KMA's Operational Marine Prediction & Forecasting System

하늘을 친구처럼, 국민을 하늘처럼

KMA

Marine Meteorology Division
Director
Dr. Sung Hyup You

Severe Marine Weather in Korea







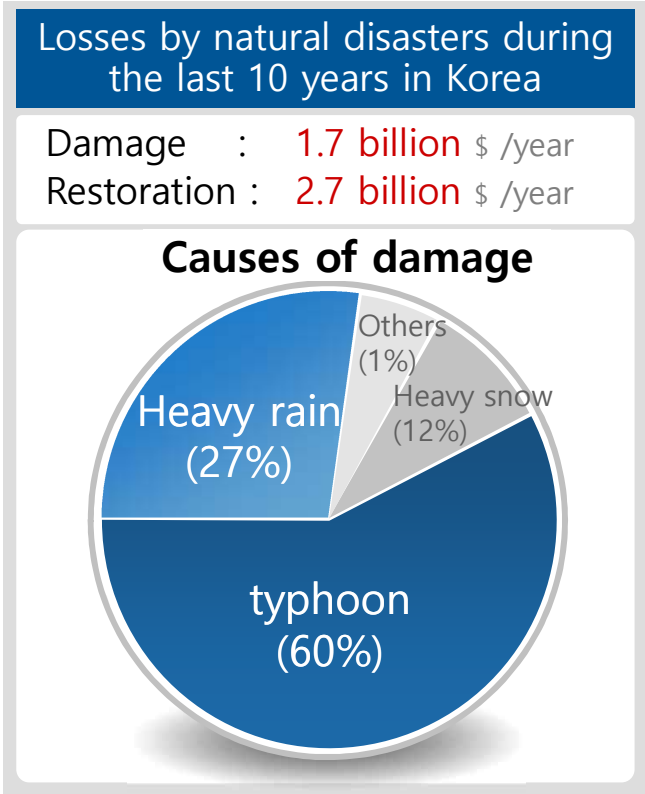

Damage by Meteorological Disasters

[Over the last decade]

- **Caused** yearly **$ 1.7 billion in property damage** and
  $ 2.7 billion in disaster recovery (0.7% of the total national budget
- **Main Causes: Typhoons: 60%, Heavy rain: 27%, Heavy Snow: 12%...**

- **Recently, damage by Asian Dust, fine(ultrafine) dust, heat wave, cold wave, fog and drought have a growing impact on people and industries, and have become new social issues.**

⇒ **Rapidly increasing demands for Met. Services from the nation and the public**

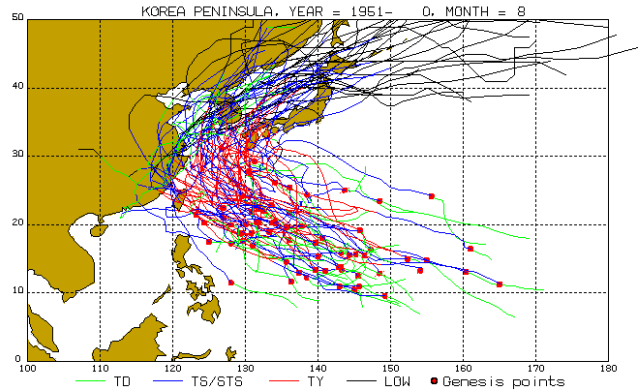


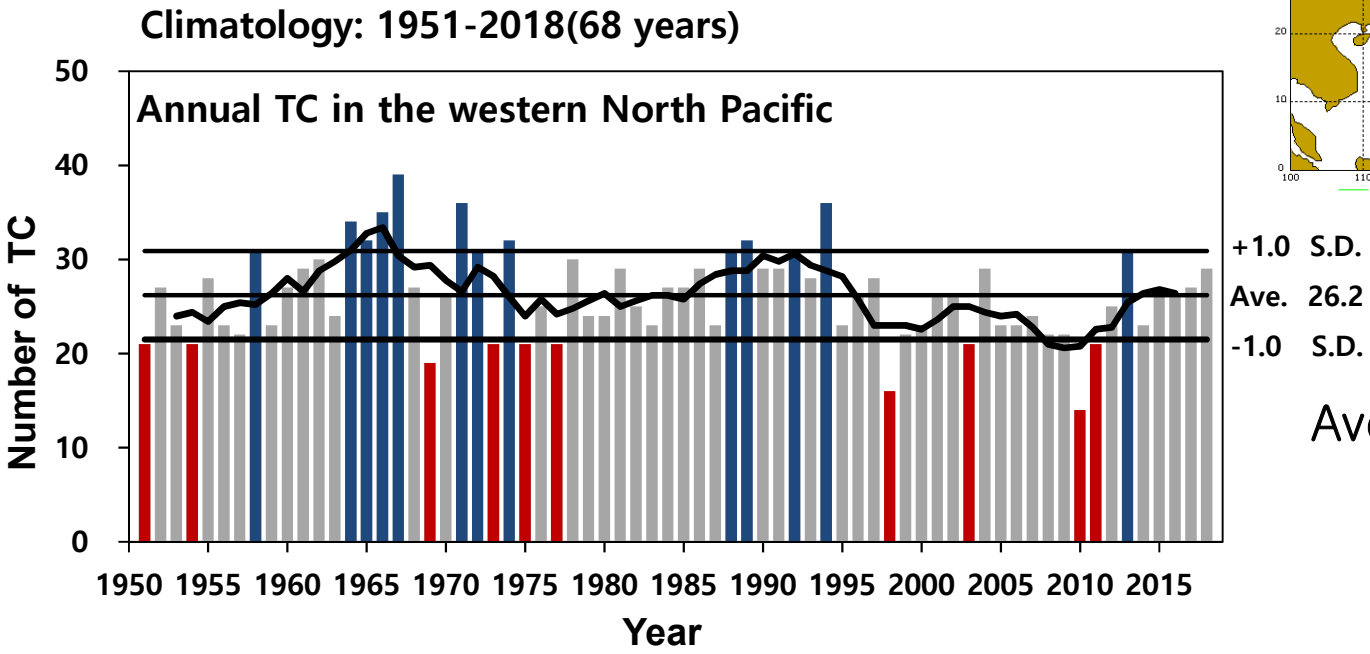
Occurrence Frequency of Typhoon

1951–2018

Month / Case	1	2	3	4	5	6	7	8	9	10	11	12	Total
A	30	17	27	48	68	122	267	376	336	252	160	79	1782
K	0	0	0	0	3	23	70	74	43	5	0	0	218

A: Typhoon occurred in Northwestern Pacific Ocean
K: Typhoon effected on the Korean Peninsula





Average No. of Typhoon

1951–2018: 26.2

1989–2018: 25.4

2009–2018: 24.5

Marine Meteorological POPS®

- Phenomenon
- Observation
- Prediction
- Service

Marine Meteorological POPS®

Phenomenon

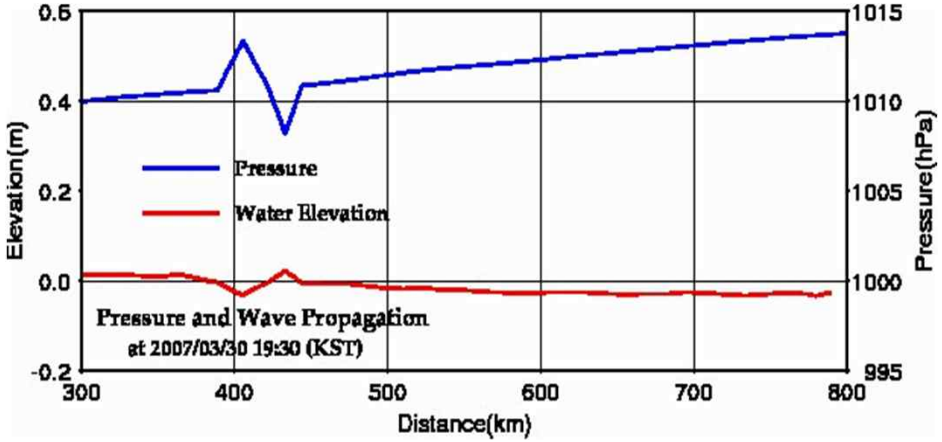
Marine Meteorological Disasters (Spring)

Spring : Meteotsunami, Abnormal Wave

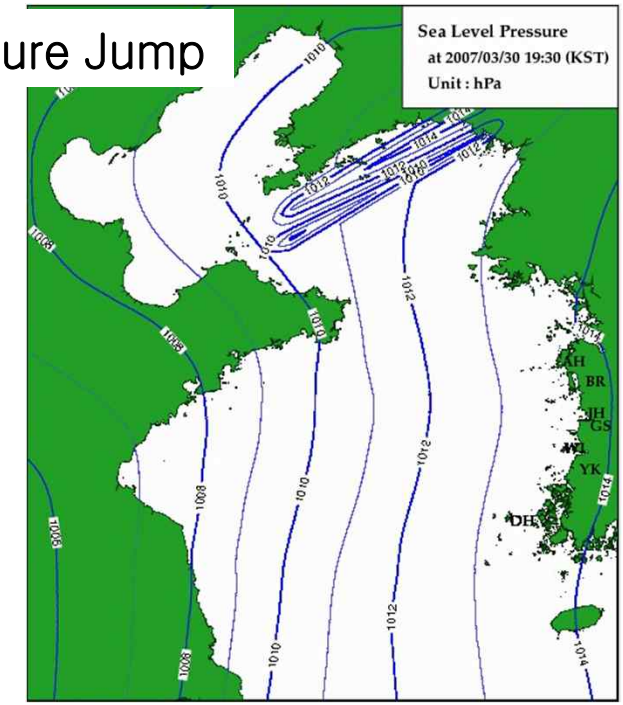
- **Juk-do, West Sea of Korea,**

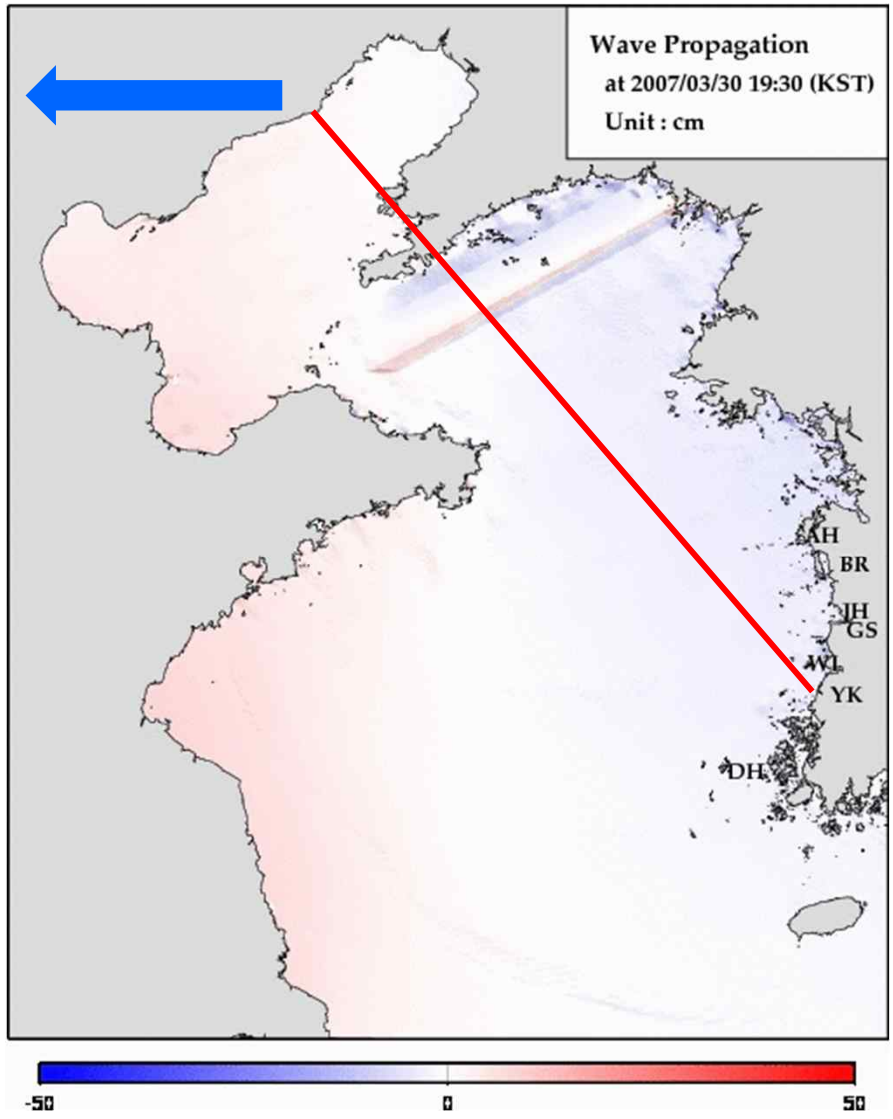
  4. May. 2008.(9 casualties)

Marine Meteorological Disasters (Spring)



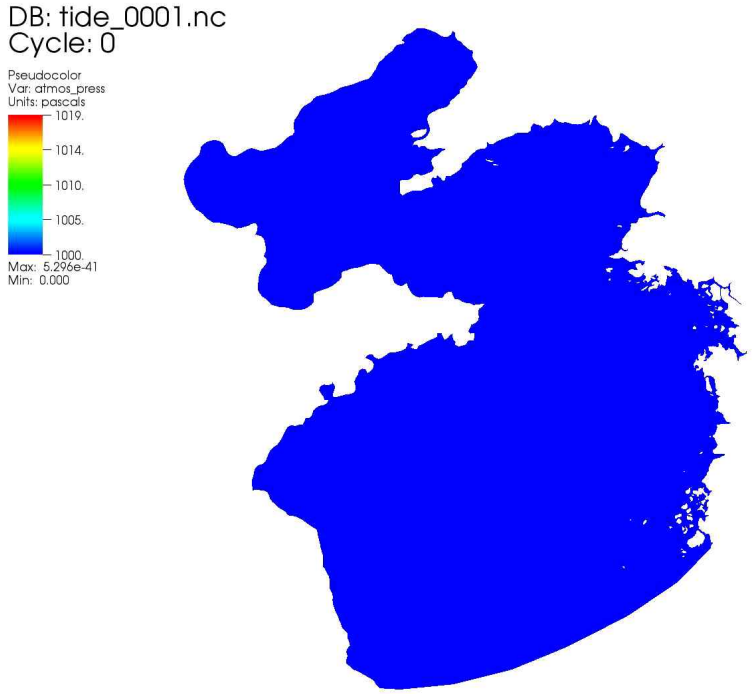
Pressure Jump



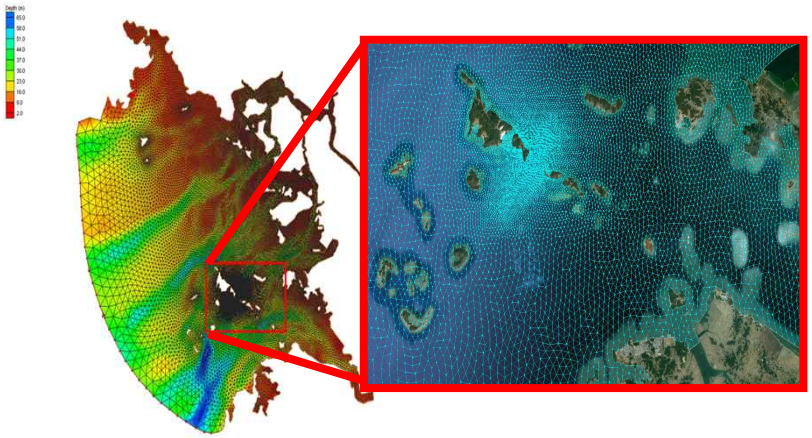


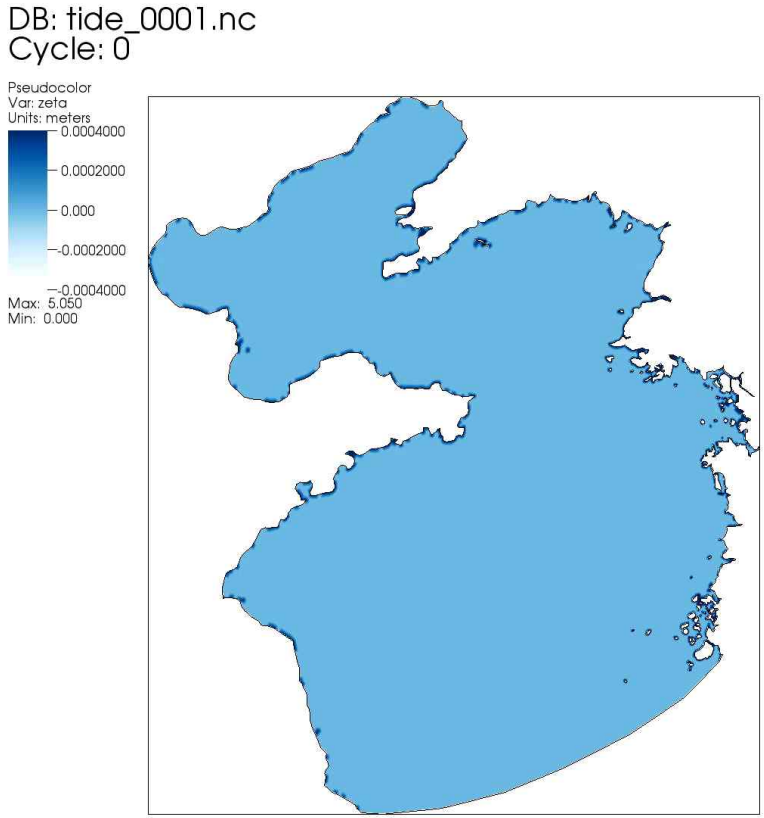
Meteotsunami Simulation by COMCOT

Marine Meteorological Disasters (Spring)



Pressure





Meteotsunami Prediction
by FVCOM

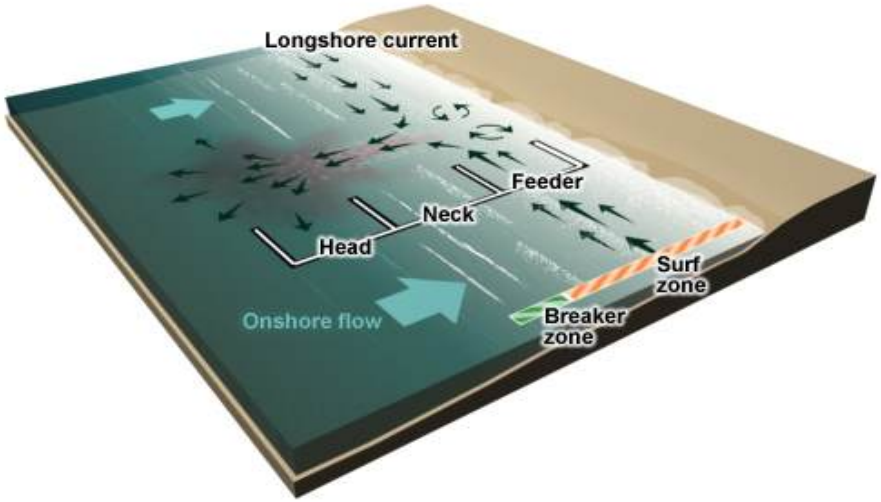
Marine Meteorological Disasters (Summer)

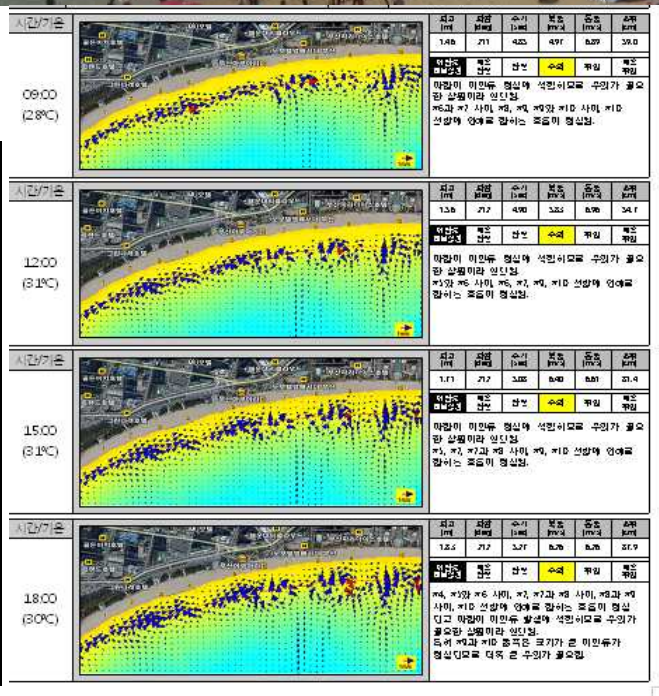
Rip Current accident(2012)

Haeundae Beach, Busan, Korea

Marine Meteorological Disasters (Summer)

Summer : Rip Current





4 Warning Stages

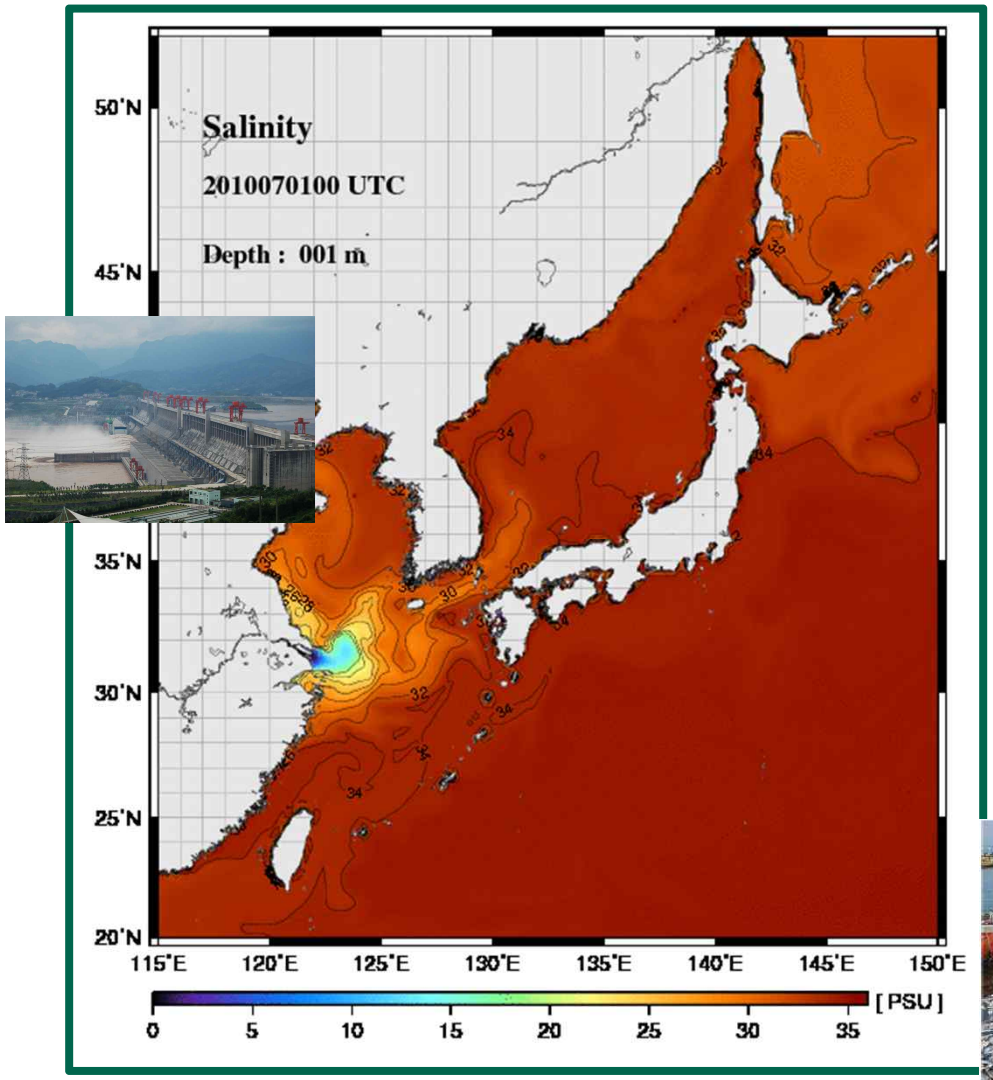
Safe
Caution
Danger
Very Danger

Haeundae Beach, Busan, Korea

Rip Current Prediction by 3 hour Interval

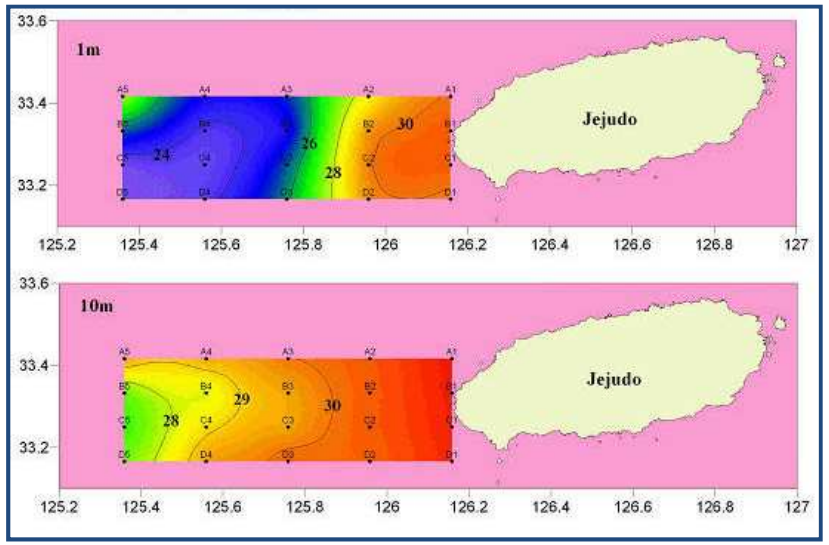
Marine Meteorological Disasters (Fall)

Fall : Low Salinity Water

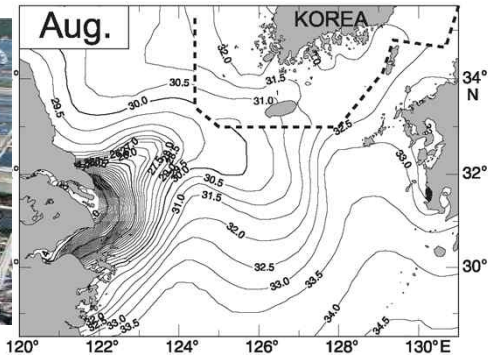


Low salinity water discharge prediction by ROMS model

Jeju Island (2. Aug. 2010)



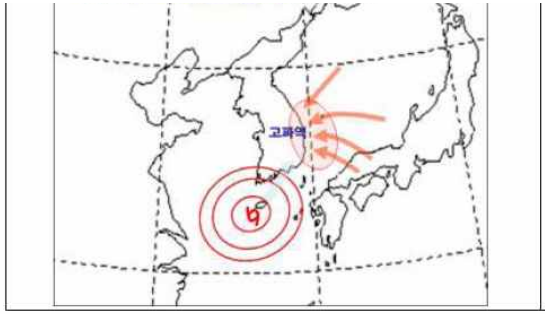
- **Low Salinity : 25.4~28 psu along western coast of Jeju Island**



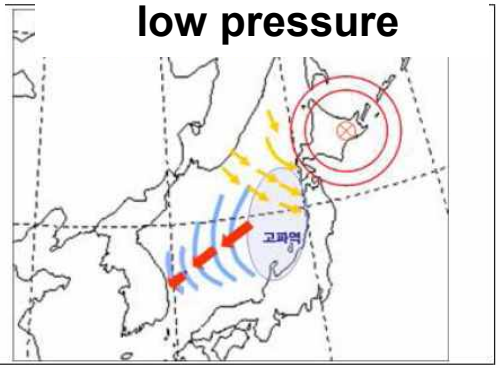
Marine Meteorological Disasters (Winter)

Winter : Swell

High waves by low pressure



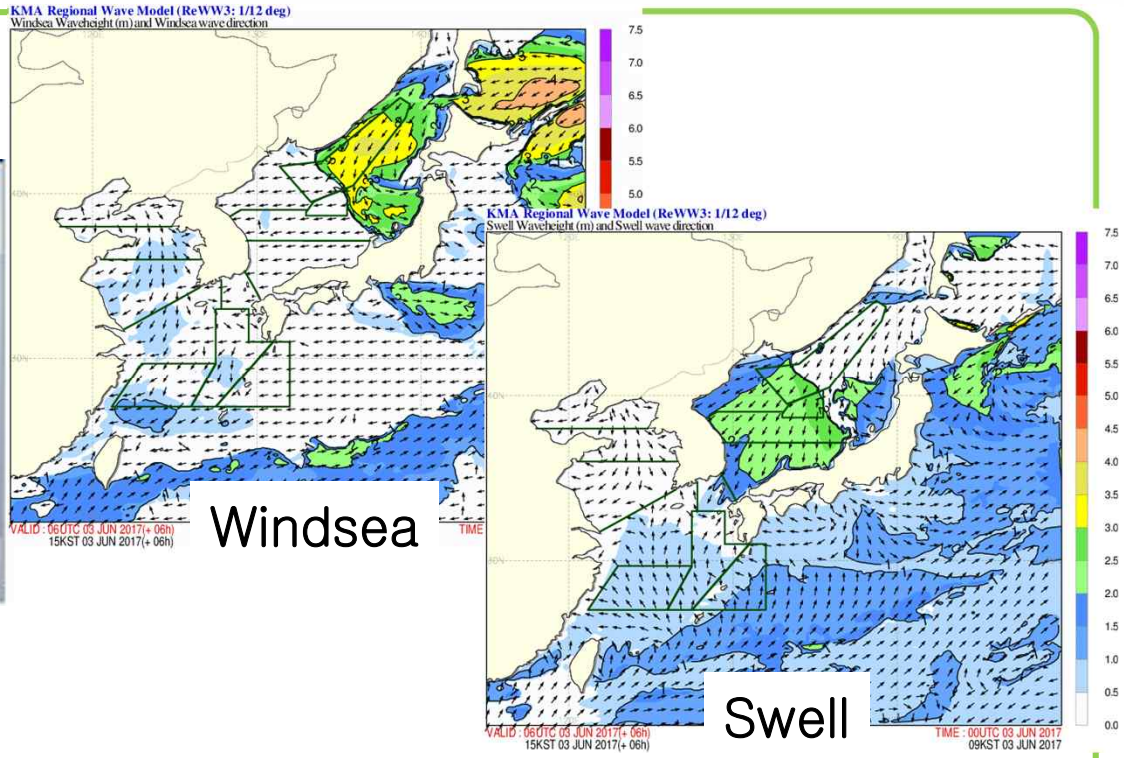
Swell by standing low pressure



- Eastern Coast of Korea

Inundation due to Swell

(10. Jan. 2009, 5 Casualties)

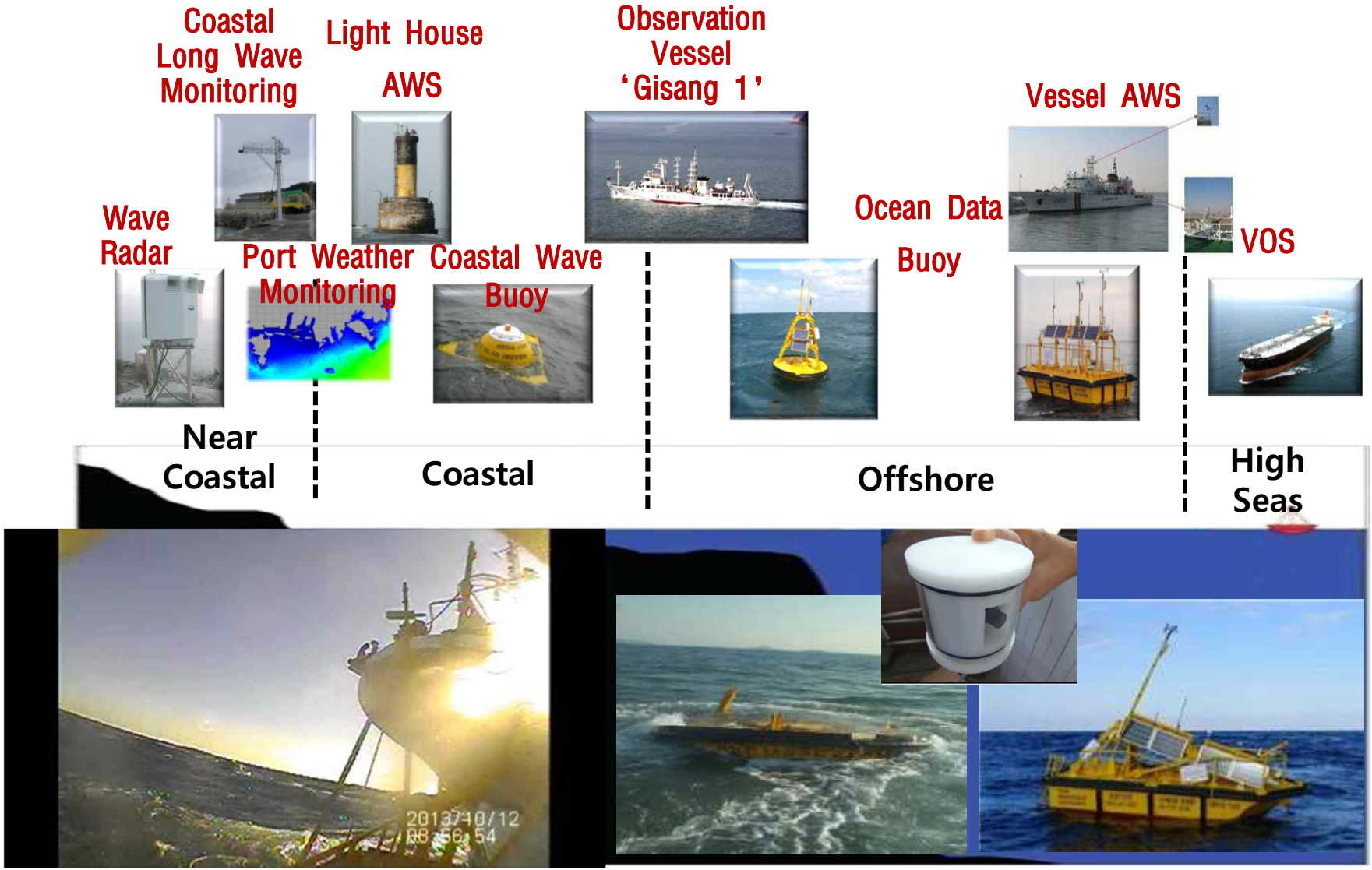


Wave Spectrum Separation by WaveWATCH III

Marine Meteorological POPS®

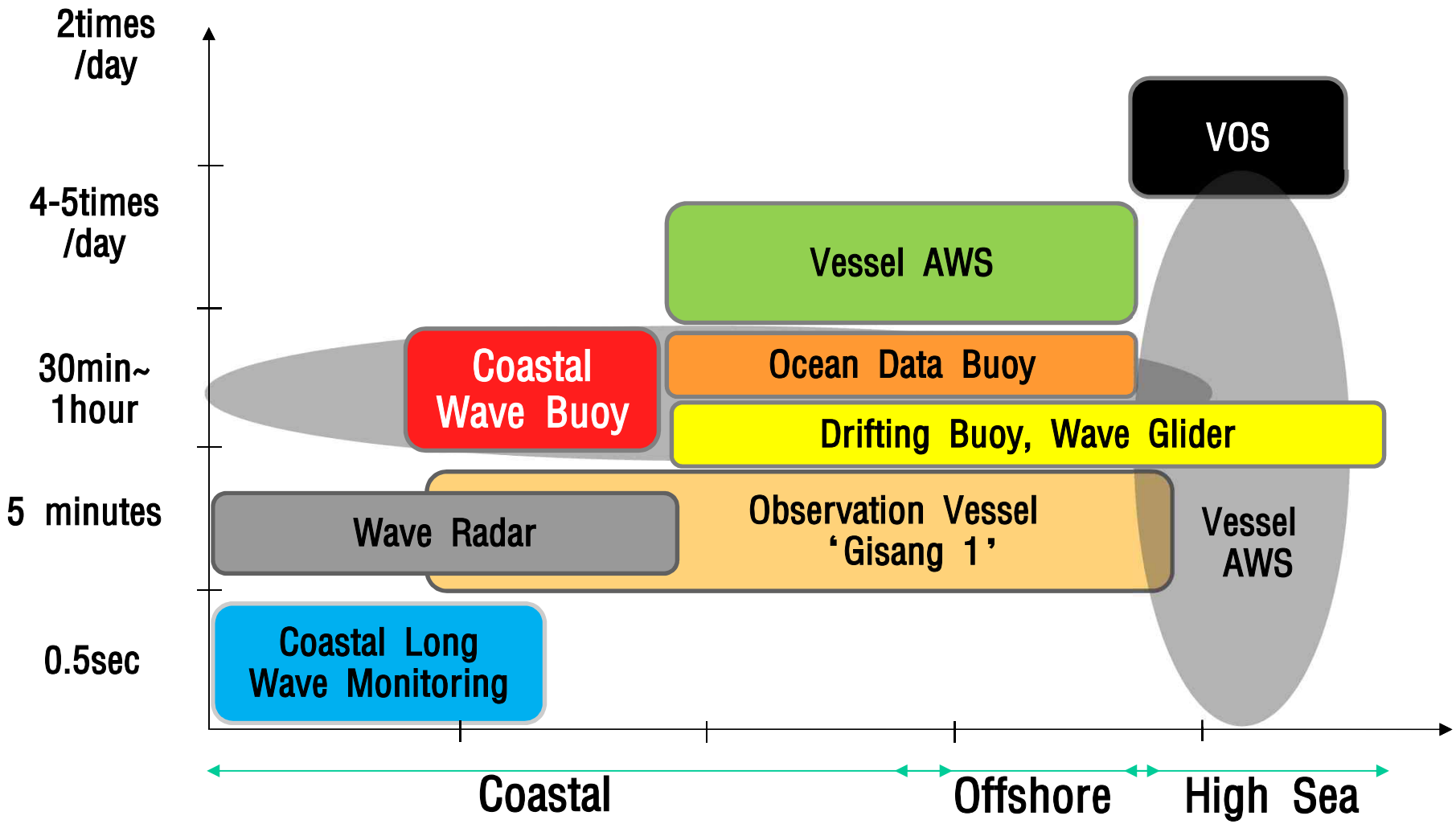
Observation

Marine Observations Network(Spatial)



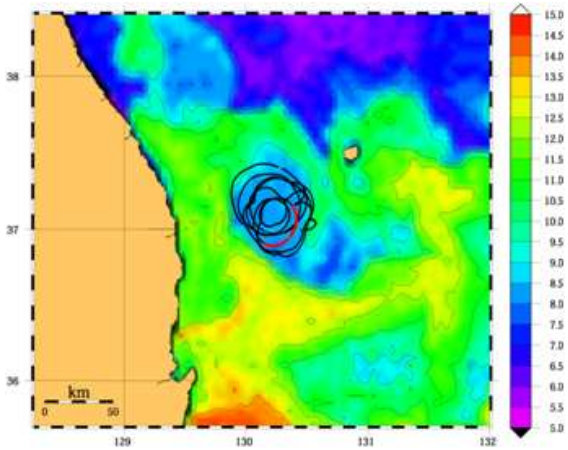
Black Box Image on Ocean Data Buoy (BuoyCAM)

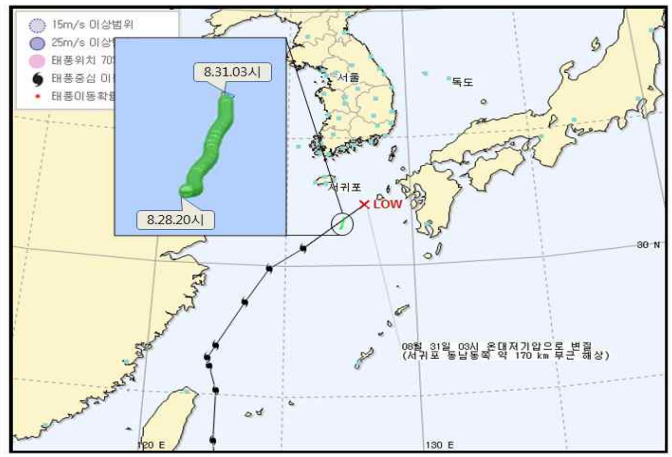
Marine Observations Network(Temporal)

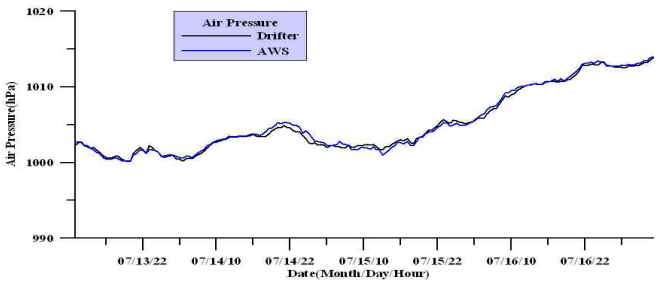


Drifting Buoy (Offshore)

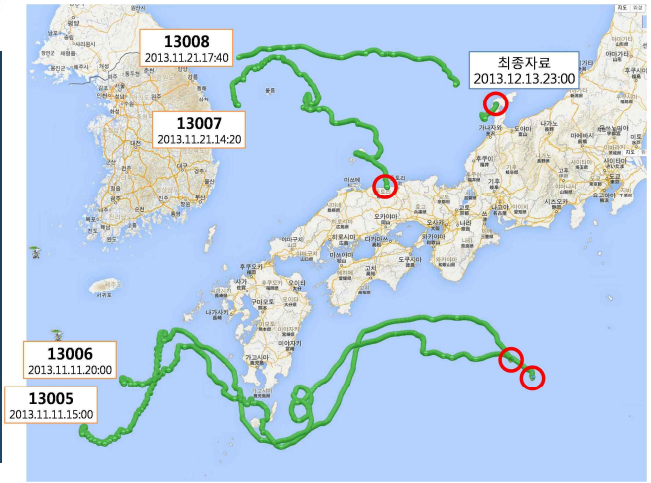
- ❖ Lagrangian observation
- ❖ GPS, Satellite Communication
- ❖ Observation : Position, Sea Temperature, Pressure, Wave







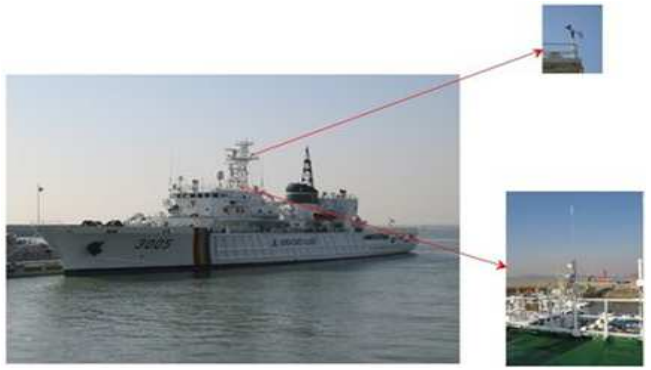
<Comparison of Pressure between AWS and buoy >



Vessel AWS (High Seas)

❖ AWS on Vessel of Government and Passenger Ship

1 Government Ship



Korea Coastal Guard

2 Passenger Ship

Ferry ship

3 VOS (Volunteer Observing Ship)

32 ships

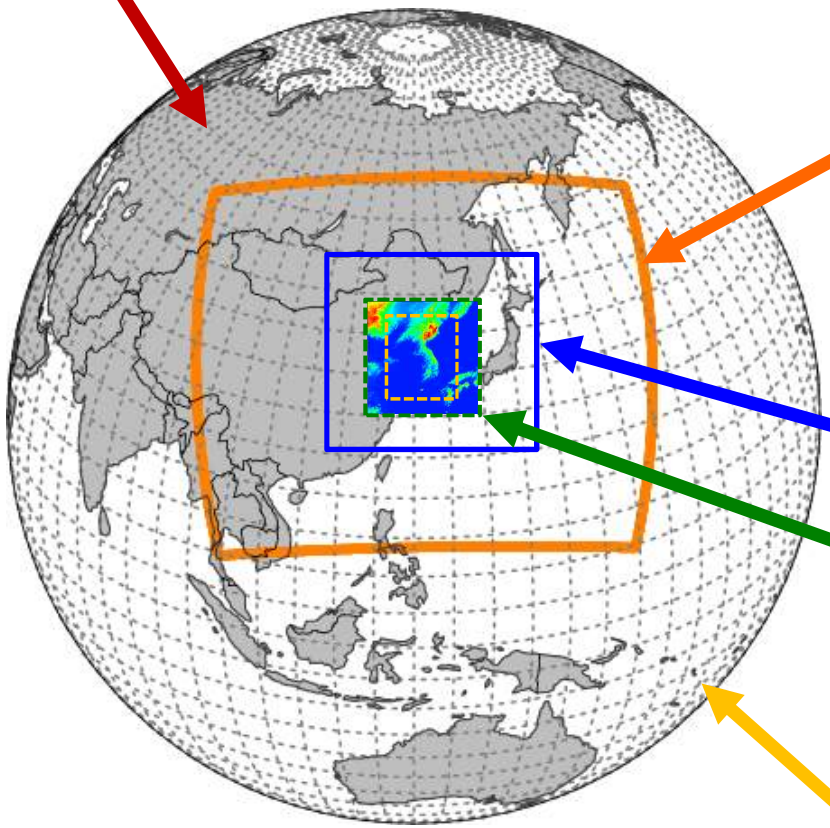
Marine Meteorological POPS®

Prediction

NWP model based on Unified Model (UM)

Global Medium-range Prediction (GDAPS / Global EPS)

- Deterministic: UM 10km L70 / T+288hrs (00/12UTC), T+87hrs (06/18UTC) / Hybrid ENS-4DVAR
- Ensemble: UM 32km L70 / T+288hrs (00/12UTC) / 24 Members / Perturb. : ETKF, RP, SKEB2



Short-range Prediction (E-Asia) (RDAPS)

- UM 12km L70 / T+87hrs (6 hourly) / 4DVAR / Deterministic

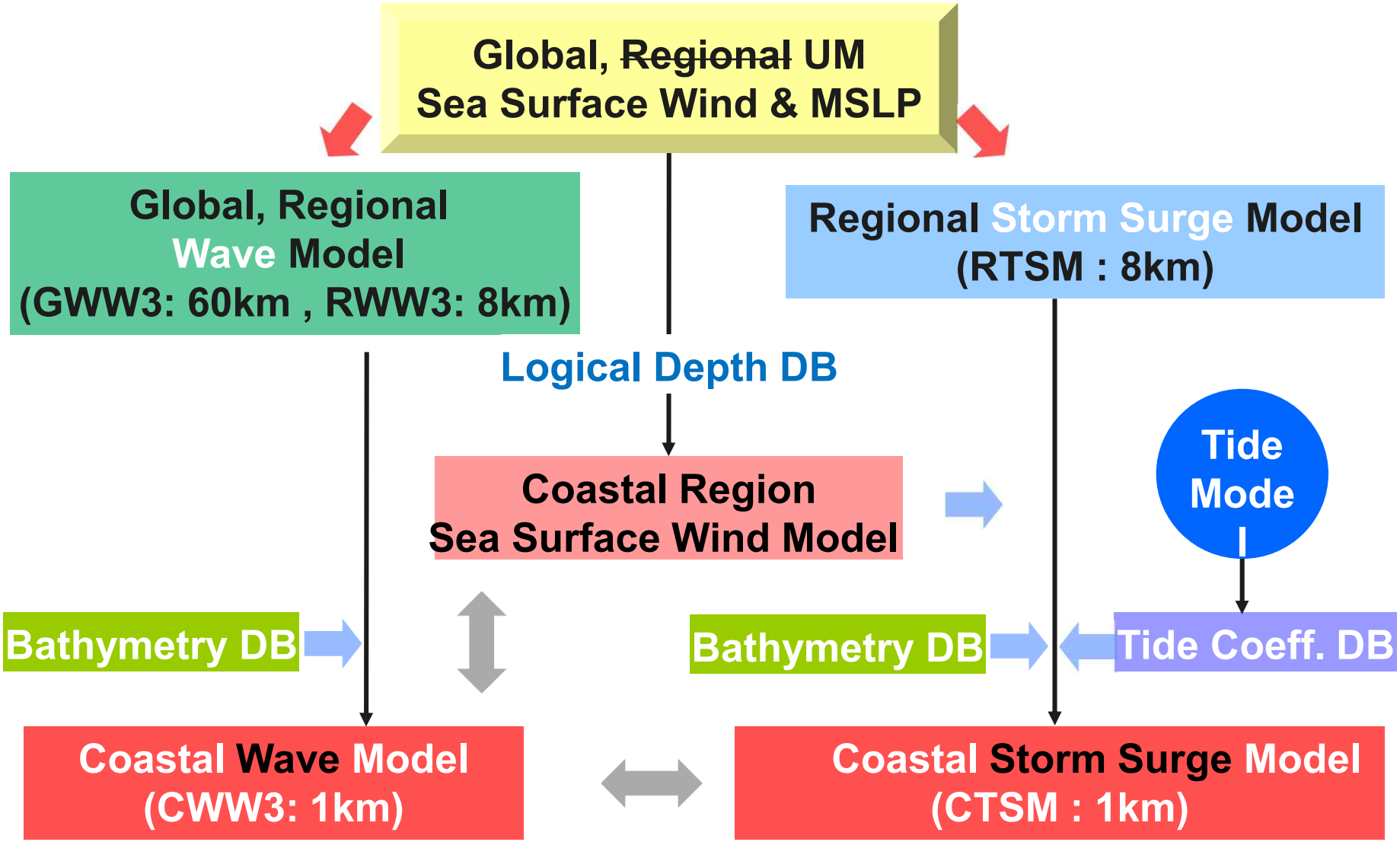
(Very) Short-range Prediction

- Deterministic : UM 1.5km L70 /
  (LDAPS)T+36hrs (6 hourly) / 3DVAR (3 hourly)
  (VDAPS)T+12hrs (1 hourly) / 3DVAR (1 hourly)
- Ensemble : UM 3km L70 / T+72hrs (LENS)

Seasonal Prediction System (Glosea5)

- GloSea5 / 60km L85 / 60, 220days
- Atmosphere(UM)+Ocean(NEMO, 30km)

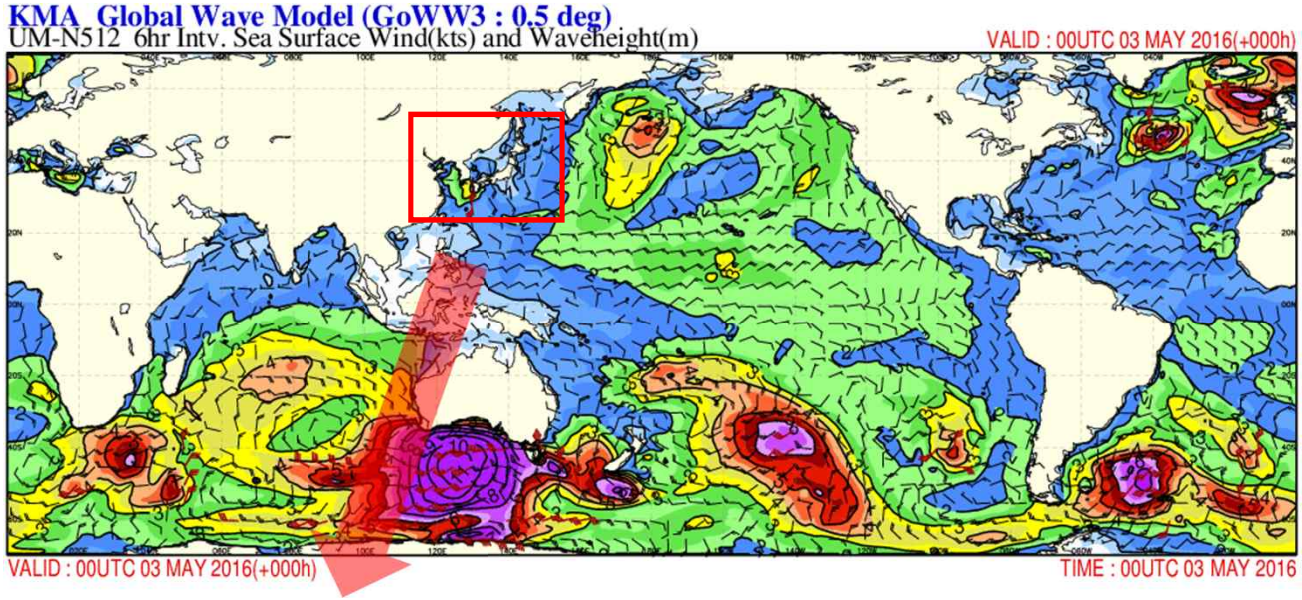
Wave/Storm Surges Forecasting System



Operational Wind Wave Prediction Models

Global

- 60Km (1/2°)
- 288 hour forecast twice/day

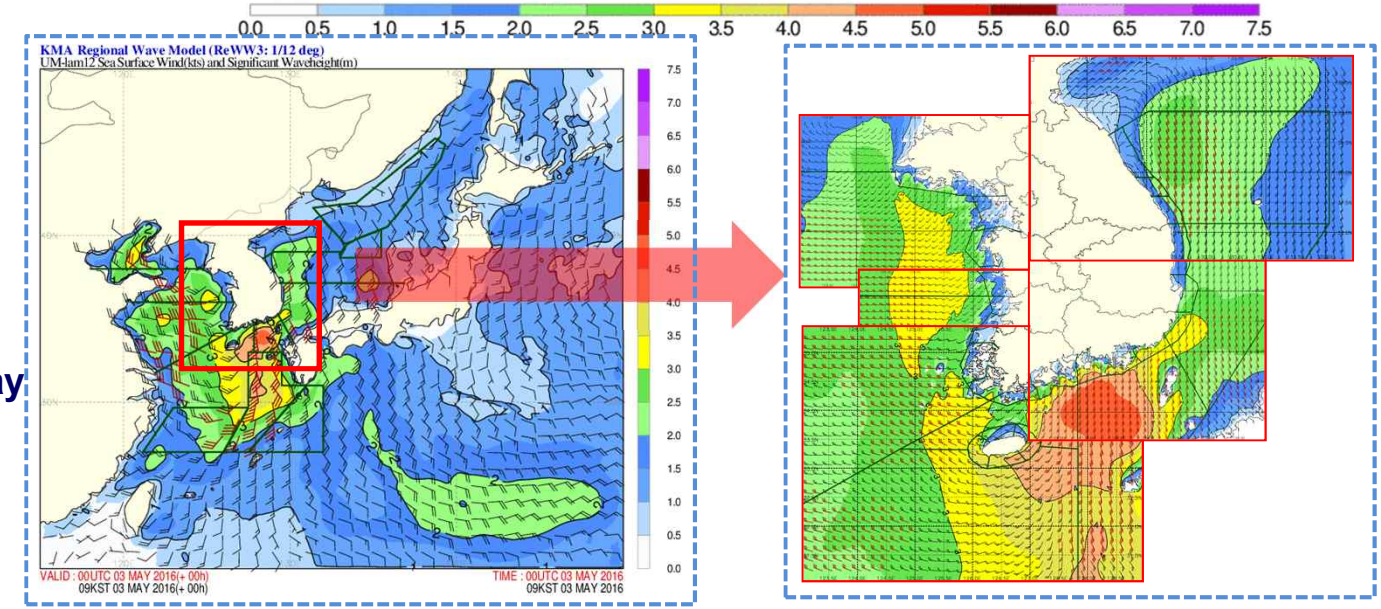


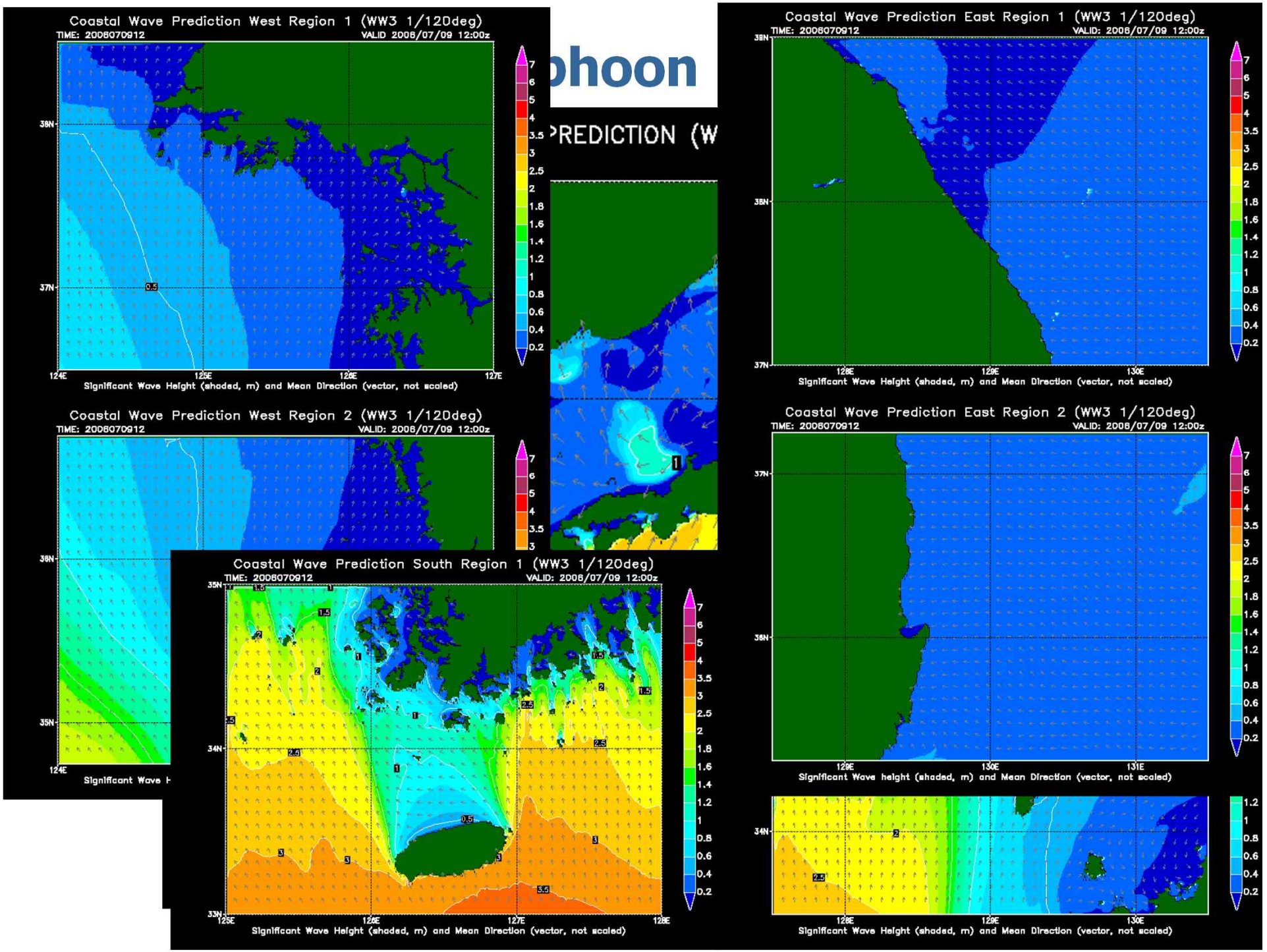
Regional

- 8Km (1/12°)
- 87 hour forecast twice/day

Coastal

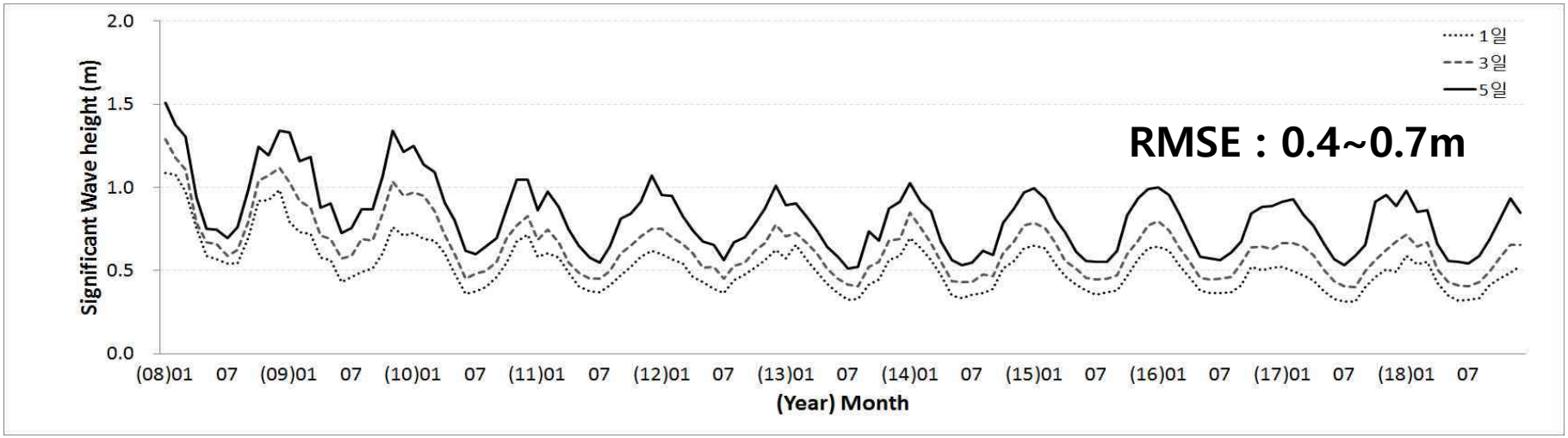
- 1km (1/120°)
- 72 hour forecast twice/day
- 6 coastal domains



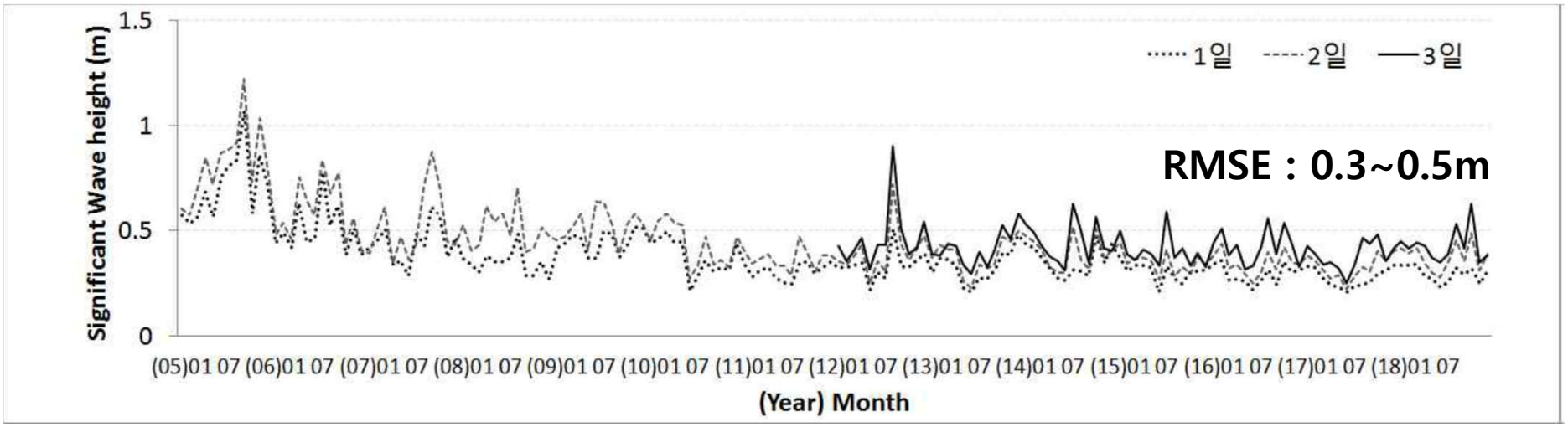

Coastal Wave Prediction West Region 1 (WW3 1/120deg)
TIME: 2006070912
VALID 2006/07/09 12:00z
Significant Wave Height (shaded, m) and Mean Direction (vector, not scaled)
Coastal Wave Prediction West Region 2 (WW3 1/120deg)
TIME: 2006070912
VALID: 2006/07/09 12:00z
Coastal Wave Prediction South Region 1 (WW3 1/120deg)
TIME: 2006070912
VALID: 2006/07/09 12:00z
Significant Wave Height (shaded, m) and Mean Direction (vector, not scaled)
Coastal Wave Prediction East Region 1 (WW3 1/120deg)
TIME: 2006070912
VALID: 2006/07/09 12:00z
Significant Wave Height (shaded, m) and Mean Direction (vector, not scaled)
Coastal Wave Prediction East Region 2 (WW3 1/120deg)
TIME: 2006070912
VALID: 2006/07/09 12:00z
Significant Wave height (shaded, m) and Mean Direction (vector, not scaled)
Significant Wave Height (shaded, m) and Mean Direction (vector, not scaled)

Wave Model Verification

Global 2008-2018



Regional 2005-2018

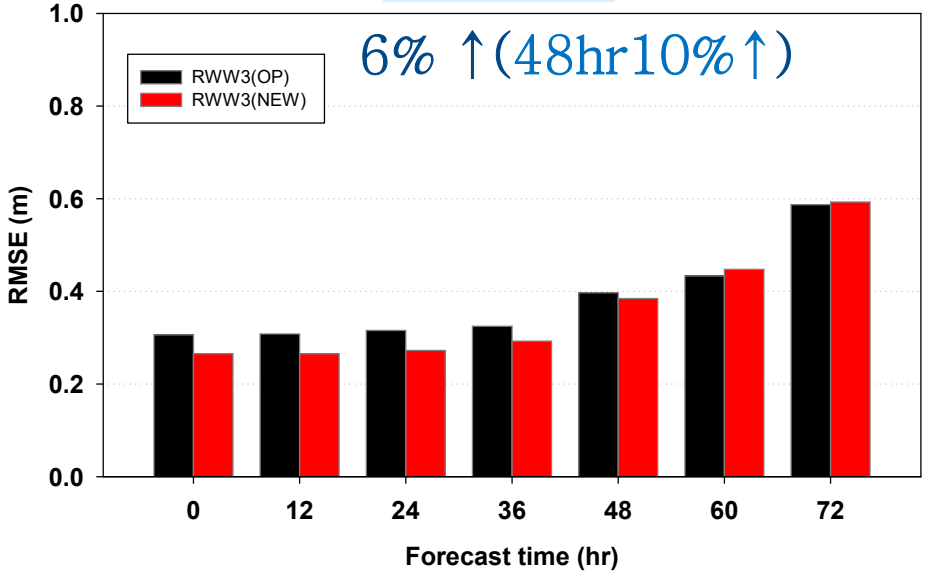


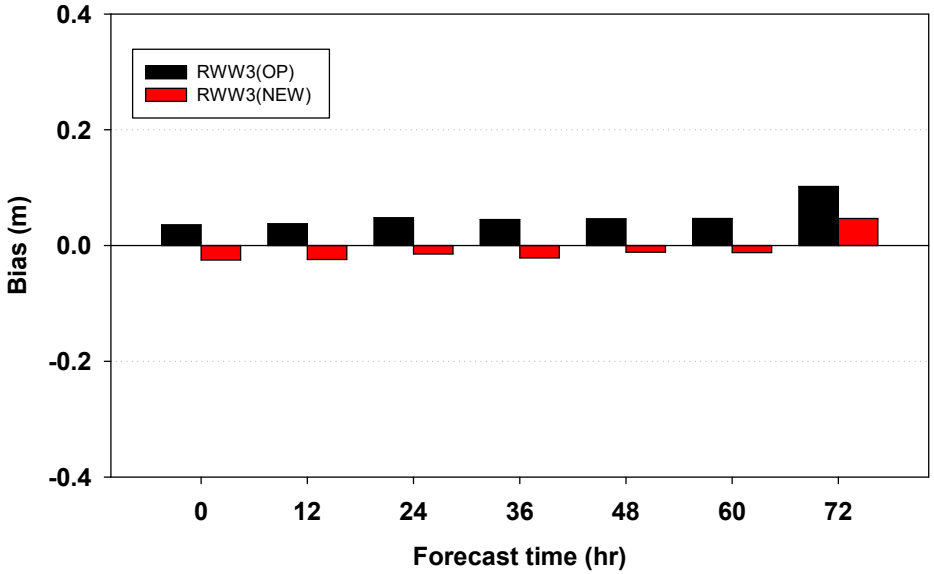
Upgraded Wave Models (Oct. 2016)

	OLD	NEW
Version	vn2.22	**vn4.18**
Atmospheric input	- GWW3: GDAPS 10m Wind (6-hourly)	**3-hourly**
	- RWW3/CWW3: RDAPS 10m Wind (3-hourly)	
Boundary condition	- RWW3: None - CWW3: RWW3	**- RWW3: GWW3** - CWW3: RWW3
Input & dissipation source terms	Tolman & Chalikov(1996)	**WAM cycle 4 (ST4)**
Depth-induced breaking	None	**Implementation**
Wind wave /Swell	**None**	**Separation**

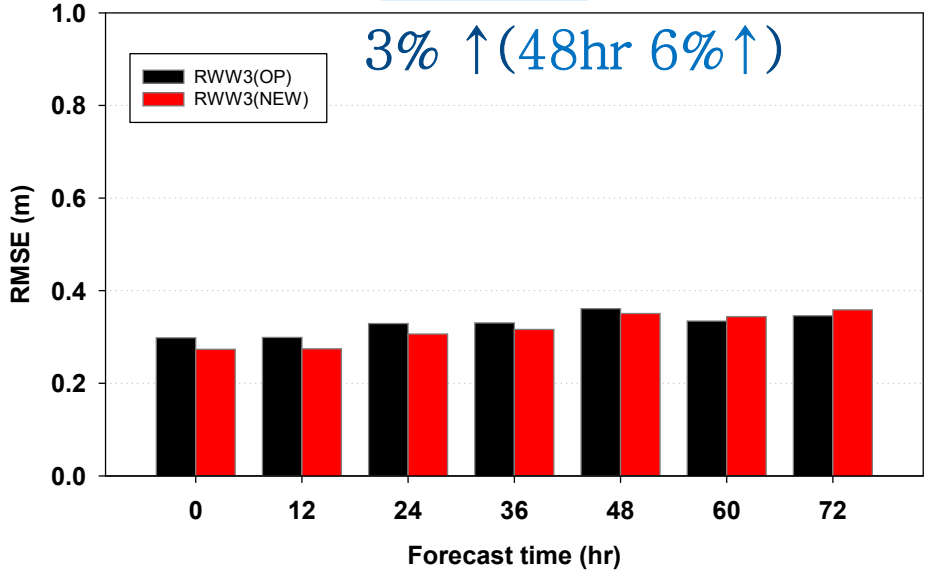
Verification of RWW3

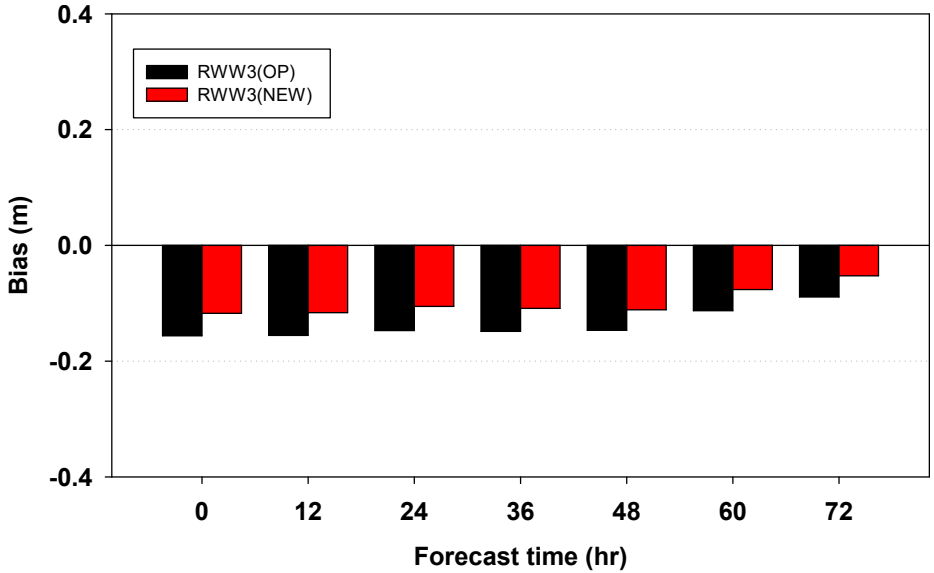
SUMMER





WINTER





26

Wave Data Assimilation by 2D-OI

Model First Guess Spectra $E_p(f,\theta)$

Model First Guess Sig. Wave Height

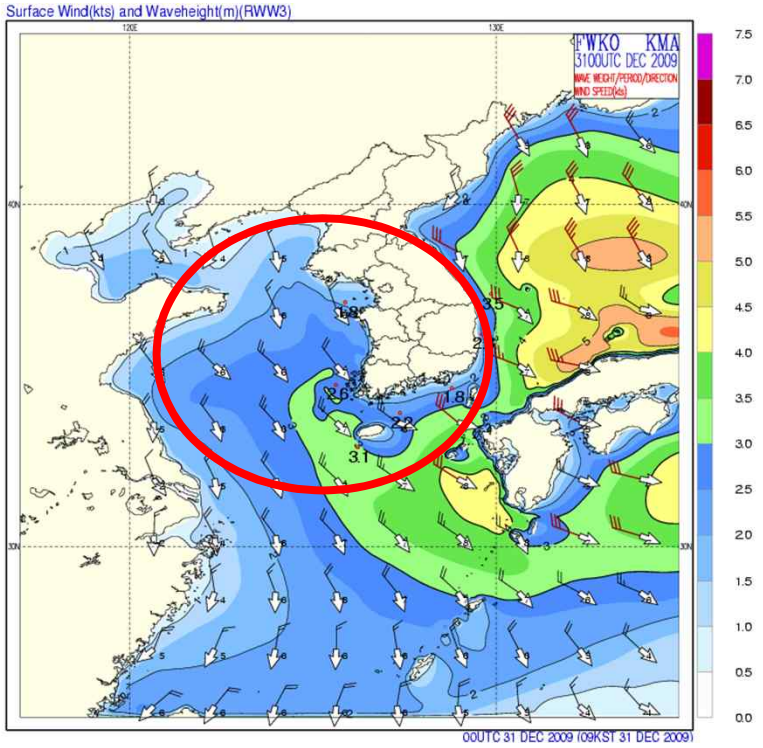
\+ 2-D Optimal Interpolation

Buoy Measured Sig. Wave Height

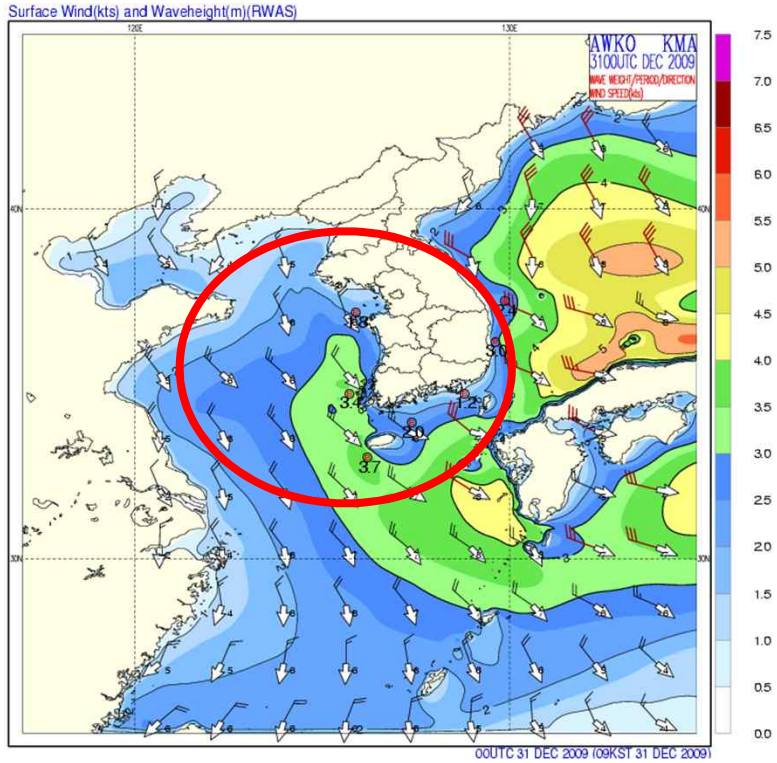
Analyzed Sig. Wave Height

Model Initial Spectra $E_A(f,\theta)$

ReWW3 without assimilation

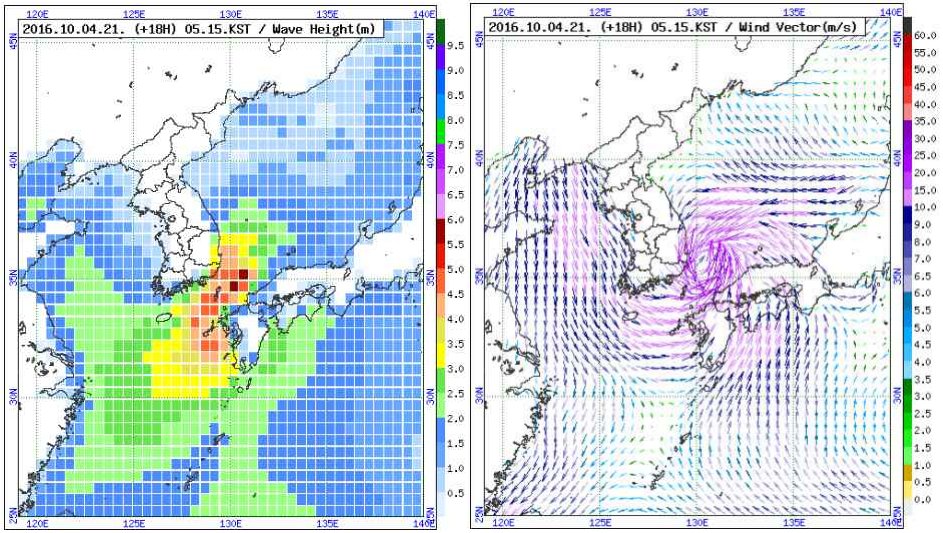


ReWW3 with buoy assimilation



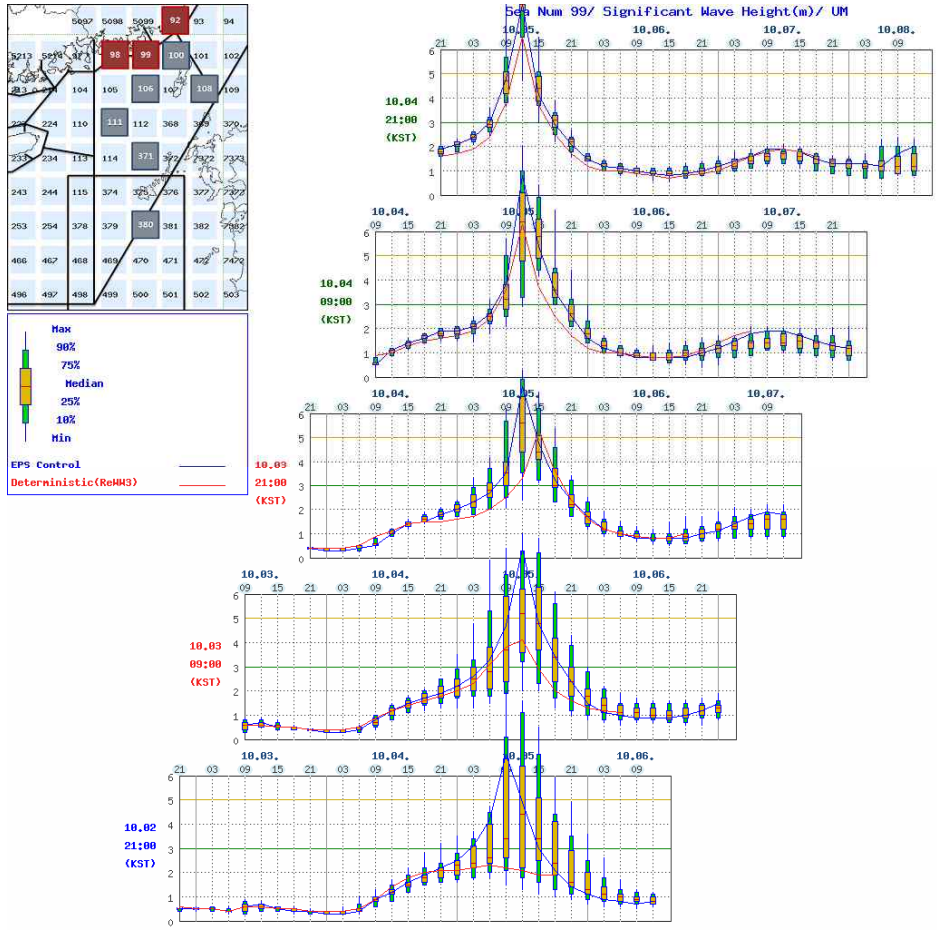
3 hour interval/day → 30 minutes/day

Ensemble Wave Model Guidance

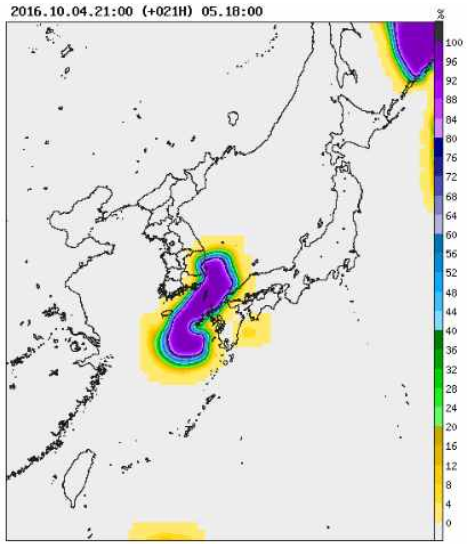


Gridded prediction (Homepage service)

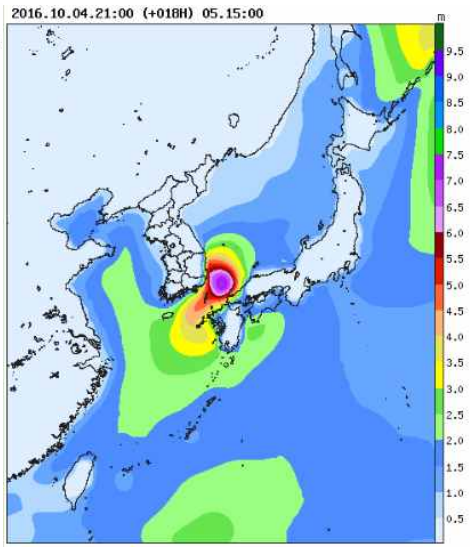
Ensemble Wave Prediction (24members)



EPSgram

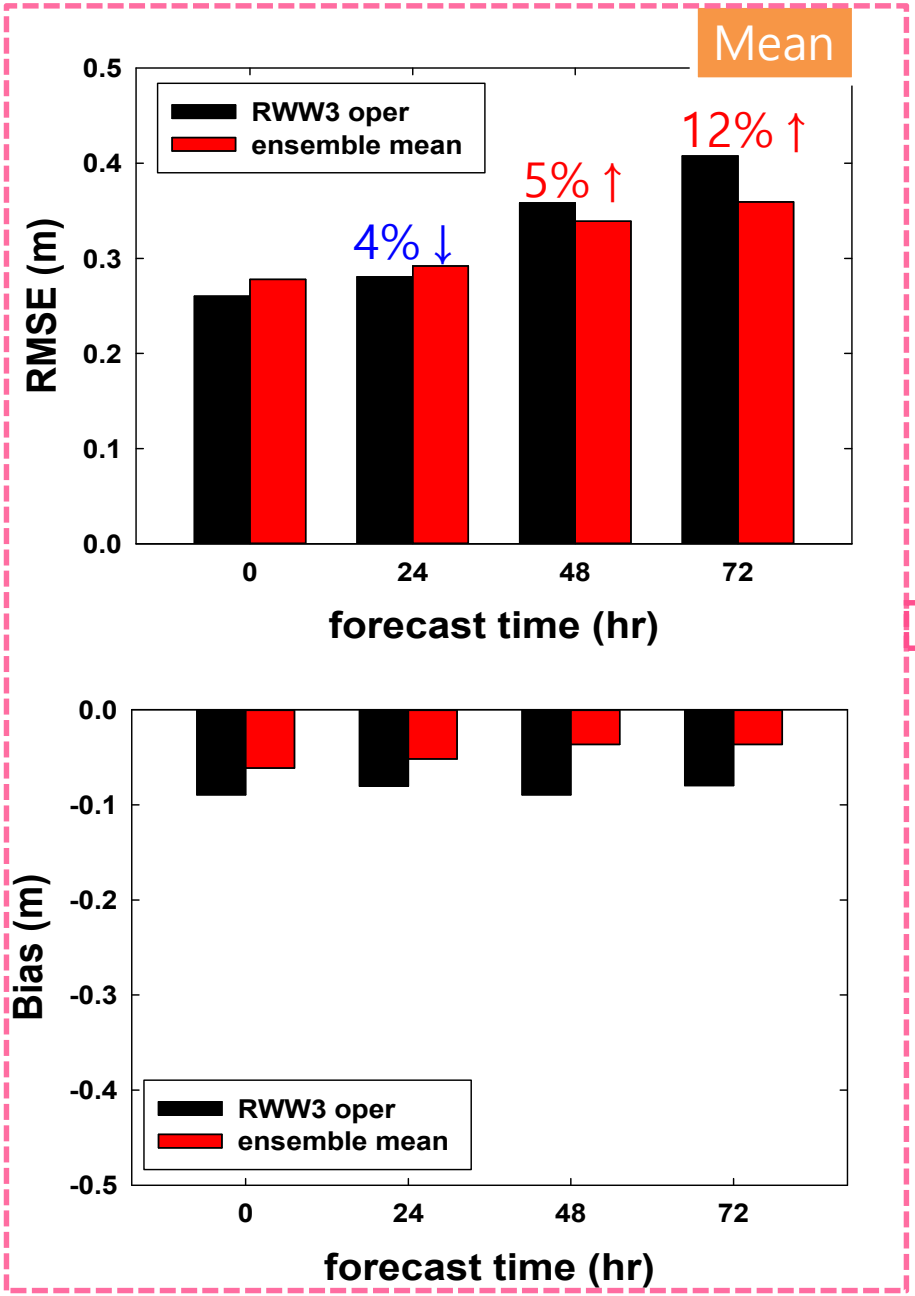


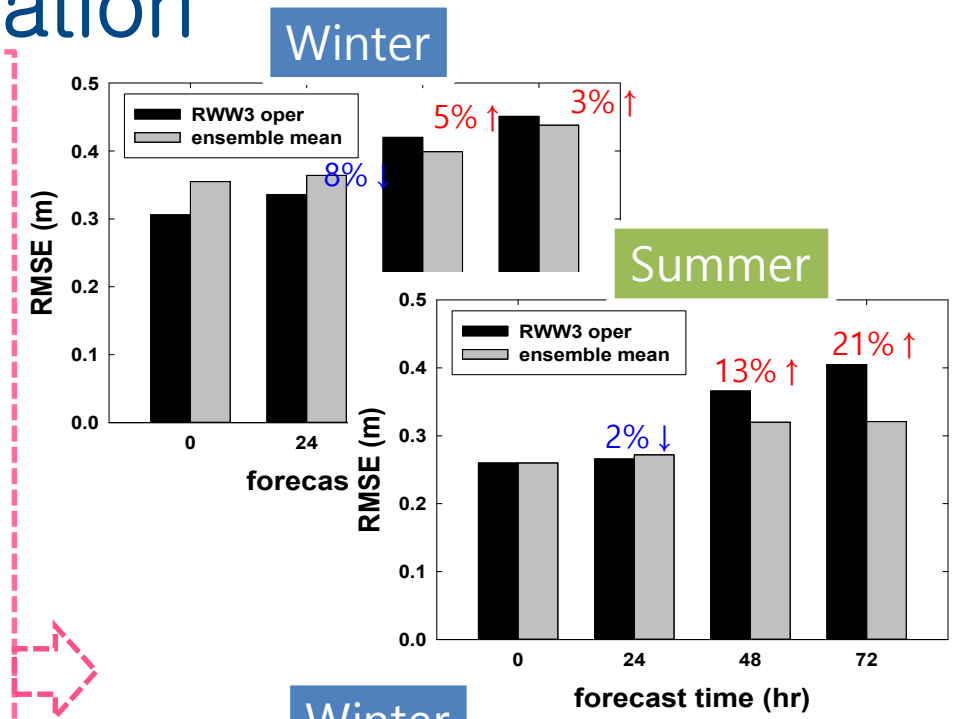
Probability
(Sig.Wave > 3m)

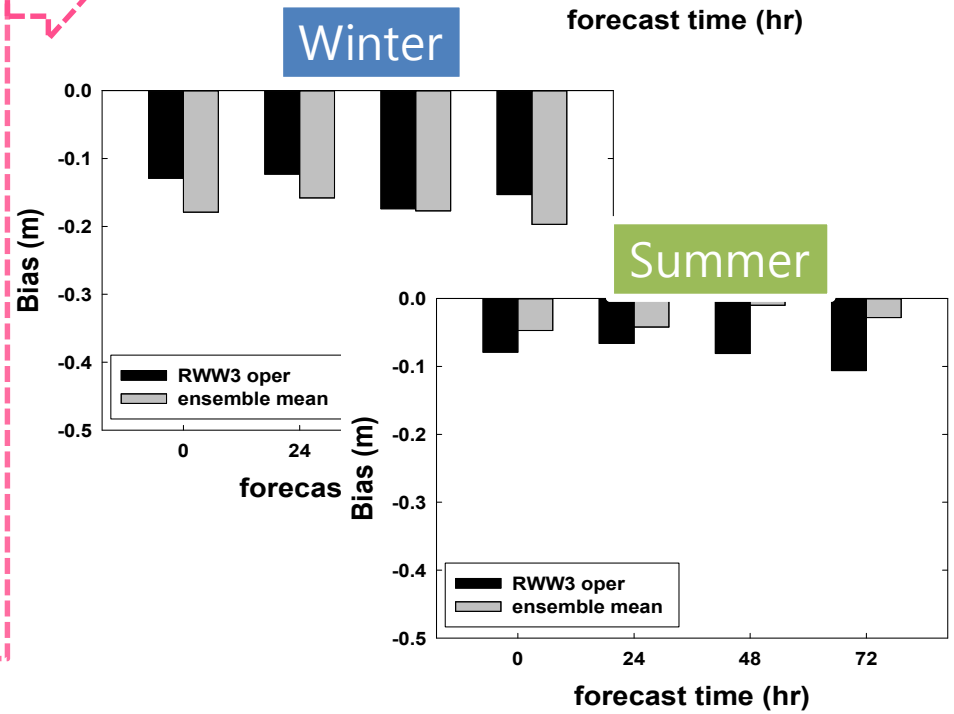


Ensemble mean

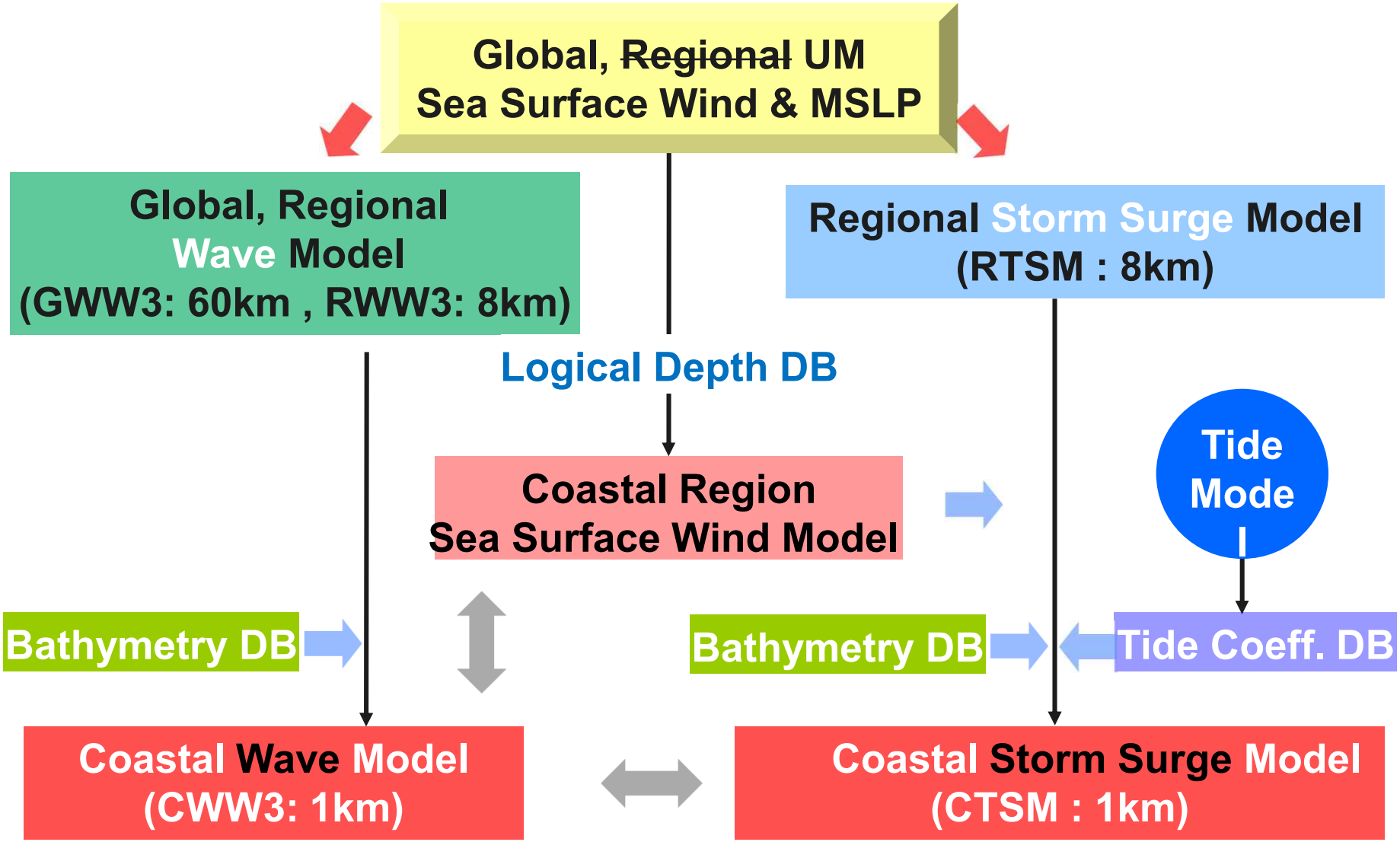
Ensemble Model Verification





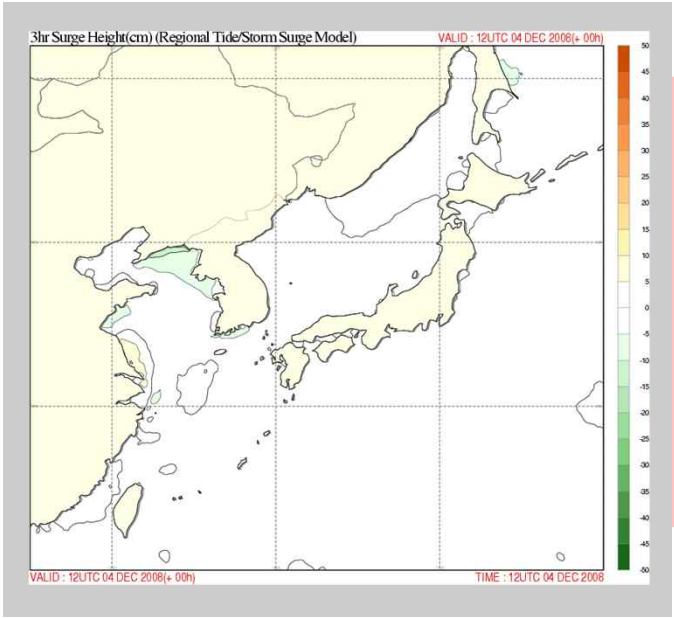


Wave/Storm Surges Forecasting System



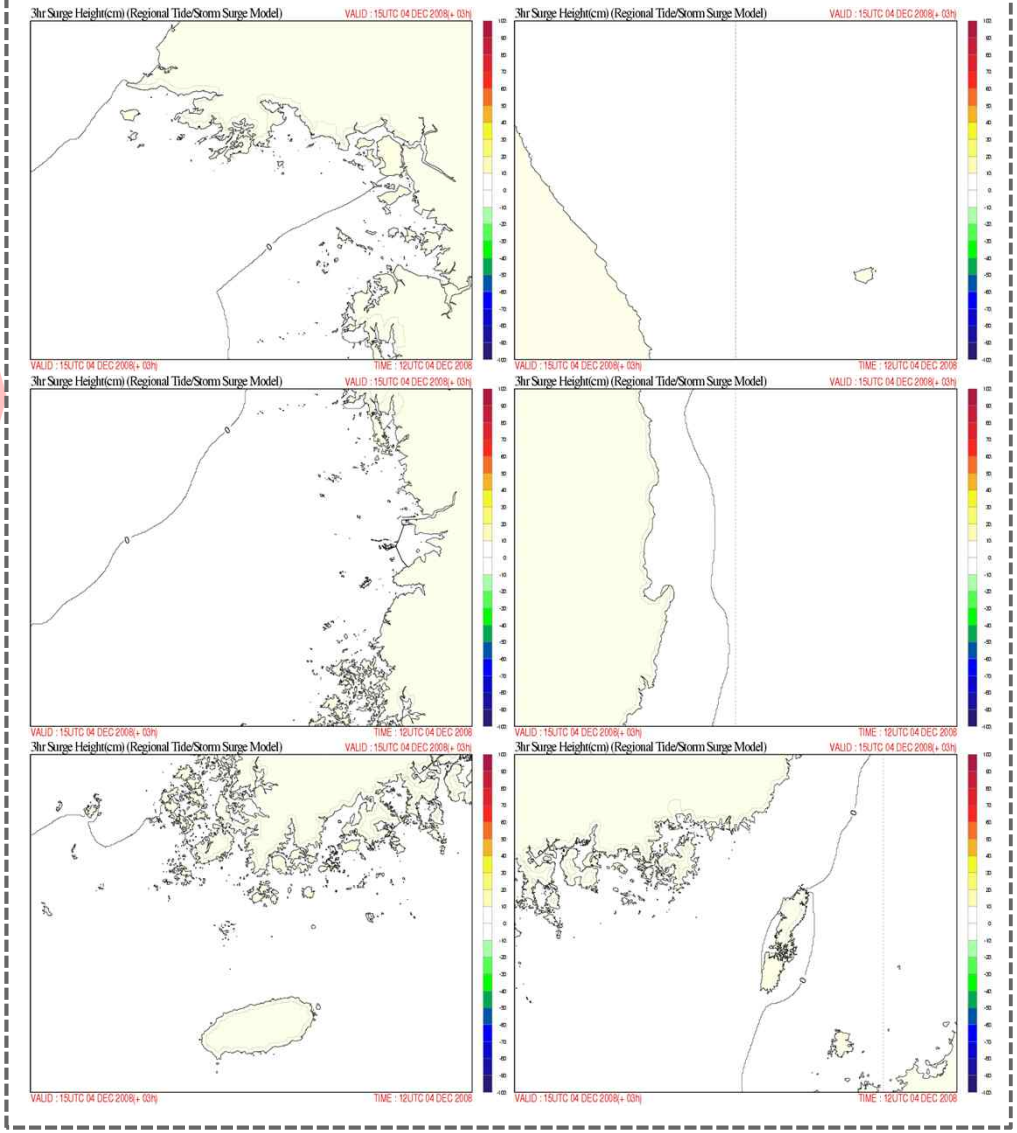
Storm Surges Forecasting System

Regional Model (8km)

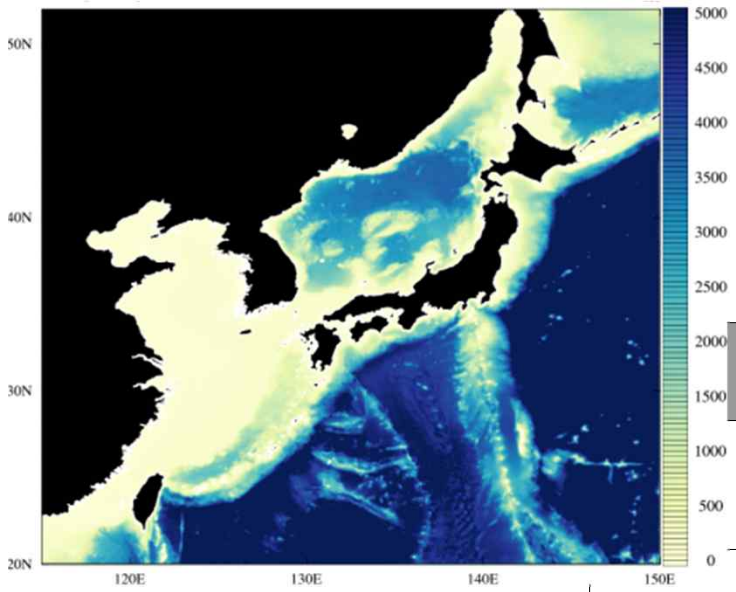


Boundary Condition
POM Model base

Coastal Model (1km Resolution)

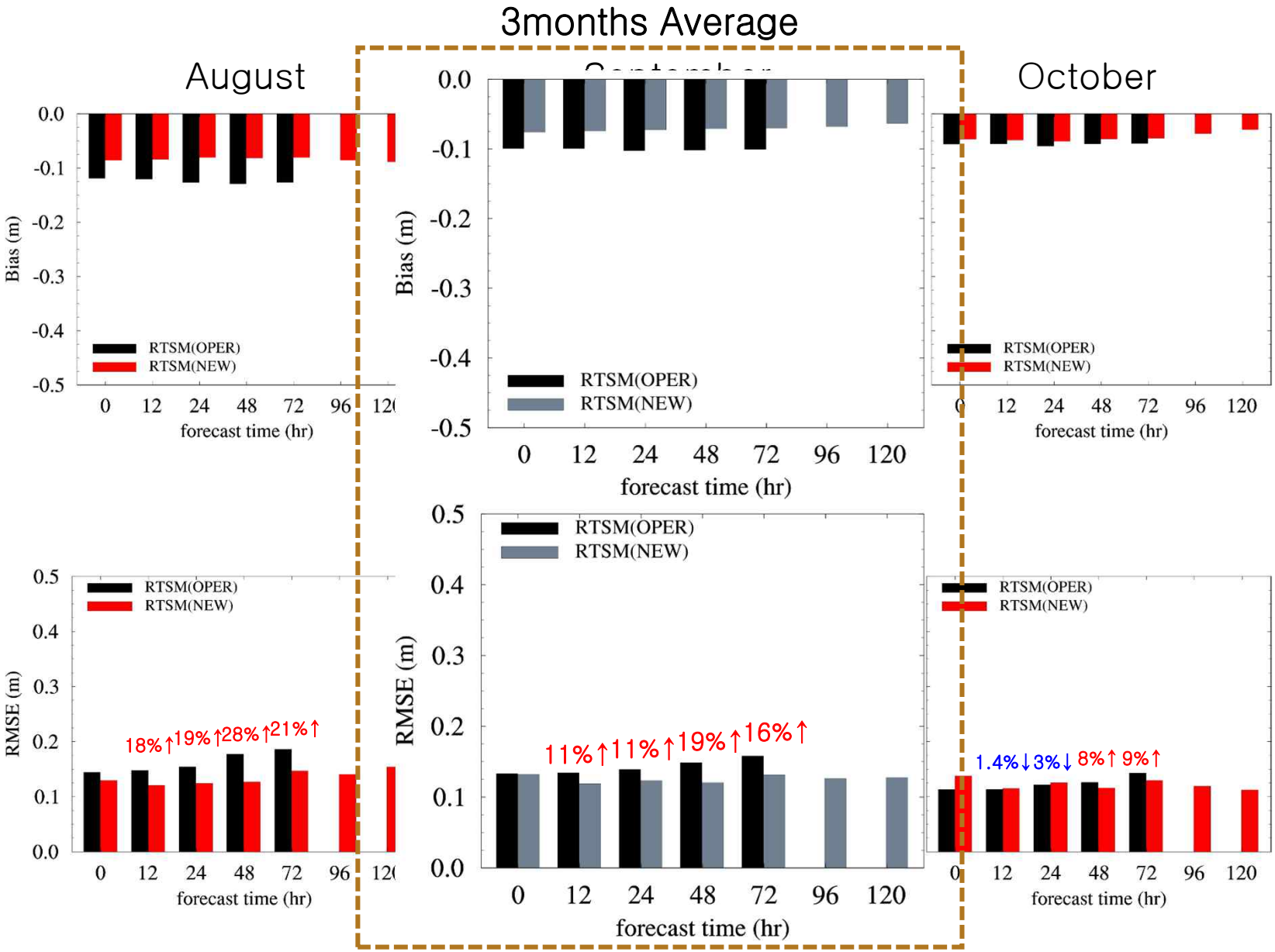


New Storm Surges Forecasting System(2019)

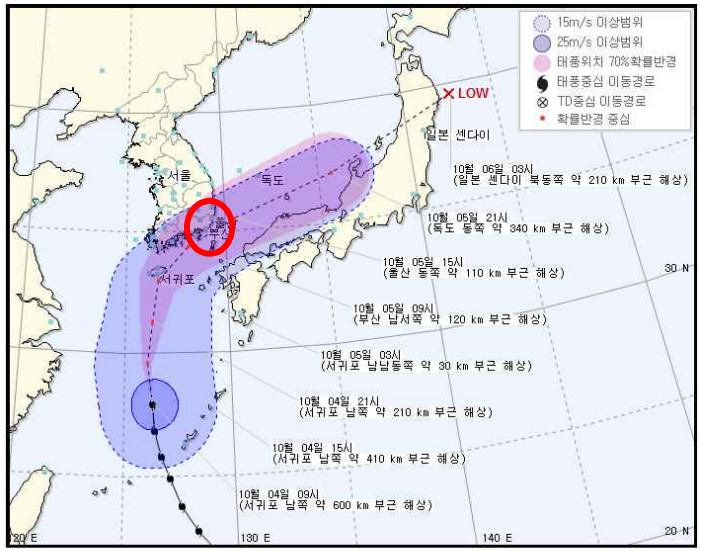


Contents	Regional Storm Surge Model
Model	POM → NEMO v3.6
Domain	115°E - 150°E , 20°N - 52°N
Resolution(Grid)	1/12° × 1/12°(421 × 385)
Prediction Time	3days → 5days (120 hours)
Initial Condition	Output of - 12 hour
Boundary Condition	13 Tidal components
Input Data	GDAPS(UM N1280 L70)
Prediction Interval	2times/day (00, 12UTC)

Model Verification (Old vs New)



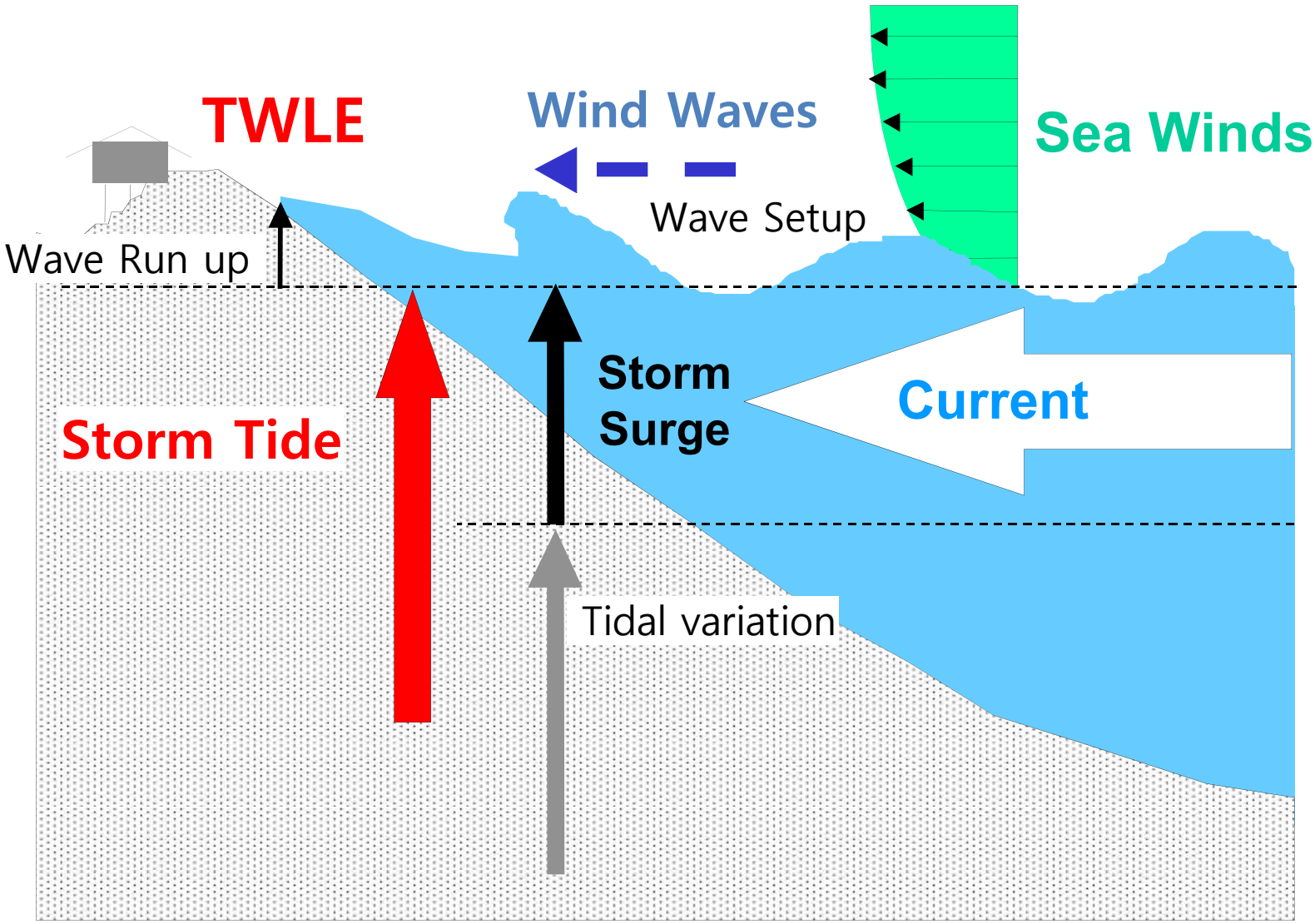
Typhoon Chaba(2016)



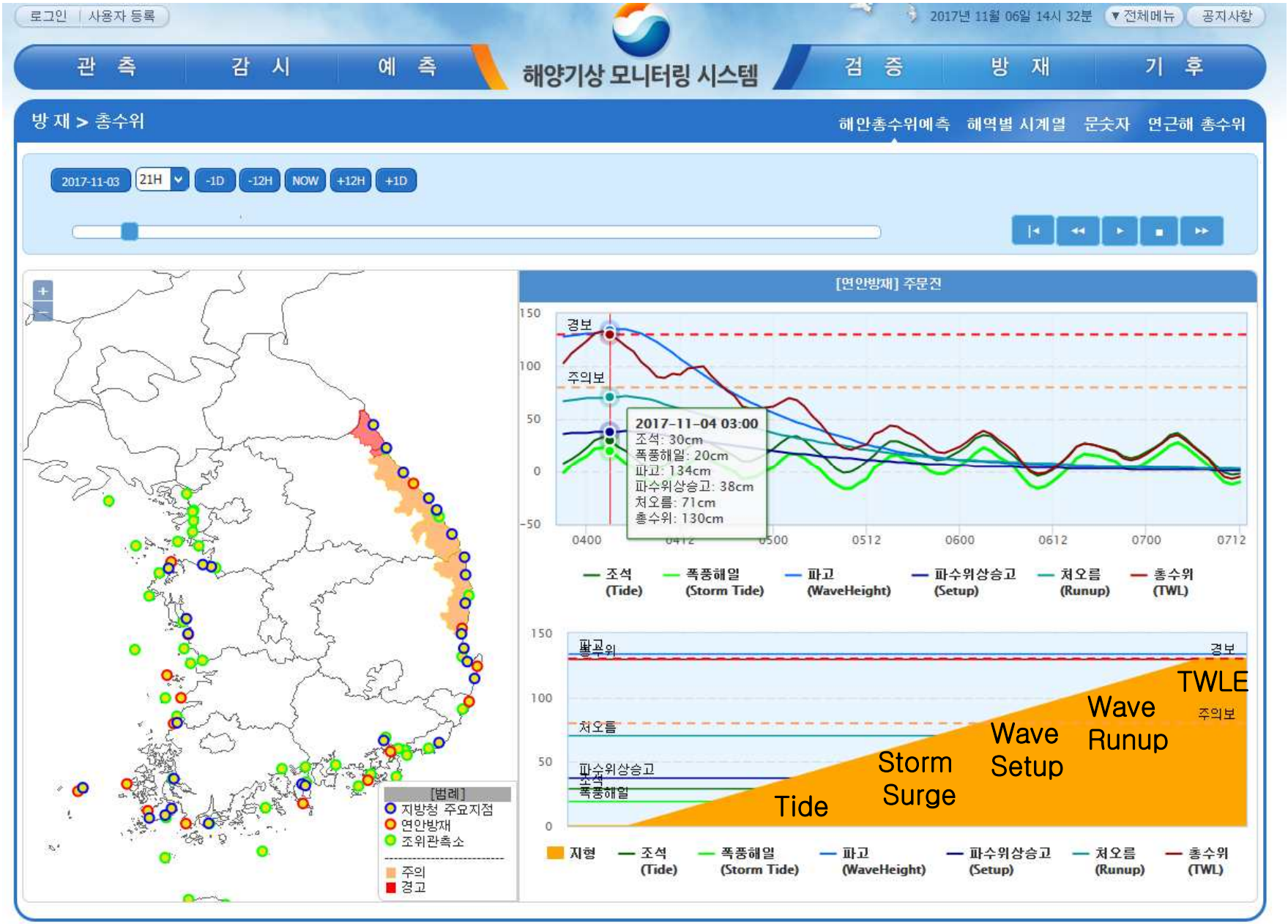
- 제18호 태풍 차바(CHABA)는 태국에서 제출한 이름으로 꽃의 한 종류임.
- 이 태풍은 42시간 이내에 온대저기압으로 변질될 것으로 예상되며, 다음 정보는 오늘(4일) 13시경에 발표될 예정임.

Haeundae Marine City, Busan, Korea

Total Water Level Elevation (TWLE)



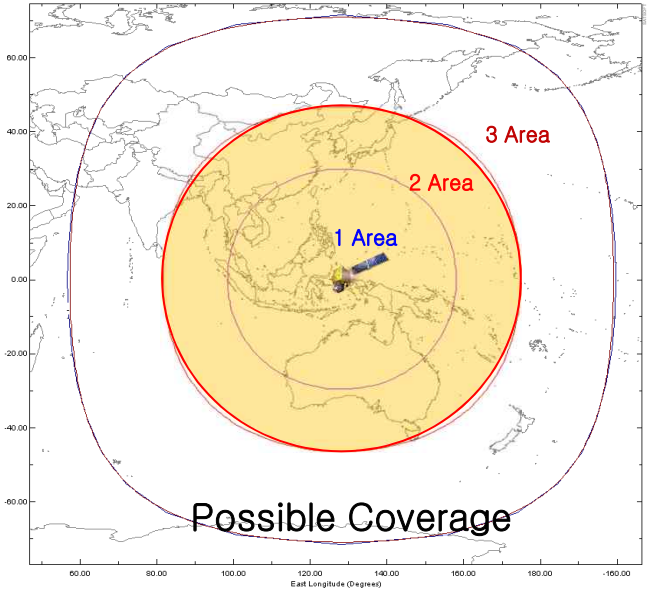
TWLE Prediction (Ocean Monitoring System)



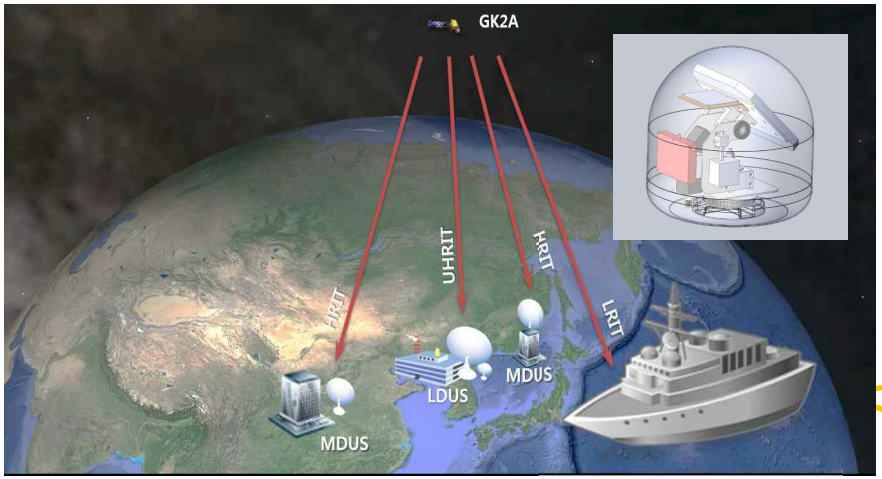
Marine Meteorological POPS®

Service

Marine Weather Broadcast Service by Satellite (GK2A)



SDUS
Antenna/LNB

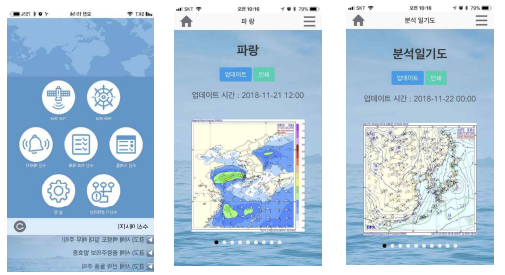


Ships

SDR

Mini PC

Wifi



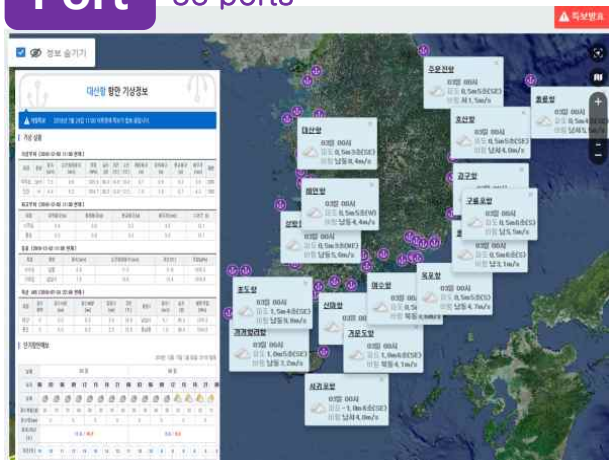
Smart Phone Web Service

USER

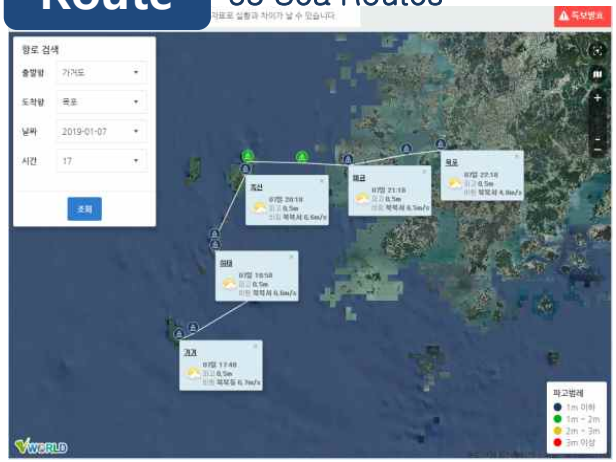
Ocean Portal Service (marine.kma.go.kr)

Port | Sea route | Leisure | Fishery | Disaster | Security

Port
53 ports

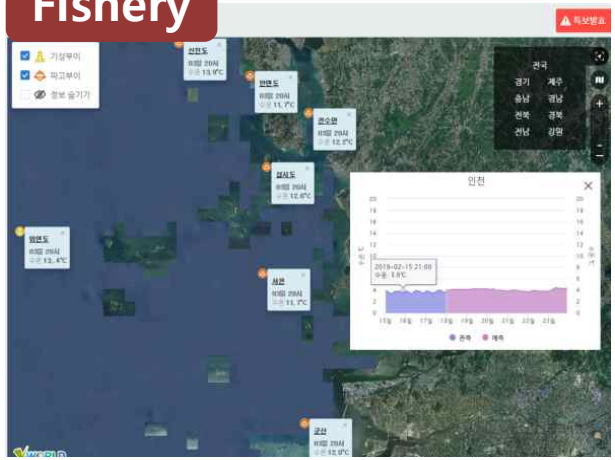


Route
65 Sea Routes

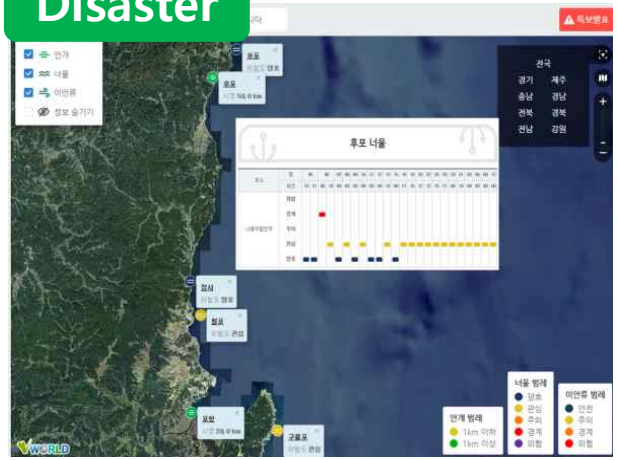


Leisure
Fish : 68 points
Surfing : 23 points

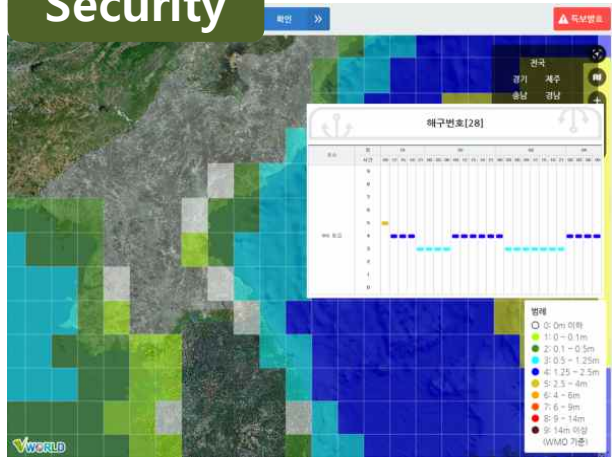
Fishery
SST : 77 stations



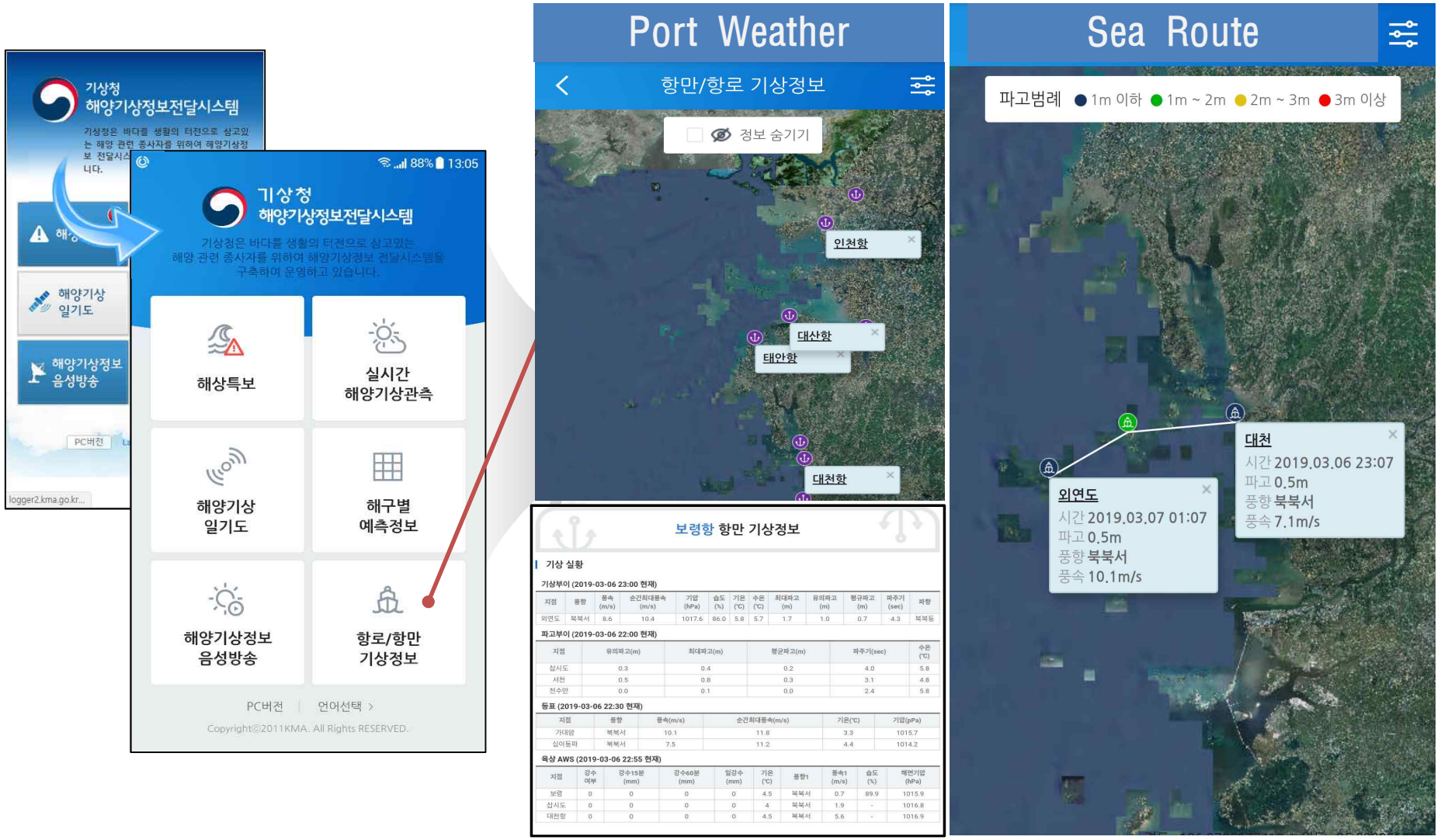
Disaster
Fog, Swell, Rip current



Security
50km grid



Smartphone Web Service

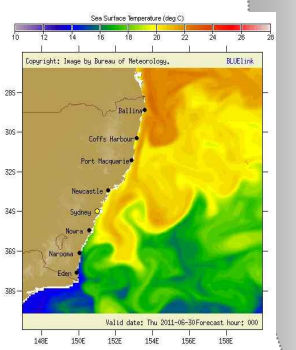


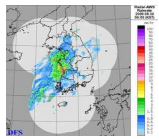
http://marine.kma.go.kr (Korean)

Multi-Disciplinary Applications

Marine weather information creates socio-economic efficiency by providing critical information essential for disaster prevention, fishery, logistics, tourism, national security, environment, etc.

Various Applications of KMA's Marine Weather Products and Services





Improve HIW prediction capacity

Meteorology

Plan for marine construction

Marine Construction

Prevent maritime accidents

Disaster Prevention

Vitalize marine leisure industry

Tourism/ Leisure

Support fishers

Fishery/ Resources

Marine logistics

Logistics

Prevent ocean pollution

Environment

Military operations

National Security


Watching the Sky friendly
Serving the People faithfully
Thank you