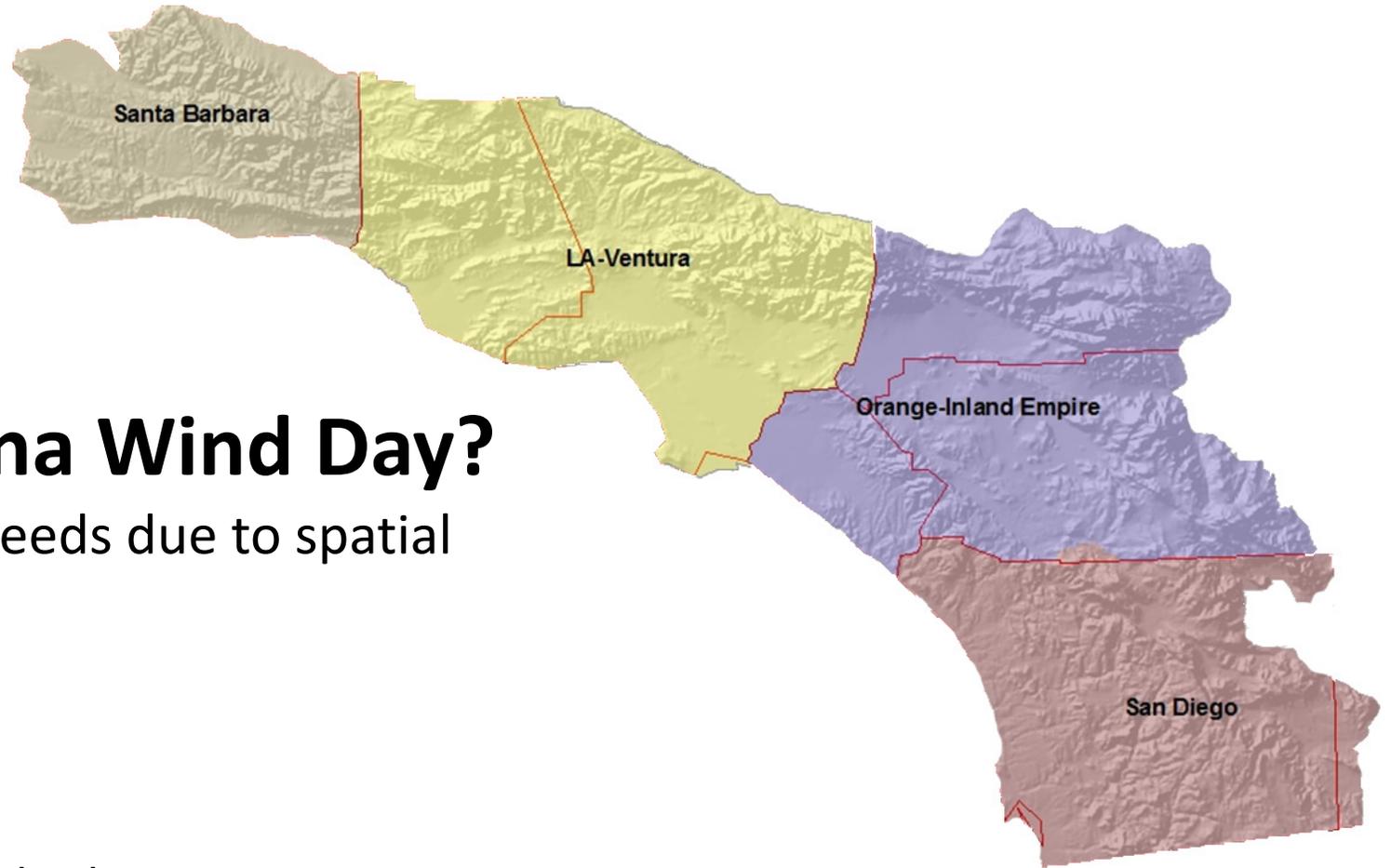


Santa Ana Wind Season Outlook

Tom Rolinski



Forecasting Santa Ana Wind Days



What is a Santa Ana Wind Day?

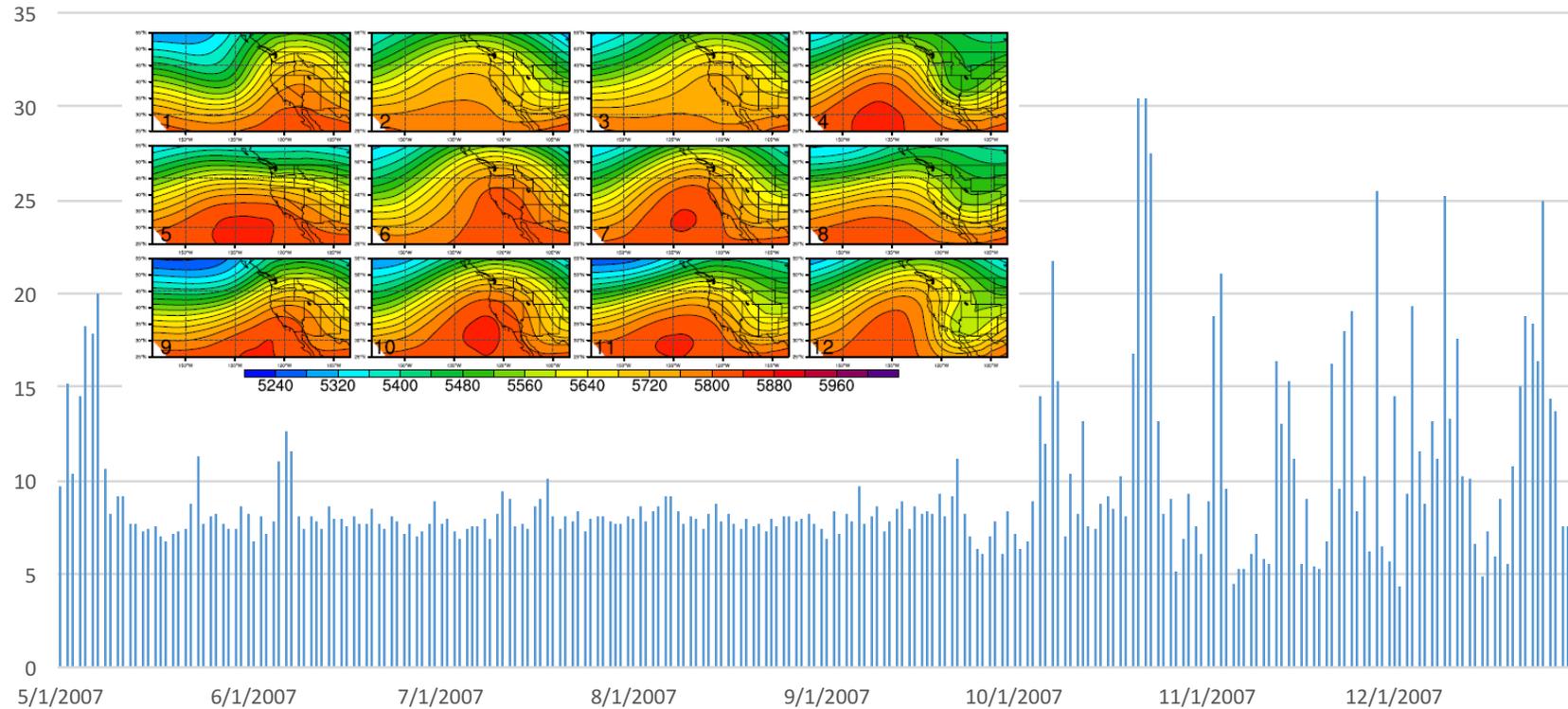
Hard to assign exact wind speeds due to spatial variability.

Criteria used:

- Wind and Dryness
- Pressure Gradients
- Verified by Map Types (12)

Introduction

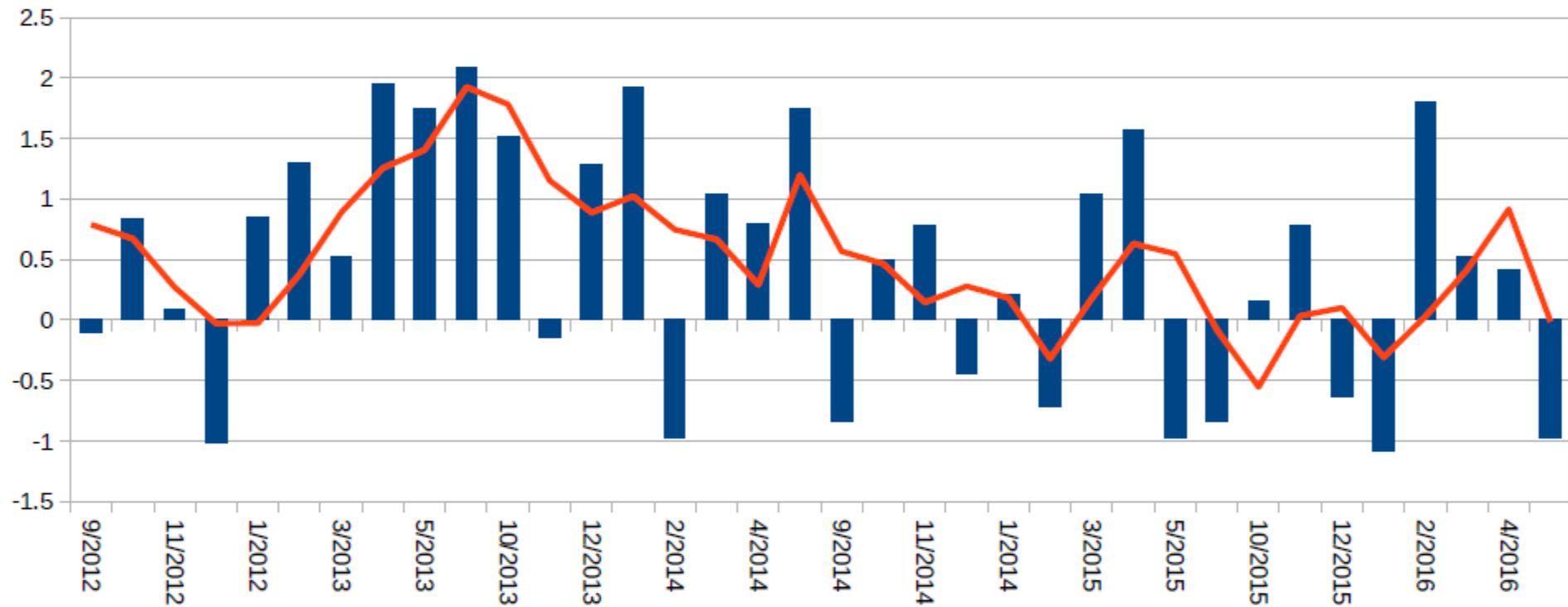
Wind Speed



- **32-year climatology**
 - **Meteorological and fuels data**
- **Currently 1984-2016**
- **We will be going back to 1981 to include the 1982/83 El Niño event.**

Long-term Trends/Cycles

There was an extended period of above normal SA day counts for **most months** between the years 2006 and 2013. For the past 2.5 years, we have experienced a **more evenly distributed mix** of below and above normal SA day counts.



Standardized (blue) and 3-month moving average (orange) SA day count timeseries between 2012 and present for all months.

Methods

3 Models/Methods

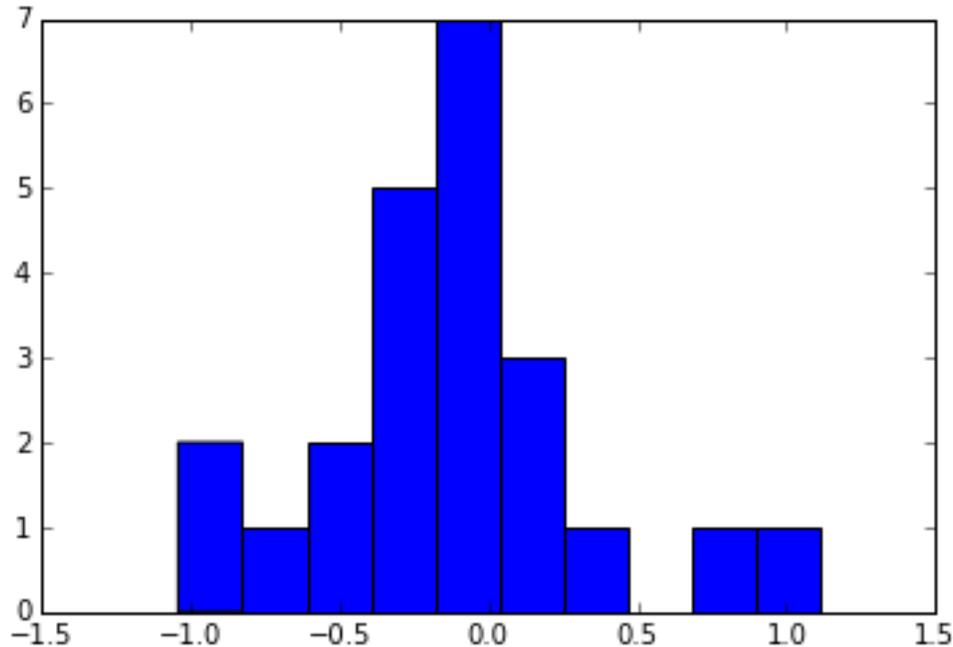
- ARIMA (Autoregressive Integrated Moving Average) Time Series
 - Uses Frequencies and Trends in the dataset
 - Example: Above normal October results in below normal December 80% of the time
 - No Outside information
- Random Forest (Machine Learning) Method
 - Uses an ensemble of decision trees
 - Uses teleconnection indices such as SOI, Nino 3.4, and PDO
 - Looking into other predictors
- Analog Method
 - Uses the same indices as listed above to select past matching years/months in the database.



Results

Number of Santa Ana wind days per month

Month	Min/Year		Max/Year		Avg
Sep	0	2015	6	2009	1
Oct	0	1987	12	2008	6
Nov	1	1984	18	1992	9



Santa Ana Wind Season Outlook

Issued: Thursday, September 1, 2016

The following is a new experimental product from Predictive Services which uses a number of statistical methods to make long range predictions of the Santa Ana wind season in Southern California. This outlook uses 30 years of historical meteorological data in conjunction with a blend of three statistical models which forecast above/below normal numbers of Santa Ana wind days for a 1 month and a 3 month time period. While it is difficult to assign specific winds speeds, a Santa Ana wind day is determined to be distinctly different from the light offshore winds which normally occur during the overnight and early morning hours of the day. Santa Ana wind days were defined by correlating wind velocities with synoptic scale weather patterns that result in gusty, dry offshore winds across Southern California. The models used in this outlook are: Random Forest, ARIMA Time Series, and Analog. The Random Forest and Analog methods use various predictors such as the Pacific Decadal Oscillation (PDO), the Southern Oscillation Index (SOI), and the Niño3.4 index. The time series model relies solely on frequencies and trends within the 30-year historical dataset.

September: For much of Southern California, the month of September is often a transition period between summer and fall. While the beginning of the month is often dominated by hot and dry weather, the latter half of the month can sometimes be associated with the first Santa Ana winds of the season. The mean number of Santa Ana wind days for the month is 1.19 with the day count ranging from 0 (2014, 2015, and in many other years) to 6 (2009). Output from 2 of the 3 statistical models suggest there will be near to slightly below normal number of Santa Ana wind days this month. However, with the mean being so small, the margin of error with this month's forecast is large and therefore confidence in this forecast is low.

September through November: Santa Ana wind days normally increase in frequency towards the end of this period. Both the Random Forest and the Analog models are leaning towards near to slightly below normal number of days during this period. Figure 1 shows the distribution of analog years to favor a slightly below normal number of days. In contrast, the Time Series model suggests a slightly above normal number of days. However it is important to note that the Time Series model does not use physically based predictors and is weighted least in the final prediction process.

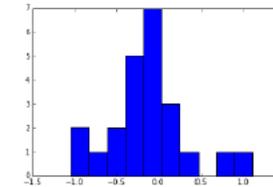


Figure 1 - Histogram of standardized Santa Ana wind day counts for all analog years.

Number of Santa Ana wind days per month					
Month	Min/Year	Max/Year			Avg
Sep	0	2015	6	2009	1
Oct	0	1987	12	2008	6
Nov	1	1984	18	1992	9

Therefore, we can expect either near normal or a slightly below normal number of Santa Ana days during this 90 day period.

Summary: To some degree, the [Pacific Decadal Oscillation \(PDO\)](#) is correlated to the frequency of Santa Ana wind days. A negative PDO tends to favor more Santa Ana wind days while a positive PDO is related to fewer days. Currently the PDO is in a positive phase but has been trending downward during the past several months. Other indices such as the [Niño3.4 Index](#) and the [Southern Oscillation Index \(SOI\)](#) can affect the overall synoptic weather patterns and ultimately the number of Santa Ana wind days in Southern California. While the forecast confidence is low for September, the overall confidence in the Sep-Nov time period is moderate to high. Two out of the three models used are forecasting near to slightly below normal number of days for both September and the September through November time periods. One caveat is that so far, none of the models used are able to determine the strength of the winds. From a fire perspective, fewer events does not necessarily equate to lower fire potential this fall. Fuels are at historically dry levels, and any Santa Ana winds that occur before winter rains commence will be problematic.

This outlook will be updated once a month, on or around the 1st of each month. Future content and format of this outlook may be subject to change.

Questions?