Evaluating Wind Gust Parameterization in the COARE Air-Sea Flux Algorithm

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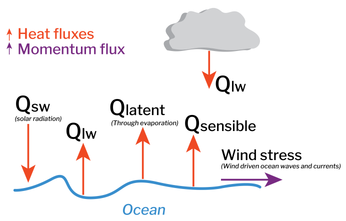
PMEL

Background & Objective

Saildrone uncrewed surface vehicle (USV) measurements in the Tropical Pacific Ocean and in Atlantic hurricanes are used to evaluate the gustiness parameter of the Coupled Ocean-Atmosphere Response Experiment version 3.6 (COARE) bulk air-sea flux algorithm.

Why are air-sea fluxes important?
They are a measure of how the ocean forces the atmosphere and vice versa through exchanges of momentum and heat.



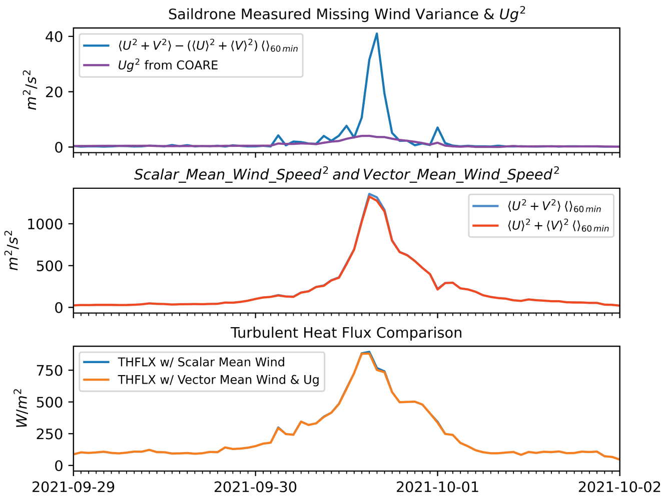
Why are bulk flux algorithms necessary?
Direct flux measurements are difficult to obtain.

What's the utility of Saildrone uncrewed surface vehicles?
Availability of high-frequency measurements (1-minute means) of oceanic and atmospheric variables.

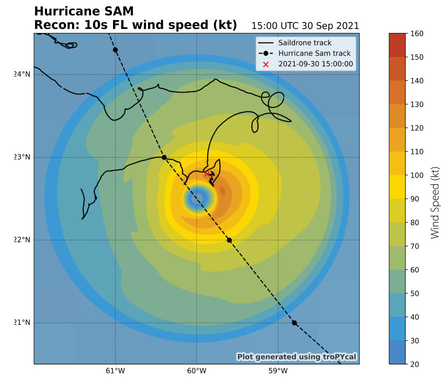
What is the gustiness parameter (Ug) from COARE?
Typically, the amplitude of the vector mean wind at 10-min or longer time scales is input to the algorithm, but this input is not always representative of variations in the wind field, especially over long averaging intervals.

Results

Hurricane Sam



Top plot --> measured missing wind variance (scalar_mean_wind² - vector_mean_wind²) and Ug²
Middle plot --> scalar_mean_wind² and vector_mean_wind²
Bottom plot --> turbulent heat flux comparison



Hurricane Sam flight level wind speed (kt) from aircraft reconnaisance data, interpolated in space and time. x marks the Saildrone position at 15:00 UTC.

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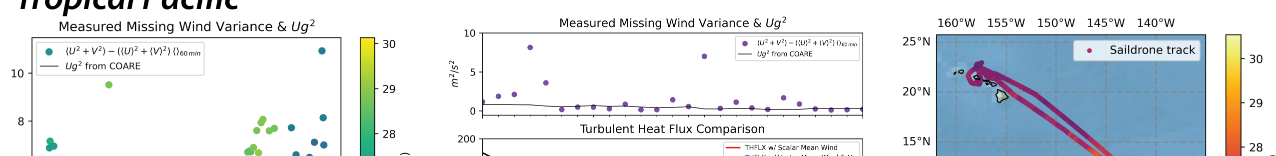
- Saildrone-measured gustiness shows little discrepancy with parameterized gustiness at wind speeds of less than ~10 m/s. When Saildrone 1045 intercepted the eyewall of Hurricane Sam, the peak difference is 37.42 m^2s^{-2}.
- Turbulent heat flux (THFLX) calculated with the vector mean wind & parameterized gustiness can be as low as 66% of the turbulent heat flux calculated with the scalar mean wind.

Methods

The COARE algorithm adds wind variance to the vector mean wind through a gustiness parameter Ug. Gustiness is parameterized as an empirical relation proportional to the convective velocity scale under the assumption that convective

Tropical Pacific



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