

Status of the open-source landscape for 3D CSEM modeling

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ABSTRACT

To-Do/-Discuss:

- Title?
- Order of authors? These authors or others?
- Other codes to include? Currently considered: SimPEG, custEM, PETGEM, and emg3d.
- Are these references OK?
 - Cockett et al. (2015) (SimPEG)
 - Rochlitz et al. (2019) (custEM)
 - Castillo-Reyes et al. (2019) (PETGEM)
 - Werthmüller et al. (2019) (emg3d).
- Exact structure of the paper?
- Exact models to calculate/show/compare?

INTRODUCTION

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CODES

Each code should outline:

- Equation system it solves;
- the used discretization possibilities;
- domains (frequency, time);
- details (anisotropy; el. perm. and mag. perm.);
- other things (inversion; other methods);

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- speed and memory estimation;
- plans for next features.

emg3d

SimPEG

custEM

PETGEM

NUMERICAL RESULTS

Layered model

A simple layered model, comparing with `empymod` (Werthmüller, 2017).

3D model

A complicated, big, 3D model with bathymetry (topography).

CONCLUSIONS

The landscape in 3D CSEM modelling greatly changed in the last five years or so. While before there were only closed-source codes owned by companies or consortia (e.g., CEMI) there was recently a wave of openly released codes.

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ACKNOWLEDGMENT

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REFERENCES

Castillo-Reyes, O., J. de la Puente, L. E. García-Castillo, and J. M. Cela, 2019, Parallel 3-D marine controlled-source electromagnetic modelling using high-order tetrahedral Nédélec elements: *Geophysical Journal International*, **219**, 39–65; doi: [10.1093/gji/ggz285](https://doi.org/10.1093/gji/ggz285).

- Cockett, R., S. Kang, L. J. Heagy, A. Pidlisecky, and D. W. Oldenburg, 2015, SimPEG: An open source framework for simulation and gradient based parameter estimation in geophysical applications: *Computers & Geosciences*, **85**, 142–154; doi: [10.1016/j.cageo.2015.09.015](https://doi.org/10.1016/j.cageo.2015.09.015).
- Rochlitz, R., N. Skibbe, and T. Günther, 2019, custEM: customizable finite element simulation of complex controlled-source electromagnetic data: *Geophysics*, **84**, F17–F33; doi: [10.1190/geo2018-0208.1](https://doi.org/10.1190/geo2018-0208.1).
- Werthmüller, D., 2017, An open-source full 3D electromagnetic modeler for 1D VTI media in Python: empymod: *Geophysics*, **82**, WB9–WB19; doi: [10.1190/geo2016-0626.1](https://doi.org/10.1190/geo2016-0626.1).
- Werthmüller, D., W. A. Mulder, and E. C. Slob, 2019, emg3d: A multigrid solver for 3d electromagnetic diffusion: *Journal of Open-Source Software*, **4**, 1463; doi: [10.21105/joss.01463](https://doi.org/10.21105/joss.01463).