



Donata Giglio

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Motivation

Characterizing the diurnal cycle of surface winds and how it changes in time <u>improves</u>

 our understanding of upper ocean processes and airsea interactions

 wind climate data records from sparse satellite data (reducing systematic error)

In-situ observations to characterize diurnal variability



- high (≤ 2 hours) temporal resolution at mooring locations
- selection: ≥ 2 years, gaps shorter than 6 months, < 1/5 missing data

Reconstructing the modulated diurnal cycle from a time record with gaps

- composite: binning by hour for each month
- <u>least squares fit</u> of sine and cosine at different frequencies

Example



Example of modulation



Example of modulation



In the following, we characterize annual modulation of the diurnal cycle, i.e.

 $\sigma_{S} = \sigma_{D} = 1$ cycle per day $\sigma_{M} = \sigma_{A} = 1$ cycle per year $a_{S} = a_{D} =$ diurnal amplitude $a_{M} = a_{A} =$ annual amplitude

Meridional wind at 10°S, 10°W





Amplitude at different frequencies: peak at frequency $\sigma_D + \sigma_A$ indicates annual modulation



amplitude [m s⁻¹] at 10°S, 10°W



Diurnal amplitude in different months



In January, the diurnal amplitude is twice the annual mean diurnal amplitude, in June is zero

Results for all the moorings: meridional wind

Annual mean diurnal amplitude, aD



relevant for cross-calibration

Maximum diurnal amplitude in the year divided by annual mean diurnal amplitude (a_D)



maximum diurnal amplitude > 1.5-2 * a_D occurs in Aug-Sep (minimum in Mar-Apr)

Results from sparse data may be biased

Legend hourly averaged data 6 obs per day at 2, 6, 10 am/pm 6 obs per day at 0, 4, 8 am/pm 10 obs per day at 6, 7, 8.45, 9.30, 12 am/pm



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Summary

- Mooring data in the global tropical ocean are used to estimate diurnal cycle and its modulation to <u>guide</u> <u>improvements of climate (wind) data records</u> from (temporally sparse) satellite observations
- Annual modulation of the diurnal cycle is observed to be <u>as</u> large as the diurnal cycle in some regions
- More than 6 observations per day are required to estimate diurnal winds and their modulation, especially where the semi-diurnal signal is strong. Observations should be taken throughout the day.



