Observed Wind and SST Variability off the California Coast During Summertime High Wind Events

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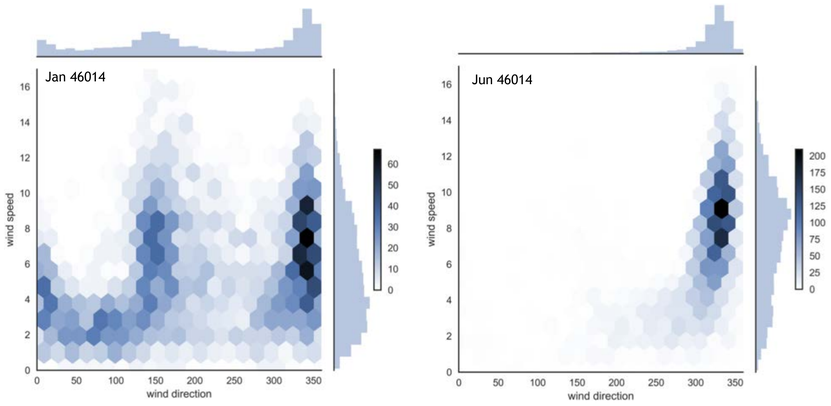
Background

Expansion fan winds are strong northerly winds off the California coast during **Spring and Summer**. This wind pattern is caused by large-scale atmospheric circulation, a meridional coastline with five major capes, and hydraulic marine boundary layer dynamics (Fewings et al. 2016).



Wind speed-direction joint histograms of NDBC buoy 46014 near coast of California in Jan and June. The majority of high-speed winds are from the north during the summer time.

- What is the **spatial and seasonal variability** of these high wind events?
- What are the effects of winds events on **sea surface temperature** (SST)?
- Can we characterize SST's variability in terms of the **duration** and **strength** of the wind events?

Data and Methods

1. Cross-Calibrated Multi-Platform Ocean Surface Wind Vector Analyses Version-2 (CCMP-2), providing 6-hourly, 0.25 degree gridded winds, are used from 2002 to 2015.
2. Hourly 10-m sea surface wind and temperature from National Data Buoy Center (NDBC). Six buoys located distributed along the coast and far offshore.
3. A case study of upper ocean response during the wind events uses California Current Ecosystem (CCE) mooring measurements.

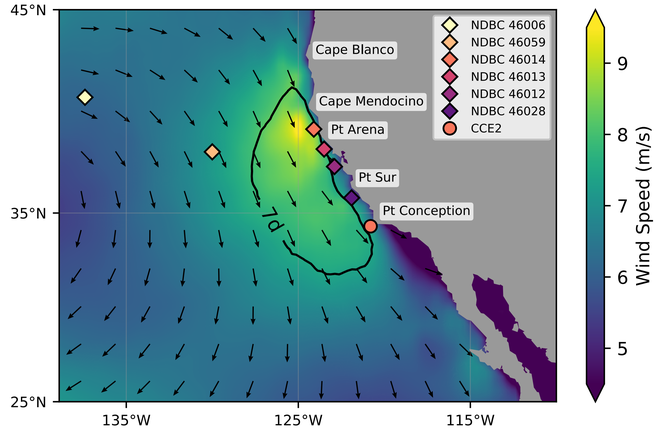
Wind Event Definition

Based on Taylor et al.'s (2008) wind event definition, we select the wind event composites based on the following optimized criteria:

i) Wind direction between **300 and 360 degrees**

ii) Wind speed exceeding the **9m/s** threshold

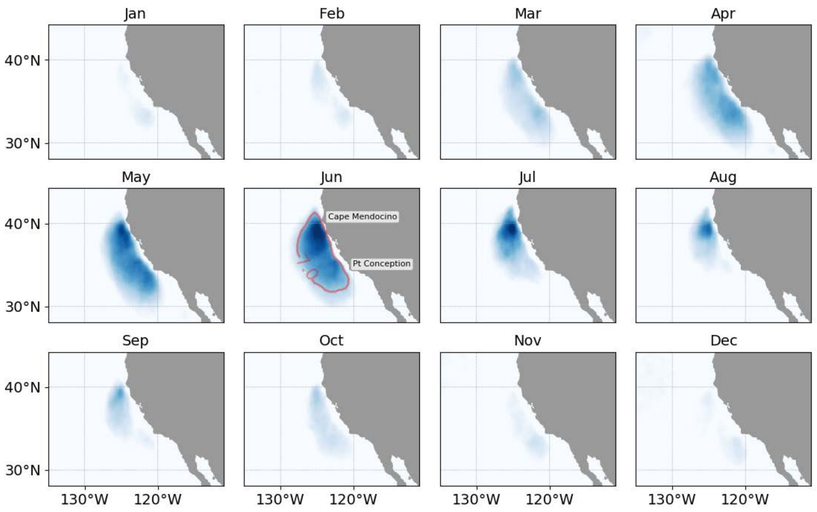
iii) Duration of wind event exceeds **36 h**.



Average wind speed in June from 2002 to 2015. The locations of six NDBC buoys and CCE-2 mooring are marked. The black line outline the wind event region.

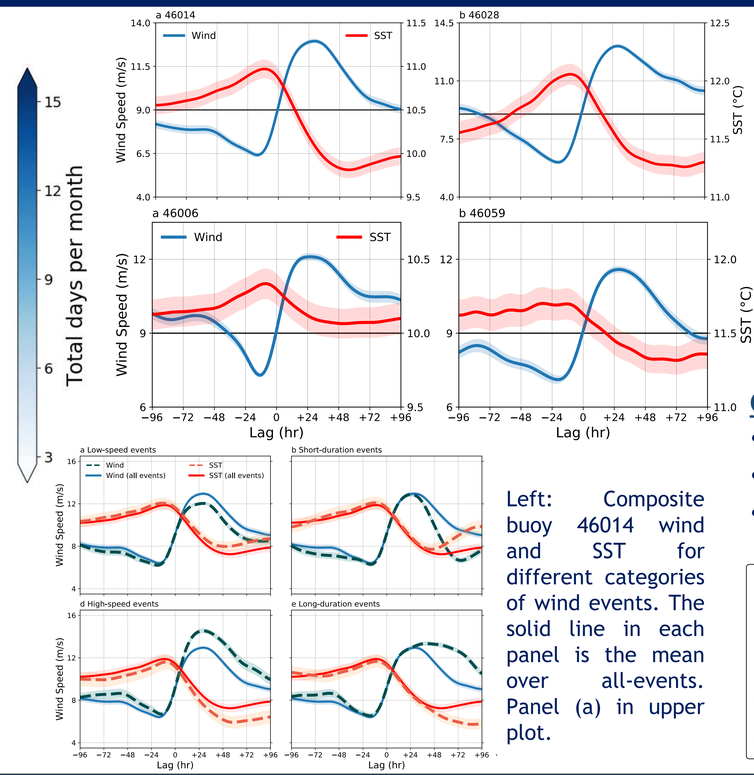
Results

Wind Events



Upper: Maps of April-July average cumulative duration (CD) of wind event. The average CD (in unit of total days per month) indicates the average number of days within a month when wind events occur. The contour of 7days in the map of June outlines the wind event region.

SST

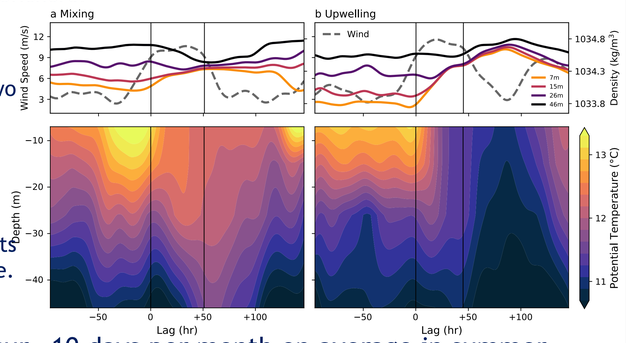


Left: Composite buoy 46014 wind and SST for different categories of wind events. The solid line in each panel is the mean over all-events. Panel (a) in upper plot.

Upper-Ocean Response

Left: Evolution of composite mean of wind speed and SST at two nearshore locations (upper row) and two offshore locations (lower row). About 1 deg cooling is observed nearshore, about 0.3 deg offshore.

Right: Time evolution of potential temperature, density with depths for two wind events. The homogenization of temperature in panel (a) suggests a wind-mixing case; The shoaling of temperature in (b) suggests a upwelling dominant case.



Conclusion

- High wind events occur ~10 days per month on average in summer.
- SST cool during these events, at both nearshore and offshore locations.
- High-wind events lead to more SST cooling, and Long-duration events lead to longer SST cooling.

Acknowledgement
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Reference

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2. Taylor, S. V., D. R. Cayan, N. E. Graham, (2008), Northerly surface winds over the eastern North Pacific Ocean in spring and summer, J. Geophys. Res., 113, D02110, doi:10.1029/2006JD008053.