An Analysis of Unique Atmospheric Observations during Multiple California PSPS Events

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Presentation Outline

1. Introduction and Background

2. Data

- PSPS events
- Unique instrumentation
- Synoptic setup (offshore flow)
- WRF setup

3. Results & Discussion

- Lidar observations
- WRF performance

4. Summary & Future Work

- Simulate more events

Public Safety Power Shutoff (PSPS)

- Investor-owned utilities (IOUs) have the power to decide when and where de-energization will take place.
- The California Public Utilities Commission (CPUC) has implemented guidelines, but does not guide or approve the occurrence of these events.
- The IOUs are responsible for information dissemination and must follow procedures implemented by the CPUC
- There are three major investor owned utilities (IOUs) in California.
 - San Diego Gas & Electric (SDG&E)
 - Southern California Edison (SCE)
 - Pacific Gas & Electric (PG&E)

Public Safety Power Shutoff (PSPS)

PG&E PSPS events	Estimate of affected customers
June 8-9	~ 22,474
September 23-26	~ 70,826
October 5-6	~ 11,609
October 9-12	~ 735,440
October 23-25	~ 178,800
October 26 – November 1	~ 967,700
November 20-21	~ 49,000

Background: Making the Connection

Offshore flow Connection

85% occurred within September and December

70% were undisputedly enhanced by an offshore flow pattern

Connection to Powerlines

50% occurred in the last decade

50% had causes classified as powerlines or electrical

	FIRE NAME (CAUSE)	DATE	COUNTY	ACRES	STRUCTURES	DEATHS
1	CAMP FIRE (Powerlines)	November 2018	Butte County	153,336	18,804	85
2	TUBBS (Electrical)	October 2017	Napa & Sonoma	36,807	5,636	22
3	TUNNEL - Oakland Hills (Rekindle)	October 1991	Alameda	1,600	2,900	25
4	CEDAR (Human Related)	October 2003	San Diego	273,246	2,820	15
5	VALLEY (Electrical)	September 2015	Lake, Napa & Sonoma	76,067	1,955	4
6	WITCH (Powerlines)	October 2007	San Diego	197,990	1,650	2
7	WOOLSEY (Under Investigation)	November 2018	Ventura	96,949	1,643	3
8	CARR (Human Related)	July 2018	Shasta County, Trinity County	229,651	1,614	8
9	NUNS (Powerline)	October 2017	Sonoma	54,382	1,355	3
10	THOMAS (Powerline)	December 2017	Ventura & Santa Barbara	281,893	1,063	2
11	OLD (Human Related)	October 2003	San Bernardino	91,281	1,003	6
12	JONES (Undetermined)	October 1999	Shasta	26,200	954	1
13	BUTTE (Powerlines)	September 2015	Amador & Calaveras	70,868	921	2
14	ATLAS (Powerline)	October 2017	Napa & Solano	51,624	783	6
15	PAINT (Arson)	June 1990	Santa Barbara	4,900	641	1
16	FOUNTAIN (Arson)	August 1992	Shasta	63,960	636	0
17	SAYRE (Misc.)	November 2008	Los Angeles	11,262	604	0
18	CITY OF BERKELEY (Powerlines)	September 1923	Alameda	130	584	0
19	HARRIS (Undetermined)	October 2007	San Diego	90,440	548	8
20	REDWOOD VALLEY (Powerline)	October 2017	Mendocino	36,523	546	9

Top 20 Most Destructive California Wildfires

"Structures" include homes, outbuildings (barns, garages, sheds, etc) and commercial properties destroyed. *This list does not include fire jurisdiction. These are the Top 20 regardless of whether they were state, federal, or local responsibility.



Offshore Flow & Geographic Overview



Mobile Instrumentation

- Doppler Lidar
- Doppler Radar (Ka-band)
- Mobile surface weather station
 - Windspeed, temperature, RH, etc.



Synoptic Setup 27 October 2019 (GFS 0.5° Analysis)



WRF Simulation



- NAM analysis (12km) data for initialization and lateral boundary conditions
- Four nested domains 9km, 3km, 1km, ¹/₃km with 80 vertical levels
- Parameterization options following Xue et al. 2020
- Domain 4 utilizing ~30 meter
 SRTM topography data





WRF Simulation



Lidar Observed Wind Profiles (Event Onset)



Lidar Observed Wind Profiles(Rotor Development)



Vertical Wind Profiles (Rotor Erosion)



WRF Error Statistics

Event averaged statistics utilizing 80 observation sites and the 1km domain (D03)



WRF Model Profile Comparison





Summary

Observations

- Intermittent rotor feature associated with downslope windstorms
- Sustained surface wind maximum of 35 ms⁻¹
- Lidar wind profile (lowest 200 m) observed winds in excess of 36 ms⁻¹ ~7 hours prior to observed surface maximum
 - Profiler is beneficial for early indication of wind event intensity

Simulation highlights

- Intensity and evolution of surface winds well represented only in select locations.
- Most exposed sites were poorly simulated utilizing multiple PBL schemes; simulation improved at these sights without PBL scheme
- WRF failed to capture the observed vertical wind profile
- The 'best' WRF simulation (lowest RMSE) did not capture onset of wind event in Sonoma county (timing missed by ~2 hour)

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Thank you!

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