The Seasonal Cycle of the Ocean's Role in Driving Air-Sea Interaction

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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 *H* that represents the volume per unit area that participates in the exchange of heat with the atmosphere via turbulent fluxes over a month. The ratio of *H* to the mixed layer depth (*R*) 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 and the heat flux feedback**. We examine the annual cycle of *H* and *R* in frontal regions including the Gulf Stream, the Kuroshio Current, and the Agulhas Current to identify when ocean processes drive air-sea interaction. 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	1/4°	Monthly	OISST
Q_{turb}	1°	Monthly	OAFLUX
Mixed layer heat content	1/4°	Weekly	Johnson and Lyman

- Remove the linear trend and the seasonal cycle
- Smooth with a 200 km full width at half maximum filter
- Place on a common monthly 1° grid

- Select WBC regions based on wintertime Q_{turb} values.

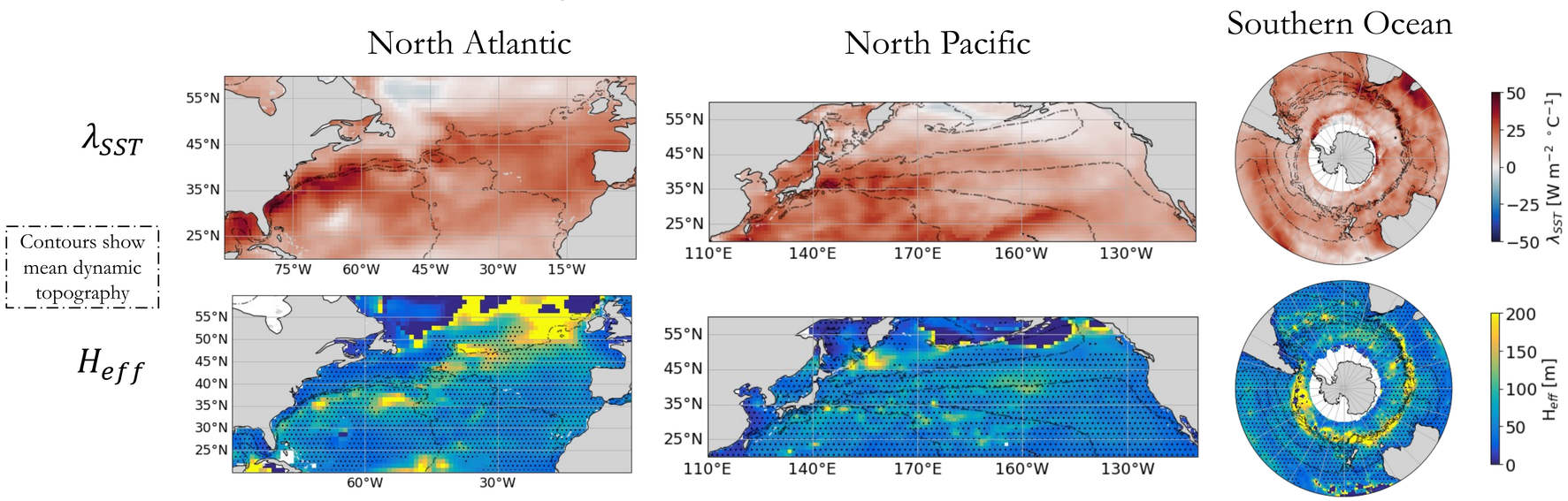
Feedback

$$\lambda_{SST}(\tau) = \frac{R_{SST-Q}(\tau)}{R_{SST-SST}(\tau)}$$

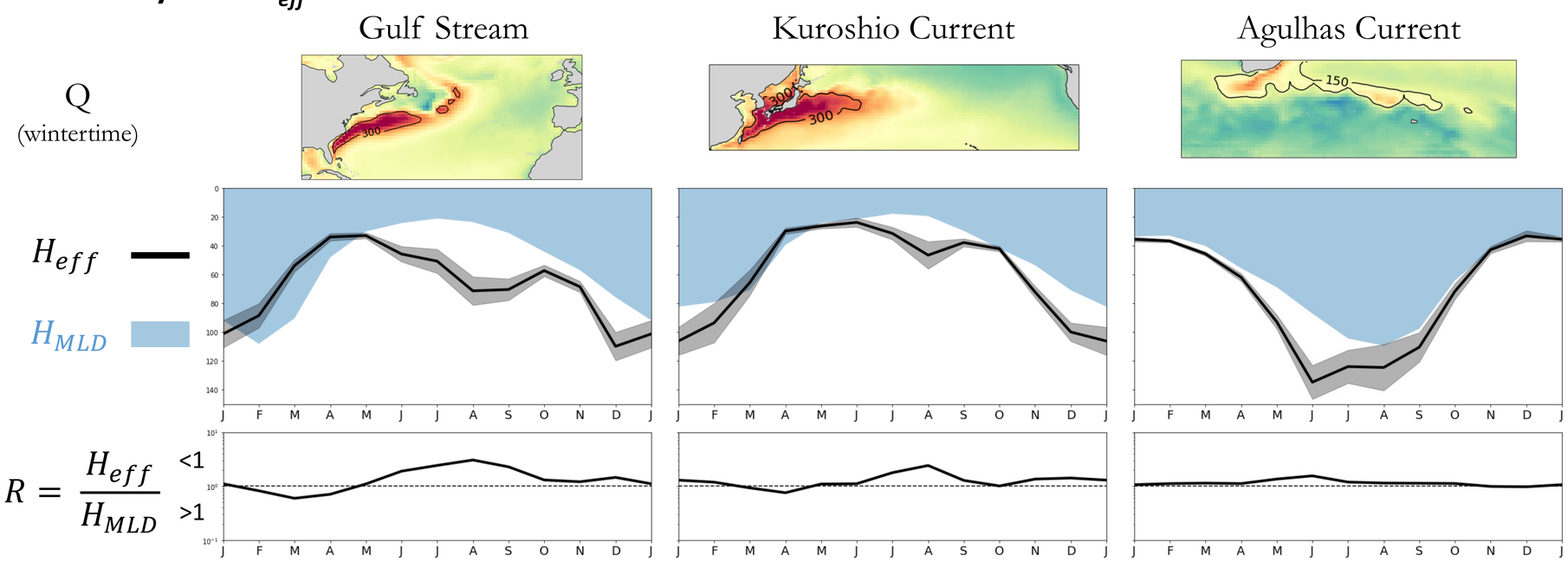
Effective Depth

$$H = \frac{\lambda_{SST}}{\lambda_{MLHC}} \frac{1}{\rho_0 C_P}$$

3. SST-Q Feedback and The Effective Depth of Air-Sea Interaction



4. Annual Cycle of H_{eff} and R



5. Discussion

Ocean processes play an important role in renewing upper ocean heat content variations and driving air-sea interaction as the mixed layer deepens from summer to winter.

- *R* exceeds 1 in the Gulf Stream and the Kuroshio Current mainly in summer and fall.
- In the Agulhas Current, H_{eff} equals H_{MLD} until May and exceeds H_{MLD} until mid-Spring.
- Differences could be caused by the small seasonal cycle of Q_{turb} in the Agulhas Current.

References

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