Sea surface debris, particularly in the coastal waters of Malta, presents severe ecological and environmental challenges that negatively affects both marine ecosystems and human activities. The issue stems from the absence of an effective system to predict and visualize the movement of sea surface debris, making it challenging to mitigate its impact effectively.

The objective of this research was to create a framework capable of forecasting future dispersal patterns of sea surface debris within Malta's coastal waters. This pipeline leverages historical sea surface currents data to predict future conditions and can also visualise the movement of marine debris. This system sought to enhance our understanding of debris movement patterns to facilitate informed decision-making for conservation efforts and to also minimize the adverse impacts of sea surface debris.

To achieve this, a comprehensive pipeline that integrates machine learning with a physical-based model was implemented. The pipeline starts by selecting a specific area of interest within the Maltese coastal waters (Figure 1). The next step is to preprocesses the historical sea surface currents data. For each point within this selected area, neural network models were trained to be able to predict the next 24 hours of sea surface currents data. These predictions were then used to simulate and visualise the movement of surface debris. Throughout the project, several discoveries and challenges emerged, notably the preprocessing of data and the complexity of accurately predicting the future sea surface currents.

The project utilized both LSTM and GRU neural networks, comparing their performance to determine the most effective model for recognizing patterns in time series data. These predictions were then fed into a Lagrangian model, which simulates and visualises the movement of sea surface debris. The visual outcome, showcasing the initial and final locations of debris after 24 hours, is illustrated in Figure 2.