**Project Name**: Validation of ECMWF Ensemble Forecasts of Surface Latent and Sensible Heat Fluxes over the Arctic Ocean

**Objective**: Assess the accuracy of ECMWF ensemble forecasts of sea surface latent and sensible heat fluxes in the Arctic using saildrone observations

**Motivations**: (1) Sea surface latent and sensible heat fluxes are critical components of the upper-ocean heat budget that is at the center of sea-ice interaction for the Arctic amplification of global warming. (2) Validation of numerical forecast of sea surface latent and sensible heat fluxes in the Arctic is extremely difficult because of very few in situ observations available there. (3) Saildrones, remotely piloted uncrewed surface vehicles, have been used to make in situ observations in the Arctic that can be used to validate numerical forecasts.

**Potential Impacts**: (1) Results from this project would help improve the particular numerical model used for the ECMWF forecast, which is one of the best in the world. (2) The procedure of validating numerical model forecasts against saildrone observation developed through this project can be applied to validate other numerical models.

**Project design**:

Step 1 (Winter Quarter 2024) – Adapt existing codes in Matlab and transform them to Python; reproduce previous results using 2019 data to confirm the usage of the codes.

Step 2 (Spring Quarter 2024) – Identify and quantify the source of errors in ECMWF ensemble forecasts of sea surface fluxes by examining the forecasts of surface state variables (sea surface temperature, surface air temperature, humidity, and wind speed).

Step 3 (Summer 2024 or Fall Quarter 2024) – Add 2018 and 2017 data to the validation.

Step 4 (after Step 2 without Step 3 or after Step 3) – Prepare a manuscript reporting the project results for journal publication.

**Student Development**: (1) Advance Python proficiency; (2) Learn applications of basic statistics to physical science, (3) Gain basic knowledge of ocean-atmosphere interaction and its role in Arctic climate, and fundamentals of modern numerical environmental predictions, and (4) Develop professional communication skills (both oral and written) in science.