

Using GIS and Geospatial Analysis for Tornado Disaster Responses in Disaster Recovery Operations

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**Disaster Assessment Manager
American Red Cross of Central and
Western Oklahoma**

In the old days, after an event occurred...

- **We started collecting preliminary damage “PDA” information to determine a best estimate for the boundaries, size and scope of the event**
- **We would send people out to visually verify and collect information.**
- **Since tornadoes typically occurred in the late afternoon or early evening, collection of visual information would be limited and/or delayed until daylight hours on the following day.**
- **At night, we were limited to collecting information from non-standard sources for information and it would later required verification.**
- **We interviewed people that came into the chapter about what they saw.**
- **We produced reports based on a best estimate of the number of homes damaged and the degree of damage (destroyed, major, minor, effected).**
- **The PDA process took 1 to 7 (or more) days.**

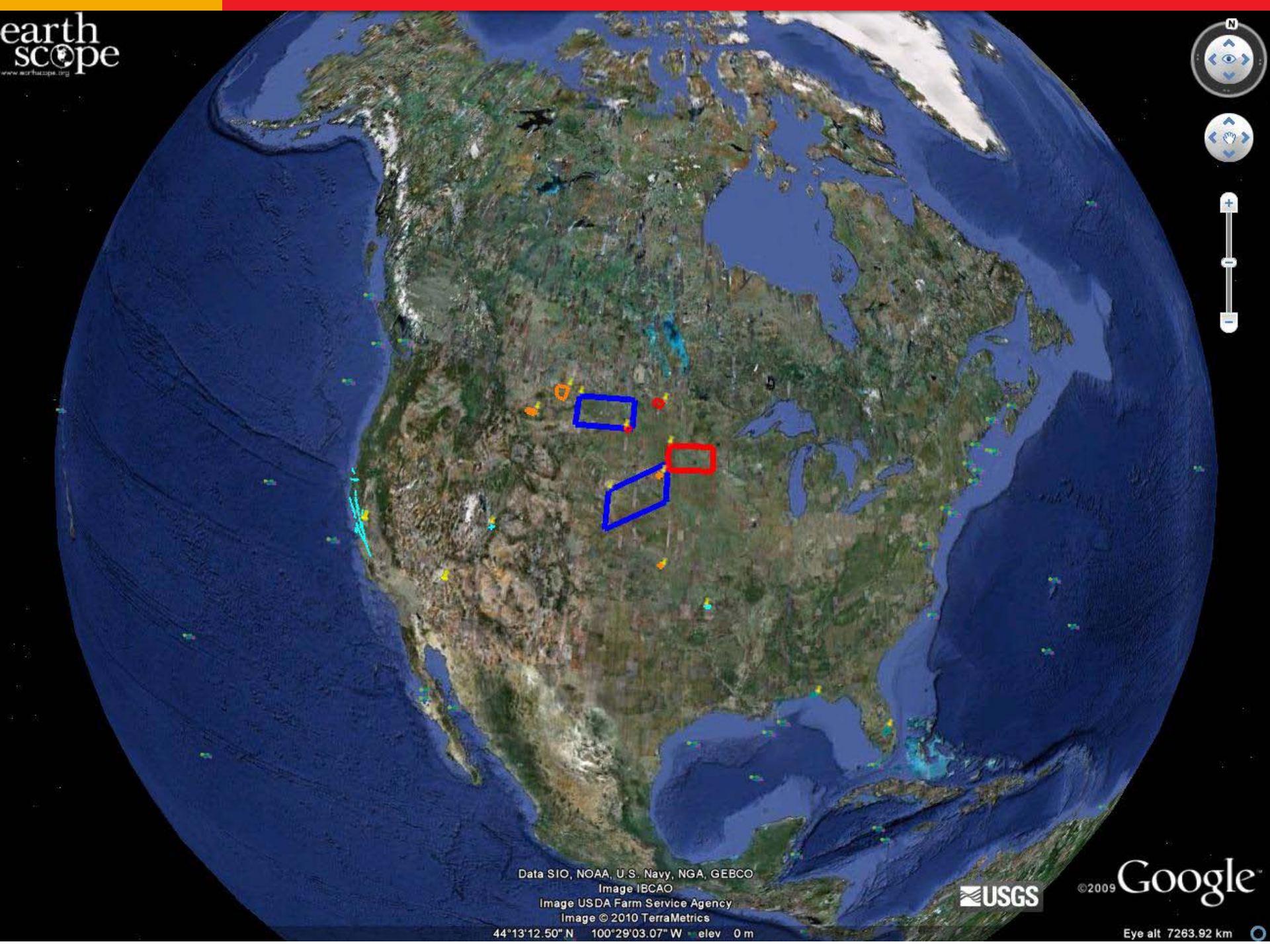
Collecting and Interpreting Data...

- Based on PDA numbers, we would make staffing decisions and requests.
- With staffing determined, we then started collecting DDA (Detailed Damage Assessment) information to determine an exact number of homes affected and their degree of damage.
- They completed “street sheets” listing each home by address and class of damage that are used in service centers.
- We produced DDA reports that would be used to determine more information about the type of service delivery would be made.
- The DDA process took an additional 1-7 days.
- We entered street sheets into computers at additional 1-3 days.
- We ended up with volumes of street shoot logs and numbers.
- The whole process took 3 days to 3 weeks or more.

Today in Central and Western Oklahoma...

- We can complete the same process, producing more information, in 12 to 72 hours with GIS and Geospatial Analysis using NSSL's Warning Decision Supplement Services-Integrated Information (WDSS-II) and other tools for Preliminary Damage Assessment.
 - First: The May 10, 2010 tornadoes in Norman and Eastern OK County, we completed the DA process in 48 hours with 980 homes damaged.
 - Second: The May 24, 2011 tornado outbreak, we completed the DA process in 48 hours with 1480 homes damaged.
 - Third: The April 13/14, 2012 tornado outbreaks, we completed the DA process in Norman (day 1) in 12 hours and Woodward (day 2) in 12 hours with 680 homes damaged during both storms.
- This is how we did it...

Tracking Tornadoes in Real-time with WDSS-II



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
Image USDA Farm Service Agency
Image © 2010 TerraMetrics

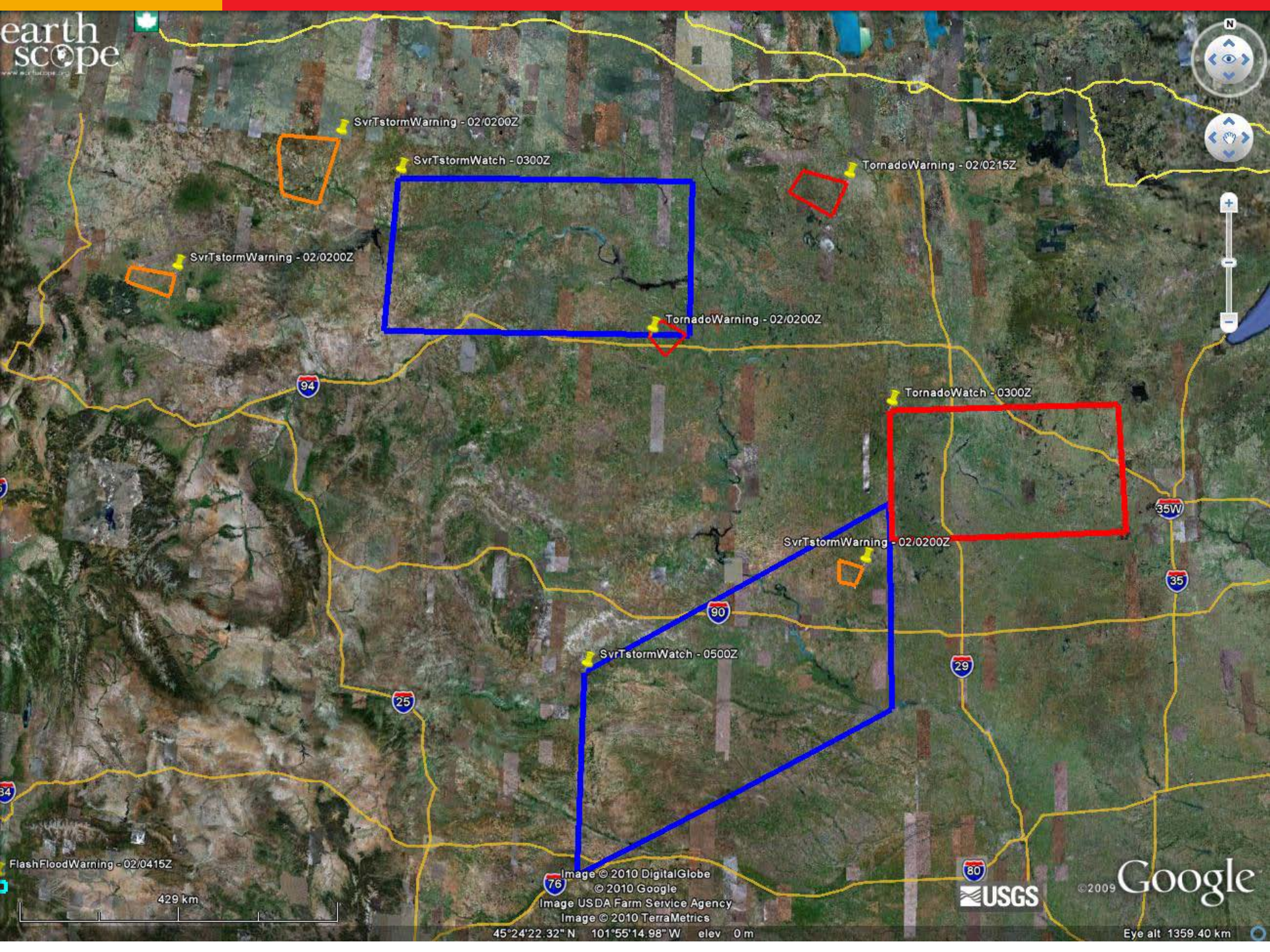
44°13'12.50" N 100°29'03.07" W elev 0 m



©2009

Google

Eye alt 7263.92 km



SvrTstormWarning - 02/0200Z

SvrTstormWatch - 0300Z

TornadoWarning - 02/0215Z

SvrTstormWarning - 02/0200Z

TornadoWarning - 02/0200Z

TornadoWatch - 0300Z

SvrTstormWarning - 02/0200Z

SvrTstormWatch - 0500Z

FlashFloodWarning - 02/0415Z

429 km

Image © 2010 DigitalGlobe
© 2010 Google
Image USDA Farm Service Agency
Image © 2010 TerraMetrics

45°24'22.32" N 101°55'14.98" W elev 0 m



©2009

Google

Eye alt 1359.40 km



SvrTstormWarning - 01/2330Z

SvrTstormWatch - 0300Z

TornadoWarning - 01/2345Z

SvrTstormWarning - 01/2330Z

TornadoWatch - 0300Z

SvrTstormWarning - 01/2315Z

SvrTstormWarning - 01/2315Z

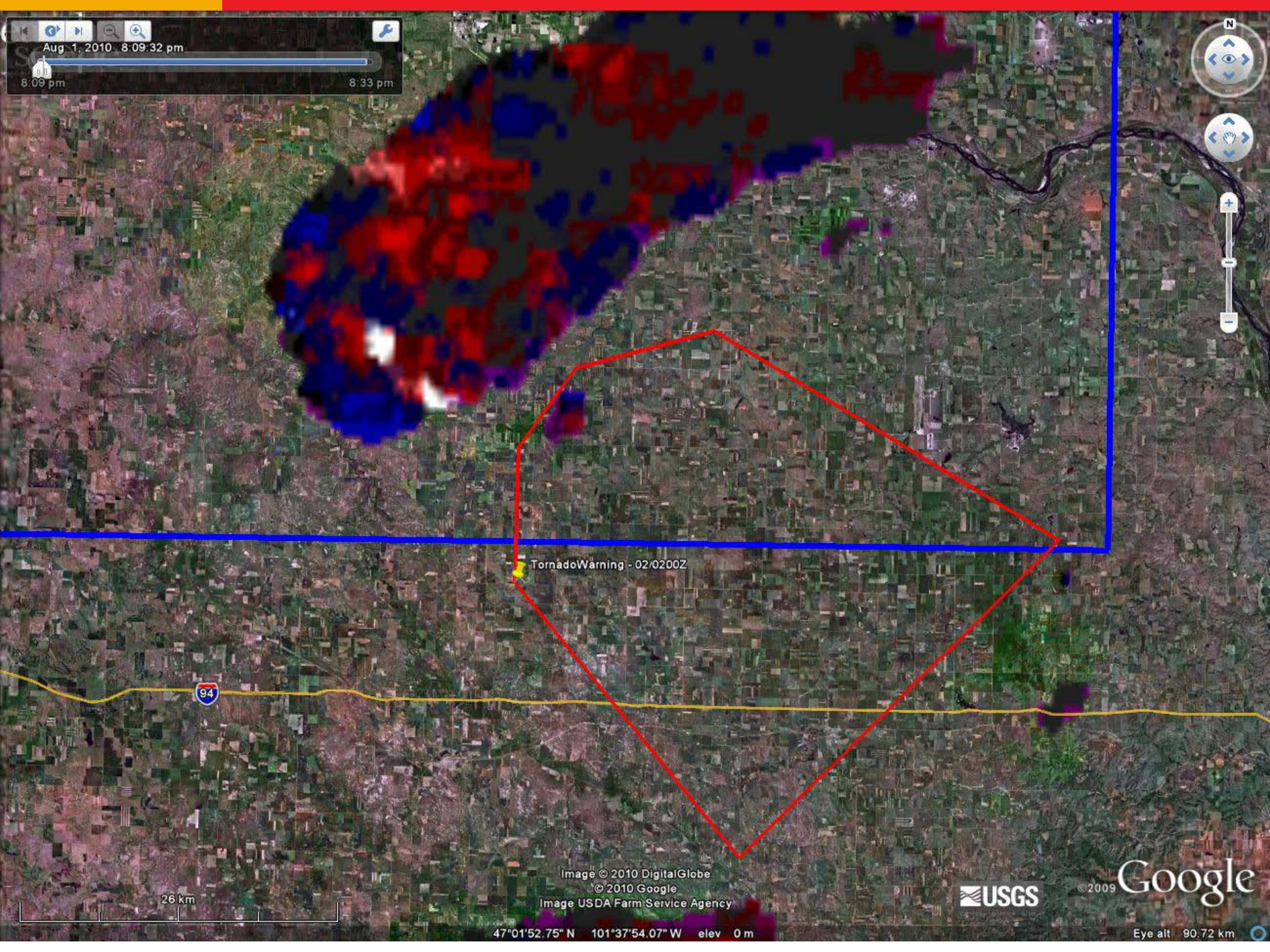
SvrTstormWatch - 0500Z

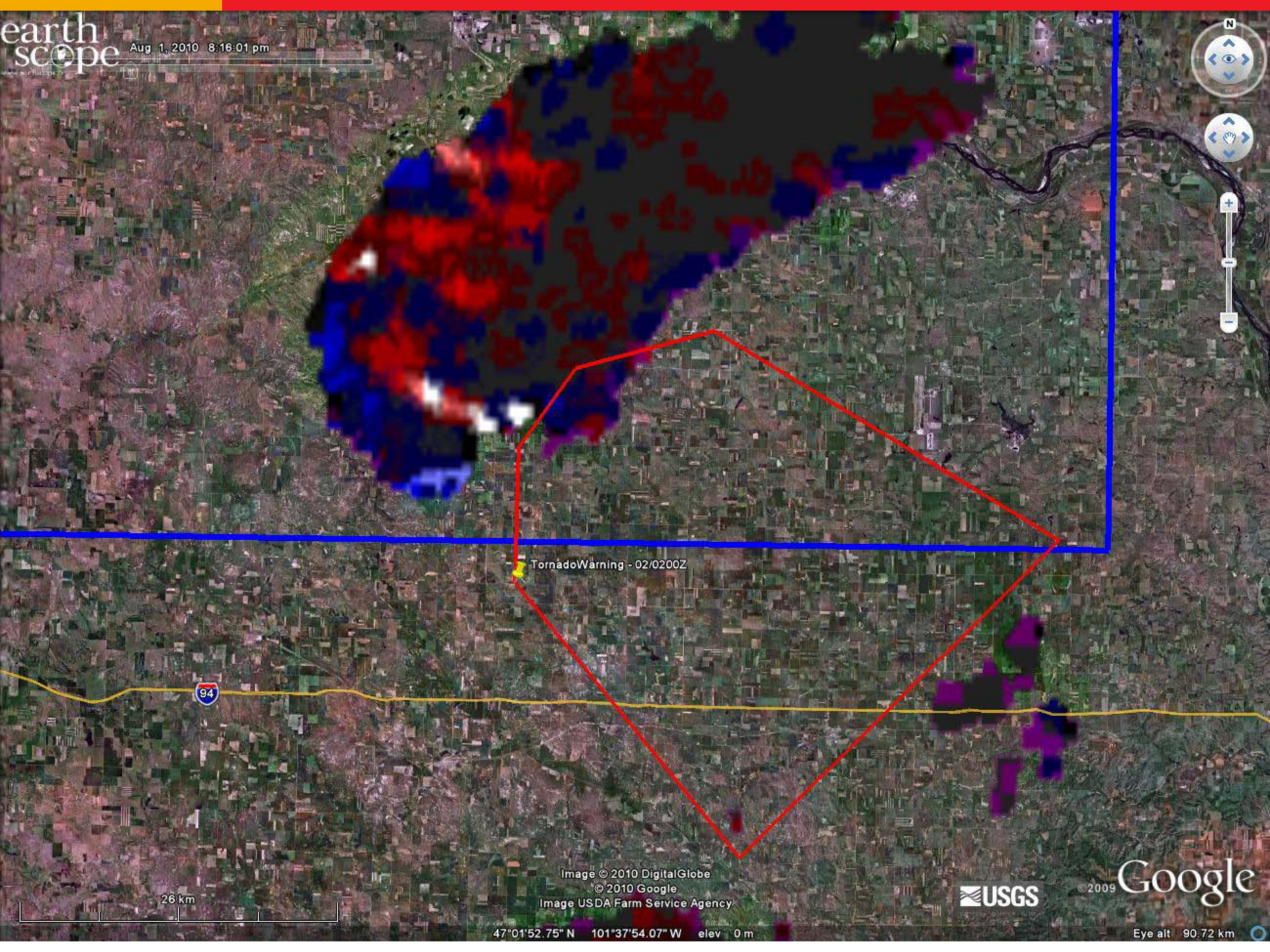
438 km

© 2010 Google
Image © 2010 TerraMetrics
Image © 2010 DigitalGlobe
Image USDA Farm Service Agency

45°16'55.71" N 101°09'28.59" W elev 0 m







TornadoWarning - 02/0200Z

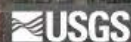
94

26 km

Image © 2010 DigitalGlobe

© 2010 Google

Image USDA Farm Service Agency



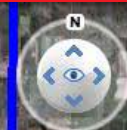
© 2009

Google

47°01'52.75" N 101°37'54.07" W elev 0 m

Eye alt 90.72 km

Aug 1, 2010 8:33:01 pm



TornadoWarning - 02/0200Z

19.1 km

Image © 2010 DigitalGlobe
© 2010 Google
Image USDA Farm Service Agency



© 2009

Google

46°57'17.98" N 101°32'47.71" W elev 0 m

Eye alt 65.68 km

Aug 1, 2010 8:28:35 pm



TornadoWarning - 02/0200Z



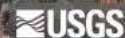
810

28 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m



© 2009

Google

Eye alt 96.65 km



TornadoWarning - 02/0200Z



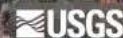
310

28 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m



© 2009

Google

Eye alt 96.65 km

Aug 1, 2010 8:31:09 pm
8:23 pm 8:47 pm

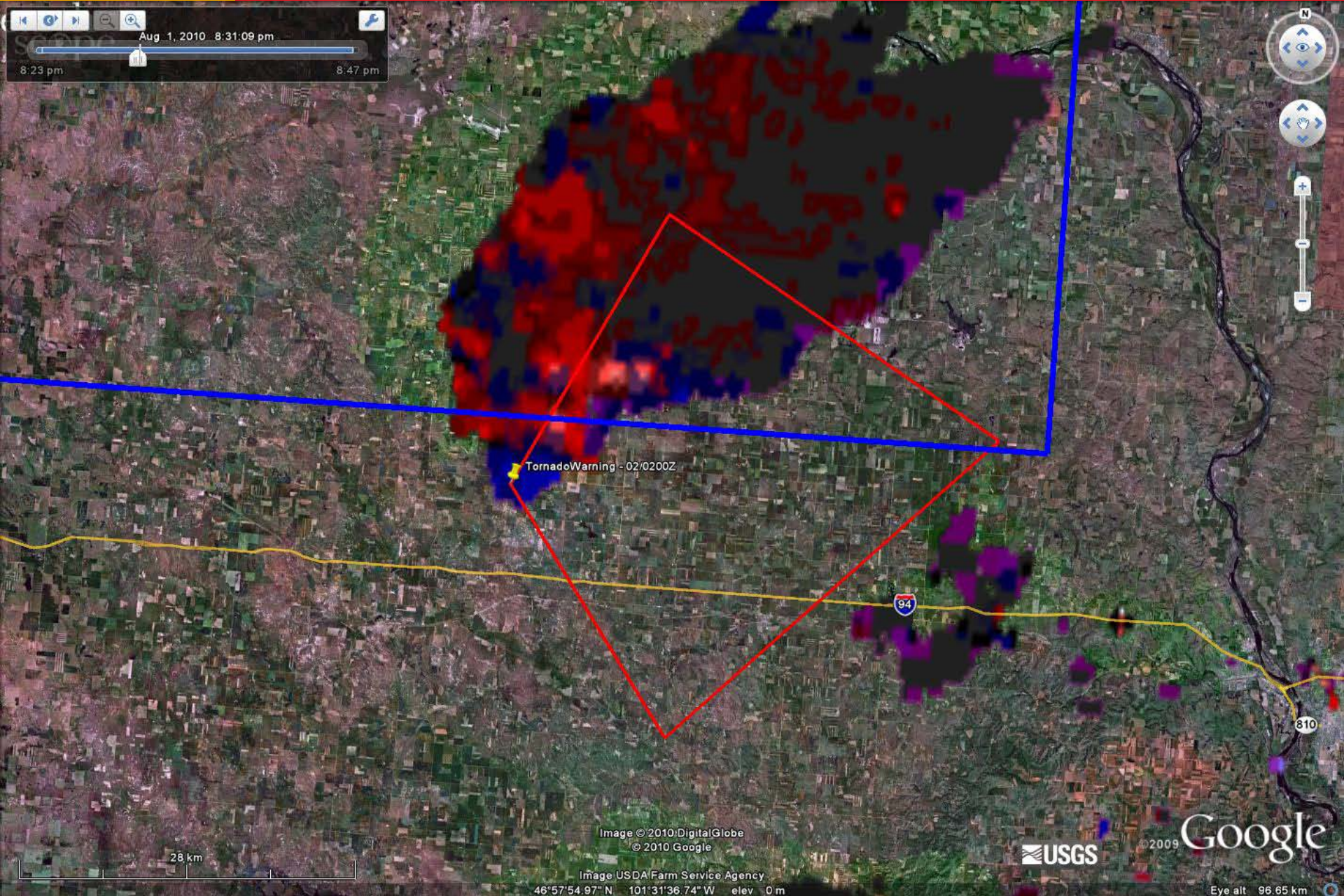
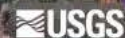


Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m

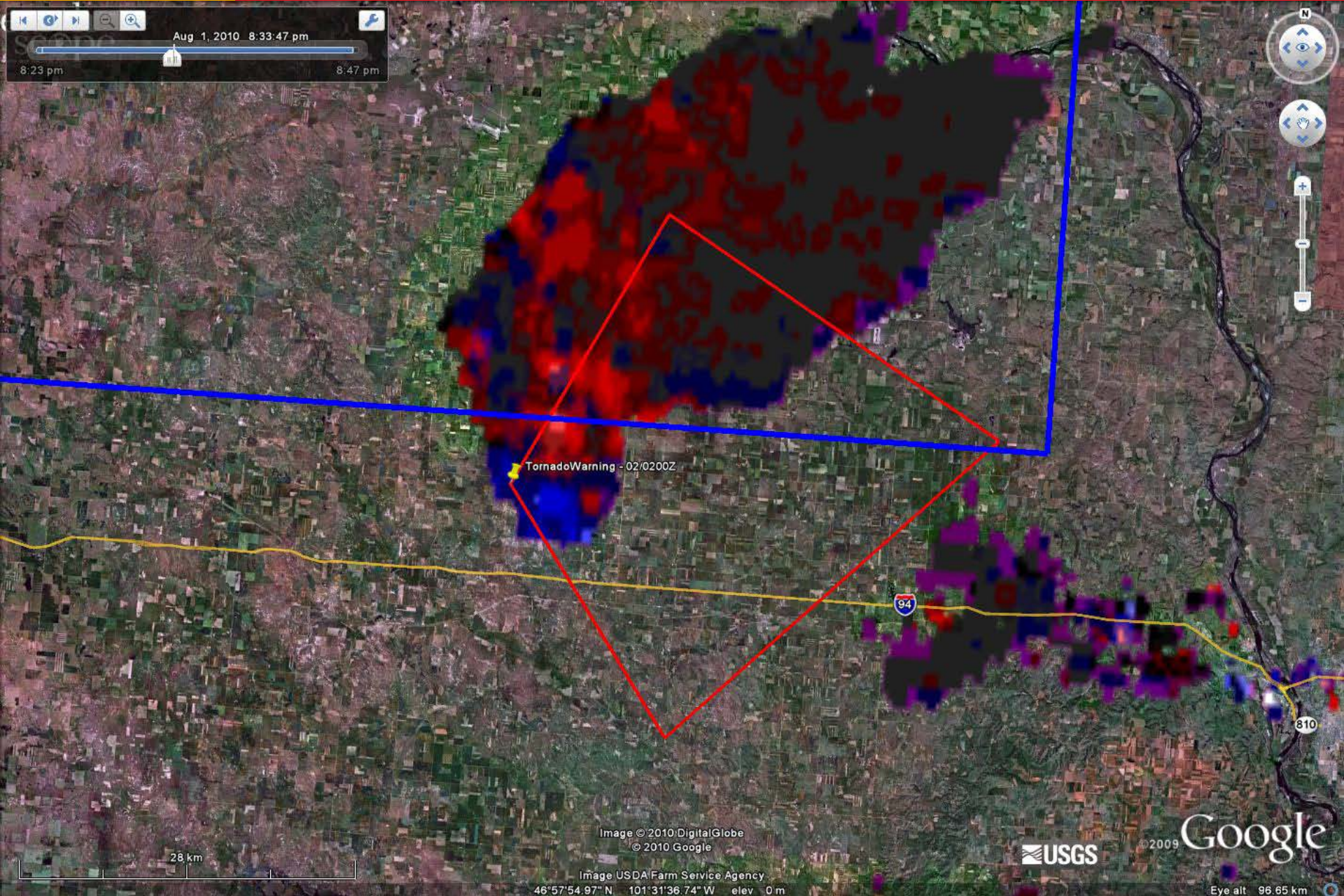


© 2009 Google

Eye alt 96.65 km

Aug 1, 2010 8:33:47 pm

8:23 pm 8:47 pm



TornadoWarning - 02/02002

94

310

28 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m

USGS

2009

Google

Eye alt 96.65 km

Aug 1, 2010 8:36:32 pm
8:23 pm 8:47 pm



TornadoWarning - 02/0200Z

28 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m

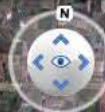
USGS

© 2009

Google

Eye alt 96.65 km

Aug 1, 2010 - 8:39:57 pm



TornadoWarning - 02/0200Z



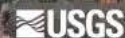
310

28 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m

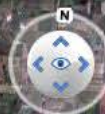


© 2009

Google

Eye alt 96.65 km

Aug 1, 2010 8:44:15 pm



TornadoWarning - 02/0200Z



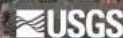
310

28 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m



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Google

Eye alt 96.65 km

Aug 1, 2010 - 8:46:19 pm



TornadoWarning - 02/0200Z

94

310

28 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m

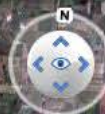
USGS

© 2009

Google

Eye alt 96.65 km

Aug 1, 2010 - 8:47:35 pm



TornadoWarning - 02/0200Z

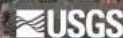


28 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°57'54.97" N 101°31'36.74" W elev 0 m



© 2009

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Eye alt 96.65 km

Aug 1, 2010 8:47:42 pm



TornadoWarning - 02/0200Z



83

810

TornadoWarning - 02/0230Z

45 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°48'58.17" N 101°18'38.35" W elev 0 m

USGS

© 2009

Google

Eye alt 155.96 km

Aug 1, 2010 8:49:54 pm

8:29 pm 8:53 pm



TornadoWarning - 02/0200Z

94

83

810

TornadoWarning - 02/0230Z

45 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°48'58.17" N 101°18'38.35" W elev 0 m

USGS

© 2009

Google

Eye alt 155.96 km

Aug 1, 2010 8:53:23 pm



TornadoWarning - 02/0200Z

94

83

810

TornadoWarning - 02/0230Z

45 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°48'58.17" N 101°18'38.35" W elev 0 m

USGS

© 2009

Google

Eye alt 155.96 km



warning

warning

TornadoWarning - 02/0230Z

warning



83

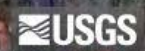
810



32 km

Image © 2010 DigitalGlobe
© 2010 Google

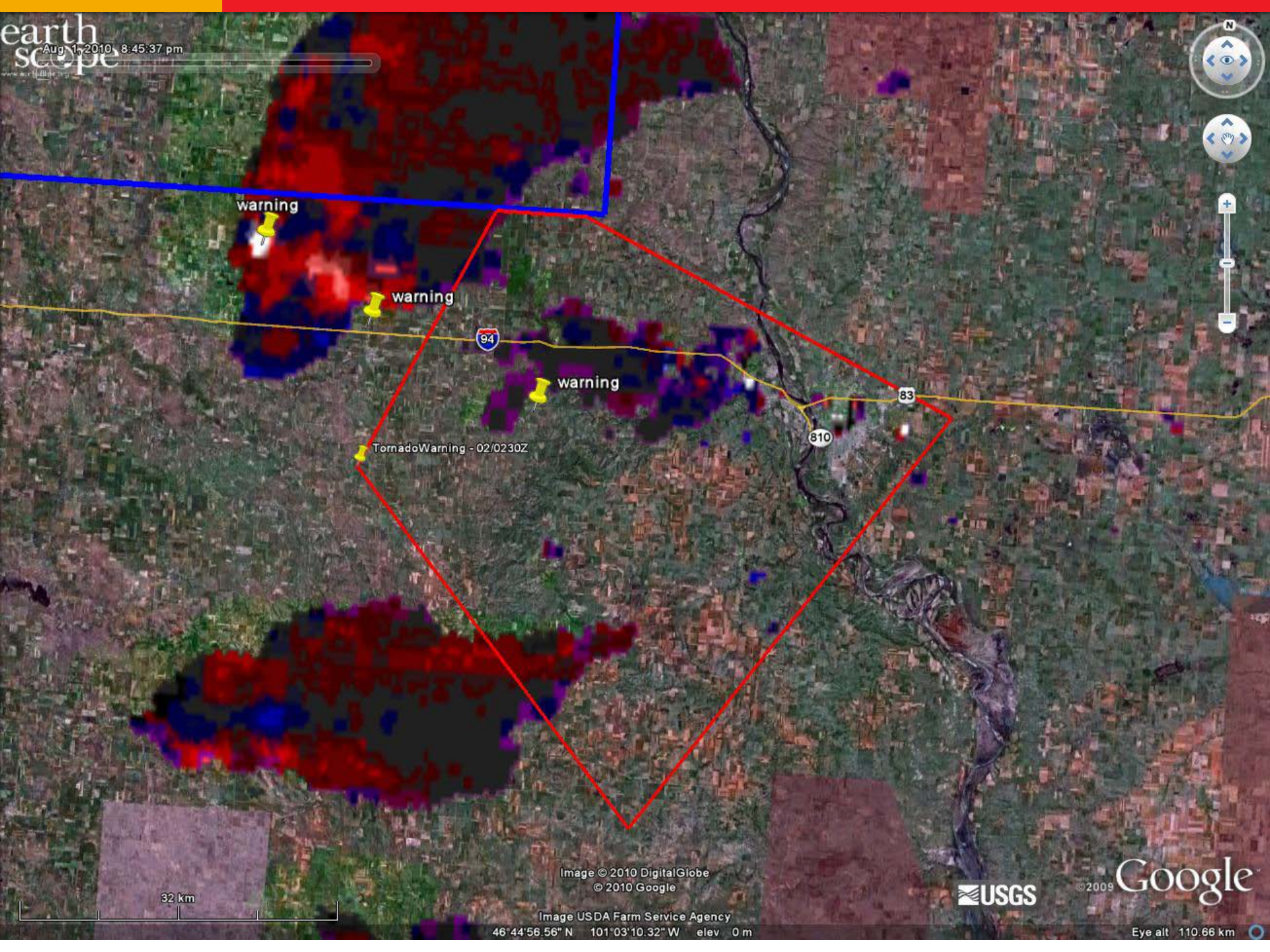
Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



©2009

Google

Eye alt 110.66 km



warning

warning

warning

TornadoWarning - 02/0230Z

94

83

810

32 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m

USGS

©2009

Google

Eye alt 110.66 km



warning

warning

warning

TornadoWarning - 02/0230Z

94

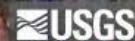
83

810

32 km

Image © 2010 DigitalGlobe
© 2010 Google

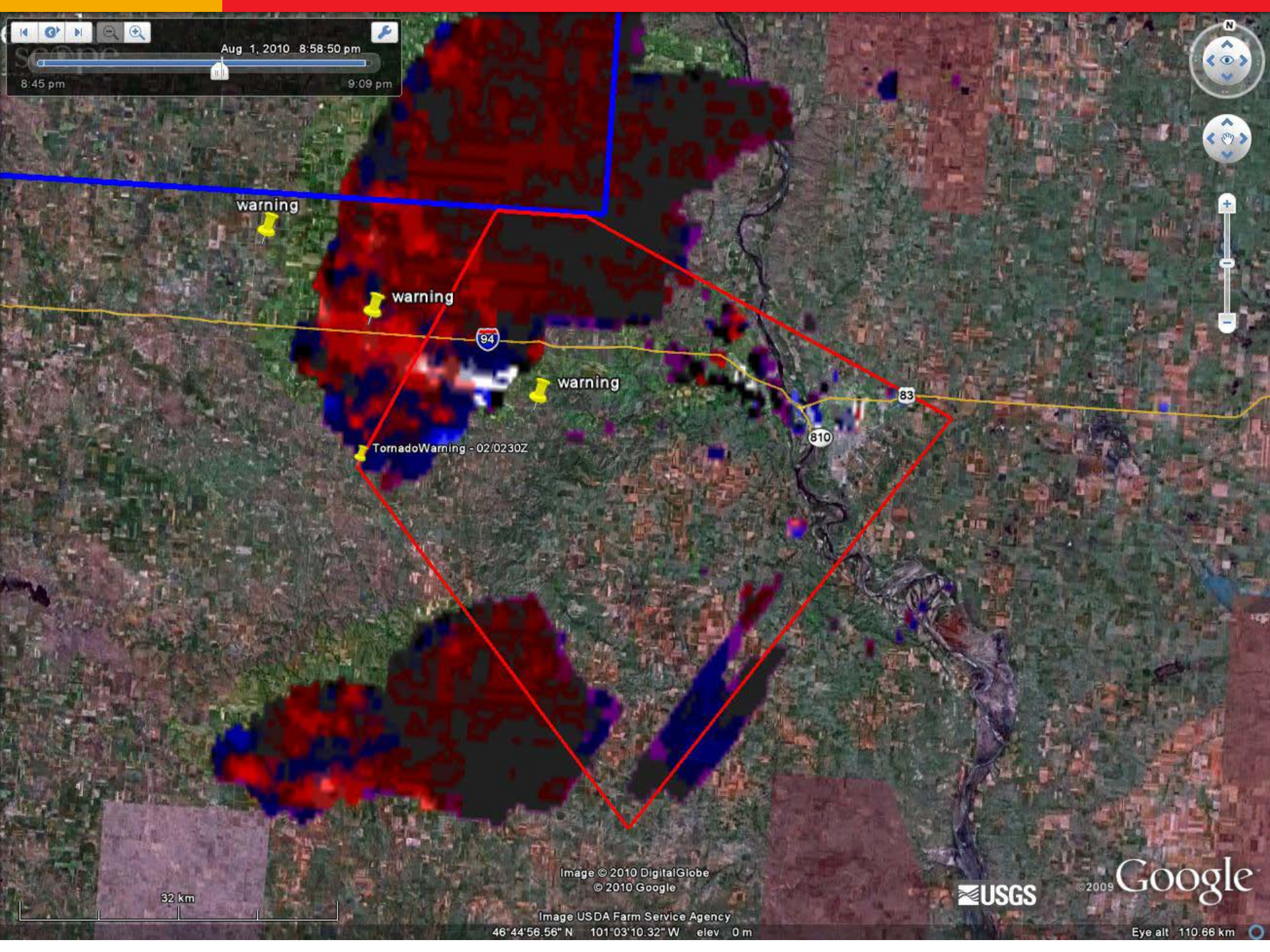
Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



© 2009

Google

Eye alt 110.66 km



Aug 1, 2010 8:58:50 pm

8:45 pm

9:09 pm

warning

warning

warning

TornadoWarning - 02/0230Z

94

83

810

32 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

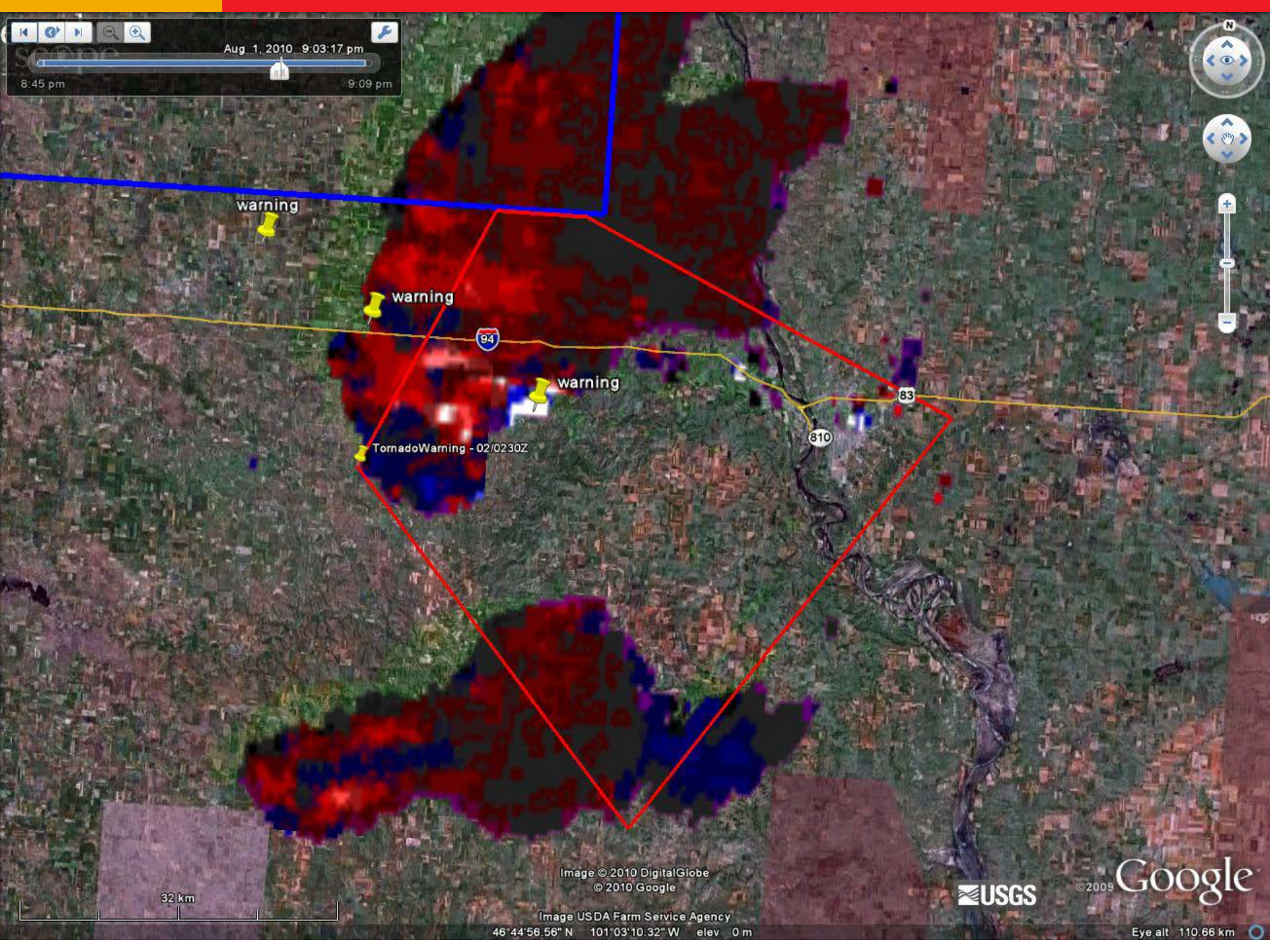
46°44'56.56" N 101°03'10.32" W elev 0 m

USGS

©2009

Google

Eye alt 110.66 km



Aug 1, 2010 9:03:17 pm

8:45 pm

9:09 pm

warning

warning

warning

TornadoWarning - 02/0230Z

94

83

810

32 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

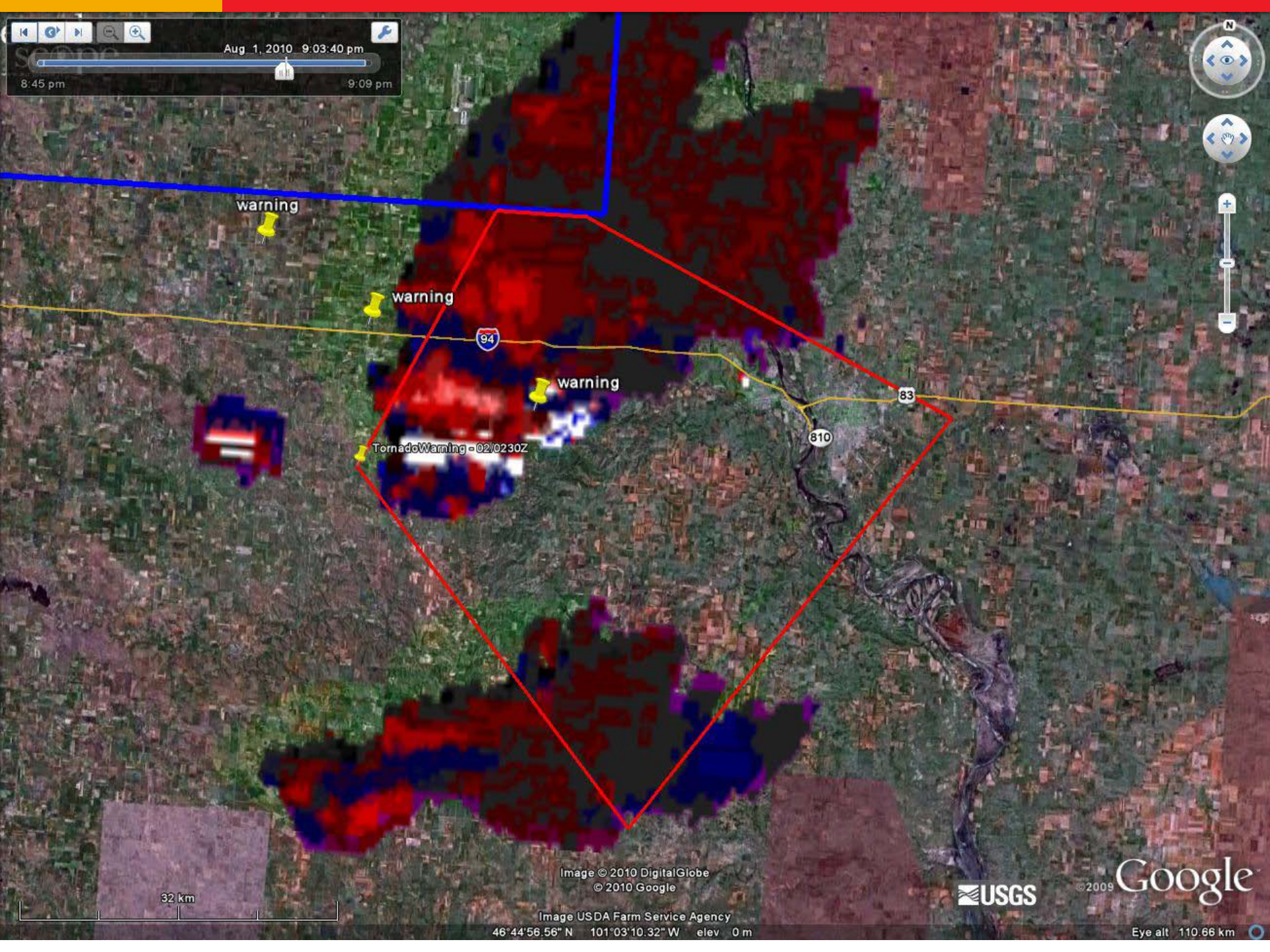
46°44'56.56" N 101°03'10.32" W elev 0 m

USGS

©2009

Google

Eye alt 110.66 km



Aug 1, 2010 9:03:40 pm

8:45 pm

9:09 pm



warning

warning

warning

TornadoWarning-02/0230Z

94

83

810

32 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°44'56.56" N 101°03'10.32" W elev 0 m



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Eye alt 110.66 km



warning

warning

warning

TornadoWarning-02/0230Z

94

83

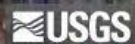
810

32 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

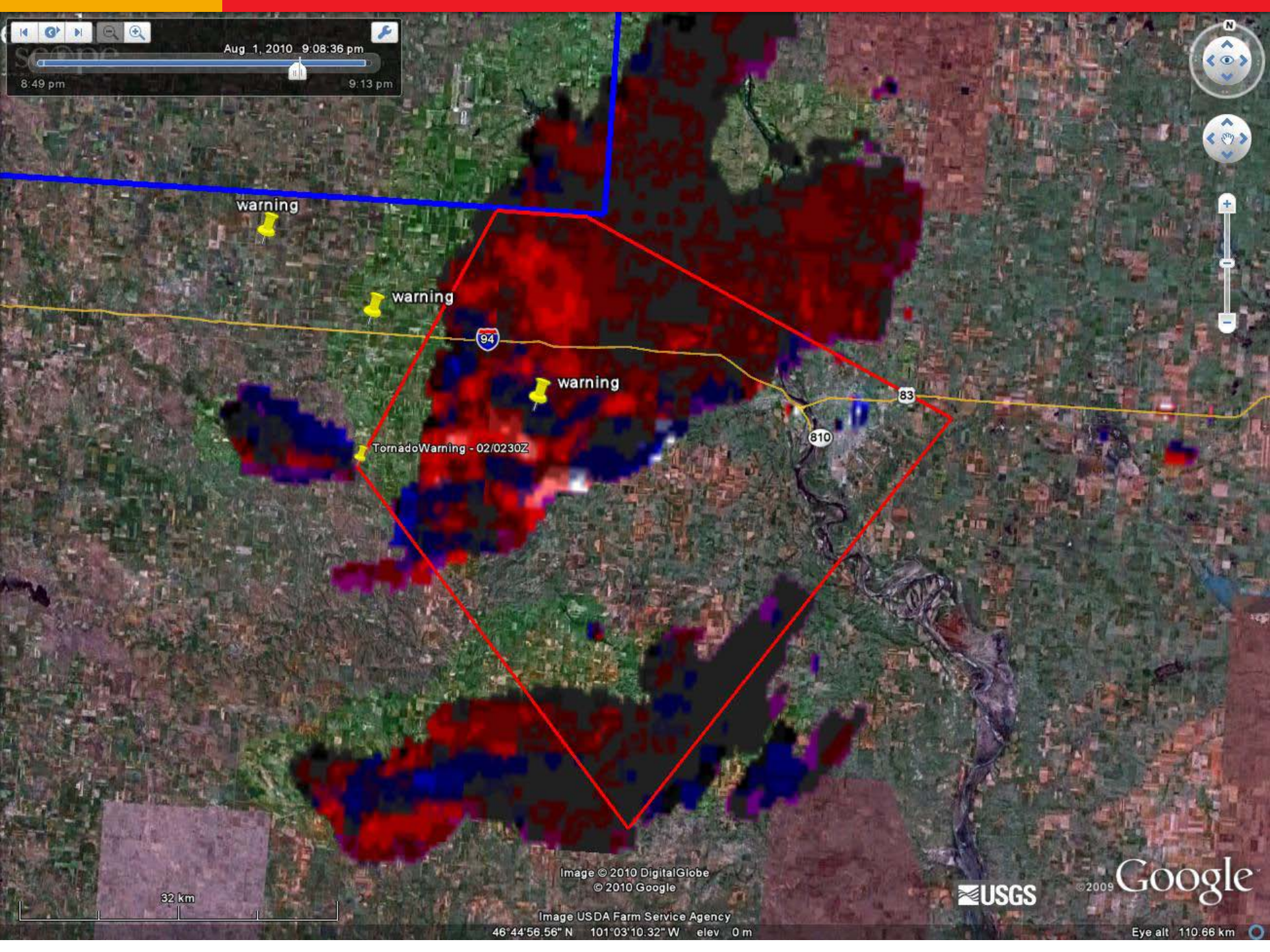
46°44'56.56" N 101°03'10.32" W elev 0 m



©2009

Google

Eye alt 110.66 km



Aug 1, 2010 9:08:36 pm

8:49 pm

9:13 pm

warning

warning

warning

TornadoWarning - 02/0230Z

94

83

810

32 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

46°44'56.56" N 101°03'10.32" W elev 0 m

USGS

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Eye alt 110.66 km

Aug 1, 2010 9:11:54 pm



warning

warning

warning

TornadoWarning - 02/0230Z

94

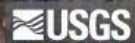
83

810

32 km

Image © 2010 DigitalGlobe
© 2010 Google

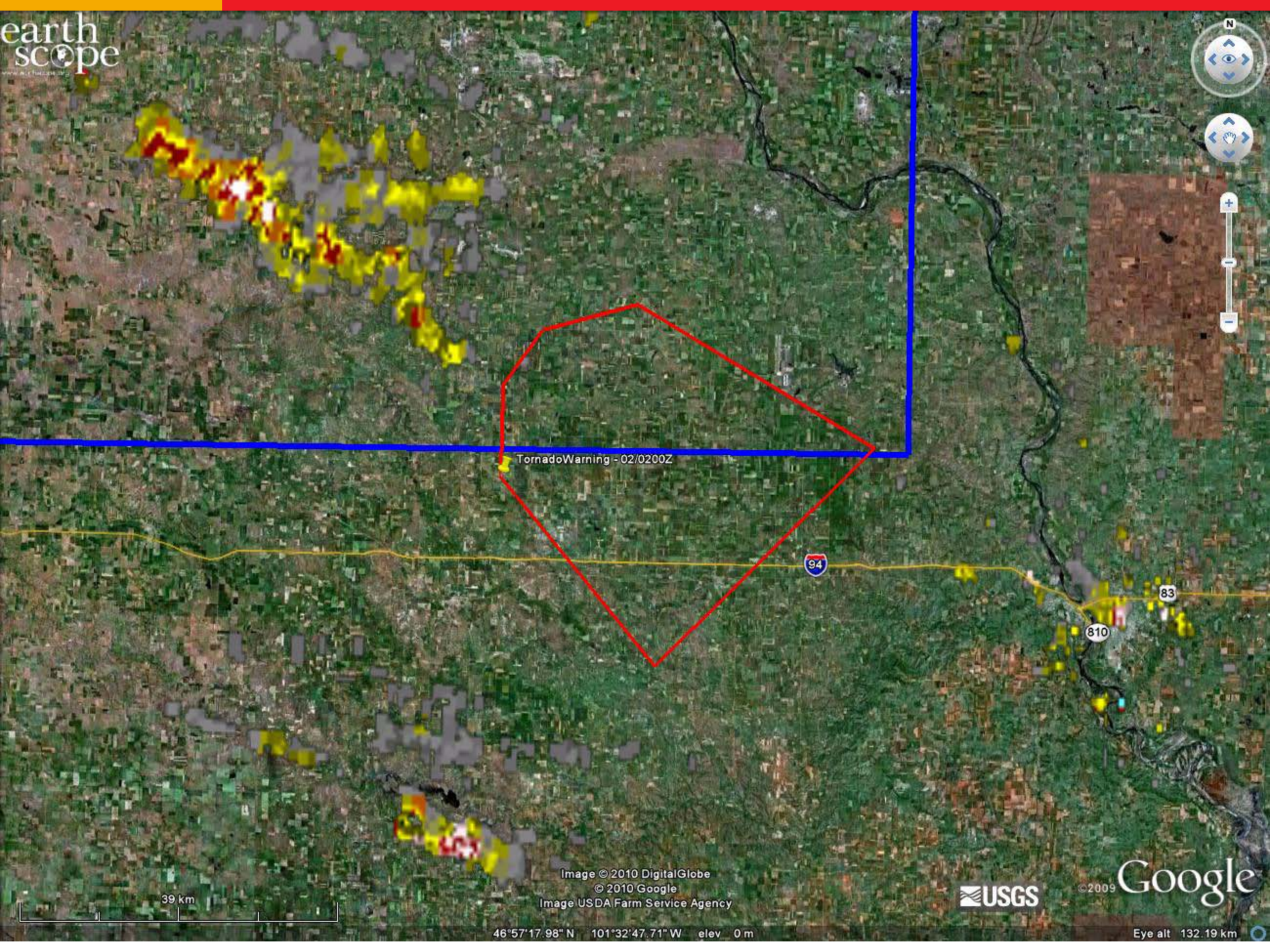
Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



©2009

Google

Eye alt 110.66 km



TornadoWarning - 02/0200Z



83

810

39 km

Image © 2010 DigitalGlobe
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Image USDA Farm Service Agency

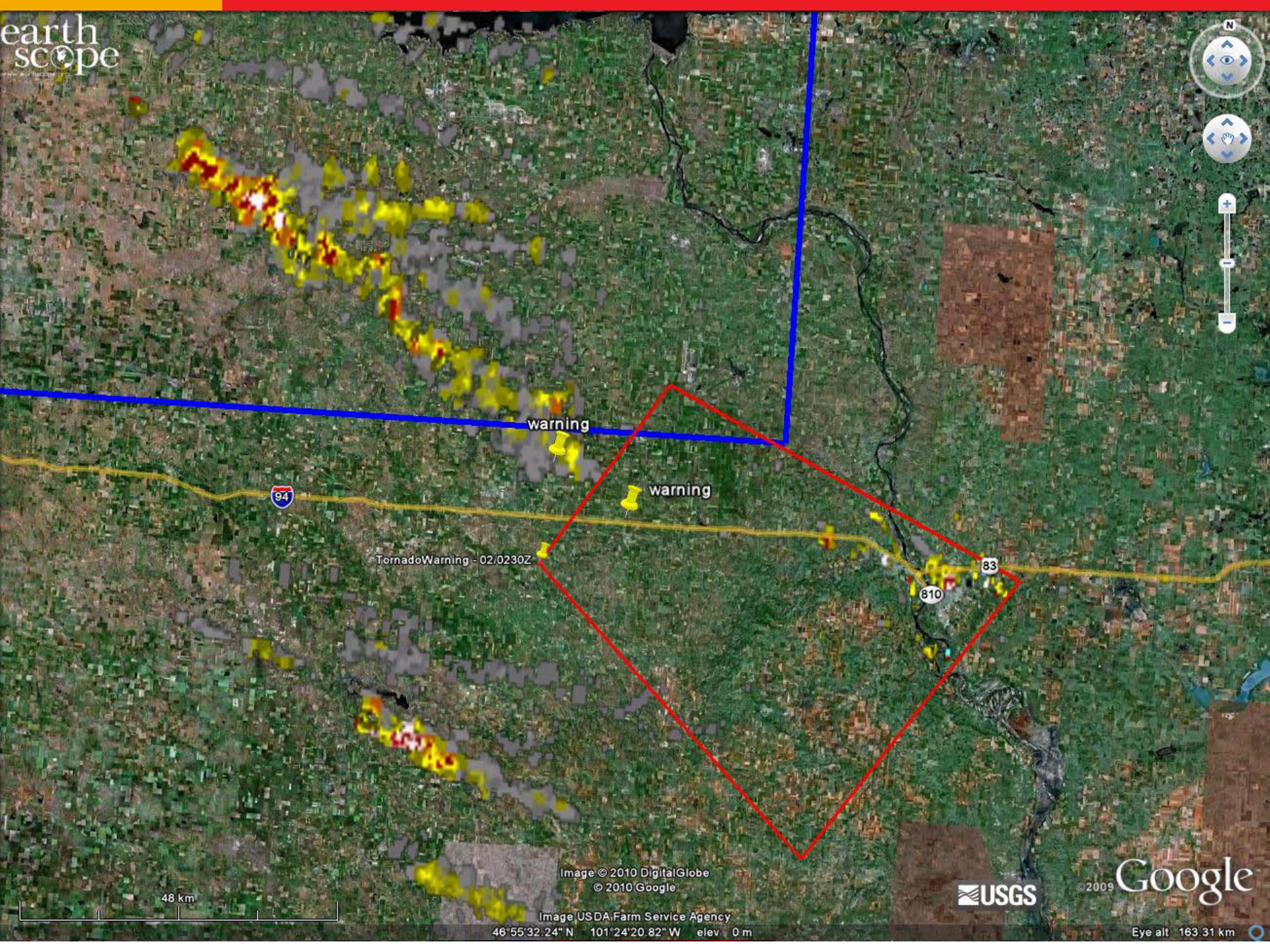


© 2009

Google

46°57'17.98" N 101°32'47.71" W elev 0 m

Eye alt 132.19 km



warning

warning

TornadoWarning - 02/0230Z

810

83

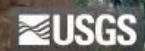


48 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°55'32.24" N 101°24'20.82" W elev 0 m



© 2009

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Eye alt 163.31 km



warning

warning



TornadoWarning - 02/0230Z

warning

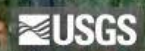
83

810

32 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



© 2009

Google

Eye alt 110.66 km



warning

warning

TornadoWarning - 02/0230Z

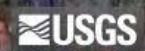
warning



32 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



©2009

Google

Eye alt 110.66 km



warning

warning

warning

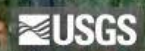
TornadoWarning - 02/0230Z



32 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



© 2009

Google

Eye alt 110.66 km



warning

warning

warning

TornadoWarning - 02/0230Z

94

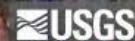
83

810

32 km

Image © 2010 DigitalGlobe
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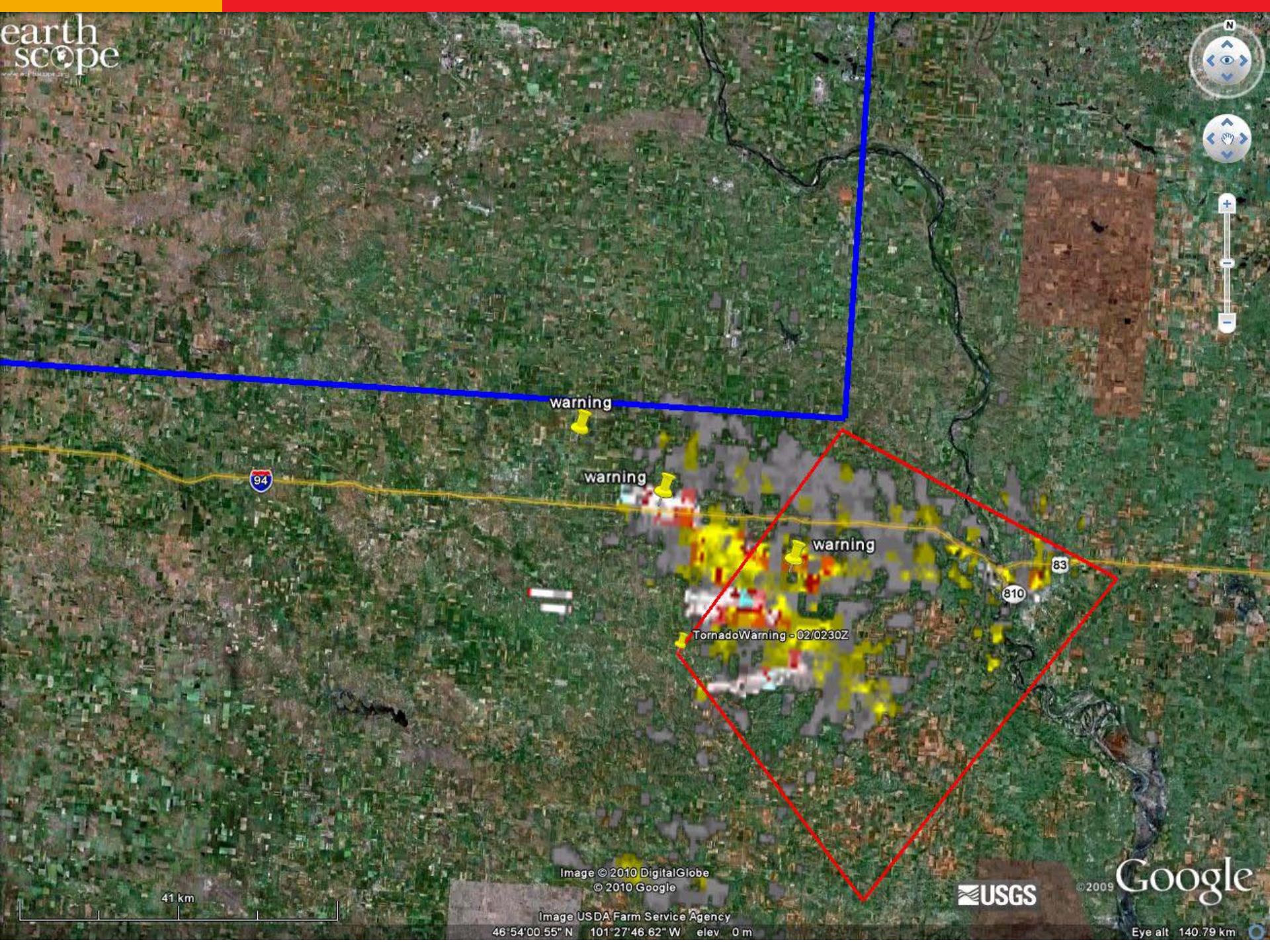
Image USDA Farm Service Agency
46°44'56.56" N 101°03'10.32" W elev 0 m



©2009

Google

Eye alt 110.66 km



94

warning

warning

warning

83

810

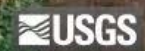
TornadoWarning - 02/0230Z

41 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

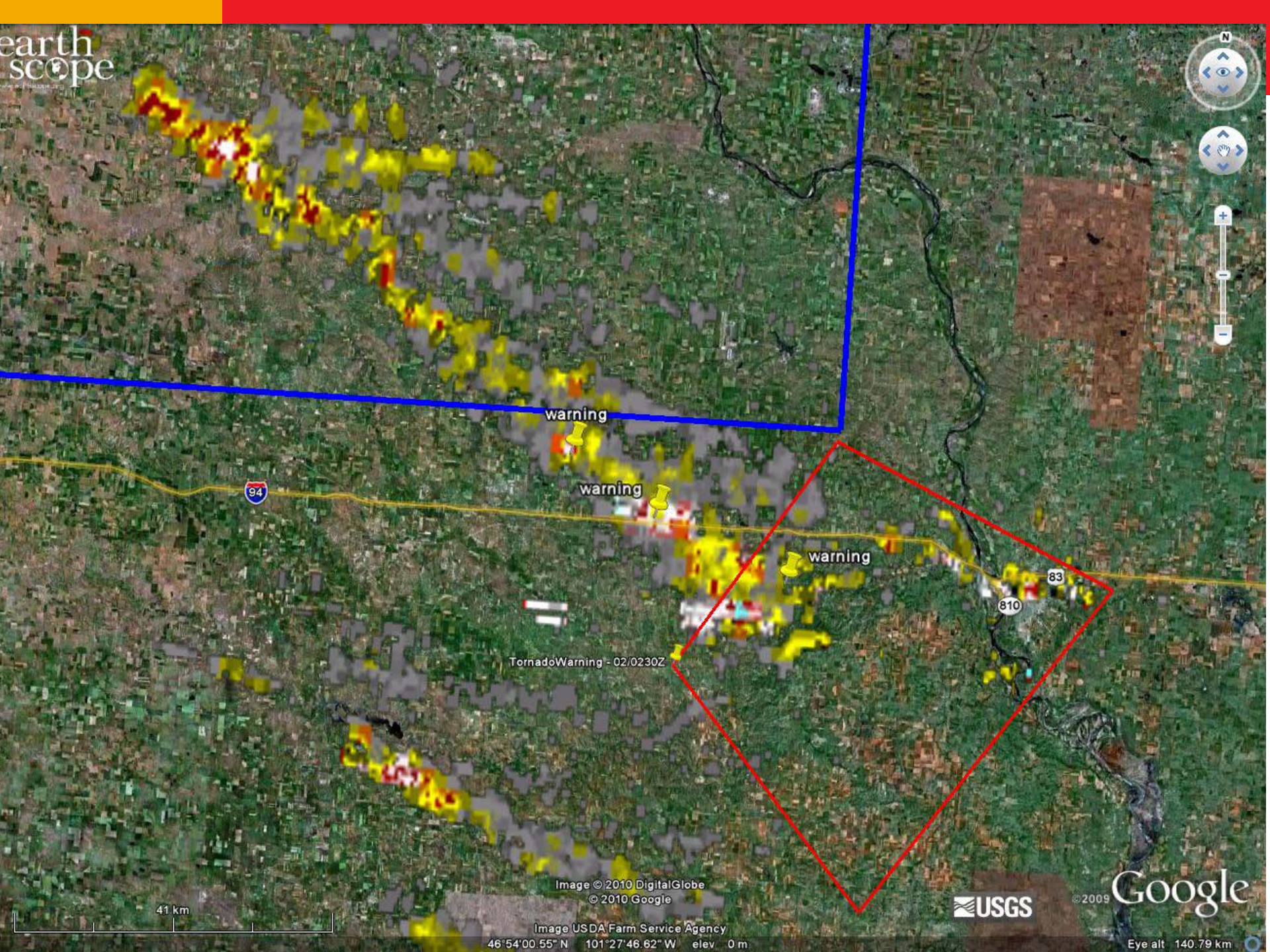
46°54'00.55" N 101°27'46.62" W elev 0 m



© 2009

Google

Eye alt 140.79 km



warning

warning

warning

TornadoWarning - 02/0230Z

83

810

94

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°54'00.55" N 101°27'46.62" W elev 0 m

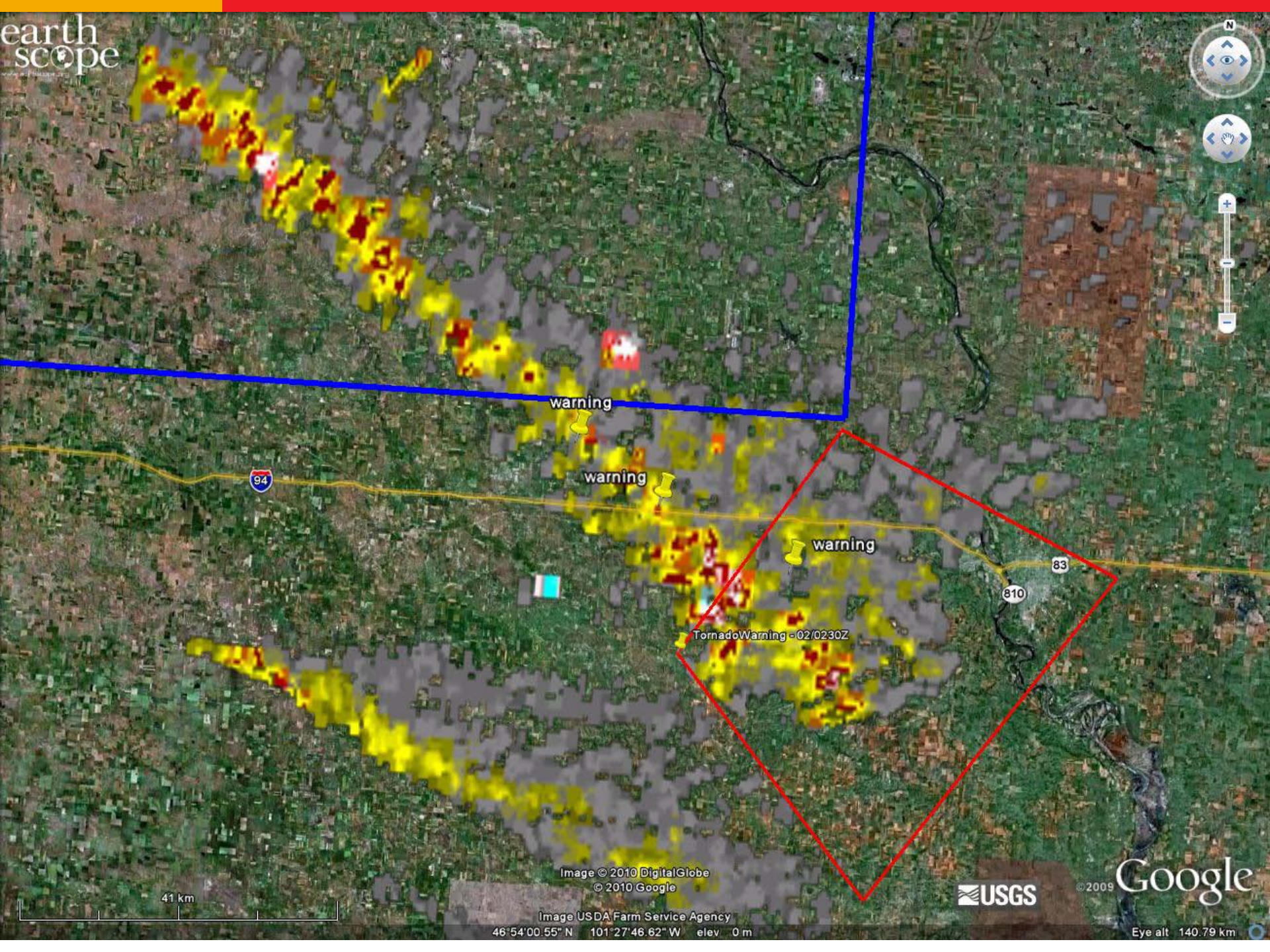
USGS

© 2009

Google

Eye alt 140.79 km

41 km



warning

warning

warning

TornadoWarning - 02/0230Z



810

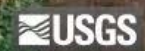
83

41 km

Image © 2010 DigitalGlobe
© 2010 Google

Image USDA Farm Service Agency

46°54'00.55" N 101°27'46.62" W elev 0 m

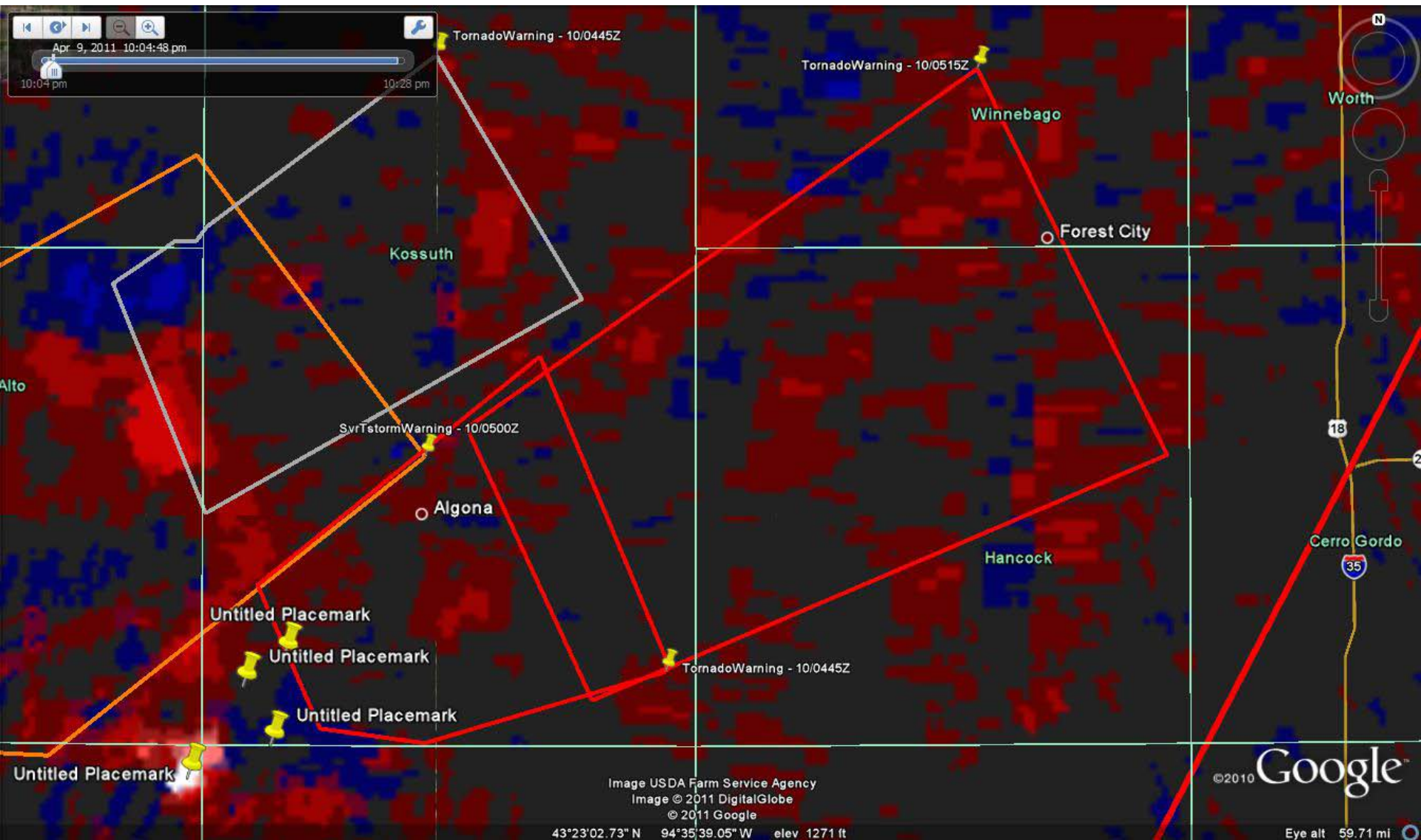


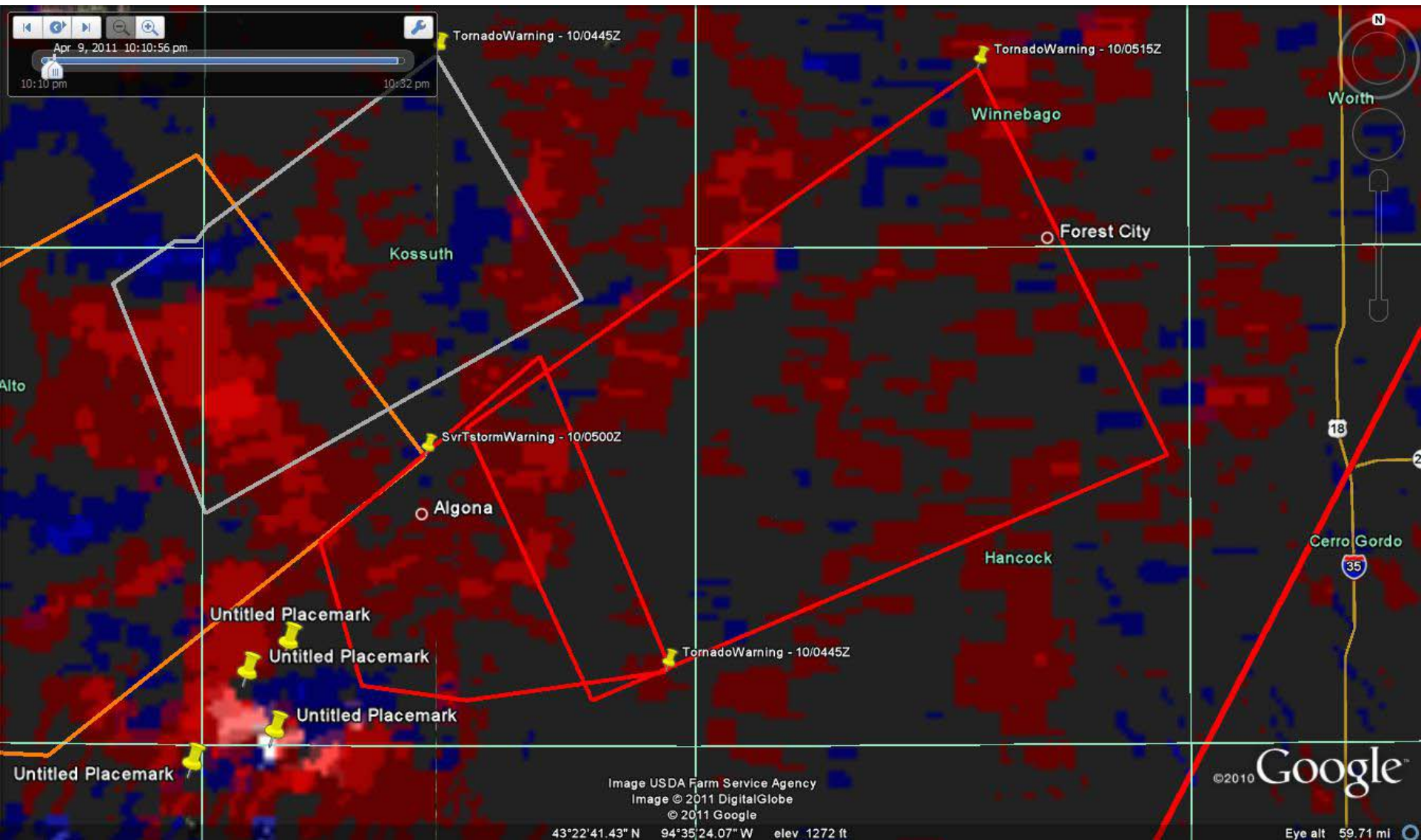
© 2009

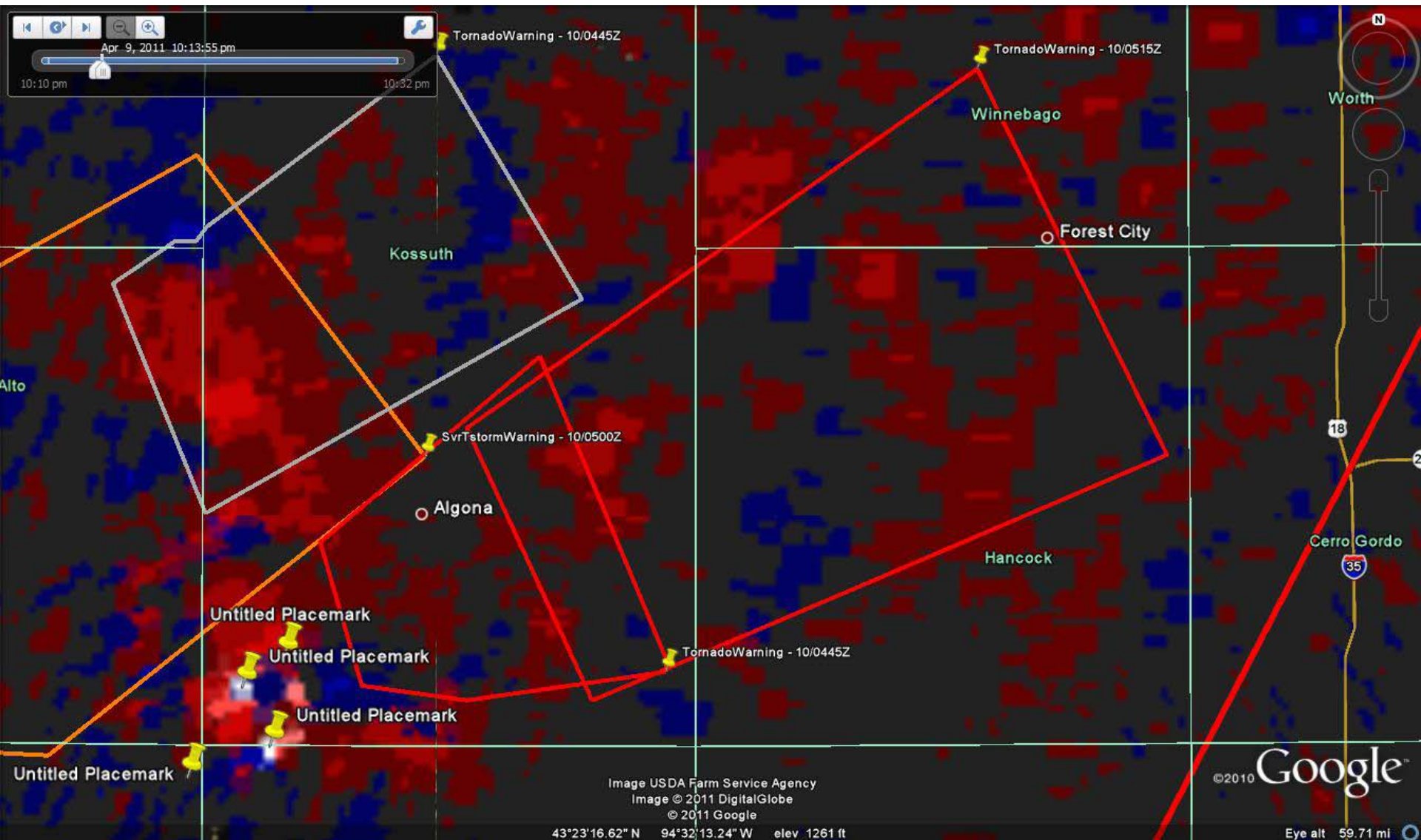
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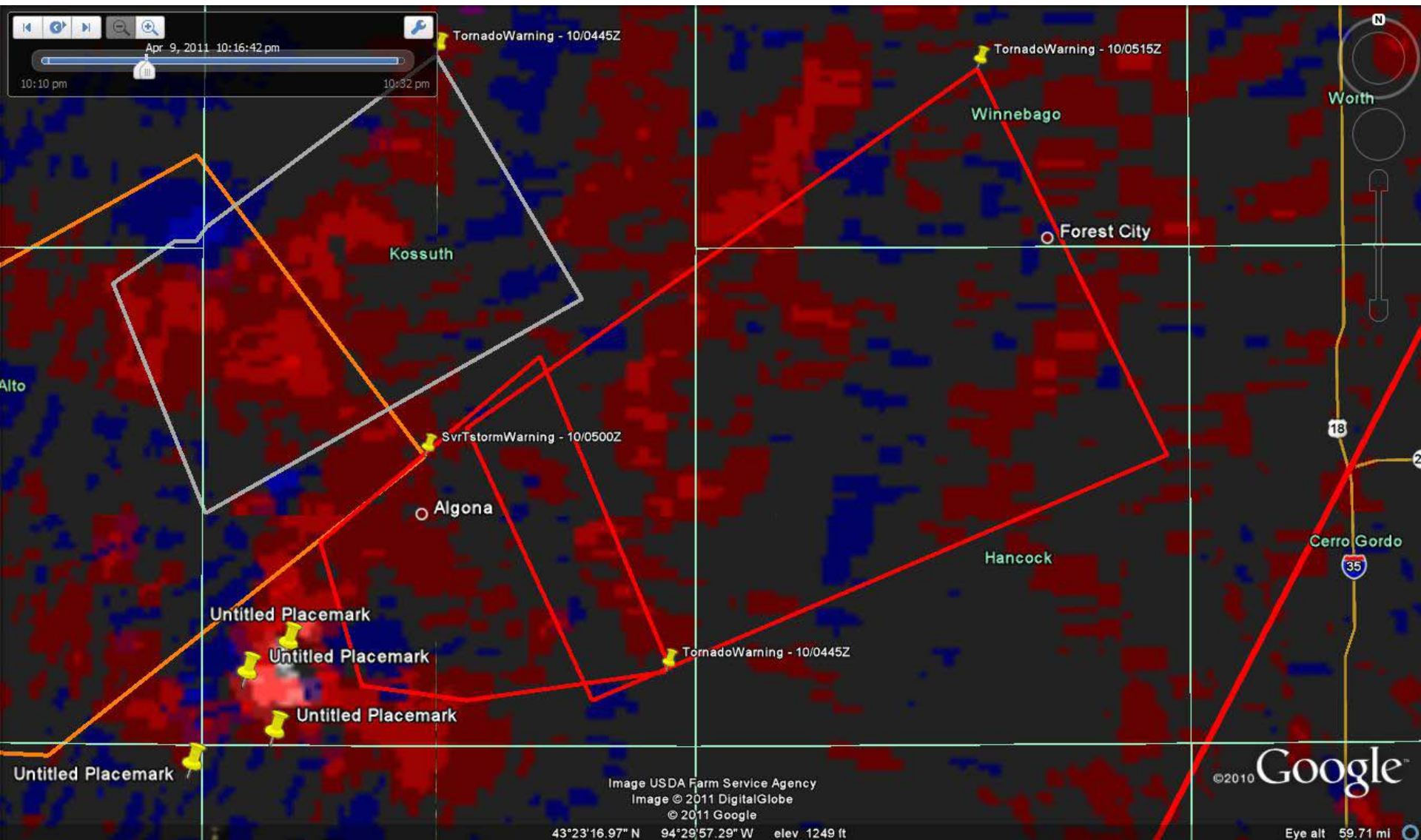
Eye alt 140.79 km

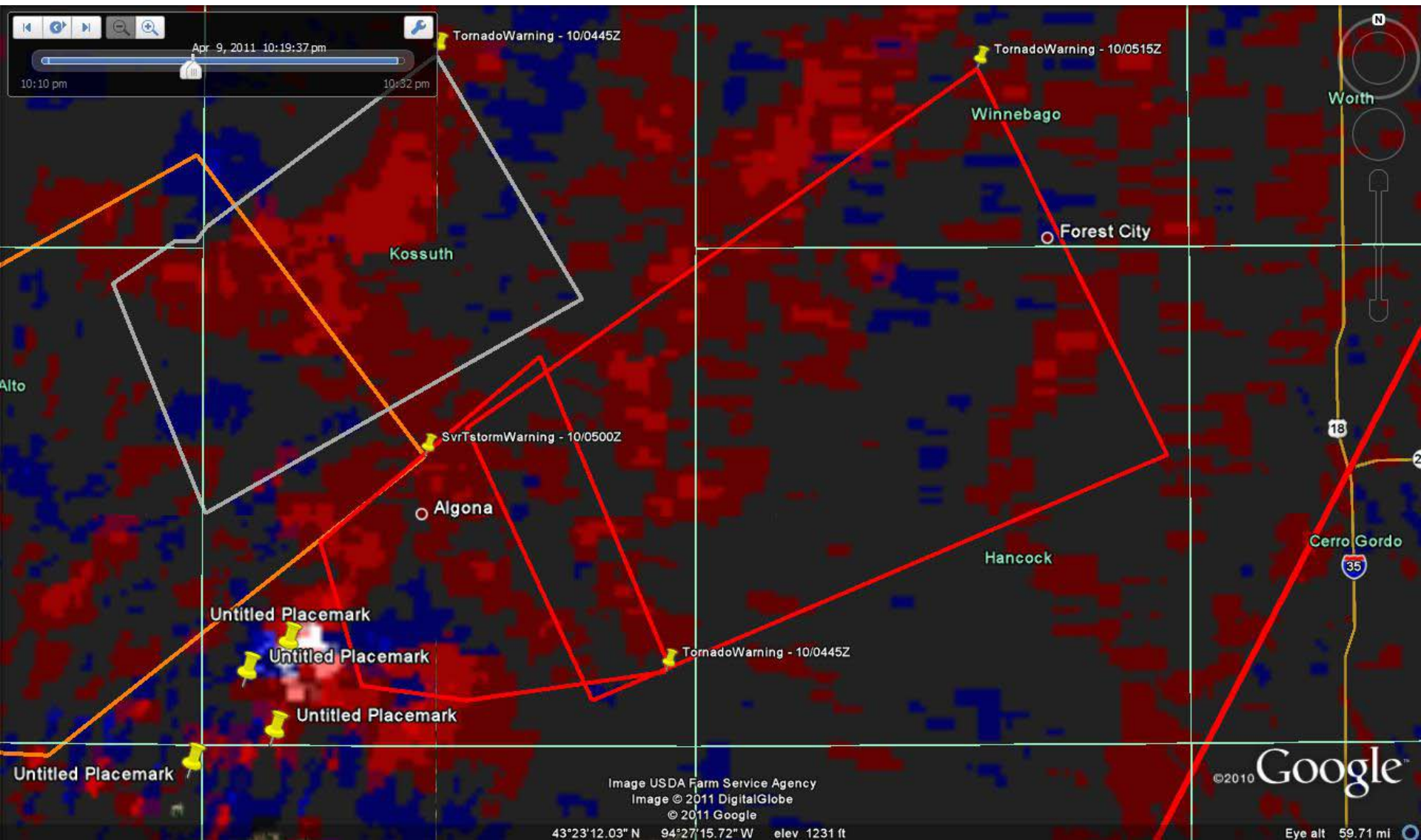
One More Example

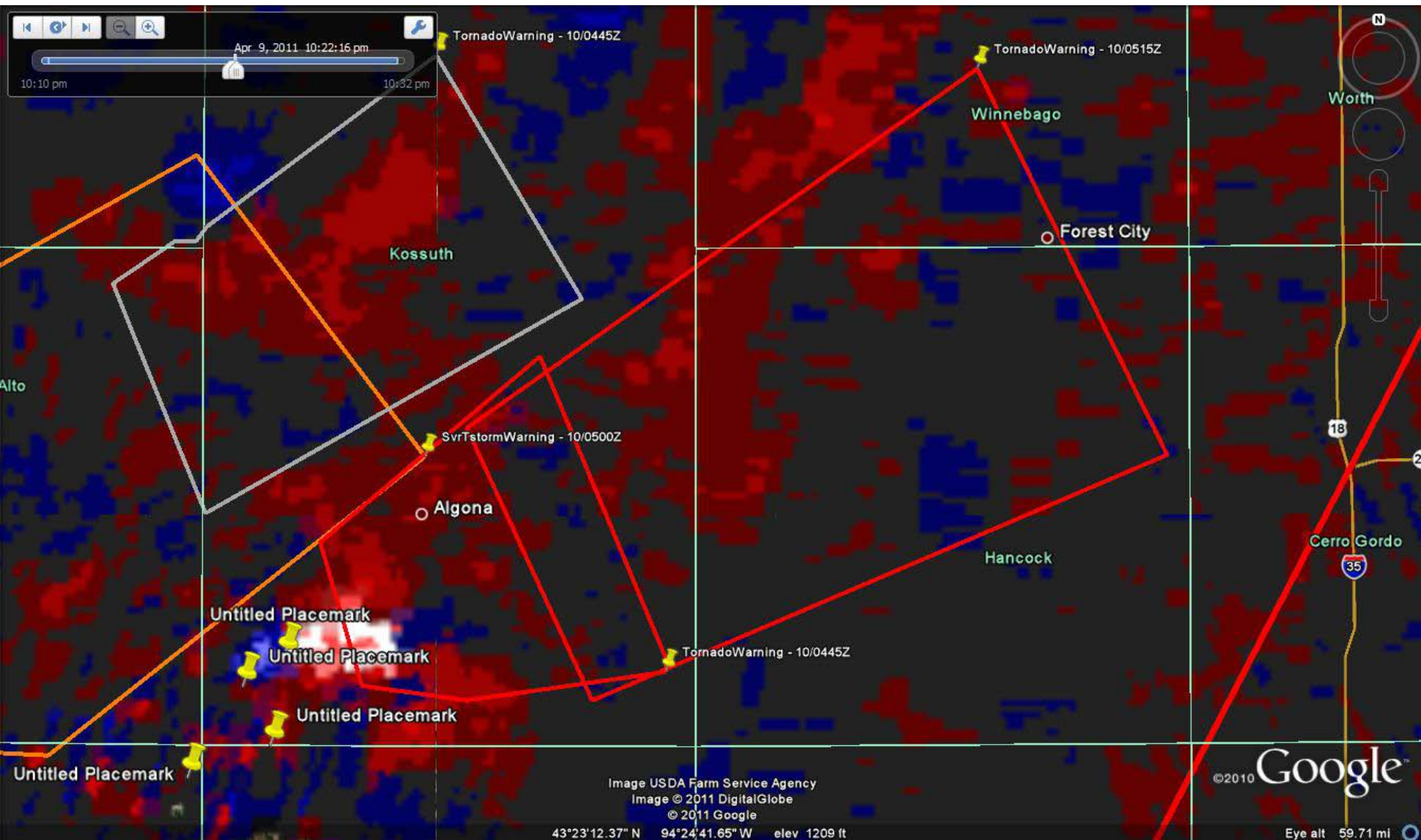


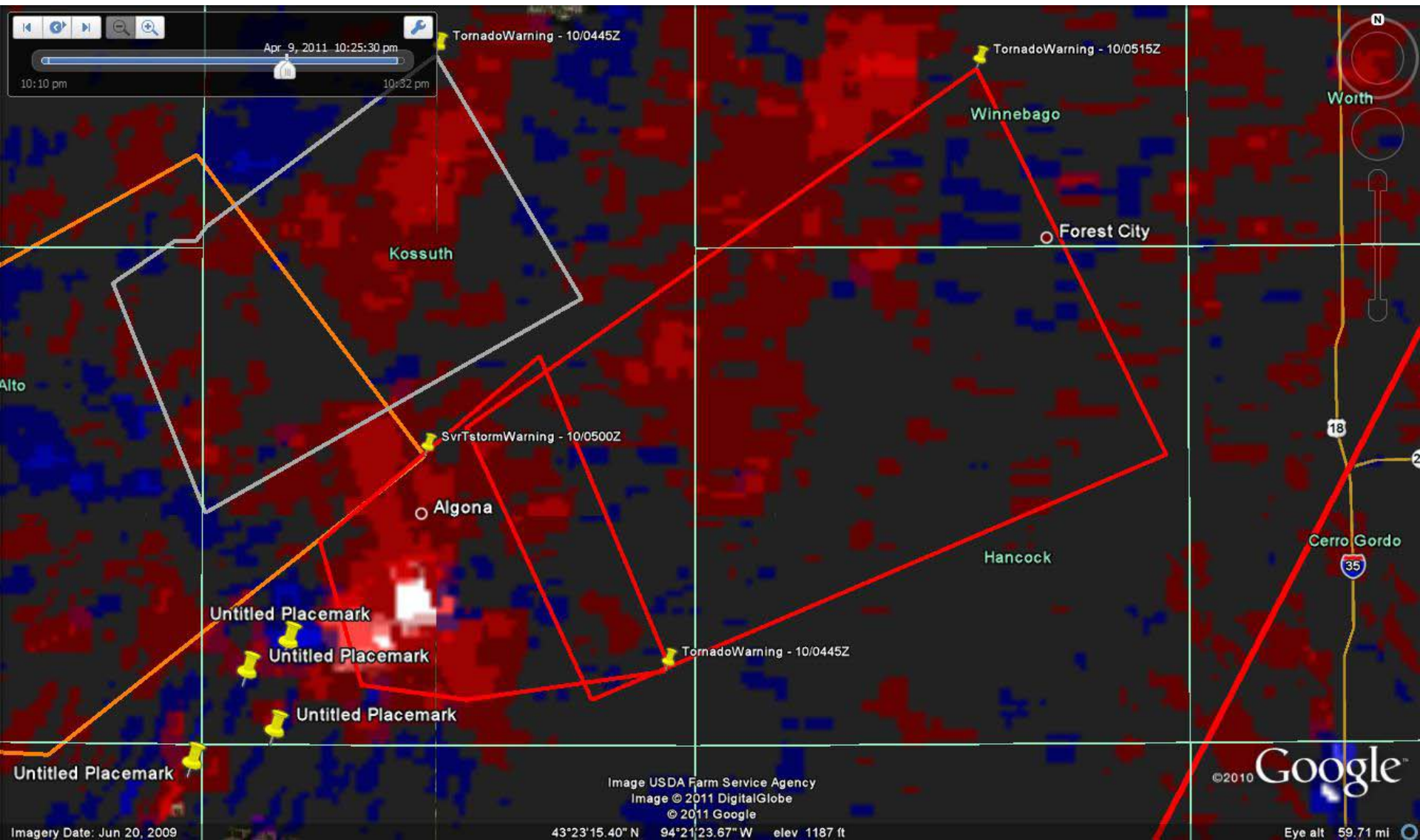


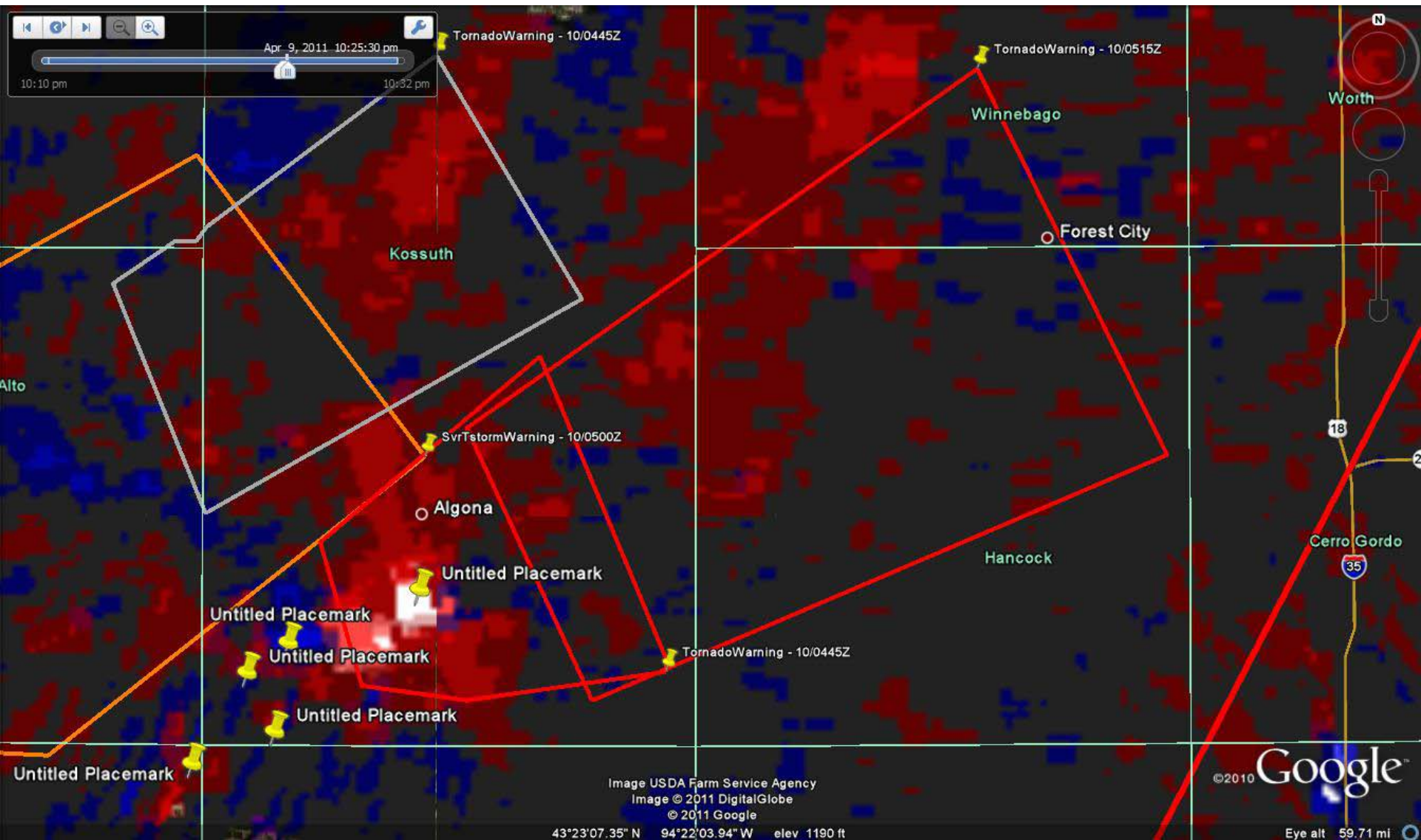


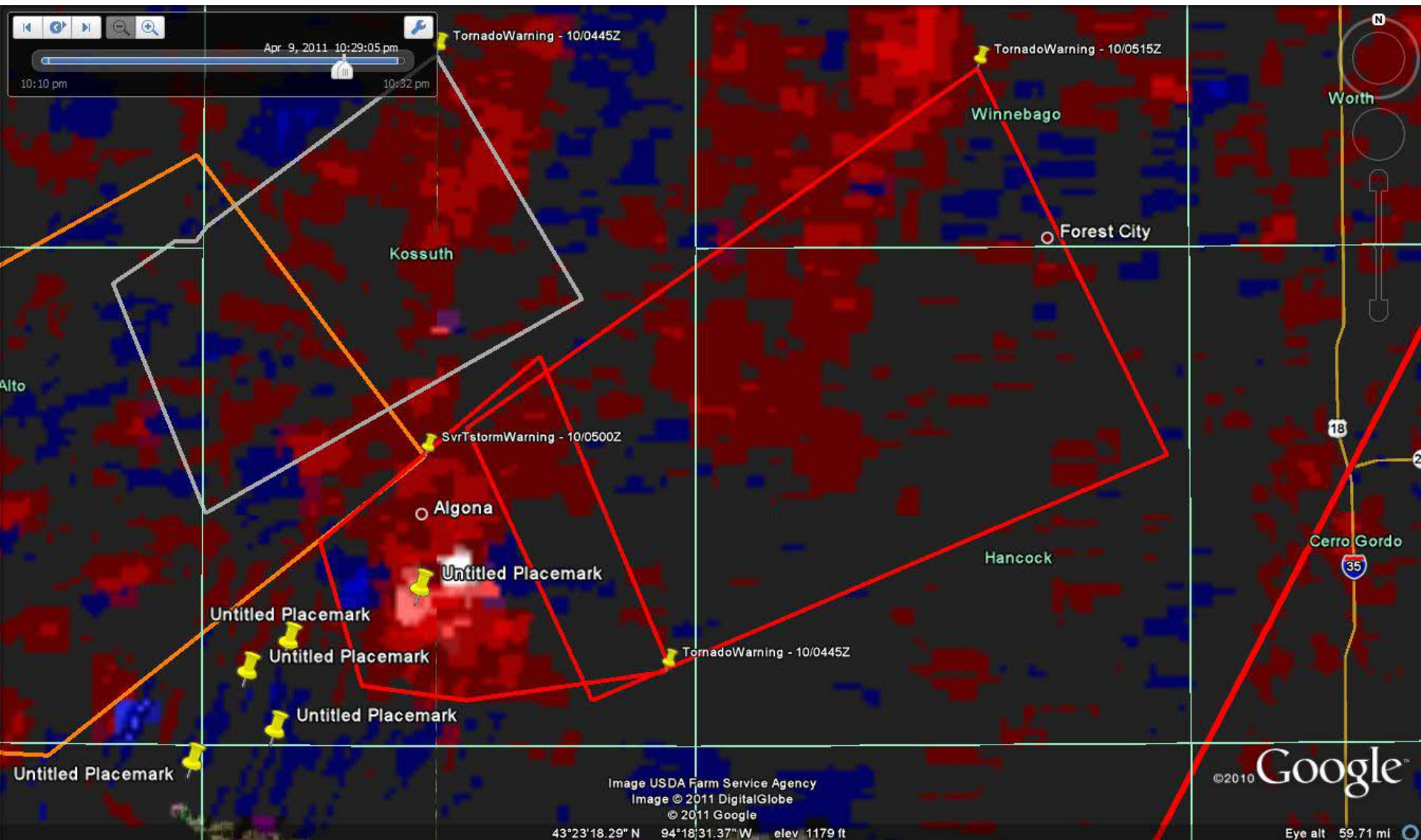


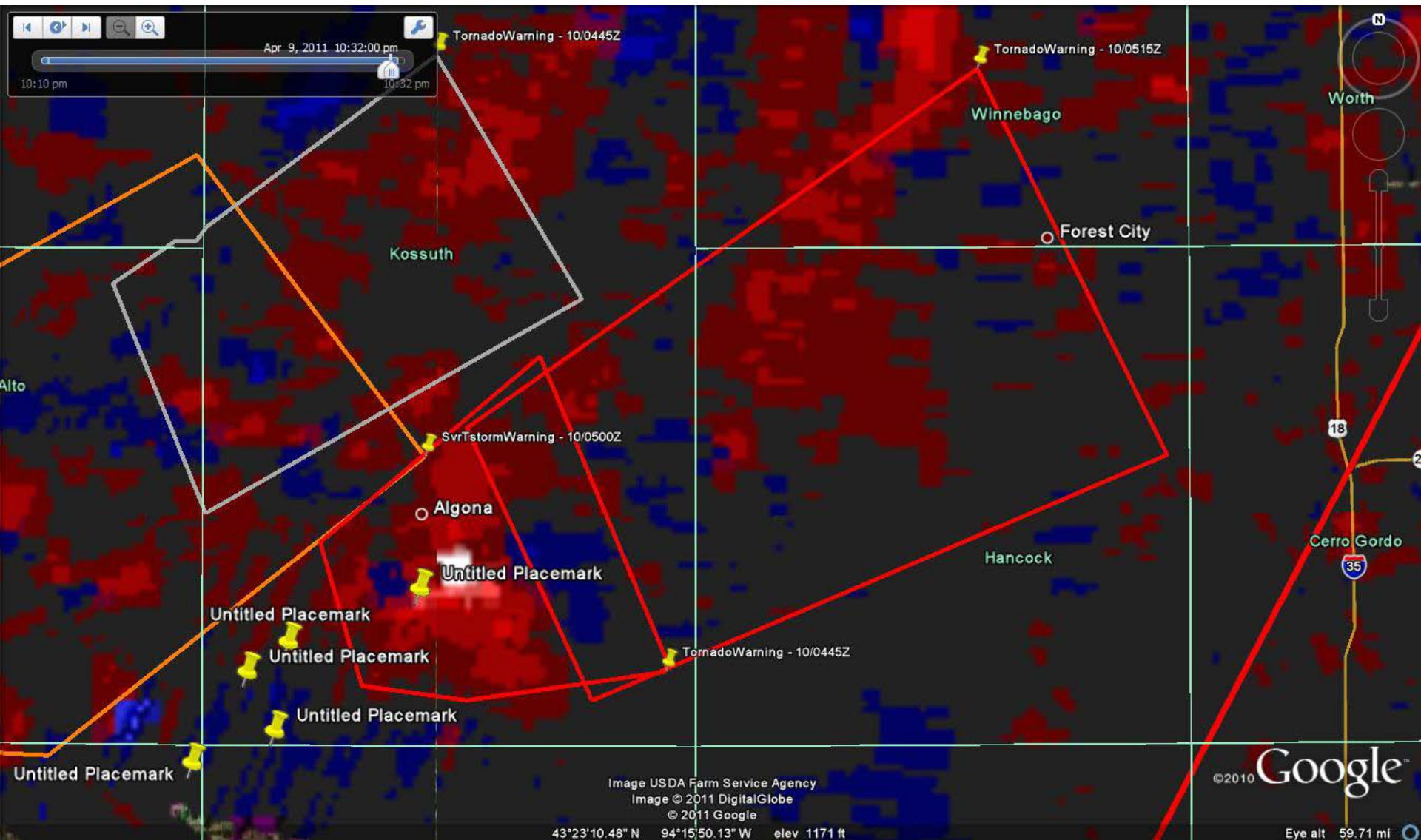


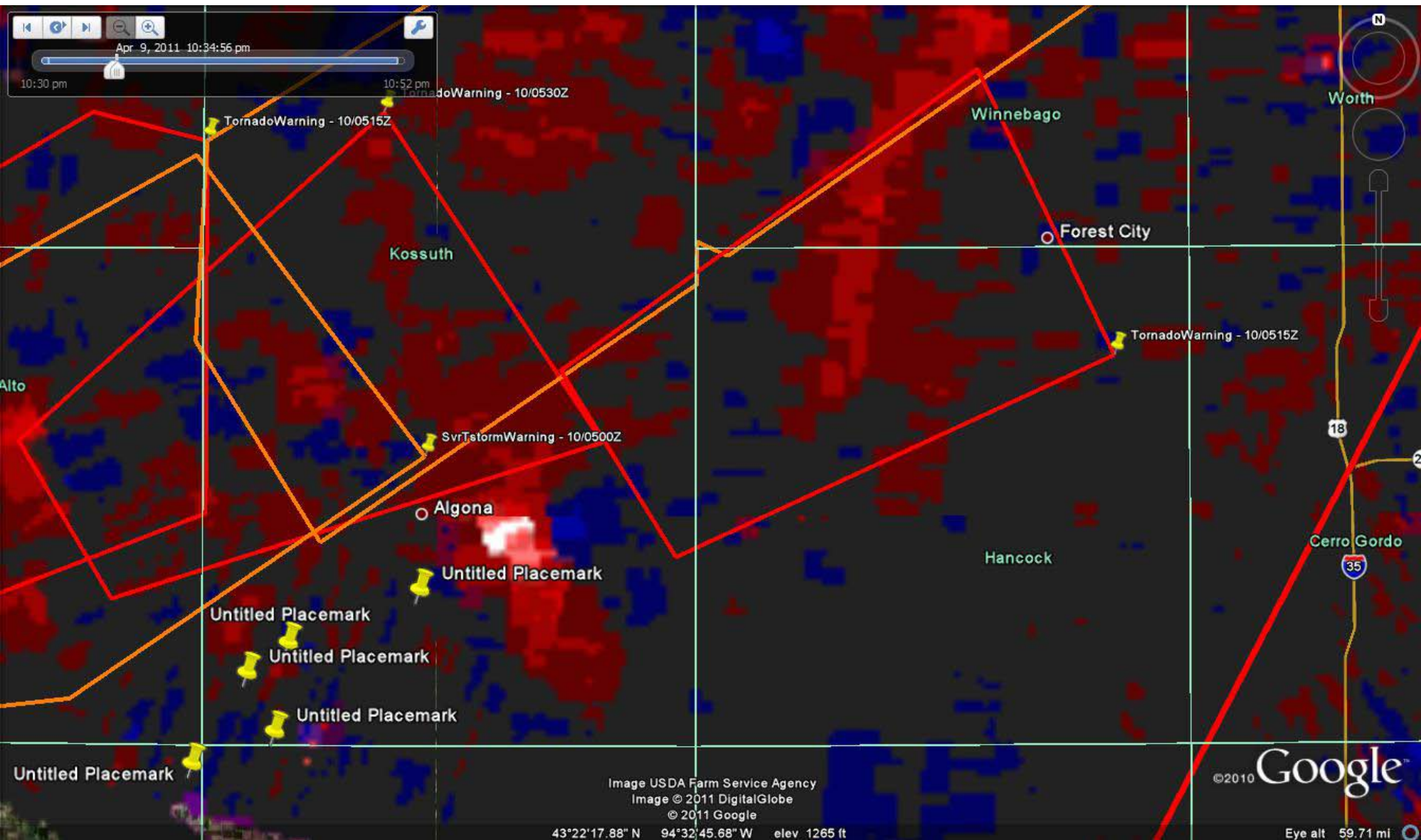


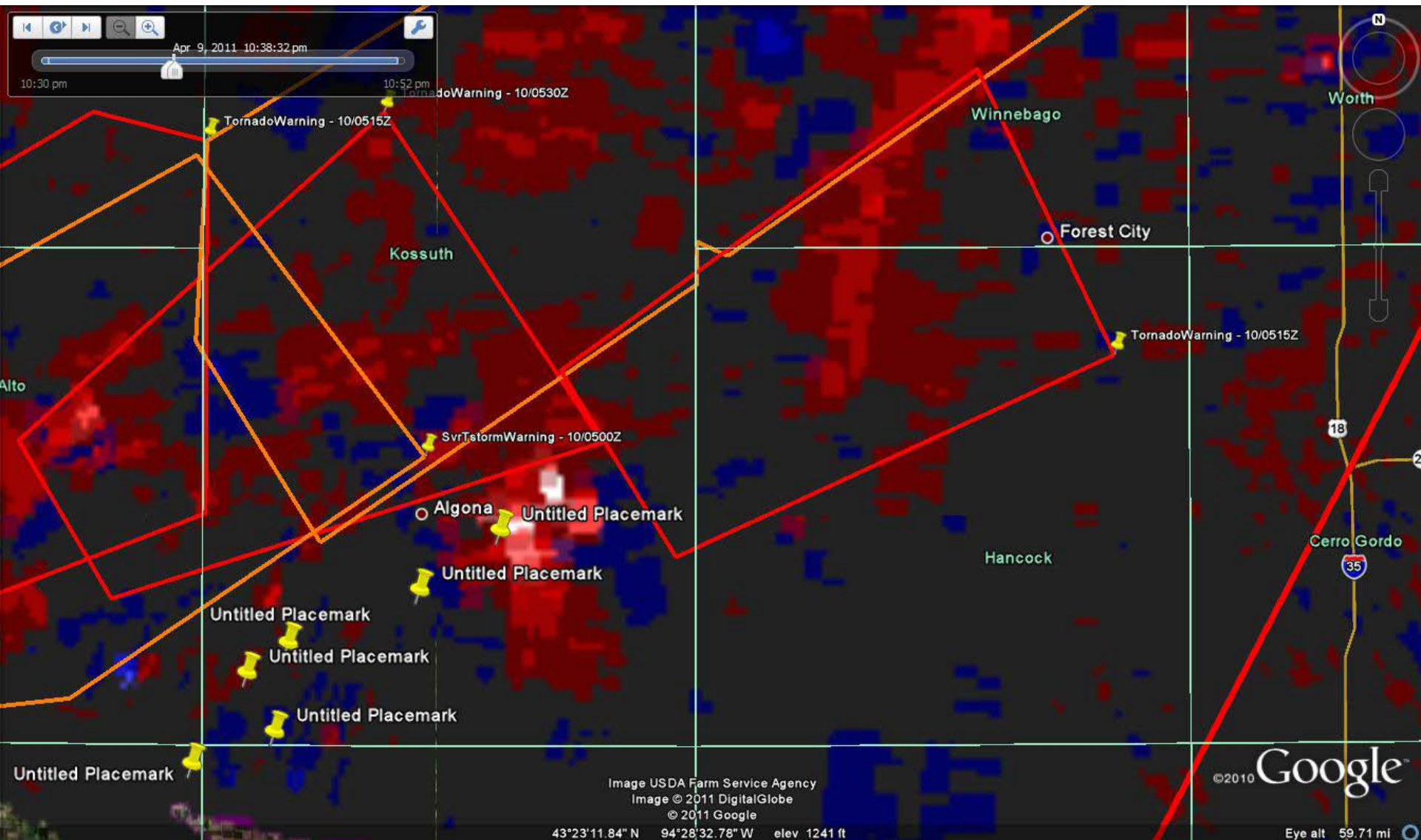


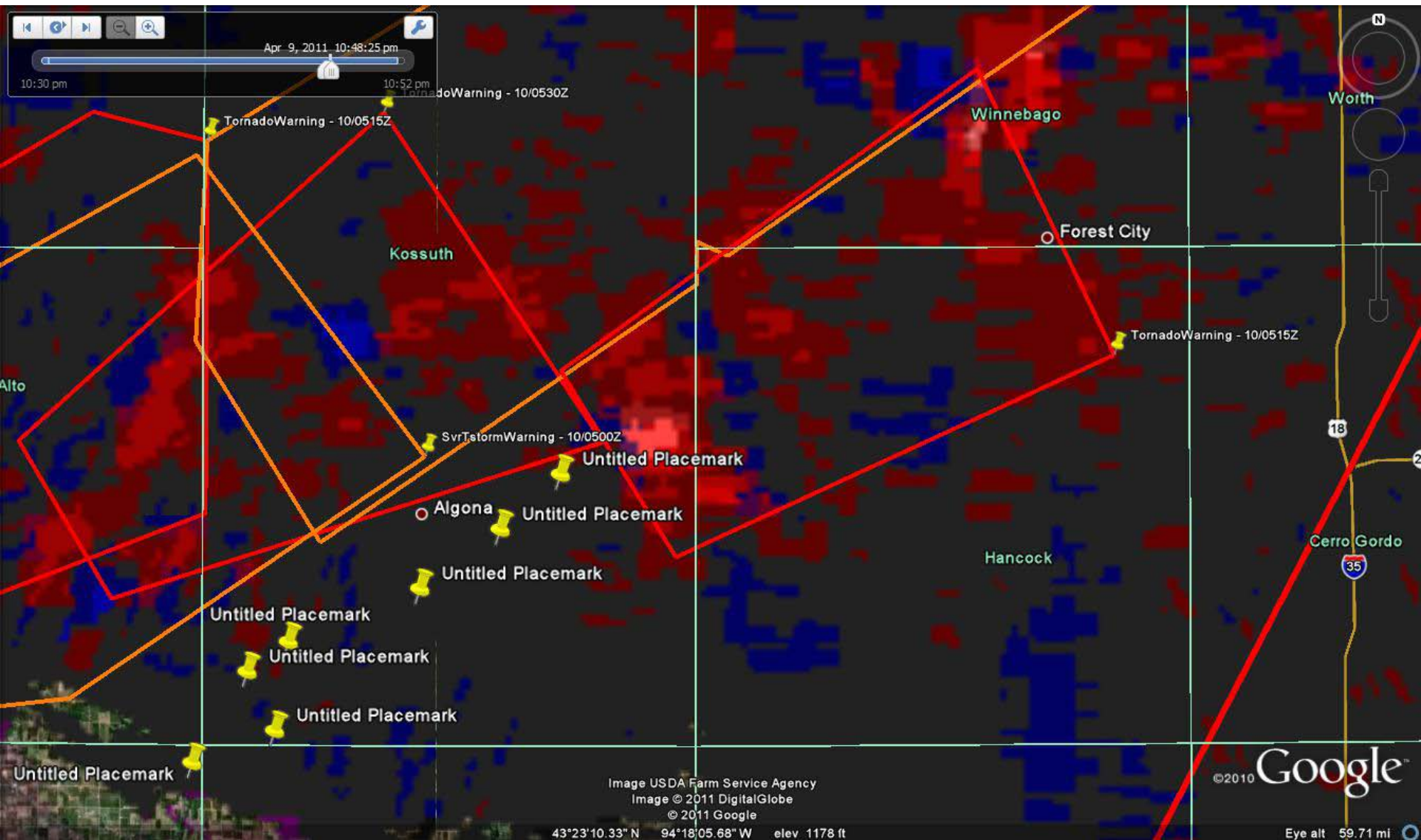


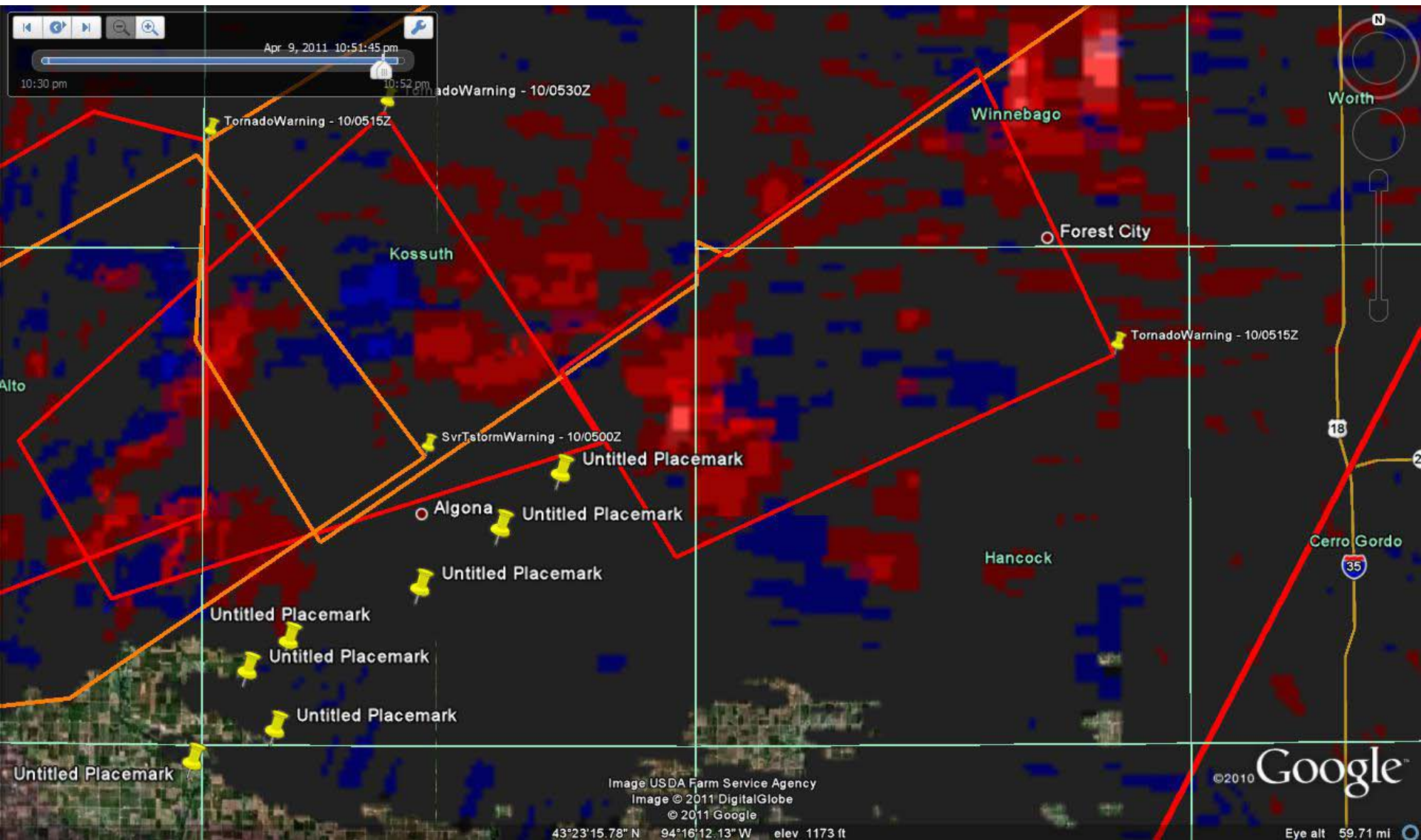


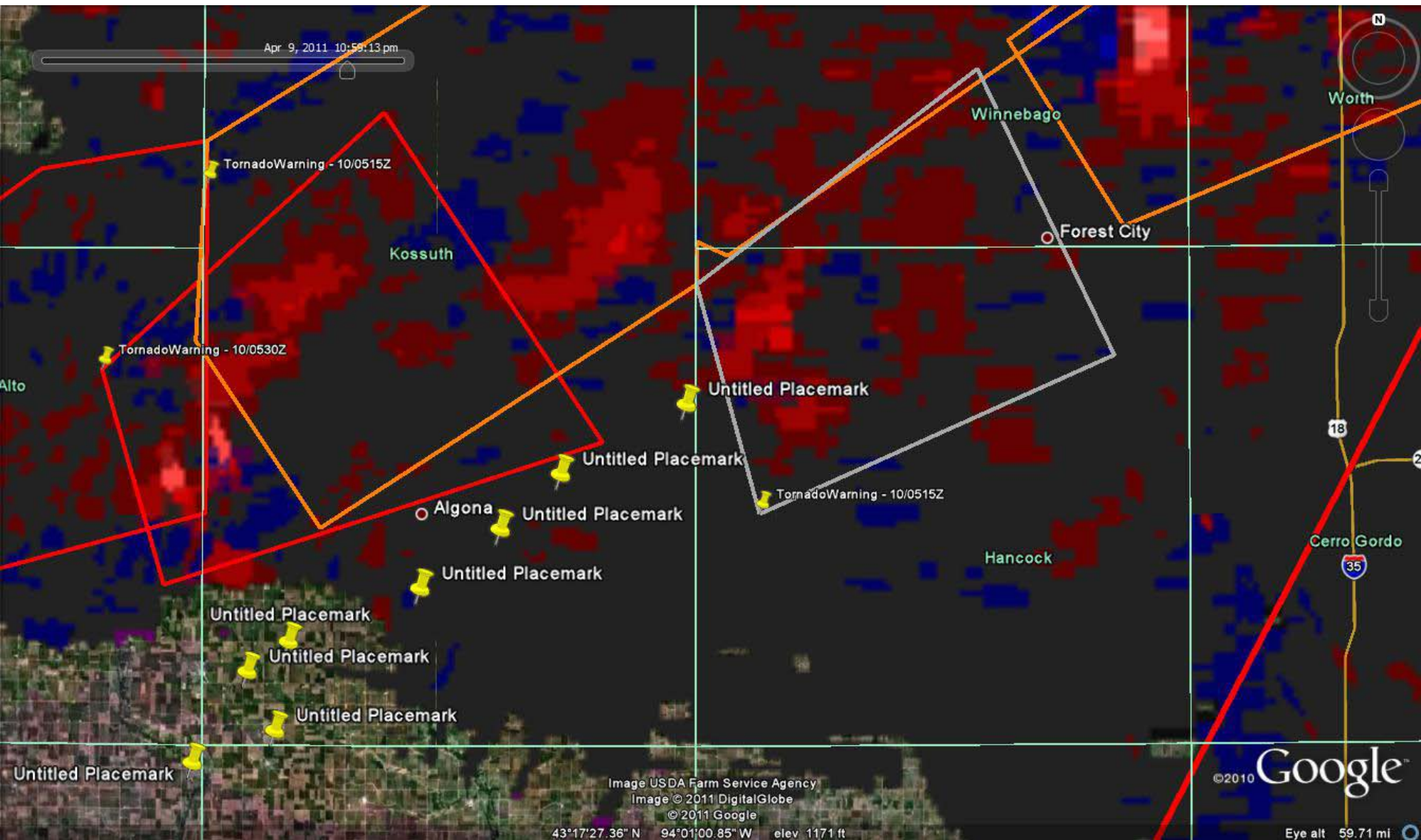






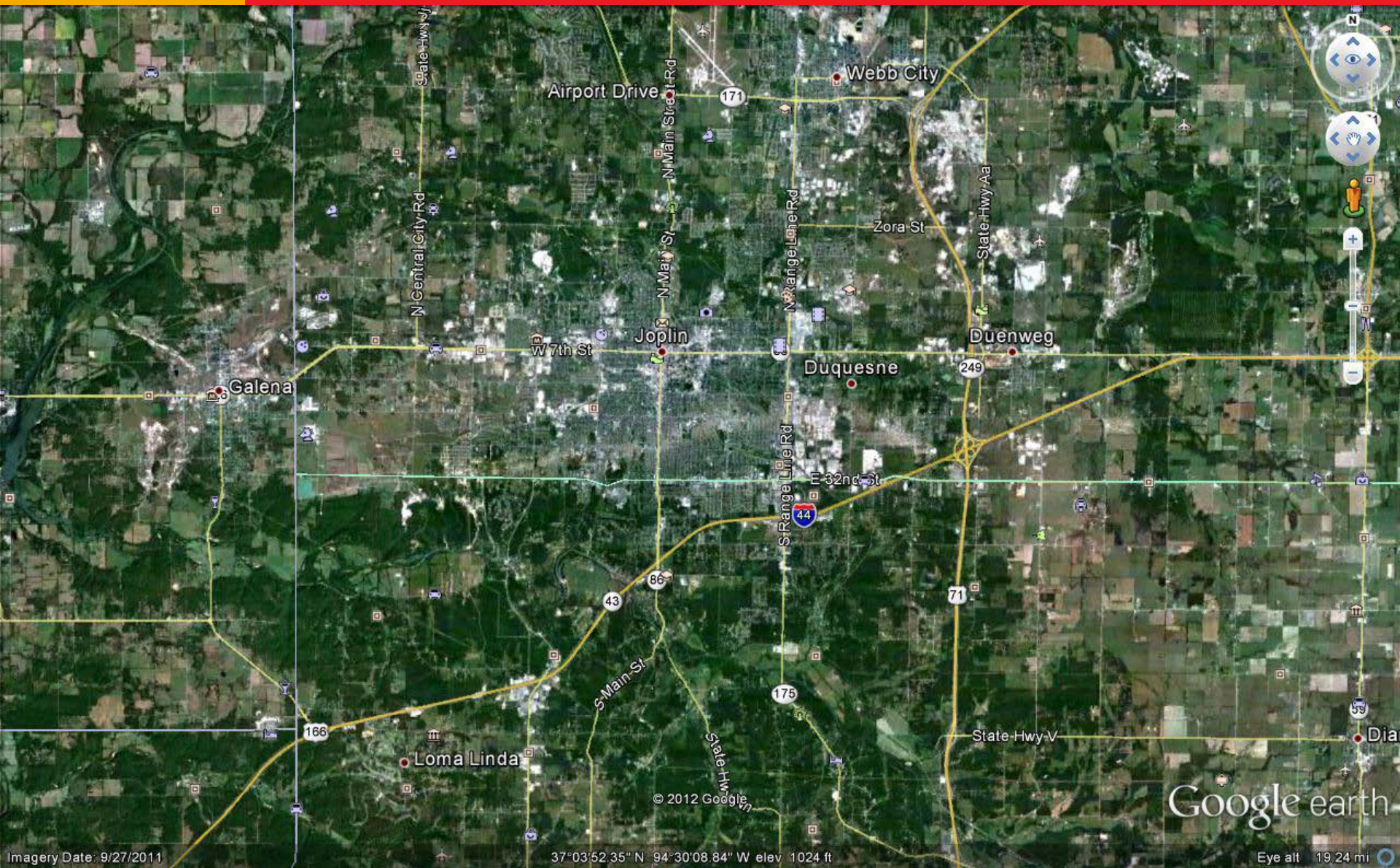






Tracking Tornadoes In Real Time...

JOPLIN MO.



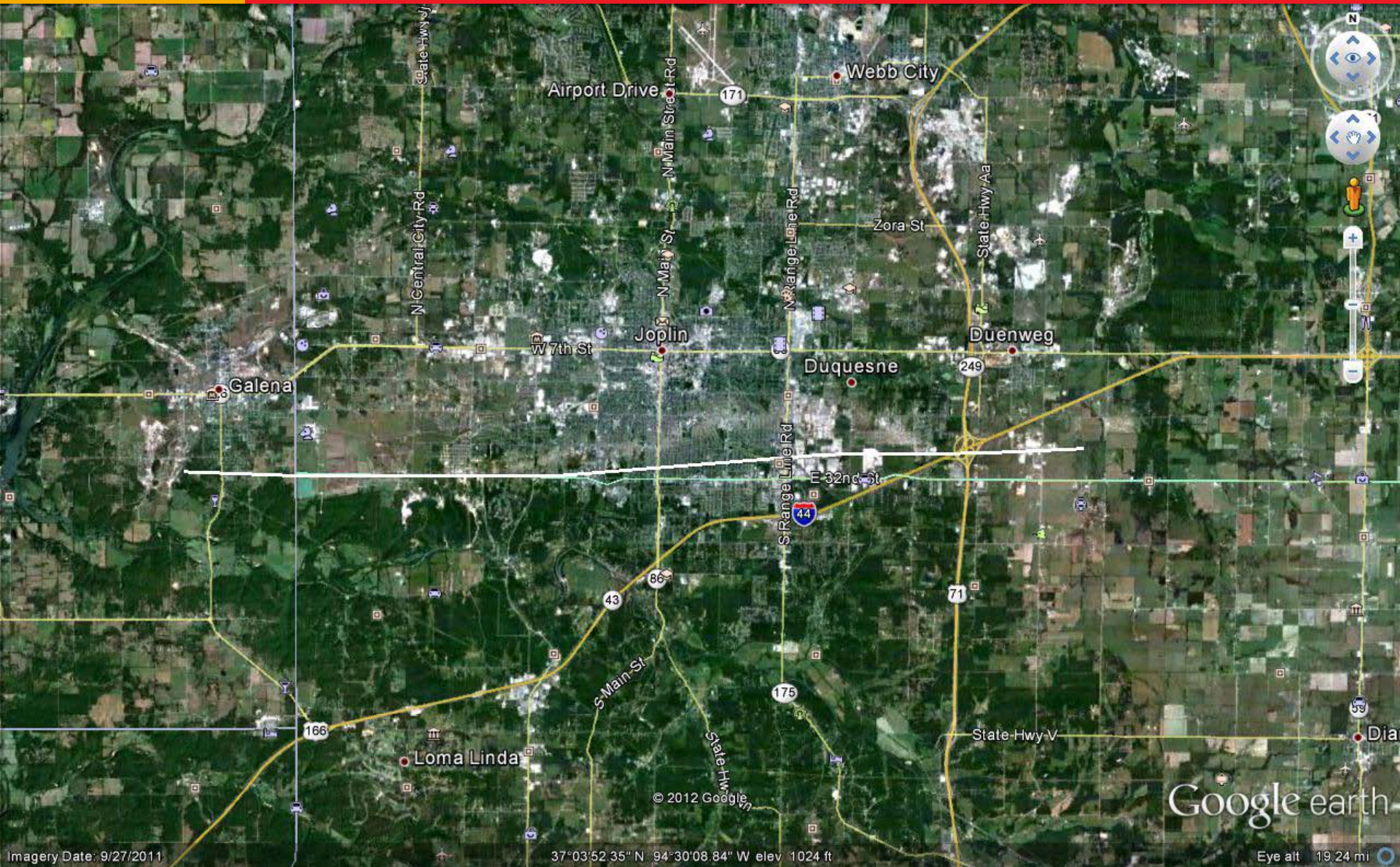
Imagery Date: 9/27/2011

37°03'52.35" N 94°30'08.84" W elev 1024 ft

Google earth

Eye alt 19.24 mi





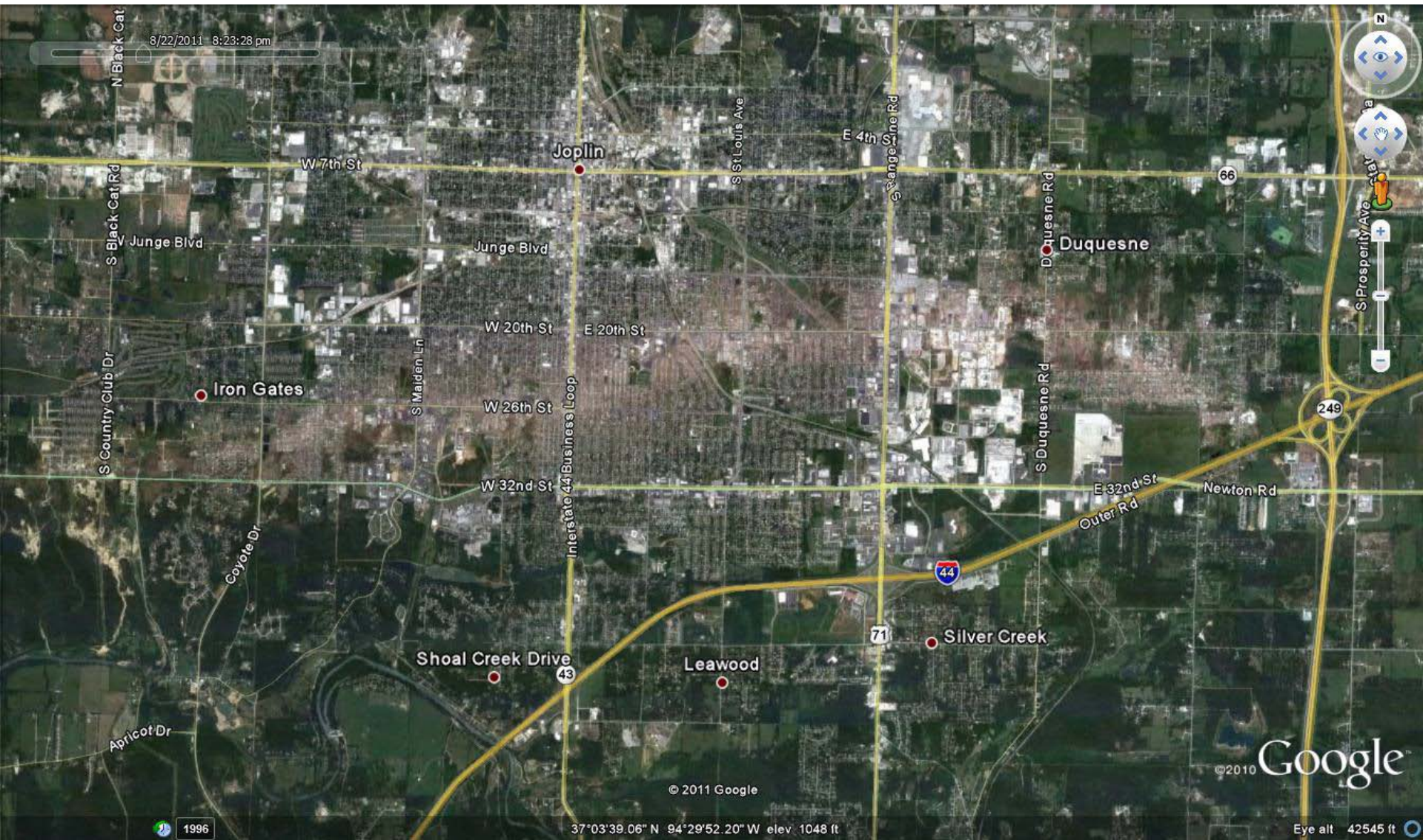
Imagery Date: 9/27/2011

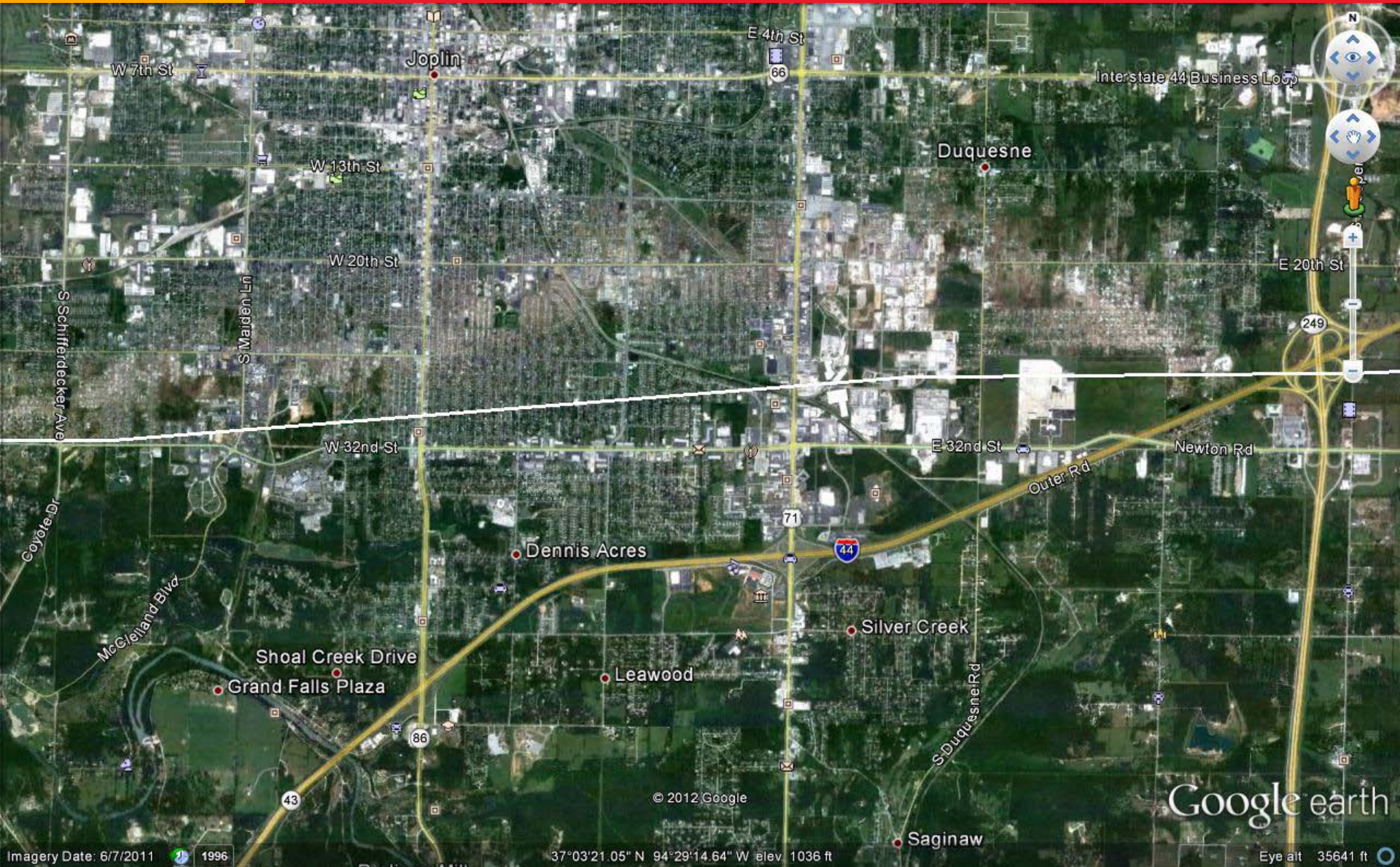
37°03'52.35" N 94°30'08.84" W elev. 1024 ft

Google earth

Eye alt 19.24 mi







Imagery Date: 6/7/2011 1996

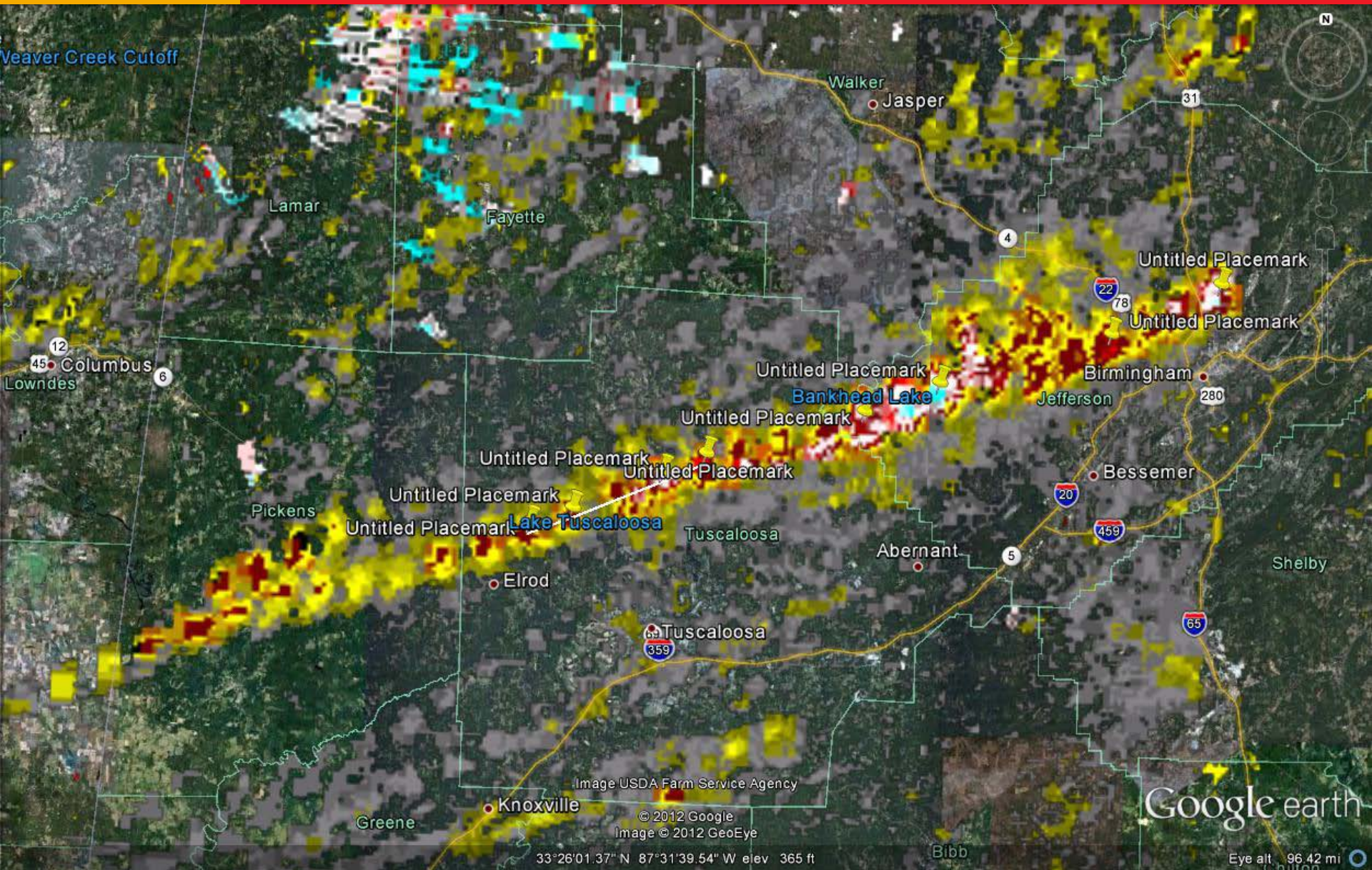
© 2012 Google
37°03'21.05" N 94°29'14.64" W elev. 1036 ft

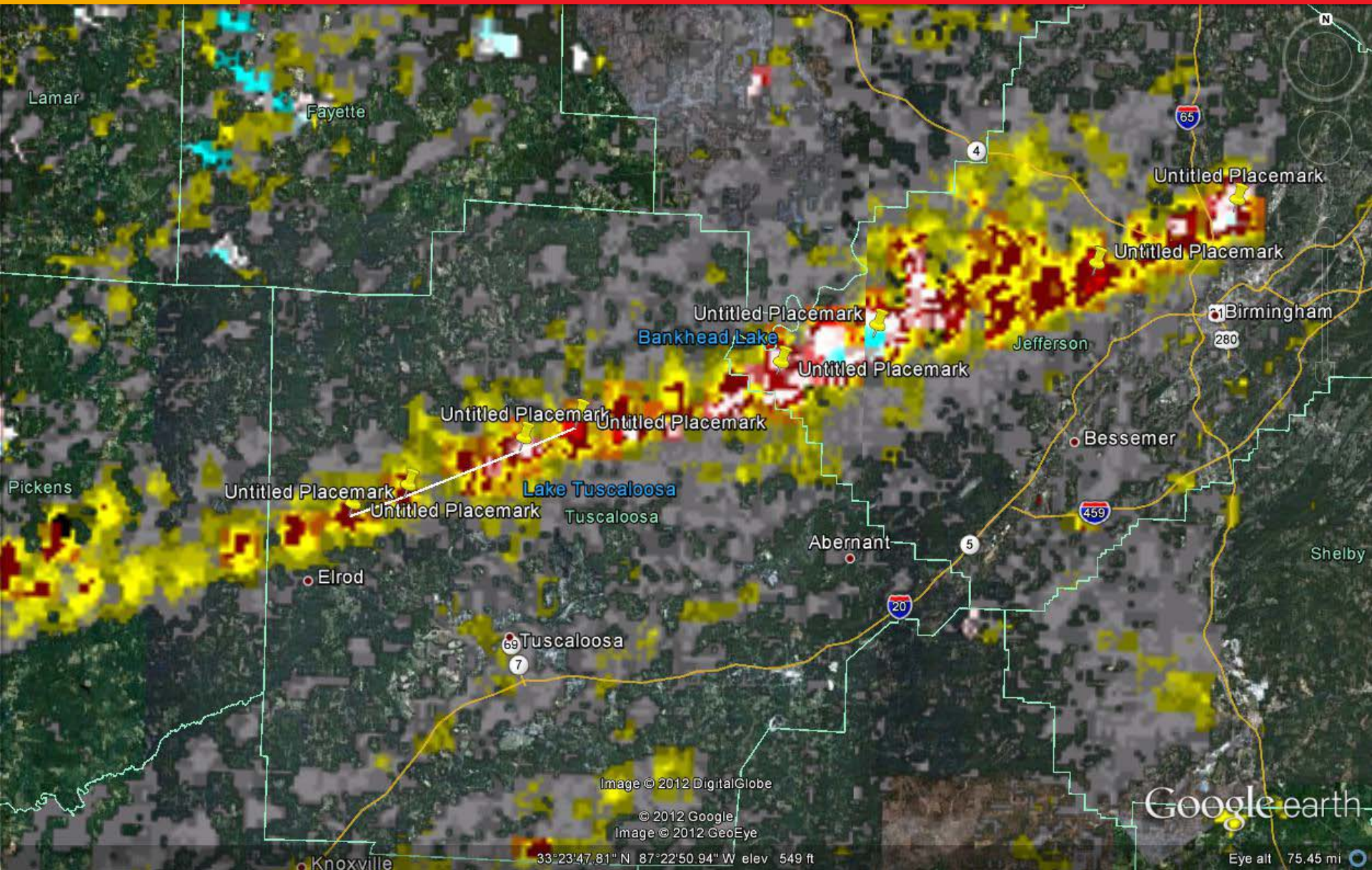
Google earth

Eye alt 35641 ft



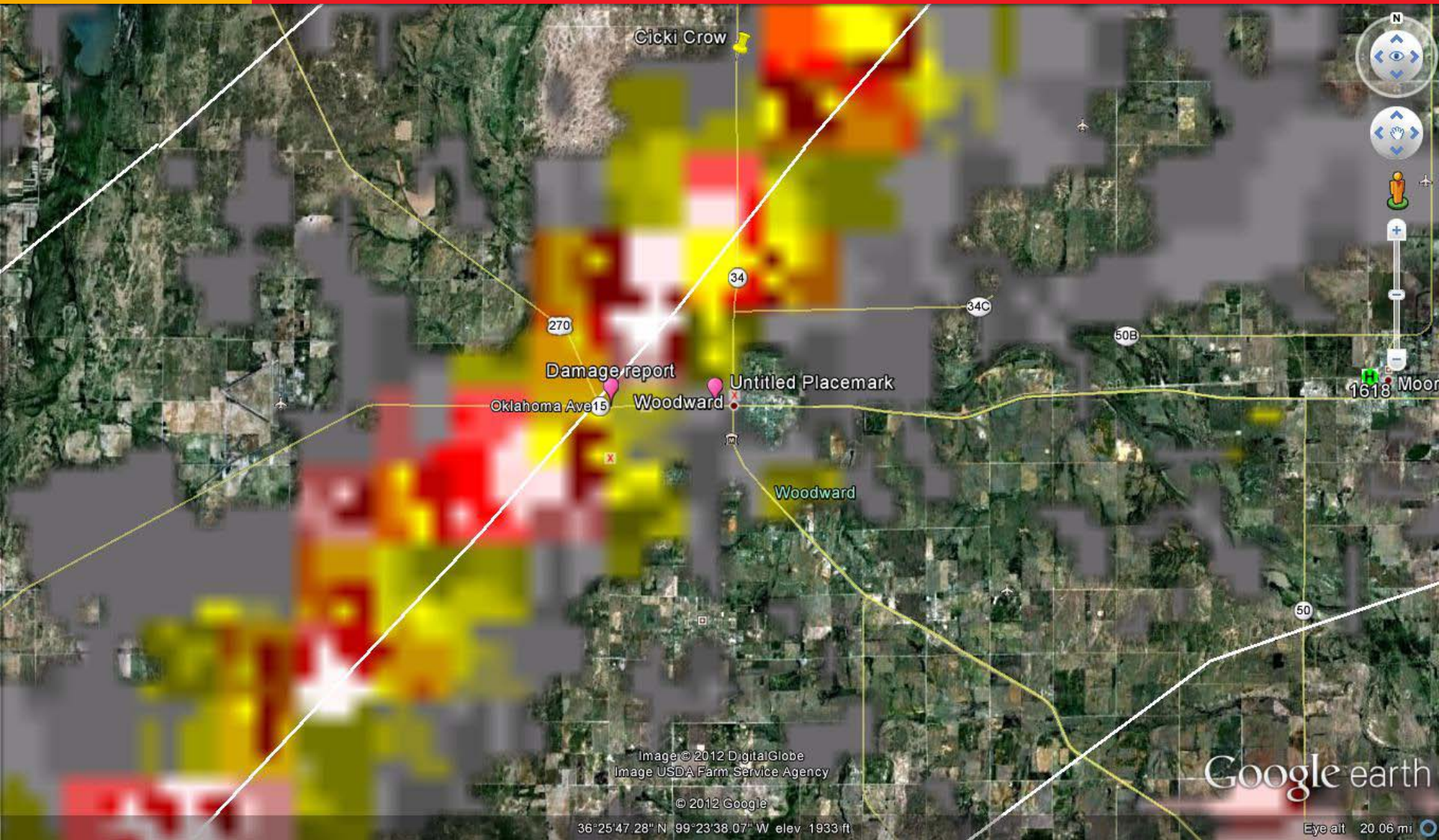
Birmingham Alabama

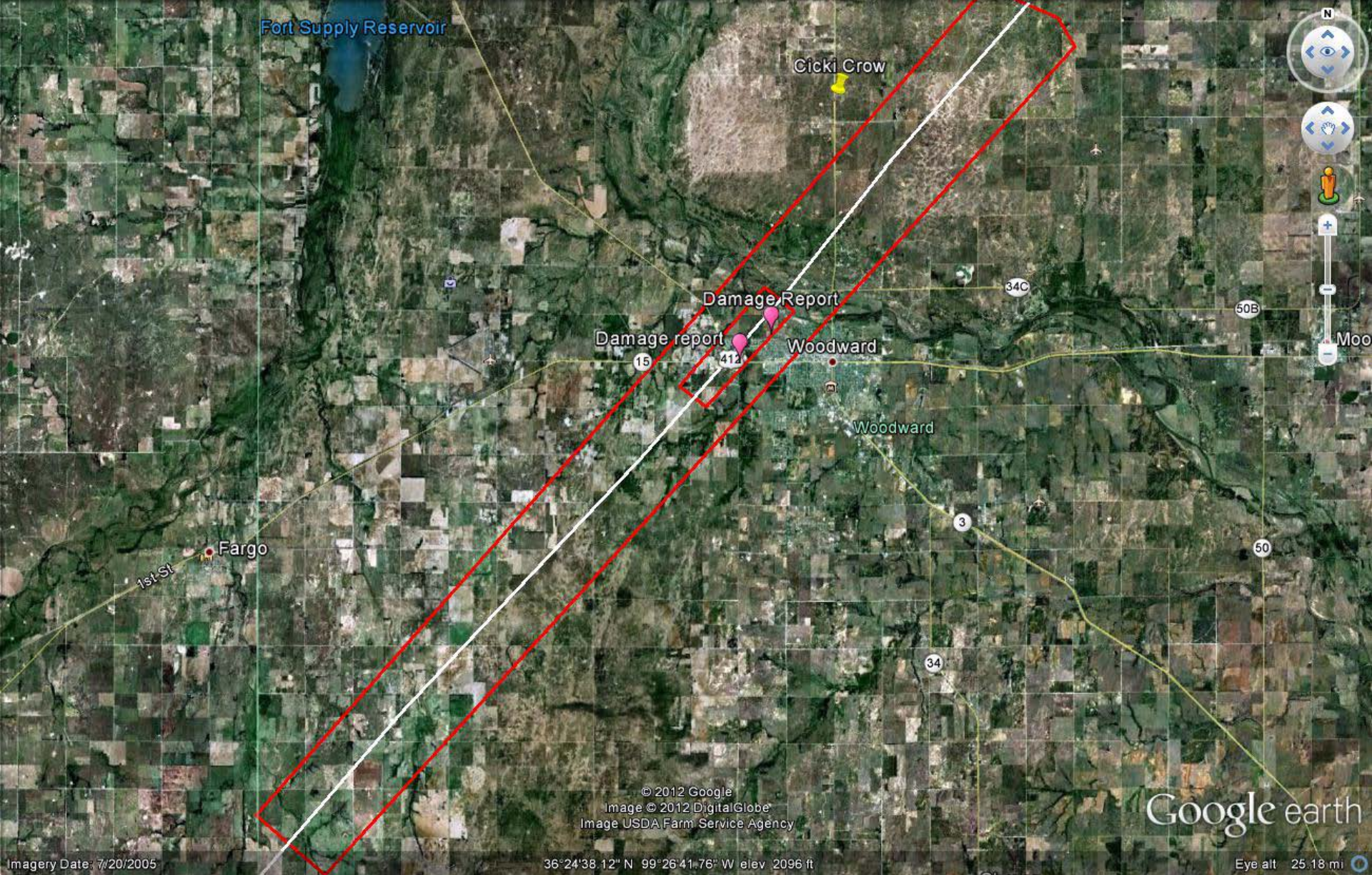




Tracking Tornadoes In Real Time...

**Woodward, OK.
The PDA Process**





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Image © 2012 DigitalGlobe
Image USDA Farm Service Agency

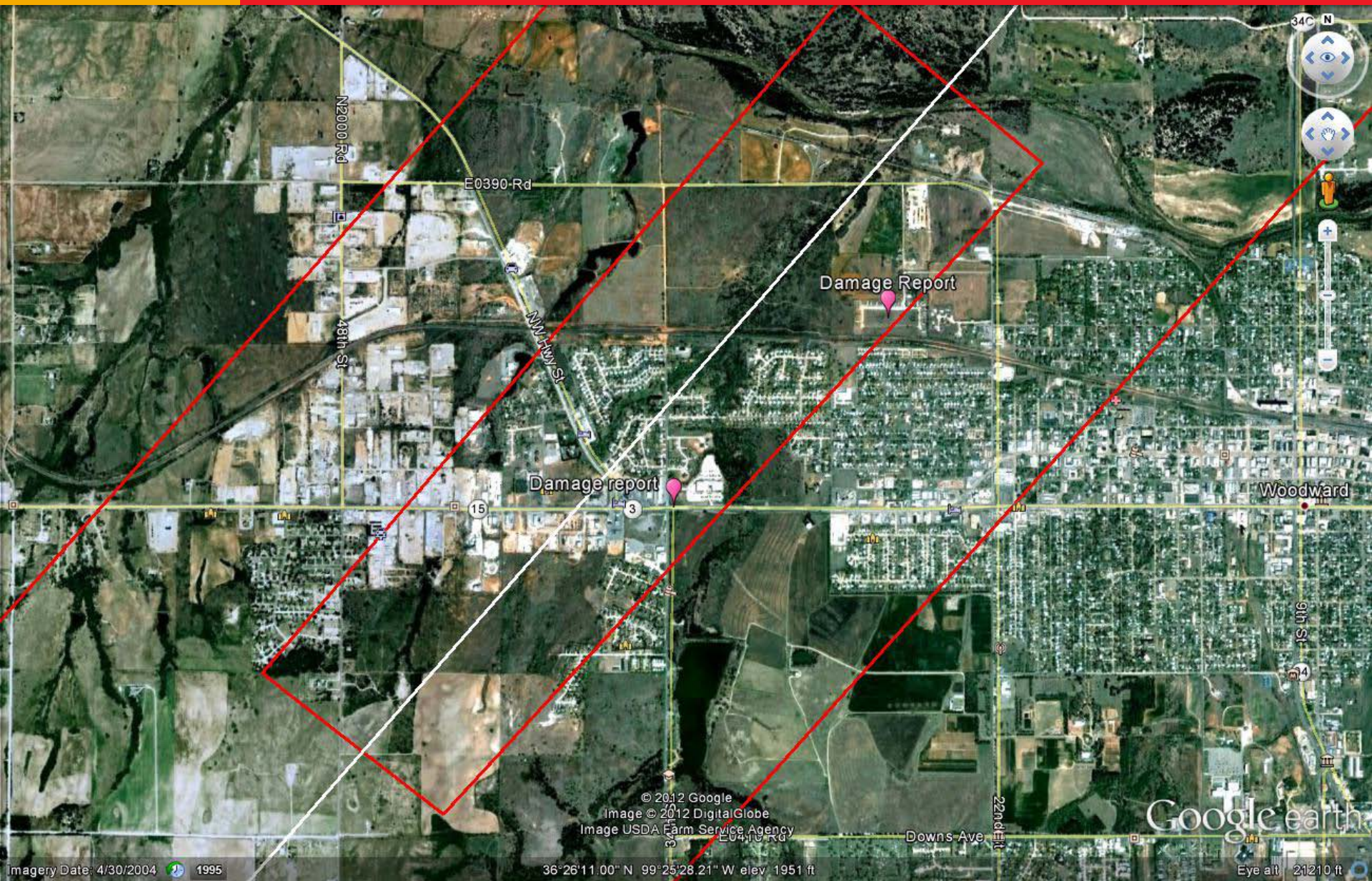
Google earth

Imagery Date: 7/20/2005

36°24'38.12" N 99°26'41.76" W elev. 2096 ft

Eye alt 25.18 mi





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Image © 2012 DigitalGlobe
Image USDA Farm Service Agency
E0410 Rd

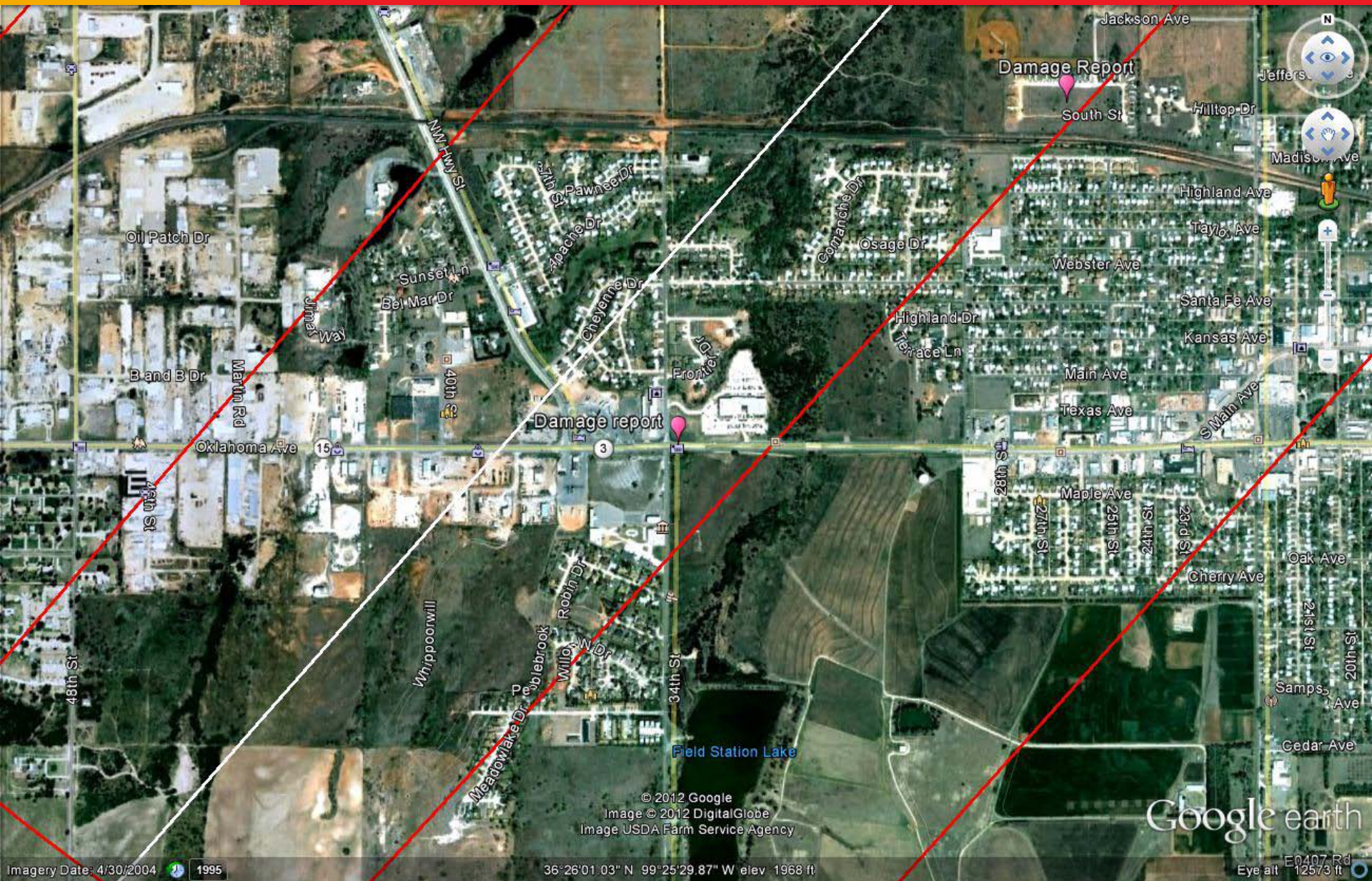
Google earth

Imagery Date: 4/30/2004 1995

36°26'11.00" N 99°25'28.21" W elev. 1951 ft

Eye alt: 21210 ft

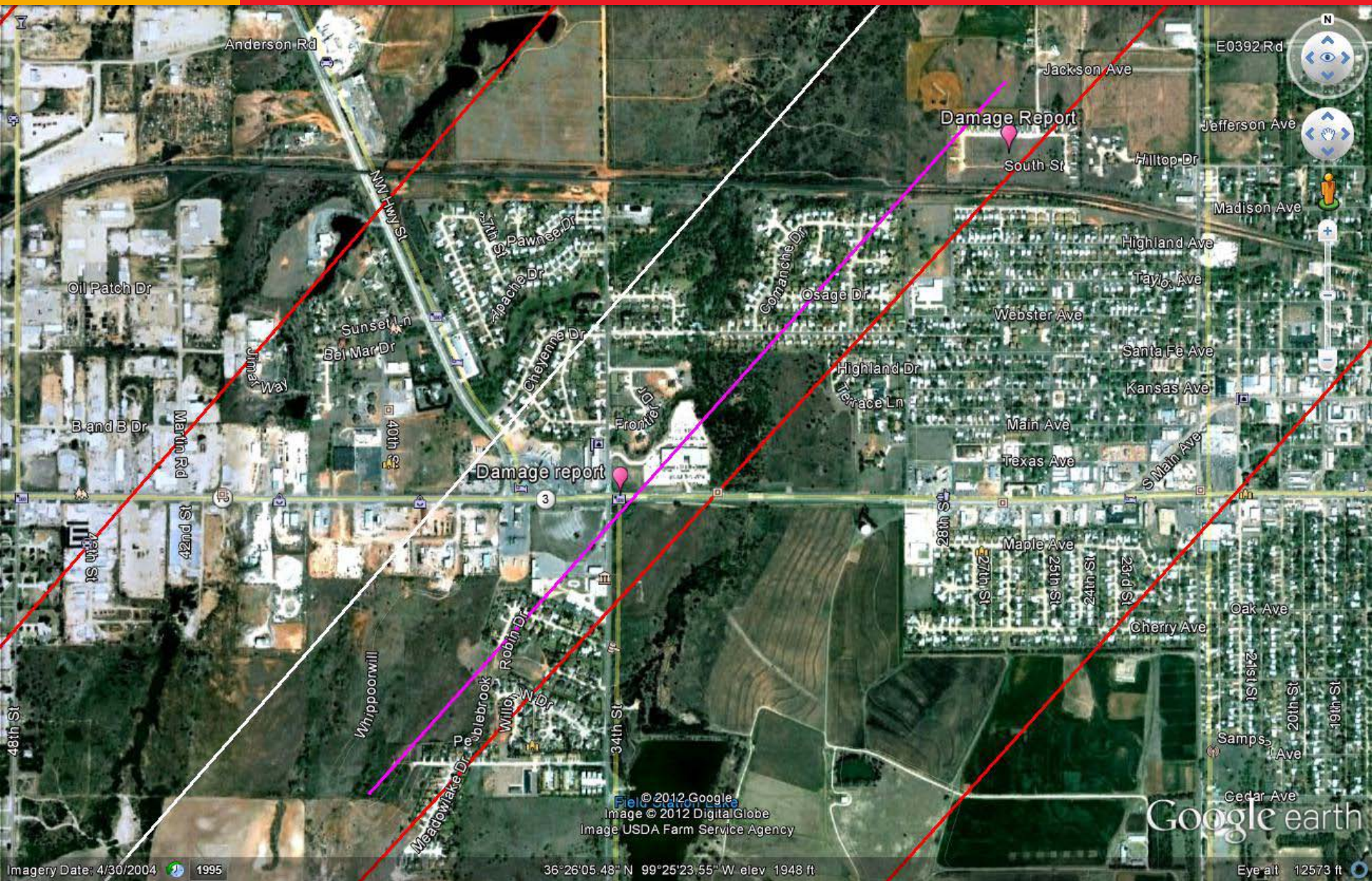


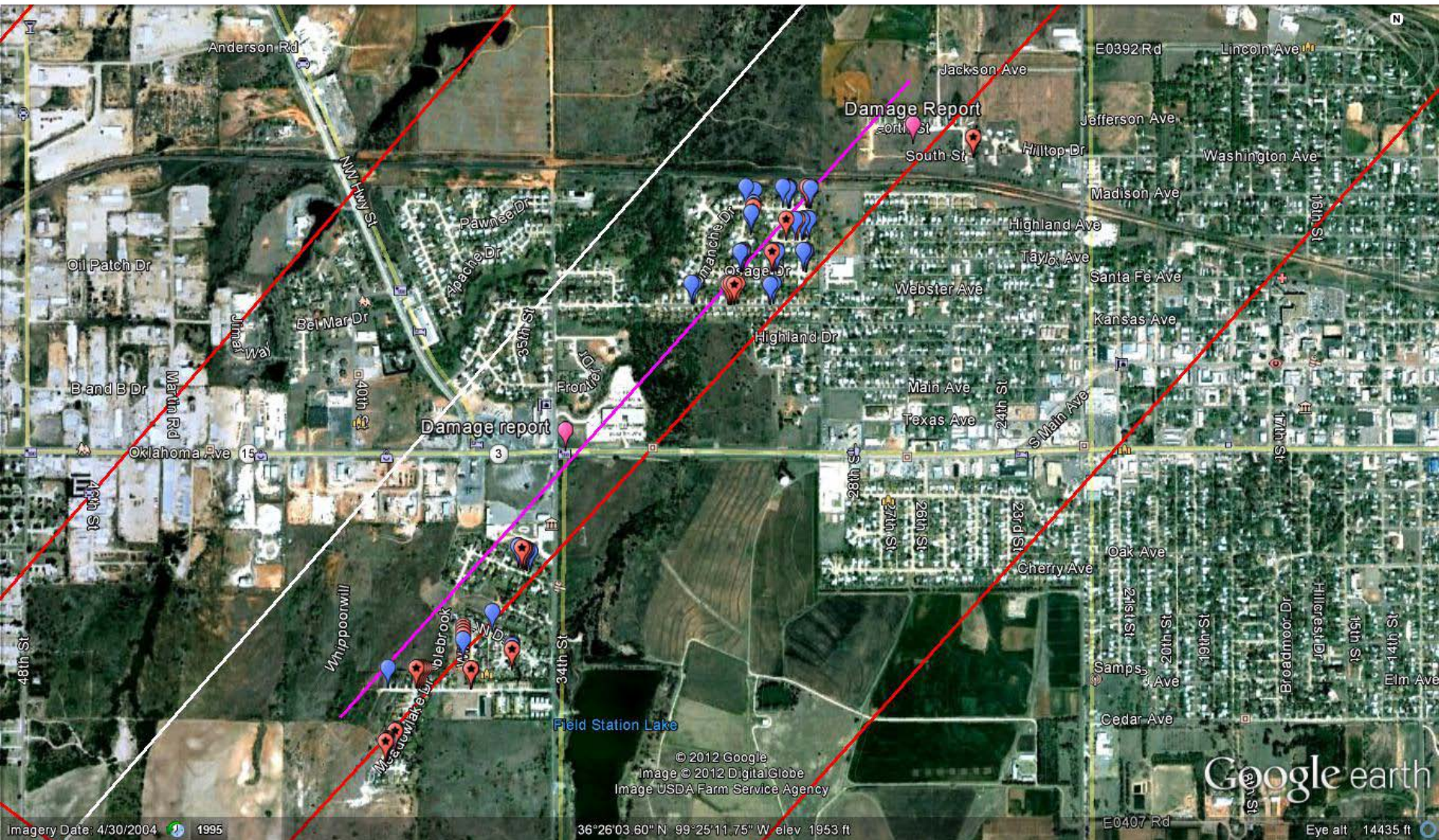


Google earth

Eye alt 12573 ft



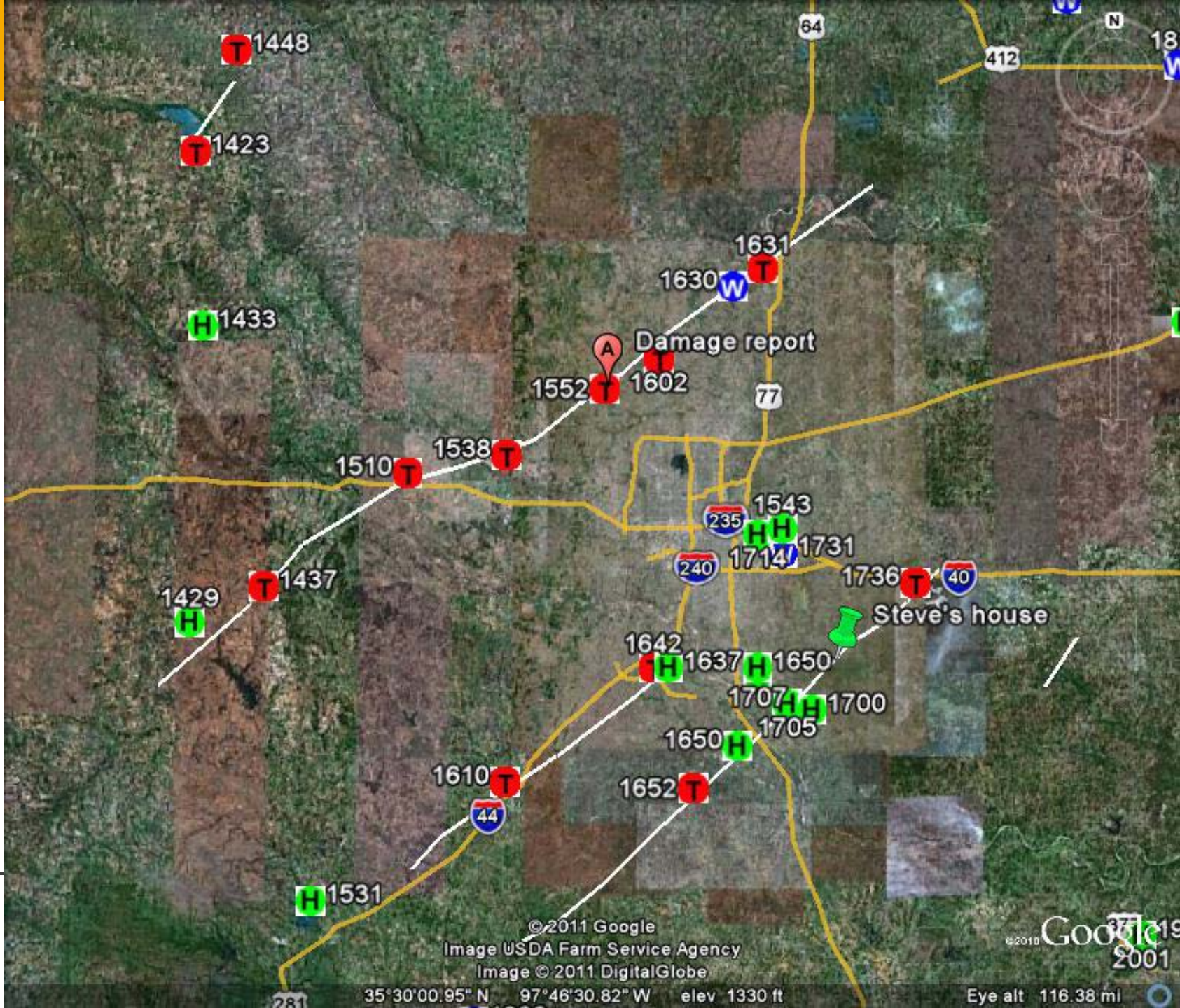




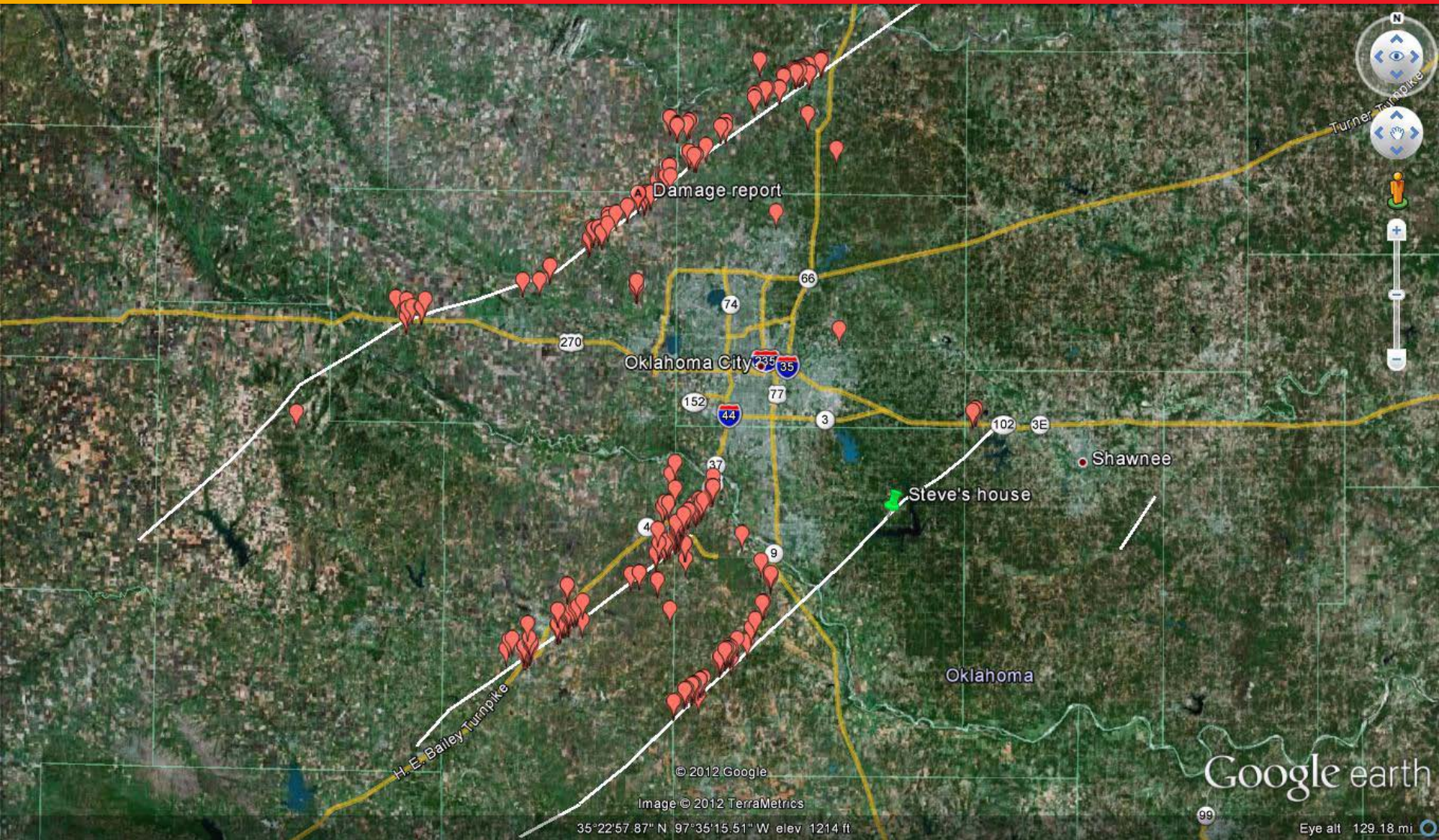
More Tornadoes...

May 24, 2011

**Piedmont, Norman, and
Tuttle OK**



can
ross



Errors with WDSS-II (Radar)...

- **Curvature of the Earth.**
- **Distance from the radar.**
- **Available beam strength.**
- **Tilt of the storm.**
- **Speed of the storm.**
- **Interference.**

Tracking Hurricanes In Real Time...

ISAAC

Comes Onshore!

Questions?

Thank you for attending!

Steve Klapp

Disaster Assessment Manager

American Red Cross of Central and Western Oklahoma

Steve.Klapp@Redcross.org

WWW.WDSSII.ORG