Twenty-65 catchments theme

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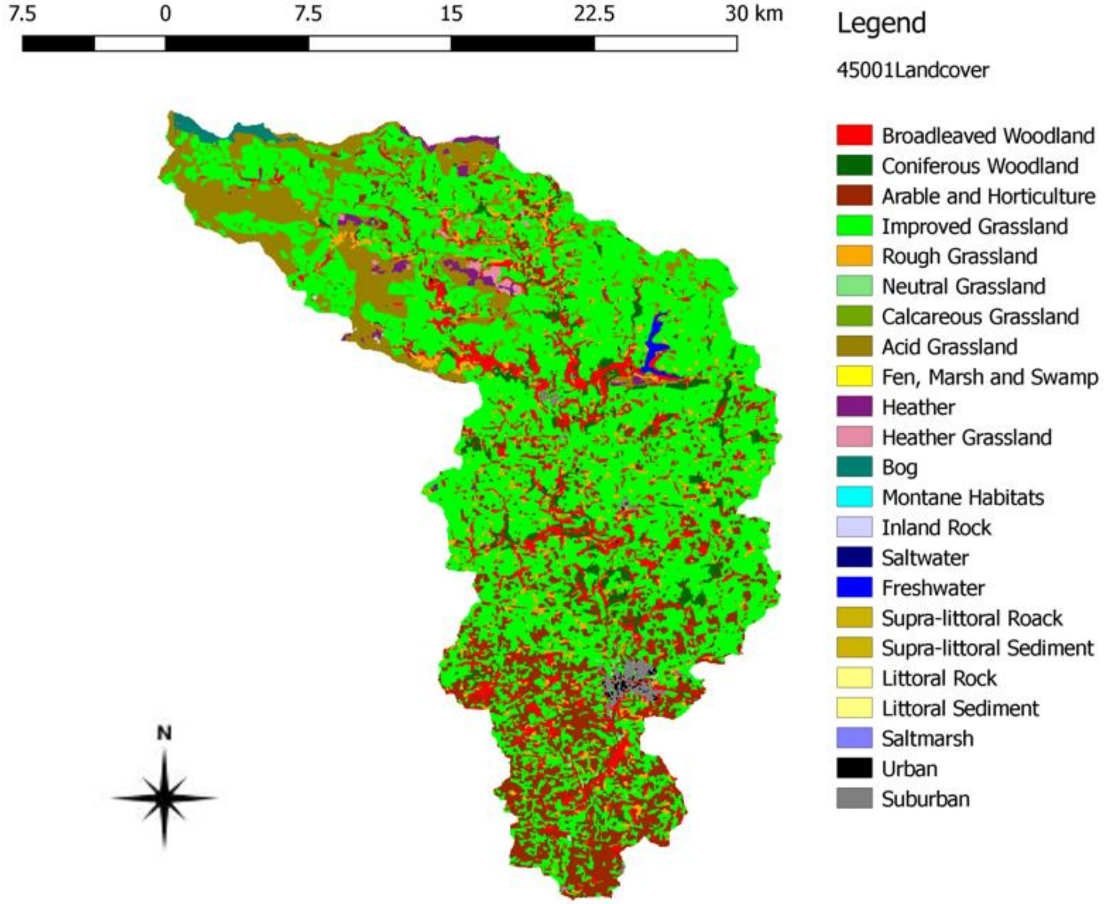
Adapting to changing catchments

- How will future changes in catchments impact upon our water supply systems?
- Can we advance current capabilities in catchment monitoring and modelling to characterise treatability?
- Imperial College, Exeter, Reading, Affinity Water and South West Water.

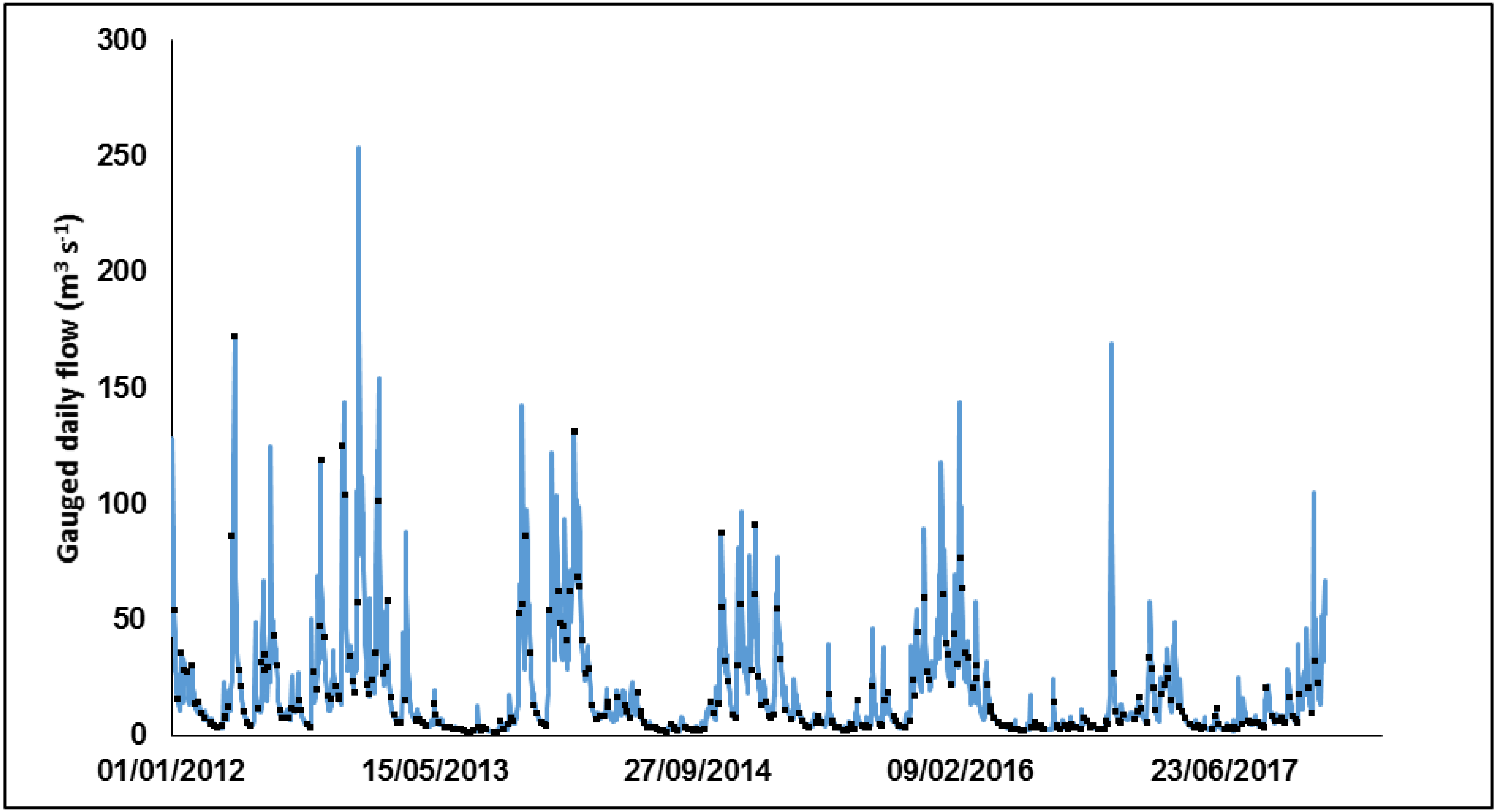
Sources of DOC in the catchment

- Analysis of 6 years of weekly grab sampling data
- Monthly catchment survey of 25 sites
- Carbon stocks under different land uses

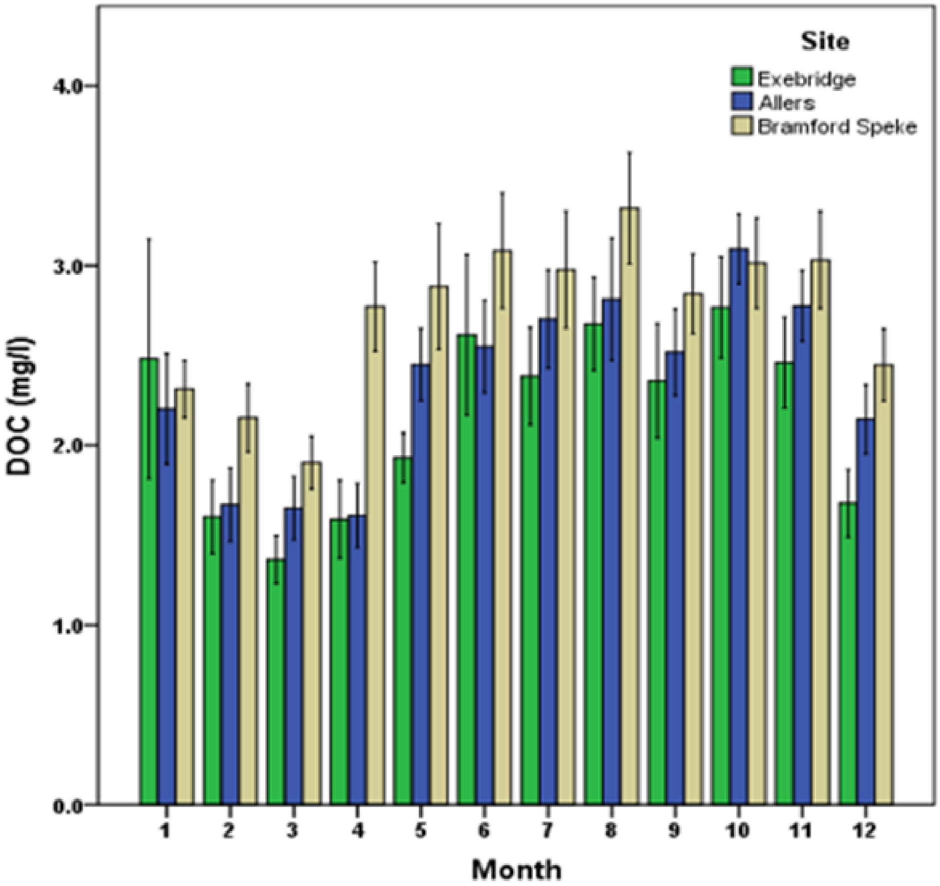
Catchment land use



- Weekly sampling gives reasonable coverage of flow conditions



Concentration and flux increase down catchment



Site	Exebridge (kg ha^{-1} year^{-1})	Bolham (kg ha^{-1} year^{-1})	Brampford Speke (kg ha^{-1} year^{-1})
2012	47.89 ± 2.14	43.11 ± 1.36	55.34 ± 2.16
2013	18.53 ± 0.74	19.67 ± 0.82	26.73 ± 1.20
2014	16.53 ± 1.41	20.91 ± 0.97	25.93 ± 1.06
2015	31.98 ± 1.66	28.57 ± 1.07	28.13 ± 1.04
2016	33.60 ± 2.96	21.24 ± 0.79	21.42 ± 0.73
2017	15.87 ± 0.42	16.51 ± 0.27	17.13 ± 0.50

Explanations

- 1. Underestimation of contribution from high flows
- 2. Significant sources of DOC downstream
- 3. Biodegradation limits impact of peaty headwaters

Monthly survey of 25 sites

Significantly higher DOC than the main channel from 5 sub-catchments.

One peaty, one woodland and three agricultural areas

No impact from small-scale aquaculture

Peat vs woodland C stocks

Peatland site		Woodland site
1,212 ± 161 g m^{-2} litter biomass	≈	961 ± 180 g m^{-2} litter biomass

10.65 ± 3.31 mg persistent DOC m^{-2}	<	20.50 ± 3.73 mg persistent DOC m^{-2}

Soil carbon and biodegradability

- SOC woodland:
- 28.3 (± 15.6) t ha^{-1} 0 – 10 cm depth
- 12.0 (± 2.5) t ha^{-1} 10 – 20 cm depth

- SOC peatland: 714.6 (± 32.6) t ha^{-1}
- Peat headwater ~5.30 mg l^{-1} at 45.0% degradable
- Woodland stream ~1.43mg l^{-1} at 25.7% degradable

Explanations

- 1. Underestimation of contribution from high flows

- 2. Significant sources of DOC downstream ✓

- 3. Biodegradation limits impact of peaty headwaters ✓

Why target peatlands?

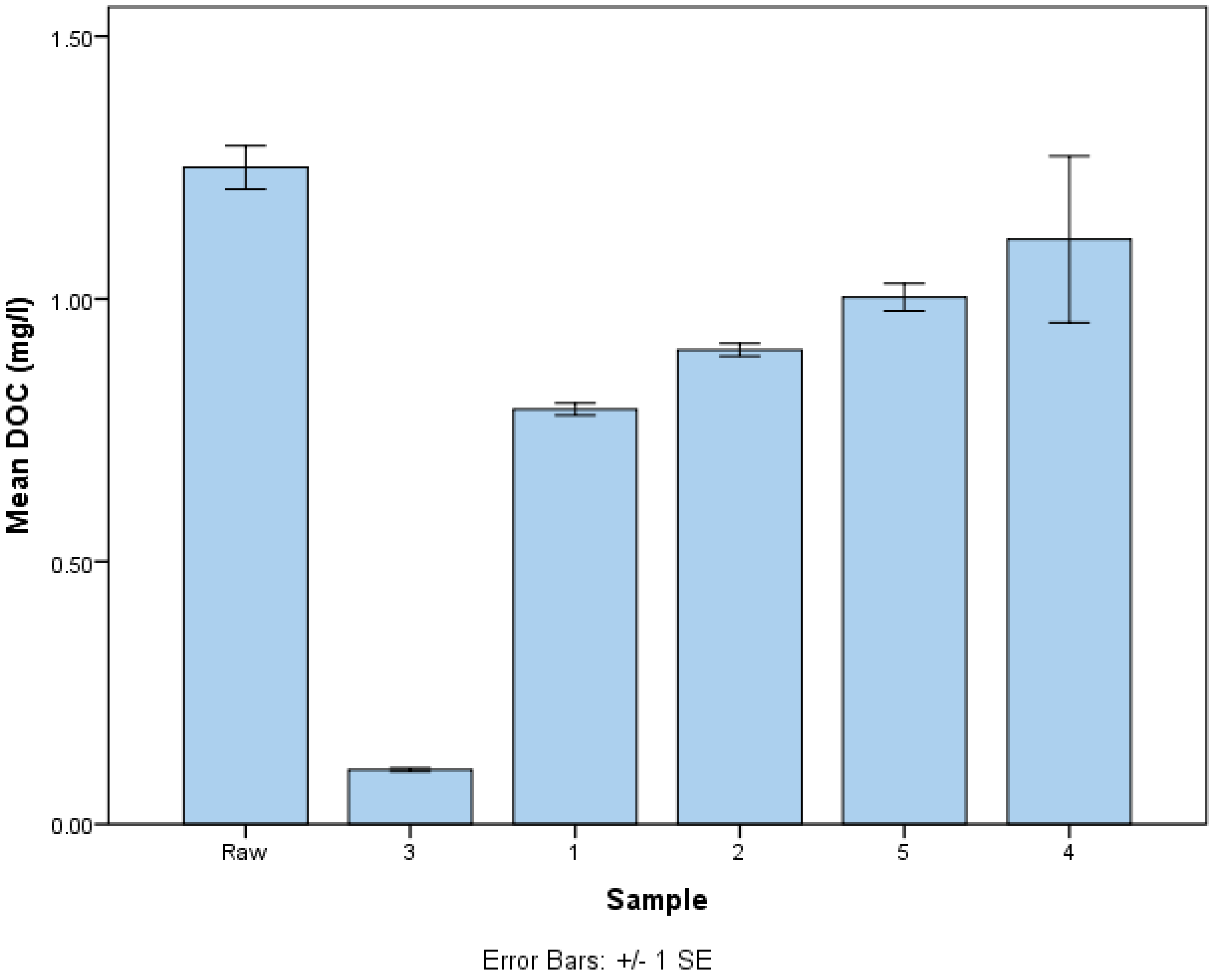
- Only area with increasing DOC trend (τ= 0.097, p=0.013).
- Vast SOC reserves that could be destabilised

- Woodland and agriculture also significant
- STW outflow significant in summer

Other work

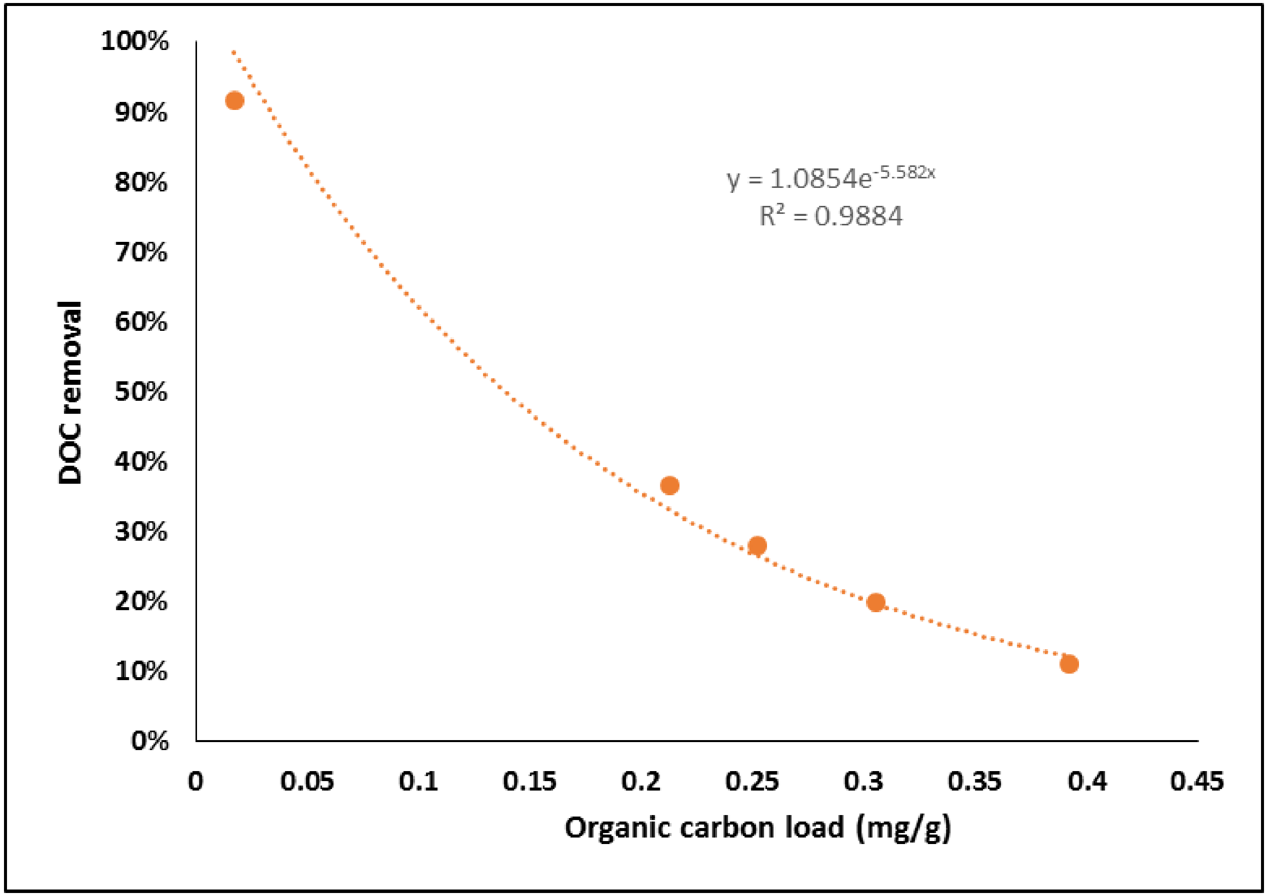
- Modelling DOC in catchments- what information do we need, can we simplify current models?
- DOC removal by GAC- methods of measuring GAC exhaustion and removal/addition of DOC by biofilm
- Remote sensing of DOC/algae

DOC removal by GAC bed age



Using EBV gives r^2 of 0.79 for DOC removal, 0.88 for THM-FP.

Measuring OC load on GAC



TGA method and simple extractions

Remote sensing: why it should work and why its getting better

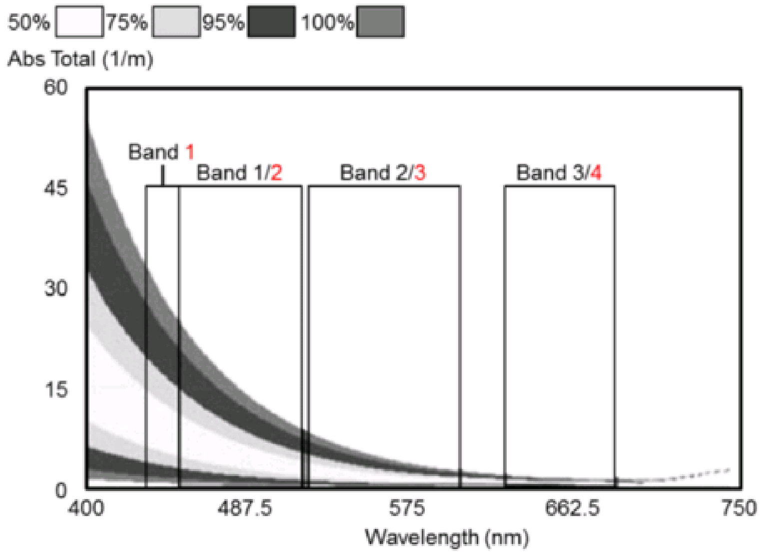


Fig. 1. The gradually decreasing absorbance of CDOM in the electromagnetic spectrum and the band location of typical multispectral satellite sensors. Dark numbers represent earlier Landsat sensors and red numbers indicate Landsat 8 bands and the improvement of Band 1 relative to the available energy. The shaded intervals represent typical ranges of 500 simulations.
(After Kutser et al., 2005b).

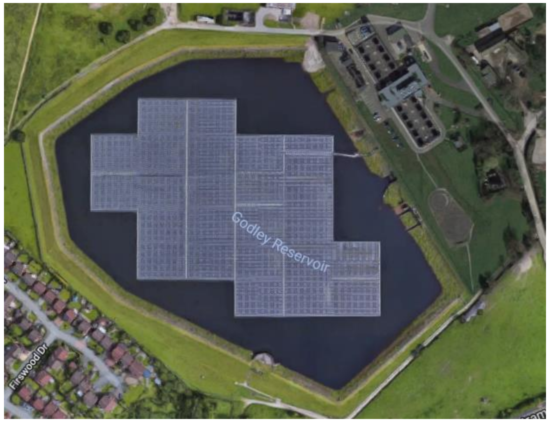
CDOM absorbs in the regions commonly used in satellite reflectance instruments

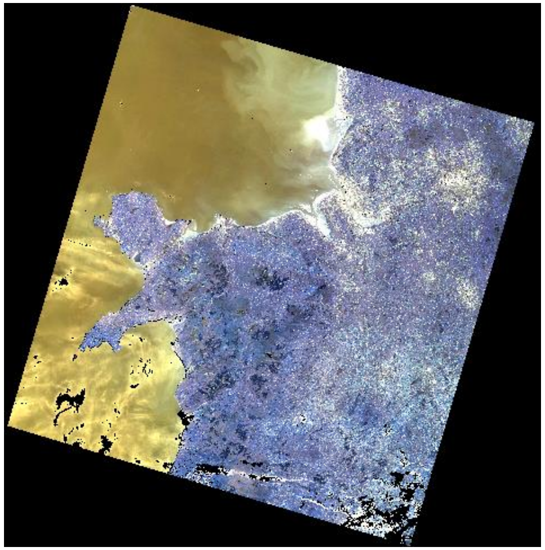
Spatial and spectral resolution is improving. In the last 10 years we've gone from 30 m to 3 m spatial.

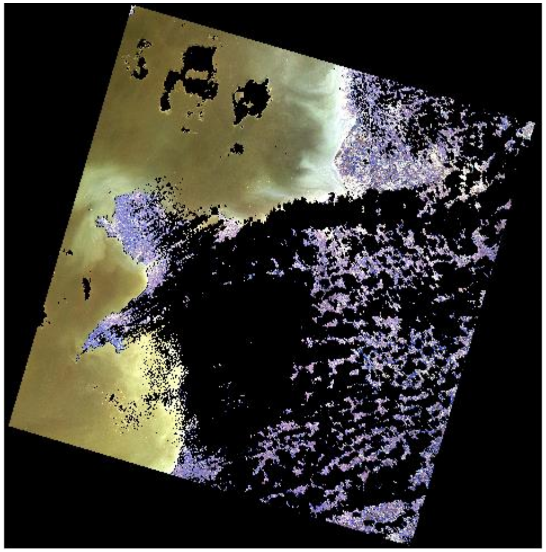
Processing of images is becoming more standardised and less on the user side.

Multiple satellites reducing return time

Why it doesn't always work (i)







1. Google Earth image of Godley reservoir

2. Landsat 8 image of Wales on a clear day

3. Landsat 8 image of Wales on a cloudy day

Conclusions

- Peat is important but also need to consider woodland and agriculture
- High-resolution measurements would give greater confidence and improve modelling
- Simple metrics can improve monitoring of GAC
- Remote sensing has great potential but lack reliability (clouds)

Acknowledgments

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