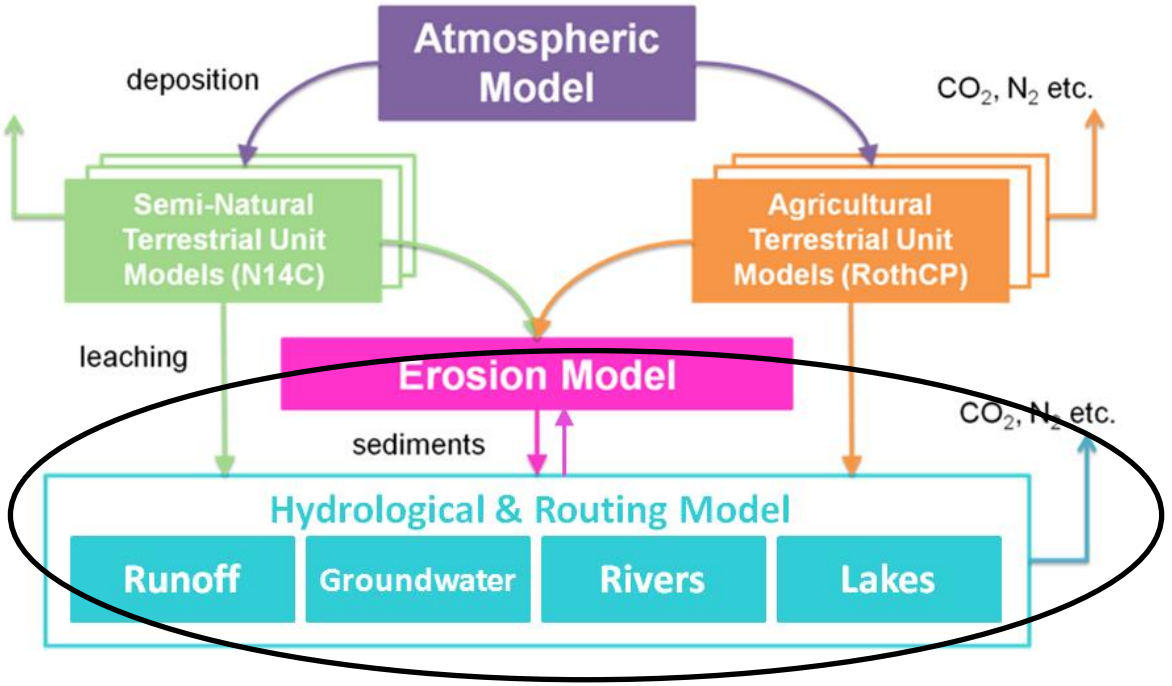
LTLS: PROGRESS ON THE INTEGRATED MODEL

Vicky Bell & Pam Naden

with thanks to Helen Davies, Steve Cole, Alison Kay, Jess Davies, John Quinton, Shibu Muhammed, Andy Whitmore, Ed Tipping, Ed Rowe



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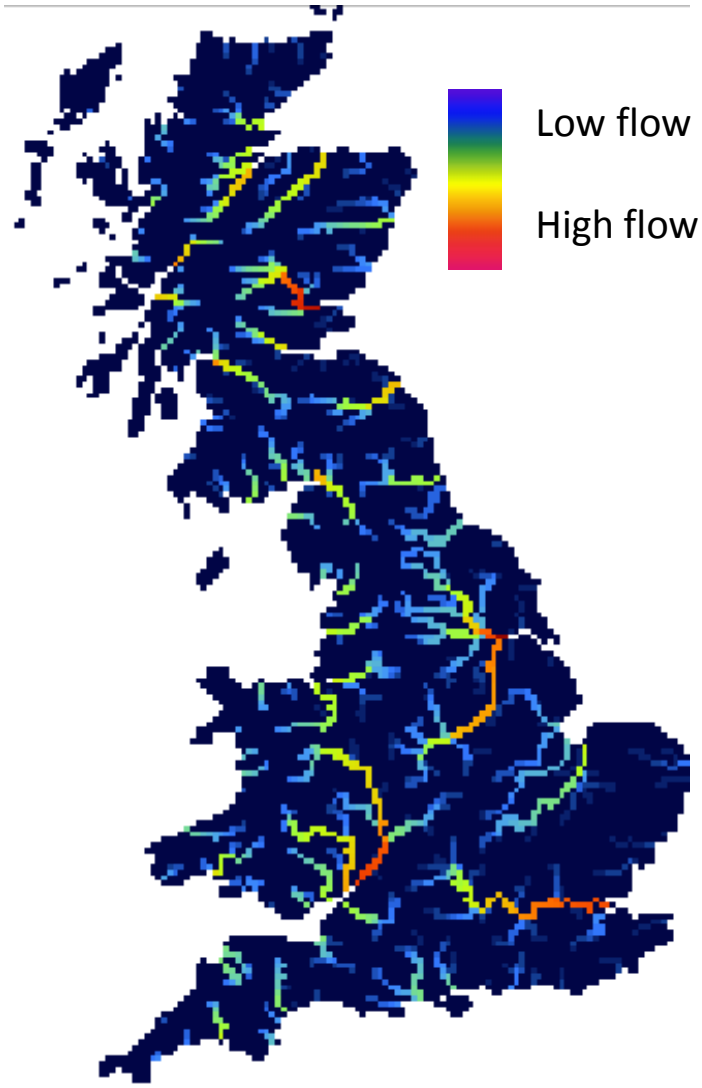
LTLS: Integrated Model (IM)

- A simple grid-based hydrological model similar to the G2G forms the basis for the IM representation of the landscape required for the LTLS.

- It provides estimates of river flow and runoff (surface and subsurface) and soil moisture on a regular grid across the UK (and Europe).

- The IM had no pre- existing capability for modelling nutrients, lakes and land-cover (apart from urban/suburban effects on downstream flows). This capability has been built-in specifically for the LTLS.

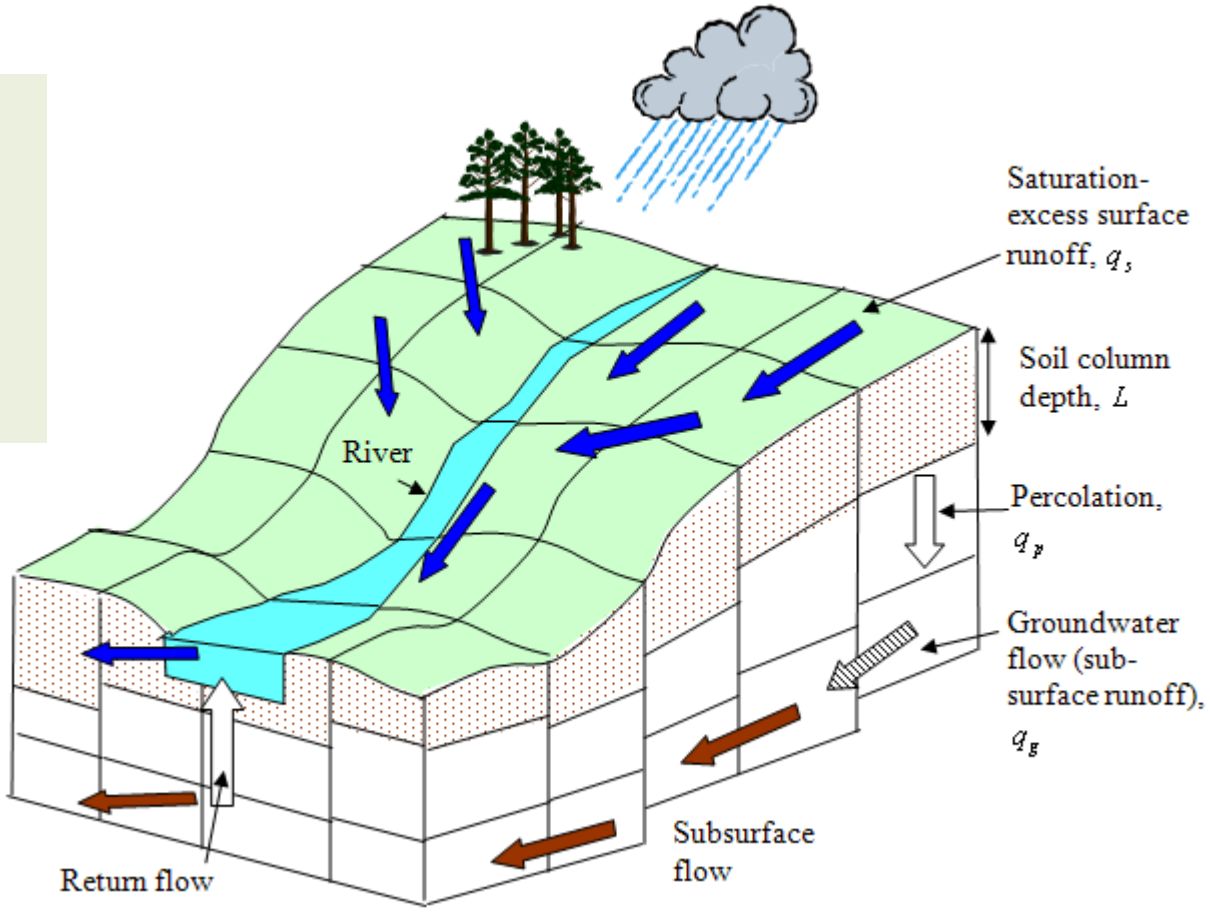
- The LTLS Integrated Model is configured on a 5km grid using spatial datasets for terrain (provides slope, elevation, flow direction), soils and takes as input gridded time-series estimates of rainfall and potential evaporation (PE).



Integrated Model (IM)

Hydrological model behind IM incorporates some basic properties of:

- soil
- land cover
- topography



For prototype:

- ❑ Model driven by daily 5km rainfall, daily 5km temperature, monthly PE (MORECS, 40km)
- ❑ Simple estimation of water temperature from air temperature based on relationship developed for hourly data for River Exe by Webb et al (2003)

LTLS: Progress building the integrated model...

WP4: Terrestrial models

C-N-P Cycling in plant-soil terrestrial units

Semi-natural areas: N14CP MODEL OUTPUT provided

Agricultural areas : Simplified output implemented in prototype

Soil erosion and delivery – *New Code in IM*

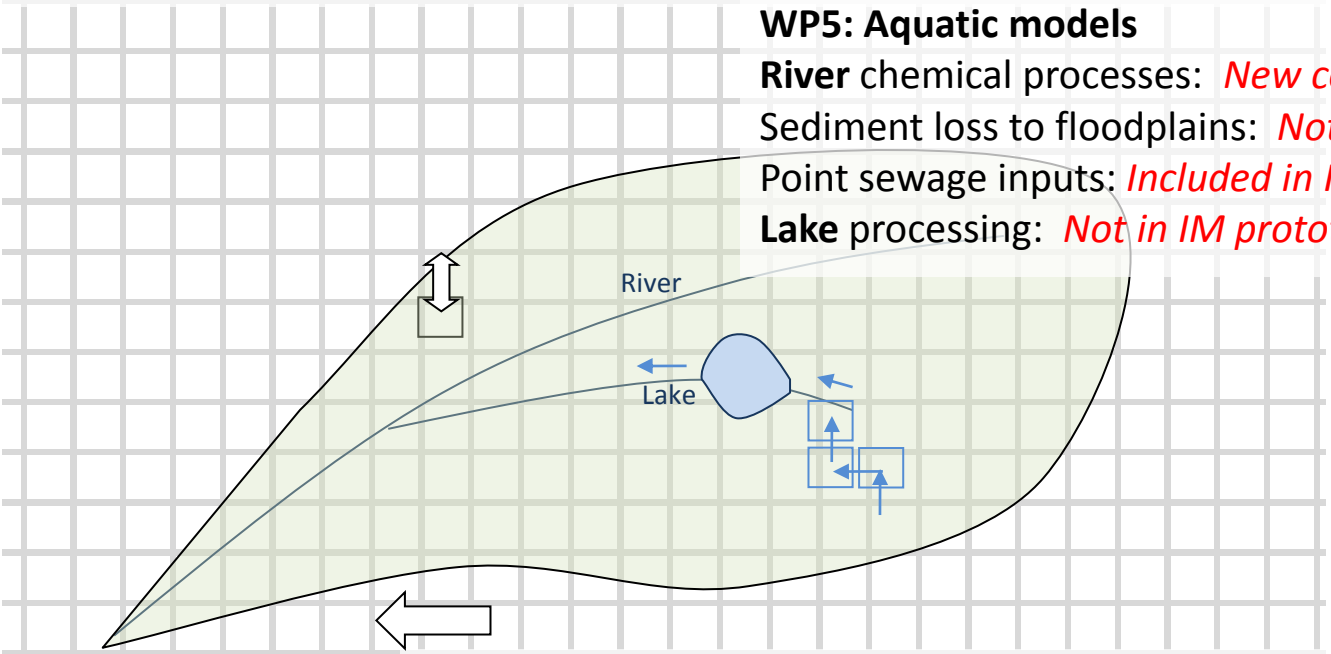
WP5: Aquatic models

River chemical processes: *New code in IM*

Sediment loss to floodplains: *Not in IM prototype*

Point sewage inputs: *Included in IM*

Lake processing: *Not in IM prototype*



WP5: Groundwater fluxes of N

Recharge from IM will form input to BGS groundwater nitrate (time-delay) model. Output from BGS to feed back into subsurface river pathways: *GW time delays received but not implemented*

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LTLS: Building the integrated model (IM)

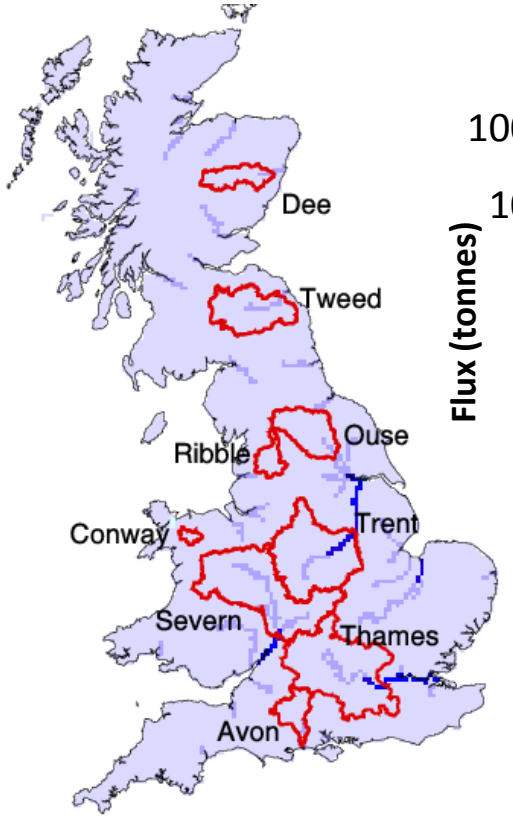
- Spatial resolution: $\Delta x = 5.0\text{km} \rightarrow \Delta t = 2\text{hr}$

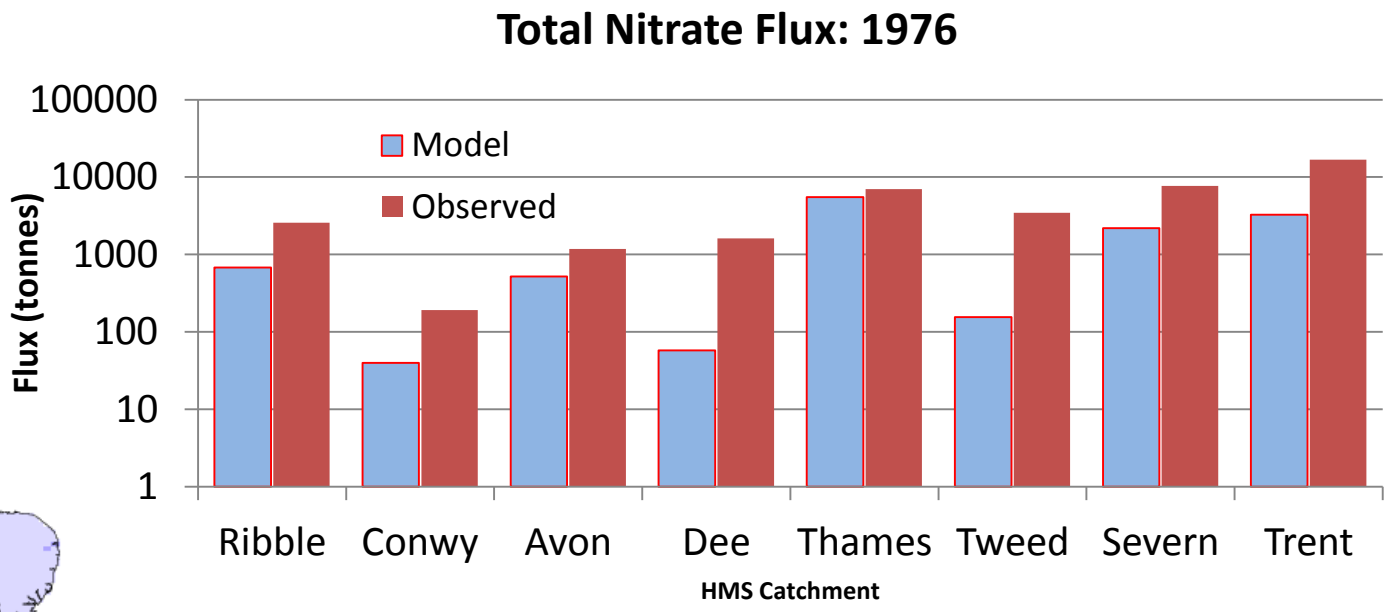
- The prototype is tested/driven by observed data from 1971 – 2007 on UK mainland

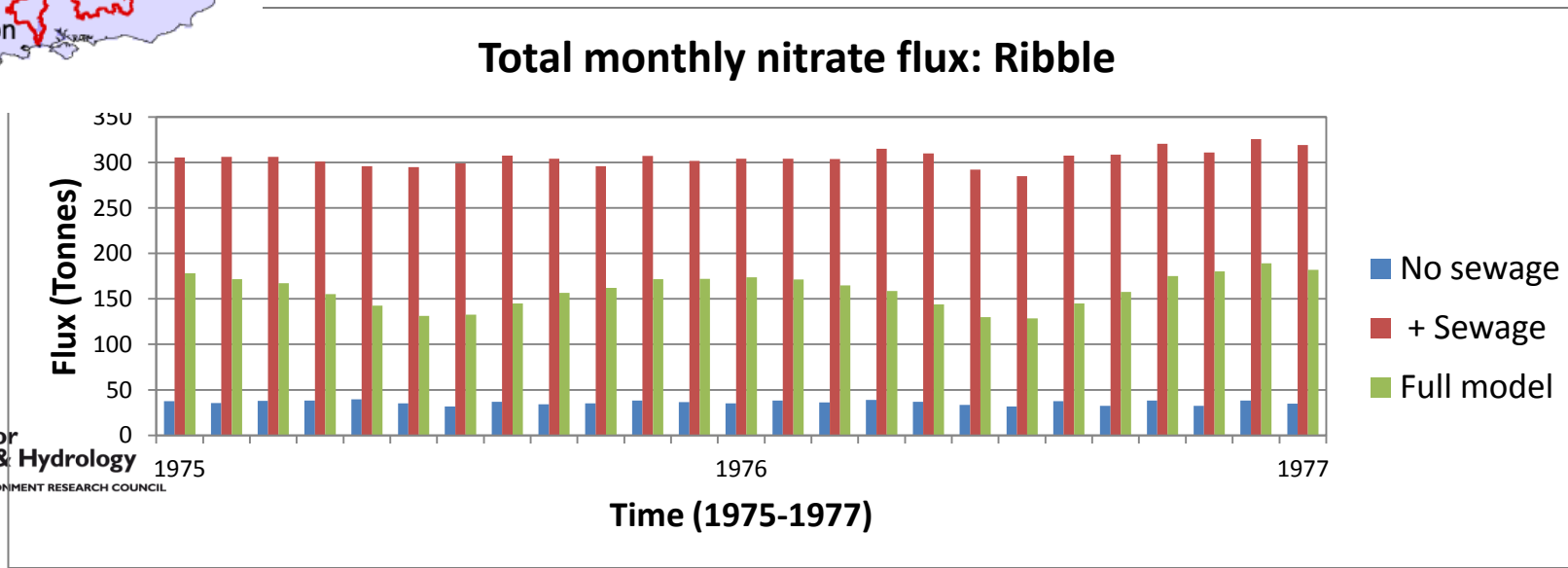
- Each 5km UK pixel (area 25km^2) can contain several land-cover types (agriculture, semi-natural, improved grassland, bare soil, urban, water)

- Modelled variables:
  - 10 dissolved nutrients (DIC, DOC, nitrate, ammonium...) ✓
  - 12 particulate nutrients (fine sediment, POCNL, PONL,...) ✓
  - + pH, O_2, algae, macrophytes, water temperature
  - + gaseous outputs from river model ✓

Annual/monthly fluxes for selected catchments:







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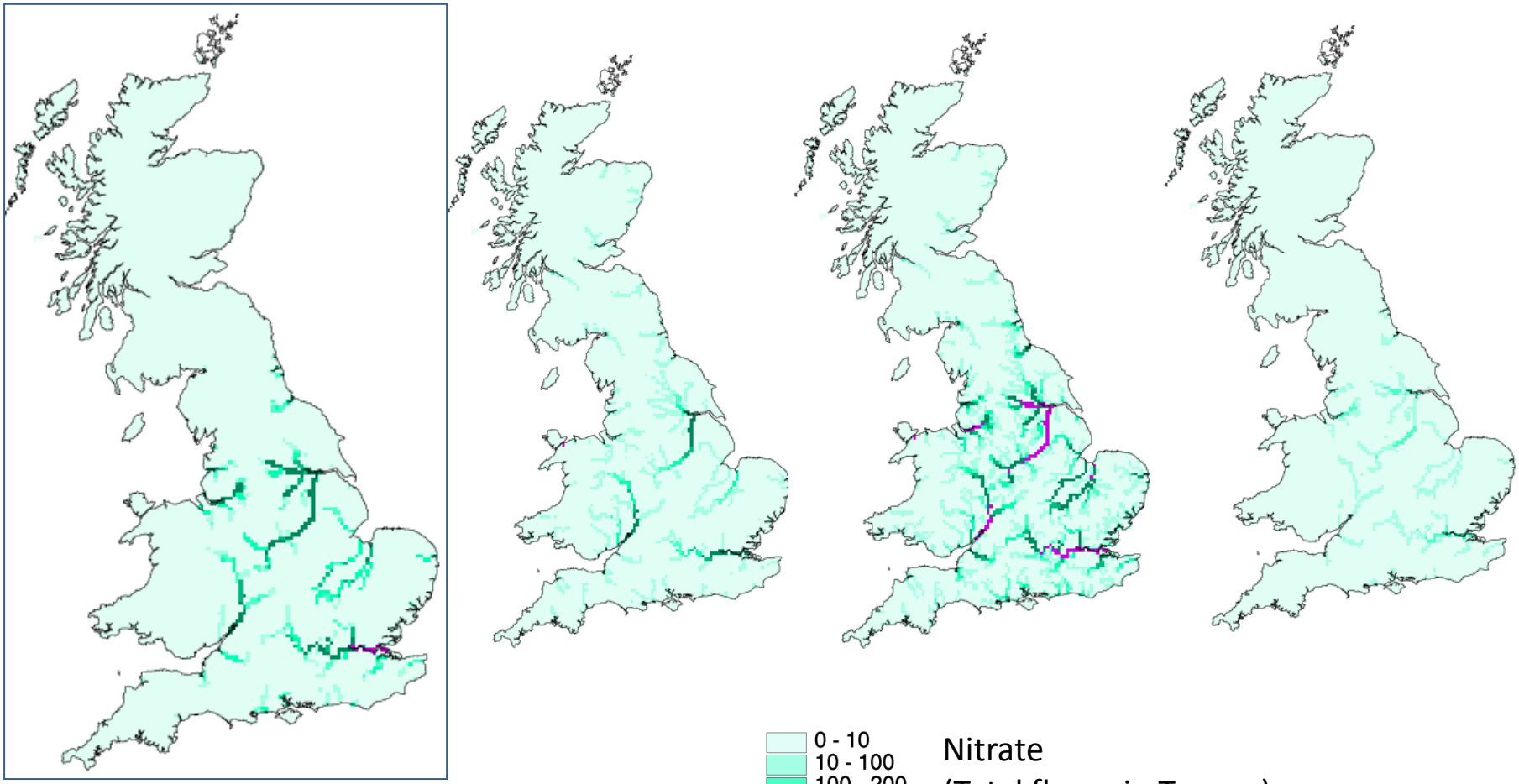
Example model output: nitrate fluxes (tonnes)

January-March 1976 totals

Total river flux **Flux from land** **Flux + sewage** **- N gas loss**



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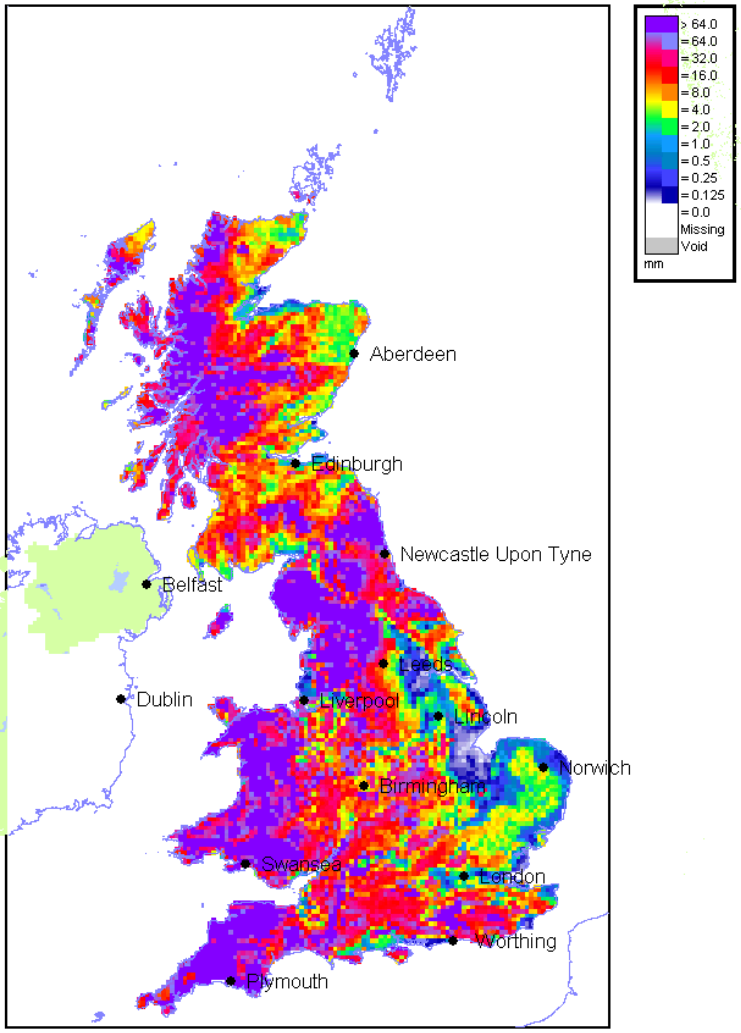
Prototype animated display using HYRAD

Surface runoff



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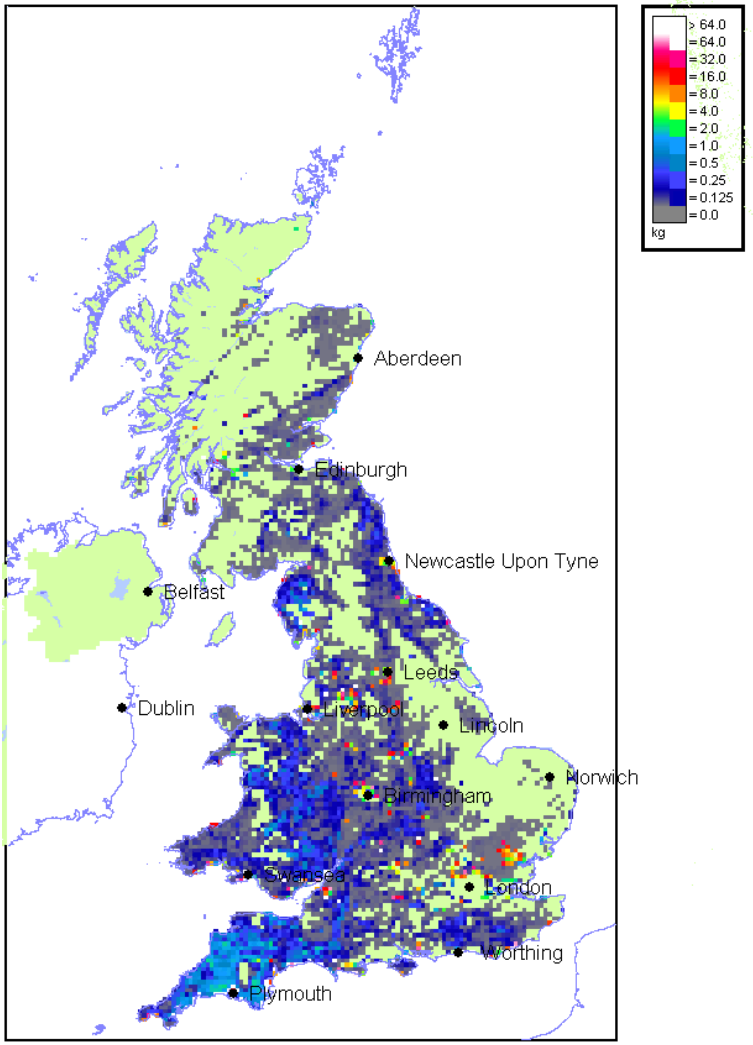
Erosion



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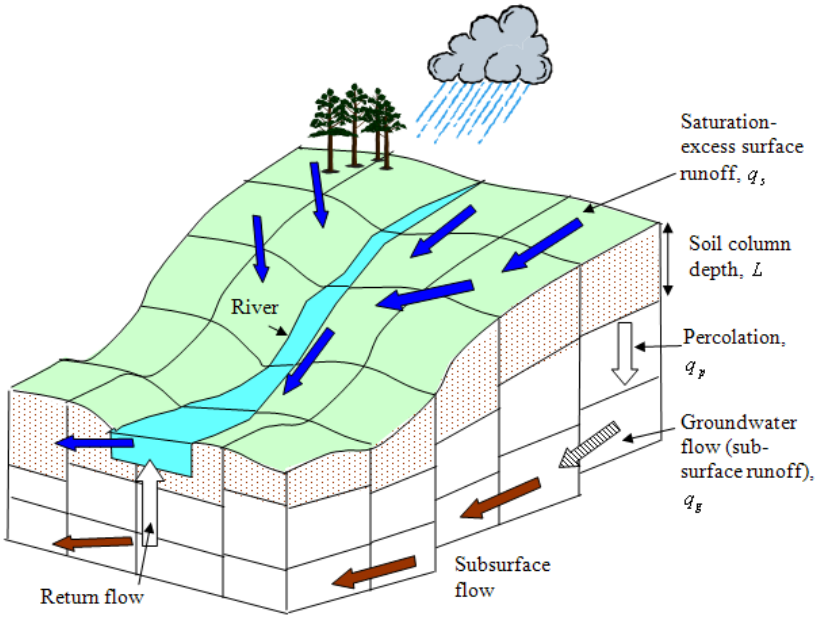
Summary and Next Steps:

- The prototype IM has been implemented on a 5km resolution across the UK
- Model run time for 1 year = 1 hour
- Modelled variables:
  - 10 dissolved nutrients (DIC, DOC, nitrate, ammonium...)
  - 12 particulate nutrients (fine sediment, POCNL, PONL,...)
  - + pH, O_2,algae, macrophytes, water temperature
  - + gaseous outputs from river model
- **Present prototype to stakeholders for feedback (Spring 2014)**
  - **Explore scenarios**
- **Complete IM version 2 (Autumn 2014).**
  - **Improve estimates of nutrient fluxes from agricultural land**
  - **Include lake processes**
  - **Sediment loss to floodplain**
  - **Groundwater fluxes**
- **IM run from 1800 to present day/future scenarios using historical/possible future driving data**

Any questions?

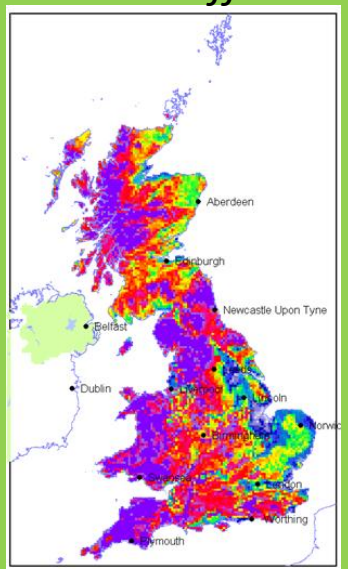
• LTLS Integrated Model (IM)

- **Spatial resolution**: Δx =5.0km → Δt= 2hr
- Prototype tested on observed data from 1971 – 2007 on UK mainland
- **Modelled variables**:
  - 10 dissolved nutrients
  - 12 particulate nutrients
  - pH, O_2,algae, macrophytes, water temperature
  - Gaseous outputs from river model

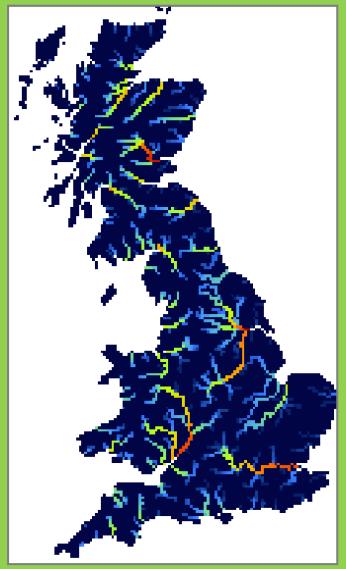


Example model output:

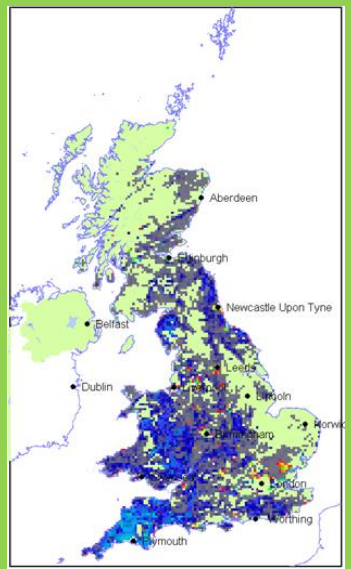
Runoff



Flow



Erosion



Nitrate