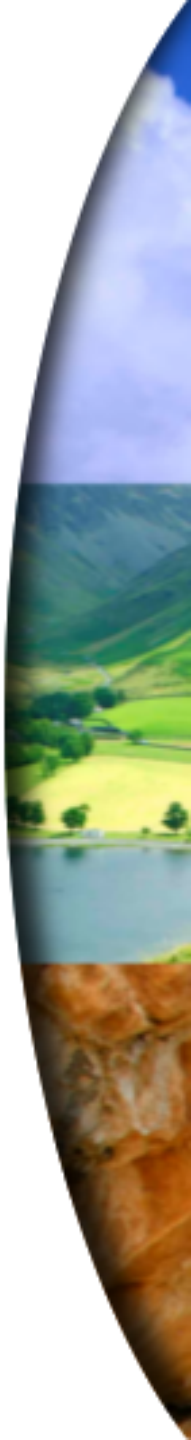

AMBER

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August 2012

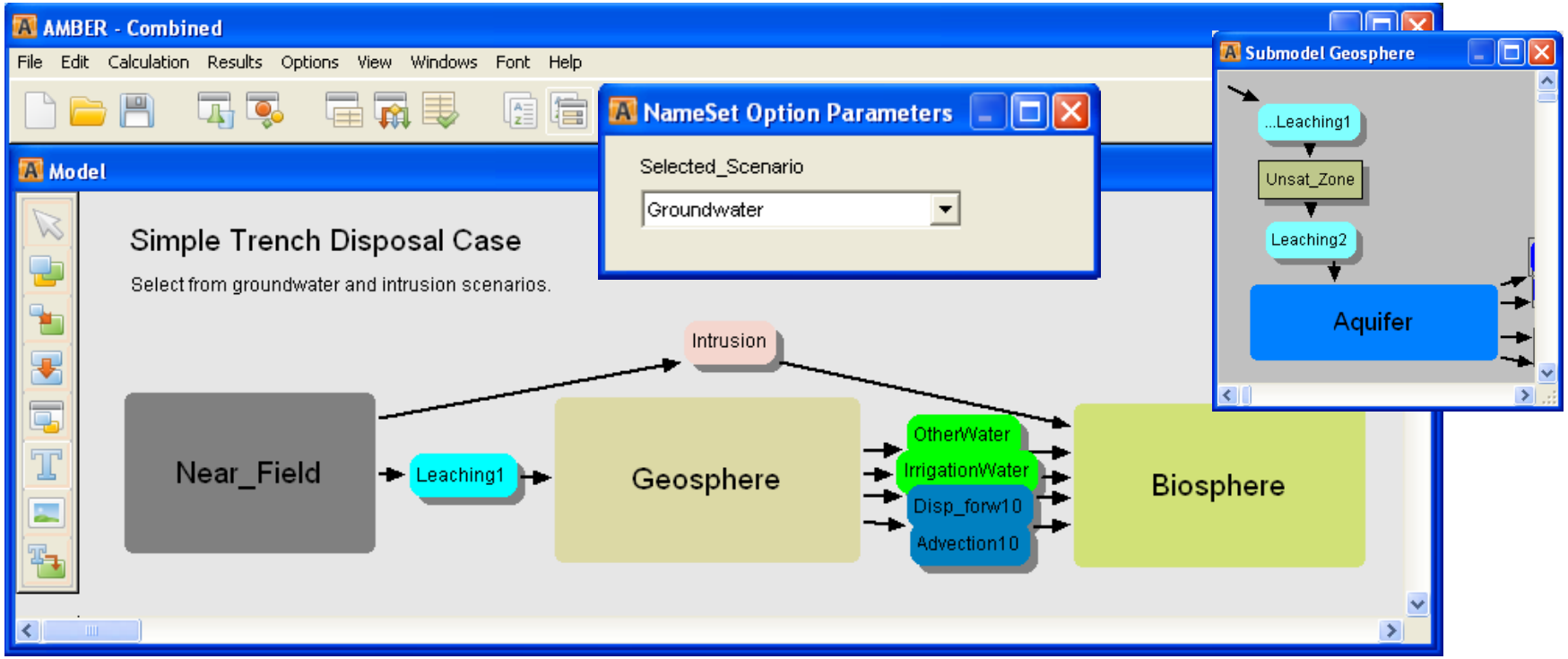
Quintessa

Outline

- What is AMBER?
- Philosophy
- Approach
- Flexibility
- AMBER and Quintessa
- Developments
- LLW Examples

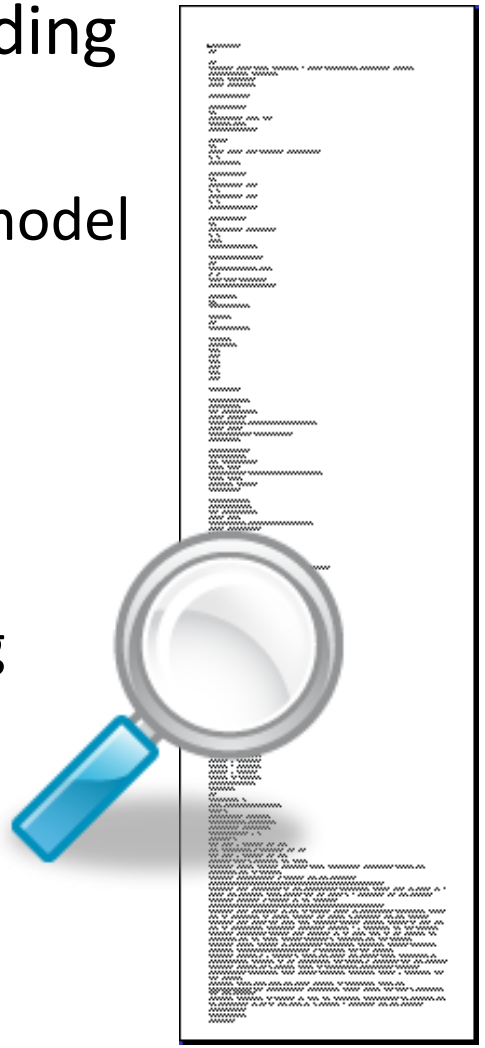
What is AMBER?

- Compartment modelling software
- Models trace contaminants in environmental systems
- Highly flexible, widely applicable
- Fast and robust solvers can model complex problems



AMBER: Philosophy

- Recognise importance of confidence building
- No ‘black box’ in-built models or data
  - User responsible for developing **their own** model
  - Encourages
    - Development of models that are appropriate
    - Transparent documentation of models and data
- Aim to provide maximum flexibility
  - Provide all tools necessary for implementing
- Transparency and auditability
  - Nothing is hidden
  - Text based files for comparison and QA

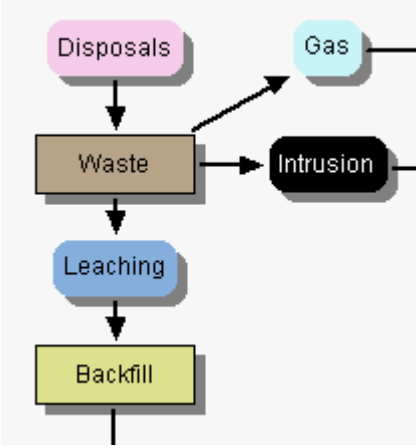


AMBER: Approach

- Discretise system into compartments and transfers
  - Use parameters to specify initial amounts, transfer rates etc.
  - AMBER solves for evolving amounts in compartments
  - Use parameters to calculate concentrations, doses, risks etc.
- Any number of user defined parameters
  - Data and expressions
  - Deterministic, probabilistic and/or time-dependent
  - Comprehensive range of mathematical functions
  - Efficient data handling via flexible indexing and ‘mapping’, e.g.
    - Mapping radionuclides to elements
    - Mapping compartments to ‘media’ (concrete, backfill, soil etc.)
- Comprehensive documentation, training and support
  - Including knowledge base of reports describing AMBER models

AMBER: Flexibility

- Can represent non-linearities
  - E.g. solubility limitation, irreversible sorption
- No limitations on size of model
  - Scoping through to regulatory applications
- Flexible 2D model layout
  - Can use sub-models to organise more complex systems



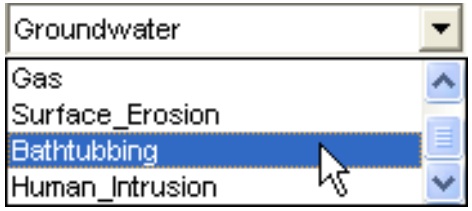
- Interface with other codes
  - Can import/export data with a range of layouts

TOUGH2 →

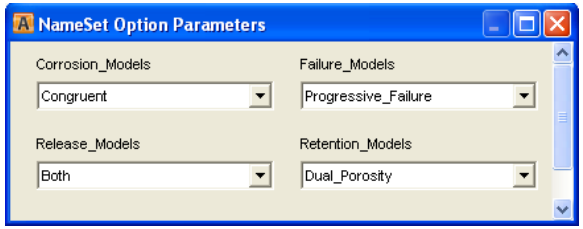
- Can be driven externally
  - Run in batch mode with full range of commands
  - Use as a transparent 'engine' behind other codes

AMBER: Uncertainty

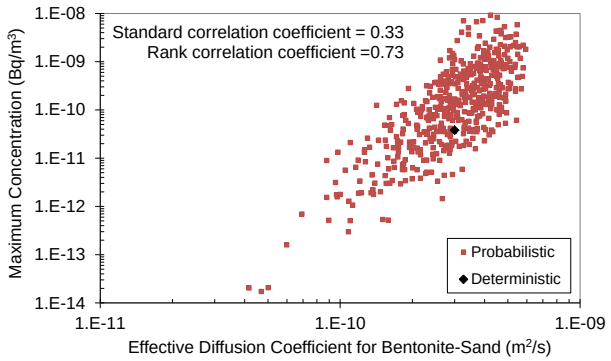
- Scenario uncertainty
  - Data and models for different scenarios can be included in one case
  - Efficient for cases with common inputs and models



- Model uncertainty
  - Flexibility to implement different models
  - Units 'awareness' provides confidence



- Parameter uncertainty
  - Full Monte Carlo or Latin hypercube
  - Full or partial sampling
  - Multiple deterministic runs

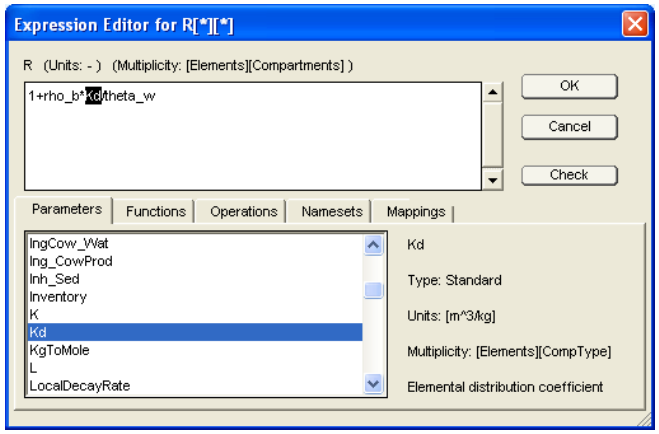


AMBER and Quintessa

- Quintessa:
  - UK and Japanese scientific consultancy
  - Employee owned, long term stability
  - Safety assessment, decision support, maths and software
- AMBER is software product and a consultancy tool
  - We sell and support licences
  - We also develop it for our own use
- Committed to long-term support
  - Focus on PA and safety assessment
  - On-going development and annual releases
    - Continuing to invest
  - Accredited software development process

AMBER: Developments

- Recent
  - Expression editor
    - Greater ease of development and checking of expressions
  - Annotation of data/expression entries
    - Aids transparency and QA checking
- Forthcoming
  - Self-referencing parameters
    - E.g. facilitates simple water-balance calculations
  - History files
    - Full track of case file development
  - Multi-platform interface



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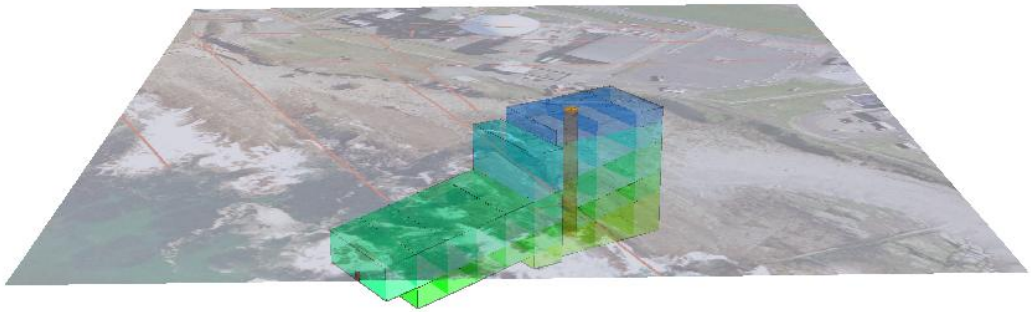
AMBER: LLW Examples

- IAEA
  - ISAM cases and training
  - Waste acceptance criteria
- UK
  - Dounreay LLW, VLLW, LLW Pits
  - Hunterston near-surface graphite
  - LLWR 2002 Safety Case
- Canada
  - OPG assessment of options
  - DGR licence application
- Sweden
  - SFR near-surface L&ILW facility
- Italy
  - National siting for surface facility
- Japan
  - Rokkasho surface LLW facility
- China
  - Nuclear Safety Centre assessments
- Russia
  - RADON near-surface facilities
- Lithuania
  - Near-surface LLW facility
- Slovenia
  - Assessment of options
  - L&ILW silo
- Romania
  - Baita Bihor geological LLW facility
- South Africa
  - Pelindaba surface LLW facility

Thank you for your attention



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