

The role of wind gusts in upper ocean diurnal variability

Giglio, Donata

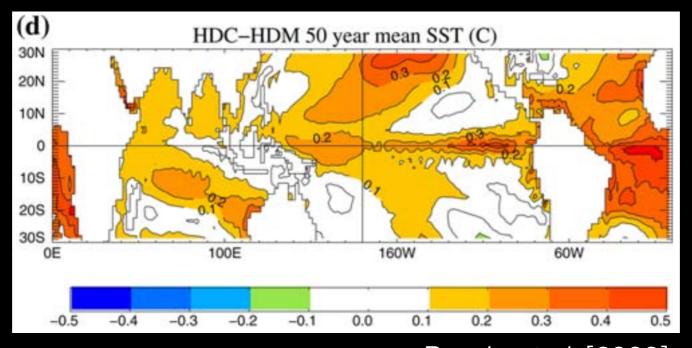
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The diurnal warm layer has a nonlinear rectification effect on longer timescales (mean SST, MJO, monsoons, ...).

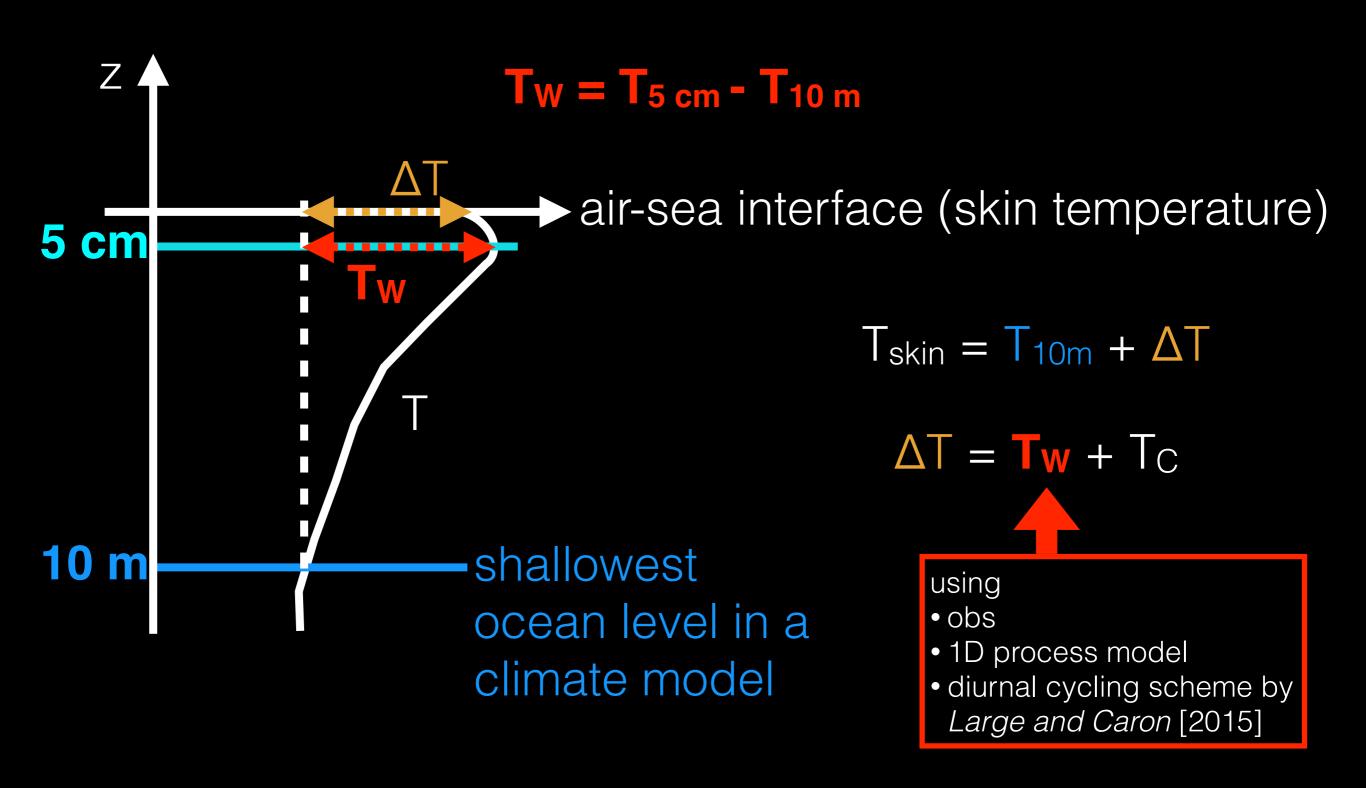
Bernie et al. [2007], Bernie et al. [2008], Weller et al. [2014], Seo et al. [2014], Large and Caron [2015], ...

Air-sea coupling resolving the diurnal cycle or not: difference in 50 year mean SST

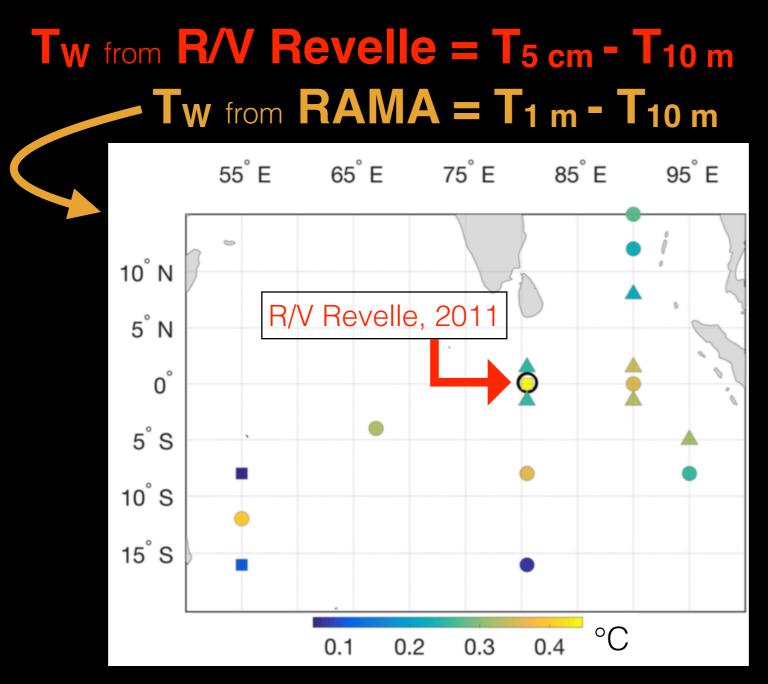


Bernie et al. [2008]

How to account for the diurnal warm layer in a climate model?



Observed Tw diurnal peak in the Indian Ocean from RAMA moorings



- 11-22 October 2011
- 13-23 November 2011

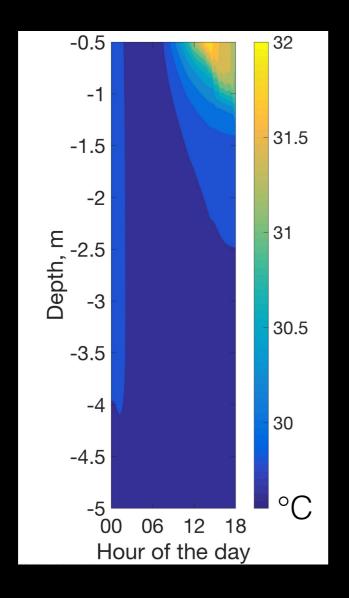
model

1D process Diurnal Cycling Scheme

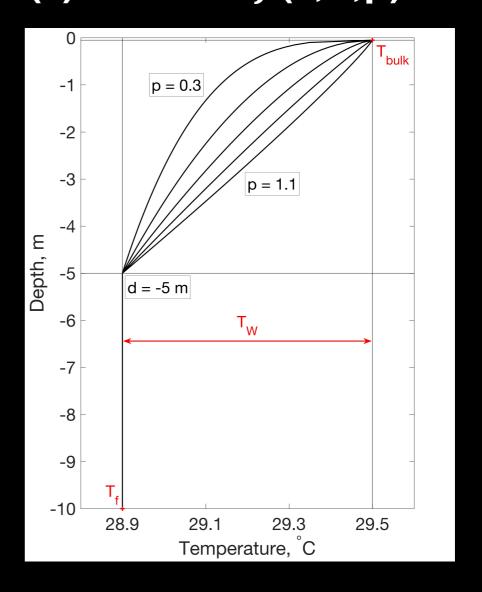
Large and Caron 2015

• $\Delta t = 5$ minute

 $\cdot \Delta z = 10 \text{ cm}$



• $T(z) = T_{5 \text{ cm}} - f(z,d,p) T_{W}$



1D process model experiments



G1, GOTM

G2, 24-hour smoothed wind

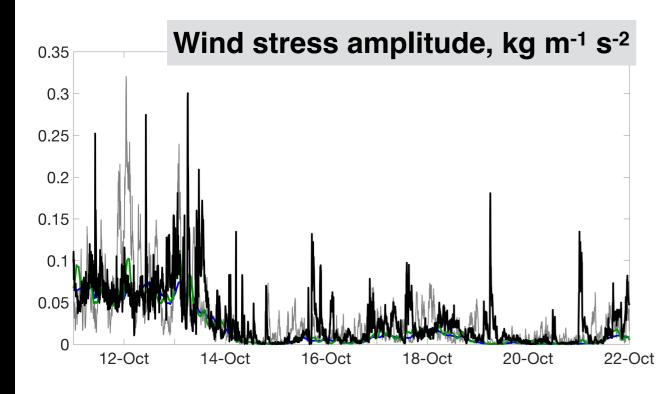
G3, G2 + diurnal wind

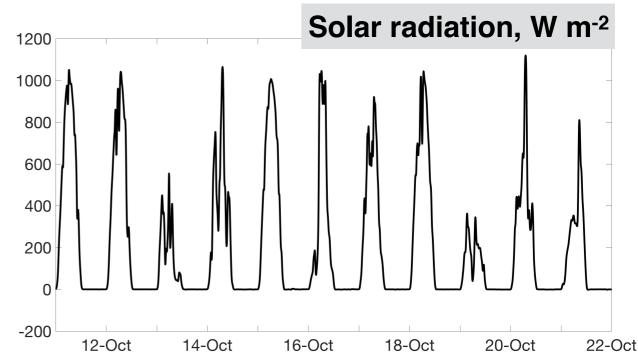
G4, G2 + random wind gusts

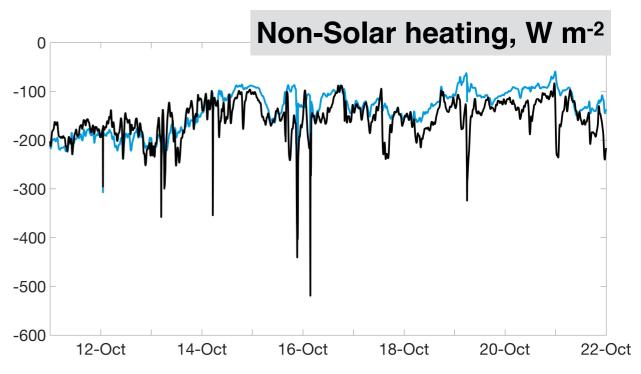
G5, G2 with non-solar heat fluxes from smoothed wind

no wind gusts

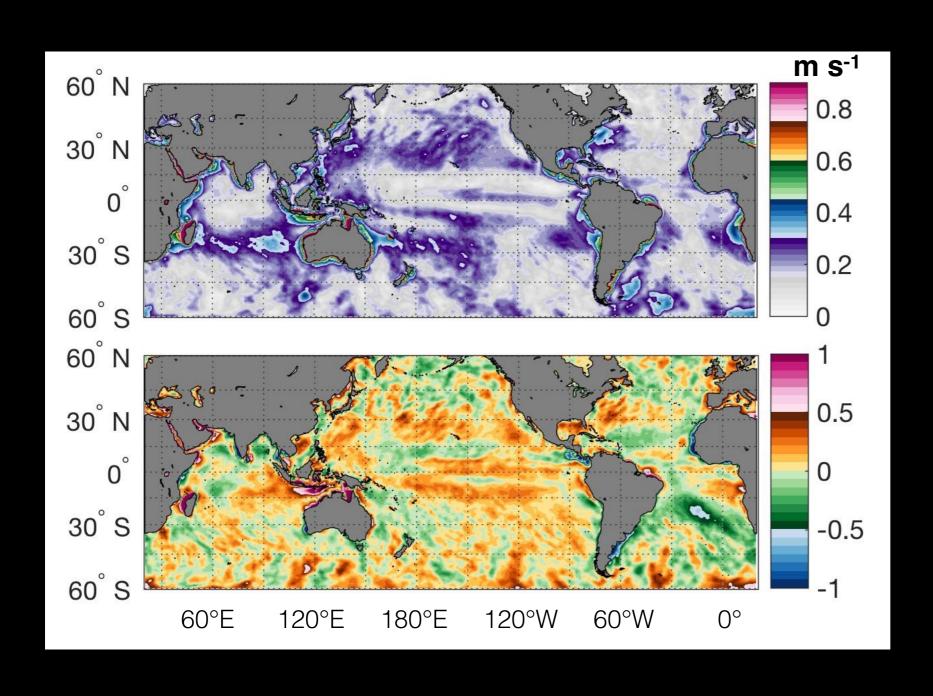
no wind gusts







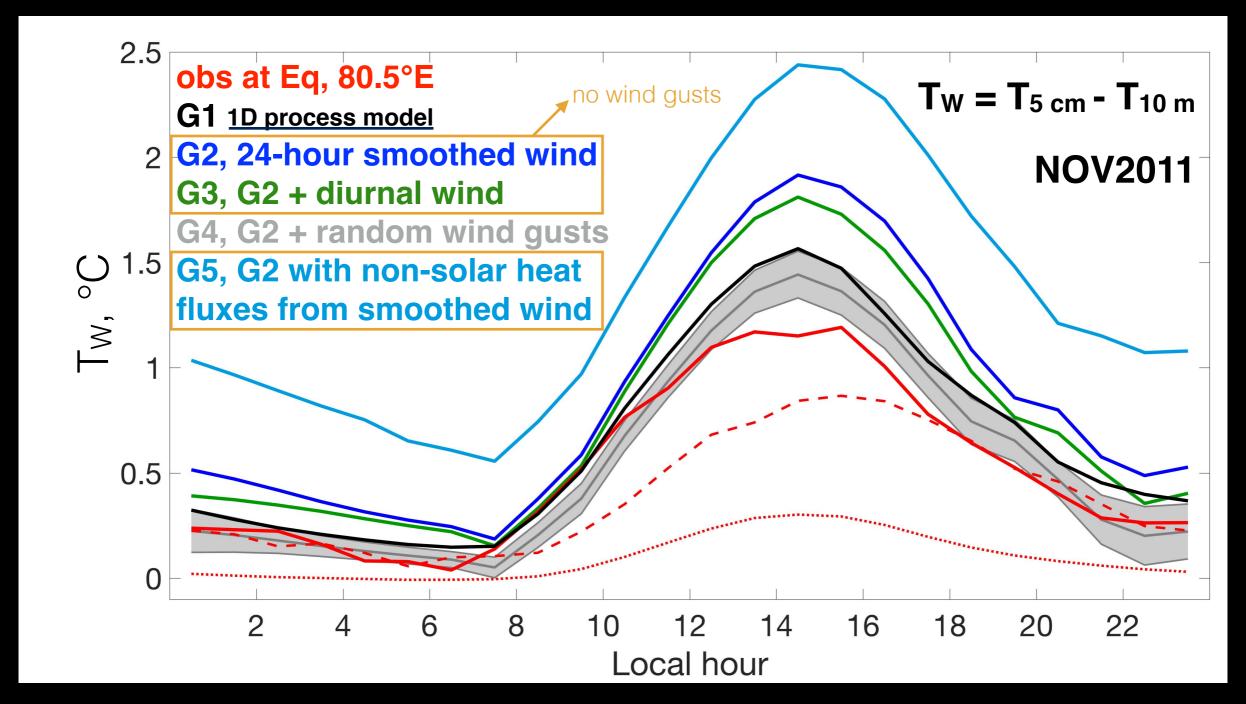
Diurnal wind: CCMP



October climatology

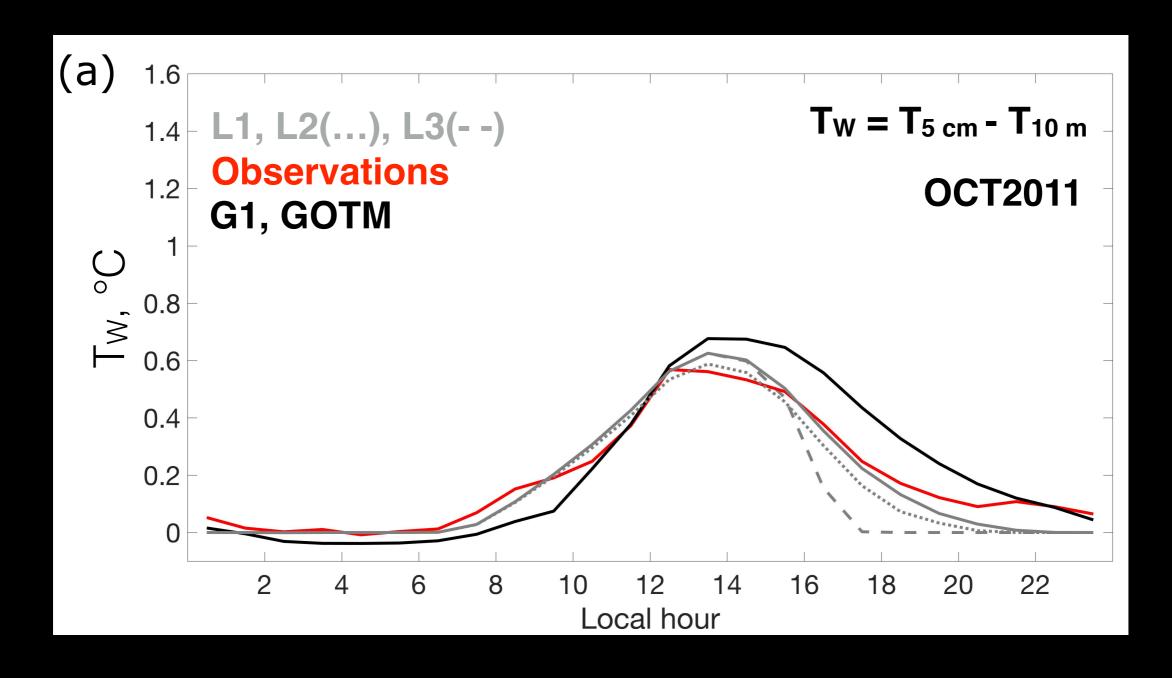
October minus
January

Wind gusts regulate downward mixing of surface water warmed by solar radiation.



Random wind gusts in input to GOTM yield a good comparison with observed T_W

A variant version of the Large and Caron [2015] diurnal cycling scheme provides a good estimate of the observed T_W



Summary

- What is the role of wind gusts versus diurnal wind on the evolution of the diurnal warm layer? Wind gusts regulate downward mixing of surface water warmed by solar radiation. Diurnal winds are weak and play a minor role.
- Can a 1D process model simulate the observed upper ocean diurnal warming? Yes, even when random wind gusts are used as forcing.
- Does the Large and Caron [2015] diurnal cycling scheme provide a good estimate of the upper ocean diurnal warming? A variant version of the Large and Caron [2015] diurnal cycling scheme does provide a good estimate, but it is not sensitive to wind gusts.

Giglio, D., S. T. Gille, A. C. Subramanian and S. Nugyen, 2017: The role of wind gusts in upper ocean diurnal variability. JGR-Ocean (sub judice)