Department for Environment Food & Rural Affairs

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Environment Agency

Flood and Coastal Erosion Risk Management Research Programme

Understanding how river channels change

Project summary FRS17183/S

This project has tested ways to provide the first national picture of river channel change in England and Wales. If we improve our understanding of how rivers function and react we can manage flood risk, and plan for and work with, river channel change better.

Context

River channels change naturally all the time. In extreme floods change can be rapid and severe, with some rivers even altering their course, damaging bridges and properties. There is currently no nationwide information showing where erosion or deposition is likely to occur.

Method

A literature review was used to identify methods that could be used to model areas of potential erosion and deposition in rivers in England and Wales. These were critically reviewed and evaluated for producing information on potential river channel change on a national scale. Two additional methods were developed by the project to use existing national datasets including river habitat surveys and national flood velocity and depth mapping. Further literature analysis was used to understand the factors that can influence river channel change and how these factors can be incorporated into the modelling methods.

Four methods were shortlisted for further analysis. These were:

- ST:REAM (sediment transport: reach equilibrium assessment method). This is a reach-based, stream power balance approach for predicting river channel adjustment. It determines the imbalance between the quantity of sediment input to the river reach and the quantity that can be transferred downstream.
- CAESAR-Lisflood. This is a landscape evolution model combined with a hydrodynamic model to route river flows over large timescales to determine flow depths, velocities and sediment transport for different grain sizes.
- Half-yield method. This new approach was designed to use readily available data (e.g. height, sediment size and roughness) to identify locations dominated by erosional or depositional behaviour.
- Shear stress data mining. This new approach uses existing large scale national flood mapping datasets for depth and velocity (the Environment Agency's risk of flooding from surface water model) to calculate local effective shear stress.

The methods were applied in 3 river catchments (one upland, one lowland and one transitional) to model 'hotspots' of river channel change. The methods and results were reviewed against multi-criteria analysis to understand their strengths and weaknesses, how suitable the approaches were to providing river change information, how scalable they were to national coverage, and the quality of the outputs.

Results

The ST:REAM and shear stress data mining methods were found to be the most efficient and effective. The CAESAR-Lisflood model indicated long-term changes in deposition and erosion, but was not suitable for producing nationwide information due to its complexity. The half-yield method relies on river habitat survey information which is limited in coverage. A further, more extensive trial was then carried out on the shear stress data mining method to create a pilot national data set for England and Wales. This is the first time that information to understand shear stresses and likely sediment risk has been produced on a national scale.

The literature analysis and a review of recent flood events identified the main factors that can influence the likelihood, rate and scale of river channel change. These include:

- channel confinement (natural or human activity in the channel)
- sediment supply and connectivity
- large wood and riparian vegetation
- magnitude, duration and sequencing of flows
- channel maintenance
- land use changes
- channel slope (natural)

The approach to incorporating these factors into the tested methods varied. Some (e.g. CAESAR-Lisflood) could incorporate data directly into the model. Others (e.g. ST:REAM) would need input datasets to be manually modified or have their results informed by other spatial datasets.

Next steps

The research showed that each of the methods trialled had merits and pitfalls. A potential way forward could be to combine national strategic scale and detailed hydraulic model results and use them where they are best applied. Data from the individual methods and the data on influencing factors could be brought together in a decision support framework.

Further work is needed to take this from a pilot into operational use and should include further results validation in more locations and user tests against operational activities.

This summary is reported in detail in the following outputs:

FRS17183/R1: Literature review and understanding local influencing factors in the scale and rate of morphological change
FRS17183/R2: Developing and evaluating methods to predict erosion, transport and deposition on a national scale
FRS17183/R3: Influence of valley confinement and flood plain infrastructure on morphological river changes during extreme flows
FRS17183/R4 Creating pilot data sets showing the potential for erosion across England and Wales using the shear stress data mining method

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Project manager: Hayley Bowman

Research collaborators: Professor Colin Thorne, Nottingham University; Dr Philip Soar, University of Portsmouth; Dr Chris Parker, University of West England; Professor David Sear, University of Southampton; and Professor Janet Hooke, University of Liverpool.

Research contractors: JBA Consulting, University of Southampton

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Email: fcerm.evidence@environment-agency.gov.uk
Enquiries: enquiries@environment-agency.gov.uk