



# Yorkshire Integrated Catchment Solutions Programme (iCASP) Project: Don Hidden Heritage Secret Streams

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[www.icasp.org.uk](http://www.icasp.org.uk)

 @YorkshireiCASP

# What is iCASP?

<https://icasp.org.uk/>

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- Using existing environmental science from partner universities to help catchment management by:
  1. Translating existing data, models, knowledge and/or expertise into tools, solutions and approaches;
  2. Embedding new knowledge through secondments;
  3. Advancing academic outputs into commercially-viable products and services.



# iCASP partners



ARUP



Peatland Programme



# iCASP core staff



**Joseph Holden**  
Director



**Dave Hodgson**  
Deputy Director



**Robert Munroe**  
Programme Manager



**Janet Richardson**  
Impact Translation Fellow  
*- Complete the majority of the work in iCASP projects*



**Finn Barlow-Duncan**  
Impact Officer  
*- Matches up research with user needs*



**Benjamin Rabb**  
Impact Translation Fellow  
*- Complete the majority of the work in iCASP projects*



**Marie Ferré**  
Impact Evaluator  
*- Support project and programme impact monitoring and evaluation*



**Susan Ballard**  
Communication Officer  
*- Support communicating science and project results*

# iCASP impact so far (~1.5yr in)...

- £4 million of economic/financial benefits to Yorkshire's economy
- £100 million of business cases supported
- 75 organisations involved



**22 project ideas in development and 10 projects in progress or completed**

# iCASP themes

- Flood and drought risk mitigation
- Flood forecasting and climate resilience
- Peatlands
- Sustainable agriculture
- Water quality



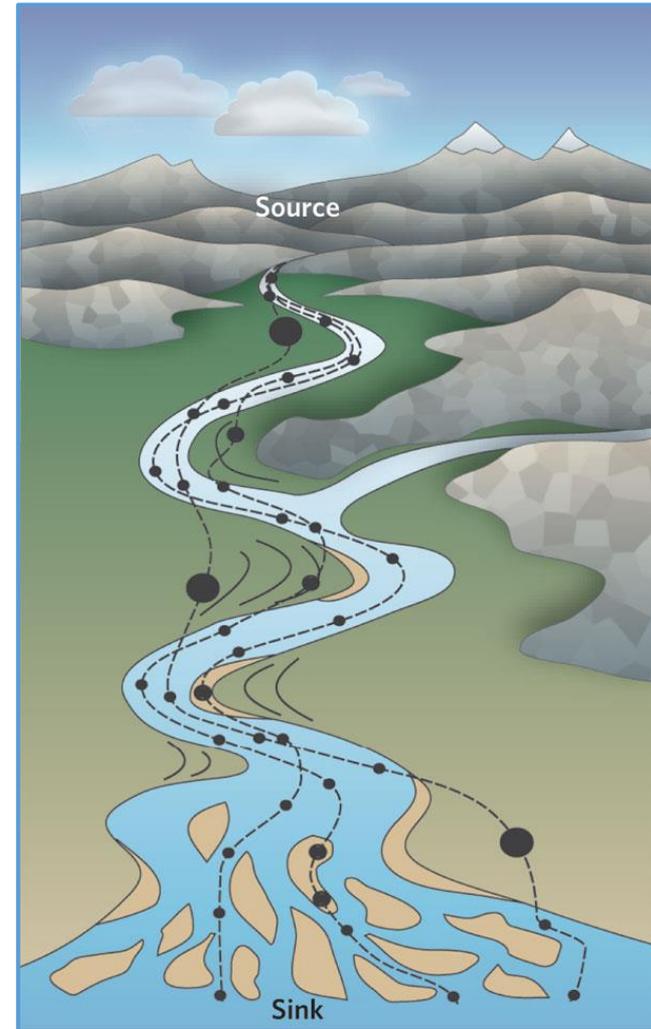
# Catchment issues: diffuse pollution

- Impacts on watercourses from increased sedimentation include:
  - dredging of waterways/reservoirs for flood defence
  - loss of recreation areas
  - impacts on ecology such as protected species (e.g., salmon, trout).
- Increased water treatment costs
- Fine grained sediment (as a diffuse pollutant) is a common reason for a waterbody to **fail** to reach a good ecological WFD standard
- Also contains other pollutants...



# Changing source to sink processes...

- Land-use changes:
  - Changes in roughness, especially in upland areas.
  - Influence suspended sediment volumes, and critical source areas have been investigated in relation to phosphorous
- Changing pathways – ‘artificial drainage’
- Changing stores – sediment traps etc.
- Understanding temporal and seasonal changes in land-use (vegetation cover) are vital for integrated land management decisions, which can be mapped using satellite data.



# Sediment/ erosion risk mapping

- The risk of soil erosion is related to:
  - 1) the availability of sediment e.g., how erodible is the substrate? and;
  - 2) the connectivity to the system e.g., can it reach the network?
- A range of equations exist, a common one is called RULSE (Revised Universal Soil Loss Equation) e.g., Boggs et al., 2001; Lu et al., 2004 etc.

$$A = R * K * L * S * C * P$$

A – average annual soil loss

R – rainfall-runoff erosivity factor

K – soil erodibility factor

L – slope length factor

S – slope steepness factor

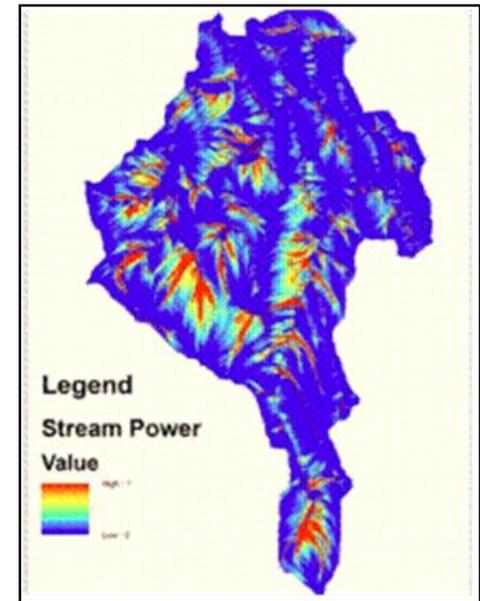
C – cover management / land use

P - support practice factor (e.g., tillage practices)

# GIS mapping e.g., SCIMAP

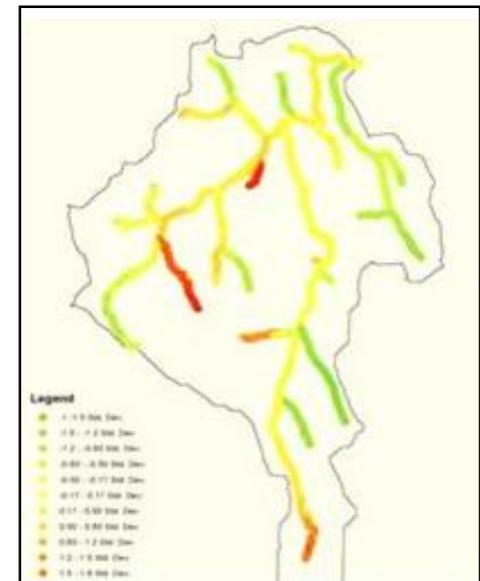
## 1. How erodible is the substrate?

- Land cover vs. energy available to erode material
- Land cover – CORINE / CEH land use maps or satellite data
- Energy – stream power (slope x upstream contributing area)



## 2. Hydrological connectivity

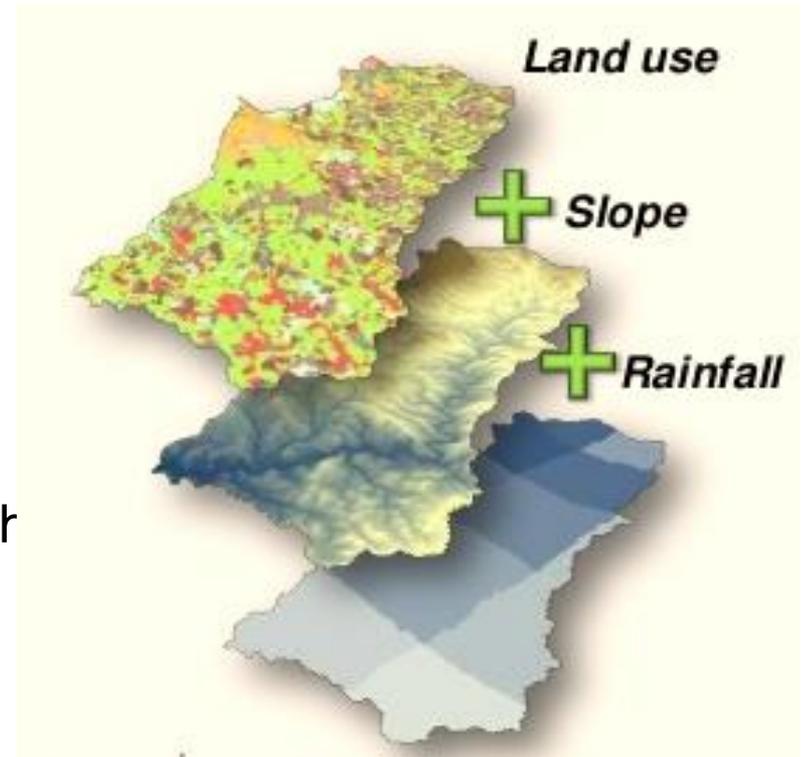
- The ability for the land to produce overland flow and have a route to the main river channel
- Calculated from topographic wetness index and connectivity network index
- Can be calculated from a digital elevation model



<http://www.scimap.org.uk/>

# Models available and assumptions

- Erodibility of substrate is linked to land use
  - Soil / geology is not integrated
- Rainfall is commonly the yearly average
  - Climate change data is not often used
- Land use maps
  - Do not show seasonal variation which is key in agricultural areas



**Data input = DEM, rainfall, land use**

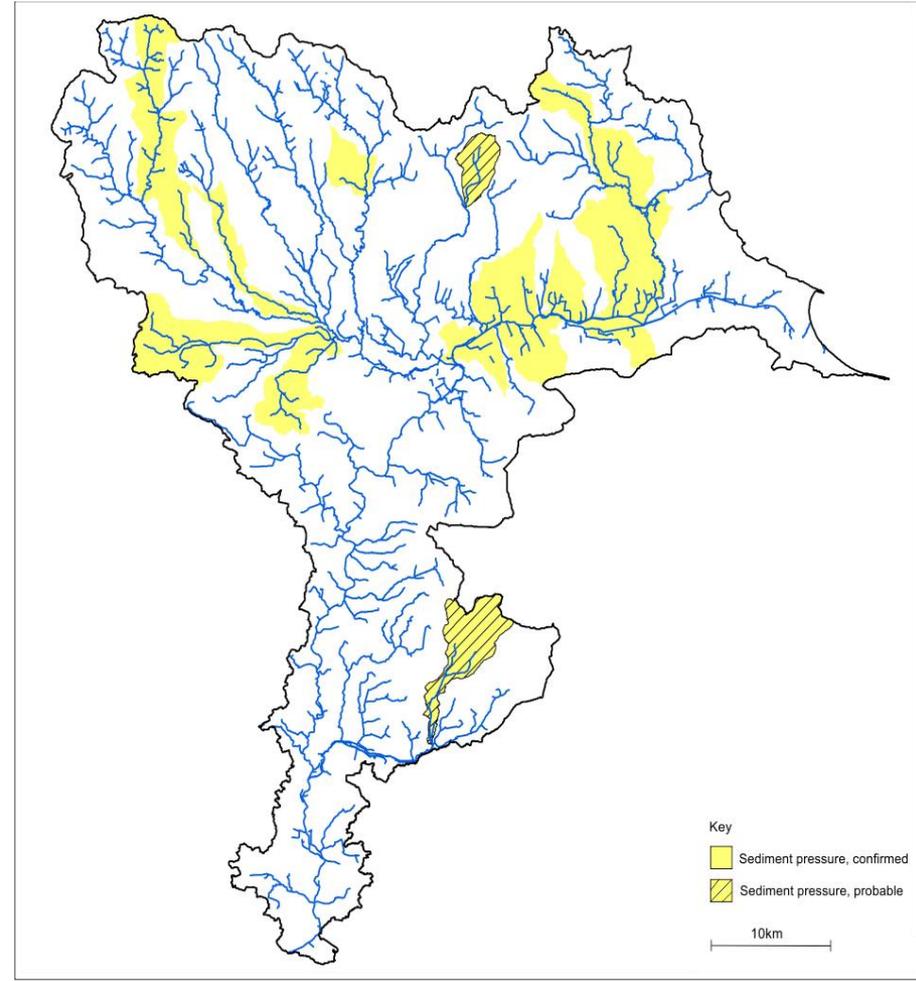
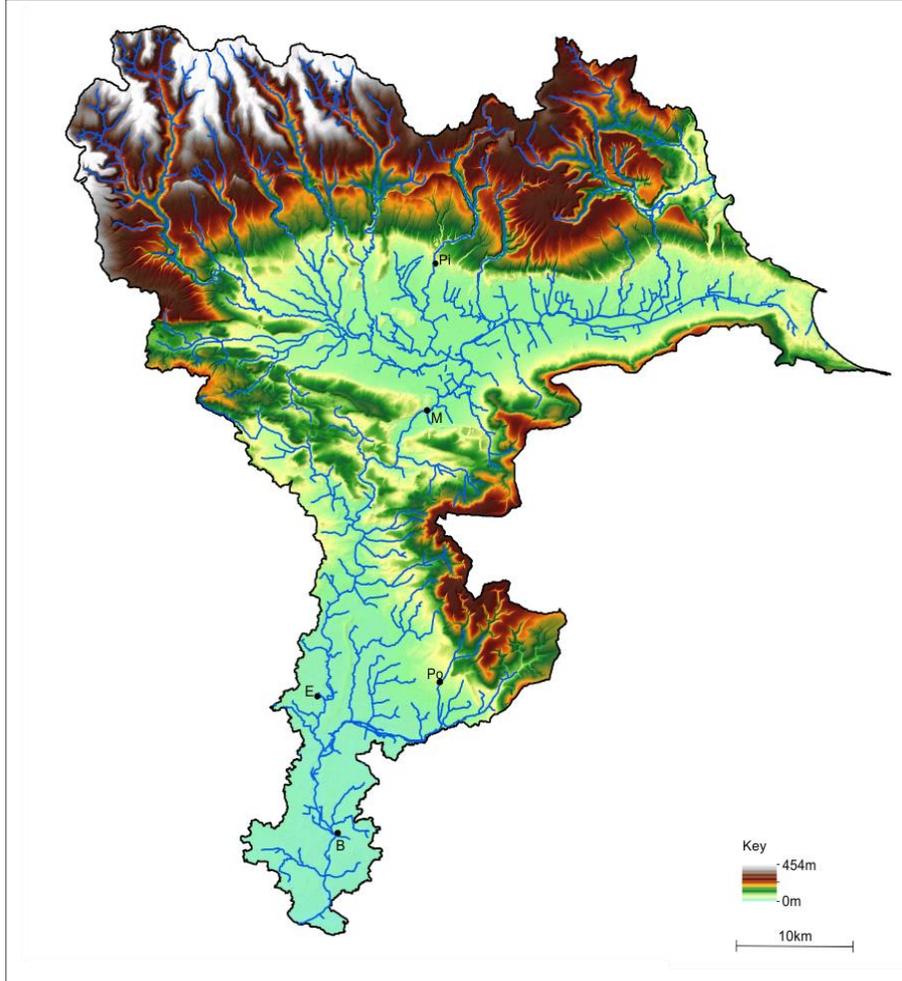
<http://www.scimap.org.uk/>

# A missing piece – bank erosion?

- Recorded in RHS surveys and fluvial audits.
- Visible from aerial imagery.



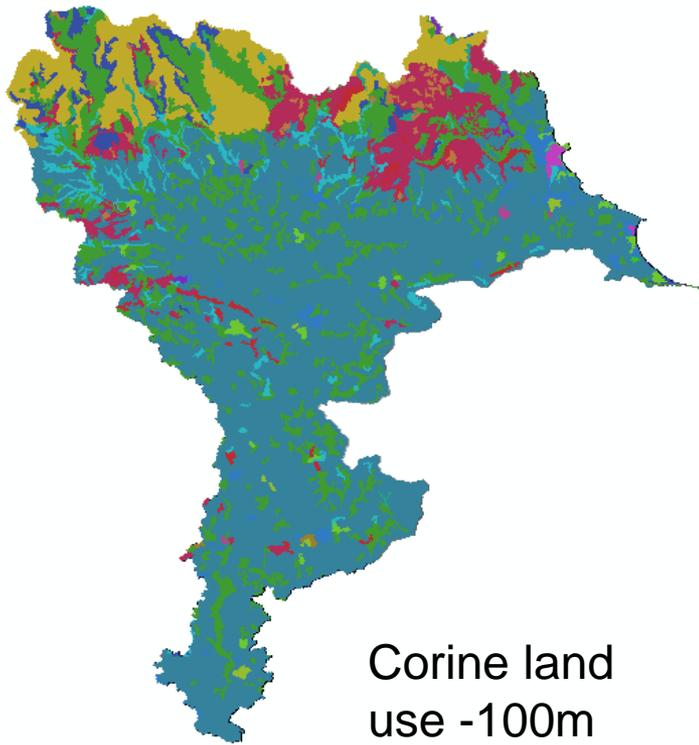
# Case study: River Derwent



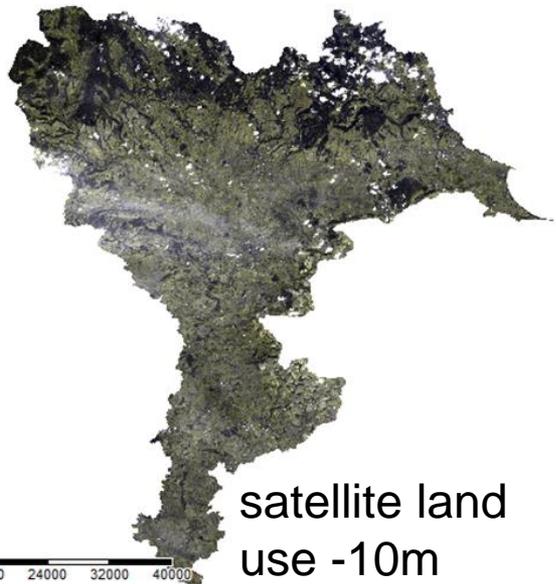
- Areas of both upland and lowlands with intensive agricultural areas.

- Yellow = pressure and reason for WFD failure

# Increasing the resolution of Corine land use maps ....



Corine land use -100m



satellite land use -10m

Properties: 61 Segments

Value	
ID	155101
VALUE	158003.000000
NAME	158003
B2_100216 (MEAN)	1054.817337
B3_100216 (MEAN)	758.207430
B4_100216 (MEAN)	627.000288
Training	5

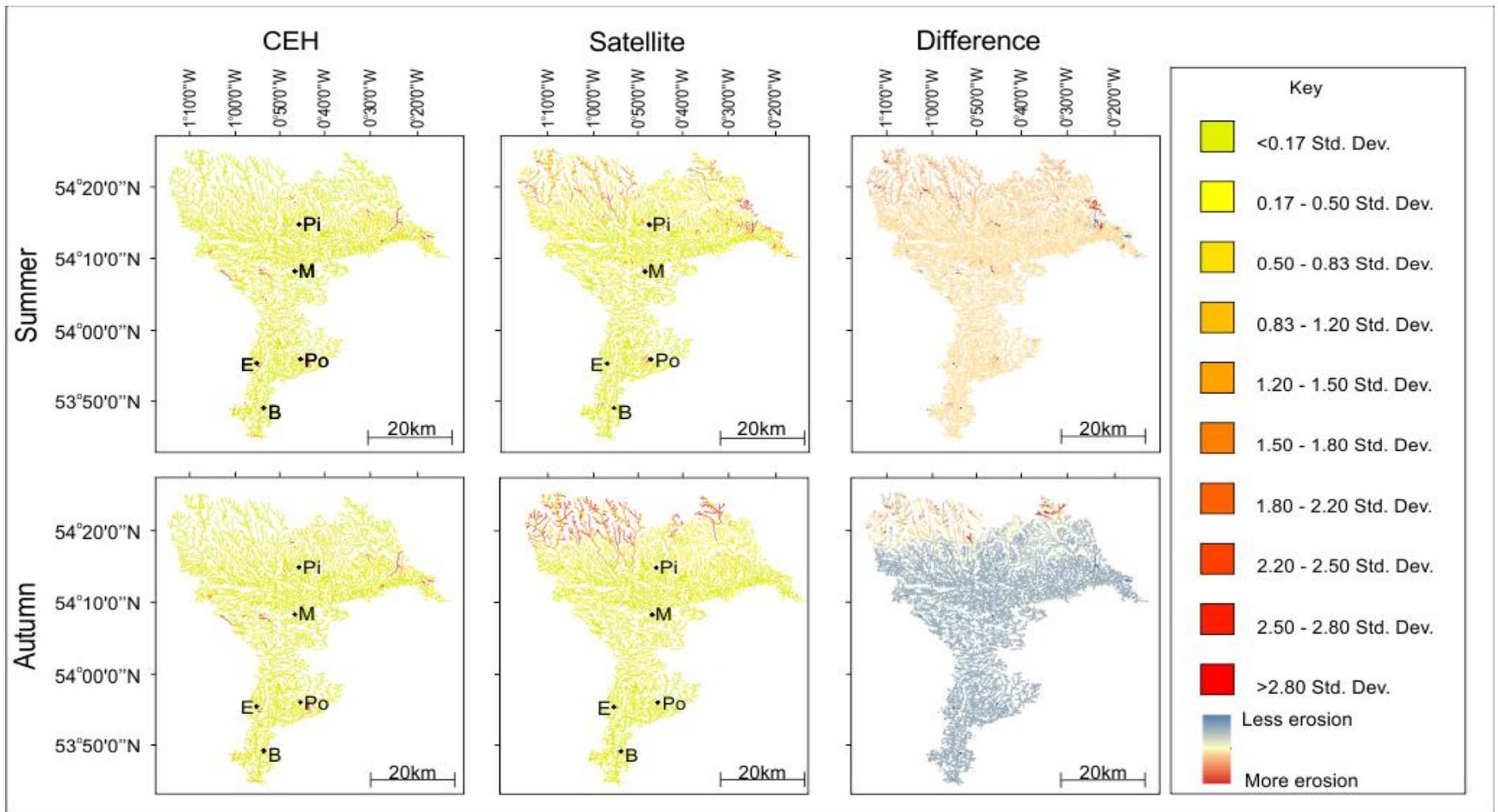
Land-use category

Messages

- [2010-06-25/14:18:35] Loading grid: D:\MF\corine\data2\FEB\Soil Adjusted Vegetation Index.sgd...ok-ty
- [2010-06-25/14:18:42] Loading grid: C:\Users\usayj\Documents\12\_NERC Fellowship\Data\Shapfiles\Cornie\_Devent\_UTM\_8...ok-ty
- [2010-06-25/14:18:44] Project has been successfully loaded
- [2010-06-25/14:25:30] Done: Difference Vegetation Index...ok-ty
- [2010-06-25/14:25:31] Done: Normalized Difference Vegetation Index...ok-ty
- [2010-06-25/14:25:31] Done: Ratio Vegetation Index...ok-ty
- [2010-06-25/14:25:32] Done: Normalized Ratio Vegetation Index...ok-ty
- [2010-06-25/14:25:33] Done: Transformed Vegetation Index...ok-ty
- [2010-06-25/14:25:33] Done: Corrected Transformed Vegetation Index...ok-ty
- [2010-06-25/14:25:34] Done: Thwait's Transformed Vegetation Index...ok-ty
- [2010-06-25/14:25:35] Done: Soil Adjusted Vegetation Index...ok-ty
- [2010-06-25/14:25:38] Done: Segments\_take 2...ok-ty

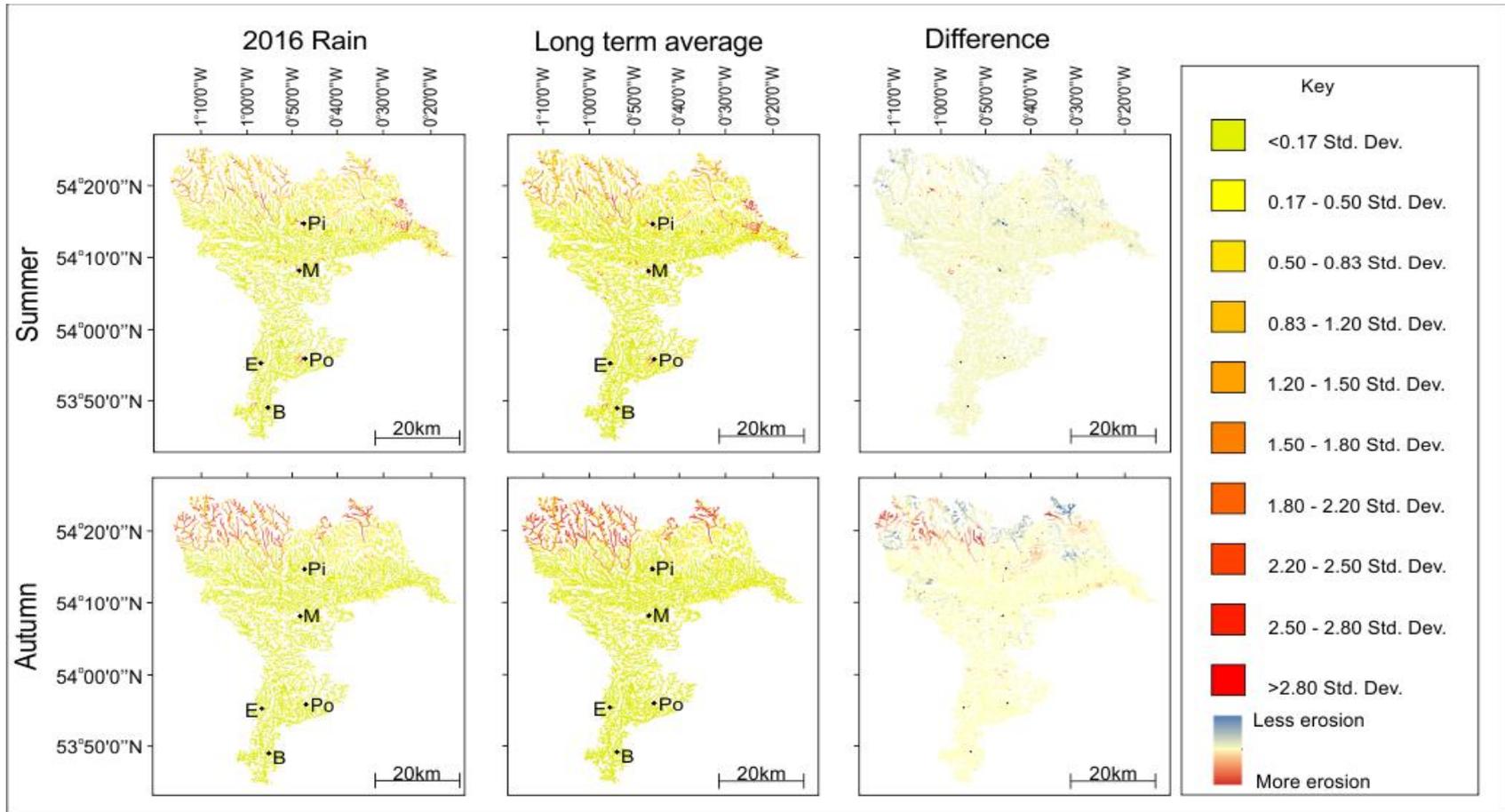
Drag and select some segments of the same land-use

# Seasonal land use maps vs. static



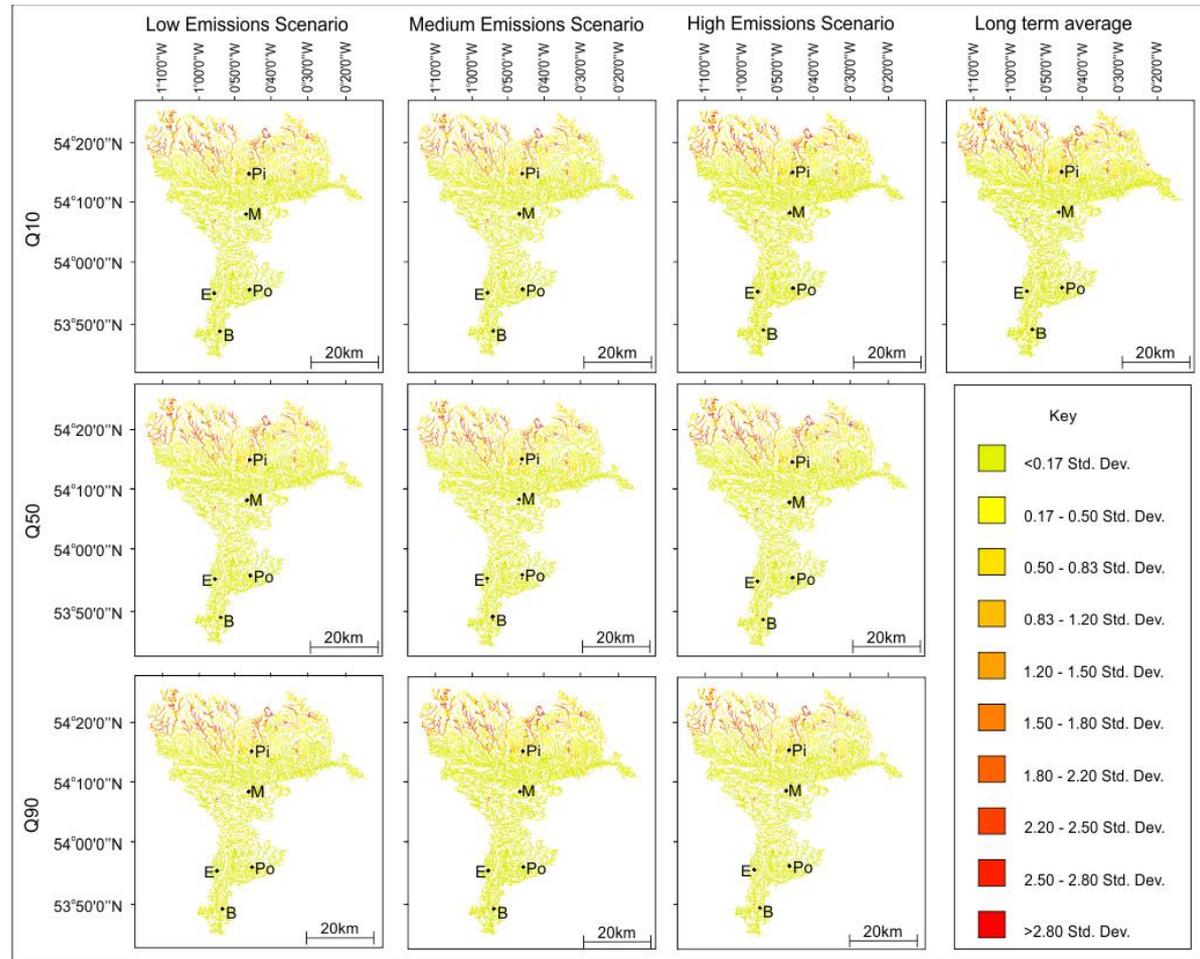
Richardson *et al.*, in prep

# Monthly rainfall vs. long term average



Richardson *et al.*, in prep

# Climate change scenarios

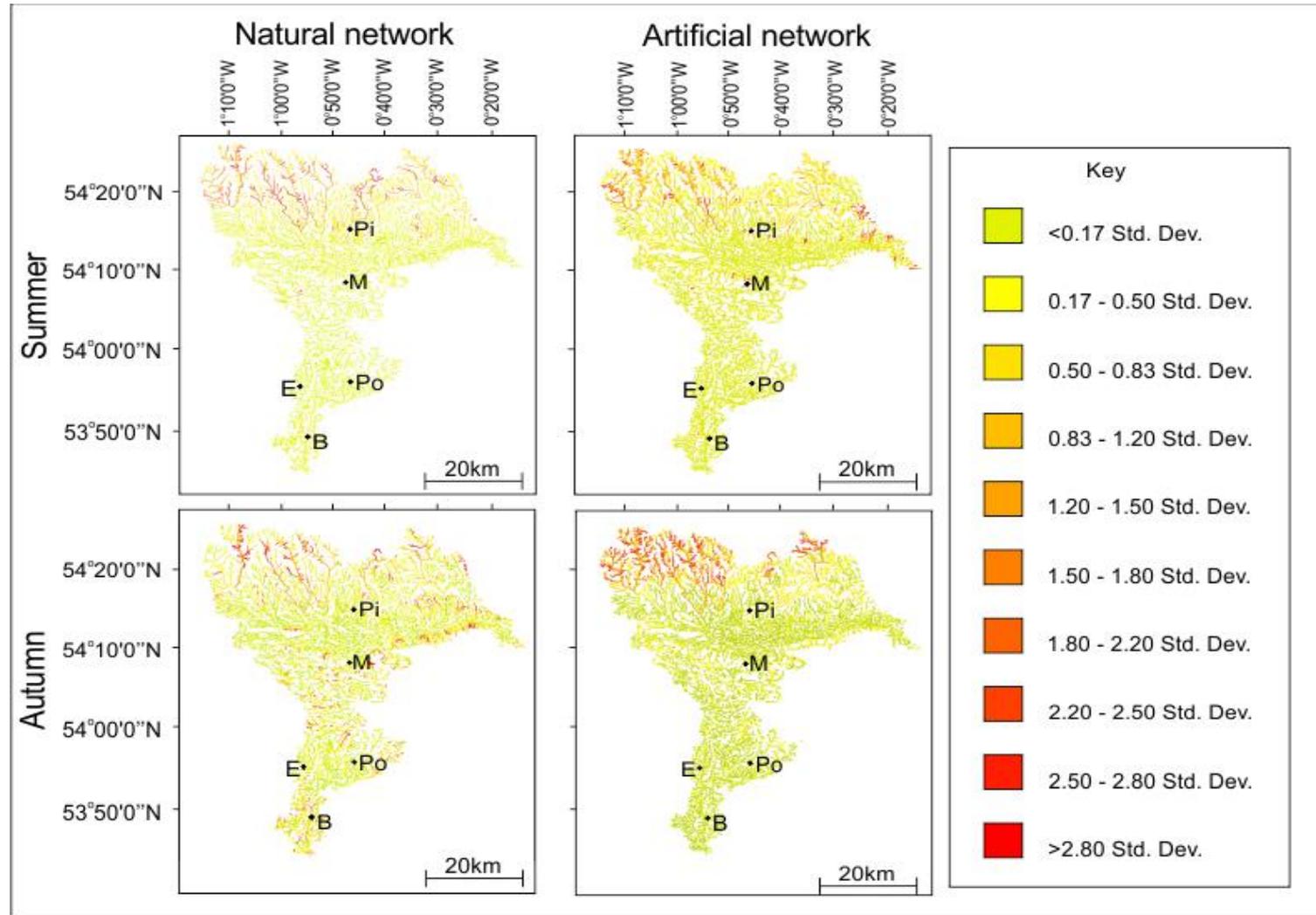


Richardson *et al.*, in prep

# Stream network



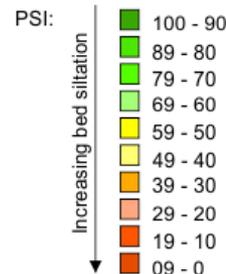
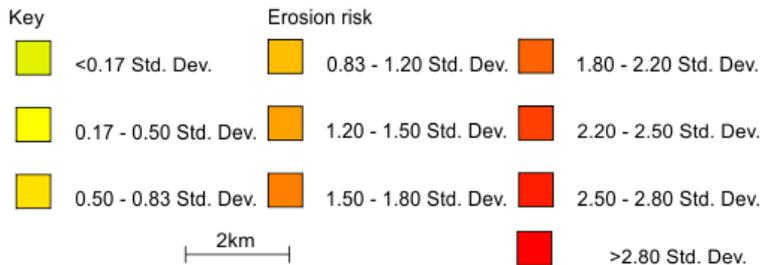
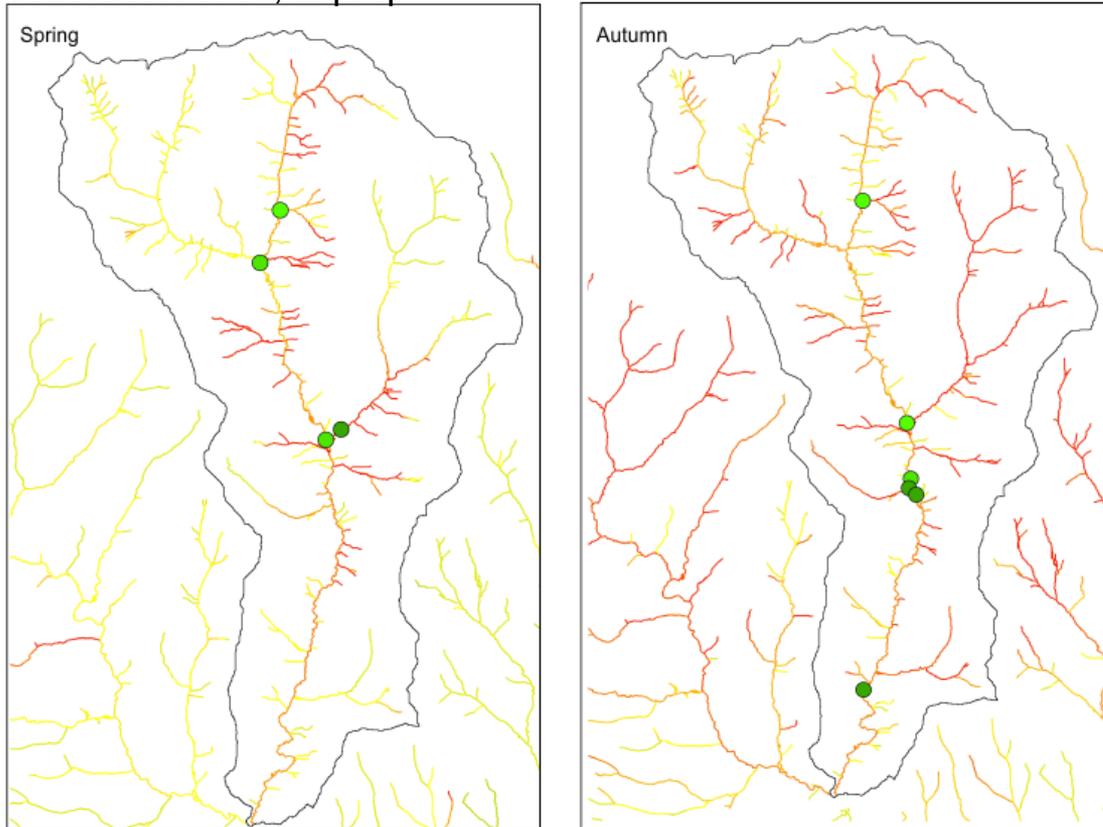
# 'Natural' stream network vs. artificial



Richardson *et al.*, in prep

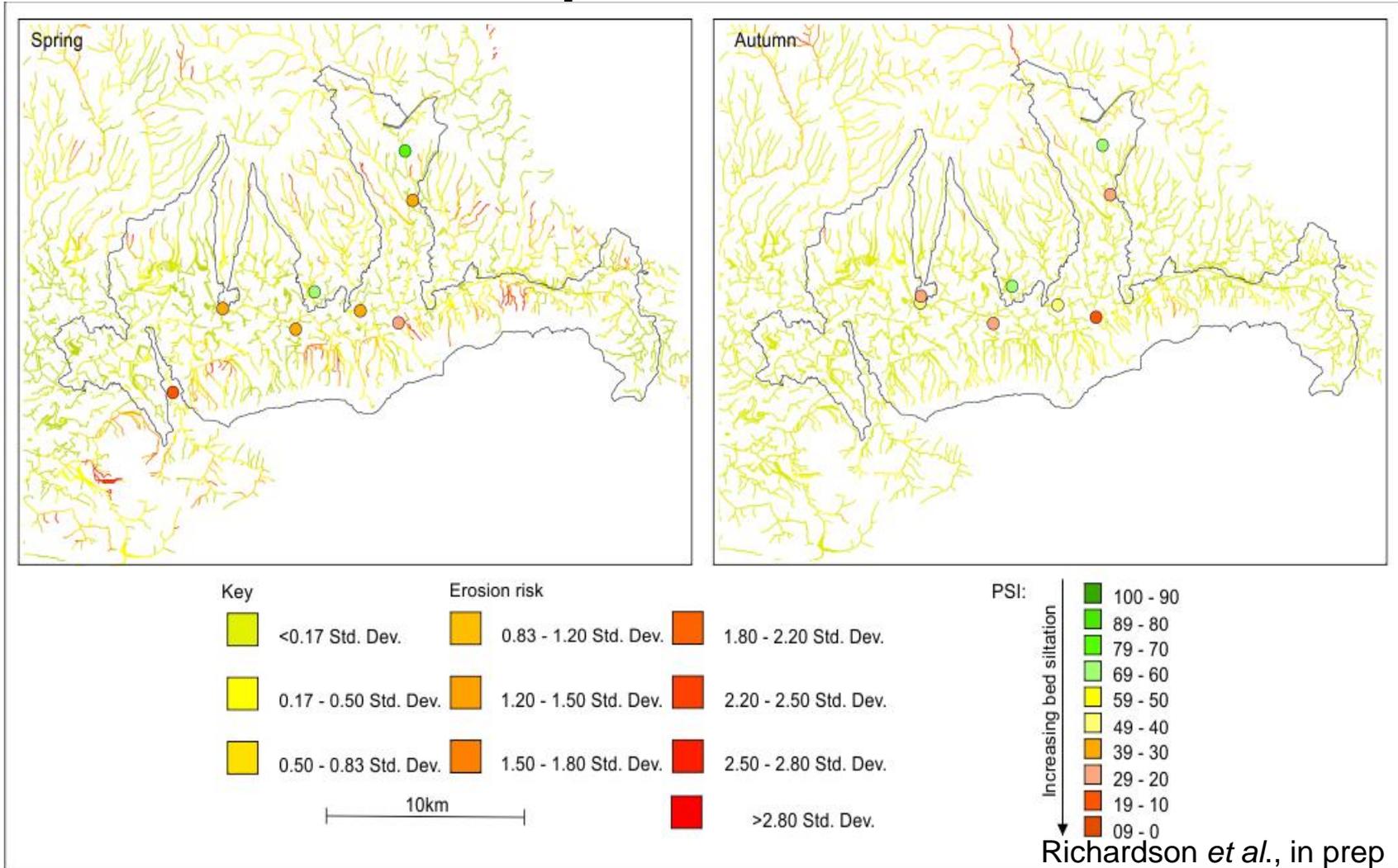
# Ground truthing: sediment sensitive species

Richardson *et al.*, in prep



- River Sefth, Upper Derwent catchment.
- Portion of sediment sensitive species (PSI)
- High values of PSI = sediment eroded here is not impacting the channel (there is enough energy to entrain the sediment).

# Ground truthing: sediment sensitive species



# Fieldwork

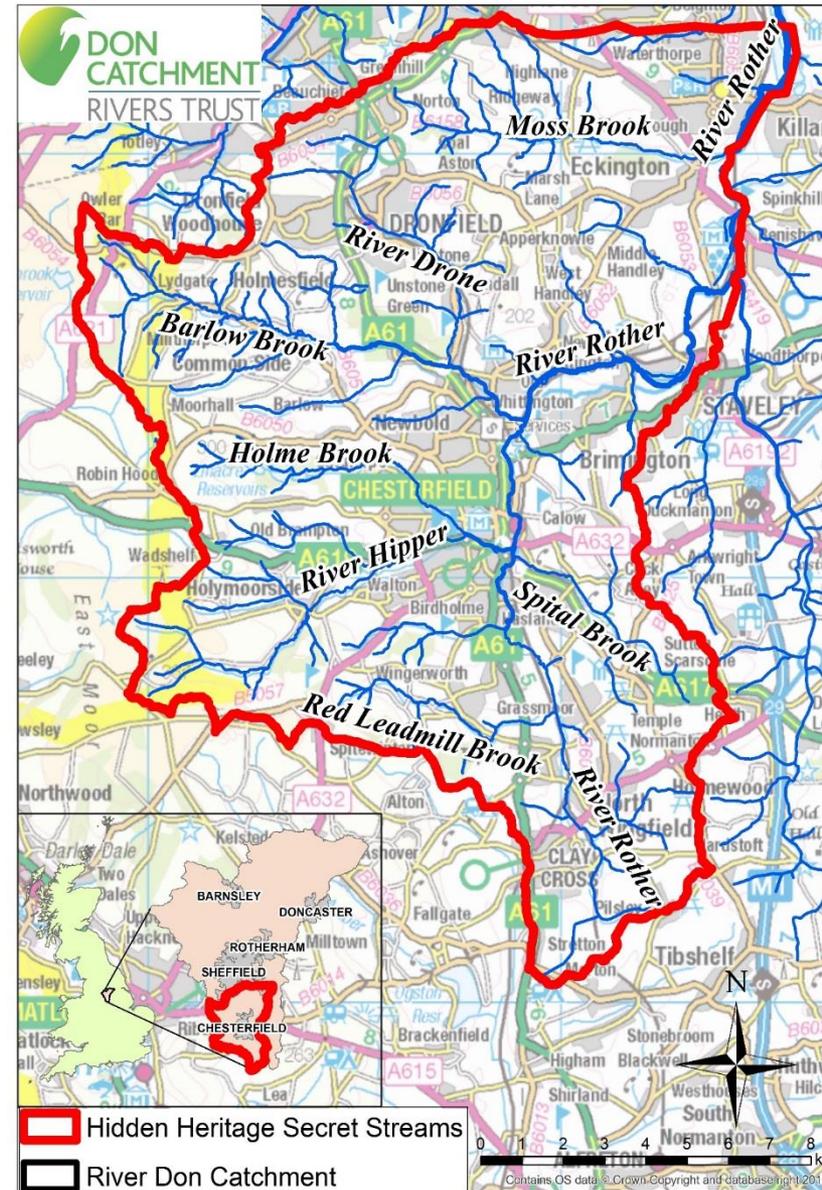


# Implications

- The erosion risk mapping has shown **seasonal variation** in erosion risk, which is highlighted by using high resolution satellite imagery.
- Future work should focus on using high resolution climate projections to assess the impact of **localised high intensity rainfall** events on erosion risk, this can be carried out when UKCP18 data are released.
- High resolution reach-scale mapping should be used to investigate **smaller pathways** (e.g., rills within woodland areas) which are often not incorporated into catchment scale mapping.
- This study assess erosion risk within the catchment, however **bank erosion** was not investigated.

# iCASP Don HHSS project overview

- One element of Hidden Heritage Secret Stream (HHSS) project is related to volunteer-led **land management activities** to:
  - Reduce diffuse agricultural pollution;
  - Slow the flow of water to reduce flood risk;
  - Increase the ecological connectedness of the landscape.
- However, there is a lack of **consolidated evidence** on whether integrated solutions can and should be used, and whether these can be implemented by volunteers.
- **Mapping** will help identify problem areas and where land management is required to optimise their output.



# What are the problems?

- The Water Framework Directive has identified the following problems in the catchment:
  - Barriers to ecological continuity
  - Urbanisation and modification of channel
  - **Sediment (related to poor soil management)**
  - **Poor nutrient management – phosphate**
  - Sewerage discharge
- Flooding in the catchment e.g. 2007:



# Interventions

- A range of interventions have been proposed:
  - Sediment focused – sediment traps, swales, infiltration trenches, detention ponds, planting
  - In channel ‘slow the flow’ – leaky debris dams
  - In channel intervention – river bank restoration
  - Upland land management – grip blocking
  - SuDS – green roofs, pervious surfaces



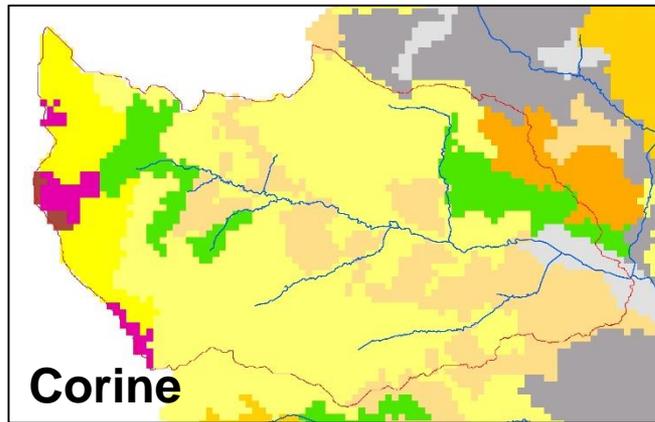
# How can the data help?

- There is lots of freely available data, however it is not often in one place or consolidated into a useful analysis.
  - Environment Agency Data
  - Natural England Data
  - OS maps
  - Flow information
- Satellite information
  - Sentinel 2 data

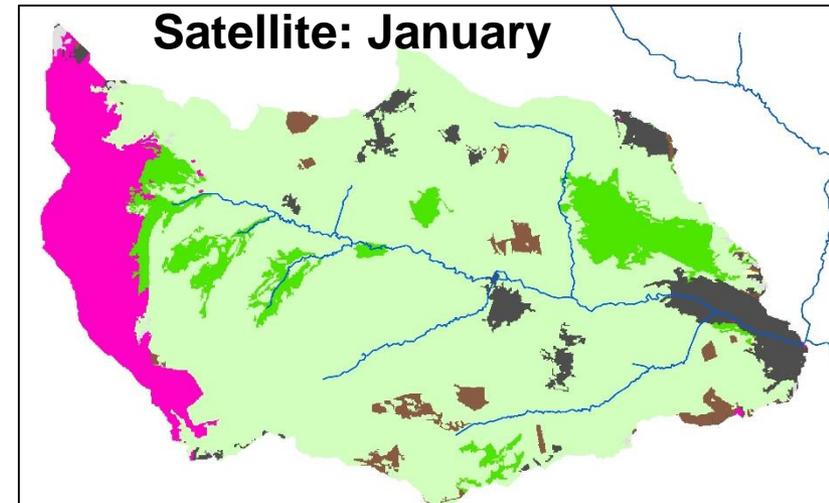
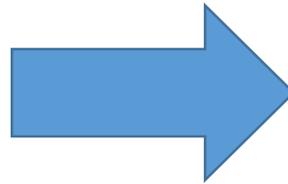


# Increased resolution of erosion risk mapping

- A similar approach to the Derwent case study.
- Producing seasonal risk maps to assess where interventions can be placed.



*Barlow Brook*

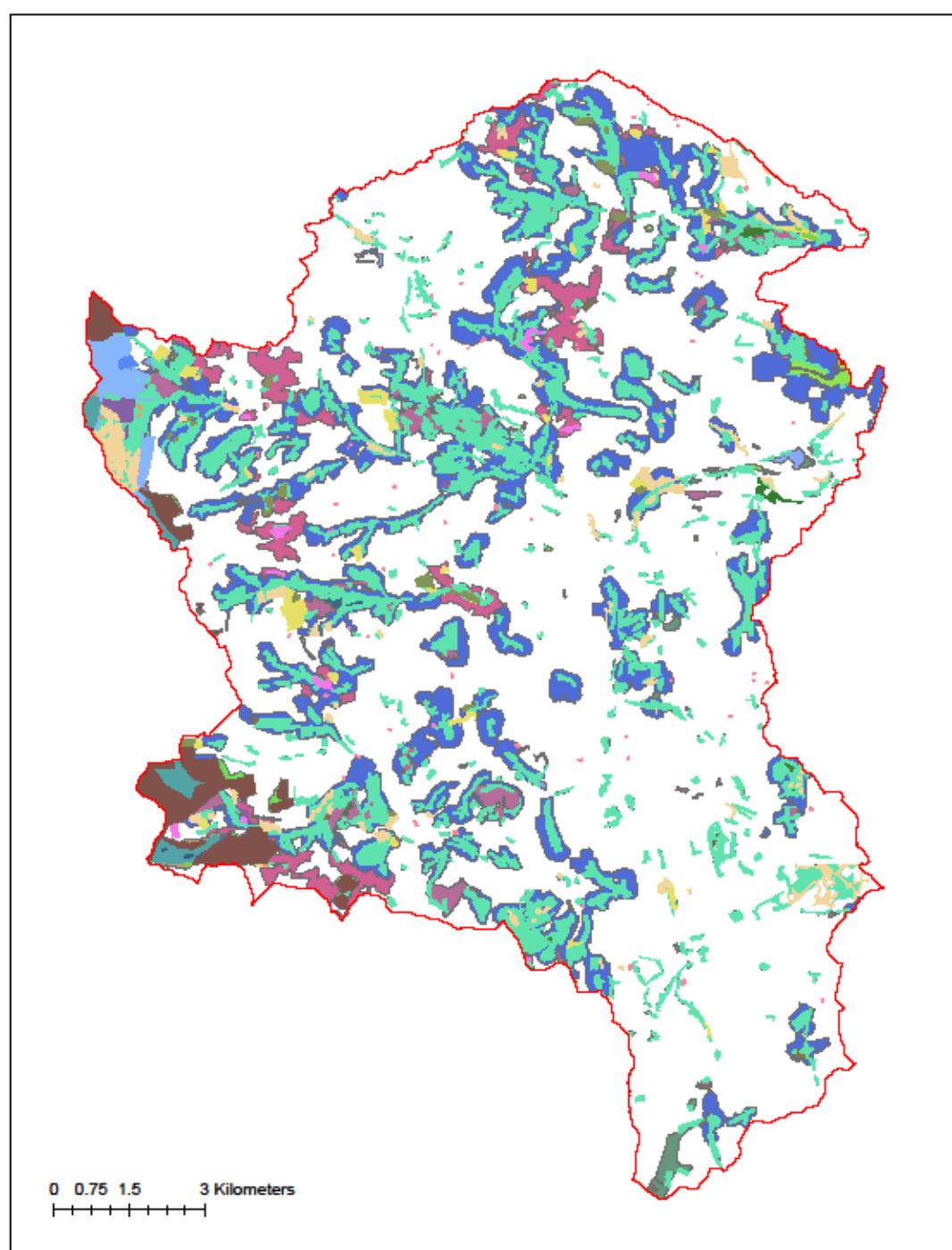


CEH

# Habitat Mapping

- Priority habitat inventory
- National forestry inventory
- English Habitat network

Expanding the maps to look at structural landscape connectivity.



# Outcomes and next steps

- Project will produce an evidence GIS database
  - Evidence will be used to make opportunity maps
- Volunteer criteria
- Monitoring proposal for the catchment
  
- Workshop in January 2019
  - Forming a framework to assess what should be implemented



Contact us through: [iCASP@leeds.ac.uk](mailto:iCASP@leeds.ac.uk)

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Any questions?