

#### 4. THE MOST IMPORTANT UNANSWERED QUESTIONS

##### (i) Bathymetry

A knowledge of the precise topography and character of the reef and continental slope is lacking in many areas particularly those away from shipping routes. This knowledge is important to circulation and mixing studies on the shelf, and on the slope where circulation is strongly controlled by local bathymetry (submarine canyons).

##### (ii) Meteorology

The nature of the wind forcing over the Coral Sea and Great Barrier Reef Region needs to be known as a function of location in order to determine wind driven circulations. In addition, the mean sea level pressure needs to be known in order to remove the "inverse barometric effect" when calibrating sea level data. Wind velocity is required when investigating wind waves, and air and sea surface temperatures are needed to specify boundary layer stability in wind-drag and wind wave generation models.

##### (iii) General Hydrography and Large Scale Circulation

The following appear to be the most important scientific questions:

1. How does the reef affect transfer, diffusivities etc. as boundary conditions for analytical and numerical models? How much transfer occurs in channels and across reef flats?
2. What are the surface fluxes of heat, salt and momentum?
3. How much mixing occurs to coastal water (including that from mangrove swamps and rivers) before it reaches and influences the local reefs? What is the nature of sediment transport?
4. What factors significantly affect transfers between lagoon water and ocean water? What is the heat and salt balance for the whole Lagoon?
5. What are the effects of tropical cyclones on mixing?
6. What is the relative importance of various mixing processes, such as surface mixing, bottom stirring and reef effects? How much mixing occurs in wakes etc. behind reefs?

(iv) Tidal Currents and Heights

The most important scientific questions are as follows:

How does the tide progress: on the shelf break?  
across reefs of varying topography?  
in the Coral Sea?

What is the transparency of the reef to long waves?

What is the nature of the tidal response/resonance of the Coral Sea?

Why does there appear to be a seasonal nature to the response of the tide in the Lagoon?

What is the nature of internal tides on the continental slope as a function of latitude?

What are the characteristics of tidal components of current measurements already made?

What are the irreversible effects of tides such as residual circulation and mixing?

There are inadequate measurements in the region north of 13°S and south of Townsville at present although presently deployed instruments will rectify this to some extent.

(v) Longer Period Currents and Heights

As for tides and general hydrography, the nature of flow across and around reefs is required in order to be able to parameterize the reef successfully in theoretical and numerical models. Other important questions are:

On a seasonal time scale, what is the dominant forcing mechanism? Wind stress and geopotential anomalies are the most likely candidates, but how do these mechanisms vary with season and location?

On subseasonal scales, what is the general nature of wind forcing, propagation and dissipation of topographically trapped waves (edge waves, Kelvin waves, shelf waves) as a function of latitude?

These characteristics have been determined for several regions of the reef for shelf waves but the relation between regions is unknown.

What is the effect of the abrupt change in shelf width at the Capricorn Channel on the equatorward propagation of trapped waves?

(vi) Wind Waves and Swell

What is the wave climate in deep water outside the reef and within the reef on the outer edge of the shelf?

How does the presence of the reef affect transmission of swell?

How does the swell act physically on the reef?

(vii) Tropical Cyclones

What is the effect of tropical cyclones on deepening of the mixed layer in the Coral Sea?

How do cyclones transport water across reefs?

To what extent do cyclones generate storm surge and the associated currents?

What are the wave fields generated by, and propagating from, tropical cyclones?