TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
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NATURAL ENVIRONMENT RESEARCH COUNCIL

Introduction to the LUCI model: **An ecosystem service modelling framework and GIS decision support tool**

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Background

- LUCI extends & implements the Polyscape framework described in Jackson et al (2013)*.
- First developed at Pontbren, with farmers & scientists working together to design intervention measures to improve economics and reduce environmental impact.
- FRMRC work up-scaling impacts of detailed farm interventions to catchment scale & conversations with farmers and interdisciplinary scientists inspired design criteria.

*Jackson, B, Pagella, T, Sinclair, F, Orellana, B, Henshaw, A, McIntyre, N, Reynolds, B, Wheater, H, Eycott, A (2013) Polyscape: a GIS mapping toolbox providing efficient and spatially explicit landscape-scale valuation of multiple ecosystem services, Urban and Landscape Planning 112, 74-88.

Underlying principles:

Practical

1) Can be run using nationally available data; i.e. available everywhere so *relevant to national spatial planning*
2) Modular – can embed other models & aspects can be embedded in other models (LUCI is a *framework*)
3) Fast running to enable "real time" scenario exploration

Conceptual

1) Operates at a spatial scale *relevant for field and sub-field level management decisions*
2) "Values" features and potential interventions by area affected, not just area directly modified
3) Addresses tradeoffs & searches for "win-win" solutions

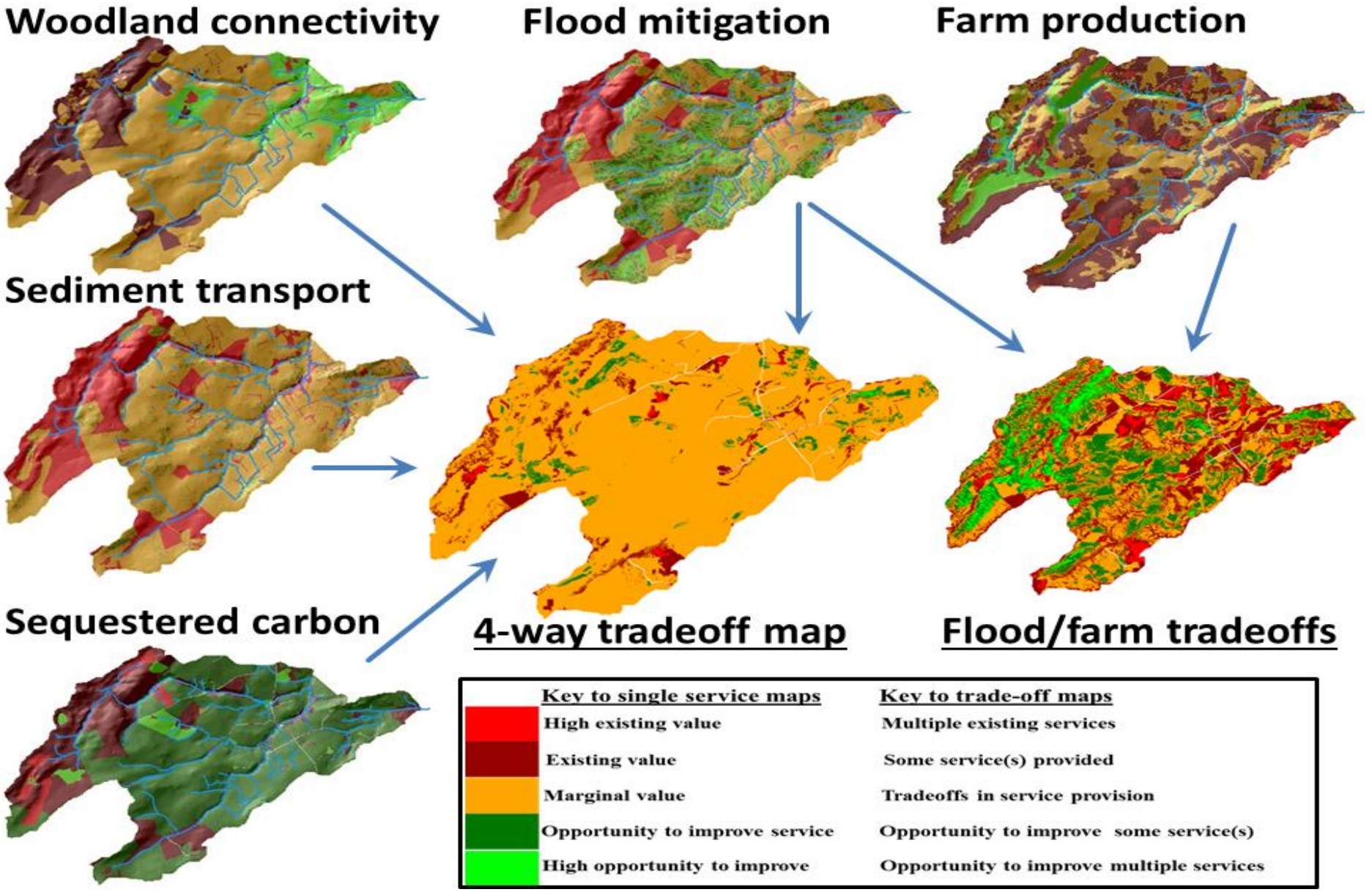
Effects of tree planting at Pontbren post 1990

Service	Actual area modified (%)	Area receiving benefit (%)
Broadleaved focal species	6.8	28.5
Runoff peak	3.2	12.0

Services currently modelled by LUCI

Service	Method
Production	Based on slope, fertility, drainage, aspect, temperature
Carbon	IPCC Tier 1 – based on soil & vegetation
Flooding	Detailed topographical routing of water accounting for storage and infiltration capacity as function of soil and land use.
Erosion	Slope, curvature, contributing area, land use, soil type
Sediment delivery	Erosion combined with detailed topographical routing
Water quality	Export coefficients combined with water flow and sediment delivery models
Habitat (Approach A)	BEETLE – Forest Research's cost-distance approach to dispersal, examines connectivity of habitats
Habitat (Approach B)	Identification of priority habitat by biophysical requirements e.g. wet grassland
Tradeoffs/synergy identification	Various layering options with categorised service maps; e.g. Boolean, conservative, weighted arithmetic

LUCI actively identifies tradeoffs and synergies

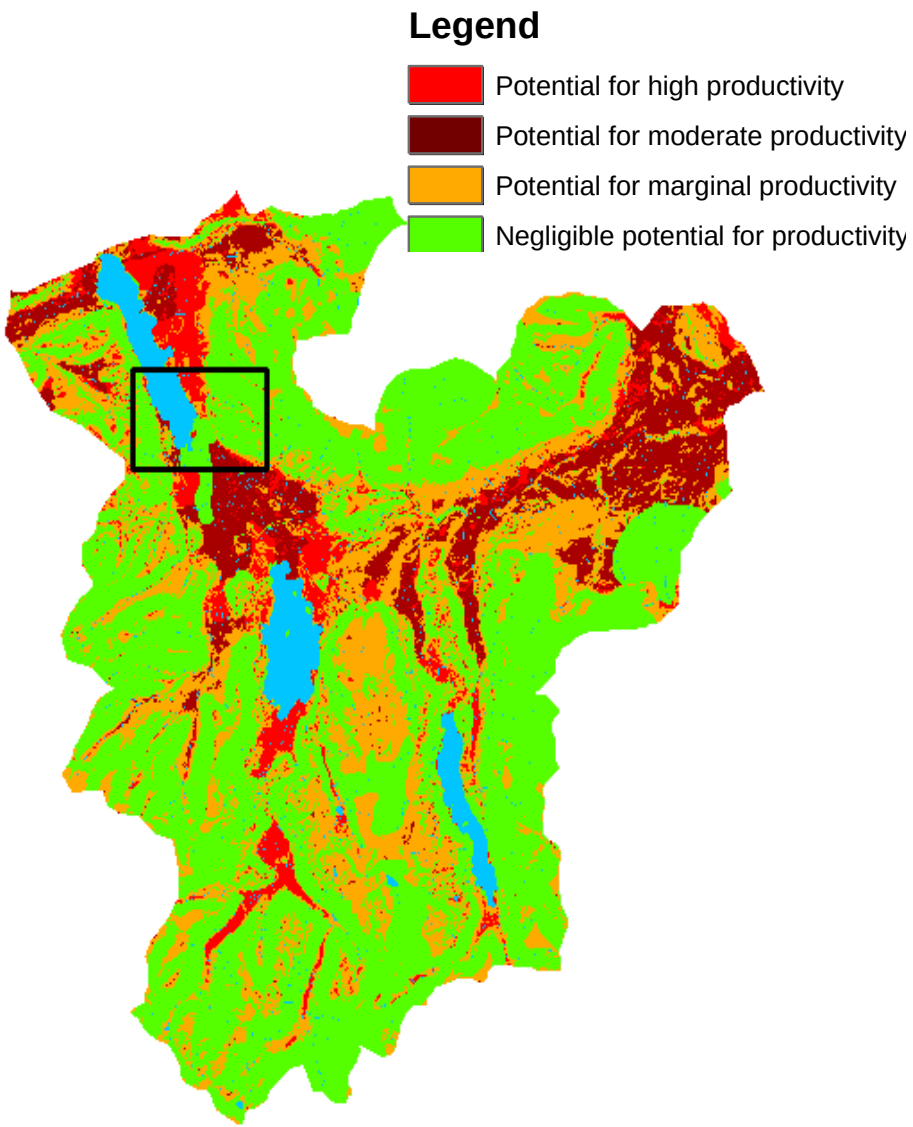


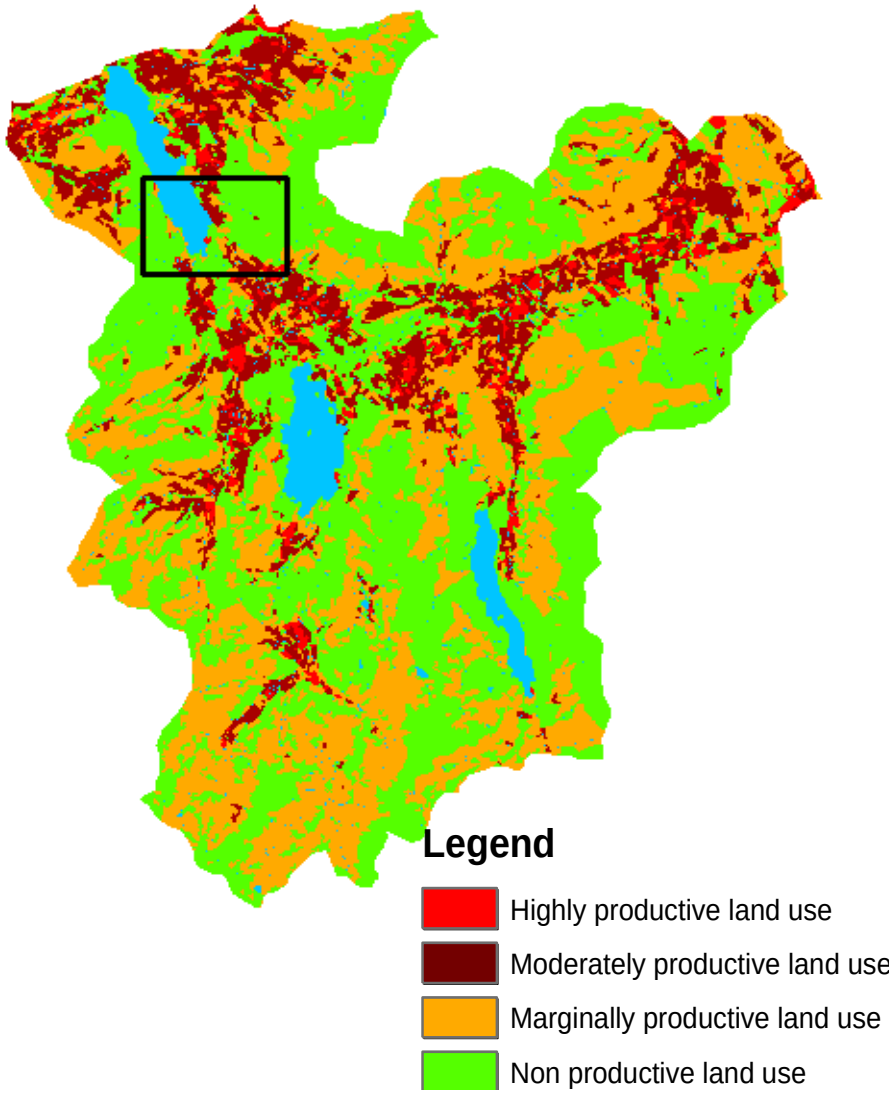
Recent Defra / NE application – Bassenthwaite

- Schemes in place paying farmers to reduce impact of production on environment.
- Concerns current interventions are not delivering “best value for money”

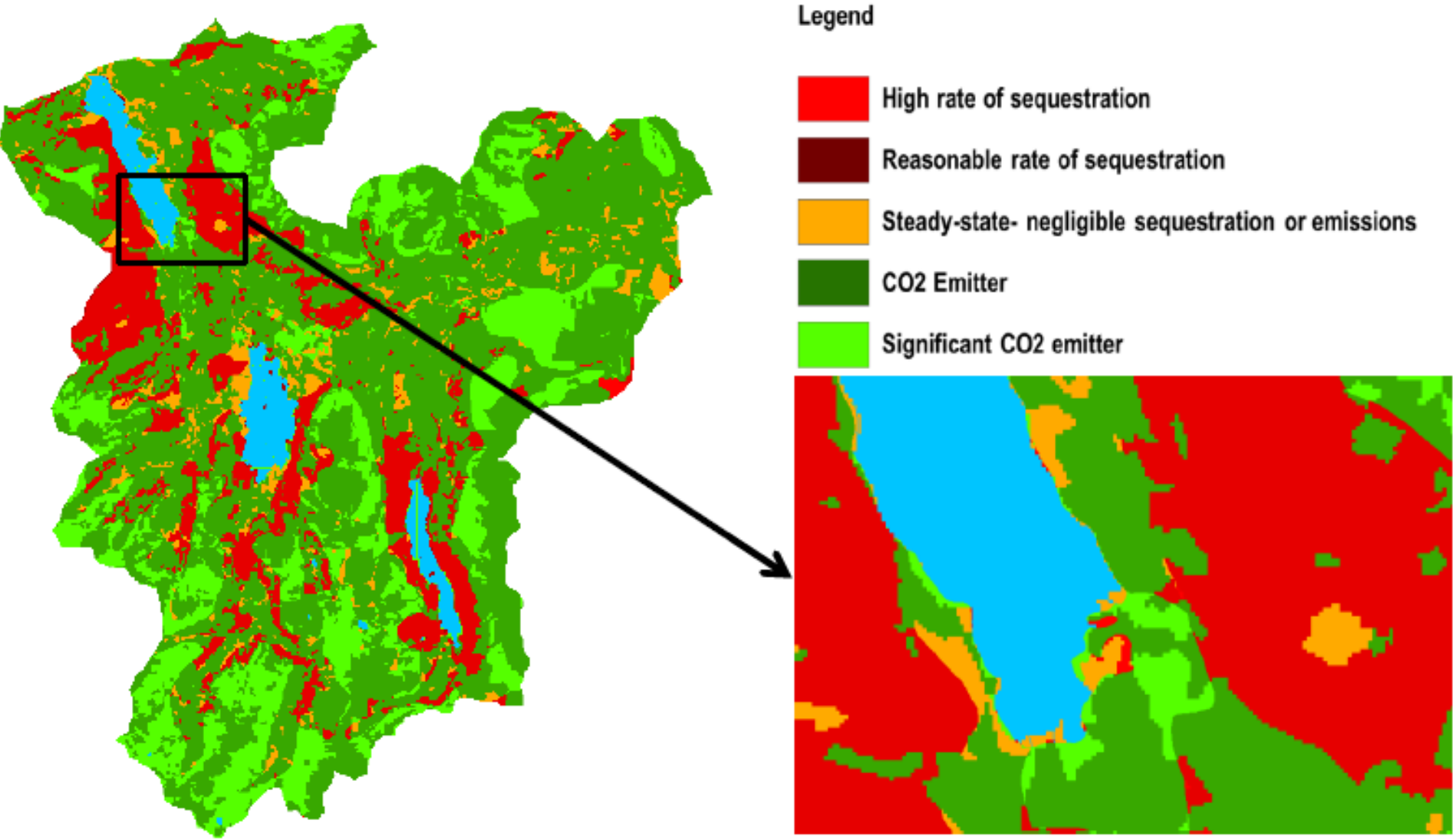
- LUCI being applied to identify where to better target agri-environment measures to improve carbon, water flow and quality, biodiversity while maintaining productivity

Potential versus current production

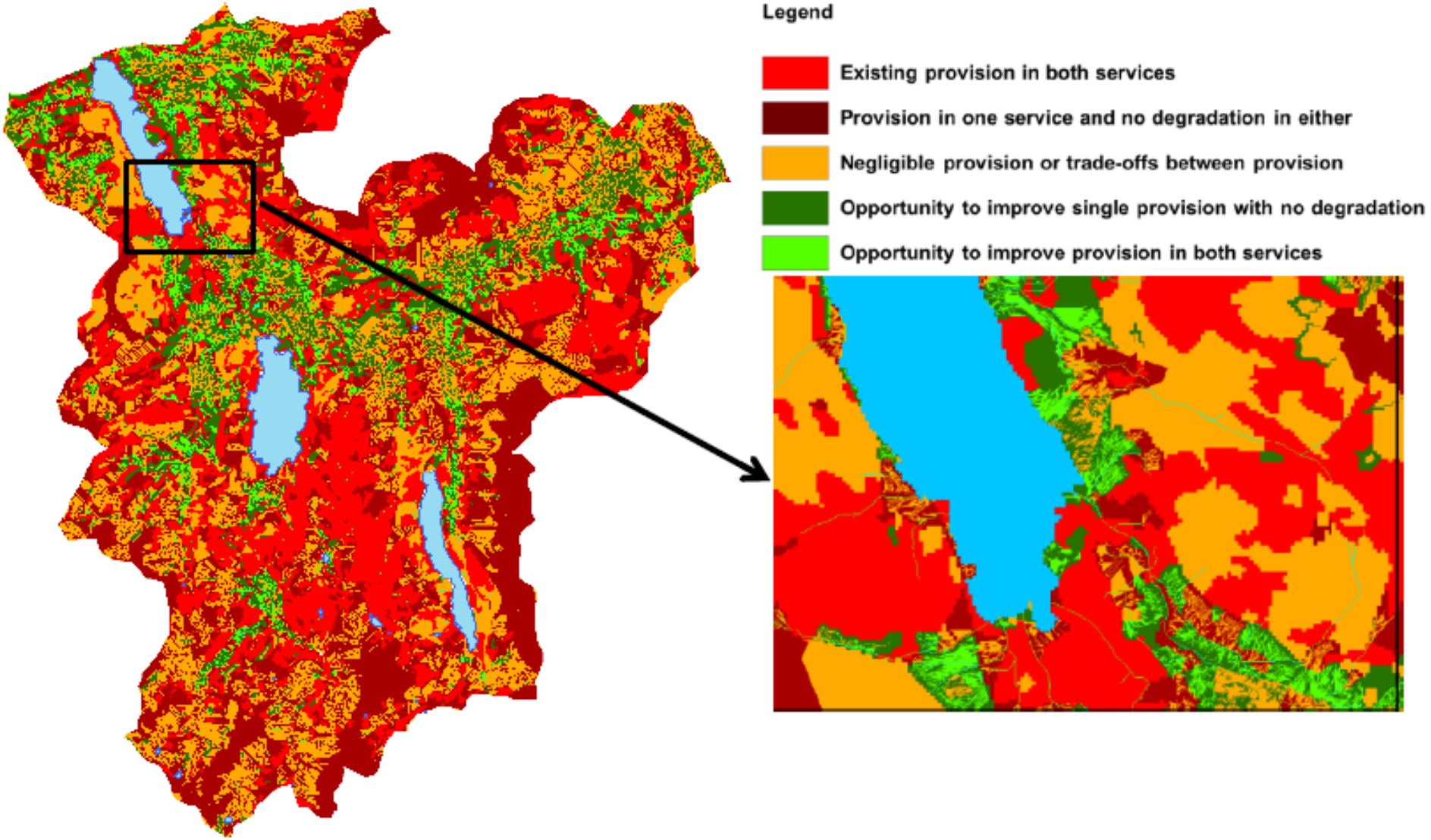




C sequestration/emission



Trade offs & synergies: broadleaved woodland habitat & flooding



Exploring benefits if interventions were spatially targeted using LUCI

Metric	Units	Pre-ES	Post-ES	Optim Area*	Optim Outcome*
Total present carbon	kg/ha	199	207	221	212
Total future carbon	kg/ha	172	193	209	198
Broadleaf woodland	km^2	18	34	32	26
Area accessible to BLW species	%	45	70	74	69
Additional wet grassland	%	-	0.2	0.8	0.6
Land in production	%	47	39	43	44
Non-“mitigated” land	%	37.7	25.5	24.3	32.7
Connected sediment generating land	%	11.3	6.7	3.6	5.9
P export to rivers/lake	kg/ha/yr	0.178	0.153	0.124	0.151
Peak flow change in max. Summer flood	%	baseline	-2.3	-9.3	-3.1

***Optim area= same area/payment, more outcome; Optim outcome = less area/payment, similar outcome**

Ongoing work - Glastir MEP

- 1st country deployment– LUCI run over all of Wales (5x5m^2 resolution)
- LUCI is mapping and quantifying effects from a range of Glastir intervention scenarios, and also identifying strategic locations where interventions might better be targeted
- Web mapping / server deployment is underway to allow non specialists and stakeholders to access scenario exploration
- Interfacing with other models & augmenting “own” models to enhance existing services, add new ones and increase temporal functionality, e.g:

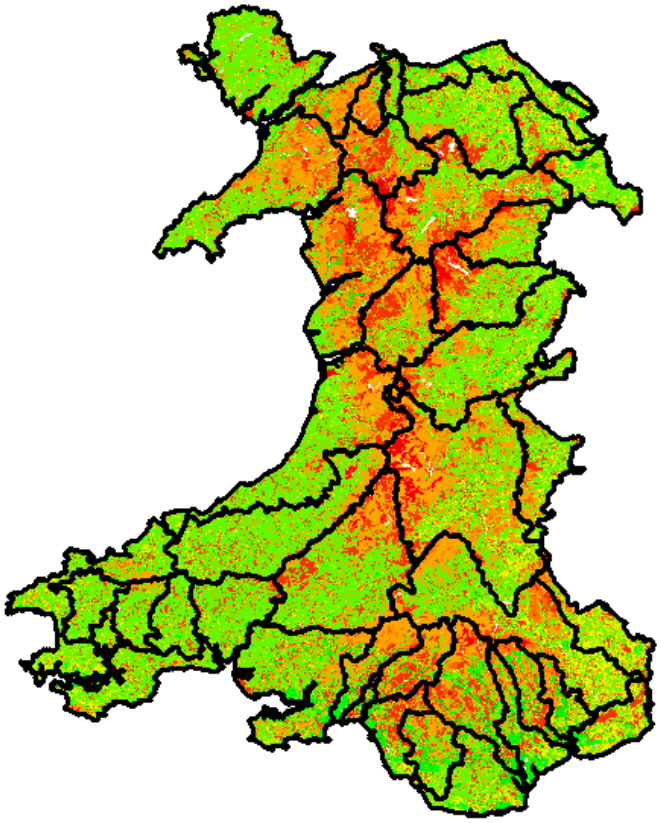
Enhancing:

- Water quality
- Priority habitat and species modelling (e.g. embedding Multimove model),
- Greenhouse gas emissions

Adding:

- Primary production and its economics
- Historic environment risk/exposure/accessibility
- Soil valuation/natural capital
- Protection of infrastructure, etc…

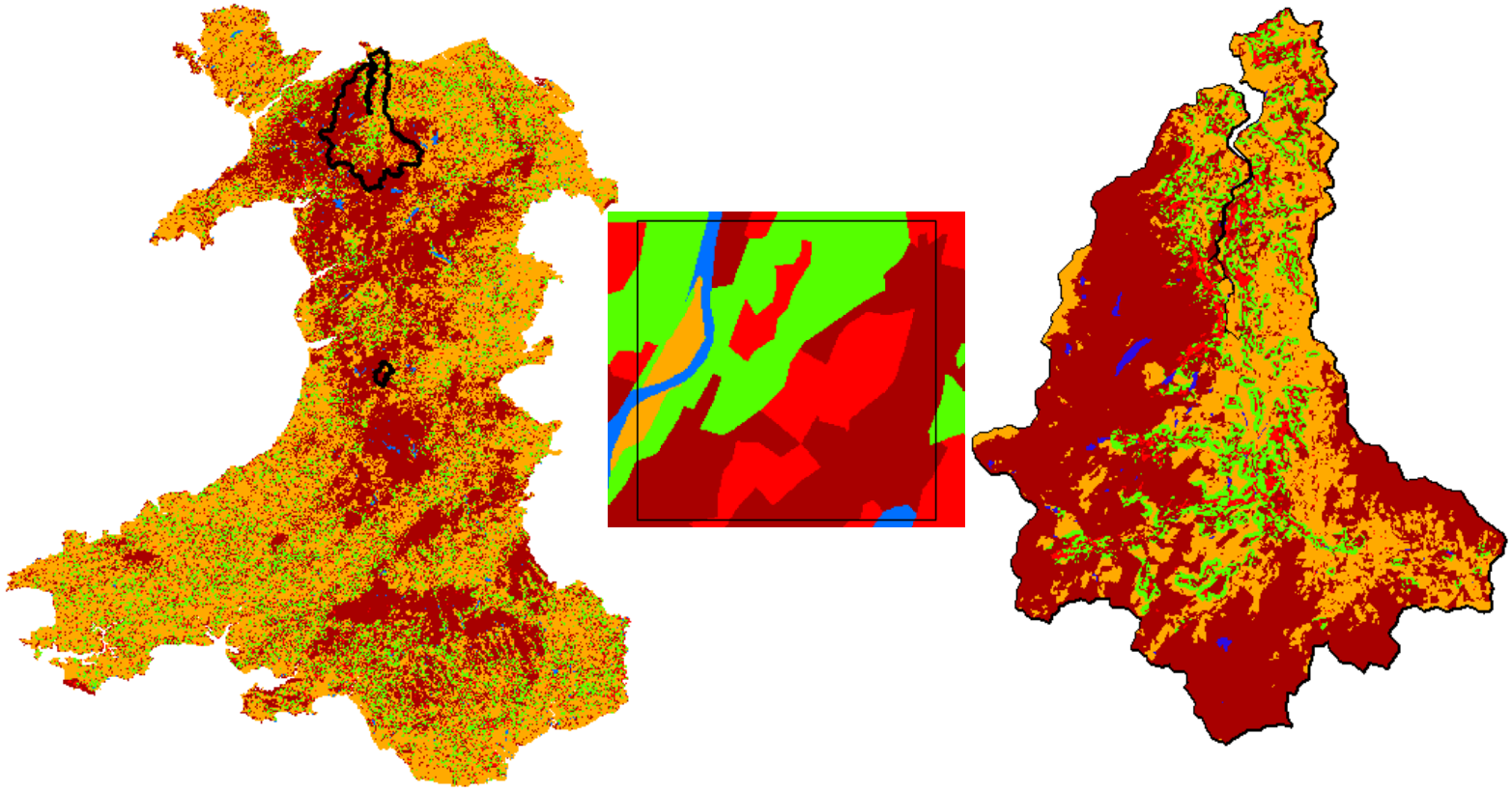
LUCI parallelised & running over all of Wales



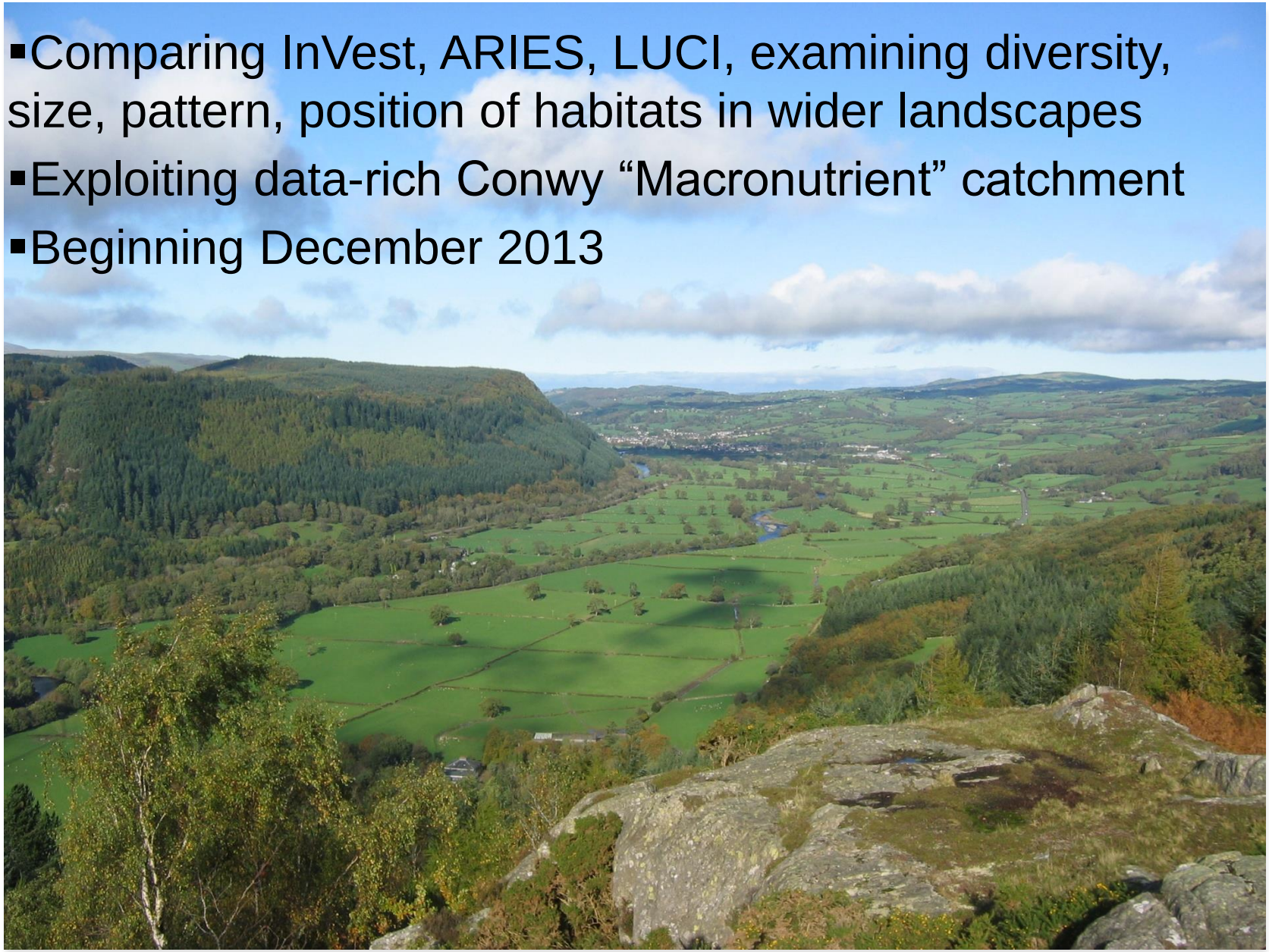
42 catchments / catchment bundles
5x5m resolution
~800 million points for each output layer
Approx 1 day to generate land management scenario, generate all ecosystem service outputs, and stitch outputs together for mapping/analysis

(output to left is carbon stock, red high, green low)

Analysing results by country, 1km square & for Conwy/Plynlimon demonstration catchments



BESS grant for Conwy app.



- Comparing InVest, ARIES, LUCI, examining diversity, size, pattern, position of habitats in wider landscapes
- Exploiting data-rich Conwy “Macronutrient” catchment
- Beginning December 2013