



Introducing a New Taxonomy for Underwater Environments

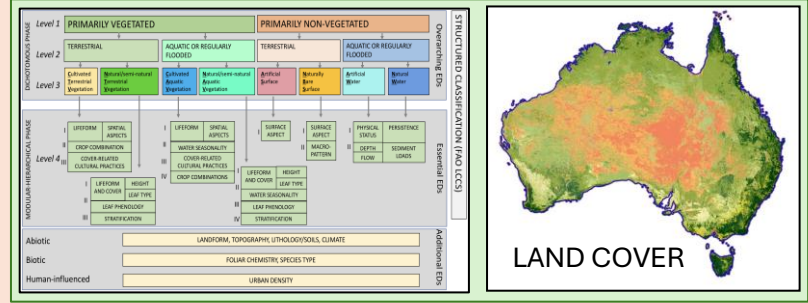


Prof. Richard Lucas, Dr. Donall Cross, Dr. Carole Planque (Uni. Geneva), Dr. Isabel Brandao and Dr. Omid Sorkhabi

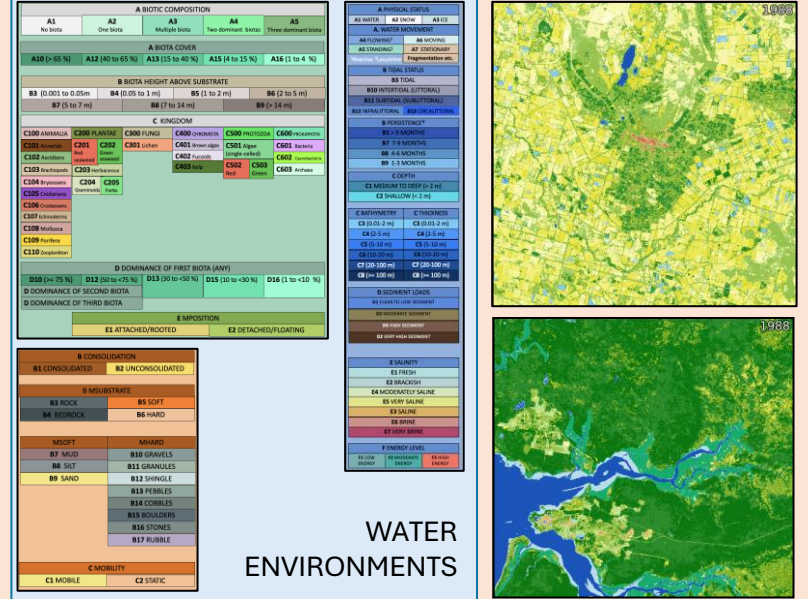
LIVING EARTH: GLOBALLY APPLICABLE AND LOCALLY RELEVANT TAXONOMIES

GLOBAL TAXONOMIES AND FRAMEWORKS

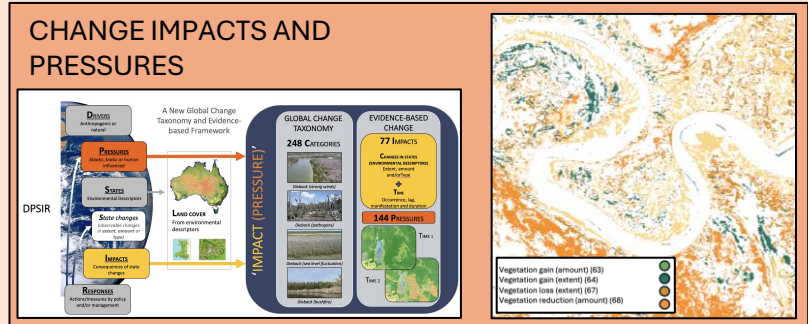
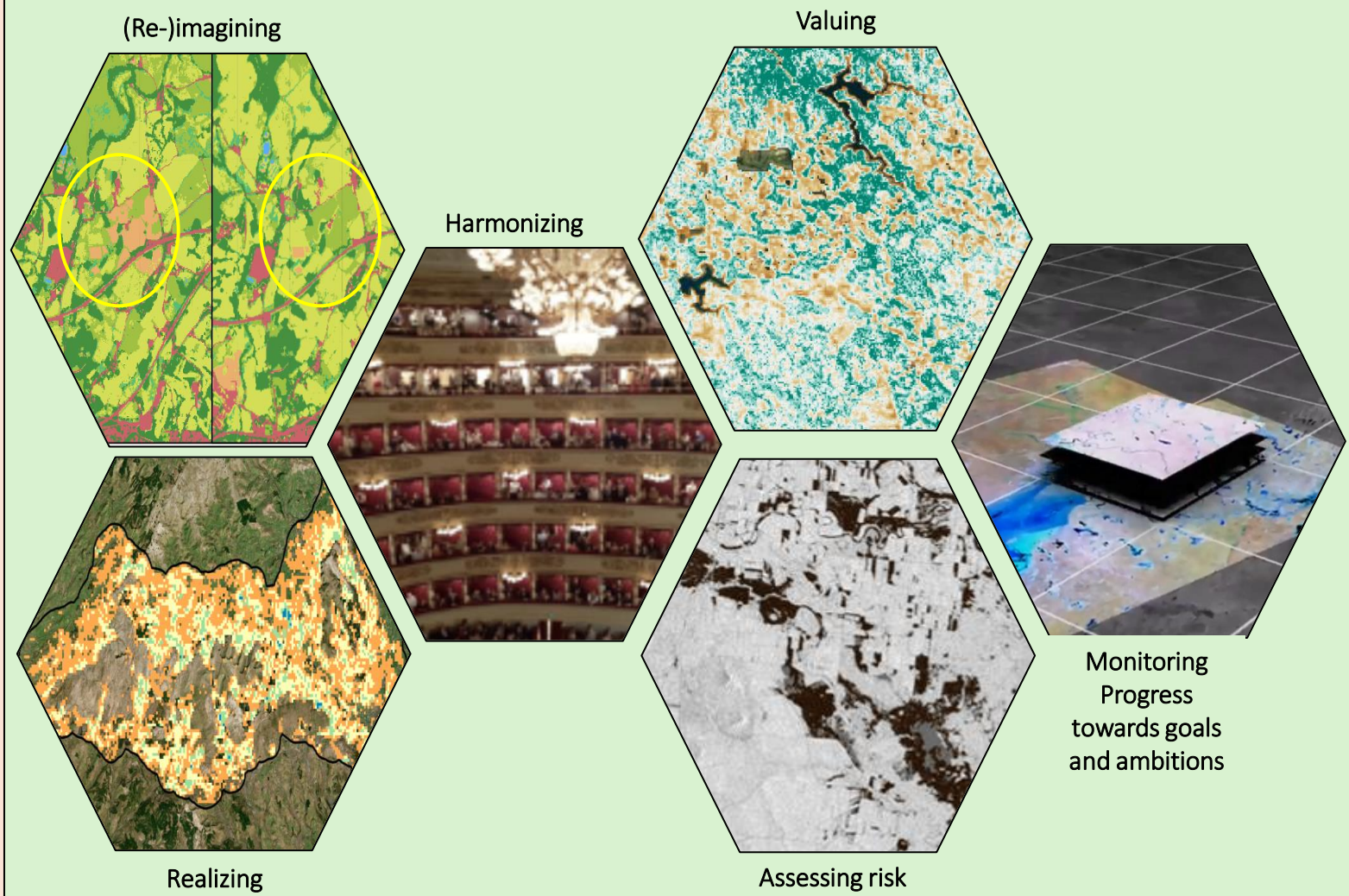
PAST AND CURRENT



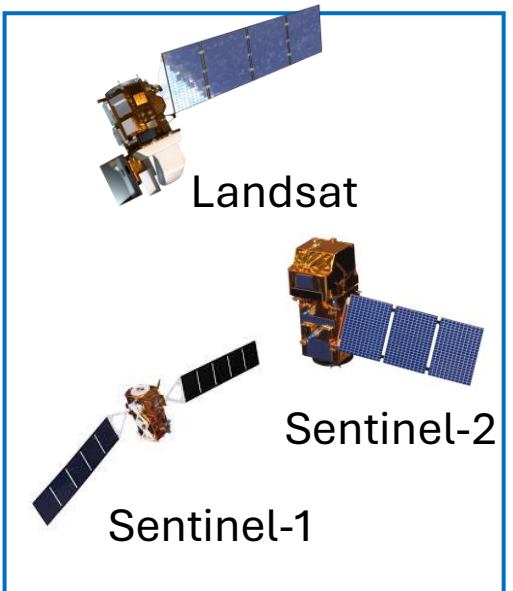
LAND COVER CHANGE



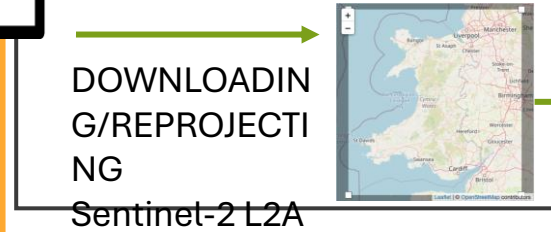
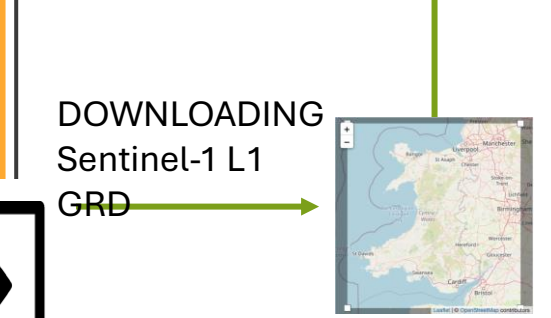
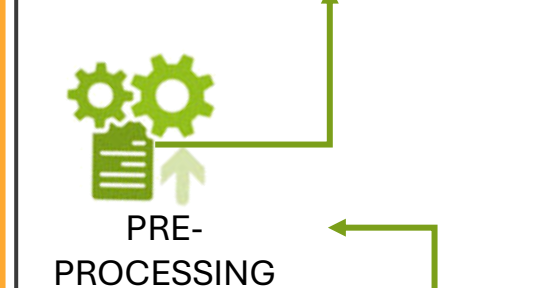
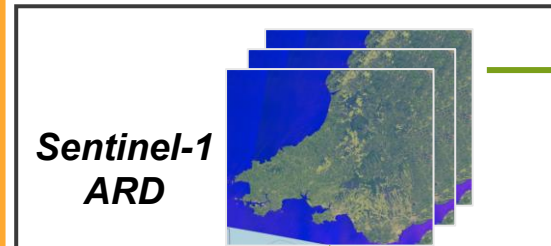
FUTURES: SUPPORTING STEPS TO ACHIEVEMENT



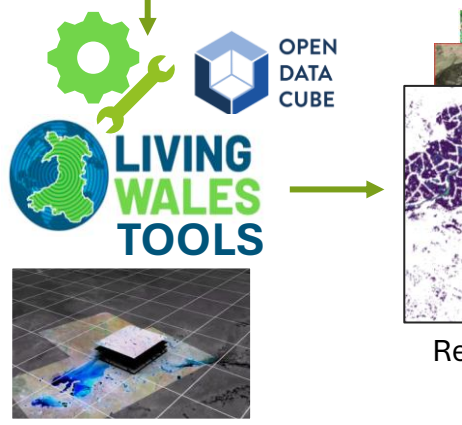
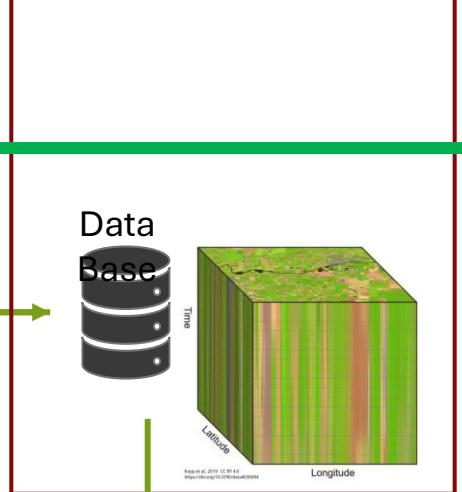
DATA PROVIDERS



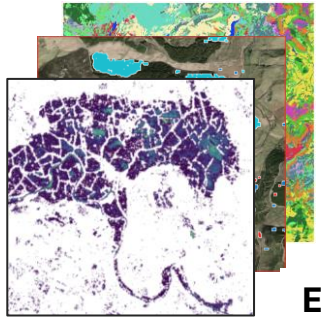
ARD



EODATADOWN



WELSH OPEN DATA CUBE



IMPORTING

Other Data

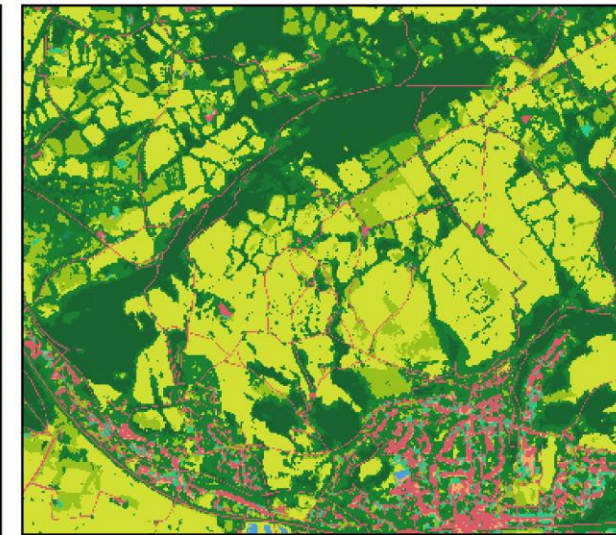
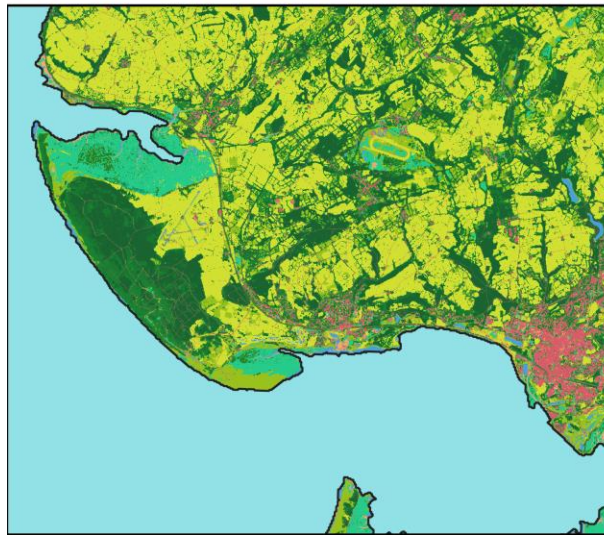
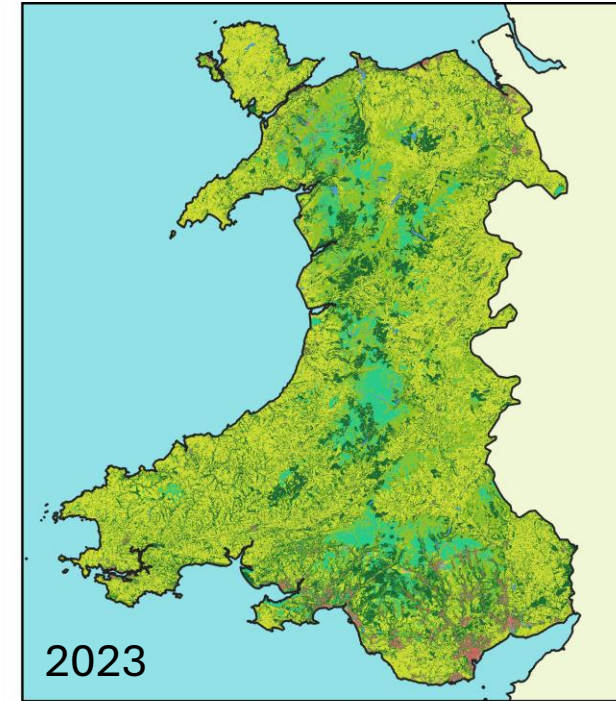
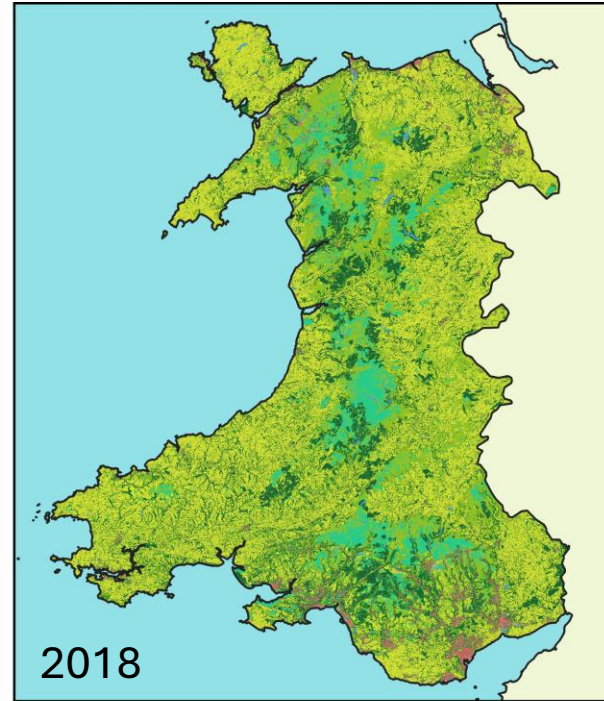
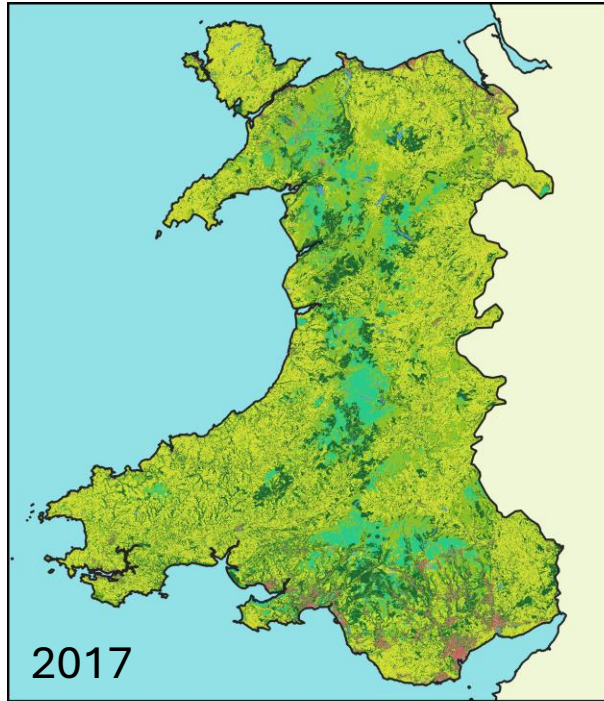
EXPORTING

DOWNLOAD



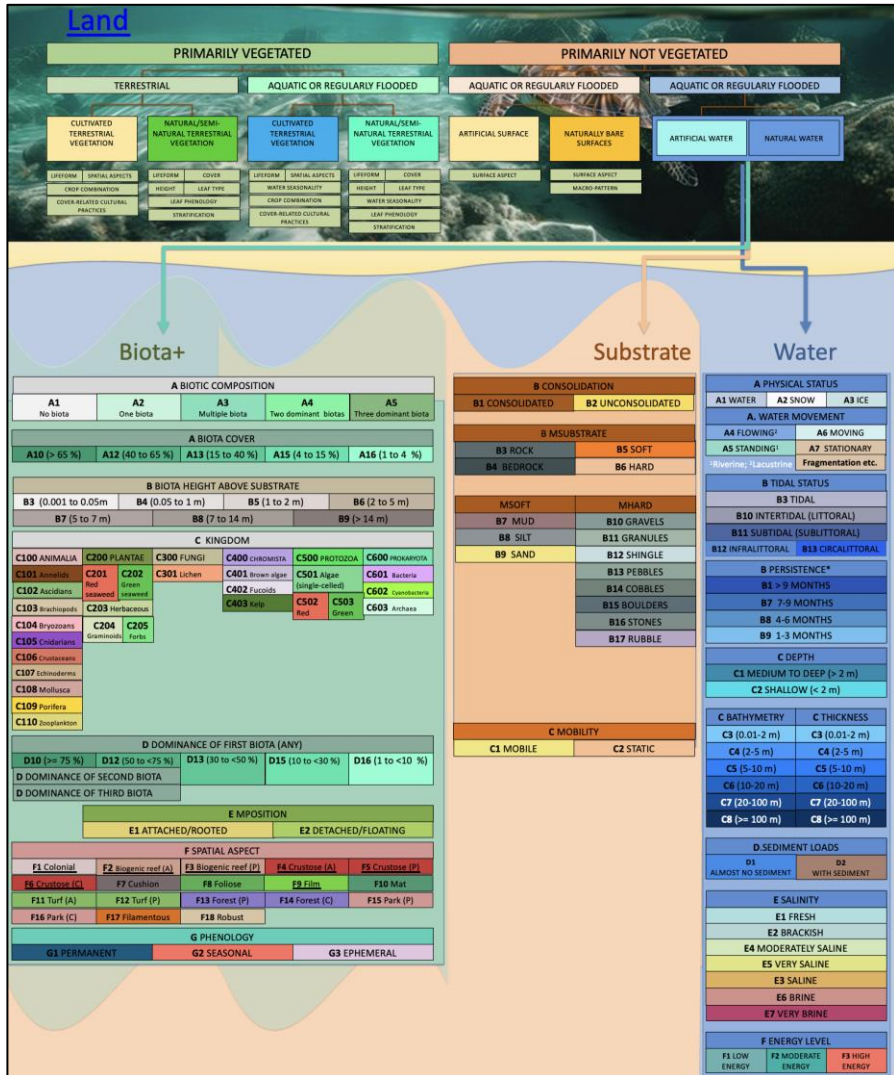


Generated according to
 the FAO LCCS

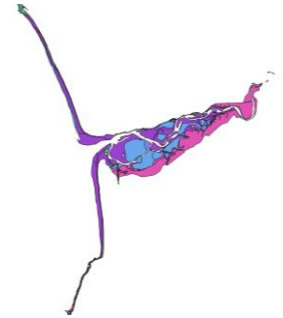


Underwater Domains

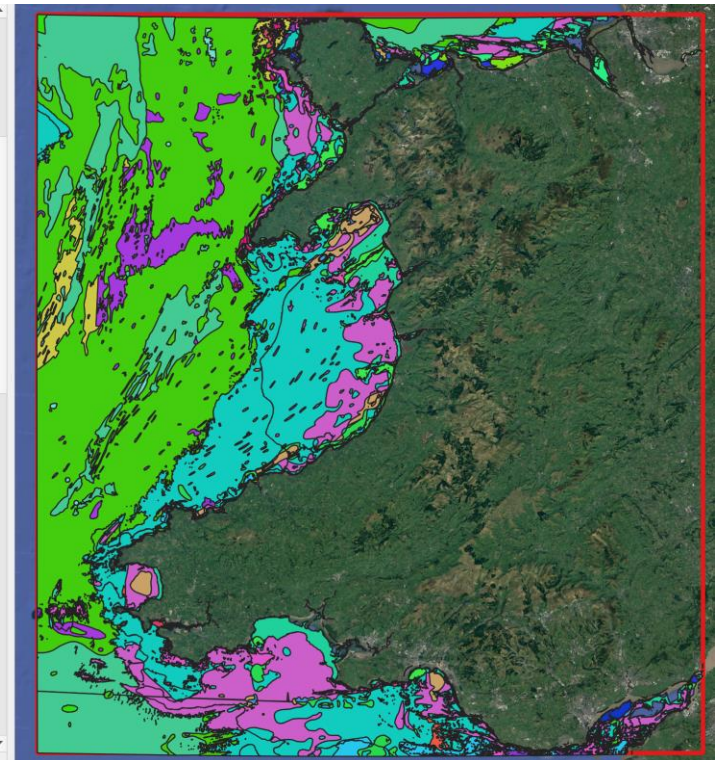
Whilst the FAO LCCS allows classification of some aquatic environments based on environmental descriptors, a new 'water-relevant' taxonomy has been developed to facilitate construction of maps of freshwater, intertidal and subtidal environments from relevant environmental descriptors retrieved primarily from Earth observation data.



- LEVEL 1
 - LEVEL 2
 - LEVEL 3
 - LEVEL 4
 - LEVEL 5
 - LEVEL 6
- Marine
 - Littoral rock (and other hard substrata)
 - High energy littoral rock
 - Mussel and/or barnacle communities
 - Mytilus edulis and barnacles on very exposed eulittoral rock
 - Citharus spp. on exposed eulittoral rock
 - Citharus spp. and Littorina pygmaea on steep exposed upper eulittoral rock
 - Semibalanus balanoides on exposed to moderately exposed or vertical sheltered eulittoral rock
 - Semibalanus balanoides, Patella vulgata and Littorina spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
 - Semibalanus balanoides, Fucus vesiculosus and red seaweeds on exposed to moderately exposed eulittoral rock
 - Semibalanus balanoides and Littorina spp. on exposed to moderately exposed eulittoral boulders and cobbles
 - Robust fucoiid and/or red seaweed communities
 - Fucus distichus and Fucus spiralis f. nana on extremely exposed upper shore rock
 - Corallina officinalis on exposed to moderately exposed lower eulittoral rock
 - Corallina officinalis and Mastocarpus stellatus on exposed to moderately exposed lower eulittoral rock
 - Corallina officinalis, Himantalia elongata and Patella lysipponensis on very exposed lower eulittoral rock
 - Himantalia elongata and red seaweeds on exposed to moderately exposed lower eulittoral rock
 - Palmaria palmata on very exposed to moderately exposed lower eulittoral rock

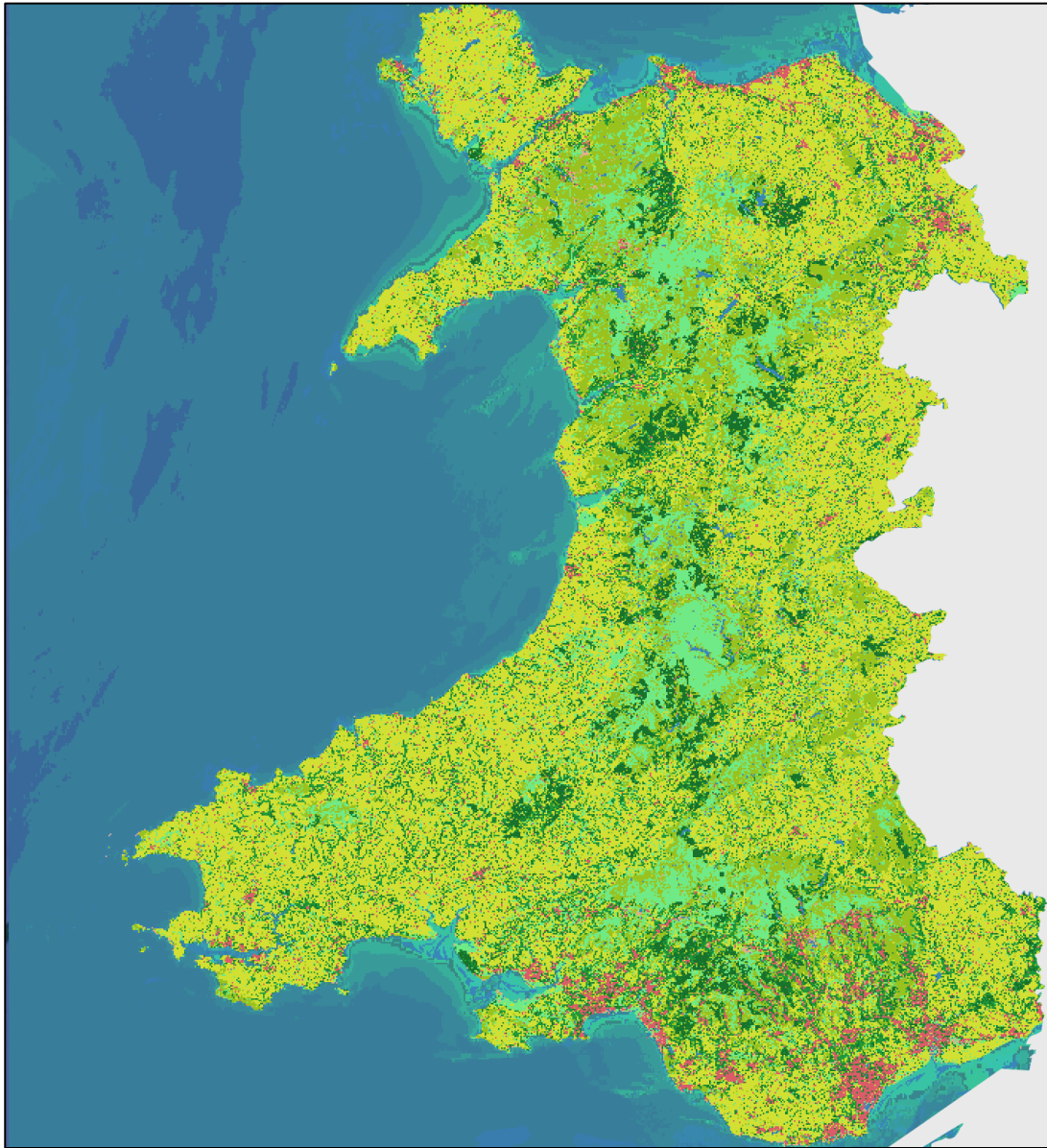


- EUSeaMap_2023-broadscale_pred_habmap_Cym_clip**
- A3.1: Atlantic and mediterranean high energy infralittoral rock
 - A3.2: Atlantic and mediterranean low energy infralittoral rock
 - A3.3: Atlantic and mediterranean low energy infralittoral rock
 - A3: Infralittoral rock and other hard substrata
 - A4.1: Atlantic and mediterranean high energy circalittoral rock
 - A4.12 or A4.27 or A4.33: Sponge communities on deep circalittoral rock or Faun
 - A4.12: Sponge communities on deep circalittoral rock
 - A4.2: Atlantic and Mediterranean moderate energy circalittoral rock
 - A4.27: Faunal communities on deep moderate energy circalittoral rock
 - A4.3: Atlantic and Mediterranean low energy circalittoral rock
 - A4.33: Faunal communities on deep low energy circalittoral rock
 - A4: Circalittoral rock and other hard substrata
 - A5.13: Infralittoral coarse sediment
 - A5.14: Circalittoral coarse sediment
 - A5.15: Deep circalittoral coarse sediment
 - A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand
 - A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand
 - A5.27: Deep circalittoral sand
 - A5.33: Infralittoral sandy mud
 - A5.34: Infralittoral fine mud
 - A5.35: Circalittoral sandy mud
 - A5.36: Circalittoral fine mud
 - A5.37: Deep circalittoral mud
 - A5.43: Infralittoral mixed sediments
 - A5.435: Oyster beds on shallow sublittoral muddy mixed sediment
 - A5.44: Circalittoral mixed sediments
 - A5.45: Deep circalittoral mixed sediments
 - A5.6: Sublittoral biogenic reefs
 - A5.61: Sublittoral polychaete worm reefs on sediment
 - A5.611: [Sabellaria spinulosa] on stable circalittoral mixed sediment
 - A5.612: Sabellaria alveolata on variable salinity sublittoral mixed sediment
 - A5.62: Sublittoral mussel beds on sediment
 - A5.625: [Mytilus edulis] beds on sublittoral sediment
 - Circalittoral seabed
 - Deep circalittoral seabed

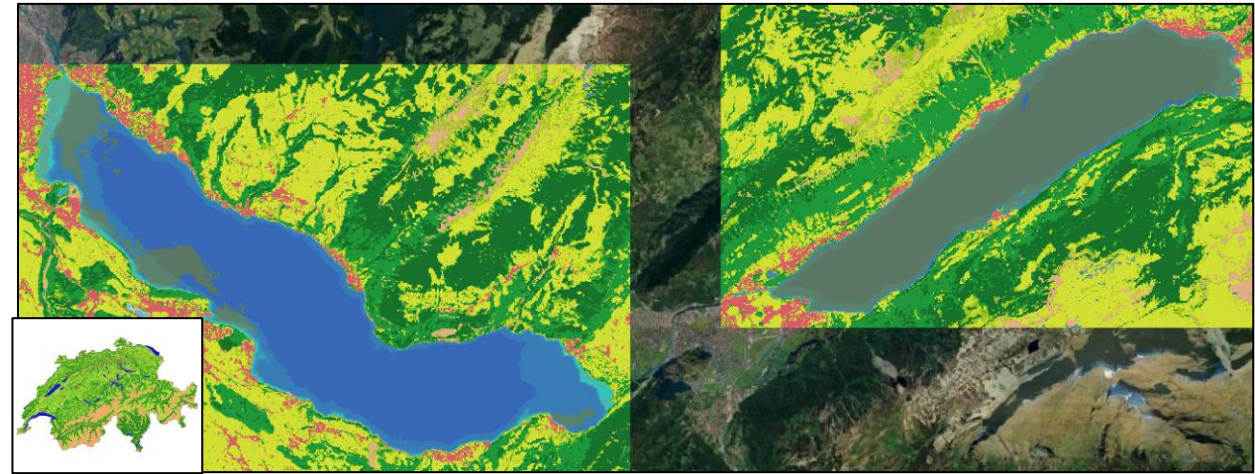


Integrated within
Living Earth
code

Case Studies: Land and Water Classifications



Living Wales – Land and Water Integration



Swiss Data Cube – Lake Biota and Turbidity

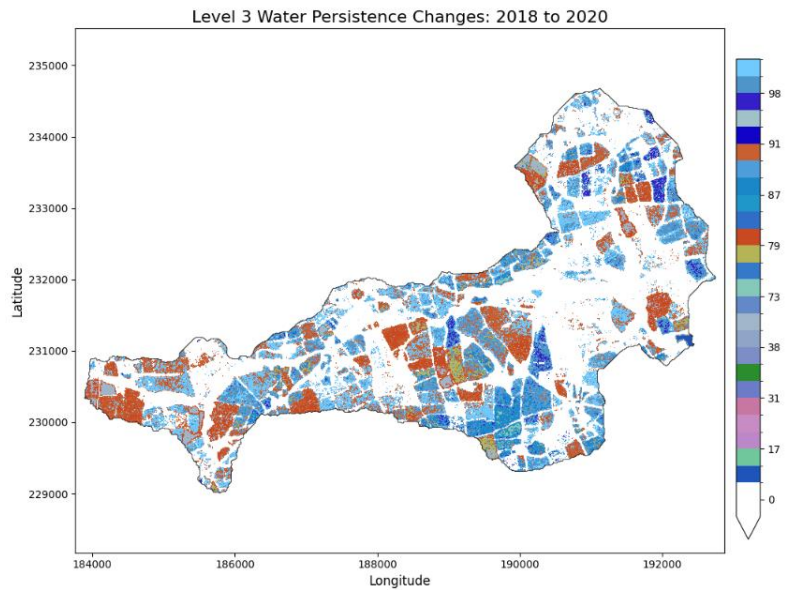
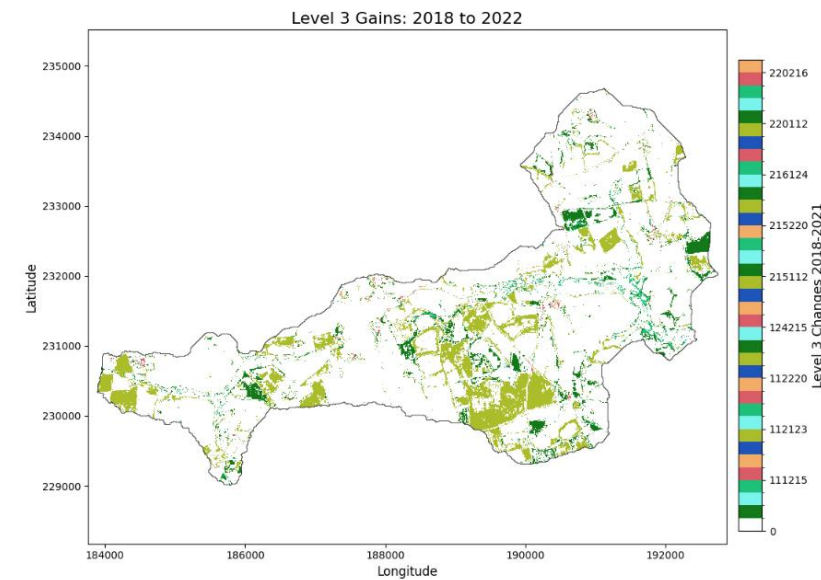
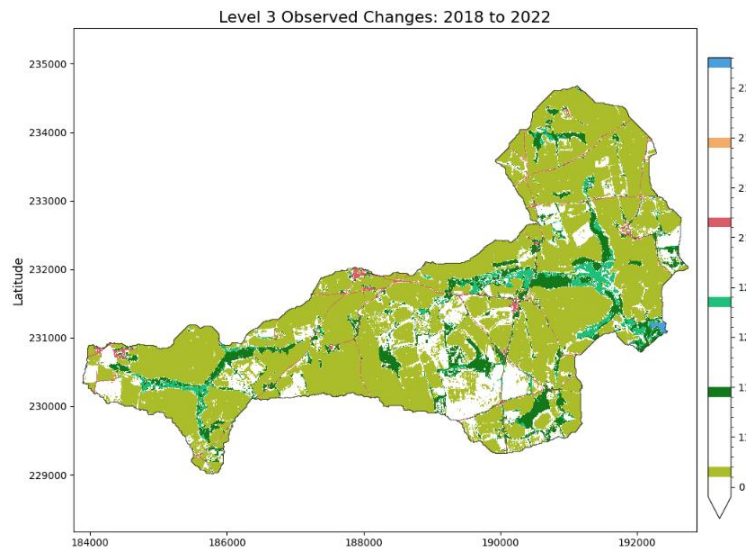
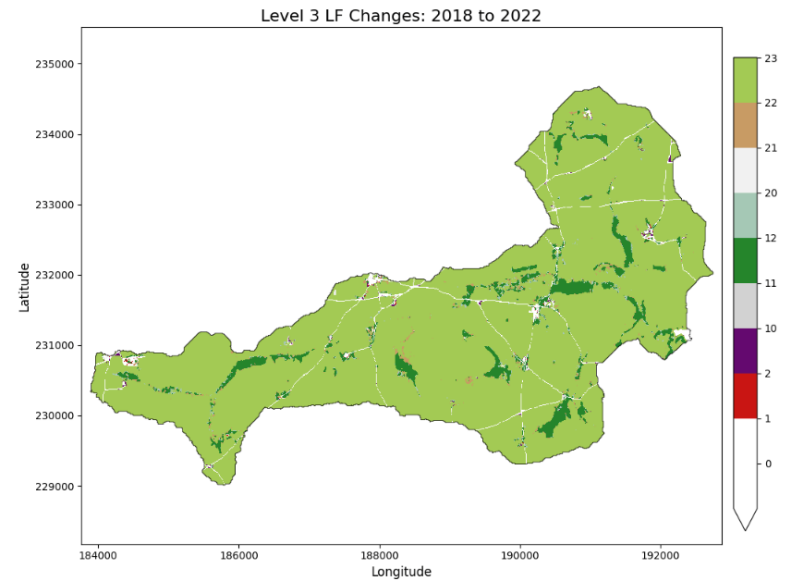
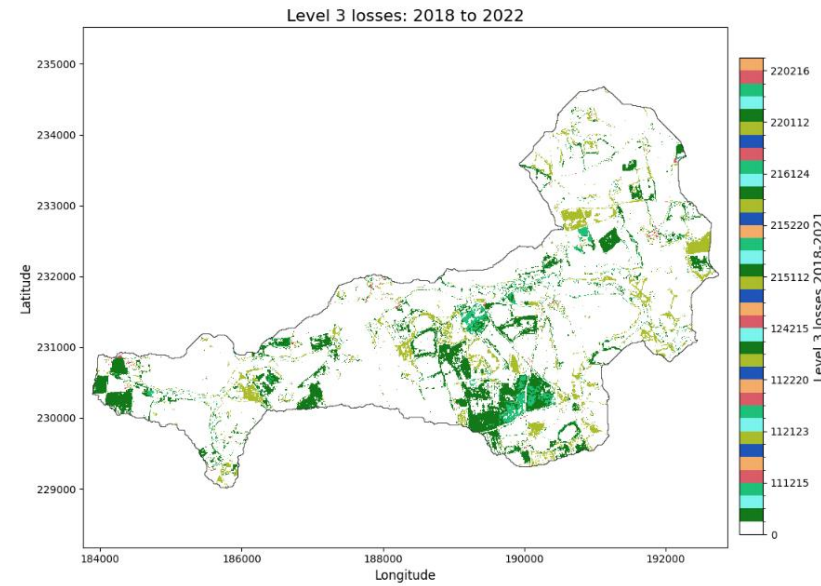
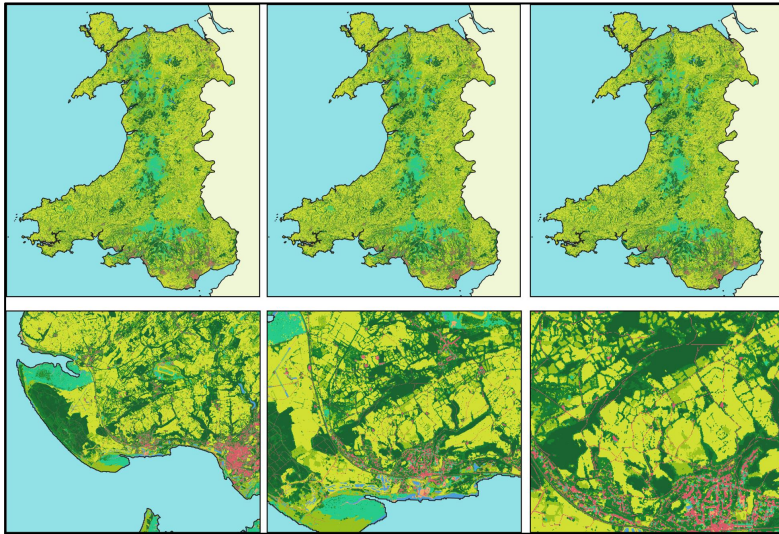


Papua New Guinea

Integration of information on corals, seagrass and turbidity

Full colour schemes for a potential 160,000 water classes.

Evidence-Based Framework Used to Identify Land Cover Change



Evidence-Based Change

Global Change Biology / Volume 28, Issue 21 / p. 6293-6317

RESEARCH ARTICLE | [Open Access](#) | 

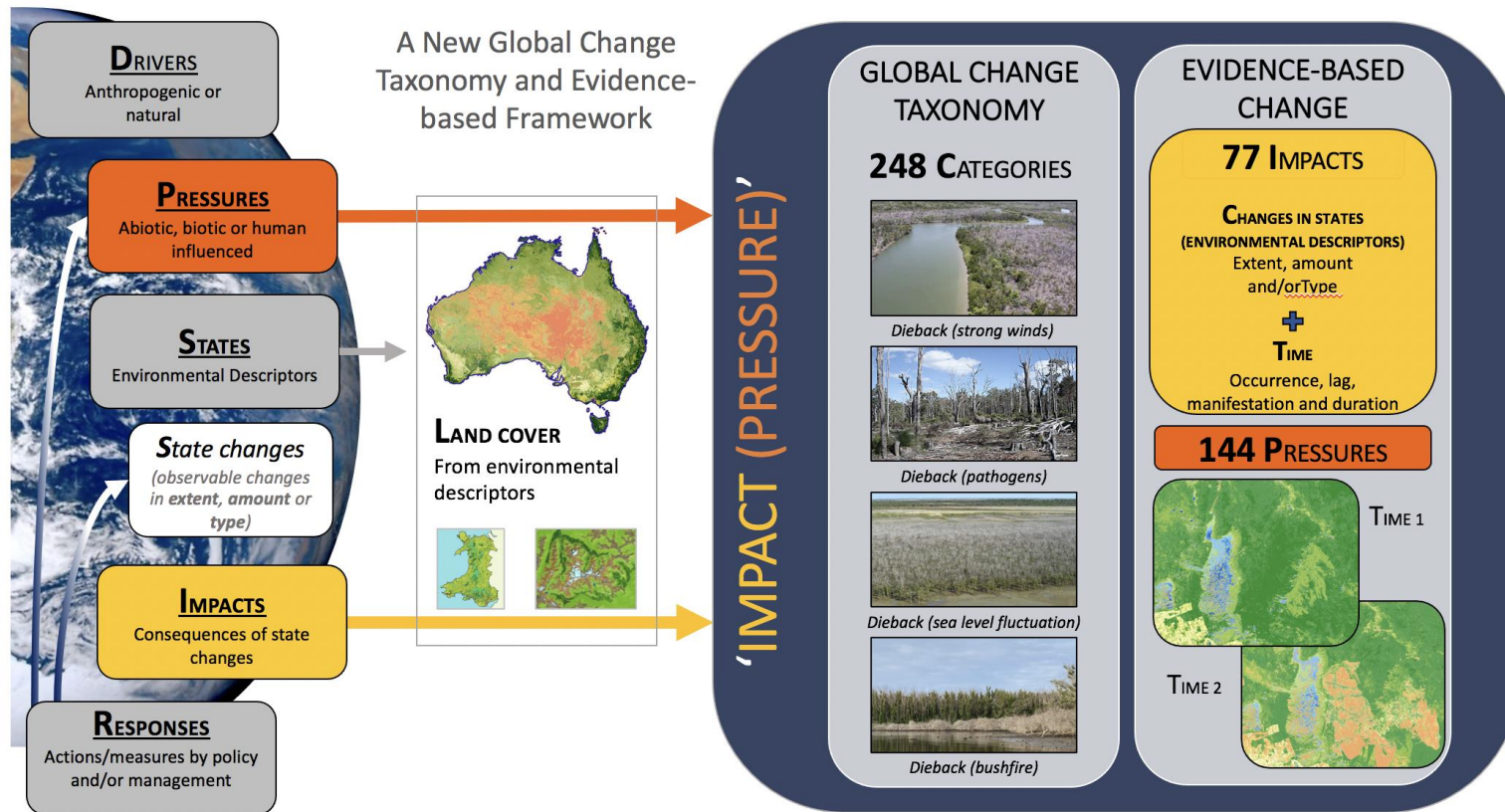
A globally relevant change taxonomy and evidence-based change framework for land monitoring

Richard M. Lucas  Sophia German, Graciela Metternicht, Rebecca K. Schmidt, Christopher J. Owers, Suzanne M. Prober, Anna E. Richards, Sally Tetreault-Campbell, Kristen J. Williams ... [See all authors](#)

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<https://doi.org/10.1111/gcb.16346>

Integrates:

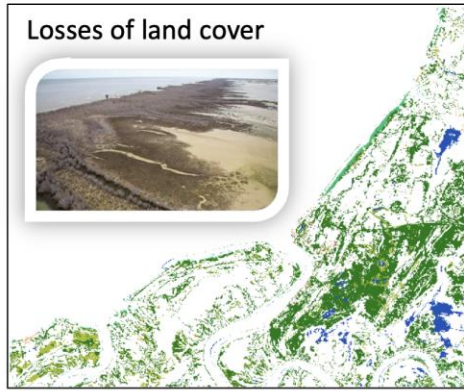
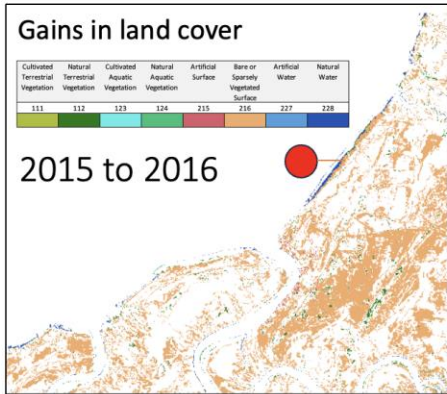
- Observed change
- Evidence for impacts
- Evidence for pressures



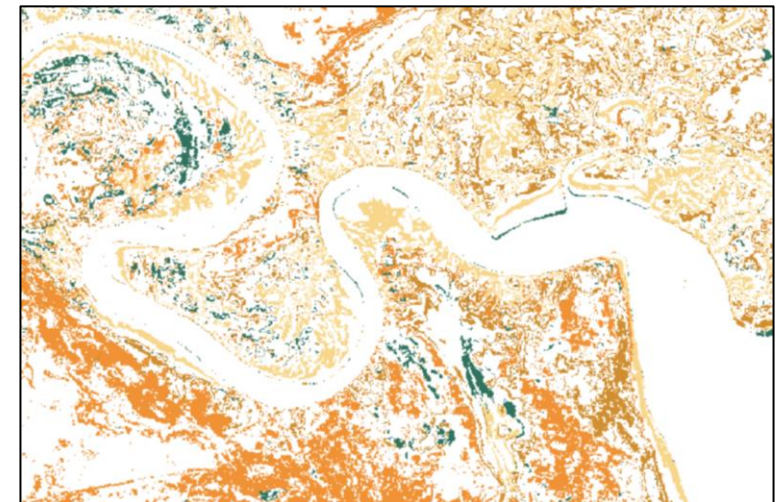
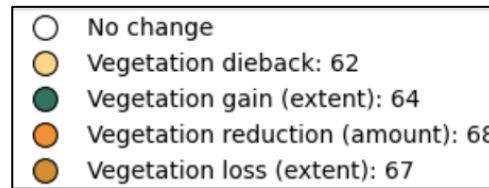
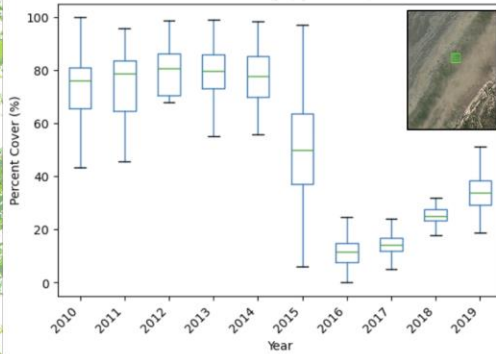
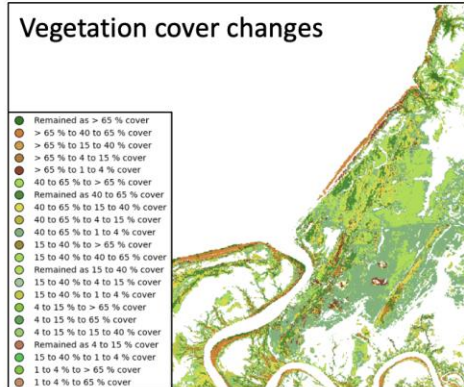
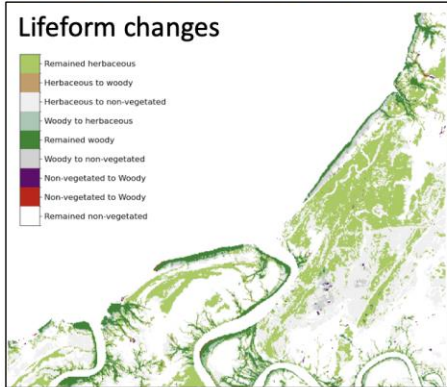
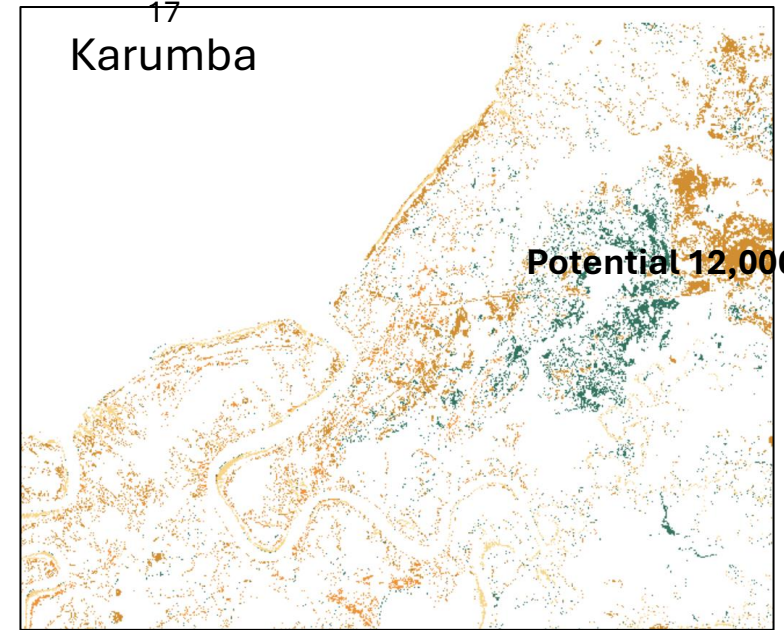
Living Earth partners developed Evidence-Based Change Framework with this building on the Driver-Pressure-State-Impacts-Response (DPSIR) framework and a Global Change Taxonomy. Currently, **77** impact and **144** pressure terms are defined, forming **246** combined 'impact(pressure)' classes. The use of EDs with pre-defined units and codes ensures scalability of the *Living Earth* approach across space and time.

Comparisons of LCCS maps and contributing EDs between time-separated periods allows evidence for change impacts to be gathered and linked to driving pressures to ascertain causes and consequences.

Coastal Dynamics – Gulf of Carpentaria, Queensland

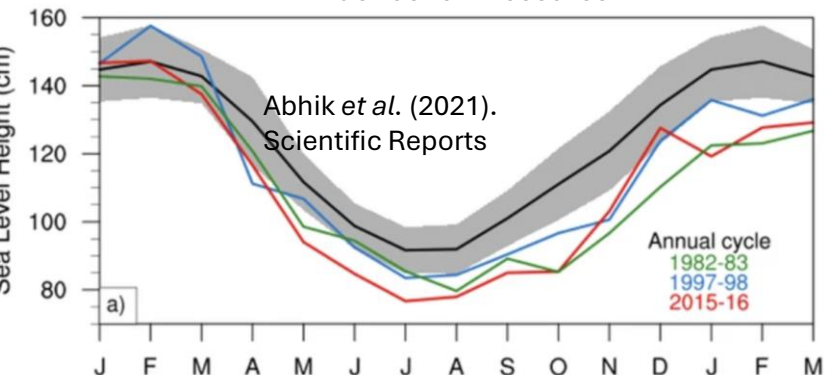


Evidence for impacts - 2014-



Roper River

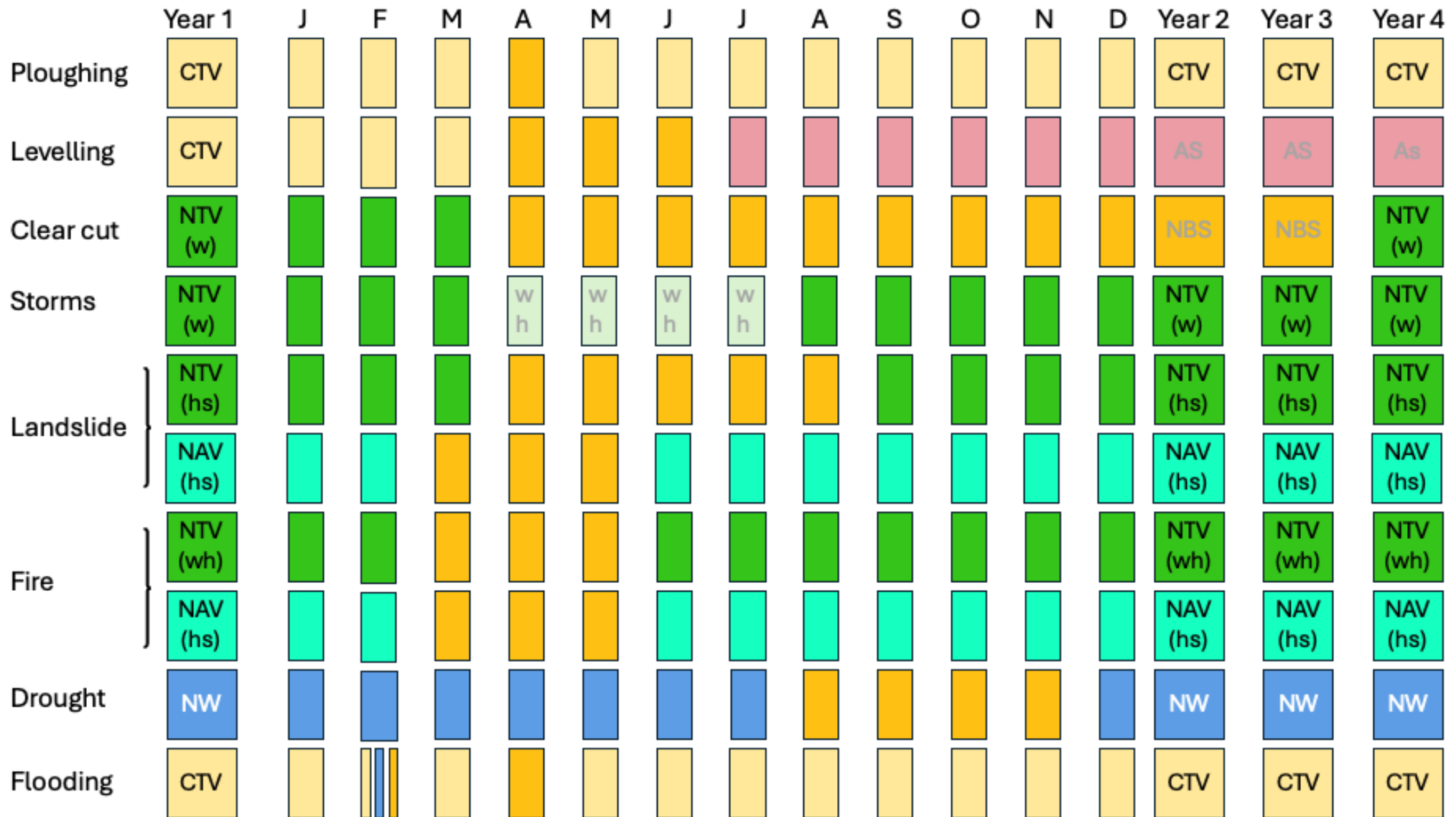
Evidence for Pressures



77 Potential Impacts discerned from evidence
144 Potential Pressures

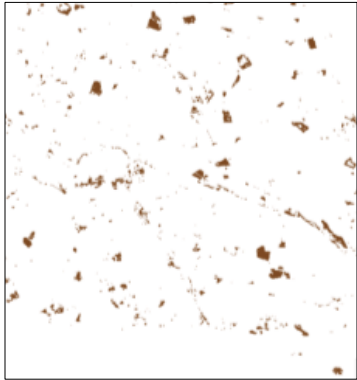
E.g., Vegetation (mangrove) dieback (sea level fluctuation)

Pressures: *Sub-annual (from Land Cover)*

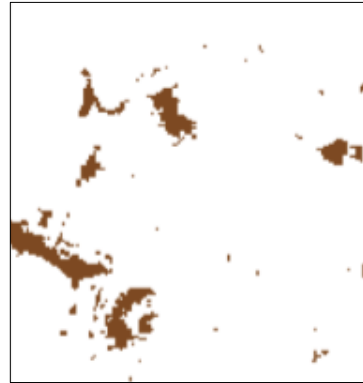


Pressures: *Sub-annual*

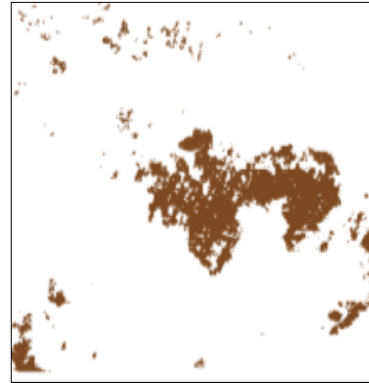
Ploughing



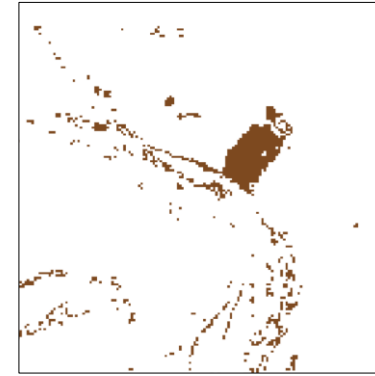
Clear Cuts



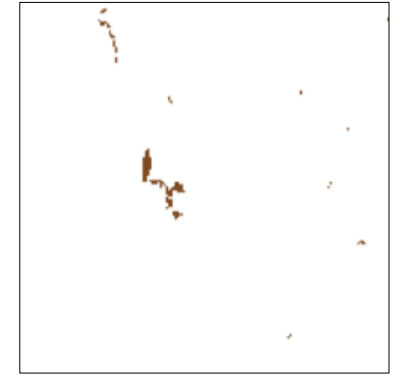
Fire



Landslide



Drought



Cultivated Terrestrial Vegetation	Natural Terrestrial Vegetation	Cultivated Aquatic Vegetation	Natural Aquatic Vegetation	Artificial Surface	Bare or Sparsely Vegetated Surface	Artificial Water	Natural Water
111	112	123	124	215	216	227	228



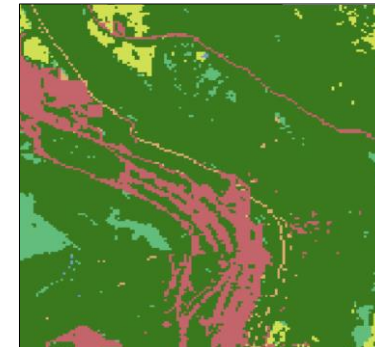
Cultivated Terrestrial Vegetation



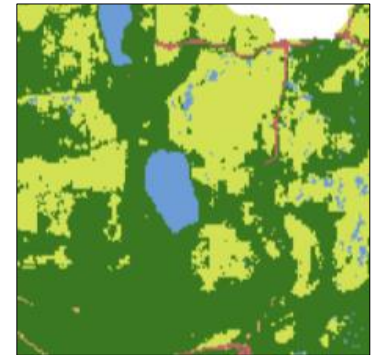
Natural Terrestrial Vegetation (Woody)



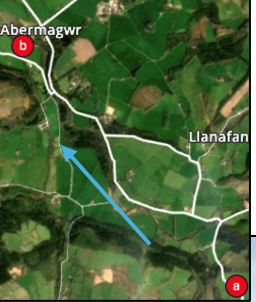
Natural Aquatic Vegetation (Herbaceous)



Natural Terrestrial Vegetation (Herbaceous)



Water



FOREST (PLANTATION)



PAST OBSERVATIONS
(Impacts – Pressures)

WATERCOURSE



MARINE ENVIRONMENT



Bare surface exposure
Clear cutting (forests)

Erosion
(Excess precipitation)

Surface elevation change
(Erosion)



24th March 2025

31st March 2025

Simultaneous 'impacts (pressures)'



6th July 2025

Increased sediment load
(sediment transport)



5th August 2025

Accretion
(sediment transport)

Simultaneous 'impacts (pressures)'



7th July 2025

Water quality change
(Nutrification)



5th August 2025

Accretion
(sediment transport)

Simultaneous 'impacts (pressures)'

TIME

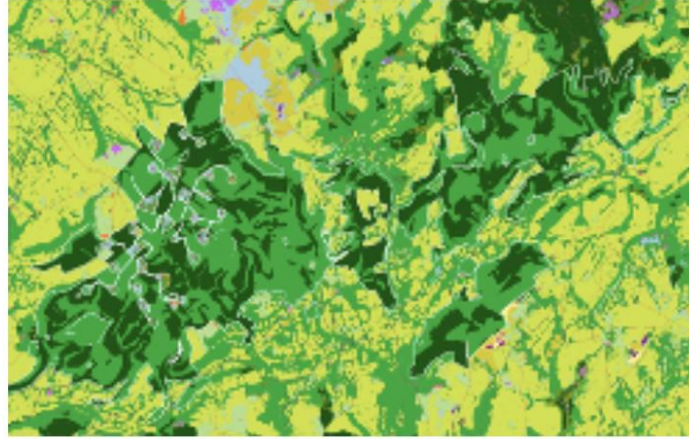


Working Towards Future Landscapes



(RE)IMAGINING

What would we like to see?



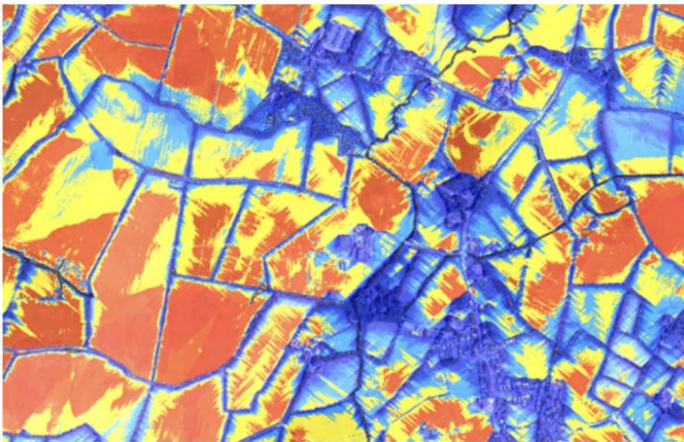
VALUING

How can we place a value on what we want?



ASSESSING RISK

How can we identify threats?



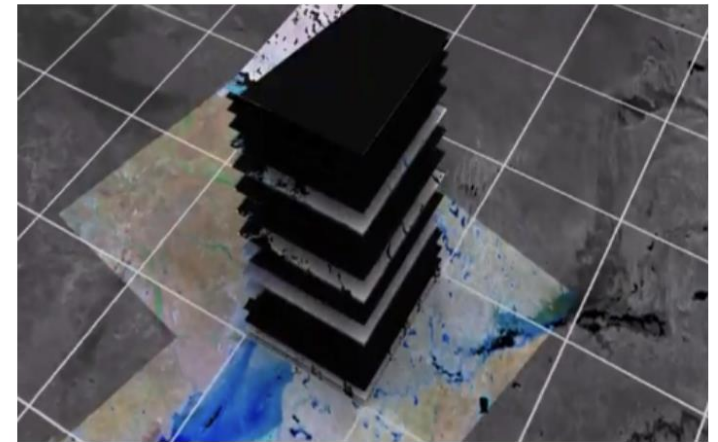
REALISING

How can we be certain?



HARMONISING

How can we agree and co-design?



MONITORING

How can we track progress towards our ambitions?

Earthtrack (Land, Water and Futures)





Living Earth: An Expanding Resource



Thank you to all contributors and collaborators over the years

Australian Traditional owners, past and present



Land cover maps according to the FAO LCCS

The Global Change Taxonomy & Evidence-Based Change Framework

Analysis Ready Data (including EODataDown)

Environmental Descriptors

Land cover maps (e.g., Wales, Australia)

EarthTrack

Open Data Cube implementation and access