

7.1 Central Valley Fog

Fog, defined as a cloud (stratus or stratocumulus) at or near the ground or ocean surface, consists of droplets approximately 100 times smaller than raindrops that remain suspended in air. These droplets can coalesce into drizzle or collect on surfaces to form “fog drip” (AMS, 2022). In California’s Central Valley, winter fog promotes colder temperatures, a critical factor for achieving a period of dormancy (see the *Winter Chill* chapter) in agricultural regions.

Both anecdotal evidence and field measurements indicate that California’s Central Valley winters are less foggy over recent decades. Baldocchi and Waller (2014) used satellite imagery and weather station data to analyze the frequency, spatial extent and long-term trends in “tule fog” — a thick winter ground fog that blankets the valley. Their analysis paired satellite records from the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration with data from a network of valley weather stations to quantify winter fog days from 1981-2014. Over the 33-year timespan, winter fog events decreased 46%, on average, with much year-to-year variability. The optimal Central Valley fog formation occurs during winters with periodic storms followed by periods of high pressure. This allows humidity from evaporating soil moisture to condense and form fog during the cold, clear nights (Baldocchi and Waller, 2014). According to Dr D. Baldocchi (personal communication, 2026), the winter of 2025-2026 has been unique, with exceptionally persistent Central Valley fog due to the heavy early rains in autumn, followed by a very strong high-pressure system that created an inversion layer, which acts like a lid to trap soil moisture and keep the fog in the valley. The early rain and strong high-pressure system set up conditions that were ripe for dense and prolonged fog to persist until a storm in December 2025 eventually pushed out the fog (NASA, 2025).

Rising air temperatures in densely populated areas (the “urban heat island effect”) have been associated with a decline in the frequency and spatial extent of valley fog (Klemm and Neng-Huei, 2016). Higher temperatures prevent the condensation of atmospheric water vapor making it less likely for fog to form, as well as accelerating the evaporation of fog after formation. Drought conditions also tend to suppress the ability of fog to form



because there is less soil moisture that can evaporate – reducing fog days during dry years (Baldocchi and Waller, 2014).

Other studies report that the observed reduction in fog in the Central Valley and in other areas worldwide strongly correlates with a decline in air pollution (Gray et al., 2019, 2016; Klemm and Neng-Huei, 2016). Airborne particles, including dust and other air pollutants, serve as nuclei for water vapor to condense around. One study concluded that climate variables (in particular, the difference between ambient temperatures and dew point) strongly influenced the short-term, year-to-year variability in fog frequency; however, changes in air pollution are driving long-term temporal and spatial trends in Central Valley fog (Gray et al., 2019). This study found that from 1930 to 1970, valley fog significantly increased due to high levels of nitrogen oxide emissions attributed to a surge in use of motor vehicles. In contrast, the downward trend in fog frequency since 1980 is consistent with the trend of decreasing air pollution due to statewide vehicular emissions regulations over the past decades.

While decreasing air pollution appears to be a major factor in the decline of fog formation, rising temperatures also play a role and will likely have an increasingly significant impact as temperatures continue to rise in the future. The concurrent roles of changes in air pollution (including agricultural burning) and climate on changing fog trends in the Central Valley remain an area of ongoing research. Despite advances in remote sensing technology, significant knowledge gaps remain regarding the application of these techniques to fog detection, especially over terrestrial ecosystems. Most methodological research has concentrated on maritime fog detection, with few studies extending these techniques to complex terrestrial environments (Chaverri et al., 2025).

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UC Berkeley

Dennis Baldocchi
Environmental Science, Policy and Management
University of California, Berkeley
baldocchi@berkeley.edu



References

- AMS (2022). American Meteorological Society. [Glossary of Meteorology](#). Retrieved March 11, 2022.
- Baldocchi D (2026). Personal communication.
- Baldocchi D and Waller E (2014). Winter fog is decreasing in the fruit growing region of the Central Valley of California. *Geophysical Research Letters* **41**(9): 3251-3256.
- Chaverri AG, Toppa RH, and Tonello KC (2025). From climate to cloud: Advancing fog detection through satellite imagery. *Climate* **13**(6): 110.
- Gray E, Baldocchi D, and Goldstein A (2016). Influence of NO_x Emissions on Central Valley Fog Frequency and Persistence. International Global Atmospheric Chemistry Conference. Breckenridge, Colorado.
- Gray E, Gilardoni S, Baldocchi D, McDonald BC, Facchini MC, et al. (2019). Impact of air pollution controls on radiation fog frequency in the Central Valley of California. *Journal of Geophysical Research: Atmospheres* **124**: 5889–5905.
- Klemm O and Neng-Huei L (2016). What causes observed fog trends: Air quality or climate change? *Aerosol and Air Quality Research* **16**: 1131–1142.
- NASA (2025). National Aeronautics and Space Administration. [An Unrelenting Tule Fog](#). Retrieved December 11, 2025.

