eu/Document.ashx?dt=web&file=/Lists/Deliverables/Attachments/103/D9.14_Published%20dataset%20on%20transfer%20in%20Mediterranean%20ecosystems_approved10052019.pdf&guid=01b5ac77-b2ec-4cda-9c98-917dba396f0f



Ecosys-87/FDMT in ECOLEGO

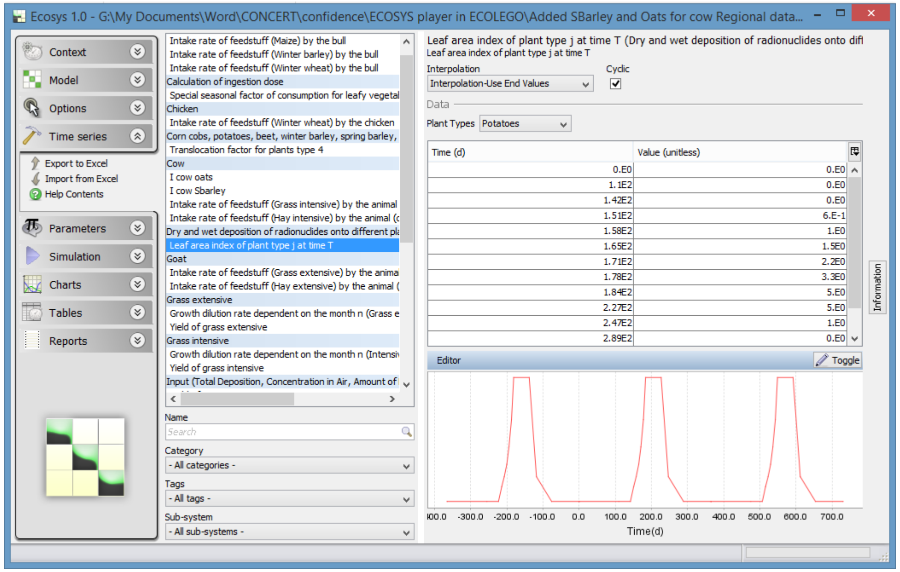
http://concert-h2020.eu/Document.ashx?dt=web&file=/Lists/Deliverables/Attachments/100/D9_13_D80_Improving%20models%20and%20learning%20from%20post-Fukushima%20studies_approval08012019.pdf&guid=01b5ac77-b2ec-4cda-9c98-917dba396f0f



This project has receive

Regionalisation (e.g. Norway)

- Three zones based around growing season
- Time of harvest for different crop types and leaf area index (yield for grass)



Leaf area index versus time for **potatoes** as entered into ECOSYS-ECOLEGO.

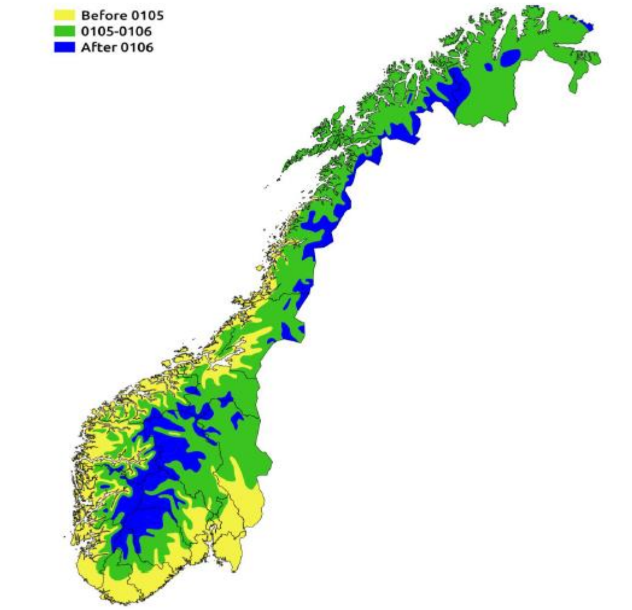
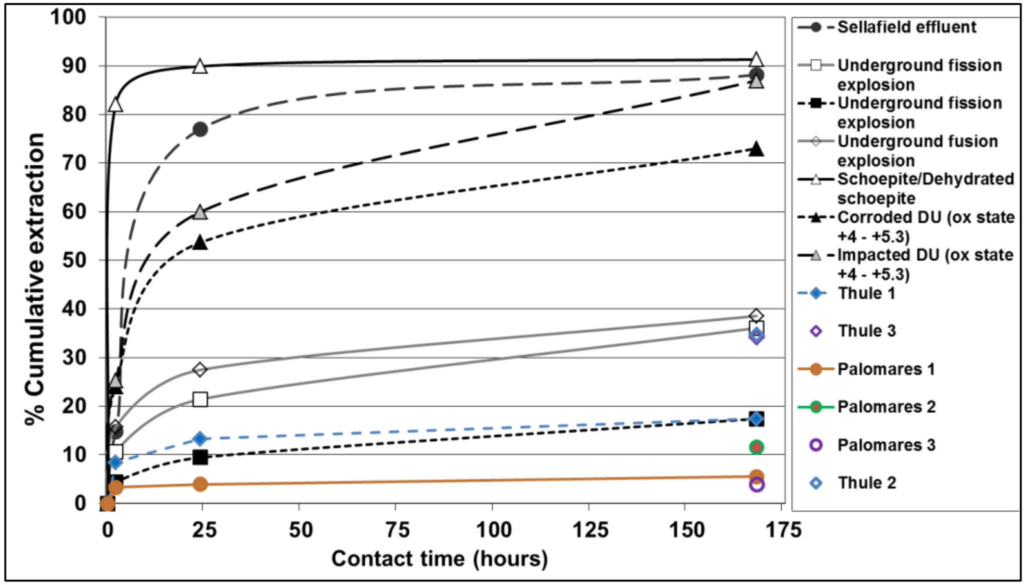


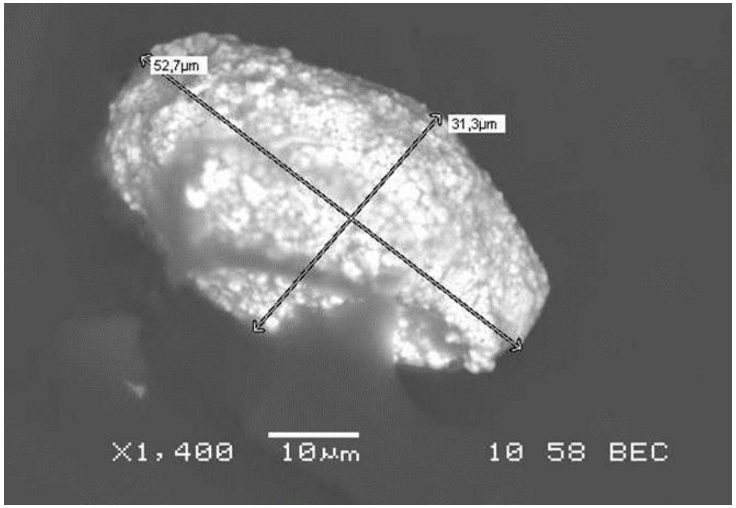
Figure 3.1: Start of growing season – approximate time when average temperature passes 5 °C in regions Z1 (yellow), Z2 (green) and Z3 (blue) (map by Tanya H. Hevrøy based on PARDNOR, 2009).

Ali/Danyl - presentation

Including ‘hot particles’ in radioecological models

- Incorporate hot particles into models to improve predictions
  - Do ‘hot particles’ matter re transfer in foodchain





Ole-Christian/Ali - presentation

Biological half-life database

- Biological half-life database established for farm animal (products)

  >600 entries

	Entry_ID	Reference	Organism_name_common_English	adult_lamb_calf_etc.	Age_years					
2	CLB 1	Andersson et al. (1990)	Hen		0.11	meat	Cs-137	Cs	Continuous	
3	CLB 2	Assimakopoulos et al. (1988)	Dairy Cow	Adult		milk	I-131	I	Field plus model	
4	CLB 3	Assimakopoulos et al. (1988)	Sheep	Ewe		milk	I-131	I	Field plus model	
5	CLB 4	Assimakopoulos et al. (1989)	Sheep	Ewe		milk	radiocaesium	Cs	Continuous administration	
6	CLB 5	Beresford et al. (1998b)	Sheep	Lamb	0.42	meat	Ce-139	Ce	Single administration plus model	
7	CLB 6	Beresford et al. (1998b)	Sheep	Lamb	0.42	liver	Ce-139	Ce	Single administration plus model	
8	CLB 7	Beresford et al. (1998b)	Sheep	Lamb	0.42	kidney	Ce-139	Ce	Single administration plus model	

info | meta | combined data | Japanese refs

Ready Filter Mode

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See poster

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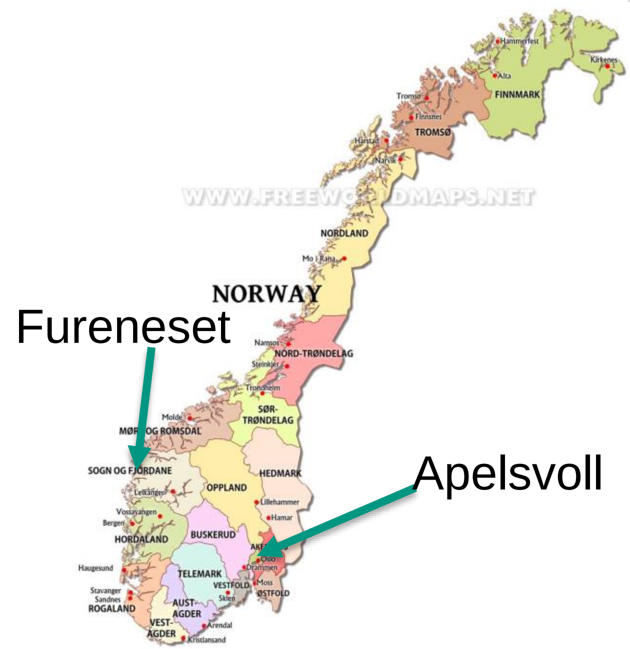
Impact of stable I and climate on I transfer to crops

Methods: I-131 tracer (in artificial rainwater) sprayed on grass and barley at two field sites: Apelsvoll (inland) and Fureneset (coastal) three times during the growing season (June-August). Samples taken for three weeks after each spraying.



Debbie - presentation

Can process based models reduce uncertainties?

What is a processed based model

Process-based models ***represent*** *and simulate physiological and biogeochemical* ***processes*** *and their interactions with the abiotic environment (water, climate, and nutrients) ……… by* ***using functional relationships*** [Larocque et al.]

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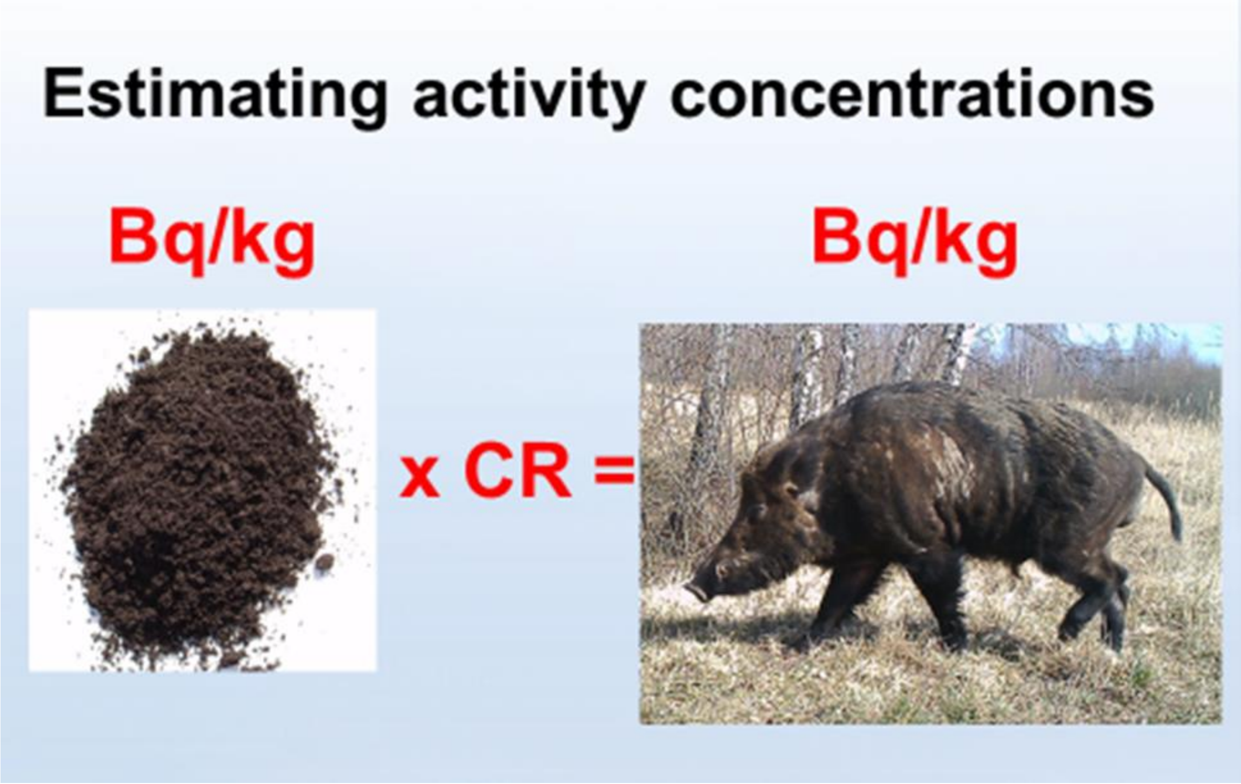

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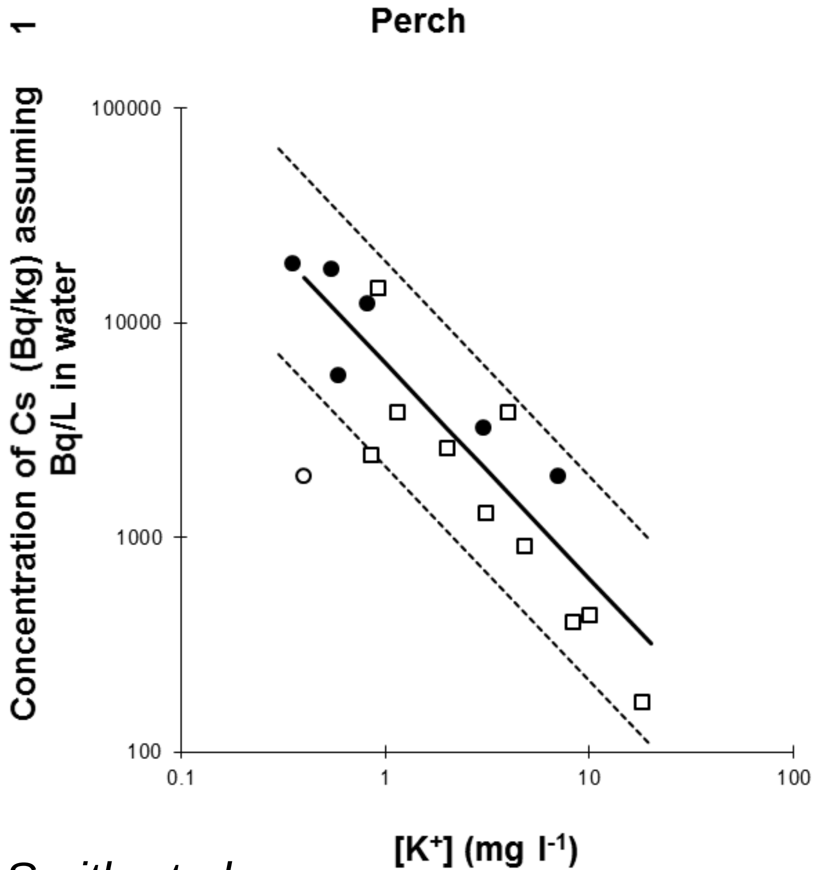
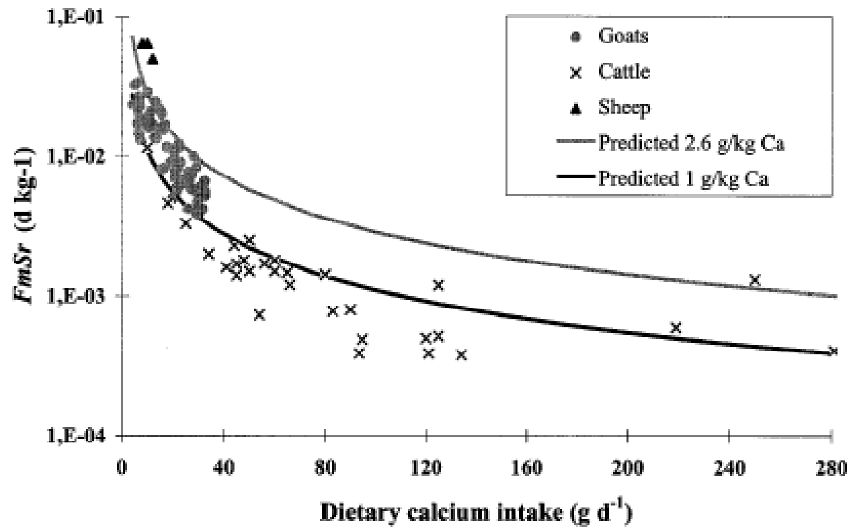


Smith et al.

Beresford et al.



$$F_m Sr = \frac{OR_{milk\text{-}diet} \cdot [Ca]_{milk}}{I_{Ca}}$$

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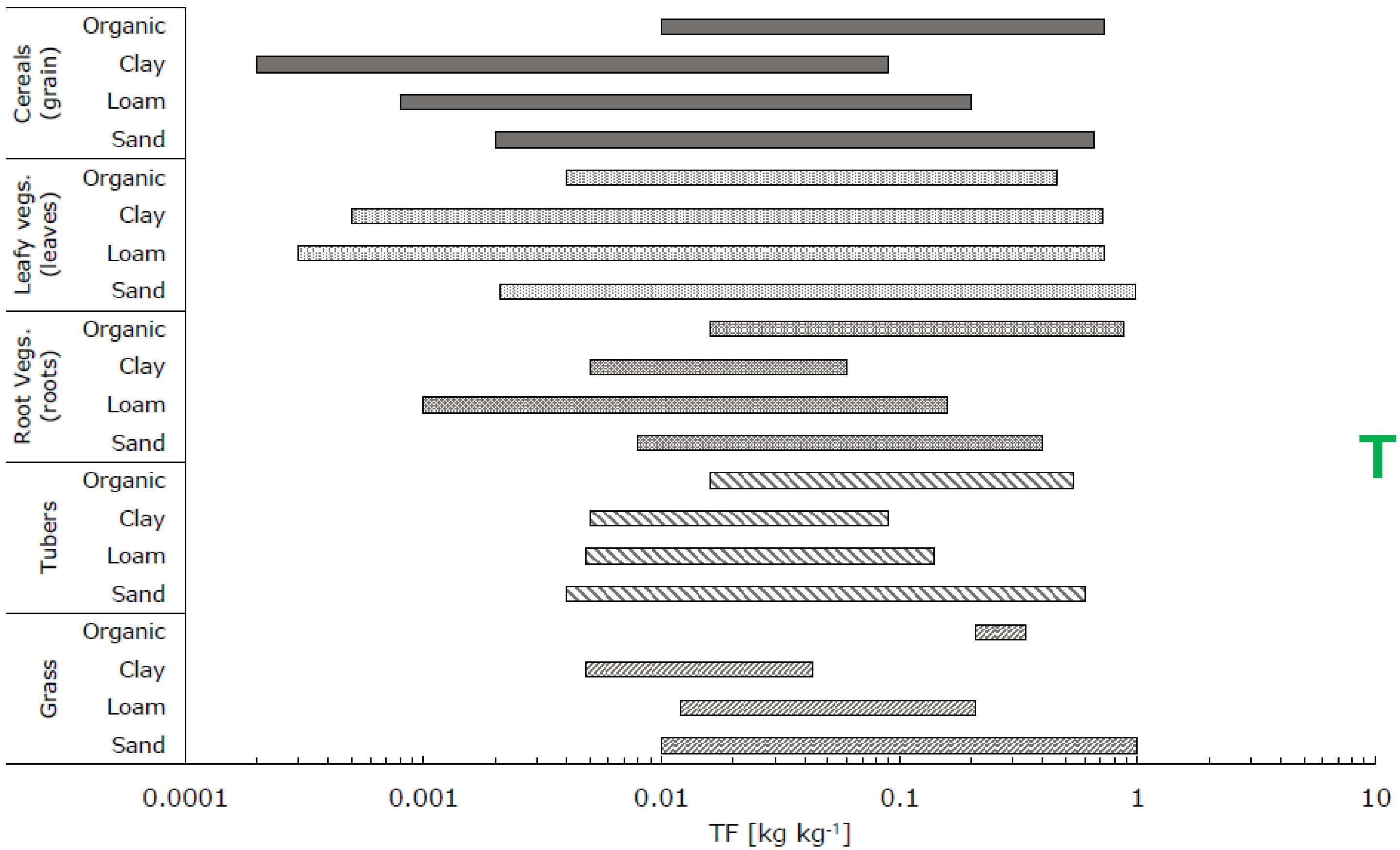
Variability in empirical transfer values



Cs

IAEA TRS472

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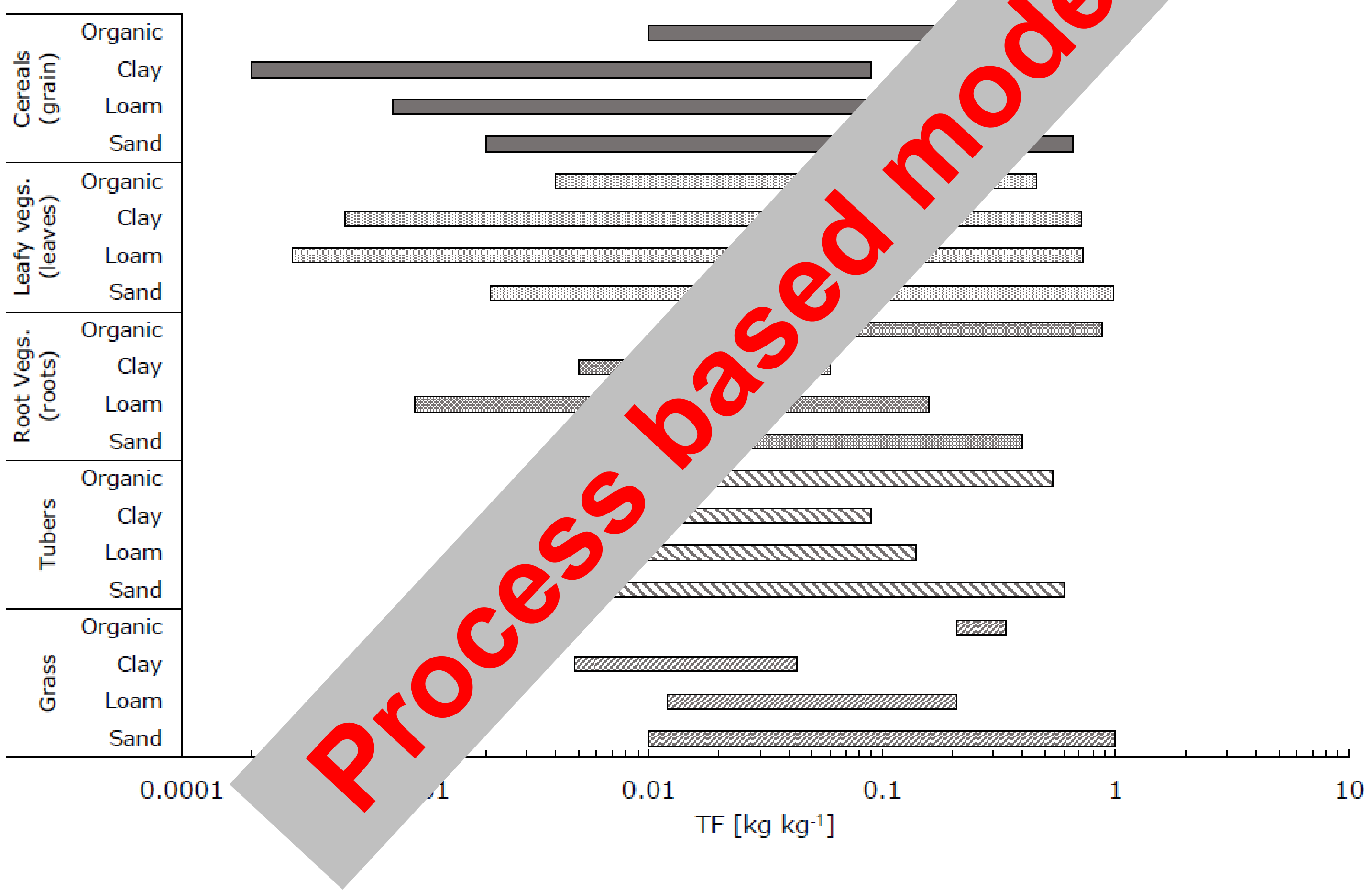
Variability in empirical transfer values



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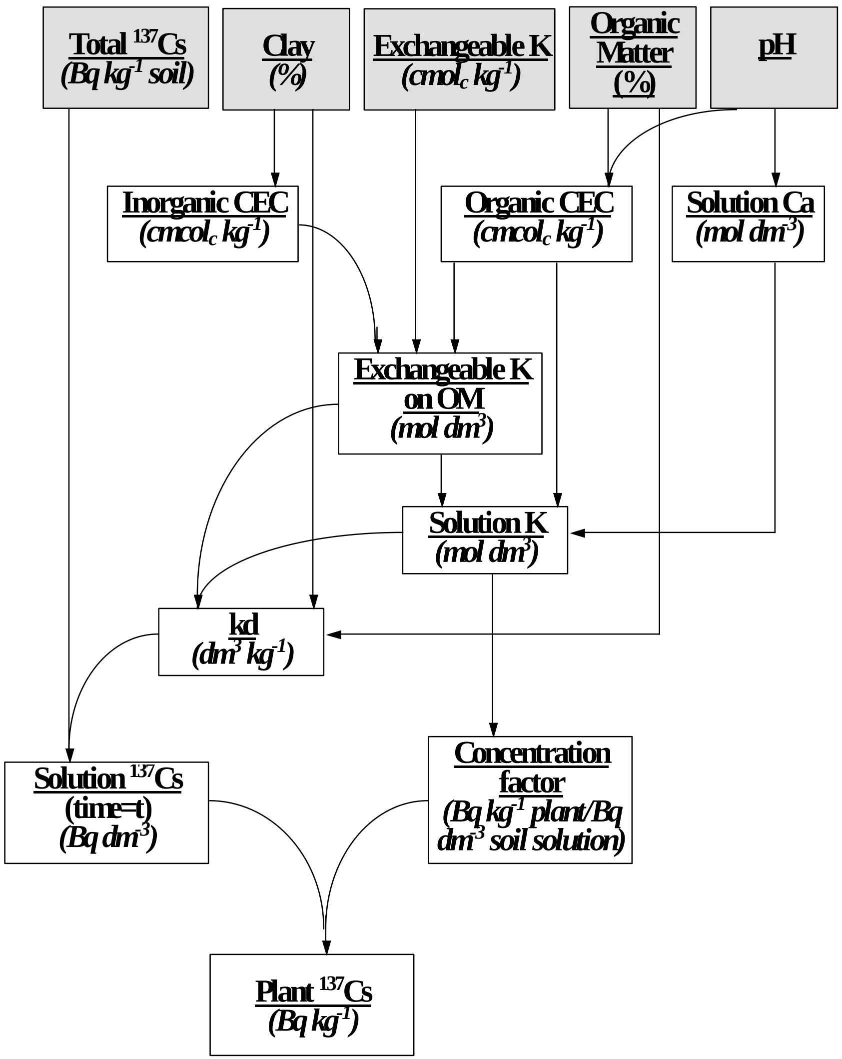
‘Absalom’ or ‘SAVE’ model for Cs



Environ. Sci. Technol. 1999, 33, 1218−1223

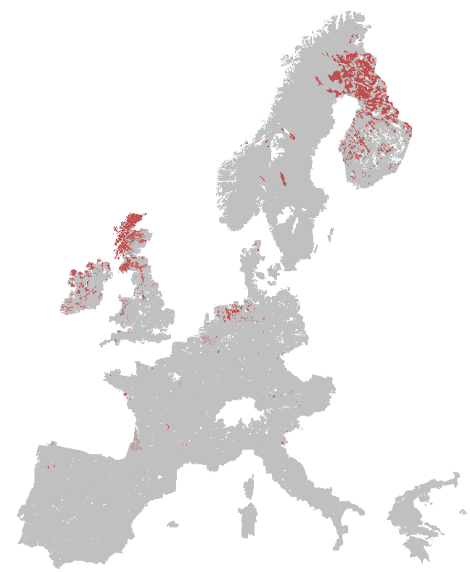
Predicting Soil to Plant Transfer of Radiocesium Using Soil Characteristics

J. P. ABSALOM,*,† S. D. YOUNG,† N. M. J. CROUT,† A. F. NISBET,‡ R. F. M. WOODMAN,‡ E. SMOLDERS,§ AND A. G. GILLETT†

School of Biological Sciences, Sutton Bonington Campus, University of Nottingham, Loughborough, Leicestershire LE12 5RD, U.K.
National Radiological Protection Board, Chilton, Didcot, Oxfordshire OX11 0RQ, U.K.
Laboratory of Soil Fertility and Soil Biology, Faculty of Applied Biological and Agricultural Sciences, K. U. Leuven, K. Mercierlaan, 92, B 3001 Heverlee, Belgium

and slaughter of sheep are in place 12 years after the Chernobyl accident with more than 350 farms affected in Wales. Radiocesium contamination of agricultural products in the areas of Belarus, Ukraine, and Russia also remains high. Failure to predict this long-term availability of radiocesium was partly due to the differences between the organic, acidic soils with a low clay and nutrient (K) status which received most of the U.K. deposition and the low-land clay-rich mineral soils on which most previous Cs studies had been conducted (*2*). Illitic clay is the principal adsorptive surface for radiocesium in soil, while potassium is the major competitor for plant and soil sorption sites. Thus, these two soil properties have a large influence on the bioavailability of radiocesium in soil.

Established models which consider radiocesium uptake by plants, such as ECOSYS (*3*) and PATHWAY (*4*), do not incorporate the effects of soil properties on radiocesium bioavailability but instead describe radiocesium uptake from a generic soil. However, radiocesium bioavailability has been shown to be strongly influenced by soil properties such as K status and clay content (*5*, *6*), both of which vary greatly

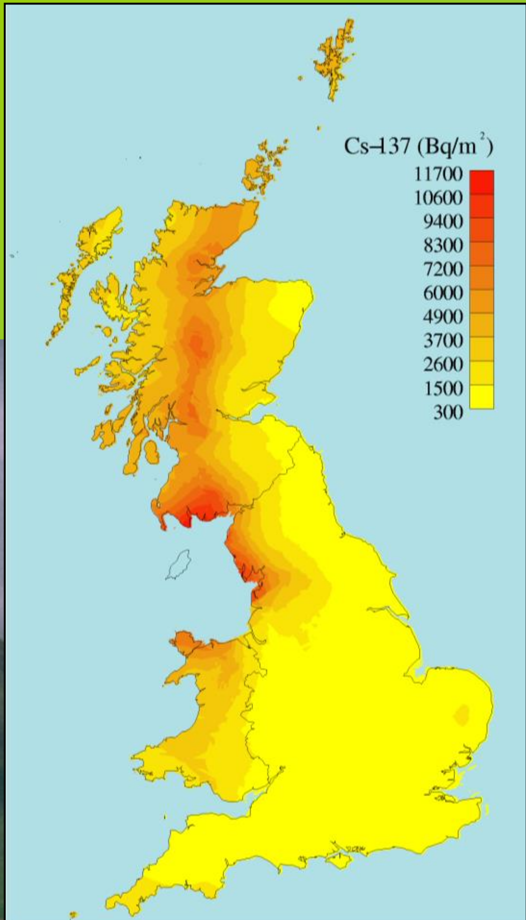


Radiat Environ Biophys (2003) 42:41–47
DOI 10.1007/s00411-003-0187-6

ORIGINAL PAPER

S. M. Wright · J. T. Smith · N. A. Beresford ·
W. A. Scott

Monte-Carlo prediction of changes in areas of west Cumbria requiring restrictions on sheep following the Chernobyl accident



http://dx.doi.org/10.1007/s00411-003-0187-6

Tag grass ($m^2\ kg^{-1}$) =

$$(0.0134e^{-0.46t} + 0.00161e^{-0t})e^{0.0339\mathbf{OM}}$$

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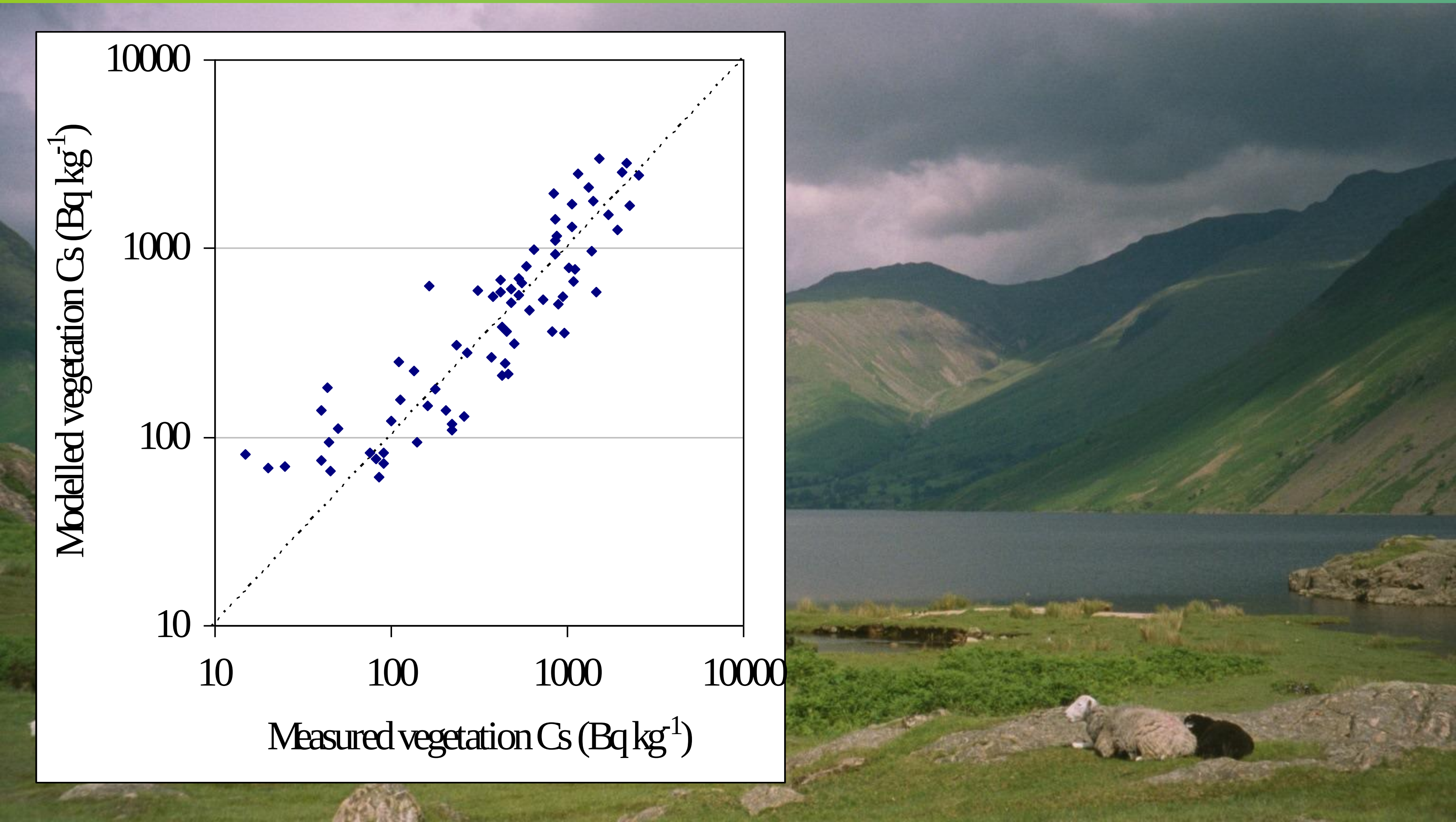

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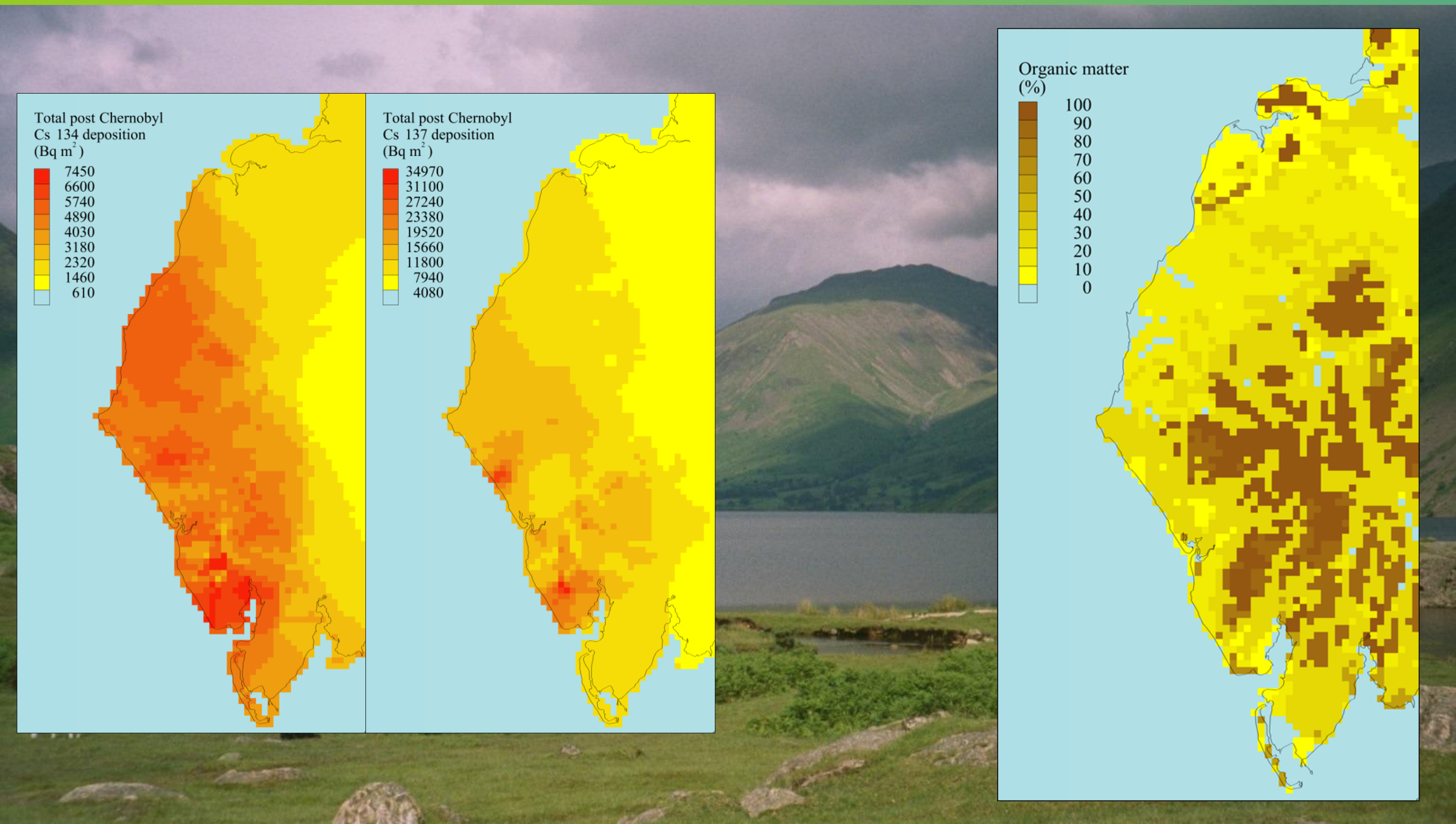
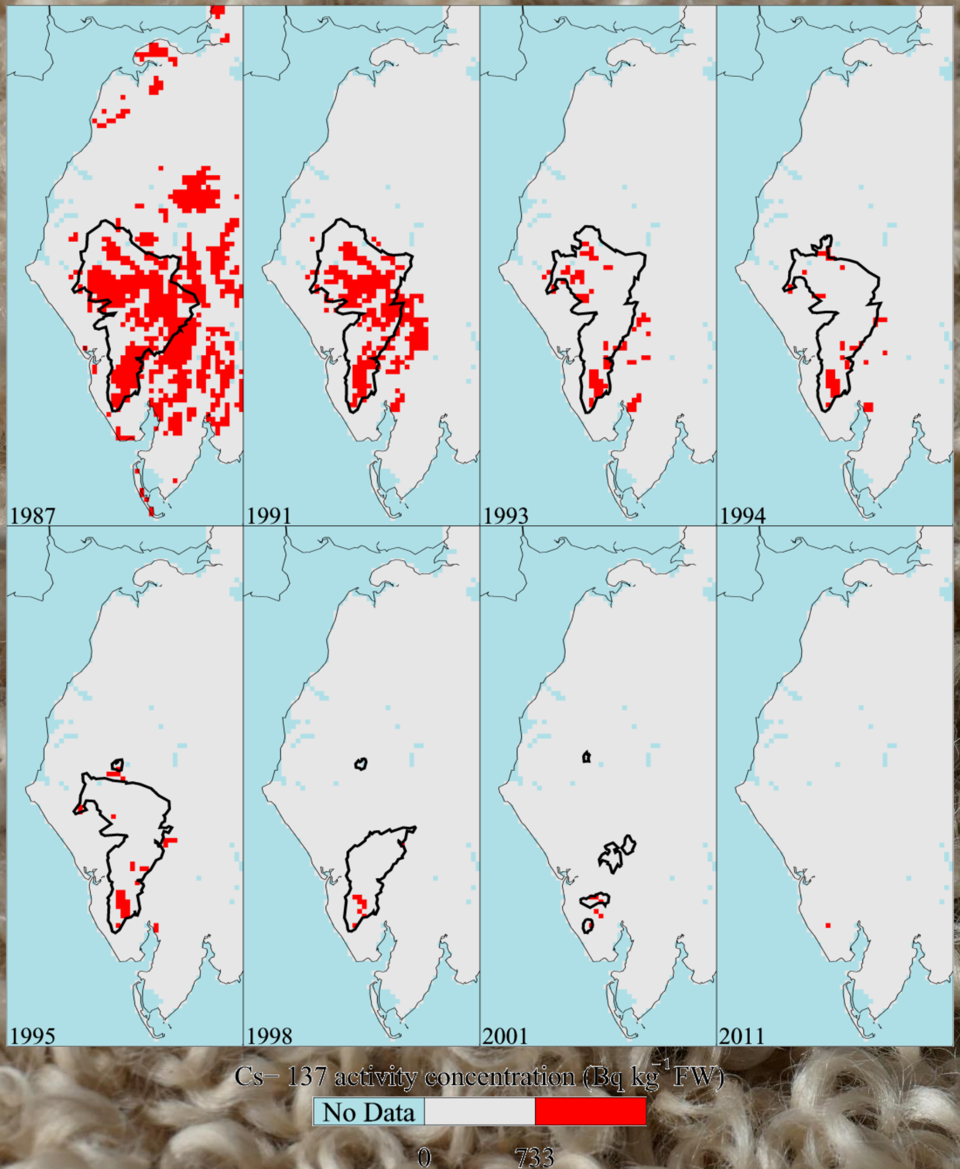
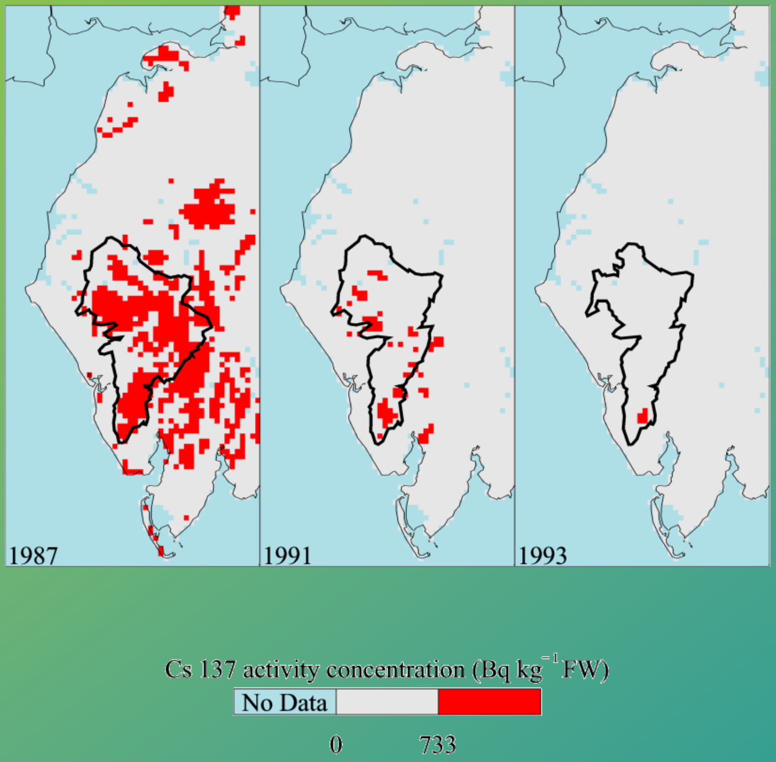


Predicted restricted areas



Restricted areas for Chernobyl ^{137}Cs & ^{134}Cs only



Wright, S.M., Smith, J.T., Beresford N.A. & Scott, W.A. 2003. Monte-Carlo prediction of changes in areas of west Cumbria requiring restrictions on sheep following the Chernobyl accident. *Radiation and Environmental Biophysics* 42, 41-47.

This workshop

- ‘Normal’ modelling approaches
- Process based models (why?)
- Human food chain radioecology – future research priorities

This workshop – what will we do with results

- Process based models
  - Breakout/plenary discussion will be summarised in deliverable report on CONFIDENCE process based modelling studies
- Human food chain radioecology – future research priorities
  - Discussions will be summarised in our final deliverable report and also feed into revision of Strategic Research Agenda

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Ask questions &
discuss
@Radioecology