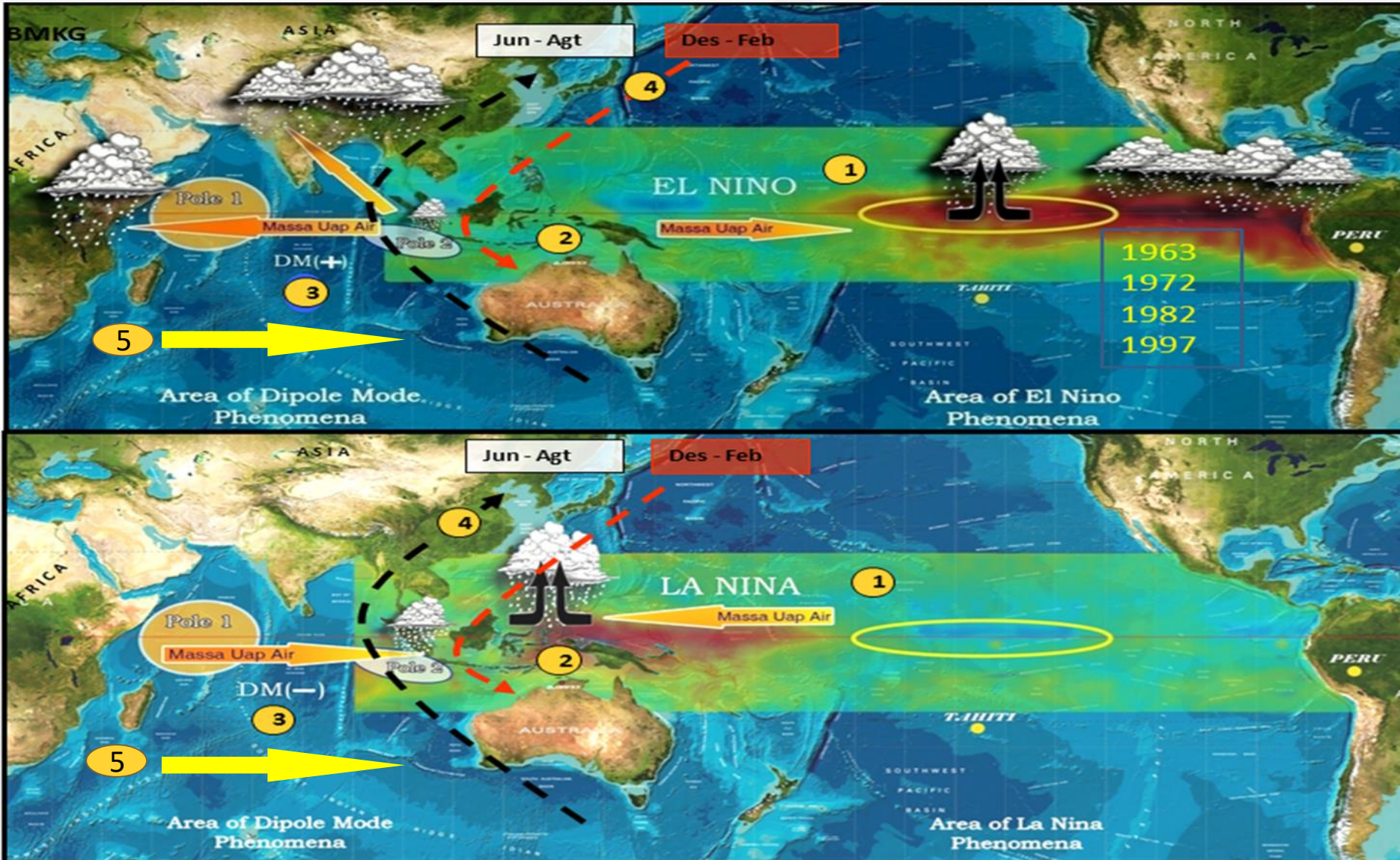




**“Improvement of Ocean Forecasting System for
Enhancing Marine Information in Maritime Continent”**



By: Dr. Nelly Florida Riama, Dr. Andri Ramdhani, Dava Amrina

Weather and Climate Phenomenon in the Region



- 1 El nino / La nina
- 2 SST
- 3 IOD / DM
- 4 Monsoon
- 5 MJO

El Nino	La Nina
0.5 – 1 Weak	-1 – 0.5 Weak
1 – 2 Moderat	-2 – -1 Moderat
> 2 Strong	< -2 Strong

WIND DIRECTION	
Jun – Agt EASTERN	eq 
Des – Feb WESTERN	eq 

INTRODUCTION

Marine Meteorology and Oceanography occupy a global role, serving a wide range of users, from international shipping, fishing and other met-ocean activities on the high seas, to the various activities which take place in coastal and offshore areas and on the coast itself.

The requirements for met-ocean forecast and services are based on a consensus of the ocean modelling, including wave model, ocean circulation and coastal dynamics model.

01

Regional Model operating for Solomon Islands. This will be the first for Solomon Islands. We will definitely benefit from this.

02

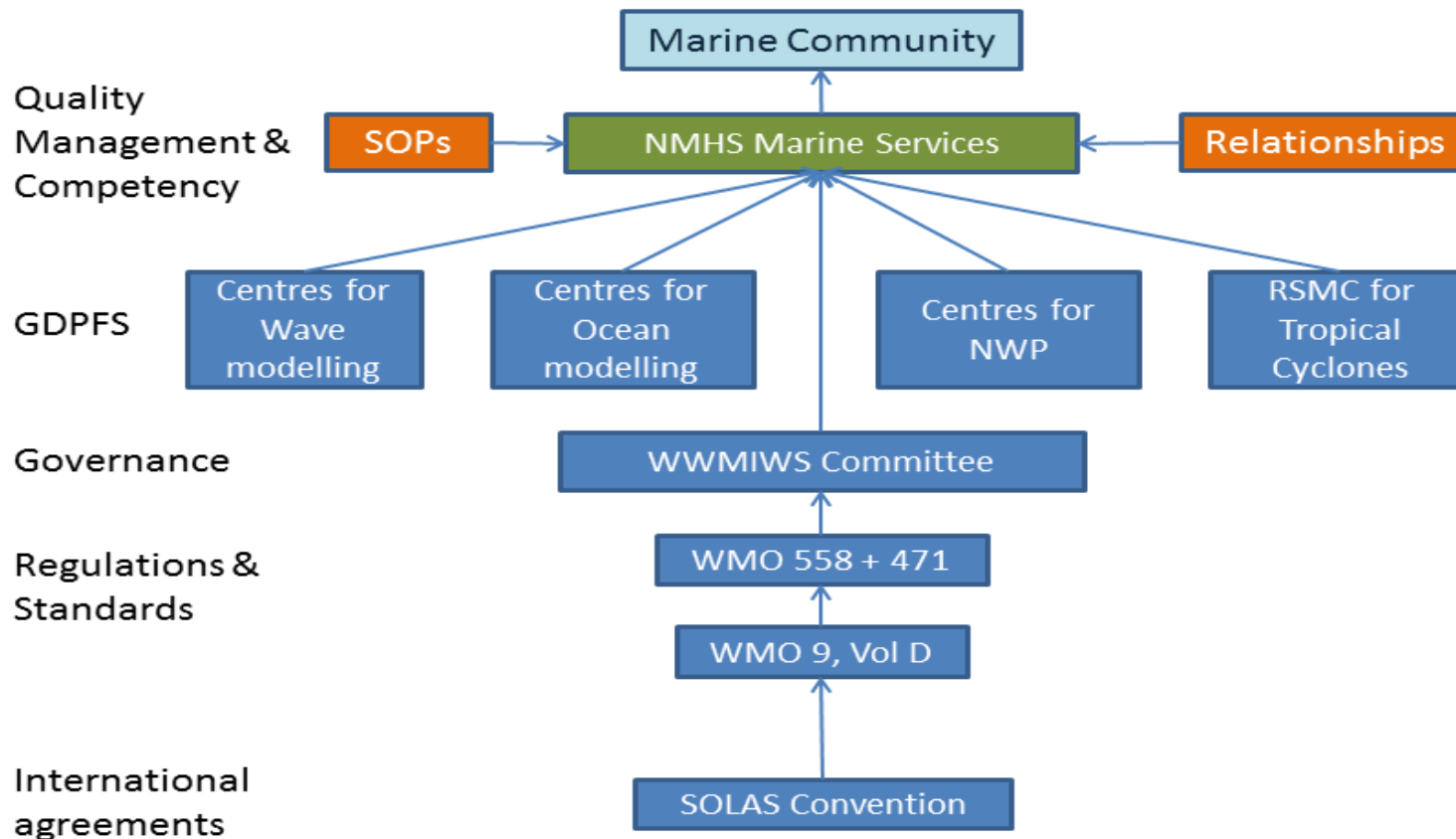
In preparation of analyses, synopses, forecasts and warnings, knowledge is required of the present state of the atmosphere and ocean.

03

Solomon Islands regional ocean modeling

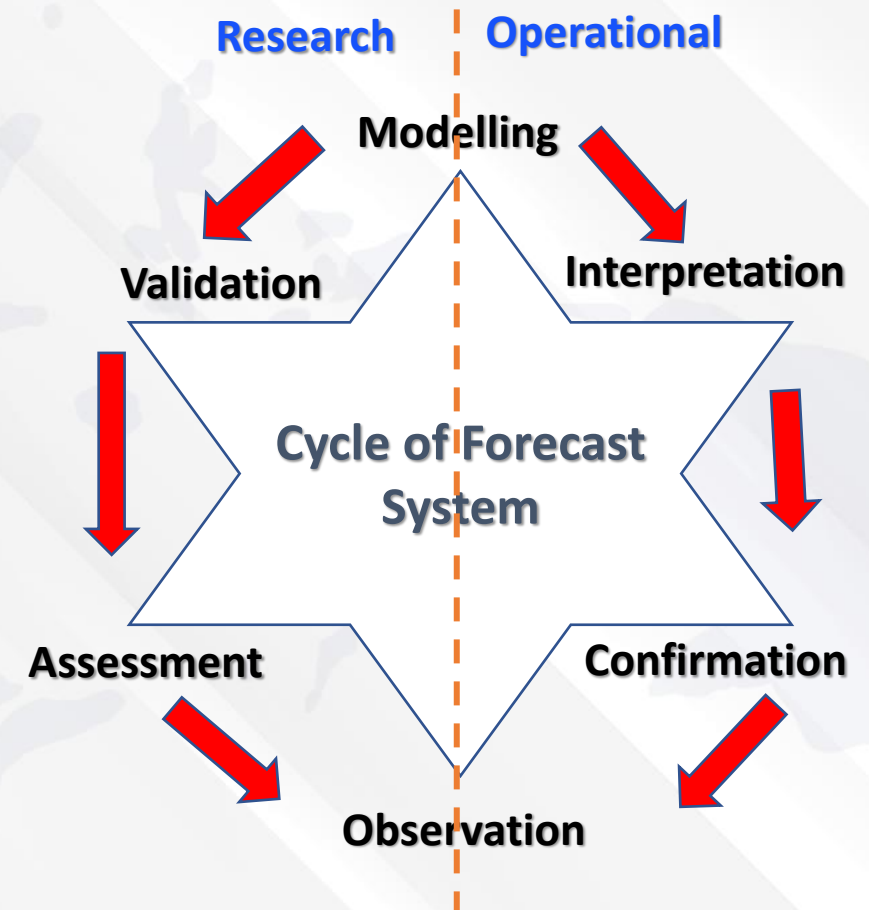
WMO Guidelines For Marine Meteorological Services

Supporting and enhancing National Marine Weather Services



Modelling (Research Vs Operational)

- High Performance Computing (HPC)
- Modelling:
 - Governing Equation;
 - Scheme;
 - Dynamics;
 - Ocean And Atmospheric Interaction;
- Observation:
 - Equipment;
 - Density;
 - Historical Data Base;



OCEAN FORECAST SYSTEM

Ocean Waves Model
(wind, waves, swell)

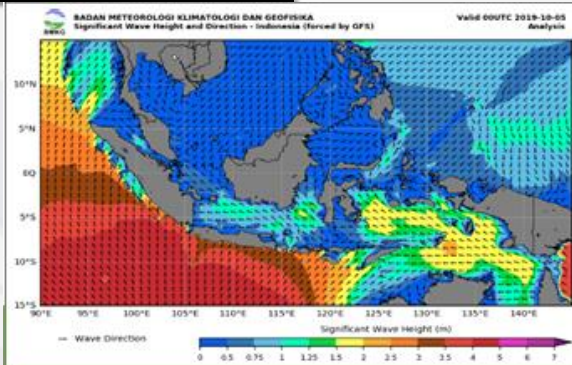
Ocean Circulation Model
(currents, sea temp., salinity)



Coastal Dynamic Model
(tide, sea level, coastal inundation)



BMKG - OCEAN FORECAST SYSTEM (OFS)



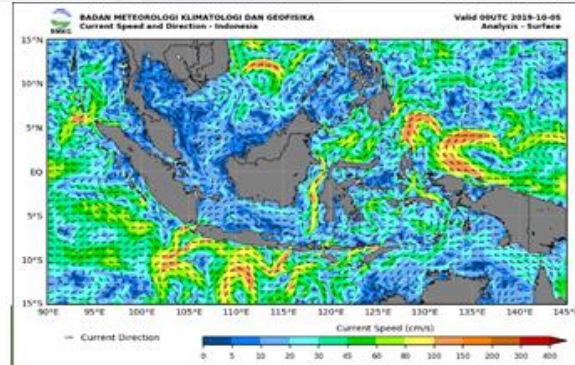
INAWAVES

1. Significant Wave
2. Swell Wave
3. Surface Wind

Surface

EXISTING

1. Res : 9 Km
2. Without Assimilation
3. 3 hours time step
4. Forcing : GFS



INAFLOWS

1. Sea Current
2. Sea Temperature
3. Salinity

Surface to 250 Meter depth



INACIFS

1. Coastal Inundation

NEXT PROJECT

1. Res : 3 Km
2. With Assimilation
3. Ensemble Model
4. 1 hour time step
5. Forcing : GFS, ECMWF, WRF



BMKG WAVE MODEL – Ina Waves

01

WAVEWATCH III community model (<https://github.com/NOAA-EMC/WW3>): operational at vn4.18-local;

02

Model configurations are forced by GFS and WRF;

03

JONSWAP bottom friction and Battjes-Janssen shallow water terms; the interaction between these and ST4 needs review for large waves in shallow water;

04

Spherical Multiple-Cell grid used:

- Improved description of energy flows around headlands and islands
- Allows higher resolution cells to be defined in areas of special interest

05

- 2x daily update of short to medium range (T+0->10 day) wave forecasts;
- Hindcast models to generate long term past climate;

06

Global models based on 'refined' grids



BMKG Wave Model Domain

RECENT WORK – Ocean Wave Model

Ina-Waves ~

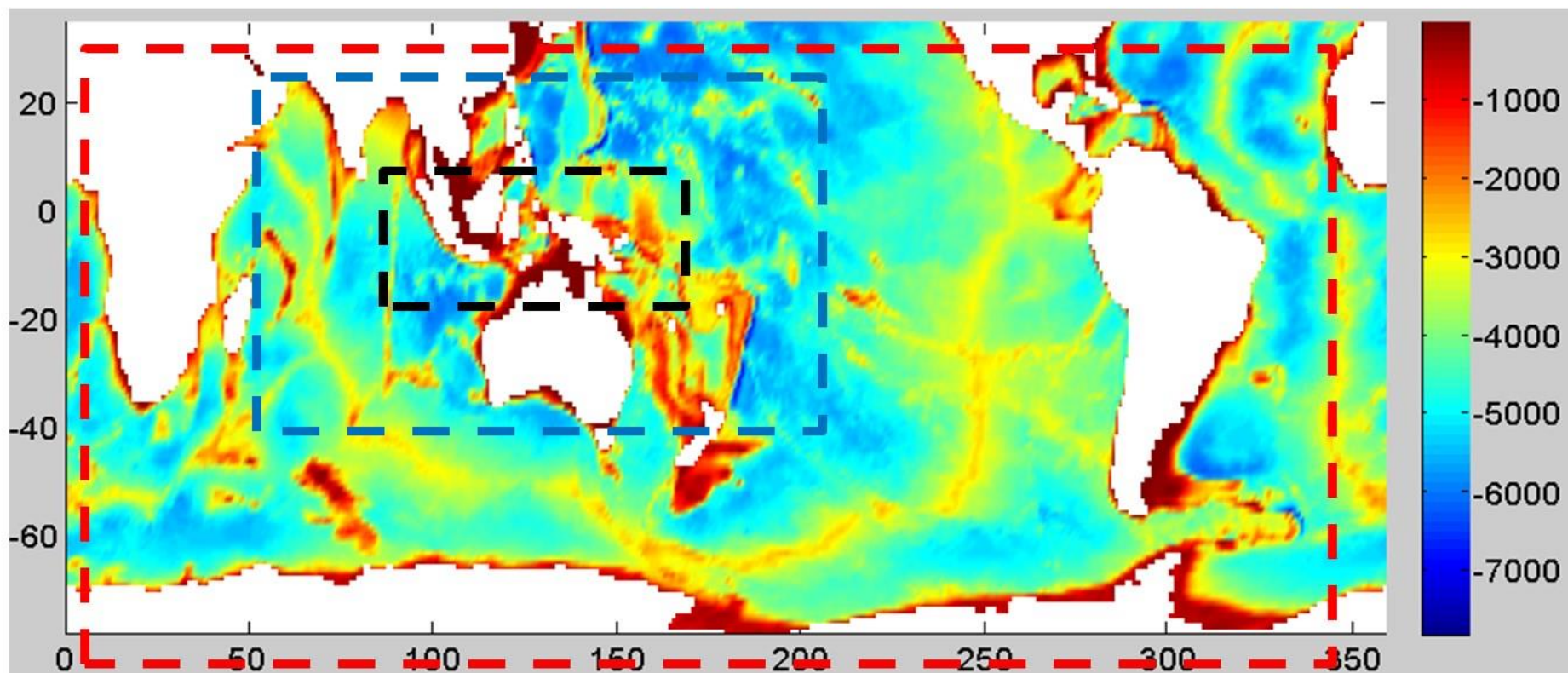
WW3- Model Domain & Grid Resolution.

Global: $1^{\circ} \times 1^{\circ}$ (lat/lon)

Asia – Australia : $0.25^{\circ} \times 0.25^{\circ}$ (lat/lon)

Indonesia Low Res : $0.125^{\circ} \times 0.125^{\circ}$ (lat/lon)

Indonesia High Res : $0.0625^{\circ} \times 0.0625^{\circ}$ (lat/lon)



Wave Model Output Visualization

BMKG-OFS Ocean Forecast System
Pusat Meteorologi Maritim
Badan Meteorologi, Klimatologi, dan Geofisika - Ocean Forecast System (OFS)

Model: Ina-waves Parameters: **Significant Wave Height** (selected)
Timezone: UTC Area: Indonesia Model Run: 18-06-2021 12UTC

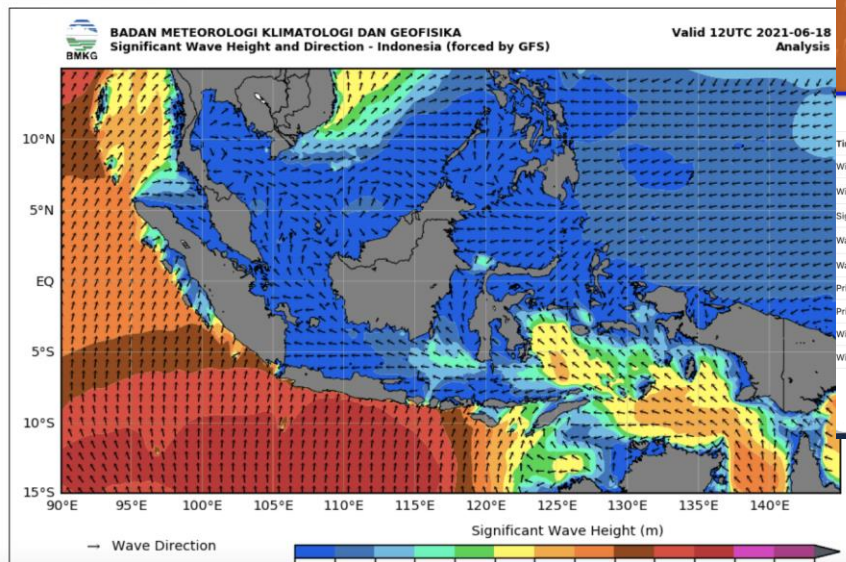
Valid for 18 Juni 2021 12:00 UTC

BMKG-OFS Ocean Forecast System

Significant Wave Height
2021-06-19 06:00 UTC
lon : 109.951172 / lat : -9.275622

	Friday, 18-06-2021				Saturday, 19-06-2021				Sunday, 20-06-2021				Monday, 21-06-2021				Tuesday, 22-06-2021																							
Time	12	15	18	21	0	3	6	9	12	15	18	21	0	3	6	9	12	15	18	21	0	3	6	9																
Wind Speed (knots)	11.8	11.2	10.1	9.9	9.2	8.7	7.6	6.5	7.6	8.9	9.2	9.1	7.7	7.7	6.6	6.3	6.8	6.5	5.4	4.3	4.5	3.2	3.2	5.3	6.4	6.8	6.9	7.4	7.8	8.8	9.0	9.9	11.3	12.2	13.2	14.5	15.9	16.7	17.7	19
Wind Direction	[Directional arrows]																																							
Significant Wave Height (m)	4.16	4.14	4.07	3.98	3.90	3.84	3.76	3.66	3.54	3.41	3.28	3.17	3.05	2.93	2.81	2.70	2.60	2.51	2.45	2.41	2.39	2.38	2.39	2.41	2.46	2.51	2.57	2.64	2.70	2.75	2.79	2.82	2.85	2.90	3.01	3.15	3.35	3.65	4.00	4.4
Wave Direction	[Directional arrows]																																							
Wave Mean Period (s)	13.57	13.69	13.62	13.45	13.22	12.96	12.72	12.53	12.34	12.14	11.91	11.68	11.47	11.27	11.12	11.01	10.95	10.93	10.96	11.03	11.13	11.24	11.38	11.56	11.80	12.07	12.35	12.57	12.70	12.71	12.60	12.42	12.14	11.74	11.20	10.58	10.00	9.55	9.21	9.0
Primary Swell Height (m)	2.51	2.99	2.94	2.87	2.78	2.71	2.62	2.54	2.45	2.37	2.27	2.17	2.07	1.97	1.87	1.79	1.72	1.67	1.63	1.59	1.59	1.59	1.60	1.64	1.69	1.76	1.83	1.91	1.97	2.02	2.01	2.02	2.02	2.01	1.98	1.89	2.08	2.55	2.86	0.1
Primary Swell Period (s)	15.71	17.73	17.44	16.60	15.79	15.62	15.35	15.03	14.79	14.63	14.51	14.36	14.02	13.63	13.45	13.36	13.31	13.27	13.25	13.32	13.46	13.53	13.57	13.67	13.94	14.28	14.31	14.16	14.09	14.17	14.24	14.26	14.20	13.95	13.63	13.44	13.26	13.08	12.88	12
Wind Sea Height (m)	1.32	1.29																																						
Wind Sea Period (s)	7.75	7.57																																						

Model: Inawaves-OFS Initial Time: 2021-06-18T12:00:00Z

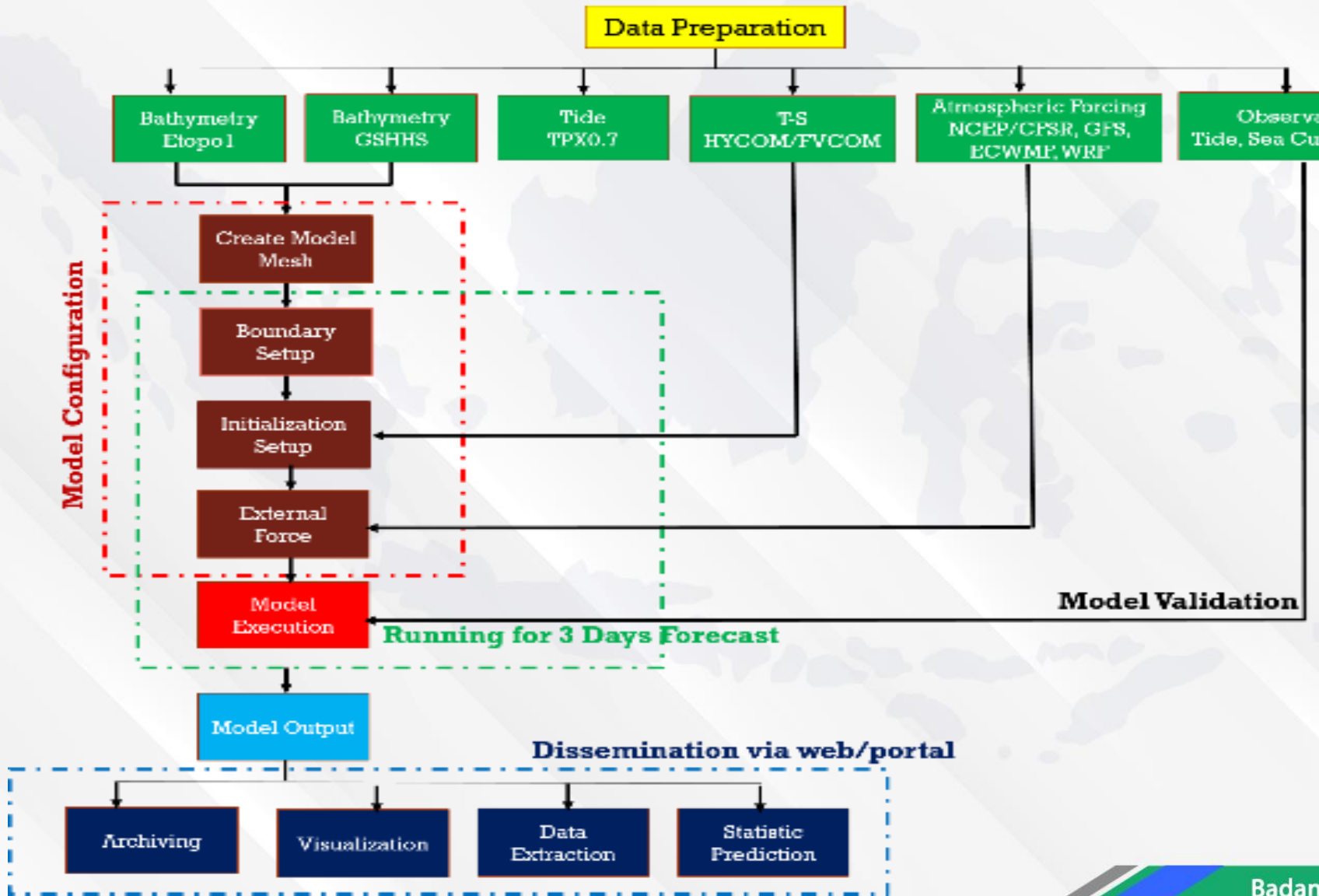


<http://peta-maritim.bmkg.go.id/of/>

<http://peta-maritim.bmkg.go.id/ofs-static>



BMKG OFS : The Flow Chart



Forecast

Up to 3 Days forecast:
Surface, 5 m, 10 m, 100 m, 250m

- Currents: speed, direction
- Sea temp: speed, direction
- Salinity

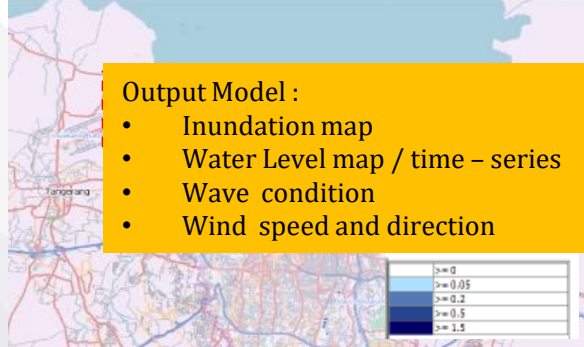
Hindcast / Reanalysis:

Current, Sea Temp, and Salinity
Climatology



End to End Coastal Inundation Forecast System

OUTPUT MODEL



Dashboard Early Warning System



Emergency Response

- ✓ Vulnerability Assesmtent
- ✓ Risk Assesmtent
- ✓ Impact Assesmtent



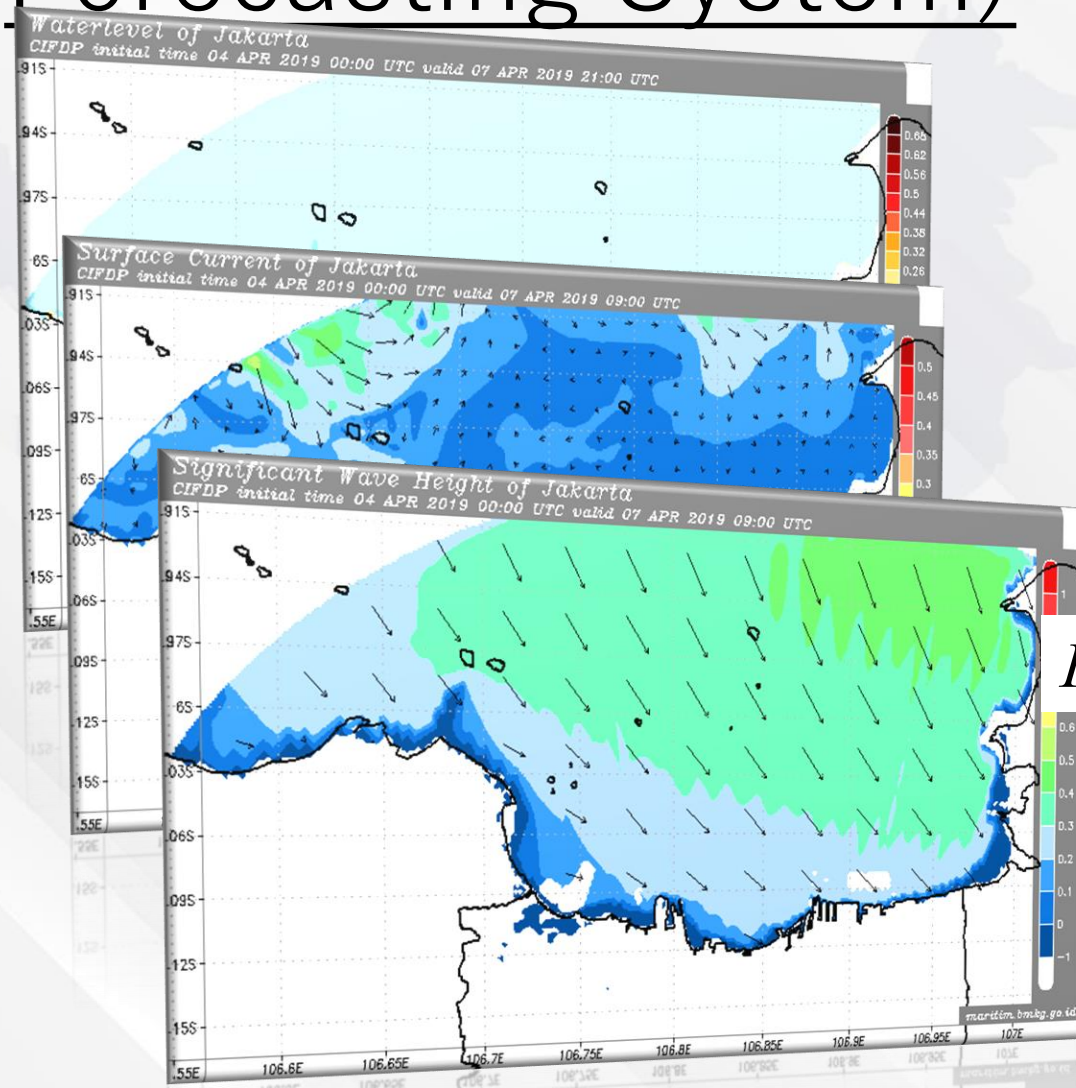
1. API Platform to bridge to another system

2. Image Output
3. Web Base interactive

Location : District warning



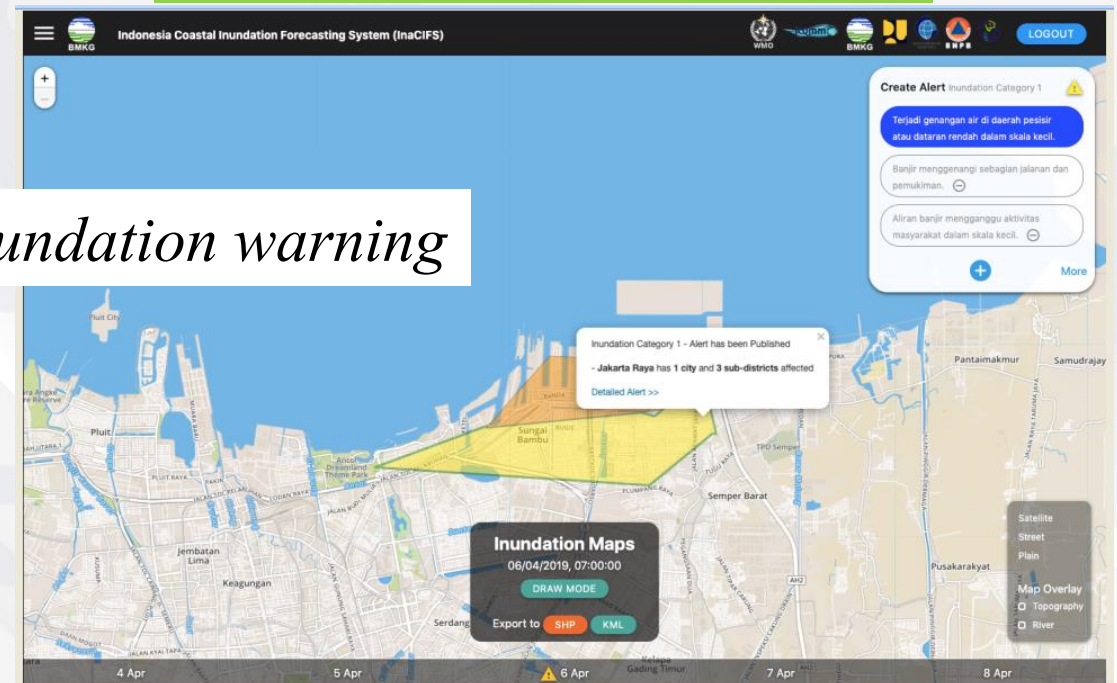
OUTPUT OF INACIFS (Coastal Inundation Forecasting System)



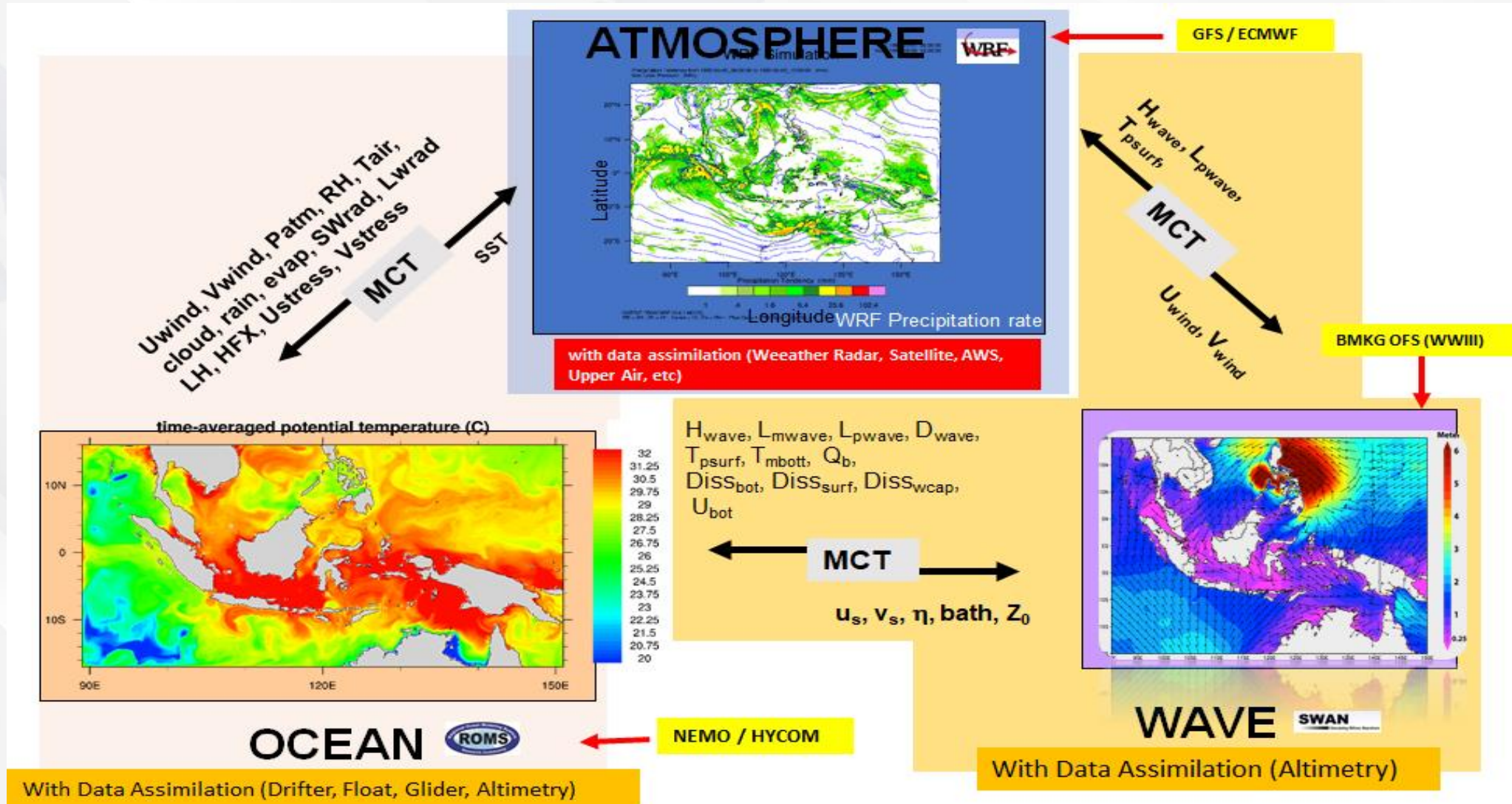
High Resolution and Coupled model for Water Level, Surface Current, Wave Height and Inundation.

Forecast up to 5 days

Inundation warning

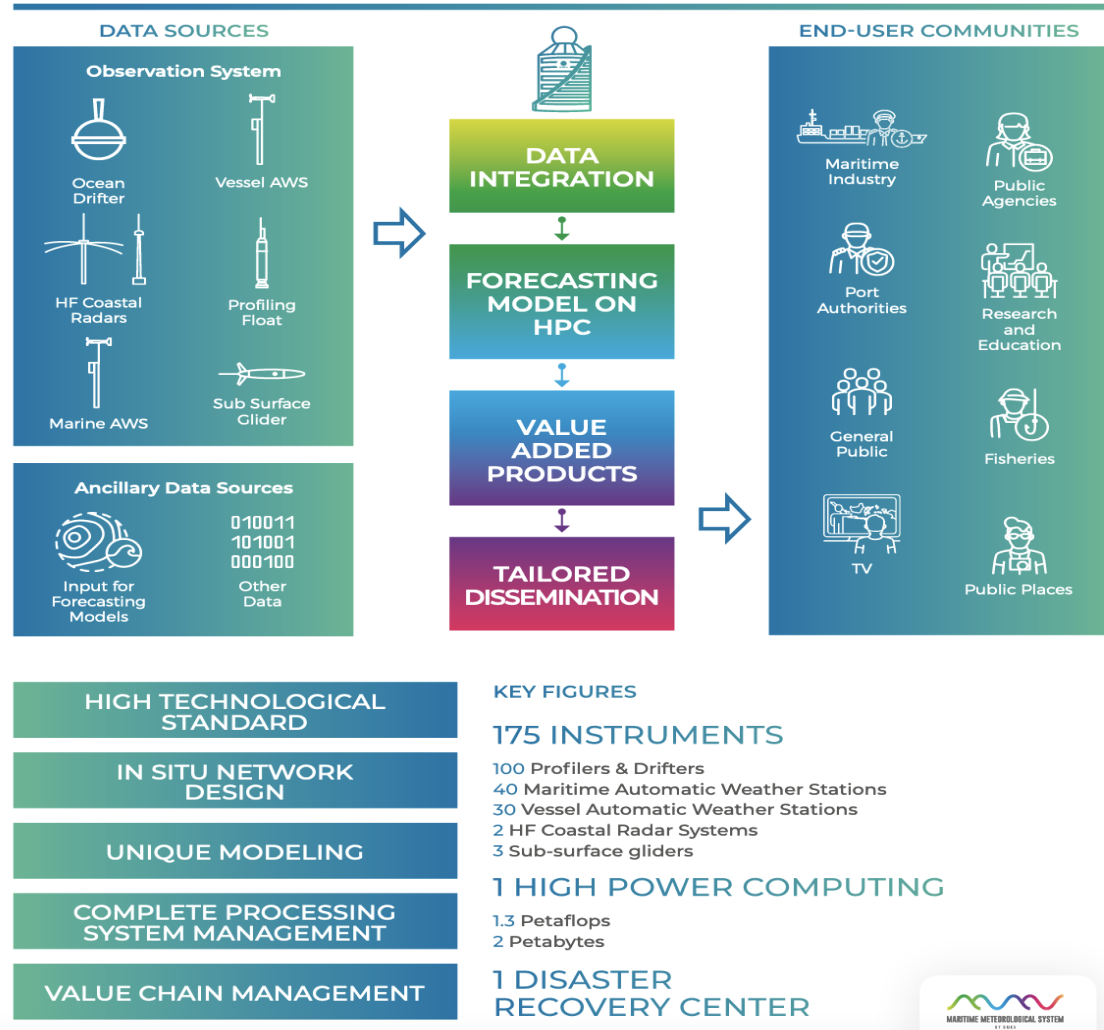


Enhancing BMKG-OFS (2021 – 2023) Coupled Atmospheric – Ocean Wave Ocean Model (CAWO)



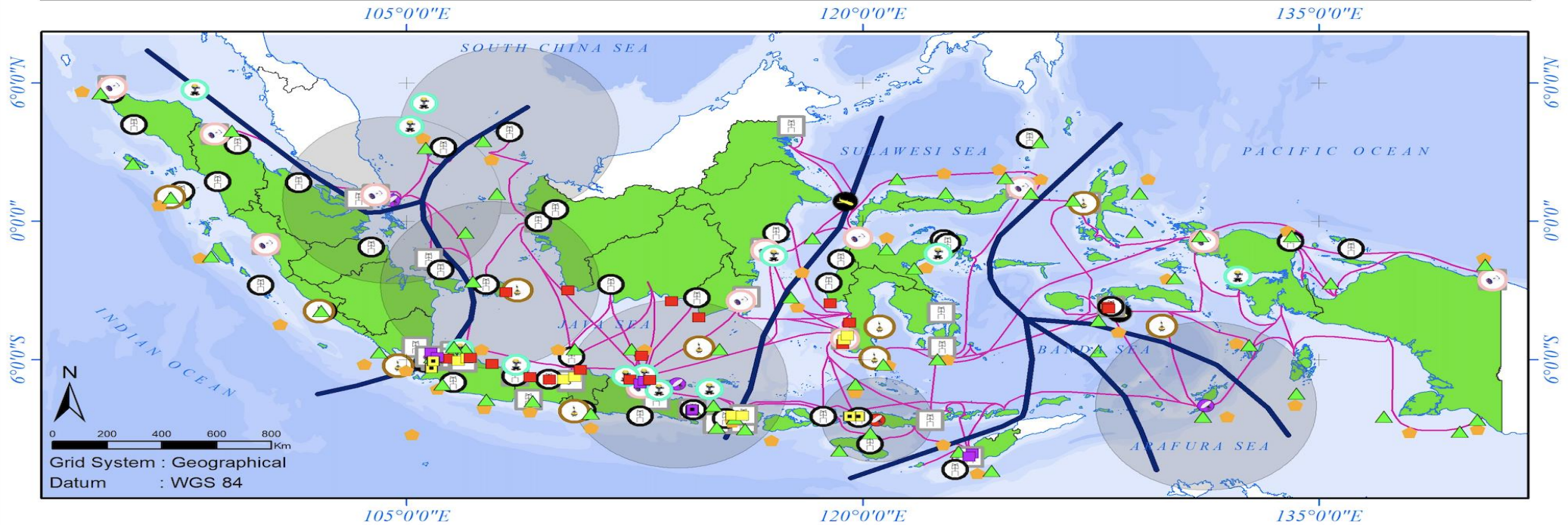
MARINE METEOROLOGICAL SYSTEM (MMS1)

A SYSTEM MANAGED FROM END-TO-END BY BMKG



Development of Maritime Observation Infrastructure Through MMS Project

EXISTING AND DEVELOPMENT PLAN OF MARINE OBSERVATION INFRASTRUCTURE BMKG (2020-2024)



LEGEND:

- Administrative Region of Indonesia
- National Boundary
- Provincial Boundary
- Coastal Line
- Line of ALKI
- Coverage of Radar

Ocean Observation Plan:

- HF Radar 5 MHz (Amount: 9 pairs)
- HF Radar 13 MHz (Amount: 4 pairs)
- HF Radar 25 MHz (Amount: 3 pairs)
- Drifter (Amount: 60)
- Float (Amount: 40)
- Wave Recorder (Amount: 12)
- Coastal Bouy (Amount: 10)

- ADCP (Amount: 12)
- Marine AWS (Amount: 40)
- Surface Glider (Amount: 2)
- Sub Surface Glider (Amount: 3)
- Radar S-Band (Amount: 5)
- Radar C-Band (Amount: 1)
- Track of Vessel AWS (Amount: 30 Ship)

Ocean Observation Existing:

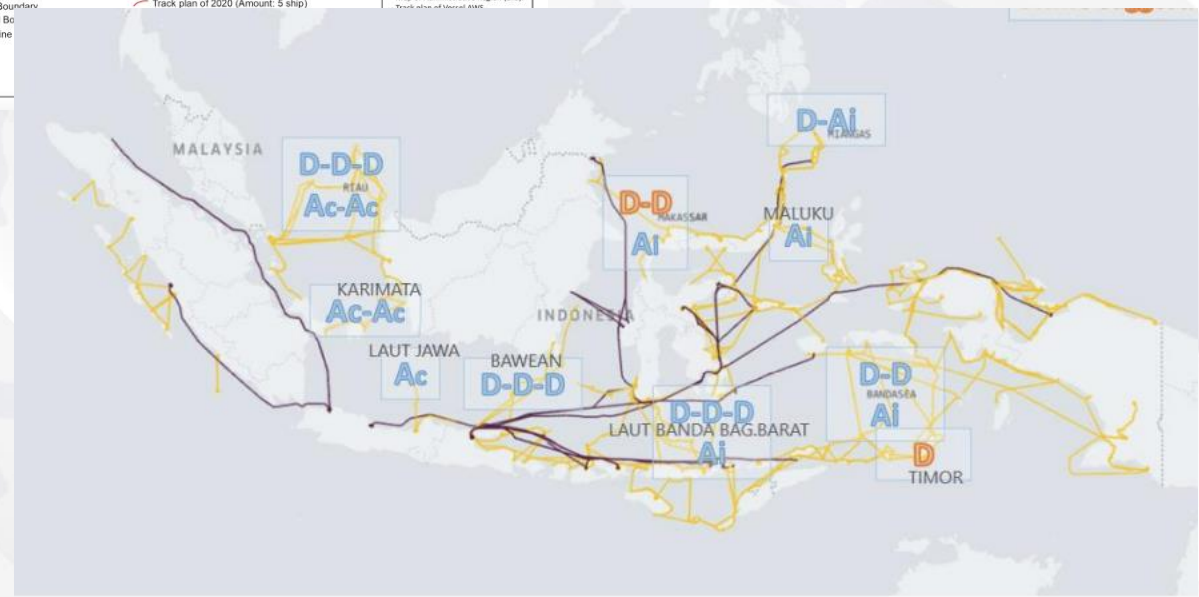
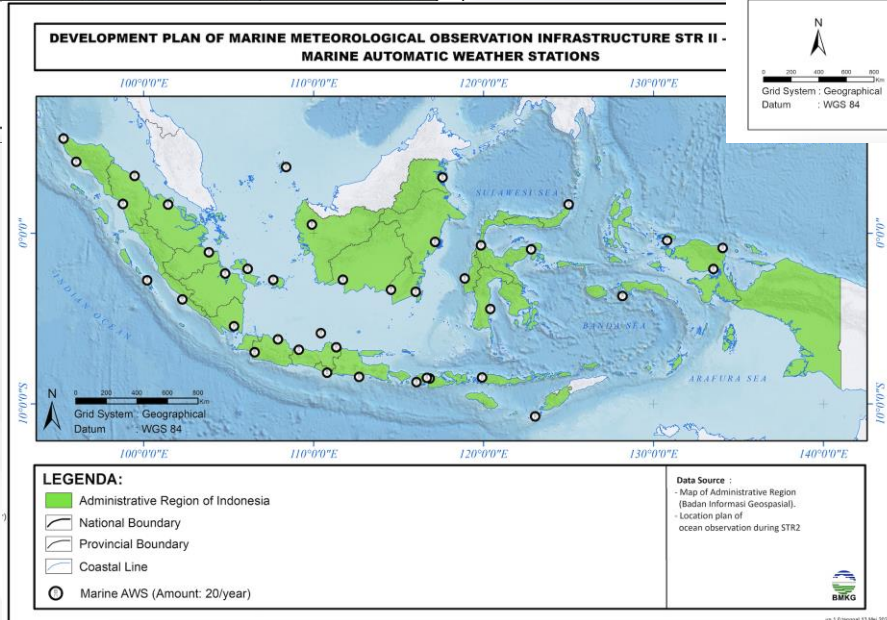
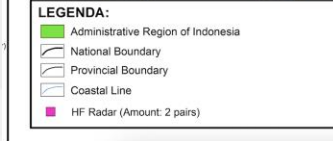
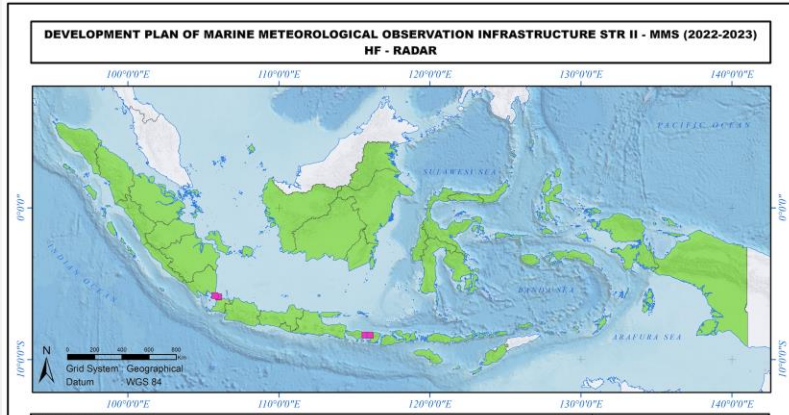
- HF Radar 13 MHz (Amount: 2 pairs)
- HF Radar 25 MHz (Amount: 1 pairs)
- Marine AWS (Amount: 35)
- ADCP (Amount: 5)

Data Source :

- Map of Administrative Region (Badan Informasi Geospasial).
- Location plan of ocean observation during STR2
- Line of ALKI (Alur Laut Kepulauan Indonesia)
- Location existing of ocean observation



MMS-1 Obs. location





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www.bmkg.go.id

Thank You

