(Some of the) Human food chain modelling within the CONFIDENCE project

https://portal.iket.kit.edu/CONFIDENCE/

….then a bit about source-sink for non-rads

Nick Beresford (nab@ceh.ac.uk; @Radioecology)
Catherine Barnett, Steve Lofts, Justin Brown, Javier Guillien, Talal Al Mahaini, Lieve Sweeck, Danyl Perez & Angelica Wasserman

CONFIDENCE

COping with u**N**certainties **F**or **I**mproved modelling and **DE**cision making in **N**uclear emergen**C**i**E**s

- Funded under 1st CONCERT call [EURATOM]
  - Co-ordinator Wolfgang Raskob (KIT)
- Research focussed on uncertainties in the area of emergency management and long-term rehabilitation
  - Focus on early and transition phases of an emergency
  - WP3 *Human food chain*

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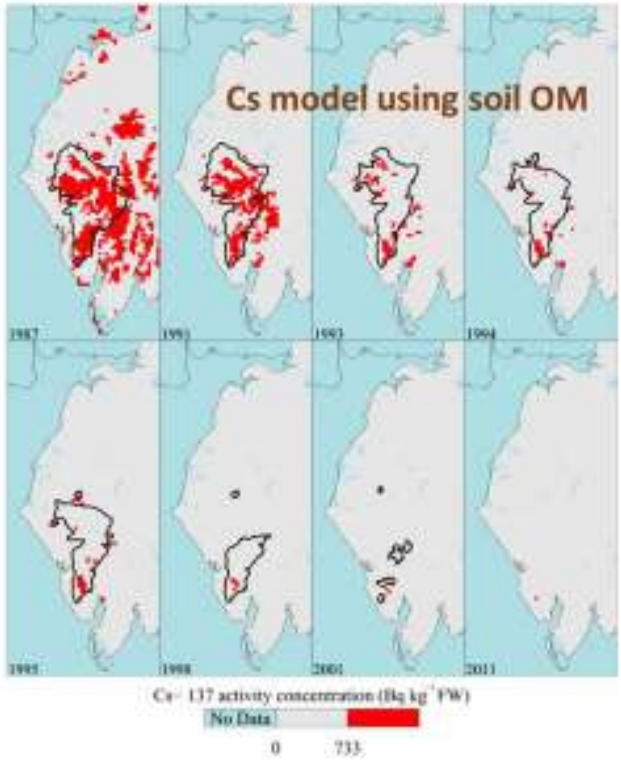
Can process based models reduce uncertainties?

- Transfer to foodstuffs generally estimated using empirical ratio [maybe classified by soil group]
- *Do process based models represent a useful alternative [give 'added value']?*



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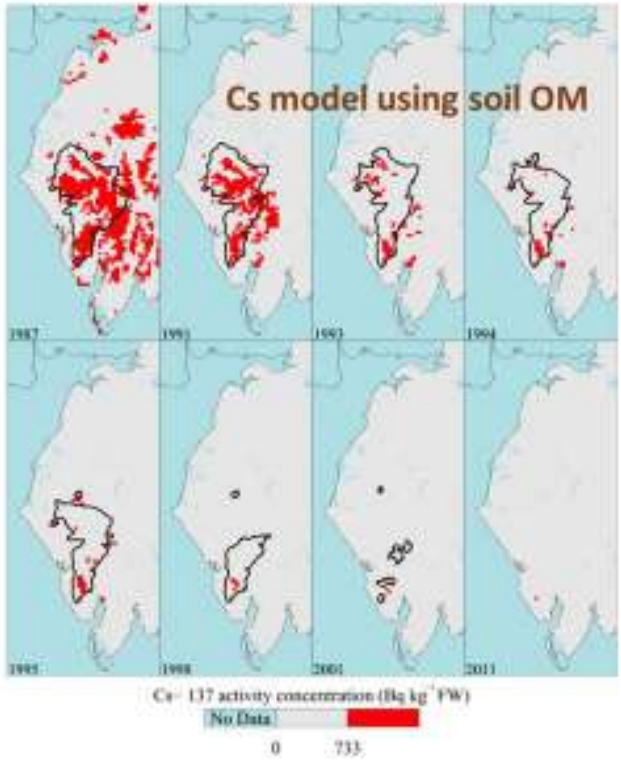
Wright et al. 2003 Rad. Environ. Biophys.

Can process based models reduce uncertainties?

- Transfer to foodstuffs generally estimated using empirical ratio [maybe classified by soil group]
- *Do process based models represent a useful alternative ['added value']?*
- Applicability to European soils
- How can process based models be incorporated into DSS?



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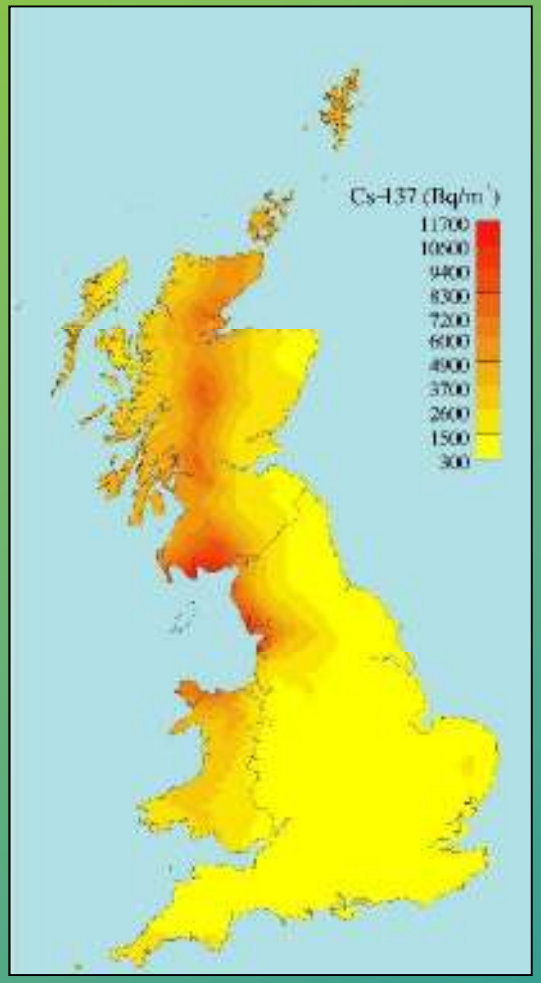
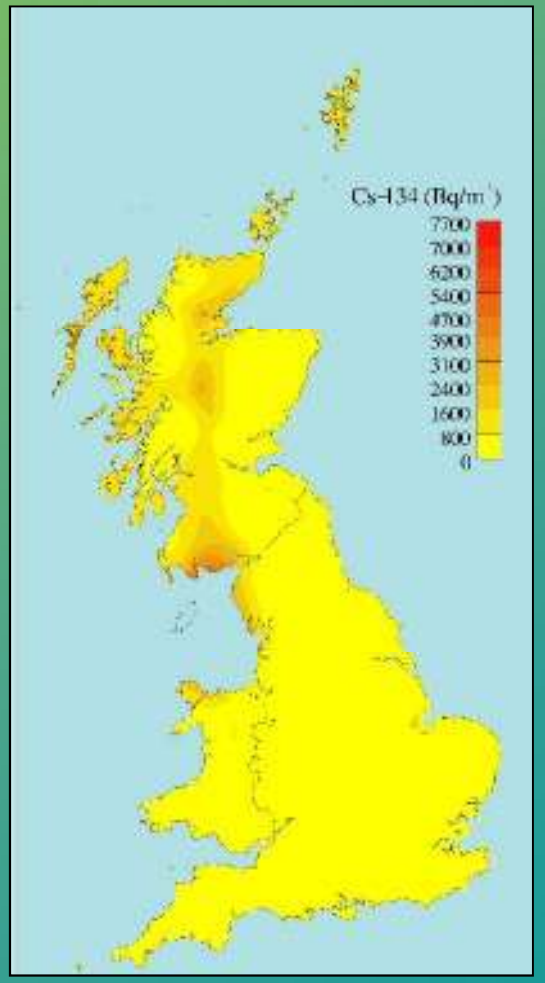
Wright et al. 2003 Rad. Environ. Biophys.

Chernobyl accident 1986



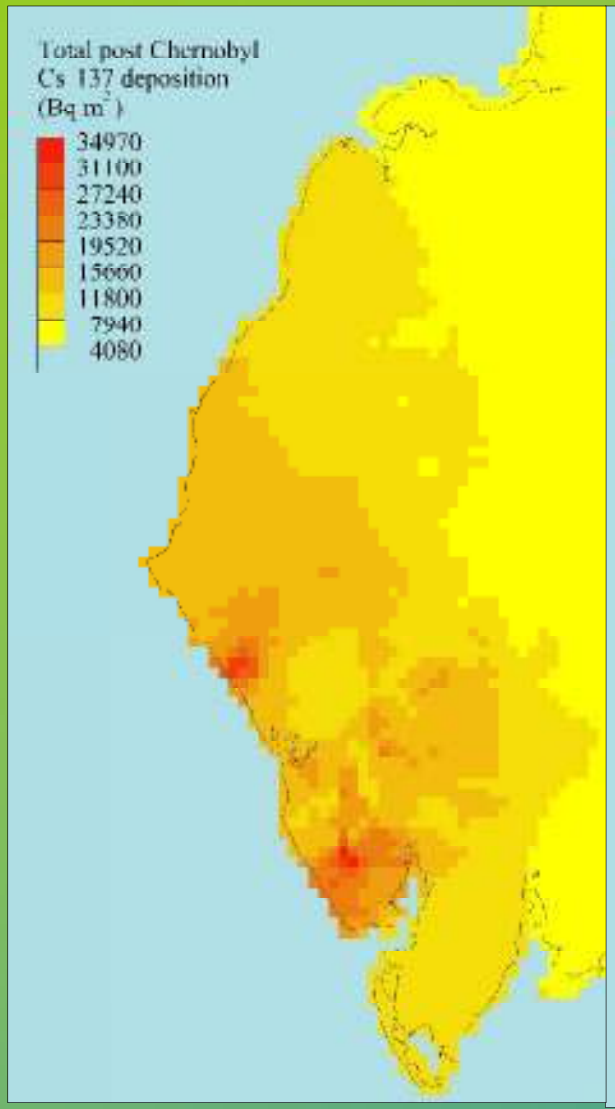


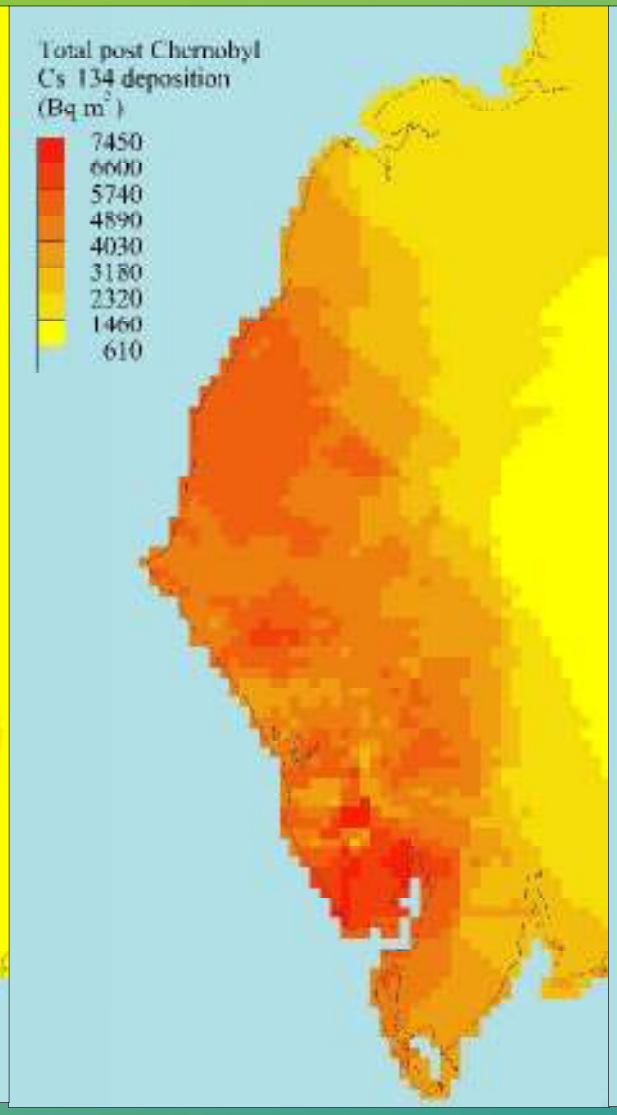
Monitoring and de-restriction

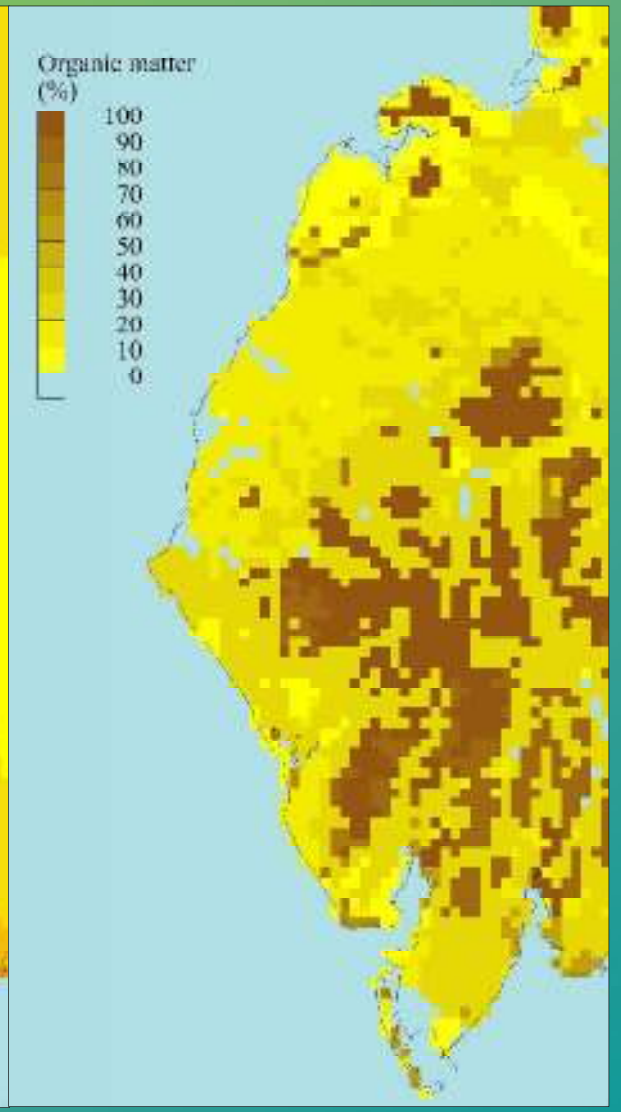
Restricted areas in west Cumbria

- 1986
  - 1,670 farms and 867,000 sheep
- 1990
  - 167 farms and 152,000 sheep
- 1992
  - 138 farms and 120,000 sheep
- 2002
  - 9 farms and 11,500 sheep

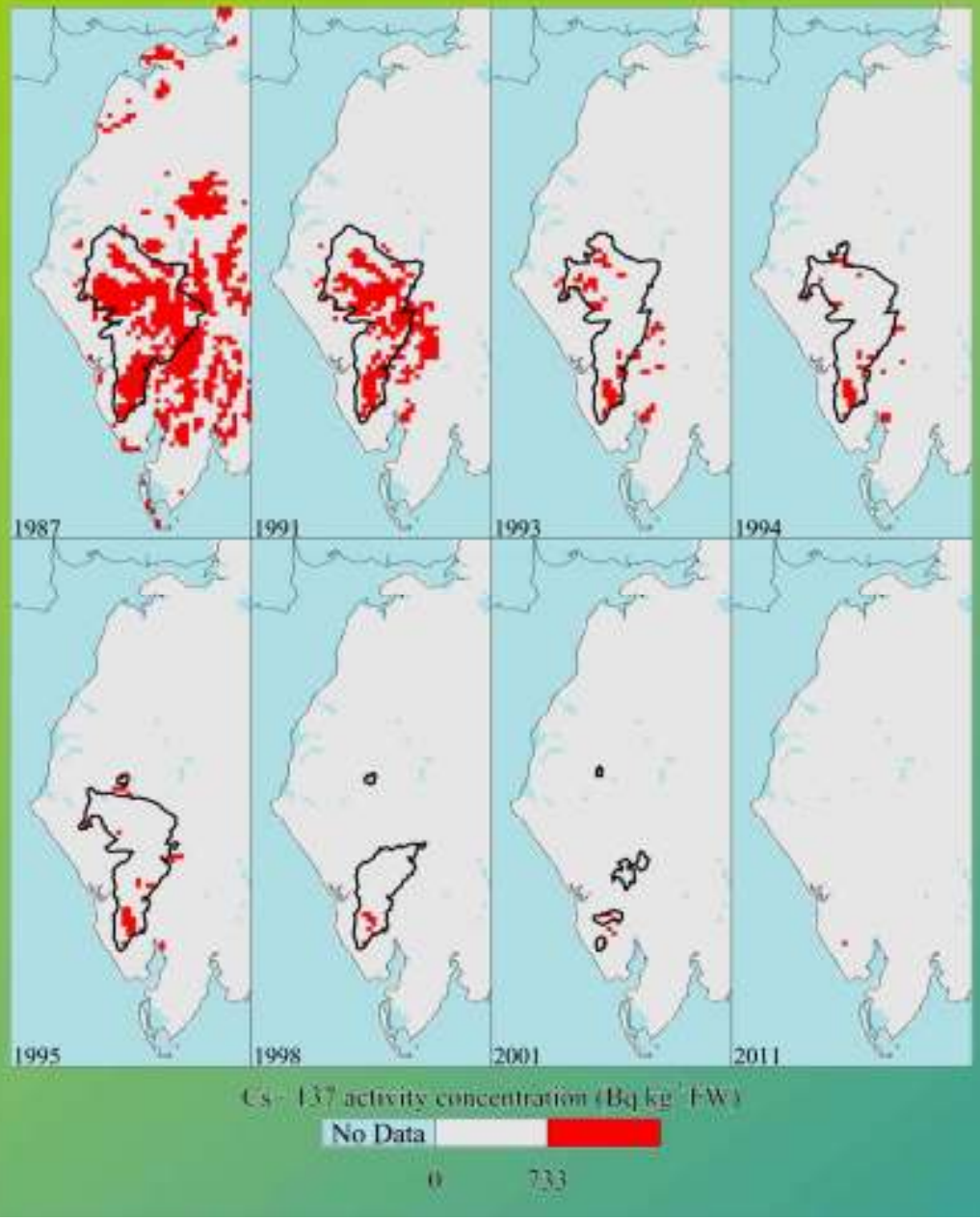
Inputs


Total post Chernobyl
Cs 137 deposition
(Bq m-2)
34970
31100
27240
23380
19520
15660
11800
7940
4080


Total post Chernobyl
Cs 134 deposition
(Bq m-2)
7450
6600
5740
4890
4030
3180
2320
1460
610


Organic matter
(%)
100
90
80
70
60
50
40
30
20
10
0

Predicted restricted areas



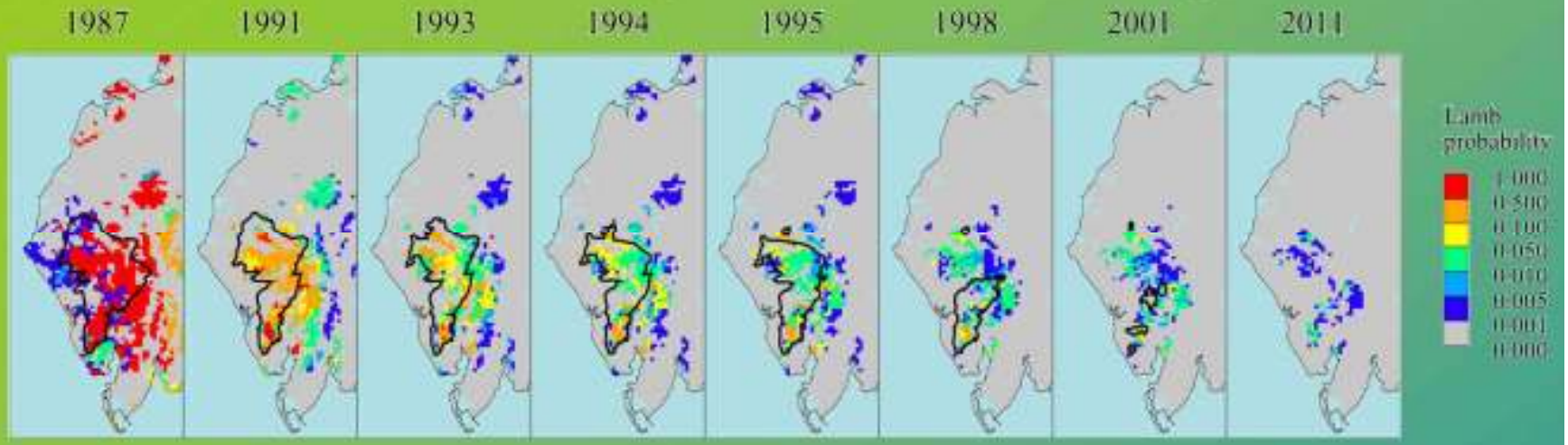
Radiat Environ Biophys (2003) 42:41–47
DOI 10.1007/s00411-003-0187-6

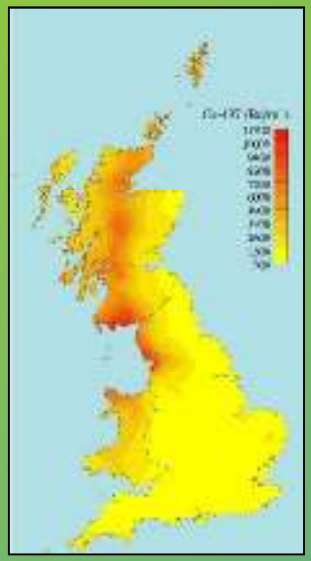
ORIGINAL PAPER

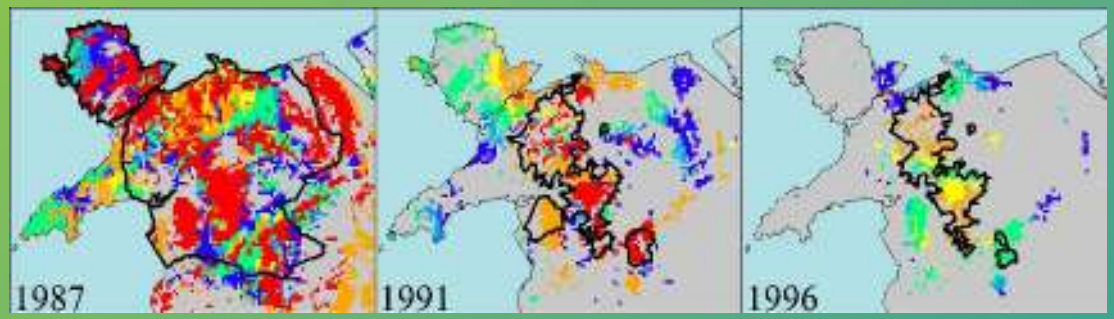
S. M. Wright · J. T. Smith · N. A. Beresford · W. A. Scott

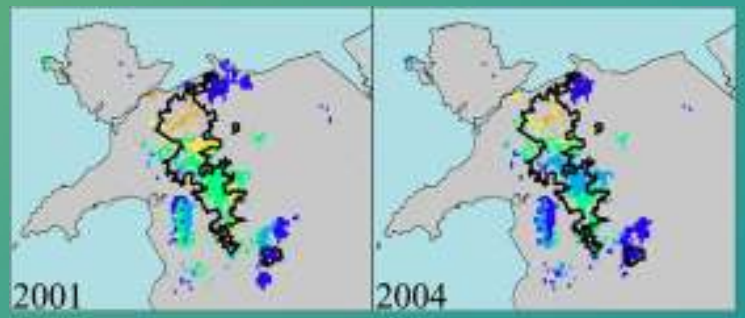
Monte-Carlo prediction of changes in areas of west Cumbria requiring restrictions on sheep following the Chernobyl accident

Also applied probablistically

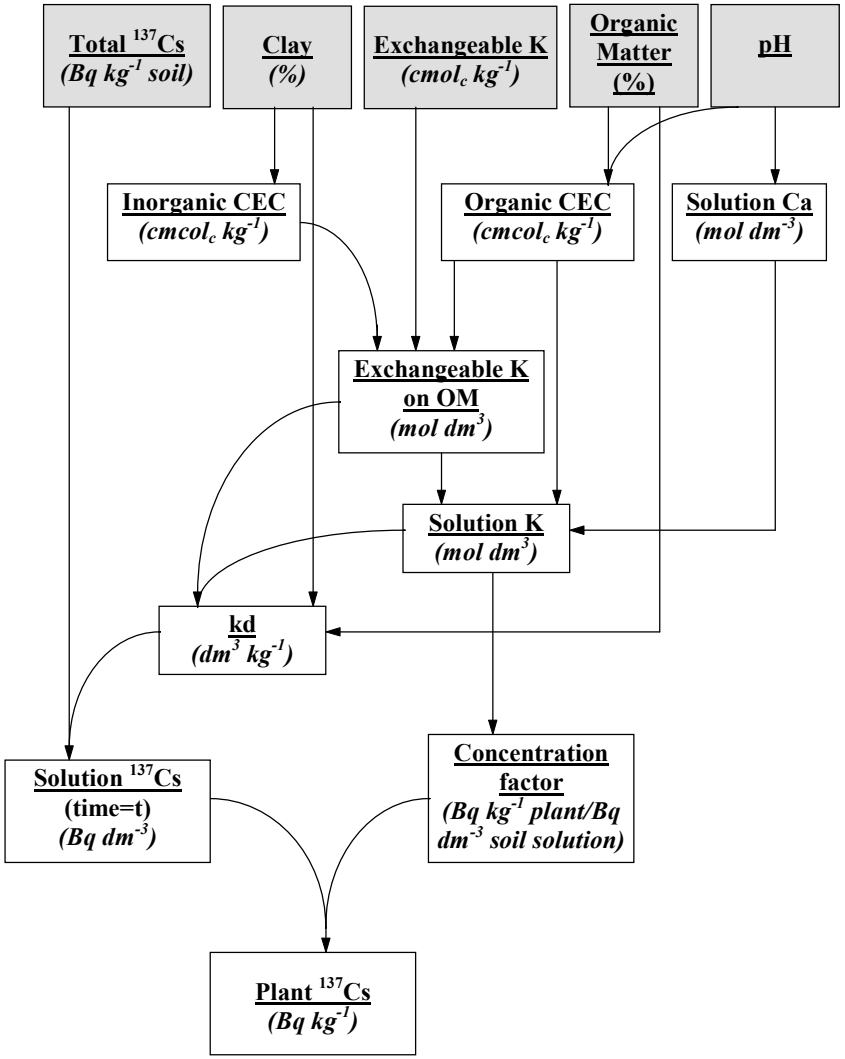








‘Absalom’ or ‘SAVE’ model



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

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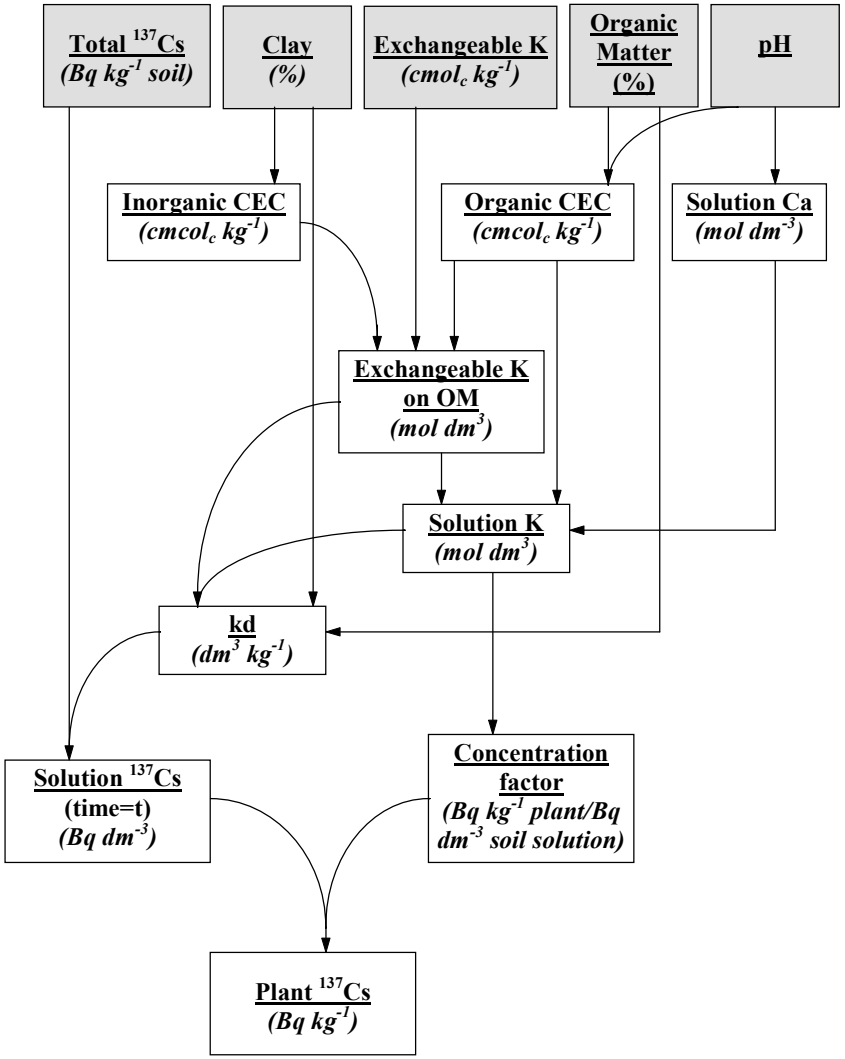
Absalom or SAVE model



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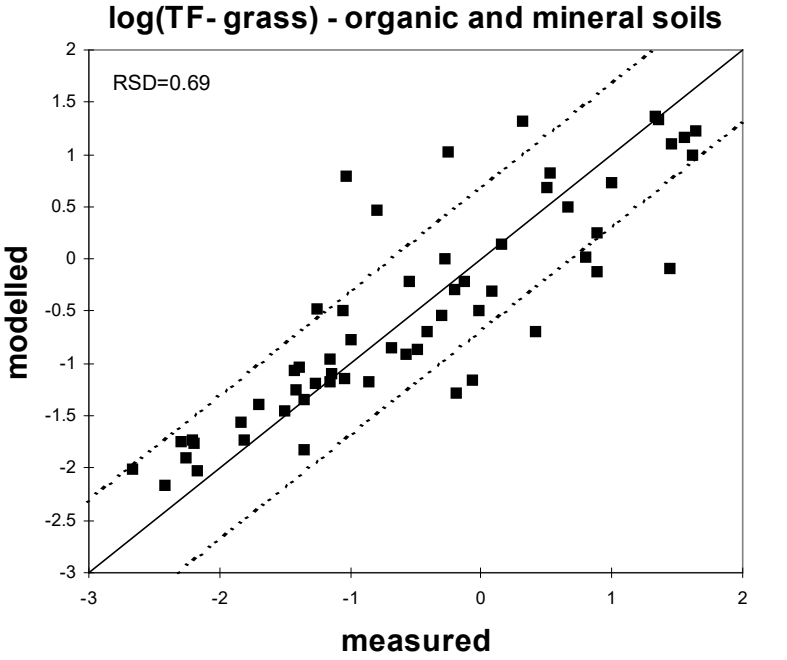
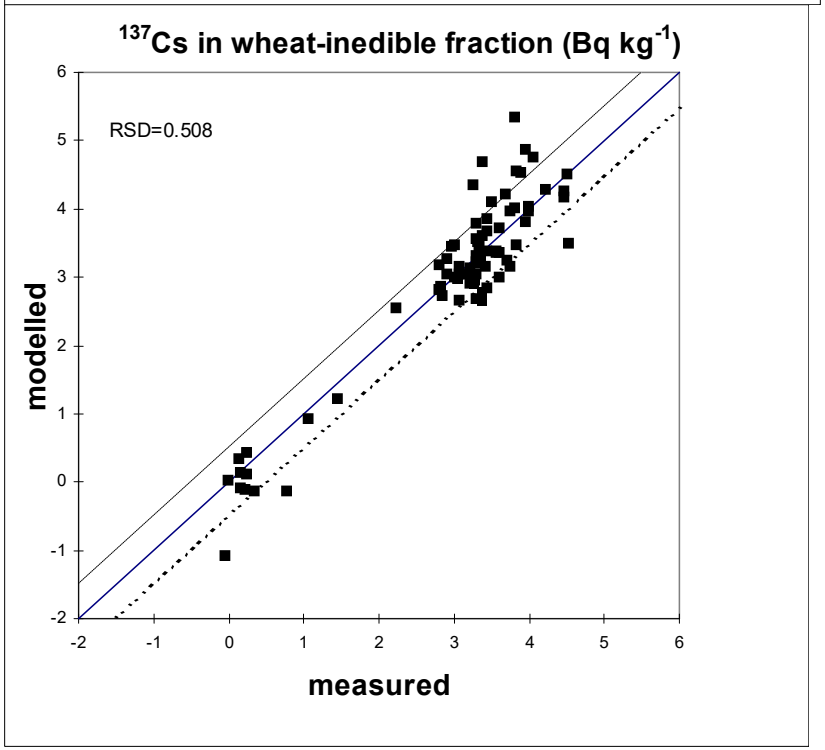
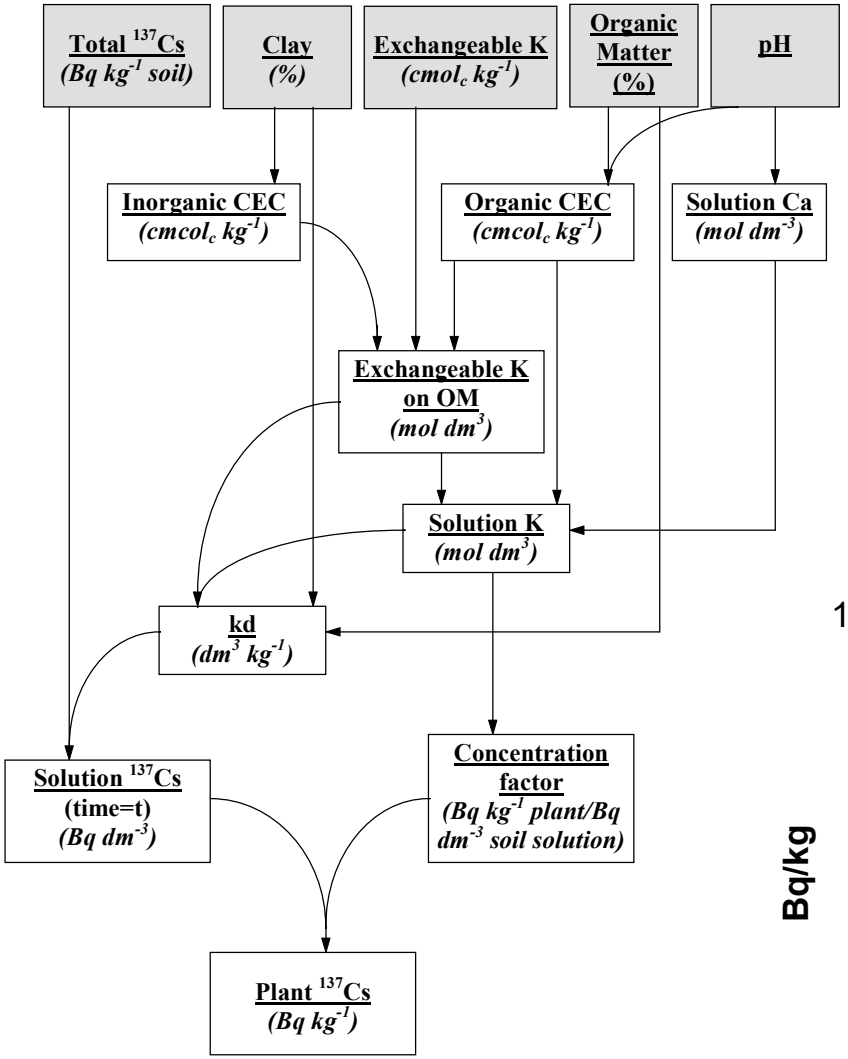




Absalom or SAVE model



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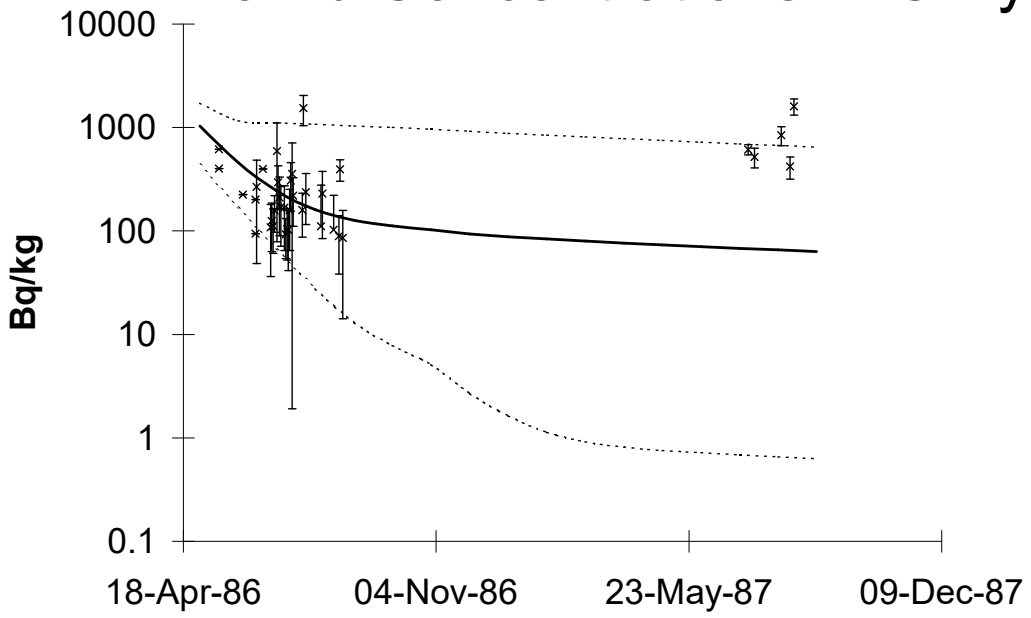
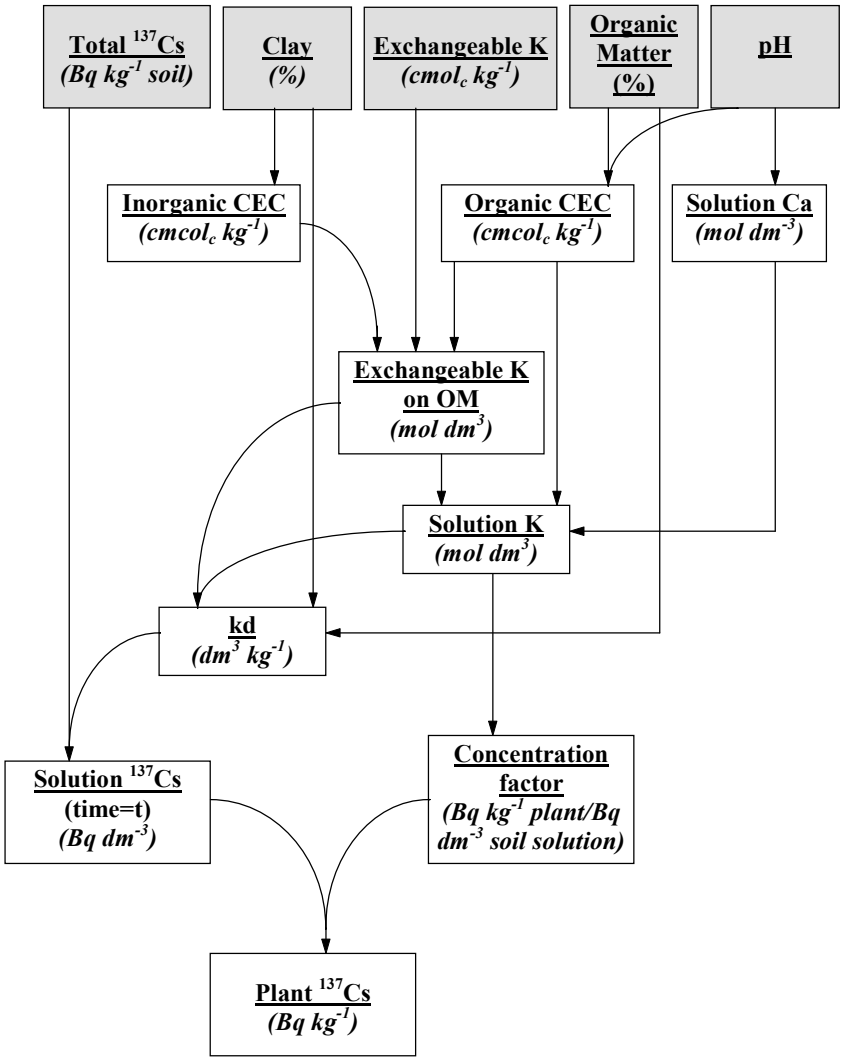
Lamb Concentrations in Clwyd



Absalom or SAVE model



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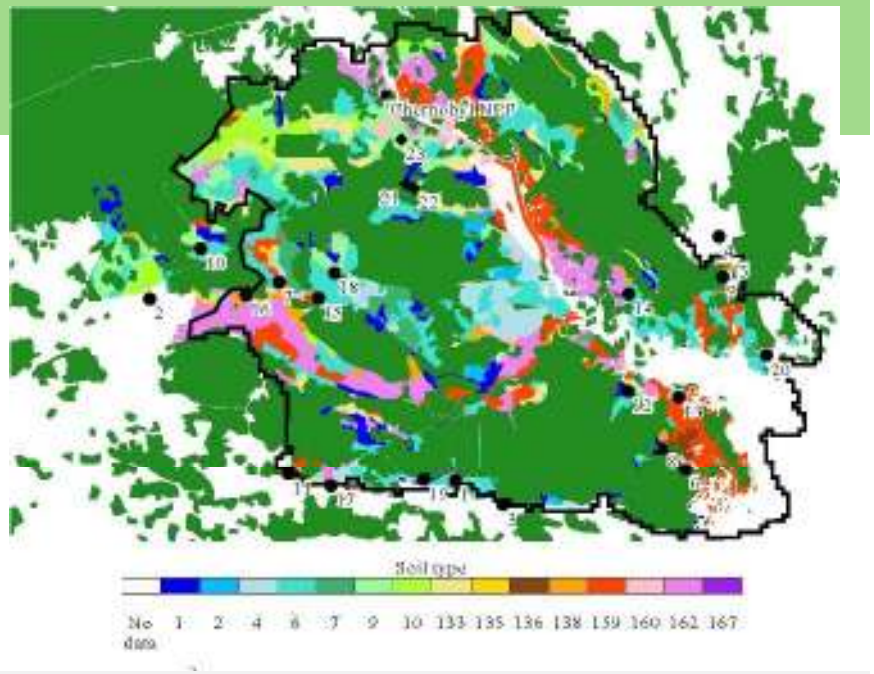
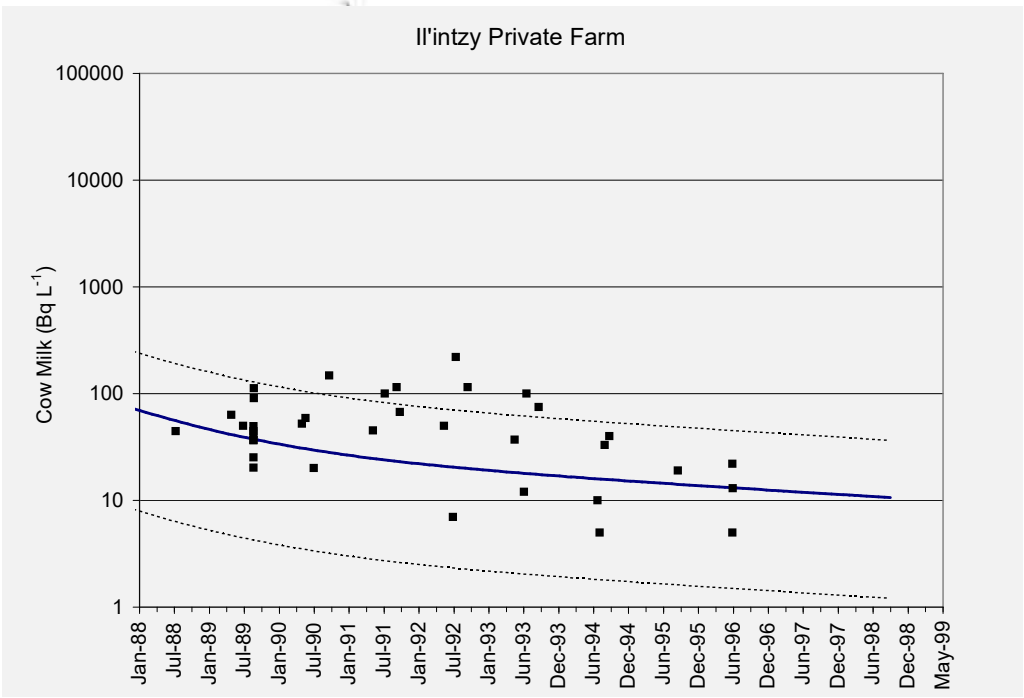
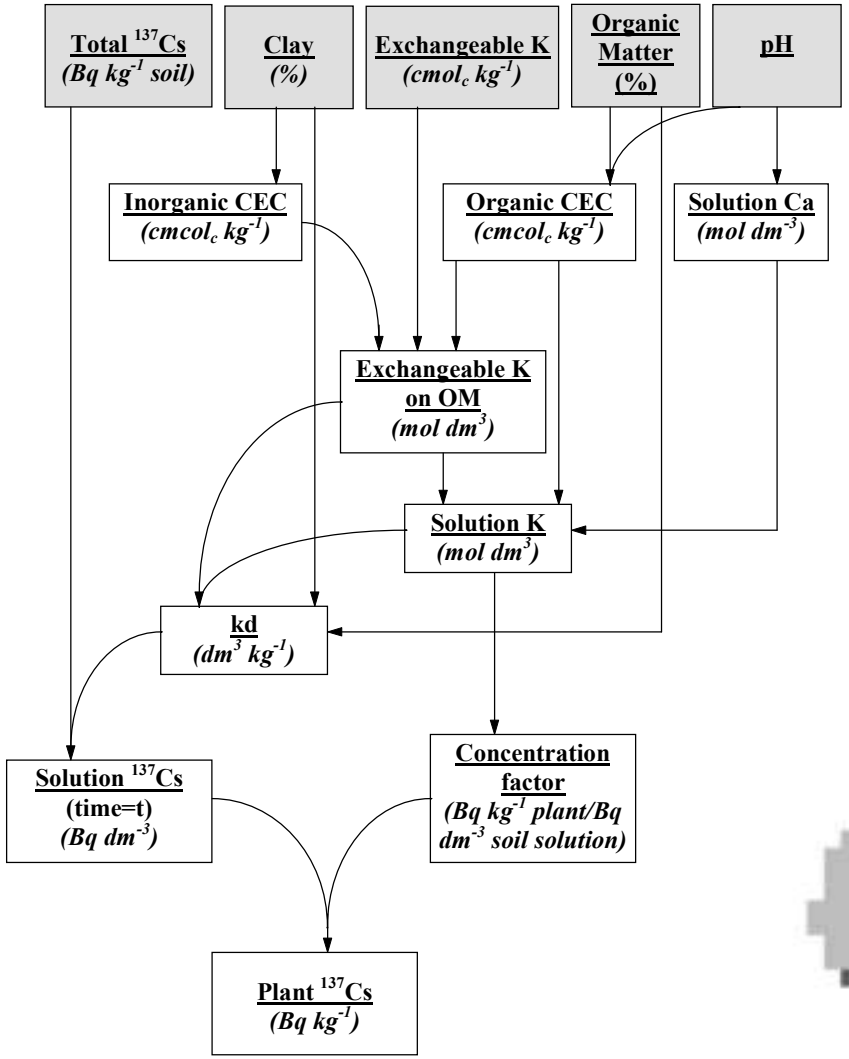




Absalom or SAVE model



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Journal of Environmental Radioactivity 83 (2005) 383–397
JOURNAL OF ENVIRONMENTAL RADIOACTIVITY
www.elsevier.com/locate/jenvrad

Identifying optimal agricultural countermeasure strategies for a hypothetical contamination scenario using the strategy model

G. Cox [a], N.A. Beresford [b], B. Alvarez-Farizo [c], D. Oughton [d], Z. Kis [e], K. Eged [e], H. Thørring [f], J. Hunt [g], S. Wright [b], C.L. Barnett [b], J.M. Gil [c], B.J. Howard [b], N.M.J. Crout [a,*]

Fig. 5. Spatial extent of skim and burial ploughing of pasture (left), clean feeding of sheep 12 months after deposition(centre) and AFCF administration to sheep 12 months after deposition (right). Dark areas indicate where the countermeasure is being applied.

….and then

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Can process based models reduce uncertainties?

Application of the Absalom model to Japanese soils
RIP predictions

RIP $|_{\text{Japanese clay}}$ ~ 1/3 x RIP $|_{\text{European clay}}$

Absalom + European soils → overestimation of RIP

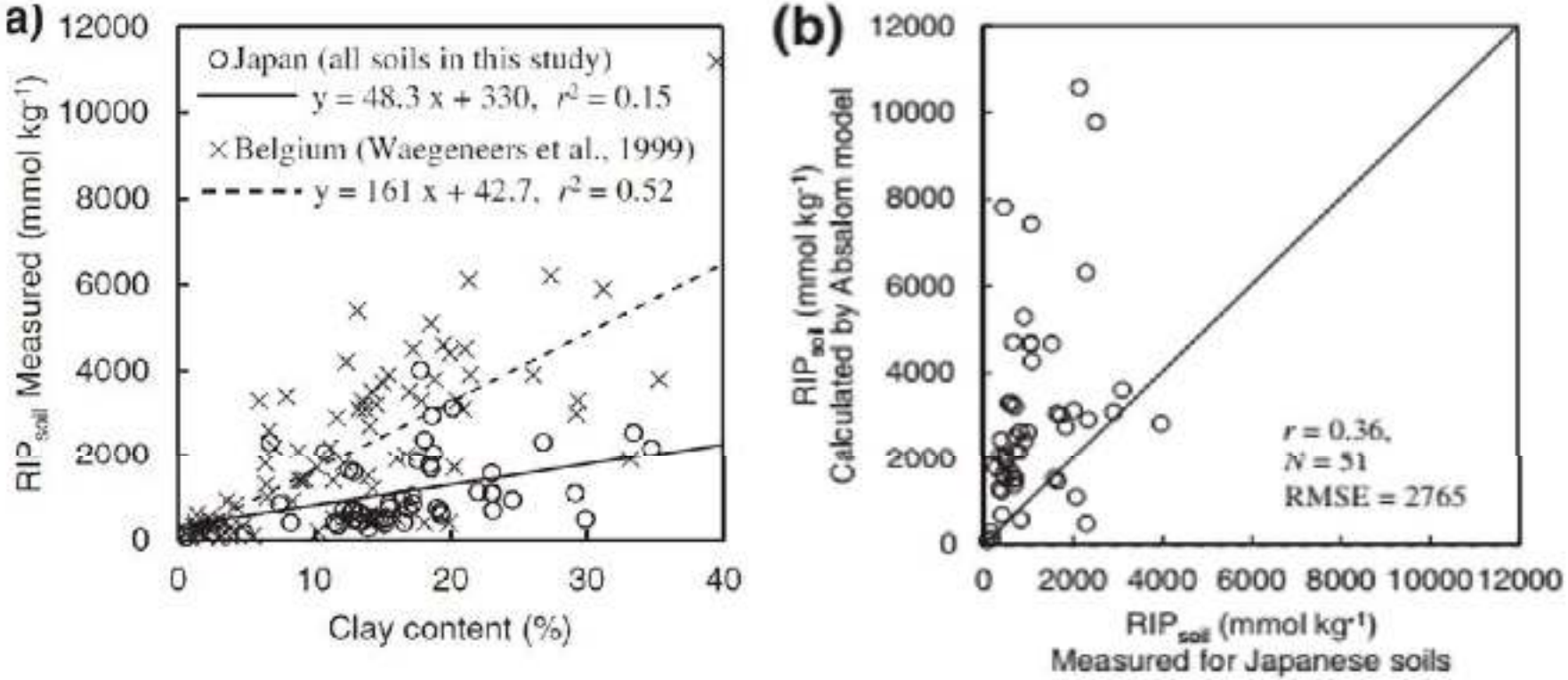

Fig. 2. The relationship between RIP_{soil} and soil clay content for (a) Japanese soils (this study, $N = 51$) and reported for Belgian soils (Waegeneers et al., 1999, $N = 88$)

Application of Absalom model would underestimate TF

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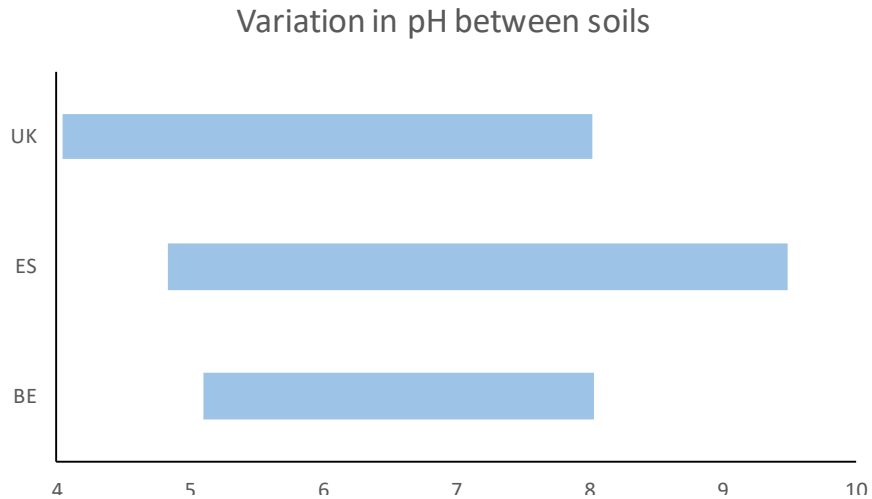
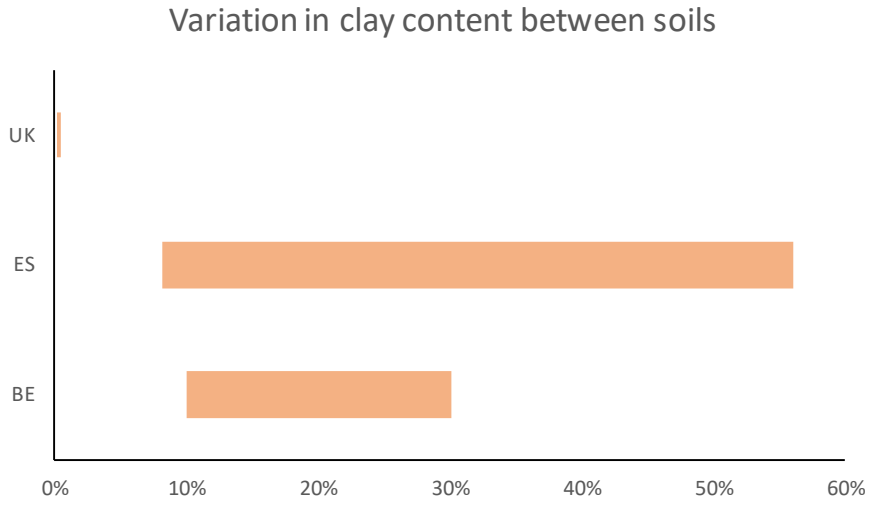
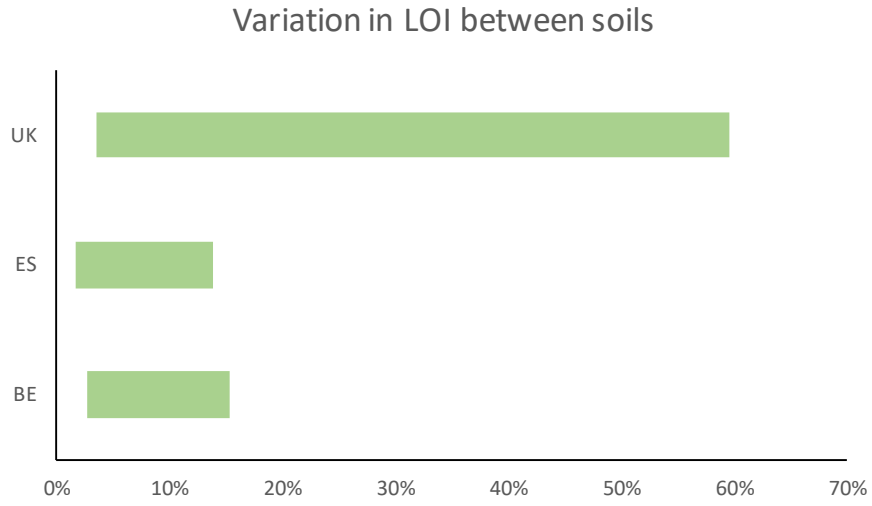
Experimental work
Soils

- Soils with a wide range of characteristics
- Different ecosystems (climate, landuse, crops, etc.)







Can process based models reduce uncertainties?

- *How about for Sr-90?*

Can process based models reduce uncertainties?

- *How about for Sr-90?*

Pergamon

Computers & Geosciences Vol. 20, No. 6, pp. 973–1023, 1994

0098-3004/94/$6700 + 0.00

0098-3004(94)E0016-M

WHAM—A CHEMICAL EQUILIBRIUM MODEL AND COMPUTER CODE FOR WATERS, SEDIMENTS, AND SOILS INCORPORATING A DISCRETE SITE/ELECTROSTATIC MODEL OF ION-BINDING BY HUMIC SUBSTANCES

E. TIPPING

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Can process based models reduce uncertainties?

- *How about for Sr-90?*

Solid—Solution Distributions of Radionuclides in Acid Soils: Application of the WHAM Chemical Speciation Model

EDWARD TIPPING,*,† COLIN WOOF,†
MICHAEL KELLY,‡
KEITH BRADSHAW,‡ AND
JANE E. ROWE‡

Parameter set
Soil solution pH
Barium chloride-extractable Na, Mg, K, Ca, NH_4, Sr
Copper chloride-extractable Al, Fe
Soil organic carbon/organic matter content Clay content
Oxalate-extractable Mn, Al, Fe

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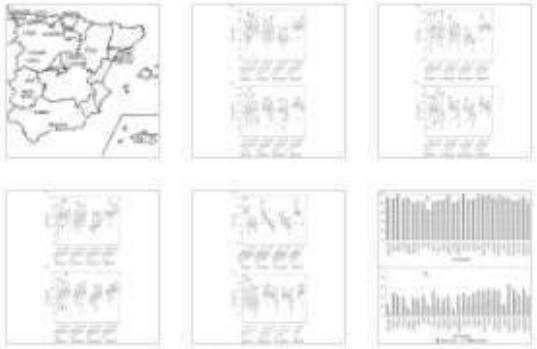
Test data

Outline

Show full outline

Figures (6)



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Applied Radiation and Isotopes

Volume 66, Issue 2, February 2008, Pages 126-138

Radionuclide sorption–desorption pattern in soils from Spain

C.J. Gil-García, A. Rigol, G. Rauret, M. Vidal

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https://doi.org/10.1016/j.apradiso.2007.07.032

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Corrigendum to "Radionuclide sorption–desorption pattern in soils from Spain" [...
Applied Radiation and Isotopes, Volume 67, Issue 2, February 2009, Pages 367

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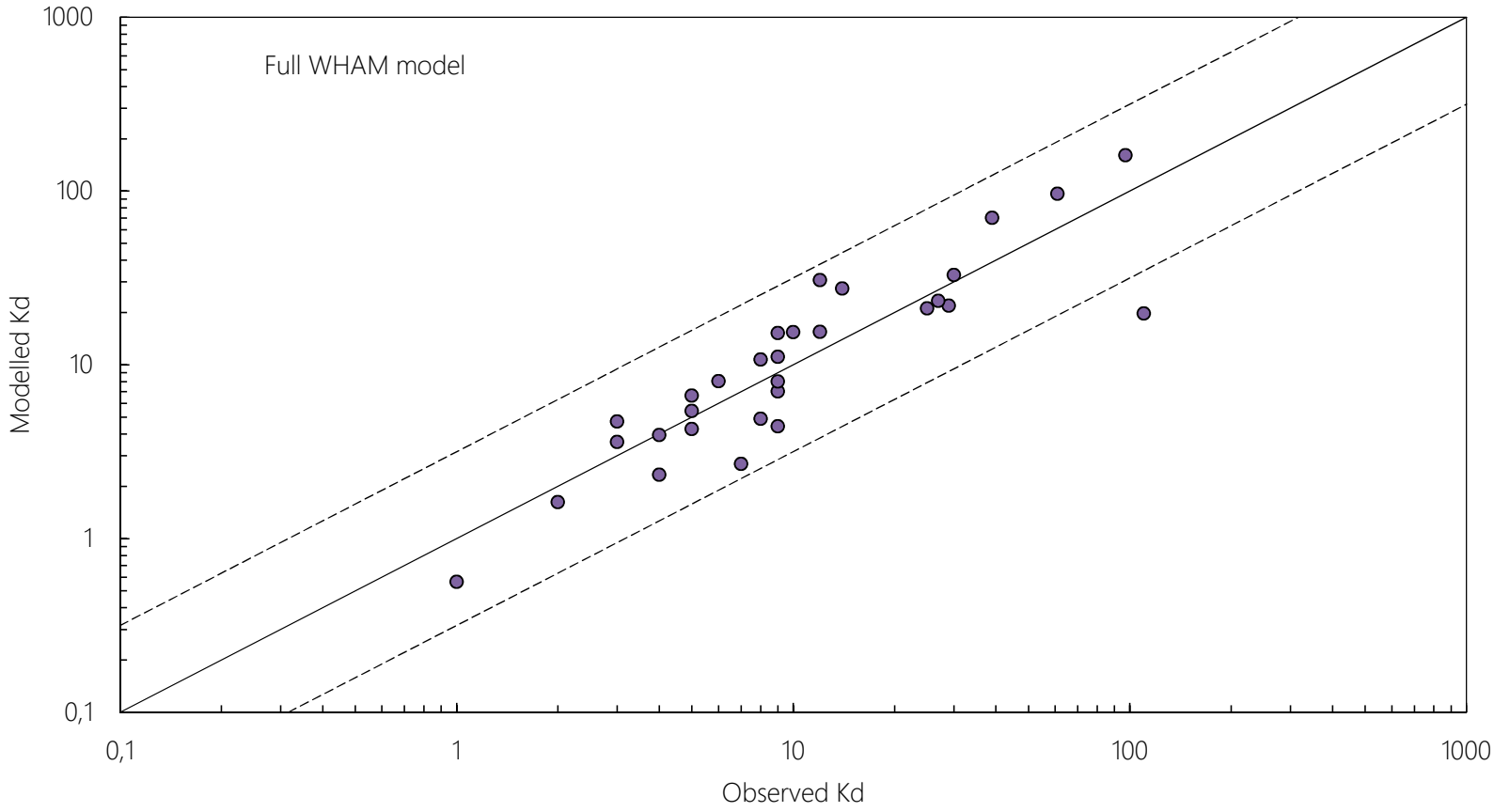
Abstract

The pattern of radiostrontium and radiocesium sorption–desorption was examined in 30 Spanish soils by the quantification of the distribution coefficients (K_d) with batch tests, the evaluation of sorption reversibility with a single extraction, the estimation of



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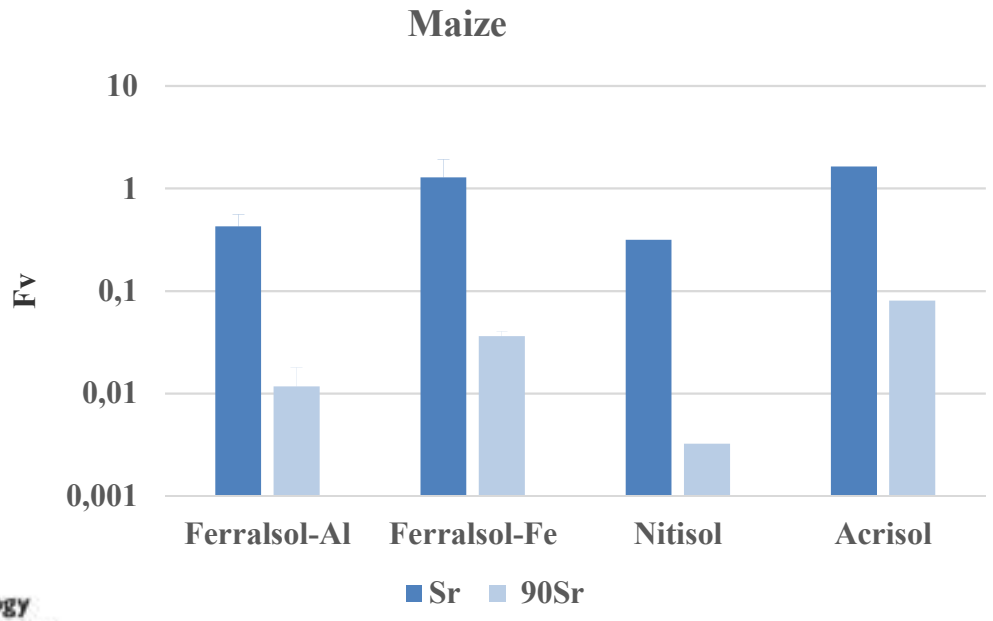
Plant uptake?



Wasserman et al. in-prep

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Plant uptake

(Some of the) Human food chain modelling within the CONFIDENCE project

https://portal.iket.kit.edu/CONFIDENCE/

….then a bit about source-sink for non-rads

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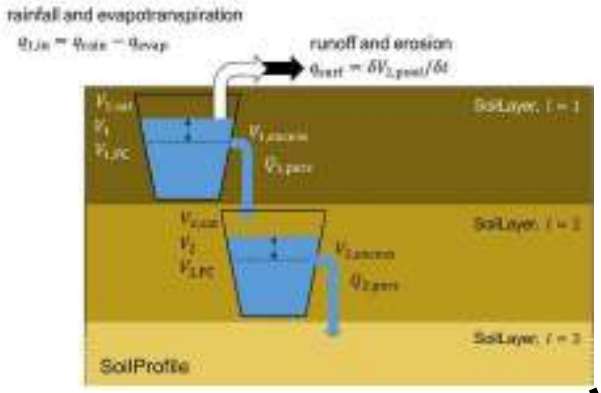
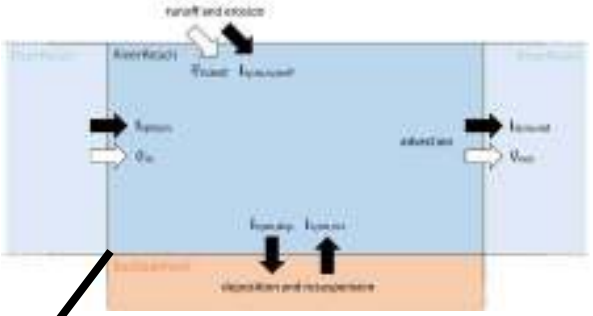
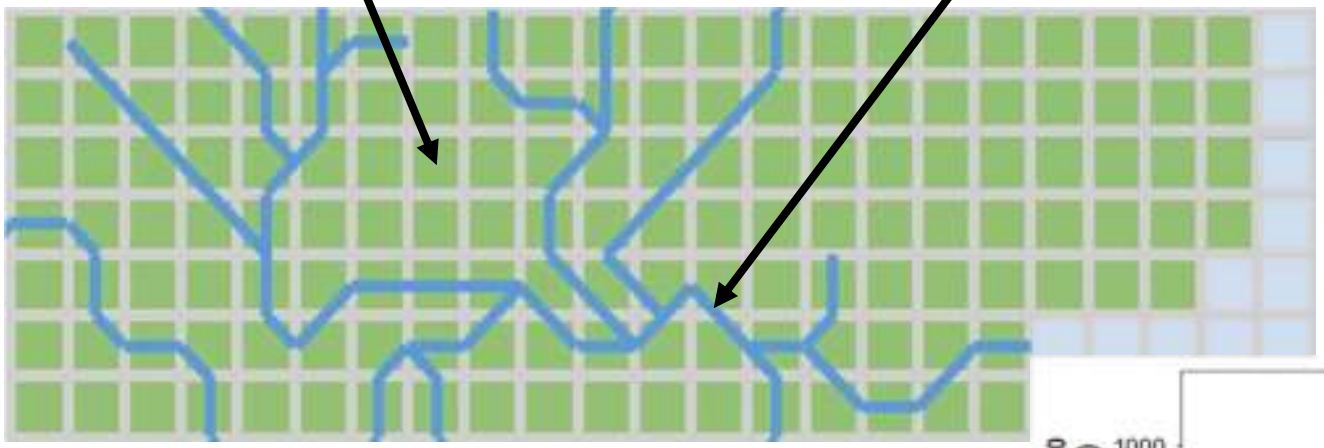
CEH Source to Sea modelling

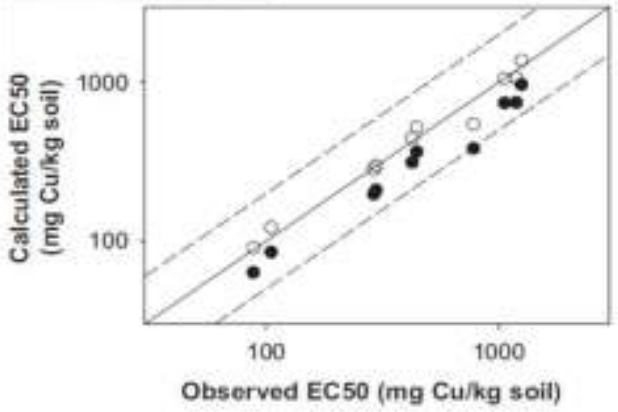
Soil

River









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Thank you