



Tackling Central California's Big Weather Issue

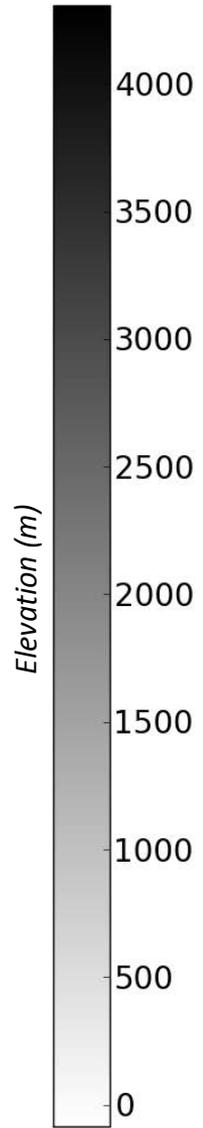
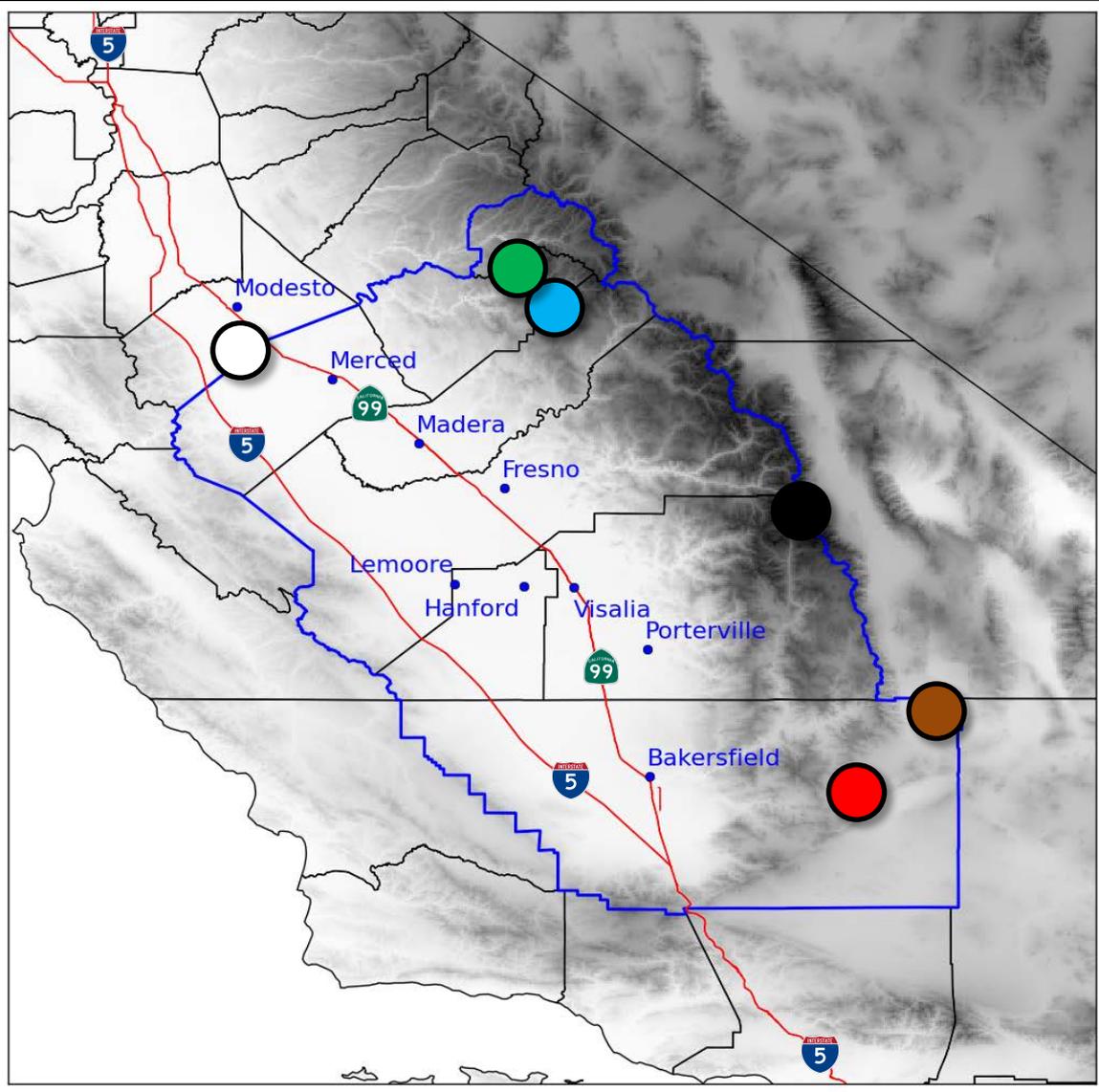
Paul Iñiguez

*Science & Operations Officer
NOAA/NWS Hanford, CA*

*GOES-R Science Seminar
27 September 2013*



NOAA/NWS Hanford



- | | |
|-----------------|--|
| Pop. | ~3 million |
| ● Highest Point | Mt. Whitney
14,495' |
| ○ Lowest Point | Merced/
Stanislaus
Co. Line
~100' |
| ● Hottest | Cantil, CA
121 °F
15 July 1972 |
| ● Coldest | Wawona, CA
-21 °F
8 January 1937 |
| ● Driest | Ridgecrest, CA
4"/yr |
| ● Wettest | Yosemite NP
64"/yr |

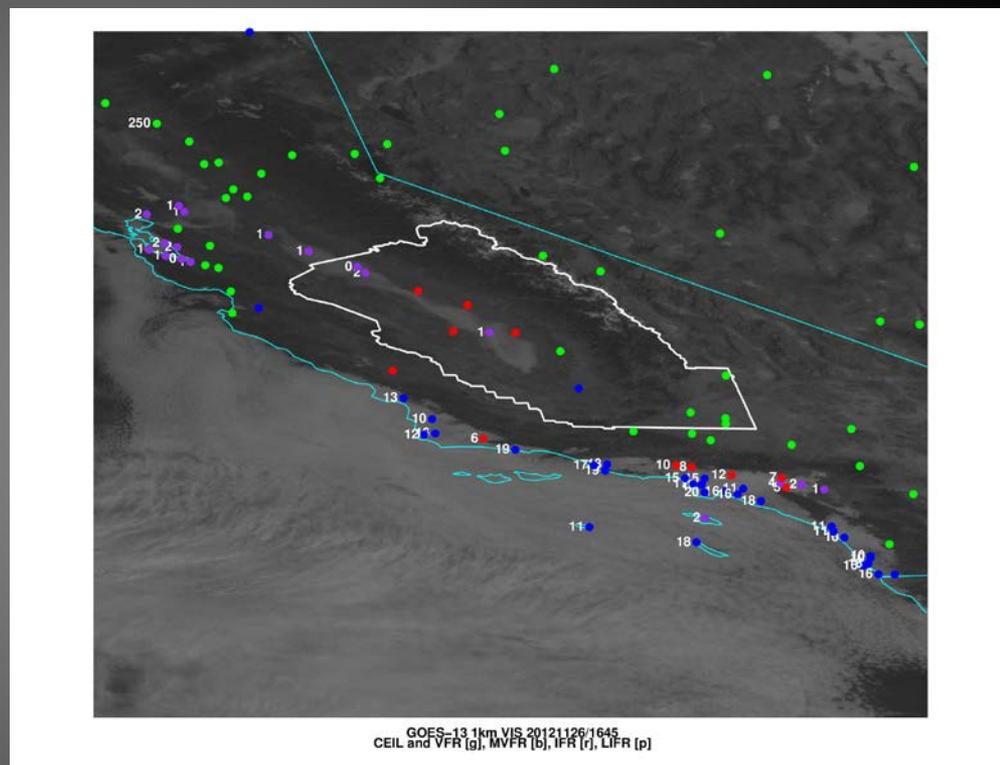
What's the problem?



What's the problem?



Example of tule fog at the NOAA/NWS Hanford, CA office on 26 Nov 2012. The KHNX radome is roughly 400 ft/120 m away in this image.



View of fog on visible satellite, approximately the same time as the bottom picture.

What's the problem?

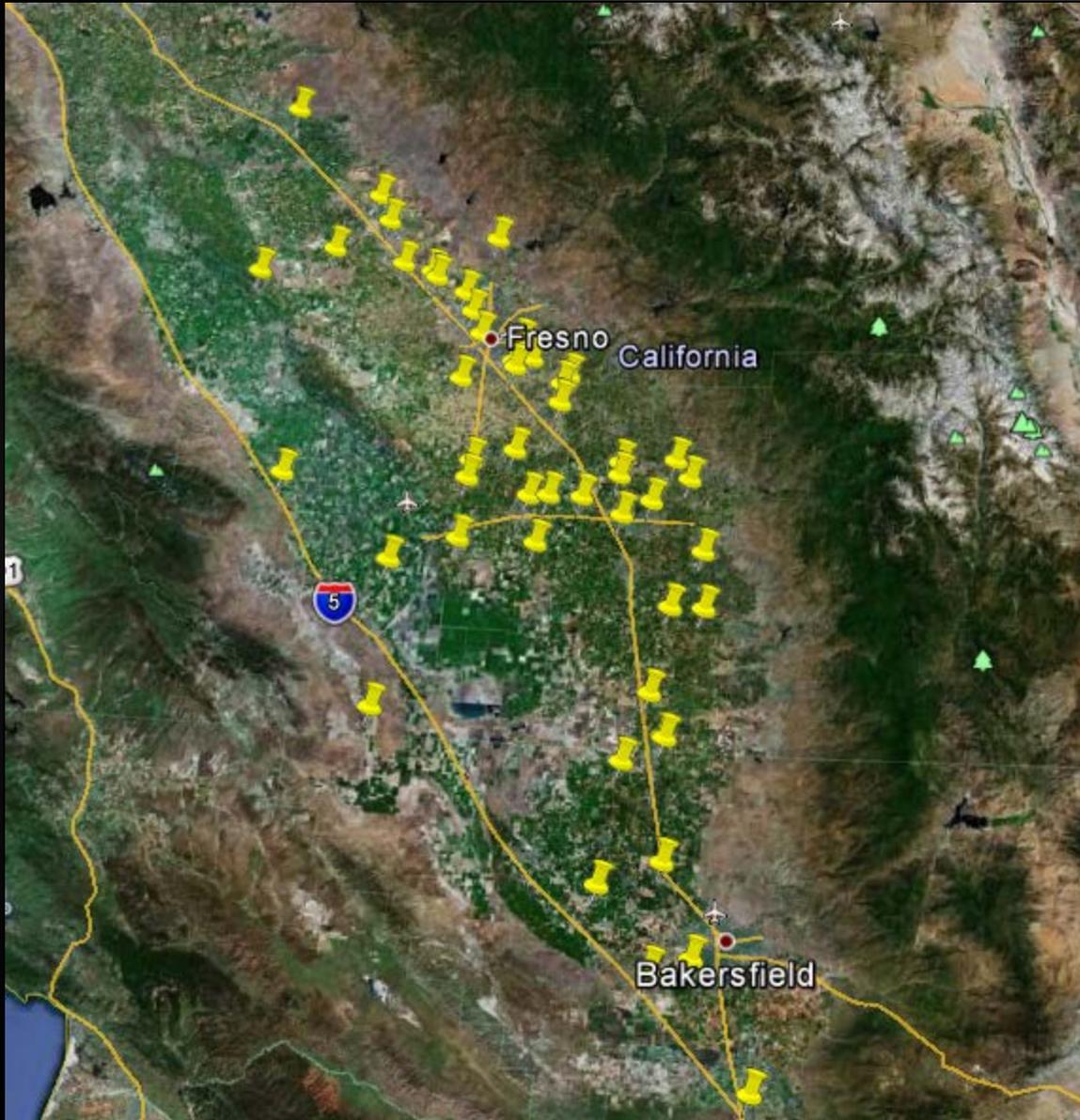
Station Name	Average Number of Hours with Fog (Visibility \leq 0.5 mi) Each Winter
KBFL - Bakersfield, CA	123
KFAT - Fresno, CA	185
KMOD - Modesto, CA	220
KNLC - Lemoore, CA	201

Based on 10 years of ASOS data.

What's the problem?



What's the problem?



Location of Fatal Fog-Related Car Crashes*

2005-2010

49 Crashes

186 Cars

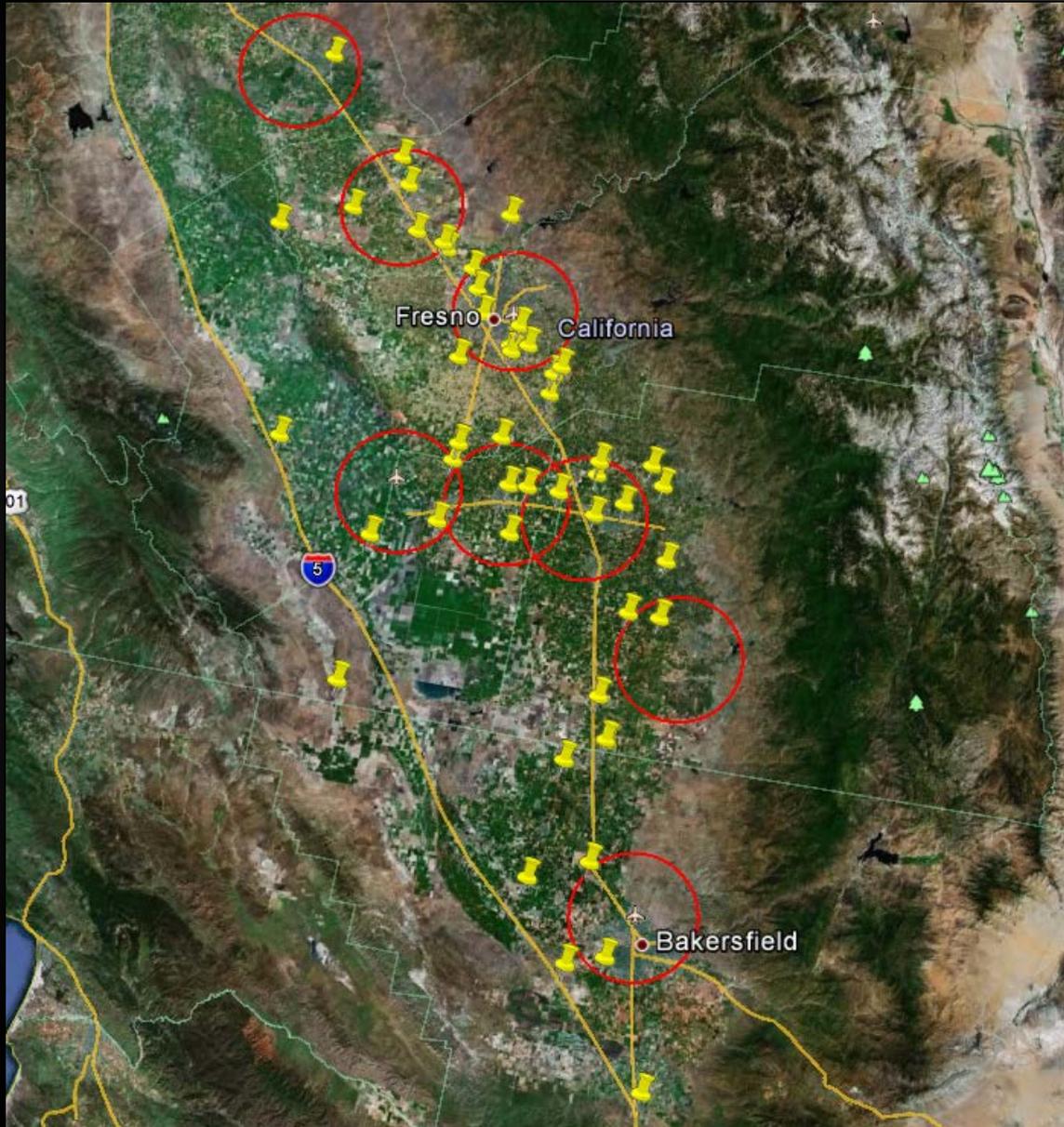
58 Deaths

FYI: No Tornado Deaths in CA History

75% of Deaths
Did Not Occur
on I-5/Hwy 99

*Does not include car-train collisions

What's the problem?



Location of Fatal Fog-Related Car Crashes

2005-2010

60% of Deaths Occurred Within 10 Miles of an ASOS

Q: What was the ASOS vis when the crashed occurred?

Don't know (right now).

Q: How representative is the ASOS?

Probably not very, fog can show tremendous spatial discontinuities.

How can we “see” fog?

ASOS/AWOS (Primary)

Satellite – Fog Channel (Difficult)

Spotters (Few)

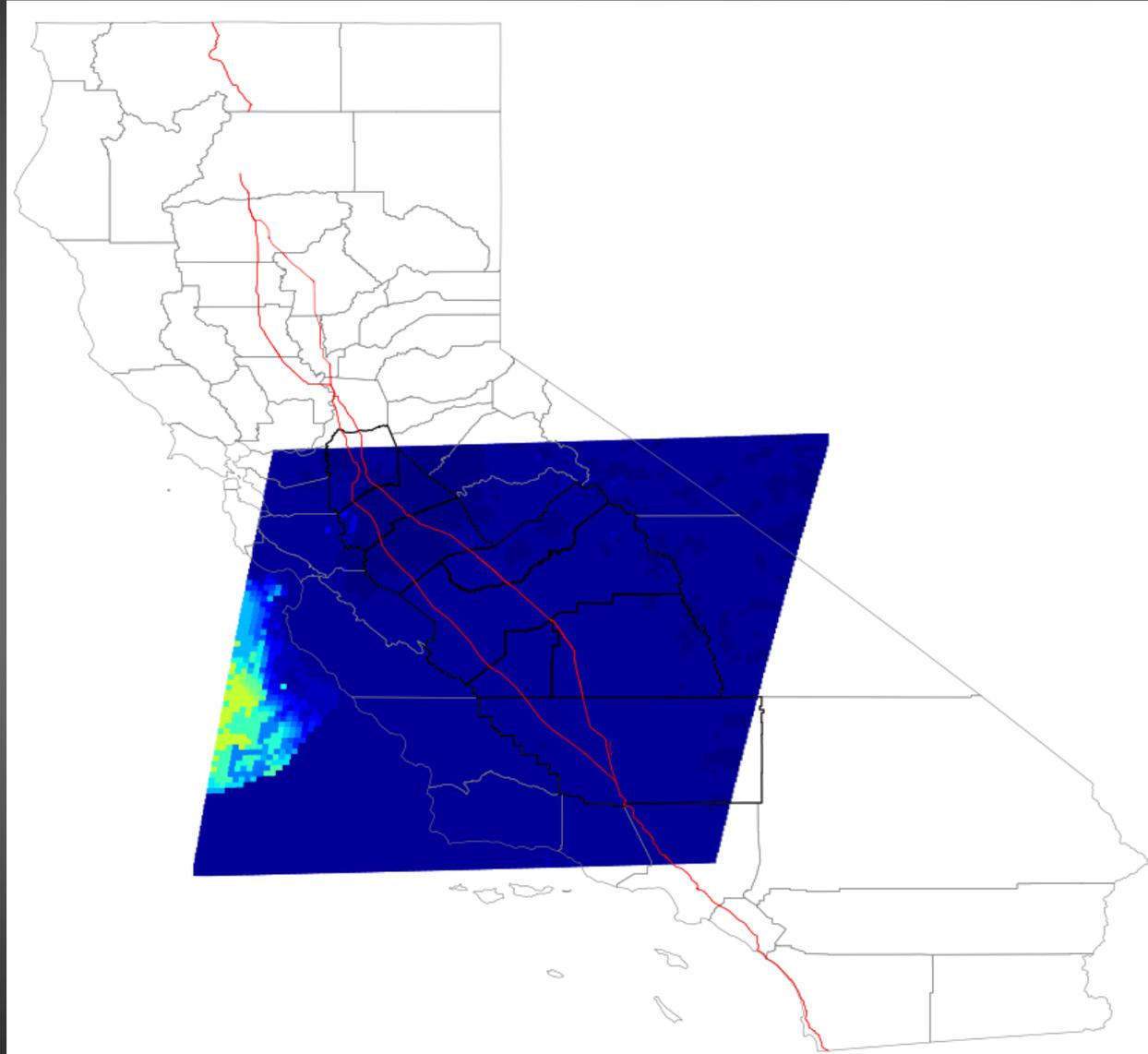
General Public via SM (expanding)

Impact data (expanding)

...generally, we have a hard time “seeing” it.

Verifying FLS

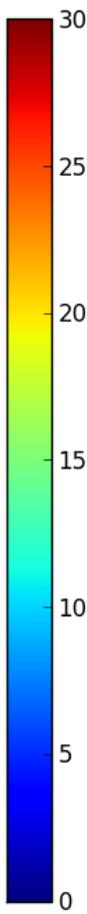
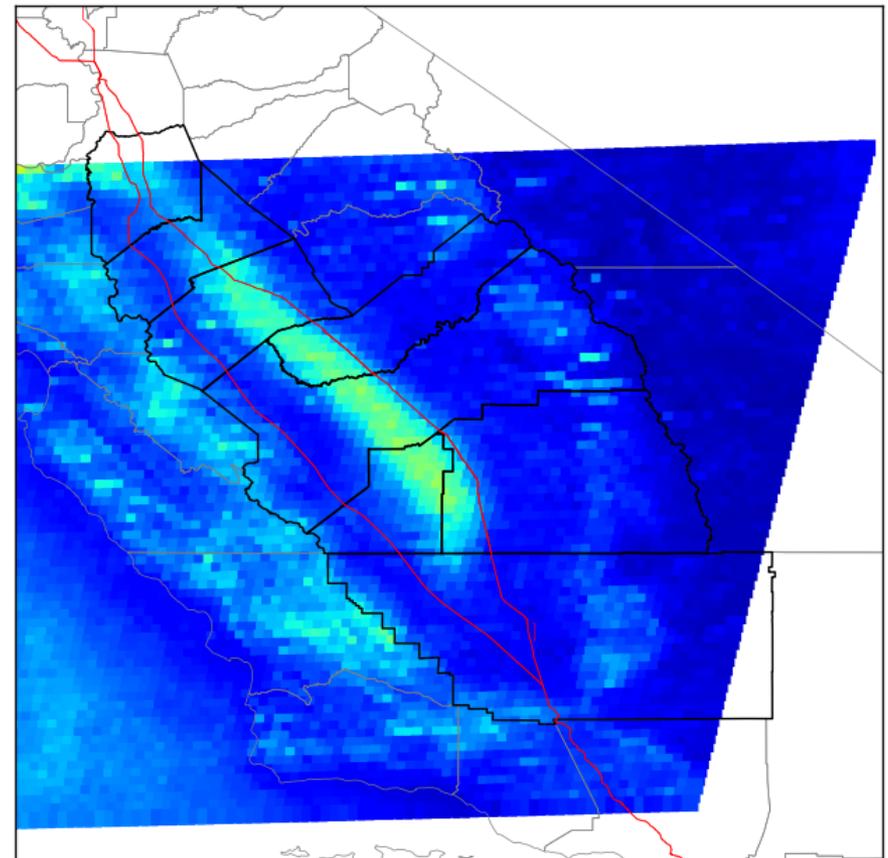
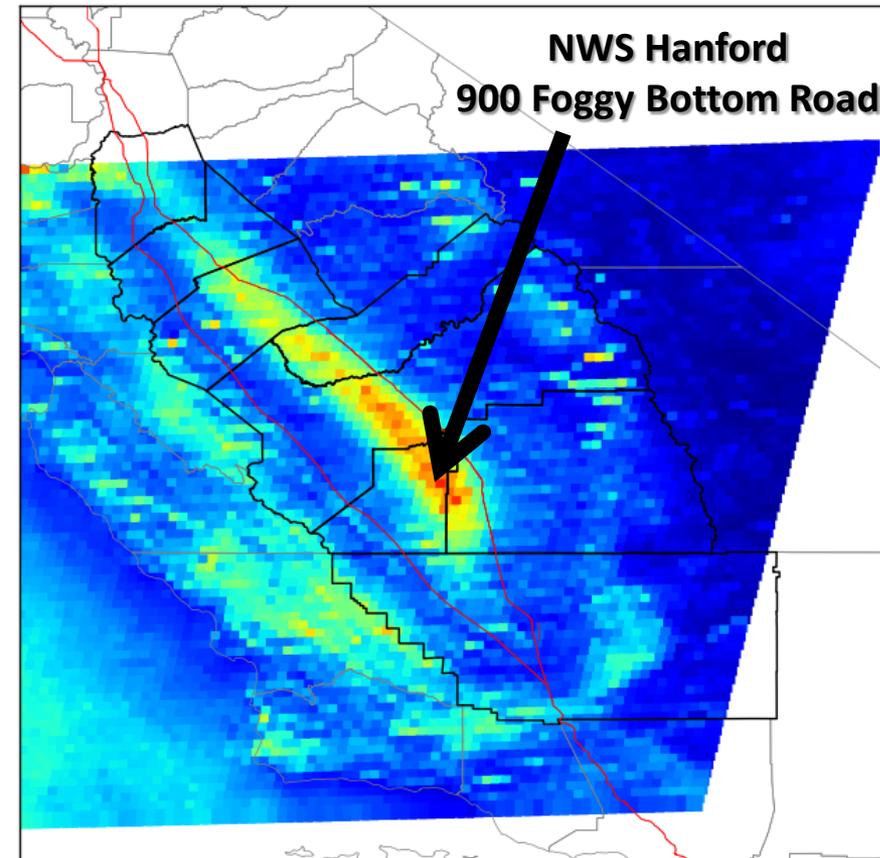
Obtained hourly FLS data from UW Madison – CIMSS for an area over our CWA. Dates covered 1 November 2012 through 28 February 2013 (2,904 hours).



Verifying FLS

Average Probability of LIFR Conditions at 15Z
1 Nov 2012 - 28 Feb 2013

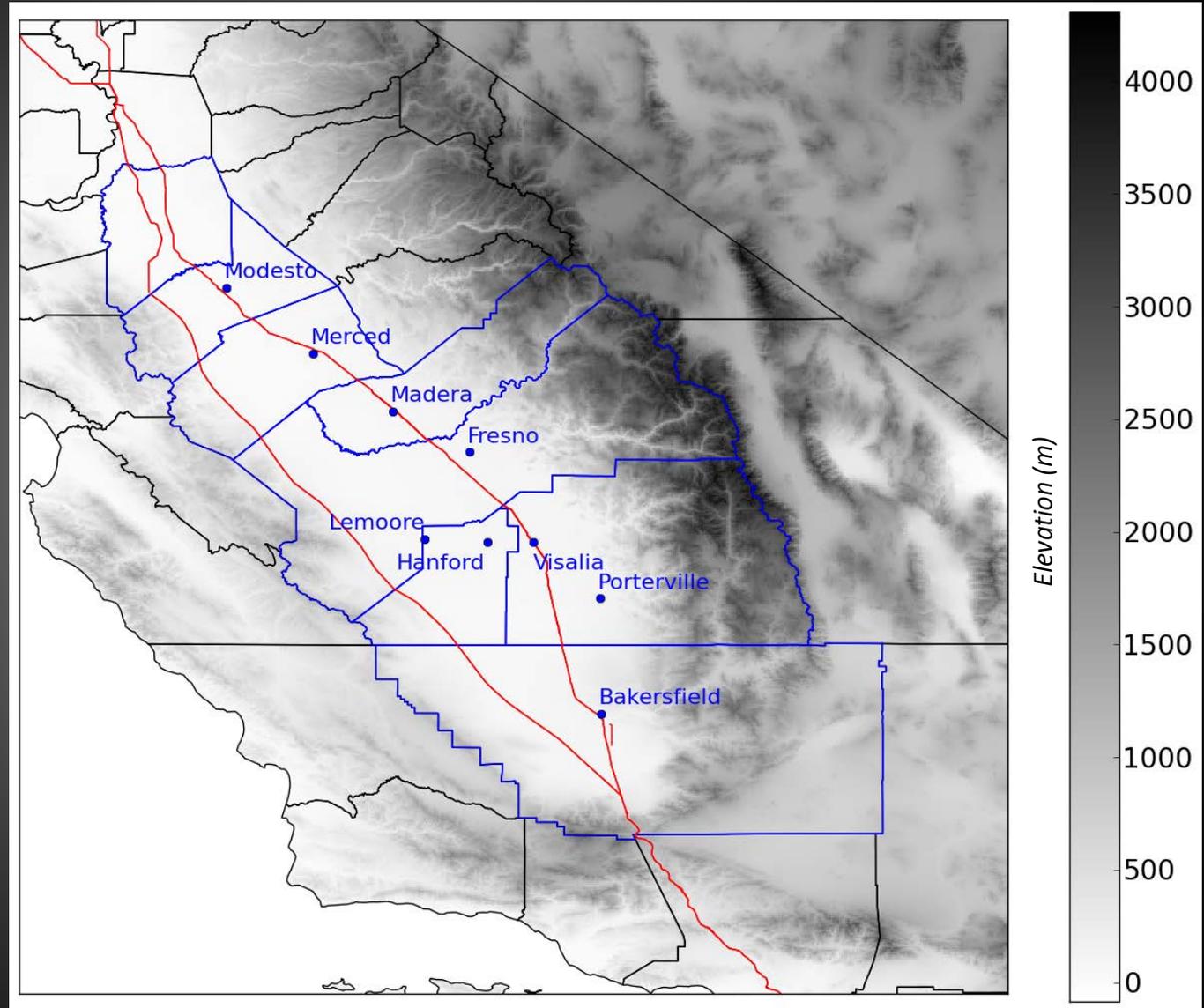
Average Probability of LIFR Conditions at 16Z
1 Nov 2012 - 28 Feb 2013



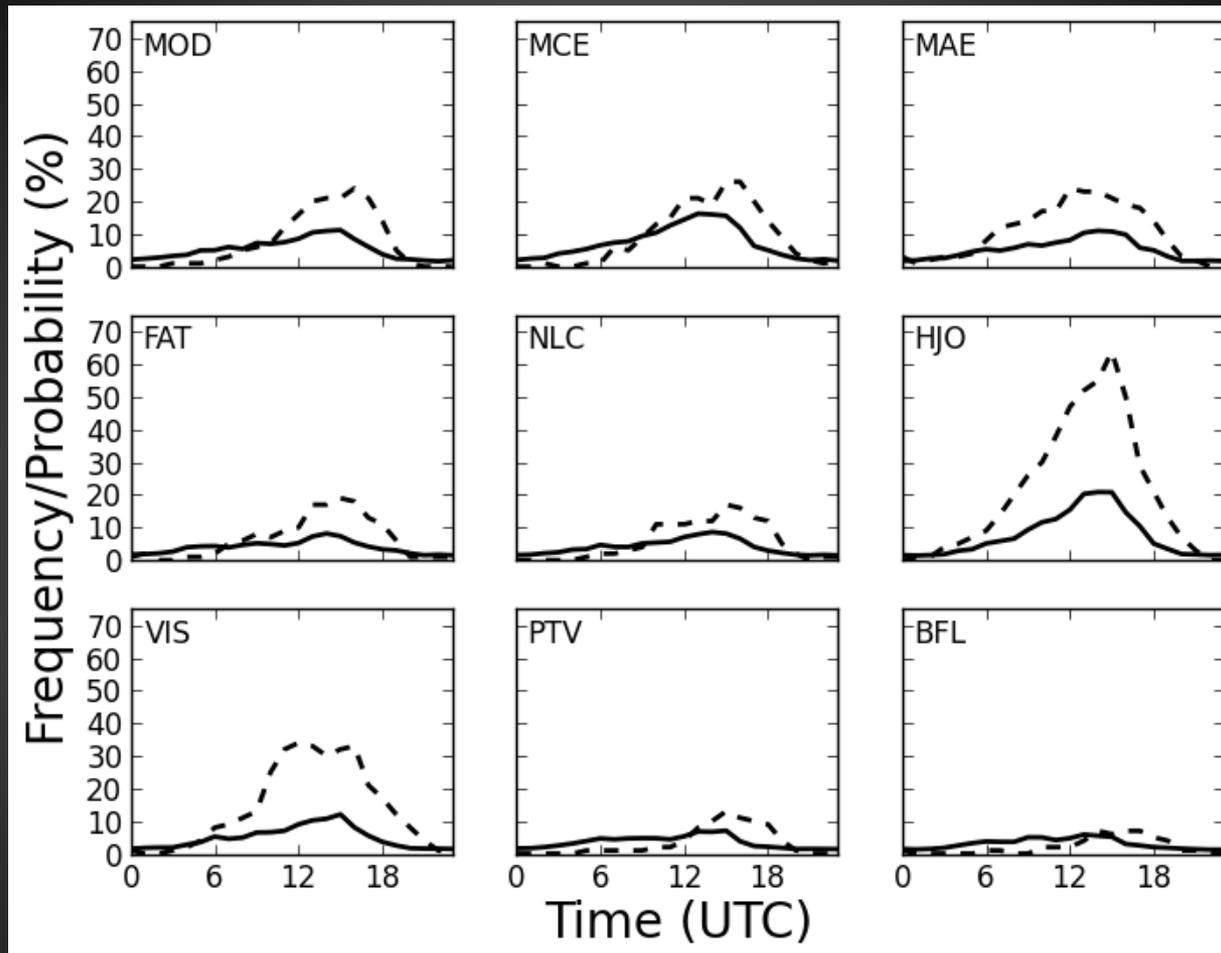
Reduction from 15Z to 16Z due to “sunrise” issues?

Verifying FLS

Obtained hourly
AWOS/ASOS
data from NCDC
for nine stations
in the San
Joaquin Valley.
Dates covered 1
November 2012
through 28
February 2013
(26,1362
station-hours).

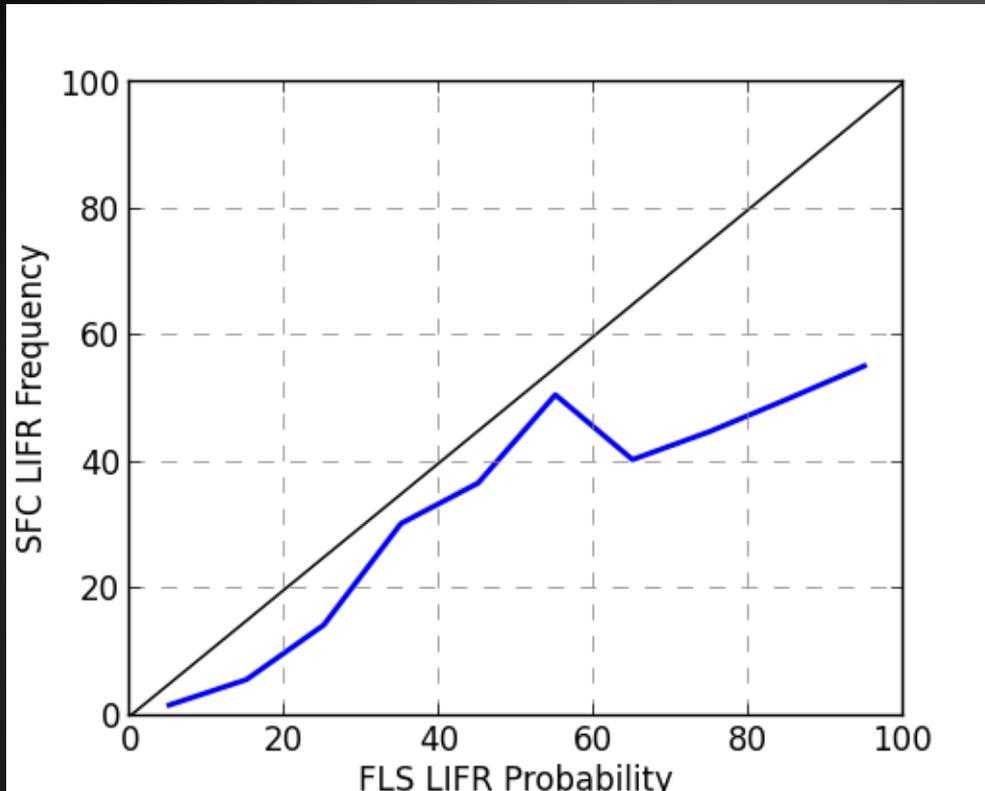


Verifying FLS



Daily mean frequency/probability of LIFR conditions (visibility only) at nine stations based on surface observations (dashed) and FLS (solid). Generally, FLS under-estimate the occurrence of LIFR conditions, significantly in some instances, with an accurate temporal distribution ($r=0.86$).

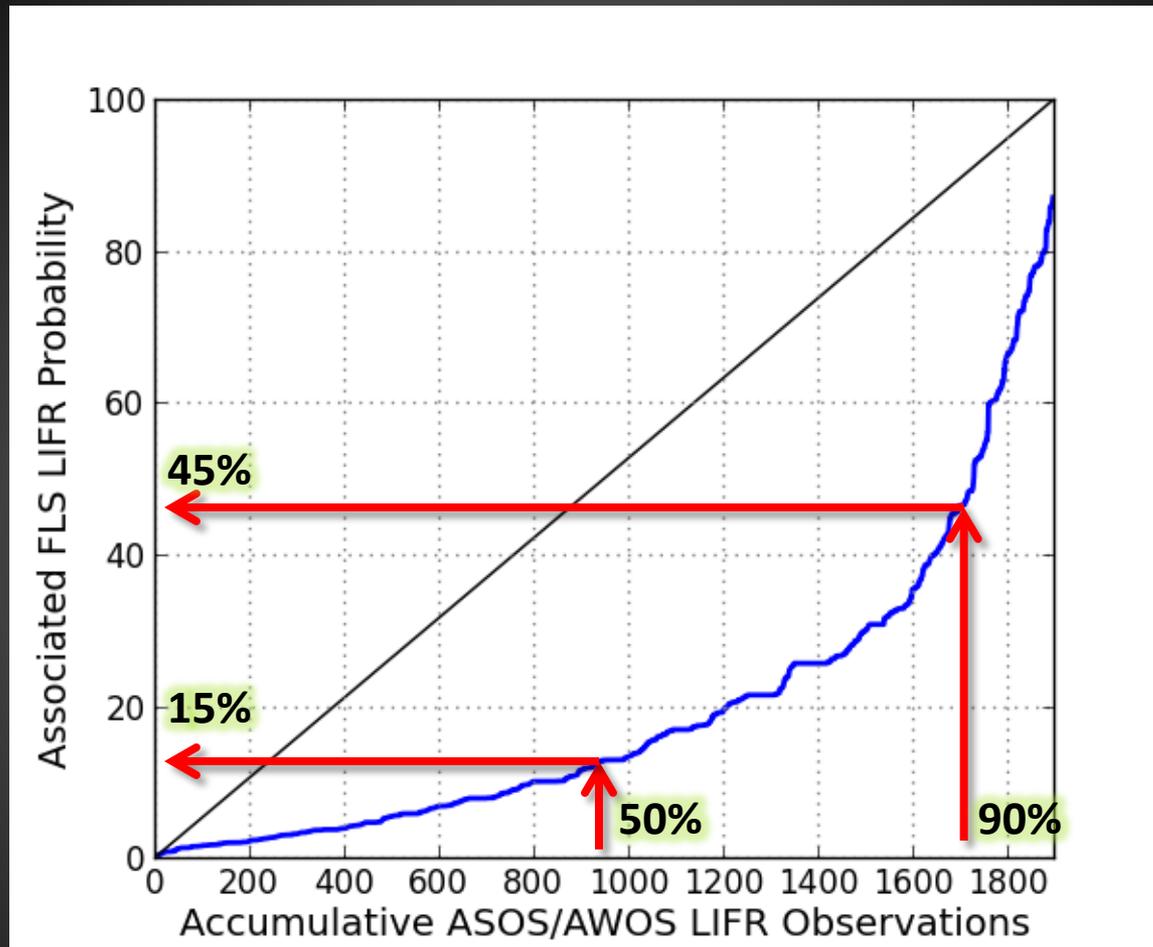
Verifying FLS



	No. Obs
<10%	15,085
10-20%	5,729
20-30%	2,308
30-40%	1,084
40-50%	449
50-60%	420
60-70%	220
70-80%	196
80-90%	178
90-100%	38

FLS reliability chart compared to surface observations (vis only). Up to 50%, FLS estimates within 5-10% (good!). Above 50%, there is a significant over-estimation. This may be partially due to a reduction in frequency of higher values and surface stations located on fringe of favored deep fog areas.

Verifying FLS



Sort all surface observations with vis only LIFR conditions (1,896) by FLS probability. Roughly 90% of observations occurred with a FLS probability below 50%. This indicates a significant underestimation by the FLS dataset.

How has FLS helped HNX?

Overall, the FLS data have been a **BIG** help to HNX operations.

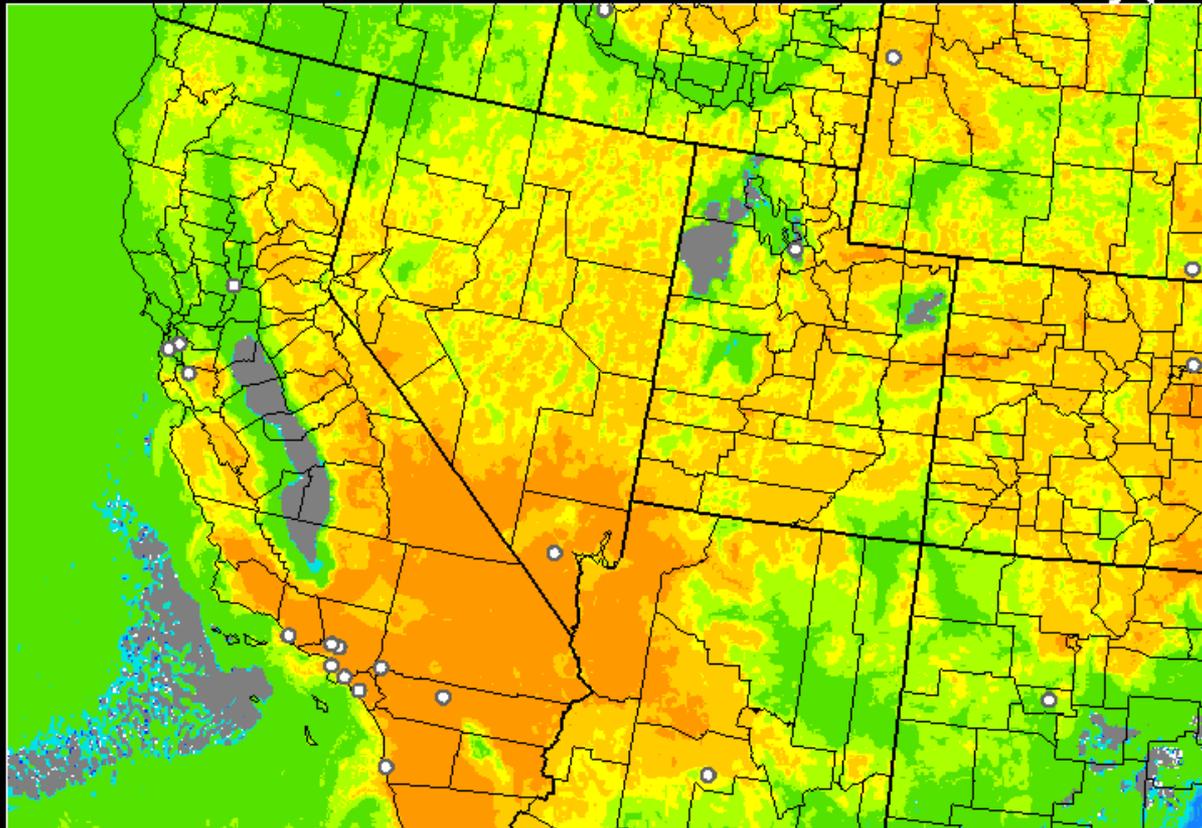
- Filled in observational gap.
- Provide a tool to ascertain spatial extent of fog.
- Allowed forecasters to be more proactive in issuing dense fog advisories.
- Were used extensively when supporting NASA DISCOVERY-AQ mission in the San Joaquin Valley during January 2013.



Another use for FLS?

HRRR 01/04/2013 (03:00) 12h fcst - Experimental

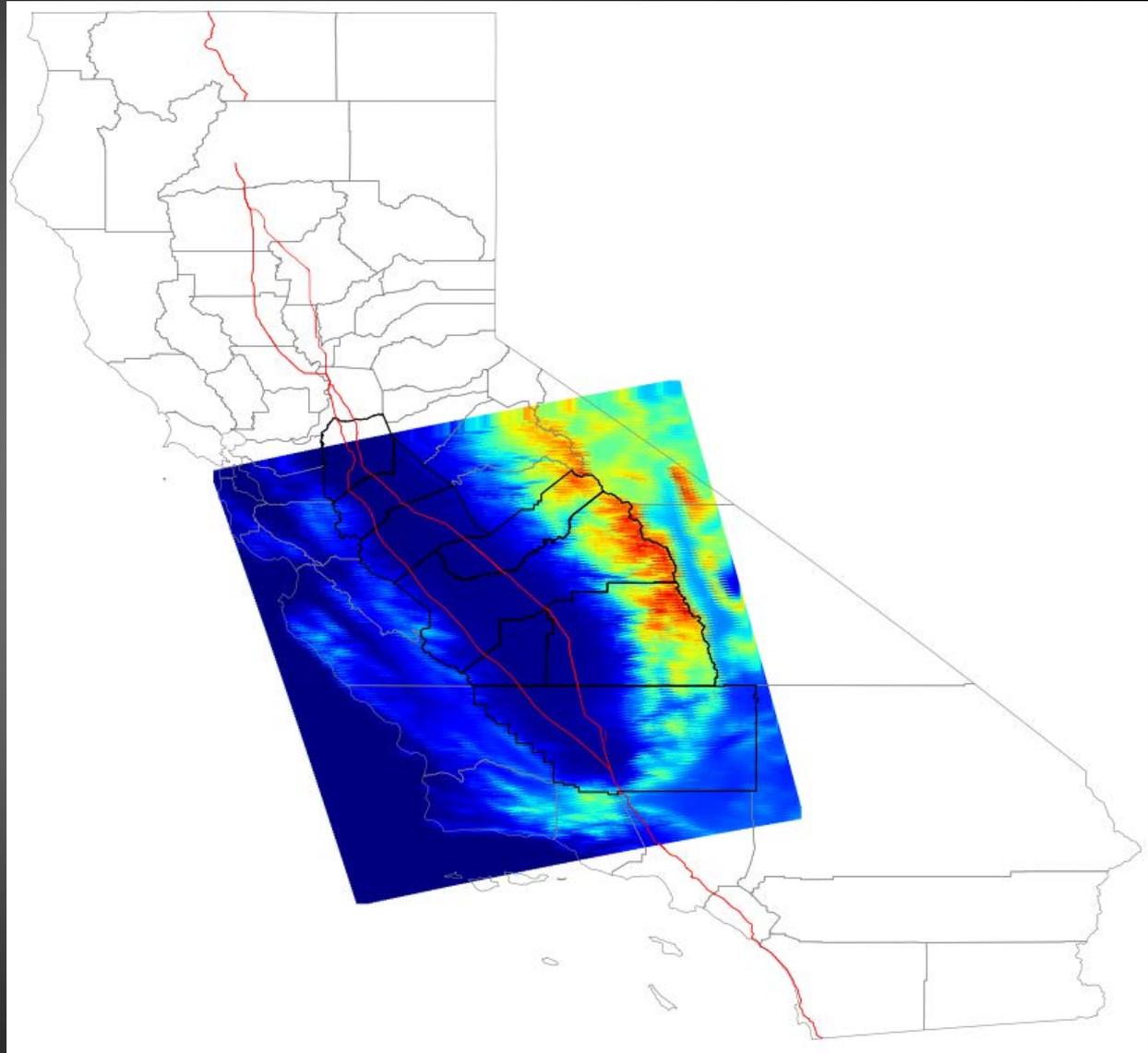
Valid 01/04/2013 15:00 UTC
Sfc Visibility (mi)



<http://rapidrefresh.noaa.gov/HRRR/>

Another use for FLS?

Obtained hourly
HRRR forecast data
from ESRL/GSD for 1
November 2012
through 28 February
2013 (32,000+ files).
Data initially for
entire hrrr domain
(60GB of data!).
Reduced to an area
over our CWA.



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Science & Operations Officer

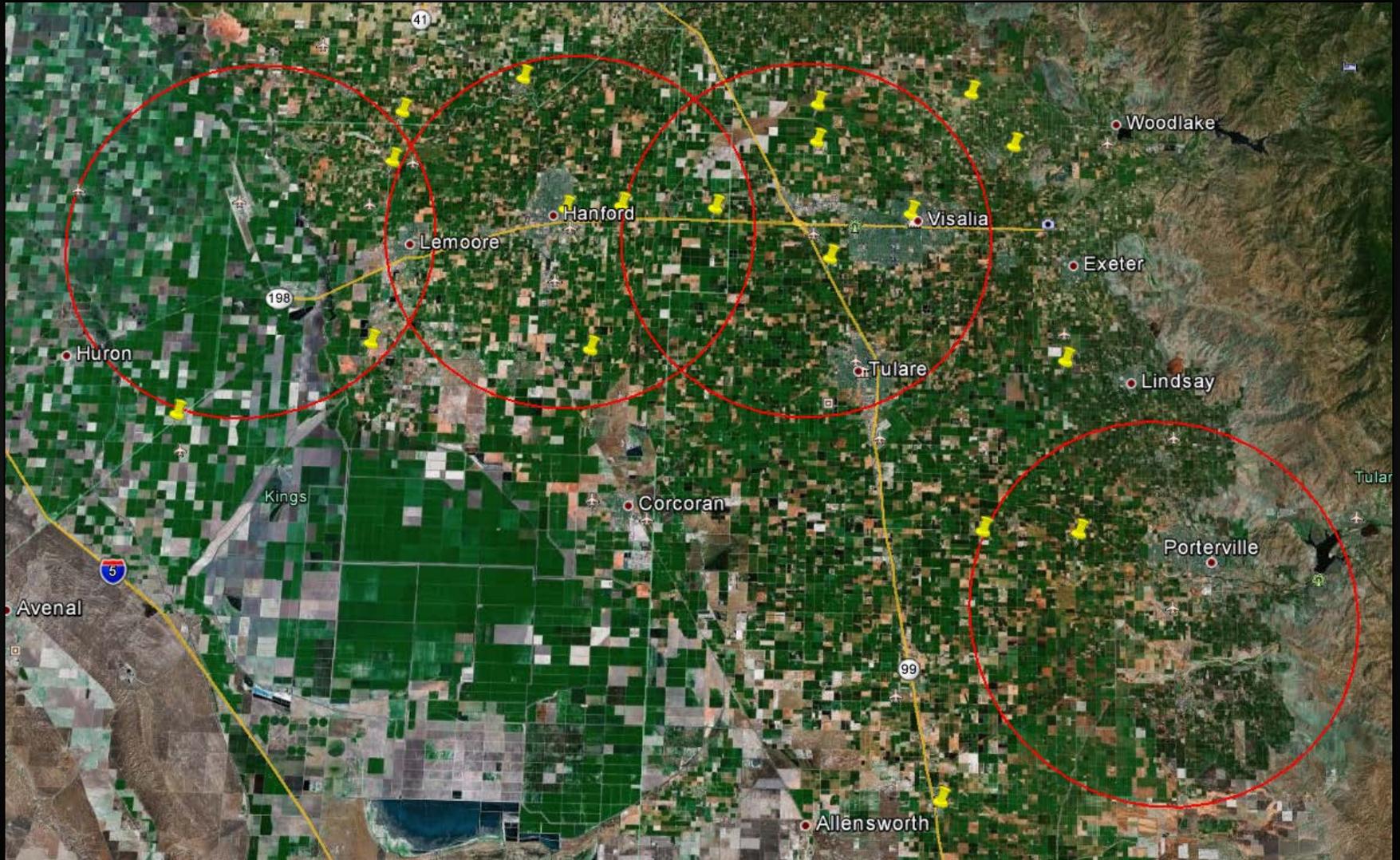
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Bonus Slides

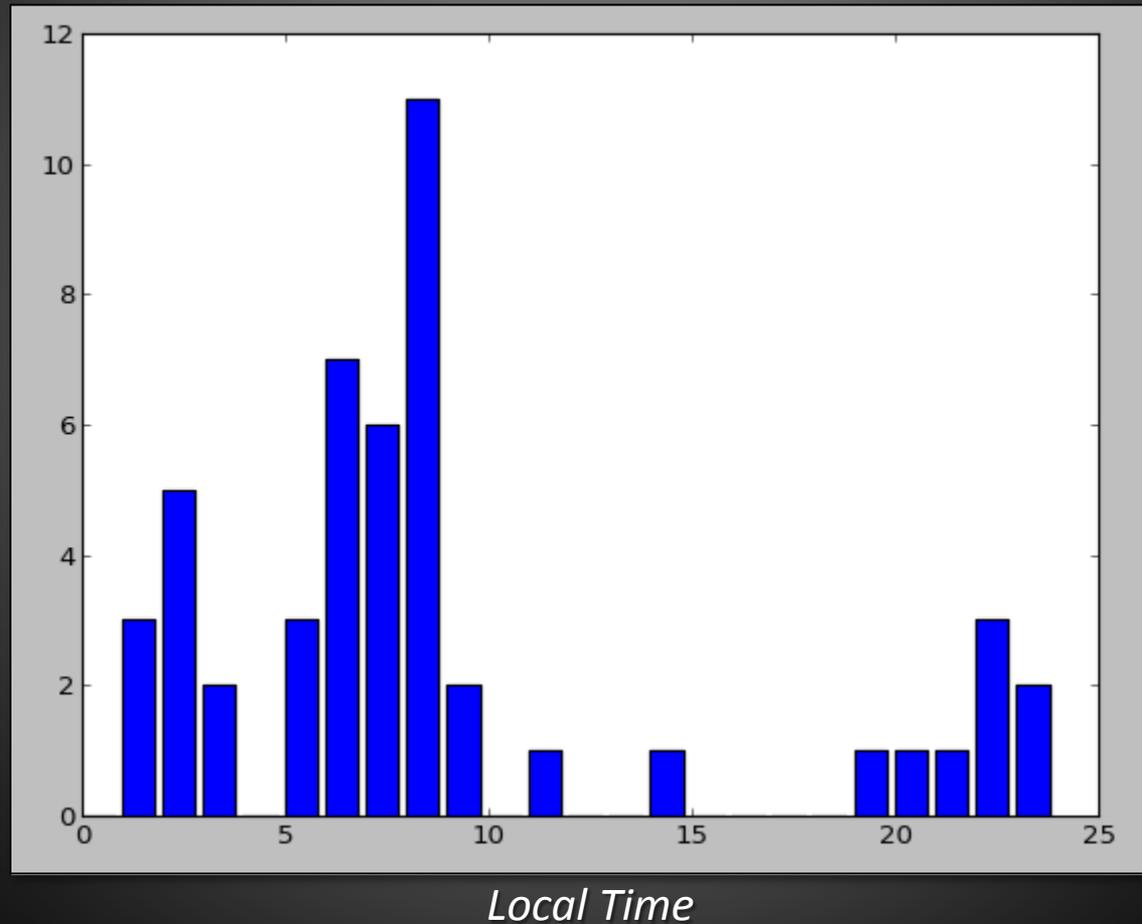
What is the problem?



What is the problem?

Temporal Distribution of Fog-Related Crashes in NWS Hanford Forecast Area

2005-2010



What is dense fog?

NWS definition is visibility $< 1/4$ mi (1300 ft).

California Highway patrol paces traffic at 500 ft or less.

Schools delay at 200-300 ft.

Driving in The Fog – What Can I See?

Amount of Time (sec) Needed By Vehicle to Travel Visibility

Speed and Visibility	2 miles	1 mi	1/2 mi 2640'	1/4 mi 1320'	1/8 mi 660'	200'
20	360.0	180.0	90.0	45.0	22.5	6.8
30	240.0	120.0	60.0	30.0	15.0	4.5
40	180.0	90.0	45.0	22.5	11.3	3.4
50	144.0	72.0	36.0	18.0	9.0	2.7
60	120.0	60.0	30.0	15.0	7.5	2.3
70	102.9	51.4	25.7	12.9	6.4	1.9

Driving in The Fog – How Fast Can I Stop?

$$\text{Stopping Sight Distance} = f(\text{Perception-Reaction Time, Vehicle Operating Speed, Braking Distance})$$

Driving in The Fog – How Fast Can I Stop?

Speed	SSD	
	Feet	Time
20	112	3.8
30	197	4.5
40	301	5.1
50	423	5.8
60	566	6.4
70	728	7.1

Driving In The Fog - What Can I Spare?

Visibility - Stopping Sight Distance = Spare Time

Speed and Visibility	2 miles	1 mi	1/2 mi 2640'	1/4 mi 1320'	1/8 mi 660'	200'
20	360.0	180.0	86.2	41.2	18.7	3.0
30	240.0	120.0	55.5	26.5	10.5	0.0
40	180.0	90.0	39.9	17.4	6.2	-1.7
50	144.0	72.0	30.2	12.2	3.2	-3.1
60	120.0	60.0	23.6	8.6	1.1	-4.1
70	102.9	51.4	18.6	5.8	-0.7	-5.2

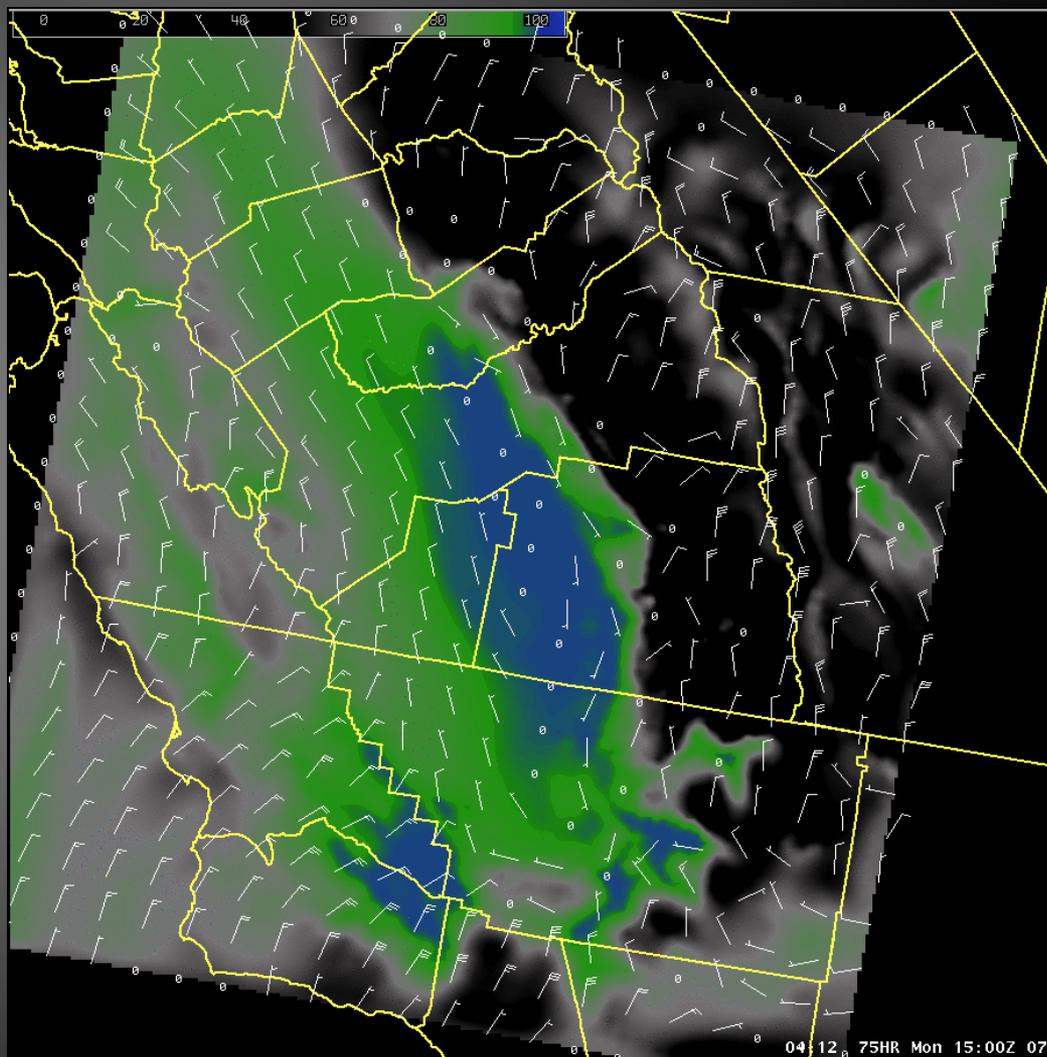
HNX Threshold is too high, but we are held back by observational systems

Accounts for 90-95% of situations.

Radiation Fog – Models

HNX WRF, 168-hr 4km, 4x per Day

No verification with
HNX WRF...may be
terrible, may be
great!



Foggy Days in Central California 2012 - Feb 2013

