

The Physical Drivers of Coral Bleaching

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Coral Bleaching: Loss of Symbiotic Algae (Zooxanthellae)

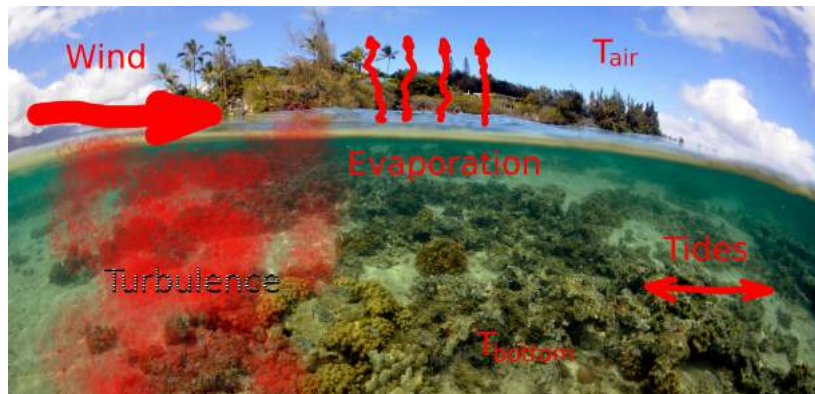
Triggers:

- ▶ Temperature (too high)
- ▶ Temperature (too low)
- ▶ Too much silt
- ▶ Sudden changes in salinity
- ▶ Pollutants
- ▶ Ocean acidification
- ▶ ...

I will focus just on temperature!

Physical processes determining T_{bottom}

Apologies for my abysmal artistic abilities.



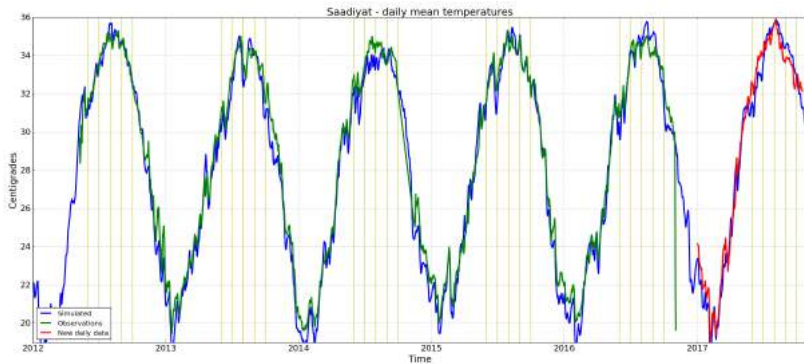
T_{bottom} needs not follow T_{air} !

A Water-Column Model

- ▶ Takes as input a set of meteorological data:
 - ▶ Surface air temperature
 - ▶ Surface wind
 - ▶ Surface air pressure
 - ▶ Relative humidity (or dew point temperature)
 - ▶ Cloud cover
- ▶ Also needs information on tides and water opacity.
- ▶ Solves a set of mathematical equations describing water's turbulent motion.
- ▶ Yields an accurate(?) representation of the physical state of the water column: e.g. temperature at the bottom.

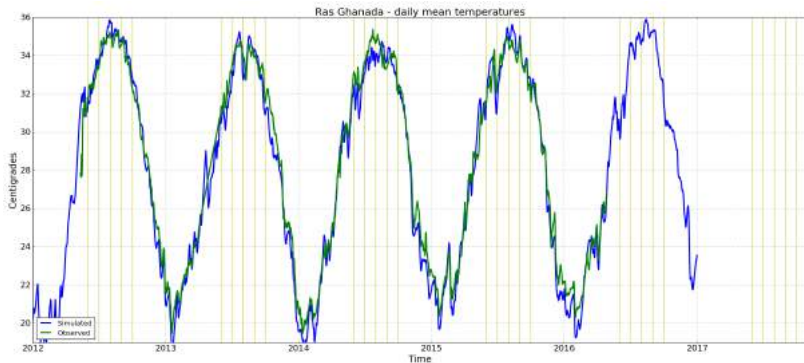
Overview of Results: Saadiyat (station depth 6m (?))

Daily mean temperatures. Observed vs. modeled



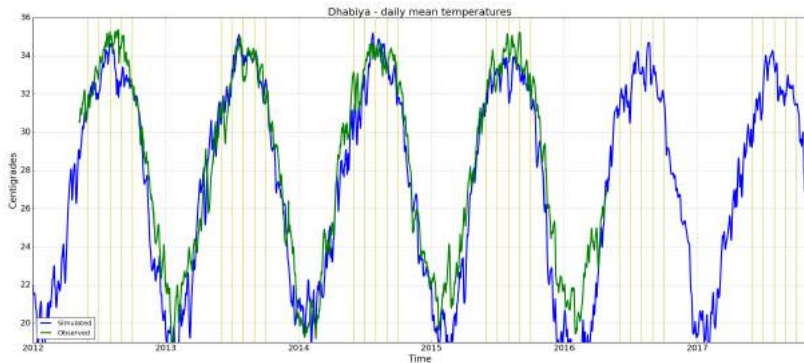
Overview of Results: Ras Ghanada (station depth 6m (?))

Daily mean temperatures. Observed vs. modeled

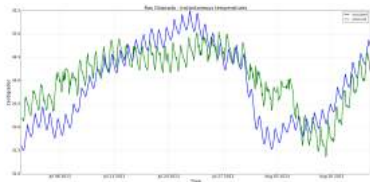
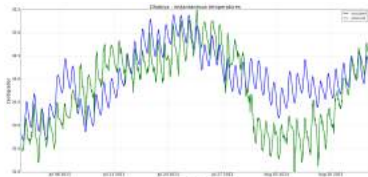
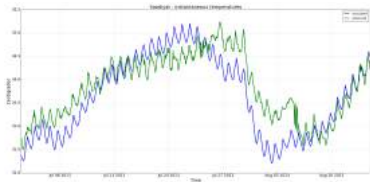


Overview of Results: Dhabiya (station depth 4m (?))

Daily mean temperatures. Observed vs. modeled



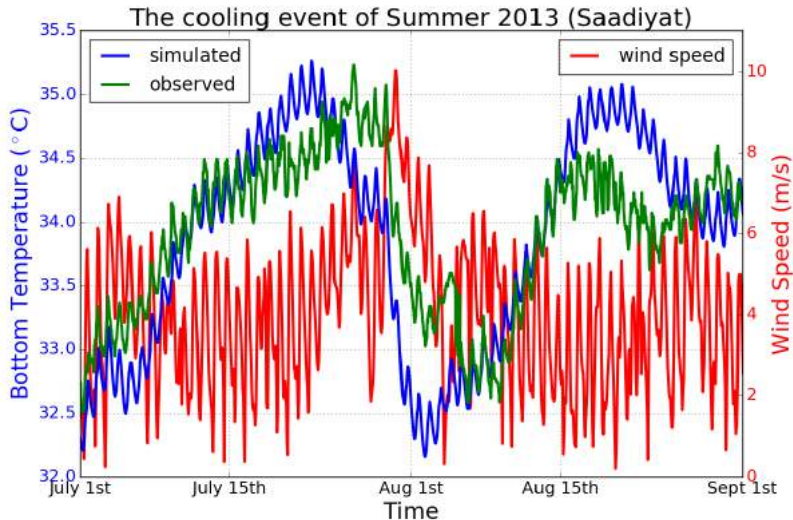
Daily Cycles



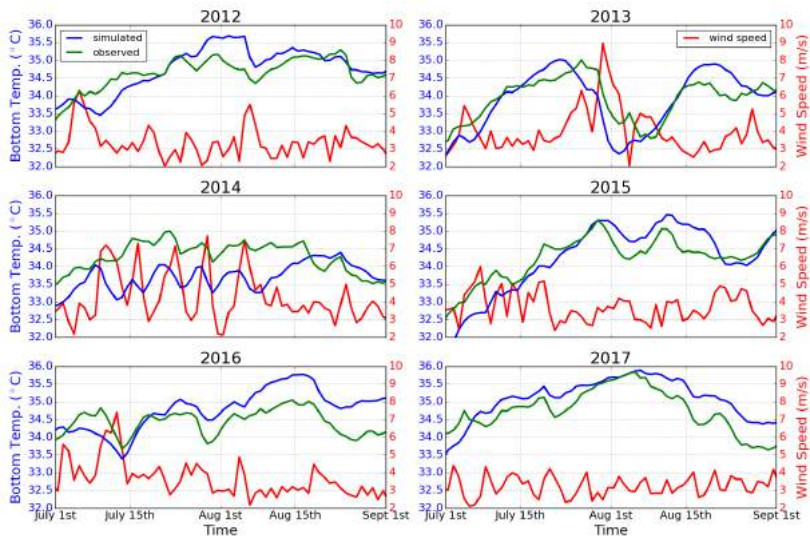
The amplitude of the daily cycles is mostly determined by the amplitude of the tidal current (phase is irrelevant).
 $A = 0.25\text{cm/s}$ Saadiyat, Ras Ghanada
 $A = 0.5\text{ cm/s}$ Dhabiya

The importance of Wind

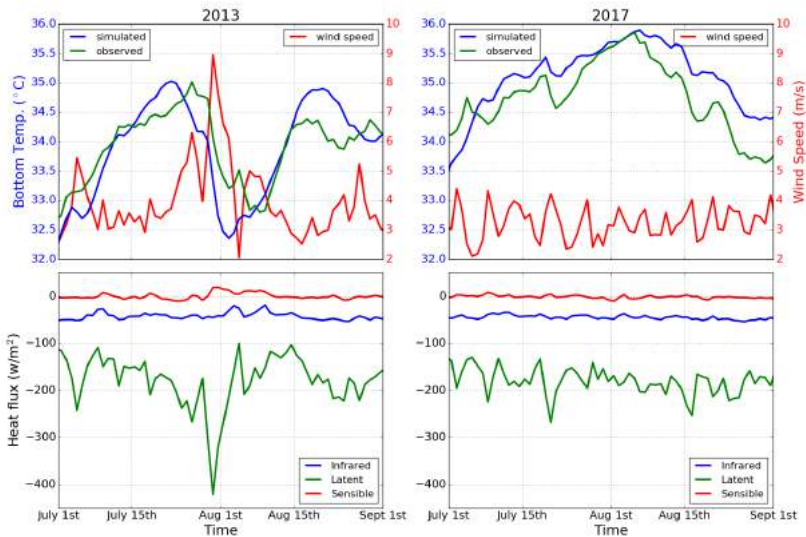
A few days of strong wind make for two weeks of cool water



All the Summers Together (daily averaged quantities)



Breakdown of the Heat Fluxes (2013 vs 2017)



Sources of Uncertainty

- ▶ Meteo data (switch to ERA5 should be beneficial)
- ▶ Surface flux parameterizations (switch to GOTM 5 might be beneficial)
- ▶ **Opacity data!** Right now I use Jerlov 3 (Jerlov 5 on Dhabiya)

