



Total Lightning Uses in Operational Terminal Aerodrome Forecasting

Bernie Meier
National Weather Service
Boulder, CO



Lightning Background

- Prior to 2013, forecasters only had cloud to ground lightning data to look at.
- Miss initial lightning, unless it was cloud to ground.
- Thunderstorms without cloud-to-ground lightning would usually go undetected.



2013 Lightning - Total Flashes

- Colorado Lightning Mapping Array (COLMA) from New Mexico Tech/Colorado State
 - Flash Points
 - Flash Density
- Geoffrey Stano of SPoRT – Spring Workshop
 - Short-term Prediction Research and Transition Center
 - Visiting Science Program



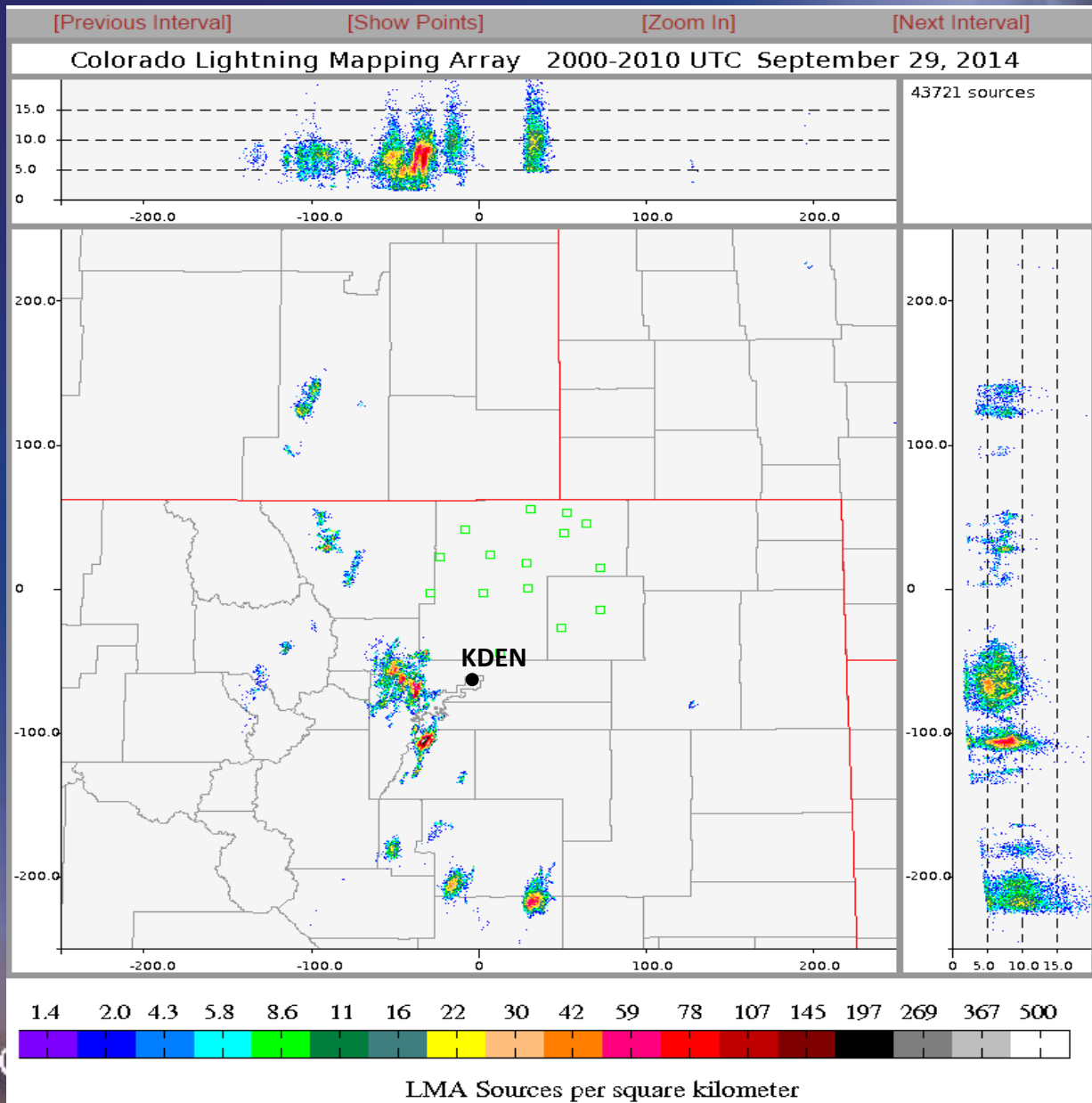
Lightning - Total Flashes

Displays

- New Mexico Tech - Web Based
 - Flash Points
 - Flash Density
 - 10 minute window, updates every minute
- AWIPS II Workstations
 - Flash Density (COLMA)
 - Overlay radar, cloud-ground lightning.
 - Updates every minute (1 minute window)
- Other lightning displays – Earth Networks, SPoRT, Vaisala (coming soon)

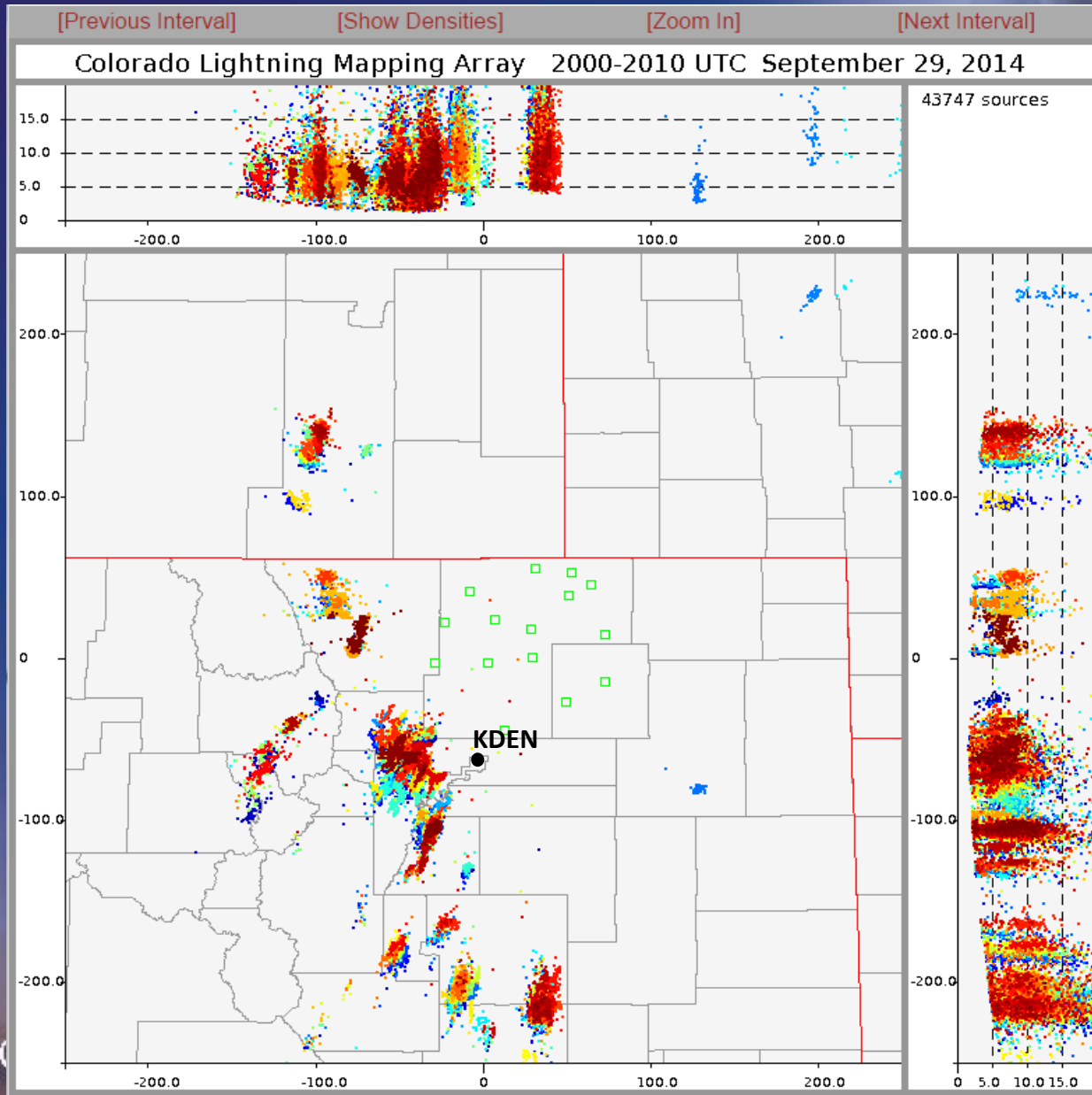


Colorado Lightning Mapping Array Flash Density





Colorado Lightning Mapping Array Flash Points

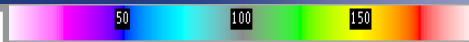




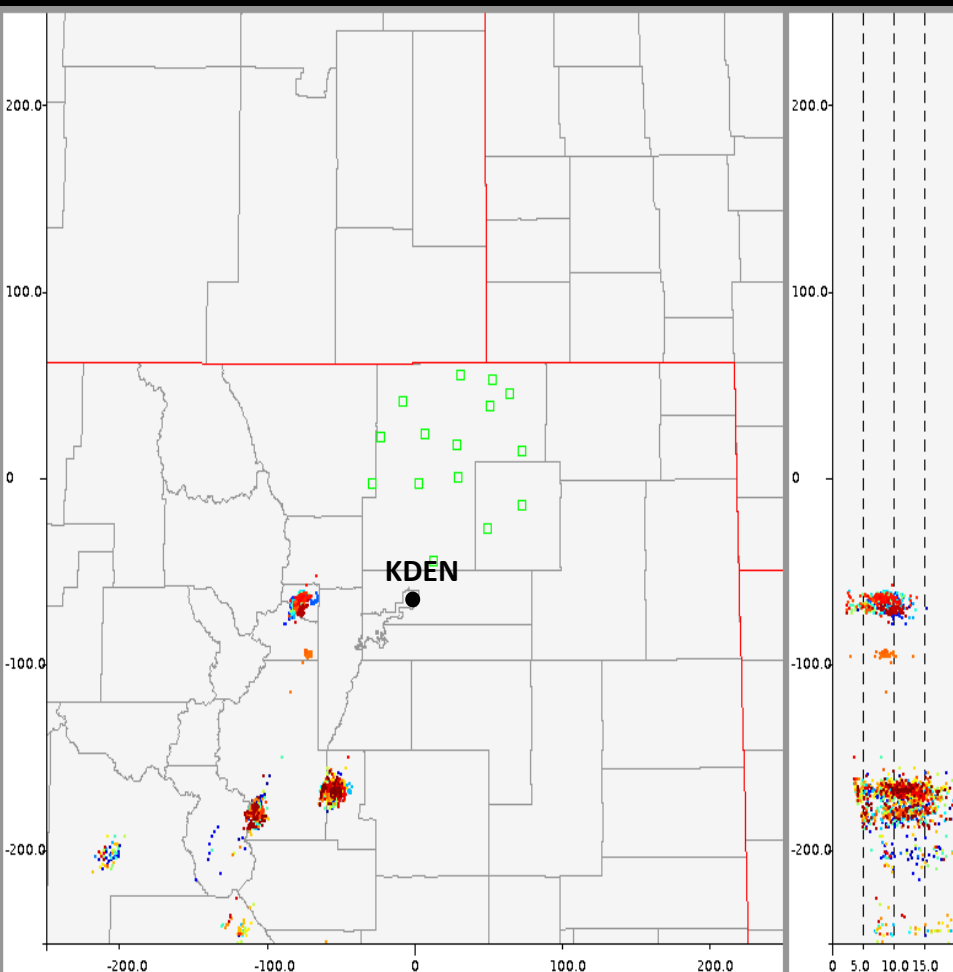
Colorado Lightning Mapping Array



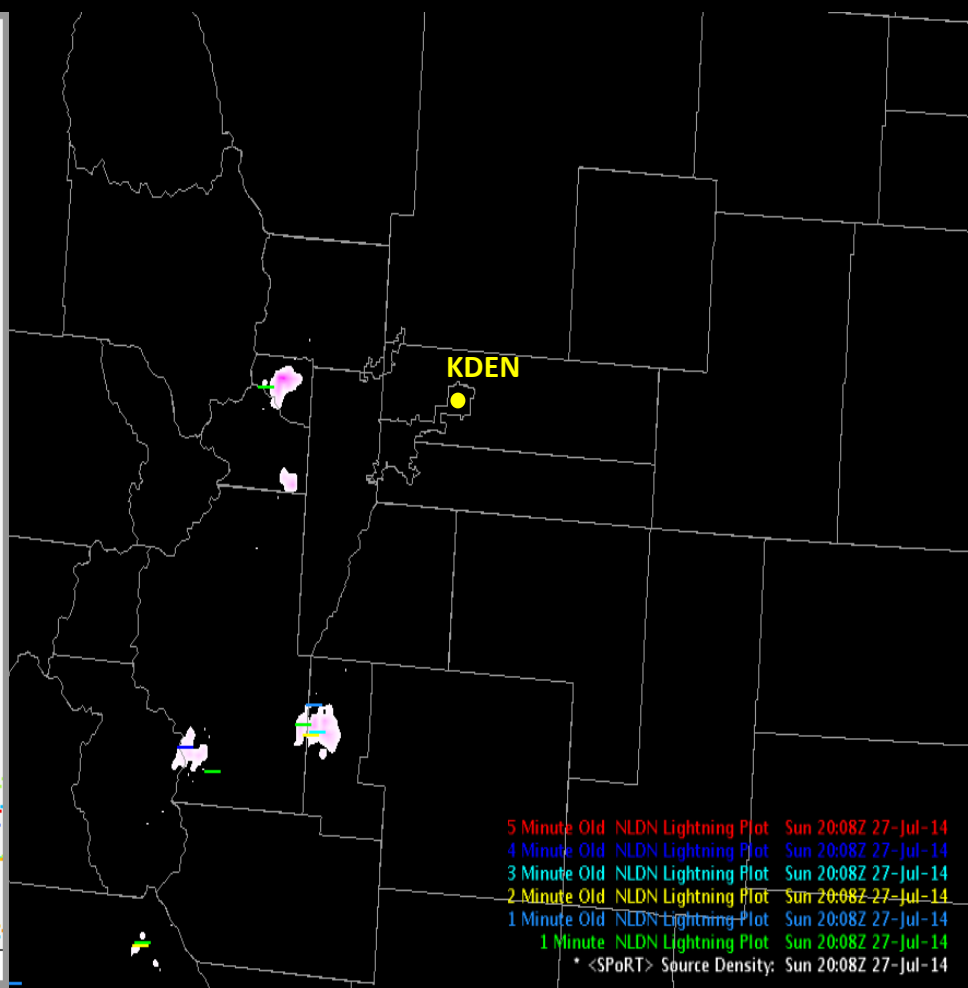
Colorado Lightning Mapping Array 2000-2010 UTC July 27, 2014



Flash Points



Flash Density & CG





MacGorman et al. (2011)



The timing of Cloud-to-Ground Lightning Relative to Total Lightning Activity

- May-July 2000, Eastern Colorado, Southwest Nebraska, and Northwest Kansas
- None of the storms produced a ground flash in the first two minutes of lightning activity
- Only half produced a ground flash in the first 31 minutes



TAFs



- Terminal Aerodrome Forecast (TAF)
 - KDEN out to 30 hours, scheduled amendment every 3 hours
 - KBJC & KAPA out to 24 hours, no scheduled amendments
 - TS (Thunderstorm within 5 miles)
 - VCTS (Vicinity Thunderstorm 5 to 10 miles away)



METARs



- Meteorological Aerodrome Report (METAR)
- Beginning of Thunderstorm
 - Thunder is heard
 - Lightning is observed at the station when the local noise level is sufficient to prevent hearing thunder
 - Lightning is detected by an automated sensor
- Ending of Thunderstorm
 - Reported as 15 minutes after the last occurrence of any of the above criteria

Federal Meteorological Handbook No. 1



Late June 1st/Early June 2nd

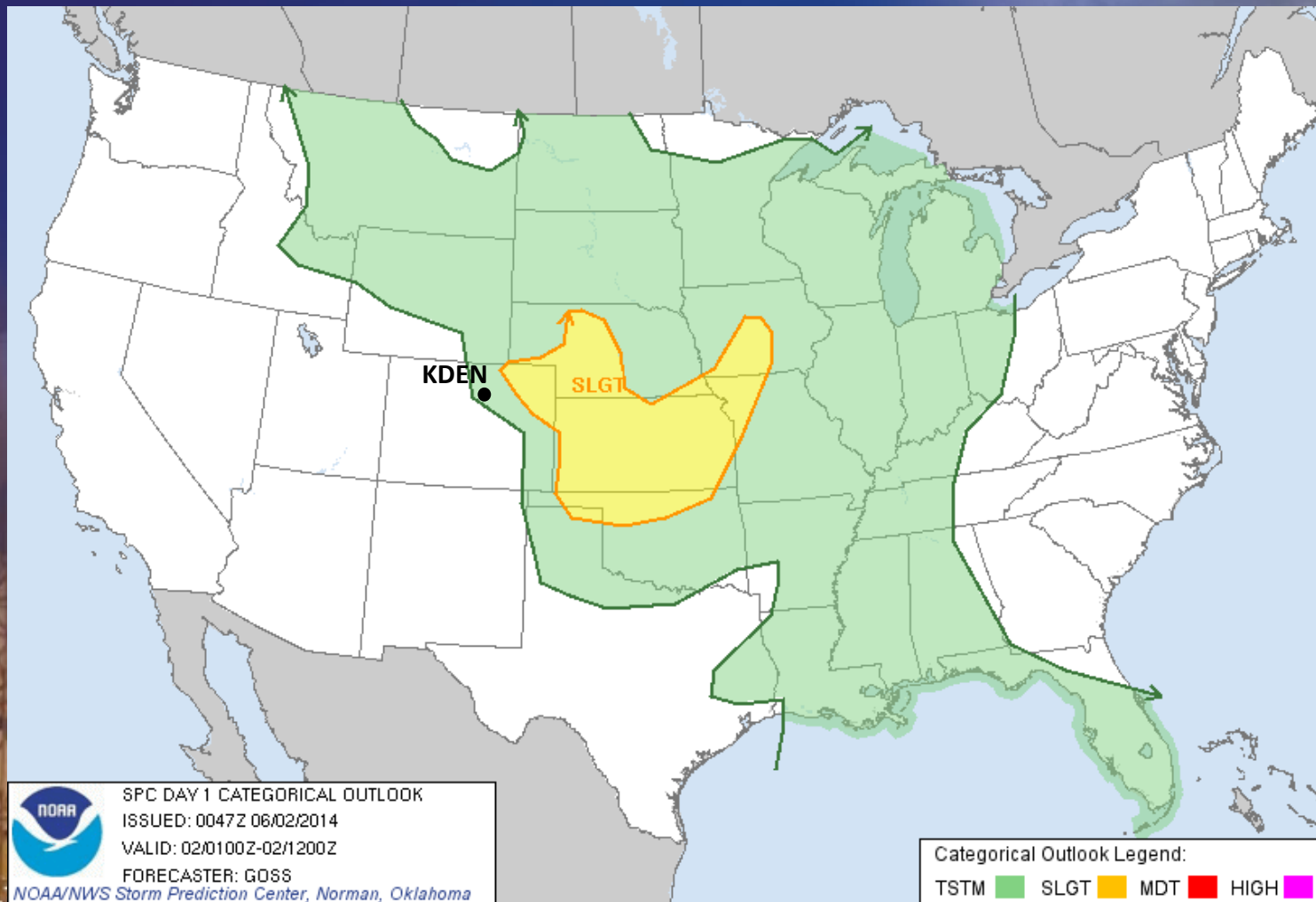
- 2000-0200Z - Isolated thunderstorms
 - Southeast Wyoming
 - Southwest Nebraska
 - Northeast Colorado.

0200-0500Z – No Thunderstorms



June 2nd 0100z

- SPC Day 1 Convective Outlook

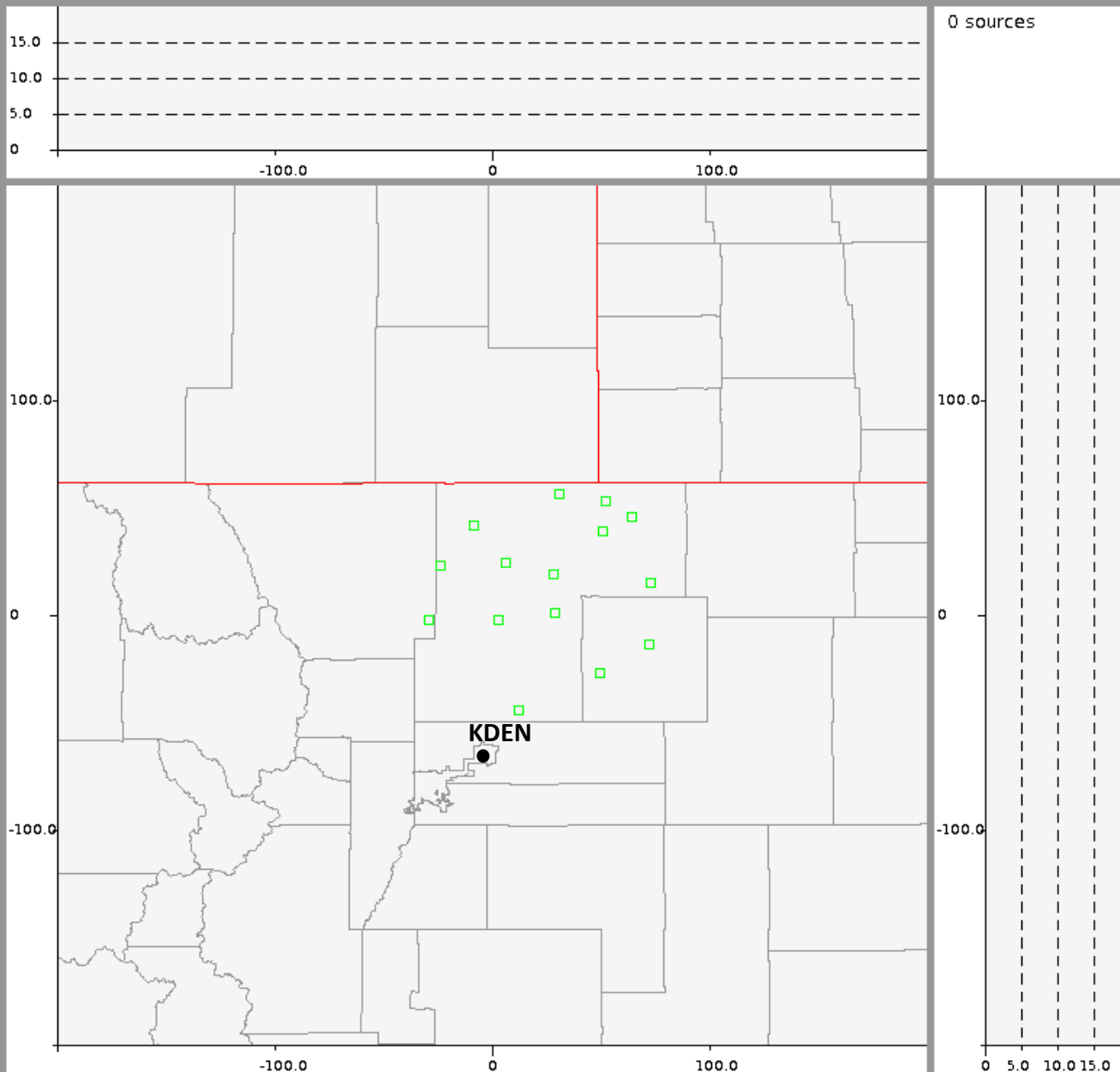




June 2nd 0500-0630Z



Colorado Lightning Mapping Array 0500-0510 UTC June 02, 2014

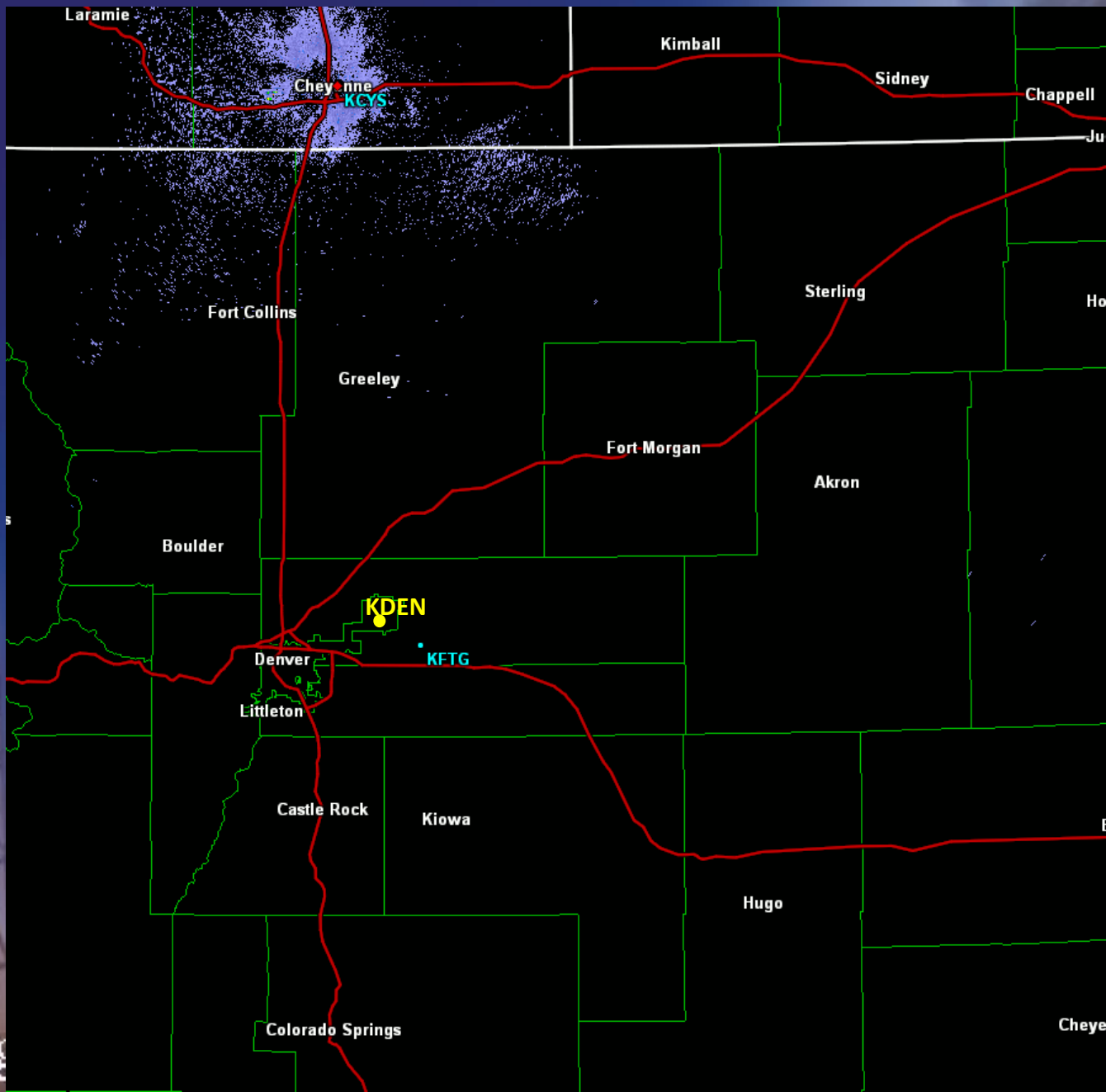


Weather.g

Weather Service



June 2nd 0500-0630Z

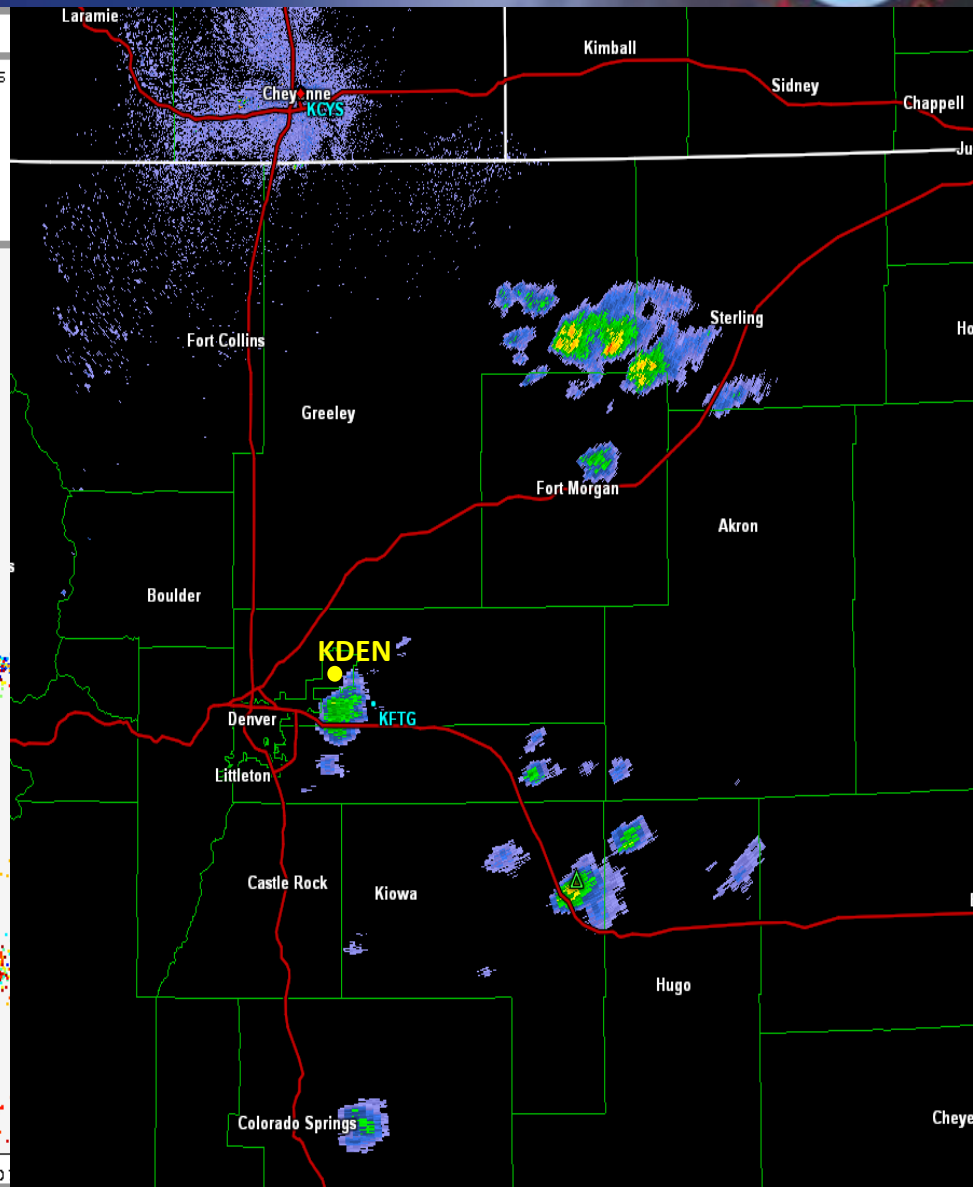
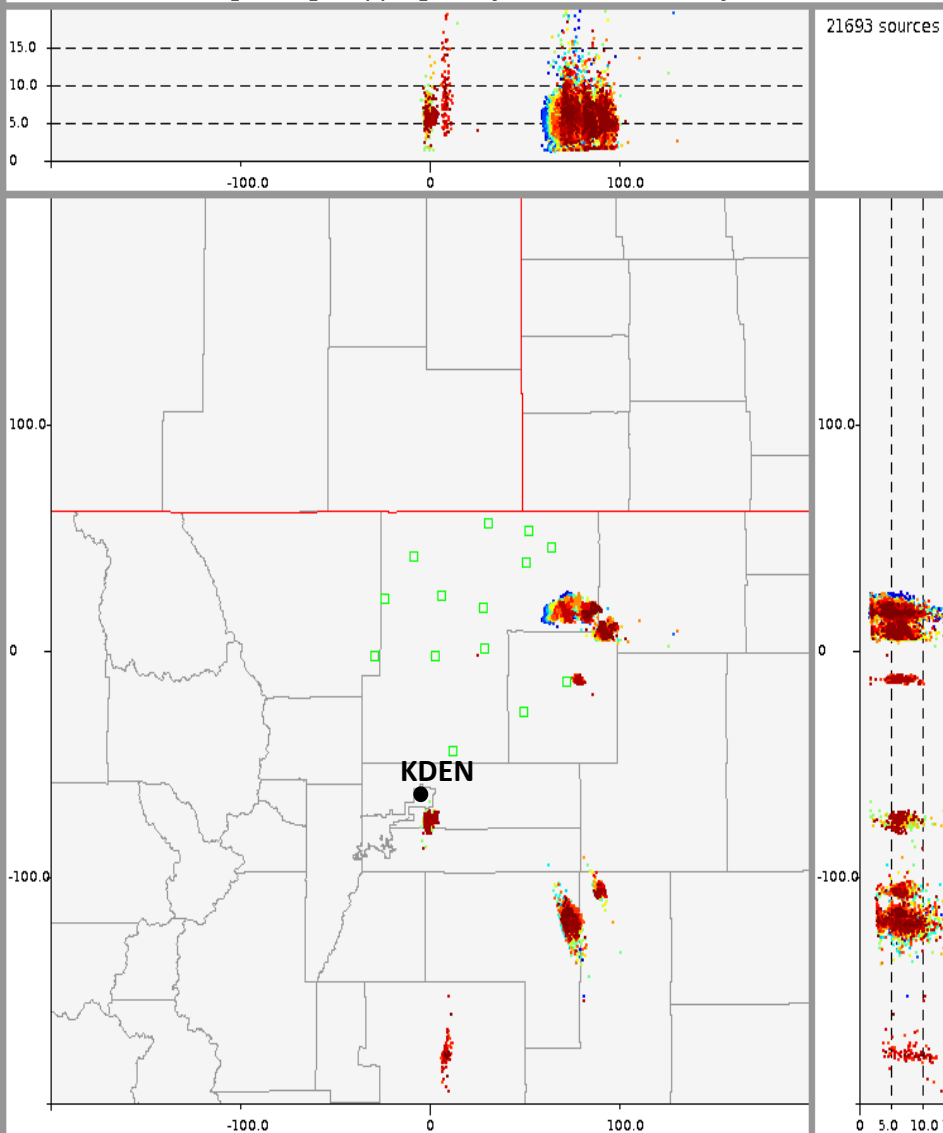




June 2nd 0550Z



Colorado Lightning Mapping Array 0540-0550 UTC June 02, 2014





June 2nd 0546-0600Z

- First Flash occurred at 0546Z
- TAF updated send for –TSRA at 0554Z
- Lightning detected by observer 0555Z
- Special METAR at 0557Z for TS
 - FRQ LTGICCC (1-6 flashes/minute)
- First Cloud-to-Ground strike after midnight
- SPECI KDEN 020557Z 35003KT 10SM TS
BKN032CB BKN043 14/09 A3015 TSB55 FRQ
LTGICCC VC S TS VC S STNRY T01440089



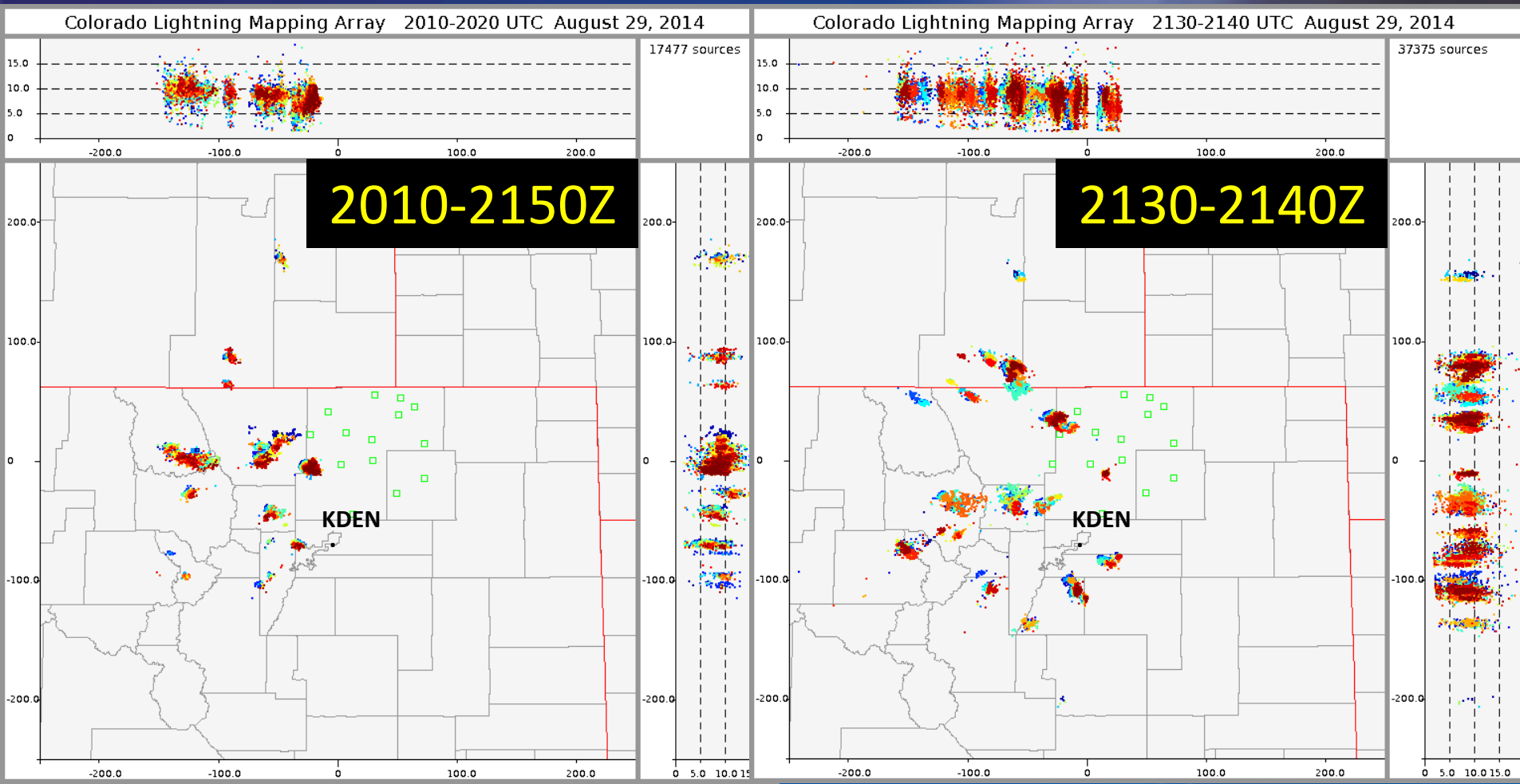
Advantages

- Lightning detection occurred 11 minutes before the observation reported lightning
- Able to amend TAF before lightning was reported by observer
- Based on near by storm development, lightning was expected to increase



August 29th 2030-2150z

- TSB at 2044Z & end 2136z in the Observation





Findings

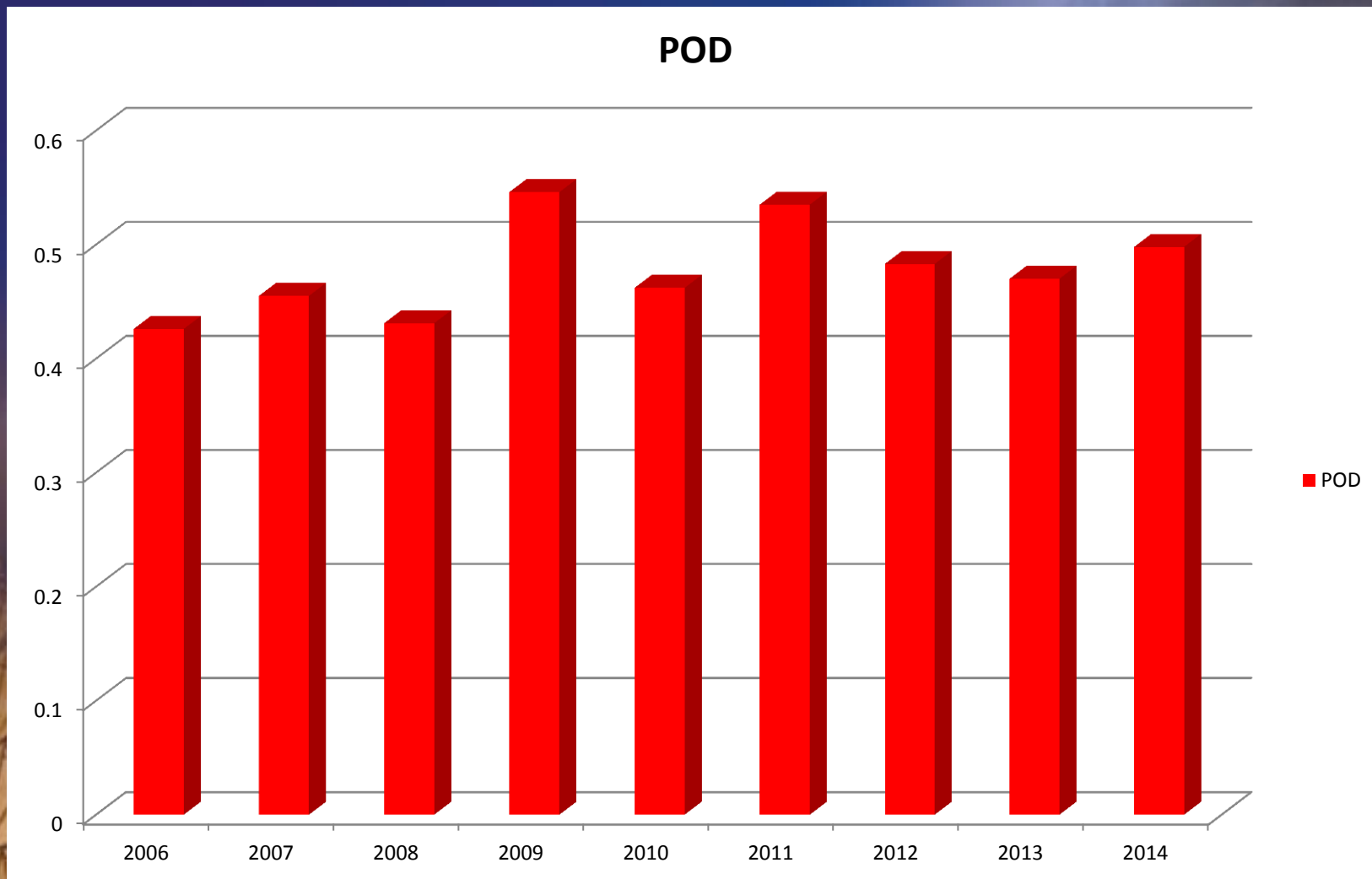
- Overall observer does a good job!
 - Beginning TS in the METAR lines up well when the first flash is within 5 miles
- In some cases are able to remove TS from the TAF before the TS ends in the METAR
 - Observer must wait 15 minutes from when TS was last observed



TAFS Thunderstorm POD



Probability of Detection of Thunderstorms in the first 3 hours (00-03 hr)





Usefulness in TAFS

- Improved detection of storms in 2014
 - However two previous years were better
 - So did it help?
- Improve lead times in some cases
- Quicker removal of “TS” from the TAFS when thunderstorms have ended



Possible Additional Forecasting Uses



- Help with quicker detection of heavy snow in mountains
 - Partial/Full radar beam blockage
- Can help with the “wait one more scan”, when deciding to issue a severe thunderstorm warning



Future Uses

- An alert for first flash. Possibly with in "X" miles of a location
- FAA Controllers and Weather Observers



Thanks

- Ed Szoke
- Eric Thaler
- Paul Wolyn
- Nezette Rydell

