**Magnetotelluric and EM interpretation software**

_**Geotools™**_ is a modern, interactive platform for the analysis of magnetotelluric (MT) and time-domain electromagnetic (TDEM) data, featuring 1D, 2D and 3D inversion modeling.

_**Geotools**_ encourages explorers to view and manipulate multiple data types, allowing ancillary information to be integrated into MT data analysis.

**Key features**

Integrated:
- Import of MT and TDEM data, 1D and 3D models, 2D grids, point and line features, georeferenced images and well traces
- 3D MT inversion setup to run on the CGG Cloud, with user-friendly I/O and progress monitoring
- Multi-property 2D and 3D models, with property calculation functions

Fast:
- Multi-threaded inversion modeling, real-time in 1D and 2D

Convenient:
- Designed to run on Windows OS
- I/O compatibility with standard formats such as EDI and USF soundings

**Data analysis and 1D modeling**

Sounding plots, maps and cross-sections of data and models.

**MT**
- Supports single and multi-site soundings, full and partial tensor
- Apparent resistivity, phase, tipper, azimuth, induction arrows, polar diagrams and phase tensor plots
- Multi-dataset concept (observed, 1D/2D/3D synthetic)
- Rotation, masking, static shift correction, re-sampling, Rho+ fit
- Interactive real-time 1D forward and inverse modeling for discrete layer models
- Non-linear, smooth, multi-layer 1D inversions

**TDEM**
- Central and coincident loop configurations
- Multiple sweeps and repetition rates supported
- Interactive, real time 1D forward and inverse modeling for discrete layer models
- Joint inversion of multiple sweeps at different repetition rates
- Display of pseudo-MT curve derived from co-located TDEM sites for simple MT statics estimation
Advanced display capabilities

- User-selected multi-property overlays (maps, sections) allowing quick, customized comparisons
- Interactive views with immediate update of all linked data across all open documents: all data- and model-based display layers are updated real-time upon source modification
- Extraction of slices or fences from 3D models in map and cross-section
- Pixel, contoured and sun-shaded layers with variable transparency
- High quality vector graphics output

MT 2D real-time inversion modeling

- Multi-threaded 2D smooth inversion code, solving on all available processor cores: inversions completed in a few minutes on a laptop
- Easy-to-use mesh builder, property population using horizons and/or existing 2D and 3D resistivity models
- Immediate model view update at each inversion iteration
- Model property editing and painting tools
- Survey design, synthetic 2D sensitivity study
- Storage of resistivity models, synthetic data, inversion parameters and detailed statistics in recallable snap-shots
- Display georeferenced image overlays to compare existing interpretations
3D MT Modeling allows to build detailed 3D resistivity models and setup jobs for 3D inversion on the CGG cloud. Forward calculations may be run on the local machine, e.g. for feasibility studies.

3D Modeling employs RLM-3D, industry-proven on many land and marine 3D projects. RLM-3D uses a finite difference solver to calculate forward responses, and non-linear conjugate gradients in the inversion engine.

3D Model Builder
- Guided workflow to create 3D models in a few clicks
- 3D mesh definition from MT survey geometry
- Variable vertical discretization to efficiently sample topography and features of interest
- A priori property population based on imported or picked horizons, or manual model painting, optionally starting from existing 3D inversion models
- Tools to modify existing models by applying value replacement or 3D smoothing filters

Response comparisons
- Produce maps and pseudo-sections of responses
- Display misfit with measured or other calculated responses in sounding view or normalized data plots

3D MT Forward runtime examples

<table>
<thead>
<tr>
<th>Model size (cells)</th>
<th>Run-time (16 frequencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PC1</td>
</tr>
<tr>
<td>250,000</td>
<td>1 min</td>
</tr>
<tr>
<td>500,000</td>
<td>3 min</td>
</tr>
<tr>
<td>1,000,000</td>
<td>6 min</td>
</tr>
</tbody>
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PC1: Workstation (2019) 2 x Intel Xeon Gold 5218 CPU 32 total cores 128GB RAM
PC2: Laptop (2018) Intel Core i7-8650U CPU 4 cores 16GB RAM
PC3: Legacy PC (2012) Intel Xeon X5650 CPU 6 cores 24GB RAM
**GEOTOOLS**

**3D MT Inversion**
- Convenient workflow to generate 3D job packets to run on the secure CGG-hosted cloud
- Flexible model regularization options and use of resistivity bounds
- Inversion for smoothest model or smoothest variations from *a priori* model
- Inversion for galvanic distortion matrices
- Review of inverted 3D resistivity structures, and compare to imported ancillary data and 1D/2D inversion models

**3D job setup and model review**

**RLM-3D on the CGG cloud**

**Contact**
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