Storm Surges Prediction using Ocean Forecast System in KMA

Sung Hyup You (shyou@metri.re.kr)

Global Environment System Research Lab. National Institute of Meteorological Research
Korea Meteorological Administration (KMA), Republic of KOREA

Introduction

The coastal areas of Korean peninsular are one of the challenging places in ocean modeling for reasonable prediction of near-shore storm surges/tide conditions. During summertime, the number of typhoons occurs in the Pacific Ocean and pass adjacent to the Korean Peninsula (Fig. 2, 3), often causing terrible damage to property in the coastal region. Establishing of newly devised ocean prediction system of Korea Meteorological Administration (KMA) is underway in conjunction with high computing environment. The main focus of storm surges prediction system lies in accommodating regional and coastal storm surges processes. The Storm surges/Tide Operational Model (STORM) in KMA covers 115°-150°E, 20°-52°N based on POM (Princeton Ocean Model) (Blumberg and Mellor, 1987) with 1/12° horizontal resolutions including the Yellow Sea, East China Sea and the East Sea, marginal seas around Korea (Fig. 1). From July, 2006 the STORM have been applied to formal forecasting model in KMA based on CRAY X1E system. Sea surface wind and pressure from the Regional Data Assimilation and Prediction System (RDAPS) is used for forcing input of storm surge model. In this model, the level of storm surge calculated by the difference between tide level and sea level change caused by meteorological effects.

In the near future, ultra-high resolution coastal storm surges/tide prediction system will be applied operational model in KMA. The developing coastal storm surges/tide model covers 6 coastal areas around Korean peninsular and the horizontal grid intervals are 1/120° for each area (Fig. 9). The model output from regional model is used for boundary condition of coastal model. This study investigated the storm surges patterns during total 9 Typhoons in 2005-2007 using model and observation results.

Storm Surges/Tide Operational Model

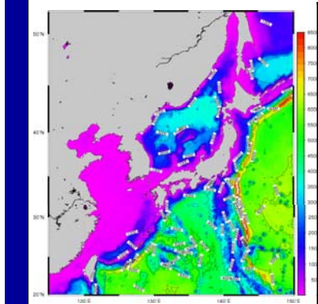
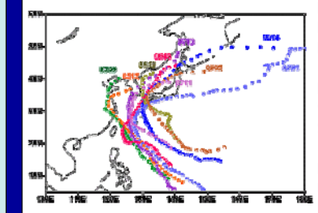


Fig. 1 Model Domain and Topography for regional storm surges/tide model

Model	2-D Ocean Circulation Model (POM 2D)
Coordinate System	Spherical Coordinate
Model Domain	115 °E-150 °E 20 °N-52 °N
Horizontal Resolution	1/12 ° by 1/12 ° (421 ×385)
ΔT	200 sec
Prediction Time	48 H (00,12UTC)
Initial Field	hot start
Input Data	RDAPS Sea Wind and Pressure 8 tidal constituents

Storm Surges Prediction



MATSA(0509)
NABI(0514)
KHANUN(0515)

EWINIAR(0603)
WUKONG(0610)
SHANSHAN(0613)

MANYI(0704)
USAGI(0705)
NARI(0711)

Fig. 2 Typhoon Tracks which affected to Korean Peninsular from 2005 to 2007

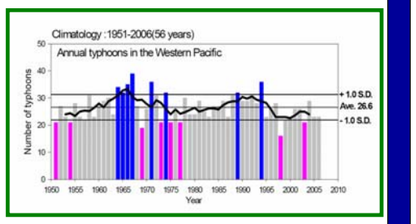
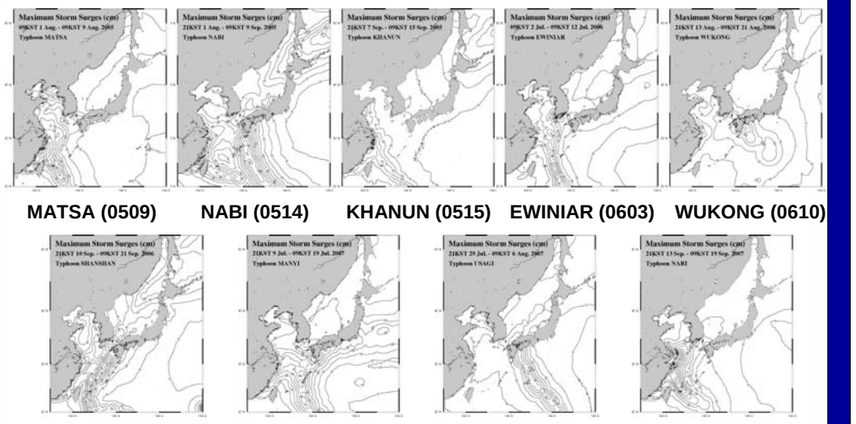


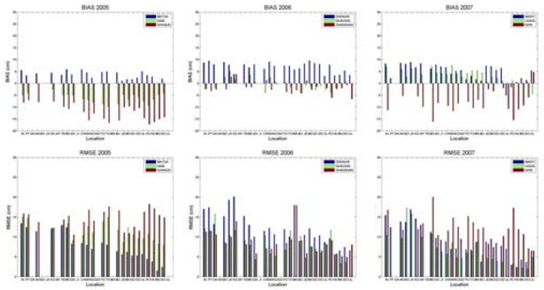
Fig. 3 The long term variations of Typhoon formation number from 1951 to 2007



MATSA (0509) NABI (0514) KHANUN (0515) EWINIAR (0603) WUKONG (0610)

SHANSHAN (0613) MANYI (0704) USAGI (0705) NARI (0711)

Fig. 4 Predicted maximum storm surges height for 9 Typhoons (2005-2007)



30 coastal stations

Fig. 5 Variations of BIAS and RMSE of storm surges during Typhoon period

Table. Averaged value of BIAS and RMSE of storm surges during Typhoon period

	MATSA (0509)	NABI (0514)	KHANUN (0515)	EWINIAR (0603)	WUKONG (0610)	SHAN SHAN (0613)	MANYI (0704)	USAGI (0705)	NARI (0711)
BIAS	3.54	-6.14	-12.06	6.92	0.79	-1.76	4.69	3.34	-7.99
RMSE	7.72	11.41	14.61	12.00	9.07	8.63	8.95	6.78	12.19

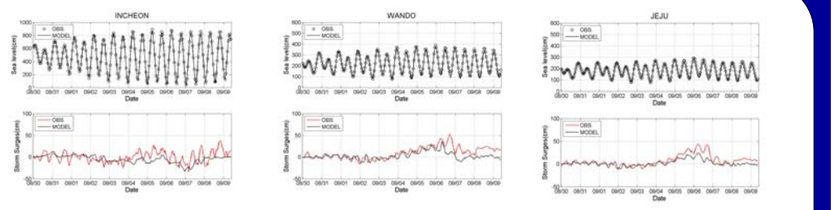


Fig. 6 The comparisons of sea level (upper) and storm surges height (lower) between data from tidal stations and model results for Typhoon NABI (0514)

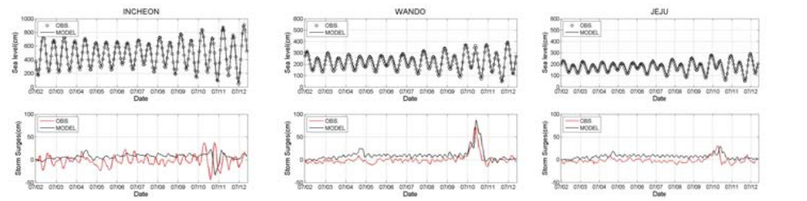


Fig. 7 The comparisons of sea level (upper) and storm surges height (lower) between data from tidal stations and model results for Typhoon EWINIAR (0603)

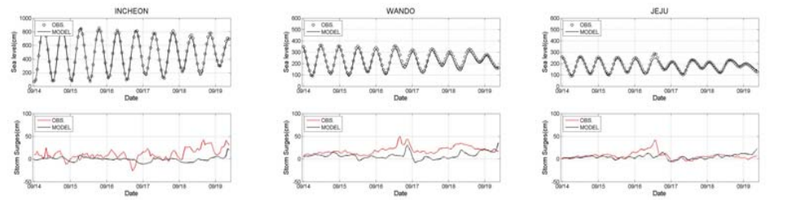


Fig. 8 The comparisons of sea level (upper) and storm surges height (lower) between data from tidal stations and model results for Typhoon NARI (0711)

High resolution Coastal Storm Surges Model

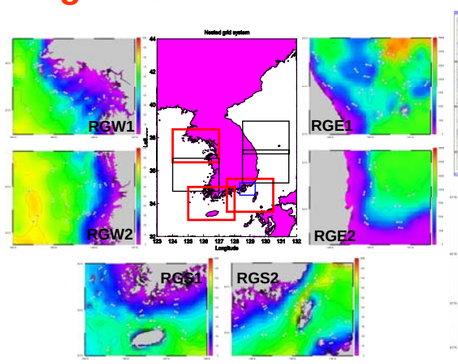


Fig. 9 Model domain and topography for coastal storm surges/tide model

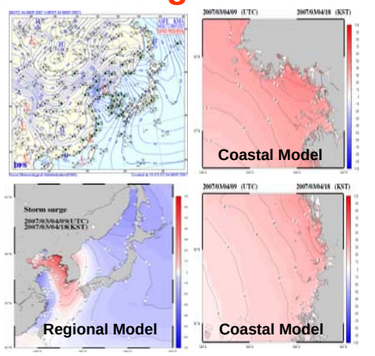


Fig. 10 Weather chart (upper left), storm surges height from Regional (Lower left) and Coastal Region W1 (Upper Right) and W2 (Lower Right) for 09 UTC 04 May 2007

Establishing of newly devised storm surges/tide prediction system of KMA is underway in conjunction with high computing environment The development of high resolution is very essential to predict the storm surges patterns in the complex coastal area of Korea Peninsular. The coastal areas of Korea Peninsular are one of the challenging places in ocean modeling for reasonable prediction of near-shore storm surges/tide conditions. The high resolution coastal storm surges/tide prediction system will be used for more precise storm surges forecasting.