Meteorological Forcing of Extreme Winds Along Continental U.S. Coasts, 1995-2012

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Research Objectives

Strong winds are a significant hazard in coastal regions, which have high densities of both population and infrastructure. Most strong coastal winds derive from synoptic-scale extratropical cyclones (ETCs) and synoptic-to-mesoscale tropical cyclones (TCs) and thunderstorms. Here we use monthly "fastest two-minute wind" speed and direction to represent extreme, sustained wind speeds at selected coastal ASOS stations to examine seasonal and spatial variability in the synoptic-scale features associated with extreme coastal winds.

*Seasonal variation of extreme wind speed (ms^{-1})**

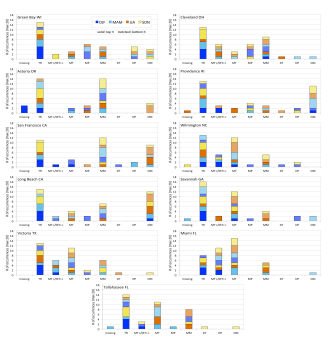
Seasonal variation of extreme wind direction

*Anemometer heights are 10 m AGL except at Cleveland OH and Long Beach CA (circled in maps above), where the anemometer height is 7.9 m AGL.

Synoptic Classification of Top- and Bottom-5 Extreme Wind Days

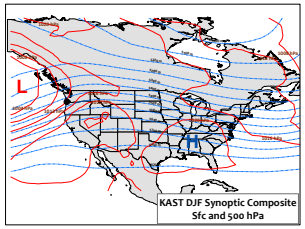
We selected the the top- and bottom-5 extreme wind speeds by season to assess whether there are differences in the synoptic environment for winds at the (approximately) 90th vs. 10th percentile of the extreme wind speed distribution. We used the Spatial Synoptic Classification (S.C. Sheridan, *Int. J. Climatol.*, 2002) to characterize the synoptic-scale setting for each date of occurrence of a top-5 or bottom-5 wind speed.

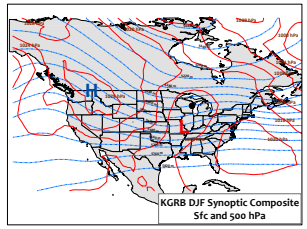
The passage of ETCs and TCs – both contained largely within the TR weather type – are important drivers of extreme winds at all stations and for all seasons. There is little difference in the synoptic classification of top- and bottom-5 extreme wind days for stations along the northern Pacific, Gulf, and southern Atlantic coasts. Top- and bottom-5 winds at stations along the southern Pacific, northern Atlantic, and Great Lakes coasts, however, appear to arise in different synoptic-scale environments.

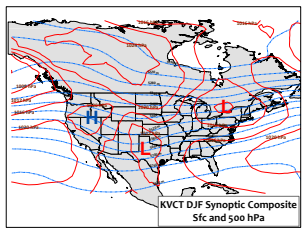


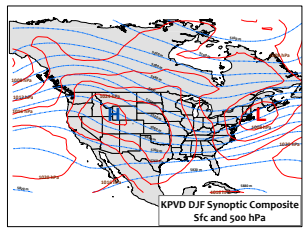
SSC Weather Types	
TR	Transition
MT+ MT++	"oppressive" Moist Tropical
MT	Moist Tropical
MP	Moist Polar
MM	Moist Moderate
DT	Dry Tropical
DP	Dry Polar
DM	Dry Moderate

The dominant synoptic-scale forcing for extreme-wind days is a surface low-pressure system near the station, accompanied by an upper-level trough and strong height gradient. This finding is consistent with the SSC results that show that days with extreme winds commonly are associated with TR weather types, especially during the cold seasons.

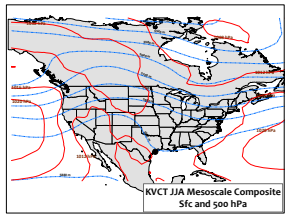


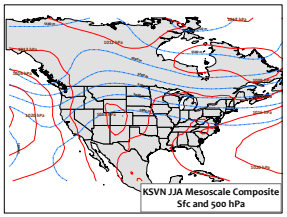






Mesoscale processes also are associated with extreme winds. The typical synoptic setting has surface high pressure and a weak upper-level height gradient. This setting is consistent with SSC results showing a strong association between extreme wind and MT/MT+ and MM weather types, particularly during the warm season.





Regionally important drivers include tropical systems (Gulf, Atlantic coasts) and offshore high pressure (Pacific coast).