Summary and the Future

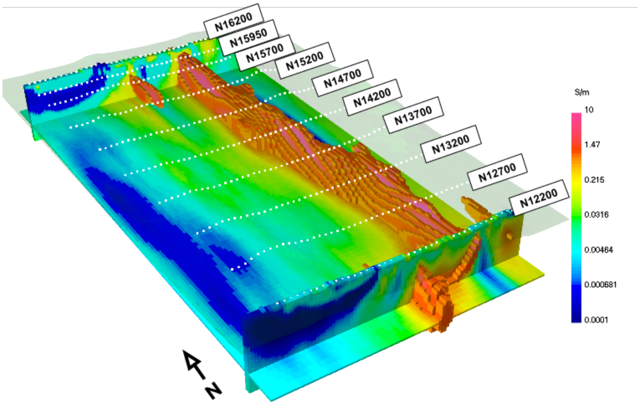
DISC

2017

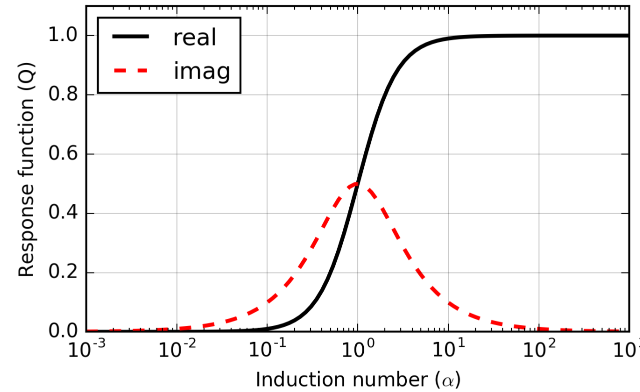
Electromagnetics
Fundamentals and Applications

What have we covered?

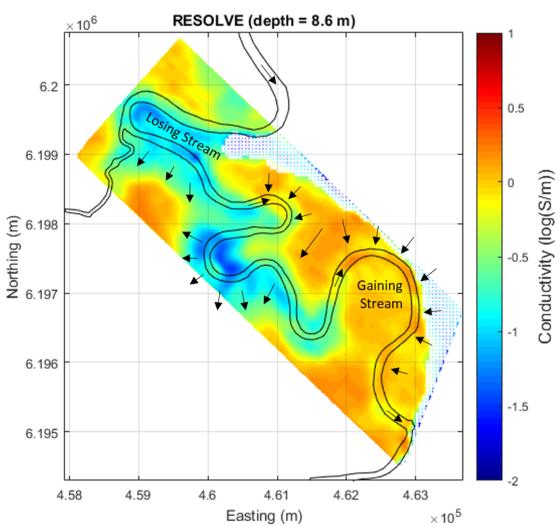
DC Resistivity



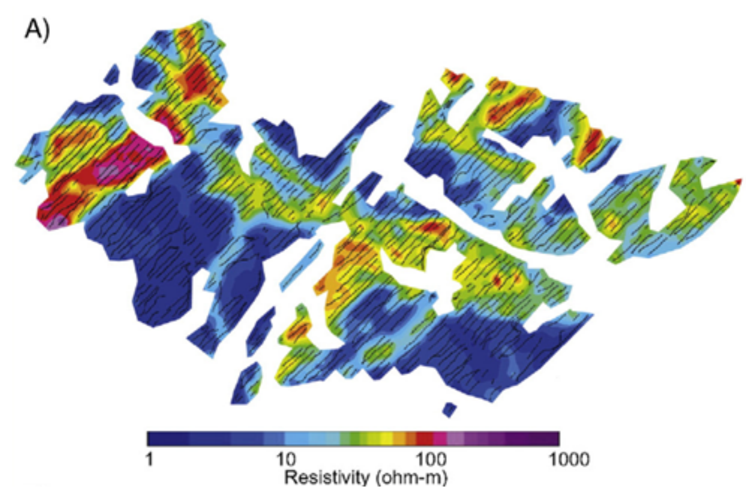
EM Fundamentals



Inductive Sources: Frequency

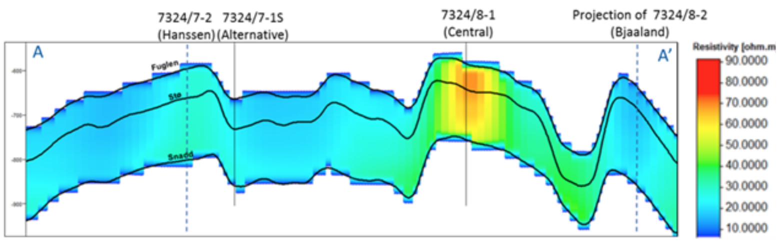


Inductive Sources: Time

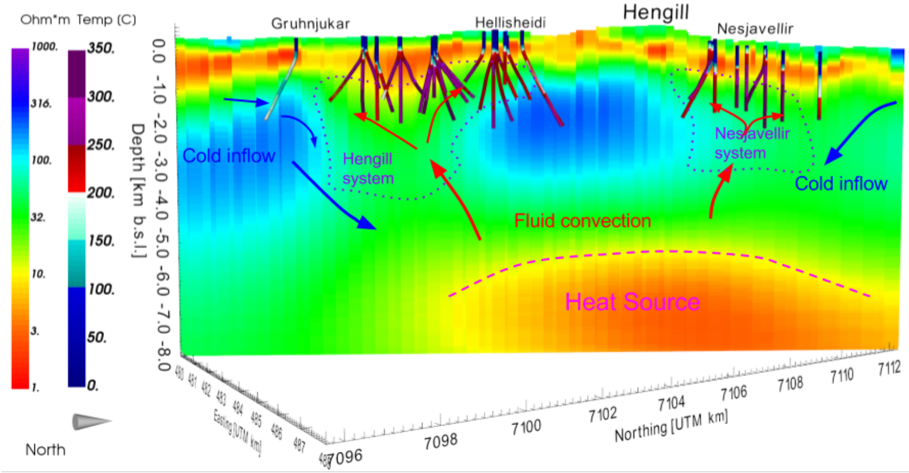


What have we covered?

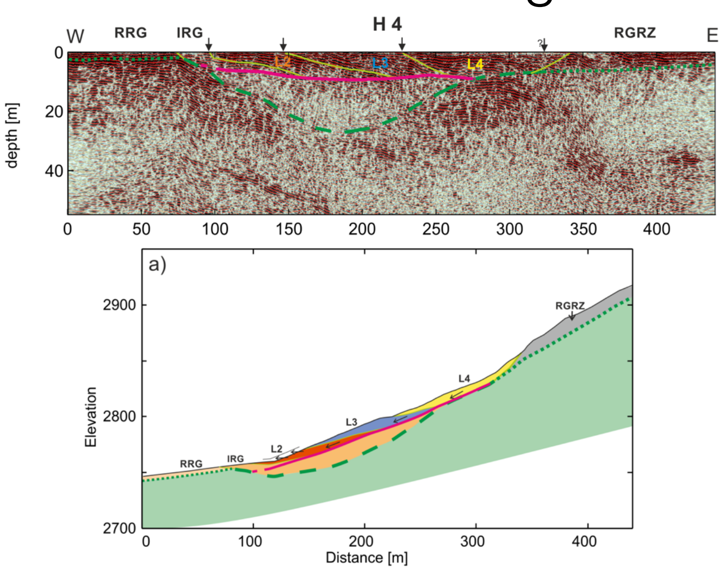
Grounded Sources



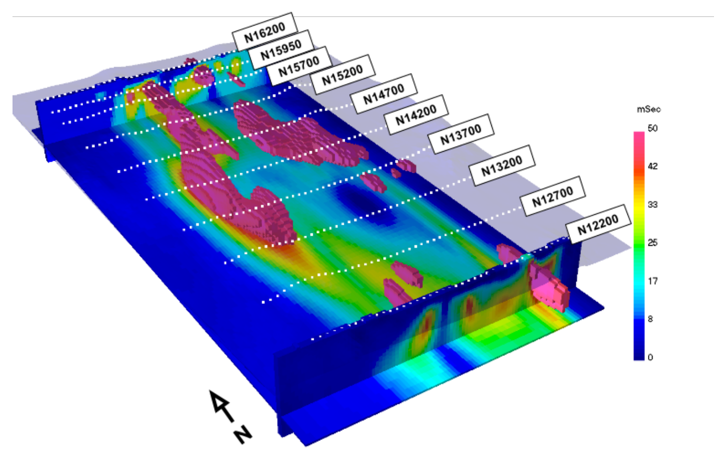
Natural Sources



Ground Penetrating Radar



Induced Polarization

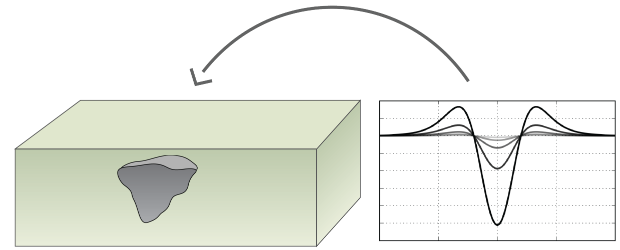


What does the future hold?

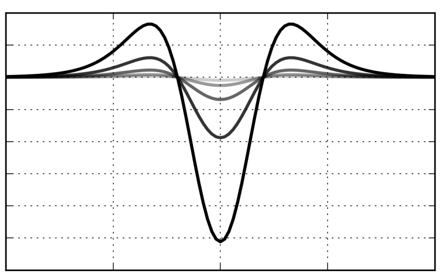
What does the future hold?

Problems

Inversion capabilities



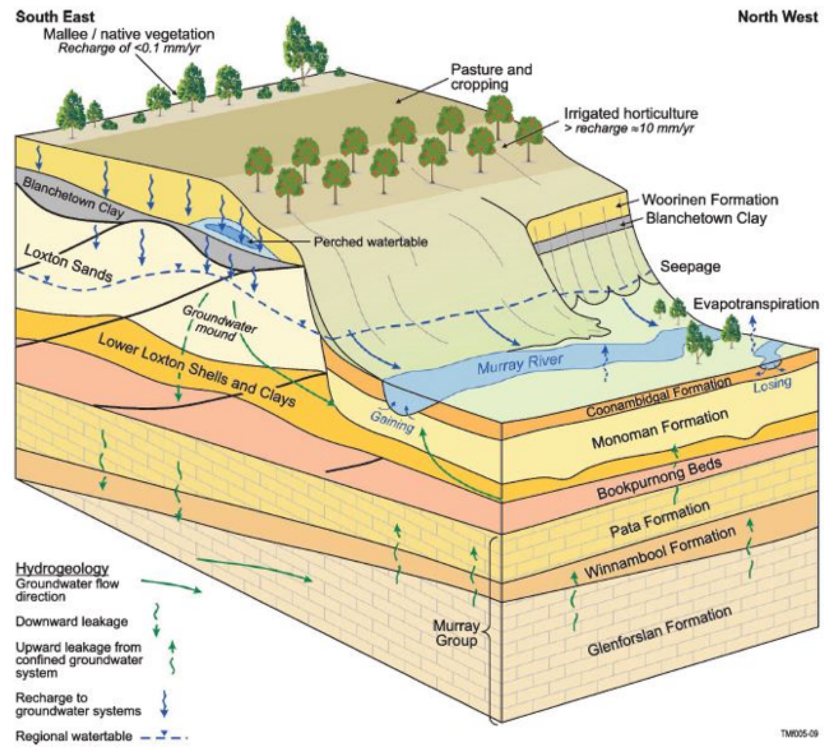
High quality data

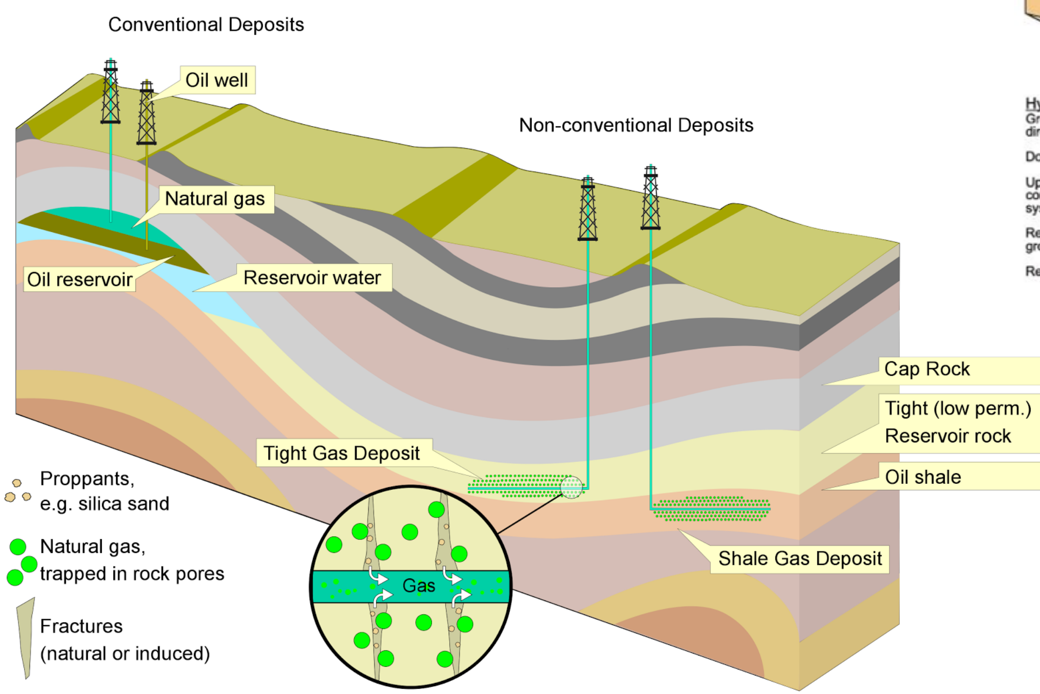


Web tools to communicate

The Future: Monitoring

- Aquifers
- Enhanced oil recovery
- Hydraulic Fracturing
- CO_2 sequestration
- Coal seam gas

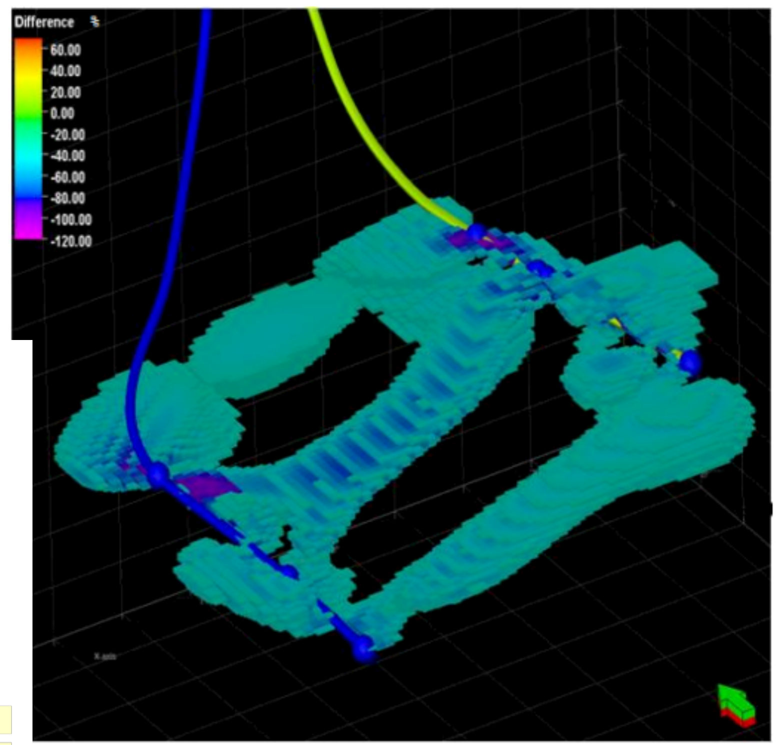




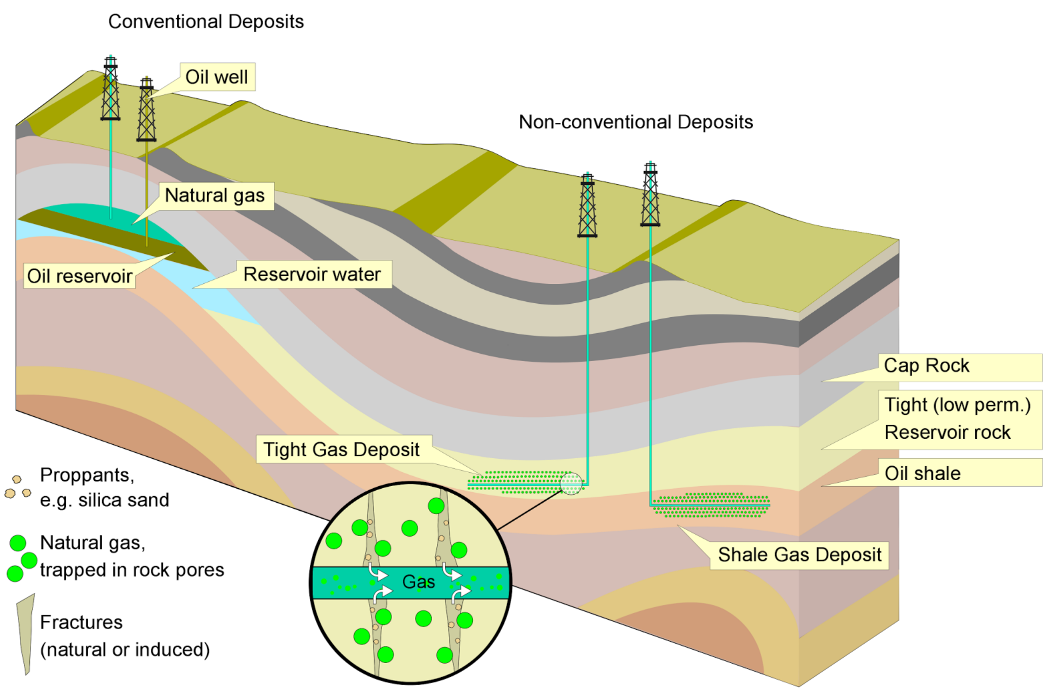
The Future: Monitoring

- Water flood
  - Cross-well EM
  - Image swept and missed regions of reservoir

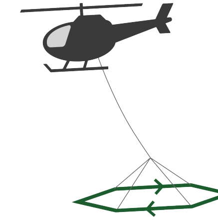
Resistivity isosurface – water flood



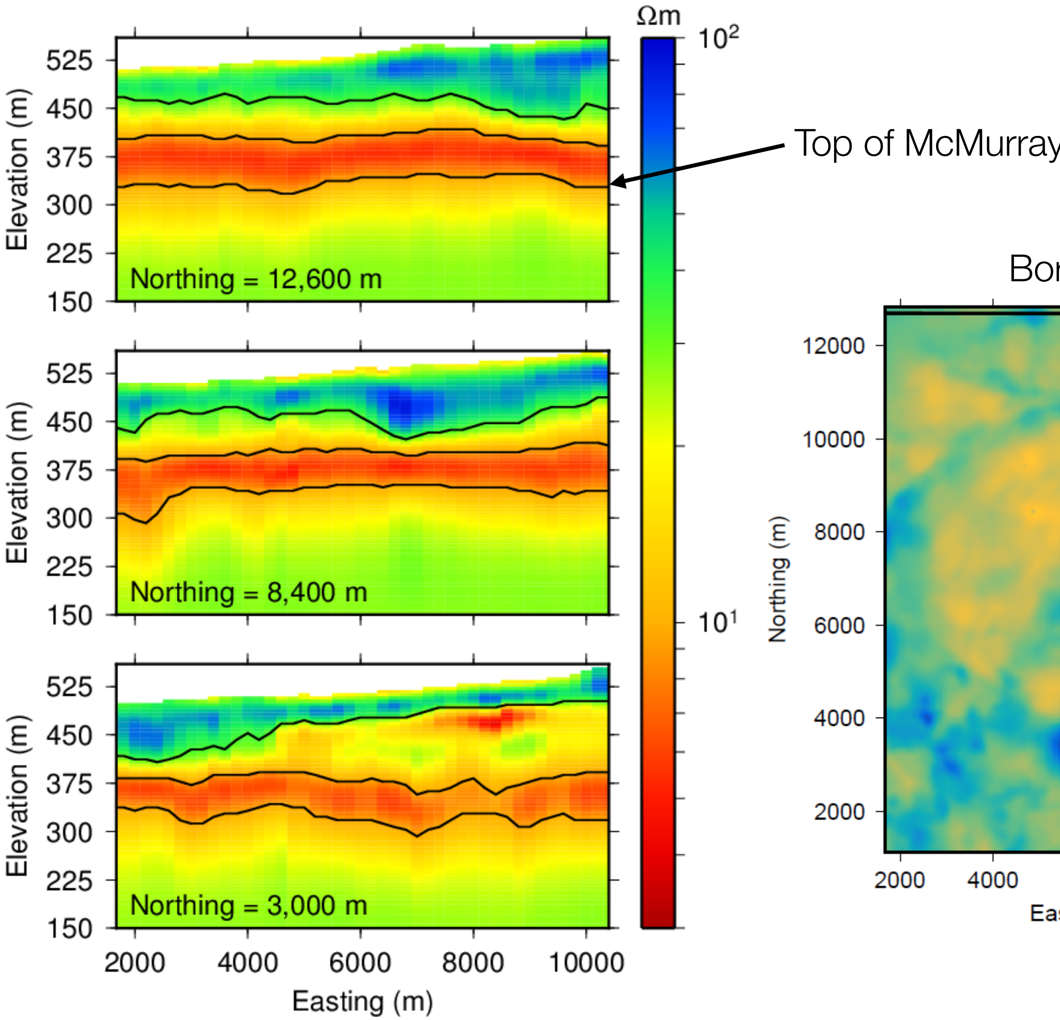
Saudi Arabia: Marsala et al., 2015

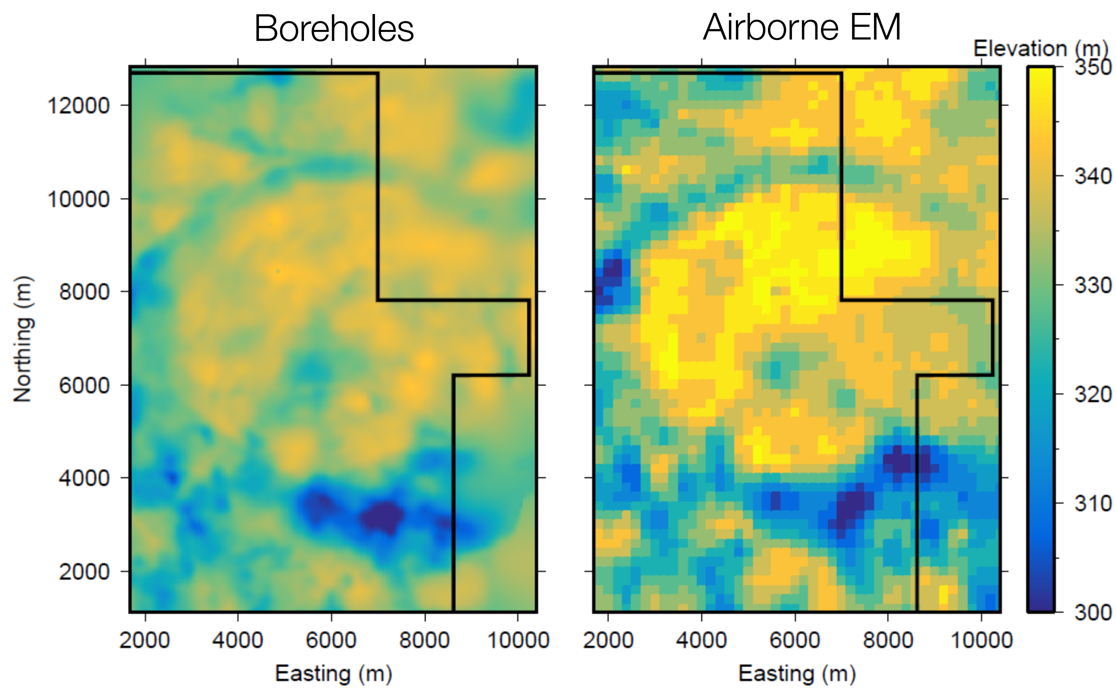


Multi-stage EM for monitoring



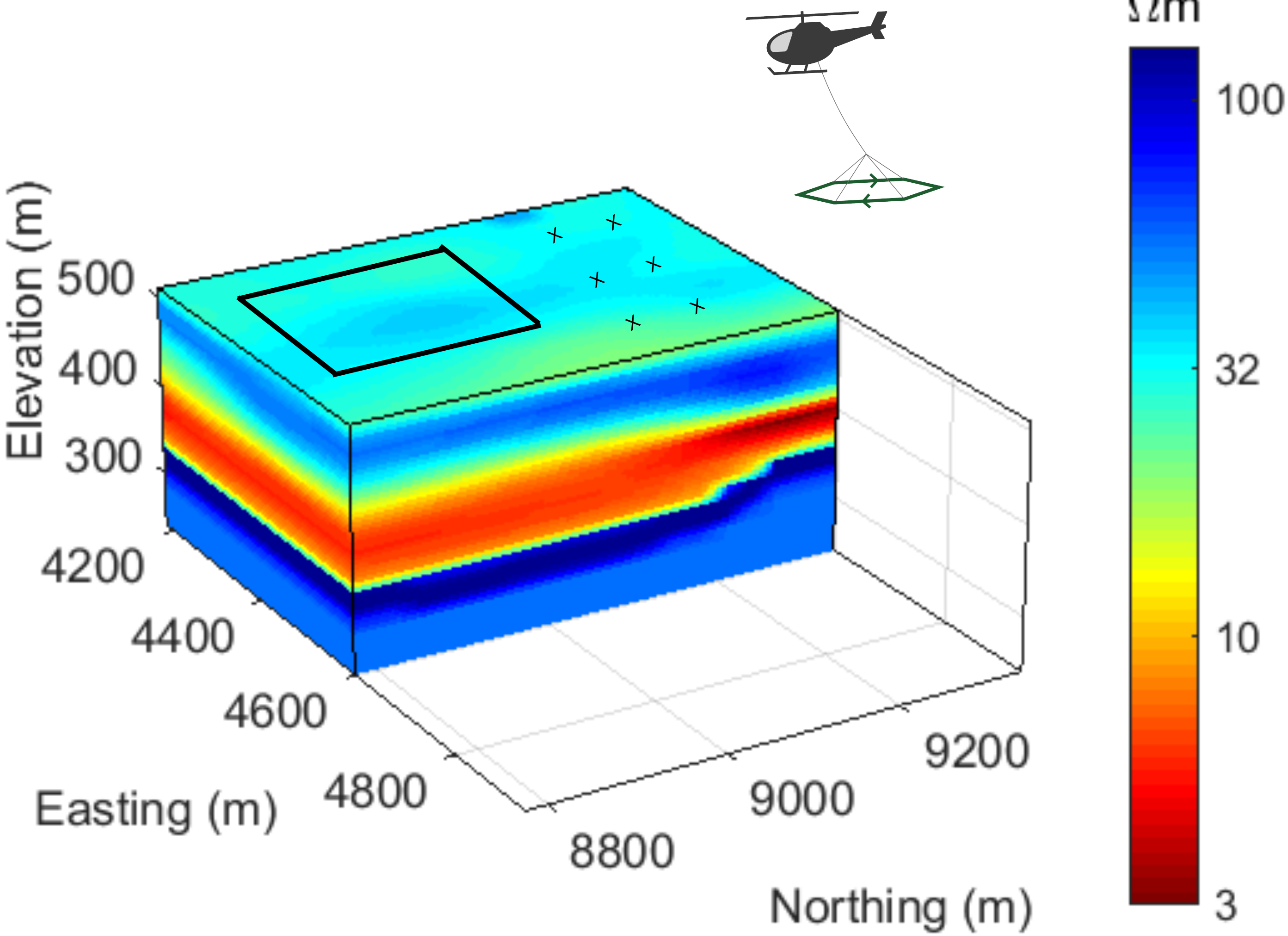
Large-scale: airborne





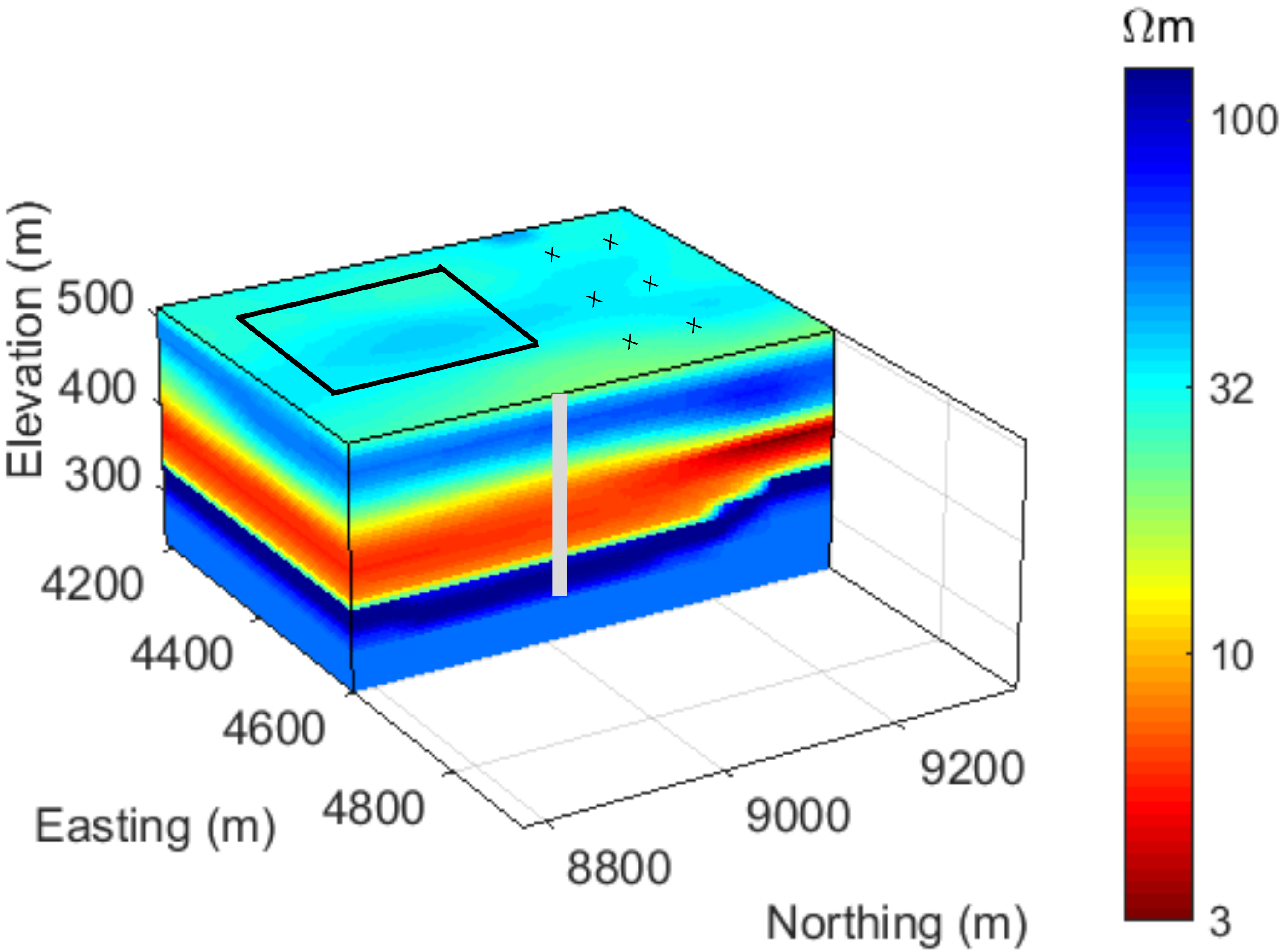
Multi-stage EM for monitoring

Local background: airborne + ground



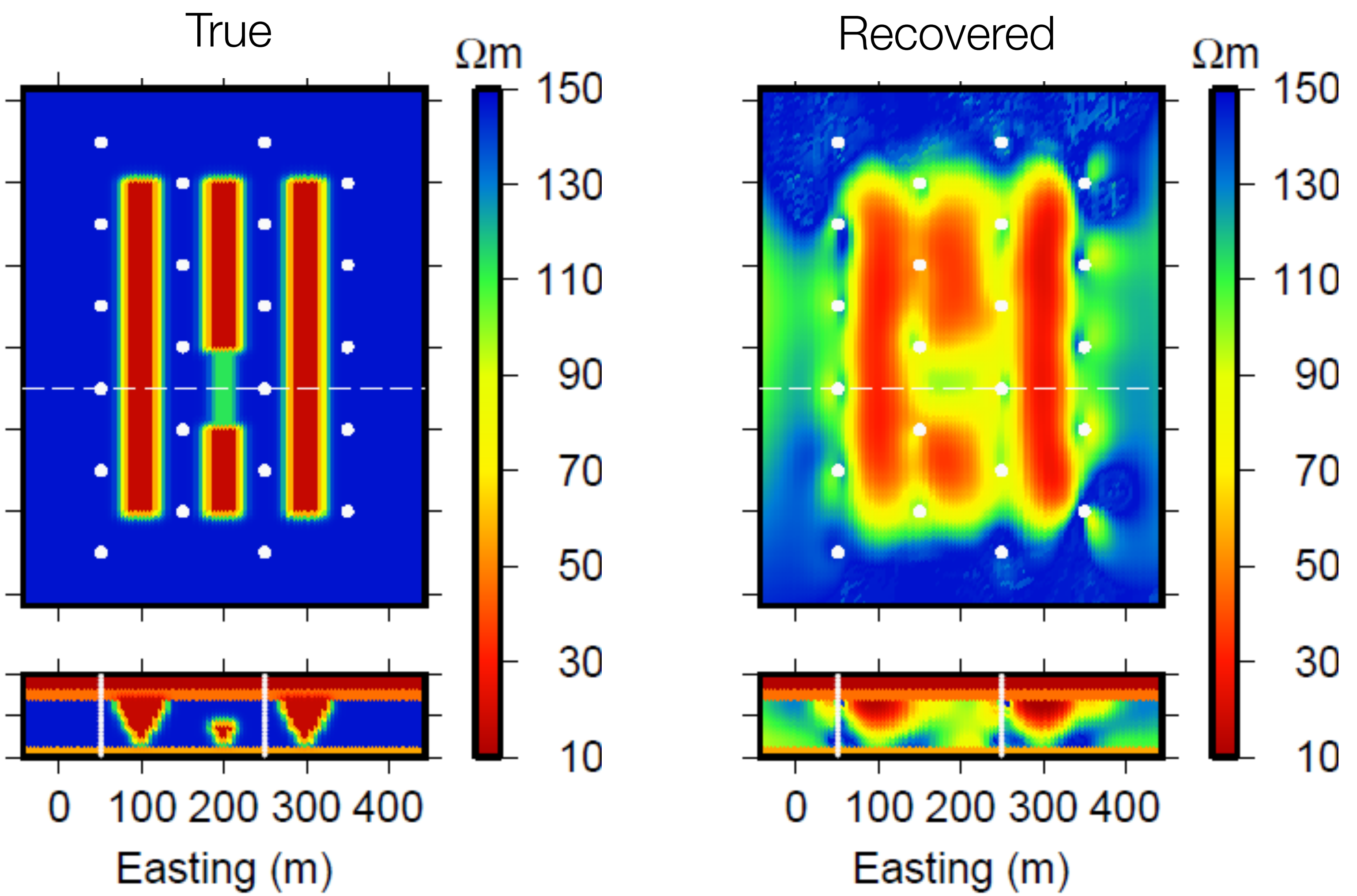
Multi-stage EM for monitoring

Pre-injection: surface sources, borehole receivers



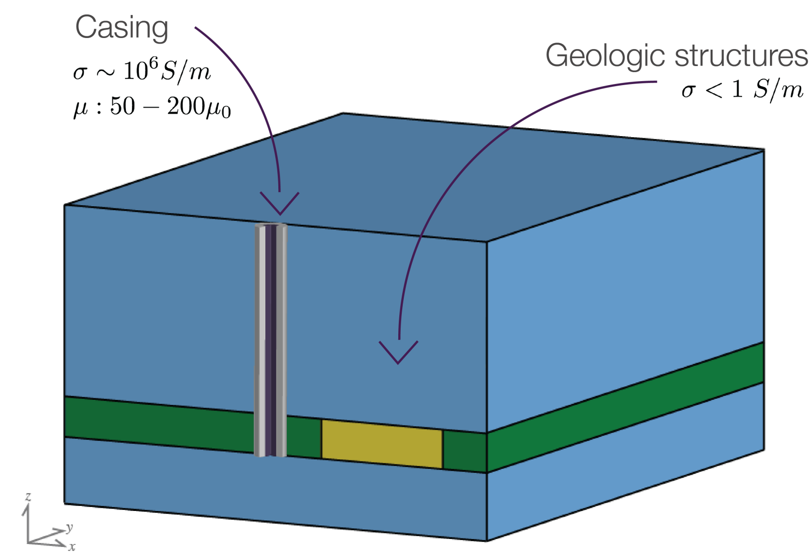
Multi-stage EM for monitoring

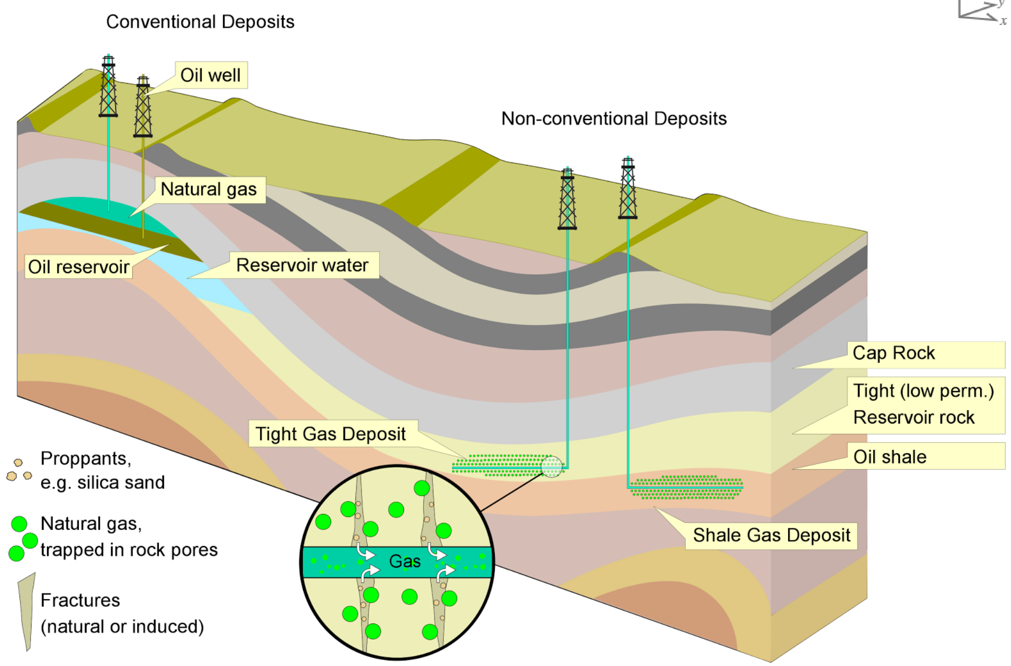
Post-injection: surface sources, borehole receivers

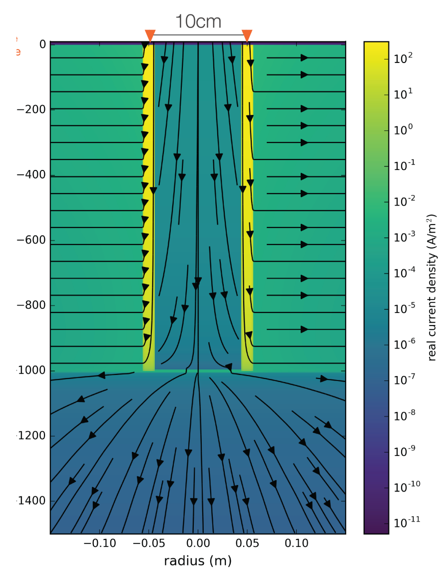


The Future: Monitoring

- Steel Casing
  - Mechanism for getting current to depth
  - Challenges:
    - Scales
    - Physical properties



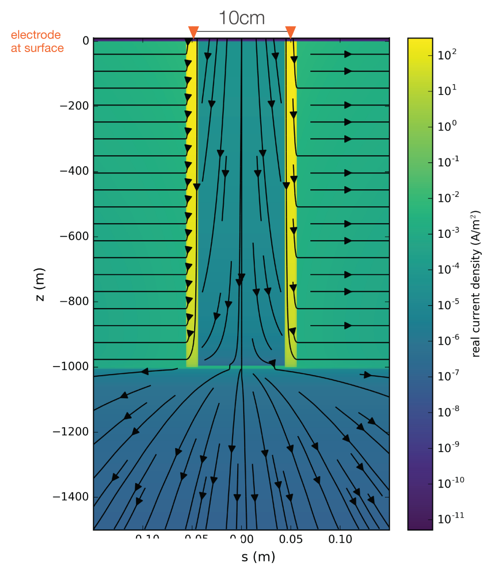


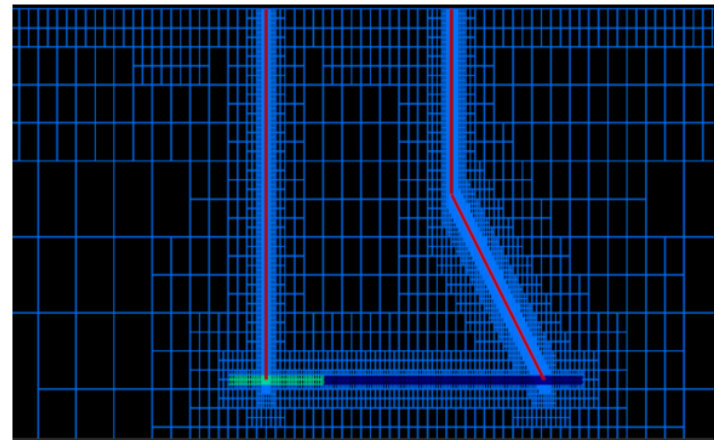


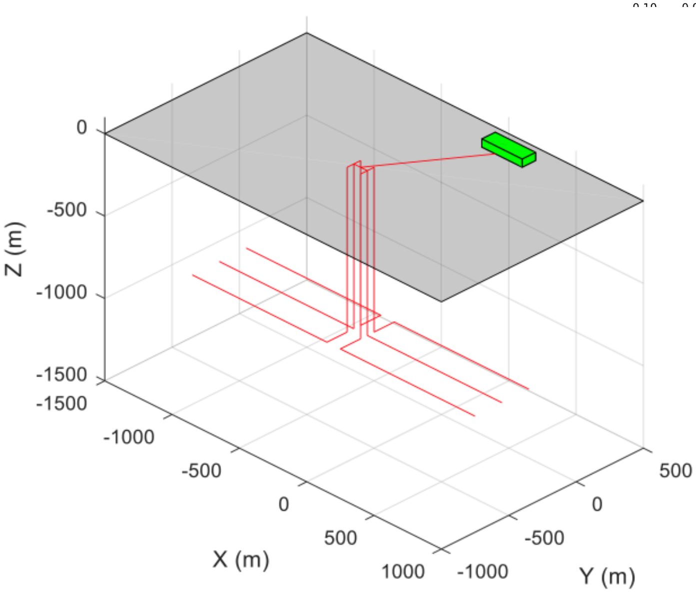
Corrosion

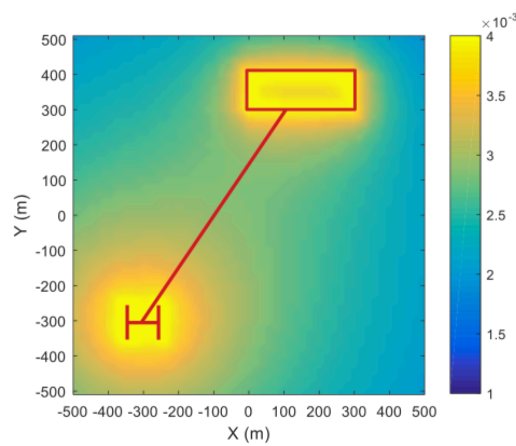
The Future: Monitoring

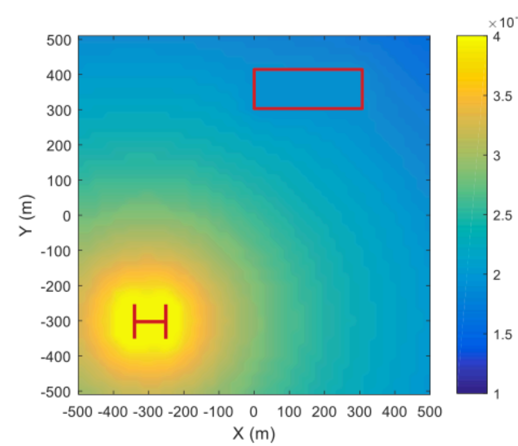
- Steel Casing





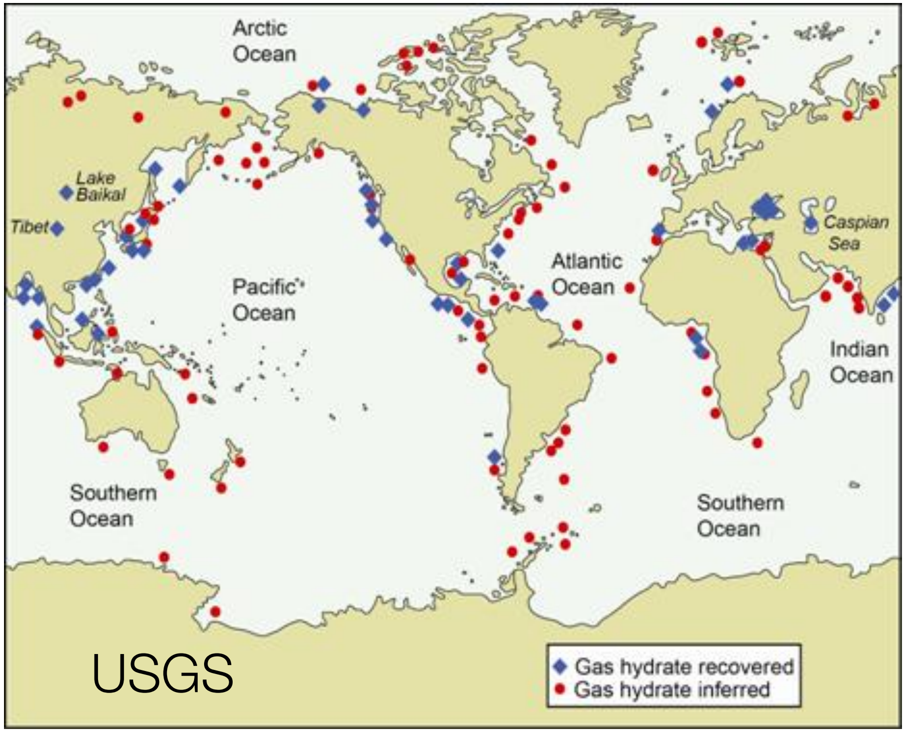


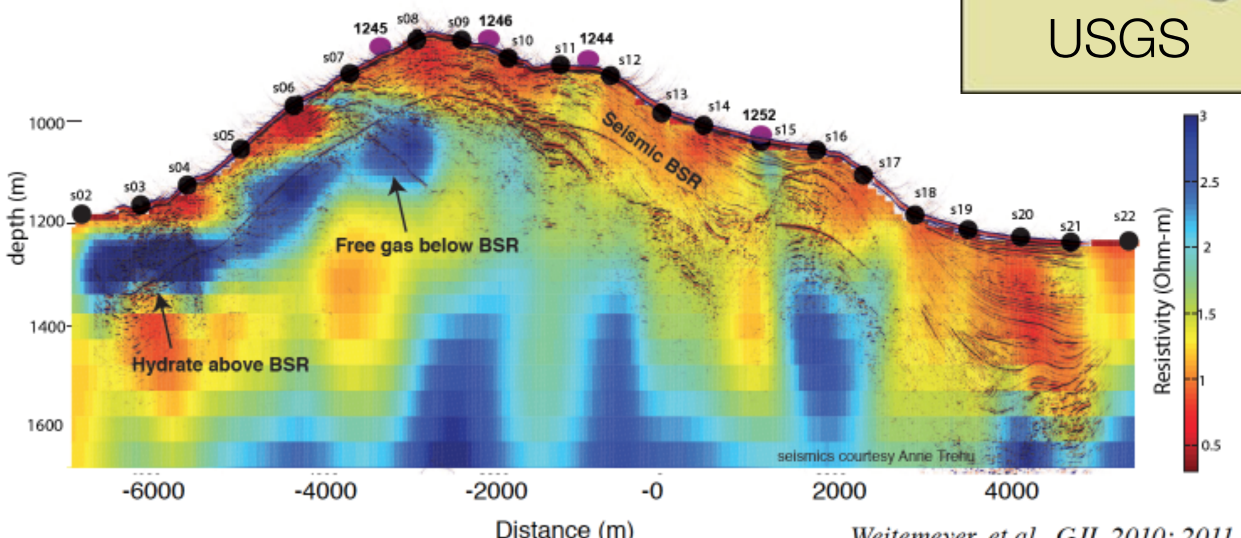




The Future: Marine EM

- Gas hydrates
  - Resistivity is diagnostic

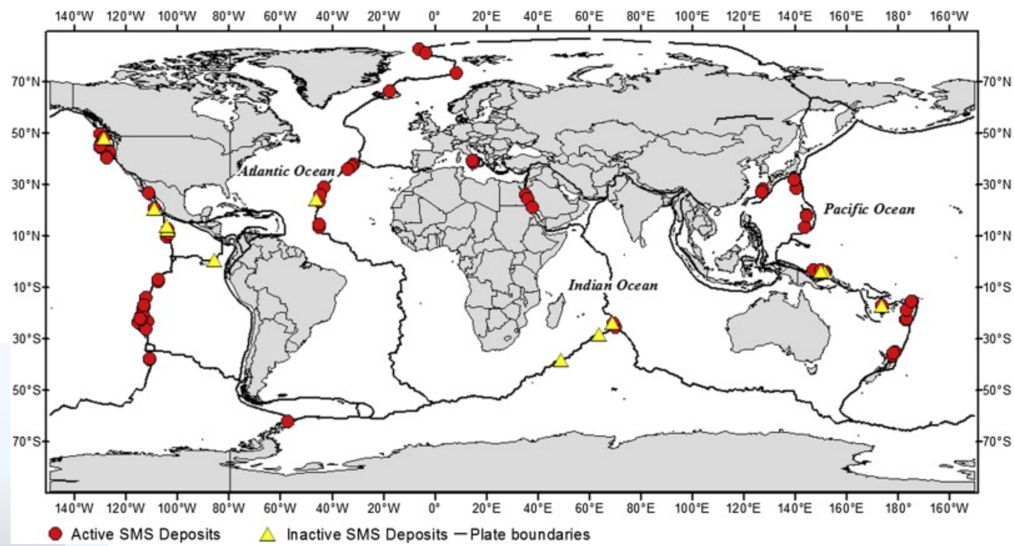


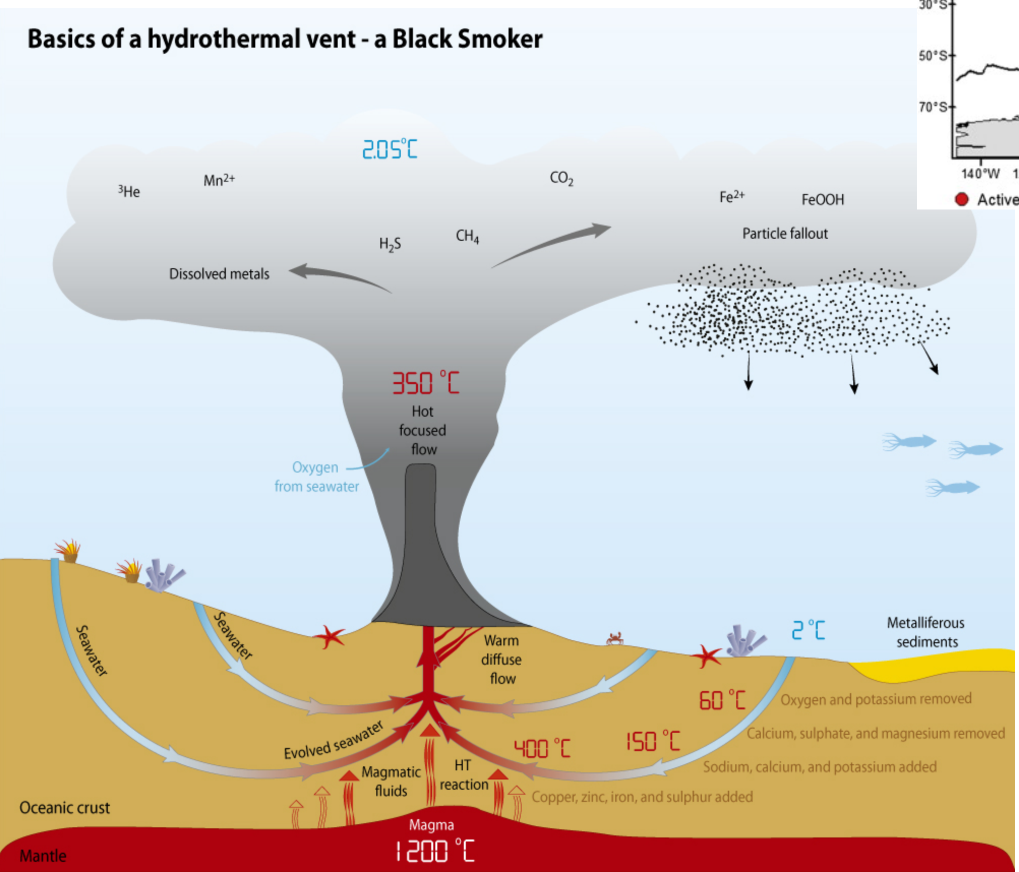


Weitemeyer, et al., GJI, 2010; 2011

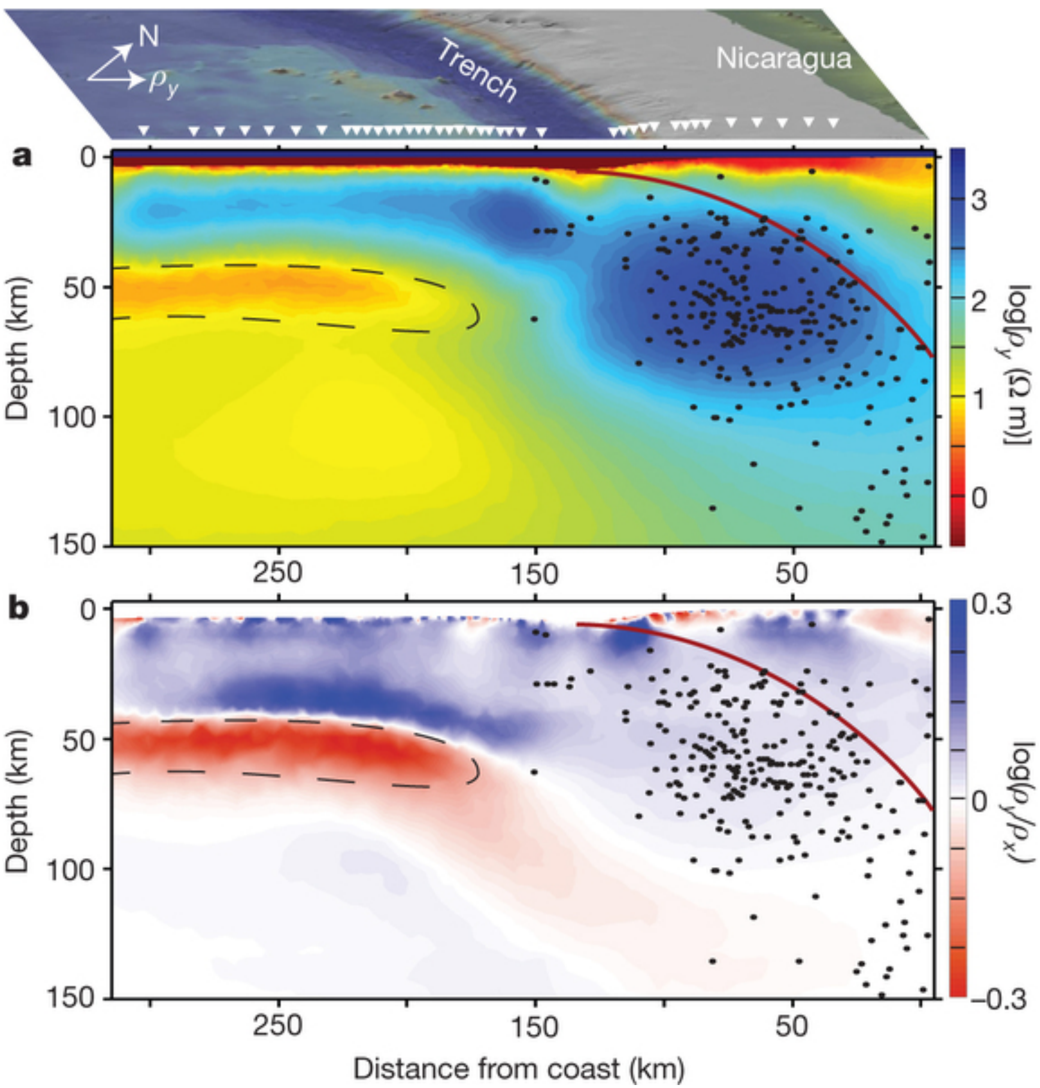
The Future: Marine EM

- Submarine massive sulfides
  - Conductive relative to background





The Future: Marine EM

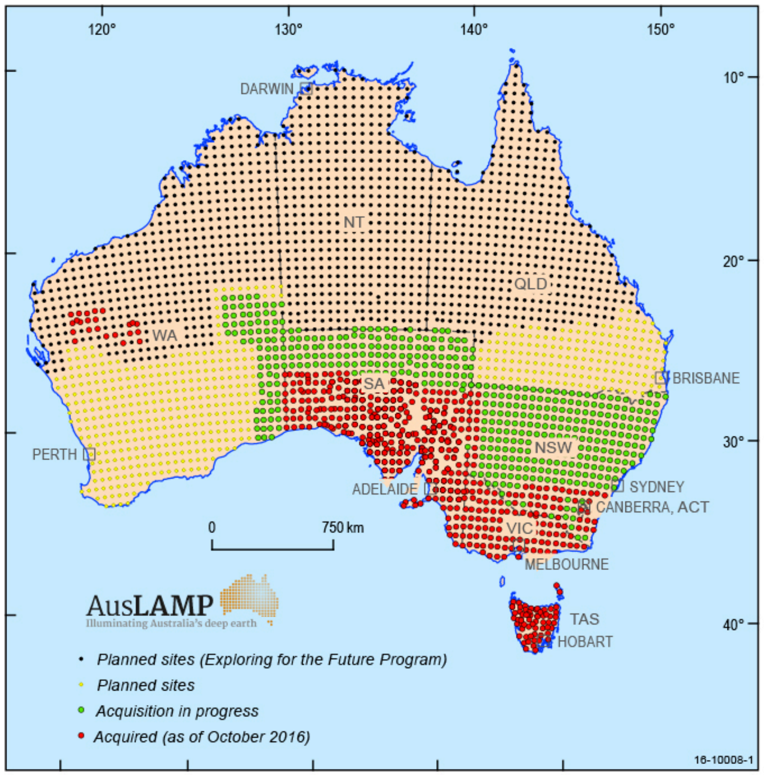


- Tectonic studies
- Large anisotropy
  - indicative of melt-rich channel

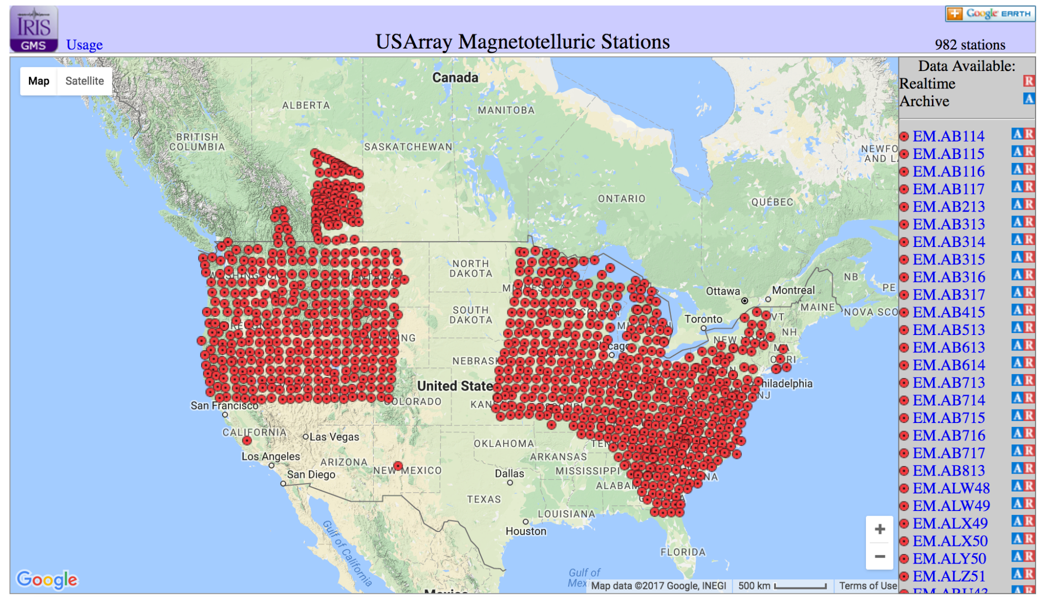
Naif et al., 2013

The Future: Large Scale MT

AusLamp

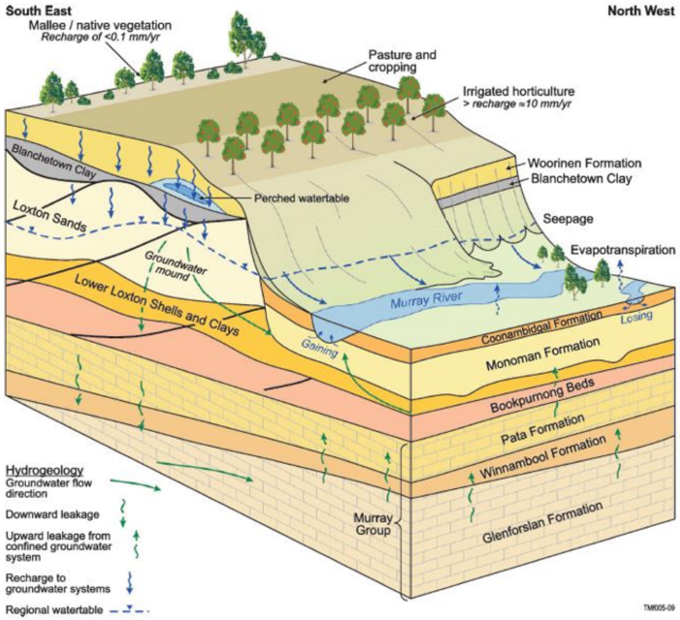


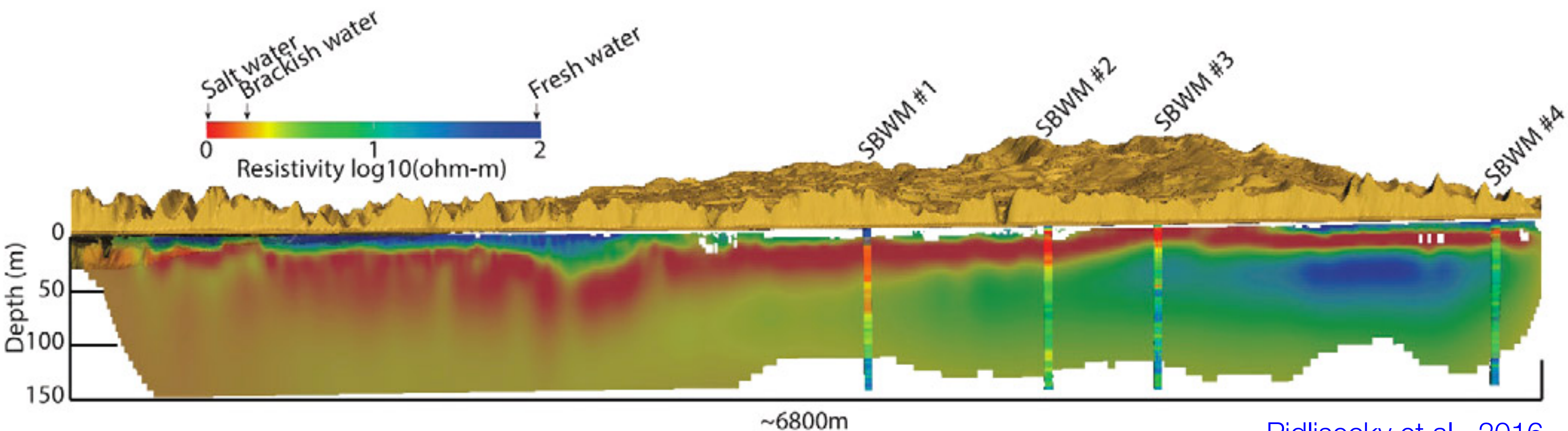
Earth scope



The Future: Water

- Finding and delineating water
- Aquifer monitoring and management
- Salt water intrusions
- Pollutants

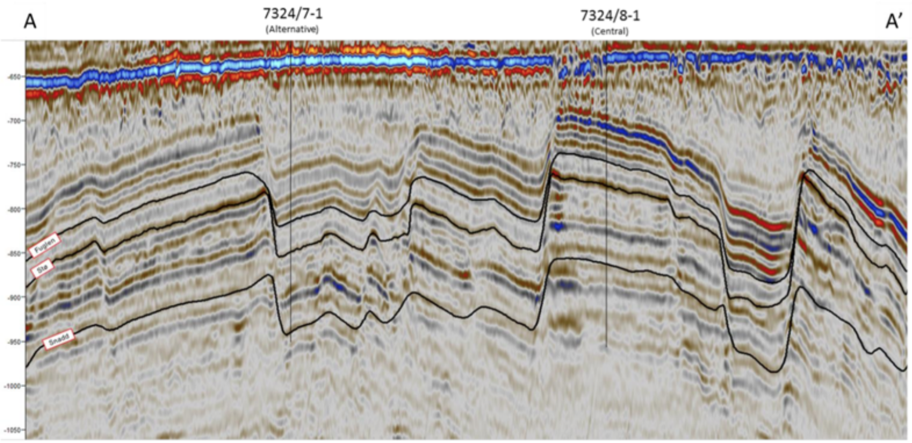




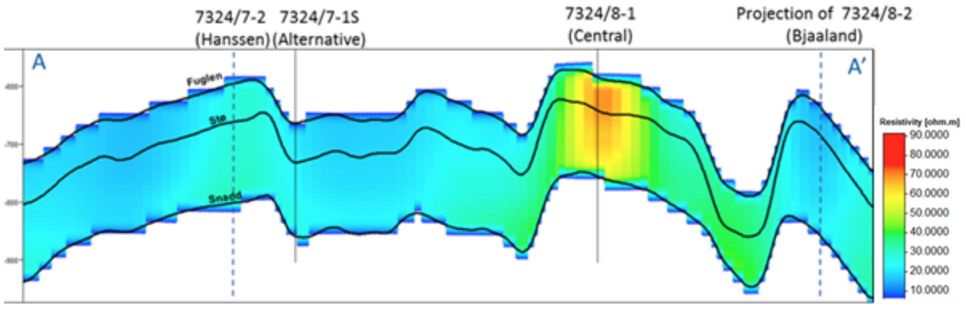
Pidlisecky et al., 2016

The Future: Data Integration & Multi-physics

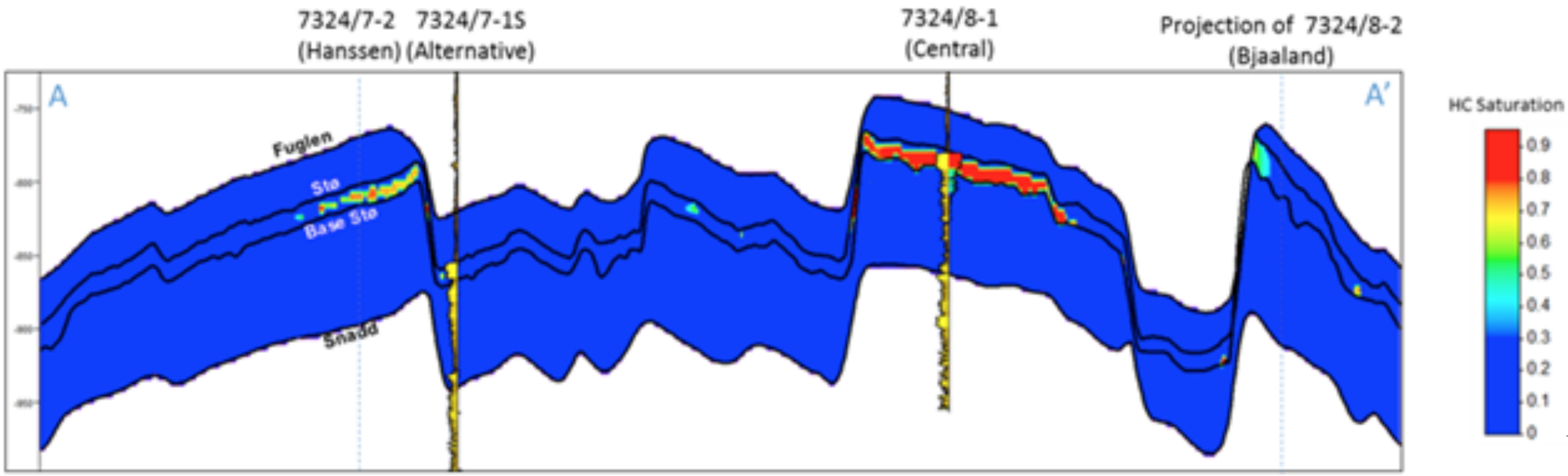
Seismic



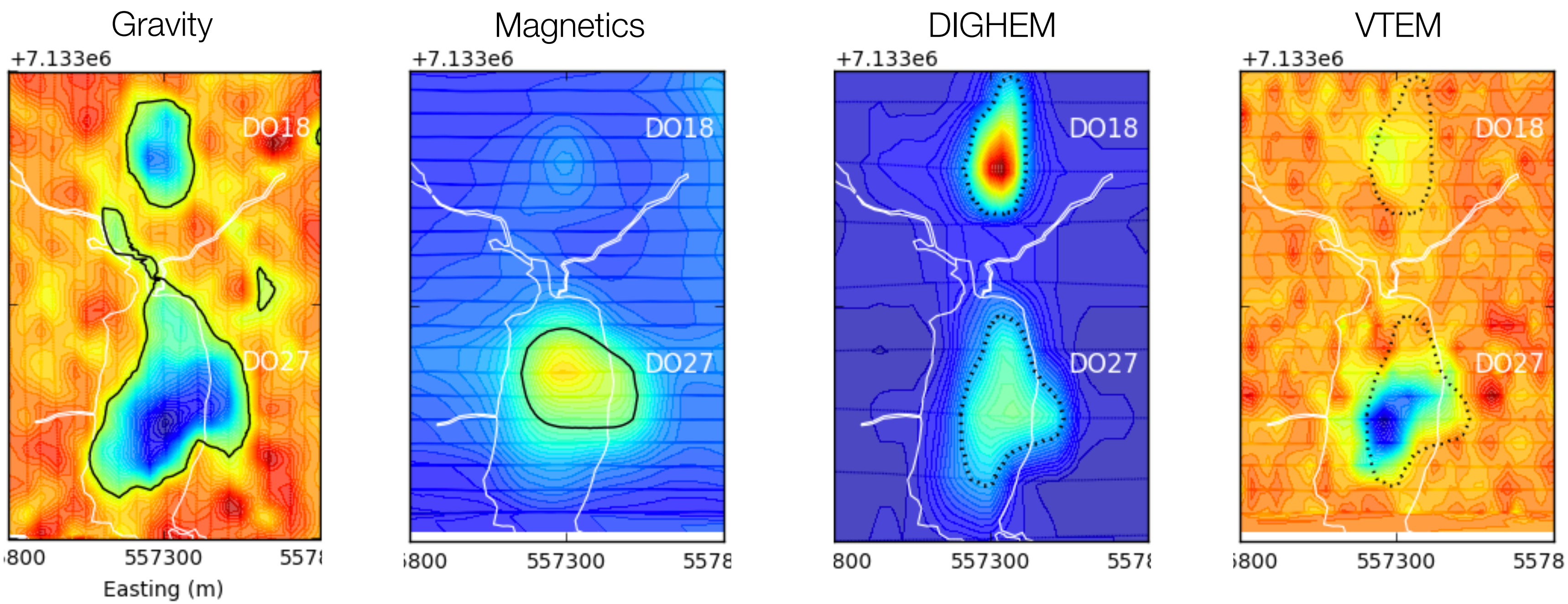
EM



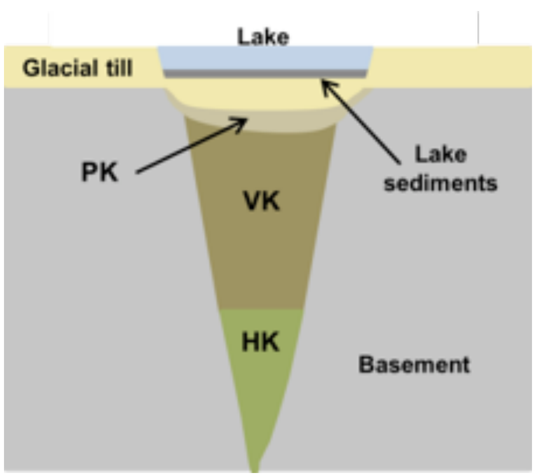
Final hydrocarbon saturation model

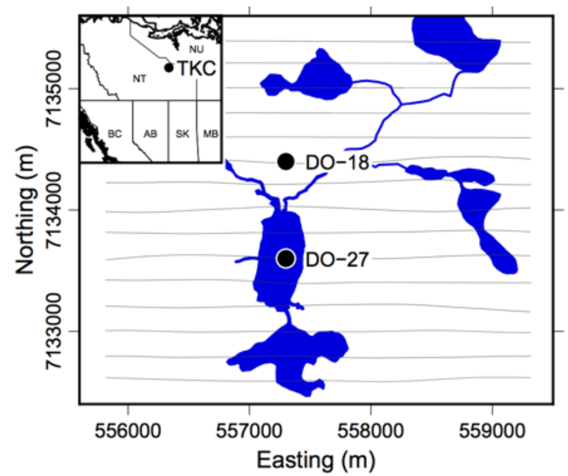


The Future: Data Integration & Multi-physics

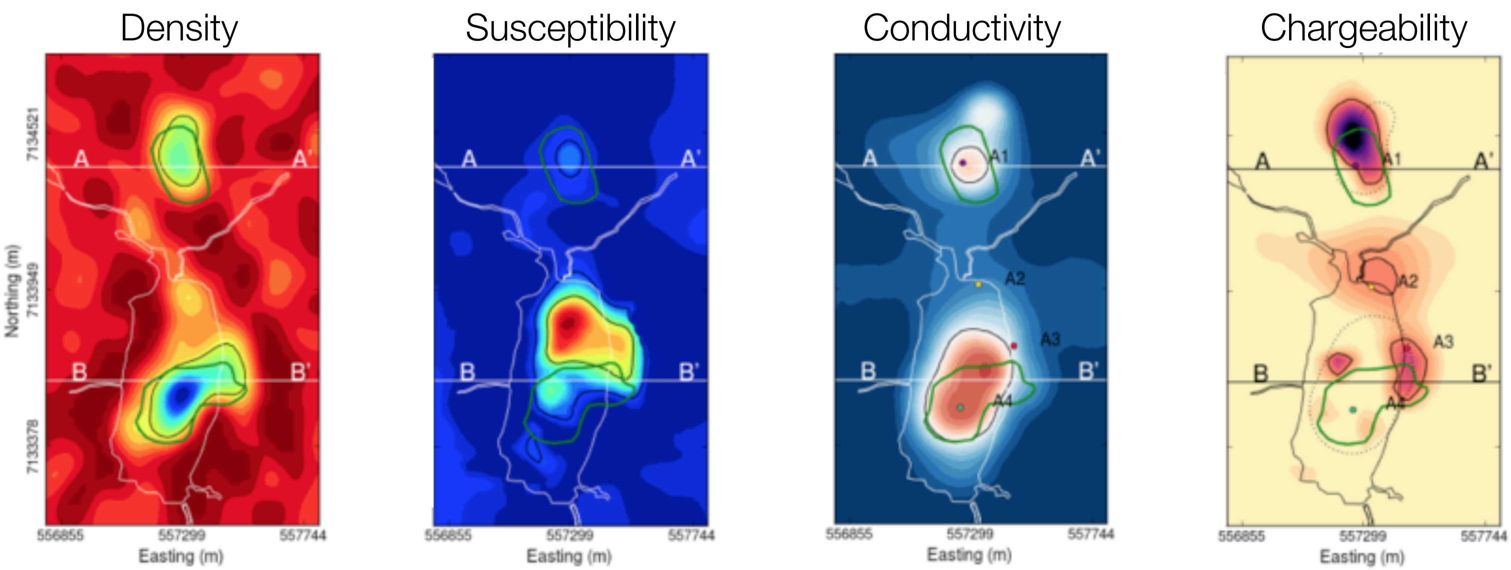


Kimberlite Model

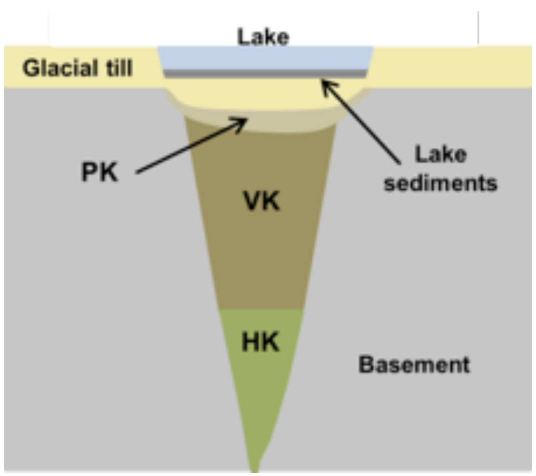




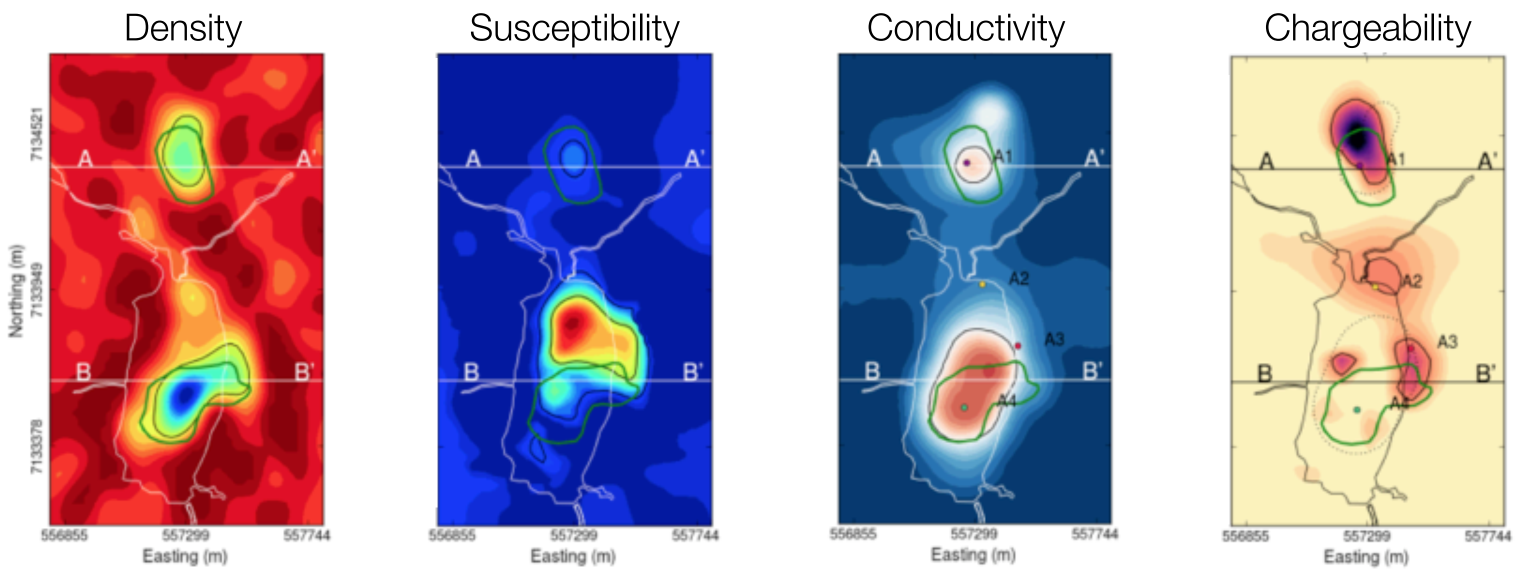
The Future: Data Integration & Multi-physics



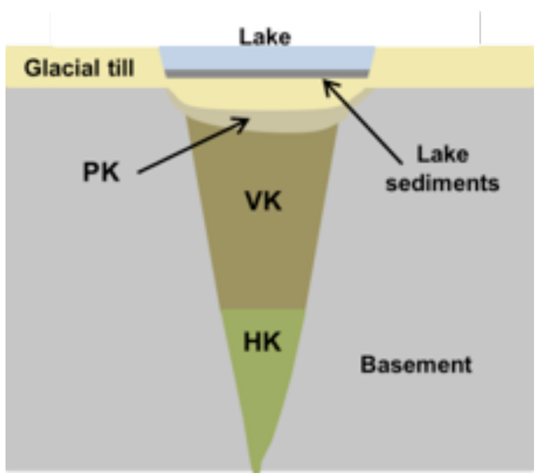
Kimberlite Model



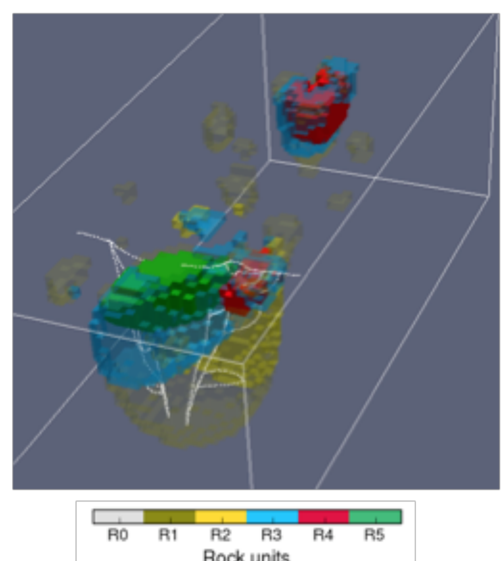
The Future: Data Integration & Multi-physics



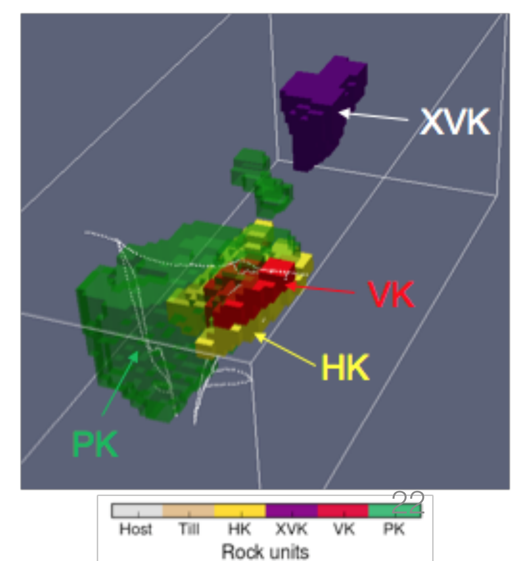
Kimberlite Model



Rock Model from Geophysics

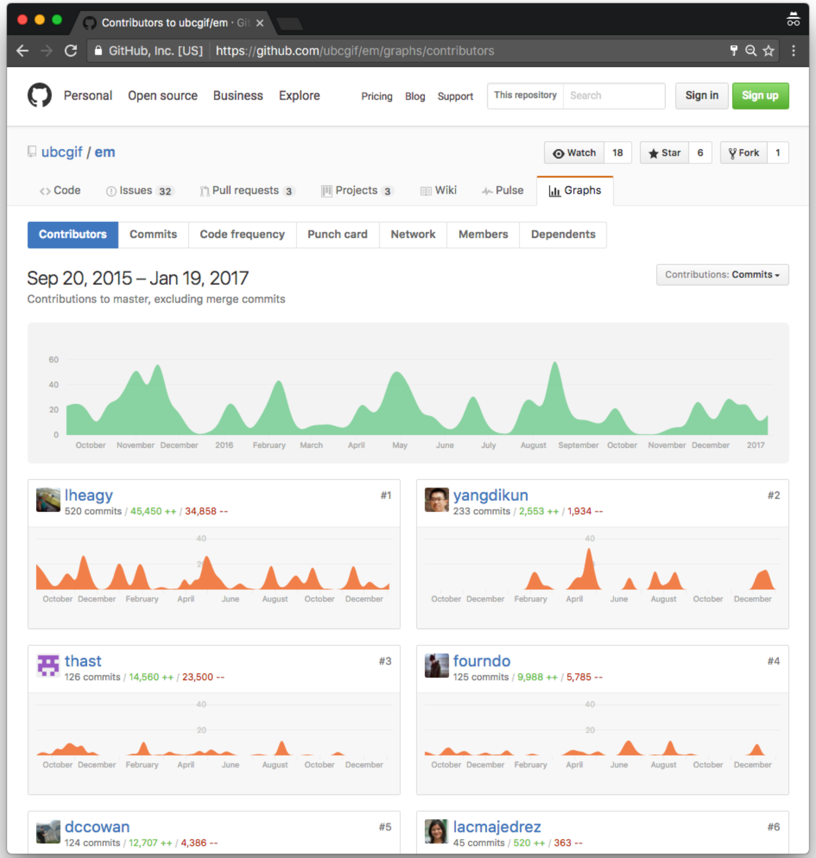


Rock Model from Drilling



The Future: Modelling and Inversion

- HPC, Cloud computing
- Collaborative development
- Open source

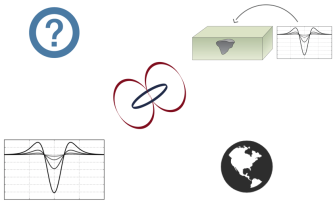


simpeg

Simulation and Parameter Estimation in Geophysics
http://simpeg.xyz

Github	Travis CI	Jupyter	Creative Commons	Python
versioning, collaborating	testing, deploy	interactive computing	licensing, reuse	computation

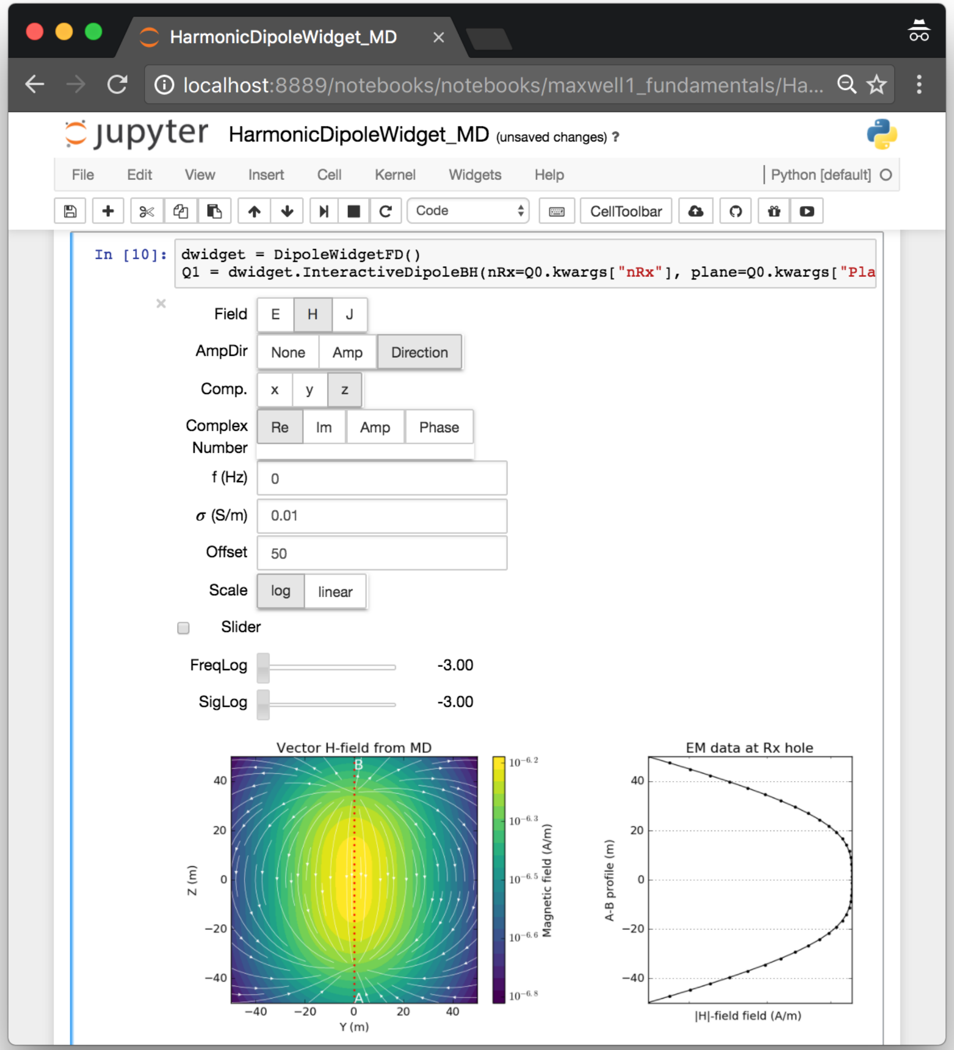
The Future: Modelling and Inversion



- Interactive computing
- Visualization

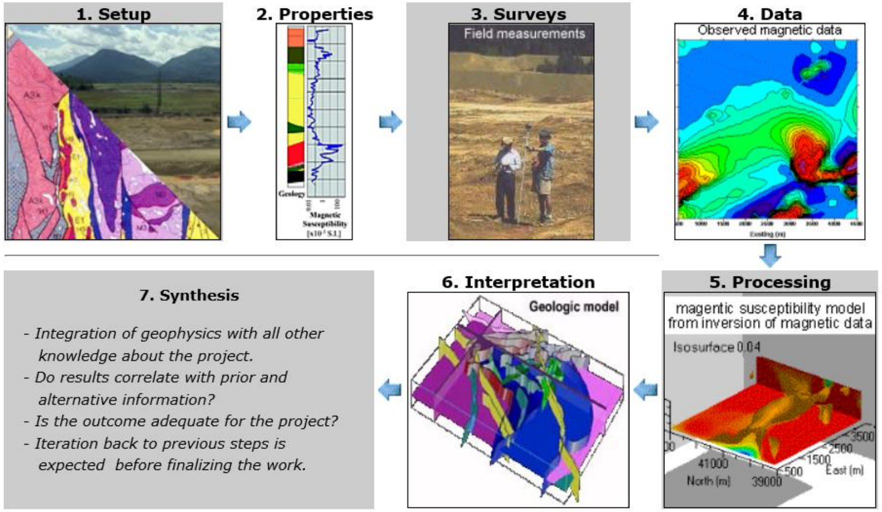
$$\nabla \times \mathbf{e} = -\frac{\partial \mathbf{b}}{\partial t}$$

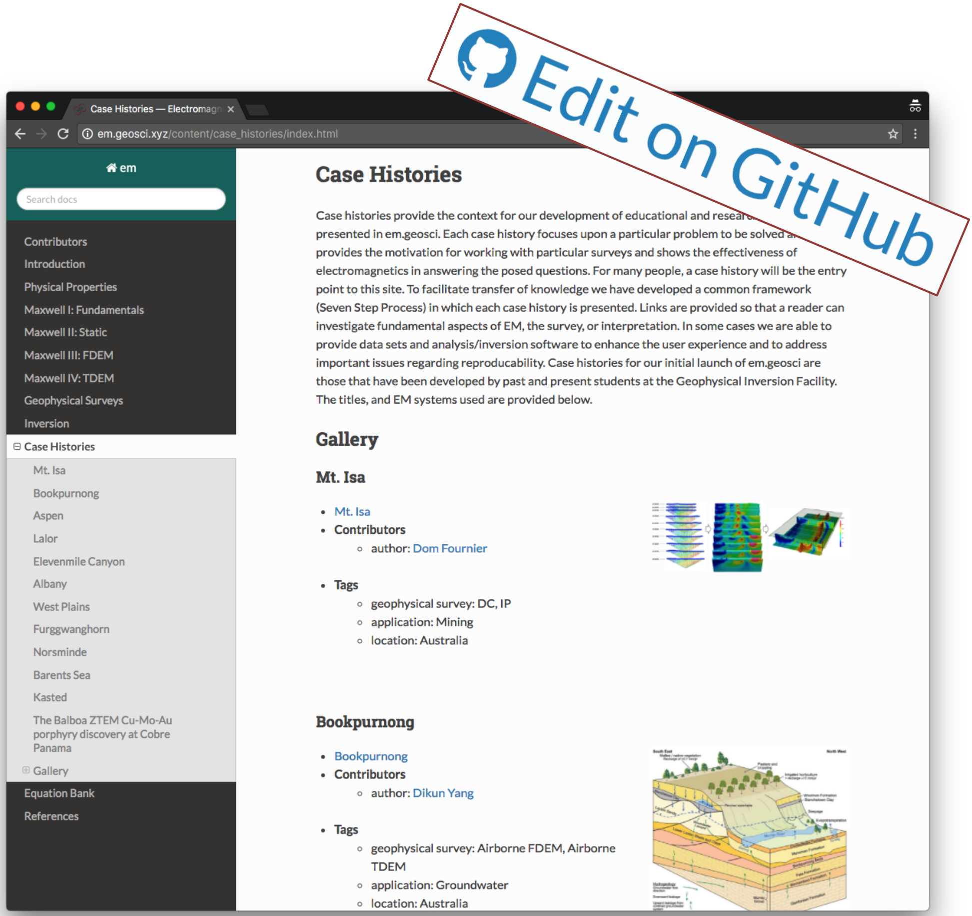
$$\nabla \times \mathbf{h} = \mathbf{j} + \frac{\partial \mathbf{d}}{\partial t}$$



http://em.geosci.xyz/apps.html

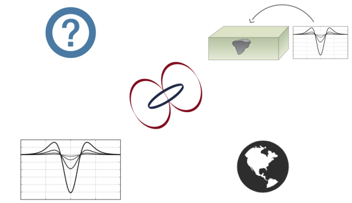
The Future: Collaboration





http://slack.geosci.xyz

Goals for the DISC



- Inspire
  - See the variety of potential applications
  - Illustrate effectiveness using case histories
- Build a foundation
  - Basic principles of EM
  - Exploration and visualization with Interactive apps
  - Open source resource: http://em.geosci.xyz
- Set realistic expectations
- Promote development of an EM community
  - Open source software
  - Capturing case histories world-wide

Resources

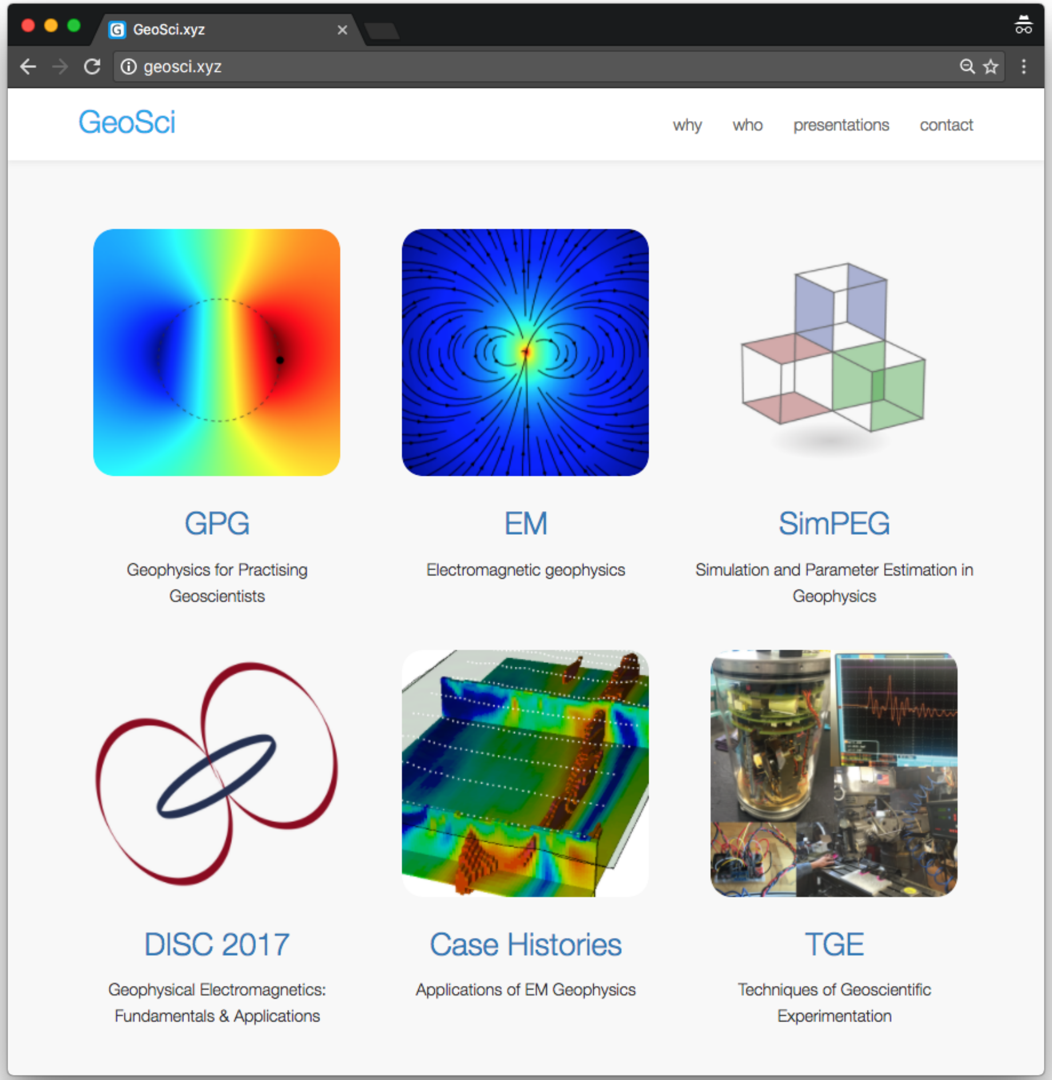
- GeoSci

  http://geosci.xyz

  - Web-textbooks
  - Software
  - Apps

- Apps:

  http://em.geosci.xyz/apps.html



GIF DISC Team


doug

lindsey

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UBC GIF Team


Thibaut

Patrick

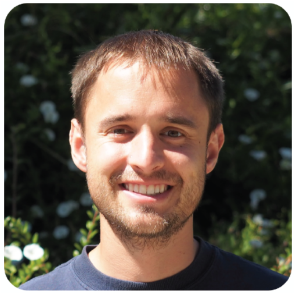
Rowan

Devin

Kris

Sarah


Dom

Mike

Mike

Gudni

Dikun

Join us tomorrow at DISC Lab

- Tell us what you are doing
- How EM is (or could!) play a role in the solution
- Continue the conversations
- Connect with other geoscientists
- Contribute to the development of a community

http://disc2017.geosci.xyz

Thank You!

http://disc2017.geosci.xyz