UC Cooperative Extension
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Agriculture & Natural Resources

Damaging rainstorms and homeless populations in the Bay Area: Interactions increase impacts for people living in stream corridors

*Understanding **both** the natural hazard and the socio-economic vulnerability is critical for managing the impacts of these frequent storm events*

San Francisco Bay Area is a "hotspot" for compound wind-rain events (CPWEs)

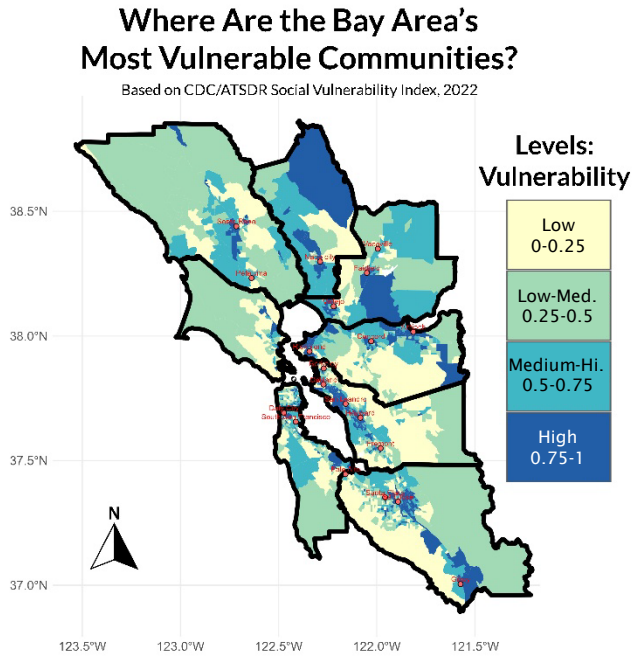
Using local-scale (4 km) data, we evaluated daily rain and wind from 1982 to 2022. We found:

- CPWEs occur yearly across our study area, with the average frequency for a windy rainstorm ranging from 2 years to 6 months.
- CPWEs have become slightly more frequent: an additional 2 rainstorms occur per decade since the 1980s. This increase was stronger for inland counties than for coastal ones.
- CPWEs have become slighly wetter over time, especially in San Mateo and Santa Clara Counties, but wind intensity has remained unchanged.
- Rain and wind observed in CPWEs vary across the study area. Shown in the table are the 98th percentile values, and an indication of increase (↑) , decrease (↓), or no change (↔) since 1982:

Counties	Rain rate	Wind speed
Northern-coastal	2 in/day ↑	20 - 28 mph ↓
Coastal	¾ - 1¾ in/day ↑↑	18 - 21 mph ↓
Southern & inland	½ - 1¼ in/day ↑	14 - 21 mph ↔

…and includes hotspots of social vulnerability

With over 7 million people facing high housing costs, San Francisco Bay includes many areas where social, political, and economic factors combine to increase susceptibility to natural hazards. This is **especially important with homeless (un-housed) populations living in or near stream corridors**, risking exposure to storm-induced floods.



Using data from the Social Vulnerability Index (CDC and ATSDR), we mapped the vulnerability of each census tract across 4 socio-economic themes (socioeconomics, household status, minority populations, and housing/transportation).

Definitions

CPWE: A "severe rainstorm" that combines high winds with heavy rain, with damaging consequences.
Social vulnerability: A population's sensitivity to hazards, combined with its ability to respond and recover.

Damaging rainstorms and social vulnerability in the San Francisco Bay Area; July 2025

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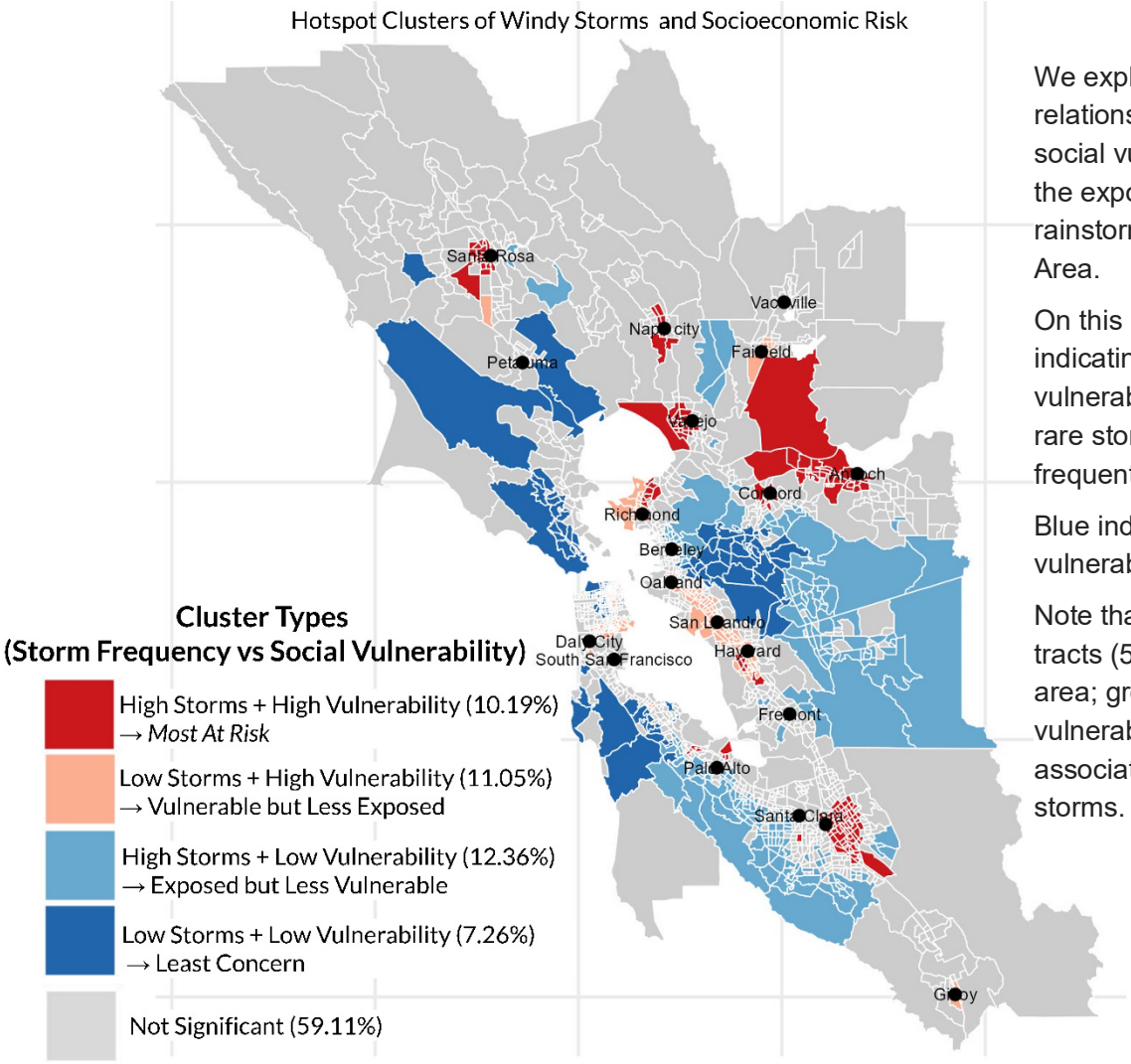
Interaction: socioeconomic vulnerability overlaps with CPWEs



We explored the relationship between social vulnerability and the exposure to damaging rainstorms across the Bay Area.

On this map, “red is bad,” indicating high social vulnerability and either rare storms (light red) or frequent storms (dak red).

Blue indicates low social vulnerability.

Note that in most census tracts (59% of the study area; grey) social vulnerability is not associated with damaging storms.

We found two types of vulnerable areas:
some inland urban areas where *storms are common and social vulnerability is high* (San jose, Vallejo), and
some coastal urban areas *with high vulnerability but infrequent storms* (Richmond, Oakland)

Policy implications

~ windy storms are **common** in the San Francisco Bay Area, and they are getting **wetter**

~ specific areas include a combination of *frequent storms and vulnerable populations*, suggesting additional effort may be needed, both to prevent flood damage and to focus efforts to shelter the homeless that are living in/around stream corridors in those areas.

References

Nikhil Kumar, G. B. Pasternack, Y. Jin, S. Alexander, Z. Wang, C. Rampini, R. Storesund, C. Lim, S. Moreno, I. Lacan. (2025). Socio-economic Risk of Rising Compound Precipitation-Wind Extremes in San Francisco Bay Area. International Journal of Climatology.