



***“Advancing Ocean Knowledge,  
Fostering Sustainable Development:  
from the Indo-Pacific to the Globe”***

### **Scientific advances in ocean observations and modelling techniques**

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Observation and numerical modelling are two key tools for ocean research, operational oceanography and providing scientific services to public. To review the progress and challenges faced in these two areas is helpful for future international cooperation. For ocean models, to accurately simulate and forecast the vertical structure of the upper ocean such as temperature and salinity remains a challenge; the forecast ability on Typhoon intensity has no progress during the past several decades while the Typhoon track forecast ability is much improved; for regional and global climate models, the prediction ability in the Australia-Asia monsoon area is the lowest on the whole world, although the social sustainability in this area is seriously affected by monsoon and marine hazards. To overcome the above barriers for marine science and technology, new generation ocean and regional climate models are urgently needed. The inclusion of the surface wave-induced vertical mixing can overcome the common problems faces by ocean models including overestimated sea surface temperature, underestimated subsurface temperature and too shallow mixed layer depth in the upper ocean for POM, ROMS, HIM, POP, MOM, NEMO, and FESOM etc; The inclusion of sea spray due to wave breaking can much change the air-sea fluxes, heat flux can be 3 times larger, and the forecast of Typhoon intensity can be improved; The inclusion of the diurnal variation in ocean models can much improve the simulation of MJO in the Indian Ocean in a regional climate model; And the inclusion of surface wave in global climate model can improve the tropical biases, which are common problems for all climate models. The above scientific achievements and knowledge are helpful not only for IOC/WESTPAC member states, but also for all countries in this world. The state-of-art knowledge on ocean and climate model development is shared through, but not limited to, annual training courses of the UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate, and international cooperation projects such as the Ocean Forecasting System (OFS) in the Southeast Asian Seas of IOC/WESTPAC. Due to the high costs of ocean observations, the ocean monitoring system in the northwest Pacific and north Indian Ocean is still quite limited. TAO/TRITON buoys in the tropical Pacific started in 1980s has played a leading role in ocean monitoring, while RAMA buoys have developed dramatically in the Indian Ocean during this century. TPOS, IIOE-II, RAMA, IPOVAI, NPOCE etc may serve as the stems of future ocean observations.