Improving Hydrologic Analysis Using Quality Controlled Weather Radar Data and the Storm Precipitation Analysis System (SPAS) – California Examples

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Presentation Outline

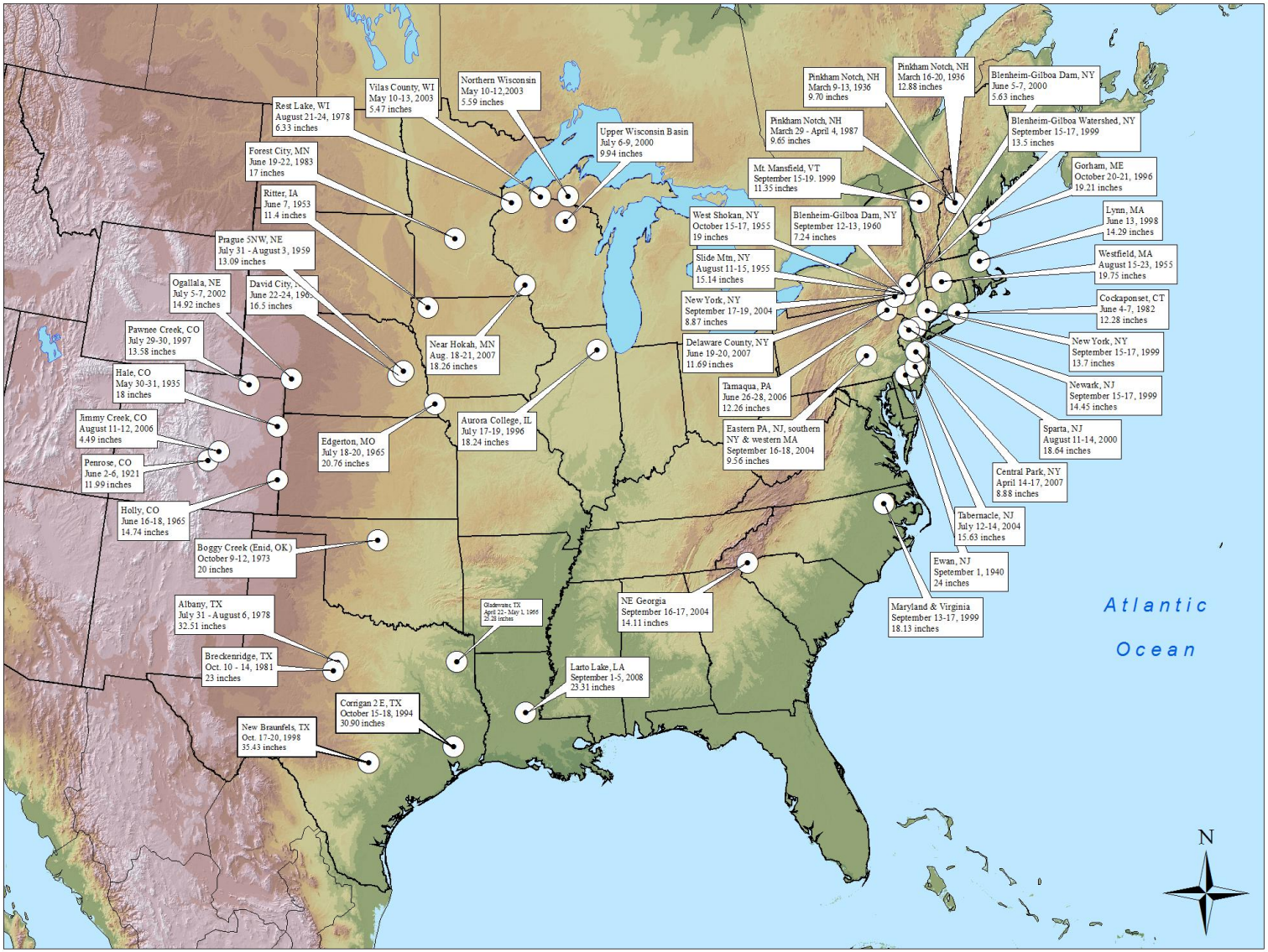
- Storm analysis background
- Storm analysis for PMP development
- Storms analyzed in California
- Overcoming issues within complex terrain
- Examples from the region
- Questions

SPAS Storm Analysis

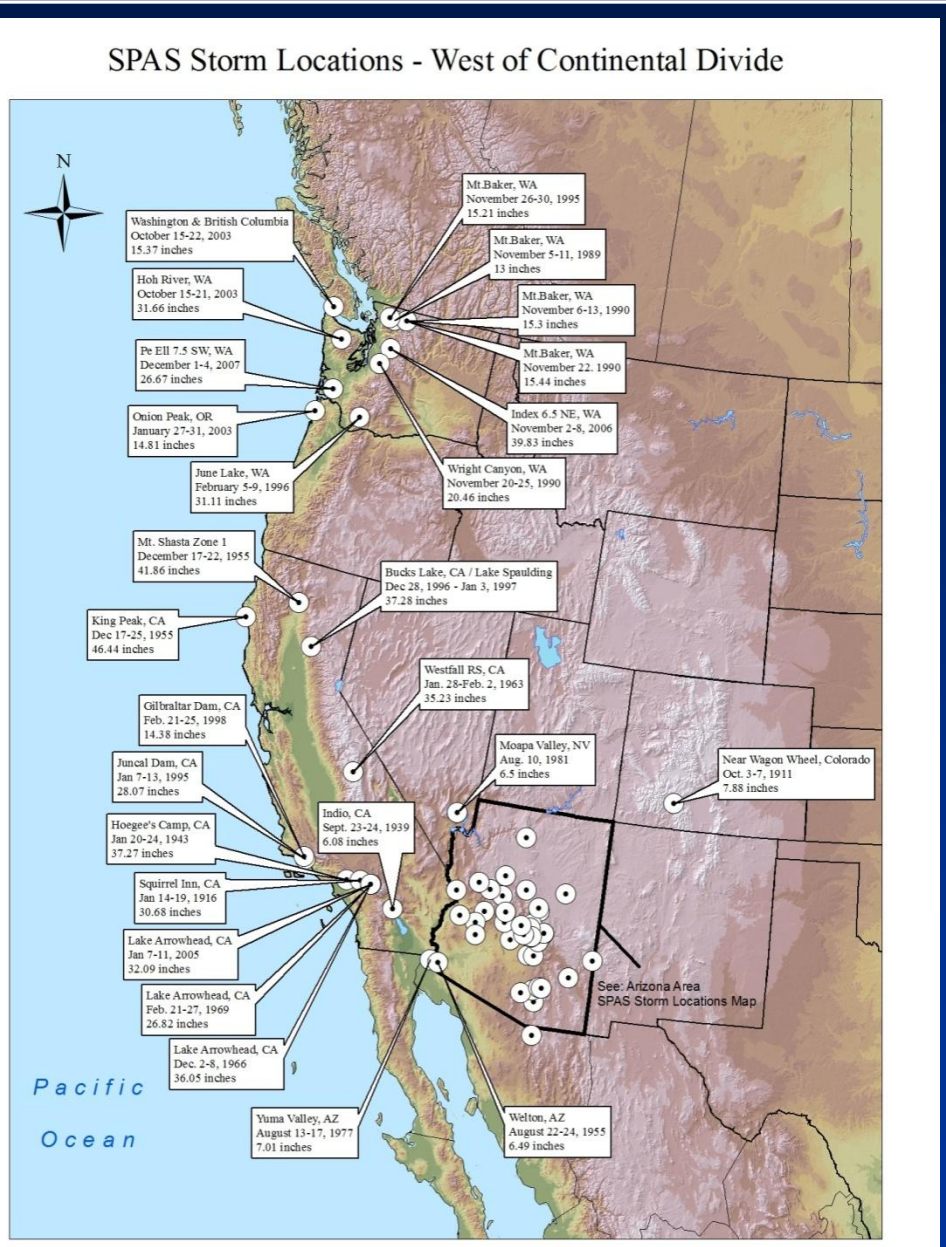
- Storm Precipitation Analysis System (SPAS)
  - State-of-the-science rainfall analysis tool
  - Necessity for analysis of extreme storms state/federally accepted Probable Maximum Precipitation (PMP) studies
  - Approximately 200 storms have been analyzed
    - Most used in PMP and hydrologic analysis
- SPAS storm analyses
  - Depth-Area-Duration (DAD) table
  - Isohyetal pattern, Hourly and Total Storm
  - Mass curves
  - Many others products used to look at each storm in time and space

SPAS Storm Locations

SPAS Storm Locations - East of Continental Divide

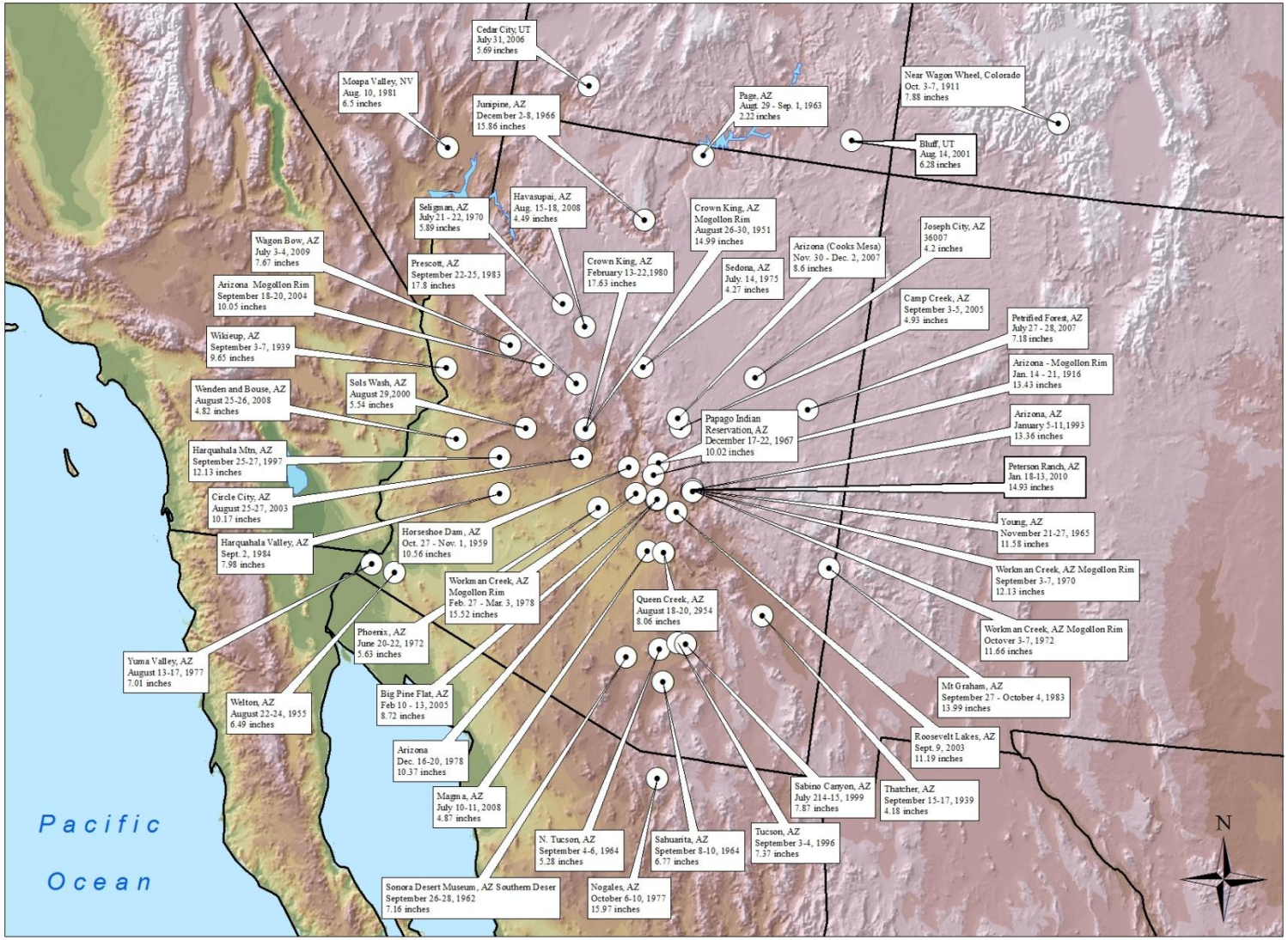


SPAS Storm Locations

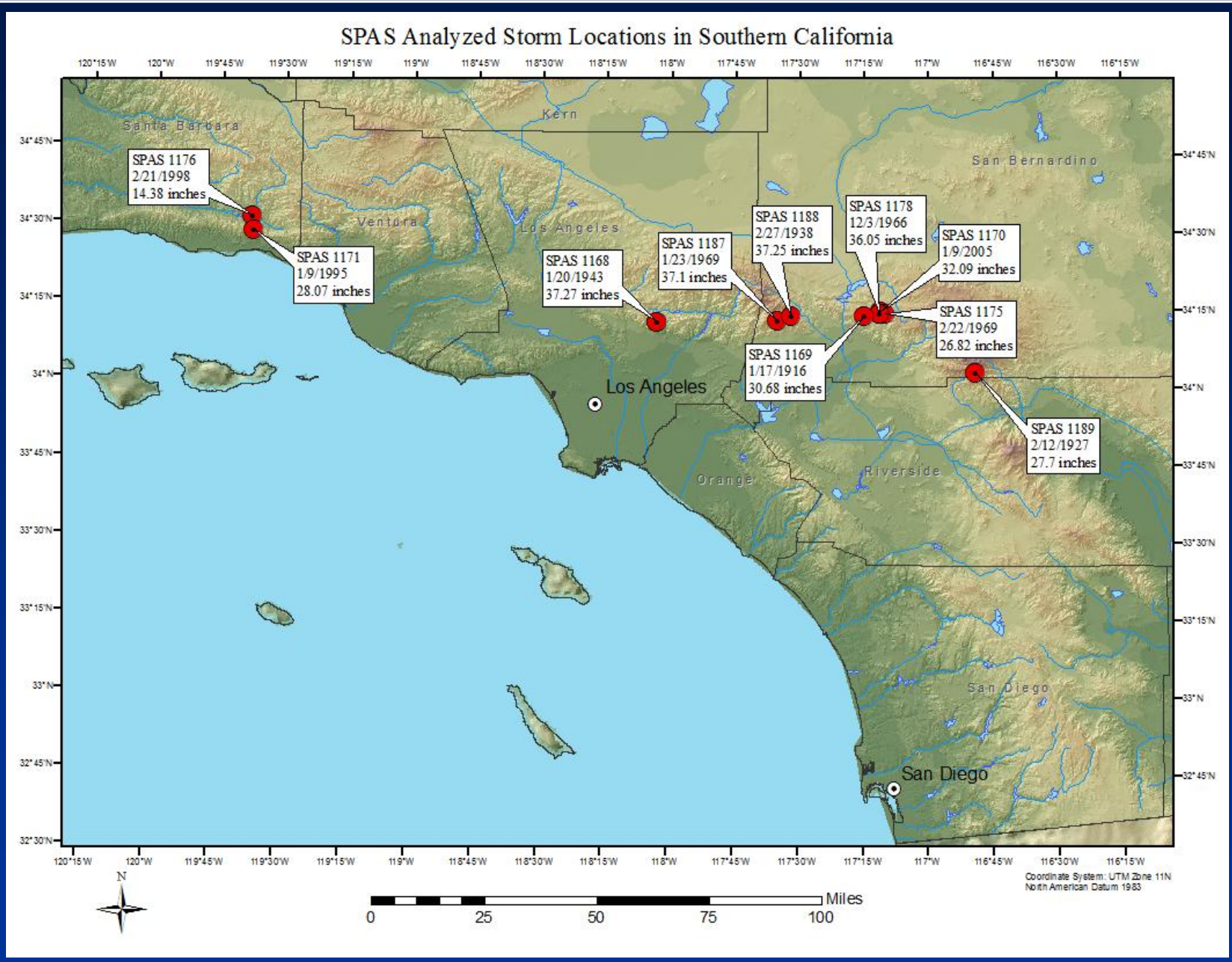


Arizona SPAS Locations

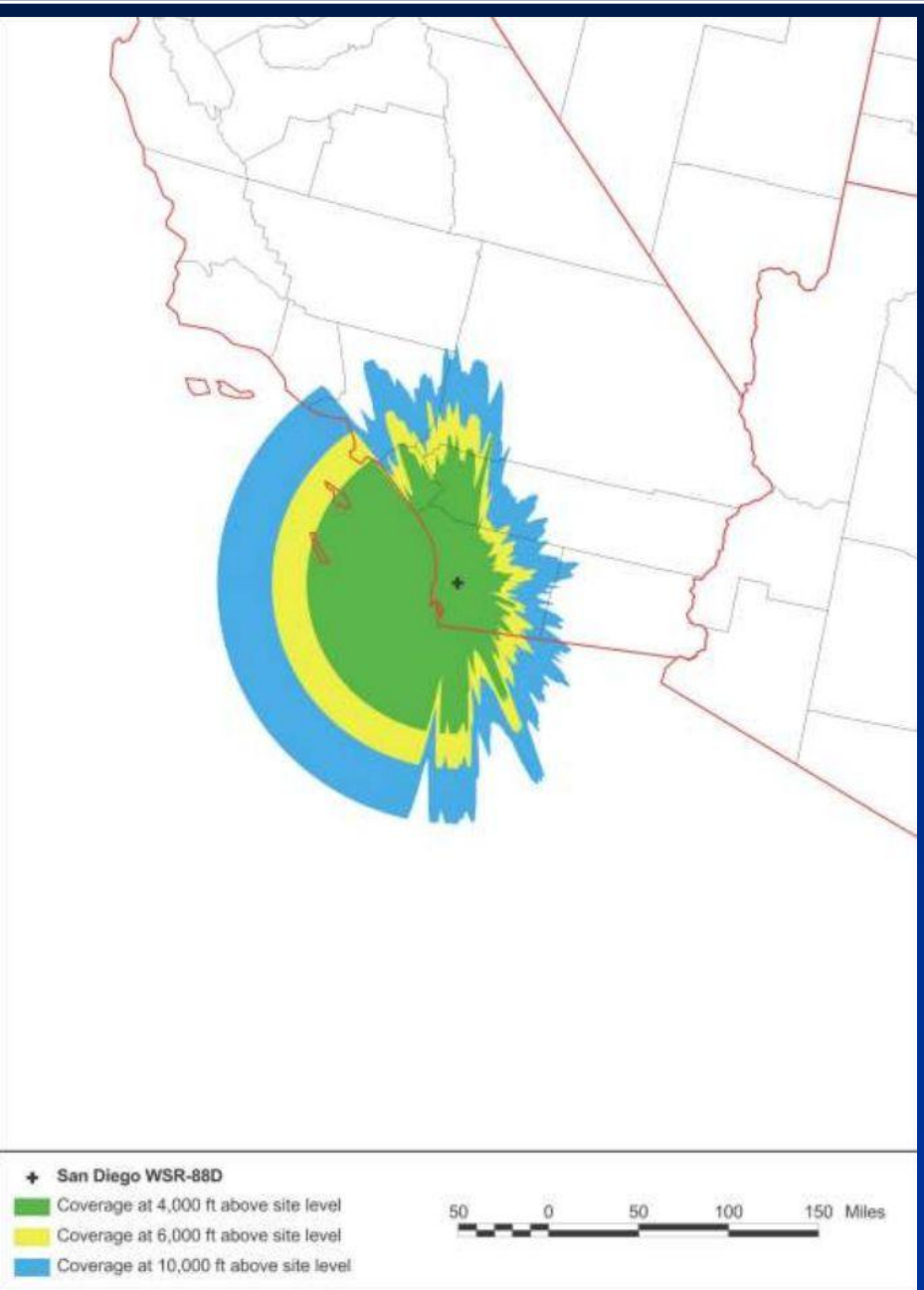
SPAS Storm Locations
Arizona Statewide PMP Project



SPAS Locations Locally



Radar Issues-Can't See the Rain



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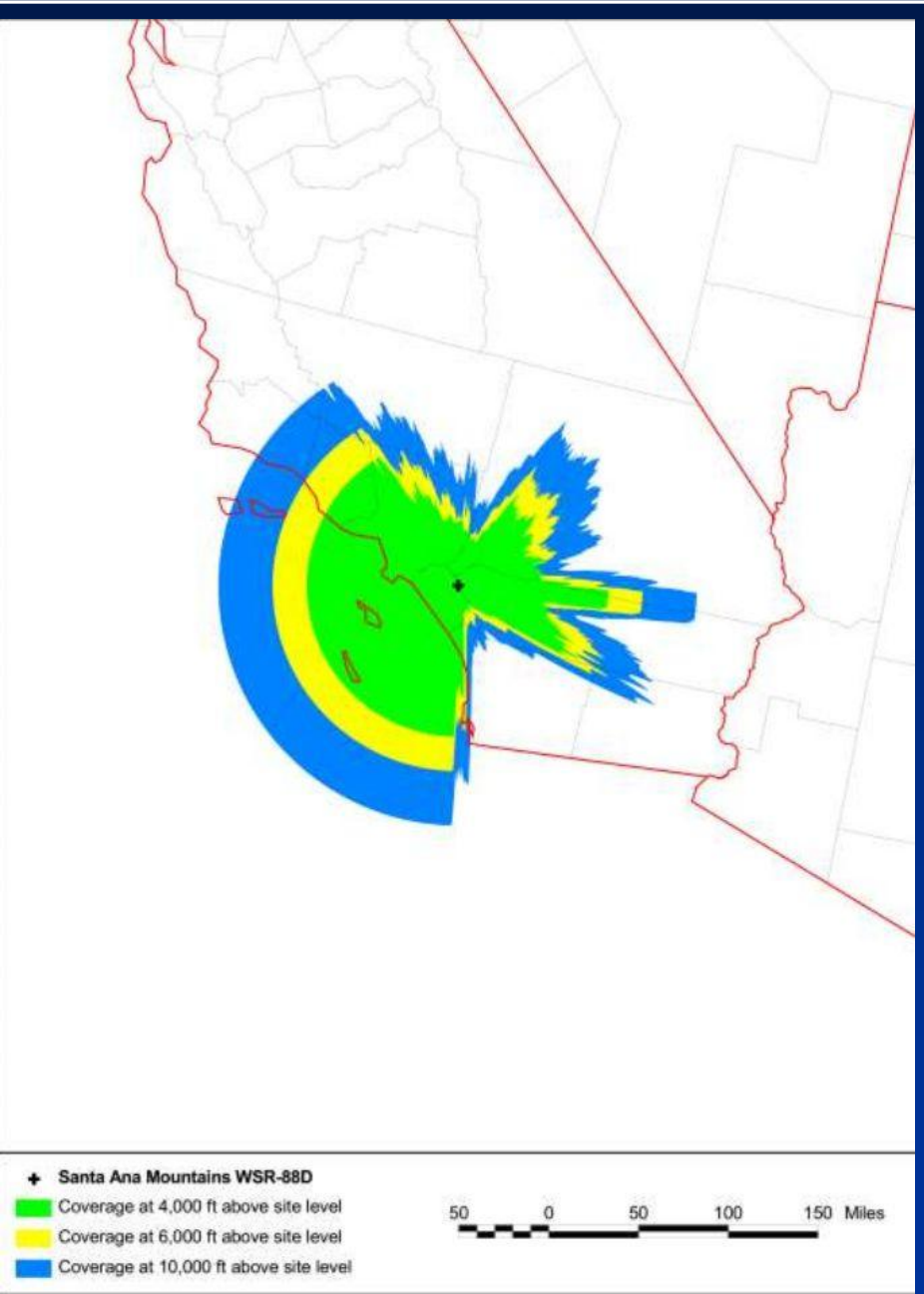
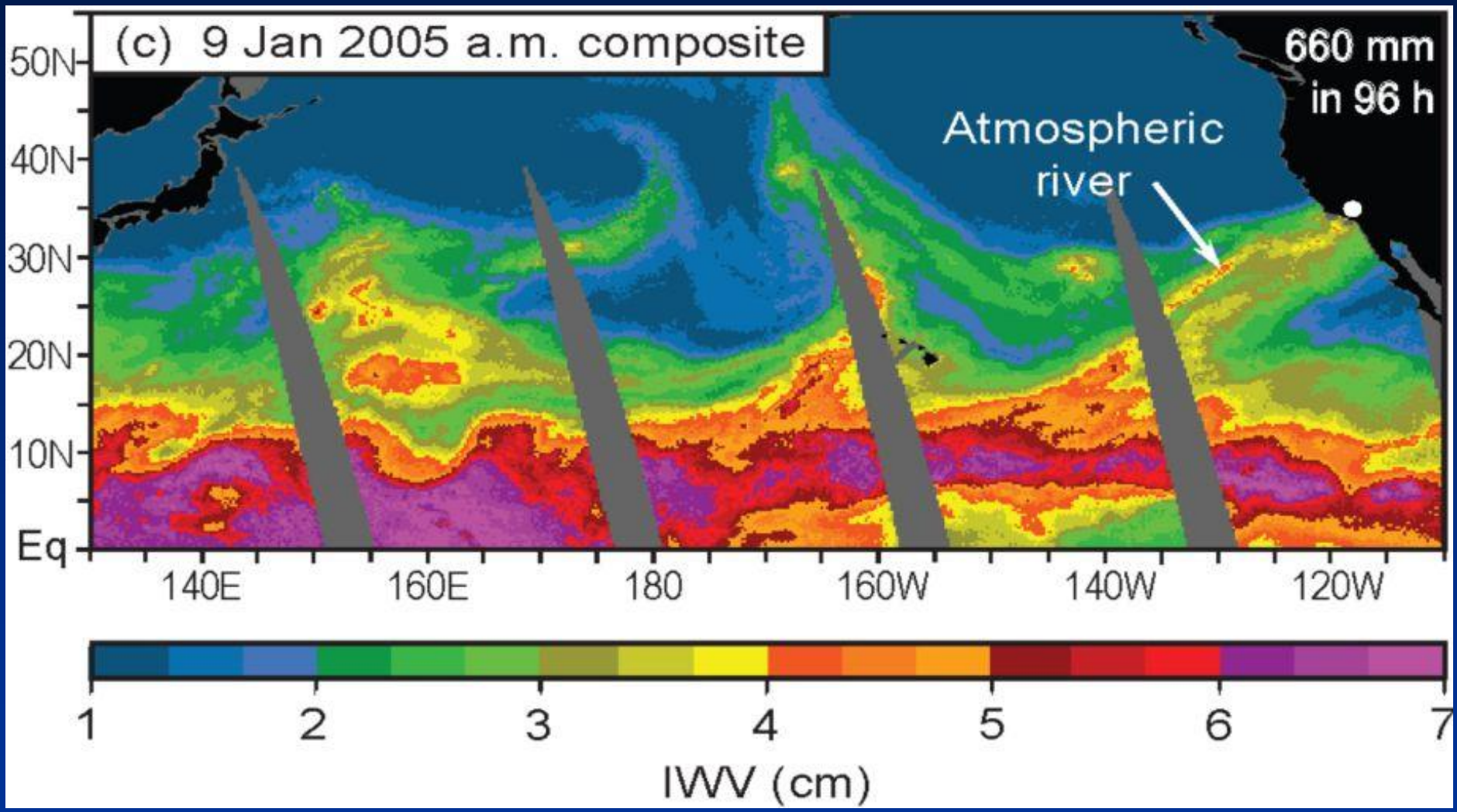
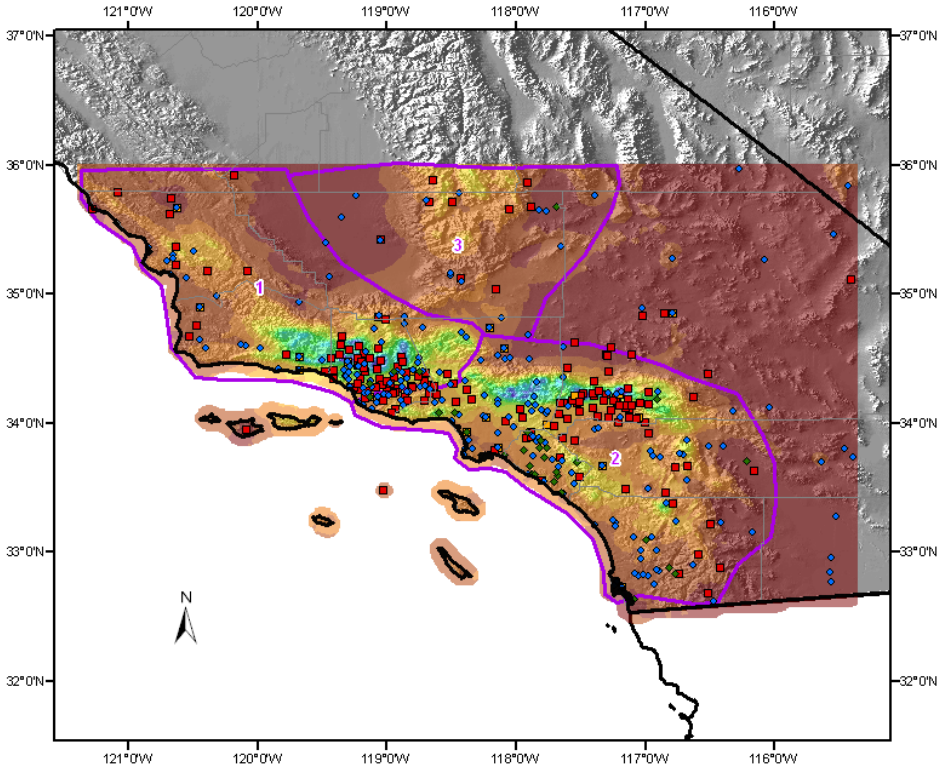


SPAS Storm Analysis Example

- January 2005 Atmospheric River
  - Very active weather pattern continuing from December
  - Largest of a series of 4 storms hit starting Jan 7th
  - Produced severe weather as well
    - Tornado near El Rio on the 10th
  - Numerous landslides, unfortunately some death resulted
  - 15-day period from Dec 27th thru Jan 10th, 16.97” of rain at downtown LA
    - Wettest 15-day period on record for LA
    - More than the annual average

Jan 2005 Atmospheric River Example





Total Precipitation (99-hours)
SPAS storm number: 1170
January 7, 2005 (1700 Z) - January 11, 2005 (1900 Z)

Miles
0 25 50 100

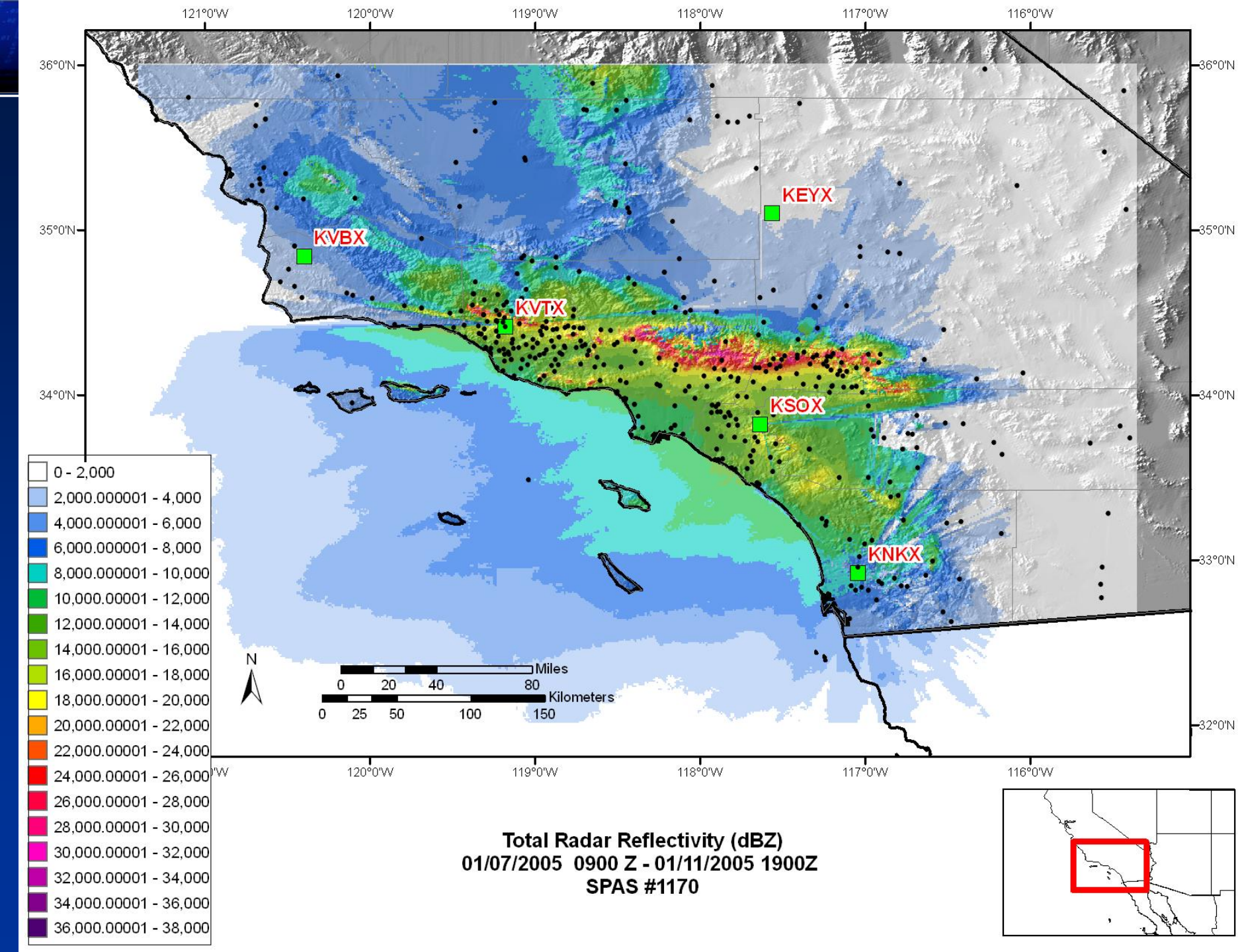
Kilometers
0 30 60 120 180

Precipitation (inches)

0.00 - 2.00	12.01 - 14.00	24.01 - 26.00
2.01 - 4.00	14.01 - 16.00	26.01 - 28.00
4.01 - 6.00	16.01 - 18.00	28.01 - 30.00
6.01 - 8.00	18.01 - 20.00	30.01 - 32.00
8.01 - 10.00	20.01 - 22.00	32.01 - 34.00
10.01 - 12.00	22.01 - 24.00	

Gauges

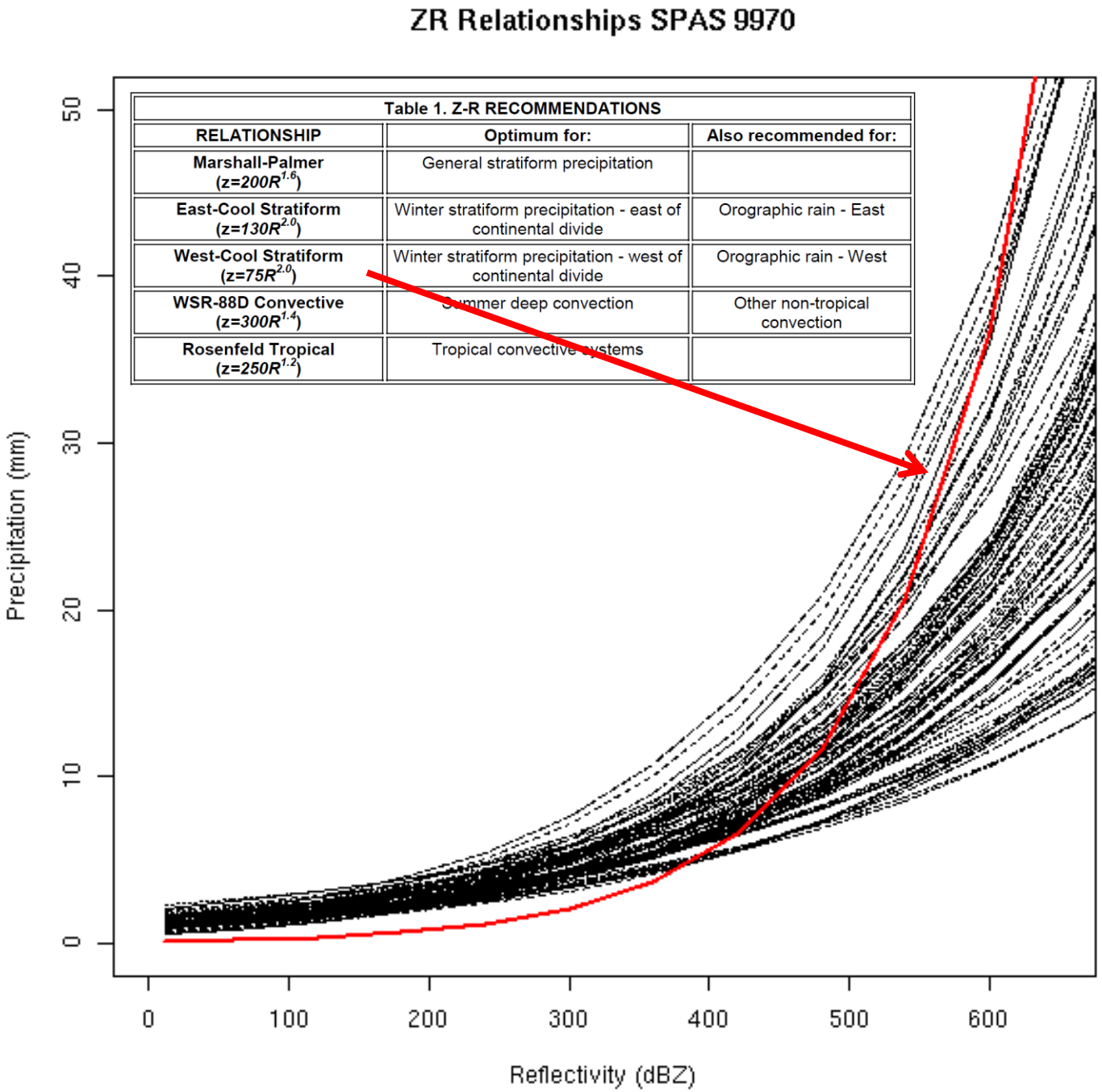
- Daily
- Hourly
- Hourly Pseudo
- Supplemental



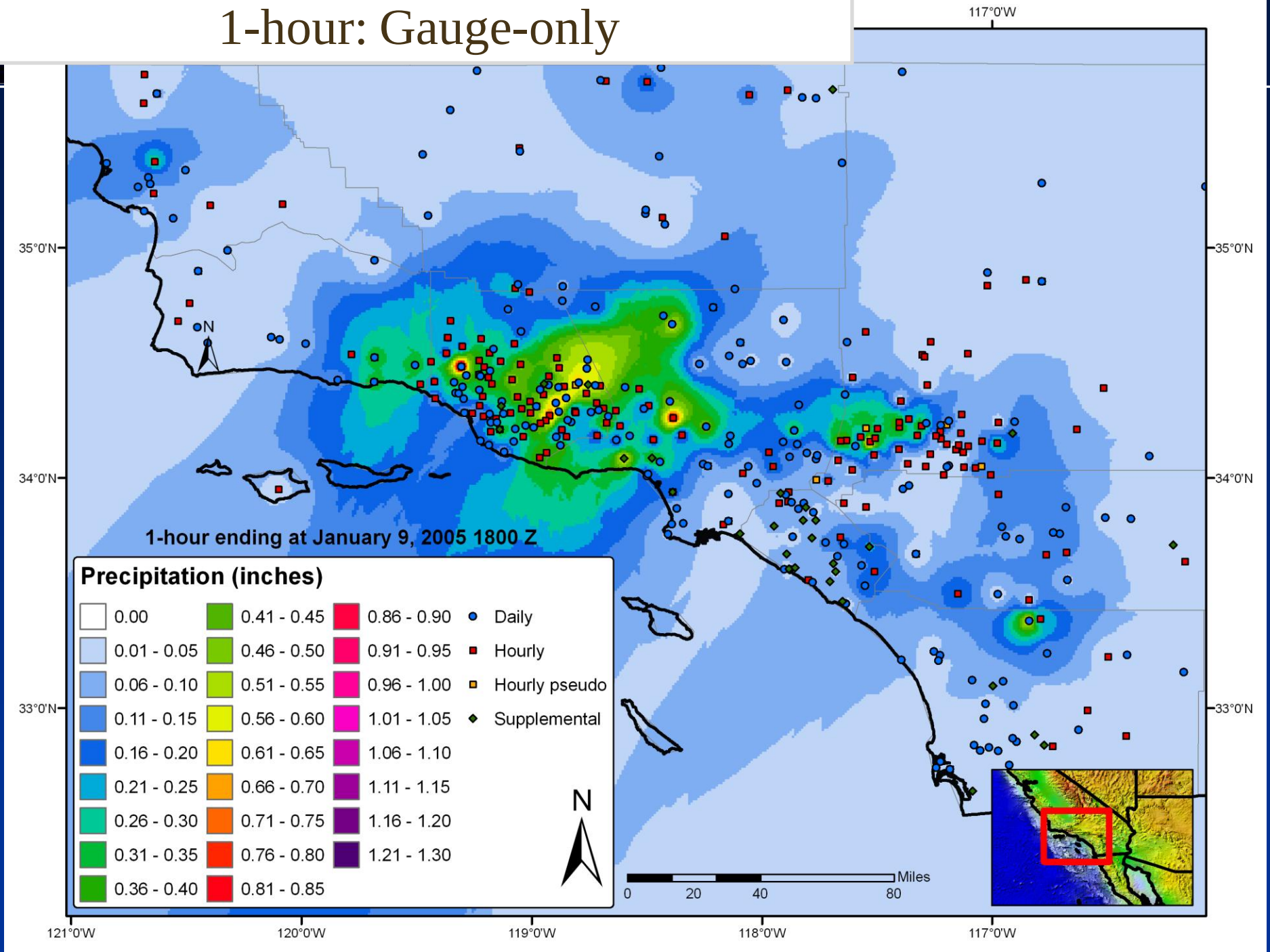
Total Radar Reflectivity (dBZ)
01/07/2005 0900 Z - 01/11/2005 1900Z
SPAS #1170

ZR Relationship Jan 2005

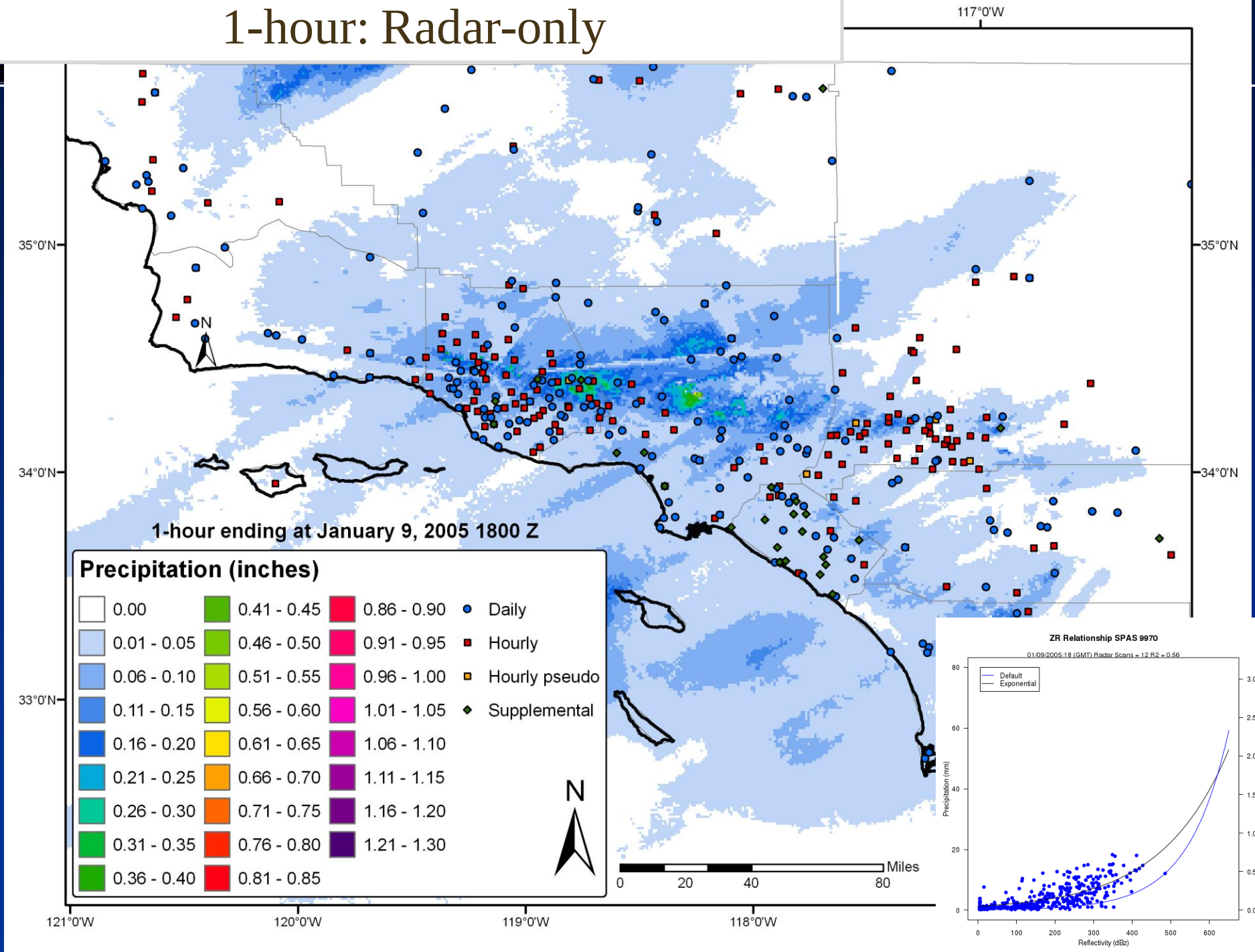
- ZRs the 99 hour analyzed Southern California vs. default ZR ("Orographic rain -West" $Z=75R^{2.0}$)



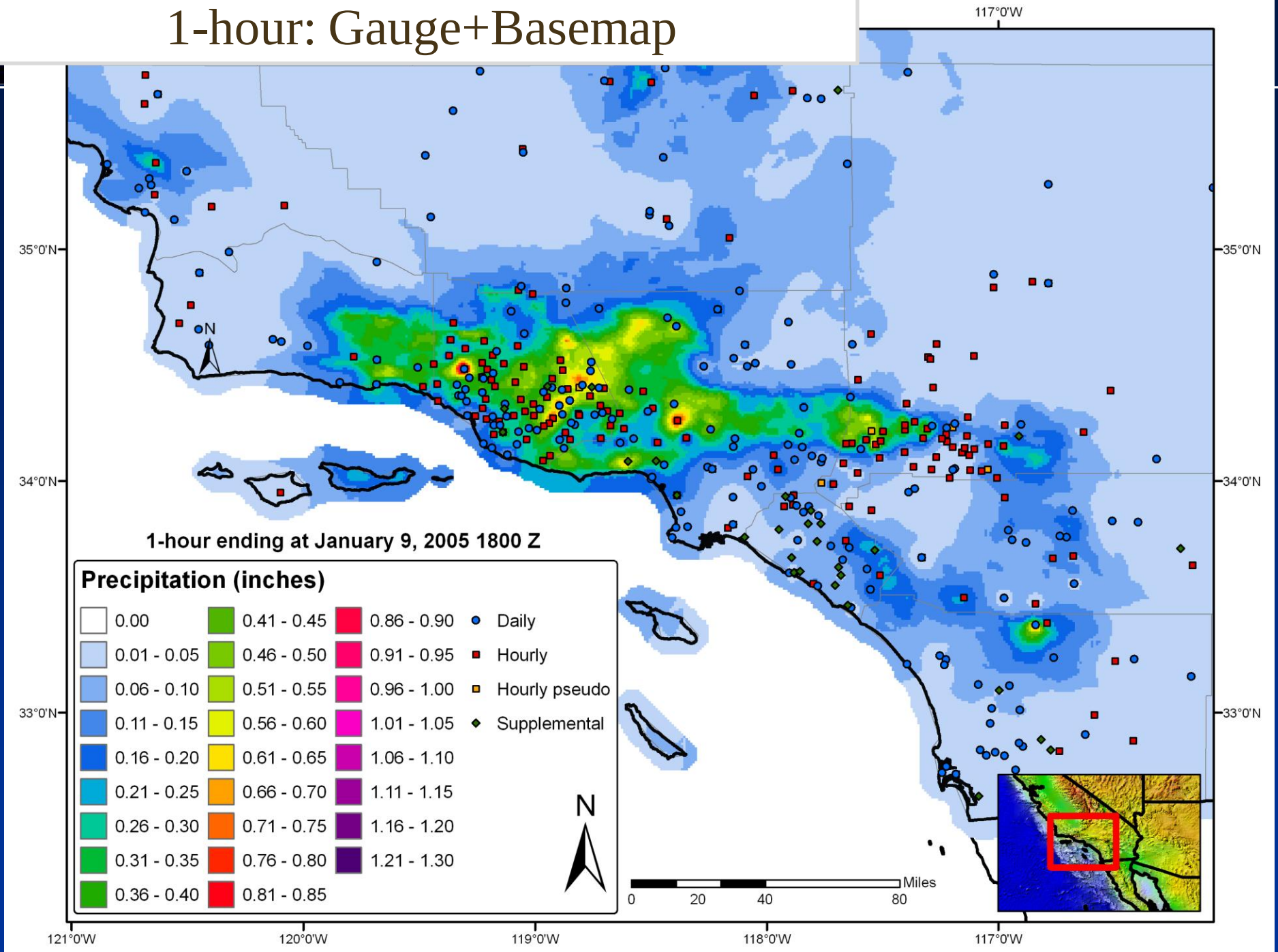
1-hour: Gauge-only



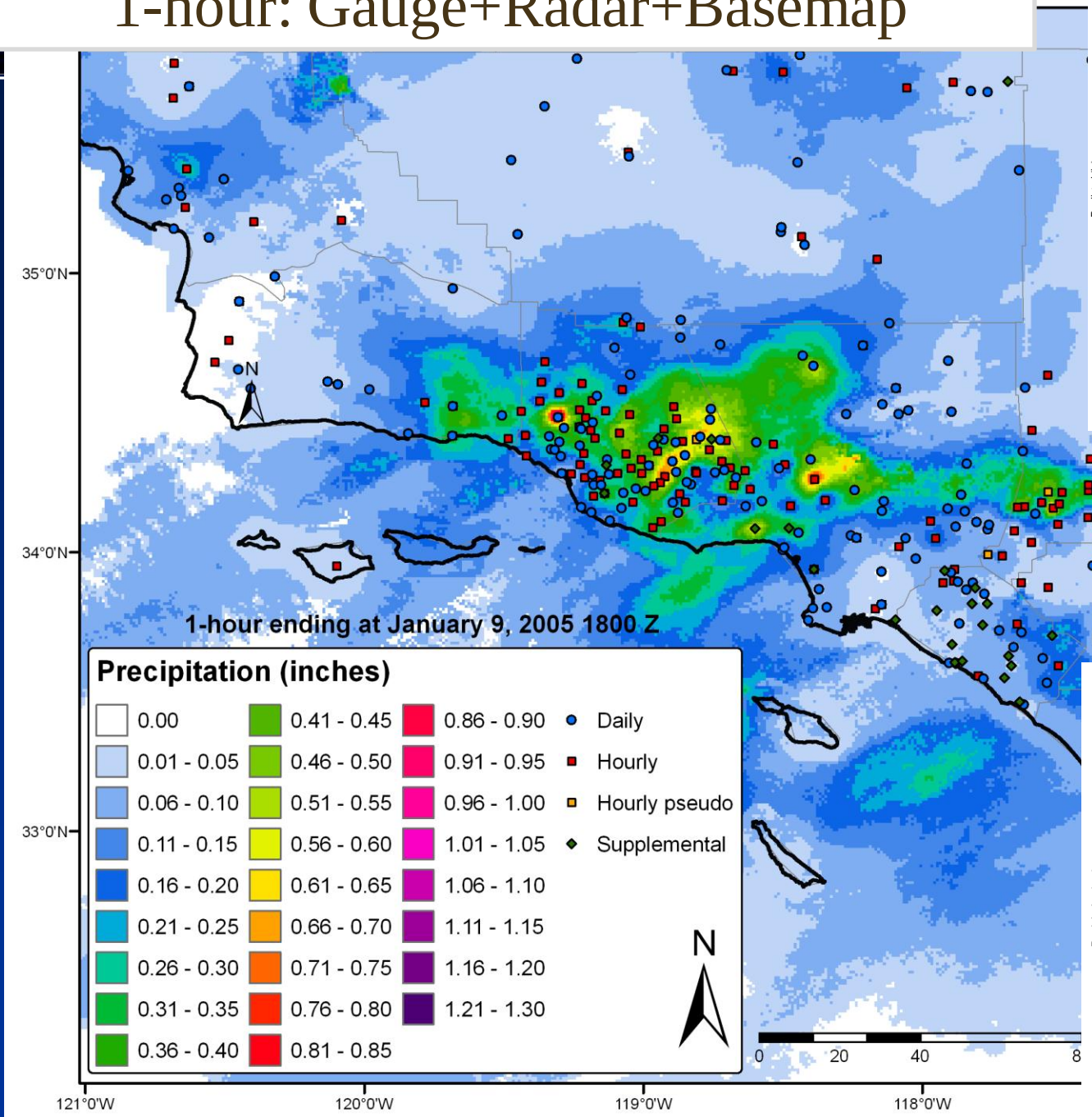
1-hour: Radar-only

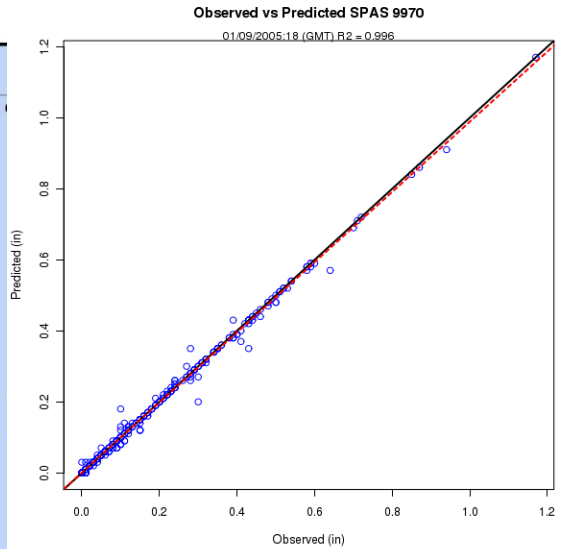


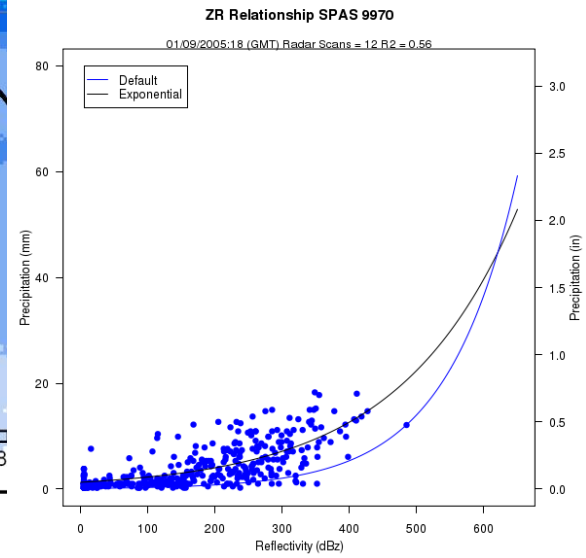
1-hour: Gauge+Basemap



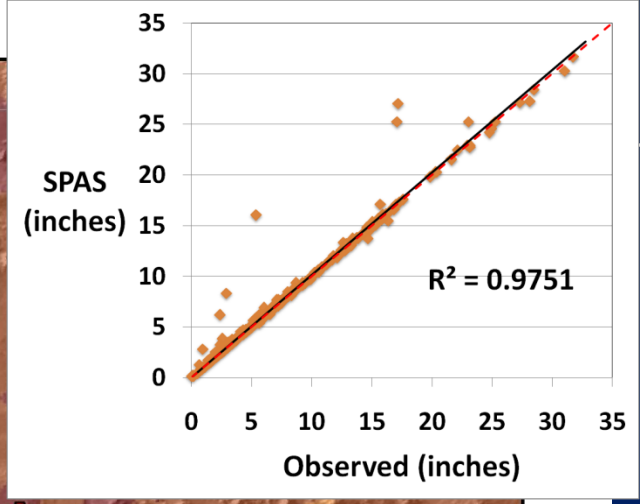
1-hour: Gauge+Radar+Basemap







Total Storm: Gauge-only



January 7, 2005 (1700 Z) - January 11, 2005 (1900 Z)

Precipitation (inches)

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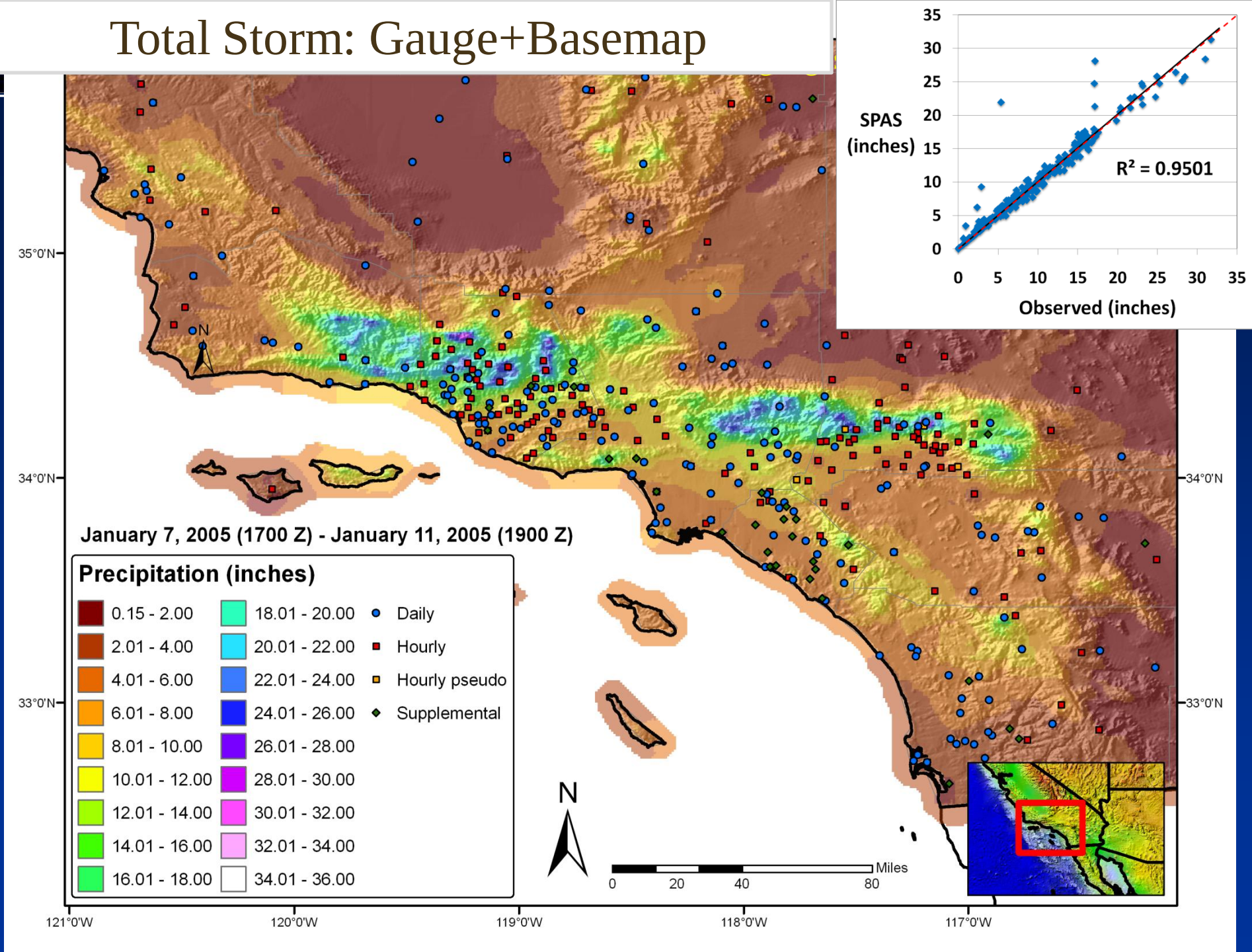
2.01 - 4.00	20.01 - 22.00	Hourly
4.01 - 6.00	22.01 - 24.00	Hourly pseudo
6.01 - 8.00	24.01 - 26.00	Supplemental
8.01 - 10.00	26.01 - 28.00	
10.01 - 12.00	28.01 - 30.00	
12.01 - 14.00	30.01 - 32.00	
14.01 - 16.00	32.01 - 34.00	
16.01 - 18.00	34.01 - 36.00	

N

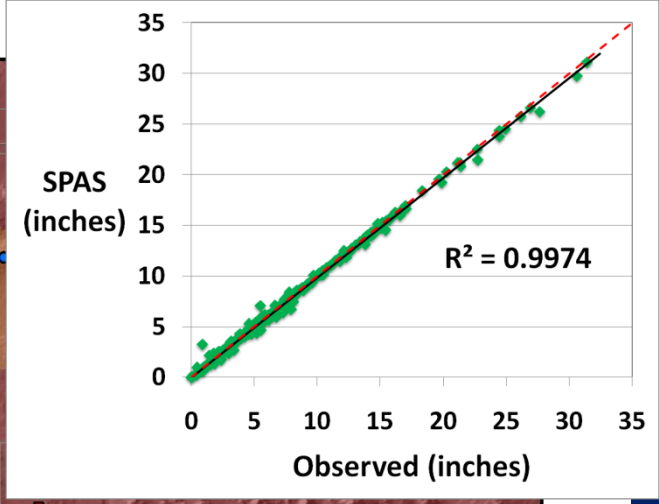
0 20 40 80 Miles

35°0'N
34°0'N
33°0'N
121°0'W
120°0'W
119°0'W
118°0'W
117°0'W

Total Storm: Gauge+Basemap



Total Storm: Gauge+Basemap+Radar



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N

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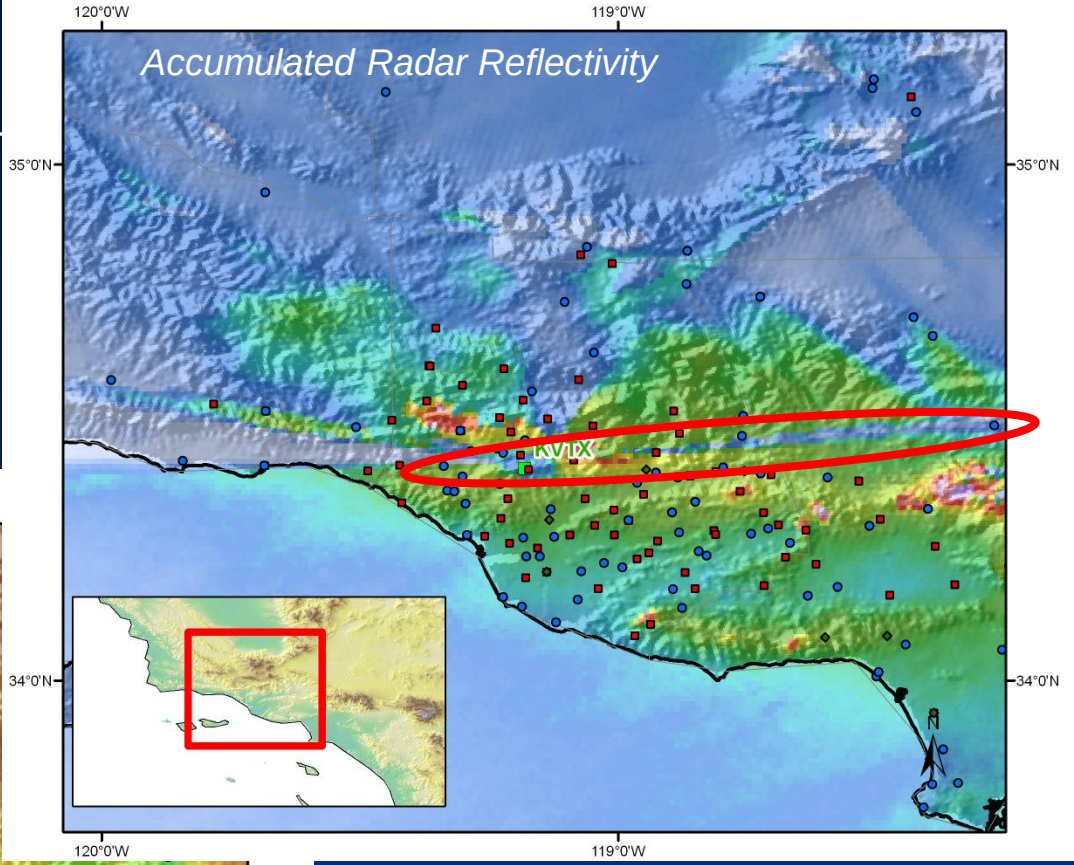
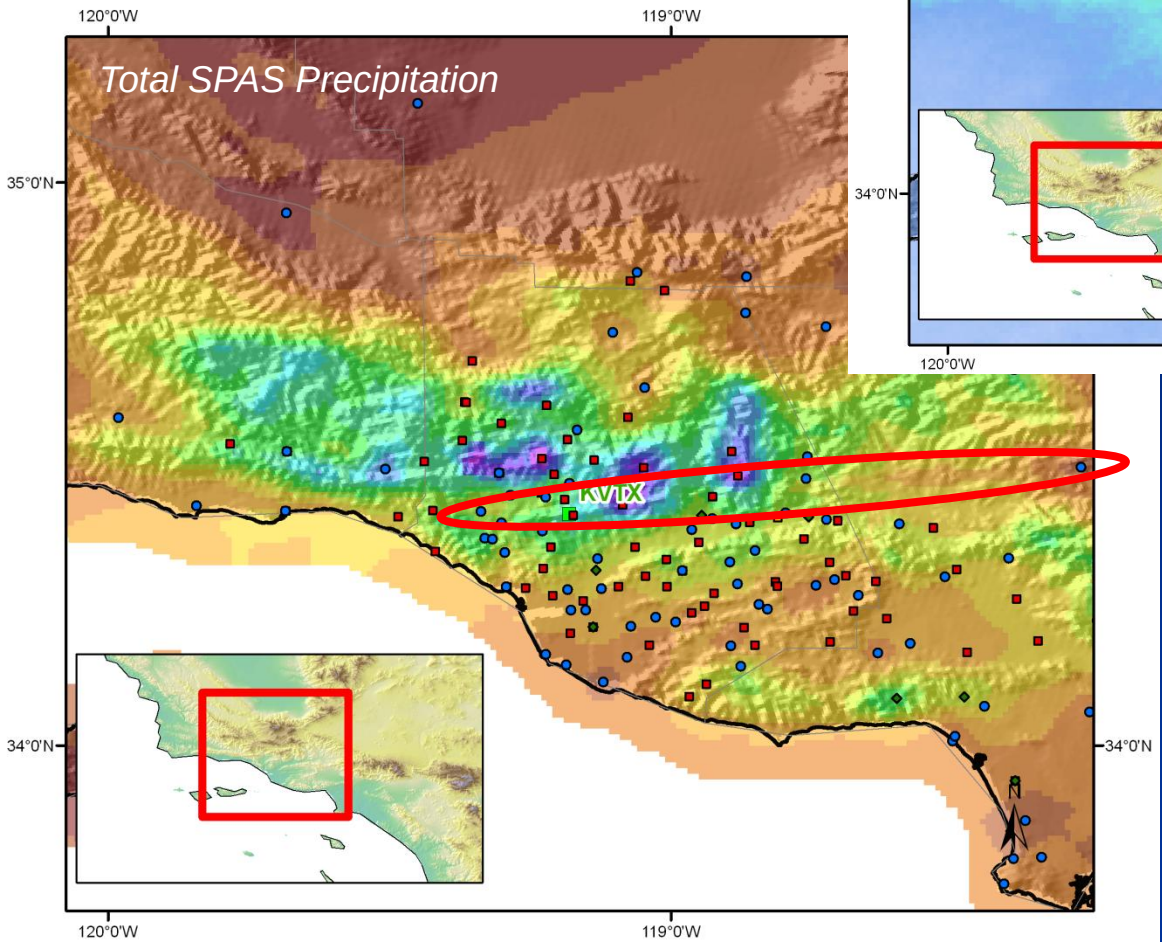
35°0'N
34°0'N
33°0'N
121°0'W
120°0'W
119°0'W
118°0'W
117°0'W

Radar Issues-Can't See the Rain

SPAS Example – Complex Terrain and Beam Blockage





Jan 6, 2005

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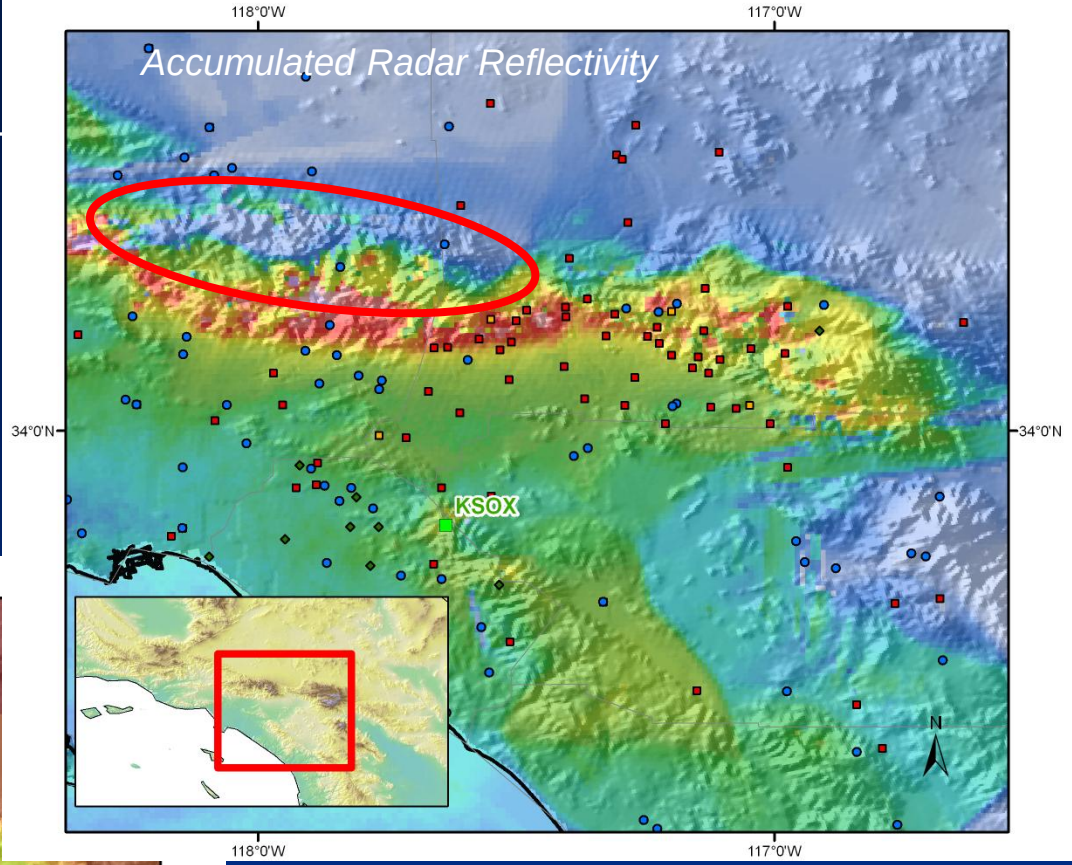
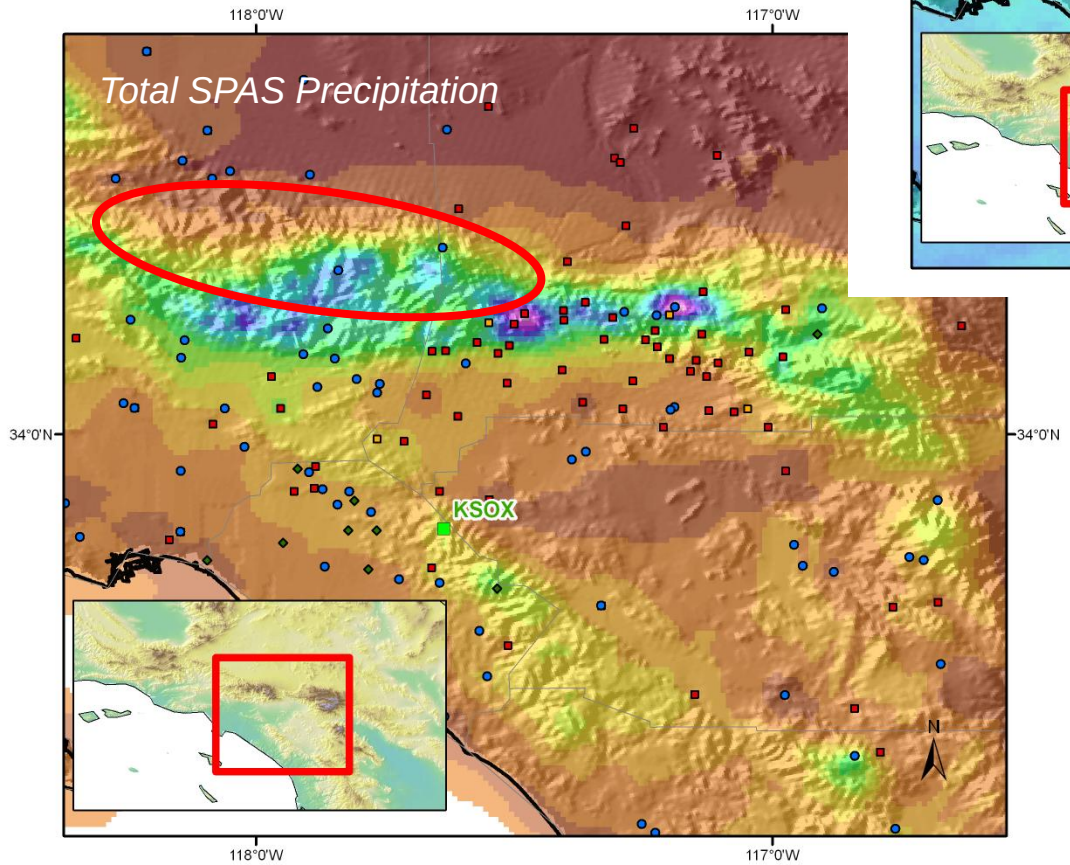
Jan 11, 2005

SPAS Example – Complex Terrain





Jan 6, 2005

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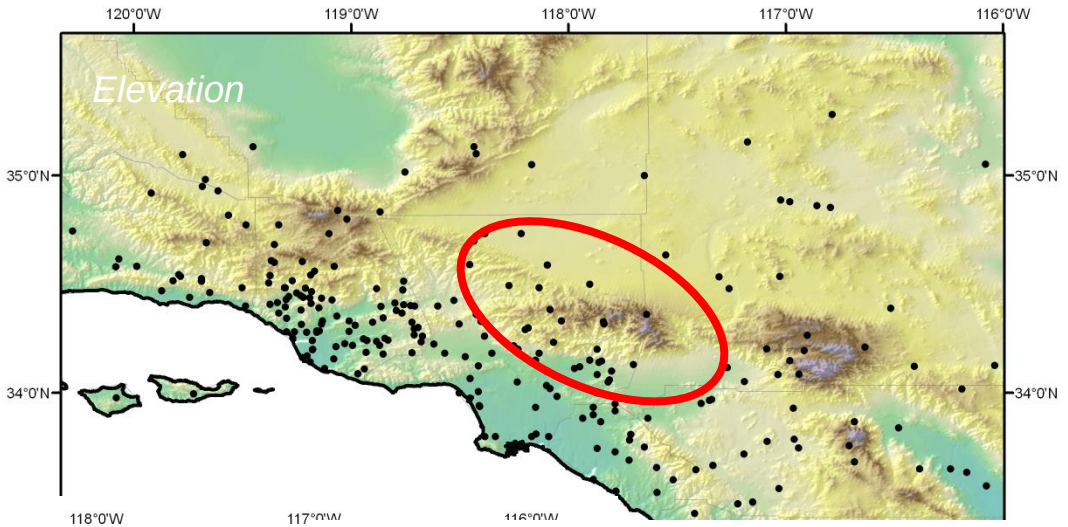
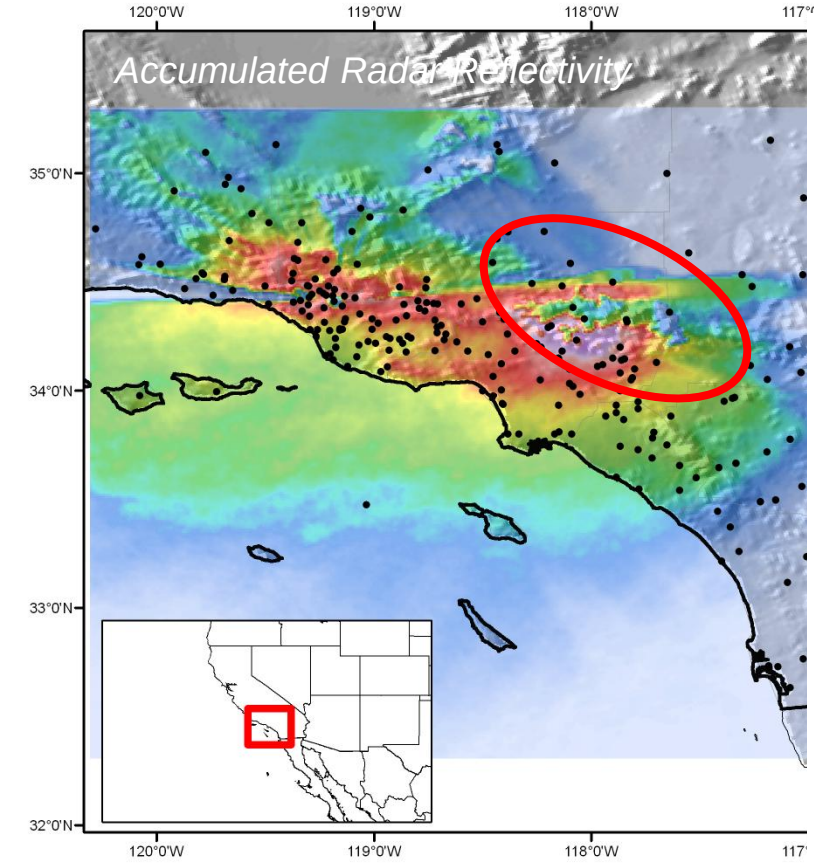
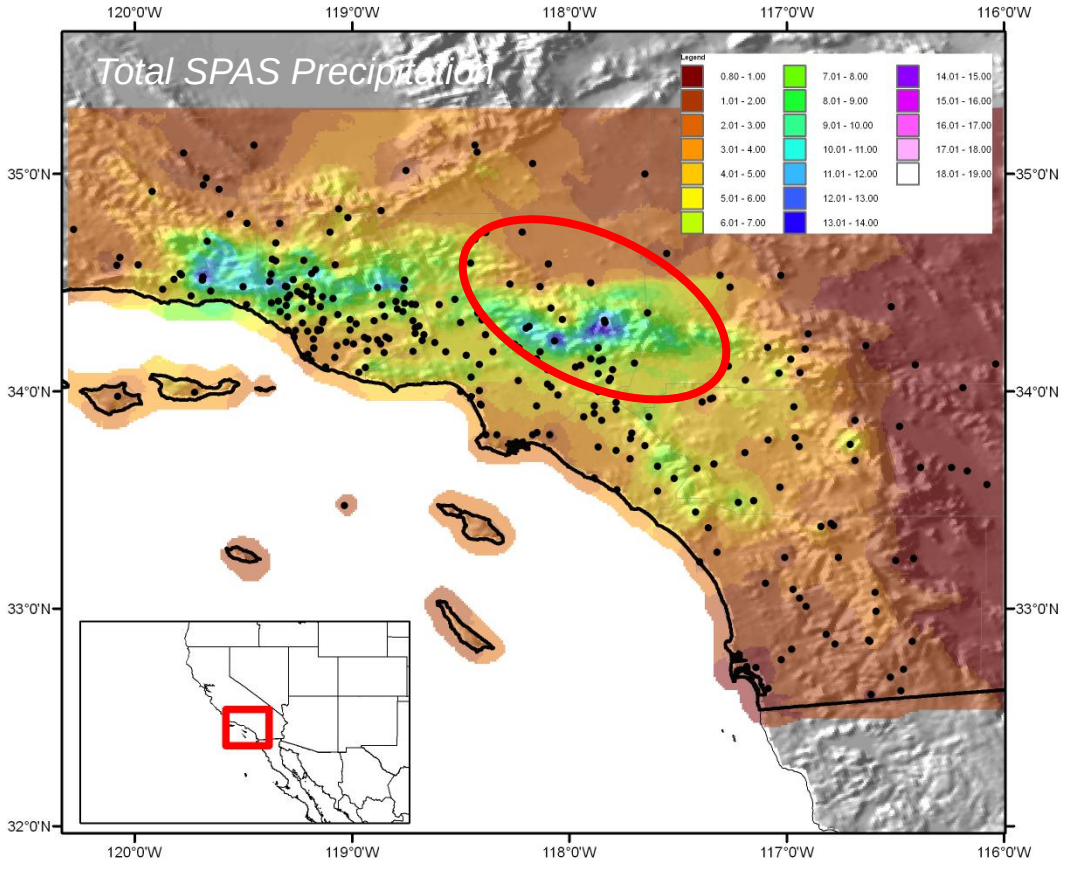
Jan 11, 2005

SPAS Example – Complex Terrain



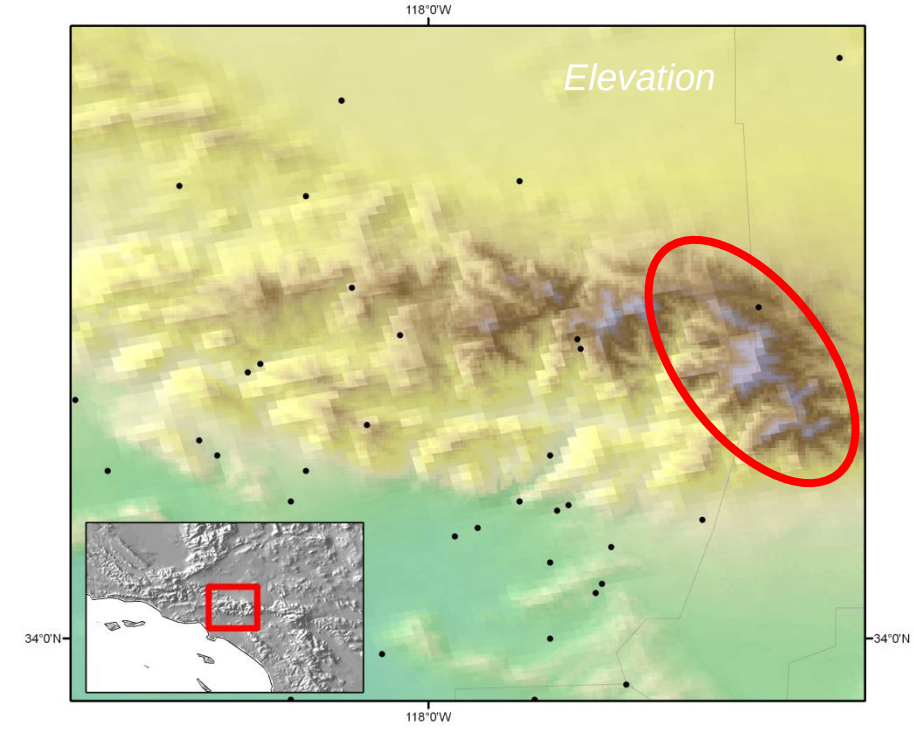
02/21/1998
-
02/24/1998

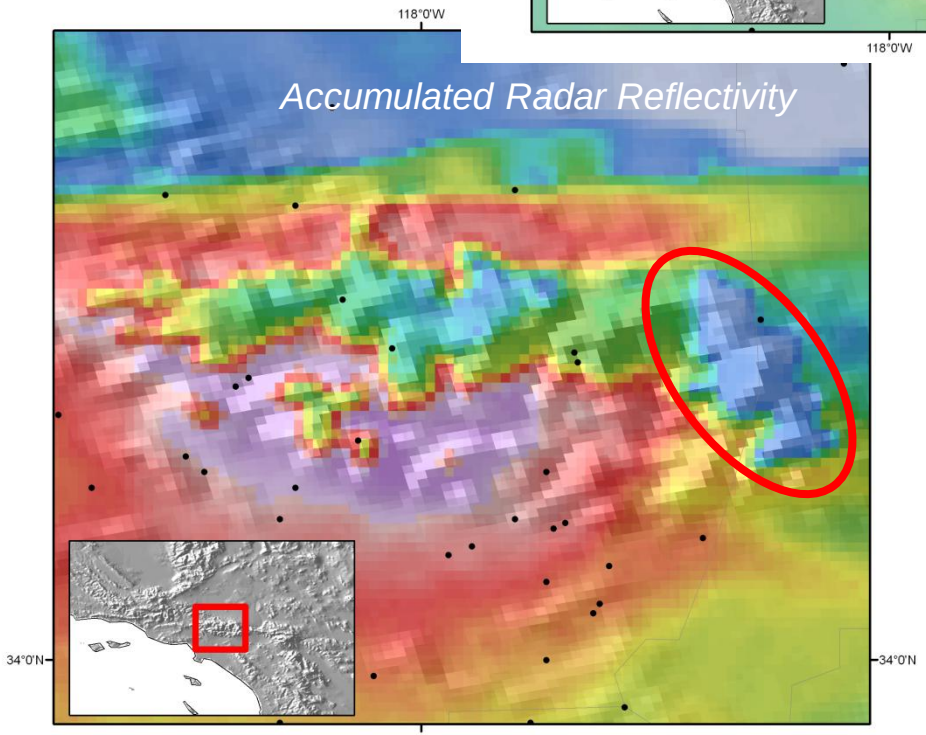


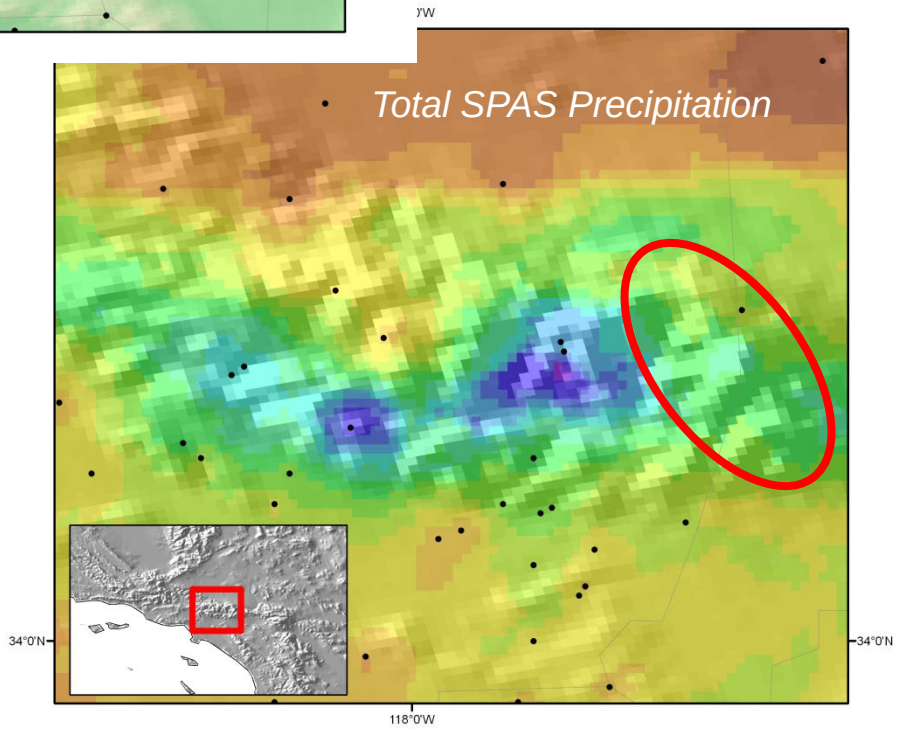


SPAS Example – Complex Terrain

Feb 21, 1998
-
Feb 24, 1998







Conclusions

- Reliability of NEXRAD in complex terrain severely lacking
  - Both spatially and in magnitude
  - But how do you know what fell between the rain gauges?
  - Careful use of radar data increases the spatial and temporal detail of precipitation information vs. the use of rain gauges only
- SPAS combines most sophisticated techniques/ data to overcome many of the short falls of traditional approaches
- Produces the most reliable estimate of precipitation available
- More rain gauges on the ground the better

Questions

Contact Info

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- Add storm examples
- Total storm isohyetals, mass curves, DAD, ARI
- Example data output for use in calibration/inflow management
- Show how SPAS improves previous analysis
- Show old isohyetal-hand drawn
- Show NEXRAD issues in the region
- Discuss NOAA Atlas 14 point only, no spatial information
- SPAS catches rainfall in between gauges with much better accuracy-often higher than what was recorded at any gauge