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INTEGRATING MODELS FOR ENVIRONMENTAL STUDIES: EXAMPLES OF COMPLEX MODEL STUDIES FOR SHELLFISH AND BATHING WATERS

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BACKGROUND

Intertek have undertaken the majority of detailed modelling assessment of bathing and shellfish waters in the UK…

…and I have been involved in most of them

These studies use numerical models (MIKE21, MIKE11, etc, and our own compliance assessment software) to provide detailed results regarding impact, source apportionment and solutions

They are by nature integrated. But integration of models and data, and NOT the production of an enormous, unwieldy and complex ‘integrated’ models

WHY MODELS

We need to **predict** impacts

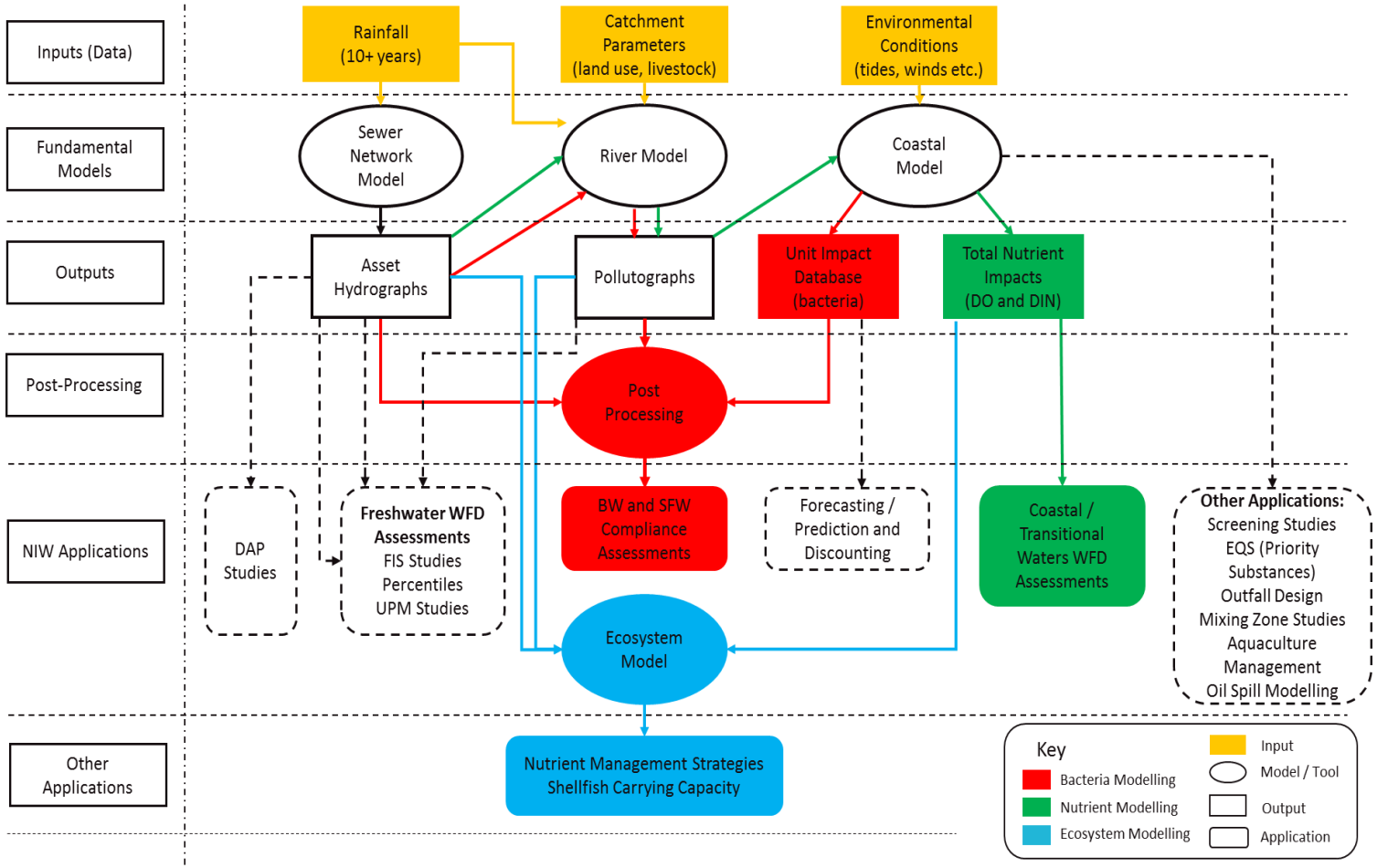
We need to be able to predict across ‘all’ scenarios, and understand the probability of their occurrence, in order to calculate the percentile values used in the compliance standards for bathing and shellfish waters

We need to be able to test solutions

We need sign-off from both client and environmental regulator

MODELLING TOOLS

COMPLEXITY


Inputs (Data)
Fundamental Models
Outputs
Post-Processing
NIW Applications
Other Applications
Rainfall (10+ years)
Catchment Parameters (land use, livestock)
Environmental Conditions (tides, winds etc.)
Sewer Network Model
River Model
Coastal Model
Asset Hydrographs
Pollutographs
Unit Impact Database (bacteria)
Total Nutrient Impacts (DO and DIN)
Post Processing
DAP Studies
Freshwater WFD Assessments
FIS Studies
Percentiles
UPM Studies
BW and SFW Compliance Assessments
Forecasting / Prediction and Discounting
Coastal / Transitional Waters WFD Assessments
Other Applications:
Screening Studies
EQS (Priority Substances)
Outfall Design
Mixing Zone Studies
Aquaculture Management
Oil Spill Modelling
Ecosystem Model
Nutrient Management Strategies
Shellfish Carrying Capacity
Key
Bacteria Modelling
Nutrient Modelling
Ecosystem Modelling
Input
Model / Tool
Output
Application

MANAGING COMPLEXITY

Data requirements

- Hydrology/catchment models (or data)
- River models (possibly data)
- Sewerage discharge and works discharge dat
- Rainfall data
- Wind data
- Source-receiver relationships (coastal data)

Integrating

- Coastal models
- Sewer network models
- River models
- Integration tools – compliance assessment
- Visualisation
- Future use – forecasting, etc

CHALLENGES

Data

- Is it any good?
- If it isn’t, how do we address the challenges?
- Characterisation – defaults or local data
- QA and analysis (screening, pre-modelling conclusions)
- Sensitivity – identifying what we need to do

Assessment

- Validation – both for model and compliance (compare with monitoring)
- Generating data/outputs that are directly relevant to standards
- Take opportunity to generate data/deliver systems for multiple use

EXAMPLES

1
UNITED UTILITIES

Regional Shellfish Water and Bathing Waters Investigation

Coastal models across the regional domain, with different local areas of high resolution

Hundreds of individual sources (300+ in Morecambe Bay alone)

River, network, estuary and coastal models required.

Large data collection exercise to characterise inputs. All integrated at various stages to produce compliance assessment

UNITED UTILITIES

Multiple scenarios to assess, and multiple scenarios for sensitivity

Many urban areas found to be insignificant; this was challenged (and disbelieved) by environmental regulator

We demonstrated potential other sources (a key example being local salt marshes and grazing sheep, and roosting birds)

The flexibility, re-runs and answering challenges would not have been possible with a complex single model.

Enormous amounts of data were produced, which remain valuable today – forecasting, prediction and management

Post-processed assessment and compliance tools were key

2
DCWW

Regional Shellfish Water and Bathing Waters Investigation

Numerous coastal models replacing three medium resolution AMP4 models

Alliance Team delivered project (with Intertek as expert advisers and undertaking mode development and compliance assessment).

Four delivery partners, DCWW, NRW and the EA were involved

River, network, estuary and coastal models required.

Large data collection exercise to characterise inputs

Lack of network models for many catchments meant an innovative estimation and quantification approach was adopted

DCWW

The programme for delivery was tight – it would not have been possible without a modular approach

Different partners utilised different strengths

The distributed nature of many of the ‘integrated models’ would have been difficult to deliver.

Data may have been wanting to fully verify performance

The parallel working that was enabled by separated models and multiple delivery partners meant that detailed outputs were possible in the timeframe.

The balance of data limitations for certain areas, the multiple source assessments and the regional extent meant that a modular approach was essential for success.

2 FORECASTING MODELS

Bathing Waters Assessments have delivered very large amounts of data that is useful in a predictive capacity as well as investment planning

Nature of the compliance approach means that the outputs can be used in a forecasting or management tool.

This includes effective real time decision making (with the right input data available)

Delivered a regional bathing waters forecasting tool for Yorkshire Water, and a simplified system for Anglian Water

Has been used to verify a data-driven Interreg project in Swansea Bay, and are developing systems for Southern Water

The tools integrate the models, data and visualisation approaches from the capital investment studies, weather forecasting data and use API data

FORECASTING MODELS

Shellfish Studies have delivered similar data and outputs and are ready to use as management systems

These could provide warnings of contamination, guidance on harvesting windows and general management strategies for the shellfish industry.

Continuing down the road of increasingly tight standards without management could spell disaster for the shellfisheries.

Tools like these may provide an alternative to absolute standards if we want to balance environmental protection and economic success?

LESSONS, CONCLUSIONS AND THE FUTURE?

LESSONS

First and foremost, these investigations need to be designed and undertaken by expert providers.

Experts from different disciplines and companies working together effectively.

Integrating (sources, models, different areas of the catchment) is essential to properly understand interactions, source apportionment and significance

This understanding is essential for effective investment planning, and environmental improvements, and sustainability

It is critical that the act of integrating models does not preclude the re-running, optimization or sensitivity testing of the system or findings

CONCLUSIONS

Water quality modelling is improved by complexity!
(representing more sources and wider catchments)

At present, representing that complexity through a modular approach appears to balance accuracy, resolution and the constraints of programme

Key to maximizing value is through effective post processing and processing control, or operating through hubs.

THE FUTURE

Hubs and control systems provide a powerful means of using today's models and data in a more effective way, and to 'squeeze' more value out of existing approaches

We can manage complexity, delivering better studies, across catchments, for a truly 'integrated' response to water quality challenges.

DHI's MIKE OPERATIONS

Our compliance tools

Your own developments…

…to push the use of the data and models we have further

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