

DISPERSION PROCESSES IN COASTAL WATERS — SOME OUTSTANDING
PRACTICAL ISSUES FOR MONITORING AND MODELLING

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Dispersion, the combined diffusion-advection phenomenon, is basically a scale-dependent process. This means that in order to find out its various attributes, one has to obtain the field data on the relevant parameters that constitute the process, at various scales in the space-time domain. It is not practical to make field observations below and above certain space and time scale in shallow waters. This is issue number one.

Physical scale-models have innate scale distortion. Geometric physical models are neither practical nor free from model induced variabilities. This is issue number two.

Numerical models have to handle a variety of assumptions and sub-problems having physical and mathematical uncertainties when applied to dispersion phenomena in shallow waters. The physics of these are still at the formative stage. Even where the models have been formulated they are far from hundred percent realistic. They are yet to be validated. However, no field data can be generated satisfying fully the spatial and temporal and accuracy requisites of a numerical model. The skill lies in making use of the available field data that are collected within practical limitations. We have been lacking in that skill. That is issue number three.

There are two approaches to dispersion studies — Lagrangian and Eulerian. Lagrangian field (that is the flow of a marked particle over space at different times) and the Eulerian field (that is flow of particles at a point over time) have some information in common. either have certain exclusive information imbedded within and not obtainable from the other. Transformation of these two fields is yet another issue.

Vertical shear (of flow) and its variability over space and time are most prevalent in coastal waters having tidal reversals. Horizontal diffusion induced by vertical shear is very dominant. There is no easy way either to measure shear diffusion or to predict it. This is an outstanding issue.

Many-a-time, a pollutant patch has a tendency to break away from the main patch and behave in somewhat erratic manner. Often such break away patches would hug the shore and propagate on a shore-parallel course increasing landfall risk. These are to be handled on ad-hoc bases. This is yet another issue in monitoring and modelling the coastal waters.

Seasonal variabilities are another issue. Most of the times a set of values for the coastal oceanographic parameters are valid for a very brief time interval. Separating crucial episodes from insignificant ones is often arbitrary and subjective.

In certain cases, there are physical limits to sampling crucial distributions of the dynamic parameters. For instance: The flow in the breaker zone, water level variations over muddy patches, propagation of tidal bores, currents during stormy weather, etc. These are issues unto themselves.

Perverse currents do prevail at coastal sites. There are two possibilities. One, they are captured during an observational sequence and are highlighted out of proportion. Two, they are missed during the field observations and are ignored totally. Both are serious issues in pollution monitoring and modelling in coastal waters.

All these give rise to site specificity. No single method or model can efficiently handle the problems associated with Indian waters all the times. This is the single most important issue to reckon with.

In summary, the outstanding issues of dispersion processes in coastal waters are :

- i) Space-time description of field parameters
- ii) Limitation of physical models
- iii) Limitations of numerical formulations
- iv) Eulerian-Lagrangian transformations
- v) Shear-induced diffusion
- vi) Breaking of pollutant patch and its shore hugging.
- vii) Seasonal variabilities
- viii) Physical limits of sampling
- ix) Perverse episodes
- x) Site-specificity of Indian waters.

In conclusion, until the field research and modelling efforts take cognizance of these issues, the monitoring and modelling exercises will be ^{on} weak grounds. A logical approach will be then :

- i) To examine the problems of each site specifically.
- ii) To make use of a combination of field data, physical models and numerical models.
- iii) To conduct, side-by-side. dedicated experiments to examine the diffusion processes as a whole in an academic level, incorporating all relevant parameters in an integrated manner, in the coastal marine environment.