1D modelling of multi-frequency electromagnetic induction data

Marta Codina Gessé

Introduction

Objectives

Methodology

Results

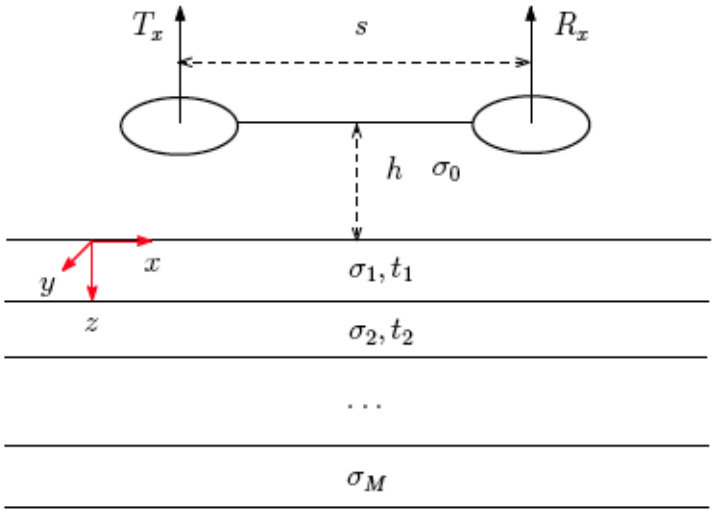
Conclusions

Introduction

Direct problem – Inverse problem

Geologic model ⇄ Experimental data

Electromagnetic induction methods



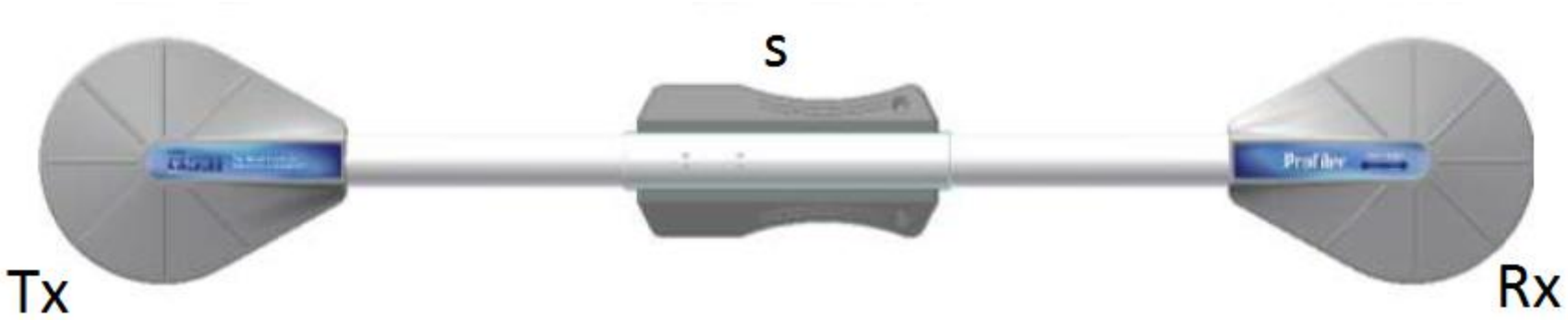
Objectives

- Study of electromagnetic **induction methods** to geophysical exploration.
- Become familiar with the **direct problem** and the inverse problem.
- Deduce the equations of the ***dual-loop* method**.
- Create a Matlab program to **solve the 1D case**.
- Know the **applications** of each method.

Methodology

<u>Dual loop method</u>

TDS RECON-400



Manual Geophyscial Survey Systems, Inc.

Methodology

Maxwell equations + *Assumptions*

Homogeneous half-space

$$\left(\frac{H_s}{H_p}\right)_v \cong \frac{i\omega\mu_0\sigma s^2}{4}$$

Earth layered model

$$\frac{H_s}{H_p} = 1 - s^3 \int_0^\infty R_0 \cdot J_0(s\lambda) \cdot \lambda^2 \cdot d\lambda$$

Methodology

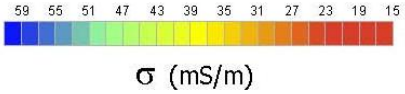
Apparent conductivity

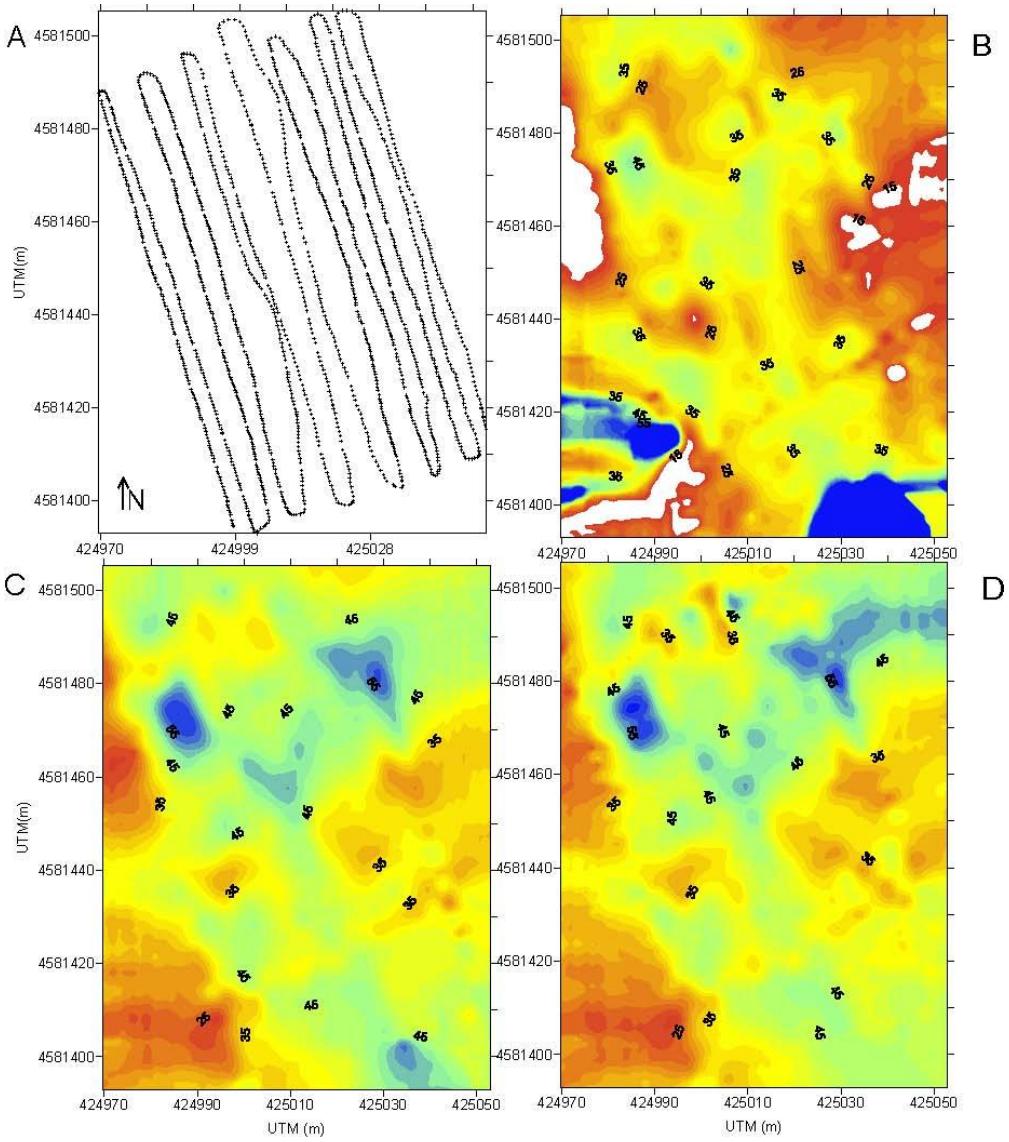
$$\sigma_a = \frac{4}{\omega \mu_0 s^2} Im\left(\frac{H_s}{H_p}\right)$$

Skin depth

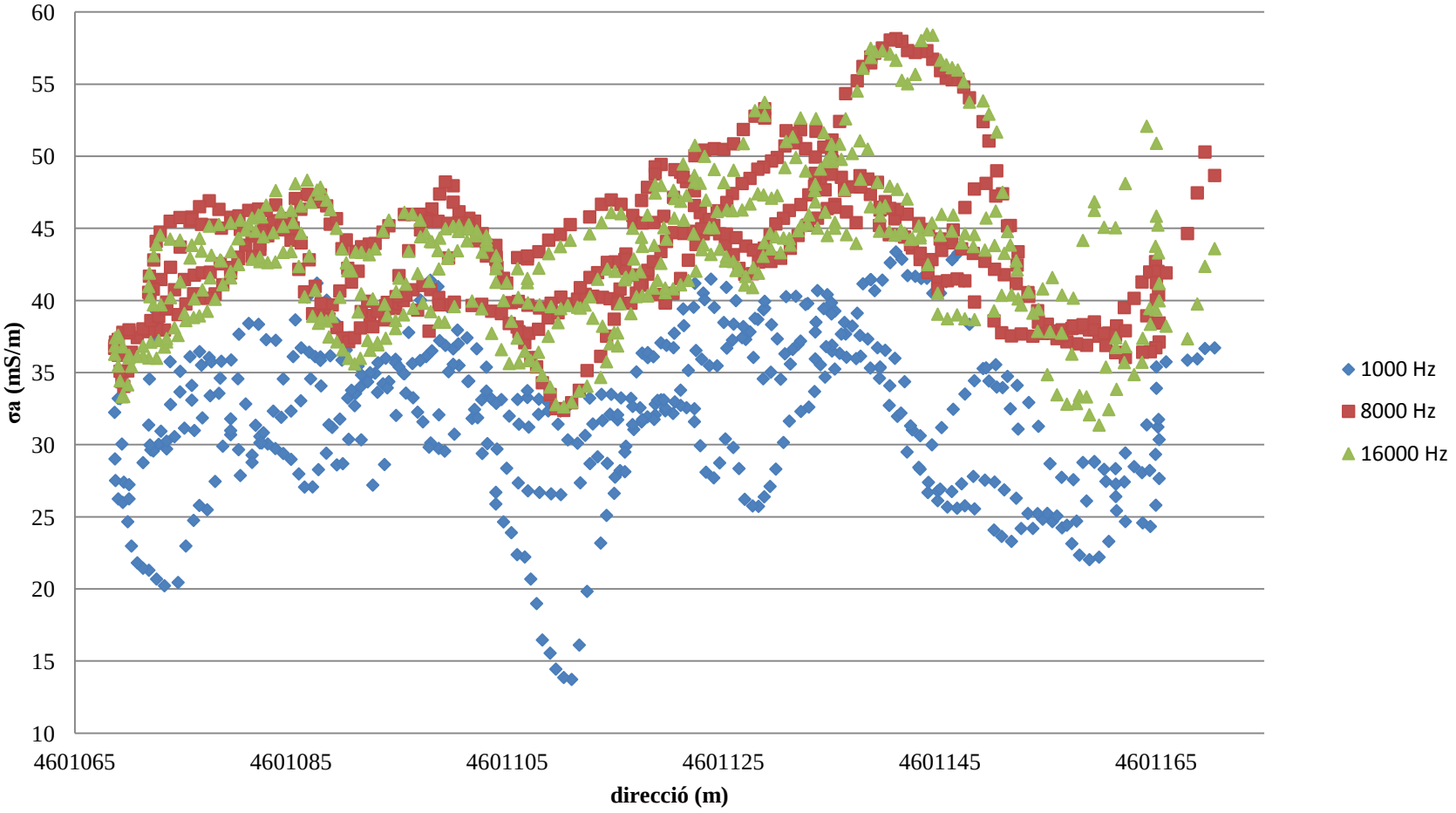
$$\delta = \sqrt{\frac{2}{\omega \mu_0 \sigma}}$$

Results


59 55 51 47 43 39 35 31 27 23 19 15
σ (mS/m)


A
B
C
D
UTM(m)
UTM (m)
N
4581500
4581480
4581460
4581440
4581420
4581400
424970
424990
425010
425030
425050
424999
425028

Results



Calibration problems ☹

Results

Homogeneous medium	
σ_{soil} (mS/m)	43.19 – 45.46

Two layered medium	
Δx (m)	15 – 16
σ_1 (mS/m)	45.46 – 50.00
σ_2 (mS/m)	10.00 – 25.00

Three layered medium	
Δx_1 (m)	5 – 10
Δx_2 (m)	5 – 20
σ_1 (mS/m)	± 50
σ_2 (mS/m)	10.00 – 25.00
$\sigma_{half\text{-}space}$ (mS/m)	10.00 – 16.67

Consistency with other geophysical tecniques ☺

Conclusions

- Program for 3 or more layers
- Application to real data and adjustment of the parameters with trialand error
- Correspondence with the results obtained with other geophysical methods

FUTURE WORK: the invers problem

Thank you for your attention