Physical Oceanography Activities in Malaysian Waters

Coastal and marine areas of Malaysian waters have played a very important role in the development of the Malasian economy and have provided an extremely necessary resource. A lot of effort has been put into protection of the marine environment and sustainable use of marine resources by the Malaysian government and various international organisations.

However, an imbalance has arisen between the processes involved in these developments. Physical oceanography as a basic and important aspect of the understanding of oceanic uncertainties has not received enough attention in the region. This is due to various reasons and constraints.
This paper attempts to summarise the status of physical oceanography activities in Malaysian waters. The views presented here are based on the experience and knowledge of the author and do not necessarily reflect the opinion of others or the government concerned.

Status
The collection of physical oceanography data, data management and research are the weak points in marine science development in Malaysia as compared to other aspects, such as marine pollution research and monitoring and marine biological studies, especially into the application of new technology and methods.

Data Collection
Basic observations do exist in Malaysia and some of these observations are available in a reasonably long time series. But most cover limited areas and serve certain specific purposes.
Periodic observations on basic physical parameters are carried out mainly by the Royal Malaysian Navy Hydrographic Department. The observed parameters include sea temperature, salinity, sea-level etc. But in most cases these observations are designed for military purposes, so that much of the data may not be freely accessed.
The observation stations are less than ideally distributed, especially for the sea areas surrounding several countries, and the parameters are far from sufficient for purposes of monitoring the marine environment, especially in coastal areas.
For the purposes of fishery, the Department of Fishery in Malaysia also conducts observations and measurements which include oceanographic parameters, e.g. temperature, salinity, DO, pH, nutrients, etc. The time-frame and location of observation sites are normally dictated by fishery requirements and observations are conducted according to the scientific institutionâ€™s own research interest.
The oil and gas industry in Malaysia have also conducted observations and measurements which include oceanographic parameters, e.g. sea temperature, current, waves, sea-level etc. The location of such observations sites are normally in the area of oil and gas fields. These observations are designed for specific engineering purposes and much of the data may not be freely accessed.
All these observations have contributed greatly to enhancing the marine sciences and to a better understanding of the marine environment in Malaysian waters. However, due to limitations in either temporal or spatial coverage of the observations or to the focused objective, long-term systematic observations serving a wider purpose do not exist in Malaysia.
This fact largely limits developments in marine science and thus slows down understanding of the marine environment and associated applications.

Modelling
It is well understood in the region that the numerical model provides effective tools for understanding of the marine environment, especially of physical processes. Some models have been introduced to and developed by scientists in the region. Some individual scientists have attempted to use their model for prediction. Due to the constraints on knowledge and necessary observational data and facilities, as well as data for boundary condition definition, most of these models are still in the preliminary stage and a lot of effort is needed to verify and upgrade them.
Some models have been introduced by partners in various co-operation initiatives, but these models are either too complicated to be handled by local scientists or, very often, too little consideration has been given to local geographic bottom and boundary conditions.
The main constraints in the development and application of numerical models are:

- Limited demand from other users of physical oceanography leading to it not being regarded as the priority it should be
- Difficulties in the education of physical oceanographers, who require extensive knowledge of mathematics and physics
- High costs of physical oceanographic observation and research as compared to other studies

Data Management
Historical datasets do exist in Malaysia and some of these even have long time series, especially those related to sea-level data. In some cases here the measurements began early this century, or even last century.
There are a few main constraints limiting the use of historical data:

- Datasets are normally kept separately in the different institutions which carried out the data collection. Data and products exchange among national institutions is far from satisfactory and this applies especially to real-time or near-real time data, which is extremely

important for physical oceanographic studies on prediction of the marine environment
- Datasets originating from before 1980 are in the format of manuscripts and log books, which underwent no QA/QC control. Digitising this data is very hard work in the sense of the required financial input and manpower availability. But unless it be done the results of most of current high-intensity observation and measurement are going to be difficult to interpret
- Data is not centralised, which makes it very difficult for the scientist to access data

Expertise

Expertise in physical oceanography is generally lacking, either in terms of the number of physical oceanographers or level of knowledge. As demand increases, the shortage of expertise is becoming more and more serious in Malaysia and some students and lecturers have been seconded out to developed countries through various co-operation initiatives. Such development is limited, because it takes long time to train a physical oceanographer.

Requirements

In general, the demand for physical oceanographic data and products come from almost all communities dealing with ocean-related activities in the region.

Physical oceanographic observations, including in-situ measurement and remotely sensed datasets are of great importance for fisheries. Parameters such as Sea Surface Temperature (SST) and sea colour may be used to distinguish water masses with different characteristics deemed useful in the prediction of optimal fishing locations.

Computer modelling of SST distribution, front formation, eddies transport, and so on, also provide significant information for fishery activities.

It is well known that the transport and distribution of pollutants in
the ocean depend highly on ocean current and circulation pattern. The involvement of physical oceanographers in further study of the transportation of pollutants in estuary areas of Malaysia is of great importance.

Accidental oil spill is another example in which current and wind-field knowledge is required to minimise effects. A recent example is that of the crash of an oil tanker in the Straits of Malacca which caused serious problems for countries in the region.

The benefits in an Oil Spill Combat situation of having an operational oceanographic monitoring system are connected to the prediction and forecasting of the behaviour of the oil-slick. The movement, spread and weathering of released oil depend upon wind speed and direction, background and tidal current speed and direction, air temperature and sea water temperature in the surface layer. These are all variables measured continuously by the observation system.

As indicated earlier, such observations and measurements exist in Malaysia and are providing useful information. However, there remain a number of problems in use of data assimilation models and hydro-dynamic models for the provision of useful scientific information to the various users. The main constraint is lack of data availability. This is limited either by a lack of systematic observation or by the lack of regular co-ordination and co-operation in observation and data exchange. This phenomenon existed widely in private and government sectors, universities and institutions in Malaysia, and has greatly influenced understanding of the marine environment and interpretation of study results.

Offshore design criteria are important wherever oil and gas reserves are developed, particularly in the early stages when the first platforms are being designed. The benefits of improving design criteria take two forms: cost savings from the avoidance of over-designed structures, and reduced losses (including reduced loss of life) from avoidance of under-designed structures. Since the consequences of under-design are so catastrophic, engineers tend to deal with uncertainty by over-designing. Over-design may add something in the order of 10 per cent to the development costs of a platform (the difference in cost between a platform that is just adequate to meet expected environmental conditions and one that has a margin of safety to account for uncertainty in environmental conditions). The value of improved environmental design criteria is some fraction of that 10 per cent, the exact amount depending on how much an improvement is made.

Continuous observations are needed during the hook-up phase and offshore operations. An important aspect is reduction in â€˜the numbers of day-off dutyâ€™ when there is an operation planned or taking place. When planning tow-out operations for large, concrete production platforms it is important to estimate the periods in which current, waves and wind are below certain threshold values. Also, on-line information from buoys is valuable for single point mooring operations (off-shore loading), diving etc.

Many marine operations have limitations with respect to weather, current and waves and therefore require real-time information for documentation of the conditions. Important decisions may have great economic consequences and often rely on real-time observations of current, waves etc. Examples are mooring operations using tug-boat or supply vessels. Lifting operations sensitive to long-period swells could benefit from real-time observations to document swell characteristics and to prepare forecasts.

Conclusions

To achieve region-wide large-scale understanding of physical conditions, a National Dynamics Centre should be set up to deal with the measurement and modelling of large scale water movement. The Malaysian National Oceanographic Directorate should lead this National Dynamic Centre. The centre should provide information, knowledge and training in relation to further studies and considerations when a new observation system is being developed.

Further to the above, scientific research regulated from the centre could provide the stepping stone towards new inventions in physical oceanography instrumentation and reverse engineering. Such products could be developed by the local industry for local and regional markets.

As indicated earlier, some regional attempts have already been made in the direction outlined in this paper. Nation-wide co-operation and co-ordination on systematic observation and model development should be further improved.

References

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