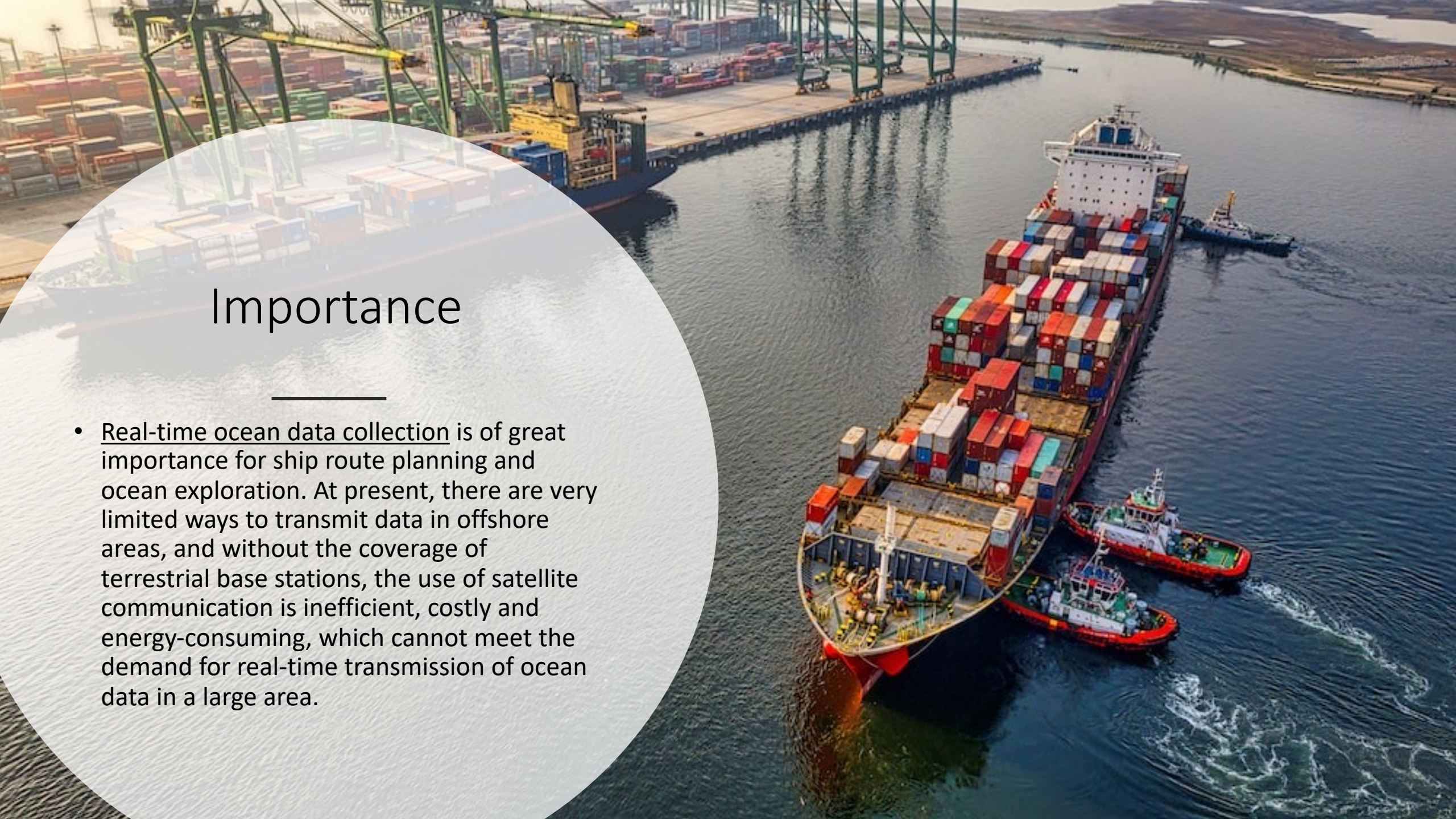
# Capstone Project Proposal

The electronic implementation of an automated marine data collection unit with mesh network function

Presenter: Yunzhong Xiao

Supervisor: Xiaoping Hong, Reza Alam (UC Berkeley)



# Importance

- Real-time ocean data collection is of great importance for ship route planning and ocean exploration. At present, there are very limited ways to transmit data in offshore areas, and without the coverage of terrestrial base stations, the use of satellite communication is inefficient, costly and energy-consuming, which cannot meet the demand for real-time transmission of ocean data in a large area.

# Estimated Market Shipping Industry

"Ships bring 80–90% of most everything you want or need, or the raw materials used for making those things," says Natasha Brown, a senior spokesperson for the London-based International Maritime Organization (IMO)

**~11 billion t**

The mass of goods transported internationally by ship

**80–90%**

Percentage of internationally traded goods transported by sea.

**100,000**

Number of large (>100 gross tons) cargo vessels in global commercial fleet.

**~1 billion t**

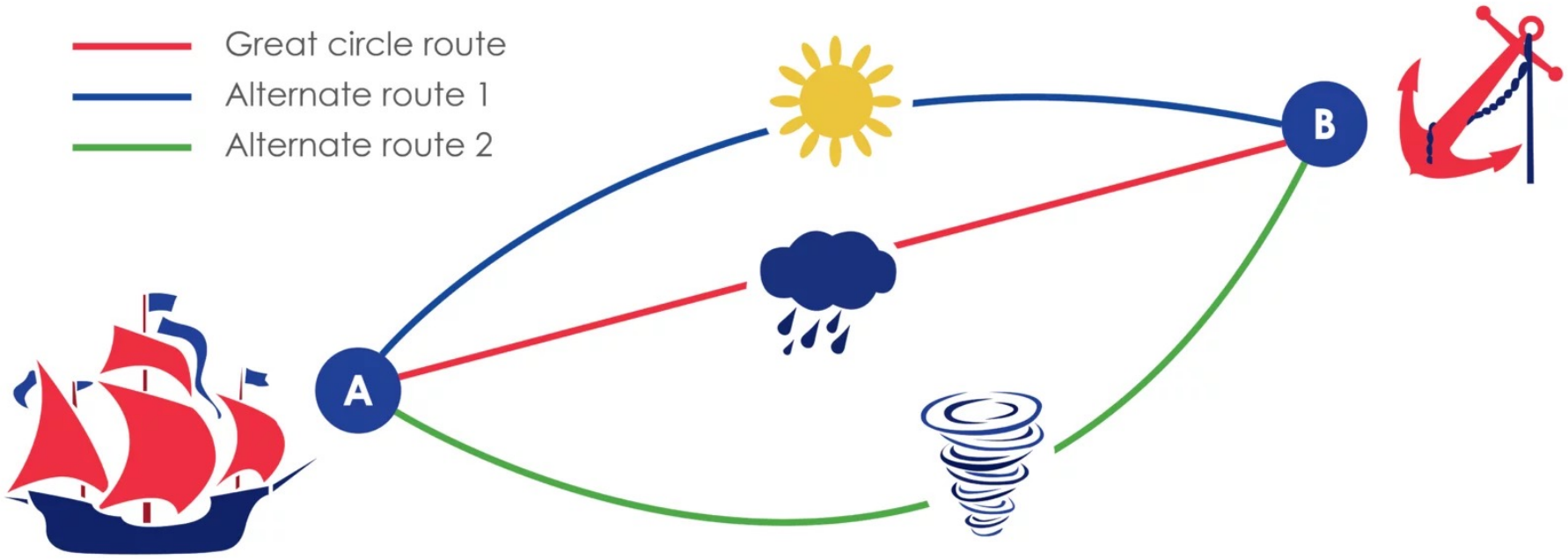
Amount of $CO_2$ emitted annually from shipping. Shipping produced 3% of global human-made $CO_2$ emissions in 2018.

**300 million t**

Mass of fossil fuels used annually by shipping.

Sources: International Maritime Organization and United Nations Conference on Trade and Development

# Proper route planning can save 20% fuel usage



# Competitors: Sofar Ocean

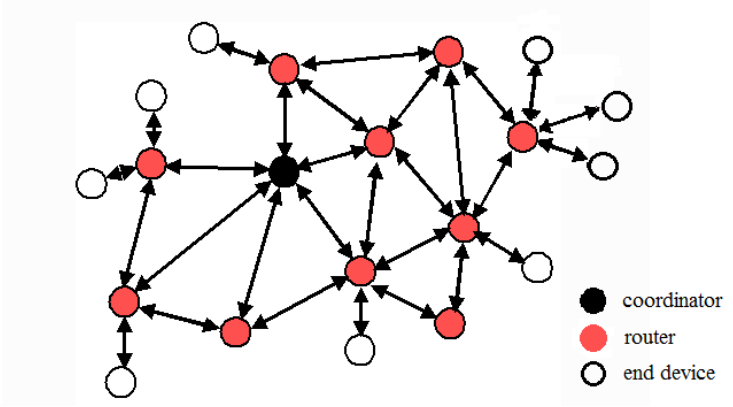
- A sensor network of free drifters, collect data every 30 minutes, satellite communication

# Competitors: Saildrone

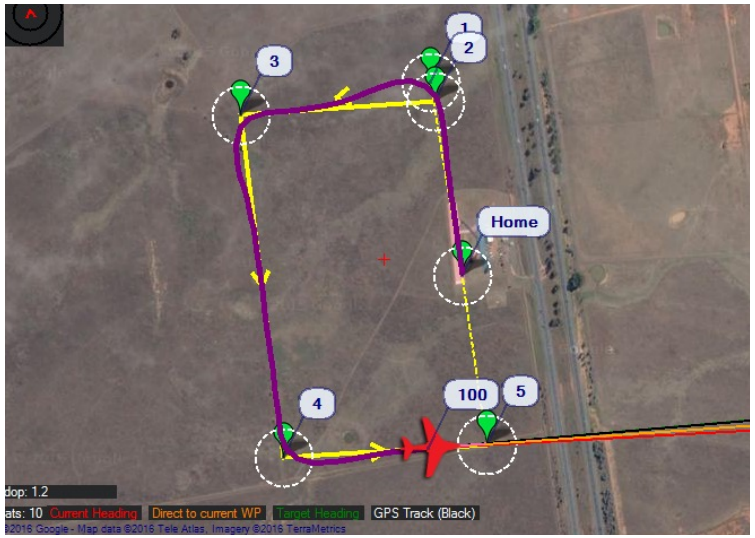

- Saildrone USVs combine wind-powered propulsion technology and solar-powered meteorological and oceanographic sensors to perform autonomous long-range data collection missions in the harshest ocean environments.

# Solution: USV unit with functions below

1. Real-time collection of sensor data, such as position coordinates, air temperature, seawater temperature, IMU inertial unit, etc.




2. Form a self-organizing network with other unmanned ship nodes, which can send, receive and forward data with other nodes in a certain range via radio antenna.




3. After receiving the command, it can automatically cruise to the specified coordinates and maintain the position within a certain radius.


4. Energy self-supply, through the application of solar panels, hydroelectric generator set to supply energy unit, to extend the range.

# Team member

**2022 Spring**

- 3 Undergraduates working on energy system, manufacturing and electronics separately

**2022 Fall**

- 1 PhD student
- 5 MEng students
- 5 Undergraduates

# Plan: two parallel processes

1. Motorboats are for testing the robustness and stability of our data collection and transmission.

G1: two working boats in the lab, still need some stability tests on the mesh network

G2: a swarm of motorboats (more than 10) with our own control system, and optimized hull design.

2. Sailboat is designed as the prototype of the final product. It should be self-sufficient and have enough space for mounting all the electronics from G2 in the future.

S1: based on an off-the-shelf RC sailboat, S1 is for testing the autonomous control system

S2: customized design aiming for our ultimate purpose

# Personal ownership

- Implemented Xbee mesh network for sensor data transmission
- Implemented autopilot function based on ArduPilot firmware
- Integrated sensor network for collecting sensor data through Arduino
- G2 Motorboat design

- Interviewed and recruited 4 new undergraduate researcher out of 30 URAP applicants
- Documentation and financial management (Notion)

# Expected Achievements: implement basic function on a swarm of motorboats

1

Implement stable mesh network function and real-time data transmission on 5 motorboats

2

Realize the swarm control function of motorboats, including automatic cruise and loitering within 10 meters radius

3

Build sensor system to achieve accurate seawater temperature measurement, air temperature and IMU data

# Q & A

Thank you for listening!