Measuring the ocean from an autonomous, yacht-sized, robotic ship
(Ref: OP2168)

Keywords: Mayflower autonomous ship, ocean signals, GNSS

One Planet Research Theme:
Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☐ | Environmental Informatics ☐

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Key Research Gaps and Questions:
1. Which oceanographic signals may be measured with the new Mayflower Autonomous Ship?
2. Can this type of platform be used to survey and monitor remote ocean regions?

Project Description: The ocean’s dynamic topography, currents and wave field provide key information on heat, freshwater, chemical and mechanical energy transfers between the atmosphere and the ocean. Such exchanges will be modified by and affect climate change. Measurements of these fields are limited because of high ship survey costs, and the low spatial/temporal resolution of satellite data. The use of unmanned surface vessels (USVs) as platforms for ocean observations is now emerging to overcome these observing system limitations.

An exciting new development for ocean science is the Mayflower Autonomous Ship (https://mas400.com/), a solar and biodiesel powered, self-piloting USV which IBM is helping to develop (https://www.bbc.co.uk/news/technology-50047449). In April 2021 this vessel is planned to travel the route taken by the original Mayflower across the Atlantic 400 years ago. Various specifically tailored research missions will take place onboard during the voyage. From high-specification on-board instrumentation, including geodetic Global Navigation Satellite System (GNSS) receivers, inertial measurement units, anemometers and current meters, precise in-situ measurements of the sea surface height may be determined covering the entire spectrum of sea surface variability from waves to quasi-steady dynamic topography and geoid. The project will first investigate which oceanographic signals can be determined using the Mayflower sensors and with what accuracy, notably high frequency wind waves and swell, short-term and more persistent dynamic topography signals, and geoid shape. The project will not only demonstrate the benefit of the Mayflower as a new ocean measurement platform, but from its multiple missions, will then improve our understanding of ocean currents and their dynamics and their response to changing winds and surface fluxes (and gravity variations) in under-observed regions anywhere in the global ocean.

The student will analyse the Mayflower Autonomous Ship sensor data collected from initial local sea trials near to Plymouth, the Atlantic crossing and follow-on missions, and use such data to compare with and enhance output from ocean circulation models, thus improving our understanding surface and upper ocean fields and hence of the ocean response to climate change. CASE partner IBM Research Europe will provide access to High Performance Computing to help with data processing, analysis and modelling.

Prerequisites: Good Master’s or Bachelor’s degree in a mathematical-based subject (e.g. maths, physics, oceanography, geophysics, engineering, surveying).

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