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Using machine learning techniques to predict beaching of marine debris on the Galapagos Islands

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The Galapagos Archipelago and the Galapagos Marine Reserve host one of the world's most unique ecosystems. Although being a UNESCO world heritage site and being isolated from any dense population, over 8 tonnes of plastic are collected on the islands each year. To decrease the impact of plastic waste in the region, scientific evidence is needed on the sources and fate of the marine debris. Here, we will assess the skill of machine learning techniques to predict beaching events on these islands. In order to do so, we combine various hydrodynamic fields from ocean-, wave-, wind- and tide-models using the OceanParcels particle tracking framework to track virtual particles through the marine reserve. In addition, a beaching parameterization has been developed and implemented to quantify where and when virtual particles wash ashore. The results show that the particle pathways and beaching probabilities strongly depend on the dry and wet seasons characteristic for the Galapagos Islands.

Therefore, it is expected that the beaching events can to some extent be predicted from the forecasts of currents, tides and waves - without performing a Lagrangian simulation. To test this hypothesis, PCA analysis and random forests are applied to a set of over 100 variables and their skill to explain the beaching variability given by the particle model is determined. In addition, the results are compared to a timeseries of observed beached litter on one of the Island of San Cristobal to apply the models in a realistic case study. This work, in combination with a growing observational data set, will form the basis of a predictive model that will support the Galapagos National Park in their efforts to free the Galapagos Archipelago from marine debris.