Environmental Virtual Observatory Pilot

The Environmental Virtual Observatory (Pilot): A new vision for Catchment Science

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Realising the potential of environmental data, models and tools

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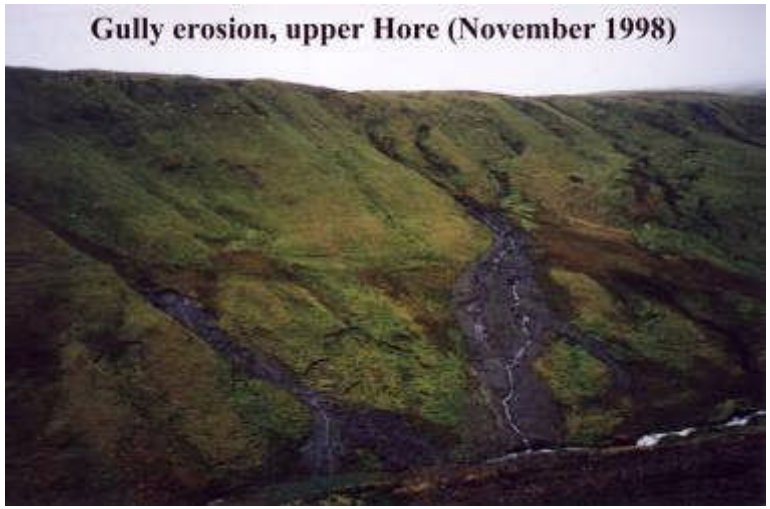
Challenges in catchment science

- We are facing unprecedented challenges in the management of soil and water.
- Our research increasingly also has real practical application.
- However, many scientific and environmental challenges are very cross-disciplinary, and require use of multiple data, models and visualisation tools across disciplines, organisations and topics.



Solutions?

- Is there are a way of providing the ‘wiring’ to help people access what resources they need, be they a scientist, policy maker, industrial body, regulator or public?

- Resources would have to go beyond data (not that useful to most people)…. so models and tools (visualisation, decision support and valuation)

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What are the opportunities offered by new cloud technologies?

- They offer a way to connect and integrate our current fragmented data, models and knowledge.
- The key to the cloud approach is the representation of everything as a service, that is our data, models, visualisation tools and expert knowledge.
- And then to view the cyber-infrastructure as a “cloud” of services out there that can be used and combined in arbitrary ways, in this case to solve environmental questions.

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HOLY GRAIL OF INTEROPERABILITY

Realising the potential of environmental data, models and tools

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28 October 2010 Last updated at 10:53

Big name firms form alliance to drive cloud standards

By Maggie Shiels
Technology reporter, BBC News, Silicon Valley

Some of the world's biggest companies are using their market clout to demand that computer equipment makers change the way they make their machines.

The 70 firms, which includes BMW, Shell and Marriott Hotels, said systems that do not work together are holding back the spread of cloud computing.

Intel referred to the launch of the Alliance as "Cloud Independence Day"

The companies have formed the Open Data Alliance Centre to push for unified standards for technology.

The businesses involved account for more than $50bn (£32bn) in IT spending.

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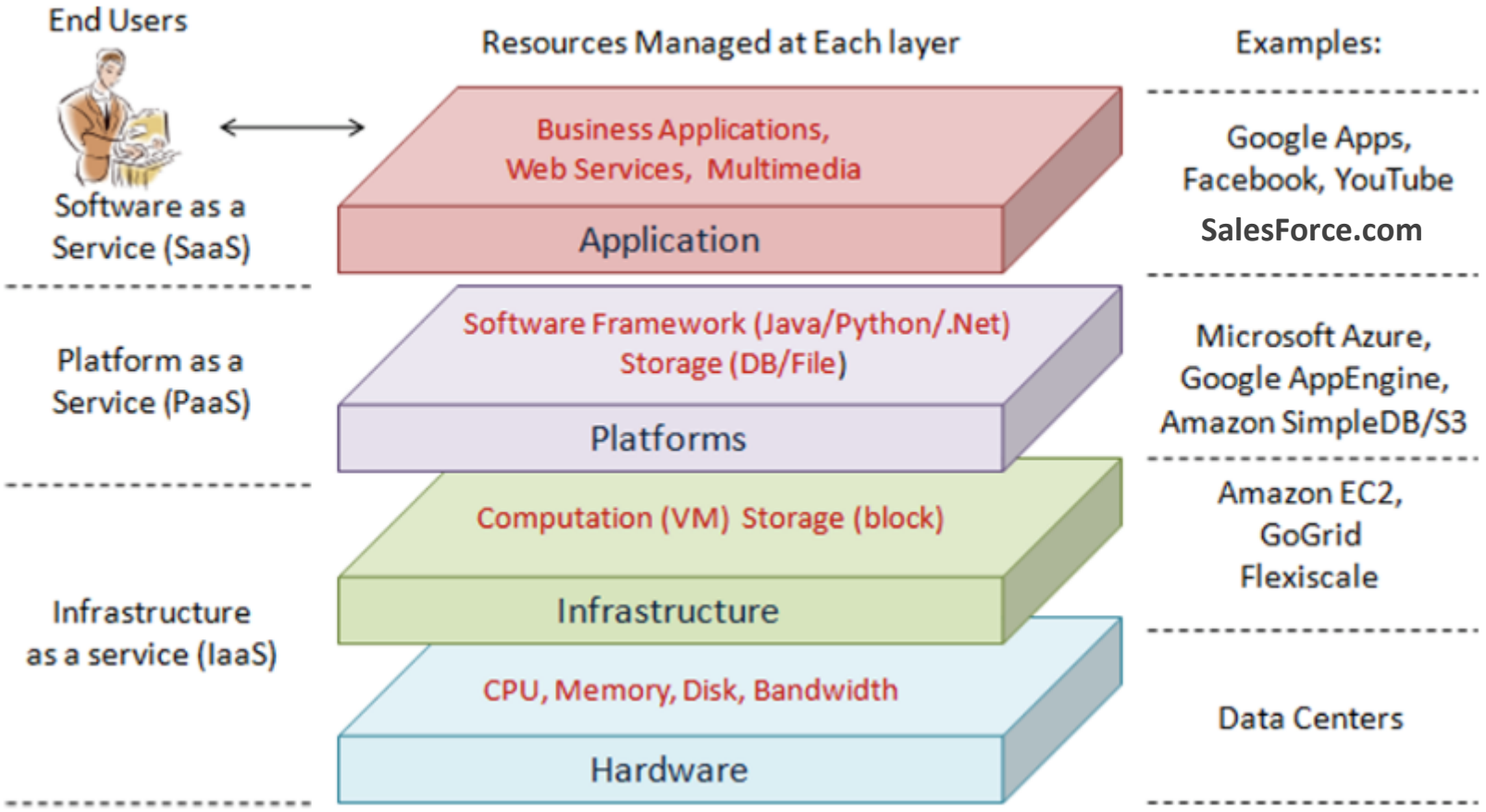
Everything As a Service



[source: Zhang, Cheng, and Boutaba, 2010]

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If you're like me – you're a bit lost now....

- Only one way of finding out – try it out on real exemplars:
  - UK Natural Environment Research Council funded a 2 year pilot project
  - Unusually, project driven by scientists, endusers and techies together
  - Three scales to capture different issues and audiences (local, national and global)
  - Deal with data, models and visualisations
- Make sure we ask people what they really want
  - 17 PIs, 13 institutions, 12 Endusers on Project Advisory Board from water companies, policy, software companies, land managers etc
- Not afraid to fail but doing it early and iterate with an even wider group of endusers
- Link across to other projects globally so as not to reinvent the wheel

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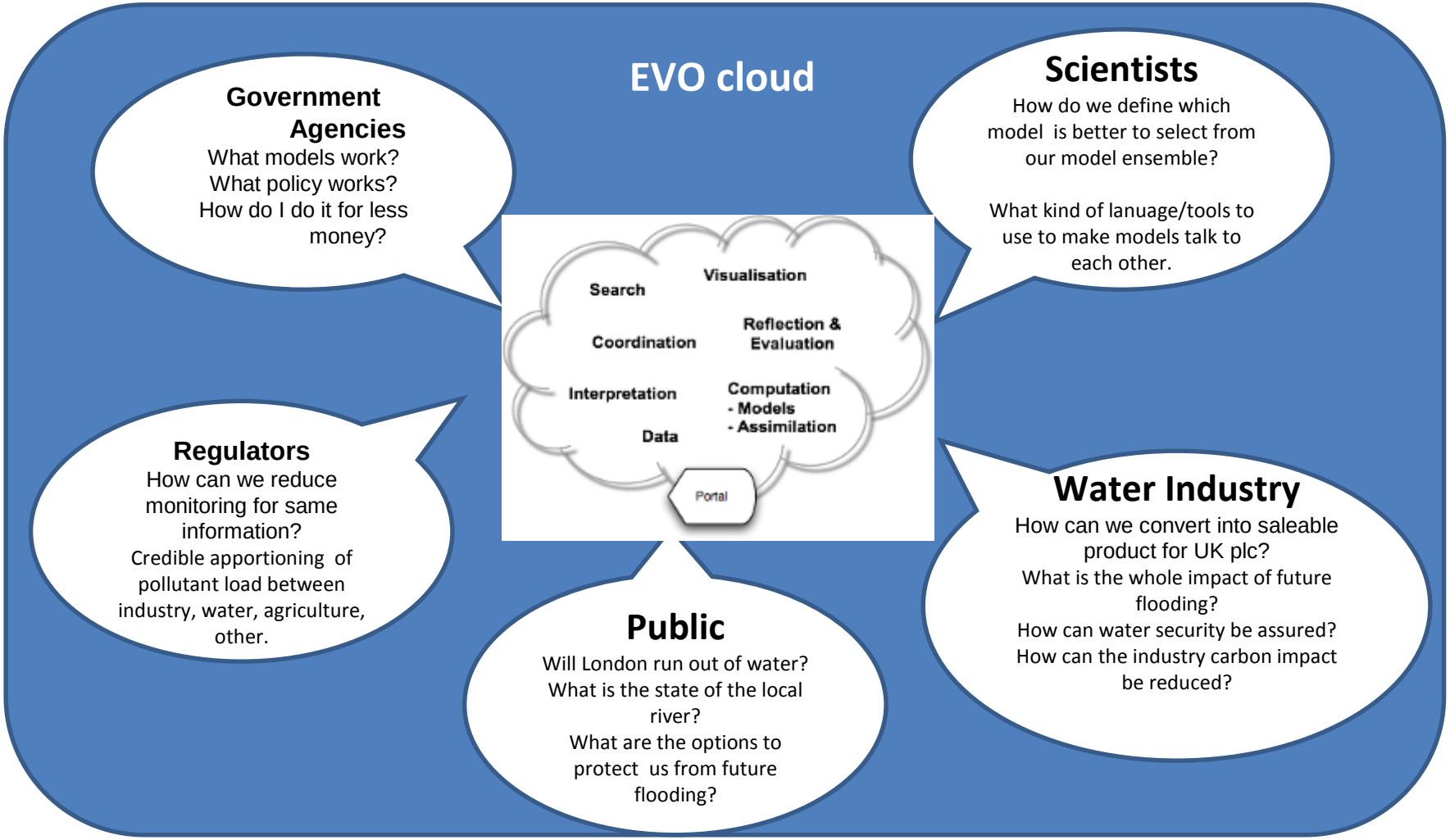
Questions the EVO could help answer



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But this is not enough for the techies to go on…

- Which data needs to be assimilated? Static or live?
- Which models? How linked?
- How do you want to visualise outputs?
- Need to be realistic about what is possible so apps for phones are not a priority
- And needs to testand demonstrate fundamentals of the cloud (techies have their needs to!). Exemplars had to show added value of cloud

Storyboards

Storyboard

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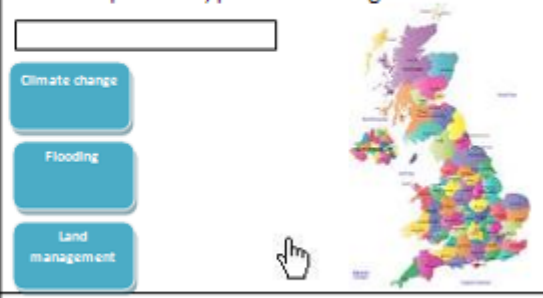
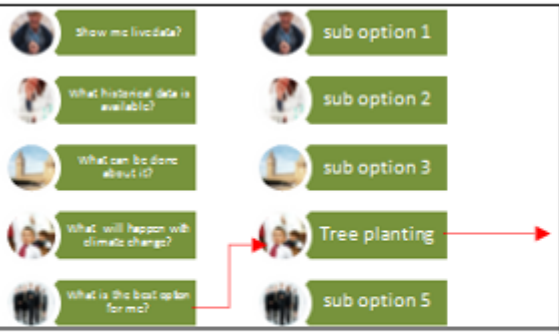
User Profile	Farmer
User Scenario	A new Government agri-environment policy states future land management will mitigate flooding under future climate change scenarios. A farmer living in mid Wales wants to know what land management techniques he can put in place to reduce flooding.

Farmer is required to implement a new Government agri-environment Policy on his farm to reduce flooding. He wants to know what prescription options are available and suitable for his farm.

- Farmer has read in agri-environment policy documentation that there's information held at EVOp website
- Click on EVO website and log in to portal

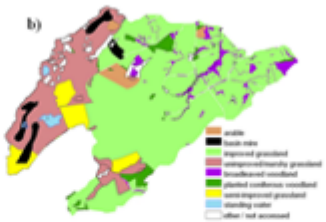


- Select area of country from map
- Click on navigation buttons which include flooding, climate change, land management.

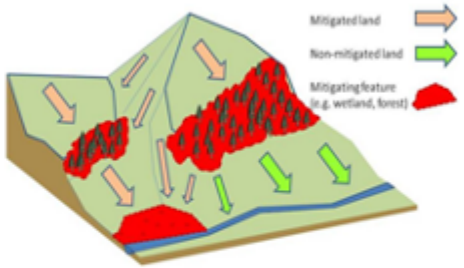


The farmer is directed to the next screen which gives him a number of options and sub options. He wants know what options are best suited to his farm and he is directed to a decision support tool.

Apply to whole farm?
Select area?



He chooses the planting trees option from the list of prescriptions, and selects the areas he wishes to plant trees. The decision support tool directs him to data sources and models required to run the tool.



The farmer can visualise what effect planting trees in the selected area will have on run off.

2. Entering the portal (Eden catchment example)

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User Login

User logs in to portal

Issue: User either has to know how to register and log in or must be shown. Needs to be clear instructions from front page

Issue: linking up between catchment webpages and EVOp needs thinking about

User selects location of area they are interested in, may also need search box by name or postcode.

User selects topic (only flood risk active) – submit

Issue: Will this portal be for everyone or vary by user or scale or use e.g. local, national?

Issue: Who is responsible for interface development?

User selects level at which they want to interact with data. This screen differentiates users and determines what accessibility is needed in the rest of the portal.

Issue: Will this be defined by user profile when registering? Or would that take away functionality unnecessarily?

5. Feedback and Iteration (Eden catchment example)

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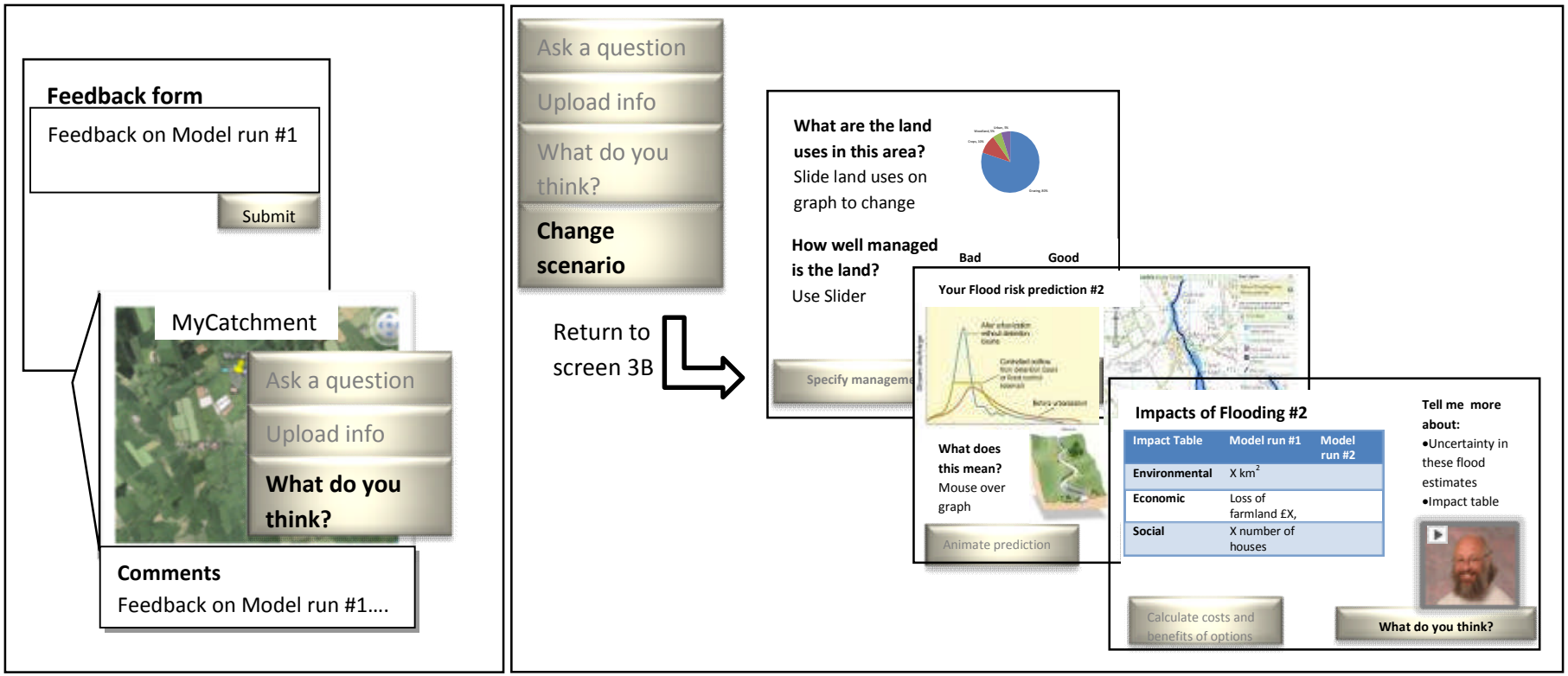

Feedback initially as a simple form which could be part of a blog but eventually would be able to tag model output maps to georeference validation data with map pins.

Issue: is this better within EVO framework or local community site?

Option to return to model input screen and rerun model with changed land use. Outputs would allow overlays on maps and additional columns in tables to allow comparison between BAU and mitigation options.

Issue: Is this possible? Can the model runs be stored and looked at again?

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BUT WHY WOULD ANYONE MAKE THEIR DATA, MODELS OR TOOLS AVAILABLE TO THE EVO CLOUD?

Realising the potential of environmental data, models and tools

Security

- Some datasets in the EVO will have access open to some but closed to others.
- How to handle access rights? Delegating the user's credentials was the key issue:
  - User logs onto portal
  - *Portal* then accesses secure data *on user's behalf* ('one hop')
  - Often Portal accesses WPS which in turn accesses secure data ('two hops')
- 'Mash my data' project solved these issues using OpenID and Proxy certificates. The user only has to sign on once and system keeps track of what they can do
  - Similar scenario using it to run simple models such as in EVOp
- Security of data-altering also a major issue; Currently digital data is not admissible in court e.g. for water quality.

Other projects found that security issues dictated the architecture of the whole system – so need to sort early.

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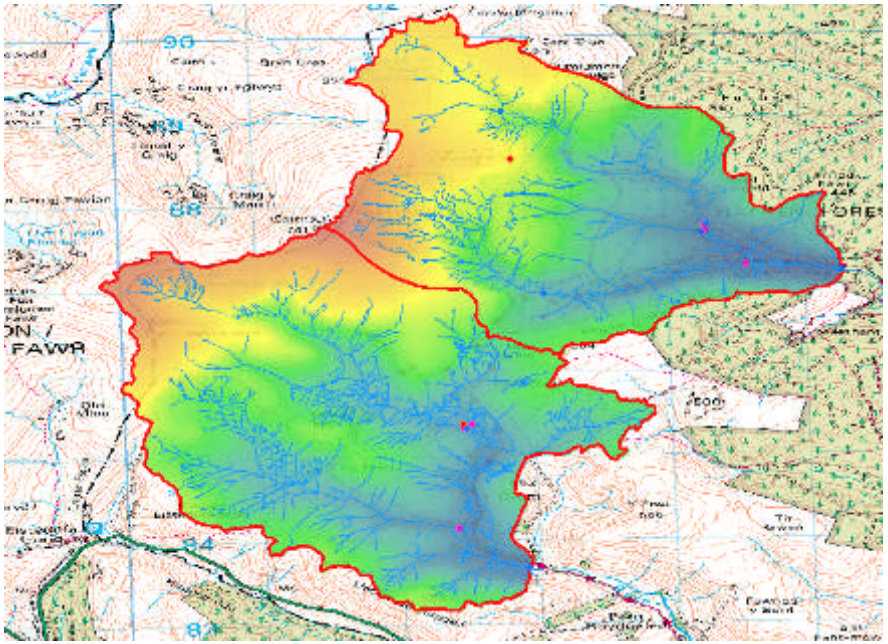
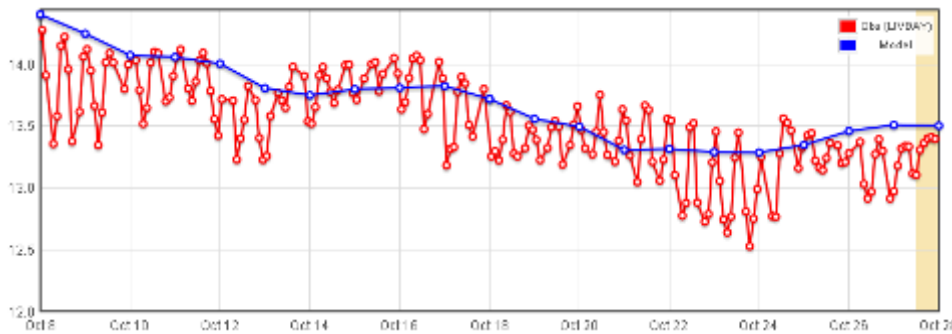
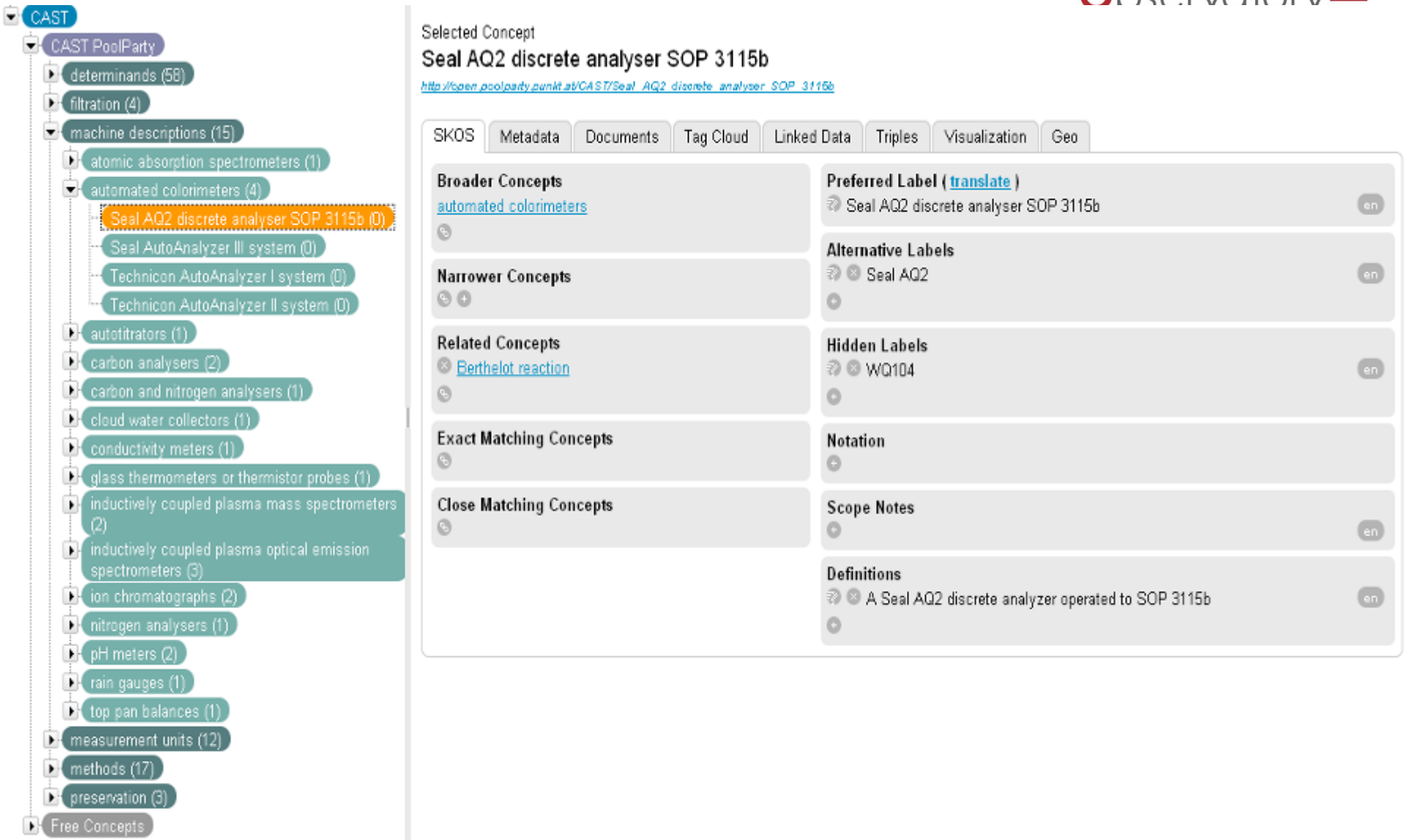
Developments for interoperability

- Lessons from the CEH Information Gateway (www.gateway.ceh.ac.uk) assimilating e.g. the Plynlimon legacy datasets, revealed a requirement for dictionaries to describe data.
- Links between locations, wide array of observations and analyses need to be defined





Dictionary development



Gaining information from linked data

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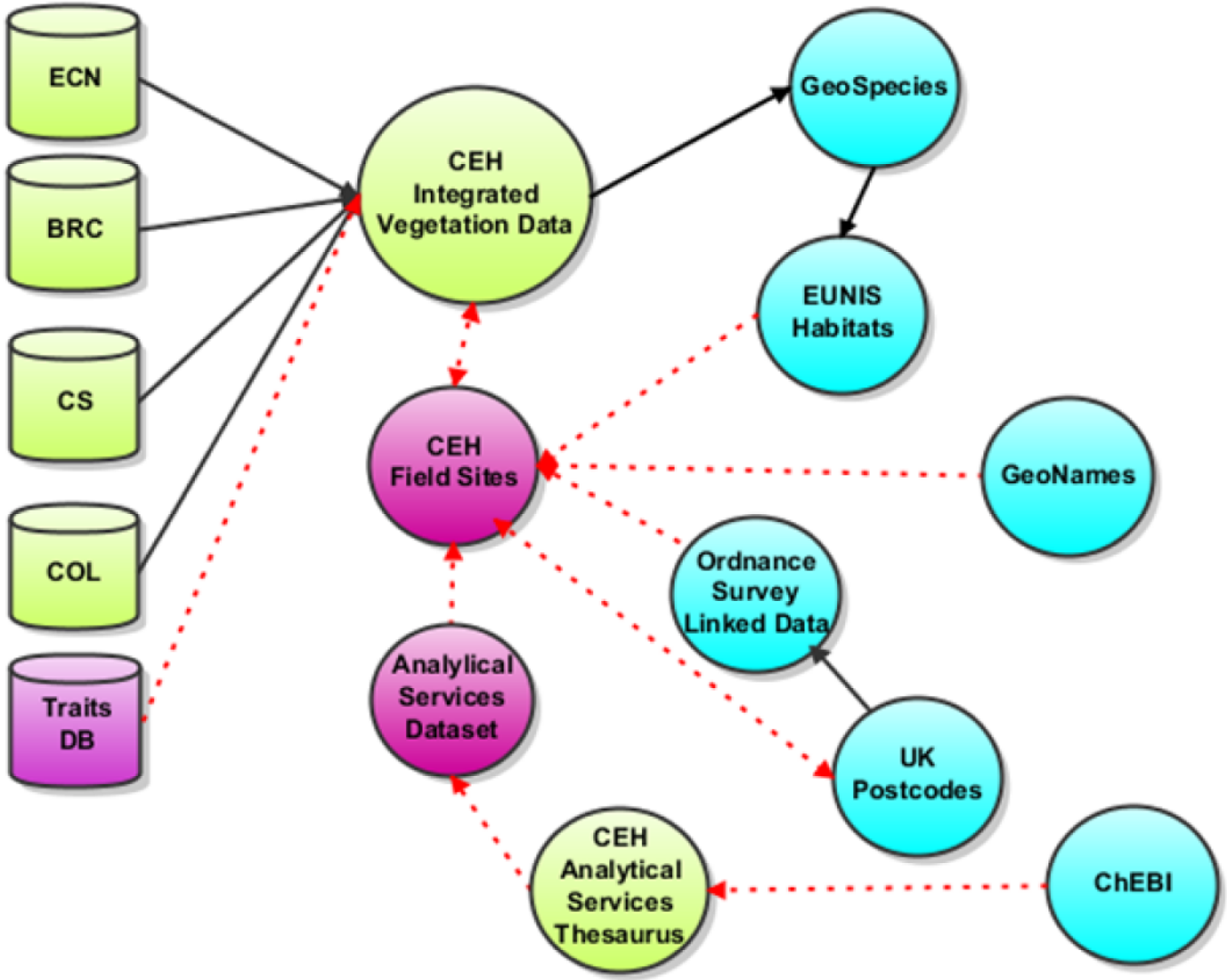

Current linked data map …

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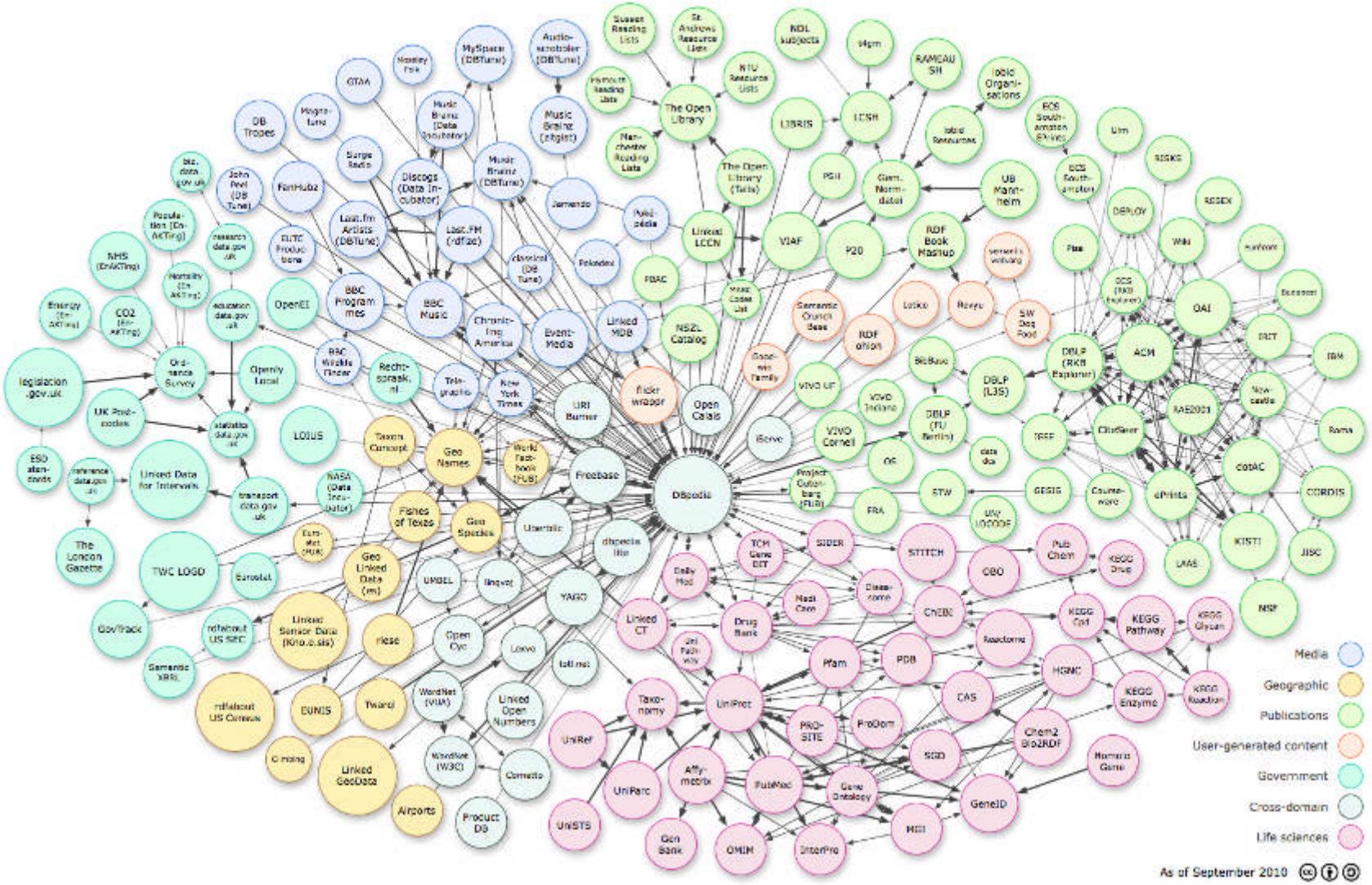

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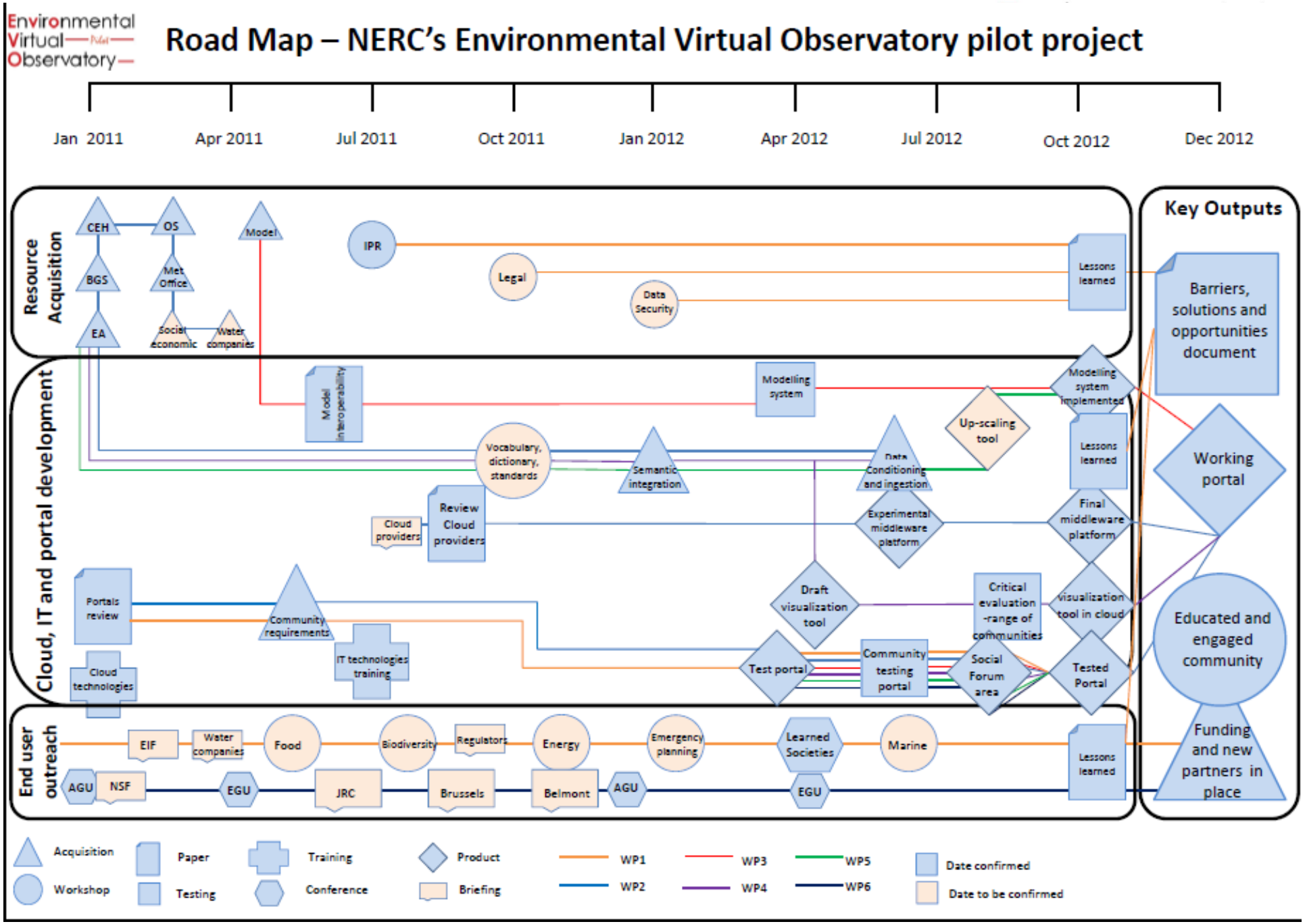
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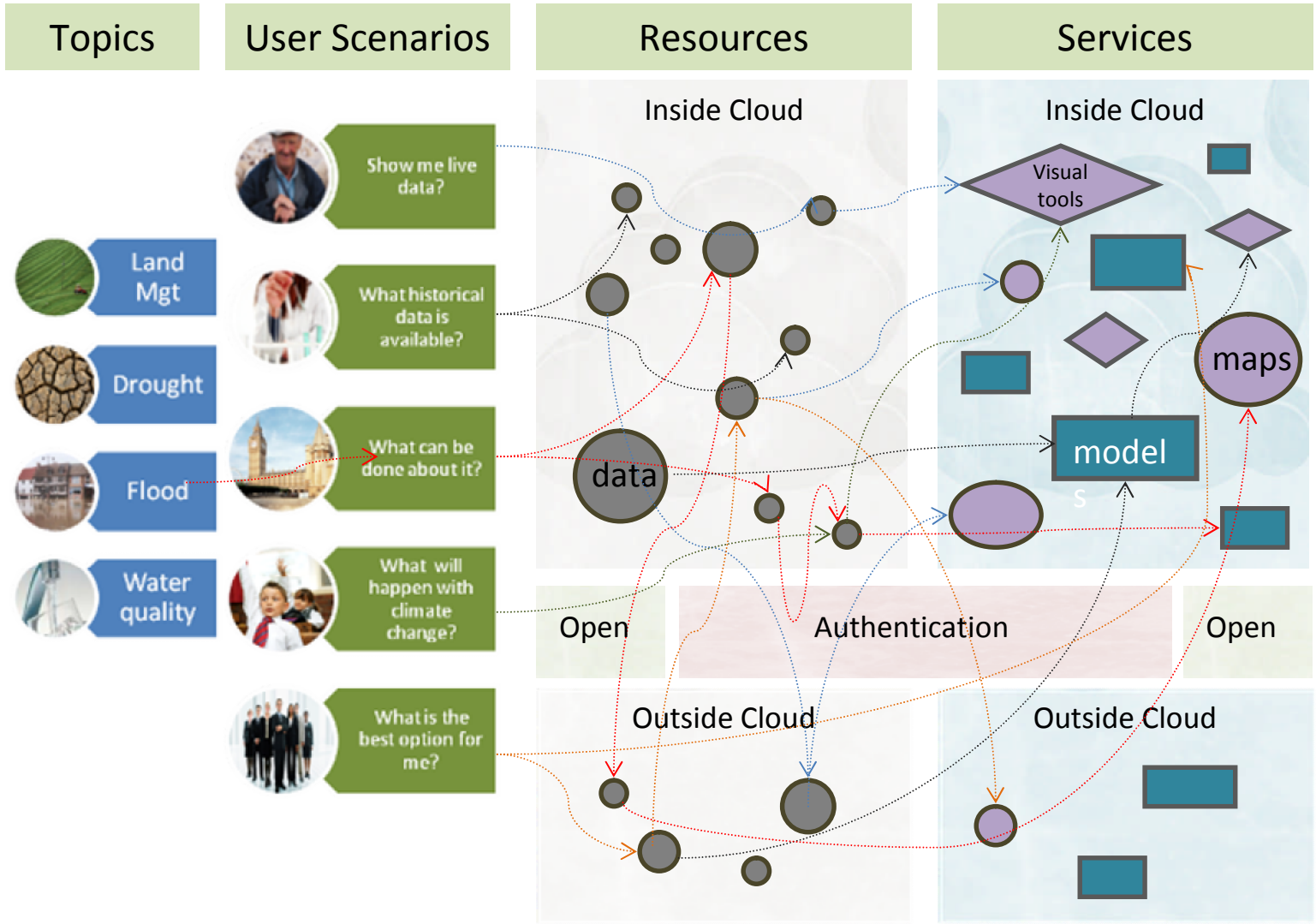
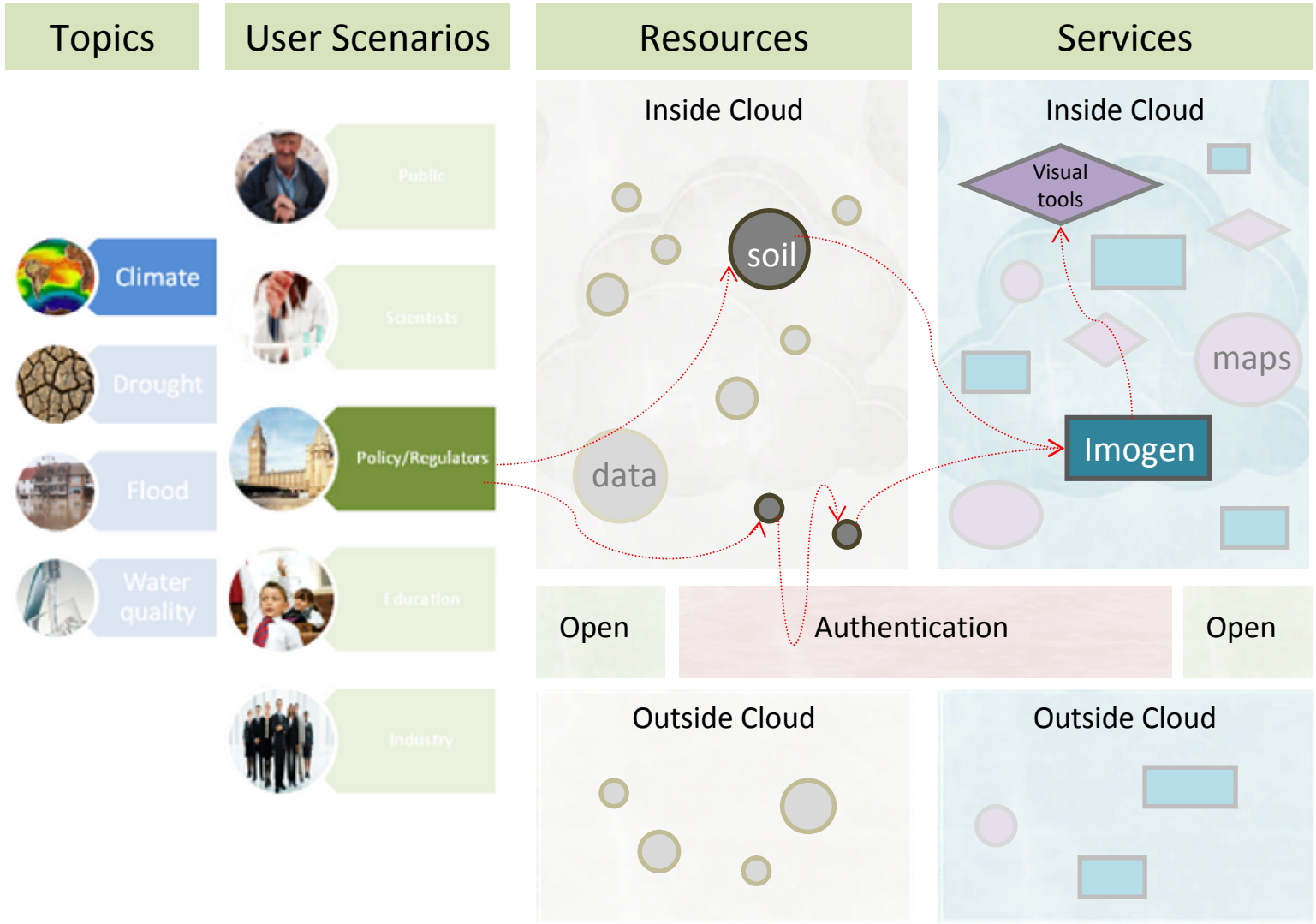
Road Map – NERC's Environmental Virtual Observatory pilot project
Jan 2011
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Dec 2012
Resource Acquisition
CEH
OS
Model
IPR
BGS
Met Office
Legal
Lessons learned
Data Security
EA
Social economic
Water companies
Cloud, IT and portal development
Model interoperability
Modelling system
Modelling system implemented
Up-scaling tool
Vocabulary, dictionary, standards
Semantic integration
Data Conditioning and ingestion
Lessons learned
Review Cloud providers
Cloud providers
Experimental middleware platform
Final middleware platform
Portals review
Community requirements
Draft visualization tool
Critical evaluation -range of communities
visualization tool in cloud
IT technologies training
Test portal
Community testing portal
Social Forum area
Tested Portal
Cloud technologies
End user outreach
EIF
Water companies
Food
Biodiversity
Regulators
Energy
Emergency planning
Learned Societies
Marine
Lessons learned
AGU
NSF
EGU
JRC
Brussels
Belmont
AGU
EGU
Key Outputs
Barriers, solutions and opportunities document
Working portal
Educated and engaged community
Funding and new partners in place
Acquisition
Workshop
Paper
Testing
Training
Conference
Product
Briefing
WP1
WP2
WP3
WP4
WP5
WP6
Date confirmed
Date to be confirmed

We will deliver a prototype portal



But …. most will be inactive with just our 3 exemplars live:
Our aim is to show potential and thus drawdown next phase of funding



International related Projects

- CUAHSI
  - Provides unified access to data, tools and models relating to hydrological research
  - Very data-oriented, but could help in visualisation
- Critical zone observatories / Soiltrec
  - Major data assimlation effort, combining with hydrological models and visualisation tools - only project with major modelling component we have come across
- INTAMAP
  - Provides real time visualisation of critical environmental variables
  - Uses OGC WPS and R interpolation modules
  - Developed UncertML
- NeOn
  - Provides support to semantic distributed applications
  - Developed the NeOn toolkit to import and manage ontologies
- LIS
  - Distributes embarrassingly-parallel processes over a flexible computational facility
  - Uses DODS to abstract remote data sources location and format
  - Uses GrADS, Live Access Server (LAS), Ferret, Matlab, Excel, etc. for visualisation
- GIGAS
  - Focuses on the representation and access interoperation of 3 initiatives:
    - GEOSS: climate, biodiversity, energy, weather, etc.
    - GMES: land, sea and air
    - INSPIRE: any spatial information2005 to 2015
- HUMBOLDT
  - Aims to demonstrate the benefits of harmonising spatial information using the standards of INSPIRE.

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If the EVO is successful, what is the benefit for scientists?

- Enabling environmental researchers to concentrate on science “Fewer wheels, more environmental science.”
- Not only those ‘in the know’ will be able to discover data portals and information “Democratisation of science”
- Stop re-invention and repeated blind alleys e.g. re-implementing models, file import and export routines etc.; End-users also suspect many contracts ‘reinvent’ work due to poor communication and lost knowledge
- Improved reputation of greater transparency and contribution to societal needs

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What would be wider implications…?

- The EVO would make our science which underpin management options and decisions to deal with our most urgent environmental problems more:
  - Efficient
  - Effective
  - And transparent

- And provide tools to help managers identify the best options for today and an array of likely futures

VISUALISING LAND AND WATER MANAGEMENT ISSUES: DEVELOPING COMMUNICATION TOOLS FOR STAKEHOLDER ENGAGEMENT

MACKAY, E[1]., BEVEN, K[1]., BREWER, P.A.[2]., HAYGARTH, P.M[1]., MACKLIN, M.G.[2]., MARSHALL, K., QUINN, P[3]., STUTTER, M[4]., THOMAS, N[2]. AND WILKINSON, M[3].

[1]Centre for Sustainable Water Management, Lancaster Environment Centre, Lancaster University, LA1 4YQ, UK.
[2]Centre for Catchment & Coastal Research, Institute of Geography & Earth Sciences, Aberystwyth University, Aberystwyth, SY23 3DB, Wales, UK.
[3]School of Civil Engineering and Geosciences, Newcastle University, Newcastle-upon-Tyne, NE1 7RU, UK.
[4]The James Hutton Institute, Craigiebuckler, Aberdeen AB15 8QH, Scotland, UK.

1. Introduction

Local community involvement in land and water management issues:

- aids better environmental decision making;
- enhances social, economic and environmental benefits; and
- increases a sense of ownership.

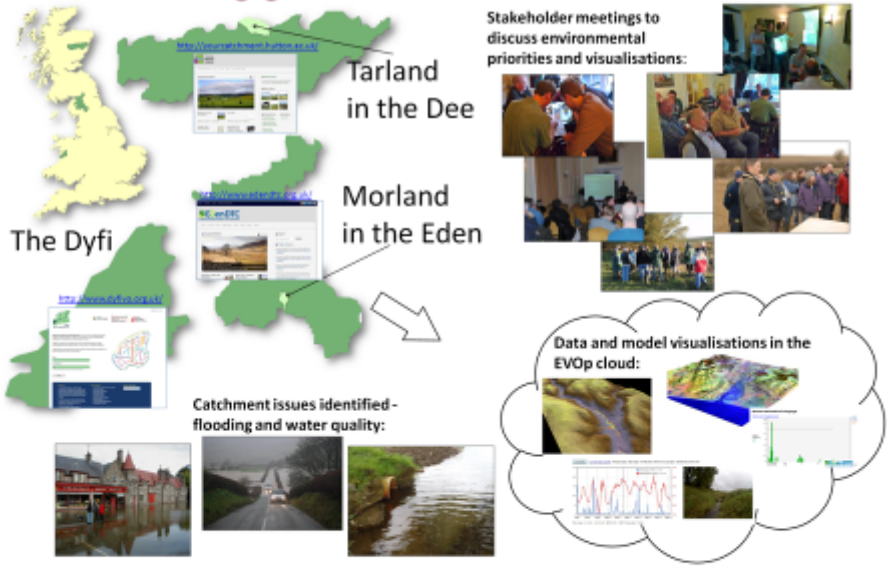
Through engagement with local community stakeholders in three different catchments (The Rivers Eden, Tarland and Dyfi), we are starting a process of developing prototype visualisation tools as part of the NERC pilot Environmental Virtual Observatory (EVO) (see the talk by Bridget Emmett), to address the specific environmental issues identified in each area.

A Local Landscape Visualisation Tool within the EVO cloud computing platform will be evolved across the life of the project that will communicate complex catchment science outcomes to reflect the needs and capabilities of a wide range of stakeholders from local citizens, to government agencies and scientists.

2. Project plan

1. Identify issues associated with flooding and diffuse pollution
2. Develop visualisations from live and modelled data
3. Test and develop visualisations with stakeholders
4. Evaluate and improve visualisations and feedback
5. Landscape Learning and Visualisation Application

3. Stakeholder engagement and visualisation in the catchments



4. Plans for the future

- Develop visualisation tools for use in the cloud, sourcing data collected from catchment data centres to run models;
- Evaluate visualisations and model outputs with stakeholders;
- Use feedback to refine the visualisations and how they are communicated;
- Improve model development by providing stakeholders with opportunities to validate model predictions.

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NATURAL ENVIRONMENT RESEARCH COUNCIL

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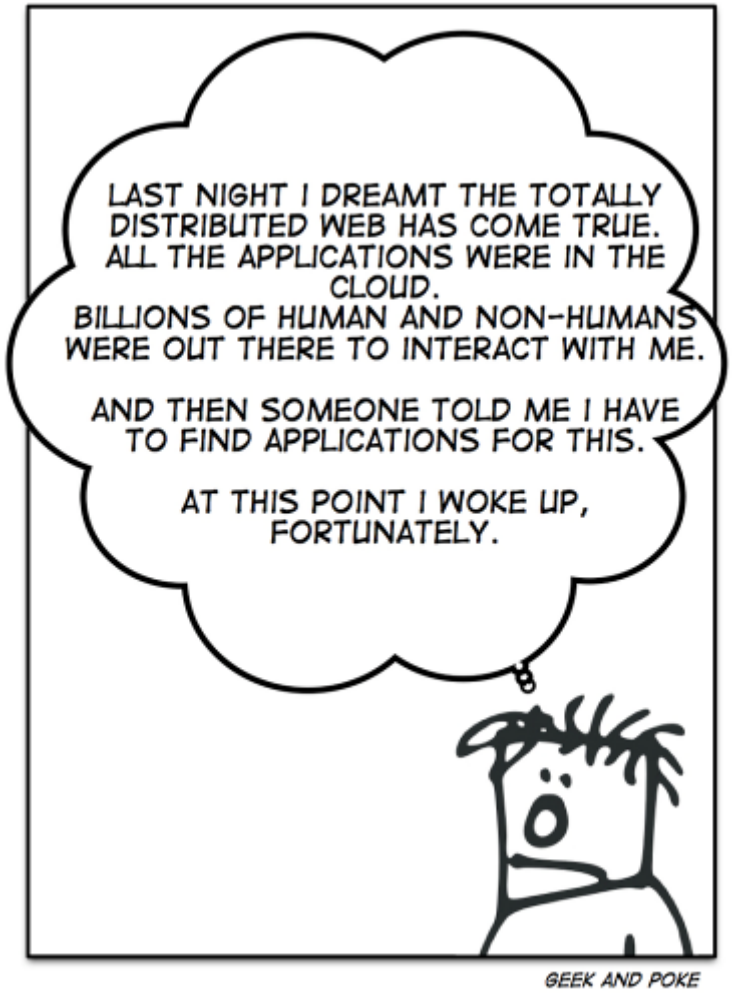
QUESTIONS?



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But, what is Cloud Computing (contd)?

- Coulouris, Dollimore, Kindberg and Blair:
  - A cloud is defined as a set of Internet-based application, storage and computing services sufficient to support most users' needs, thus enabling them to largely or totally dispense with local data storage and application software. The term also promotes a view of everything as a service from physical or virtual infrastructure through to software, often paid for on a per-usage basis rather than purchased