Plan, Build, and Protect Remotely Mapping Geology

with Naturally Sourced Electromagnetic Analysis (NSEM)

by Dynamic Measurement LLC for

Mississippi River Commission Presentation

by

Kathy Haggar

27 March 2015

Presentation Topic Areas

1. NSEM - A new technology to identify geologic hazards
   - Questions & Answers & Discussion
2. The meteorology behind lightning databases
   - Questions & Answers & Discussion
3. Examples of using lightning databases to map geology
   - Questions & Answers & Discussion
4. Goose Point – tectonic driven subsidence lightning case history
   - Questions & Answers & Discussion

DML will help the nation's engineers!

See Lightning Think
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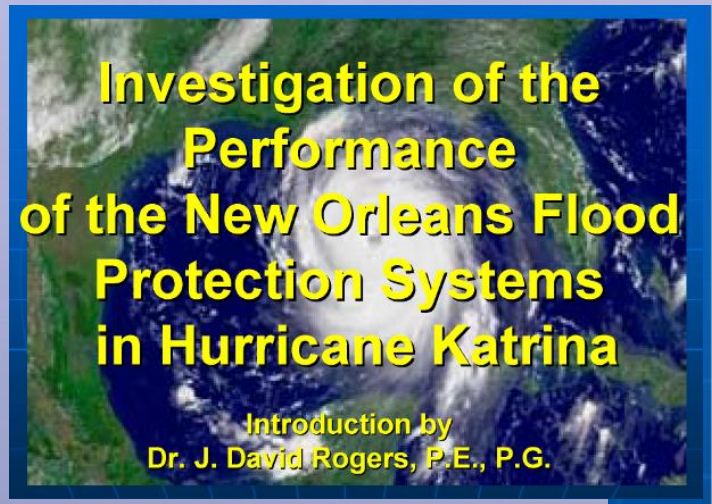
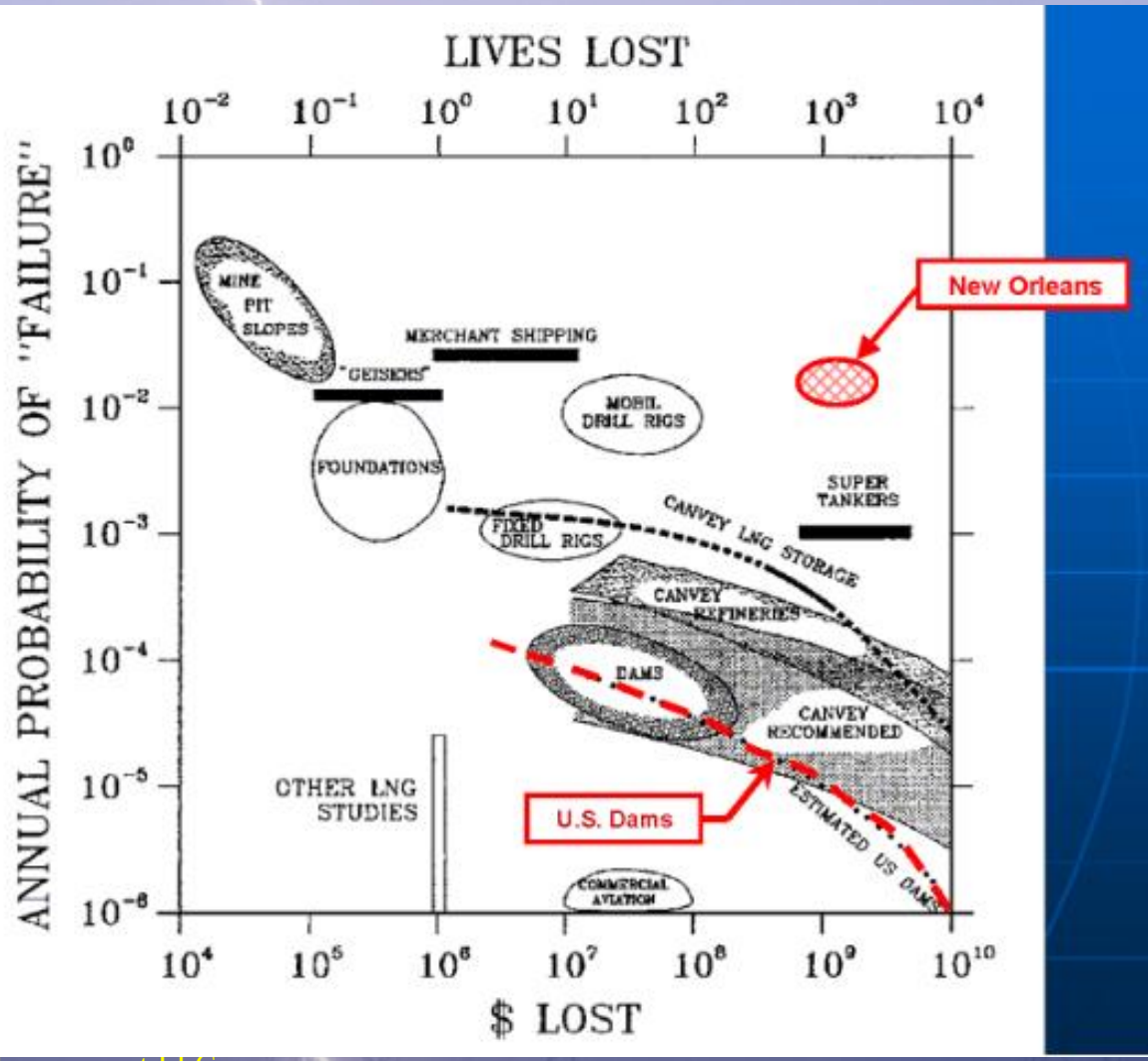


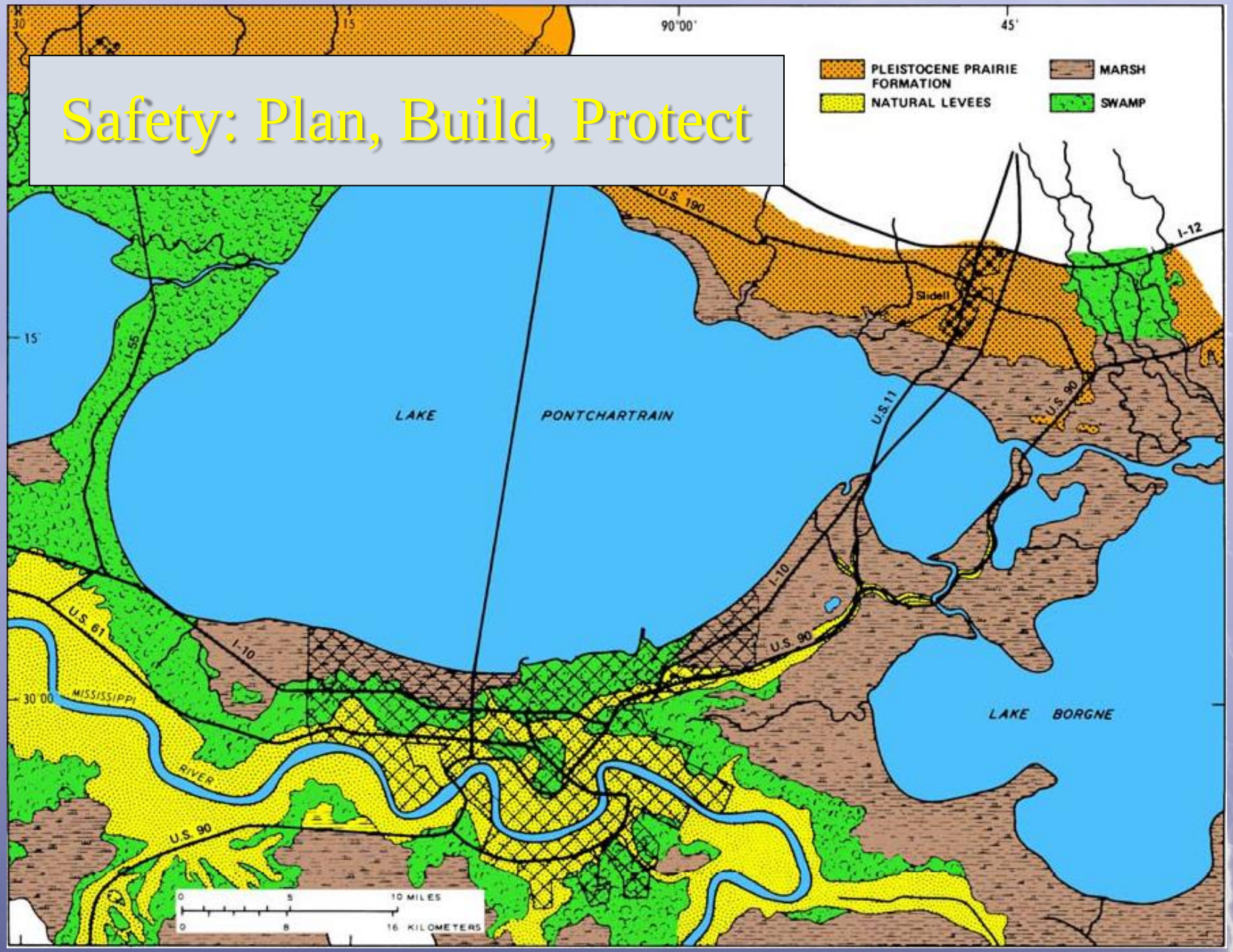
"... individual projects are at high risk."

Lt. Gen. Thomas Bostick,
commander of the U.S.A.C.E.

10 Dec 2015



Safety: Plan, Build, Protect

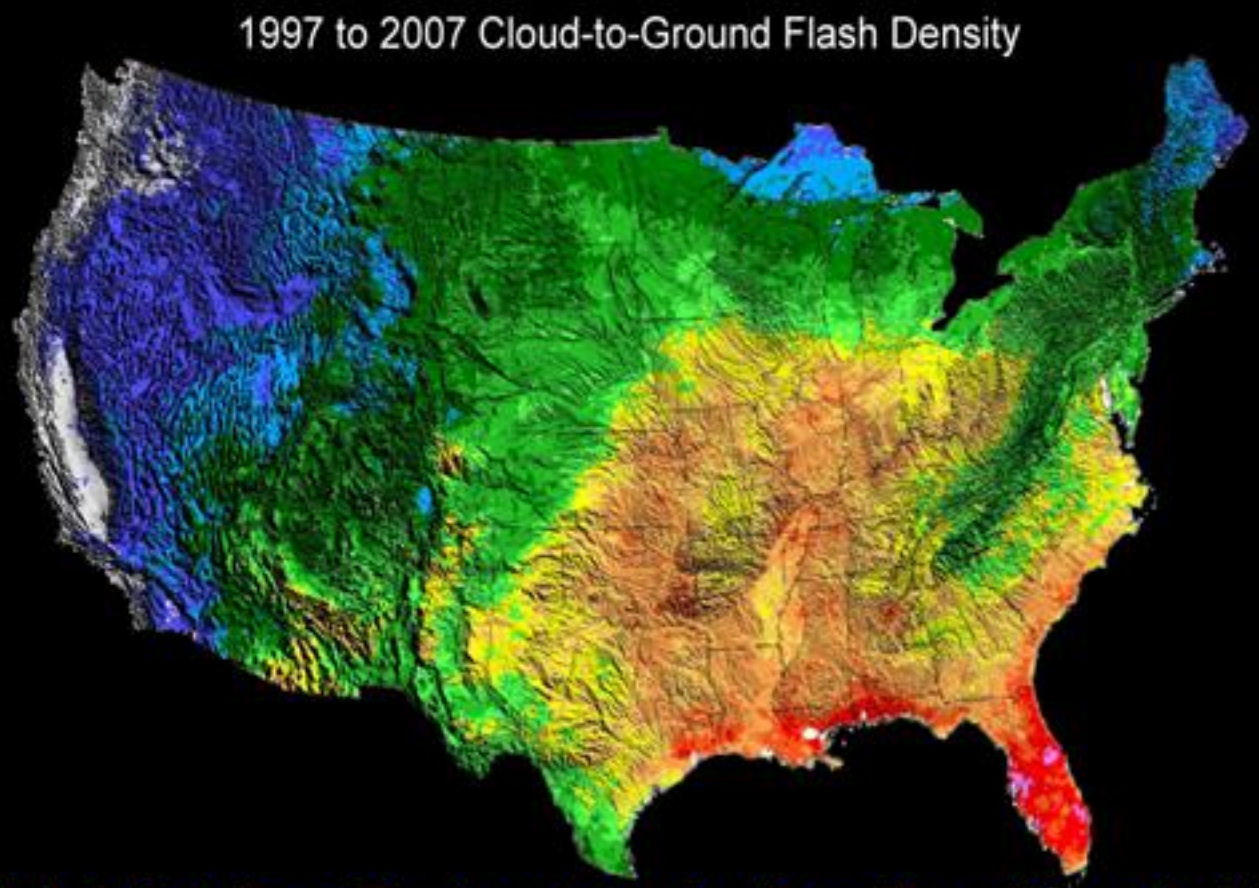


- Picture shows geology and its associated sedimentary geo-hazards
- Distributary and inter-distributary linear events

Lightning Theories and Facts

- Lightning occurs everywhere.
- Cloud to cloud lightning travels up to about 150 miles (250 km).
- Cloud to ground lightning follows terralevis/shallow earth currents which reflect geology. Some strikes do hit topography, vegetation, and infrastructure, but can be edited out from location and attribute data.
- Lightning Attributes contain data from various depths and image subsurface features and lineaments such as transforms, faults, drainage basins, and paleo channels.

Strike Density (NLDN) and Topography



Ave. Flash Density
strikes/sq.km/yr.

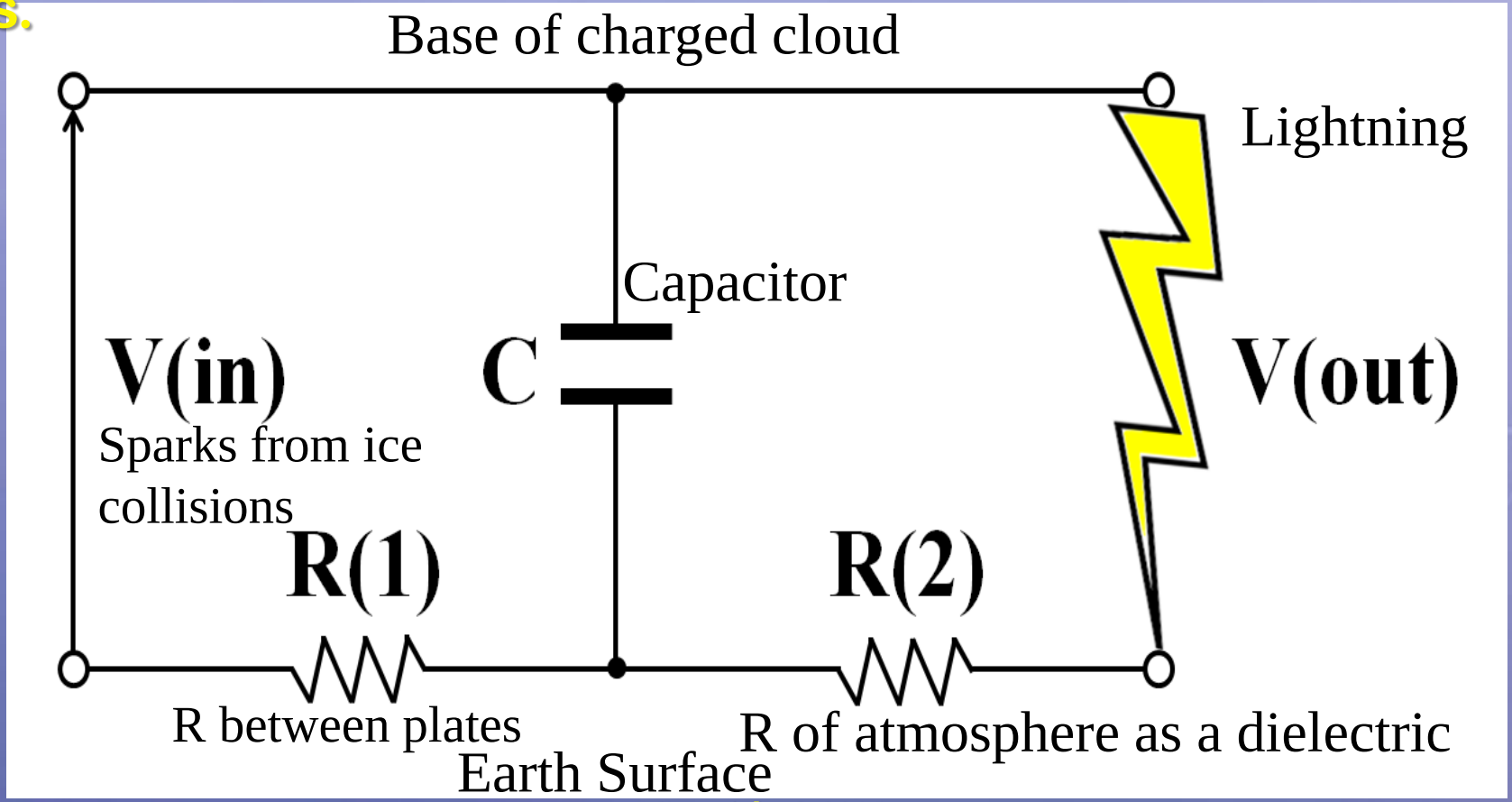
- 14 and up
- 10 to 14
- 8 to 10
- 6 to 8
- 5 to 6
- 4 to 5
- 3 to 4
- 2 to 3
- 1 to 2
- 0.5 to 1.0
- 0.1 to 0.5
- 0+ to 0.1

330 Lightning Detectors in the Continental US.
Evergreen Data Set -16 years of data available.

Main lightning bolt tied to geology

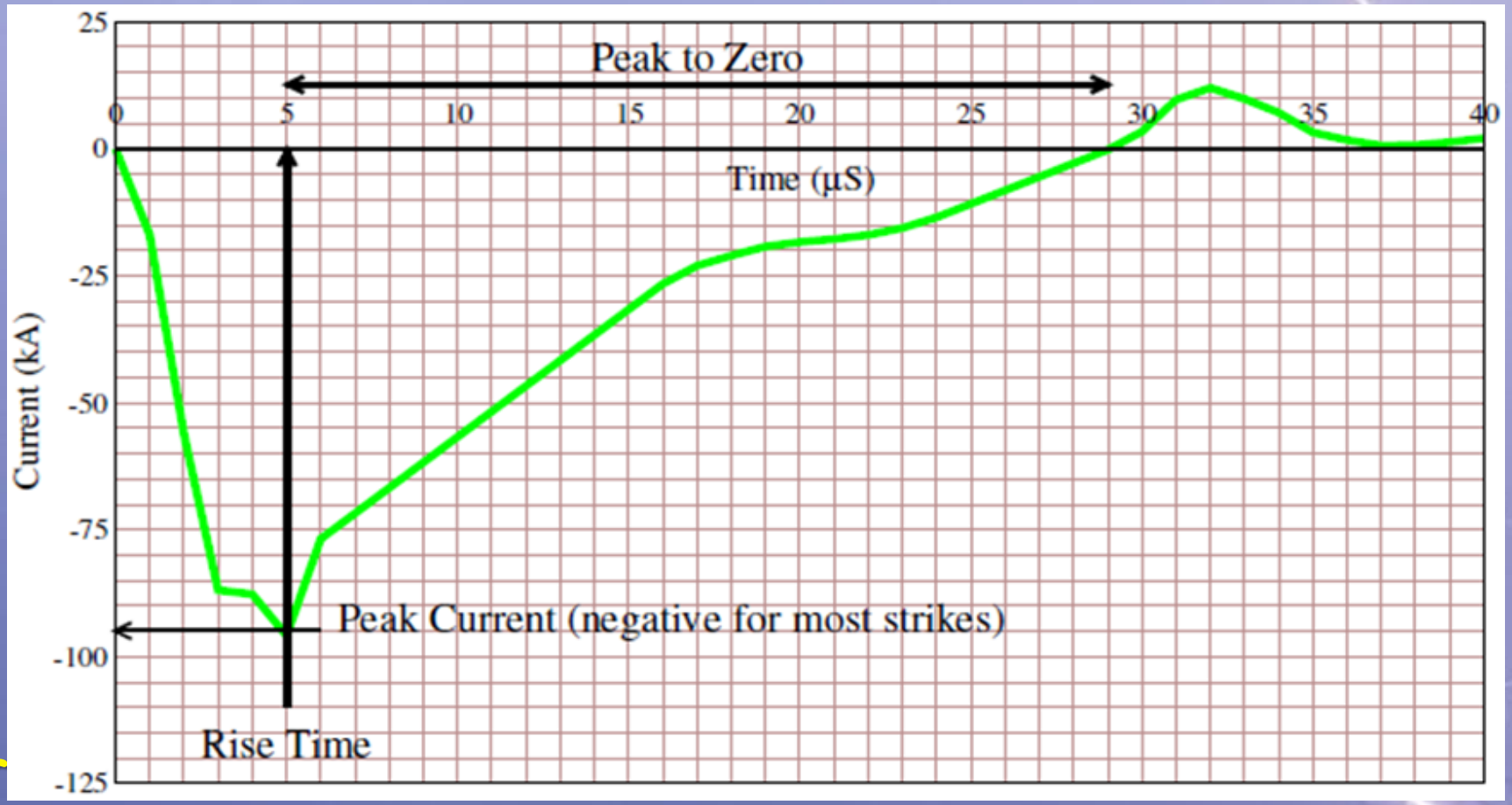
Lightning

Two conducting plates, the storm cloud and the earth, are separated by an insulating dielectric, the atmosphere. Voltage is created by collision of ice within the cloud and lightning bolts rebalance the charge between the plates.

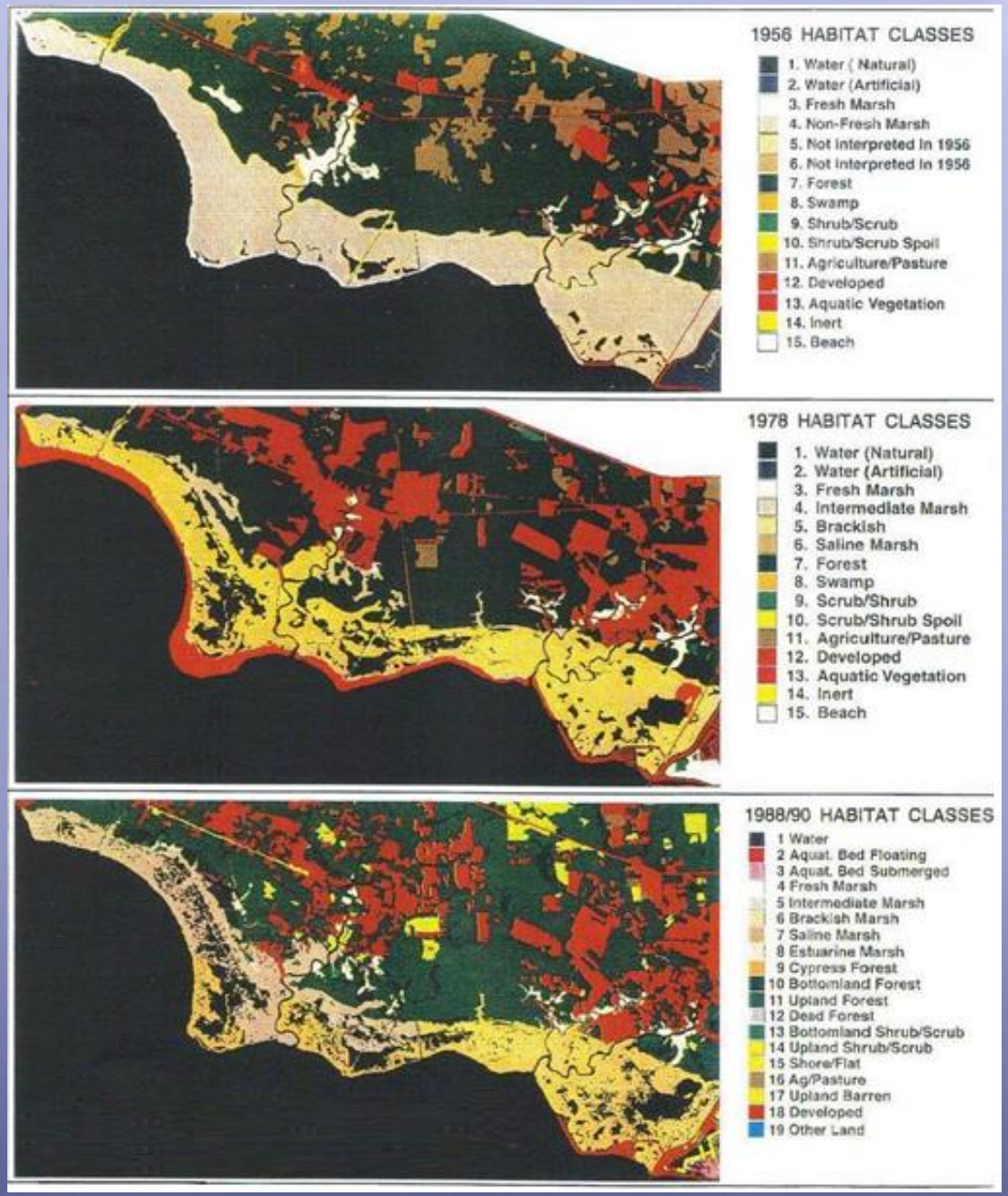


Lightning Measurements/Attributes, & Wave Form

- Location / Time and Duration / # of Sensors
- Rise Time
- Peak Current
- Peak to Zero
- Polarity
- Chi Squared
- Number of Sensor



5. Goose Point – tectonic driven subsidence lightning case history (in the making)



1956

1978

1988-90

Landscape changes rapidly enough to be noticed

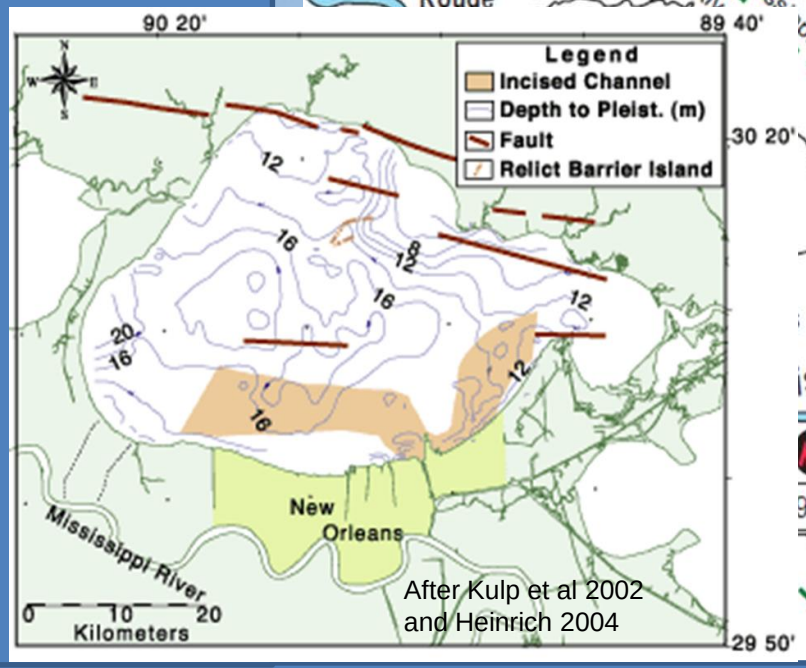
Geology is the Foundation of Human Activity

"The land here never sleeps. It's moving in two directions - vertically and horizontally - all the time. "

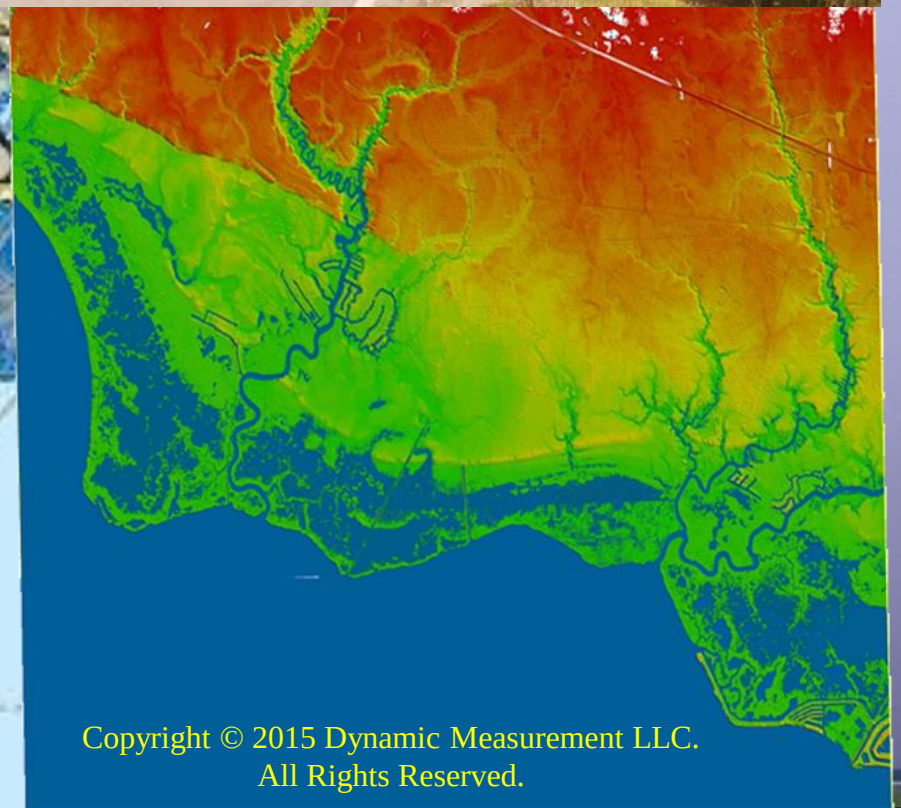
Stephan Estopinal, PE,
President SLFPA-E

When geology moves, it impacts whatever is at the surface!

Regional Tectonic Setting



After Kulp et al 2002 and Heinrich 2004



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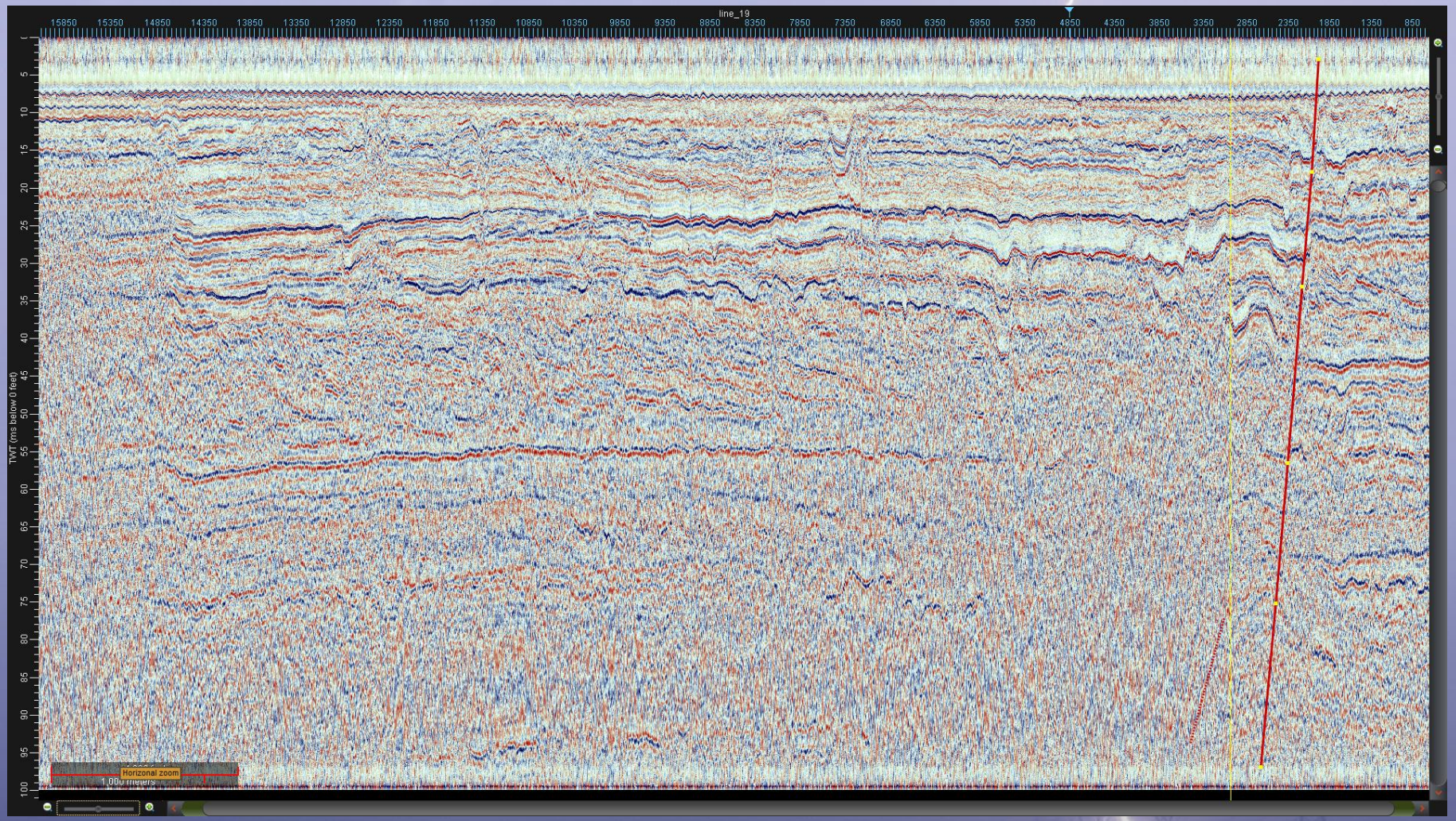
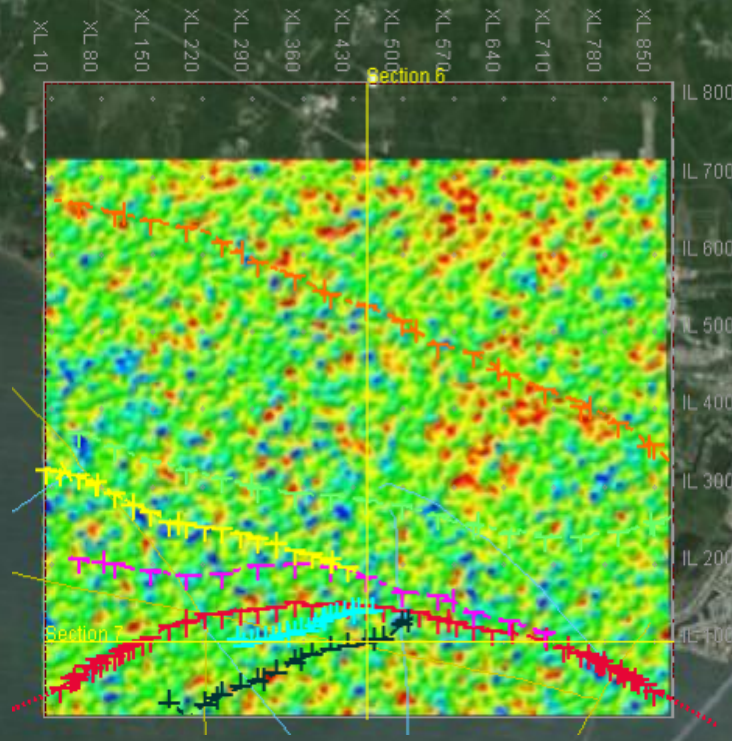
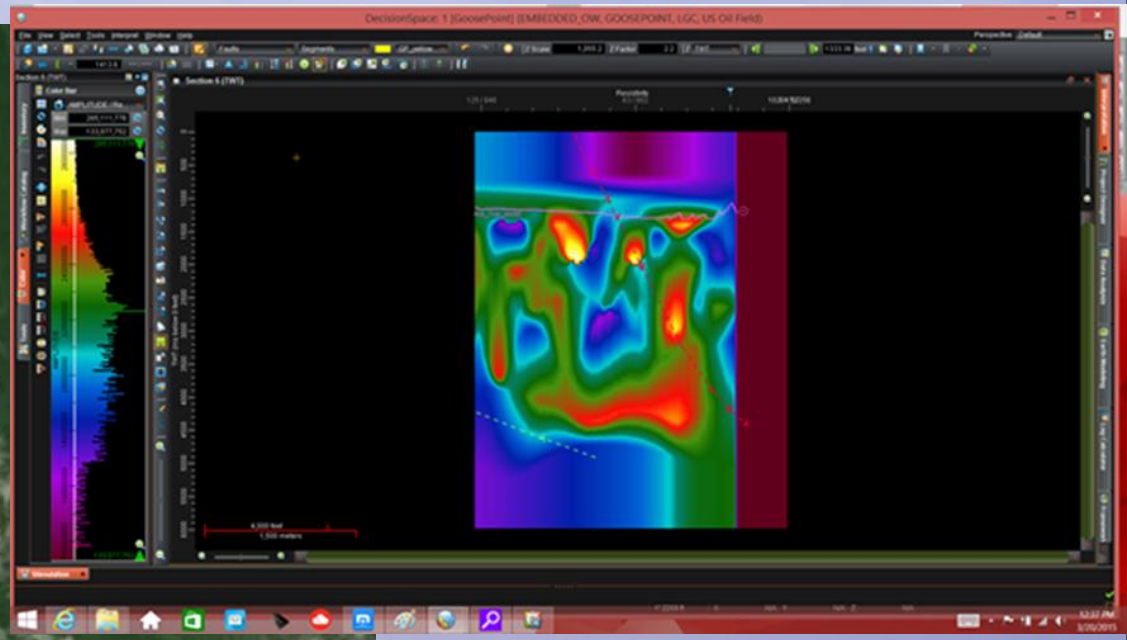
LIDAR over the same area

Sparker Line 19







Rise Time Attribute with Interpreted Faults

Line 19 Sparker along Railroad Bridge

Preliminary results as of 26 Mar 2015

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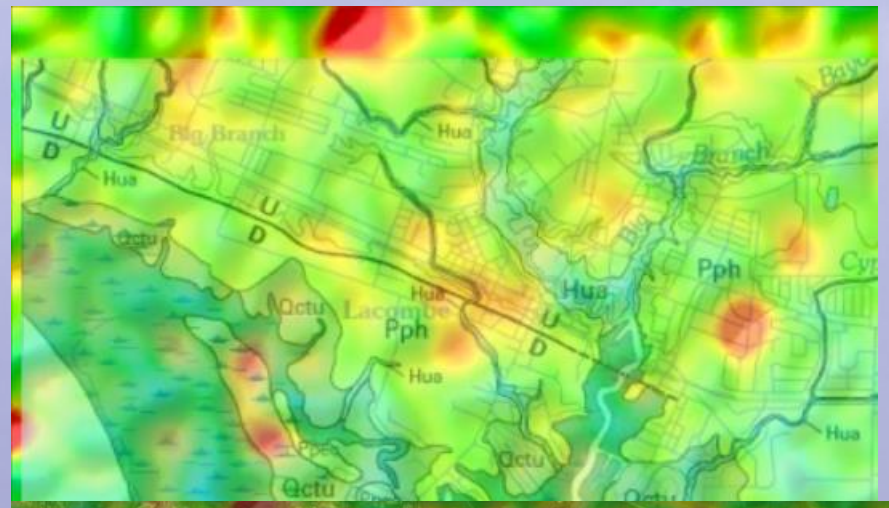
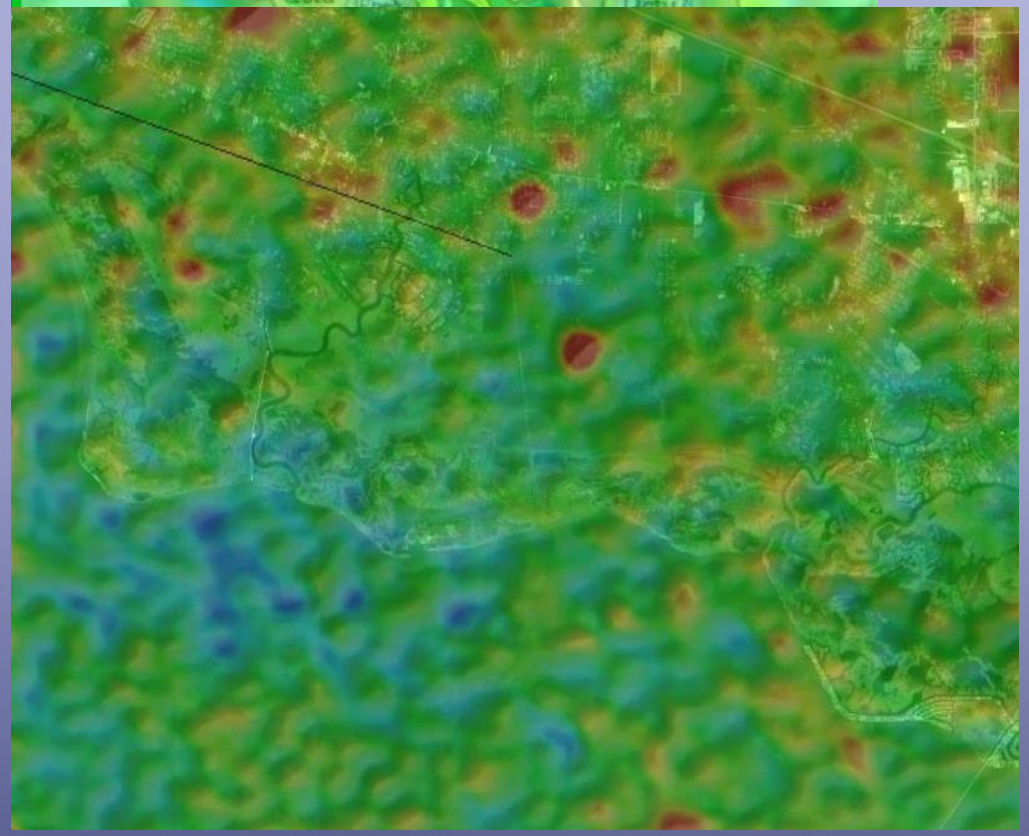
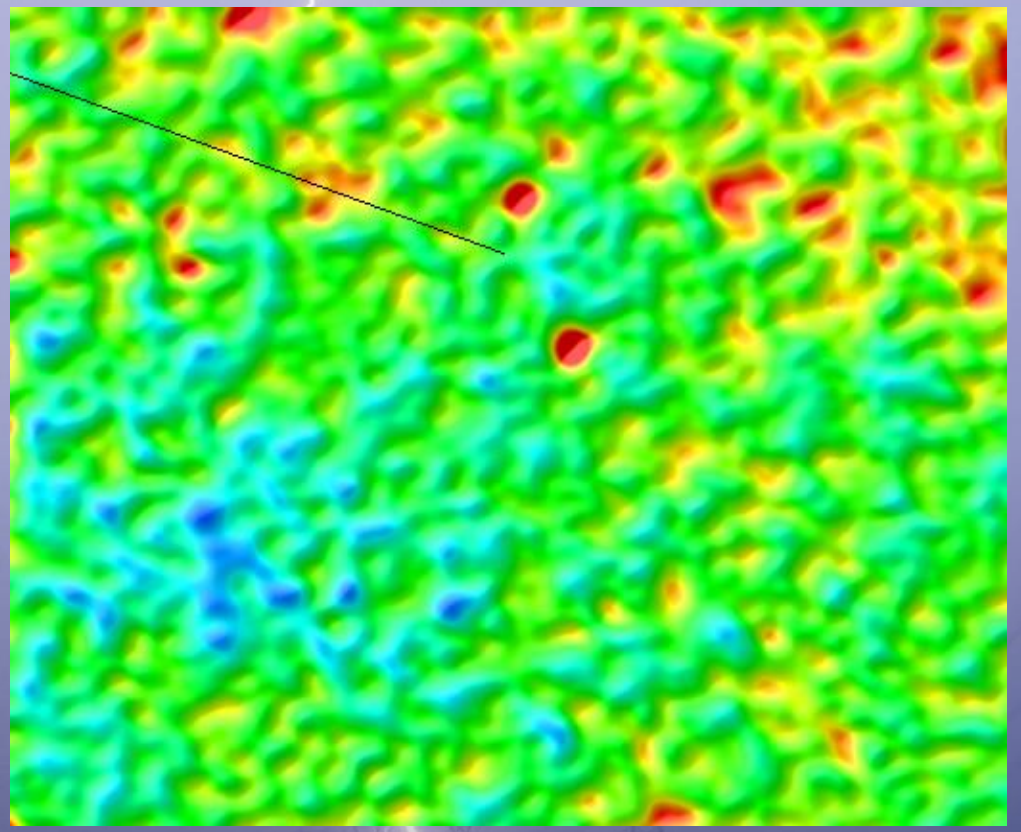
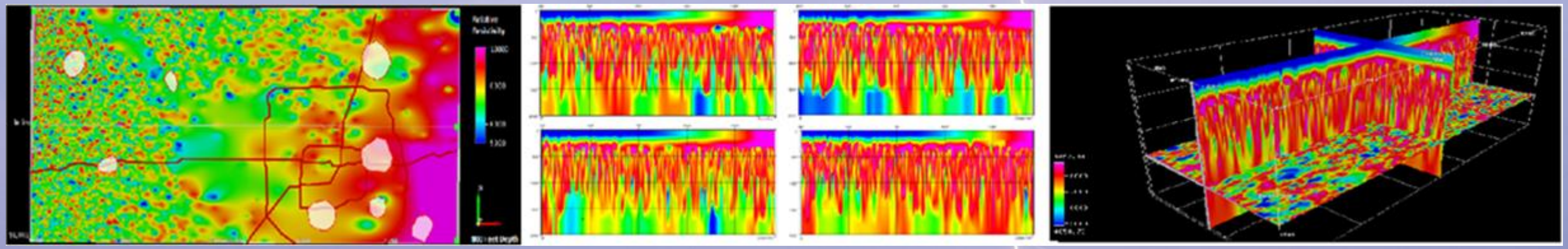
Strike Density paralleling Lacombe Fault





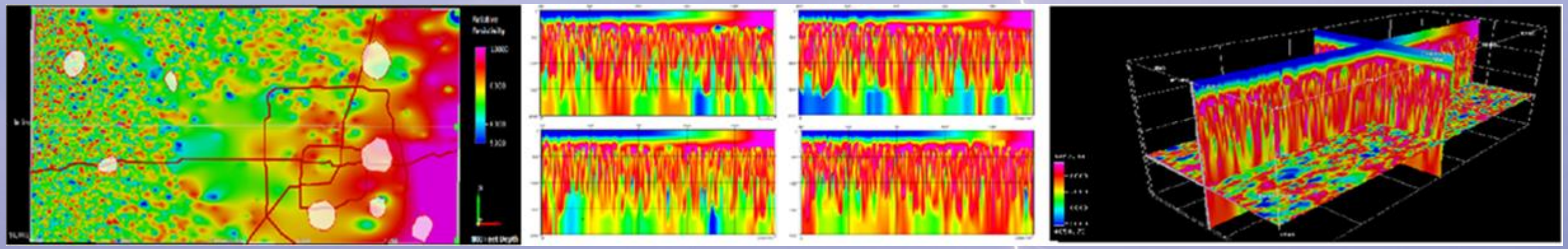


NSEM and Resistivity Volumes are a Technology Breakthrough



- Attribute maps identify lineaments related to faulting
- Resistivity volumes provide an independent view of geology
- Resistivity volumes can be created to match 3-D geometry
- We anticipate a merger of resistivity volumes and lithology predictions

NSEM and Resistivity Volumes are a Technology Breakthrough



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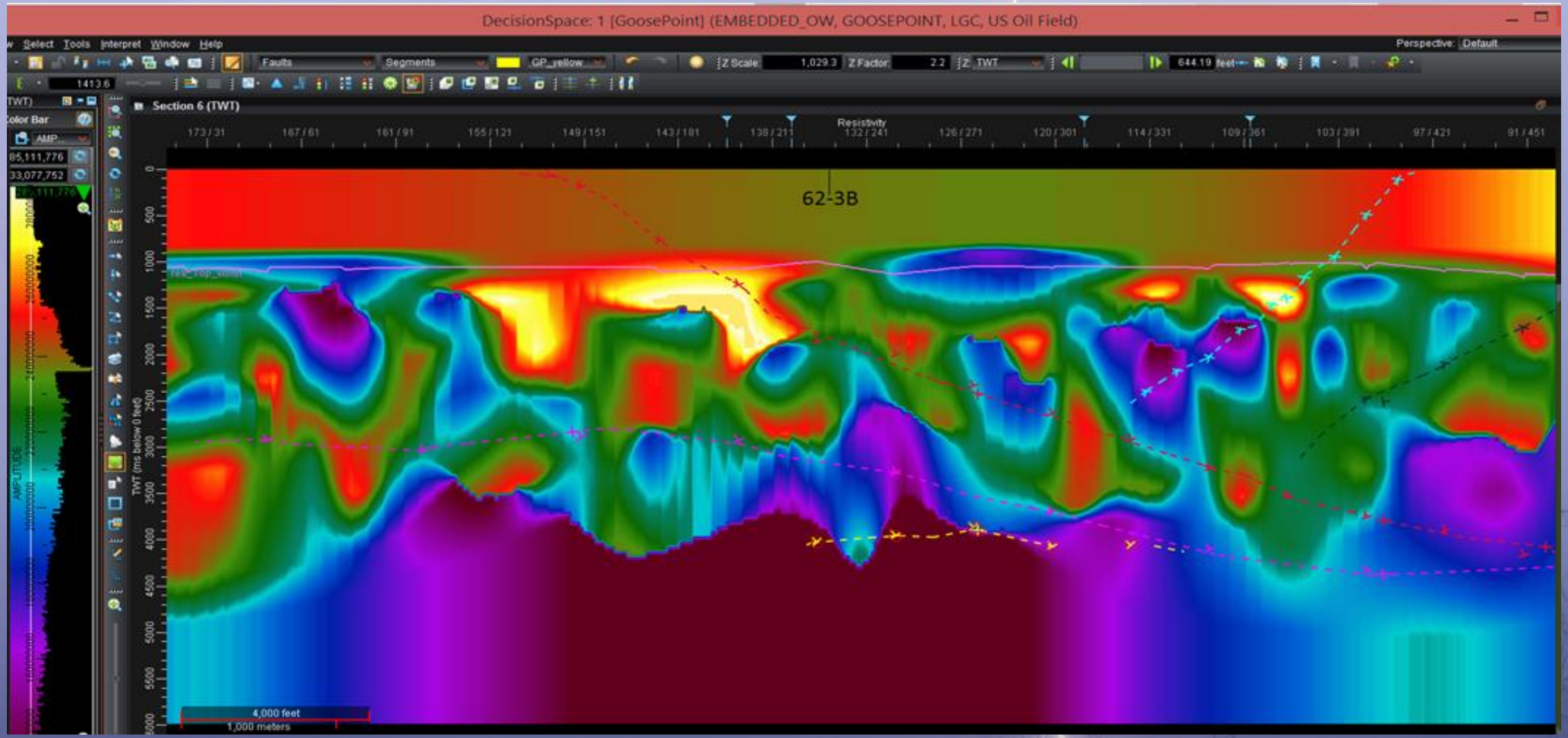
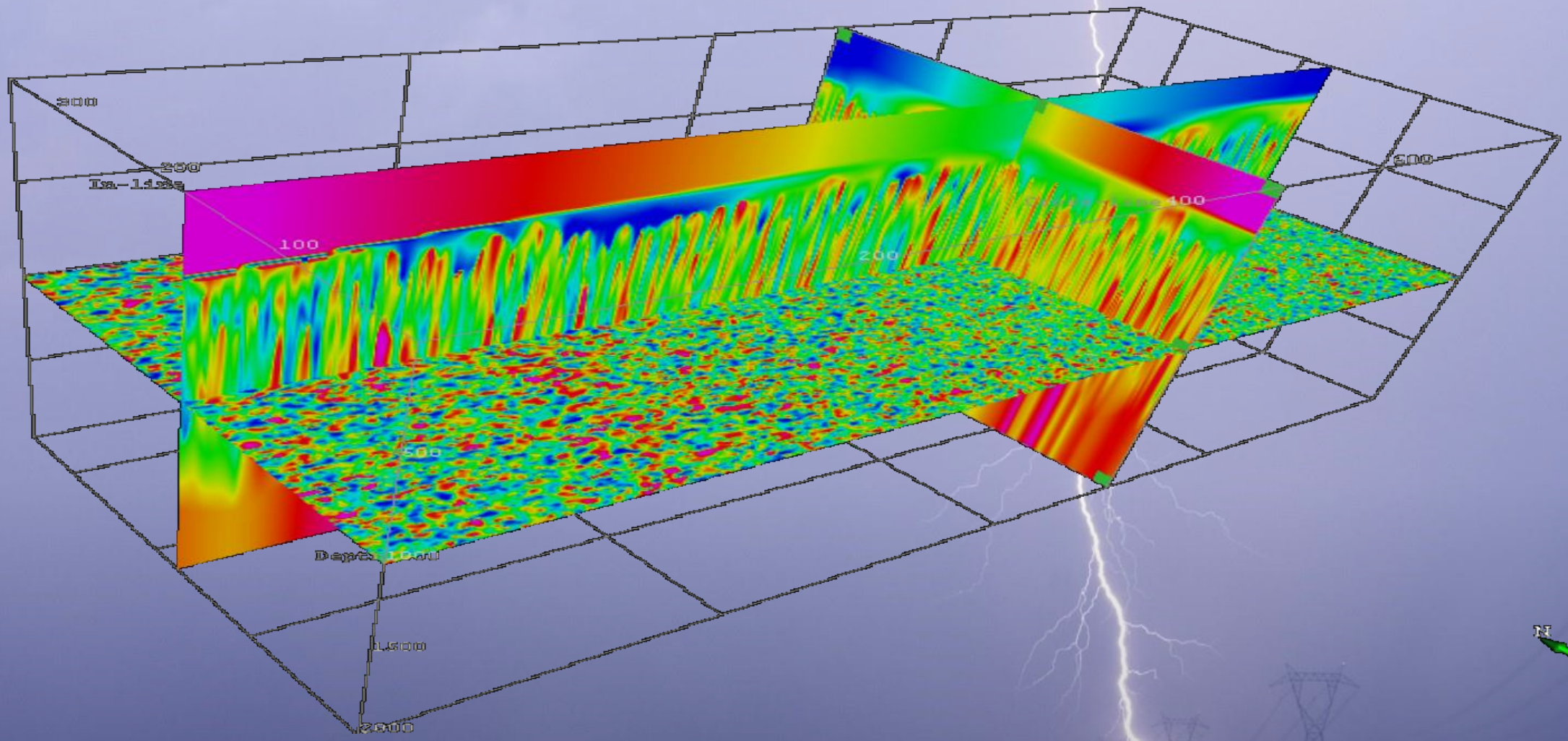
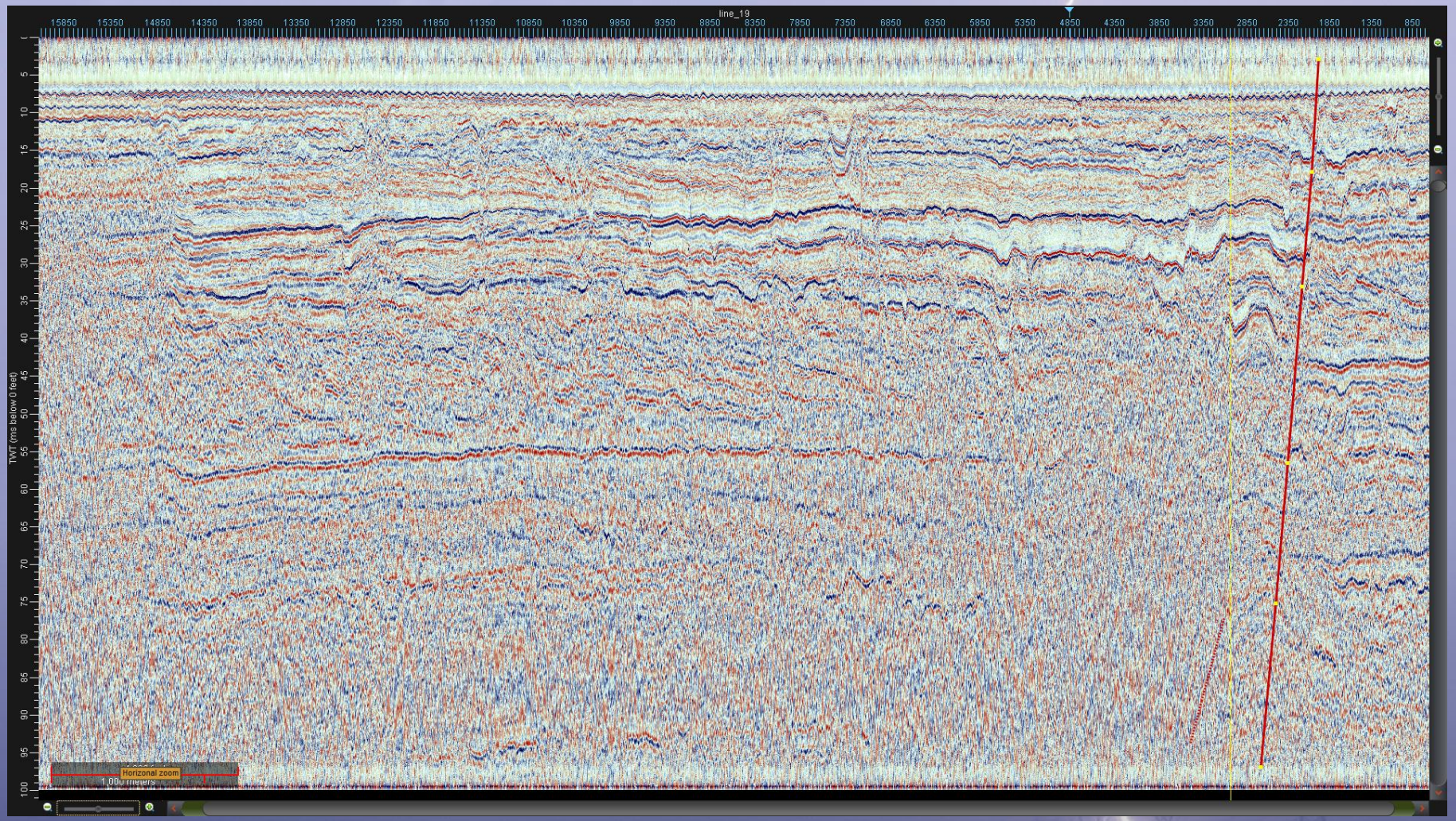
Resistivity Volume Cross-Section at Goose Point



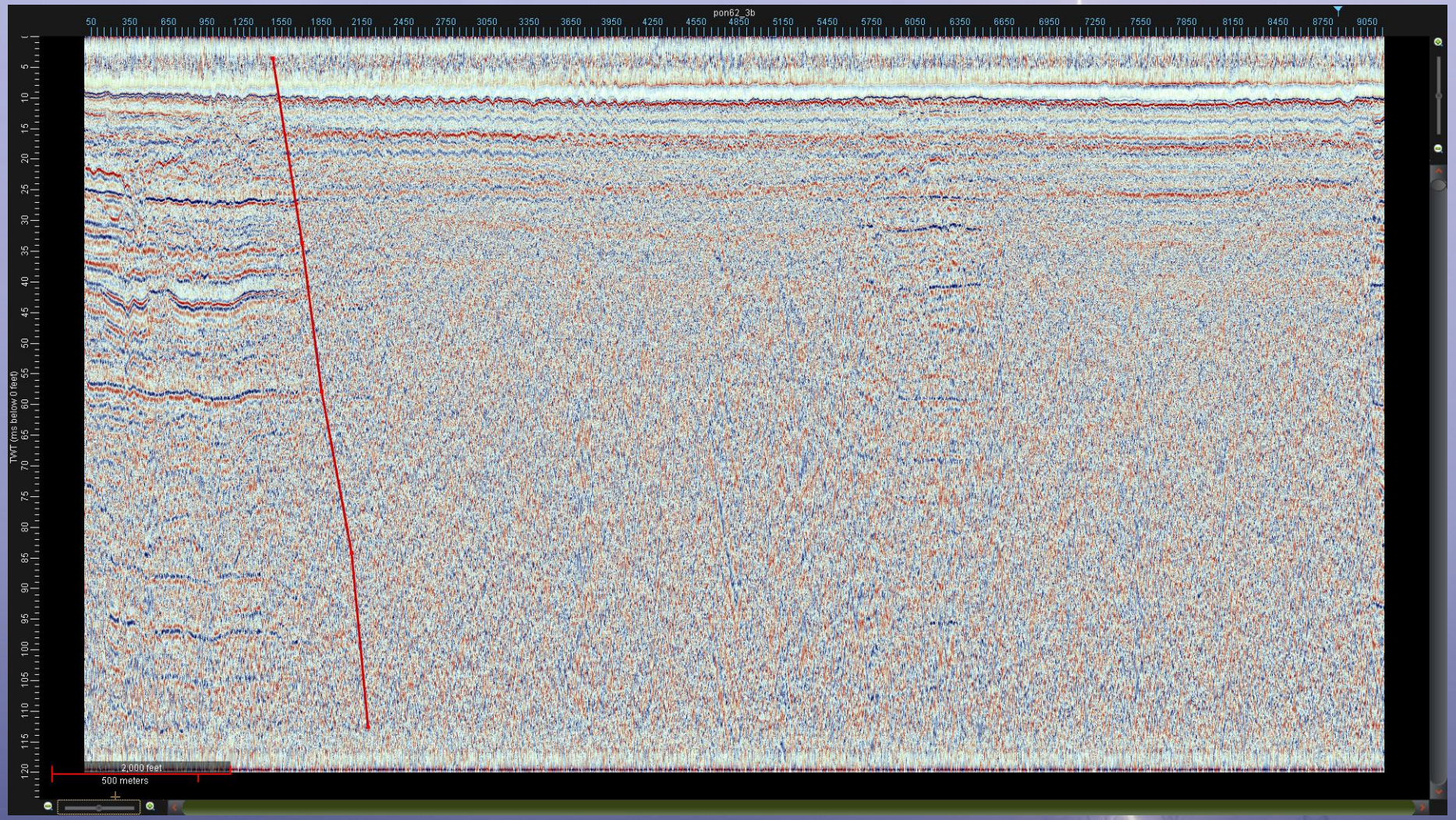
A Resistivity Volume



Sparker Line 19



Sparker Line 3b



We hope the Corps will seek regular updates on the development of the Goose Point Case History

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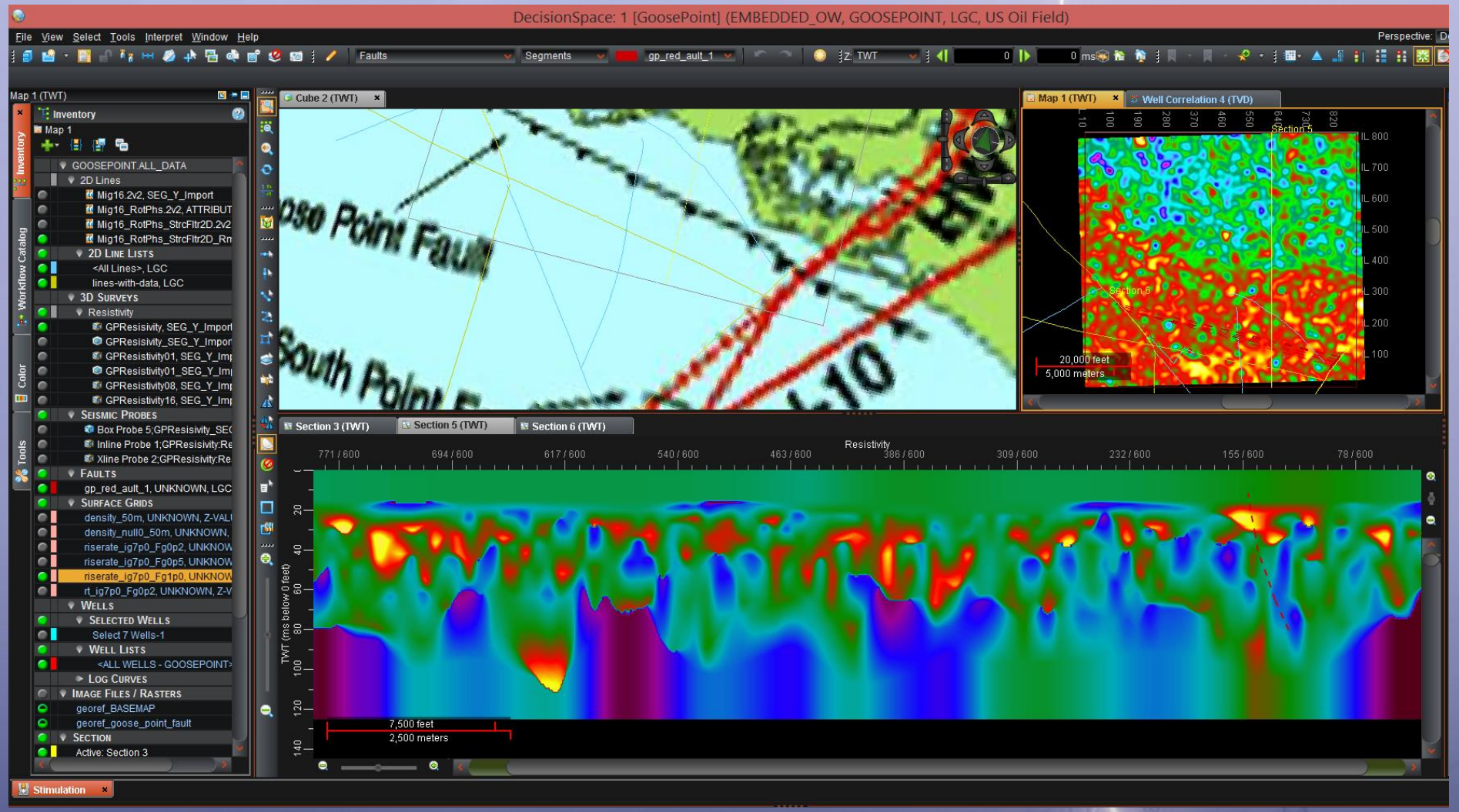

What we have covered:

1. NSEM - A new technology to identify geologic hazards
   -
2. The meteorology behind lightning databases
   -
3. Calculating resistivity volumes from lightning databases
   -
4. Examples of using lightning databases to map geology
   -
5. Goose Point – tectonic driven subsidence lightning case history

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- Contact Information:
  - H. Roice Nelson, Jr.

    cell: 713.542.2207

    e-mail: roice@dynamicmeasurement.com
  - Dr. Jim Siebert

    cell: 832.423.2355

    e-mail: jim@dynamicmeasurement.com
  - Les R. Denham

    cell: 281.879.6010

    e-mail: les@dynamicmeasurement.com
  - Kathleen S. Haggar

    cell: 225.953.1076

    e-mail: kathy@dynamicmeasurement.com

- www.dynamicmeasurement.com
- 211 Baker Road #382
  Barker, TX 77413
  Office: 281.579.0172
- 2155 West 700 South #31
  Cedar City, UT 84720
  - Fax: 435.267.2668
- P.O. Box 40873
  Baton Rogue, LA 70835

Find out more at

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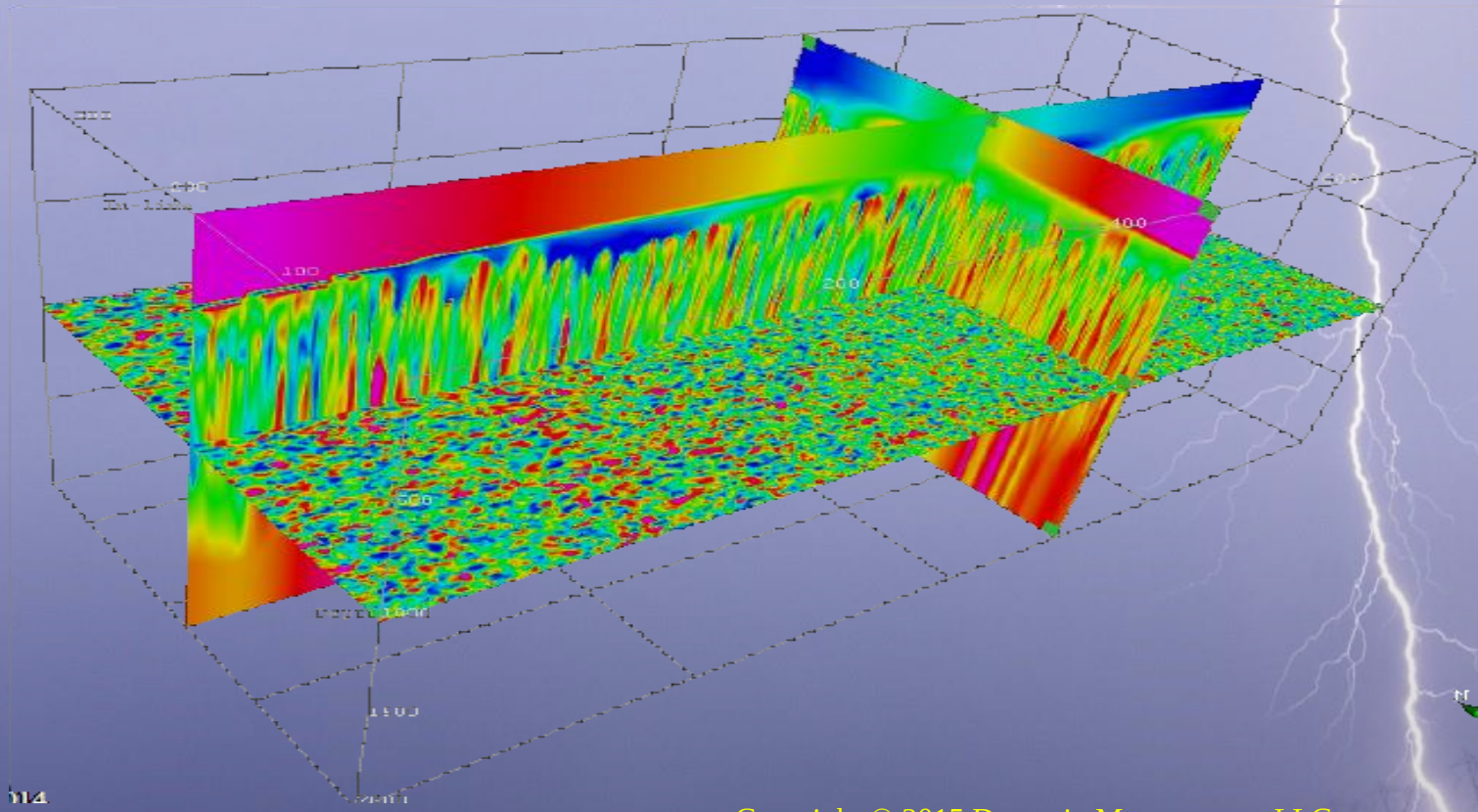
Thank You!



See Lightning,
Think DML!