MATH MODELING CAN MAKE YOU FILTHY RICH

ROBERT KAPLINSKY

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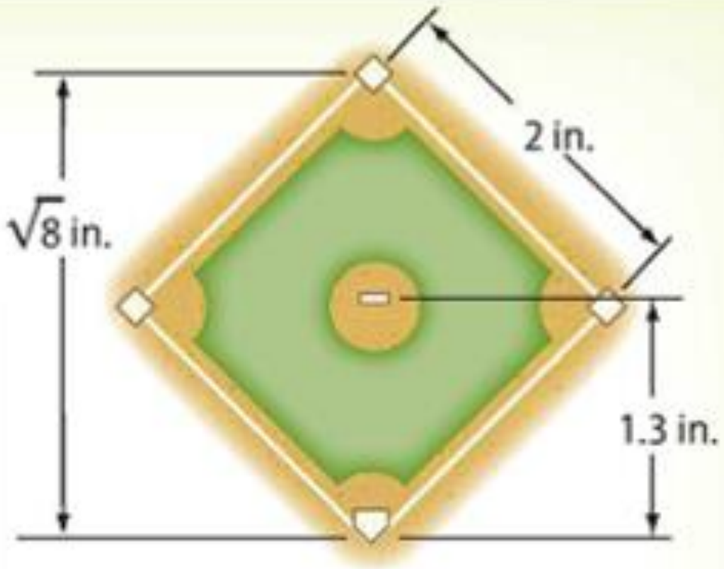
@robertkaplinsky

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Real-World Link

Common Core State Standards

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8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
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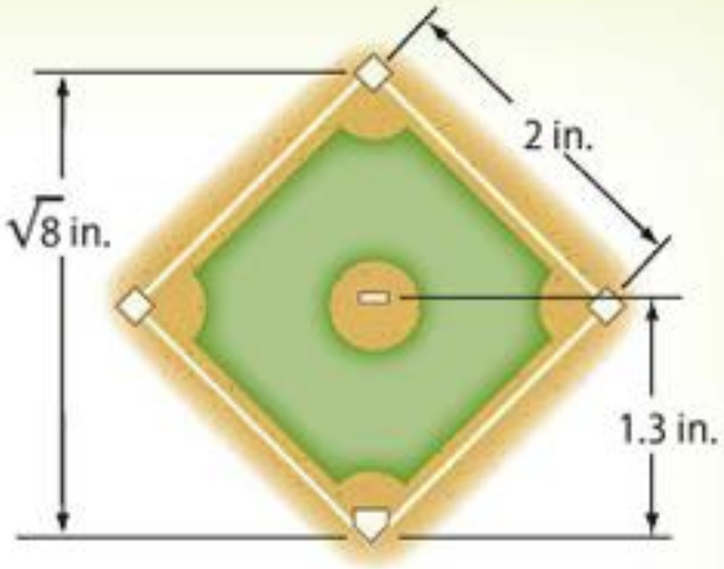

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Doritos® & Cheetos® Mix

20 Singles

DORITOS® Nacho Cheese Flavored Tortilla Chips 1 OZ. EA. DORITOS® COOL RANCH® Flavored Tortilla Chips 1 OZ. EA. CHEETOS® Puffs Cheese Flavored Snacks ⅞ OZ. EA. CHEETOS® Crunchy Cheese Flavored Snacks 1 OZ. EA.

20 INDIVIDUAL BAGS: ⅞ OZ. EACH, 1 OZ. EACH, TOTAL NET WT. 19⅝ OZ. (1 LB. 3⅝ OZ.) 556.3 g

⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

THINKING TIME

- Why did many of you expect there to be five of each?
- Why was it not five of each?
- How might they decide on this combination?

Classic Mix

20 Singles

LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)

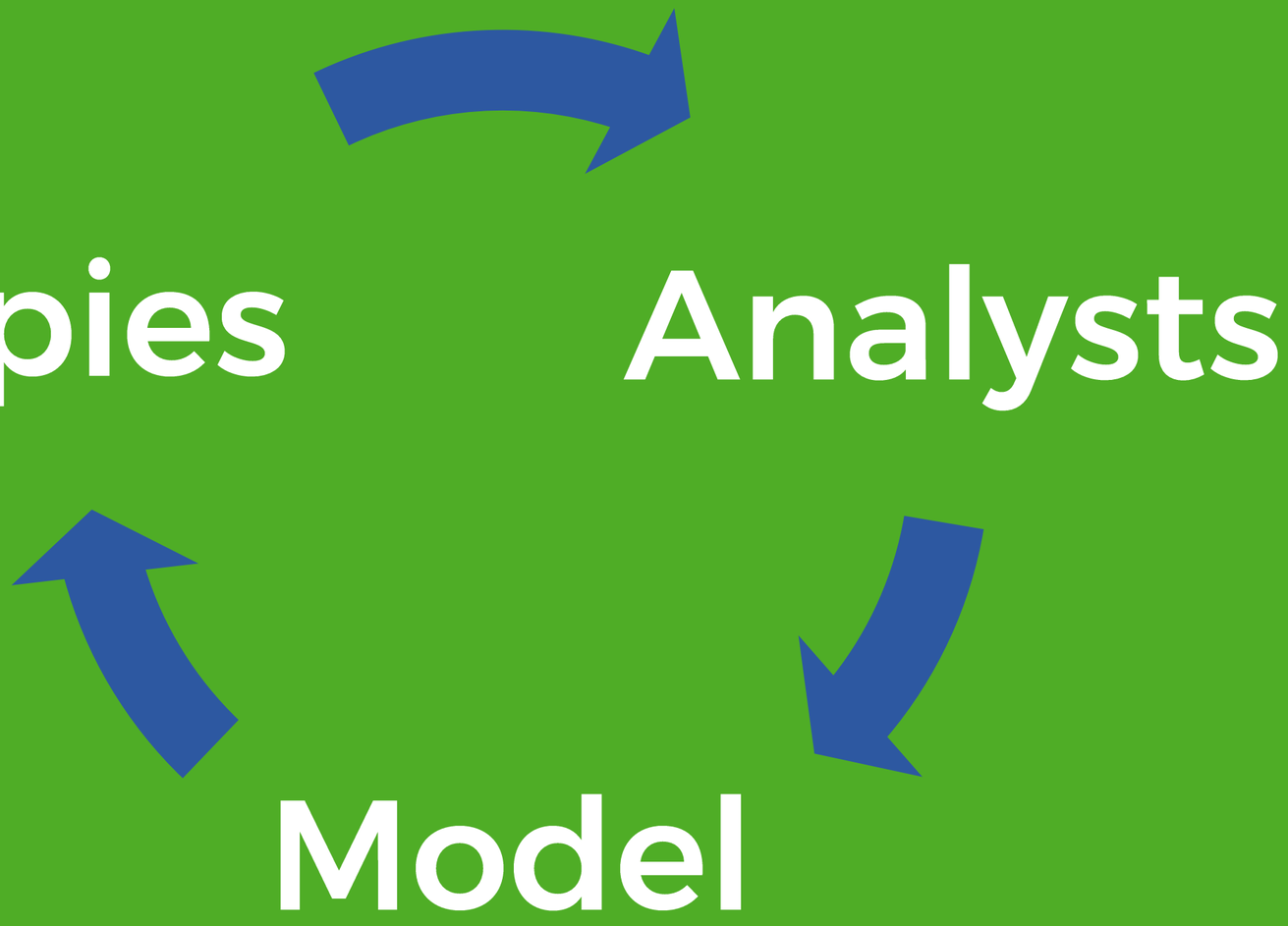
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g

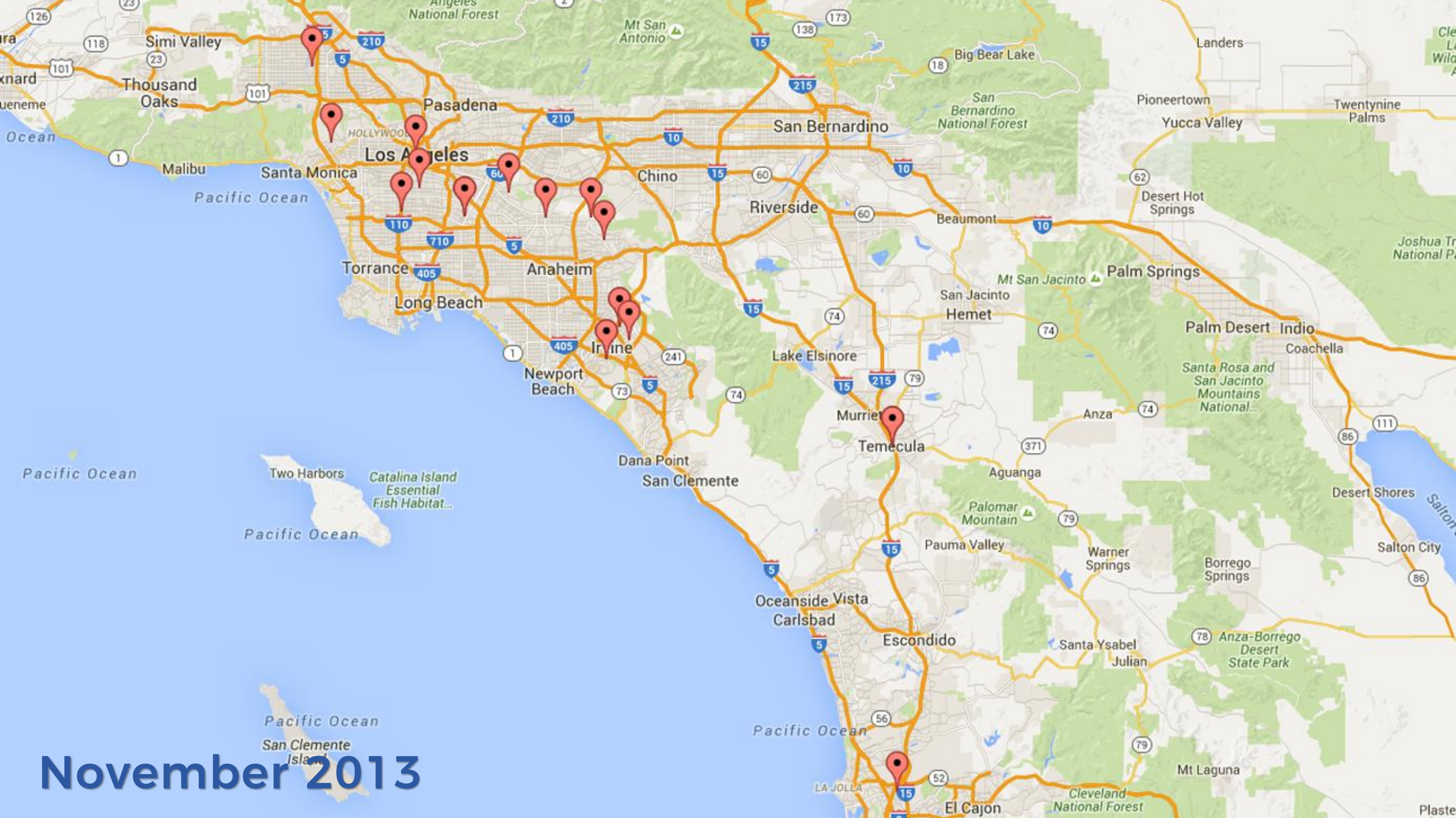
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

GOALS

- ❑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ❑ IS IT JUST ANSWERING QUESTIONS?
- ❑ HOW DO YOU PROFIT FROM MATH MODELING?
- ❑ HOW DO WE HELP OUR STUDENTS IMPROVE?
- ❑ WHERE CAN WE FIND MORE RESOURCES?


CENTRAL INTELLIGENCE AGENCY
UNITED STATES OF AMERICA


Spies
Analysts
Model



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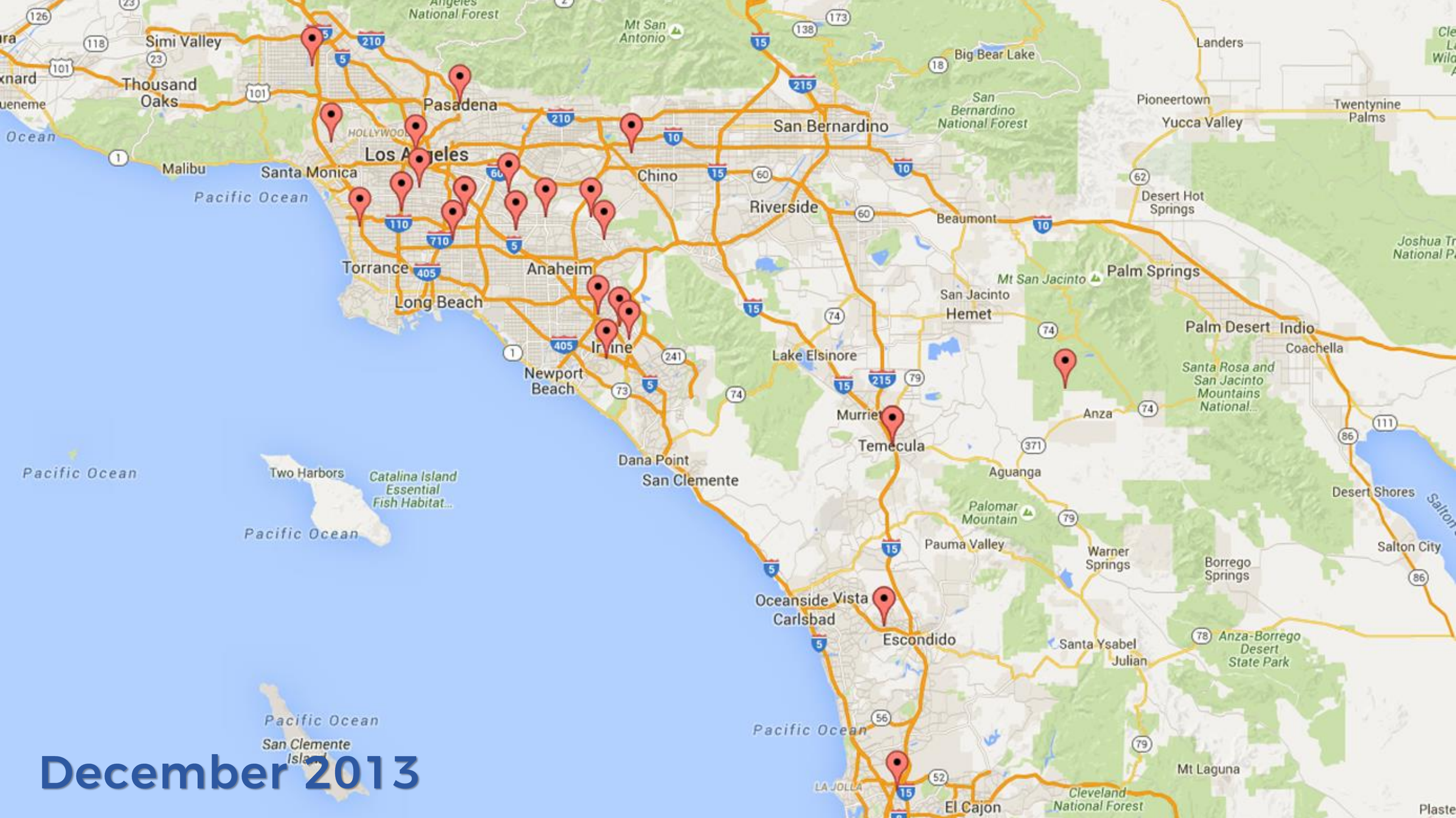
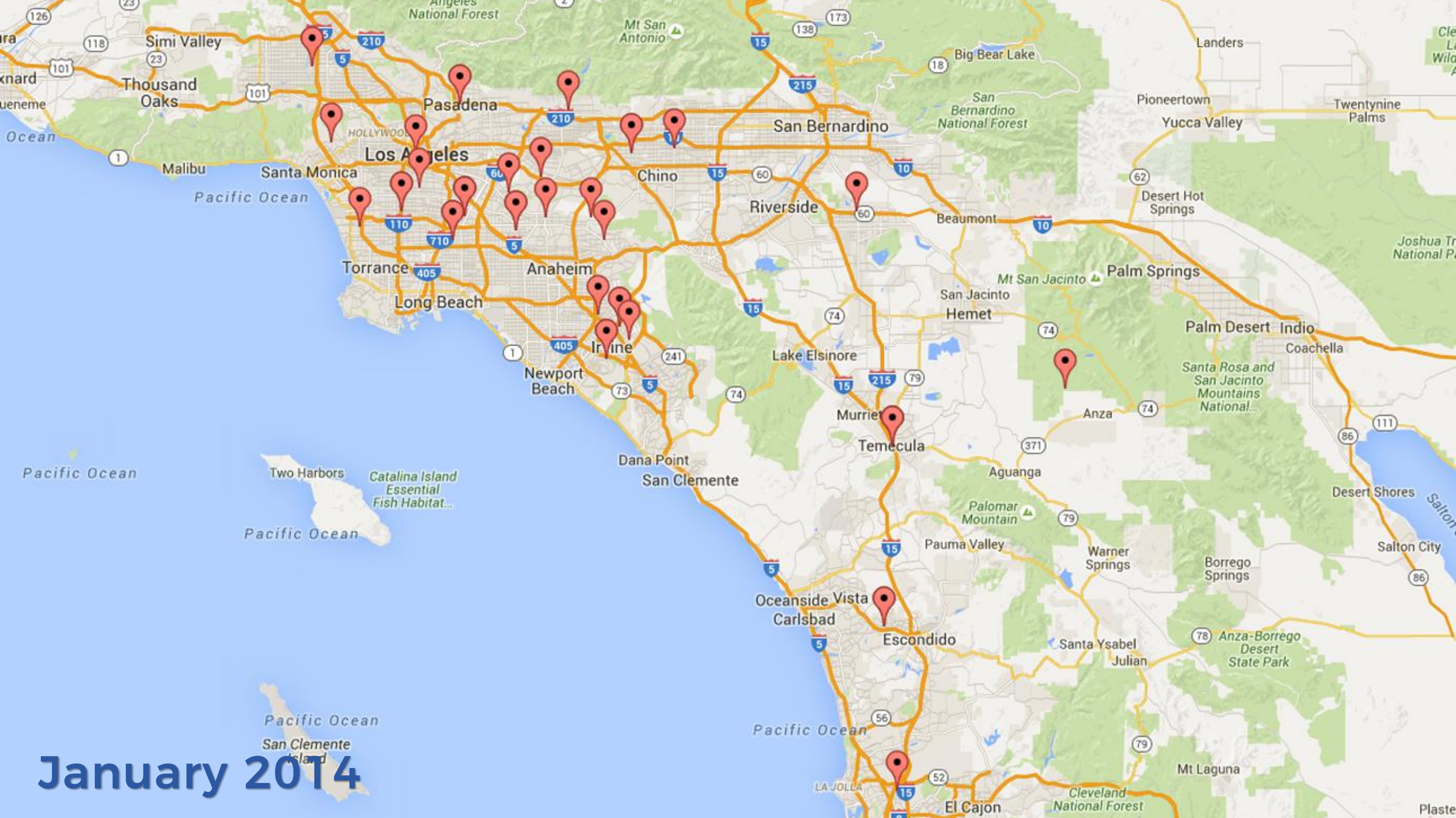
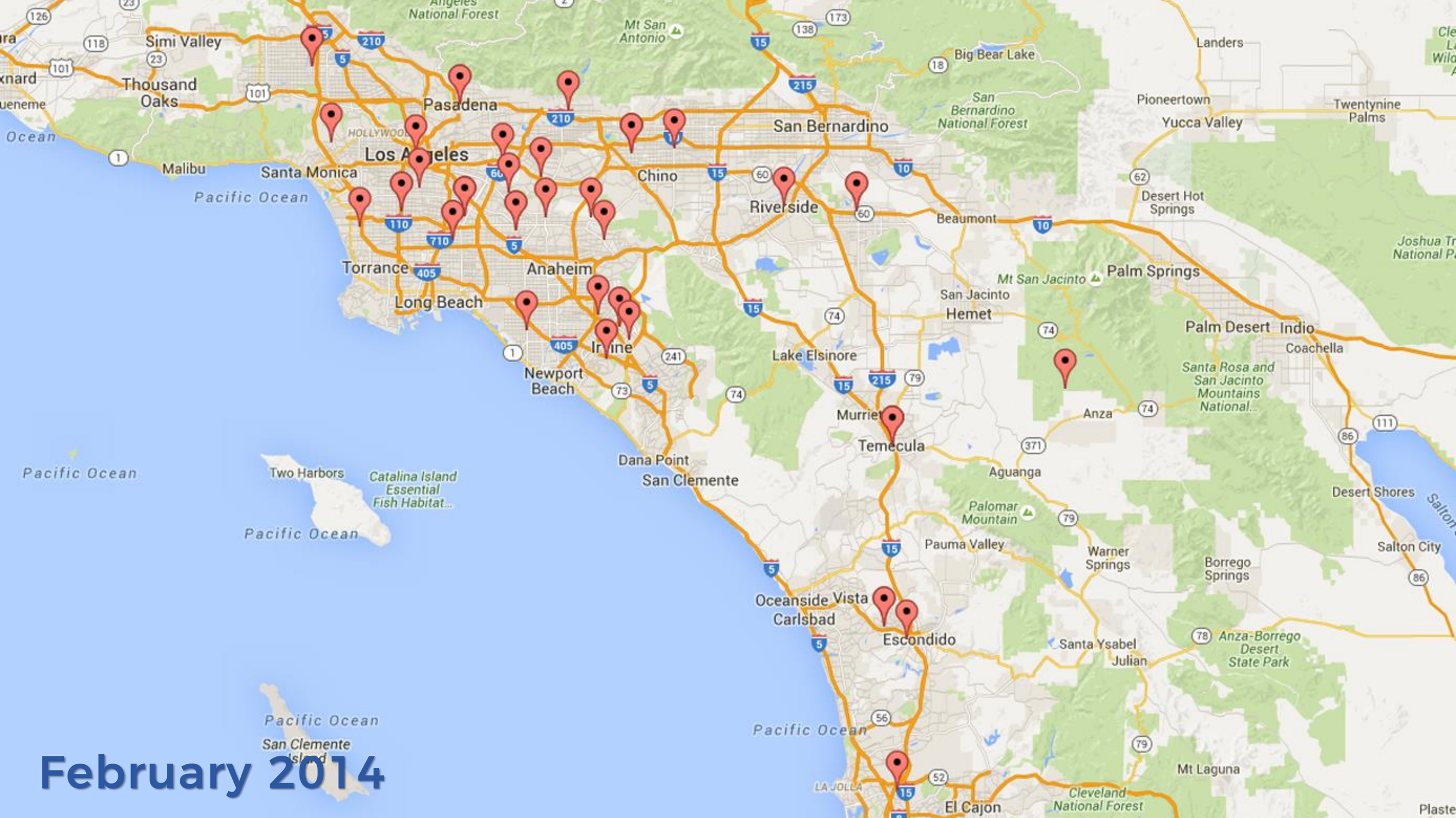


December 2013



January 2014



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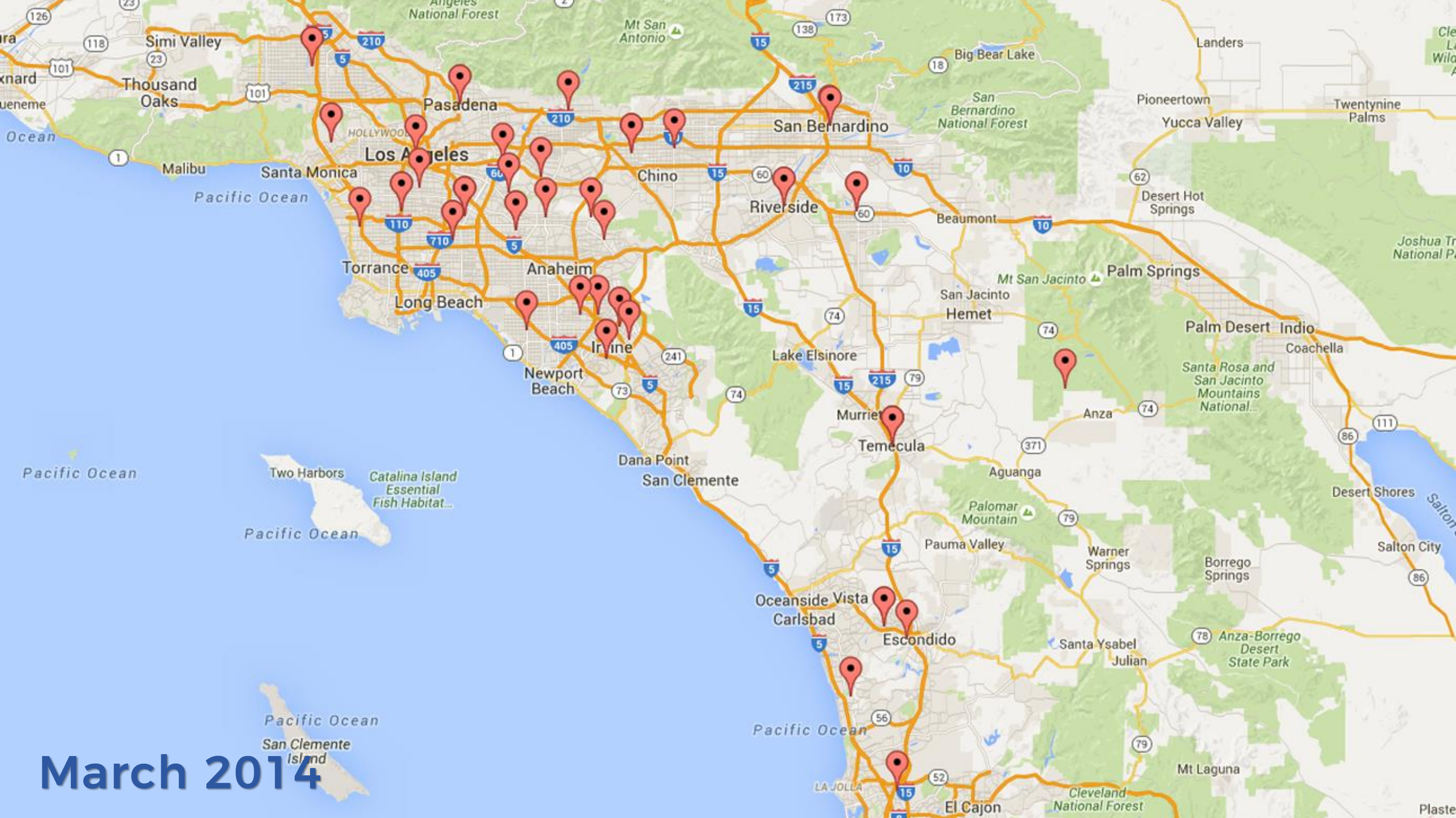
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Thousand Oaks
Pasadena
Los Angeles
Malibu
Santa Monica
Pacific Ocean
Chino
San Bernardino
Riverside
Big Bear Lake
Landers
Pioneertown
Yucca Valley
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Catalina Island Essential Fish Habitat...
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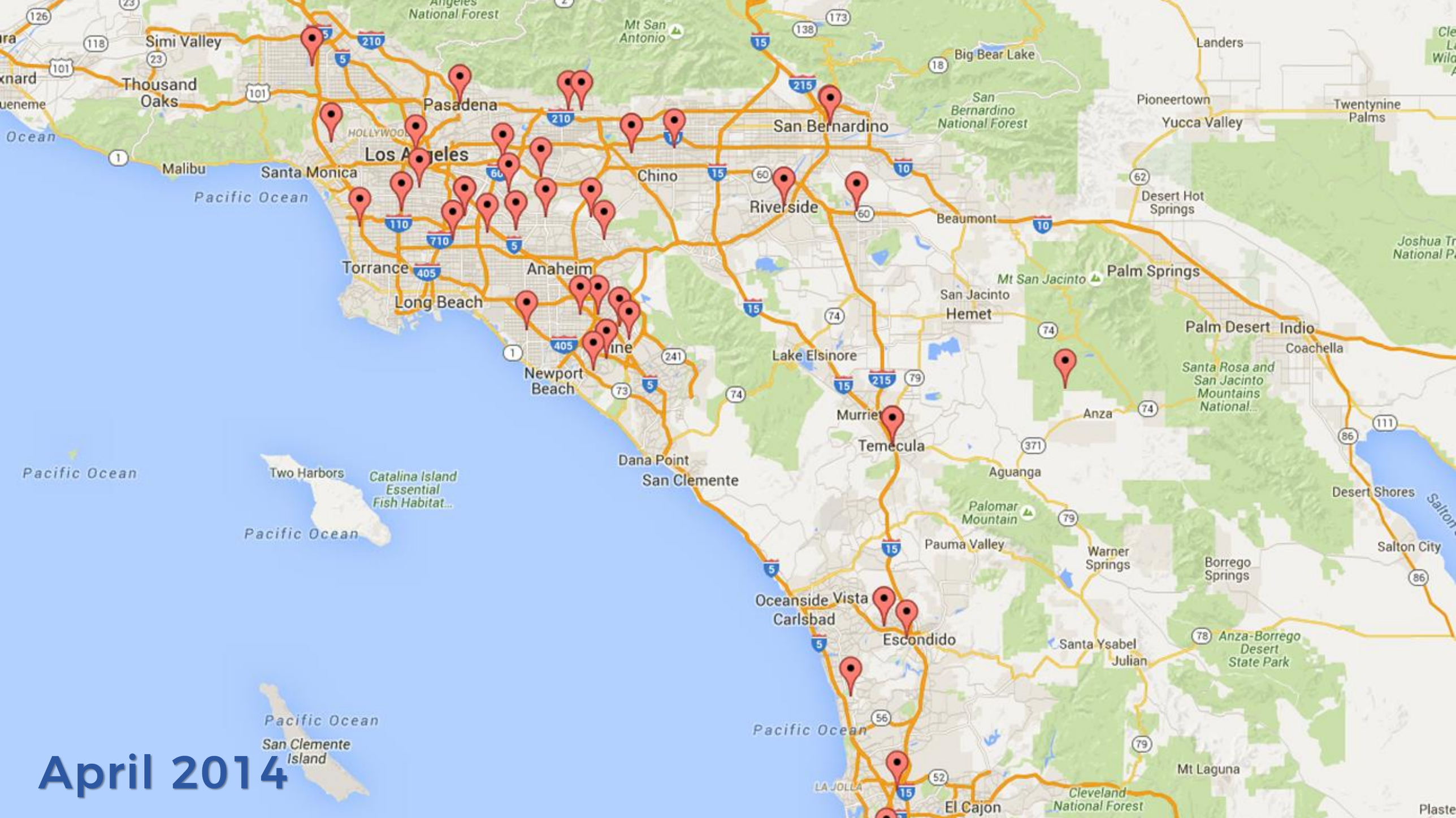
Santa Rosa and San Jacinto Mountains National...

March 2014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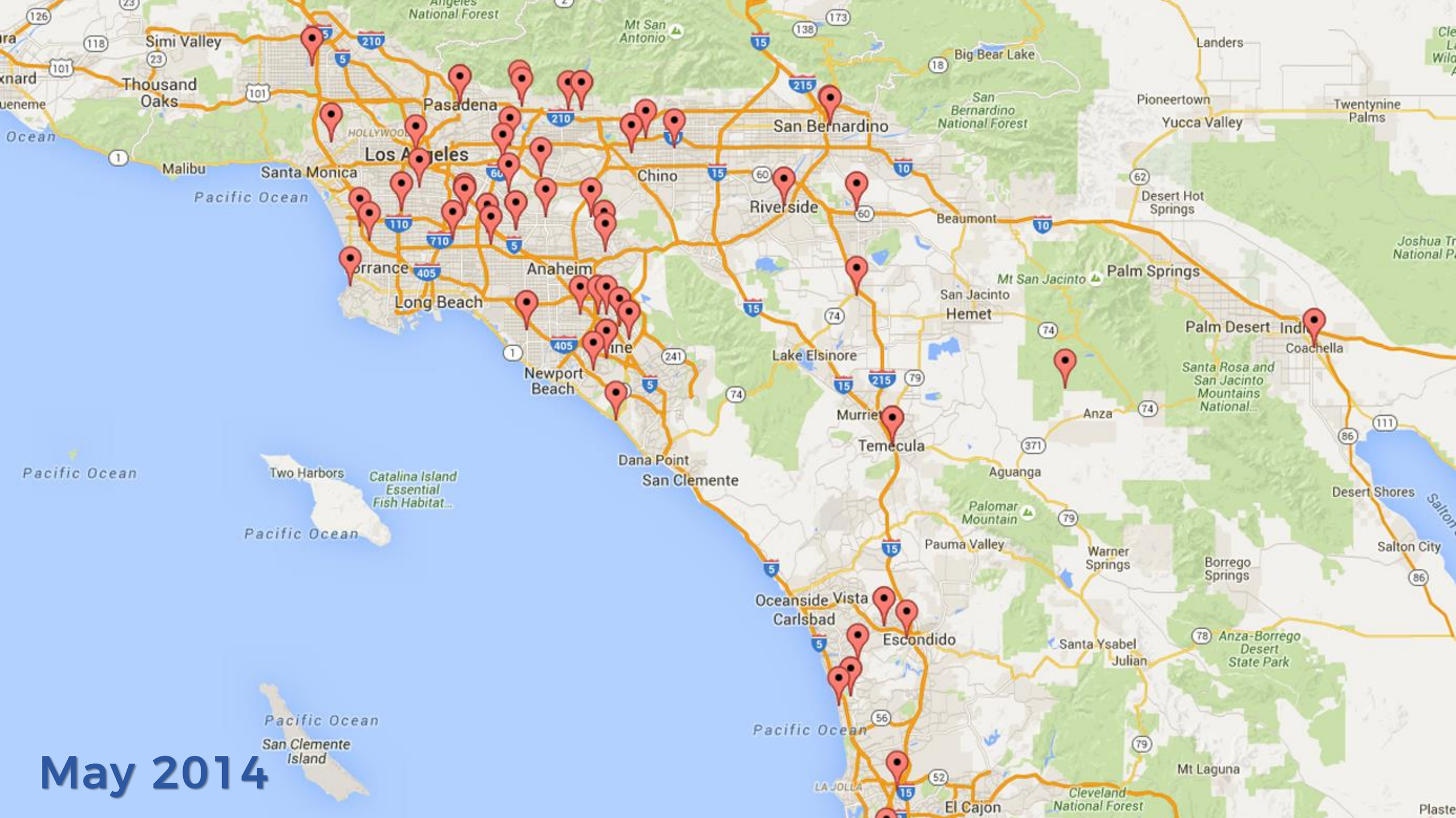
April 2014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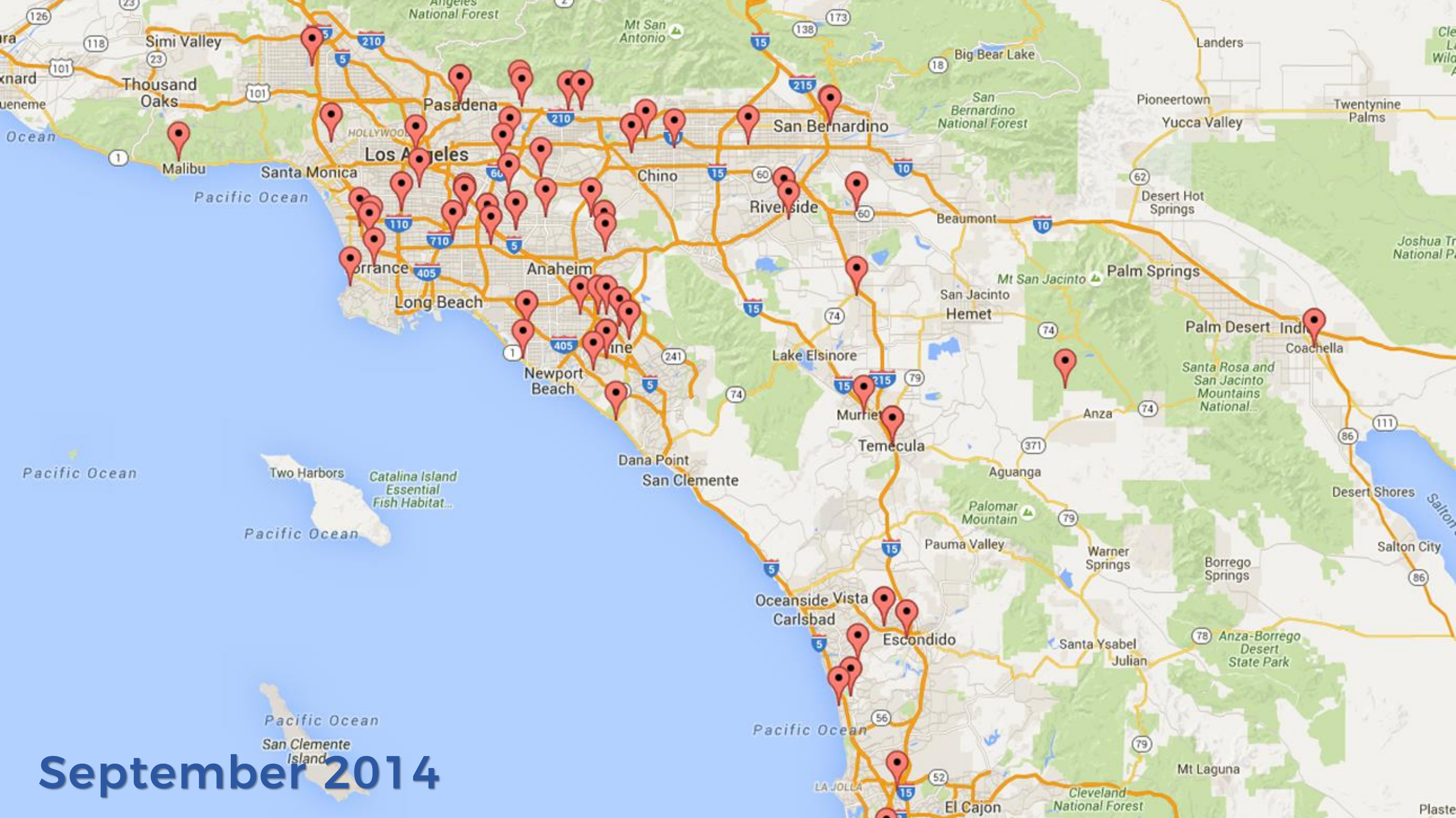
Cleveland National Forest
LA JOLLA
HOLLYWOOD



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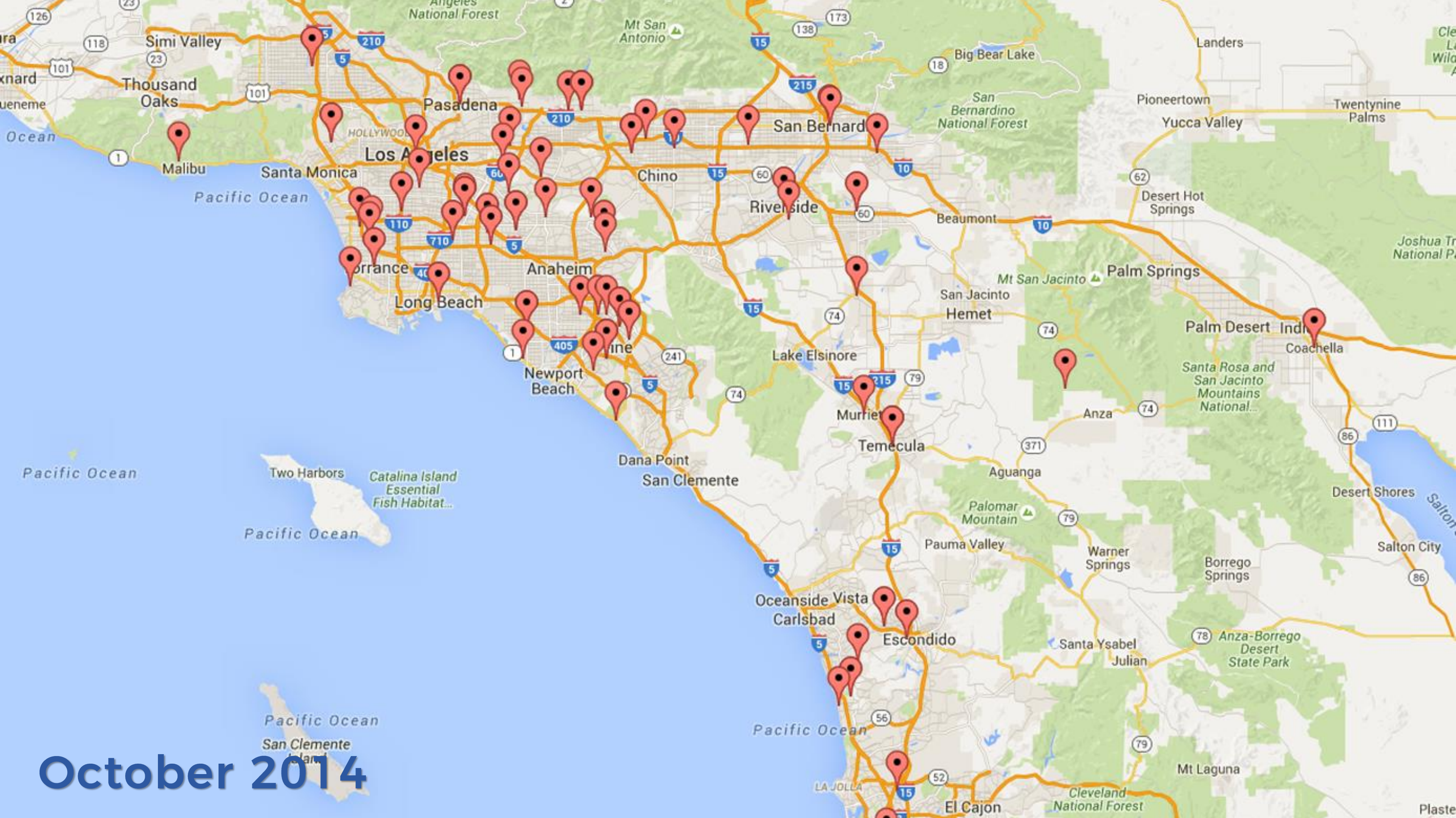

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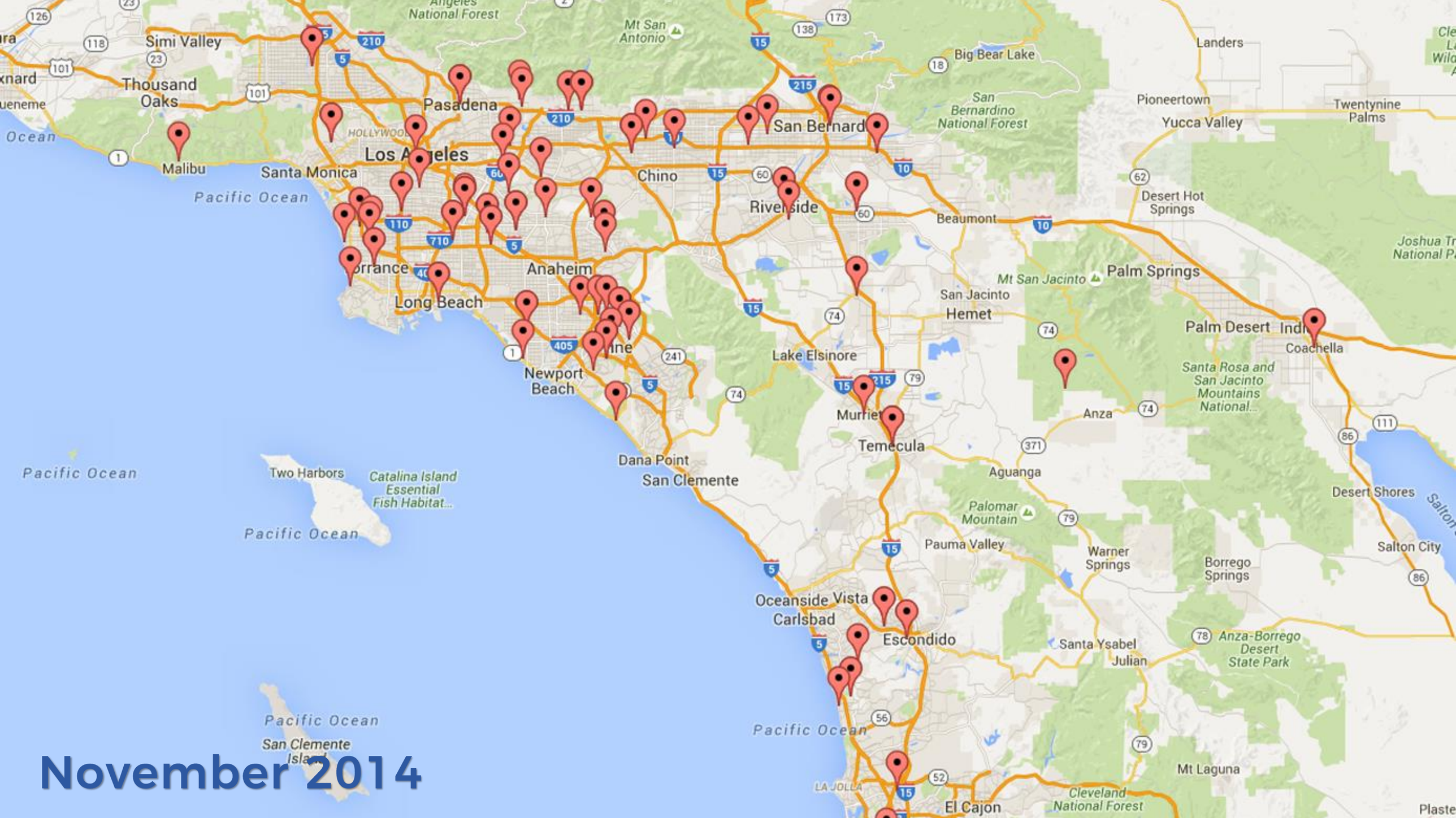

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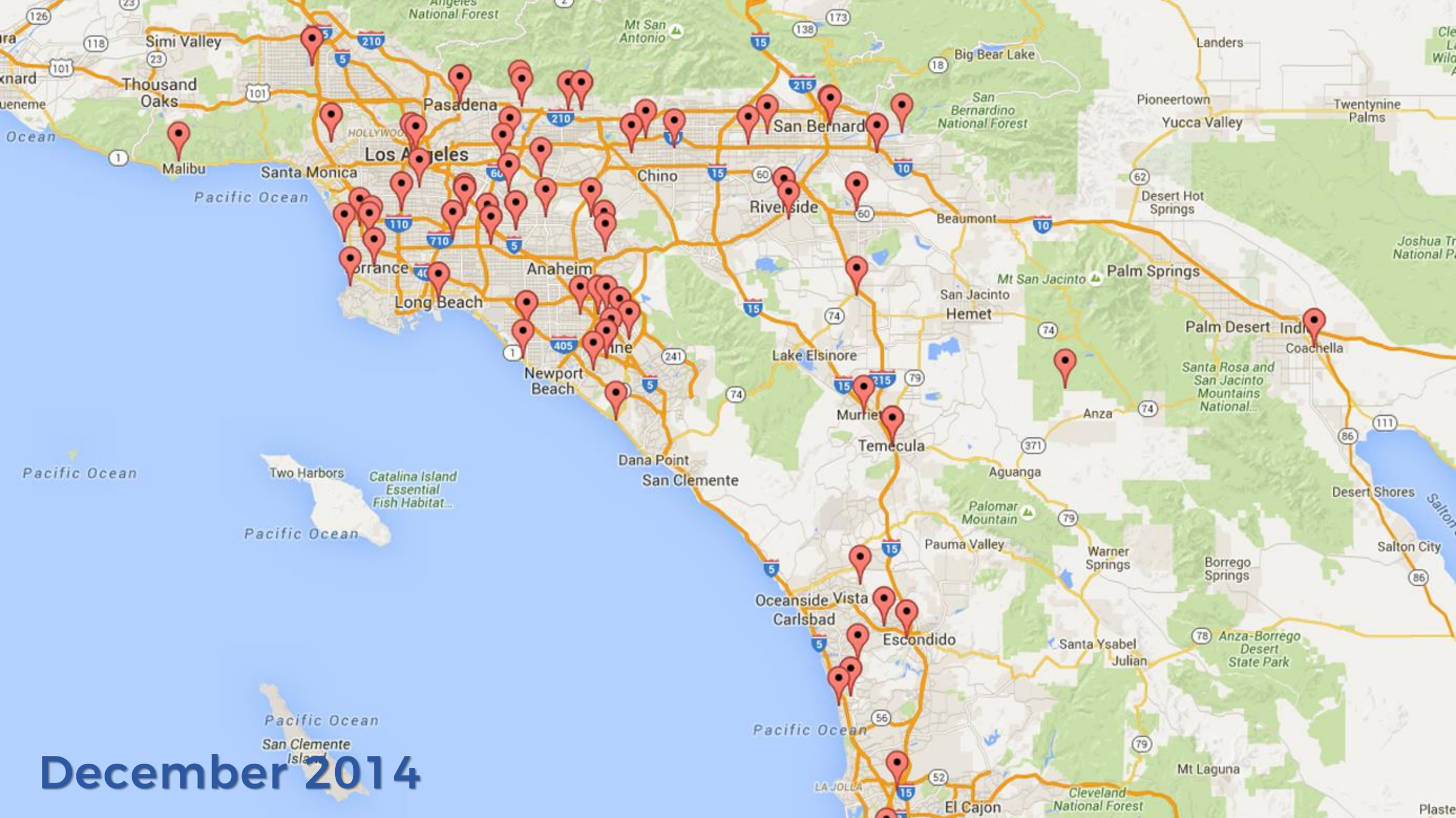

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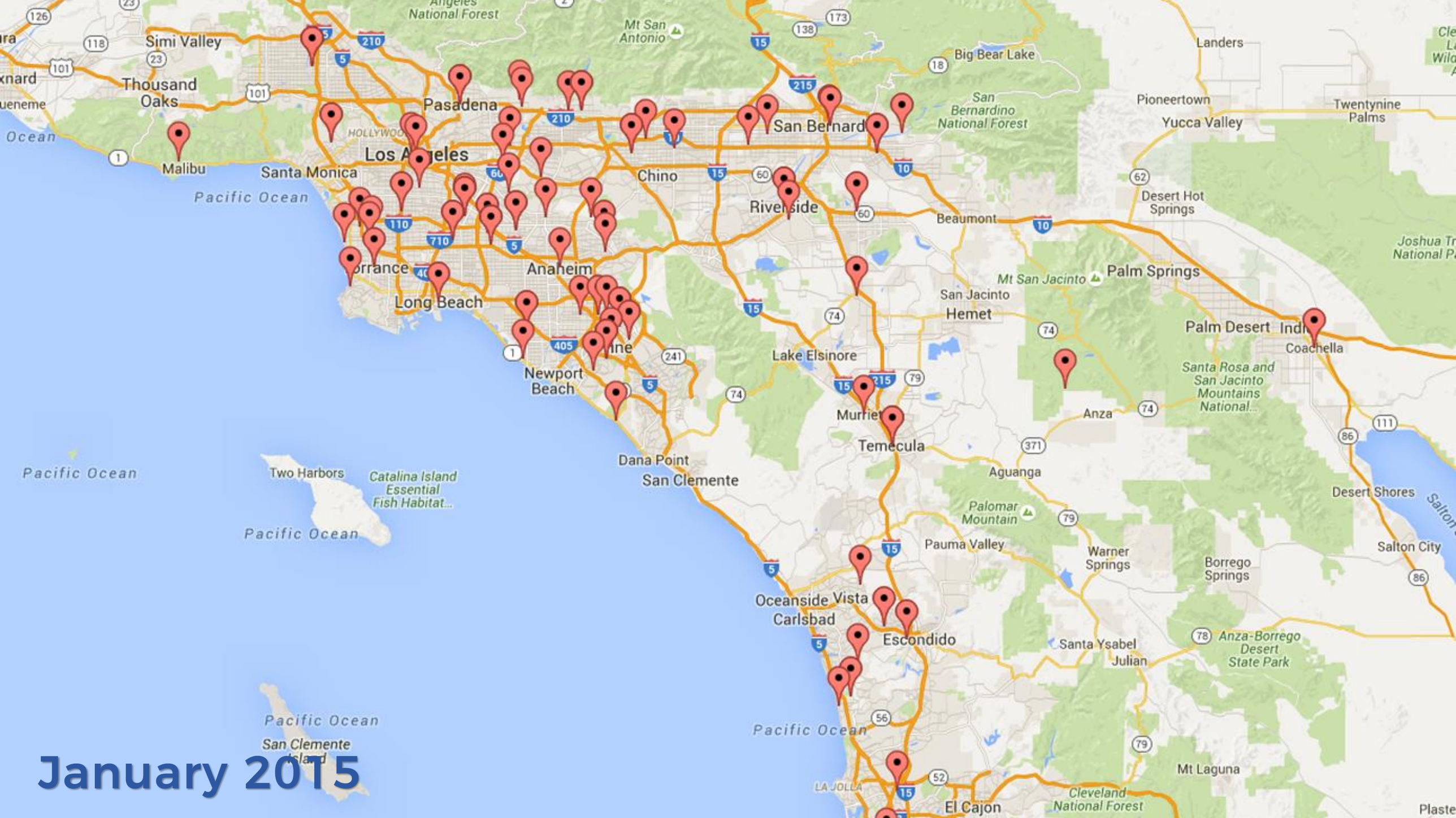

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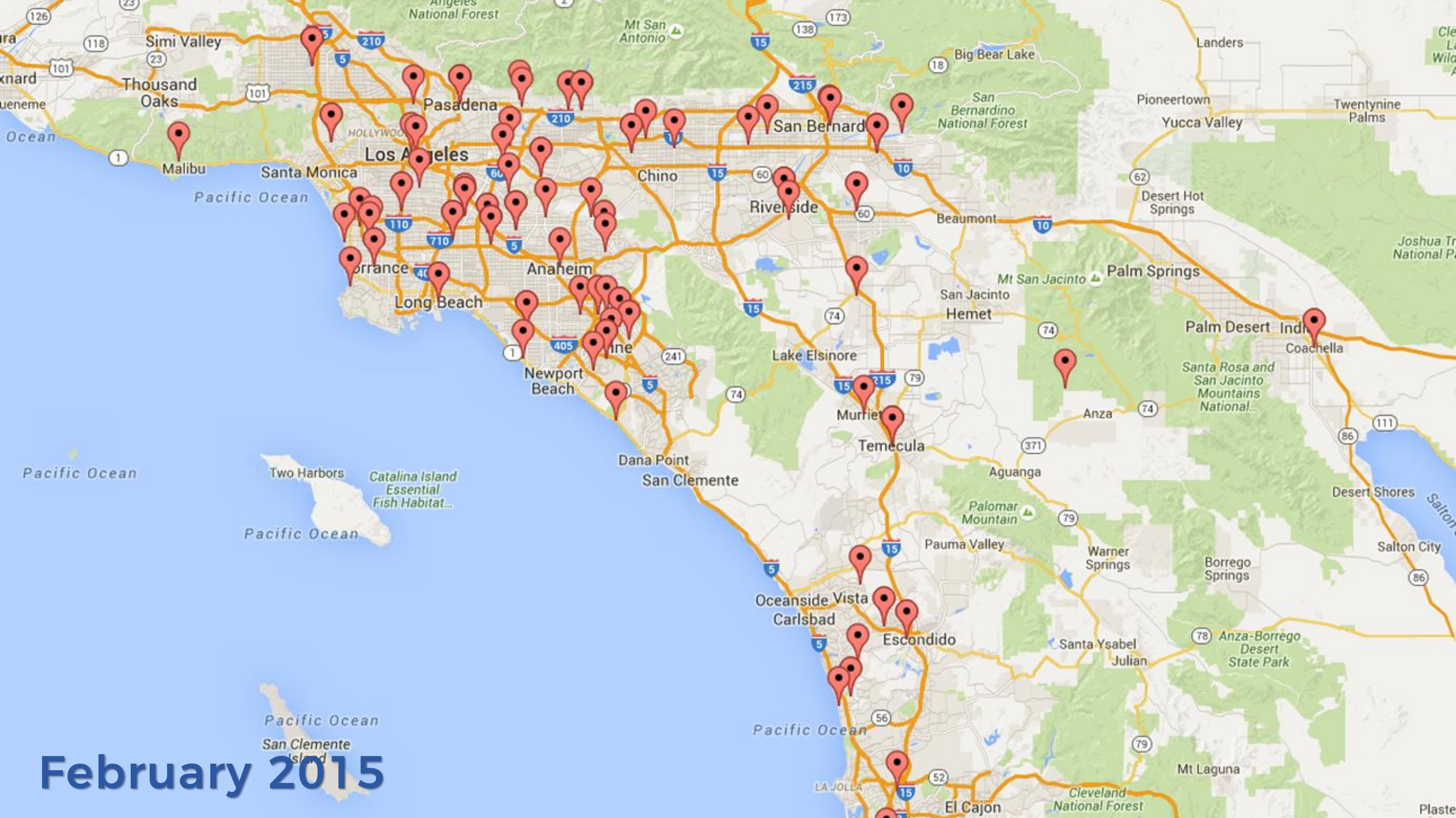

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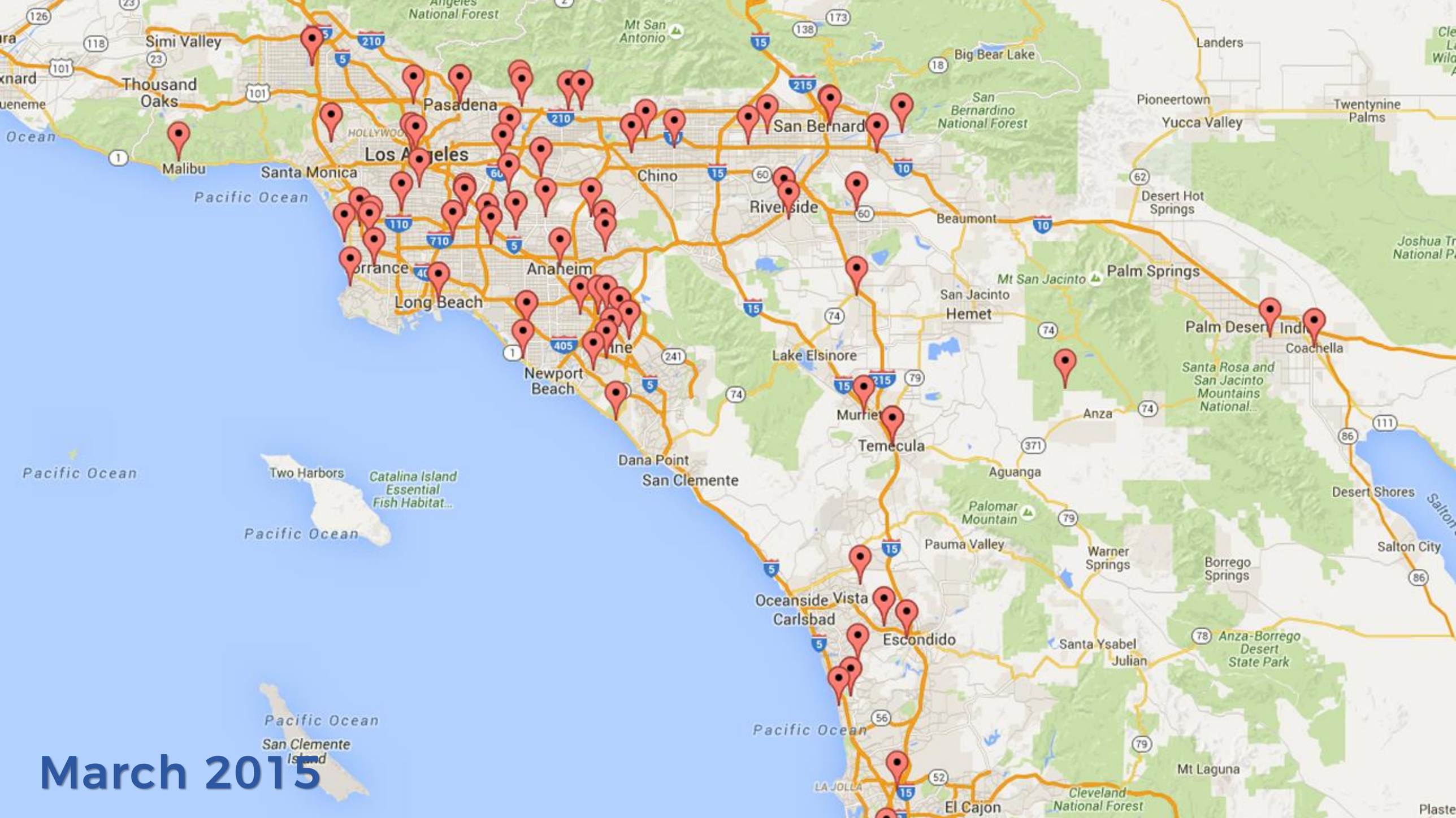
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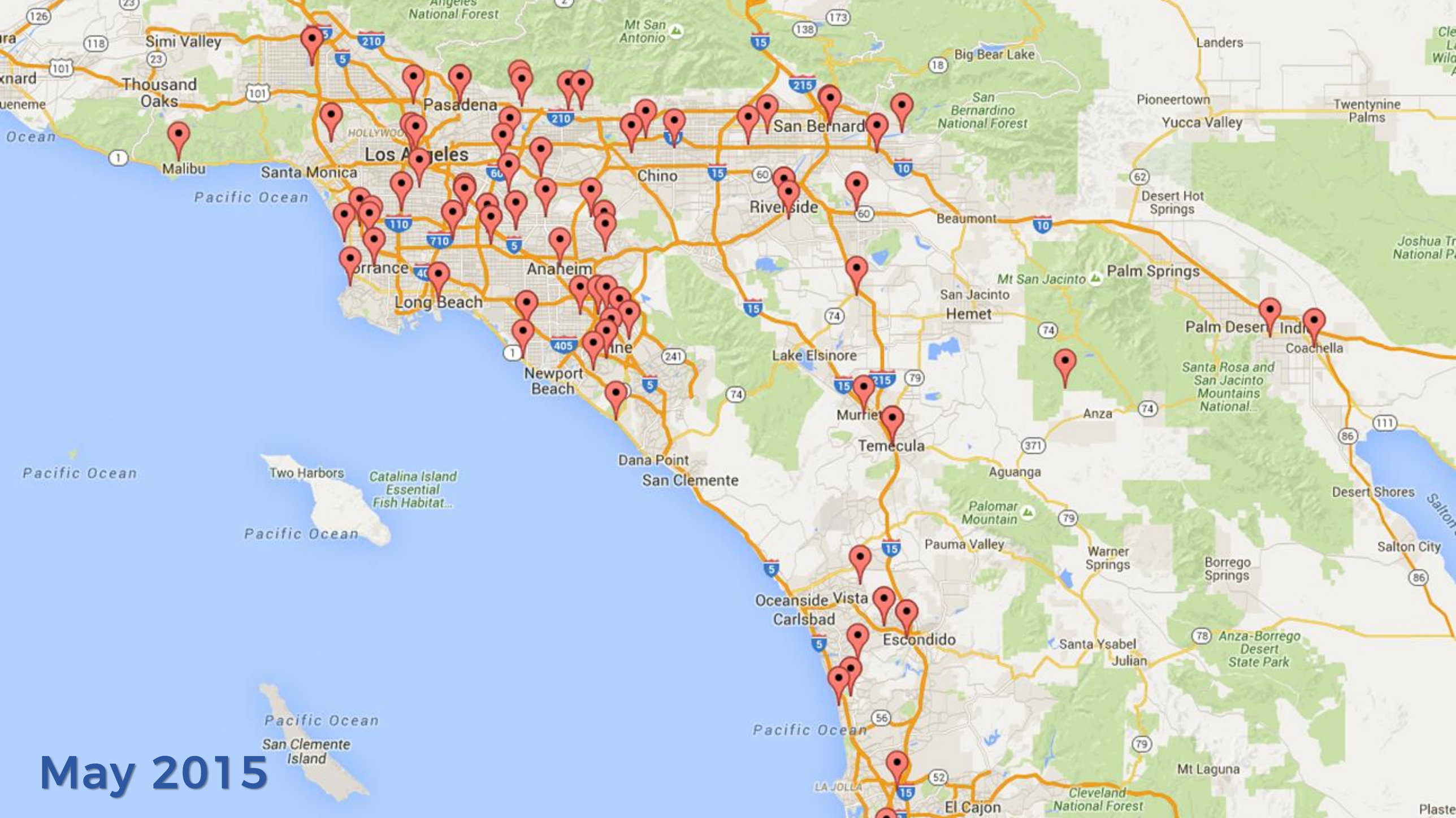
March 2015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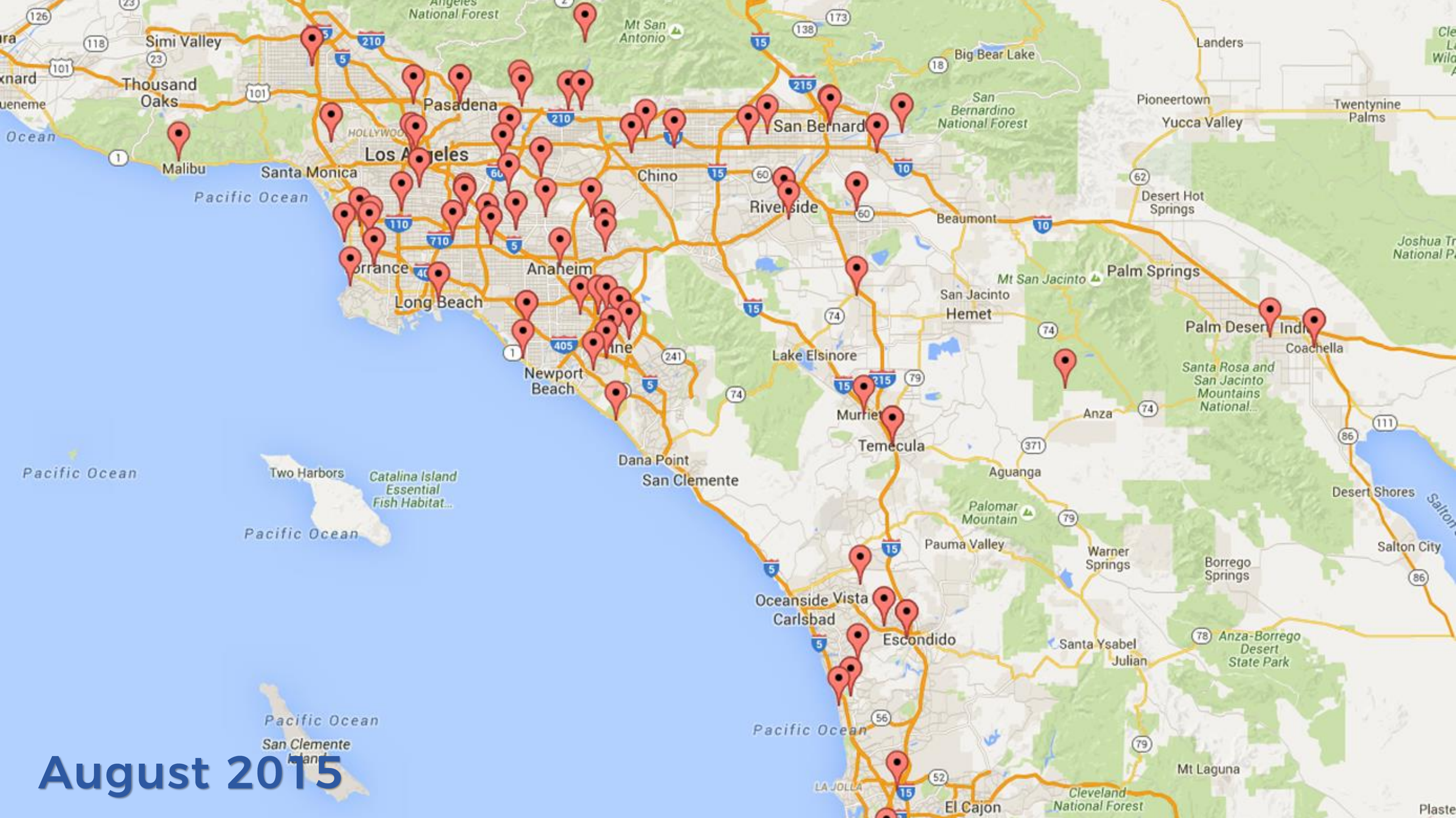
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Pacific Ocean

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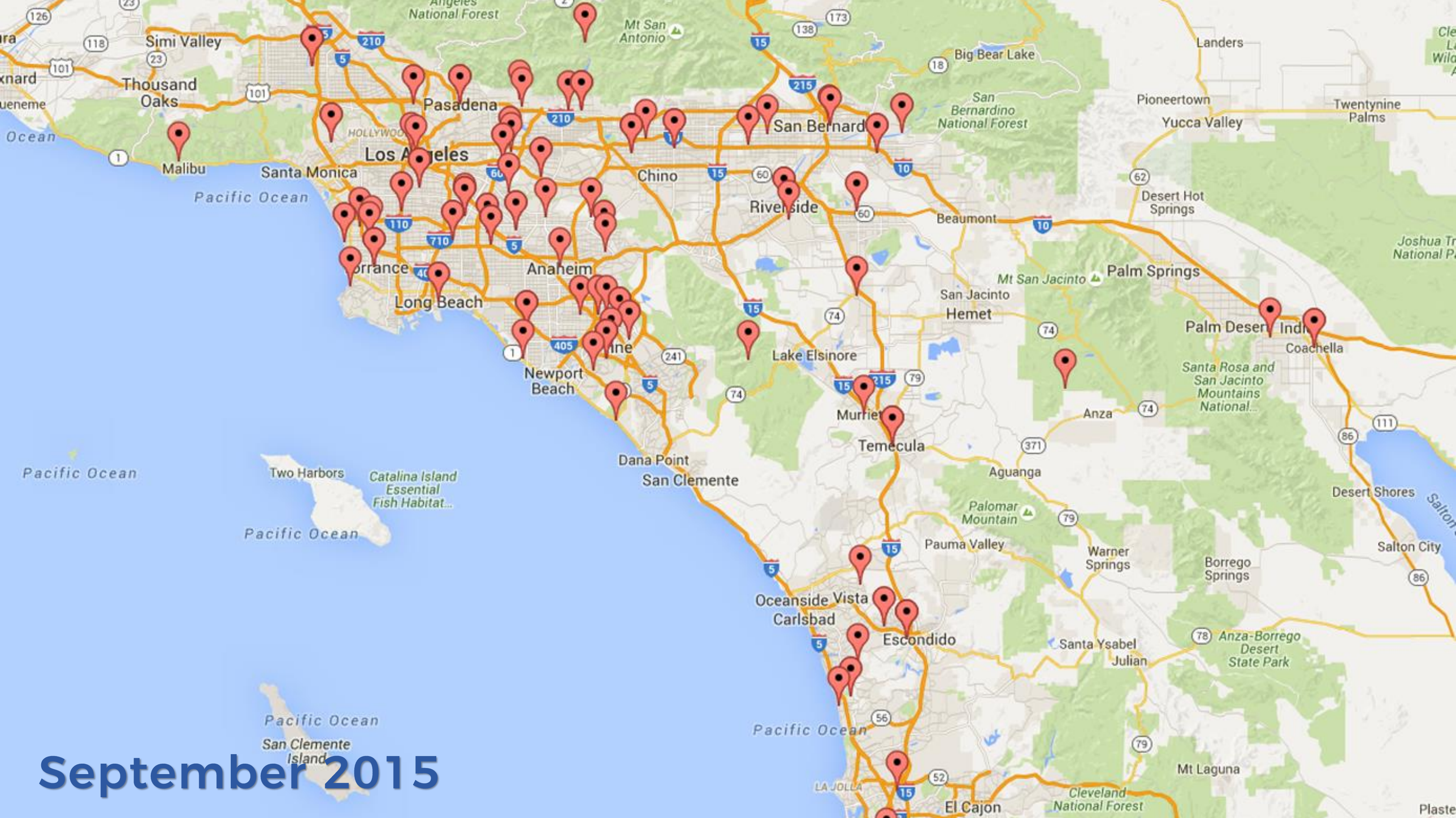

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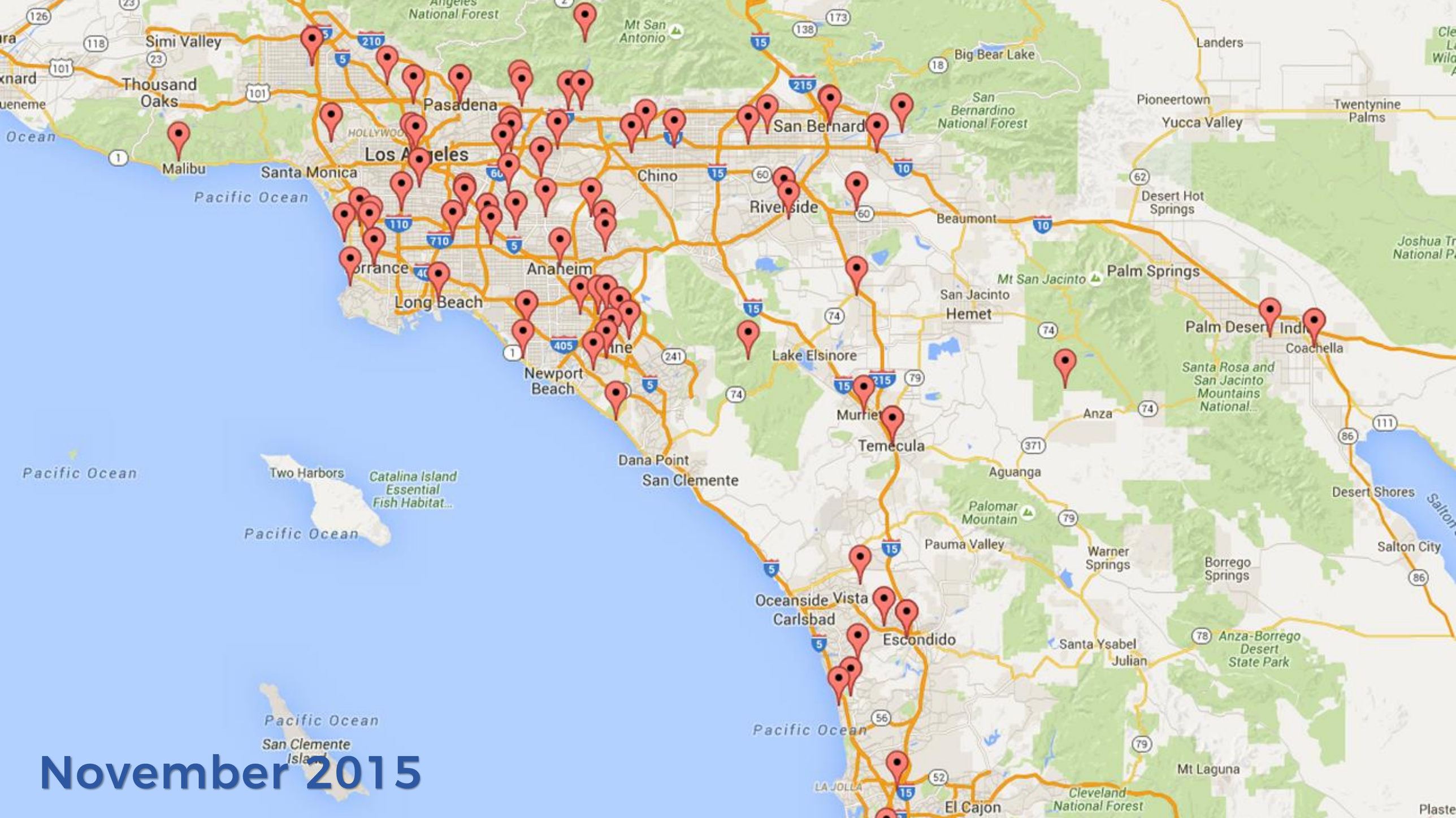

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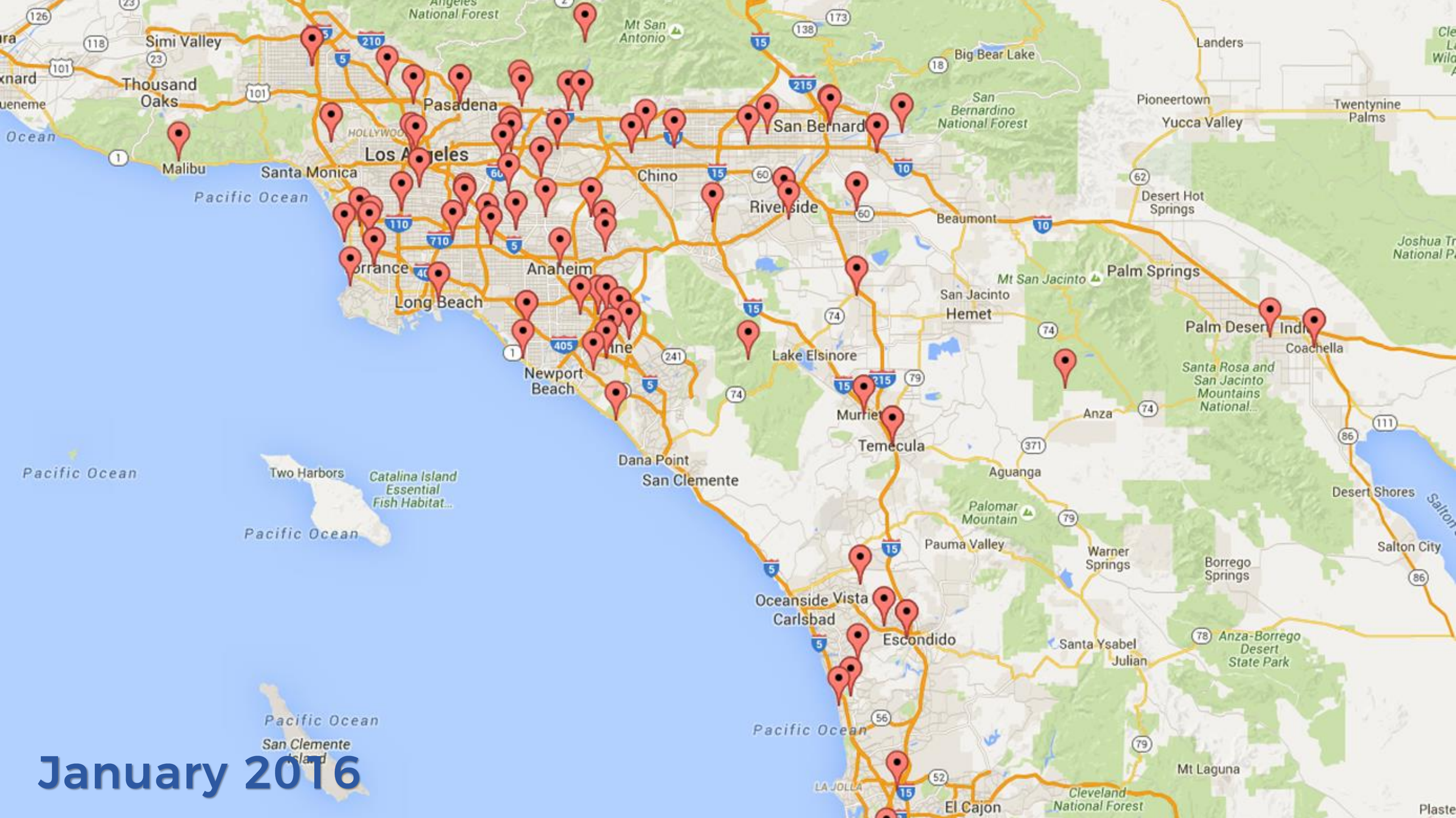

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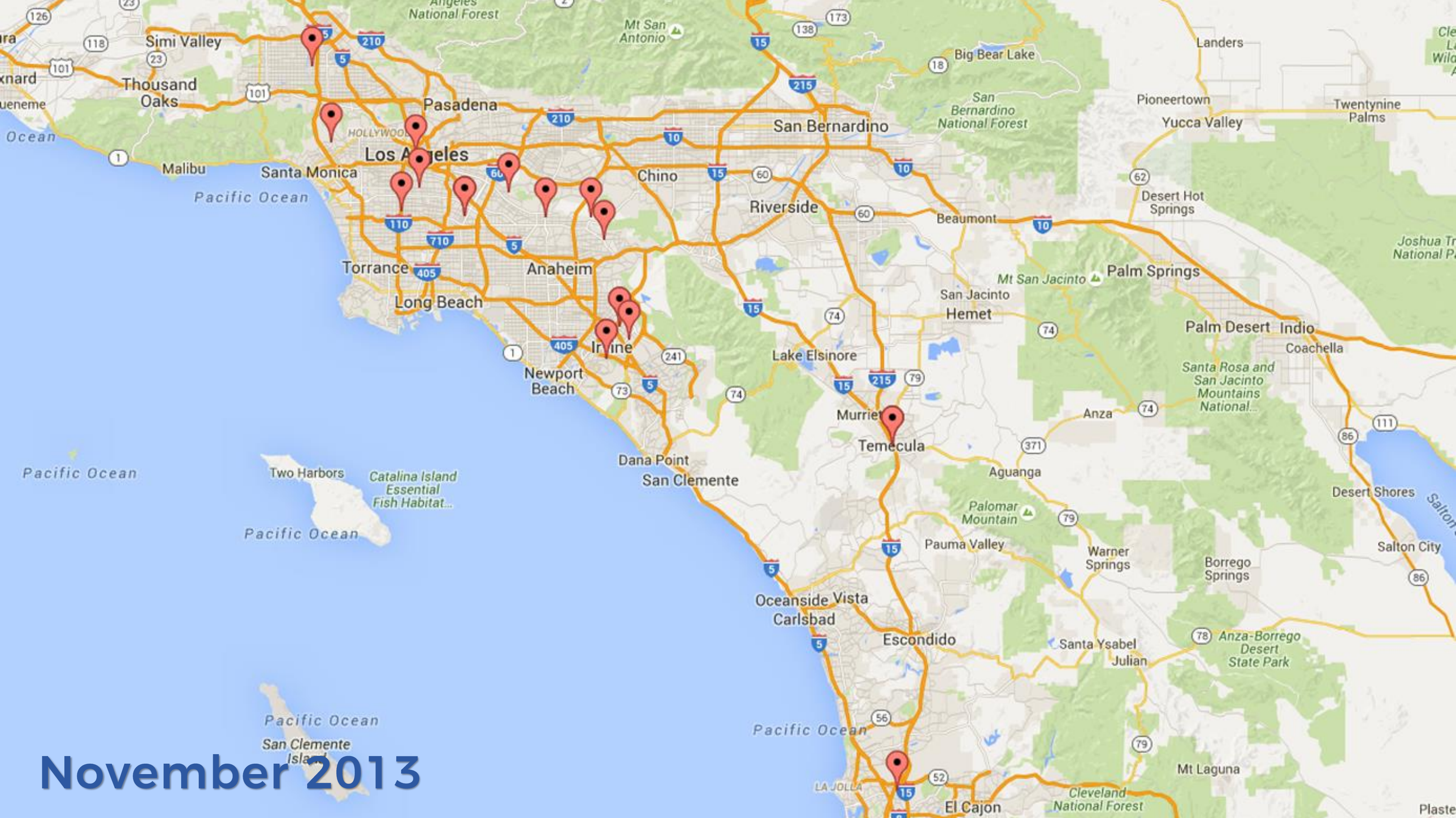

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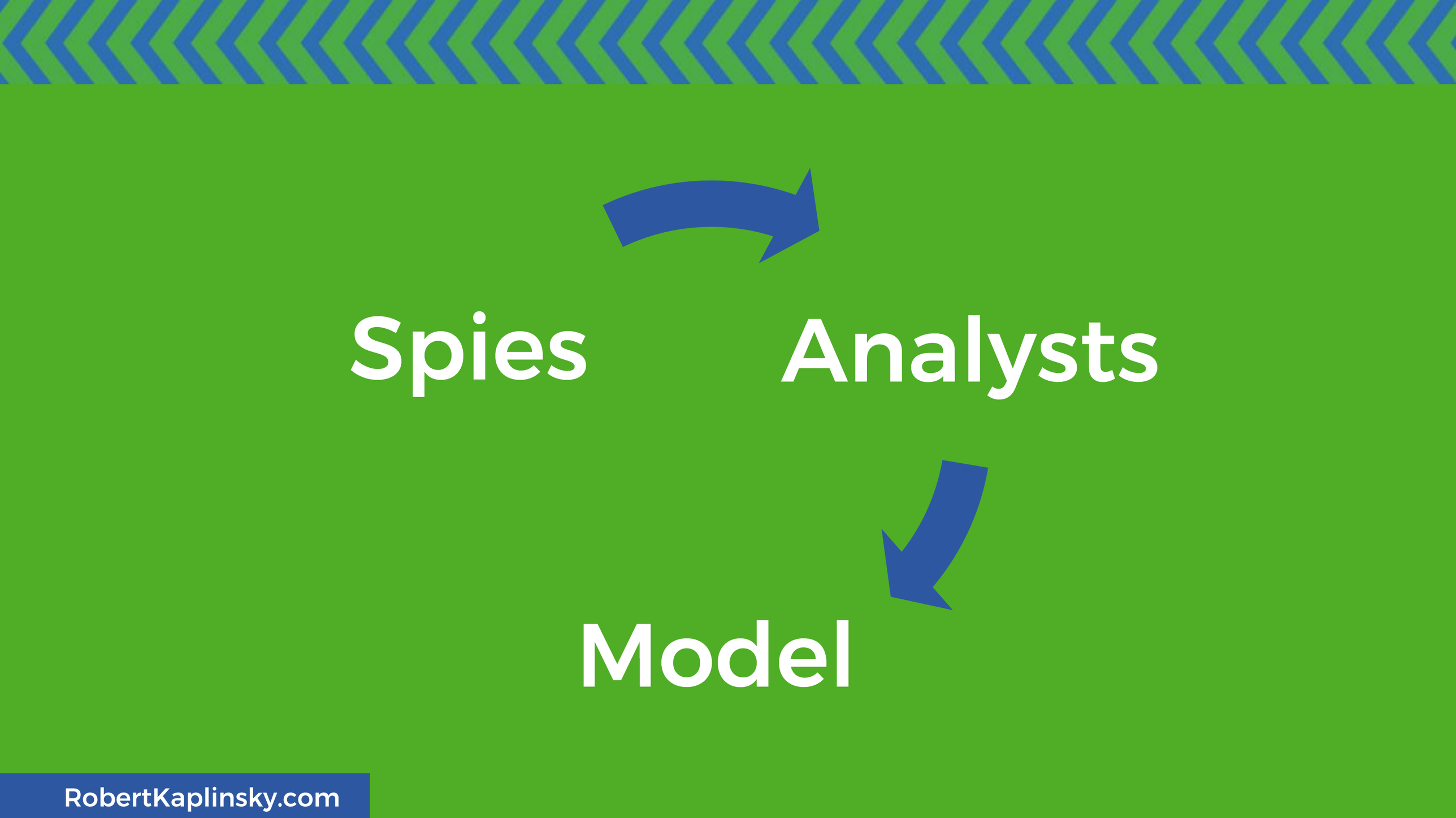
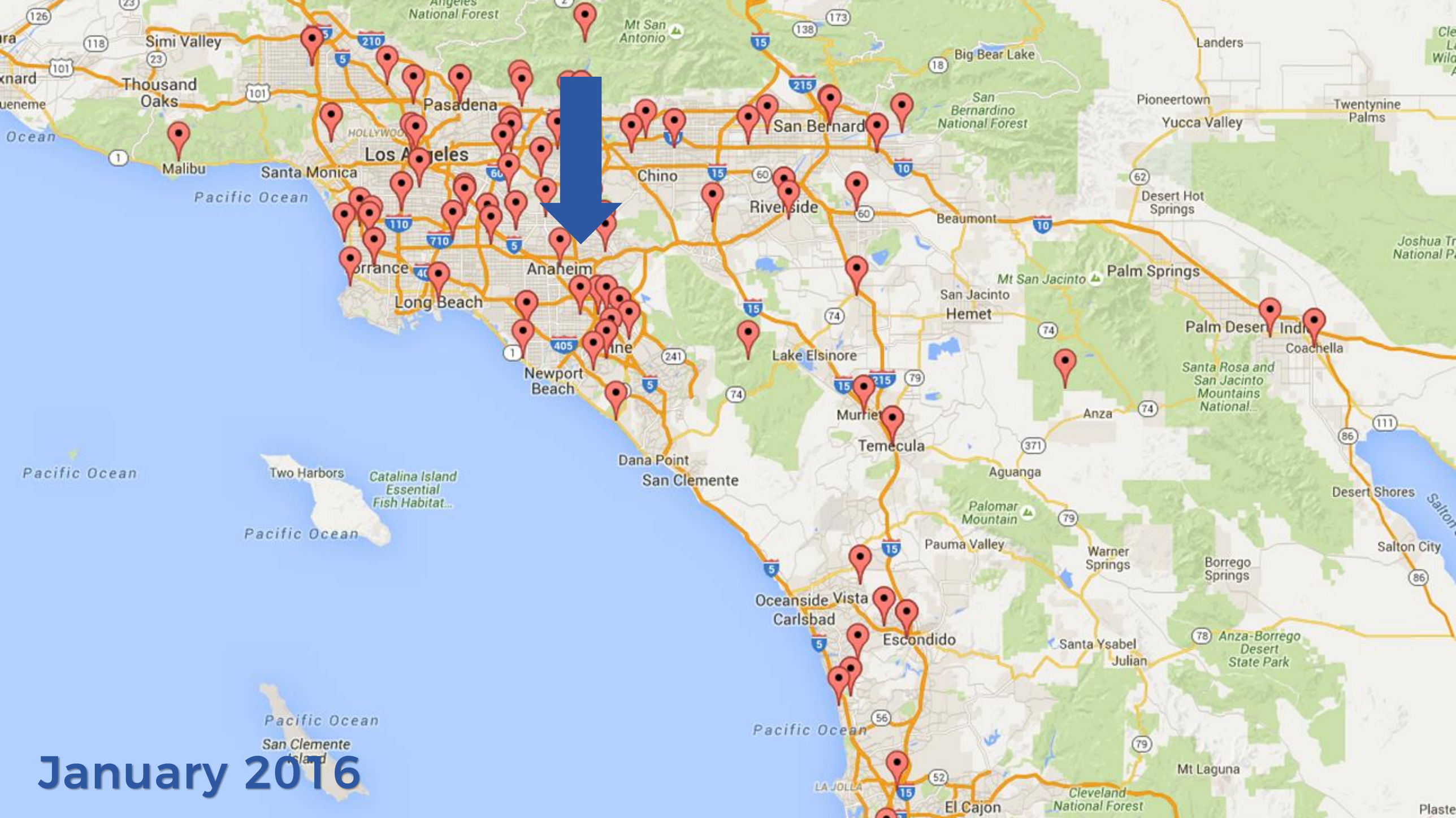

Spies
Analysts
Model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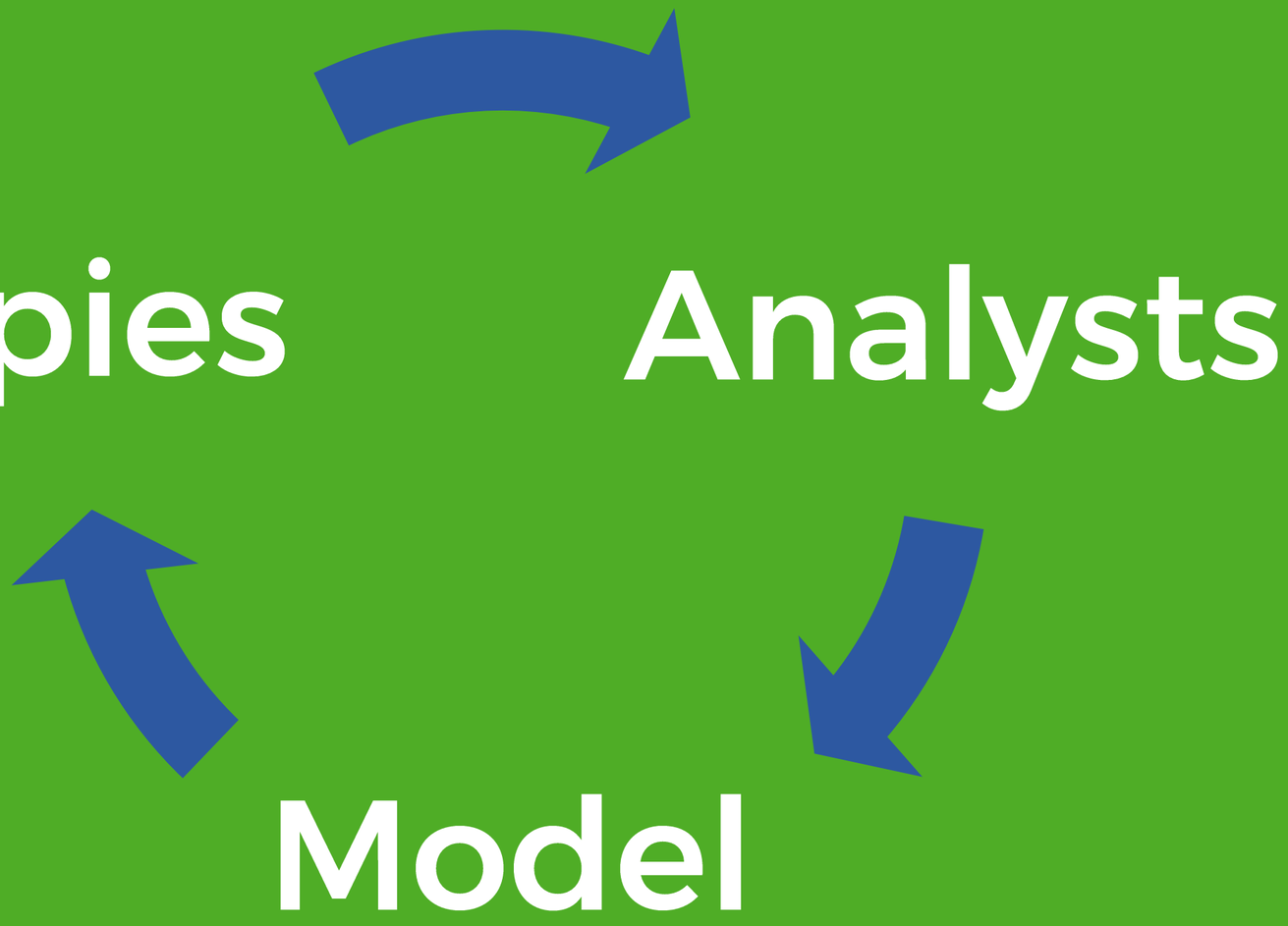
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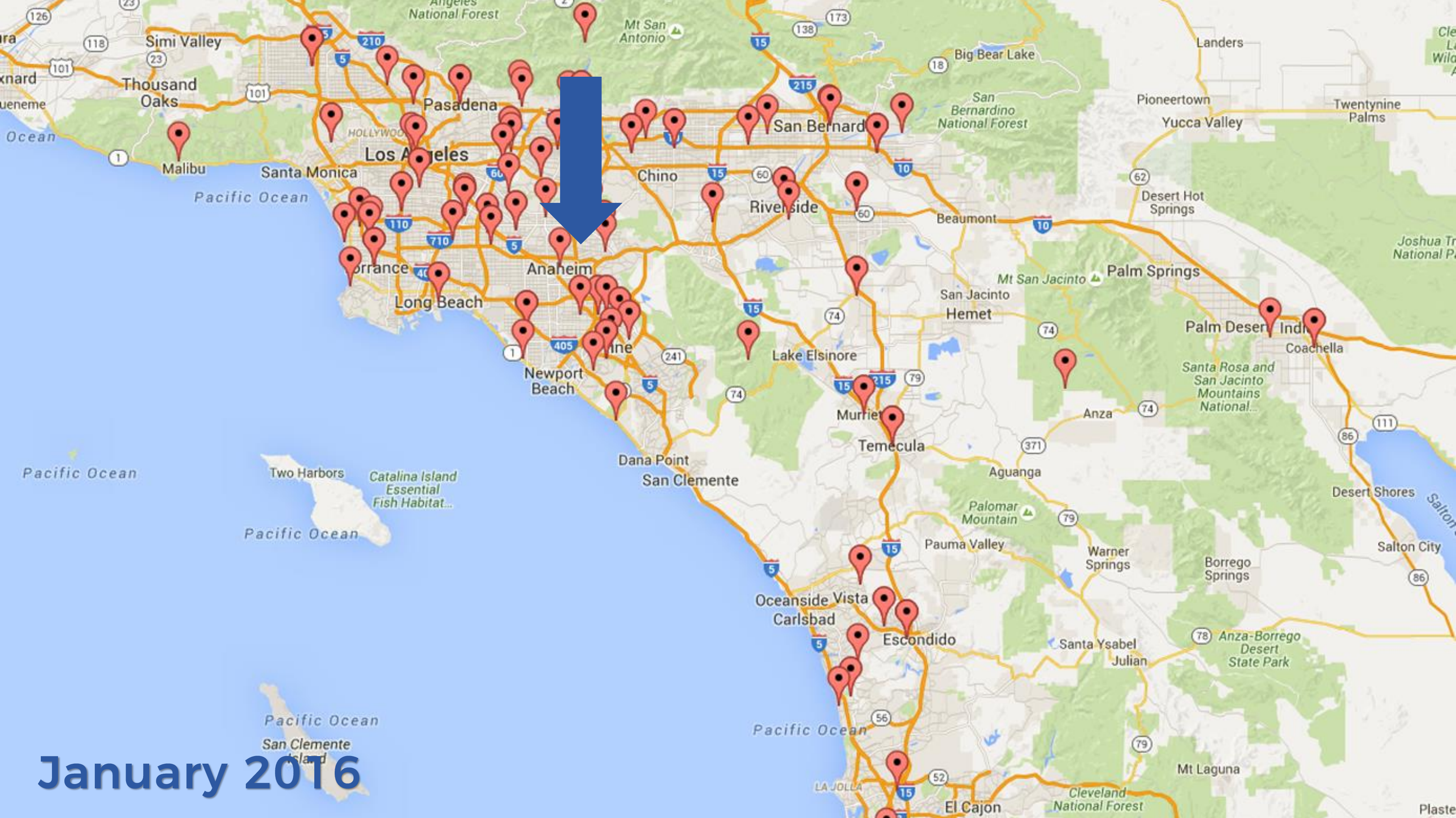
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All models are wrong, but some are useful.

GEORGE E. P. BOX

Classic Mix

20 Singles

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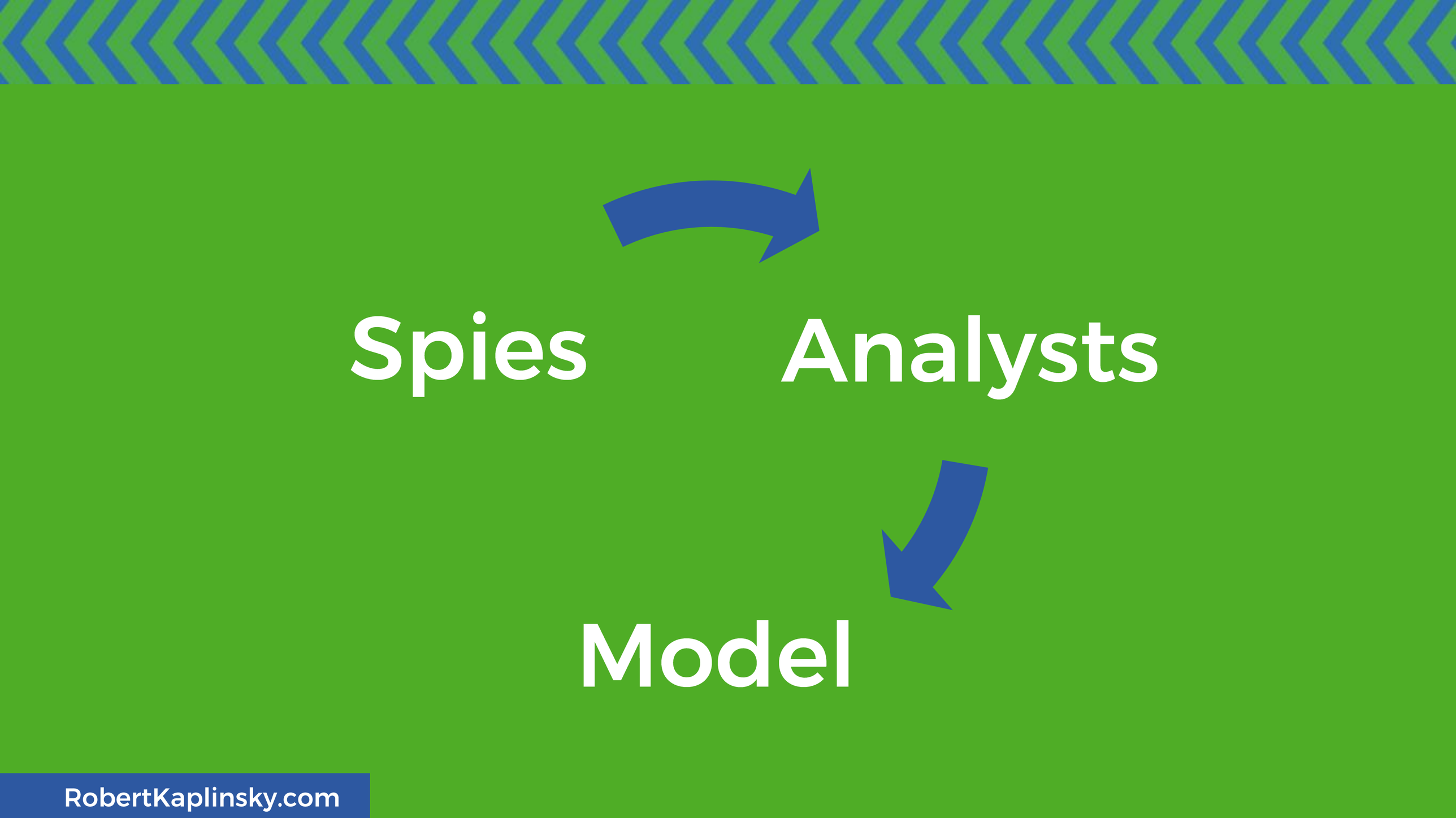
Spies
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Model

THINKING TIME

RobertKaplinsky.com

Robert Kaplinsky
@robertkaplinsky

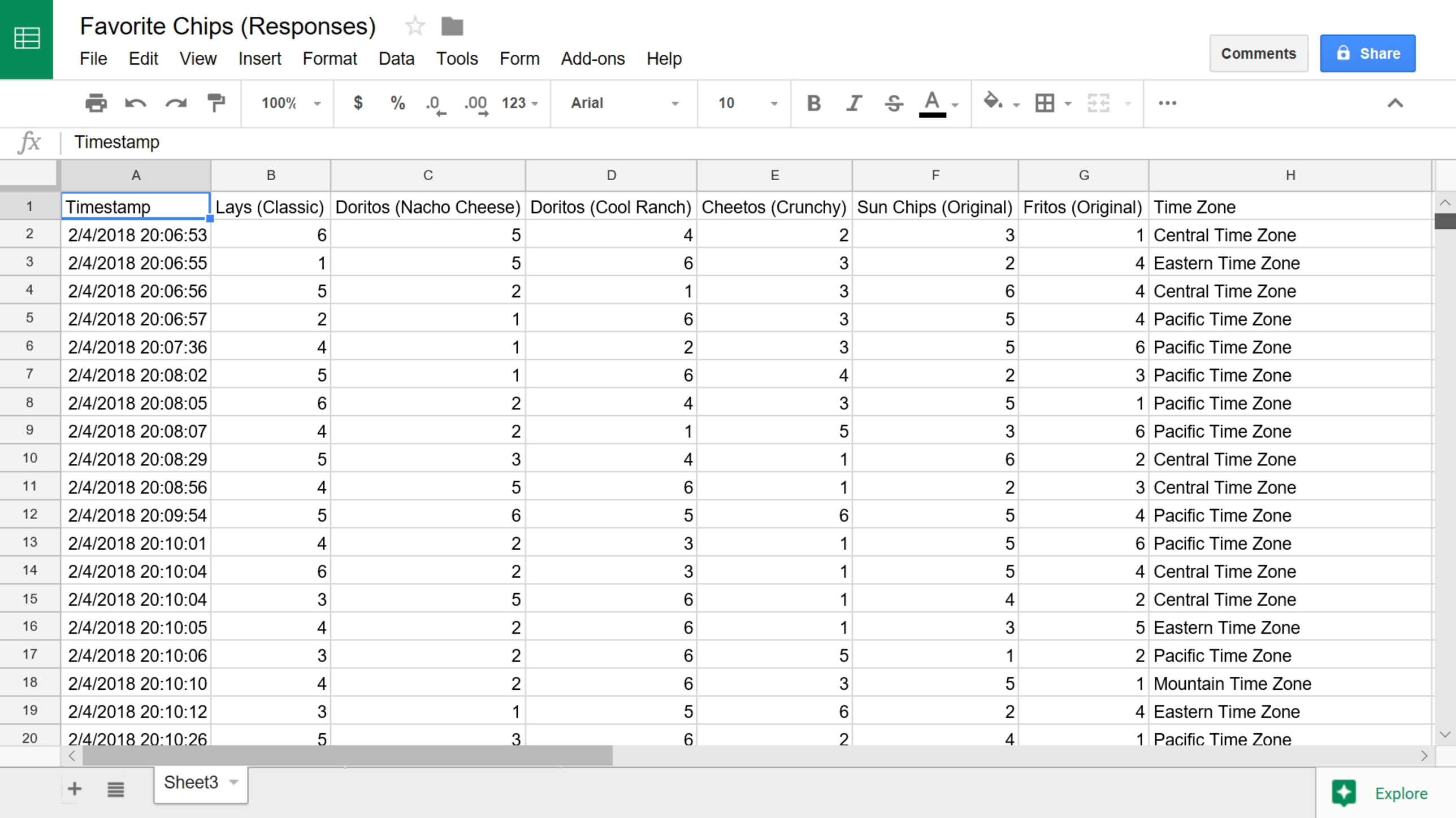
Hey #MTBoS, can you do me a favor and complete this 3 question anonymous survey about your favorite chips? I need data for a presentation. Please RT.
goo.gl/forms/etPtujII… #iteachmath

Favorite Chips
Please complete this anonymous survey. I'll be using this data in a presentation.
docs.google.com

8:05 PM - 4 Feb 2018

63 Retweets **45** Likes

18 63 45



	A	B	C	D	E	F	G	H
1	Timestamp	Lays (Classic)	Doritos (Nacho Cheese)	Doritos (Cool Ranch)	Cheetos (Crunchy)	Sun Chips (Original)	Fritos (Original)	Time Zone
2	2/4/2018 20:06:53	6	5	4	2	3	1	Central Time Zone
3	2/4/2018 20:06:55	1	5	6	3	2	4	Eastern Time Zone
4	2/4/2018 20:06:56	5	2	1	3	6	4	Central Time Zone
5	2/4/2018 20:06:57	2	1	6	3	5	4	Pacific Time Zone
6	2/4/2018 20:07:36	4	1	2	3	5	6	Pacific Time Zone
7	2/4/2018 20:08:02	5	1	6	4	2	3	Pacific Time Zone
8	2/4/2018 20:08:05	6	2	4	3	5	1	Pacific Time Zone
9	2/4/2018 20:08:07	4	2	1	5	3	6	Pacific Time Zone
10	2/4/2018 20:08:29	5	3	4	1	6	2	Central Time Zone
11	2/4/2018 20:08:56	4	5	6	1	2	3	Central Time Zone
12	2/4/2018 20:09:54	5	6	5	6	5	4	Pacific Time Zone
13	2/4/2018 20:10:01	4	2	3	1	5	6	Pacific Time Zone
14	2/4/2018 20:10:04	6	2	3	1	5	4	Central Time Zone
15	2/4/2018 20:10:04	3	5	6	1	4	2	Central Time Zone
16	2/4/2018 20:10:05	4	2	6	1	3	5	Eastern Time Zone
17	2/4/2018 20:10:06	3	2	6	5	1	2	Pacific Time Zone
18	2/4/2018 20:10:10	4	2	6	3	5	1	Mountain Time Zone
19	2/4/2018 20:10:12	3	1	5	6	2	4	Eastern Time Zone
20	2/4/2018 20:10:26	5	3	6	2	4	1	Pacific Time Zone

THINKING TIME

- The available data includes:
  - Lays, Nacho Cheese Doritos, Cool Ranch Doritos, Cheetos, Sun Chips, and Fritos ranked from 1 to 6
  - Geographic region: West, Central, or Eastern

ANALYSTS' JOB FOR THE TOP 1

1. Count all the first place votes for each chip type.
2. Divide the total first place votes for each chip type by the total number of votes.
3. Multiply that fraction by 20 to find how many bags there would be in a twenty pack, rounding as necessary.

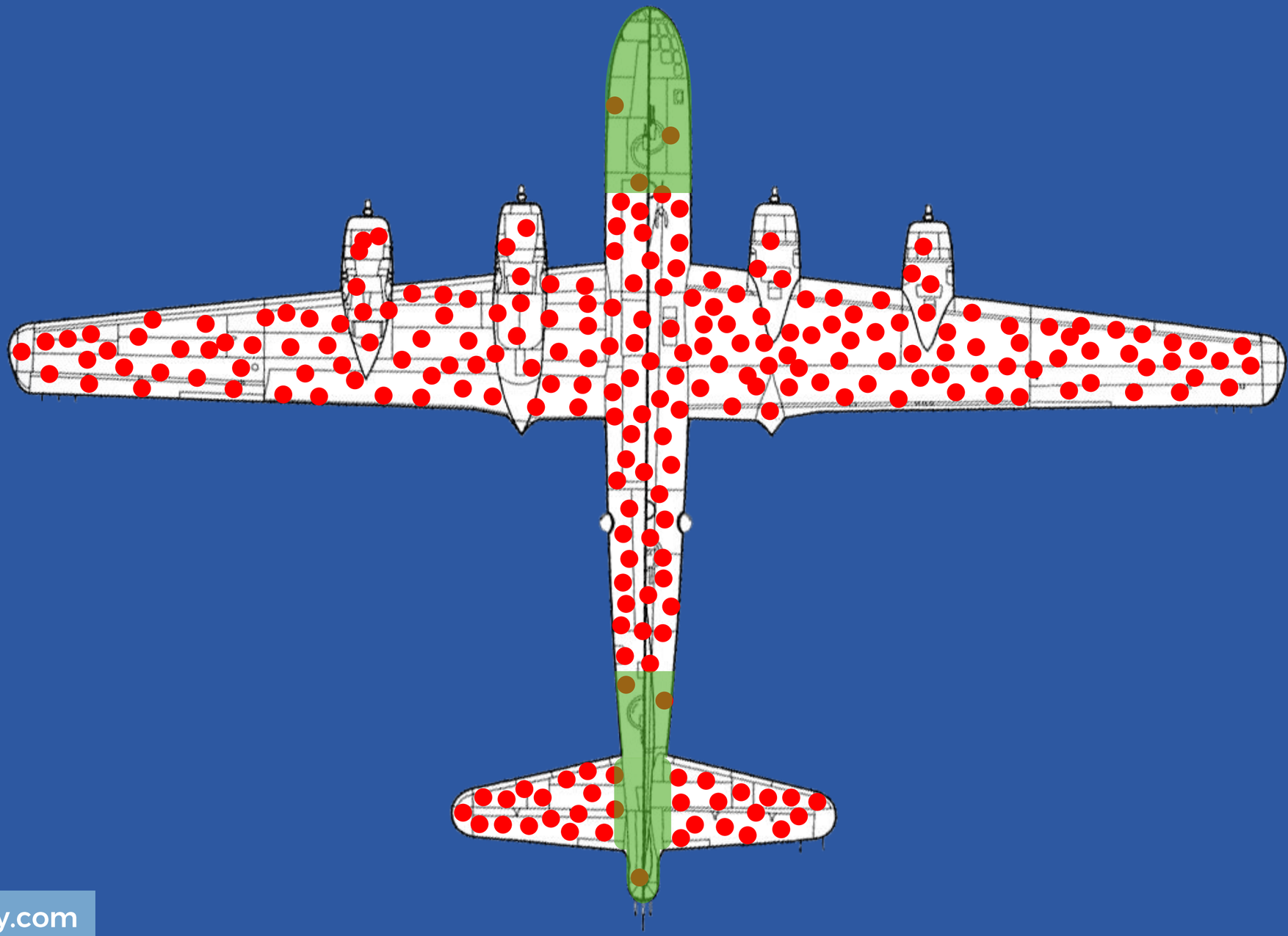
ANALYSTS' EXAMPLE

CHIP BAG RESULTS

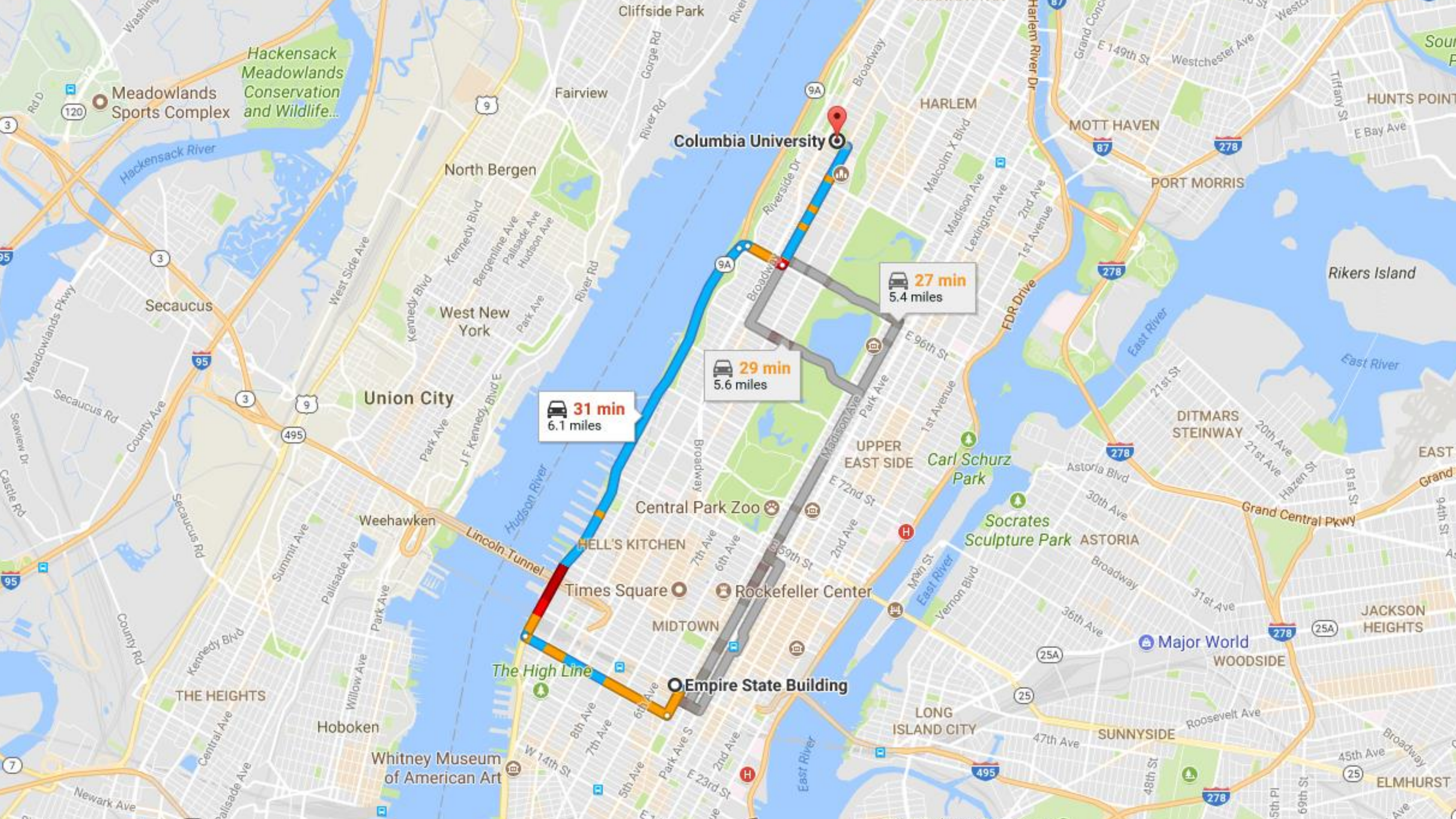
GOALS

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [ ] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW DO YOU PROFIT FROM MATH MODELING?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?
- [ ] WHERE CAN WE FIND MORE RESOURCES?


224612



- ~~How do we protect our planes?~~
- ~~Which parts of the plane are being hit by the most bullets?~~
- Which parts of the plane are the most critical to protect?


Columbia University
Empire State Building
31 min
6.1 miles
29 min
5.6 miles
27 min
5.4 miles
Cliffside Park
Fairview
North Bergen
West New York
Union City
Weehawken
Hoboken
Secaucus
Meadowlands Sports Complex
Hackensack Meadowlands Conservation and Wildlife...
Hackensack River
Hudson River
Lincoln Tunnel
HELL'S KITCHEN
Times Square
Rockefeller Center
MIDTOWN
Central Park Zoo
The High Line
Whitney Museum of American Art
THE HEIGHTS
HARLEM
MOTT HAVEN
HUNTS POINT
PORT MORRIS
Rikers Island
East River
UPPER EAST SIDE
Carl Schurz Park
Socrates Sculpture Park
ASTORIA
DITMARS STEINWAY
LONG ISLAND CITY
SUNNYSIDE
WOODSIDE
JACKSON HEIGHTS
ELMHURST
Major World
Grand Central Pkwy
FDR Drive
Harlem River Dr

- ~~How do we find the fastest route for each customer?~~
- How do we find the fastest route for each customer without impacting our other customers?

Classic Mix

20 Singles

4 LAY'S® Classic Potato Chips, 4 DORITOS® Nacho Cheese Flavored Tortilla Chips, 2 DORITOS® COOL RANCH® Flavored Tortilla Chips, 4 CHEETOS® Crunchy Cheese Flavored Snacks, 2 SUNCHIPS® Original Multigrain Snacks, 4 FRITOS® Original Corn Chips (All 1 OZ. Each)

20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g

⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

- ~~How many of each flavor should we put in a package?~~
- ~~How many of each flavor should we put in a package for each region?~~
- How can we determine if the extra cost of creating different packages will make us more money?

Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.

CCSS MATH PRACTICE 4

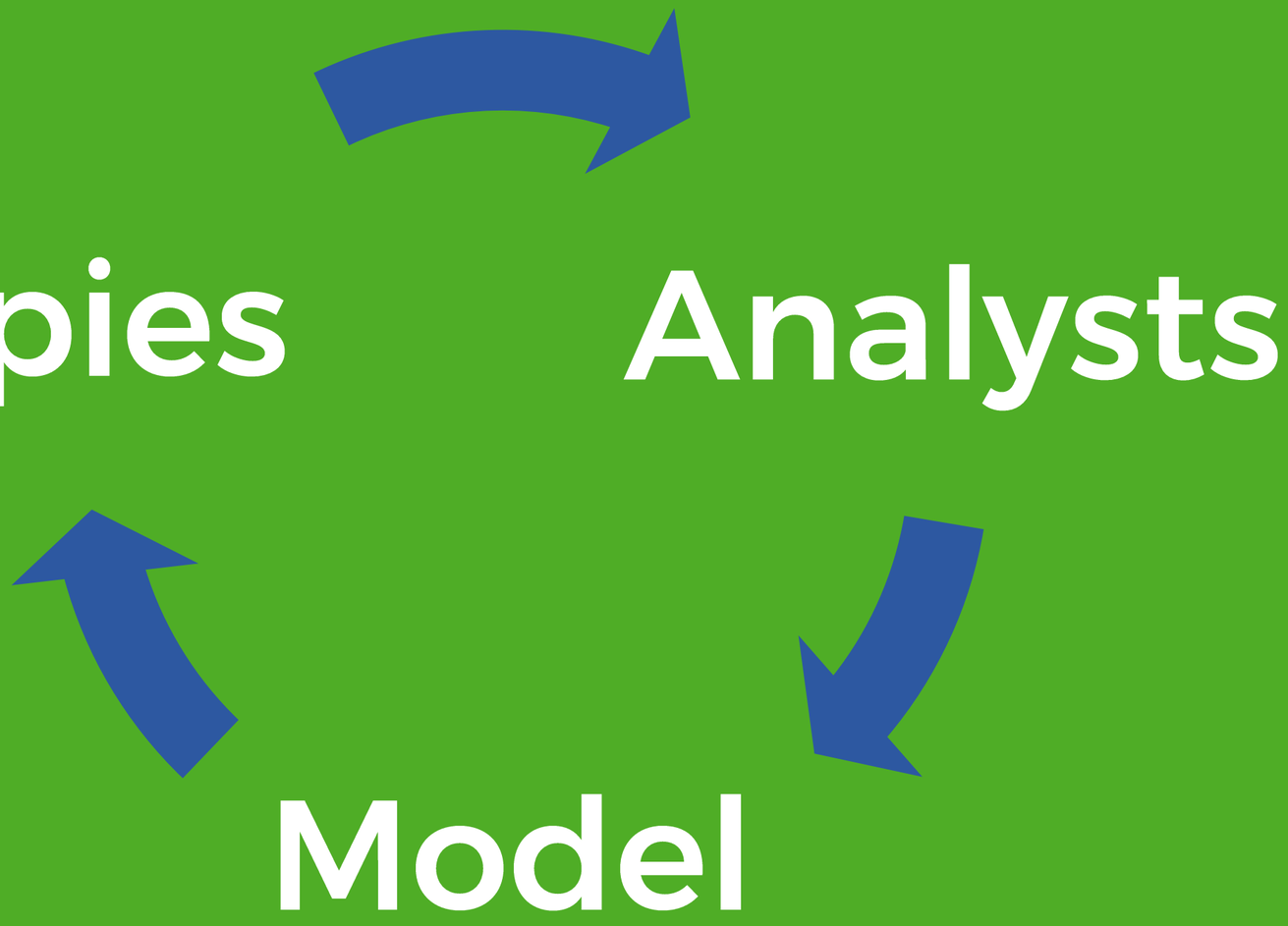
They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSS MATH PRACTICE 4

GOALS

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [x] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW DO YOU PROFIT FROM MATH MODELING?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?
- [ ] WHERE CAN WE FIND MORE RESOURCES?


TARGET
TARGET PARKING

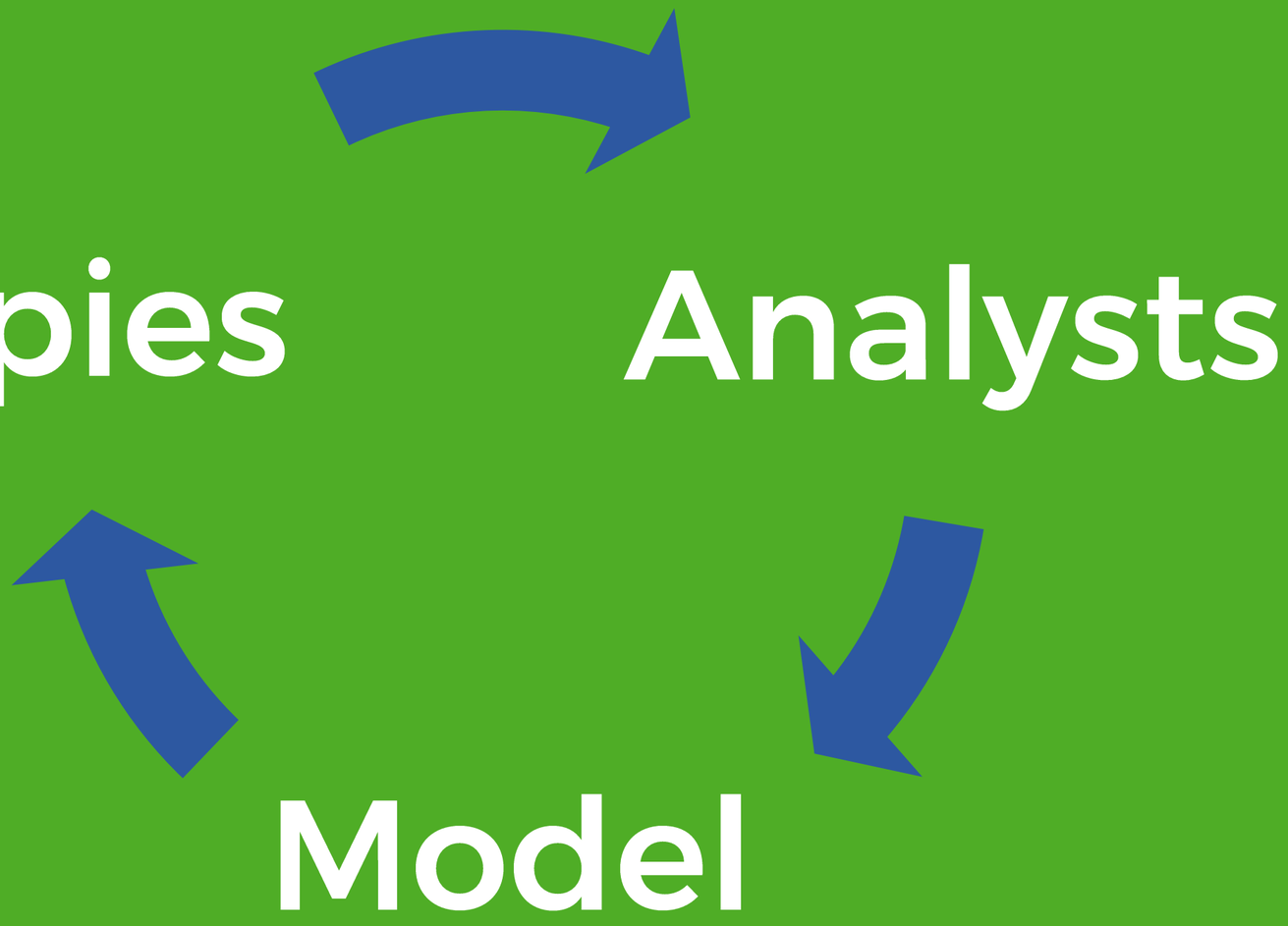

Spies
Analysts
Model

They used 25 products for a pregnancy prediction' score including:

- unscented lotion
- mineral supplements
- cotton balls

Source: New York Times


UNITED


Spies
Analysts
Model

Priority is determined by:

- passenger's fare class
- itinerary
- frequent flyer program membership
- check-in time

Source: United Airlines

Search

Robert | Home

Robert Kaplinsky

- News Feed
- Messenger
- Watch
- Marketplace

Explore

- Pages
- Events
- Groups
- Friend Lists
- On This Day 3
- Insights
- Games 7
- Fundraisers
- Live Video
- Pokes
- See More...

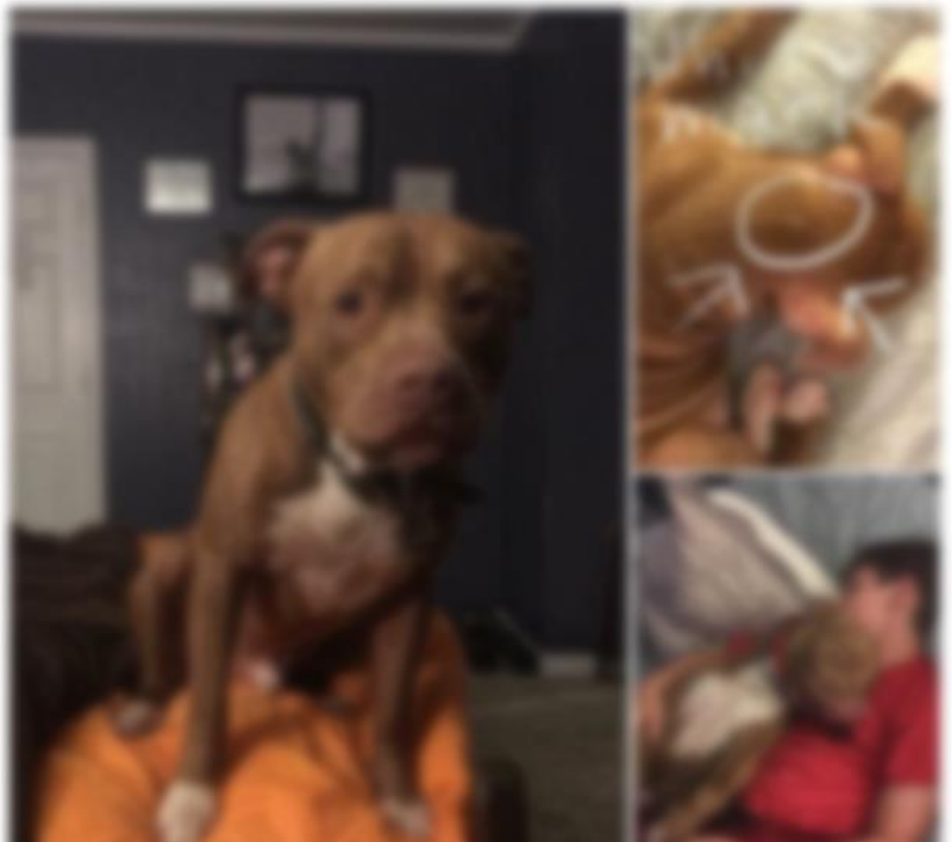
Create

Ad · Page · Group · Event · Fundraiser

Make Post | Photo/Video Album | Live Video

What's on your mind, Robert?

Photo/Video | Feeling/Activity | ...

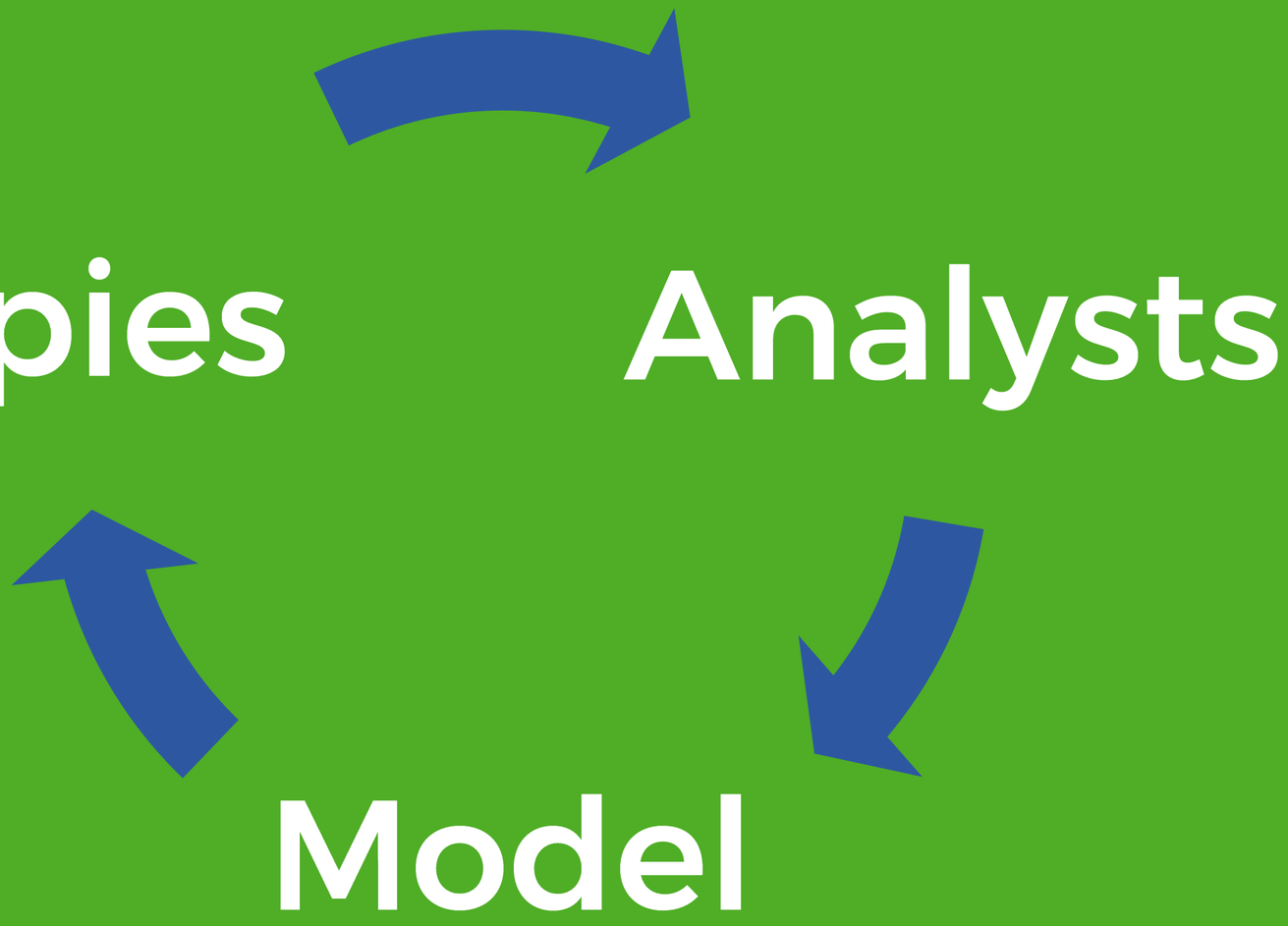


Trending

Watchlist: Latest Episodes

See All

Sponsored Create Ad


Spies
Analysts
Model

The stories that show in your News Feed are influenced by:

- friends you interact with the most
- the number of comments and likes a post receives
- what kind of story it is (ex: photo, video, status update)

Source: Facebook

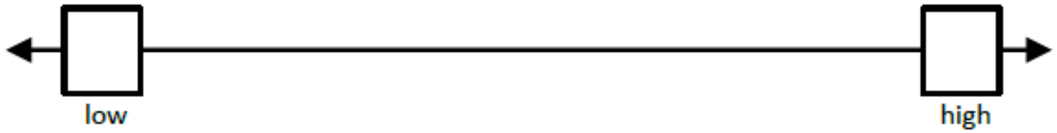
MORE EXAMPLES

- How does US News and World Reports rank colleges?
- How does Google know which results to show?
- How do sports teams know who to draft?
- How does Amazon know what products to recommend?
- How does Zillow estimate home prices?
- How does Pandora know what music to play?
- How does eHarmony know which people to show you?
- How do they figure out who should speak at a conference?

GOALS

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW DO YOU PROFIT FROM MATH MODELING?
- ❑ HOW DO WE HELP OUR STUDENTS IMPROVE?
- ❑ WHERE CAN WE FIND MORE RESOURCES?

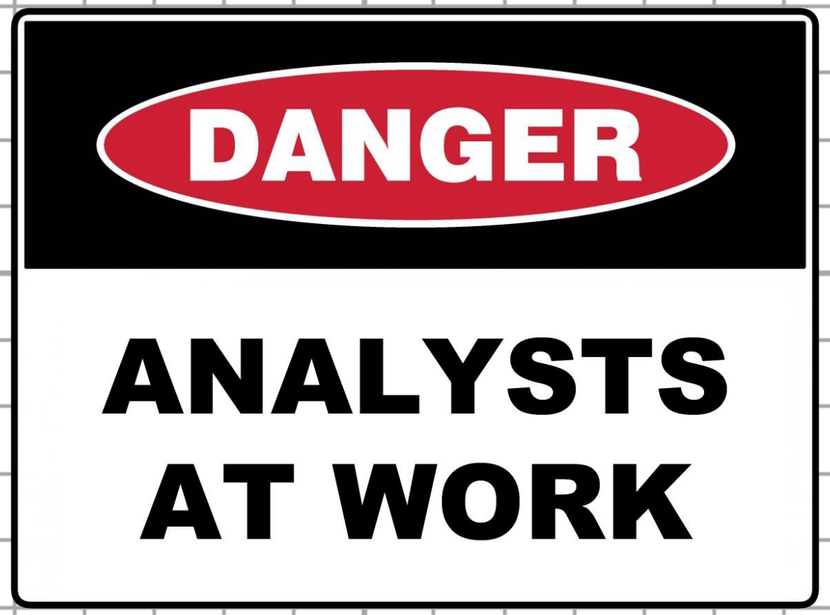
Name: _____ Period: _____ Date: _____

What problem are you trying to figure out?	What estimates do you have?
	 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**

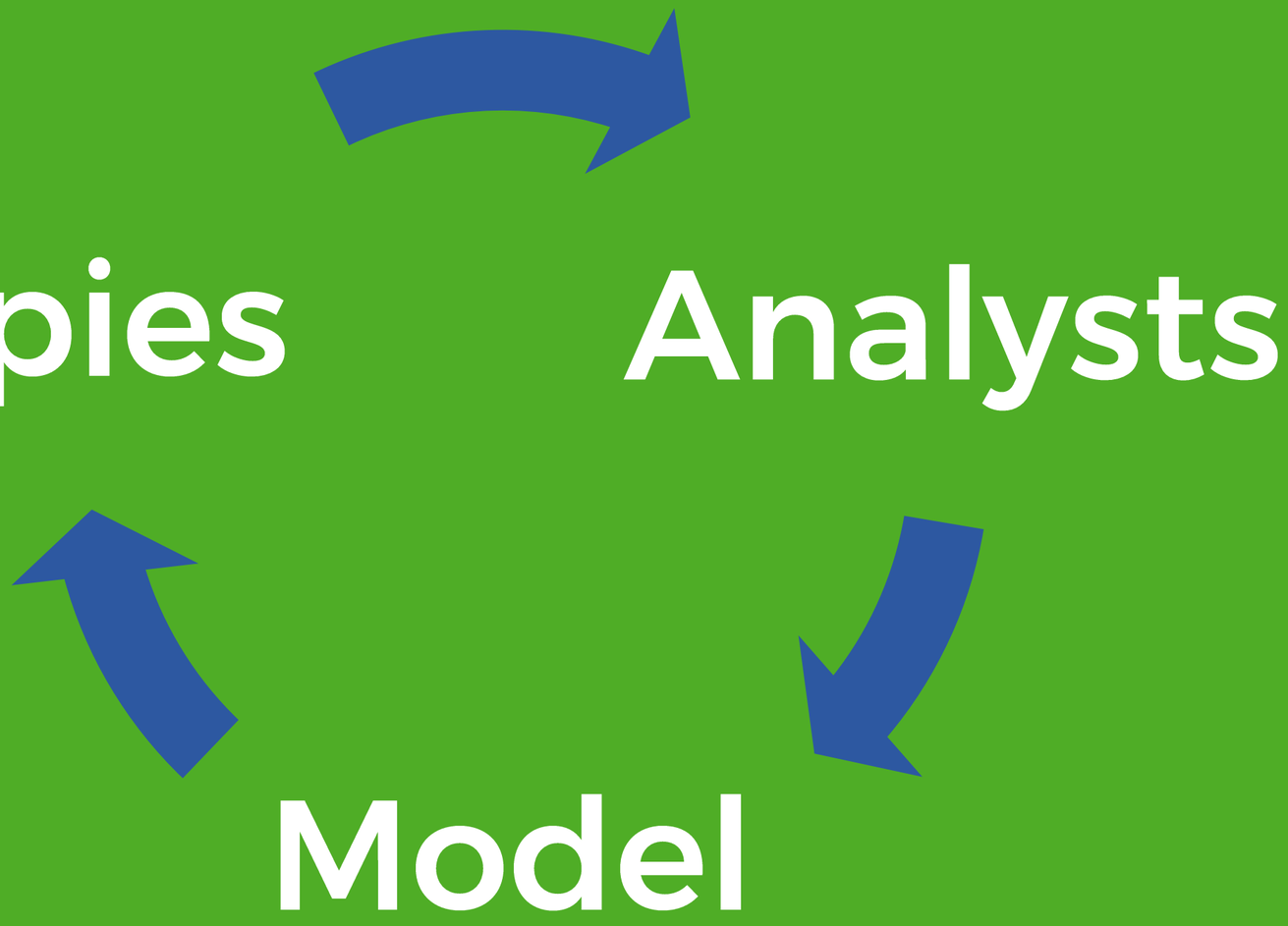
TOP SECRET! SPIES ONLY

What is your conclusion? How did you reach that conclusion?

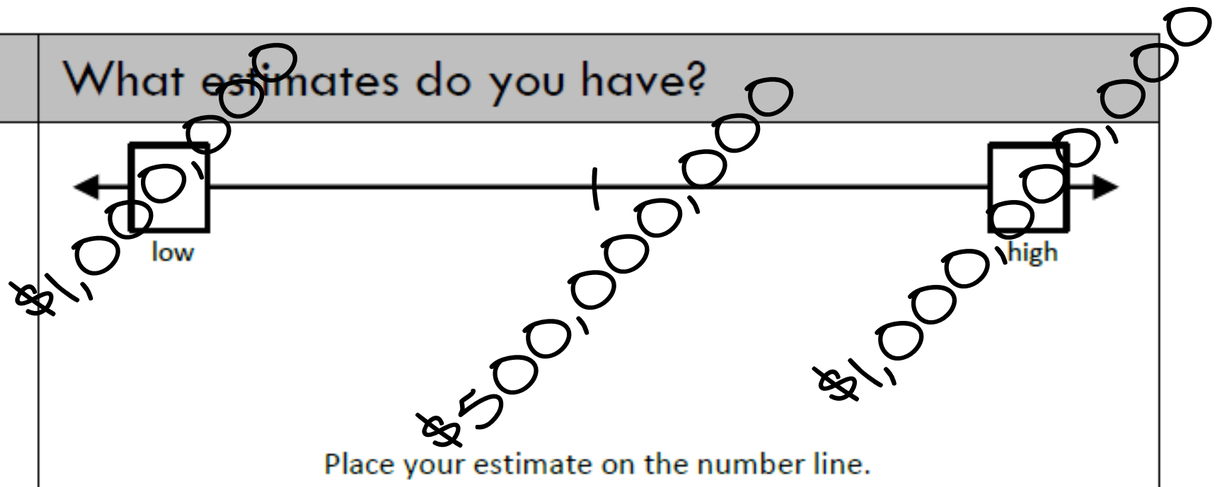
Your work



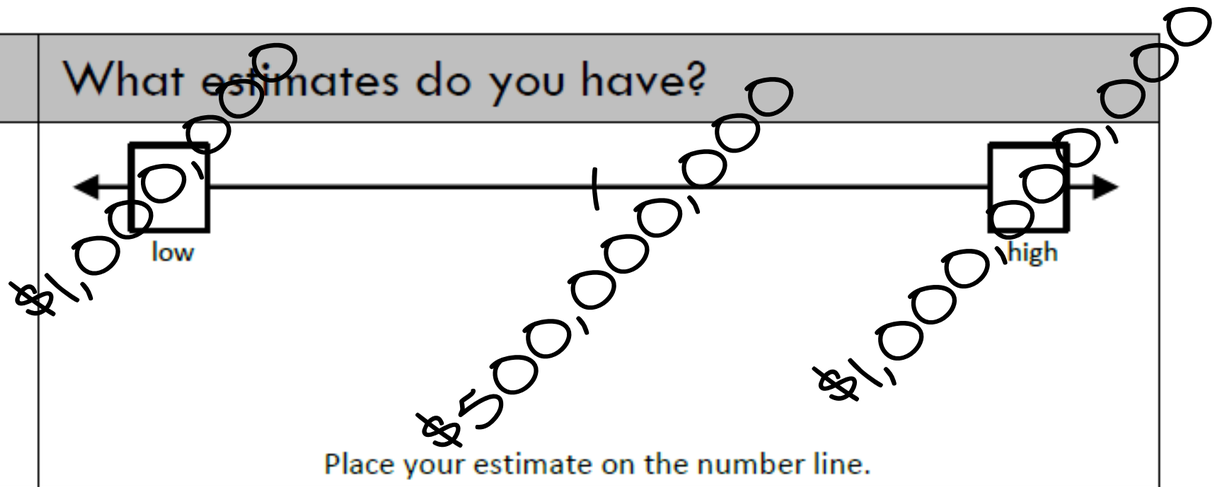

IVE
FOX NEWS
Junction


Spies
Analysts
Model

Name: _____ Period: _____ Date: _____

What problem are you trying to figure out?	What estimates do you have?
How much money was that?	 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• There is a lot of money. • It is in a pile. • It is in bundles.	• Is it all the same denomination? • ~~How much does one bill weigh?~~ • ~~How much does all the money weigh?~~
What is your conclusion? How did you reach that conclusion?	

Name: _____ Period: _____ Date: _____

What problem are you trying to figure out?	What estimates do you have?
How much money was that?	 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• There is a lot of money. • It is in a pile. • It is in bundles.	• Is it all the same denomination? • How many rows and columns are there? • How many bills are in one stack?
What is your conclusion? How did you reach that conclusion?	


PGR
SIEDO

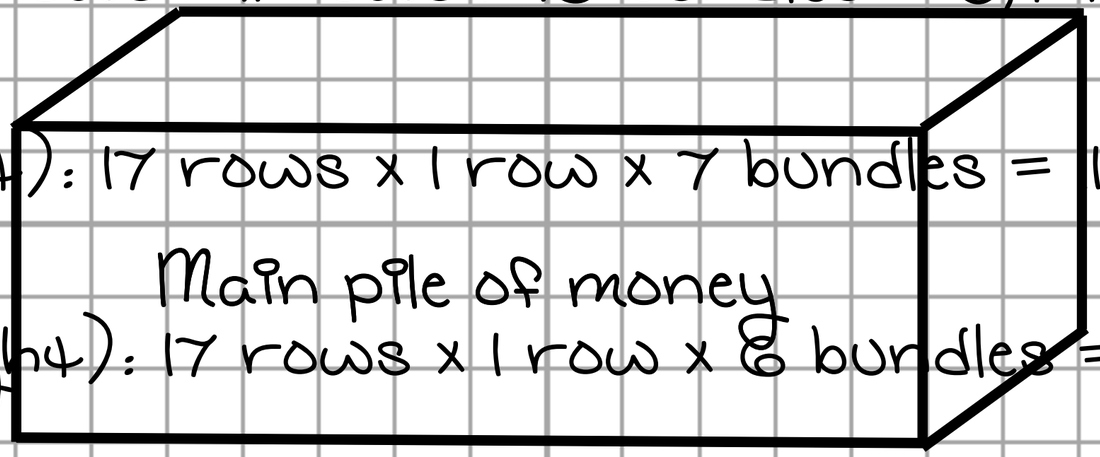

PGR
SIEDO
PGR
SIEDO

Your work

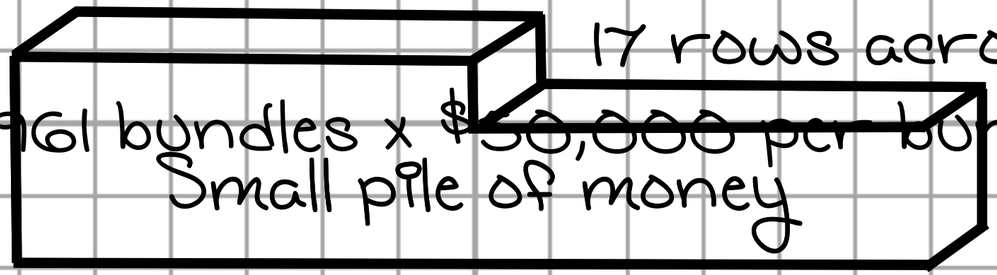
Main pile: 34 rows x 11 rows across x 10 bundles = 3,740 bundles

Small pile (left): 17 rows x 1 row x 7 bundles = 119 bundles

Small pile (right): 17 rows x 1 row x 8 bundles = 102 bundles



Total bundles: 3,740 + 119 + 102 = 3,961 bundles



Total money: 3,961 bundles x $50,000 per bundle = $198,050,000


FOX
FOX NEWS

GOALS

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW DO YOU PROFIT FROM MATH MODELING?
- ☑ HOW DO WE HELP OUR STUDENTS IMPROVE?
- ☐ WHERE CAN WE FIND MORE RESOURCES?

PBL RESOURCES

- Problem-based lesson search engine:
  robertkaplinsky.com/prbl-search-engine
- My lessons (Elementary, Middle, and High School)
  robertkaplinsky.com/lessons
- Dan Meyer (Middle and High School)
  threeacts.mrmeyer.com
- Andrew Stadel (Elementary and Middle School)
  www.estimation180.com/lessons.html
- Graham Fletcher (Elementary and Middle School)
  gfletchy.com/3-act-lessons

Home

Math resources that create problem solvers, not robots.

Download my favorite lessons for elementary, middle, and high school.

GET FREE LESSONS TAKE MY WORKSHOP

What happens next?

1

Keep coming back for more free lessons and resources.

2

Learn implementation tips from my blog and weekly emails.

3

Take my online workshop for more implementation support.

Lessons

View all | Kinder | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | Alg 1 | Geo | Alg 2

How Much Money Were Those Pennies?

How Can We #SaveNelly?

How Many Chip Bags Will There Be?

How Can We Make Stronger Passwords?

Search

Type and hit enter ...

Get My Emails

Do you like the ideas you're reading? If so, you'll love having the best ones sent to you via email!

First Name

Last Name

Email address

Zip Code (optional)

Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

Resources

Depth of Knowledge

- Open Middle
- Open Middle Worksheet – English (student version)
- Open Middle Worksheet – English (document camera version)
- Open Middle Worksheet – Spanish (student version)
- Open Middle Worksheet – Spanish (document camera version)
- Robert's blog posts on Depth of Knowledge
- Tool to Distinguish Between Depth of Knowledge Levels

Problem-Based Lesson Tools

- Problem-Based Lesson Search Engine
- Problem Solving Framework v8.1
- Robert's blog posts on Problem-Based Learning

Problem-Based Lesson Sources

- 101 Questions
- Andrew Gael
- Andrew Stadel
- Catherine Castillo
- Christina Tondevold
- Dan Meyer
- Dane Ehlert
- Emergent Math's Problem Based Curriculum Maps

Robert Kaplinsky's Problem-Based Lessons

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D	E	F	G	H	
1	Lesson	Concept / Skill	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5	Standard 6	Stan 7
2	How Much Money Were Those Pennies?	Money, Multiplying Decimals, Proportions	4.MD.2	5.NBT.5	5.NBT.7	7.RP.3			
3	How Can We #SaveNelly?	Dividing Decimals	6.NS.3						
4	How Many Chip Bags Will There Be?	Ratio and Proportions, Population Sampling	6.RP.3	6.RP.3c	7.RP.2	7.RP.3	7.SP.1	7.SP.2	
5	How Can We Make Stronger Passwords?	Permutations, Combinations, Probability, Exponents, Exponential Growth	7.SP.8	8.EE.1	S-MD.7	S-CP.5	S-CP.9		
6	How Many Hot Dogs And Buns Should He Buy?	Least Common Multiple (LCM)	6.NS.4						
7	What Does 2000 Calories Look Like?	Unit Rates, Ratios, Solving Equations, and Solving Inequalities	6.EE.3	6.EE.4	6.EE.5	6.EE.6	6.EE.7	6.EE.8	6.RP.2
8	How Much Money Are The Coins Worth?	Decimal Operations and Coin Counting	2.MD.8	5.NBT.7	6.NS.3				
9	How Many Times Will A Case of Paper Jam?	Interpreting Percentages	6.RP.3c	7.RP.3					
10	How Many Soda Combinations Are There On A Coke Freestyle?	Counting, Composing, and Decomposing Numbers	K.CC.5	K.CC.6	K.OA.1	K.OA.2	K.OA.3	K.OA.4	K.NBT
11	What Should The Freeway Sign Show?	Fractions on Number Lines, Converting Units, Decimal and Fraction Operations	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	4.MD.
12	How Fast Was The Fastest Motorcycle Speeding Ticket Ever?	Converting Units and Unit Rates	5.MD.1	6.RP.3d	7.RP.1	N.Q.1			
13	How Much Did Patrick Peterson Lose By Not Cashing His Check?	Compound and/or Simple Interest	7.RP.3	N-RN.2	A-SSE.1	A-SSE.3c	A-SSE.4	A-REI.11	F-IF.4
14	How Many Biscuits Can You Make?	Dividing Fractions and Mixed Numbers	5.NF.7	5.NF.7a	5.NF.7b	5.NF.7c	6.NS.1		
15	How Much Bigger Should They Make Zoolander's School?	Scale and Proportions	5.NF.5A	7.RP.2	7.G.1				
16	Where Is The Freeway Sign Located?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	3.NF.3
17	How Far Apart Are Exits On A Ring Road?	Arc length measures	G-C.5						
18	How Much Is One Third Of A Cup Of Butter?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2	3.NF.2a	3.NF.2b	3.NF.3	3.NF.3a	3.NF.3
19	How Do Skytypers Write Messages?	Transformations (Rotations, Reflections, Dilations, and Translations)	8.G.1	8.G.2	8.G.3	8.G.4	G-CO.2	G-CO.3	G-CO
20	How Big Is The Bermuda Triangle?	Coordinate Geometry: Area of Triangle	G-GPE.7						
21	What Fraction Of Children Are In The Right Car Seat?	Representing and Comparing Fractions	3.NF.1	3.NF.2	3.NF.3	4.NF.1	4.NF.2		
22	How Much Did The Temperature Drop?	Absolute Value	6.NS.7c	7.NS.1c					
23	How Much Shorter Are Staggered Pipe Stacks?	Circles, Pythagorean Theorem, trigonometric ratios, and linear functions	8.G.7	A-CED.1	A-CED.3	A-CED.4	A-SSE.1a	A-SSE.1b	A-SSE
24	How Do You Write A Check To Pay For Something?	Expanded Form	2.NBT.3	4.NBT.2	5.NBT.3a				
25	How Can We Correct The Scarecrow?	Pythagorean Theorem	8.G.6	G-SRT.4					
26	How Much Does A 100×100 In-N-Out Cheeseburger Cost?	Building and Interpretting Linear Functions	8.F.1	8.F.3	8.F.4	8.F.5	F-IF.4	F-IF.5	F-IF.6
27	How Can We Water All Of The Grass?	Circles, Pythagorean Theorem, trigonometric ratios	7.G.4	8.G.7	G-SRT.8	G-MG.1	G-MG.3		
28	How Much Money IS That?!	Volume of rectangular prism	5.MD.3	5.MD.4	5.MD.5	5.MD.5b	5.MD.5c	6.G.2	7.G.6
29	How Much Money Should Dr. Evil Demand?	Exponential Growth	N-RN.2	A-SSE.1	A-SSE.3c	A-SSE.4	A-REI.11	F-IF.4	F-IF.7
30	How Tall Is Mini-Me?	Scale and Dividing Decimals	5.NF.5	5.NF.5a	5.NF.5b	6.NS.3			
31	How Did They Make Ms. Pac-Man?	Transformations (Rotations, Reflections, and Translations)	8.G.1	8.G.2	8.G.3	8.G.4	G-SRT.2	G-CO.4	G-CO
32	Which Ticket Option Is The Best Deal?	Unit Rates and Ratios	6.RP.2	6.RP.3	6.RP.3a	6.RP.3b			
33	How Far Apart Are The Freeway Exits?	Fractions on a Number Line and Subtracting Fractions	3.NF.2	3.NF.2b	4.NF.2	4.NF.3a	4.NF.3c	4.NF.3d	5.NF.1
34	Do We Have Enough Paint?	Area	3.MD.5	3.MD.6	3.MD.7				

Sheet1

GOALS

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
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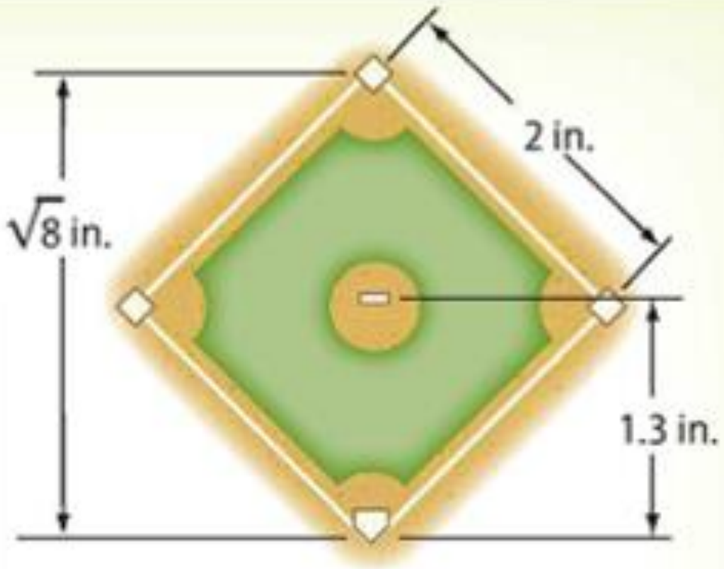
Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Real-World Link

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

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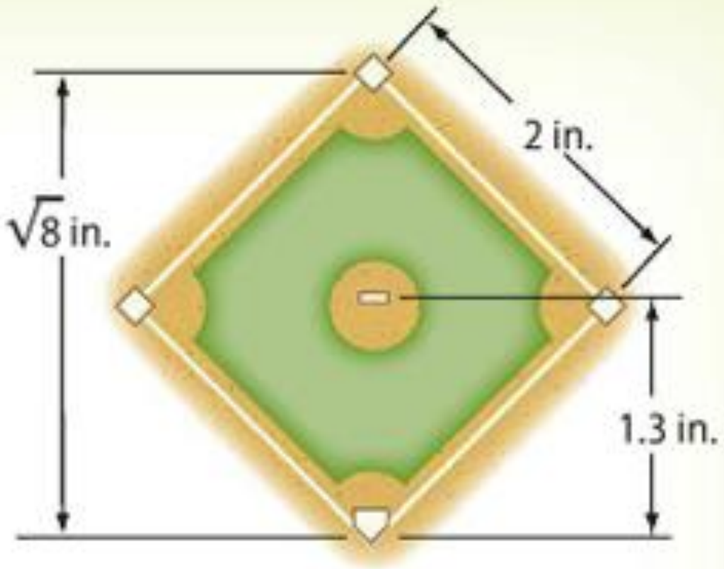

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Scary & Dangerous


2009
NETFLIX
DATE: 09·21·09
PAY TO THE ORDER OF: BellKor's Pragmatic Chaos
$ 1,000,000 00
AMOUNT: ONE MILLION 00/100
FOR The Netflix Prize
Reed Hastings

MATH MODELING CAN MAKE YOU FILTHY RICH

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