

Prediction of Plastic (Urban Waste) Distribution Along Coast in Tuban District Based on Geographical Information System

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Abstract

Beach waste such as plastic in the waters north of Java comes from consigned waste collected from various downstream parts of the river and flows into the sea from time to time. effect of human interaction and community activities on coastal environment is a major problem in coastal area management. This research aims to create a simulation model of movement of plastic/urban waste in Tuban Regency during four seasonal winds and determine prediction results at research points using oceanographic parameters such as direction and speed of sea breeze. One of movement factors is direction and speed of sea breeze. Using data on direction and speed of sea winds off coast of Tuban for 2018 - 2020 with quarterly data processing (quarters of a month). Research results obtained from this research are prediction data for 2021 -2025 in form of data on direction and speed of seasonal winds at 6 points on Tuban coast. Modeling direction of seasonal winds using ArcGIS software, resulting in a model proven by a survey of area of rubbish on beach in August – September 2022 that point of rubbish in first transitional season winds is towards southwest, east monsoon winds are towards southeast, second transitional season winds are towards south and west to southeast monsoon winds.

Keywords: Windwaves-05 ; ArcGIS ; Forecasting Linear Regression ; Modelling

1. Introduction

A large amount of beach waste such as plastic in waters of northern Java, more precisely in Tuban Regency, East Java, comes from consigned waste collected from several downstream parts of river and are associated with specific items that flow into sea from time to time. (Joesidawati, 2017). When water runoff increases and floods occur, all these types of waste flow downstream and into sea. This land waste originates from modern human life and is found every day in places where plastic is often used as disposable items such as water bottles and plastic cutlery (Sari, 2019). number and density of settlements along coast can be a factor in amount and growth of waste in area (Widyastuti, et al., 2010).

Plastic that is in aquatic environments will last for a very long time and because it is light, plastic will concentrate on surface of water (Takarina, et al., 2022). This will make

it easier to transport plastic waste anywhere by currents and waves. According to (Noya & Tuahatu, 2021) movement of waste at sea will also be greatly influenced by wind and currents.

Tuban Regency is located at coordinates 111° 30' - 112° 35' East Longitude and 6° 40' - 7°18' South Latitude, and has an area of 183,994,561 Ha. It is one of coastal cities in North Coast (Pantura) area of East Java which has a long beach 165 km stretches from east in Palang sub-district to west in Bancar sub-district, with an ocean area of 16,950 Ha and consists of 5 coastal sub-districts, namely Palang, Tuban, Jenu, Tambakboyo and Bancar sub-districts (Joesidawati, 2016). climate in Tuban Regency consists of two seasons, namely rainy season and dry season (tropical climate) with an average temperature of 200C - 330C with climate types C and D, where wet months start from October - May, while dry months start from July - September (BPS, 2017).

This research aims to simulate movement of marine debris using oceanographic parameters in form of currents, waves, and sea breezes. research carried out is predictions in form of wind and wave data on Tuban coast. data processing method uses linear regression and is validated to produce error values that are appropriate for model results. From this study, researchers created a Geographic Information System which aims to provide information and identify beach waste points.

2. Methods

The research was carried out using data on direction and speed of sea winds around Tuban waters. direction and sea speed data used in research represent several locations starting from Palang beach, Tuban beach, Jenu beach, Tambakboyo beach, and Bancar beach. sea wind direction and speed data used in research use data from Perak Class II Maritime Meteorological Station, Surabaya, Meteorology, Climatology and Geophysics Agency (BMKG) for the last 4 years (2018-2021) as a basis for predictions or estimates of distribution of plastic/urban waste along coast in district Tuban.

2.1. Determining Research Locations

Research regarding prediction simulation of distribution of coastal waste in Tuban was carried out from March to September 2022. research was in Tuban coastal area. research used six different coordinate points in Tuban coastal area to find out ocean physics data in form of wind speed, waves, and currents. From a research point, it was taken 2 miles or 3.2 km from coastline with Google Earth Pro software. a general location map can be seen in Fig 1.



Fig. 1. Research location for marine physics data, points were taken 2 miles from shoreline of Tuban waters

2.2. Data Processing

Data collection on sea wind direction and speed in Tuban waters using windwaves-05 software. Windwaves-05 software is used to process GRIB data which contains current, wind, and sea wave data. results of running data from Windwaves-05 are then processed in Microsoft Excel software to determine wind speed and direction, currents, and height, and low of sea waves.

Data processing is with three-month/quarterly data based on 4 Tuban coastal wind seasons using data for 2018 – 2020 in time-series data based on time per hour/1 hour (Temps Universel Coordonné/UTC), to predict direction and speed of sea winds for 2021 – 2025.

Type of data used in this research is secondary data. secondary data used is direction and speed of Tuban coastal sea breeze. Data was obtained from Perak Class II Surabaya Maritime Meteorology Station, Meteorology and Geophysics Agency.

2.3. Linear Regression Forecasting

Forecasting also called prediction, can be assumed to be an activity to predict what will happen in future (Sumayang, 2003). A prediction can be qualitative (not in form of numbers) or quantitative (in form of numbers) (Render & Heizer, 2001).

Linear Regression Method is a method for completing forecasting or predictions. Make predictions using development of mathematical relationships between variables, namely dependent variable (Y) and independent variable (X). following are stages of calculating linear regression predictions.

3.2. Prediction of Sea Wind Direction and Speed

Based on graph above, an average value of wind direction data and seasonal wind speed data for third months (quarters) on Tuban coast in Point 6 Research Point area for 8 year period (2018-2025) shows an average wind speed of 4-5 m/s and predominantly blows in SE (Southeast) direction. Calculation of prediction data for 6 research data points for 2018-2020 predicts direction and speed of Tuban coastal wind in 2021 - 2025. Fig 3.

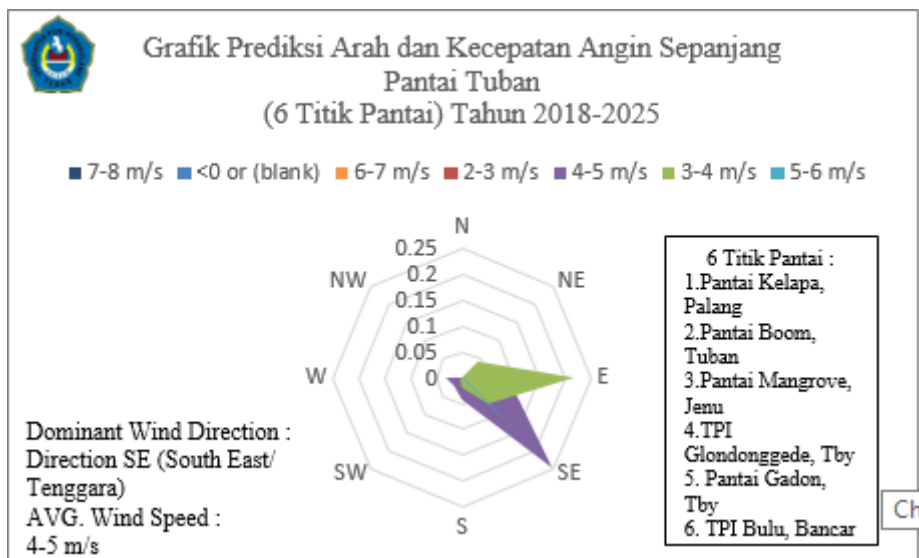


Fig. 3. Graph of seasonal wind speed and direction for 2018-2025 6 Research Points

3.3. Modeling Direction and Speed of Sea Wind for Distribution of Marine Debris

Modeling of sea wind direction and speed for distribution of marine debris in transition season I (data for March–May) in coastal areas dominantly towards southwest (southwest) with an average wind speed of 6-7 m/s in Mangrove Beach point area, Jenu is attached to Fig 4.



Fig. 4. Modeling of wind direction and speed for first transitional season in coastal areas in 2022

Meanwhile, the direction and wind speed of east monsoon season (data for June - August) in coastal areas is dominant towards southeast (southeast) with an average wind speed of 5 m/s in TPI Glondong, Tambakboyo point areas and 5.4 – 5, 5 m/s in Gadon beach point area, Tambakboyo Fig 5.

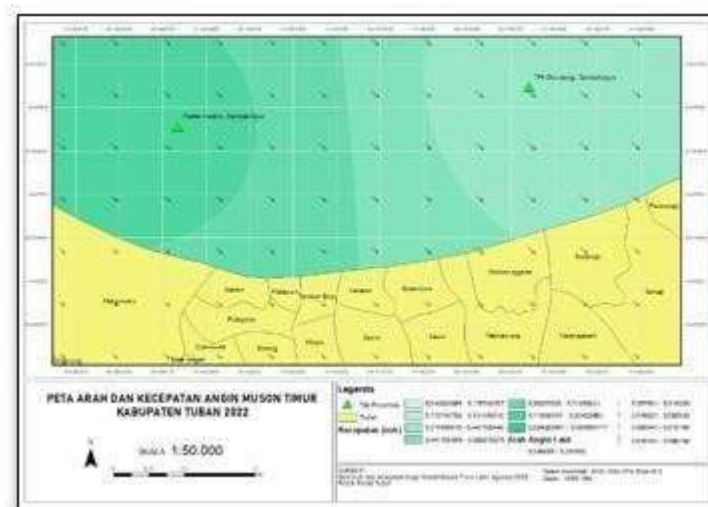


Fig. 5. Modeling of direction and speed of east monsoon season in coastal areas in 2022

Direction and speed of west monsoon season (data from December - January) in coastal areas is dominant towards southeast (southeast) with an average wind speed of 4 - 5 m/s

4. Conclusion

Characteristics of wind speed on Tuban coast, especially in Palang and Tuban beach areas, have a wind speed of 4.1 m/s, dominant direction is in East (E), in Jenu to Bancar areas average is 4.5 - 4.6 with dominant direction being Southeast (SE). Wind direction and speed are one of factors that support movement of marine debris in waters. It was proven by a survey of an area of rubbish on a beach in August – September 2022 that rubbish point was heading west to southeast from a research point as far as 2 miles from the shoreline.

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