Estimation of design wave height through long-term simulation of sea states for the North East Asia regional seas

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Korea Ocean Research and Development Institute Ansan P.O. Box 29, Ansan, Korea Wave Information for Application

in-direct method of wave data production To Overcome the space and time limitation by Indirect method of wave data production: "Numerical Wave Modelling"

- Hindcasting

- . extreme wave height(design wave),
- . operational wave height the construction of coastal structures, coastal development
- Nowcasting & Forecasting
  Safe Navigation, Ocean Service for
  Marine Operation

Methods of Design Value Calculation

- 1) Long-term Obs. Wave Data or
- 2) Long-term Hindcast
  - => Extreme Statistical Analysis
- 3) Calculation for Design Storm
- Typhoon: 50 year
  - Extra Tropical Storm : 20-30 years
- Extreme statistics analysis . Return period 10, 20, 30, 50 and 100 years

. Combination after separate statistical analysis for extra-tropical storm and typhoon

# Wave Hindcast

## 1. Contineous hindcast

Period: 1979~2004 Wind Input: ECMWF Wind data Wave Model: 2nd generation Hybrid Parametric Model Grid: 18km (1/6 deg) Period: 1979~2004

# 2. Extreme case hindcast

## for Extra tropical storm

Wind Input: ECMWF Wind data Wave Model: WAM 4, WAVE-WATCH III model Grid: 18km(1/6 deg)

## Typhoon case

Period: 1951~2004 Wind input: Typhoon wind model Wave model: HYPA, WAM 4, WAVE-WATCH III model Grid: 18km(1/6 deg)

### 18 Km Grid System



### Example of extreme wave analysis



![](_page_6_Figure_0.jpeg)

The grid points of design wave height calculation in 1988.

![](_page_6_Figure_2.jpeg)

Grid points for design wave height estimation.

![](_page_7_Picture_0.jpeg)

### Design Waves for 55km grid (1988)

### Design Waves for 18km grid (1988)

![](_page_7_Picture_3.jpeg)

# Example of retrieval of design waves for arbitrary location

			Return Period(year)					
		DII	10.0 2	20.0	30.0	50.0	100.0	
		Ν	2.0	2.6	3.0	3.5	4.3	
	I = 55	NNE	2.0	2.5	2.7	3.1	3.5	
	J =122	NE	2.0	2.3	2.4	2.6	2.8	
F	X = 54.8	ENE	2.1	2.3	2.5	2.7	2.9	
	Y =121.8	Е	2.4	2.9	3.1	3.4	3.8	
	Latitude	ESE	2.4	2.8	3.1	3.4	3.8	
	Long I cua	SE	2.3	2.8	3.0	3.3	3.7	
	Latitude Longitud	SSE	2.3	2.7	2.9	3.2	3.5	
		S	26	32	3.5	3.9	4 4	
		SSW	3.6	4 6	5.1	59	6.8	
		SW	3.3	4 1	4.6	53	6.2	
			2.8	35	<i>A</i> 0	Δ.6	5.Z	
		۷۷۵۷۷ ۱۸/	2.0	3.5 3.5	-+.0 ∕ ∩	+.0 ∕I 7	5.6	
		V V \	2.7	0.0 0.6	- <del>1</del> .0	<del>ヿ</del> ./ つつ	0.0 2 0	
		VVINVV	Z. I	2.0	2.9	ა.ა ი ი	J.O	
		NVV	1./	2.3	2.6	3.0	3.7	
		NNW	1.7	2.2	2.5	3.0	3.6	
		TOT	3.8	4.6	5.3	5.8	6.9	

### Example of spatial distribution of design waves height

![](_page_9_Figure_1.jpeg)

![](_page_10_Figure_0.jpeg)

Comparison of design wave height for return period of 50 years along the coastal grid points estimated for different period of hindcasting duration

# Extreme Wave Analysis without typhoon Maemi (2002) data and typhoon Maemi's data

![](_page_11_Figure_1.jpeg)

#### Return Period of Typhoon Maemi Waves along the coast

![](_page_12_Figure_1.jpeg)

### Typhoon frequency, intensity

![](_page_13_Figure_1.jpeg)

## NW Pacific Increase of Typhoon PDI

PDI (potential destructi veness Index) is defin ed as the third power o f maximum wind speed over the lifetime of a t ropical cyclone

![](_page_14_Figure_2.jpeg)

Figure 2 | Annually accumulated PDI for the western North Pacific, compared to July-November average SST. The PDI has been multiplied by a factor of  $8.3 \times 10^{-13}$  and the HadISST (with a constant offset) is averaged over a box bounded in latitude by 5° N and 15° N, and in longitude by 130° E and 180° E. Both quantities have been smoothed twice using equation (3). Power dissipation by western North Pacific tropical cyclones has increased by about 75% in the past 30 yr.

![](_page_14_Figure_4.jpeg)

# Variation of Max Wind at 20-30N, 120-130E

# Global Warming Effects?

- There is a tendency that the intensity and frequency of typhoon become increasing
- Is it the result of global climate change?
- If so, Coastal Defense Strategy need to be changed considering Global Climate Change, which is so uncertain..
- Intensive monitoring and research
- is needed for west pacific region
- to reduce such uncertainty
- in the future

![](_page_15_Picture_8.jpeg)