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VISCOUS: Taking account of spatial variability in water body classification

Science summary SC080051/SS

The Environment Agency has published a report describing the development of a new tool to take account of spatial variation when classifying water bodies for the Water Framework Directive (WFD).

The WFD requires the Environment Agency to classify the ecological status of all lakes, rivers, estuaries and coastal waters, and provide a measure of confidence in the accuracy of these classifications. This can be particularly complicated as conditions can vary significantly between monitoring sites within the same water body.

To tackle this problem, the Environment Agency commissioned research consultancy WRc to develop a generic tool that take account of spatial variation when classifying water bodies. The result was a tool called VISCOUS – Variability In Spatial Component Objectively Unified Statistically – which classifies water bodies using Ecological Quality Ratios (EQRs) and calculates the degree of confidence associated with that classification.

VISCOUS can accommodate water bodies with conditions that are broadly similar throughout (homogeneous), and those that have more distinct areas with different ecological conditions (heterogeneous water bodies). The model deals with these heterogeneous water bodies by subdividing them up into a number of strata, each of which represent a distinct area with its own set of ecological conditions and mean EQR. VISCOUS also incorporates a test to help users judge whether a water body is homogeneous or heterogeneous.

VISCOUS was originally developed as an MS Excel spreadsheet which allowed users to analyse a single water body at a time. This was later refined, for example allowing data for multiple water bodies to be entered at once.

A final stage of development saw VISCOUS implemented as an MS Access database; while this lacked some of the functionality of the spreadsheet, it was able to automatically process data from large numbers of water bodies. This database version was first used by the Environment Agency in March 2009 to classify river water bodies for the first River Basin Management Plans.

VISCOUS represents a significant addition to the Environment Agency's toolset, and has several key advantages including:

- Flexibility; it acknowledges spatial variability within water bodies and can accommodate homogeneous and heterogeneous water bodies.
- It is capable of dealing with a number of sites within a strata or water body, and can calculate a measure of confidence in classification for water bodies with just a single survey site.

However, the current version does also have some limitations, such as:

- It makes a number of simplifying assumptions to accommodate data on a variety of quality elements measured in a variety of water body types.
- It requires sites to be assigned to strata within a water body manually, which limits the functionality that can be applied when automatically processing data from a large number of water bodies.
- The model assumes that measurements integrate variation over time, so may not fully take into account how ecological conditions within a particular water body were sampled in time and space.

According to the report authors, efforts to further develop VISCOUS should focus on three areas:

- Automatic identification of sections within water bodies.
- Greater flexibility in generic estimates of spatial variability.
- Incorporating temporal variation.

This summary relates to information from Science Project SC080051, reported in detail in the following output:

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