



## 3D inversion of the semi-airborne EM data from Germany

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### Introduction

We present a new semi-airborne frequency domain electromagnetic system being developed within the DESMEX project. In the system, the high-moment transmitter is positioned on the ground and the receivers (induction coil, fluxgate and total field magnetometers) are installed in a helicopter-towed bird. The major difficulty is to overcome the problem of motion noise and motion-induced voltages, due to the pendulum-like behavior of the bird. For this purpose, we developed a processing scheme which corrects data for motion related noise. Specifically, for processing in frequency domain we utilize only free-of-motion-noise frequencies. [for more details: C.Nittinger, Semi-airborne EM Measurements with Induction Coil and Fluxgate Sensors]. The system performance was tested in several flight experiments, two in Sarstedt-Hildesheim area, near helicopter base and one in Schleiz (Thuringen) area - a historical antimony mine.

### Findings

- Semi-airborne approach with helicopter-borne fluxgate and induction coil magnetometers is feasible.
- The system allows us to cover an area of around 36 km<sup>2</sup> in one flight resulting in penetration depth of 1-1.5 km
- 3D inversion models agree well with other EM/Geoelectric models
- Ground electric field data will further improve 3D inversion results.

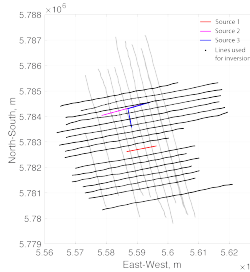
### Flight experiments

**Sarstedt - Hildesheim, Feb. 2016**  
**Sarstedt - Hildesheim, Feb. 2017**  
 3 source positions >> 3 flights  
 20A x 1km, 50% and 100% duty cycle,  
 13.9 Hz and 9 Hz  
 line spacing 300 m  
 flight area - 7x4 km<sup>2</sup>

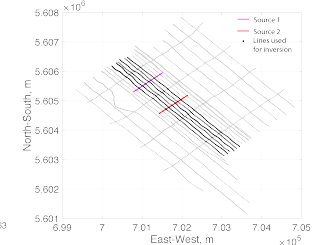
**Schleiz, Sept. 2016**  
 3 source positions >> 3 flights  
 20A x 1km, 50% duty cycle, 10.4 Hz  
 line spacing 100 and 300 m  
 flight area - 4x4 km<sup>2</sup>

**Schleiz, semi-airborne survey in Oct. 2017**  
 2 sources running simultaneously  
 area - 13x8 km<sup>2</sup>  
 ground CSEM 3D array  
 LOTEM survey in Sept. 2017

Sarstedt Hildesheim, 2017

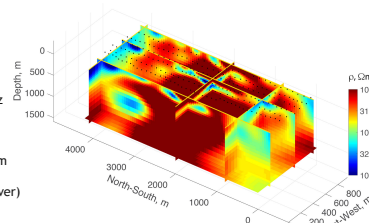


Schleiz, 2016

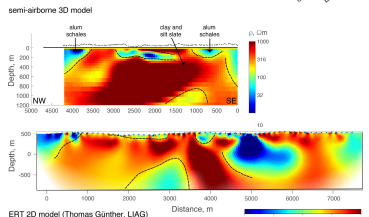


### 3D inversion, Schleiz (Thuringen)

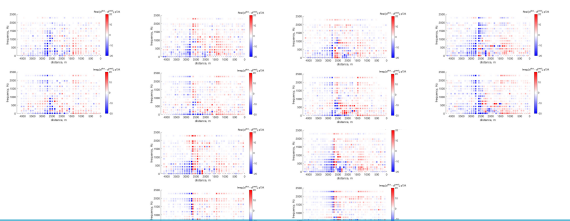
**Input data:**  
 TF: Re(Bz/I) and Im(Bz/I) [nT/A]  
 6 flight lines, 100m spacing  
 16 frequencies (10.4 - 2281.3 Hz )  
 fluxgate < 400 Hz; coils > 400 Hz  
 error floor - 5%  
**Source:**  
 1km, 20A, 50% duty cycle, 10.4 Hz  
**Model parameters:**  
 mesh: 101x46x57 cells  
 halfspace - 200 Ωm  
 minimum horizontal cell size - 50m  
 minimum vertical cell size - 20m  
 3DINV code (R.Streich and A.Grayver)



Comparison with ERT 2D model shows good agreement in major features.

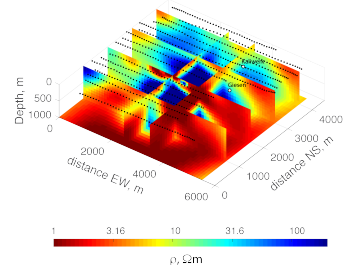


Data misfit, final rms = 2.3

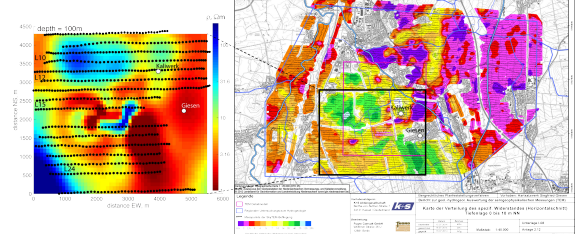


### 3D inversion, Hildesheim (Niedersachsen)

**Input data:**  
 TF: Re(Bz/I) and Im(Bz/I) [nT/A]  
 16 flight lines, 300 m spacing  
 14 frequencies (9.6 - 2200 Hz )  
 fluxgate < 400 Hz; coils > 400 Hz  
 error floor - 5%  
**Source:**  
 1km, 20A, 50% duty cycle, 9.6 Hz  
**Model parameters:**  
 mesh: 60x71x57 cells  
 halfspace - 40 Ωm  
 minimum horizontal cell size - 100m  
 minimum vertical cell size - 20m



Comparison with SkyTEM model



Data misfit, final rms = 4.1  
 worse data fit near source

