METEOROLOGICAL CONDITIONS ASSOCIATED WITH POST-FIRE DEBRIS FLOWS IN CALIFORNIA

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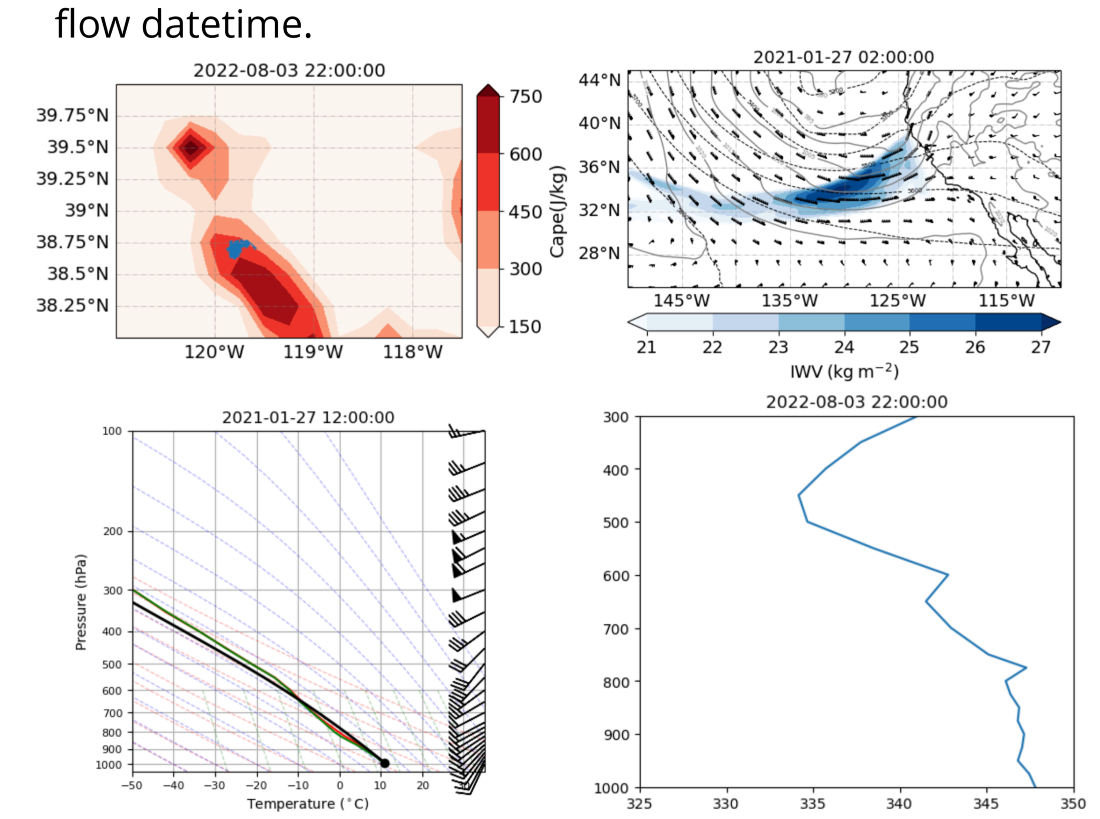
Introduction

One way to contribute to reduce severe impacts caused by post-fire debris flows is to understand better the drivers behind the occurrence of post-fire debris flows, from the triggering rainfall to ground conditions in the location of the events. This preliminary work aims to investigate the predominant atmospheric conditions associated with storms triggering post-fire debris flows in California, to later associate them with other environmental variables and develop a model that determines the most important factors playing a role in the occurrence of the hazard.

Figure 1. Debris flows in the Dolan (left) and El Dorado (right) fires on January 27, 2021, and September 12, 2022, respectively.

Methodology

- ERA5 reanalysis dataset was used to obtain variables representative of convective stability, orientation of the storms and moisture transport.
- The nearest hour was identified as a reference to extract a subset of variables in time. Timing of debris flow was based on highest peak intensity at 15, 30 or 60 min .
- To understand synoptic conditions, variables like Integrated Vapor Transport (IVT) , Integrated Water Vapor (IWV) , geopotential height at 500 hPa were plotted every 3 hours for 3 days before and after the post-fire debris flow initiation.
- Skew –Ts, equivalent potential temperature profile and Convective Available Potential Energy (CAPE) were plotted every hour for a day before and after the post-fire debris flow datetime.



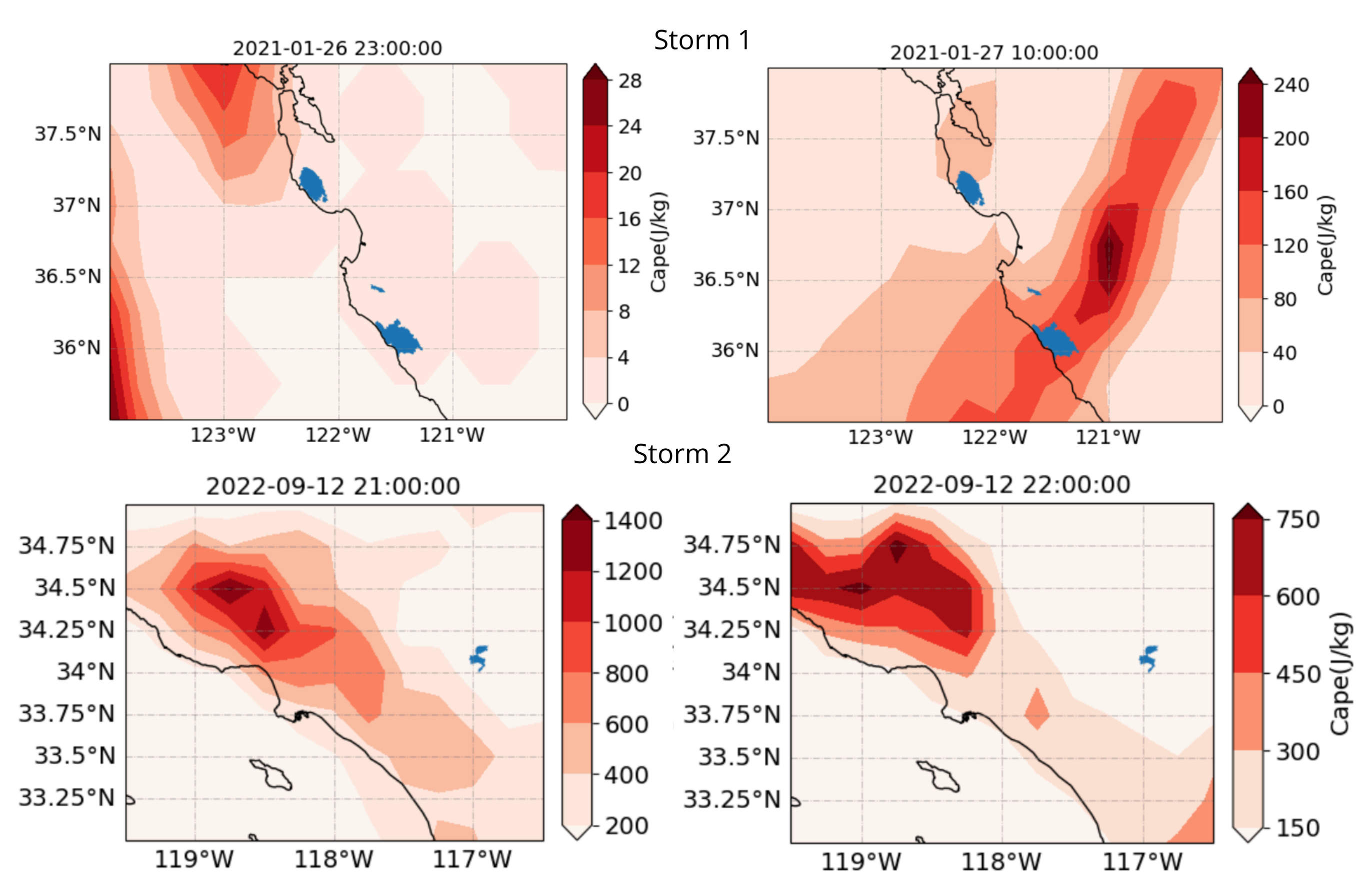
Preliminary results

Here, we analyze two storms 1) on January 27, 2021 triggering post-fire debris flows in the CZU Lightning Complex, Carmel and Dolan fires and 2) on September 12, 2022 triggering an event in the El Dorado Fire.

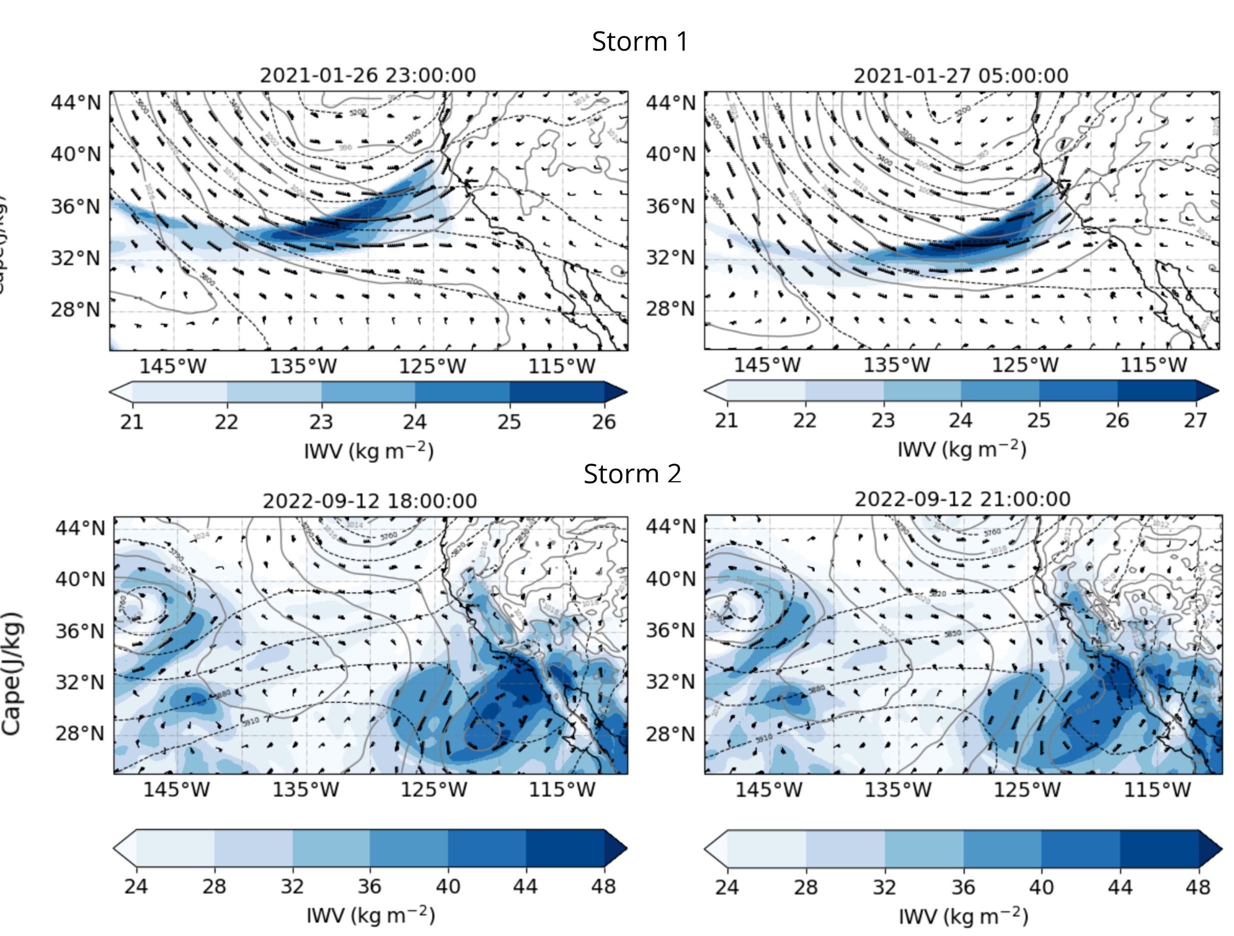
Rainfall conditions triggering post-fire debris flows

	Storm Starts UTC	Storm Duration (h)	Accumulated rainfall (mm)	Peak 15 min intensity (mm/h)	Peak 15 min intensity datetime UTC
Storm 1: January 2021	2021-01-26 23:00	24.1-56.8	81.28 – 222.5	44.7	2021-01-27 10:00
Storm 2: September 2022	2022-09-12 21:00	6.25	49.02	49.78	2022-09-12 22:00

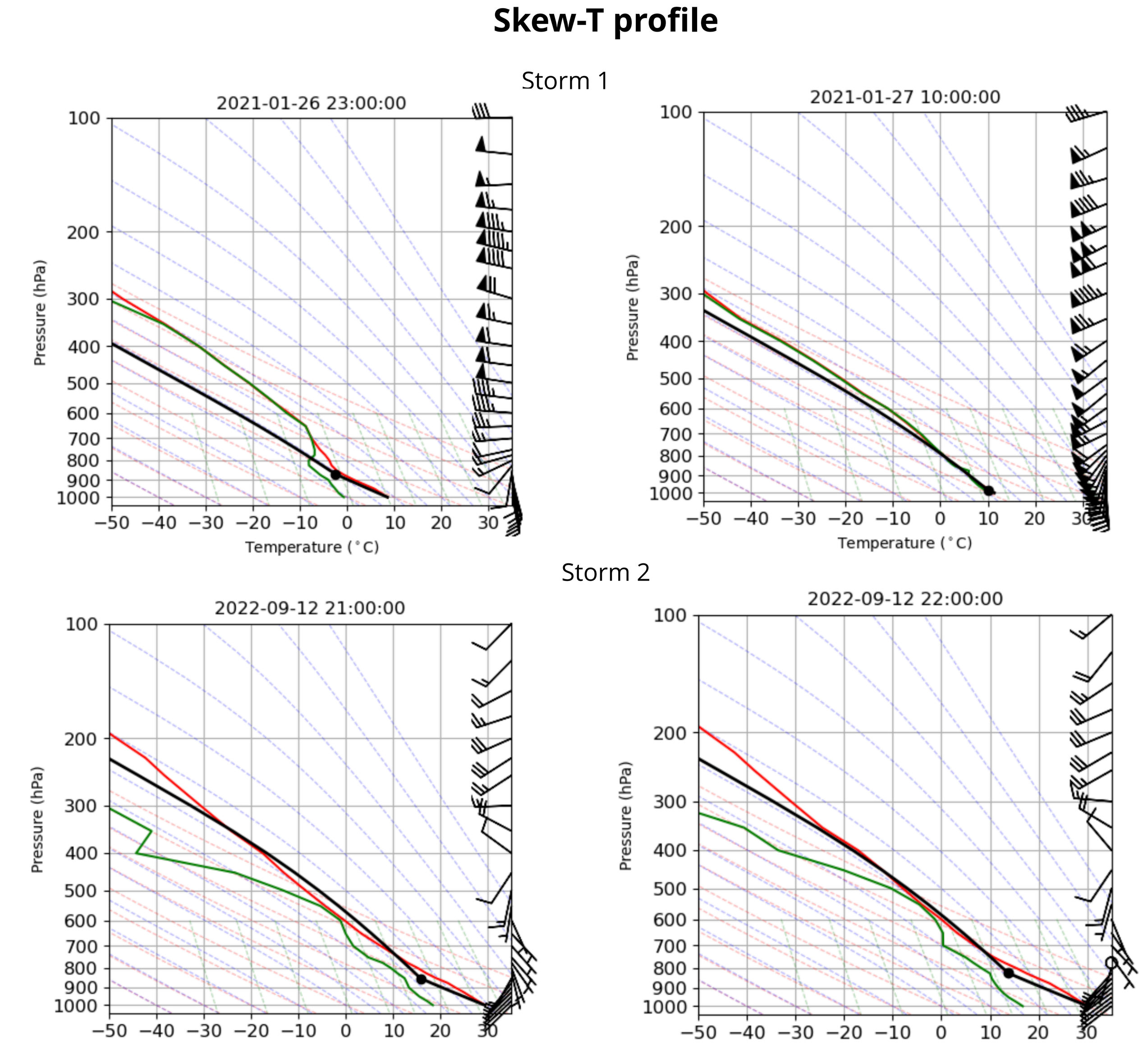
Convective Available Potential Energy (CAPE)



IWV, IVT



Skew-T profile



Theta-e profile

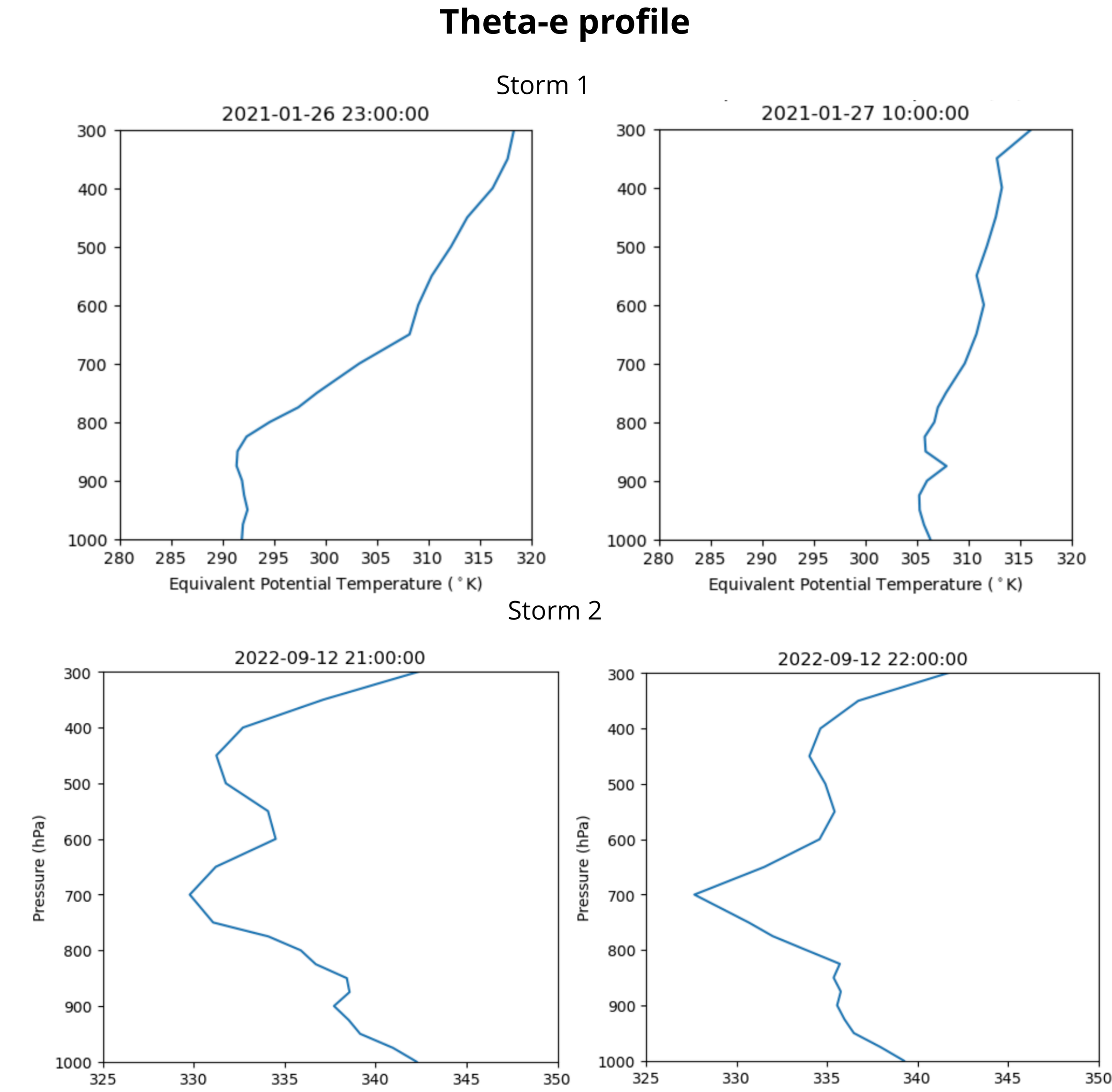


Figure 2. **Top left**: CAPE contours near fire polygons filled in blue; **top right**: IWV as contours, IVT winds, geopotential height at 500 hPa (dashed lines) and mean sea level pressure (gray lines); **bottom left:** skew-Ts with temperature (red), dew point temperature(green), parcel profile (black) and winds at pressure levels (right side); **bottom right:** Equivalent potential temperature profile.

Future work

- Radar data and launched radiosondes to the post-fire debris flows must be reviewed with the aim to contrast with skew-t's from reanalysis dataset as well as to identify mesoscale features like Narrow Cold Frontal Rainbands or isolated cells.

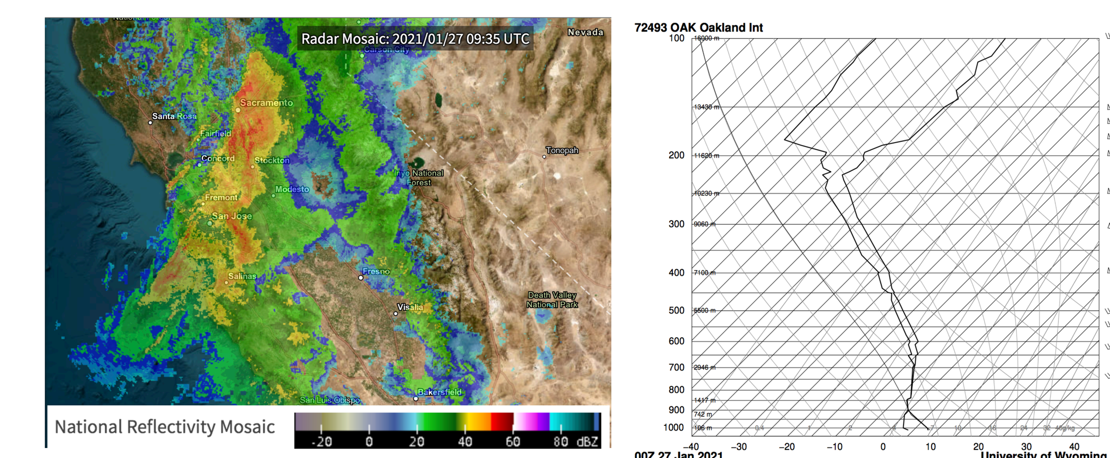


Figure 3. Radar reflectivity at peak 15min intensity from NEXRAD data (left) and radiosonde profile launched from Oakland on 2021-01-27 00:00 UTC (right).

- Geomorphic and environmental data like slope, vegetation and burn severity must also be analyzed to understand their relationship with rainfall rates and meteorological variables.

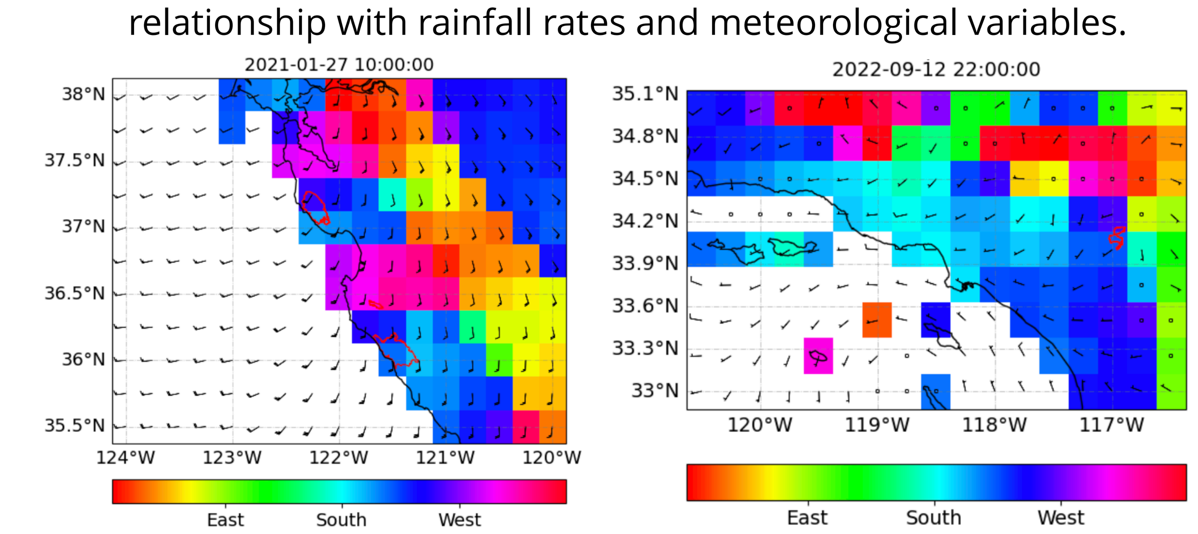


Figure 4. Shaded aspect values with 925 hPa winds at peak 15 min intensities on Jan 27, 2021 (left) and September 12, 2022 (right)

- Develop an empirical model of rainfall, atmospheric, environmental, geomorphic and burn severity variables that determines the most important drivers for the occurrence of post-fire debris flows.

Acknowledgments

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