The following section provides a very brief introduction to this topic, which is frequently encountered as part of addressing specific impacts within estuaries. The section is included so that these aspects are not forgotten but the reader is referred to the literature cited for more extensive coverage.

WATER QUALITY

Water quality modelling solves the equation of advection-diffusion for a predefined computational grid on a wide range of model substances. Water quality models aim to provide the user with information regarding the "condition" of a water body. Typically, water quality models are not hydrodynamic models and require tidal information to drive the model.

The impact of a discharge on any water body is dependent on a discharge quantity and prevailing physical and chemical conditions. Typically, spatial and temporal conditions for each individual water are highly variable. This is due to tidal and wind currents, bathymetry, fluvial flow and so on. To asses the impact of a discharge it is necessary to predict the duration over which the pollutants may act and the area likely to be effected.

Defining the Model

It is essential to define the major issues and variables under consideration at the outset in order to select an appropriate model.

- Model Duration - Temporal extent of the discharge. It defines the simulation period which the model simulates processes.
- Model Domain - Spatial extent of the model determined from knowledge of the location and temporal effect of the discharge.
- Model Dimensions - Requires the knowledge of the hydrology of the area and behaviour of the pollutants.

Which then need to be mapped onto what the different types of model can deliver:

- 1 Dimensional Model - Single scale, e.g. length down an estuary. Typically 1D modelling is undertaken for river networks and estuaries, which are well mixed where longitudinal variation is important

- 2 Dimensional Model - Two scales, e.g. length and depth of an estuary. Typically, 2D water quality modelling is undertaken for water bodies, which are well mixed but have a significant width.

- 3 Dimensional Model - Three scales, e.g. length, width and depth. If width and depth variation are important a 3D dynamic model is required.

- Box Models - These are simple representations of complex systems that focus on fluxes between boxes and transformations within boxes that are considered relatively homogeneous. In water quality modelling box models can be used in a variety of ways. For example, the simplest box model is the tidal prism model. However, a collection of simple box models can be linked together horizontally and vertically to represent the major features of an estuarine system. They are effective water quality management tools that can incorporate information from measured data or higher order two and three-dimensional models results (Ibrahim, 1996).

- Inverse models - This type of model is able to interpolate objectively between scattered data by making use of a system of governing equations (for example conservation equations for mass and momentum). They require no boundary data, thus they are only useful when only scattered observations rather than boundary data are available. An inverse model needs good data for assimilation (Lam *et al*. 1984; Copeland, 1994; Copeland & Bayne, 1999).

Modelled Substances

There is a wide range of substances that can be included within a water quality model these include:

- Conservative substances (salinity, chloride, traces);
- Decayable substances;
- Suspended sediment;
- Temperature;
- Nutrients (ammonia, nitrate, phosphate, silicate);
- Organic Matter (nitrogen, carbon, phosphorus, silicon);
- Oxygen;
- BOD and COD (biological and chemical oxygen demand);
- Algae;
- Bacteria;
- Heavy Metals.

Water quality models allow the user to specify a wide range of physical, biological, ecological and chemical processes. These processes include;

- Sedimentation and resuspension;
- Reaeration of oxygen
- Algae growth and mortality
- Mineralisation of organic substances;
- Denitrification;
- Adsorption of heavy metals.

Model Calibration/Validation

Calibration is the process by which the model is adjusted to reproduce the characteristics of the study area for a given set of conditions (STOWA/RIZA, 1999) Water quality calibration consists of concentrations of the modelled substances at points throughout the model area over the period of interest. Seasonal variation may be important for some parameters such as nutrients and chlorophyll. In addition, it is important that all inputs to the model area from e.g. outfalls or rivers are accurately specified.

Model validation demonstrates the accuracy of the model output with a separate, independent dataset. Calibration and validation of a water quality model should reflect the timescales of the parameters in question, tidal and possibly seasonal variability.

References

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