

# Marine Debris Modeling in Indonesian Seas

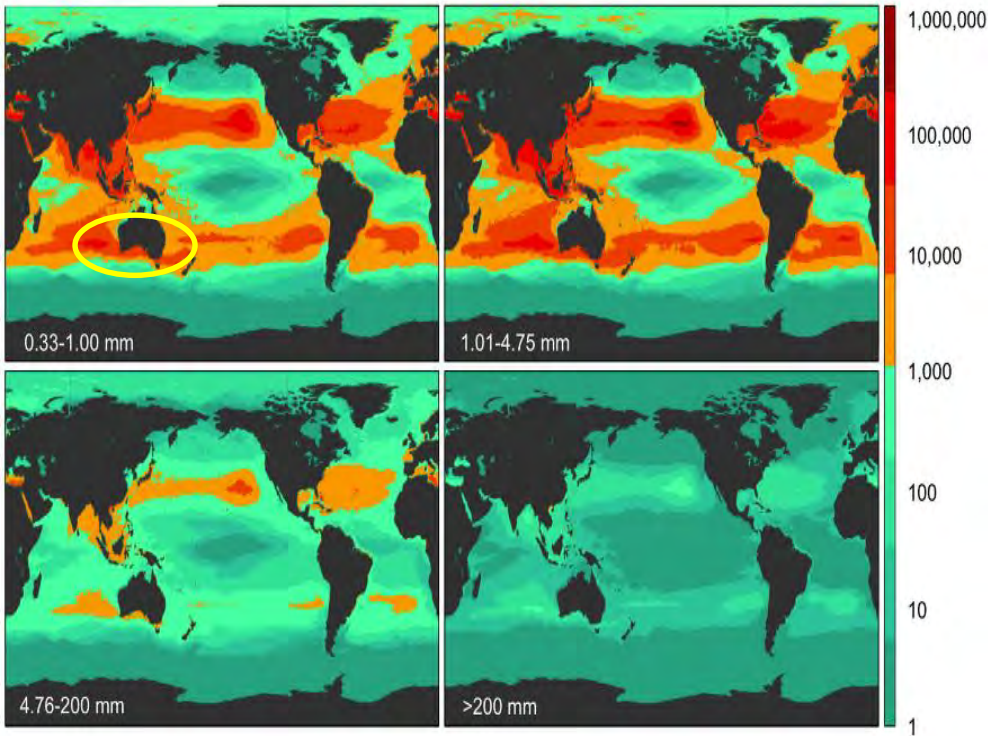


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Institut Teknologi Bandung



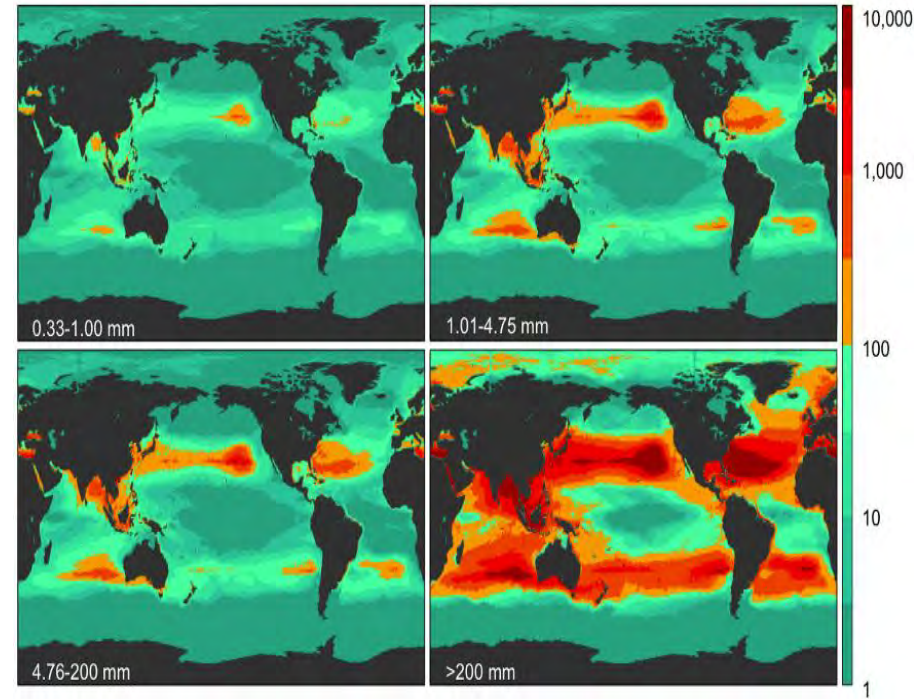
Sumber: Bank Dunia (2017); Analisa tim

# INTRODUCTION



Distribution of number of marine debris in the world (Eriksen et al, 2014)

marine debris type	size (mm)
Megadebris	>100
Macrodebris	20-100
Mesodebris	5-20
Microdebris	0.3-5



Distribution of weight of marine debris in the world (Eriksen et al, 2014)



## LEAKAGE PLASTIC FROM LAND TO OCEANS ENVIRONMENT IN INDONESIA

**150 Millions**  
population

**38 Millions**  
ton/year increase  
of garbage

**80 %**  
Leakage of  
plastic waste  
comes from land

**17 Ton Millions/year**  
waste is not organized.

**45%** waste is throw away to  
drains, park and burned.

**1,29 Millions**  
ton matrix/year leakage of  
plastic waste to oceans.

**30% Leakage of  
waste is plastic**

Sumber: Bank Dunia (2017); Analisa tim

Hendiarti, 2018

# Selected Cases



PELABUHAN  
RATU BAY

WAKATOBI  
ARCHIPELAGO

AMBON BAY

KUTA BEACH  
AND BALI ISLAND  
Open water

# MARINE DEBRIS IN BALI ISLAND

- Every year during the west monsoon season, from December to March, marine debris is stranded on Kuta Beach ,Bali and its surroundings.
- **PLASTIC MARINE DEBRIS IS THE DOMINANT MATERIAL**
  - 67,5% (Yosafat et al, 2012)
  - 75% → 52% from terrestrial/land, 14% from ocean, and 34% from both (Hendrawan et al, 2015)
- **MORE MARINE DEBRIS COMES FROM RIVER DURING RAINY /WEST MONSOON SEASON** (Hendrawan et al, 2015)
  - Ijo Gading River: 3000 organic waster/hour and 816 plastic debris/hour
- **TIME TO REACH KUTA BEACH FROM RIVER SOURCES**
  - 2-7 Days (Yosafat et al, 2012)

# METHOD: OBSERVATION DATA

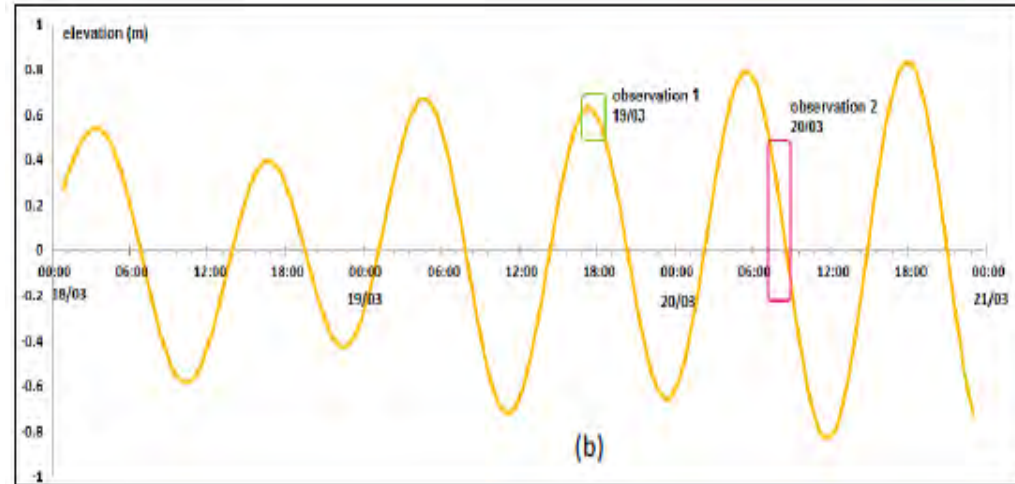
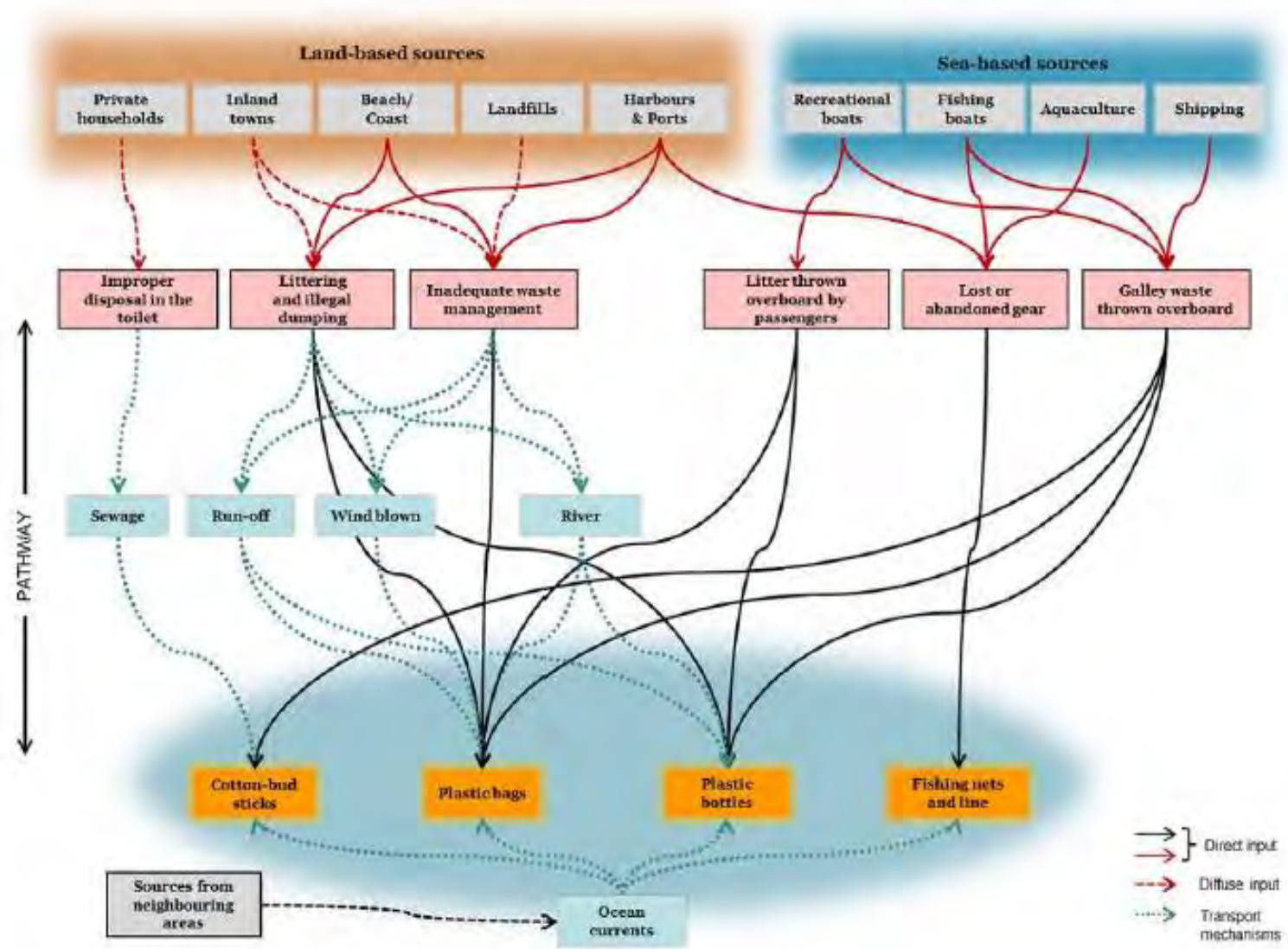


Figure 3. Survey area on 19 - 20 March 2012 (source: Google Earth)

TABLE I THE AMOUNT AND PERCENTAGE OF MARINE DEBRIS BASED ON ITS TYPE ON 100 M SAMPLING UNIT

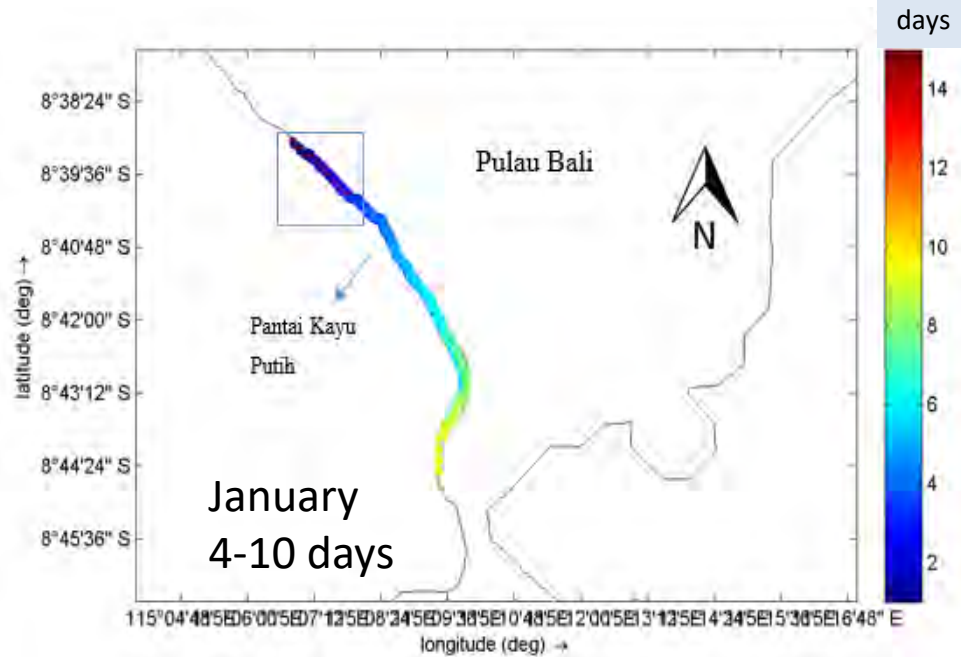
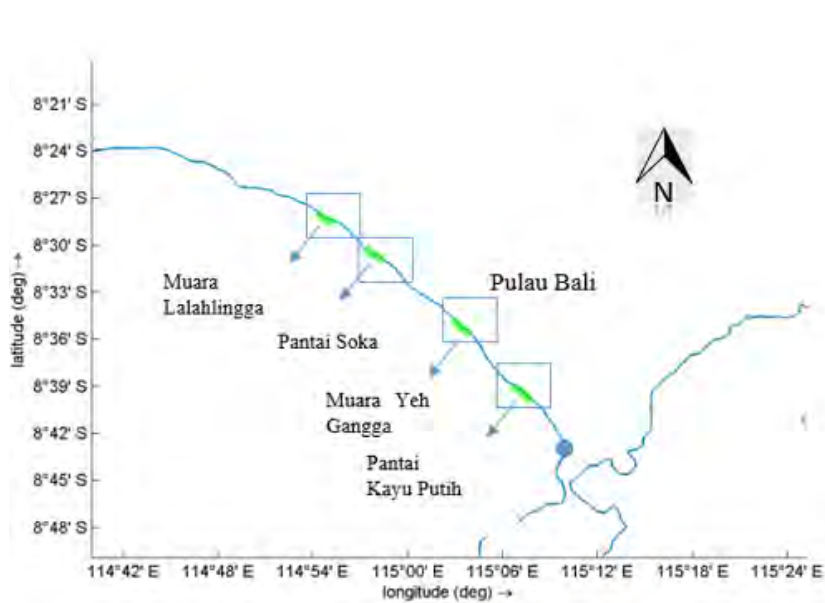
Type	Amount			Percentage		
	19-Mar	20-Mar	Total	19-Mar (%)	20-Mar (%)	Mean (%)
Plastic/Polystyrene	998	537	1535	63.77	75.85	67.53
Wood	500	143	643	31.95	20.20	28.29
Rubber	28	9	37	1.79	1.27	1.63
Paper/cardboard	23	1	24	1.47	0.14	1.06
Glass	9	9	18	0.58	1.27	0.79
Medical waste	2	5	7	0.13	0.71	0.31
Cloth	4	2	6	0.26	0.28	0.26
Metal	0	2	2	0.00	0.28	0.09
Sanitary waste	1	0	1	0.06	0.00	0.04
<b>Total</b>	<b>1565</b>	<b>708</b>	<b>2273</b>	<b>100</b>	<b>100</b>	<b>100</b>

# MARINE LITTER SOURCES

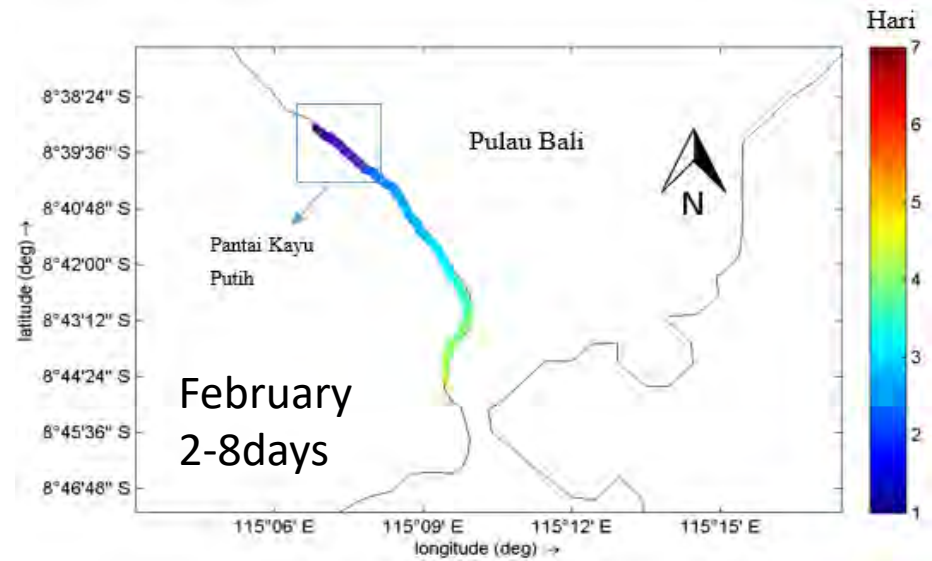
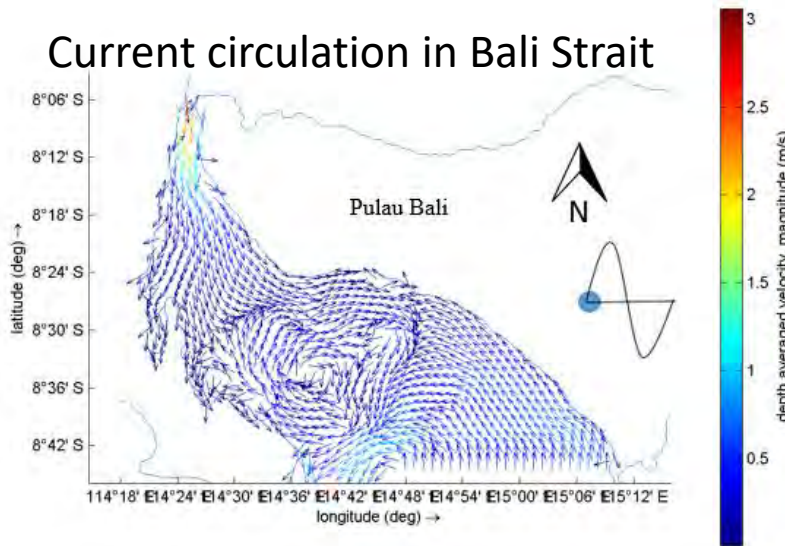


(Source: Veiga, 2016. *Identifying Sources of Marine Litter*. European Commission's science and knowledge service.)

# Land based litter from river/coastal area

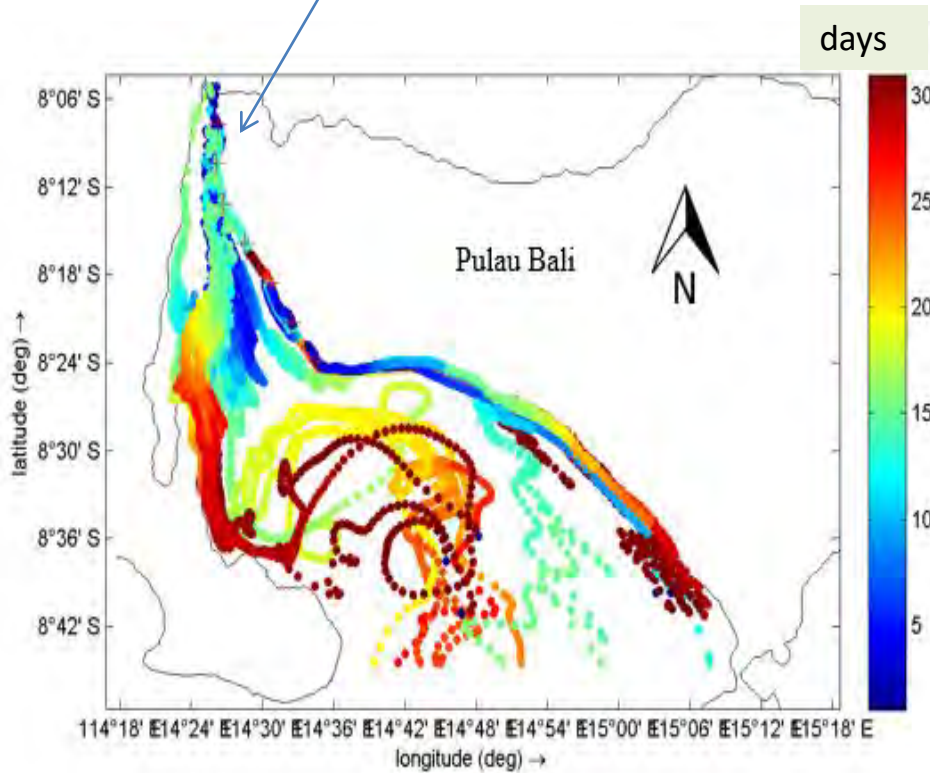


## Current circulation in Bali Strait

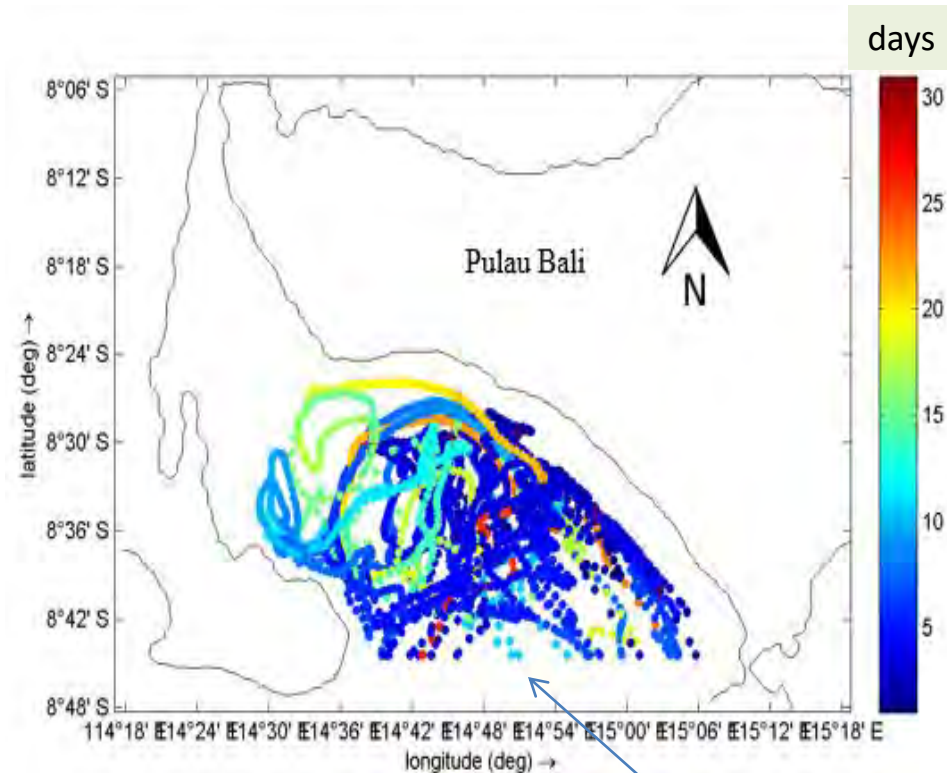




# Distribution of Marine Debris from Sea based litter during West Monsoon

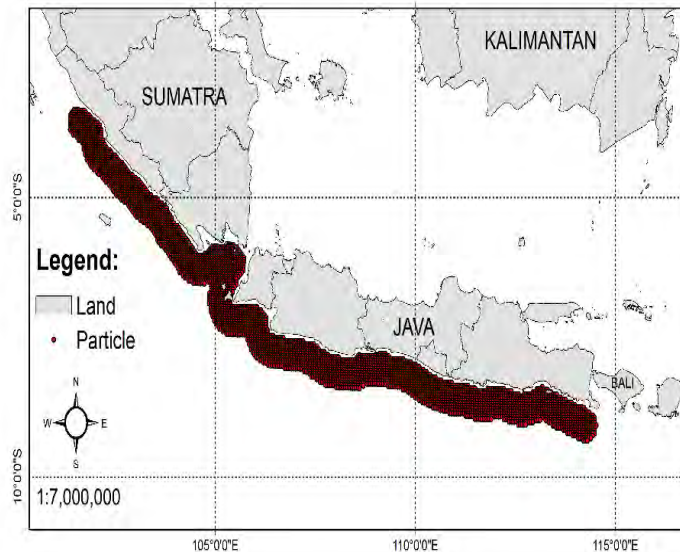
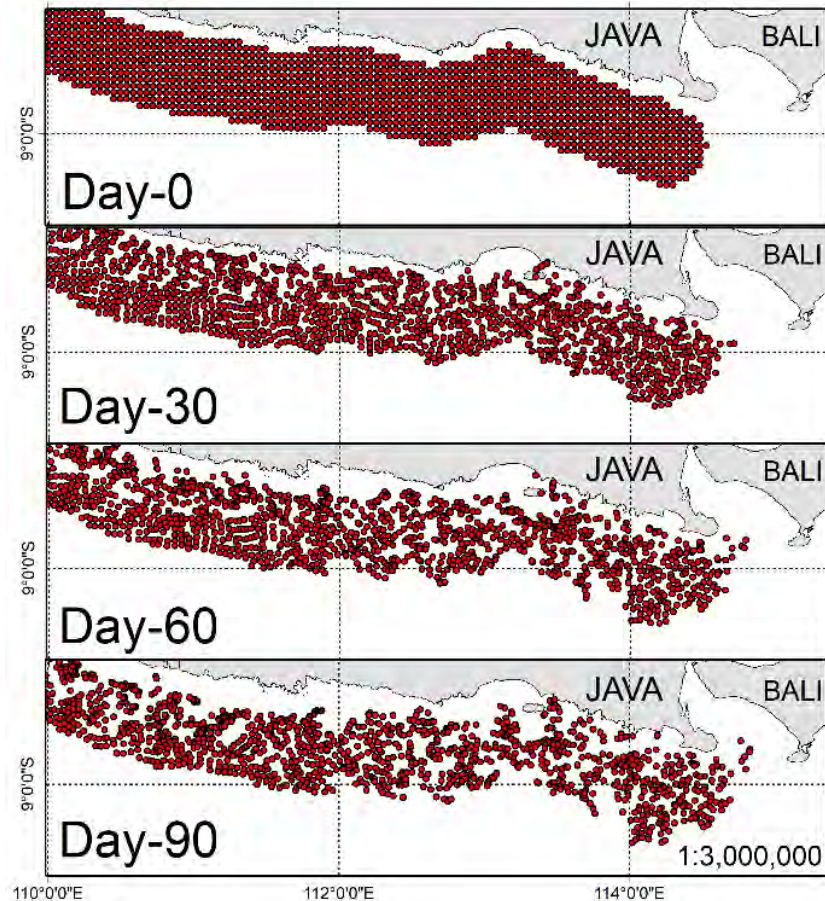
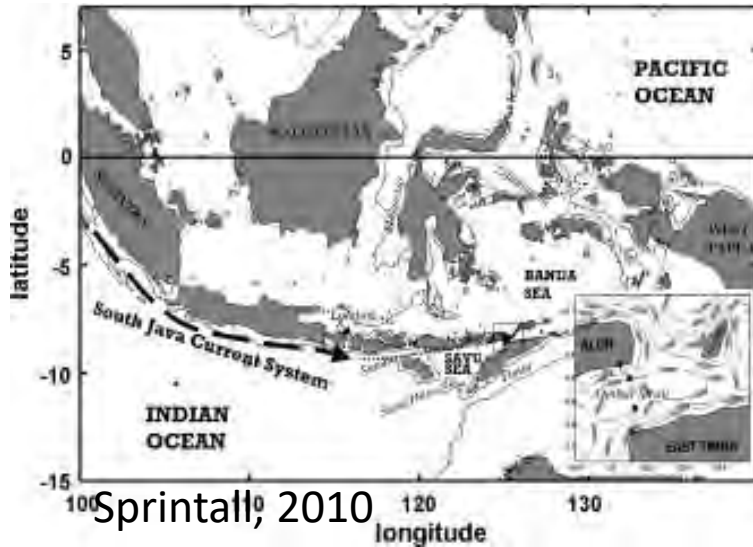


Source from North part of Bali Strait



Source from south part of Bali Strait

# Simulation results of particle originated from West Sumatra and south Java during West Monsoon



Particles source release

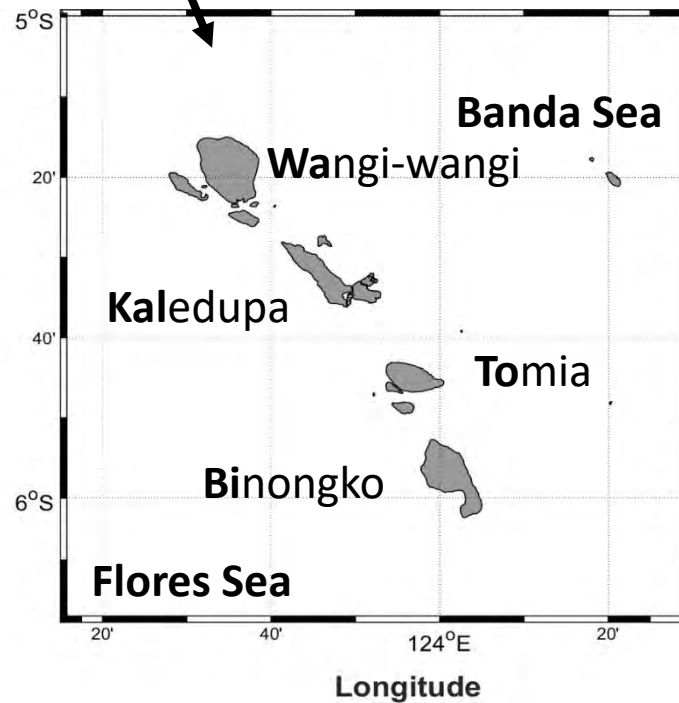
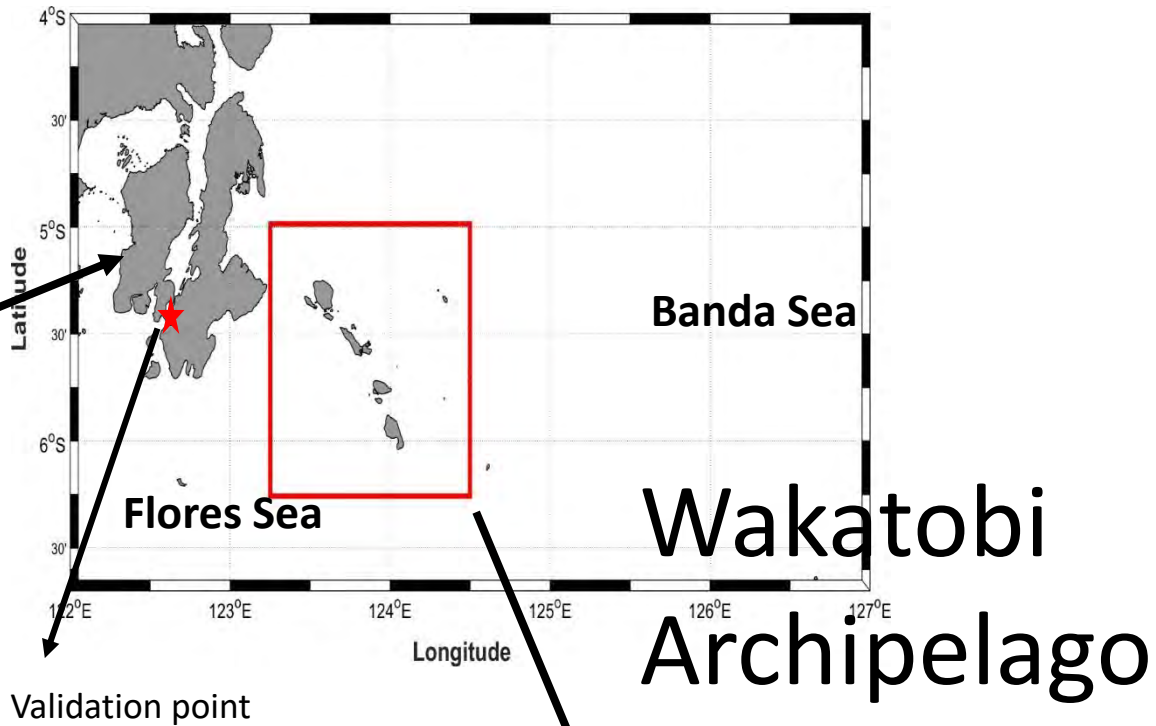
Only 3.47% particles enter Bali Strait

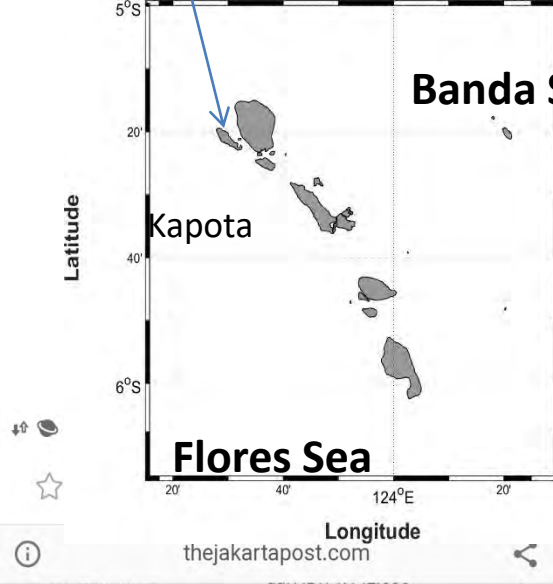
I Putu Ranu, I M Radjawane and Gede Hendrawan (submitted to EES IOP , 2019)

Funded by Kemenristekdikti



Source: Google Earth





**Banda Sea**

Kapota

**Flores Sea**

ITEM	WEIGHT (GRAM)
115 PLASTIC CUPS	750
19 HARD PLASTIC PIECES	140
4 PLASTIC BOTTLES	150
25 PLASTIC BAGS	260
6 WOOD SPLINTERS	740
2 RUBBER SANDALS	270
1 NYLON SACK	200
> 1000 PLASTIC ROPE	3.260
<b>TOTAL</b>	<b>5.9 KG</b>

***TRANSBOUNDARY PROBLEMS ?***



**TheJakartaPost**

NATIONAL

**6 kg of garbage found in dead whale's stomach in Wakatobi**

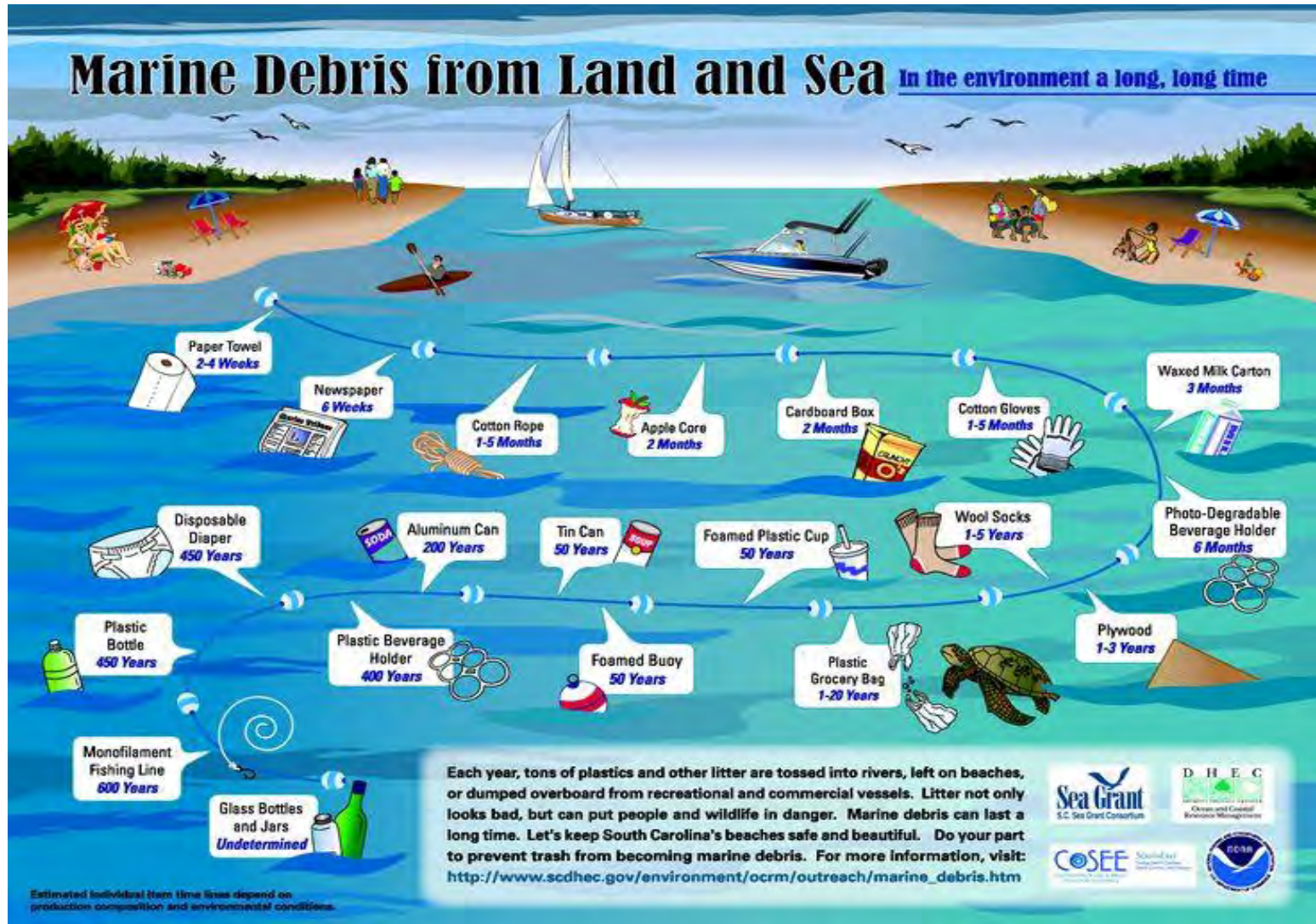
News Desk

The Jakarta Post  
Jakarta

Jakarta / Wed, November 21, 2018 / 08:39 am



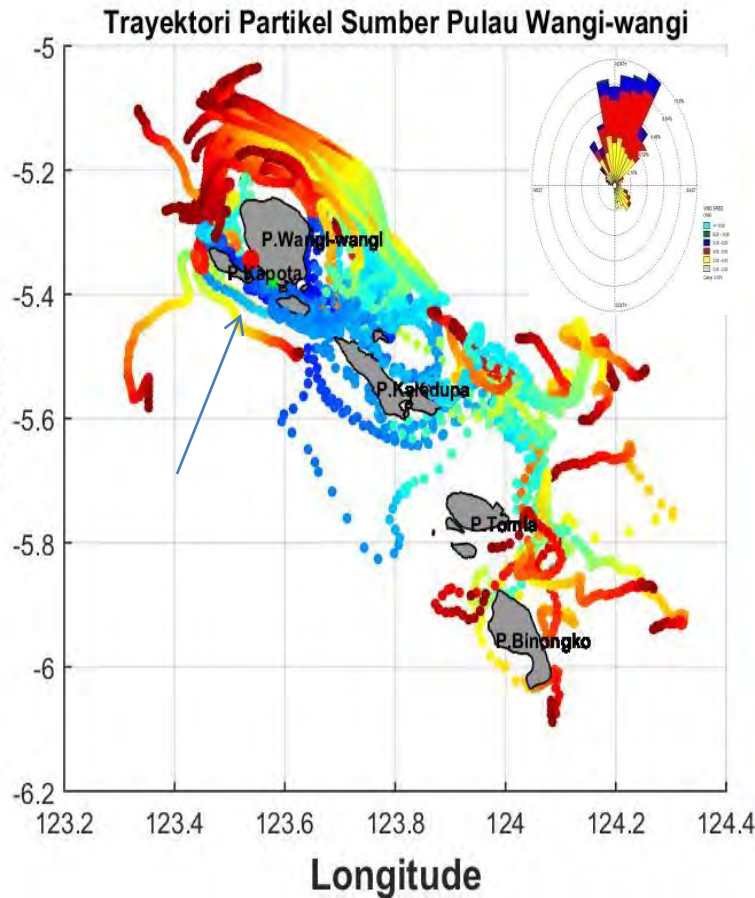
# DEGRADATION RATE



# MARINE DEBRIS PARTICLE MOVEMENT AND DISTRIBUTION SOURCE FROM WANGI-WANGI ISLAND

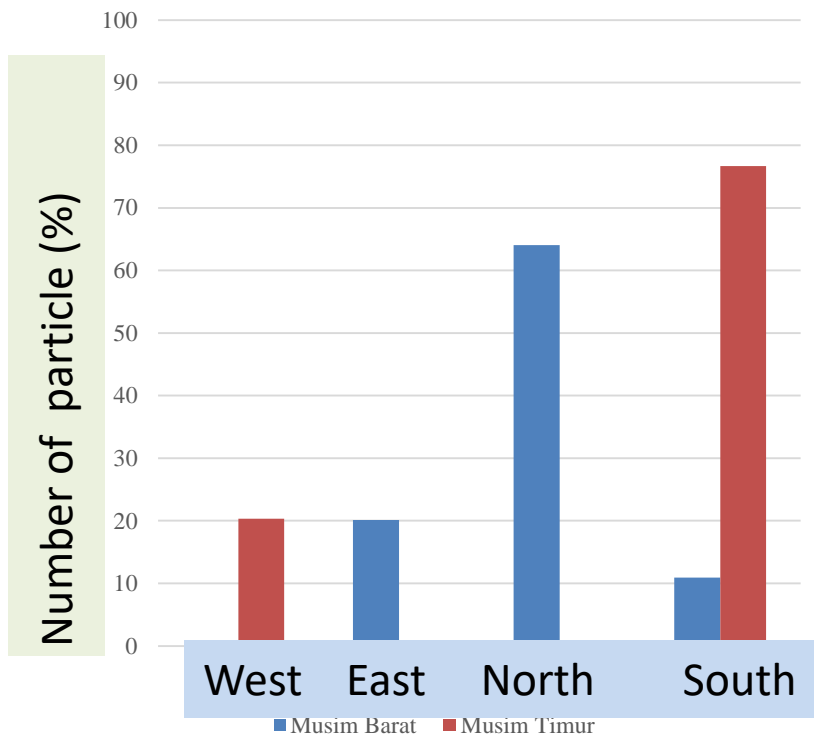
WEST (NW) MONSOON (DEC 2017-APRIL 2018)

EAST (SE) MONSOON (JUNE-SEPT2018)

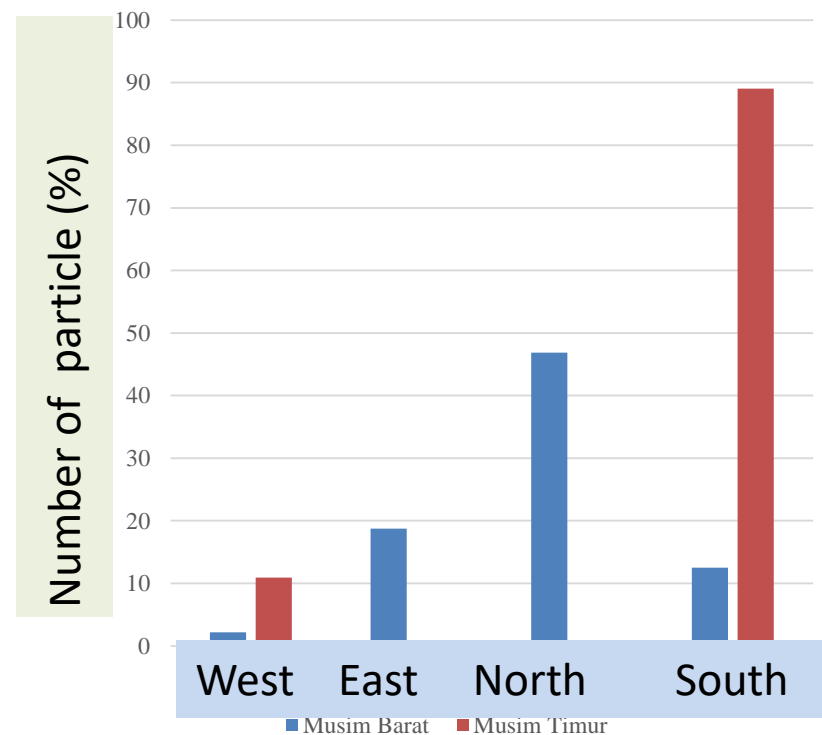


# Marine plastic debris stranded location

## Source from Wangi-wangi Island



## Source from Kapota Island



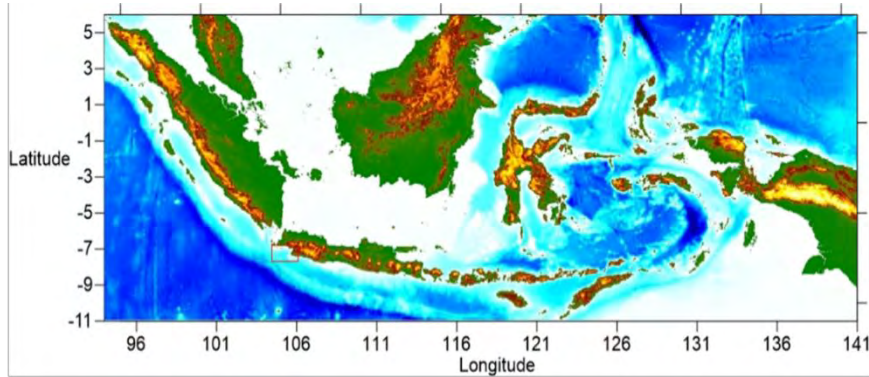
Red : East Monsoon  
Blue: West Monsoon

# Pelabuhan Ratu Coastal Area

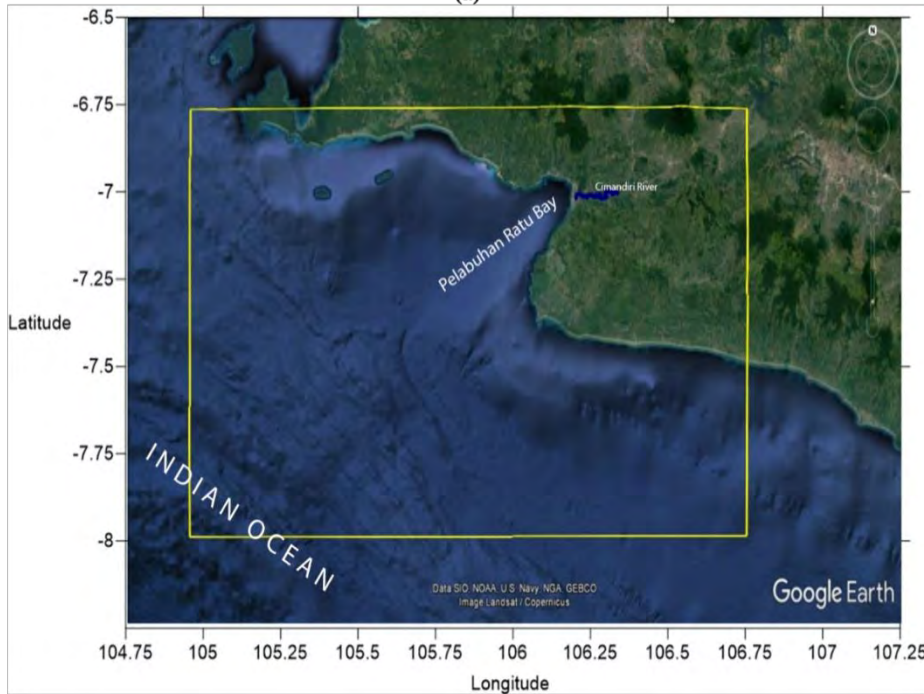
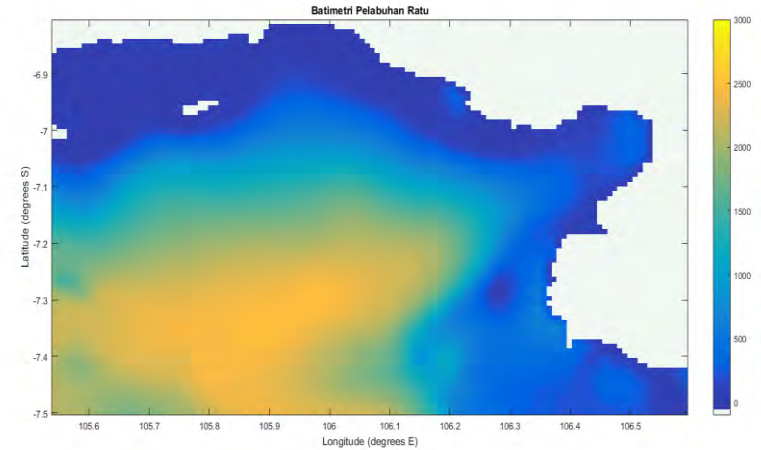
- Located in southern part of West Java Province
- Facing to Indian Ocean
- Prevent semi diurnal tide
- Pelabuhan Ratu Bay is a semi enclosed bay
- Place where 4 rivers poured out
  - Cimandiri River
  - Cibareno River
  - Cilentuk River
  - Cikanteh River
- Famous tourism area
- Number of tourist came to this location is 3.600.613 people in year 2016
- Sometimes the marine litter came when the high waves hit the bay and stranded the litter at the beach (Poskota News, February 3, 2018)



# Pelabuhan Ratu Bay

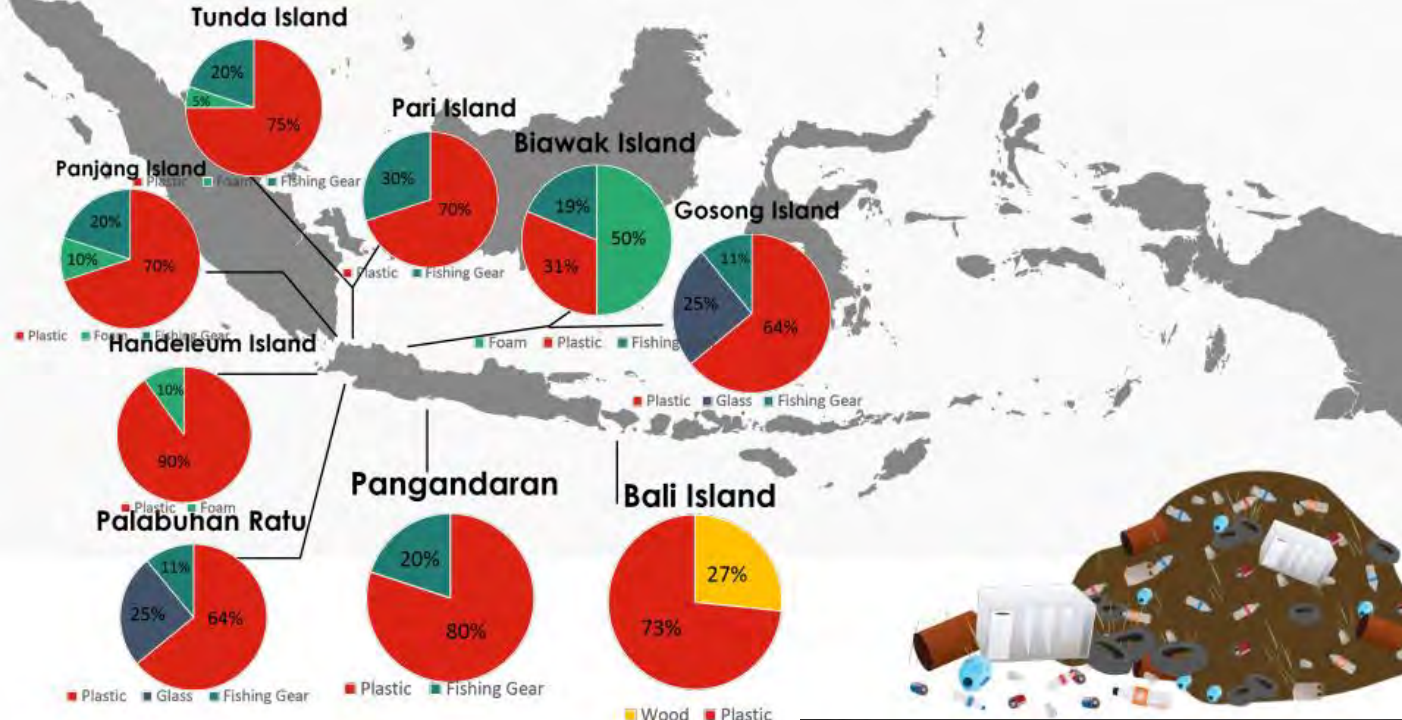


(a)



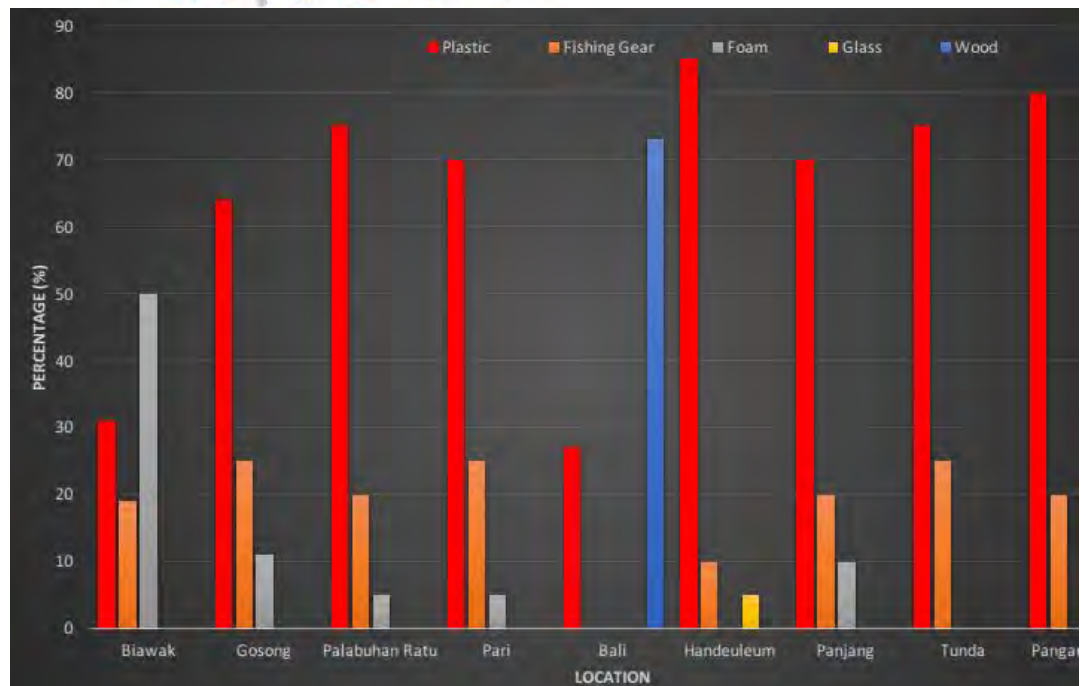
(b)

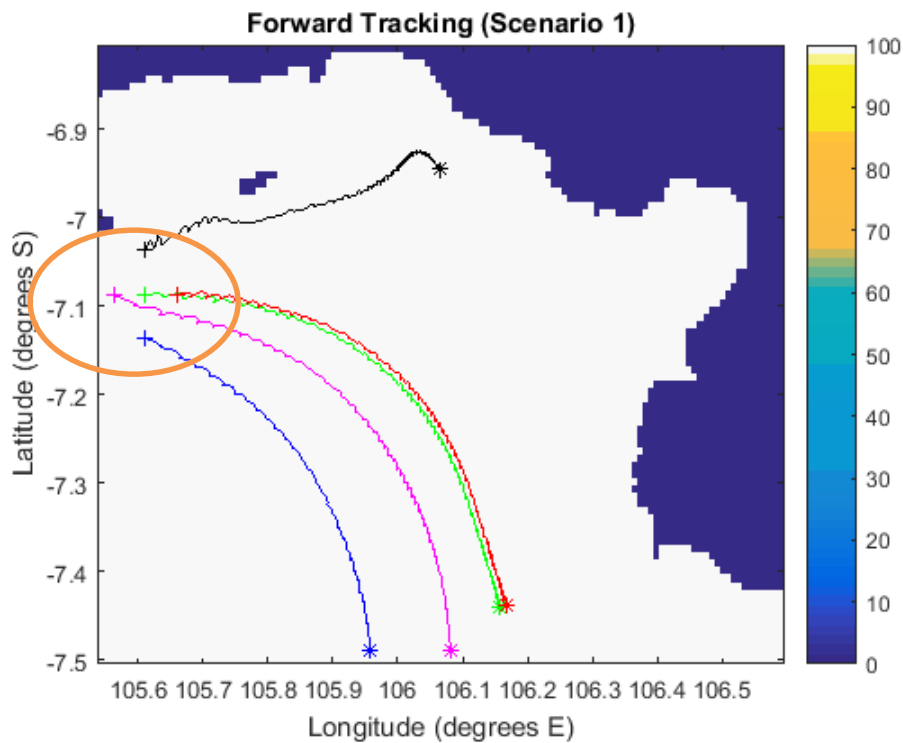




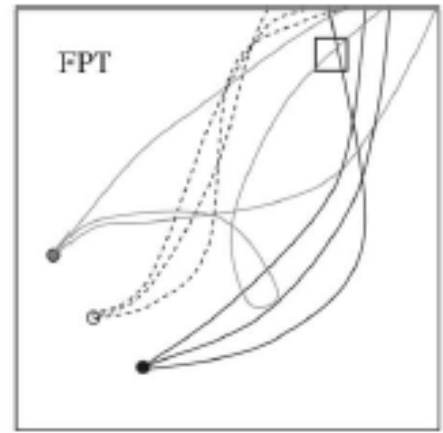
## Plastic in dominant marine debris in Pelabuhan Ratu

Purba, N.P., Pangestu, I.F., Nurrahman, Y. 2016. Marine Debris in Indonesia, Finding Debris. Int. Seminar on Marine Plastic Debris, 1<sup>st</sup> Summit, Pullman-Jakarta

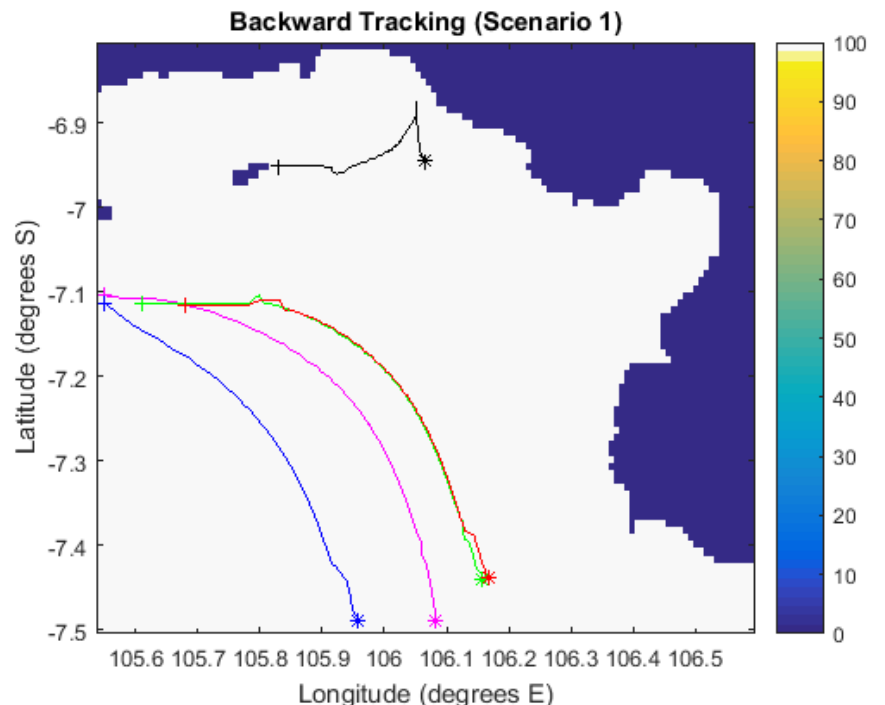
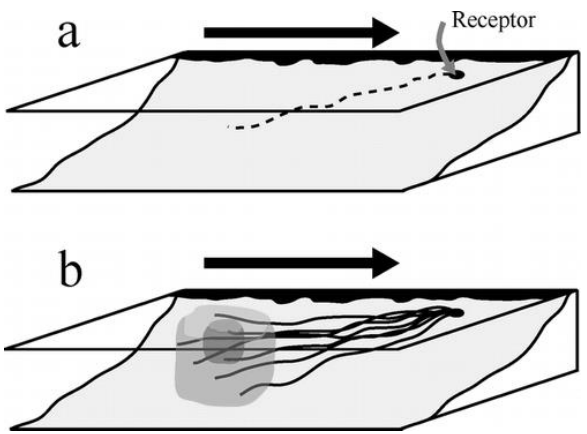


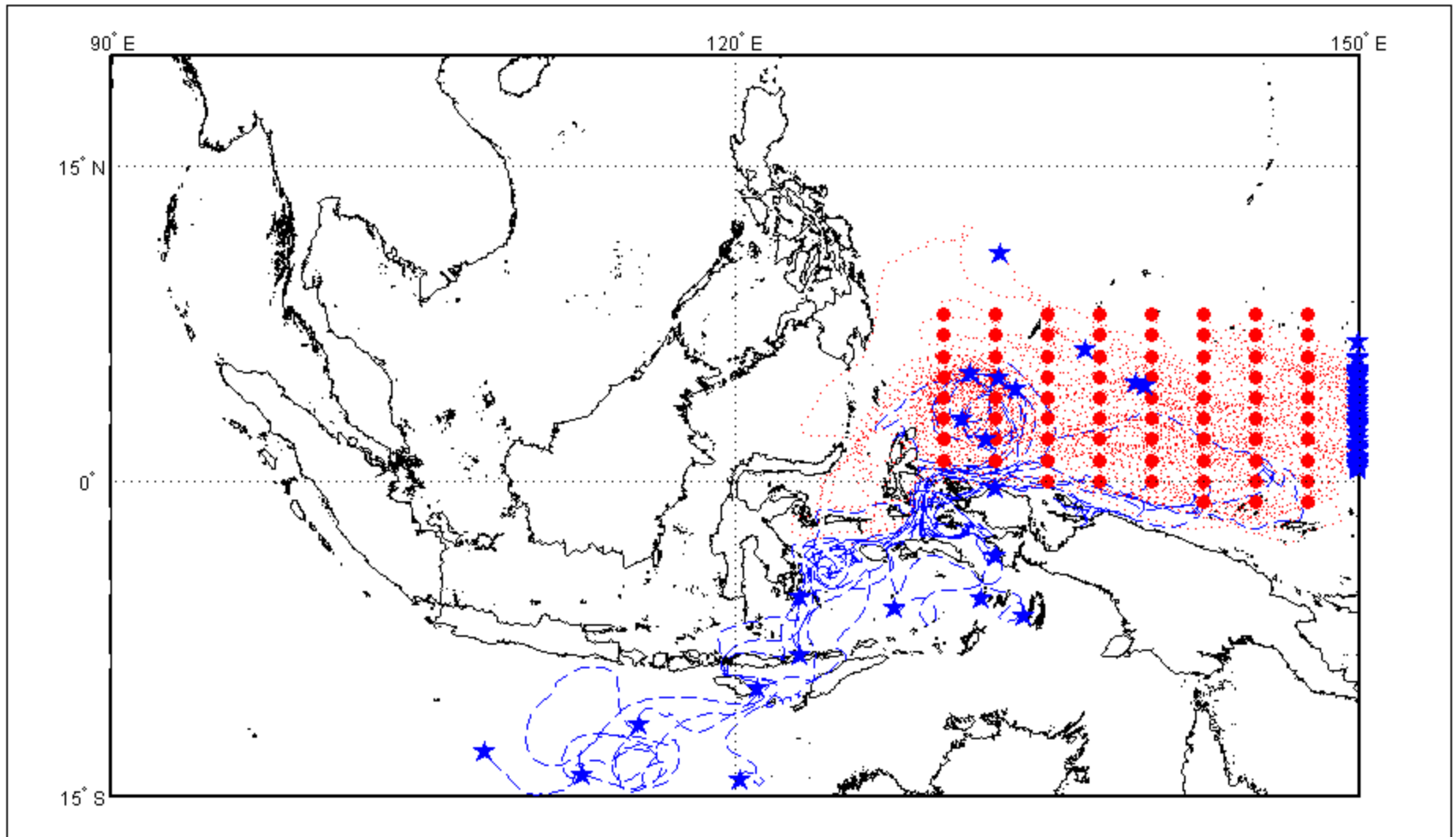


Fate from the source  
Forward method



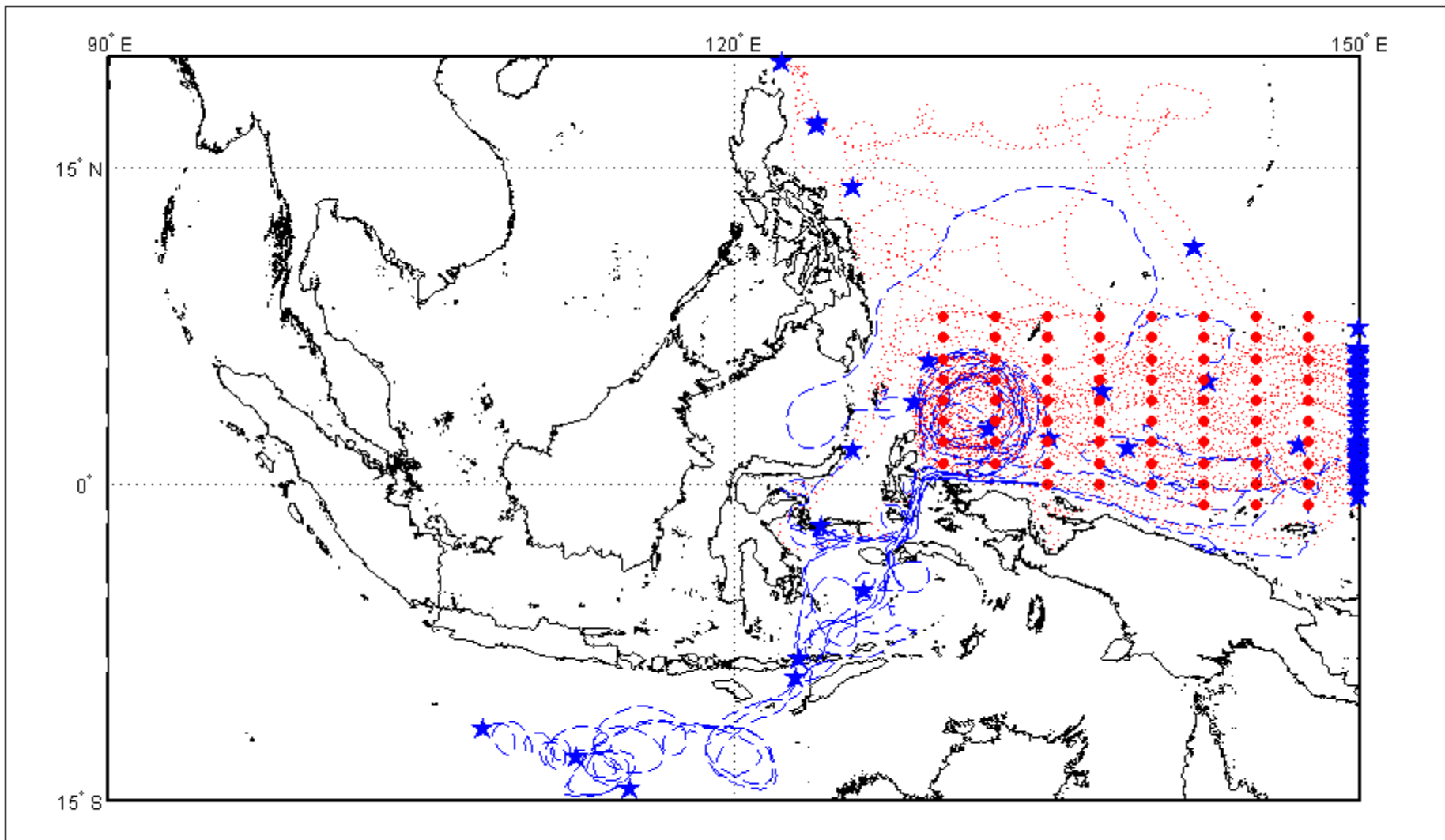
Tracing the source  
Backward method





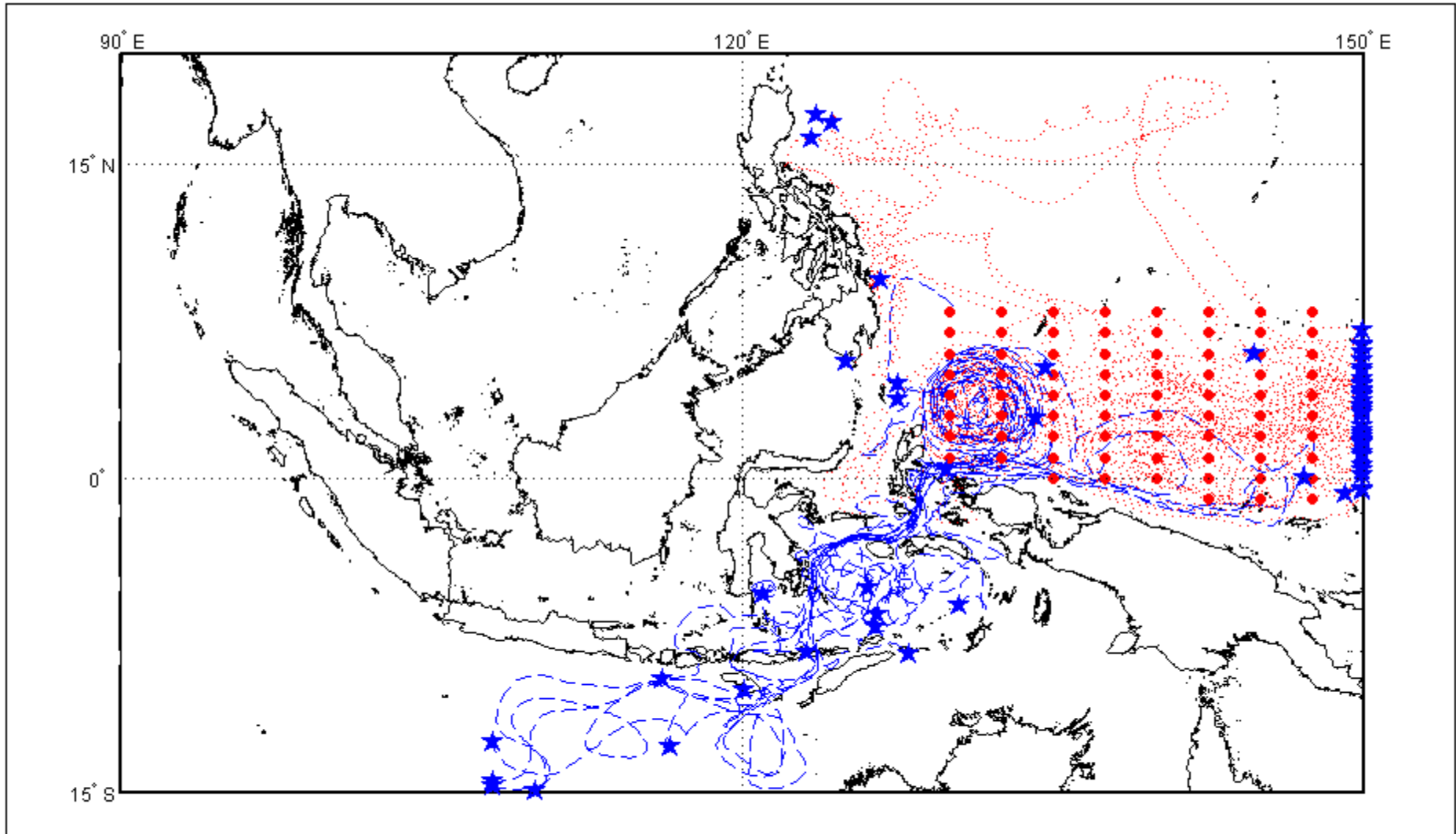
**Date : 1 July - 31 December 2014**

**Depth: 0 m**



**Date : 1 July - 31 December 2014**

**Depth: 25 m**



**Date : 1 July - 31 December 2014**

**Depth: 50 m**