High-resolution sediment source apportionment: **Where does the sediment come from?**

Richard Cooper, Kevin Hiscock, Barry Rawlins, Tobi Krueger



The Issue

Rivers affected by excessive sediment loadings suffer from an array of detrimental impacts which threaten **sustainable ecosystem functioning**. These include:

- Elevated turbidity
- Smothering of benthic habitats
- Loss of salmonid spawning gravels
- Damage to fish gills
- Scouring of macrophytes and periphyton
- Eutrophication from sediment-phosphorus association
- Increased dredging and water treatment costs

The Solution

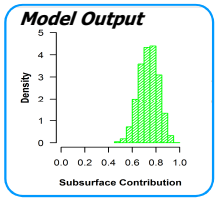
It is essential to understand sediment provenance if mitigation measures aimed at reducing land-to-river sediment transfers are to be targeted effectively.

Sediment source apportionment (or sediment '**fingerprinting**') is a technique for estimating sediment contributions from various eroding terrestrial sources to fluvial sediment load via a mixing model approach.

How is it Done?

Catchment walkover surveys identify potential **sediment source areas** for sampling. Instream suspended sediments are collected at high-resolution (60 min) during rainfall events by bankside **automatic water samplers**.

After wet filtering samples, sediment geochemistry is analysed directly from sediment covered filter papers by X-ray fluorescence spectroscopy (**XRFS**) and diffuse reflectance infra-red Fourier transform spectroscopy (**DRIFTS**).



Resulting geochemical data is run through a comprehensive **Bayesian mixing model** to quantitatively apportion the masses of fluvial sediment derived from each source area within realistic levels of uncertainty.

Results

In the River Blackwater (Wensum) catchment, three sediment source areas were identified:

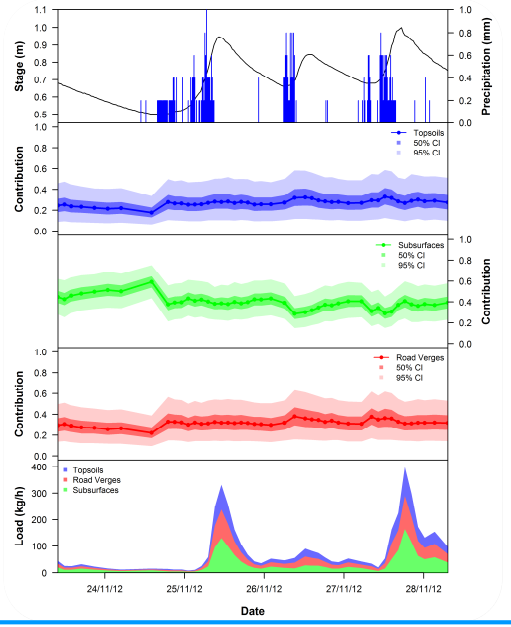
- arable **topsoils**
- damaged **road verges**
- combined **subsurface** channel bank and agricultural field drain source

Subsurface sediment contributions dominate under lower flow pre- and post-rainfall conditions.

Surface source inputs increases rapidly during rainfall after initiation of surface runoff, with **metalled roads** significantly increasing land-to-river connectivity.

Results

High-resolution sediment source apportionment results for the River Blackwater during three successive rainfall events



Conclusions

1. Coupling automatic water samplers with direct spectroscopic analysis of sediment covered filter papers provides an **accurate**, **cost-effective** and **time-efficient** method for high-temporal resolution sediment source apportionment.
2. A comprehensive **Bayesian mixing model** provides quantitative source apportionment estimates whilst accounting for all perceived uncertainties.
3. Understanding sediment provenance throughout the duration of precipitation events can assist catchment managers with the targeting of **erosion mitigation measures**.

Contact:
Richard Cooper
Richard.J.Cooper@uea.ac.uk
School of Environmental Sciences, University of East Anglia

Understanding the Issues