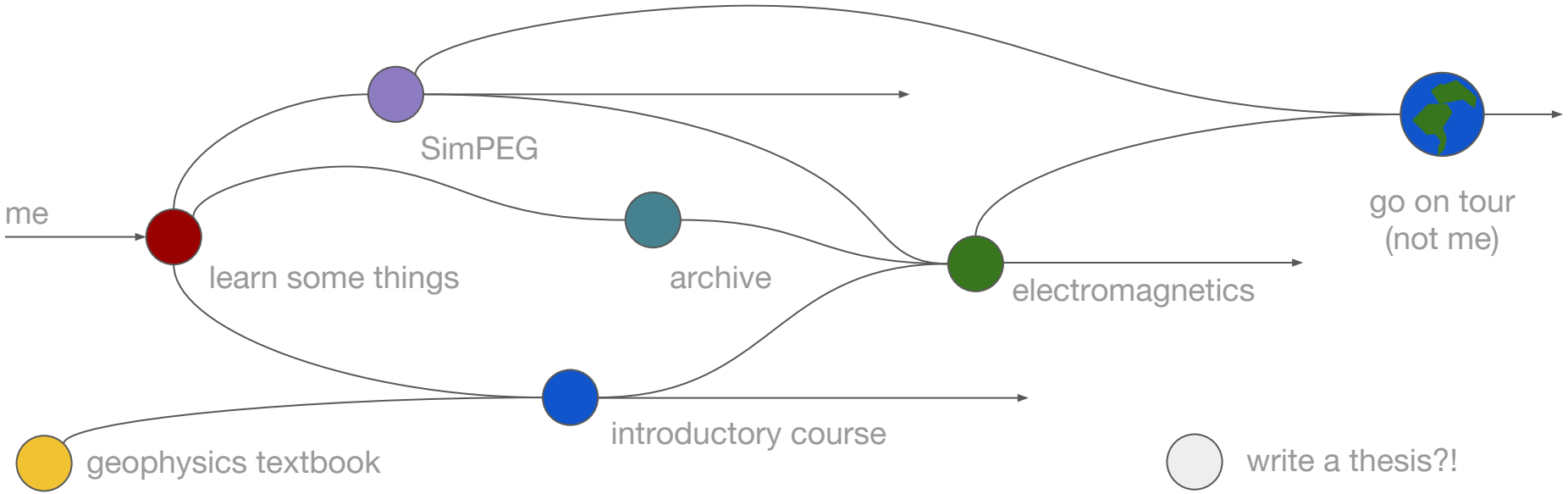
Using open source tools to refactor geoscience education

Lindsey Heagy
& GeoSci Team


SimPEG
me
learn some things
archive
electromagnetics
go on tour
(not me)
introductory course
geophysics textbook
write a thesis?!



UBC


gpg

GIF



SEG
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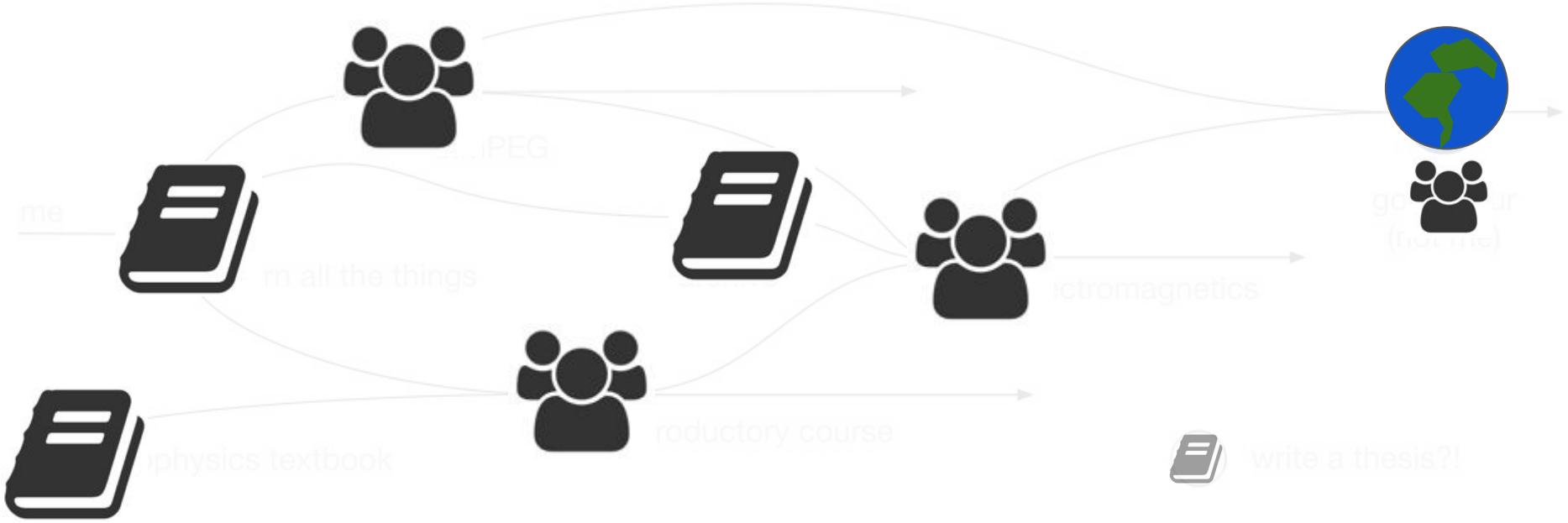

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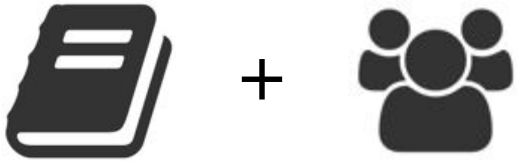

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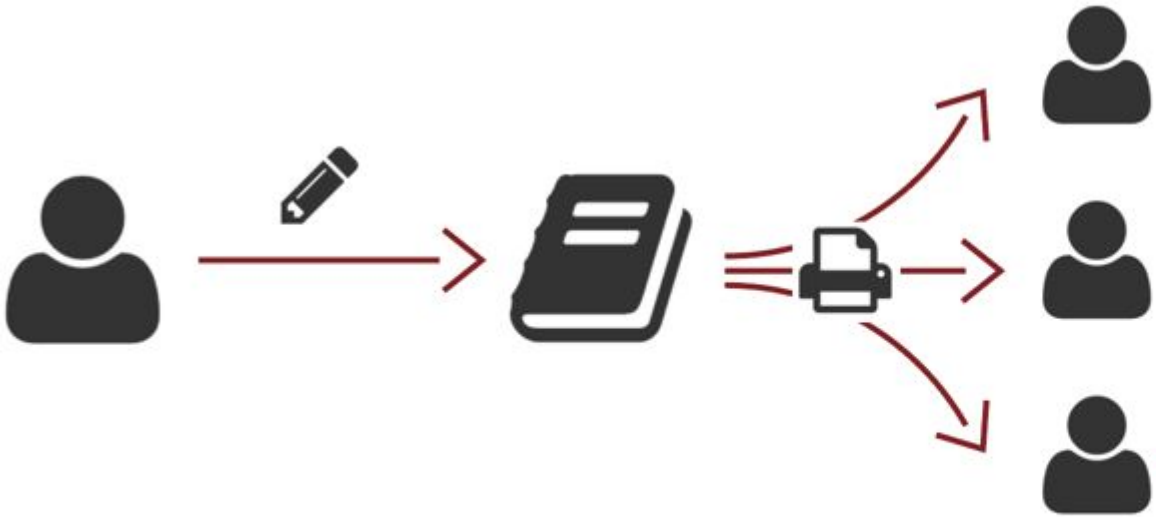

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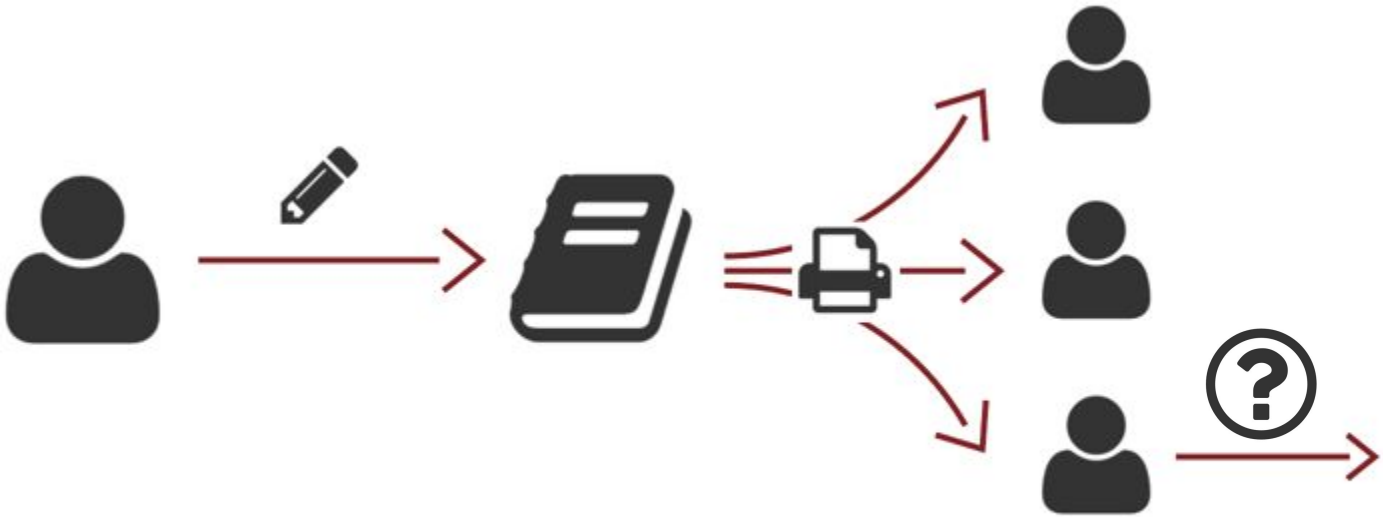

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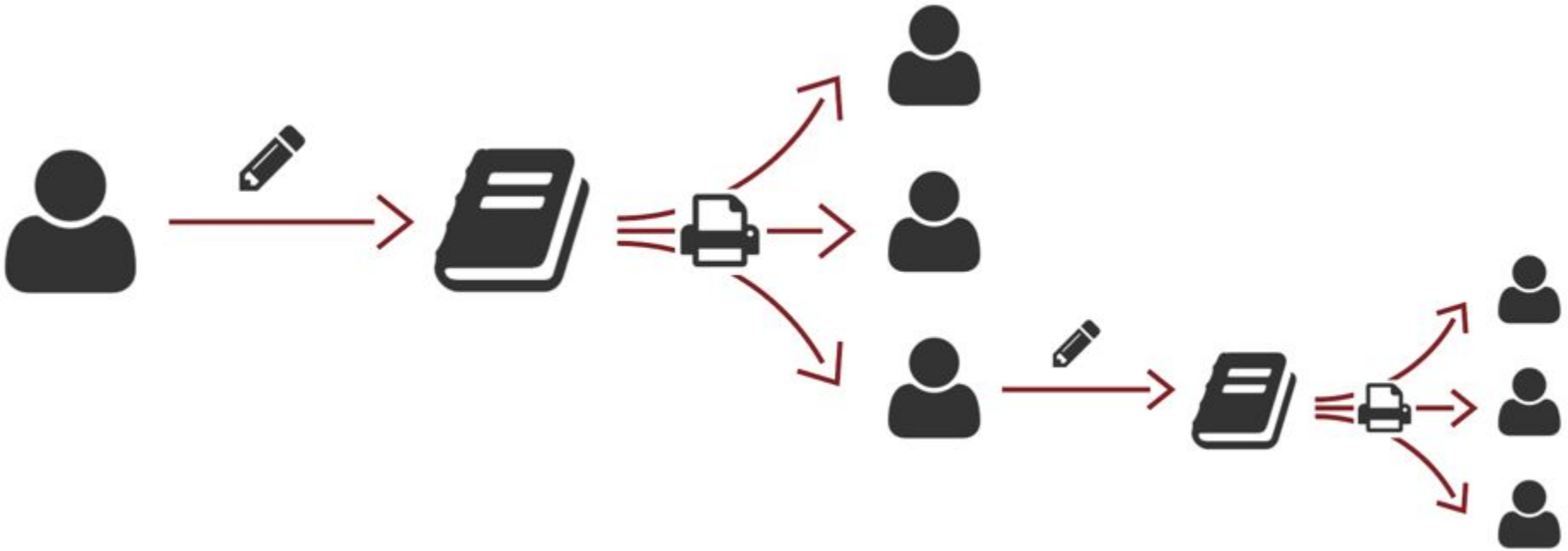
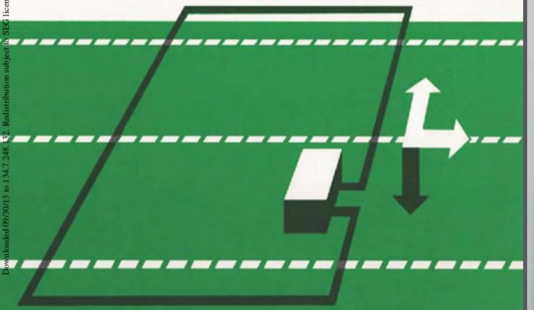


INVESTIGATIONS IN GEOPHYSICS NO. 3

ELECTROMAGNETIC METHODS IN APPLIED GEOPHYSICS

VOLUME 2, APPLICATION, PARTS A AND B

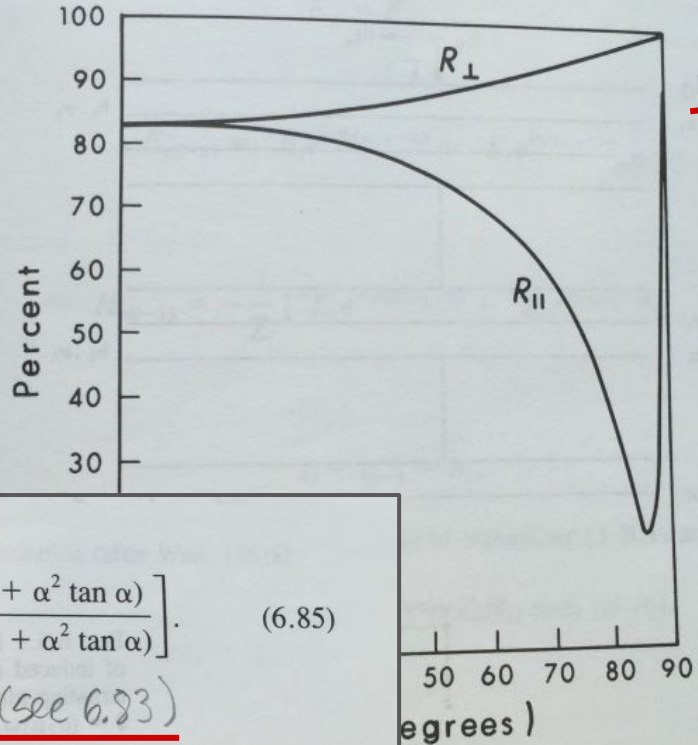
EDITED BY MISAC N. NABIGHIAN



SOCIETY OF EXPLORATION GEOPHYSICISTS

(3.91)

The angle that this equation satisfies is known as the Brewster angle. For reflection from a conductive surface, there will be a minimum in $R_{\parallel}$, analogous to the Brewster angle, for some particular angle of incidence. No such minimum occurs in $R_{\perp}$ (Stratton, 1941, p. 508). Figure 3.3 illustrates these features.



missing factor of 400
ie if
$\sigma_{seawater} = \frac{3}{400}$ S/m
you get this figure

$R_{\perp}$ versus angle of incidence for plane waves at permitivity of sea water are taken to be 3 S/m, H_z (after Stratton, 1941).

in which

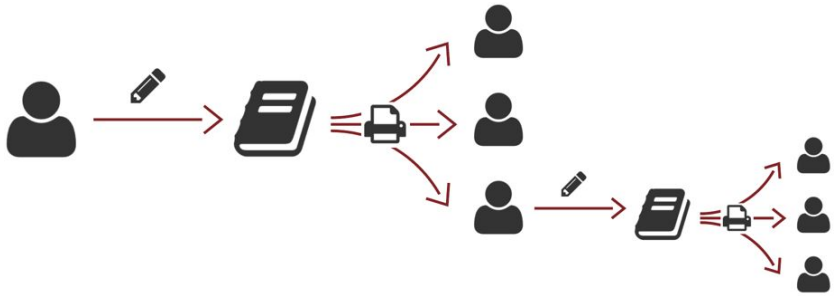
$$M - iN = \left[\frac{2\mu_2(\tan\alpha - \alpha) - \mu_1(\alpha - \tan\alpha + \alpha^2\tan\alpha)}{2\mu_2(\tan\alpha - \alpha) + 2\mu_1(\alpha - \tan\alpha + \alpha^2\tan\alpha)}\right]. \qquad (6.85)$$

should be + (see 6.83)

The field is given by

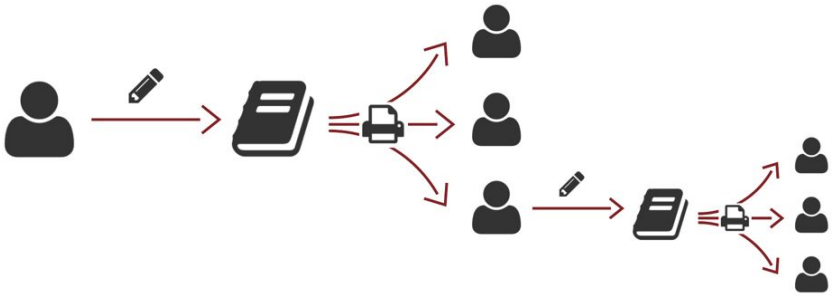
$$\mathbf{H} = H_0 R^3 (M - iN)\frac{(2x^2 - y^2 - z^2)\mathbf{u}_x + 3xy\mathbf{u}_y + 3xz\mathbf{u}_z}{r^5}, \qquad (6.86)$$

currently

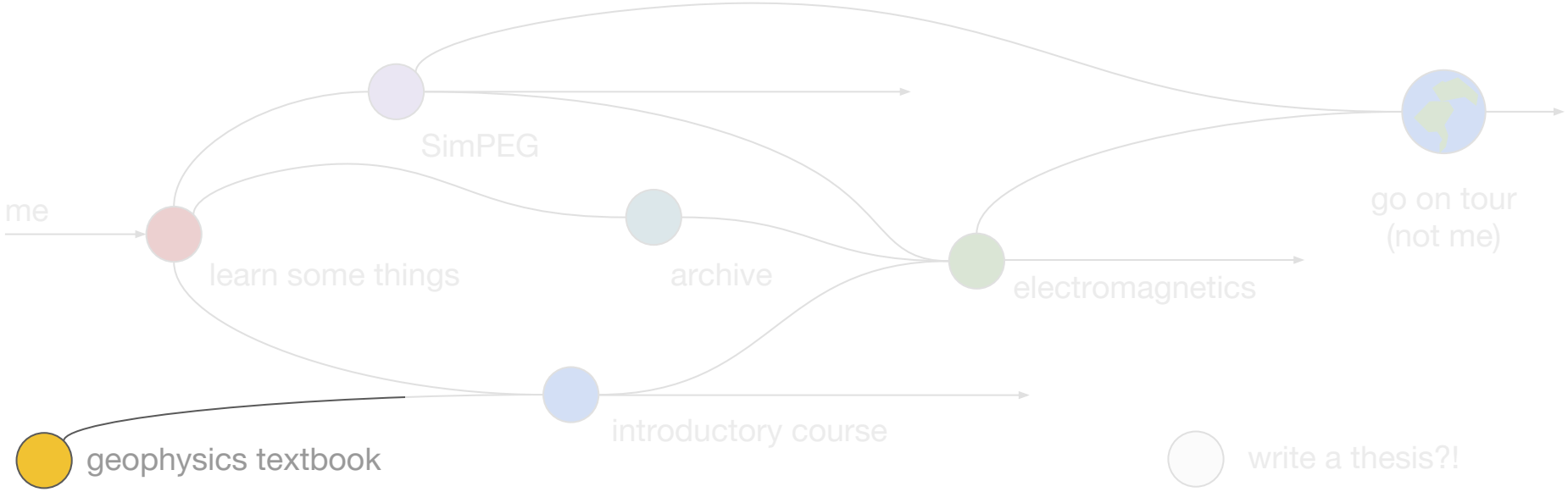


- Bugs
- Reviewed by ~2 people
- No discussion / issue board?
- How did they make that figure?
- Is it Current? out of date?
- Limited input / feedback
- Reuse is limited
    - copy paste writing
    - licensing restrictions

- Roadmap? Is there one?
- Who do I ask? are there stewards of this work?
- Limited collaboration opportunities
    - 1 or 2 (the good ones have 2)
- Diff? What changed in this version?
    - version 1 is in the used book store and is $100 cheaper. What changed? - only question order?



this is a
problem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Geophysics for Practicing

https://www.eoas.ubc.ca/courses/eosc350/content/index.htm

The UBC
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Geophysics for Practicing Geoscientists

GPG Contents

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1. + **GPG Welcome**
2. + **Foundations**
3. + **Geophysical surveys**
4. + **Inversion concepts**
5. + **Exercises**
6. + **Case histories**
7. + **Sftwr & manuals**
8. + **Resources/Ref's**

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Geophysics for Practising Geoscientists; Learning Resources about Applied Geophysics

Version 1.0 (2007/11)

**by Francis H.M. Jones and D.W. Oldenburg,
University of British Columbia,
Department of Earth and Ocean Sciences.**

Welcome to the GPG resource package for learning about applied geophysics. This collection of resources contains readings and exercises directed at undergraduates in the geosciences who are NOT majoring ingephysics. Basic content was developed for UBC courses EOSC350 and EOSC351. Geophysical inversion materials were developed for applied geophysics courses aimed at geophysics honours students, and graduate students.

The GPG is derived primarily from the IAG resource package (Inversion for Applied Geophysics) developed by F. Jones and D. Oldenburg of the UBC Geophysical Inversion Facility. Content about seismic refraction and GPR were produced specifically for eosc350.

Version 1.0 (2007/11)

Geophysics for Practicing

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DC resistivity surveys

https://www.eoas.ubc.ca/courses/eosc350/content/methods/meth_1/index.htm

AGLO
About & Acknowledgements

DC resistivity

Resources

1. Introduction
2. Measurements and data
3. Principles

Appx I: Instruments
Appx II: Array type
Appx III: Azimuthal res'y
All text only - **PDF**

Activities

a) Using arrays
b) Working with soundings
c) Reading pseudosections
d) Sounding or profiling?
e) Self test quiz

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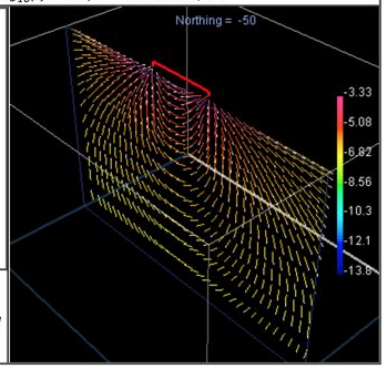
Applied Geophysics Learning Objects
F. Jones, UBC Earth & Ocean Science.

Amperes per square metre (A/m²); so the maximum shown is $Log_{10}(J)$=-3.33, or J=0.000468 A/m².

Top	North	East
slice 1	slice 1	slice 1
slice 2	slice 2	slice 2
slice 3	slice 3	slice 3
slice 4	slice 4	slice 4
slice 5	slice 5	slice 5
slice 6	slice 6	slice 6
slice 7	slice 7	slice 7
slice 8	slice 8 *	slice 8
slice 9	slice 9	slice 9
slice 10	slice 10	slice 10
slice 11	slice 11	slice 11
slice 12	slice 12	slice 12
slice 13	slice 13	slice 13
	slice 14	slice 14
shell	slice 15	slice 15
	slice 16	slice 16



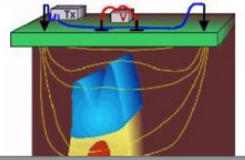
There is no need to click: moving your mouse over the links simulates animations.

Vector plots of current distribution were generated using 3D EM modeling code developed by the UBC Geophysical Inversion Facility.

Normally the earth is NOT uniform. Galvanic currents will flow *towards* regions of high conductivity and *away from* regions of high resistivity, as illustrated in Figure 2.

Figure 2. Click buttons for images a. through e.

a. The Elura ore body. Depth to top of gossan (in blue) is approximately 100 m.
b. A DC resistivity survey involves injecting current at one location and measuring resulting potentials at another location.
c. Current will flow. Current density increases within conductive regions, and decreases within resistive regions.
d. Charges build up at interfaces between regions of different electrical conductivity.
e. Variations in charge distribution are detected as variations in distribution of potential, or voltage, at the surface.



Elura Orebody Electrical resistivities

Rock Type	Ohm-m
Overburden	12
Host rocks	200
Gossan	420
Mineralization (pyritic)	0.6

starting points

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https://www.eoas.ubc.ca/courses/eosc350/content/index.htm

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GIF

gpg

SEG
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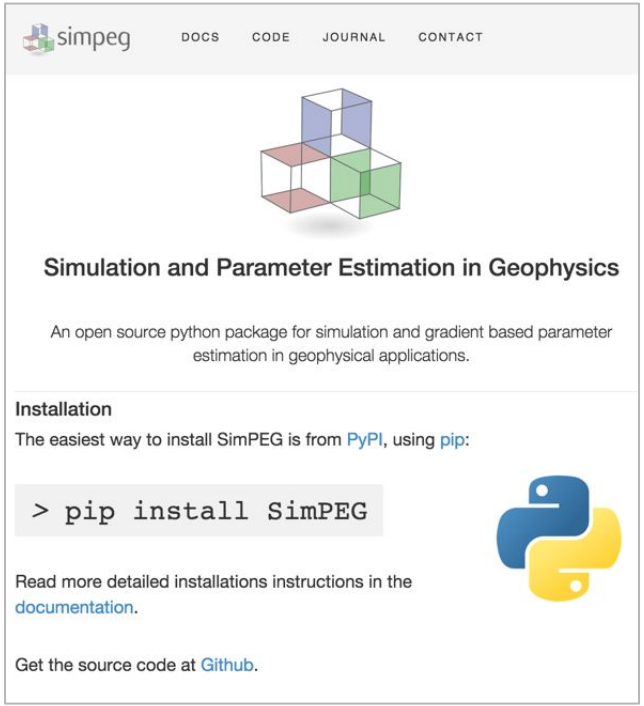
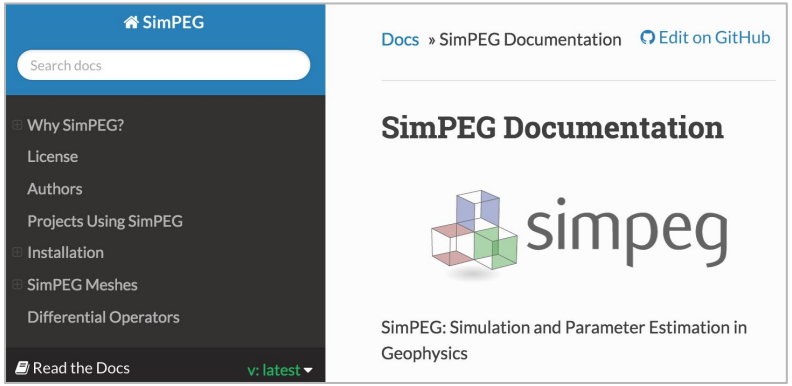
simpeg

starting points

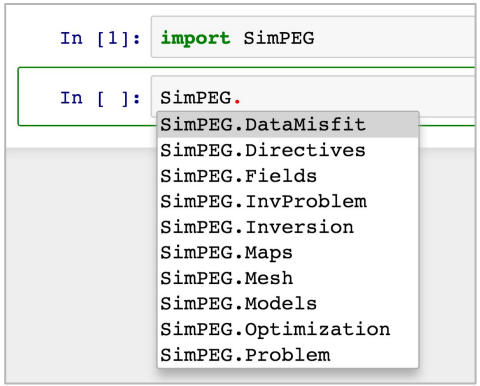
pypi v0.1.3 | downloads 832/month | license MIT | build passing | coverage 77%

http://simpeg.xyz





Package	State
SimPEG	✔
SimPEG.EM	✔
SimPEG.FLOW	↻
simpegMT	↻
simpegDC	⚗
simpegPF	⚗
simpegSEIS	🔧
simpegGPR	🔧




Rowan


Seogi


Lindsey

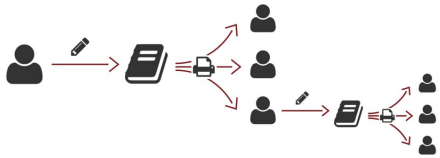

Guðni

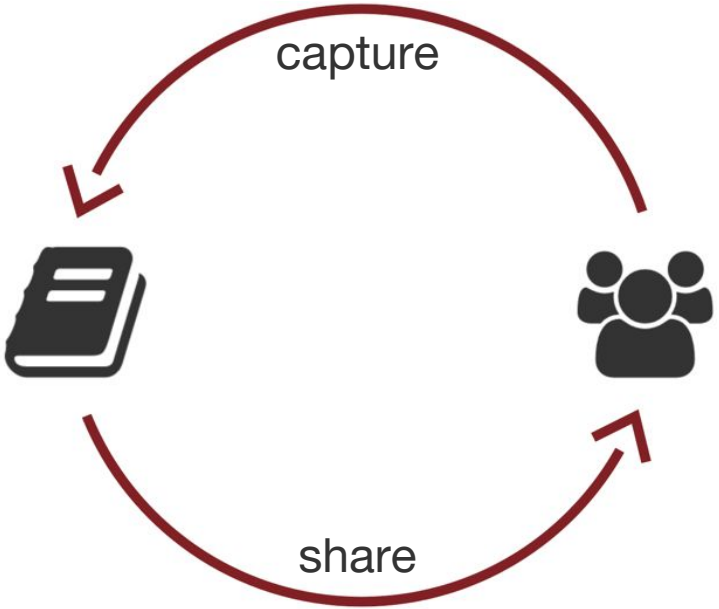

Brendan


Adam


Doug


Contributors





- iterate in place
- versioned
- reproducible
- tested
- collaborative
- track issues
- continuous peer review
- feedback
- interoperable
- extensible
- multiple media types
- ...

practices

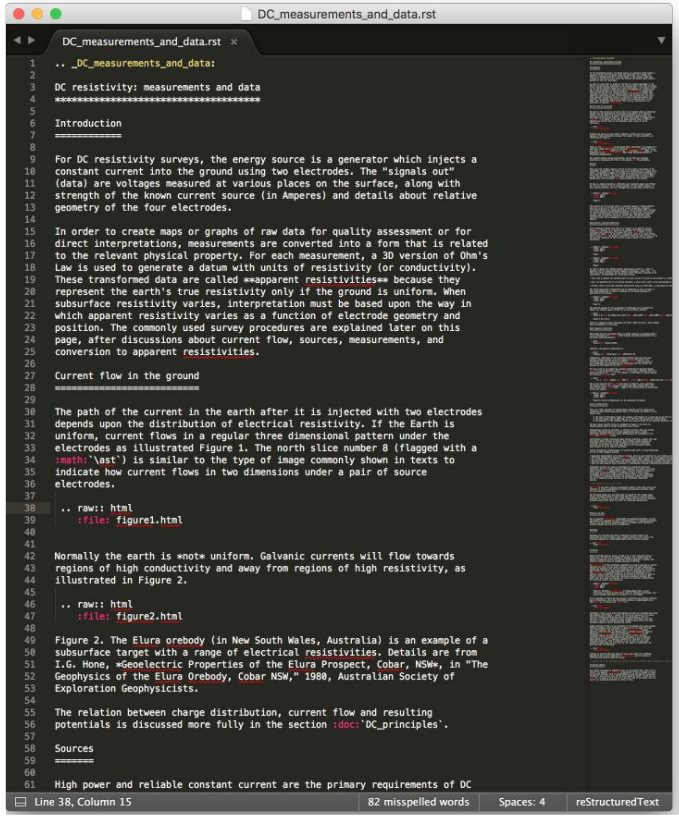
- versioning
- issue tracking
- peer review
- pull requests
- forking
- testing
- deployment
- licensing

tools

- git
- Github
- Sphinx
- Read the Docs
- Travis CI
- PyPi
- licenses
- Google App Engine

for → def

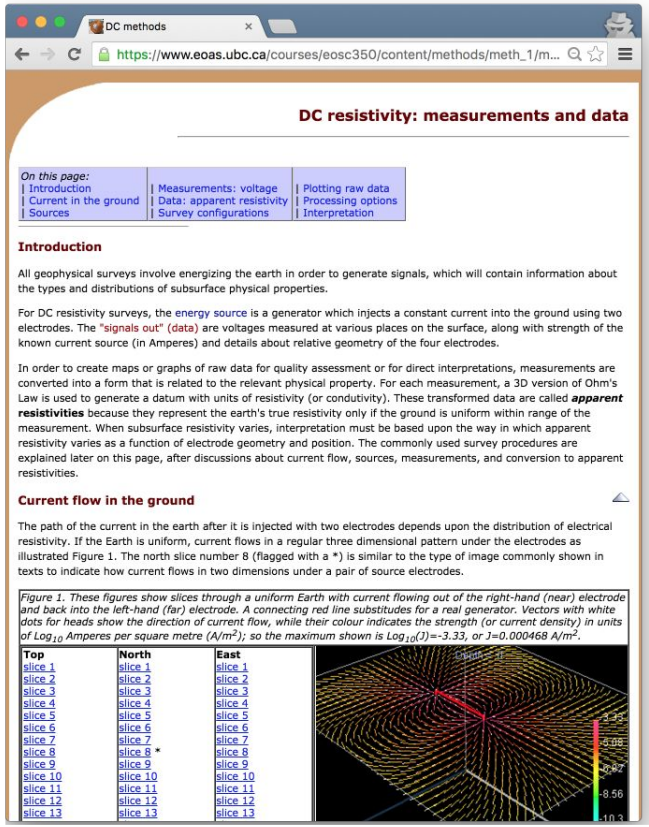
separate style and data

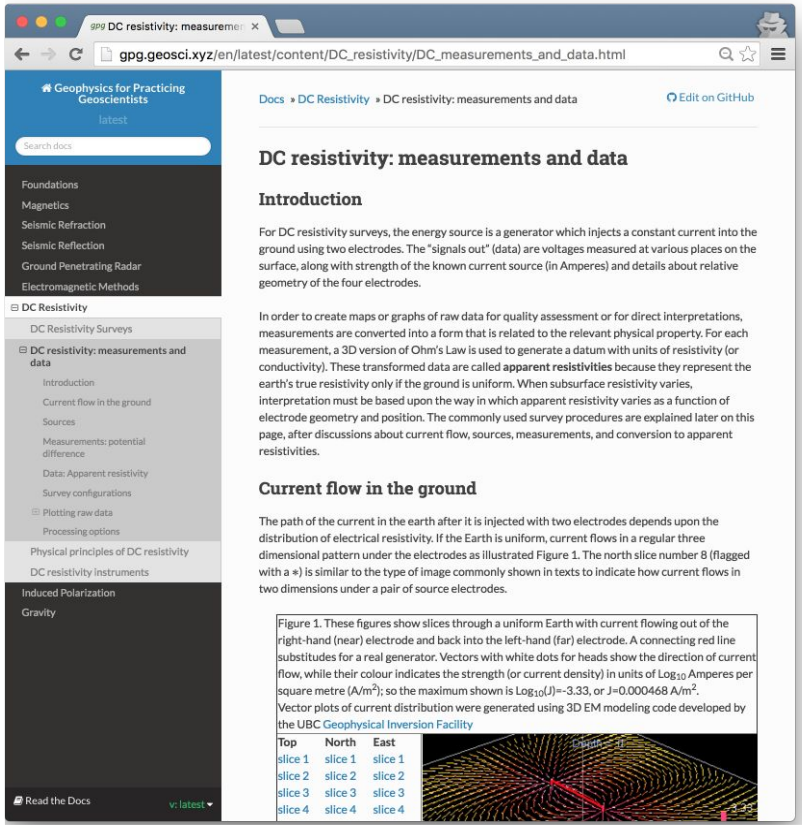


`html + css + javascript + text`

`my_data`

separate style and data





`html + css + javascript + text`

`html = sphinx(my_data, style='nicer')`

capture inputs and functions

electrostatic_sphere.rst

```
Potentials
----------

Assuming an x-directed uniform electric field and zero potential at infinity,
the integration from :eq:`V_from_e` gives


.. math::
    V_p = - E_0 x = -E_0 r \cos\theta
    :label: Primary_Potential


.. plot::

    from examples.sphere import *

    sig0 = 10.**-3.         # conductivity of the whole-space in S/m
    sig1 = 10.**-1.         # conductivity of the sphere in S/m
    R    = 50.          # radius of the sphere in m
    E0   = 1.           # inducing field strength in V/m
    n = 50             #level of discretization
    xr = np.linspace(-2.*R, 2.*R, n) # X-axis discretization
    yr = xr.copy()      # Y-axis discretization
    zr = np.r_[0]          # identical to saying `zr = np.array([0])`
    XYZ = ndgrid(xr,yr,zr) # Space Definition

    fig, ax = plt.subplots(1,1, figsize = (8,6))
    ax = Plot_Primary_Potential(XYZ,sig0,sig1,R,E0,ax)

    plt.show()

The total potential outside the sphere :math:`(r > R)` is

.. math::
    V_1 = -E_0 \big(1 - \frac{R^3}{r^3}\frac{\sigma_1 - \sigma_0}{\sigma_1 + 2\sigma_0} \b
    :label: totalP_outside

and inside the sphere :math:`(r < R)`

.. math::
    V_2 = -E_0 \frac{3\sigma_0}{\sigma_1+2\sigma_0}r \cos\theta
    :label: totalP_inside


.. plot::

    from examples.sphere import *

    sig0 = 10.**-3.         # conductivity of the whole-space in S/m
    sig1 = 10.**-1.         # conductivity of the sphere in S/m
    sig2 = 10.**-5.         # conductivity of the sphere in S/m
    R    = 50.          # radius of the sphere in m
    E0   = 1.           # inducing field strength in V/m
    n = 50             #level of discretization
    xr = np.linspace(-2.*R, 2.*R, n) # X-axis discretization
    yr = xr.copy()      # Y-axis discretization
    dx = xr[1]-xr[0]       # mesh spacing
    dy = yr[1]-yr[0]       # mesh spacing
    zr = np.r_[0]          # identical to saying `zr = np.array([0])`
    XYZ = ndgrid(xr,yr,zr) # Space Definition
```

Comparing against : HEAD, Line 470, Column 1 | 431 misspelled words | Spaces: 4 | reStructured

Conducting sphere in a uni

em.geosci.xyz/content/maxwell2_dc/fields_from_grounded_sources_dcr/electrostatic...

EM.geosci | Why | Contents | « Current sourc... | Point current... » | Search

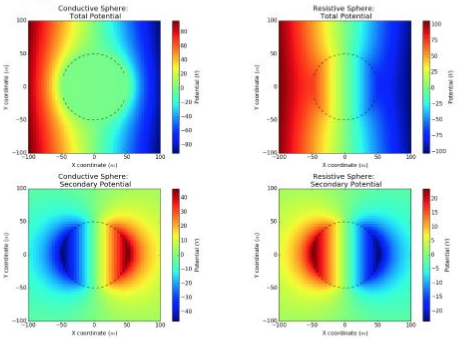
(Source code, png, hires.png, pdf)

Conducting sphere in a uniform electric field

- Setup
- Governing Equations
- Potentials
- Electric Field
- Current Density
  - Secondary Current
- Charge Accumulation
- Data
- Building some Intuition for DC problem

Question, Issues

Edit page



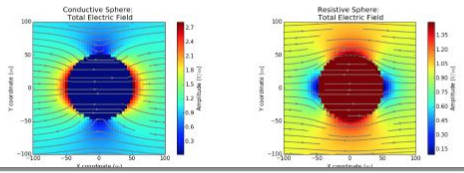
Electric Field

When an external electric field crosses conductivity discontinuities within heterogeneous media, it leads to charge buildup on the interface, which immediately gives rise to a secondary electric field governed by Gauss's Law, to oppose the change of the primary field. Considering that the electric field is defined as the negative gradient of the potential, according to (6) and (7), the electric field at any point (x,y,z) is

$$E_1 = E_0\hat{\mathbf{x}} + E_0\frac{\sigma_1-\sigma_0}{\sigma_1+2\sigma_0}\frac{R^3}{r^5}\left[(2x^2-y^2-z^2)\hat{\mathbf{x}} + (3xy)\hat{\mathbf{y}} + (3xz)\hat{\mathbf{z}}\right] \quad (r > R) \tag{8}$$

$$E_2 = E_0\frac{3\sigma_0}{\sigma_1+2\sigma_0}\hat{\mathbf{x}} \quad (r < R) \tag{9}$$

(Source code, png, hires.png, pdf)



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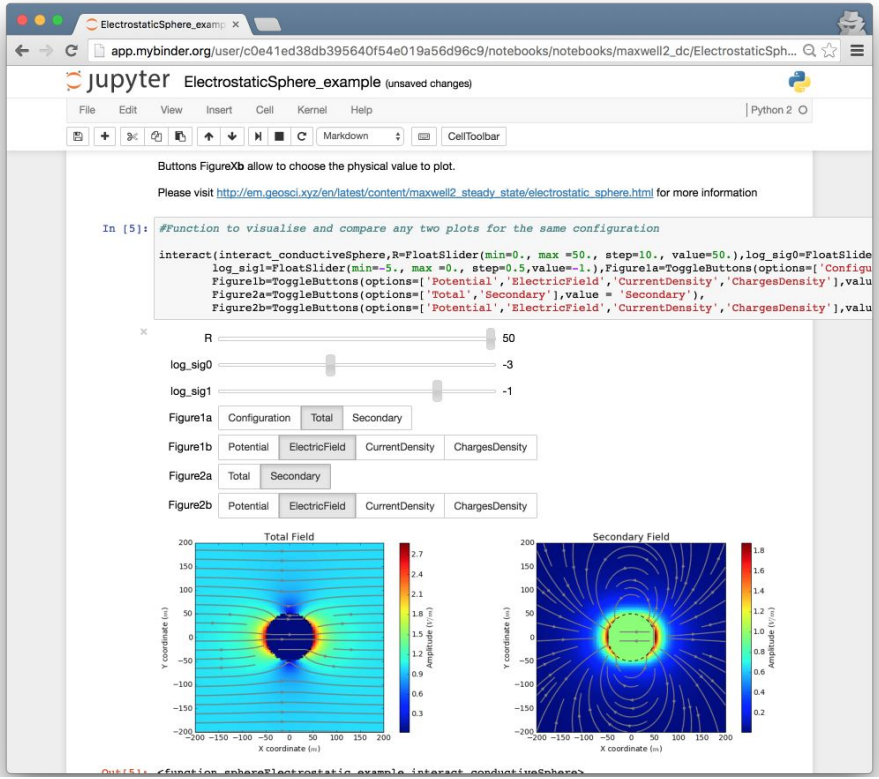
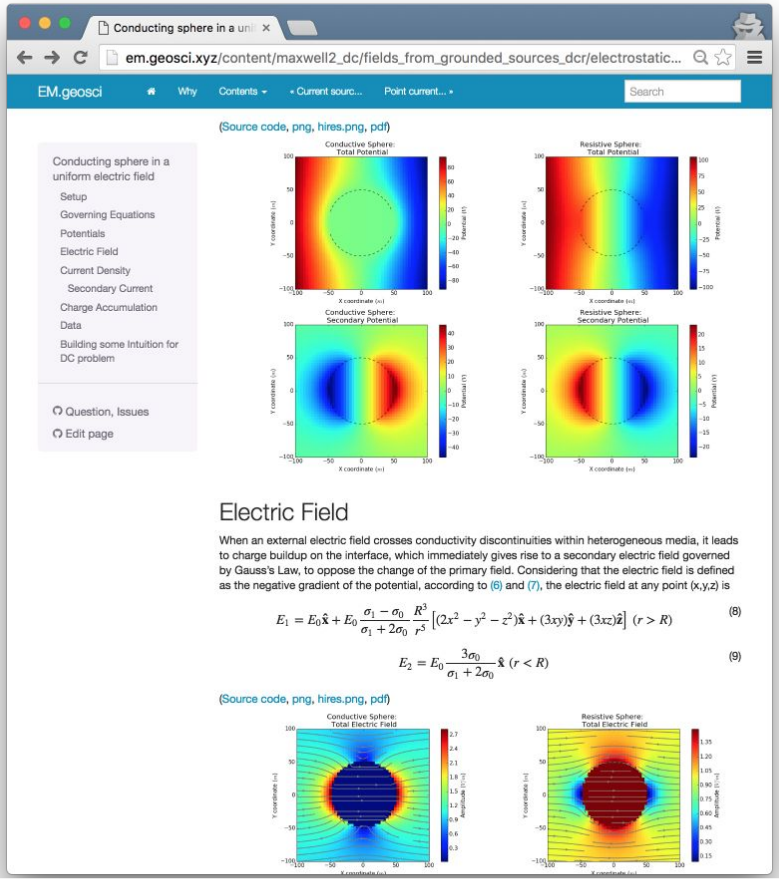
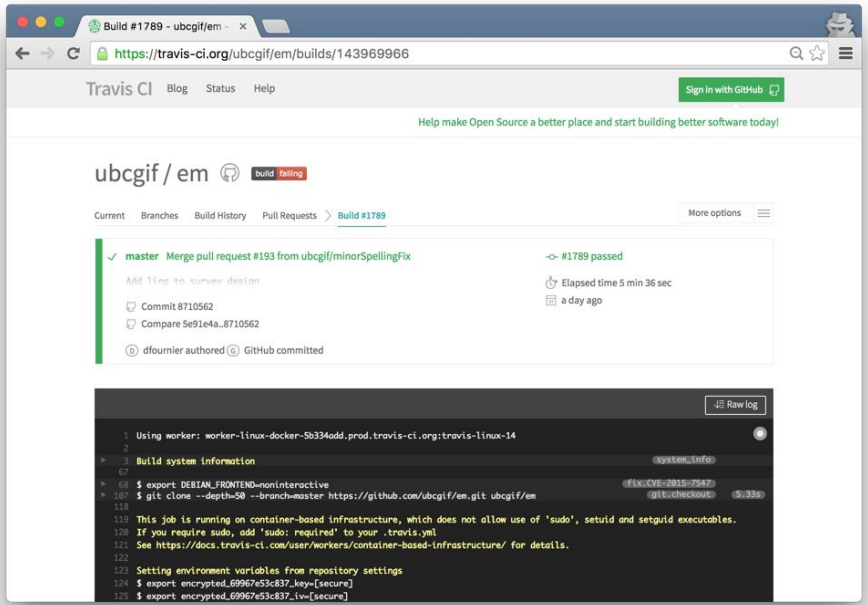
change inputs

refactoring

launch binder






Build #1789 - ubcgif/em
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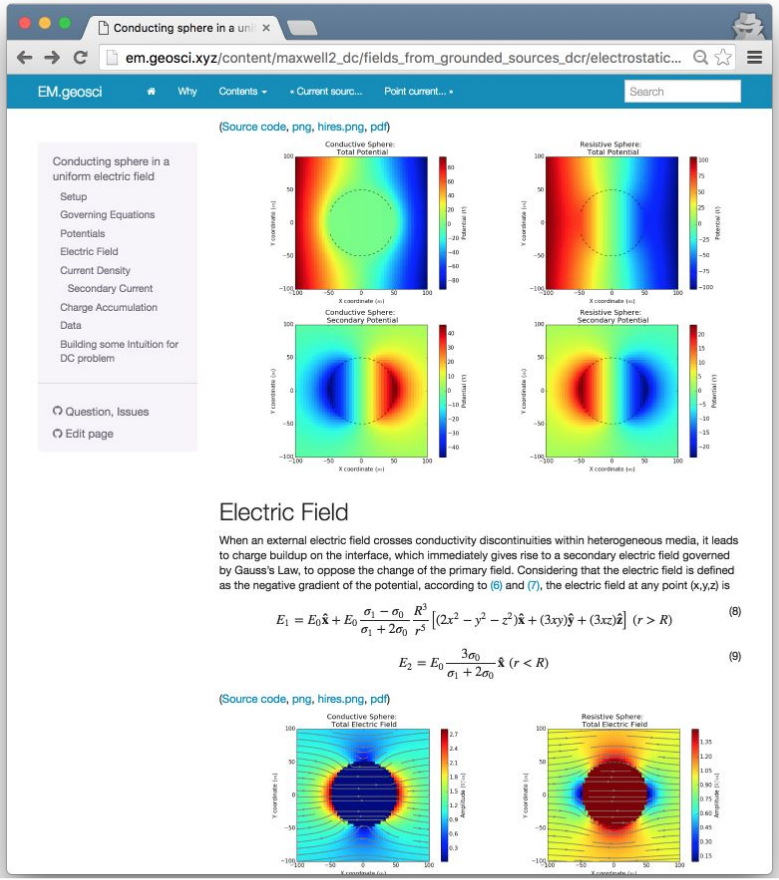
Travis CI
Blog
Status
Help
Sign in with GitHub
Help make Open Source a better place and start building better software today!
ubcgif / em
build failing
Current
Branches
Build History
Pull Requests
Build #1789
More options
master Merge pull request #193 from ubcgif/minorSpellingFix
#1789 passed
Elapsed time 5 min 36 sec
a day ago
Commit 8710562
Compare 5e91e4a..8710562
dfournier authored
GitHub committed
Raw log
Using worker: worker-linux-docker-5b334add.prod.travis-ci.org:travis-linux-14
Build system information
system_info
$ export DEBIAN_FRONTEND=noninteractive
fix.CVE-2015-7547
$ git clone --depth=50 --branch=master https://github.com/ubcgif/em.git ubcgif/em
git.checkout
5.33s
This job is running on container-based infrastructure, which does not allow use of 'sudo', setuid and setgid executables.
If you require sudo, add 'sudo: required' to your .travis.yml
See https://docs.travis-ci.com/user/workers/container-based-infrastructure/ for details.
Setting environment variables from repository settings
$ export encrypted_69967e53c837_key=[secure]
$ export encrypted_69967e53c837_iv=[secure]


Conducting sphere in a uni
em.geosci.xyz/content/maxwell2_dc/fields_from_grounded_sources_dcr/electrostatic...
EM.geosci
Why
Contents
« Current sourc...
Point current... »
Search
Conducting sphere in a uniform electric field
Setup
Governing Equations
Potentials
Electric Field
Current Density
Secondary Current
Charge Accumulation
Data
Building some Intuition for DC problem
Question, Issues
Edit page
(Source code, png, hires.png, pdf)
Conductive Sphere: Total Potential
Resistive Sphere: Total Potential
Conductive Sphere: Secondary Potential
Resistive Sphere: Secondary Potential
Electric Field
When an external electric field crosses conductivity discontinuities within heterogeneous media, it leads to charge buildup on the interface, which immediately gives rise to a secondary electric field governed by Gauss's Law, to oppose the change of the primary field. Considering that the electric field is defined as the negative gradient of the potential, according to (6) and (7), the electric field at any point (x,y,z) is
$E_1 = E_0\hat{\mathbf{x}} + E_0\frac{\sigma_1-\sigma_0}{\sigma_1+2\sigma_0}\frac{R^3}{r^5}\left[(2x^2-y^2-z^2)\hat{\mathbf{x}}+(3xy)\hat{\mathbf{y}}+(3xz)\hat{\mathbf{z}}\right] \quad (r>R)$ (8)
$E_2 = E_0\frac{3\sigma_0}{\sigma_1+2\sigma_0}\hat{\mathbf{x}} \quad (r<R)$ (9)
(Source code, png, hires.png, pdf)
Conductive Sphere: Total Electric Field
Resistive Sphere: Total Electric Field

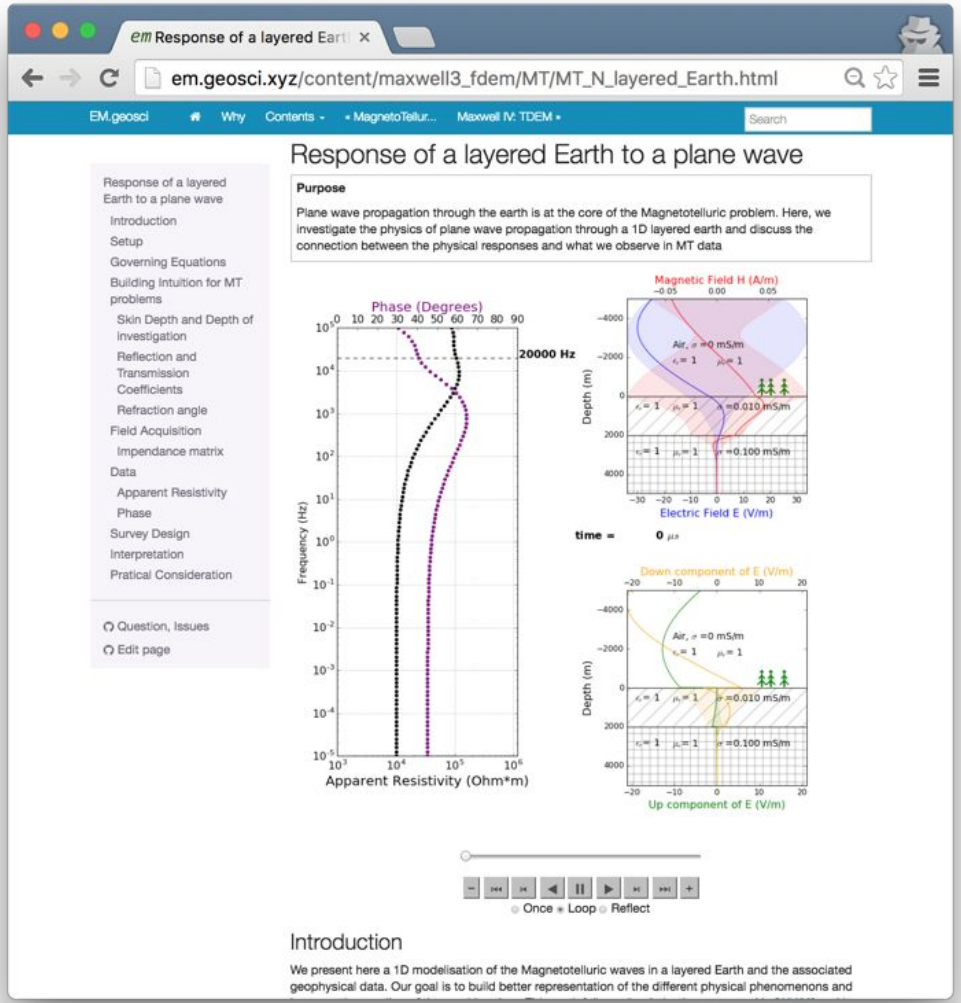
- human readable
- explorable
- testable

def → class

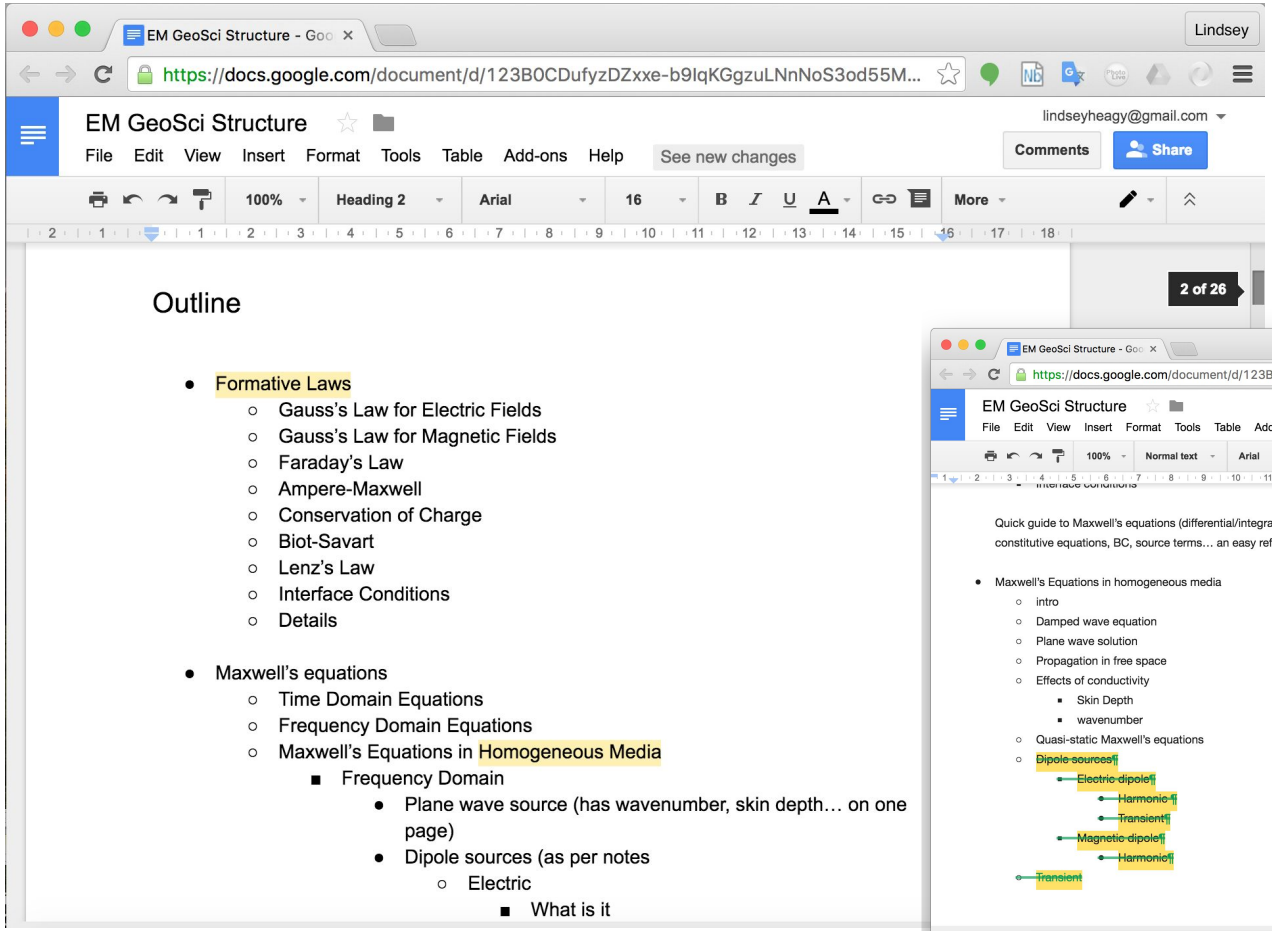
def → class

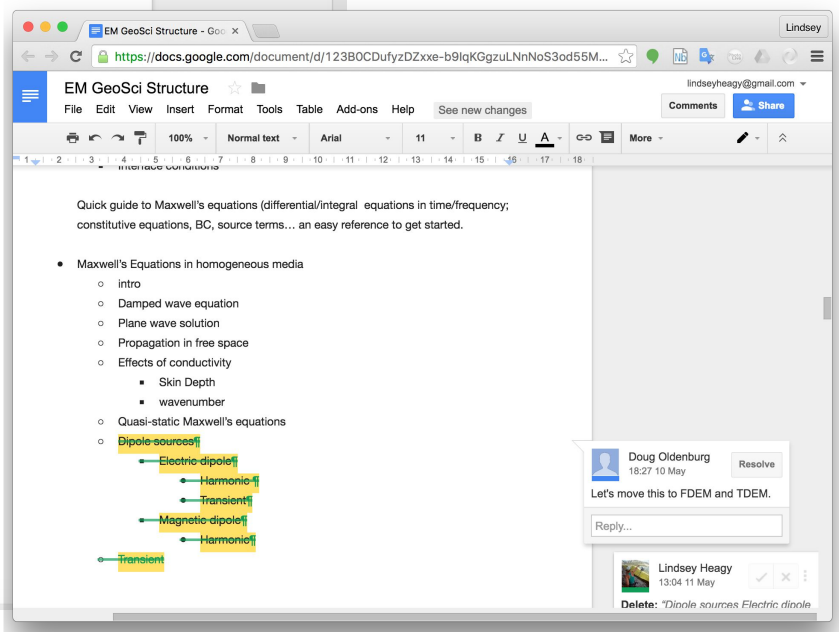
Page:

- Title
- Contributors
- Purpose
- Introduction
- Content
- Images
- Movies!



what is a base class?





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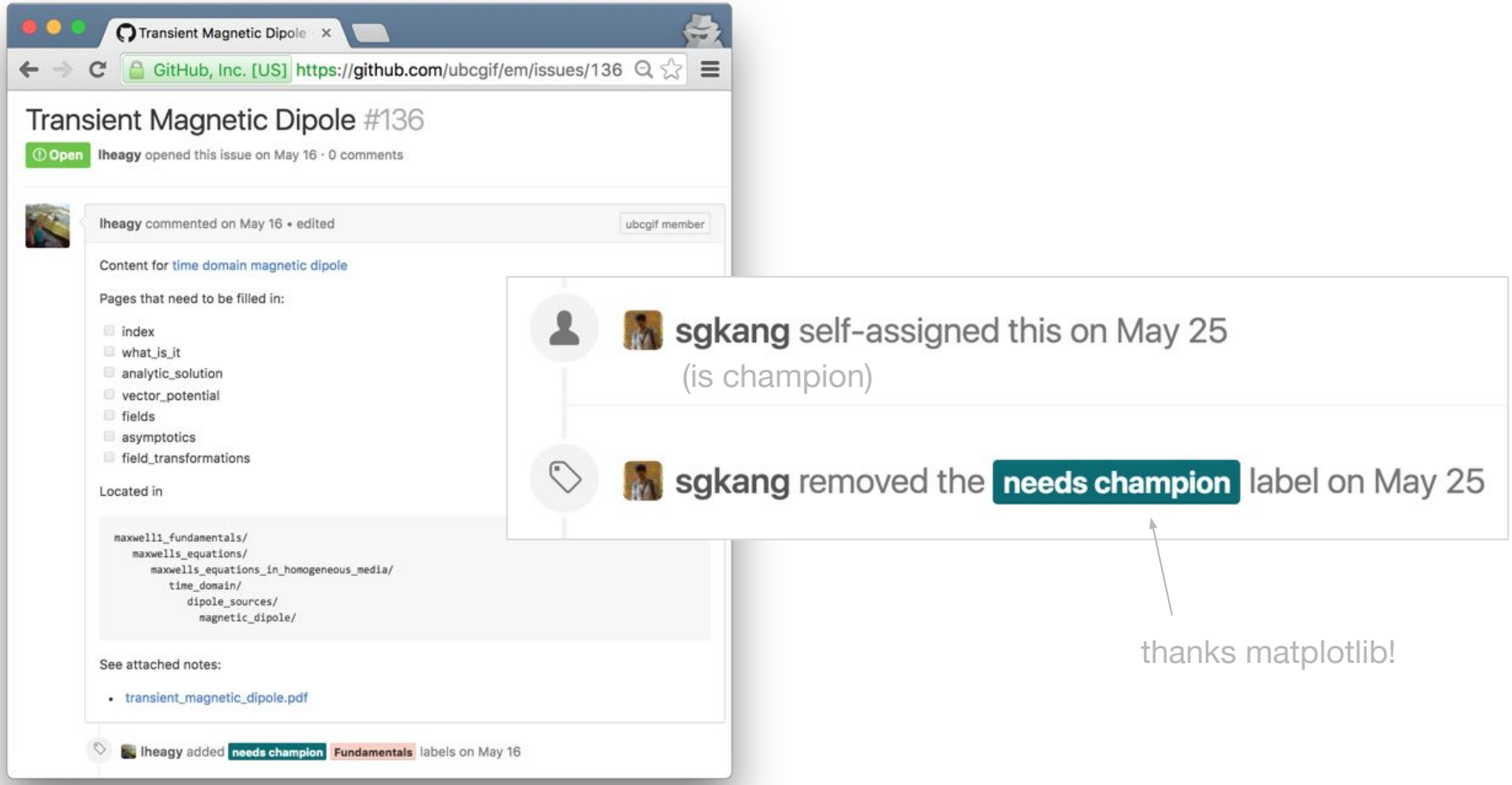


def → class

practices

needs review

reviewed

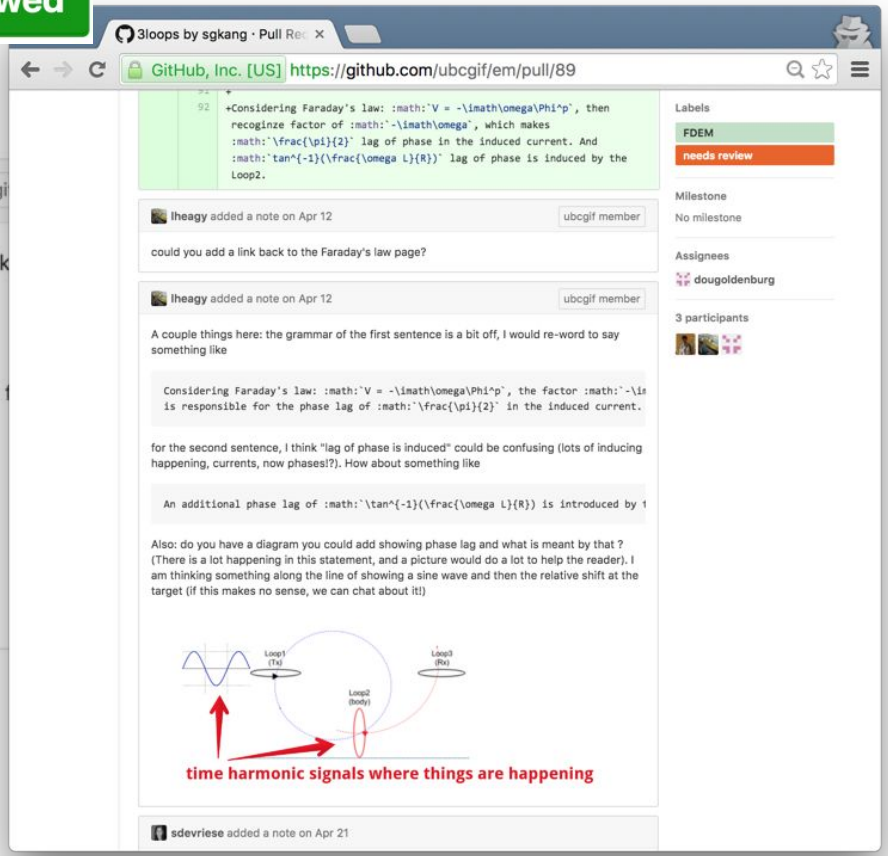
sdevriese commented on May 16 • edited

Wave equation material updated and reworked into new Fundamentals framework

- Doug's edits + flow suggestions incorporated
- Needs apps.
- Need to add wave propagating figures (they are in image folder, just need to f
  them in the text)

Suggested reviewers:

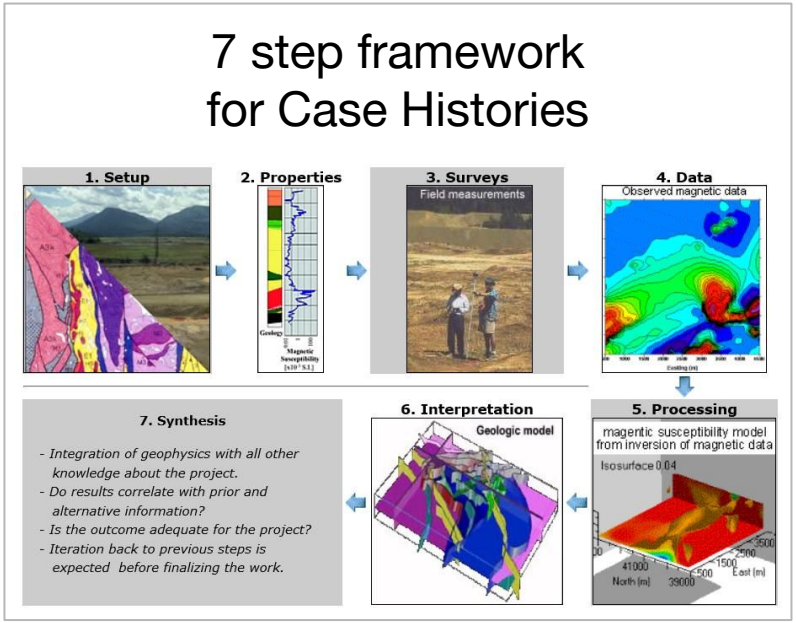
- [ ] **@dougoldenburg**
- [ ] **@micmitch**
- [ ] **@fourndo**

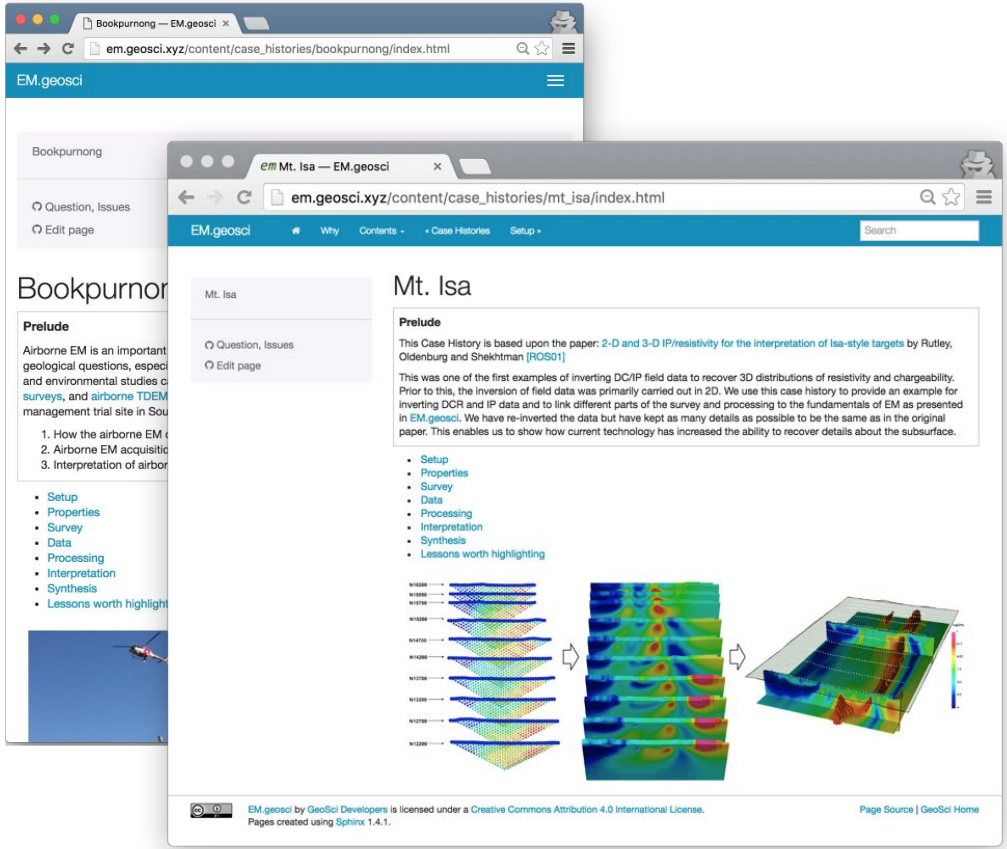


def → class

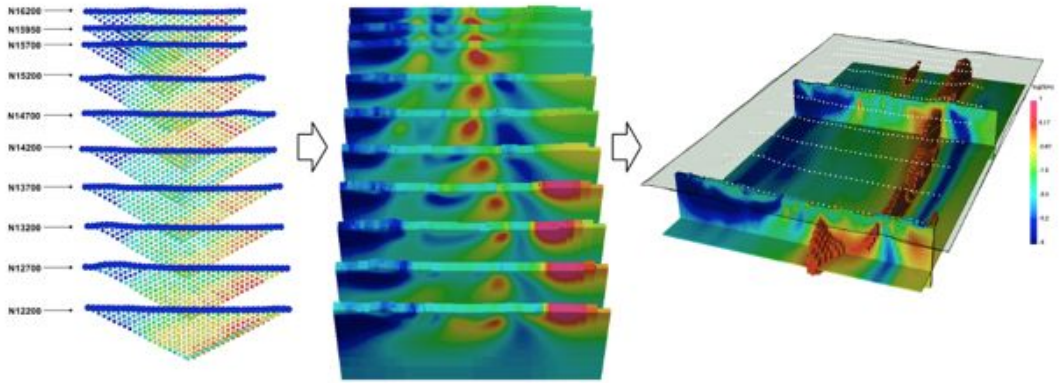
define and inherit structure

refactoring





We want your case histories!



- see the current case histories
- view the request for case histories
- start from the case history template
- contact us with questions

http://disc2017.geosci.xyz

def → class

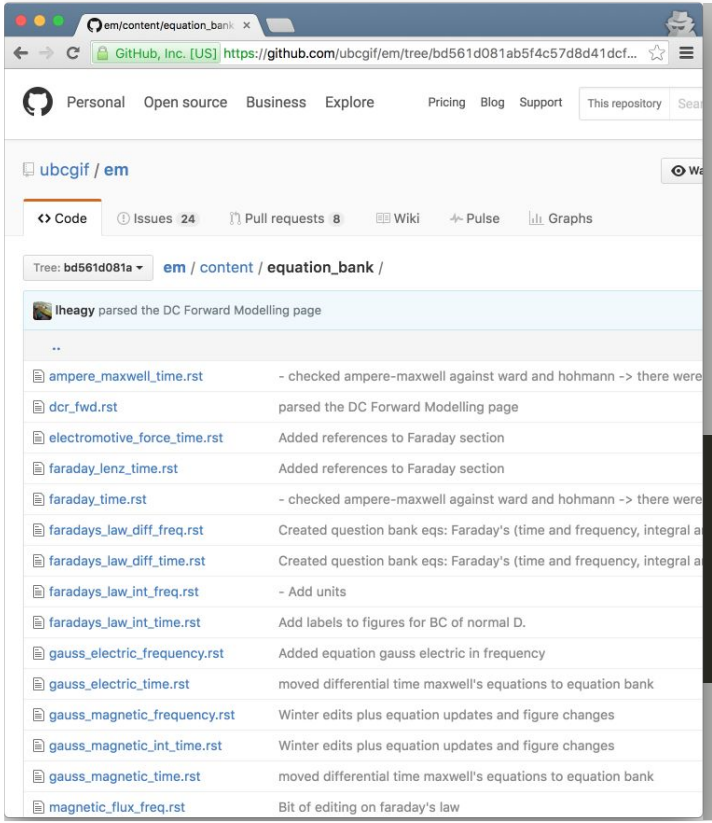
- organization
- template
- collaborate

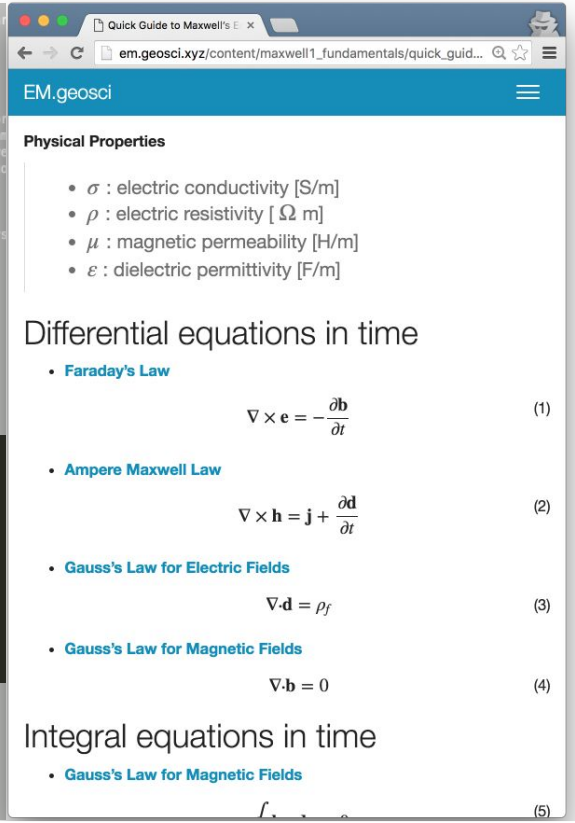
class → import

class → import

don't repeat

refactoring





class → import

em Data — EM.geosci

em.geosci.xyz/content/case_histories/mt_isa/data.html

EM.geosci | Why | Contents | « Survey | Processing » | Search

Data
- DCR
- IP

Question, Issues

Edit page

Data

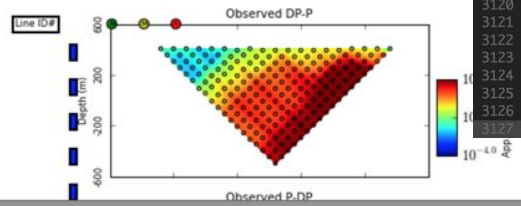
The MIMDAS system collects both a pole-dipole (P-DP) and a dipole-pole (DP-P) configuration in general. Furthermore, both DC and IP data were collected through the system. The data are viewed prior to quality control measures.

DCR

In preparation for the inversion, a first-pass assessment of data quality is compl
visualization. While sensing the same Earth, these two configurations can yield d
consequently be subject to different noise levels. The DC data were first separat
survey configuration.

Note that a large portion of the DP-P shows higher apparent conductivity data t
DP configuration. This may be explained by the presence of conductive units on
survey. As demonstrated with the numerical simulation, current channeling throu
Shale unit and the mineralization at depth may consider reduce the measure
these anomalies.

Table 3 : DCR data separated in its P-DP and DP-P configuration

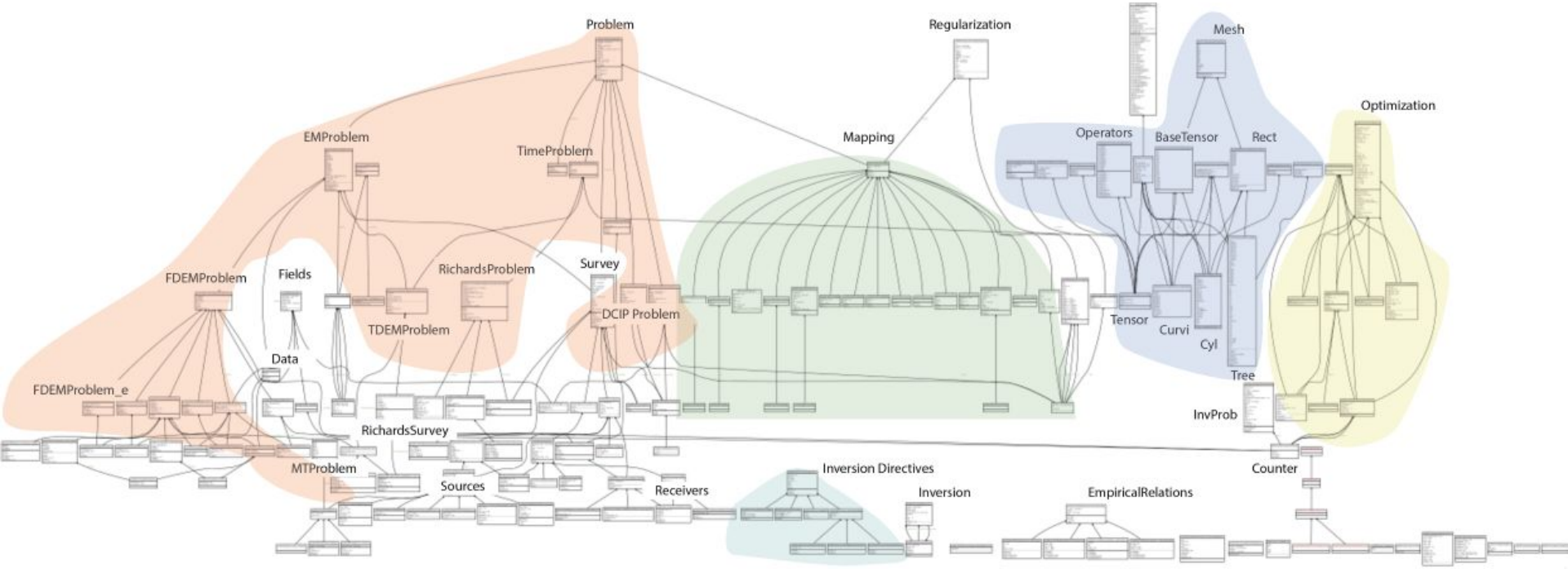



```
3099 updating environment: 0 added, 1 changed, 0 removed
3100 reading sources... [100%] content/equation_bank
3101 looking for now-outdated files... none found
3102 pickling environment... done
3103 checking consistency... done
3104 preparing documents... done
3105 writing output... [  0%] content/case_histories/bookpurnong/data
3106 writing output... [  0%] content/case_histories/bookpurnong/index
3107 (line   29) redirect  http://library.seg.org/doi/abs/10.1071/EG08027 - with Found to http://library.seg.org/act
3108 (line   31) ok        http://www.hgg.geo.au.dk/ref_manager/VIEZZOLI2010C.pdf
3109 (line   48) ok        http://www.cowi.dk/menu/nyhederogmedier/nyheder/vandogmiljoe/lavtflyvende-helikopter-kort
3110 writing output... [  1%] content/case_histories/bookpurnong/interpretation
3111 writing output... [  1%] content/case_histories/bookpurnong/processing
3112 writing output... [  2%] content/case_histories/bookpurnong/properties
3113 writing output... [  2%] content/case_histories/bookpurnong/setup
3114 writing output... [  3%] content/case_histories/bookpurnong/survey
3115 writing output... [  3%] content/case_histories/bookpurnong/synthesis
3116 writing output... [  4%] content/case_histories/index
3117 writing output... [  4%] content/case_histories/mt_isa/data
3118 (line    6) ok        http://www.smedg.org.au/Sym01NS.htm
3119 writing output... [  5%] content/case_histories/mt_isa/index
3120 (line    8) ok        http://gif.eos.ubc.ca/sites/default/files/EG01156.pdf
3121 writing output... [  5%] content/case_histories/mt_isa/interpretation
3122 writing output... [  6%] content/case_histories/mt_isa/lessons
3123 writing output... [  6%] content/case_histories/mt_isa/processing
3124 (line   96) -ignored- http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_aac46307-fce8-449d-e044-00144f
3125 (line  171) -ignored- http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_aac46307-fce8-449d-e044-00144f
3126 writing output... [  6%] content/case_histories/mt_isa/properties
3127 writing output... [  7%] content/case_histories/mt_isa/setup
```

class → import

introspect

refactoring

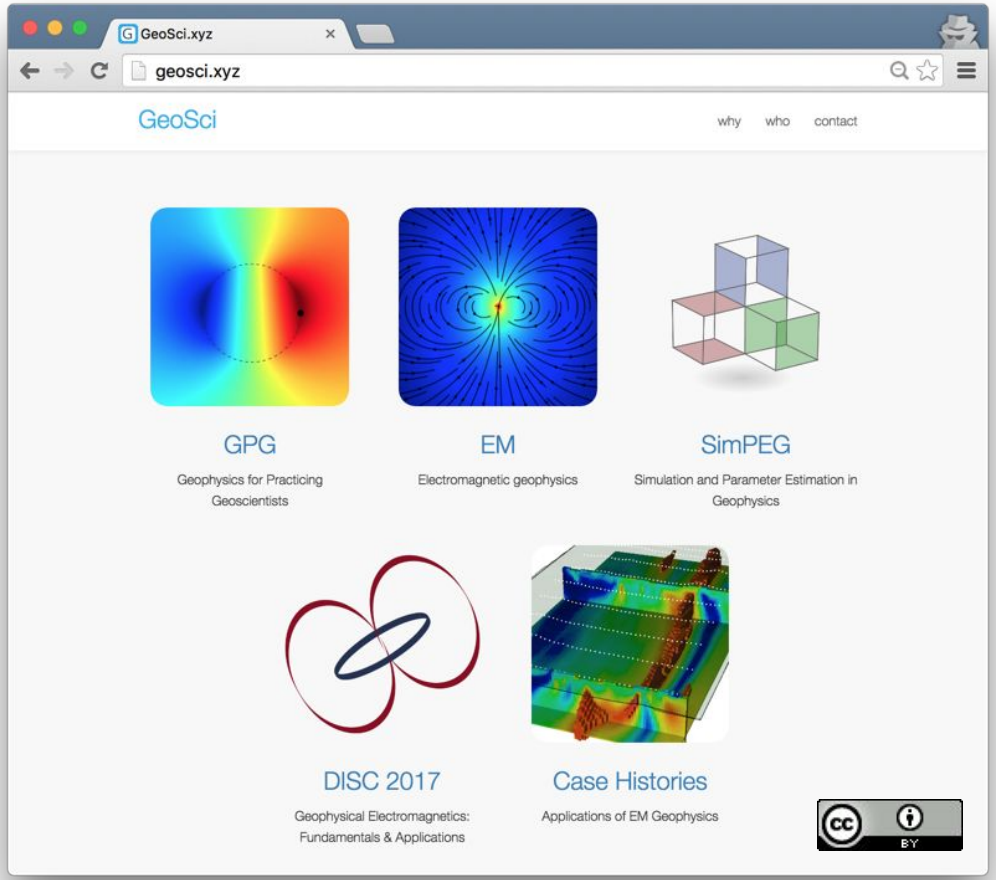


- Conceptual requirements
- Inheritance

import → pip

import → pip

refactoring



- licensing
- dependencies
- versioning

practices

- versioning
- issue tracking
- peer review
- pull requests
- forking
- testing
- deployment
- licensing

tools

- git
- Github
- Sphinx
- Read the Docs
- Travis CI
- PyPi
- licenses
- Google App Engine

(3.91)

that this equation satisfies is known as the Brewster angle.
ion from a conductive surface, there will be a minimum in $R_{\parallel}$, analogous to the
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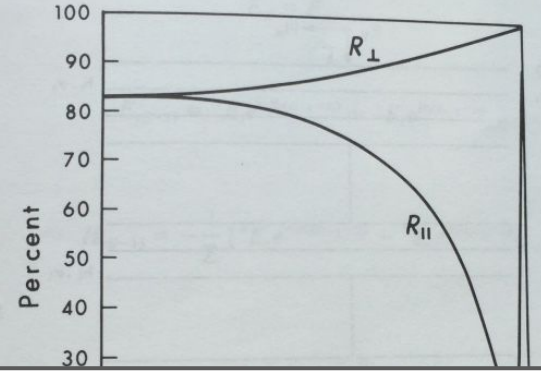
41, p. 508). Figure 3.3 illustrates these features.



missing factor of 400
ie if
$\sigma_{seawater} = \frac{3}{400}$ S/m
you get this figure

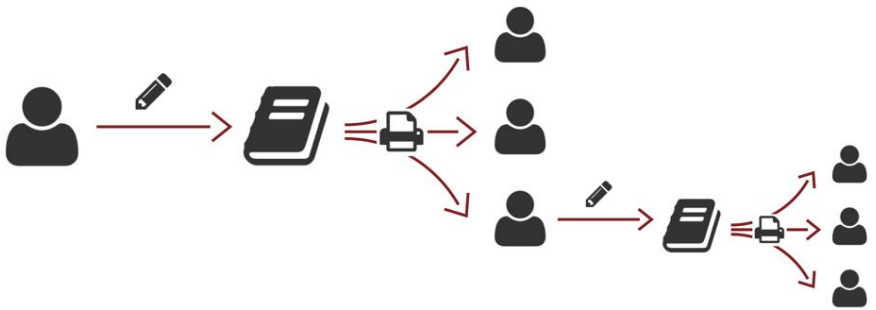
in which

$$M - iN = \left[\frac{2\mu_2(\tan\alpha - \alpha) - \mu_1(\alpha - \tan\alpha + \alpha^2\tan\alpha)}{2\mu_2(\tan\alpha - \alpha) + 2\mu_1(\alpha - \tan\alpha + \alpha^2\tan\alpha)}\right]. \quad (6.85)$$

should be + (see 6.83)

The field is given by

$$\mathbf{H} = H_0 R^3 (M - iN)\frac{(2x^2 - y^2 - z^2)\mathbf{u}_x + 3xy\mathbf{u}_y + 3xz\mathbf{u}_z}{r^5}, \quad (6.86)$$



(3.91)

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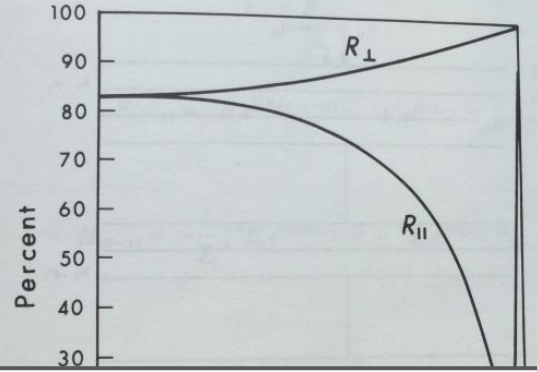

72

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ie if
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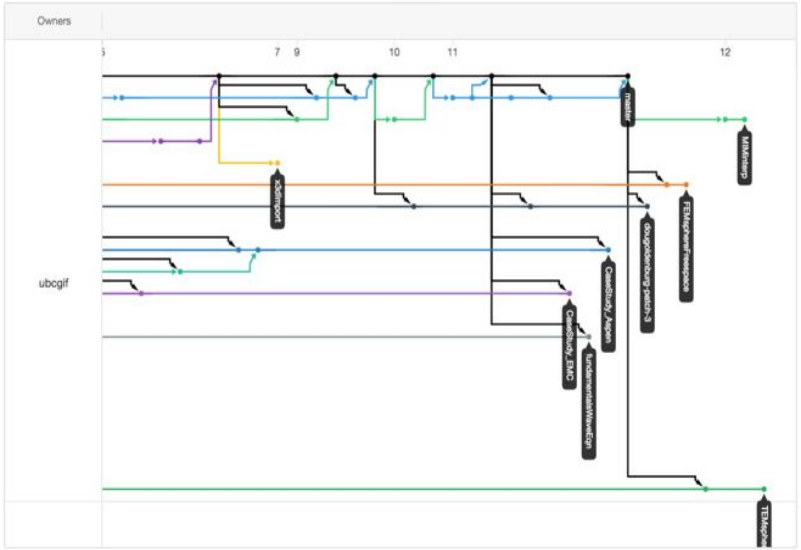

Typo in apparent conductivity? #38

Closed | lheagy opened this issue on Nov 7, 2015 · 0 comments

lheagy commented on Nov 7, 2015 — ubcgif member

In the formula for apparent conductivity, the second term should be \sigma_2 * \phi_v, not \phi_h?

(http://gpg.geosci.xyz/en/latest/content/electromagnetics/electromagnetics_fk_domain_systems.html#multilayer-earth-structures)

1,359 commits | 18 branches | 0 releases | 17 contributors

(3.91)

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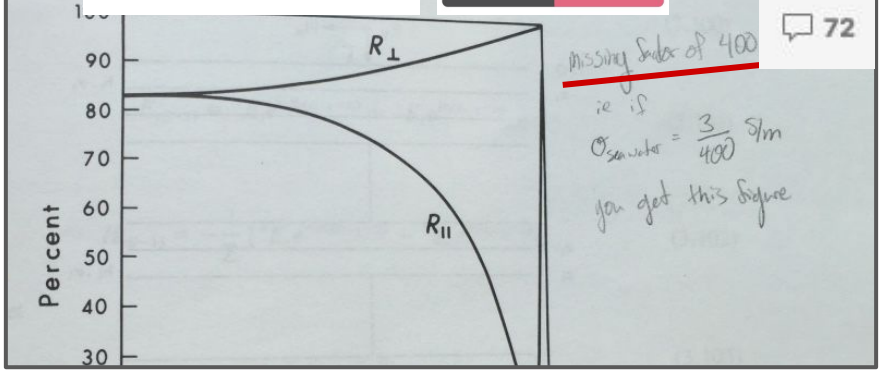
41, p. 50

(Source code, png, hires.png, pdf)

launch binder

72



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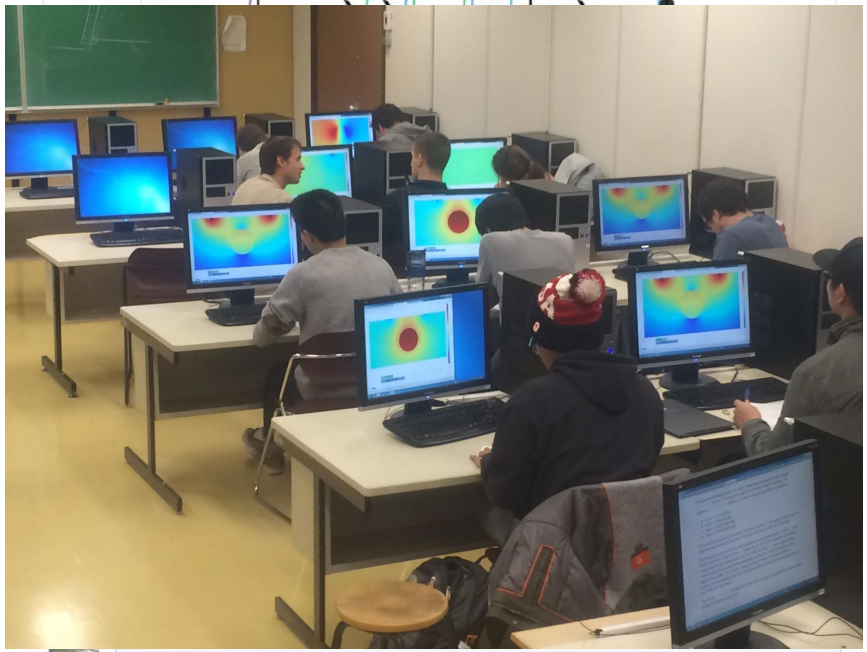

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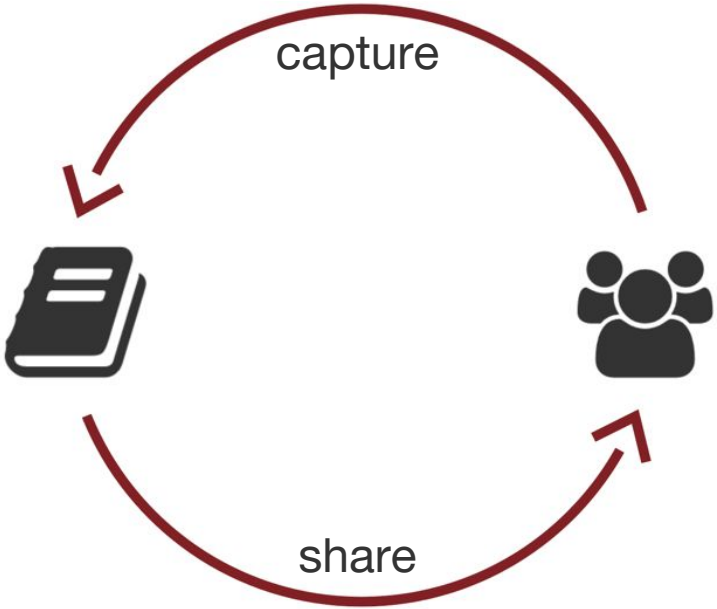
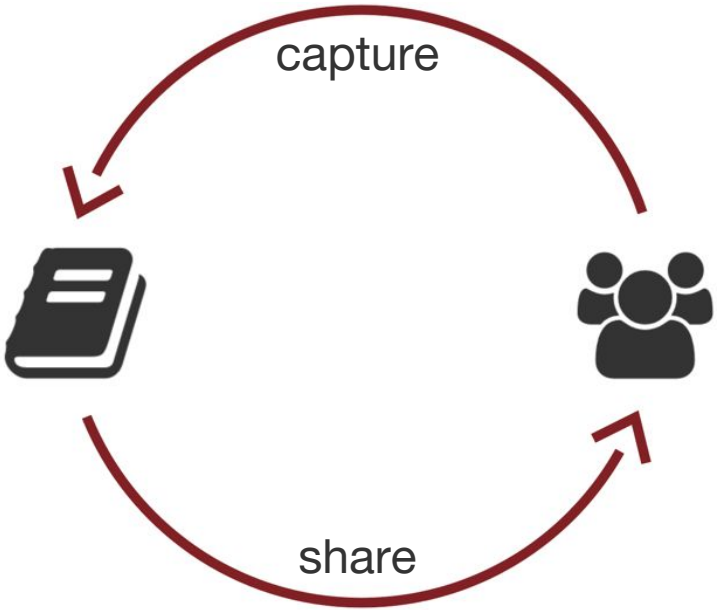


- iterate in place
- versioned
- reproducible
- tested
- collaborative
- track issues
- continuous peer review
- feedback
- interoperable
- extensible
- multiple media types
- ...



http://geosci.xyz

(end)