

MARINE DEBRIS SOURCE AND TRAJECTORY MODEL STUDY CASE : BANTEN BAY AND JAKARTA BAY, INDONESIA

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APEC Capacity Building on Global Marine Debris Monitoring and Modelling
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Presentation Outline

- *OVERVIEW OF INDONESIA'S PLAN OF ACTION FOR COMBATTING MARINE DEBRIS 2018-2025 AND ROLE OF MARINE RESEARCH CENTER-MMAF*
- *BACKGROUND OF THIS STUDY*
- *WASTE MANAGEMENT IN SERANG CITY AND SERANG REGENCY*
- *MODELLING RESULT AND DISCUSSION*
- *WATER QUALITY MEASUREMENT ON BANTEN BAY*
- *SUMMARY AND PERSPECTIVE*

PoA for COMBATTING MARINE DEBRIS



The key important aspects in handling marine debris in Indonesia are three-fold:

- 1 Coordination between institutions responsible for waste management. This involves strengthening regulation and human resources in various sectors and institutions;
- 2 Application of technology to control plastic debris, including the application of science-based management;
- 3 The significant importance of societal efforts to reduce, recycle and reuse plastic debris to be advanced since early age.

ROLE OF MARINE RESEARCH CENTER MMAF



PRESIDEN
REPUBLIK INDONESIA

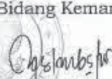
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No.	Program	Kegiatan	Sasaran	Target /Output	Jangka Waktu							Penanggung Jawab	Instansi Terkait	Sumber Dana	
					2018	2019	2020	2021	2022	2023	2024				2025
		Penelitian pencemaran sampah di laut dan dampaknya	Tersedianya data dan hasil kajian dampak sampah di laut	Data dan hasil kajian di 11 Wilayah Pengelolaan Perikanan (WPP)	1	2	2	2	1	1	1	1	KKP	Kemenperin, KLHK, Kementerian ESD, BPPT, LIPI, TNI AL, Pemda, perguruan tinggi	APBN, APBD, dan sumber dana lainnya yang sah sesuai ketentuan peraturan perundang-undangan
		Kajian dampak mikro dan nano plastik pada tubuh manusia	Tersedianya hasil kajian dampak mikro dan nano plastik pada tubuh manusia	8 data dan hasil kajian	1	1	1	1	1	1	1	1	Kemenkes	KLHK, Kementerian ESD, LIPI, Pemda, perguruan tinggi	APBN, APBD, dan sumber dana lainnya yang sah sesuai ketentuan peraturan perundang-undangan

PRESIDEN REPUBLIK INDONESIA,
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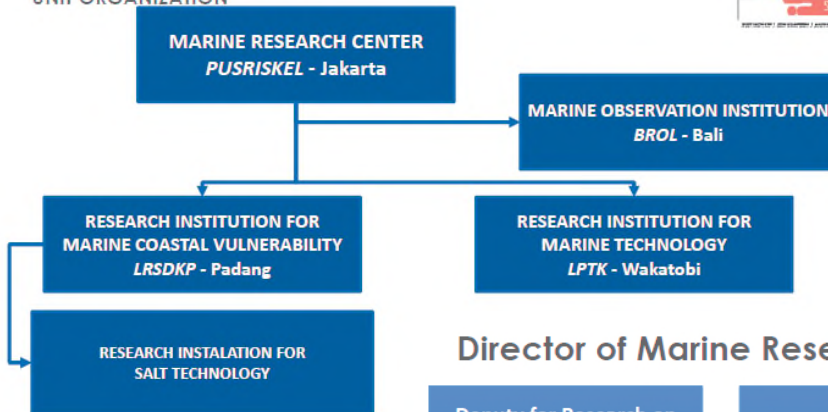
JOKO WIDODO

Salinan sesuai dengan aslinya
SEKRETARIAT KABINET RI
Deputi Bidang Kemaritiman,


Agustina Murbaningsih

PROFILE OF MARINE RESEARCH CENTER

MARINE RESEARCH CENTER UNIT ORGANIZATION



Director of Marine Research Center



Deputy for Research on Mitigation, Adaptation and Marine Conservation

- Ocean Acidification
- Sea Level Rise: modeling
- SST & Coral Bleaching: CB Early Warning System
- Carbon Stock: Carbon stock database
- Ocean atmosphere interaction
- Marine Environment, marine debris, marine conservation
- Pollution Monitoring and Control (water quality database, pollution source analysis, predictive mapping of polluted areas, marine debris)
- Reclamation (ecosystem mapping, impact assessment)
- Others oceanographic research

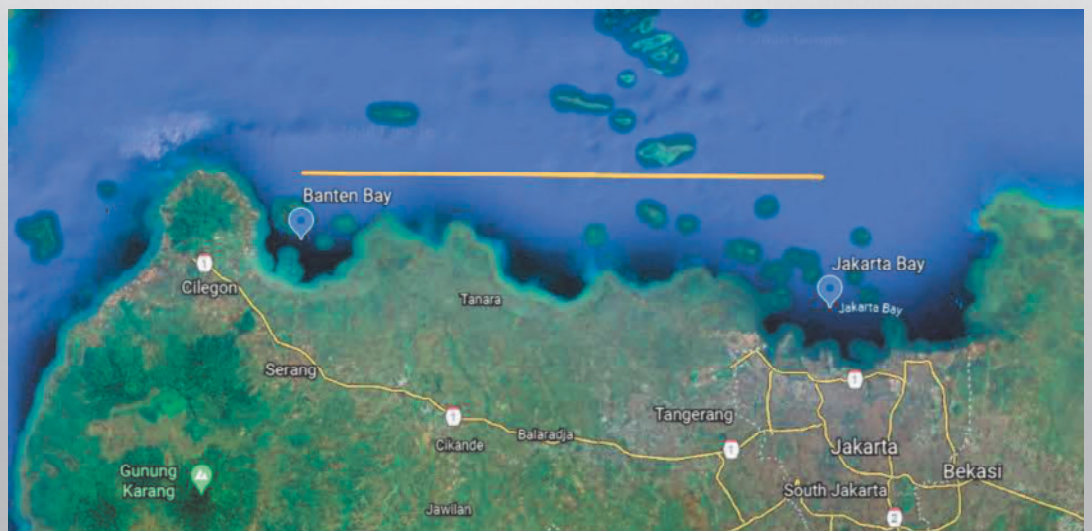
Deputy for Research on Marine Technology

- Seawater utilization technology (salt, deepsea water/energy, production technology)
- Tools and Research Support Facilities (building workshops, seaglidgers, UAVs)
- Technology Test (small-scale vessels, non-fish waste treatment plants),
- Applied Technology (water monitoring, ecosystem rehabilitation, marine structures and coastal protection structures)
- Guidelines
- Others marine technology/engineering and research

Deputy for Research on Maritime Territories and Marine Resources

- Marine non living resources and geodynamic research
- Marine-coastal spatial management and Coastal Water Quality Monitoring
- Maritime territories, continental shelf, sediment and deepseabed resources
- Provision of coastal and marine datasets
- Ocean Health Index and phenomena studies
- Research Cruise (Indian Ocean, ITF, Banda, SATAL, Paleoceanographic)
- Marine services (marine tourism and maritime archeology)
- Others marine geology and geophysics research

BANTEN BAY AND JAKARTA BAY



BACKGROUND OF STUDY

- THE BANTEN BAY HAS A ANTHROPOGENIC PRESSURE COMING FROM THE INCREASING NUMBER OF POPULATION, INDUSTRY, ETC. IT HAS AN ECONOMIC GROWTH SINCE BANTEN LOCATED NEAR JAKARTA.
- THE SOURCE OF MARINE DEBRIS IN BANTEN BAY?
- MARINE DEBRIS OF BANTEN BAY COMING TO THE JAKARTA BAY OR VICE VERSA?
- HOW THE WATER QUALITY OF BANTEN BAY?

LAND BASED WASTE MANAGEMENT



1	Jembatan kaliasin
2	Kaibon
3	Pasar Karangantu
4	Sampah liar di DAS
5	Sampah loss di sungai
6	Sungai Kroya
7	TPS Kaligandu
8	TPS Parung
9	TPS Penancangan
10	TPS Rusun
11	TPS cimuncang
12	TPS liar cantilan
13	TPS liar sawah luhur
14	TPS sementara Kepandean
15	TPS terminal cipocok
16	Teluk Karangantu
17	Tpas cilowong



TEMPORARY LANDFILL



Kepandean



Cipocok

UNMANAGED WASTE



Cantilan



Kroya

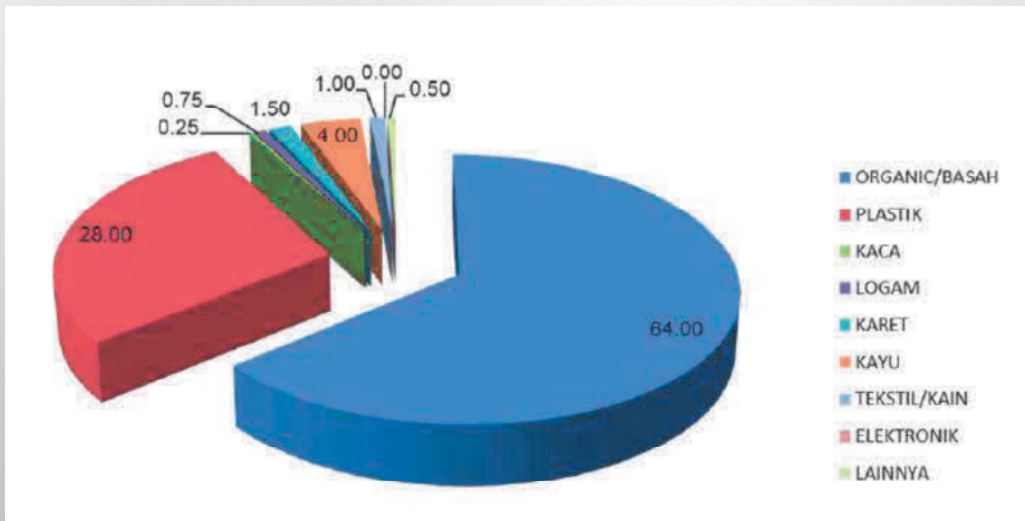
WASTE MANAGEMENT ON SUBSIDIZED APARTMENT



CILOWONG LANDFILL

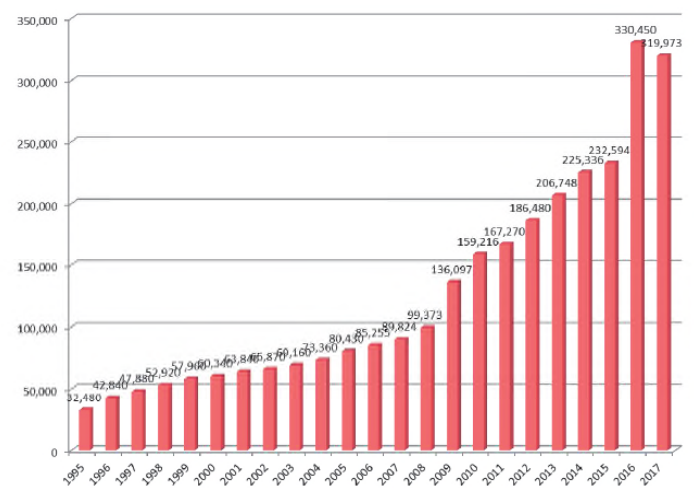
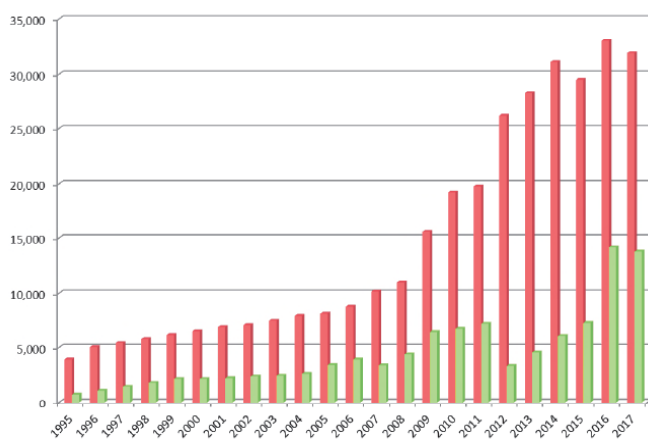


WASTE COMPOSITION OF CILOWONG LANDFILL



- ORGANIC
- PLASTIK
- GLASS
- METAL
- WOOD
- TEXTILE
- ELECTRONIC
- OTHERS

VOLUME AND SOURCE OF WASTE CILOWONG LANDFILL



NUMBER OF UNMANAGED AND MANAGED WASTE IN SERANG CITY IN 2017

No.	Sub district	Semester 1			Semester 2		
		managed	Waste volume	%	managed	Waste volume	%
1	CIPOCOK JAYA	32,760	47,468	69	33,228	47,468	70
2	CURUG	6,750	22,732	30	6,820	22,732	30
3	KASEMEN	12,825	42,777	30	12,835	42,777	30
4	SERANG	70,245	101,095	69	70,771	101,095	70
5	TAKTAKAN	10,430	40,187	26	11,654	40,187	29
6	WALAMTAKA	10,630	40,491	26	11,742	40,491	29
	total	143,640	294,750	49	147,050	294,750	30

In Serang Regency it is worst because only 6% waste that can be managed by Sanitary Office of Local Government

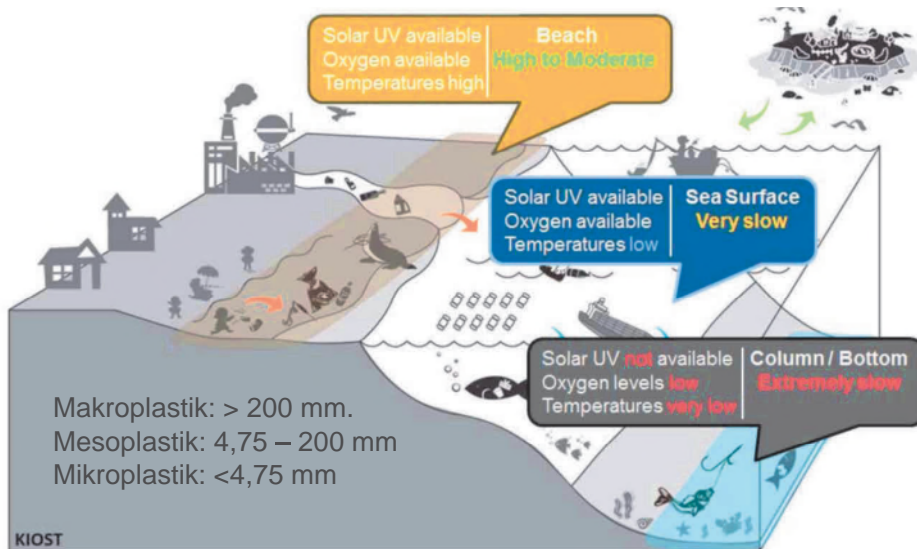


Figure 4.6 Factors affecting the degradation and fragmentation of plastic in different ocean compartments (GESAMP 2015)

THE FLUX AND COMPARTMENT OF PLASTIC WASTE

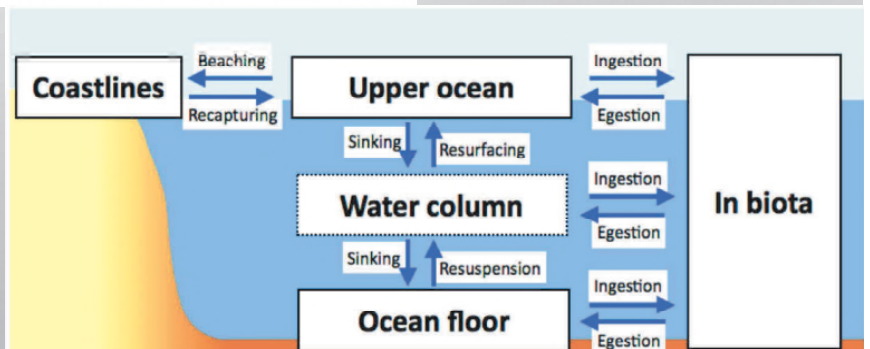
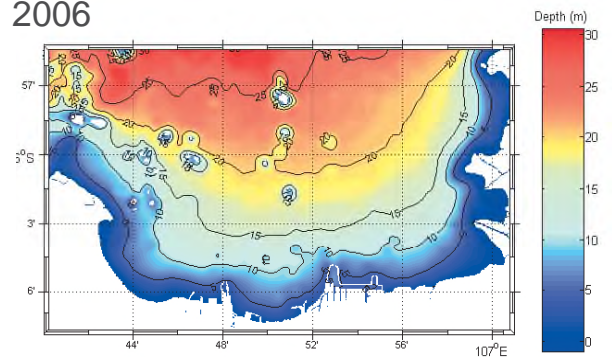


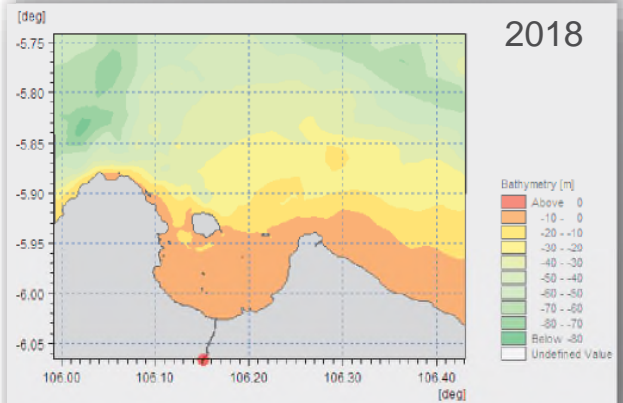
Figure 6.3 Overview of compartments and fluxes of marine plastics (figure based on a version by Erik van Sebille, taken from GESAMP 2016).

Methodology

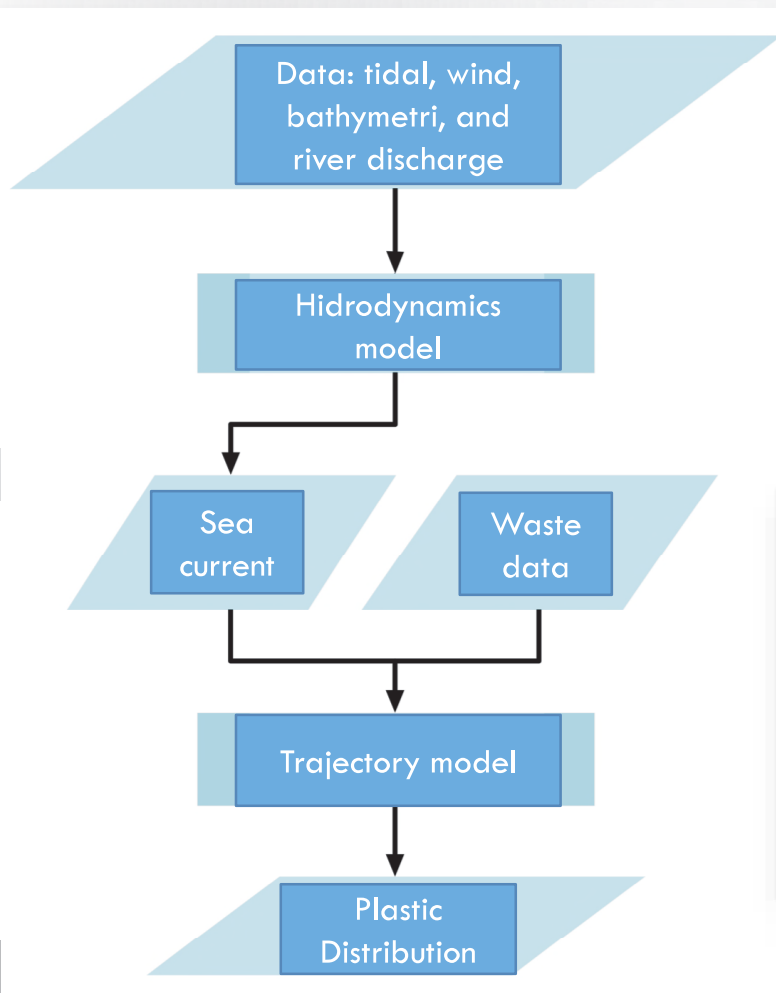
2006



2018



Bathymetry of Jakarta Bay (up) and Banten Bay (below)
(source: Indonesia Navy)



Methodology

FOR SIMULATION OF JAKARTA BAY
USING DATA 2006

- USING RIVER DISCHARGE FROM 11 RIVERS
- 3D HYDRODYNAMICS MODEL: *HAMBURG SHELF OCEAN MODEL (HAMSOM)*
- $DX=DY=100M$, WITH $DZ=4M$ ON THE FIRST LAYER, SECOND LAYER UNTIL 10M DEPTH, $DZ=2M$, NEXT $DZ=5M$
- TRANSPORT MODEL AND 3D TRAJECTORY
ASSUMPTION: WASTE COMPOSITION IS HOMOGEN
- DURATION OF SIMULATION:
NOVEMBER 2005 – NOVEMBER 2006.

For Simulation of Banten Bay
(2018)

- River discharge from 1 river (River Banten)
- Hidrodynamics Model 2D: *MIKE Flexible Mesh* from DHI
- *Modul Particle Tracking*
assumption: waste composition is homogen
- Duration of simulation : one periode of tidal that consist of *spring tide* and *neap tide* on the west monsoon (January) and east monsoon (July)
1 – 31 January 2018 dan 1 – 31 July 2018.

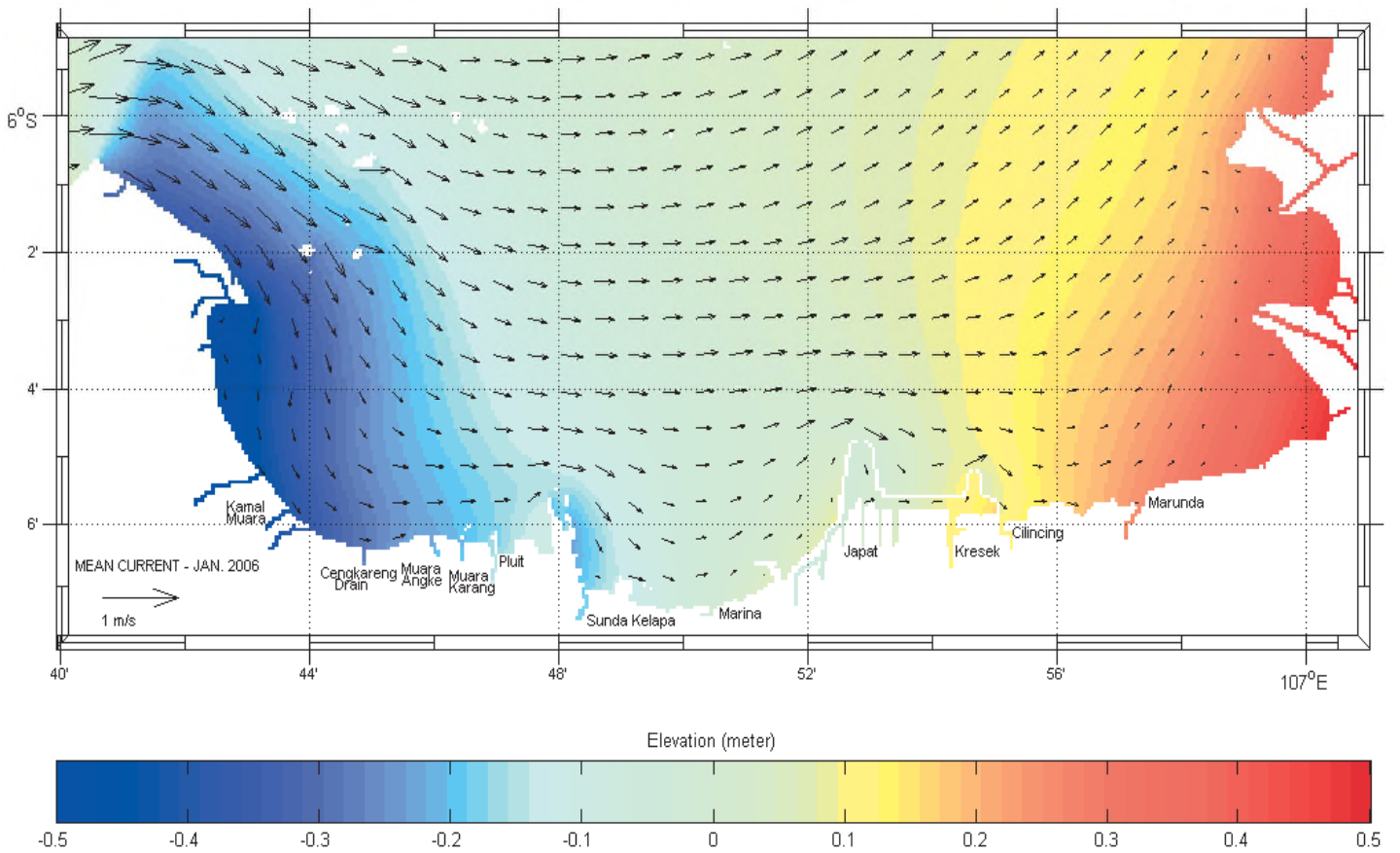
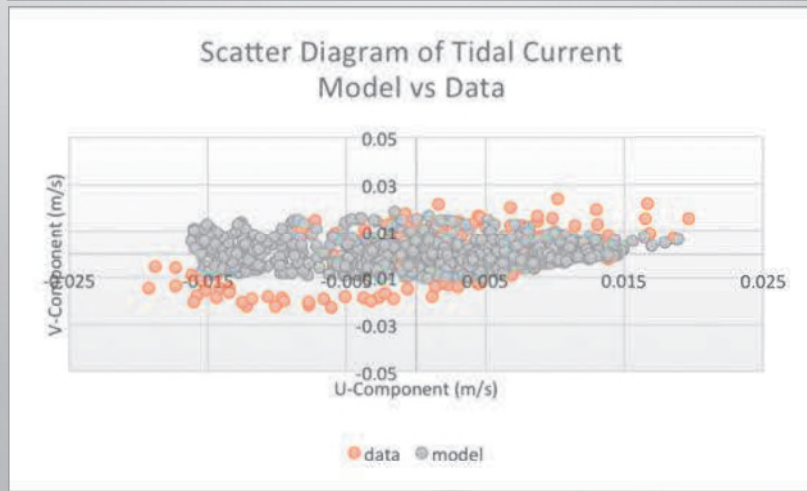
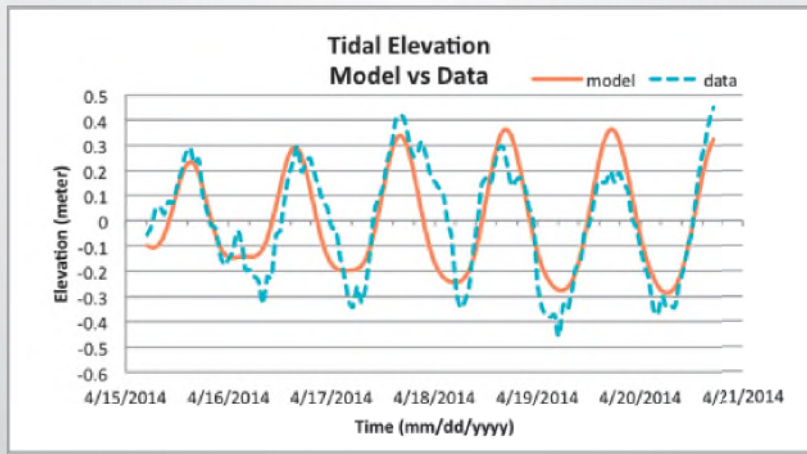
DATA USING FOR SIMULATION OF JAKARTA BAY

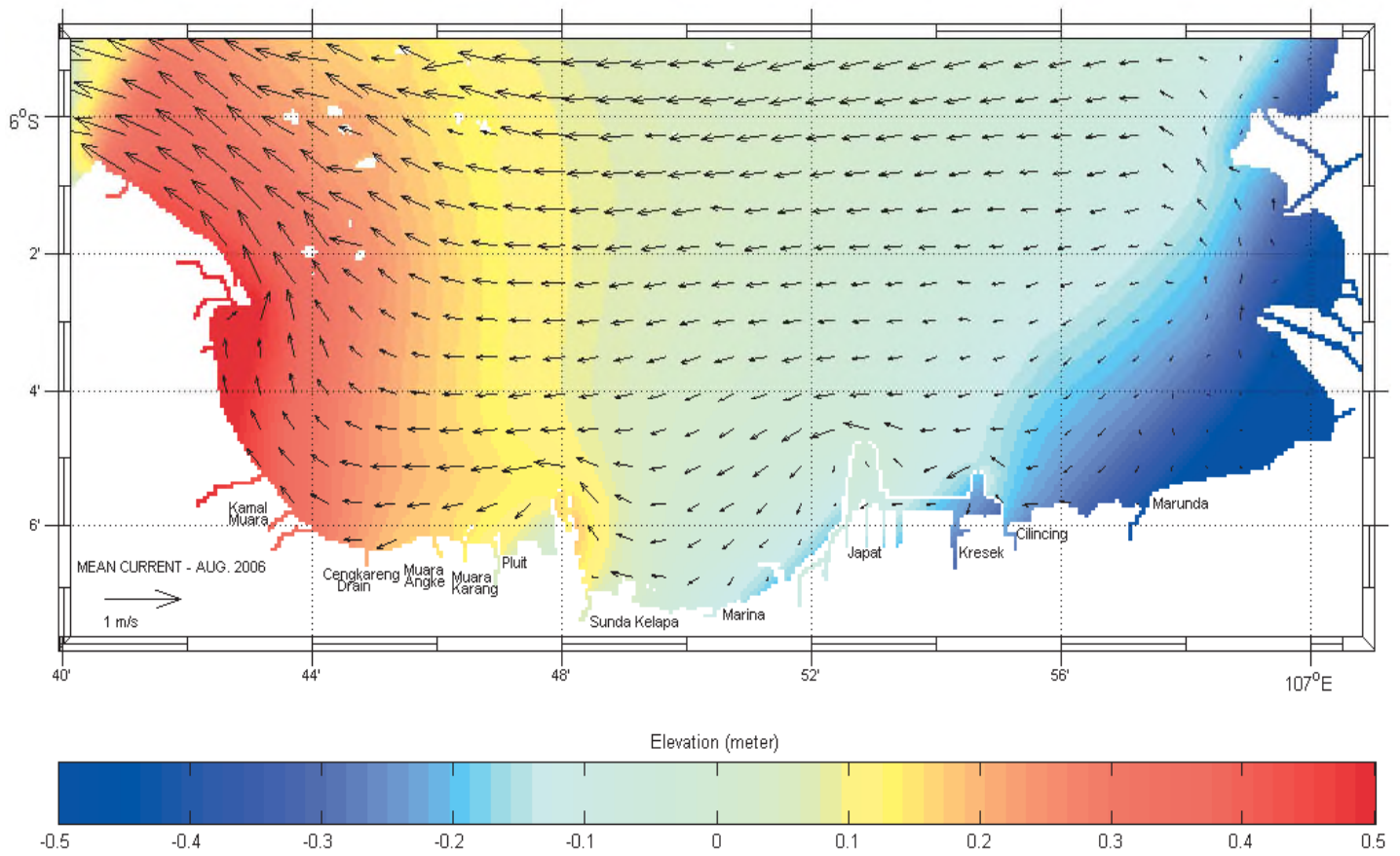
- BATHYMETRI:
INDONESIA NAVY MAPS
- TEMPERATUR DAN SALINITY:
WORLD OCEAN ATLAS (WOA) 2001
- METEOROLOGY:
NATIONAL CENTRE FOR ENVIRONMENTAL PREDICTION (NCEP)
- RIVER DISCHARGE:
 - ✓ BOOK II NKLD 1999 DKI JAKARTA;
 - ✓ TANJUNG PRIOK PORT REPORT 1993
- WASTE DATA:
 - ✓ FIELD SURVEY ON THE WEIGHT, VOLUME AND SPECIFIC WEIGHT OF WASTE

DATA USING FOR BANTEN BAY SIMULATION

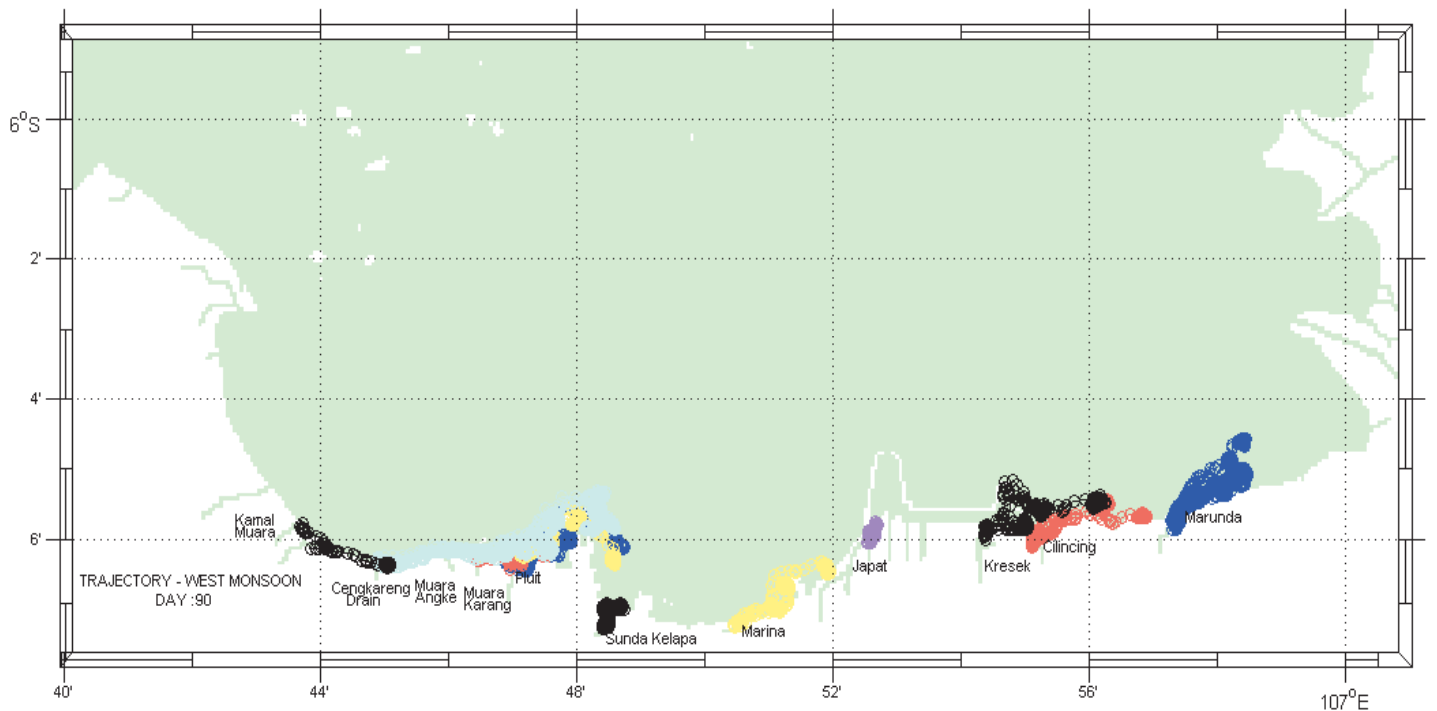
- BATHYMETRI:
 - ✓ INDONESIA NAVY MAPS
- METEOROLOGI:
 - ✓ ECMWF
- DEBIT SUNGAI:
 - ✓ WATER RESOURCES AND MINING OFFICE OF BANTEN PROVINCE
(DINAS SDAP PROPINSI BANTEN)
- WASTE DATA:
 - ✓ ESTIMATION OF UNMANAGED WASTE 2017 FROM SERANG
CITY SANITARY OFFICE

Model Verification of Jakarta Bay

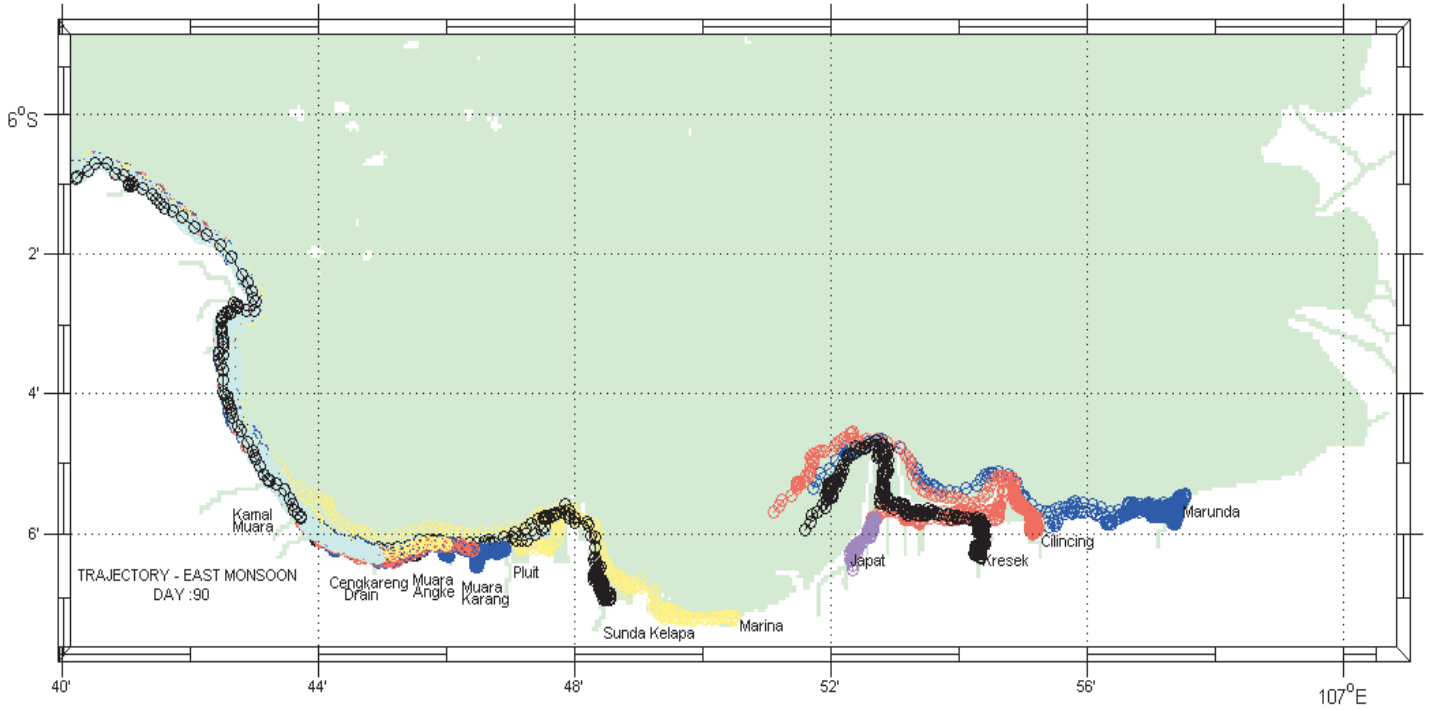




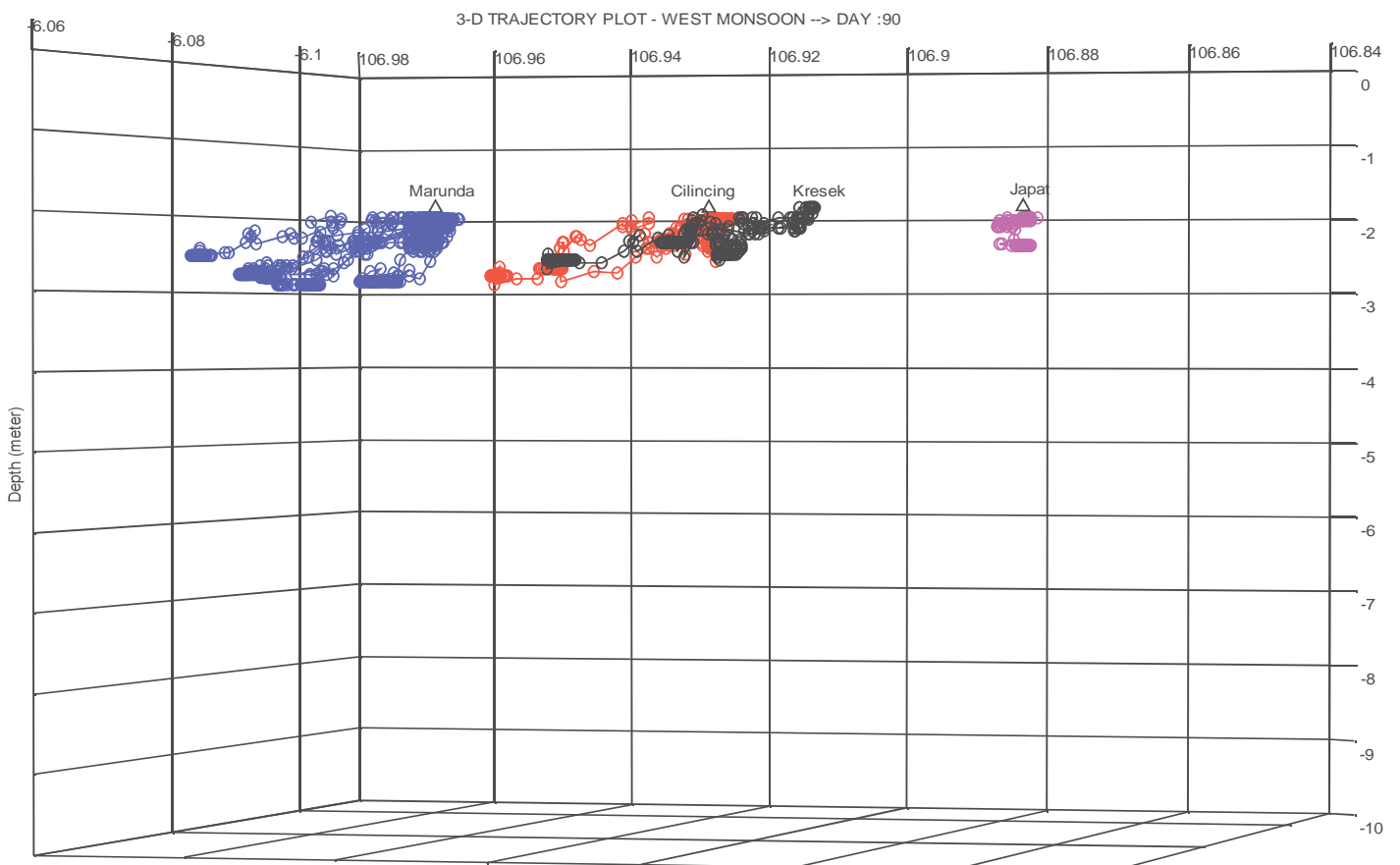
Plastic Marine Debris Trajectory and Distribution on West Monsoon



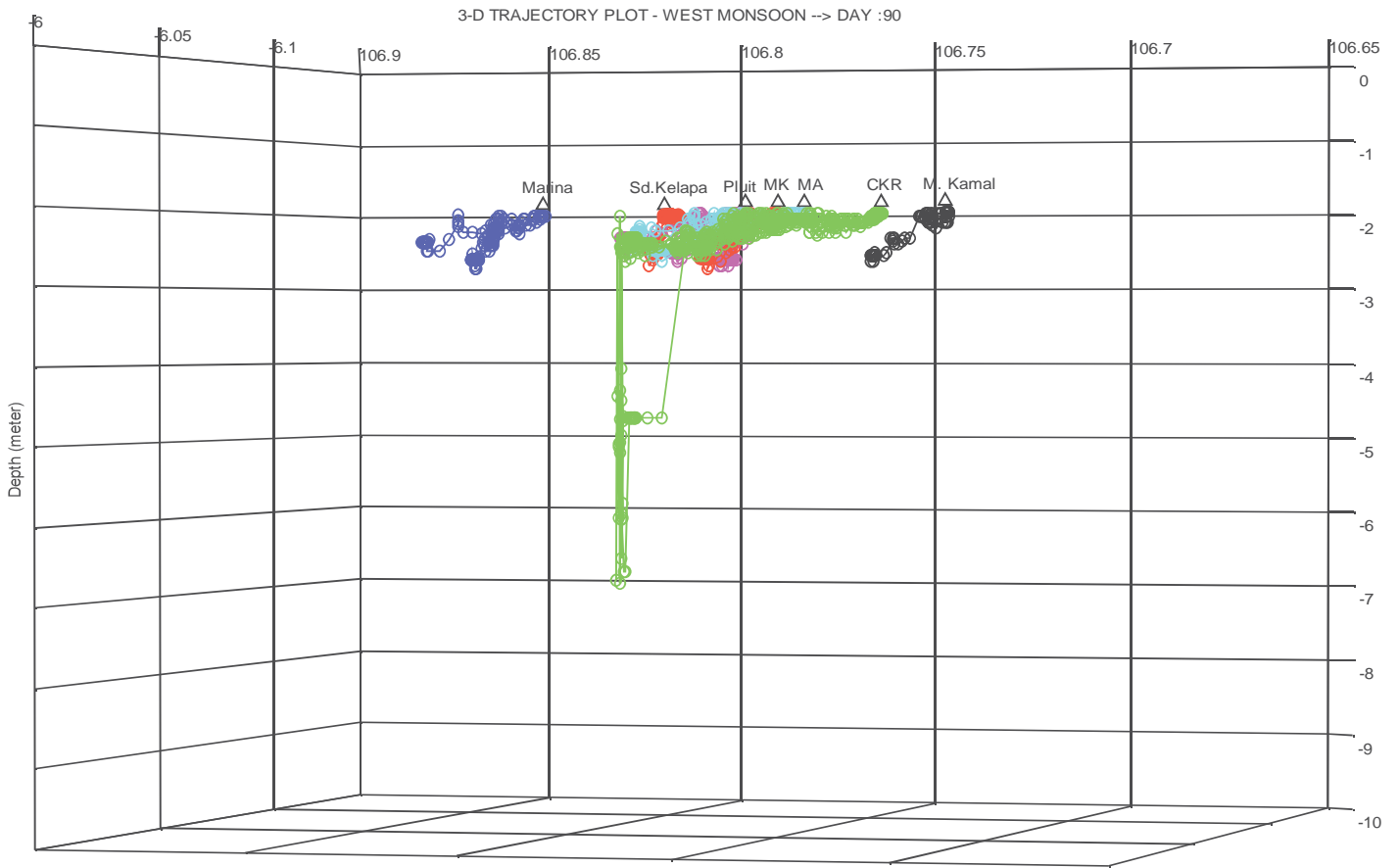
Plastic Marine Debris Trajectory and Distribution on East Monsoon



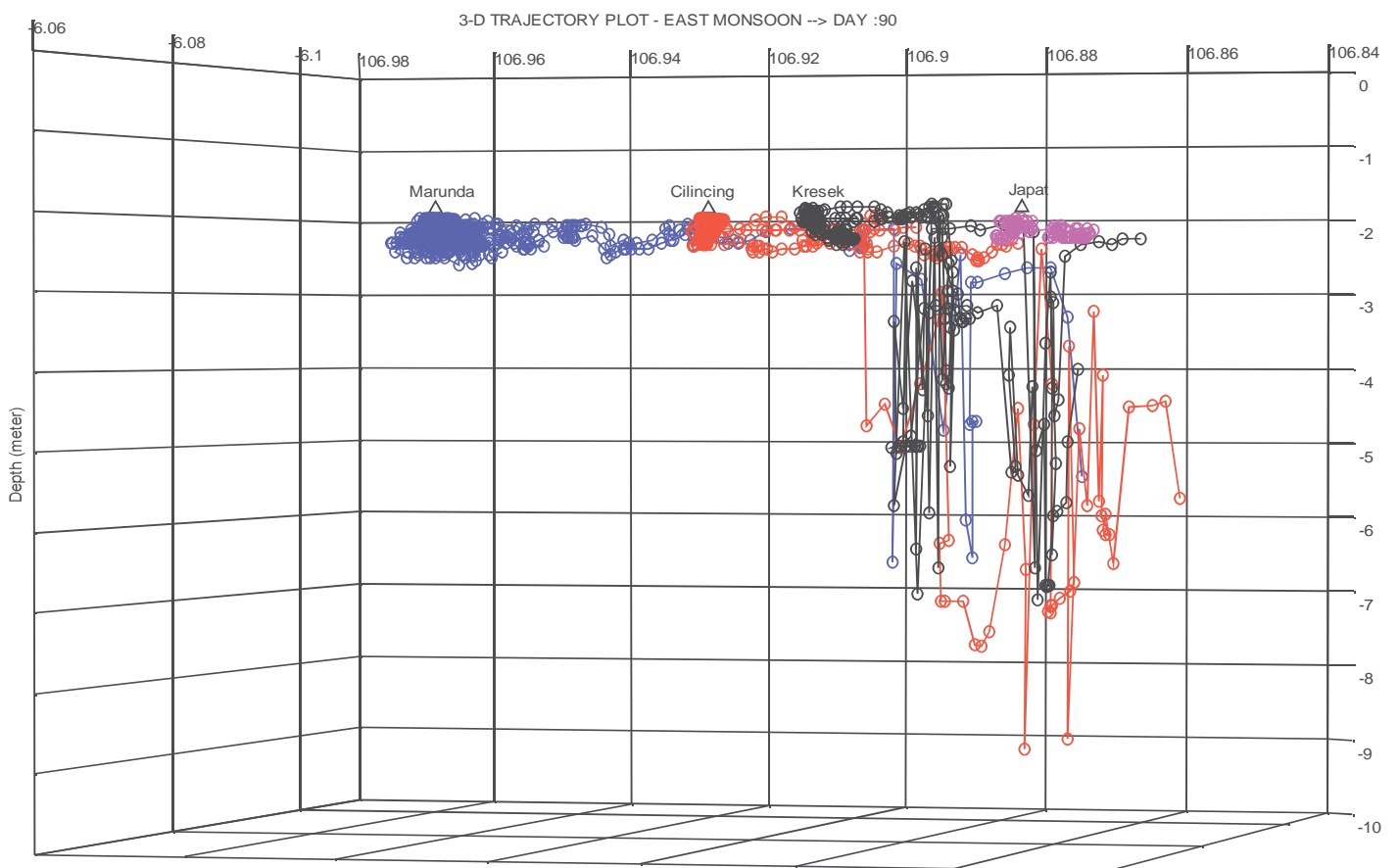
Vertical Movement on East Monsoon



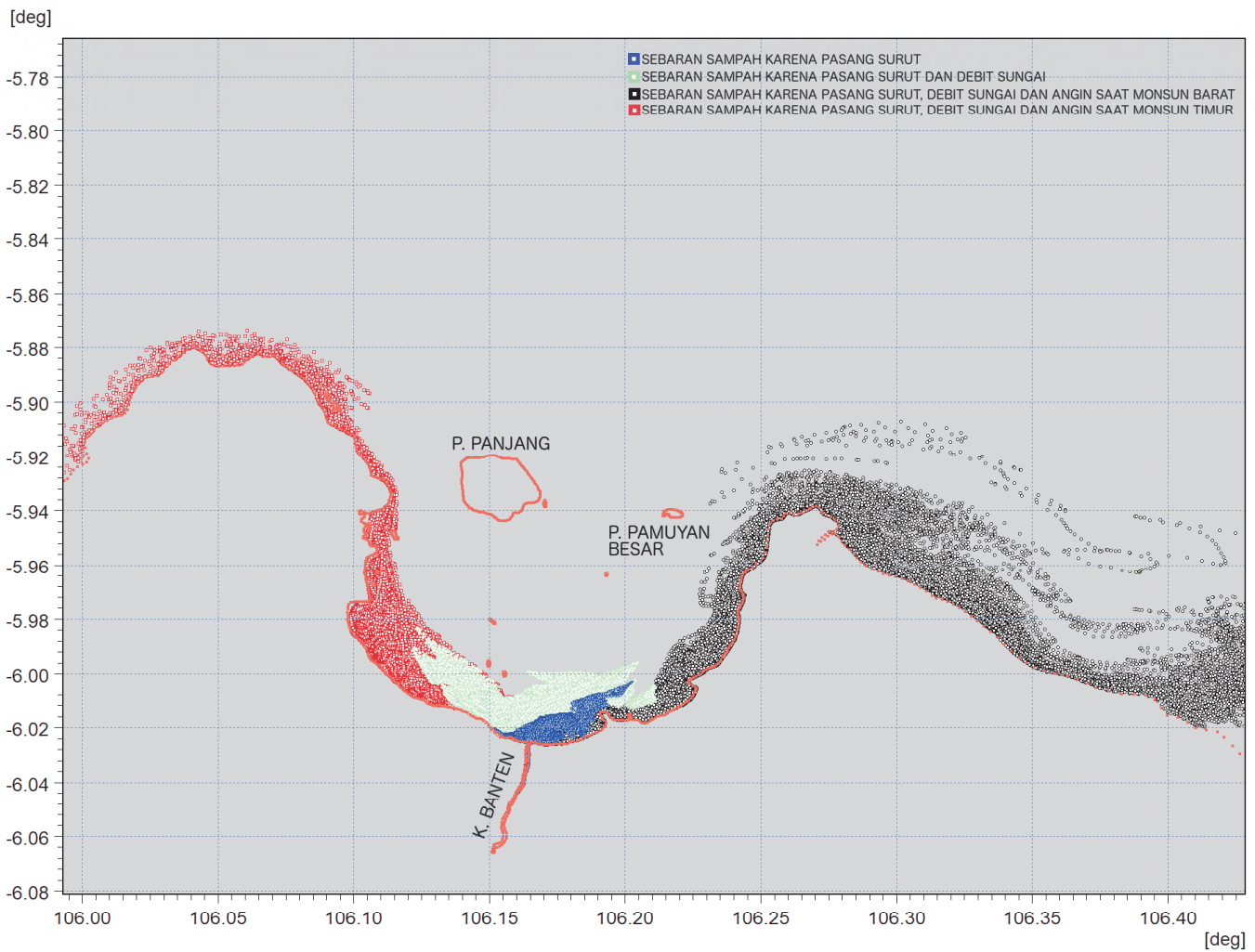
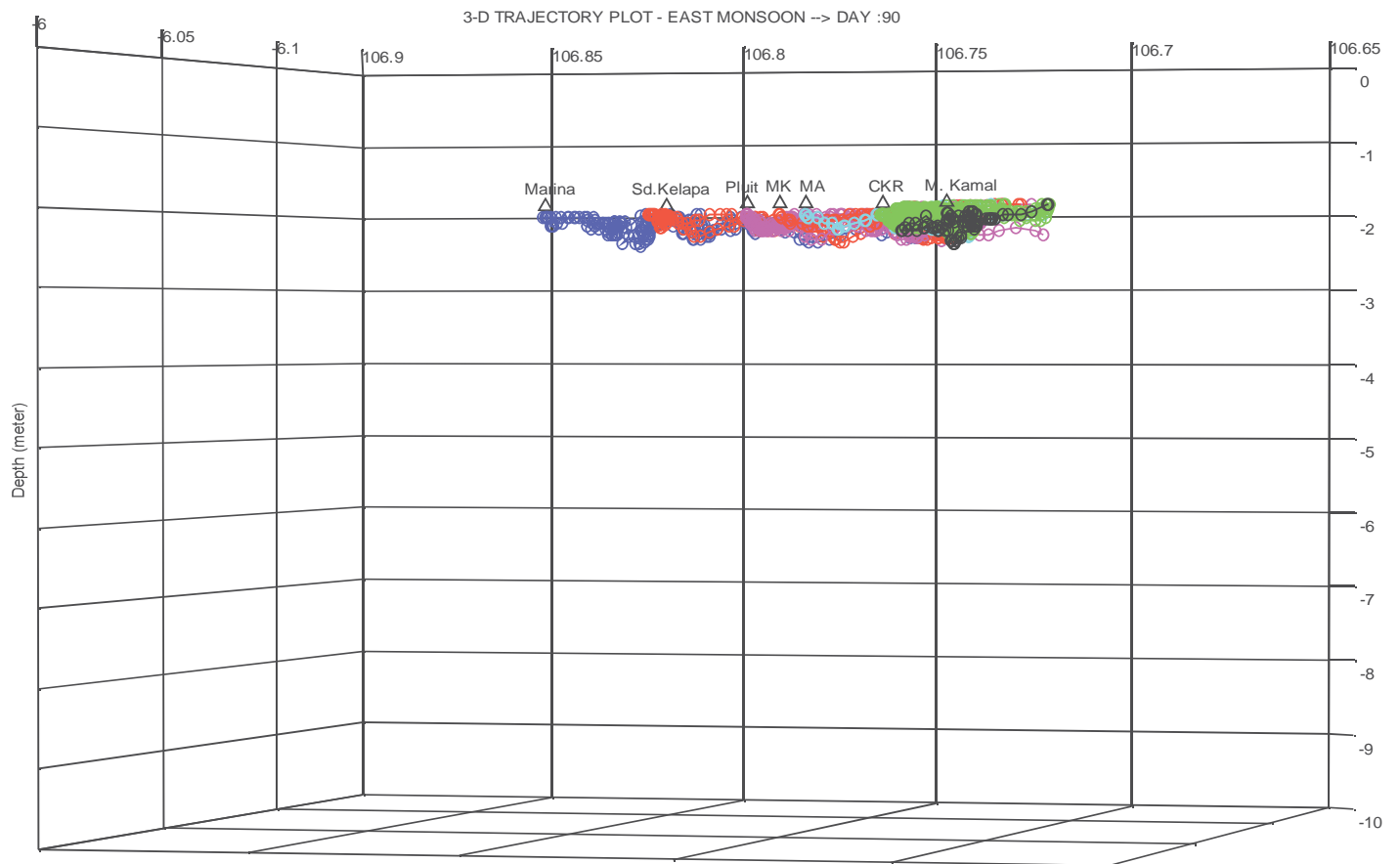
Vertical Movement on West Monsoon



Vertical Movement on East Monsoon



Vertical Movement on West Monsoon



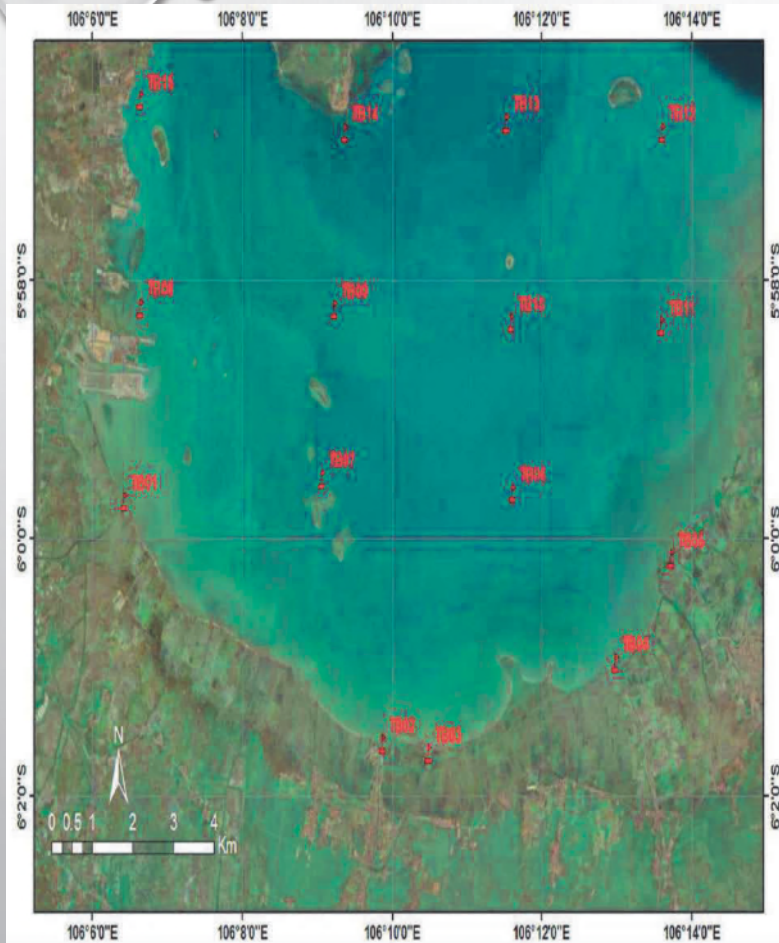
RESULT OF JAKARTA BAY MODEL

- ON THE EAST MONSOON (APRIL/MAY TO OCTOBER) THE PLASTIC MARINE DEBRIS WAS MOVED AND SPREAD IN THE JAKARTA BAY AND REACHED THE THOUSAND ISLAND MEANWHILE ON THE WEST MONSOON (NOVEMBER TO MARCH) THE CONCENTRATION MORE DISTRIBUTED AROUND THE ESTUARY TO 1 KM ONSHORE.
- THE MAJORITY OF THE PLASTIC MARINE DEBRIS WAS MOVED ON THE SURFACE (2-3 M DEPTH) AND ONLY 20-30% THAT SANK UNTIL 7-8 M DEPTH.
- WITH UNCONTINUE SOURCE, THE REMAIN OF THE PLASTIC MARINE DEBRIS WAS DISTRIBUTED
 - UNTIL 900 M FROM THE BEACH ON THE WEST MONSOON (AFTER 40 DAYS)
 - 300-400 M FROM THE BEACH ON THE EST MONSOON (AFTER 46 DAYS)

RESULT OF BANTEN BAY MODEL

- WIND DIRECTION IS A DOMINANT FACTOR FOR THE TRAJECTORY AND DISTRIBUTION OF PLASTIC MARINE DEBRIS
- ON THE EAST MONSOON, THE WIND DIRECTION DOMINANT TO THE WEST SO THE PLASTIC MARINE DEBRIS FROM BANTEN RIVER WAS MOVED ALONG THE SHORE TO THE WEST.
- ON THE WEST MONSOON, IT WILL MOVED TO THE EAST.
- WITH THE RESULT OF THIS SIMULATION, THE PLASTIC MARINE DEBRIS COMING FROM THE BANTEN RIVER IS POTENTIALLY MOVED TO THE SUNDA STRAIT ON EST MONSOON AND TO THE JAKARTA BAY ON THE WEST MONSOON.

BANTEN BAY WATER QUALITY CHECK



- PHYSICS PARAMETER:
 - TURBIDITY
 - SALINITY
 - TEMPERATURE
 - TOTAL DISSOLVED SOLID
 - CONDUCTIVITY
 - DISSOLVED OXYGEN
 - ACIDITY (PH)
- CHEMICAL PARAMETER:
 - CHEMICAL OXYGEN DEMAND
 - AMMONIA TOTAL (NH₃-N),
 - NITRATE (NO₃-N),
 - PHOSPHATE (PO₄-P),
 - HEAVY METALS: MERCURY (HG),
 - CADMIUM (CD), CUPRUM (CU) DAN PLUMBUM (PB),
 - KLOOROFIL-A
 - PLANKTON

SUMMARY

- THE BANTEN BAY HAS A ANTHROPOGENIC PRESSURE COMING FROM THE INCREASING NUMBER OF POPULATION. THE VOLUME OF UNMANAGED WASTE VOLUME SHOULD BE REDUCED SIGNIFICANTLY IN ORDER TO ELIMINATE THE LEAKAGE TO THE RIVER
- THE TRAJECTORY MODEL SHOWED THE DISTRIBUTION OF MARINE DEBRIS ON BANTEN BAY AND JAKARTA BAY AND THEIR POTENTIAL IMPACT VICE VERSA
- THE BANTEN BAY HAVE A PROBLEM WITH WATER QUALITY AND SHOULD HAVE SOME ACTIONS TO IMPROVE THE WATER QUALITY
- THE MODEL SHOULD BE IMPROVED WITH BETTER DATA INPUT AND NEED VALIDATION OF MARINE DEBRIS TRAJECTORY

"An approximate answer to the right problem is worth a good deal more than an exact answer to an approximate problem." -- John Tukey

TERIMAKASIH
THANK YOU
GRACIAS

ขอบคุณ

CẢM ƠN
SALAMAT
СПАСИБО ТЕБЕ
谢谢你
ありがとう