Quantifying the relative role of atmospheric and oceanic processes in driving air-sea interaction in the Gulf Stream region

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1. Motivation

Sea surface temperature variability is controlled both by ocean processes such as advection, Ekman transport, and mixing, and by surface heat flux driven by atmospheric variations. Here, we present a local metric derived from surface observations that quantifies the relative influence of ocean and atmospheric forcing in controlling upper ocean heat content variability. The ratio of H to the mixed layer depth gives an estimate of the renewal rate of the mixed-layer heat content from interior ocean processes relative to that from atmospherically driven surface fluxes. High ratios indicate the dominance of ocean processes relative to atmospheric variability on controlling mixed-layer heat content variability. Improved knowledge of how ocean dynamics drive air-sea interaction has the potential to improve climate forecasts on sub-seasonal to decadal timescales.

2. Data and Methods

Variable	Resolution	Timescale	Source
Sea Surface Temperature	1°	Monthly 1993-2019	OISST
Q_{turb}	1°	Monthly 1993-2019	OAFLUX
Sea Level Anomaly	0.25°	Daily, 1993-2019	CMEMS

- Smooth with a 200 km full width at half maximum filter
- Remove the linear trend and the seasonal cycle
- Place on a common monthly 1° grid
- R_{MLD} is the regression coefficient of SLA to mixed layer heat content

Feedback

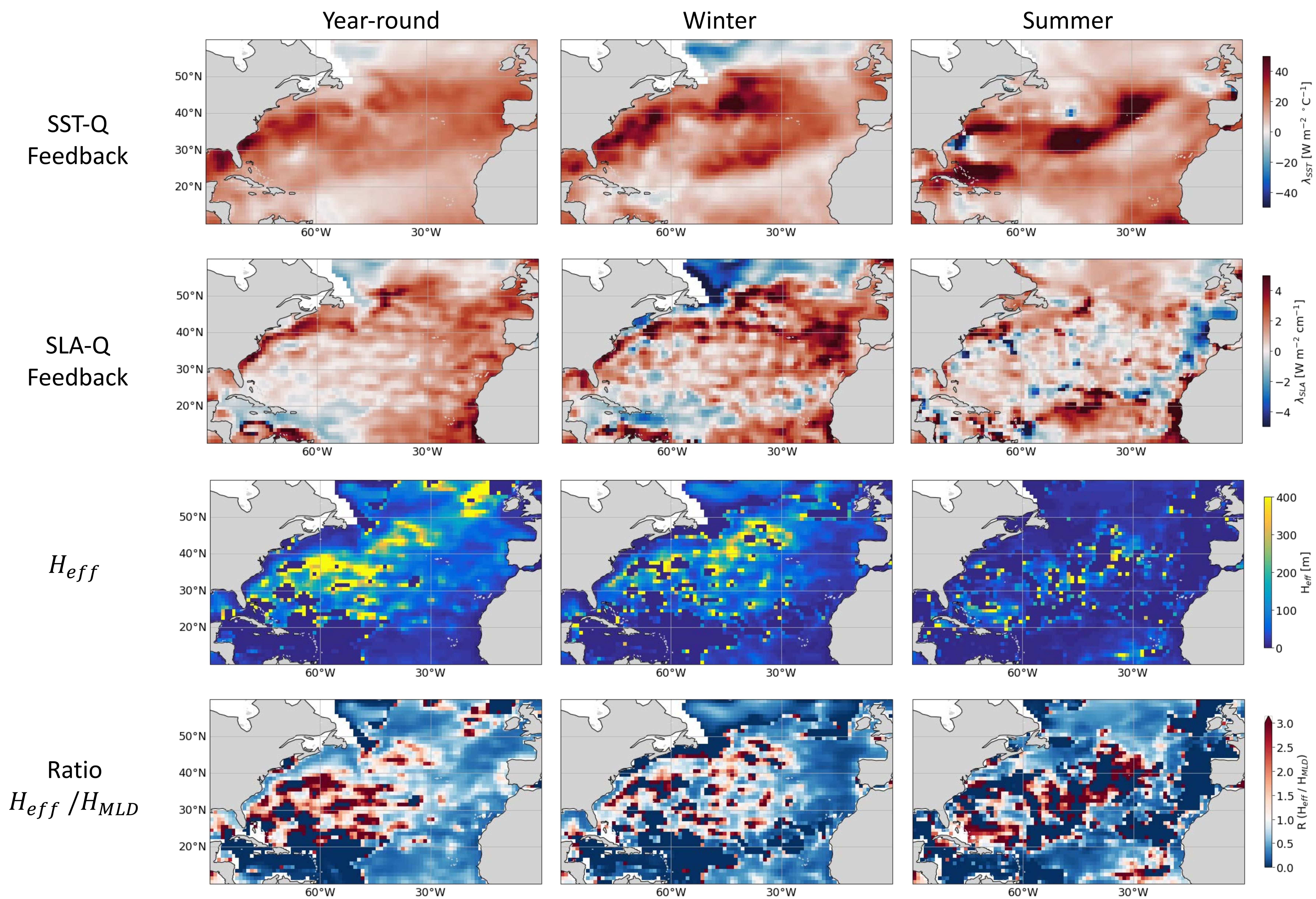
$$\lambda_{SST} = \frac{C_{TQ}\sigma_{TQ}}{C_{TT}\sigma_{TT}}$$

Effective Depth

$$H_{eff} = \frac{R_{MLD}}{\rho_0 C_p}\frac{\lambda_{SST}}{\lambda_{SLA}}$$

3. Results

A large effective depth of air-sea interaction (row 3) and ratio (row 4) indicate that oceanic processes drive air-sea interaction and upper ocean heat content variability.



4. Discussion and Future Work

Oceanic processes play an important role in renewing upper ocean heat content variations and driving air-sea heat interaction in the Gulf Stream. The role of ocean dynamics is enhanced during the winter.

- Do observational results agree with model results?
- Does the heat budget support our interpretation of the effective depth?
- We plan to recalculate R_{MLD} based on the seasonal mixed layer heat content

References

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