The 2nd Meeting of the Project Steering Committee for the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand

5th – 6th November 2019

Pullman Hotels and Resorts, MIRI, SARAWAK, MALAYSIA

OCEAN MODELLING SYSTEM[1]

I. INTRODUCTION

Taking into consideration during the past decades (2006-2008), Collaborative research activities of the SCS Project and SEAFDEC have resulted in a preliminary information base on key spawning (sources) and nursery areas (sinks) of economically important species in the South China Sea. These research activities involved analysis of information collected during cruises of the SEAFDEC Research Vessel M.V. SEAFDEC in the following areas: the Gulf of Thailand and the East Coast of Peninsular Malaysia; the West Coast of Sabah, Sarawak, and Brunei Darussalam; the West Coast of Luzon, Philippines; and in Vietnamese Waters. Drawing on these data, the distribution and abundance of the larvae of important demersal and pelagic fish species in the South China Sea was mapped. To improve regional understanding of fish early life history and links to critical habitats, the component 2 of this project aims to build on this foundational work on data mapping via the development of a modelling system, linking known sources and sinks of fish larvae to ocean circulation patterns and nutrient/chlorophyll concentrations in the South China Sea and the Gulf of Thailand.

II. ISSUES AND CHALLENGES ON DEVELOPMENT OF OCEAN MODELLING

Over the past 40 years, numerical modelling has developed rapidly in scope (from hydrodynamics to ecology) and resolution (from one-dimensional, 10^2 elements to 3-D, 10^8 elements) exploiting the contemporaneous development of computing power. Associated challenges and future options to sustain the science and technology to meet the requirements of the end-user are identified. In reviewing future strategies for the development of modelling, subsequent sections examine sub-components of this system, namely: the requirements of the end-user; scope and development of modelling; operation of models; data requirements from observations and coupled models (see Figure 1).

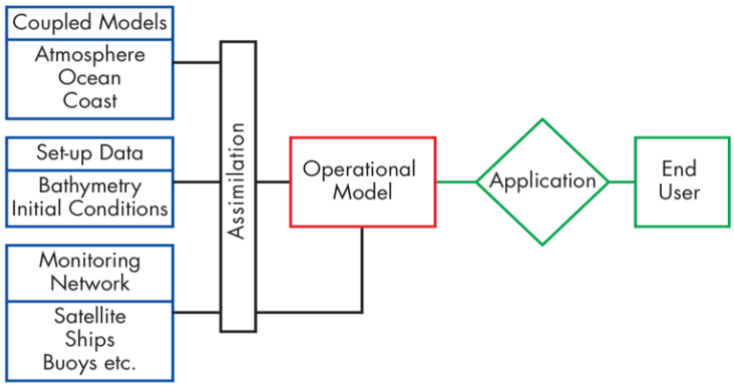


Figure 1: Components of a modelling simulation system

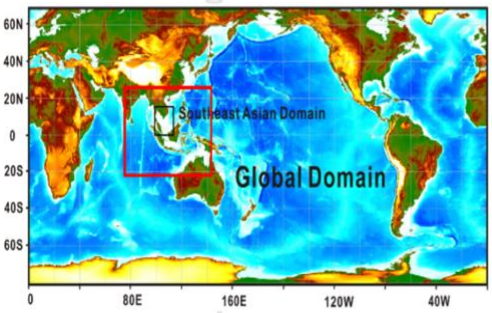
[1] SEAFDEC, 2019: PROGRESS IN OCEAN FORECASTING SYSTEM IN THAILAND, Thailand-China Joint Laboratory for Climate and Marine Ecosystem in the 2nd Meeting of the Regional Scientific and Technical Committee Meeting held on 21-23 May 2019 in Kampot, Cambodia.

In addition, an effective operation of both ocean and coupled shelf-sea models requires access to supercomputers and continuous maintenance of software. Major infrastructural investment is needed and high cost for long term maintenance.

III. EXISTING OCEAN MODELLING

During the project development in 2007-2008, Ocean modelling system in the Southeast Asia was quite new and very interesting subject that help scientist to understanding ocean circulation and other parameters which could be applied for management of fisheries. Ocean Forecasting Demonstration System (OFDS) was officially launched for the first time during the 8th IOC-WESTPAC Meeting in Bali, Indonesia in May 2010. The system was developed by the First Institute of Oceanography (FIO) based on wave-tide-circulation model. In Phase I of the project in 2010-2012, the first version of OFS covers only the southern South China Sea and was operated by Dr.Wendy Watson-Wright, Executive Secretary of IOC, Assistant Director General of UNESCO. The Phase II in 2013-2015, the domain was extended to cover entire Southeast Asian area including northwest Pacific, South China Sea, and the northeastern Indian Ocean. The breakthrough of the OFS happened on 9 October 2013 when Chinese Premiere Keqiang Li proposed to initiate the China-ASEAN Cooperation Fund and announced to subsidize the first 17 projects which included the OFS in the 16th China-ASEAN Summit.

At present, the Ocean Forecasting System Framework (OFS) is based on wave-circulation coupled model, MASNUM: Laboratory of MArine Sciences and NUmerical Modeling, State Oceanic Administration, China. The circulation part is based on POM (Princeton Ocean Model) and the wave component is based on MASNUM-WAM model. The model is forced by forcing obtained from NCEP products. An advancement of this model is a way to couple wave and circulation model through the so-called wave-induced viscosity Bv by introducing it into the Mellor-Yamada scheme (Mellor and Yamada, 1982) in POM. A nested scheme from the quasi-global to Southeast Asian area is used to obtain the open boundary conditions (figure 2).



OFS Thailand Products	
Domain	80° E – 150° E, 20° S – 25° N
Resolution	1/6° x 1/6°
Grids	Horizon: 421x271 Vertical: 21 layers
Results	July, 2015 – present

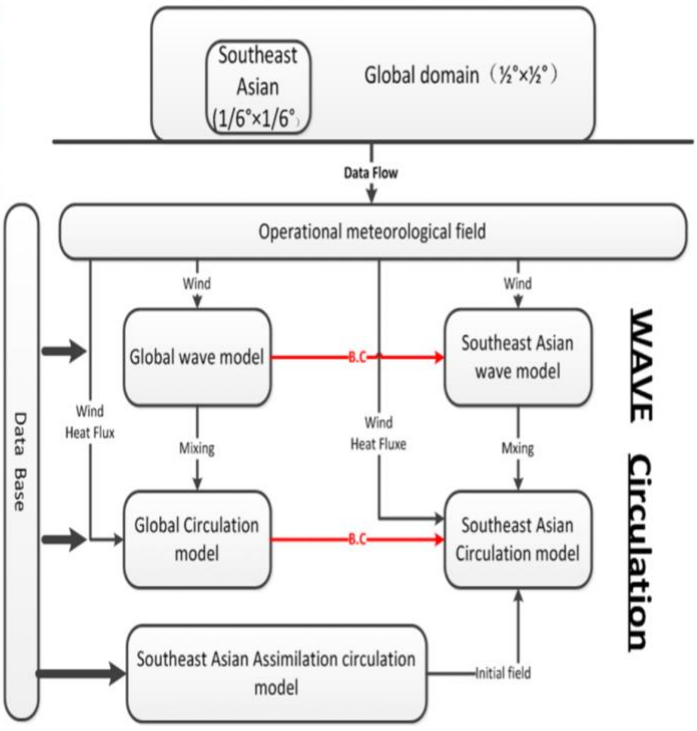


Figure 2: OFS simulation domain (Left) and framework (right)

In 2014, the Department of Marine and Coastal Resources (DMCR) of Thailand has got the budget for in setting up the OFS system in Thailand. And one year later, the DMCR in collaboration with the FIO installed the OFS system at Phuket Marine Biological Center (PMBC), Phuket, Thailand and also organize workshops instructing the DMCR to operate the system routinely. OFS Thailand has run since July 2015 providing output in five parameters; i.e., wind, wave height, sea level, current and temperature, the last two of which are in 21 layers. The forecast results can be shown the vertical profiling which are beneficial for capturing the mixed-layer depth. The data archives are available for downloading at http://ofs.dmcr.go.th/ thailand/archives.jsp (details in figure 3).

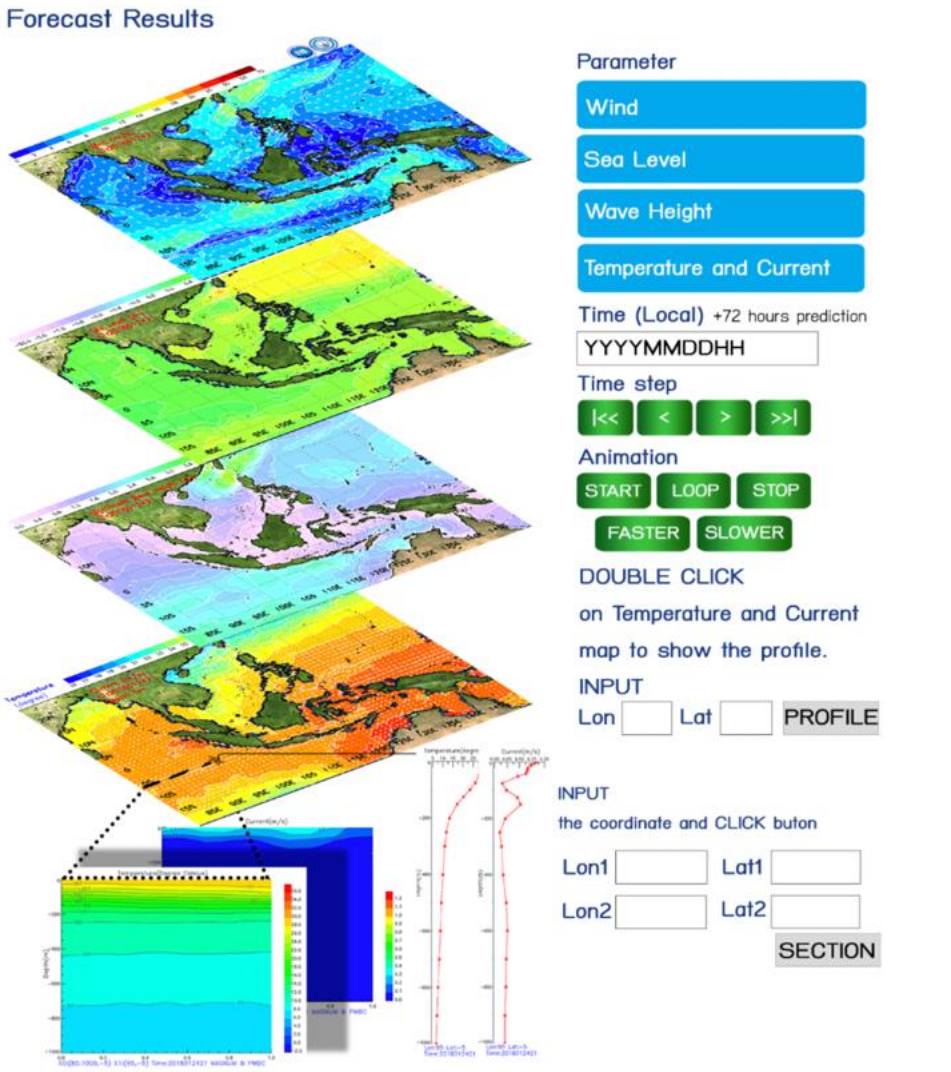


Figure 3: OFS visualization and tools for extracting specific results

IV. PROJECT DECISION ON USING OF OCEAN MODELLING

This issue was addressed at the 2nd Meeting of the Regional Scientific and Technical Committee Meeting in May 2019 in Kampot, Cambodia. The expert from the Phuket Marine Biological Center of the DMCR, was invited to introduce OFS visualization and tools including the URL on the ocean circulation and future improvement of the system for higher resolution in the specific region including the Southeast Asia.

With OFS breakthroughs during the 2nd phase, the first surface wave-tide-circulation coupled model of FIO-COM was established in 2013, and then adopted as the core to produce reanalysis dataset for the period Jan., 2014 to April, 2016. It became in the operational OFS since May, 2016. Highly efficient parallel scheme is designed to use full-scale of Taihu-Light with 10,649,600 CPU cores (Qiao et al., 2016), which was on the finalist of the international ACM Gordon Bell Prize. The forecasting products can be easily accessed both through website http://221.215.61.118:2018/#/ and cell phone APP of "Global Ocean on Desk" (GOOD). To cite this dataset this dataset, please quote the version number and cite Qiao *et al*, (2019) (figure 4)

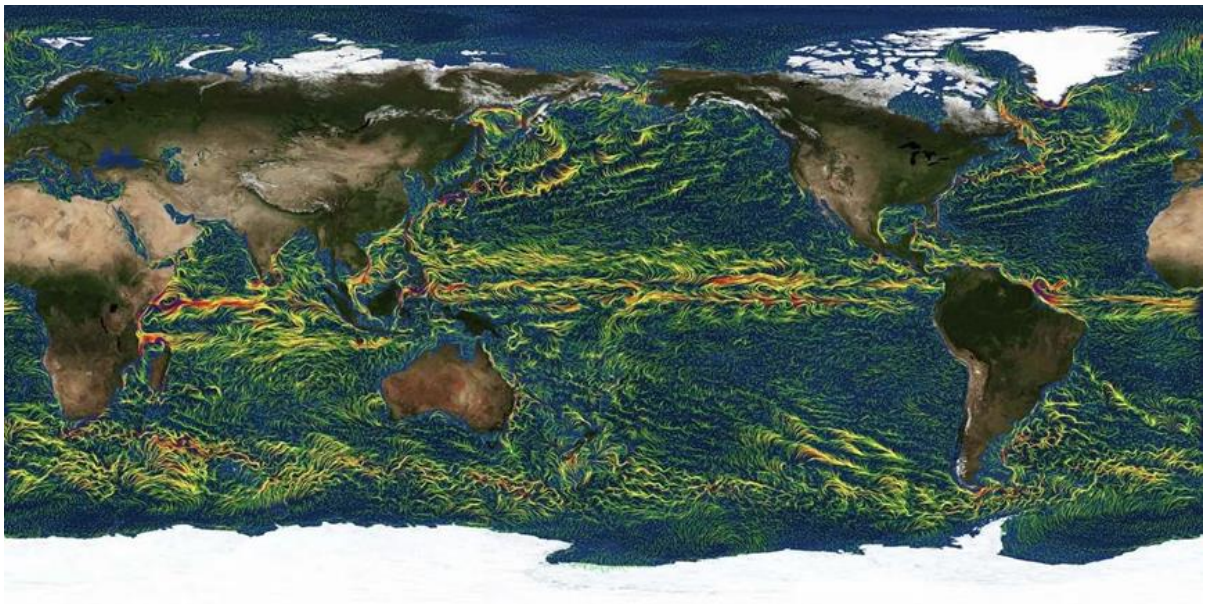


Figure 4 The snapshot of the OFS for 21st Century Maritime Silk Road published on 10 December 2018 through http://221.215.61.118:2018/#/

V. CONSIDERATION AND DECISION BY THE COMMITTEE

- The Committee is requested to take note on the existing Ocean Forecasting System that includes many parameters such as wind, current, temperature, sea level, high wave, etc. which are very useful for integration with the fisheries parameters to support the management of fisheries and establishment of fisheries refugia.
- Refers to the project budget which planned for hiring consultant(s) for developing the system is therefore not necessary, taking into account the over efforts, and costly for long term system management/maintenance. The PCU therefore, requests the committee for consideration and decision the proposed revision this budget for other purposes.
- The committee is welcomed to provide the advice and comments on this matter.