

PARTICLE TRACKING

This technique typically uses the output from hydrodynamic and/or advection-diffusion models to predict particle movements in a Lagrangian manner. The flow regime is seeded with particles having defined properties (size, density, settling velocity, etc) and tracked as they move with the flow. This is a useful means of visualising flow patterns, particularly eddies and recirculation cells but can also be used to examine the movement of material away from particular activities such as dredging, dumping, outfalls, etc. By examining the statistics of how particles are re-distributed in the model domain, it is also possible to extract some quantitative information.

The discharged or spilled material is considered as particles being advected with the surrounding water body and dispersed as a result of random processes including the dispersion caused by current, wind-induced turbulence and molecular diffusion. To each particle a corresponding mass is attached. This mass can change during the simulation as a result of decay and the particles can deposit with a constant settling velocity and re-suspend again.

Particle Tracking methods are an important technique for simulating transport phenomena such as transport of pollutants in coastal waters. Particle tracking methods can quite accurately predict the pollutant transport in cases of steep concentration gradients after the pollutant has just entered into the water whereas conventional methods such as finite difference and finite volume methods may have difficulties. Since the computation time in a particle model increases linearly with the number of particles, this often forms a limiting factor.

Data Requirements

In addition to the data requirements outlined for the hydrodynamic and advection/diffusion the following requirements are identified:

- **Model set-up**
 - Characteristics of particle to be tracked
- **Boundary conditions**
 - Seaward and riverine suspended sediment concentrations
 - Location of sediment inputs
- **Calibration and verification data**
 - Suspended sediment concentrations
 - Historic bathymetric data

For further information see: (DHI, 1991b; DHI, 1991a; CERC, 1993; DHI, 1993; van Stijn *et al.* 1987; Hai *et al.* 1998; WL|delft hydraulics, 2001)

References

CERC, 1993, Volume 4: Modelling of saltmarsh and mudflat processes, Erosion and Accretion processes on British saltmarshes, Report for MAFF by Cambridge Environmental Research Consultants Ltd, Cambridge, Report No: Report ES19B(4).

DHI, 1991a, Mathematical modelling systems of flow circulation and transport for the English Channel and Bristol Channels, Danish Hydraulic Institute, Copenhagen.

DHI, 1991b, User Guide and Reference Manual: MIKE 21 PARTICLE, Danish Hydraulic Institute, Copenhagen.

DHI, 1993, Benchmark testing programme for models for the purpose of marine hydrodynamic and bacterial dispersion modelling, Danish Hydraulic Institute, Copenhagen, Report No: FWR Project P-007.

Hai XL, Cosman A, Heemink A, Stijnen J, van Beek P, 1998, Parallelization of the Particle Model SIMPAR, In: Anon.

van Stijn TL, Praagman N, van Eijkeren J, 1987, Positive advection schemes for environmental studies, In: Taylor C (Ed.), Numerical Methods in Laminar and Turbulent Flow, Pineridge Press, Swansea, pp. 1256-1267.

WL|delft hydraulics, 2001, User Manual Delft3D-FLOW, Delft3D-WAQ and Delft3D-PART, WL|delft hydraulics, Delft.