Smarter Weather Monitoring for your Wind Farm through Weather and Climate Analysis

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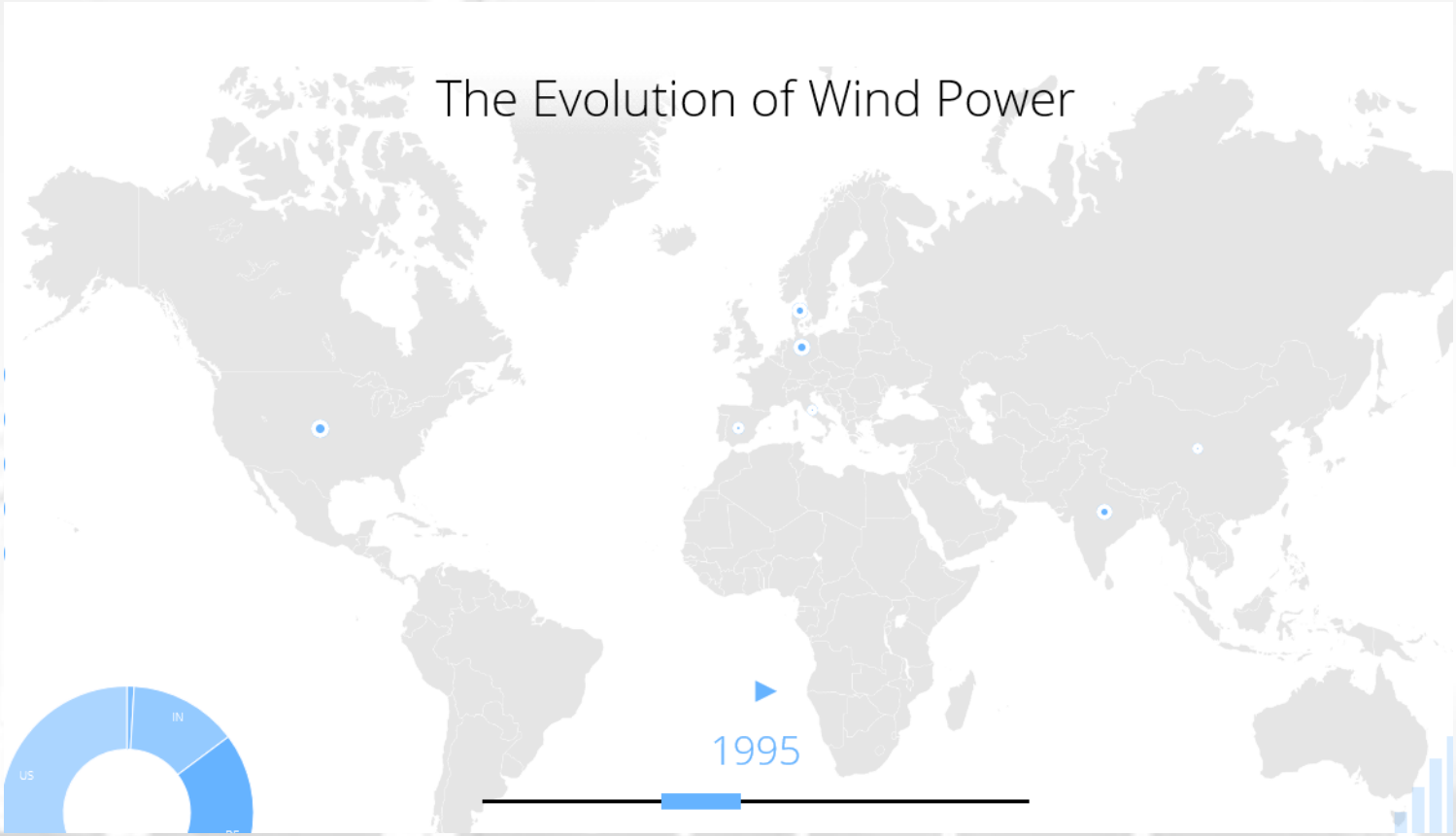
AWEA O&M 2017 San Diego

The Global Growth of Wind



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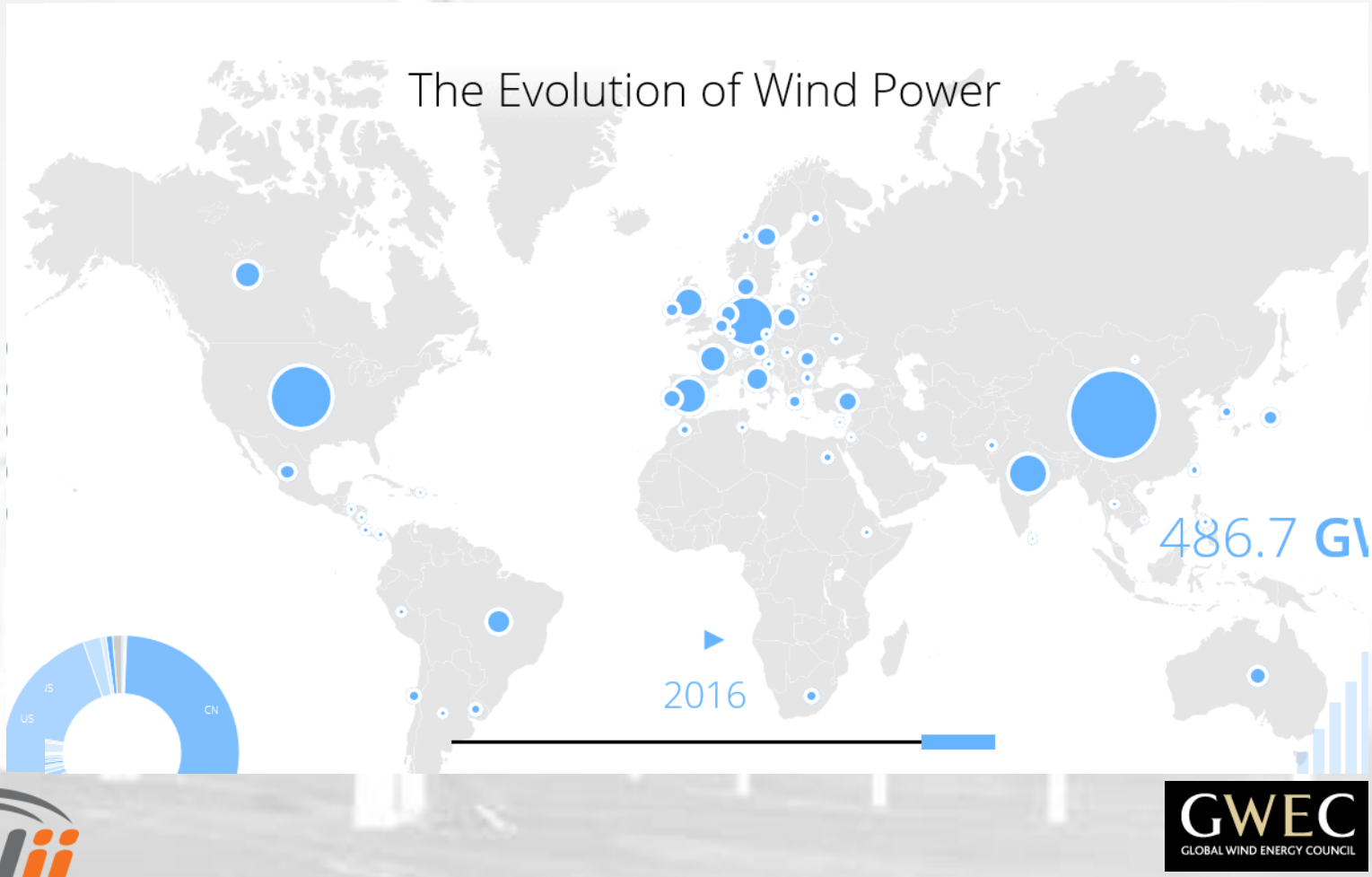
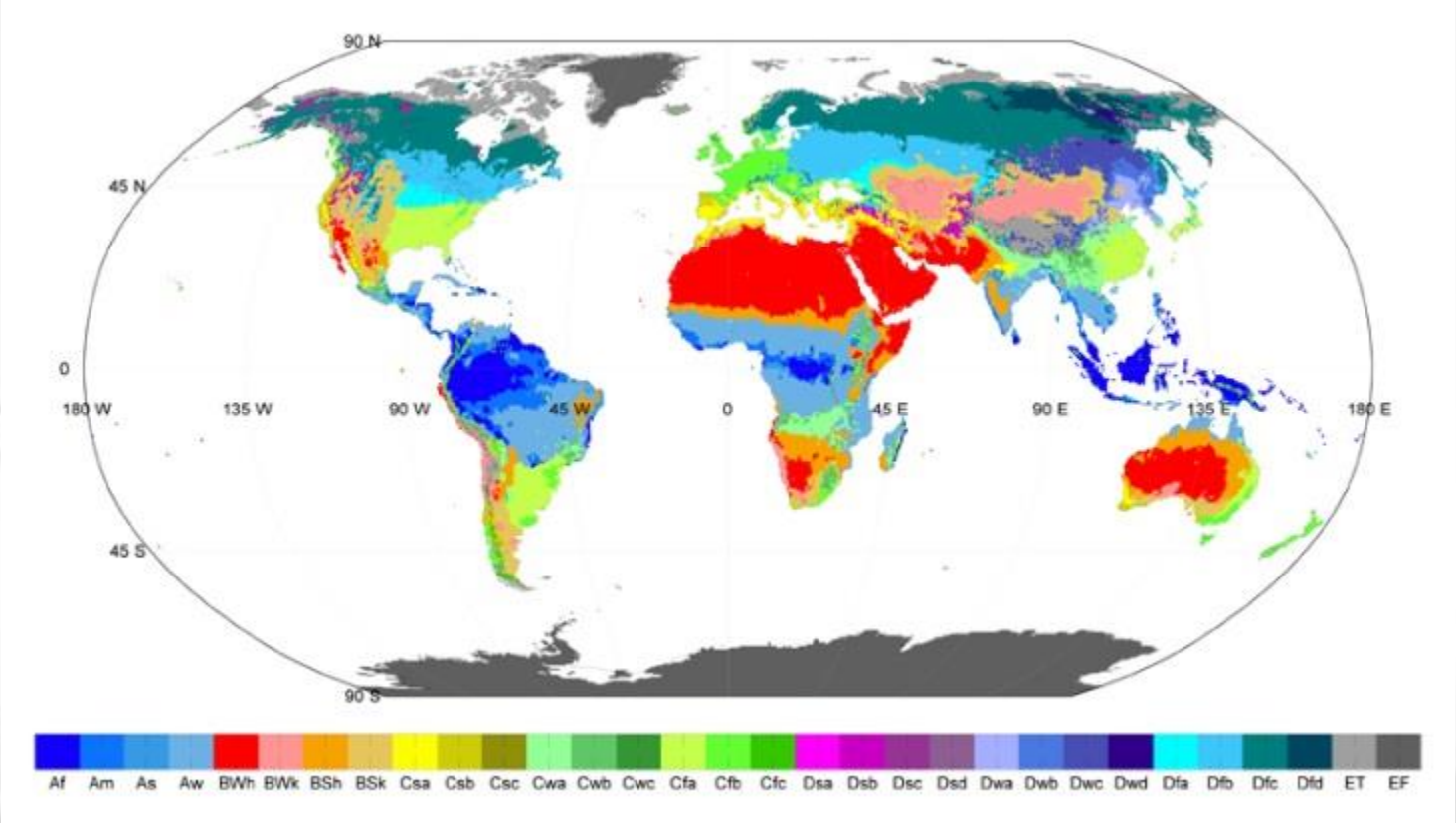
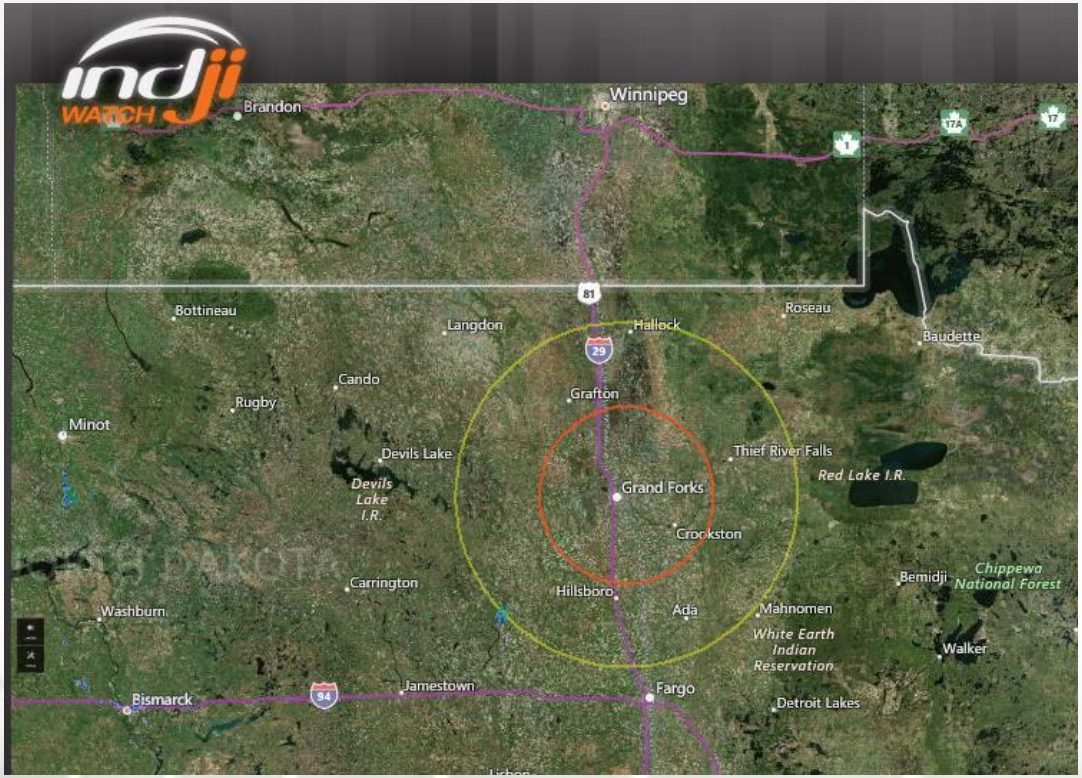


Koppen Climate Classification System



Standard Wind Farm Monitoring

- Rings to identify areas of concern
- Standard settings
- Based on ???



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How Fast do Storms Move?

- 0 to 60 ??
- Depends on many factors
- Terrain and Maritime influences too

La Ventosa

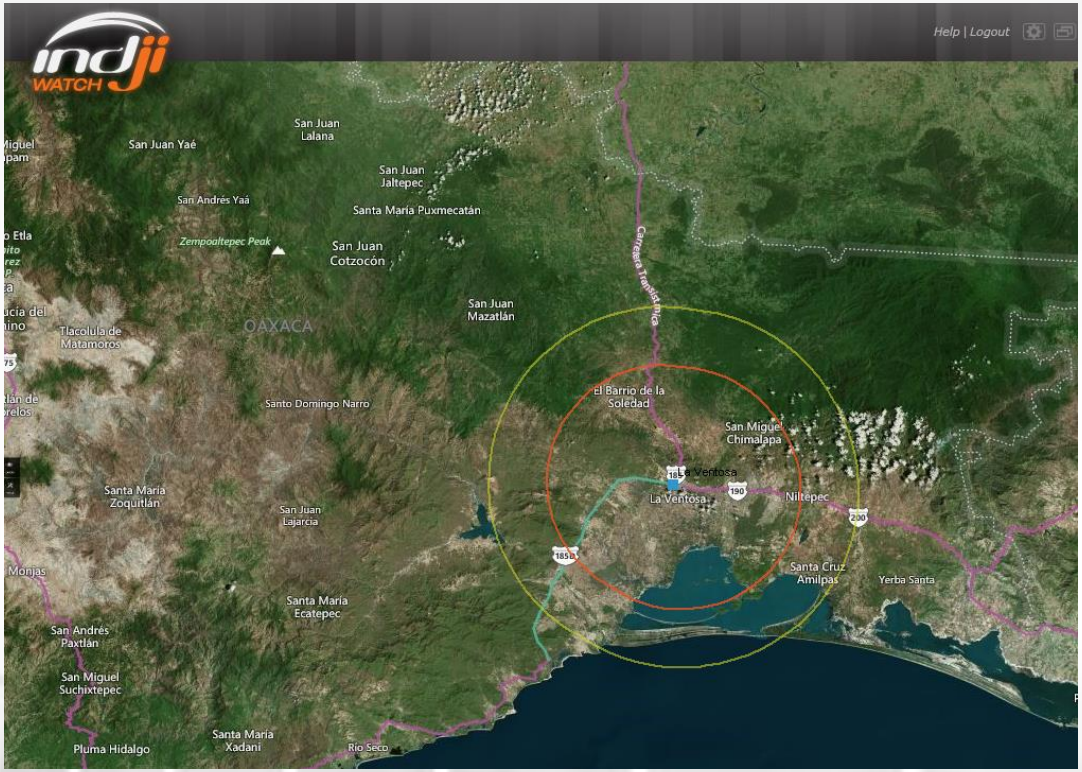
- Isthmus of Tehuantepec
- 27 2.5 MW turbines
- Power purchased by Walmart

La Ventosa

- Weather was creating challenges for productivity
- Frequent lightning alerts that caused tower stand-downs
- Alerts often did not lead to threatening weather at the wind farm

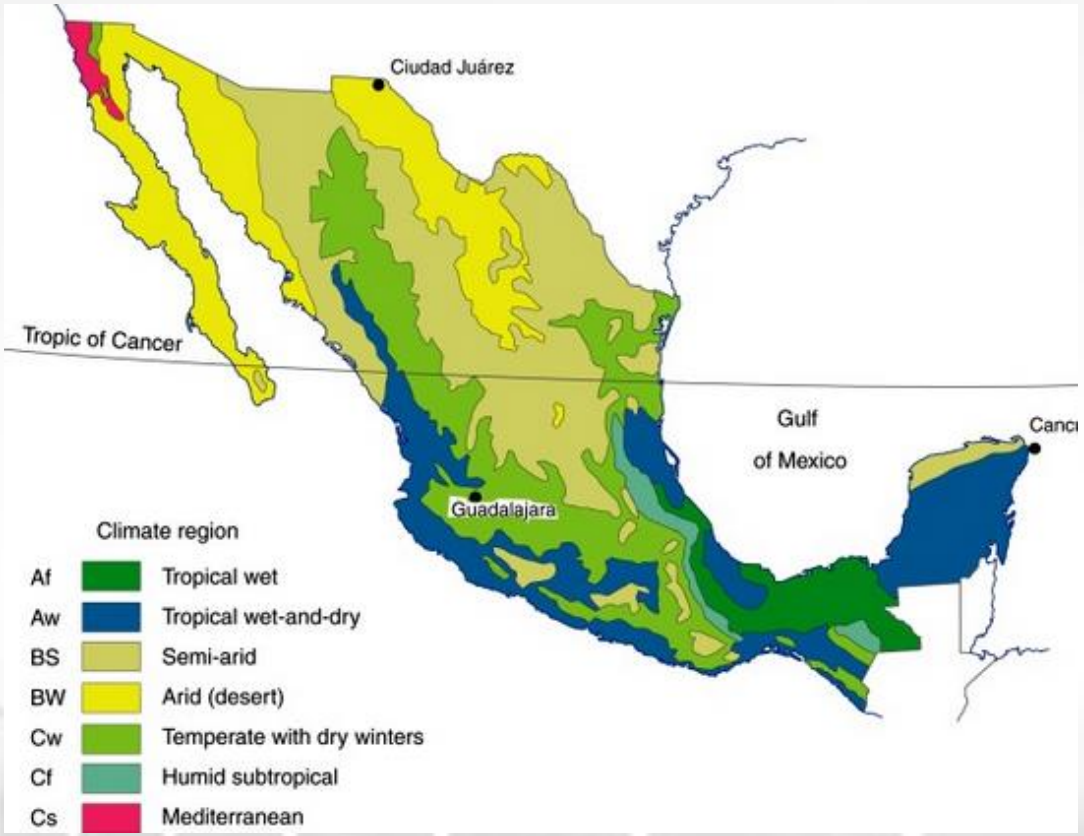
La Ventosa

- Client approached us
- Discovery and understanding phase
- Decision to investigate options for more targeted lightning alerts based on ring size



The climate of Oaxaca

- Officially classified as a Savana Climate
  - Warm to hot temperatures every month
  - Pronounced Dry Season
    - Except in mountain ranges

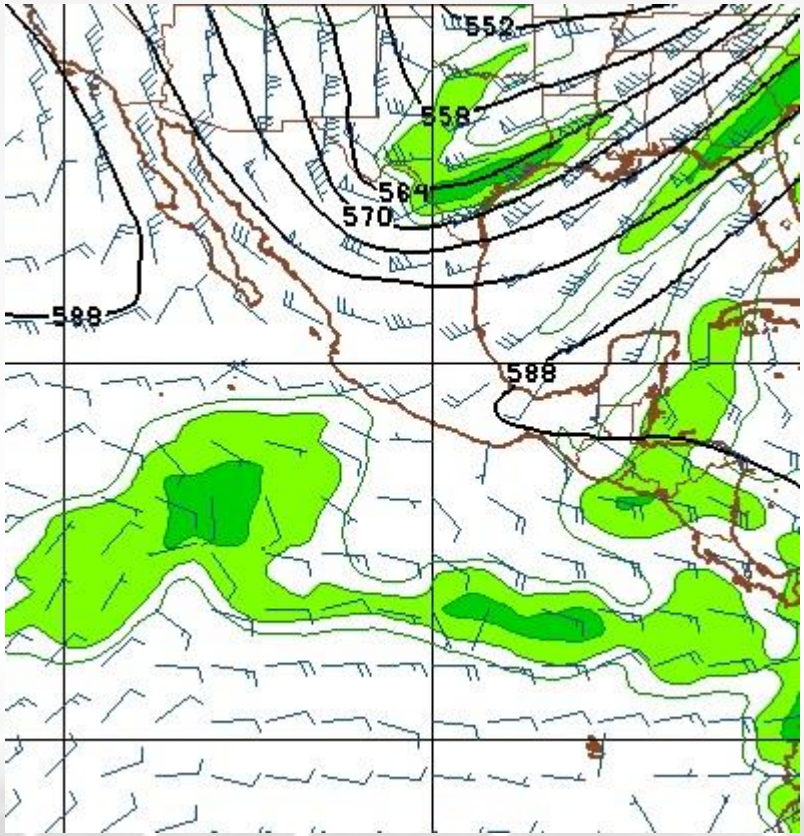


Official Climate Data

Climate data for Oaxaca (1951–2010) [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	38.5 (101.3)	38.0 (100.4)	40.5 (104.9)	41.6 (106.9)	43.0 (109.4)	40.0 (104)	36.7 (98.1)	36.5 (97.7)	36.0 (96.8)	35.5 (95.9)	35.0 (95)	34.0 (93.2)	43.0 (109.4)
Average high °C (°F)	27.6 (81.7)	29.5 (85.1)	31.9 (89.4)	33.2 (91.8)	32.4 (90.3)	29.4 (84.9)	28.5 (83.3)	28.5 (83.3)	27.8 (82)	27.9 (82.2)	27.7 (81.9)	27.0 (80.6)	29.3 (84.7)
Daily mean °C (°F)	18.3 (64.9)	19.8 (67.6)	22.3 (72.1)	24.0 (75.2)	24.1 (75.4)	22.8 (73)	21.9 (71.4)	21.8 (71.2)	21.5 (70.7)	20.8 (69.4)	19.4 (66.9)	18.3 (64.9)	21.3 (70.3)
Average low °C (°F)	9.0 (48.2)	10.2 (50.4)	12.7 (54.9)	14.8 (58.6)	15.9 (60.6)	16.1 (61)	15.2 (59.4)	15.0 (59)	15.3 (59.5)	13.7 (56.7)	11.1 (52)	9.6 (49.3)	13.2 (55.8)
Record low °C (°F)	0.5 (32.9)	1.0 (33.8)	3.0 (37.4)	4.0 (39.2)	9.0 (48.2)	9.0 (48.2)	9.0 (48.2)	9.0 (48.2)	9.0 (48.2)	4.5 (40.1)	1.0 (33.8)	0.0 (32)	0.0 (32)
Precipitation mm (inches)	3.3 (0.13)	5.1 (0.201)	13.1 (0.516)	39.3 (1.547)	86.4 (3.402)	170.4 (6.709)	116.3 (4.579)	111.6 (4.394)	135.6 (5.339)	52.3 (2.059)	9.3 (0.366)	3.3 (0.13)	746.0 (29.37)
Avg. precipitation days (≥ 0.1 mm)	0.9	1.3	2.3	5.7	10.7	17.2	16.9	16.3	17.1	7.8	2.3	1.0	99.5
% humidity	47	42	41	42	46	57	57	57	60	56	52	48	50
Source #1: Servicio Meteorológico Nacional[10][11]													
Source #2: Colegio de Postgraduados (humidity)[12]													

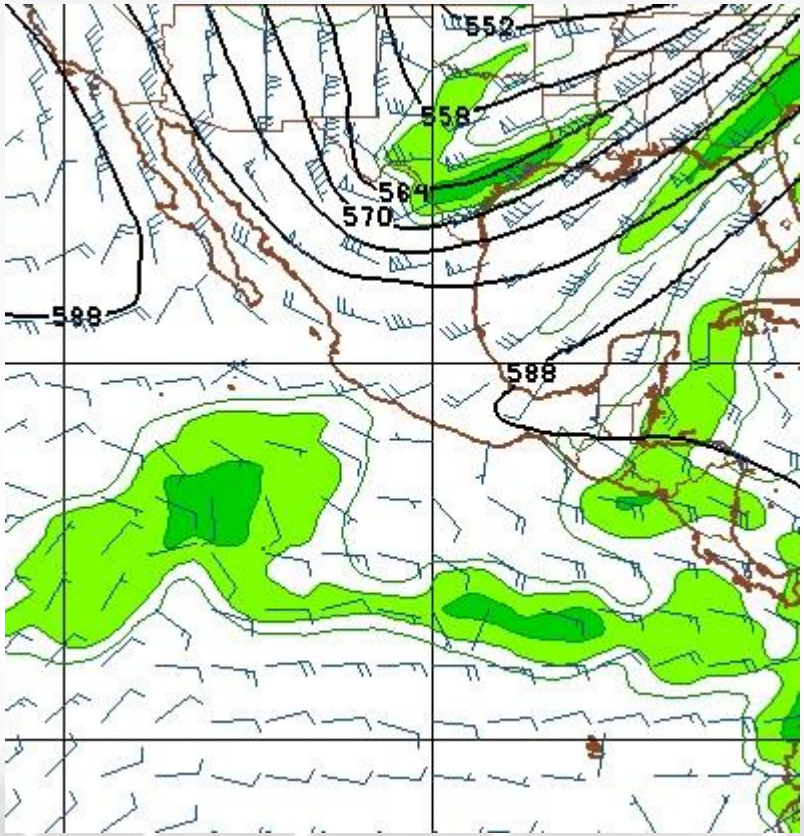
Seasonal Weather Breakdown

- Nov. - February
  - Very Dry
  - High Pressure Dome
    - Stable
  - West or Northwest winds aloft
    - Can have an influence, cooler and drier



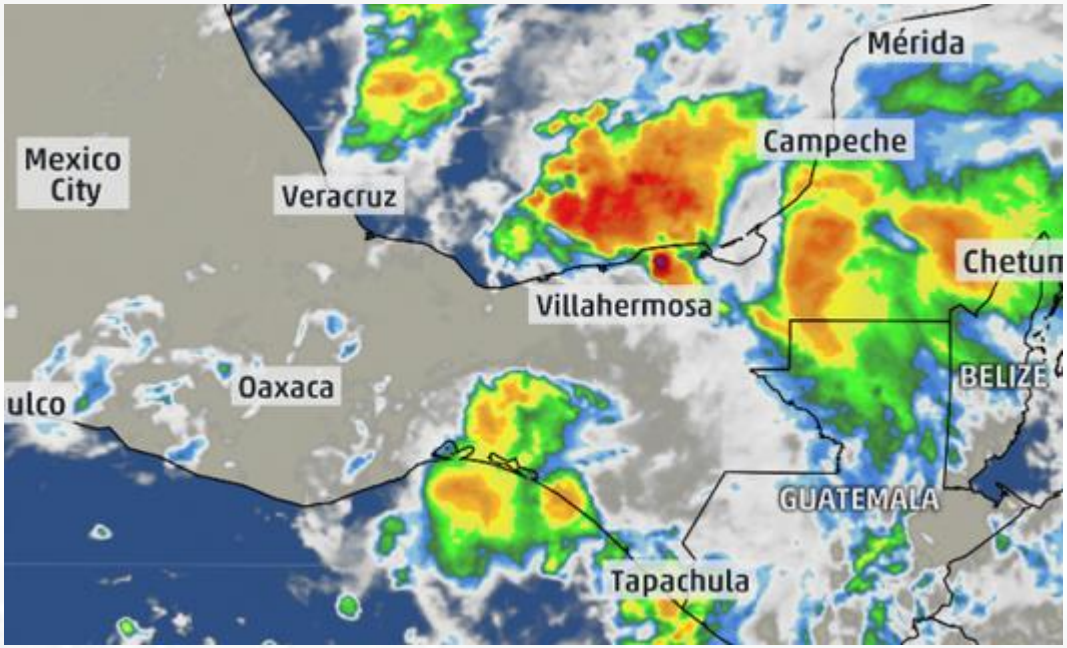
Seasonal Weather Breakdown

- March - May
  - Hottest months
  - Transition to Spring
  - Humidity increase
  - Daytime heating storms
    - Most likely inland
    - Higher elevations



Seasonal Weather Breakdown

- June-October
  - Very wet
  - Especially June to Sept.
  - Dominated by easterly winds aloft, tropical season
  - Storms that are offshore are prone to stay there, especially Aug-Sept.
  - Ocean Breeze can trigger inland storms



Oaxaca Weather Challenges

- Predicting storm development location is a challenge
  - No fronts!
  - Tropical waves are tough to spot for lay person (explain)
  - Mountains are common location

La Ventosa

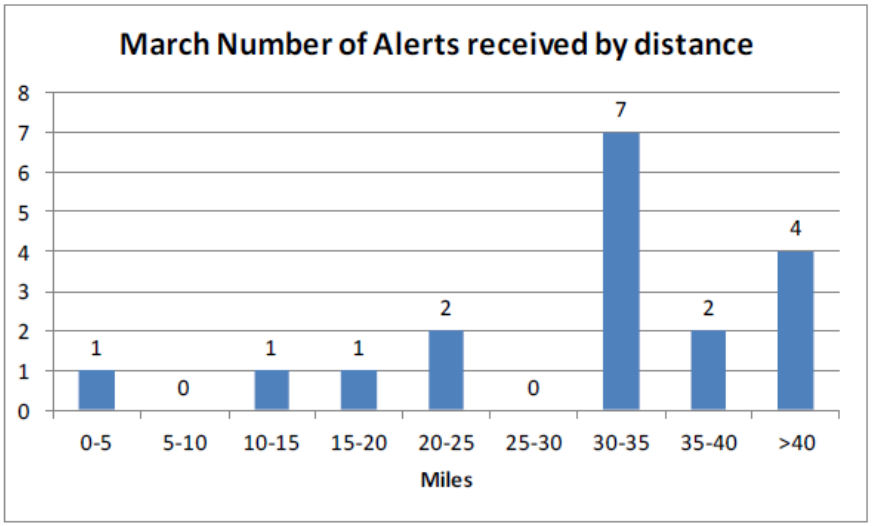
- Weather and climate analysis results
- Conclusions

La Ventosa

- Client conducted internal analysis of potential update to ring size
- Studied a two-month period, March and April 2015

La Ventosa

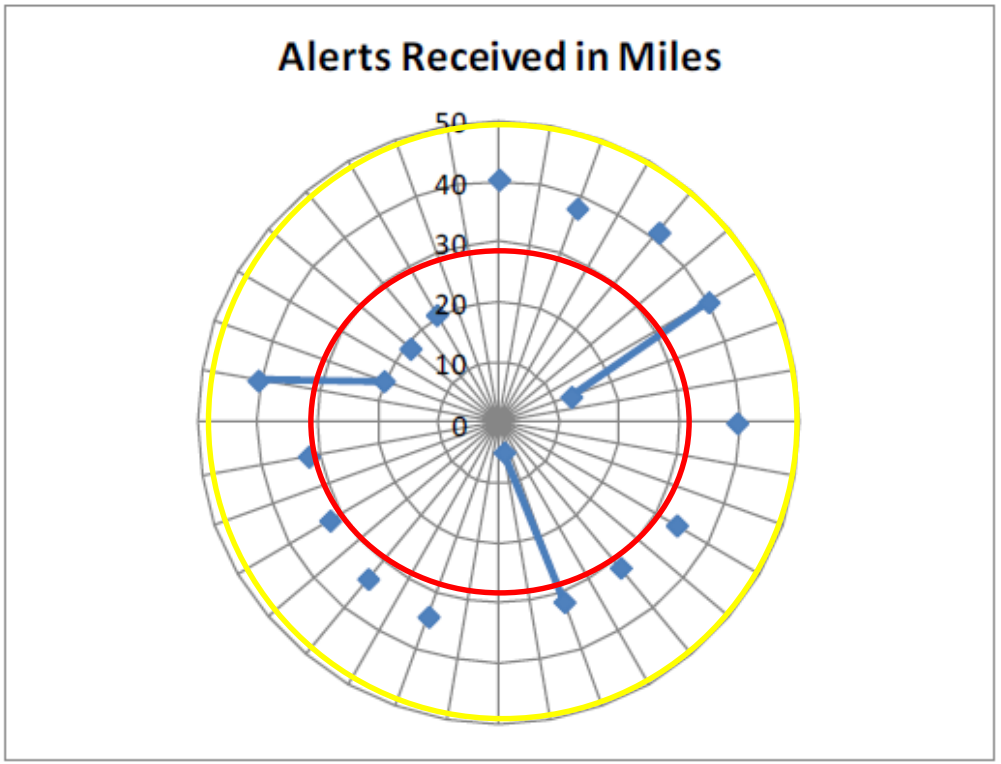
- Client analysis results



GP.01. Number of watching/warning alerts received group by distance in miles from the center of the site. (La Mata – La Ventosa)

La Ventosa

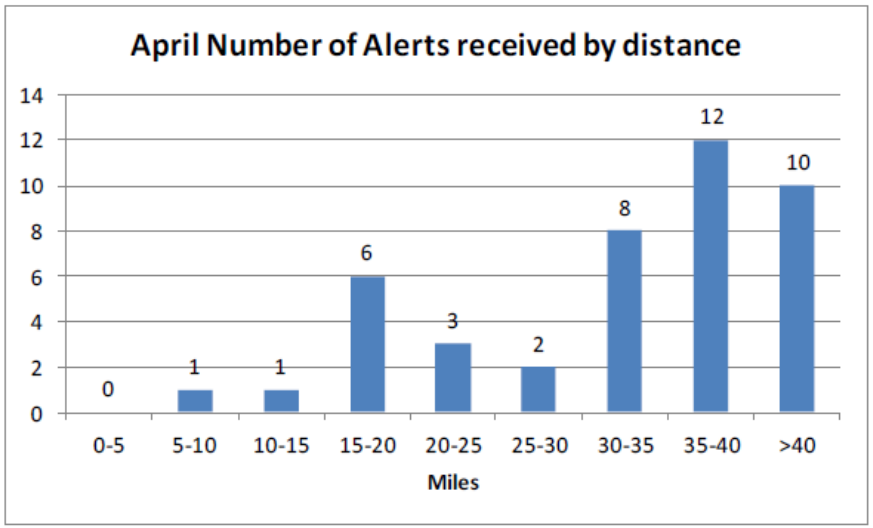
- Client analysis results



GP.02. Watching/Warning alerts graphic by rings of miles

La Ventosa

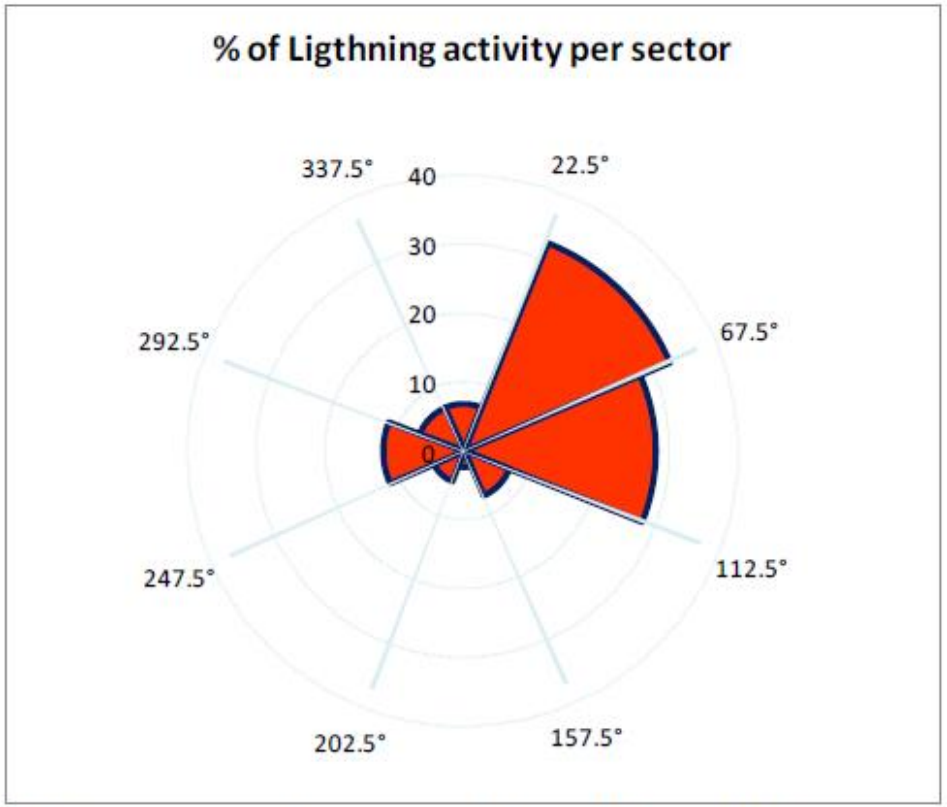
- Client analysis results



GP.06. Number of watching/warning alerts received group by distance in miles from the center of the site. (La Mata – La Ventosa)

La Ventosa

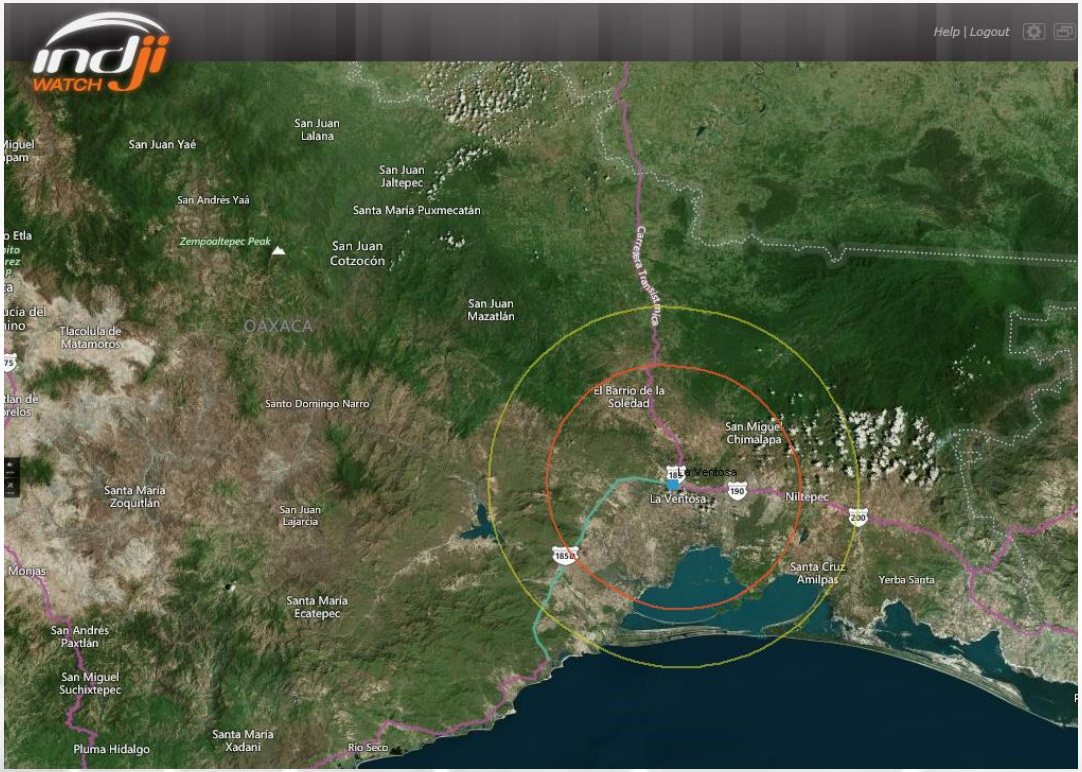
- Client analysis results



GP.08 Percentage of occurrence of the lightning alerts by sector

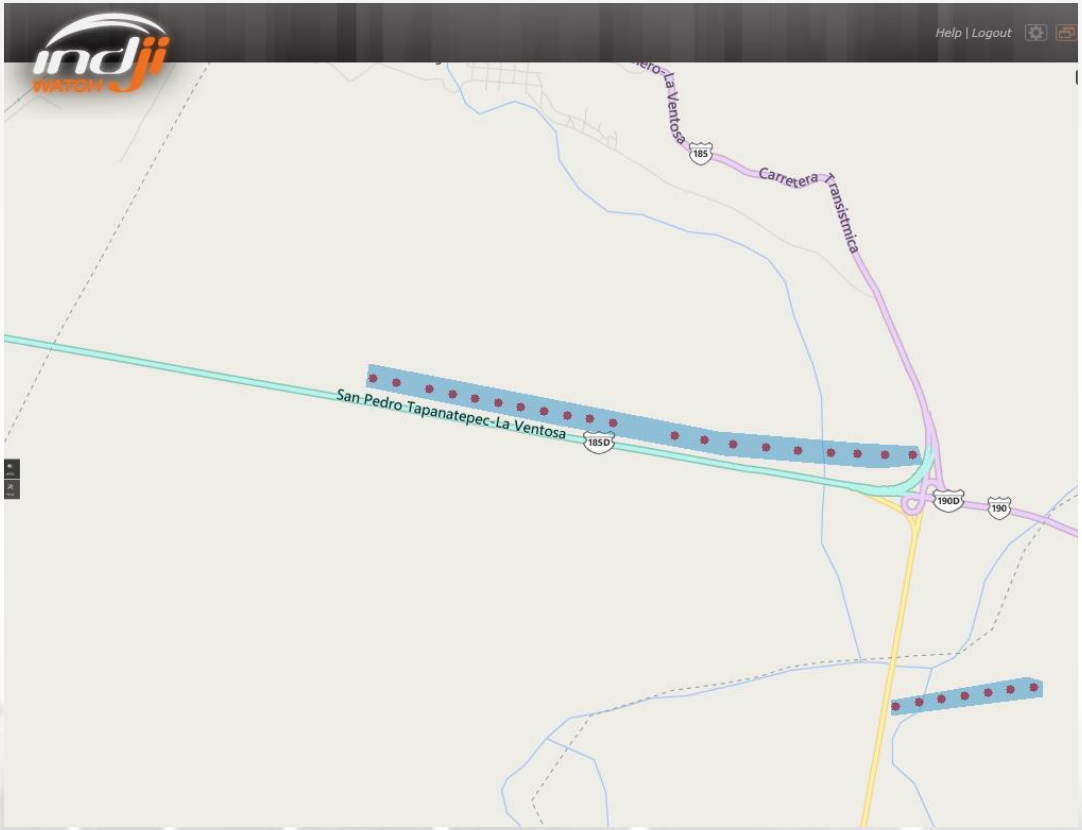
La Ventosa

- Client study results
- Conclusions



La Ventosa

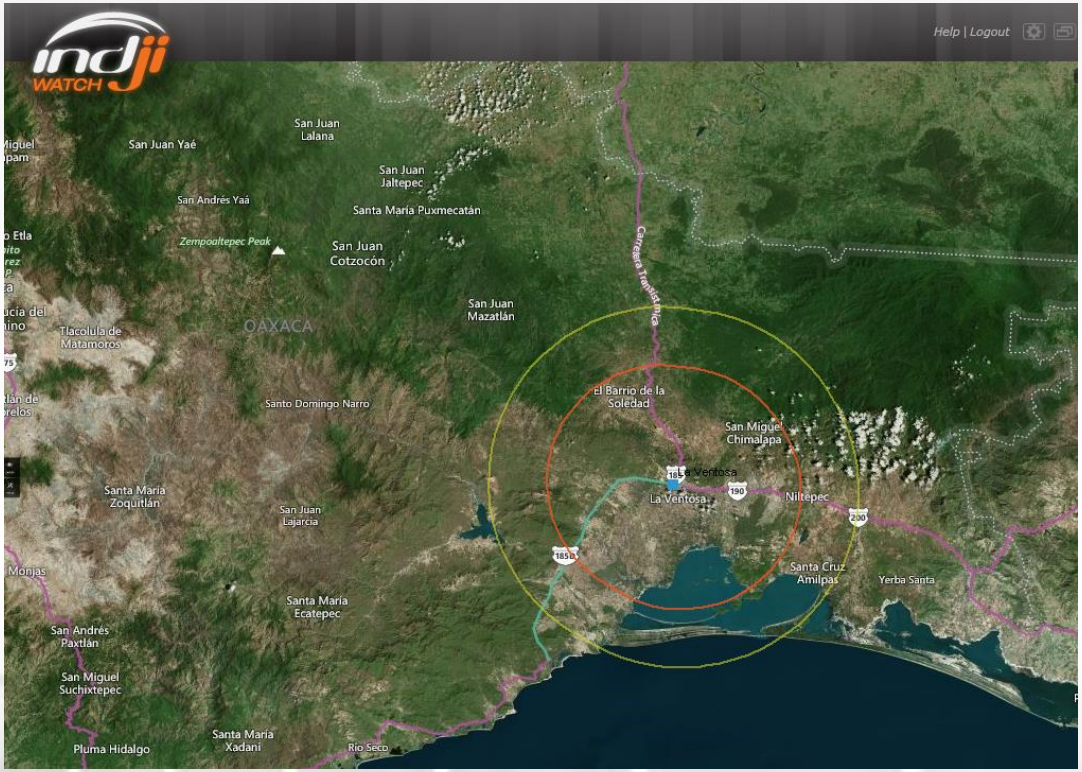
- Monitoring method is also important
- What is the foot-print or aerial coverage of your farm?



La Ventosa

Weather and Climate Analysis

- Rings now set at 20 and 30
- Level of safety has been maintained
- Productivity has increased
- Significant savings on cranes and mobilization costs
- More turbine uptime, more power generation



Q&A

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