



Master Program in Geothermal Exploration  
Universitas Indonesia



**NewQuest**  
GEOTECHNOLOGY

# STATICSHIFTER-X: STATIC SHIFT CORRECTION SOFTWARE FOR MT DATA



StaticShifter-X™ 2010  
Version 10.9



Geothermal Laboratory  
The University of Indonesia

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**Dr. Eng. Yunus Daud, Dipl. Geotherm. Tech., M.Sc.**

# Content

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- ❑ Introduction
- ❑ What is static shift
- ❑ How to correct static shift effect
- ❑ Correction using static shift software



# Introduction

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- ❑ MT Data is sometimes influenced by static effect
  - Near surface heterogeneity
  - Topography
  - Vertical Contact
  
- ❑ This problem should be solved. Otherwise it will cause:
  - Mis-interpretation of subsurface resistivity data
  - Increase drilling risk
  - Increase exploration cost



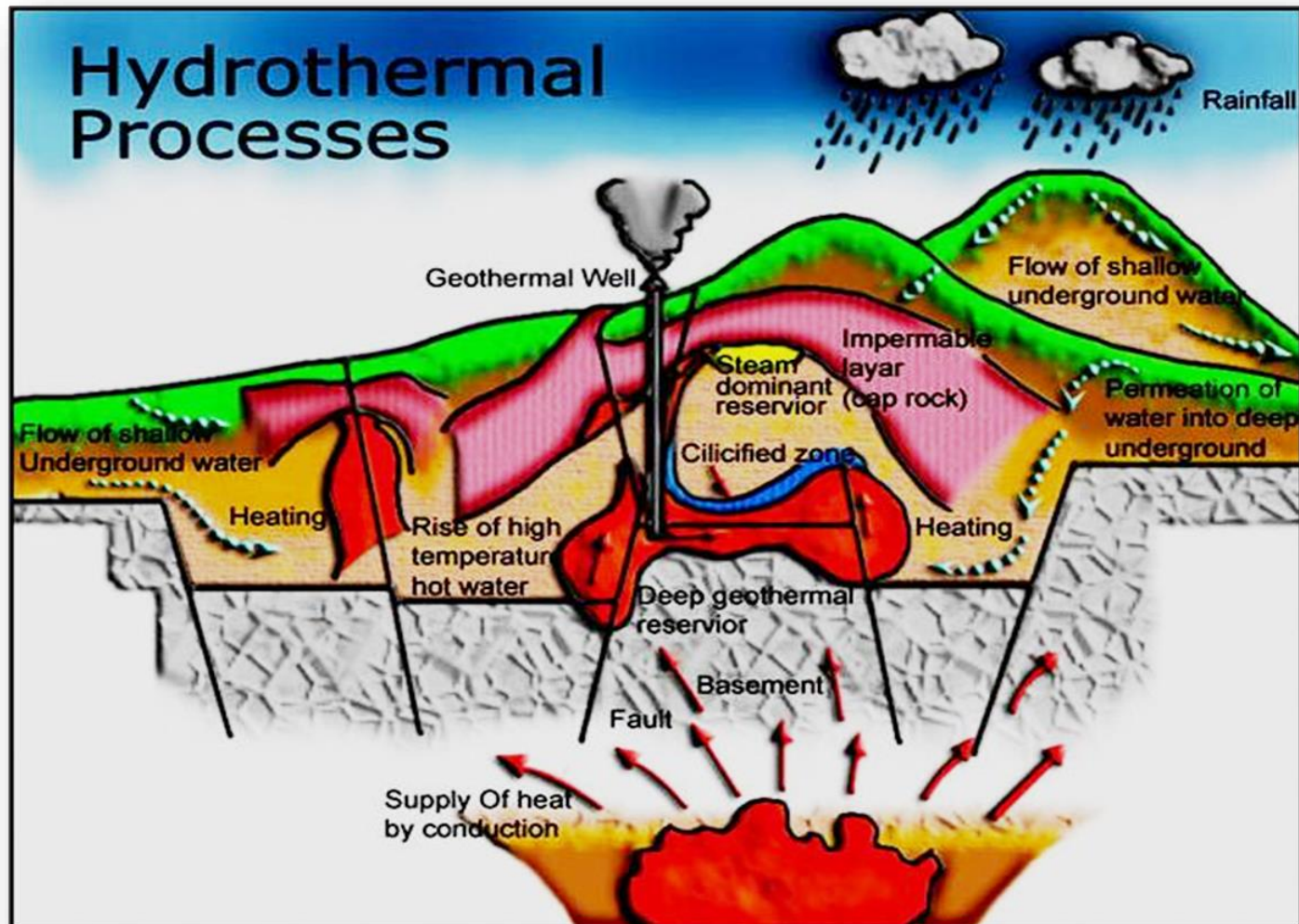
# Typical Characteristics of Geothermal Systems in Indonesia



- High terrain
- Deep (1-3 km) &
- Concealed reservoir
- Complex Structure
- Located in a dense jungle
- Some fields with long and deep outflow



# Typical Geothermal System Model in Indonesia



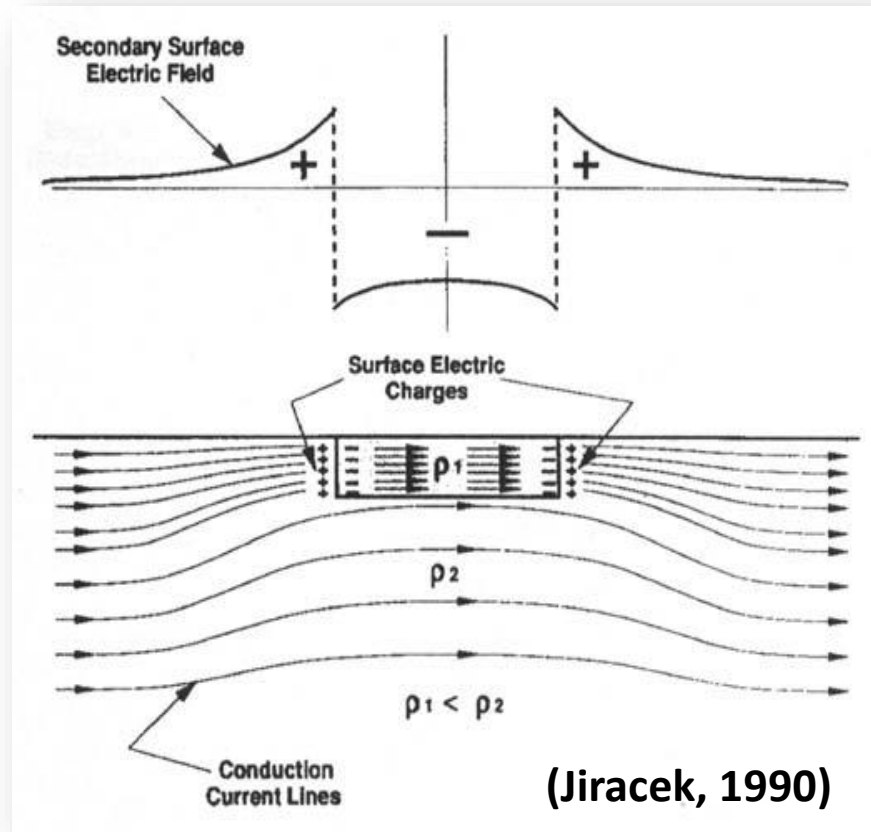
# What is Static Shift Effect?

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- ❑ The vertical offset of the entire MT (frequency vs. apparent resistivity) profile, caused by isolated horizontal resistivity gradients near the surface.
- ❑ Can be near-surface inhomogeneity, vertical contact, or topographic effects



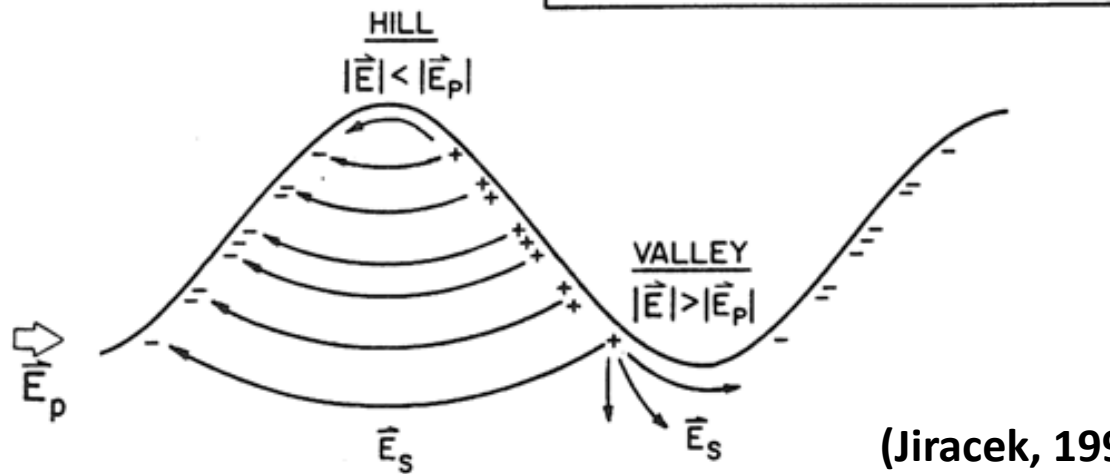
# Static Shift Caused by Near Surface Inhomogeneity



# Static Shift Caused by Topography

a

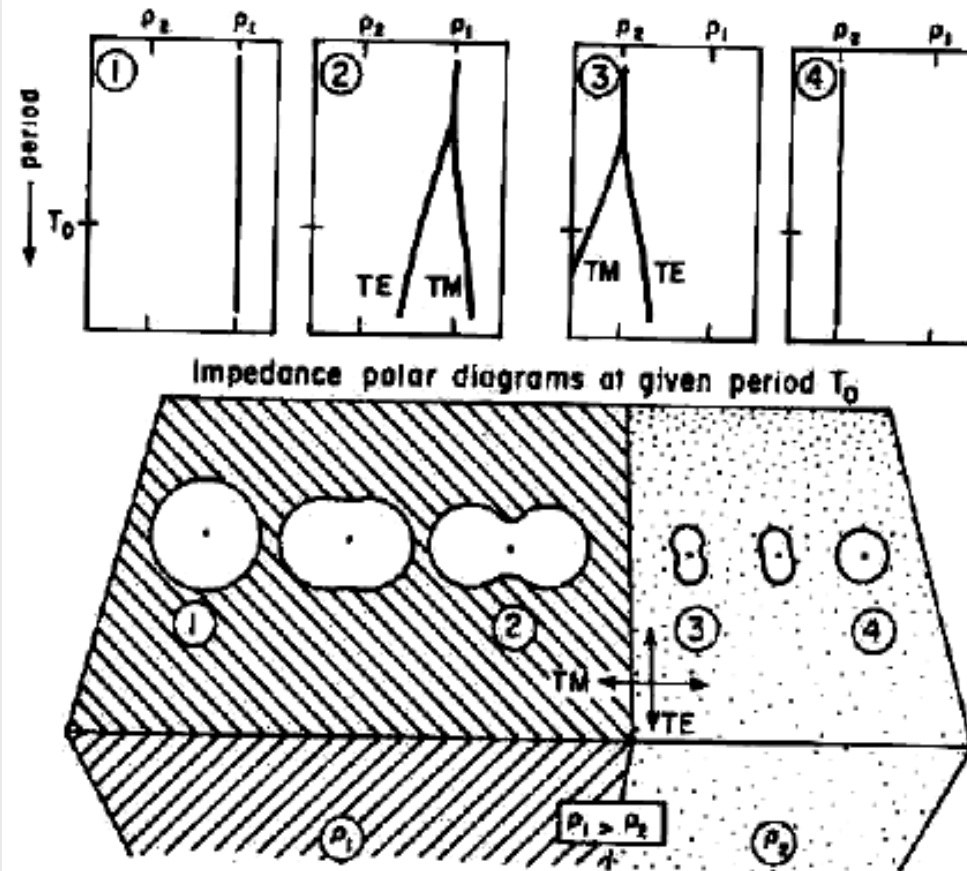
TOTAL E FIELD =  
PRIMARY E FIELD  
+ SECONDARY E FIELD  
 $\vec{E} = \vec{E}_p + \vec{E}_s$



(Jiracek, 1990)



# Static Shift Caused by Vertical Contact



# Software *MT2DFor-X* (Forward Modeling of MT Data)

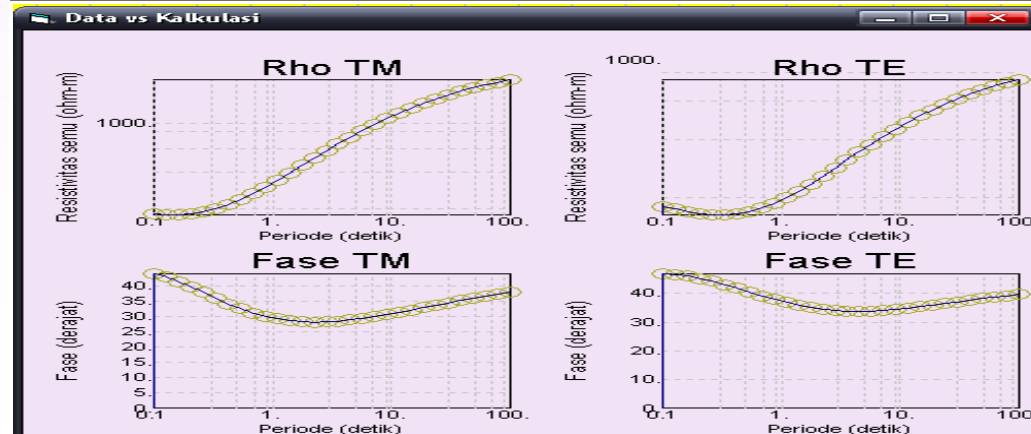
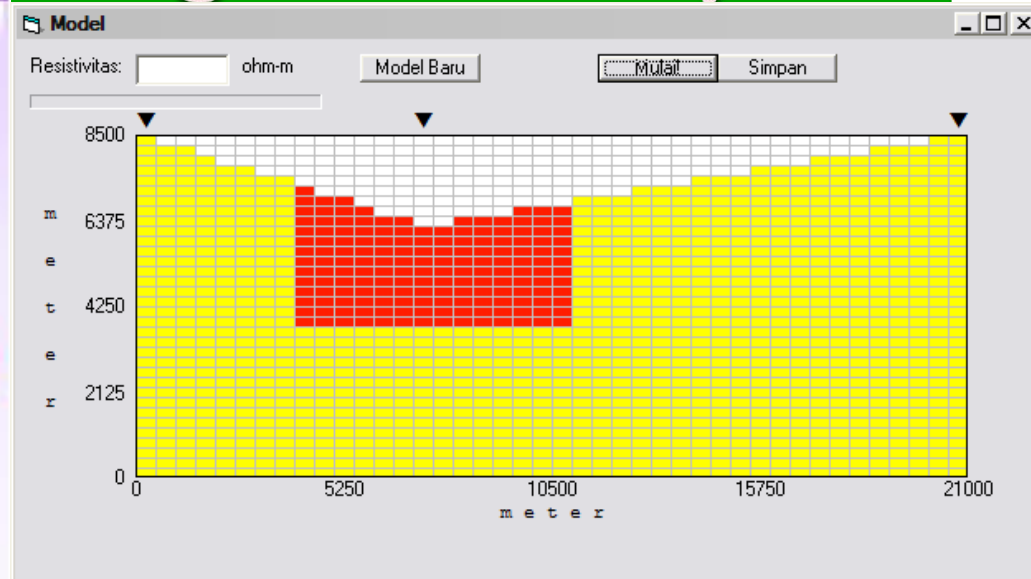


Program Modelling Magnetotelurik 2-Dimensi

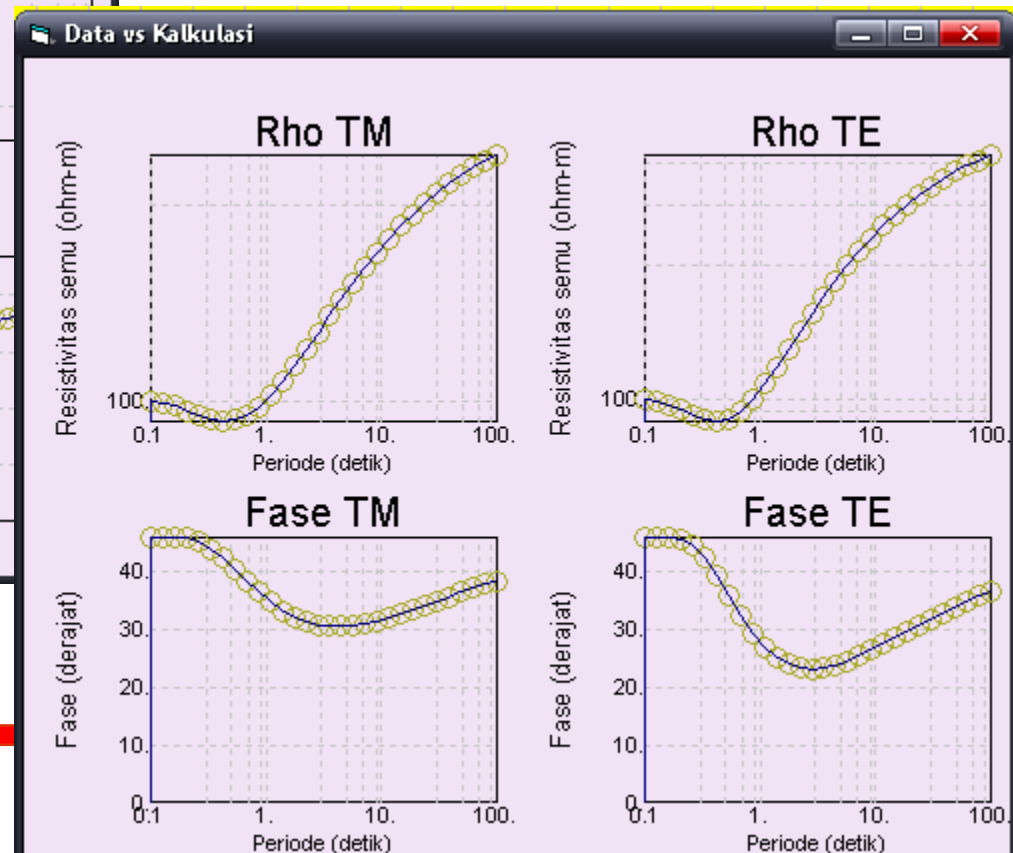
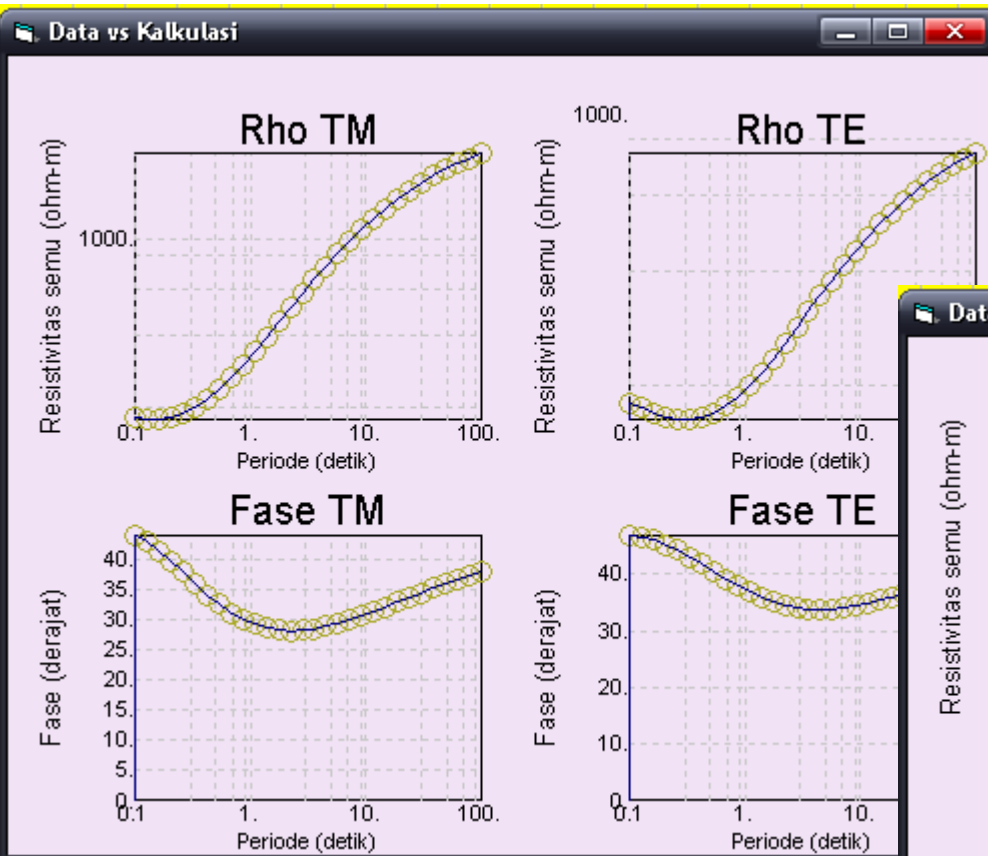
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2007

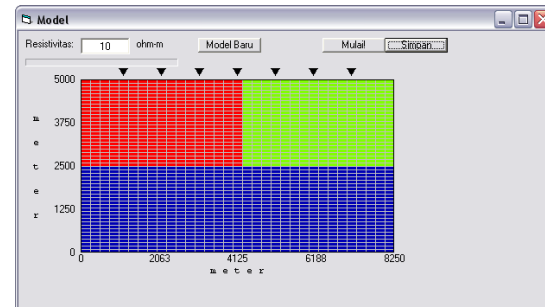
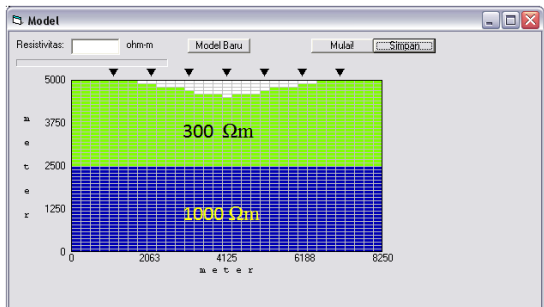
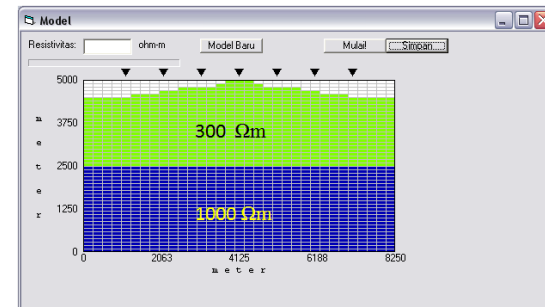
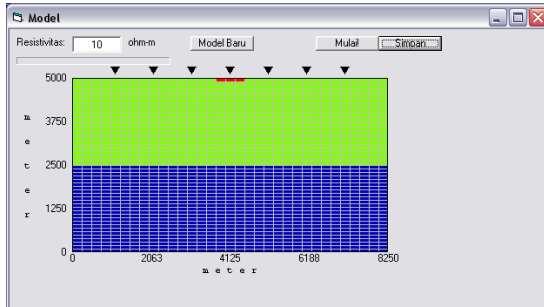
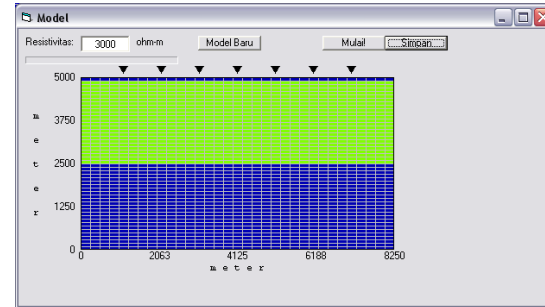
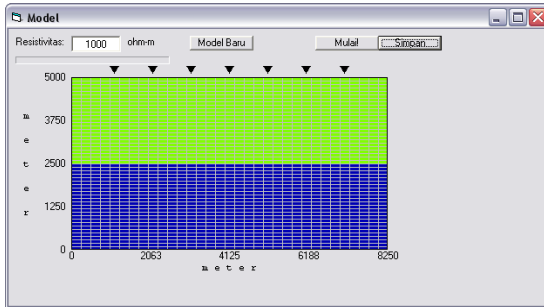
	Jumlah Blok	Panjang Blok
Arah-X	42	500
Arah-Z	34	250
	minimum (dtk)	maksimum
Periode	0.01	100
Jumlah Periode	30	Tutup
Jumlah Stasiun	3	OK



# MT Curves Derived from Forward Modeling

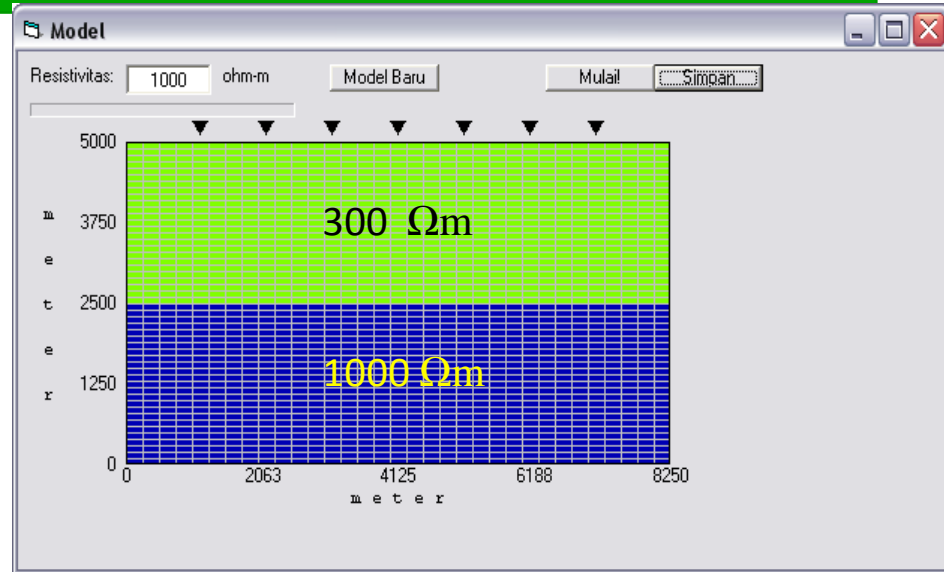
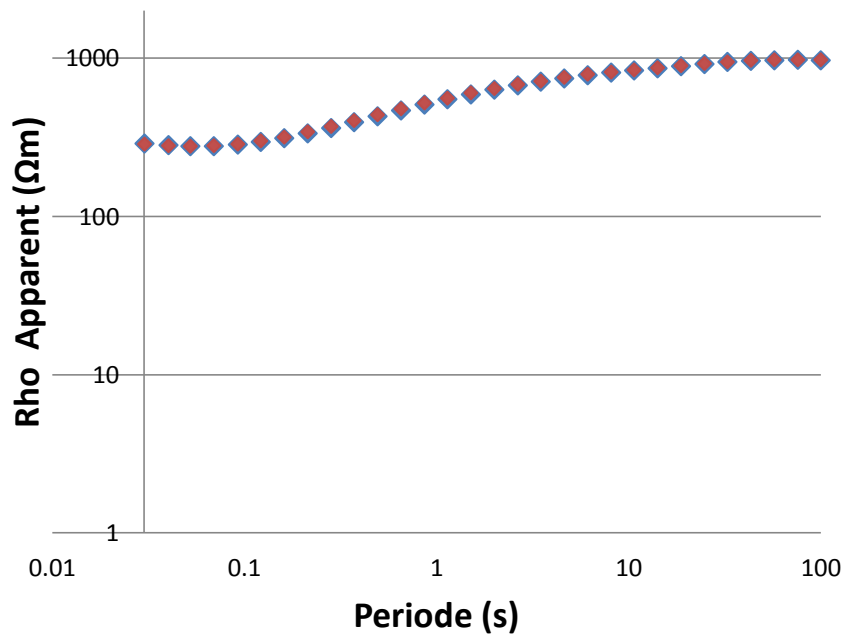


# 2-D Models



# 2-D Forward Modeling

KURVA TM DAN TE

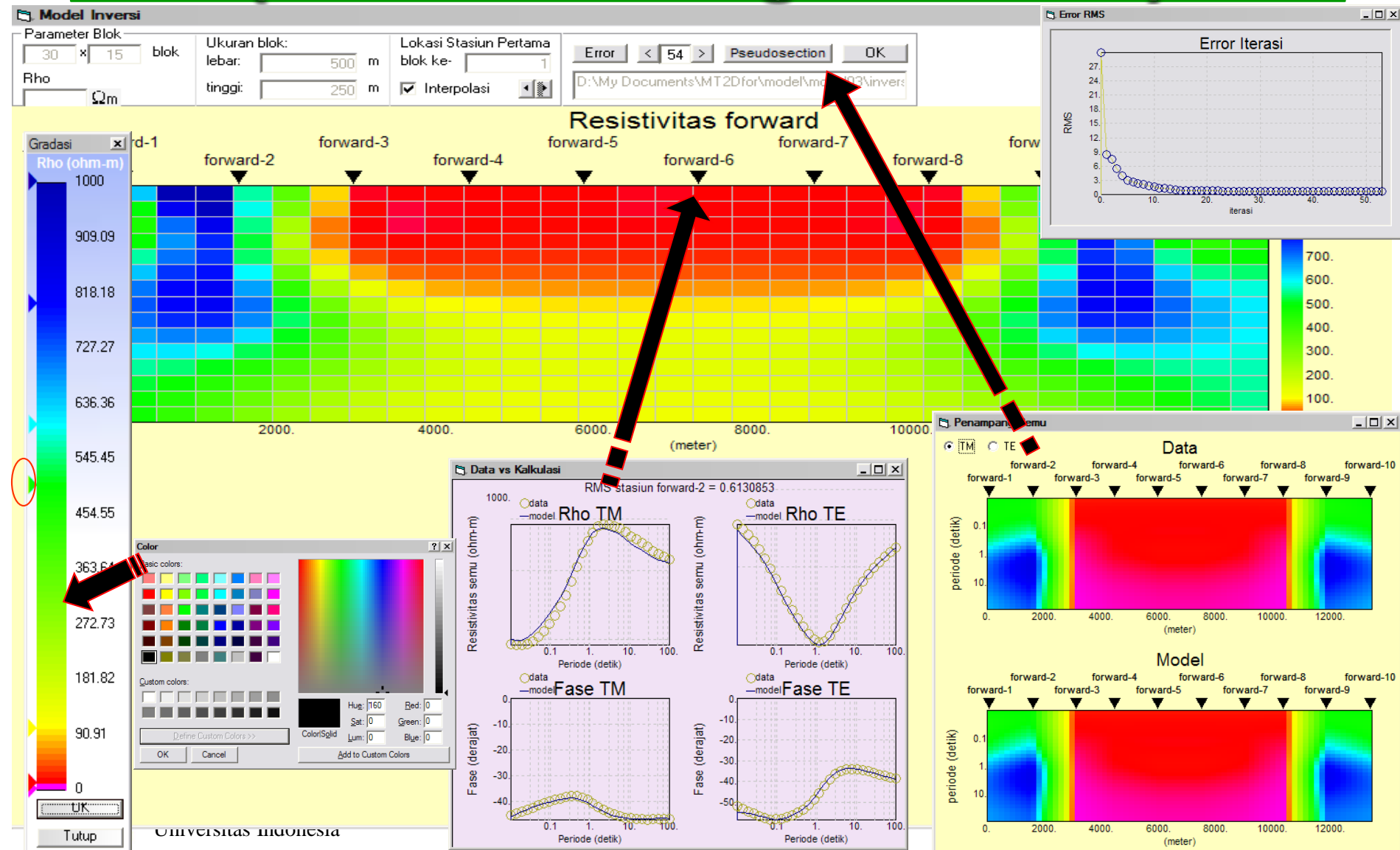


◆ TM  
◆ TE

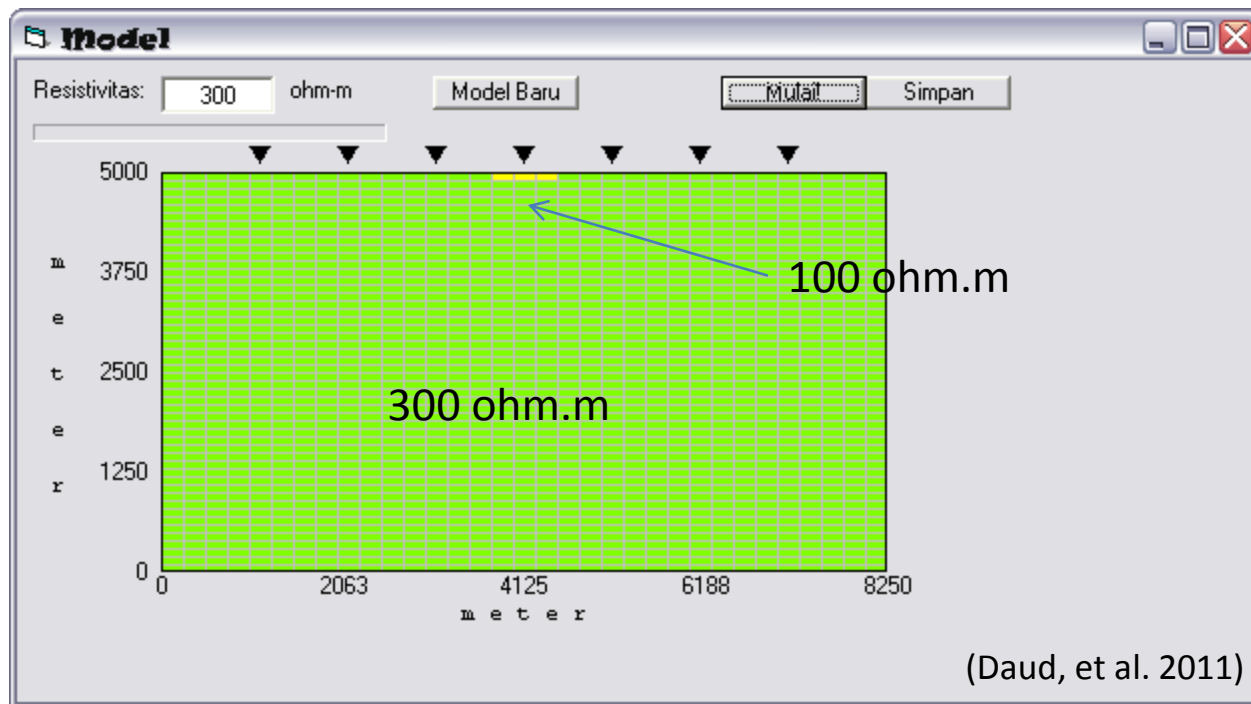


# Software MT2DInv-X

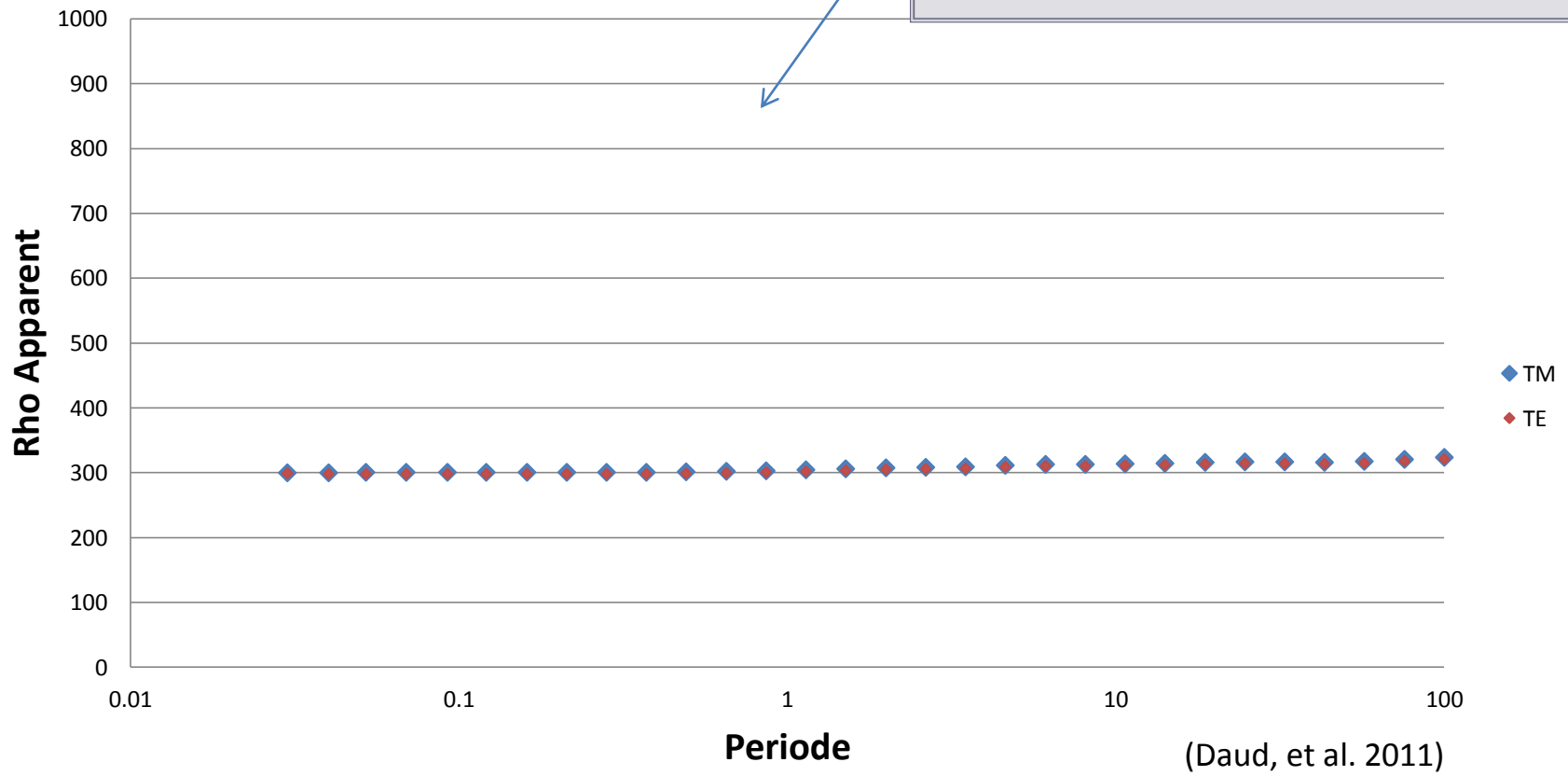
## (Inverse Modeling of MT Data)

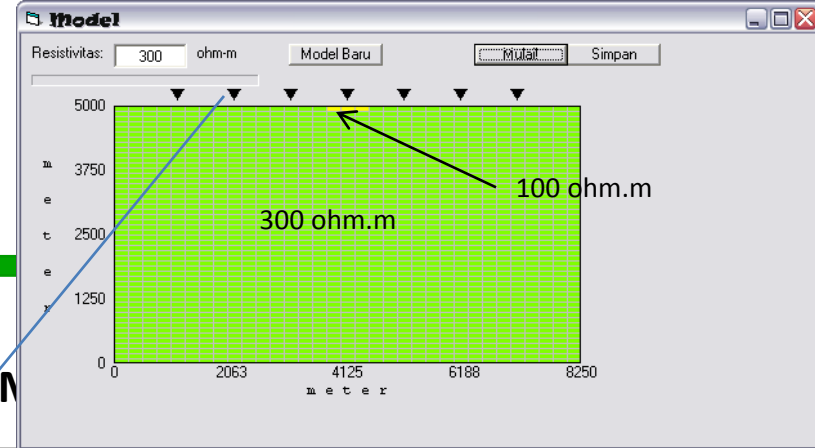


# 2-D Static Shift Modelling

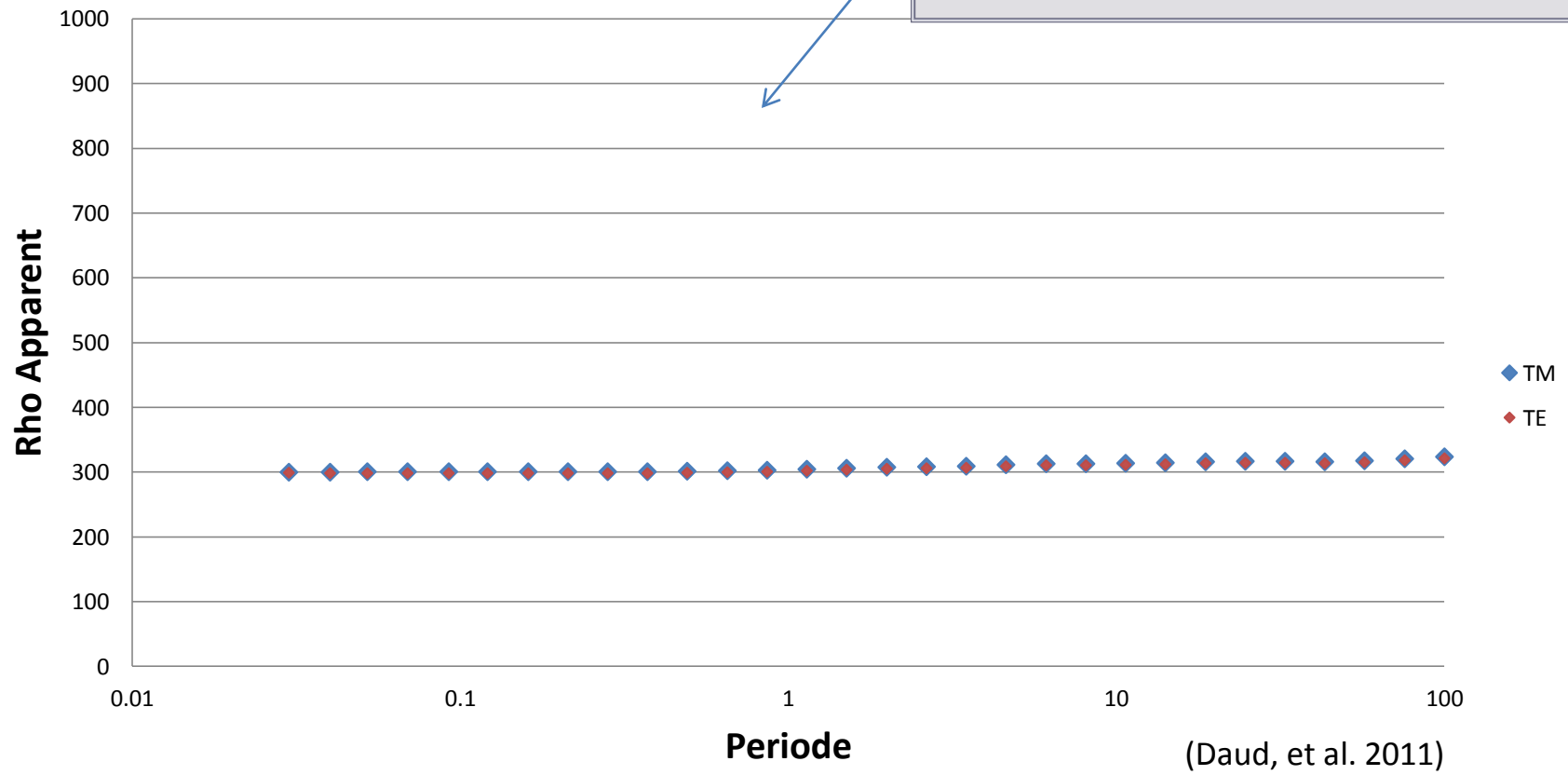


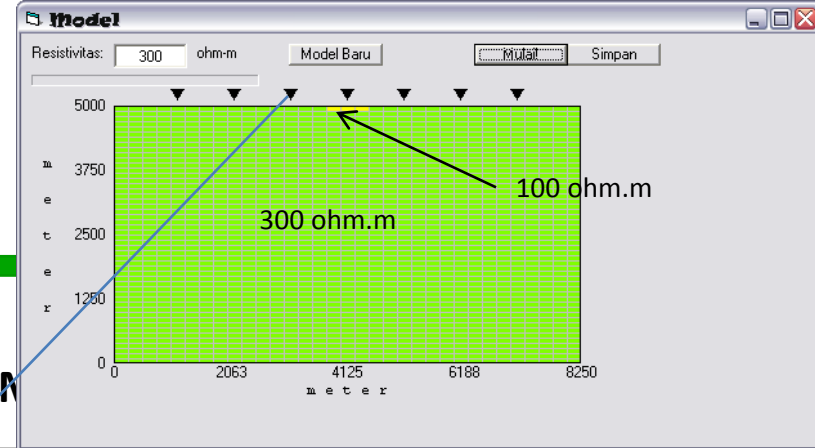
Kurva TE dan TM



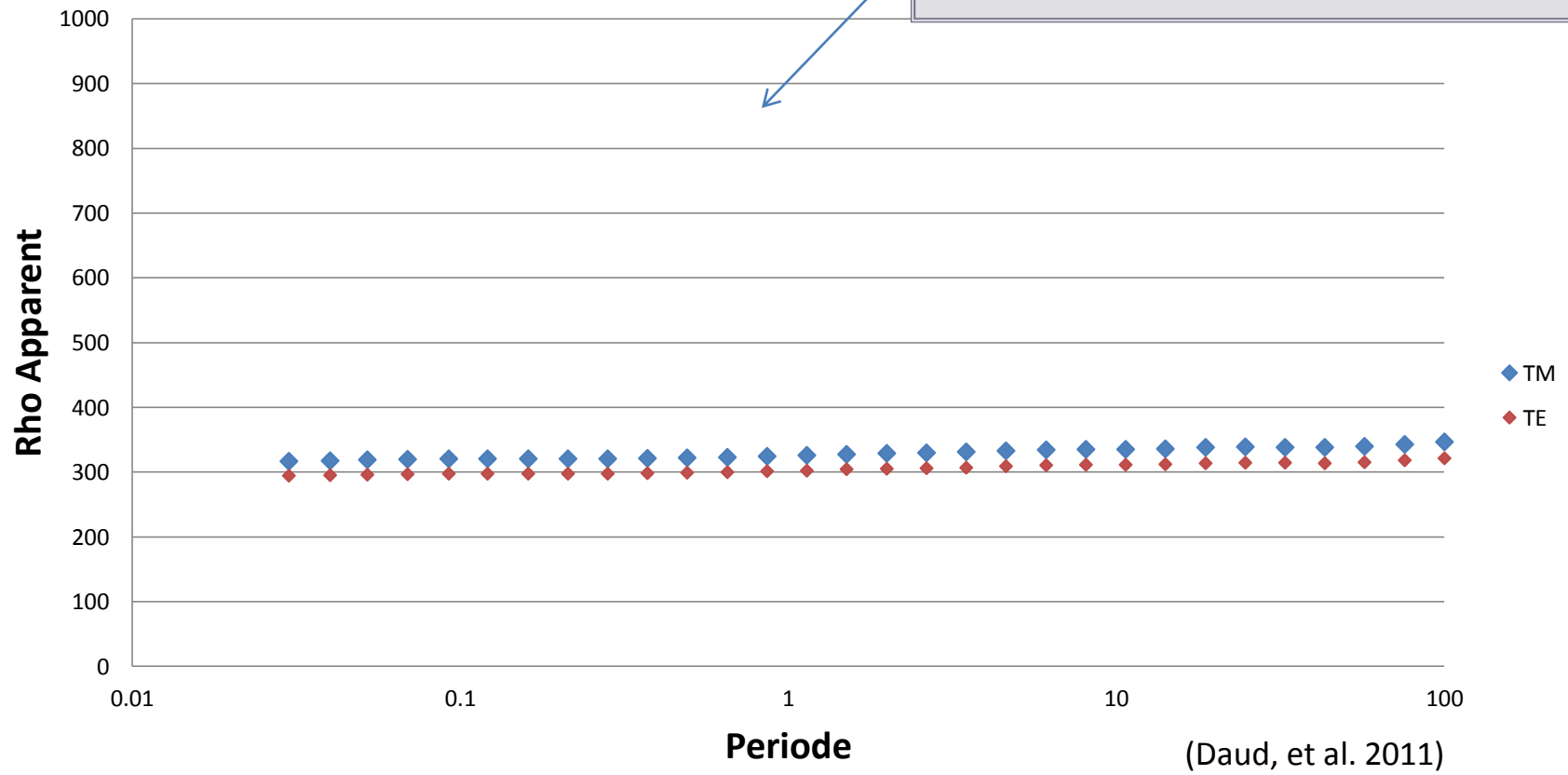


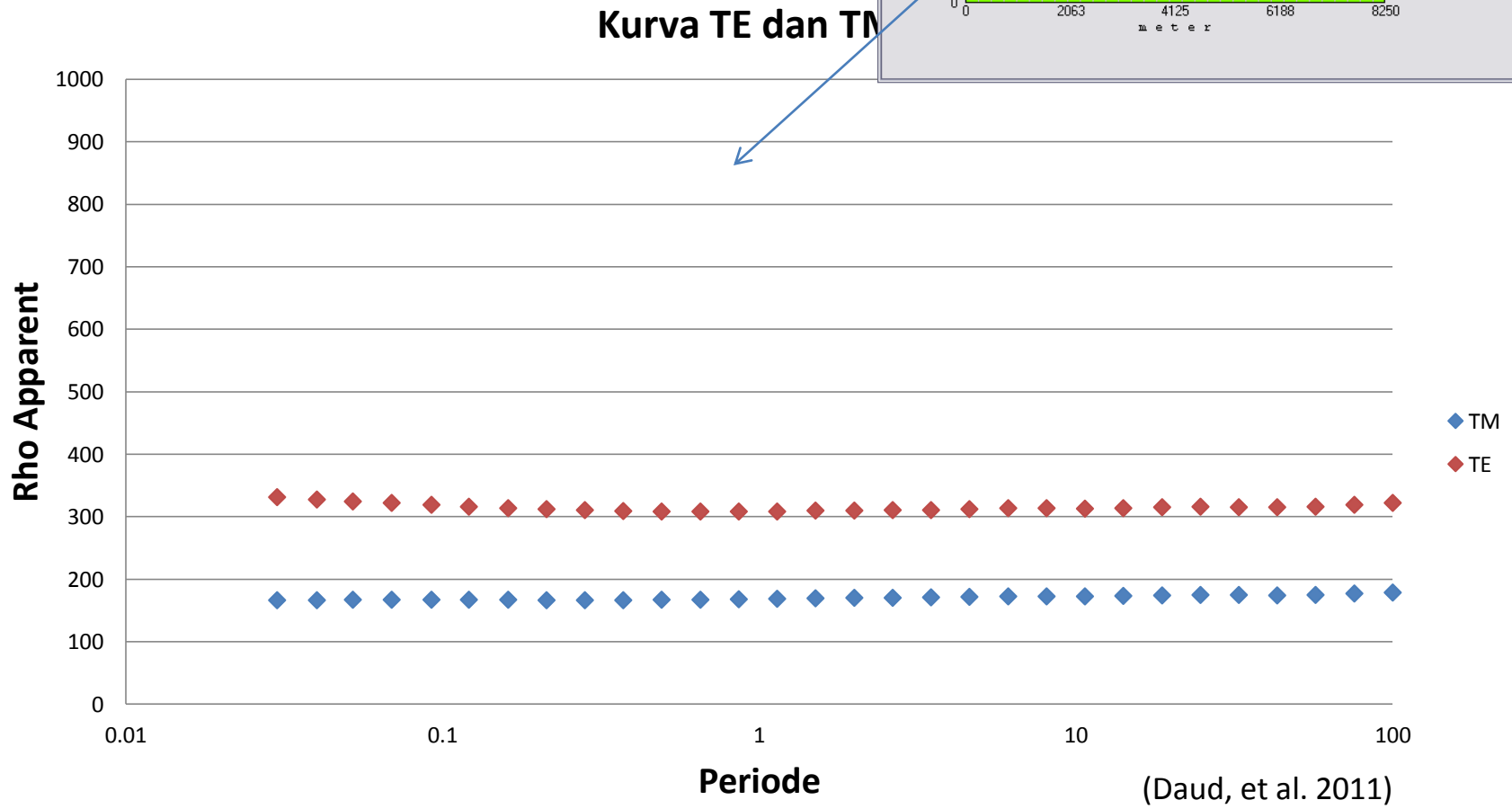
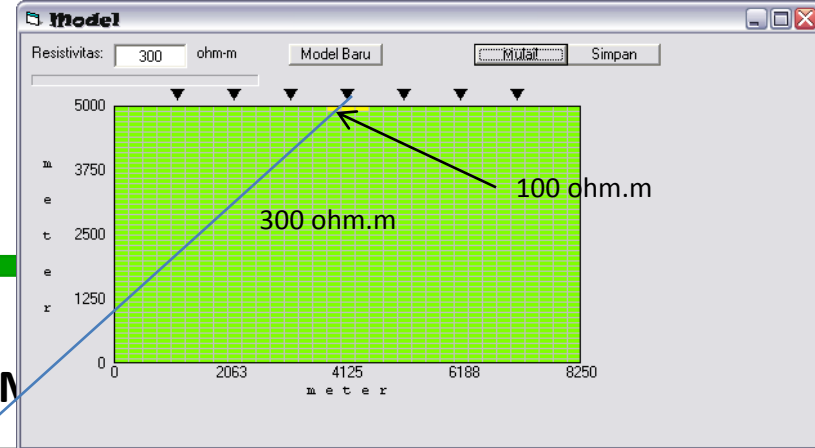
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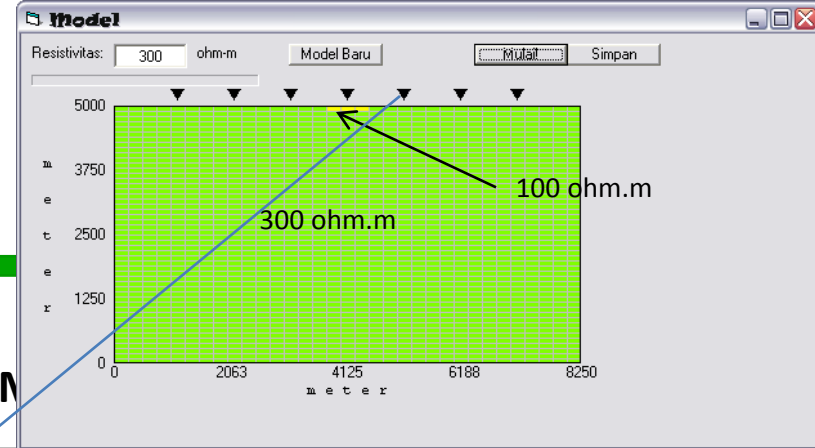




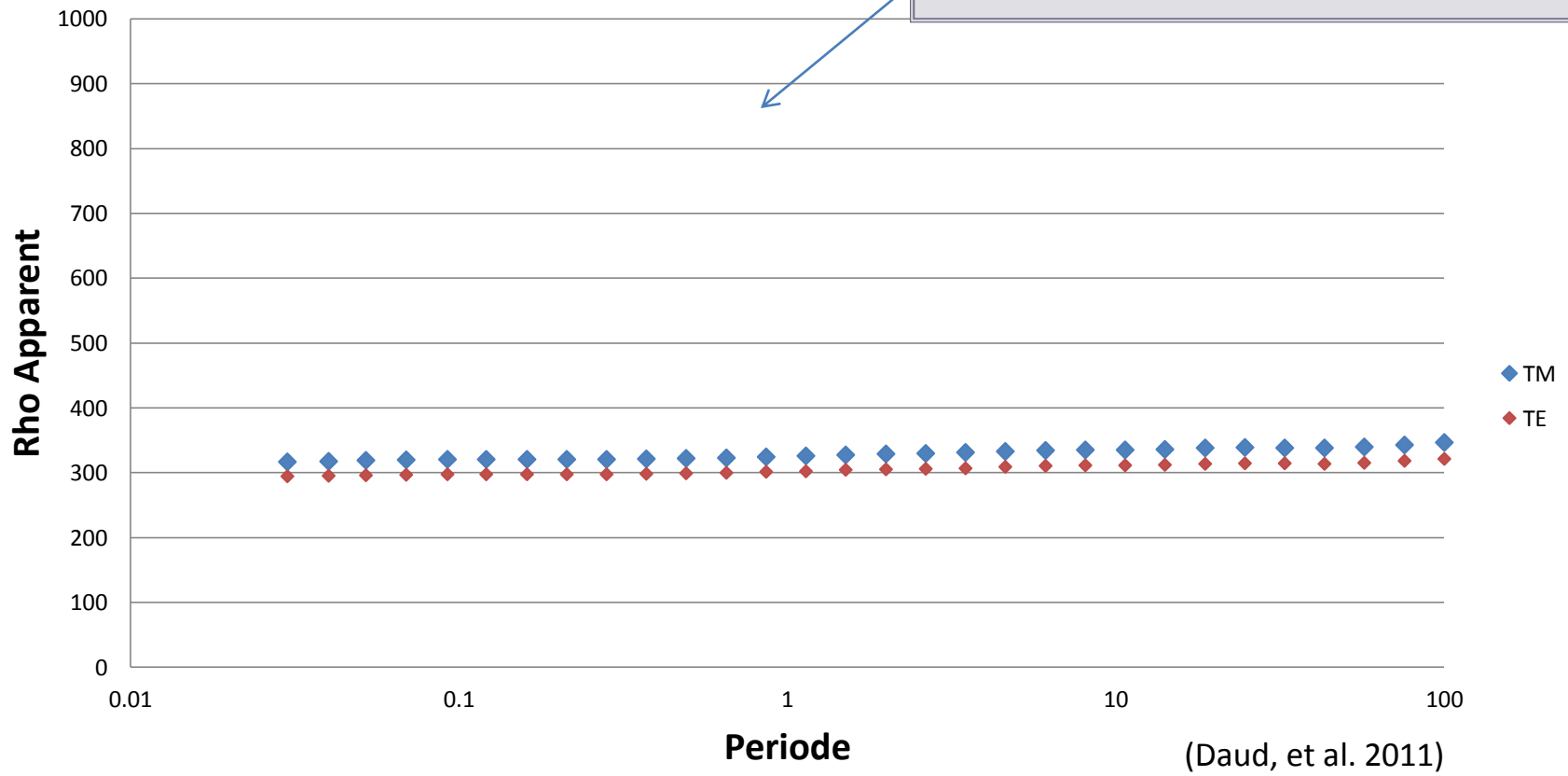
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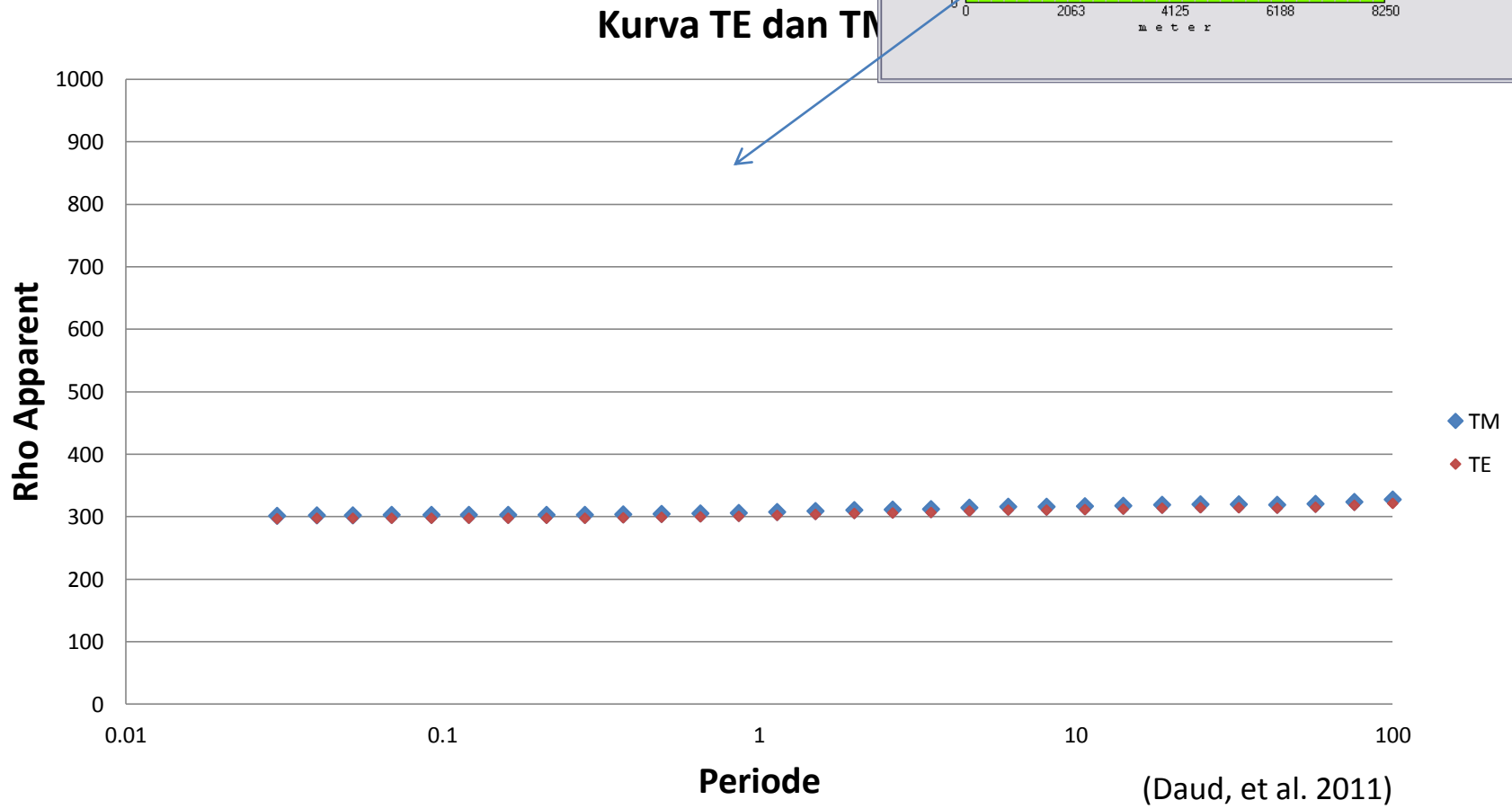
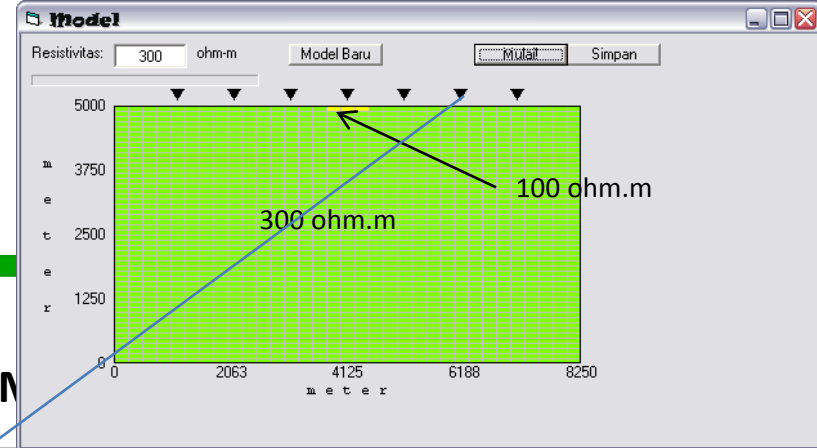




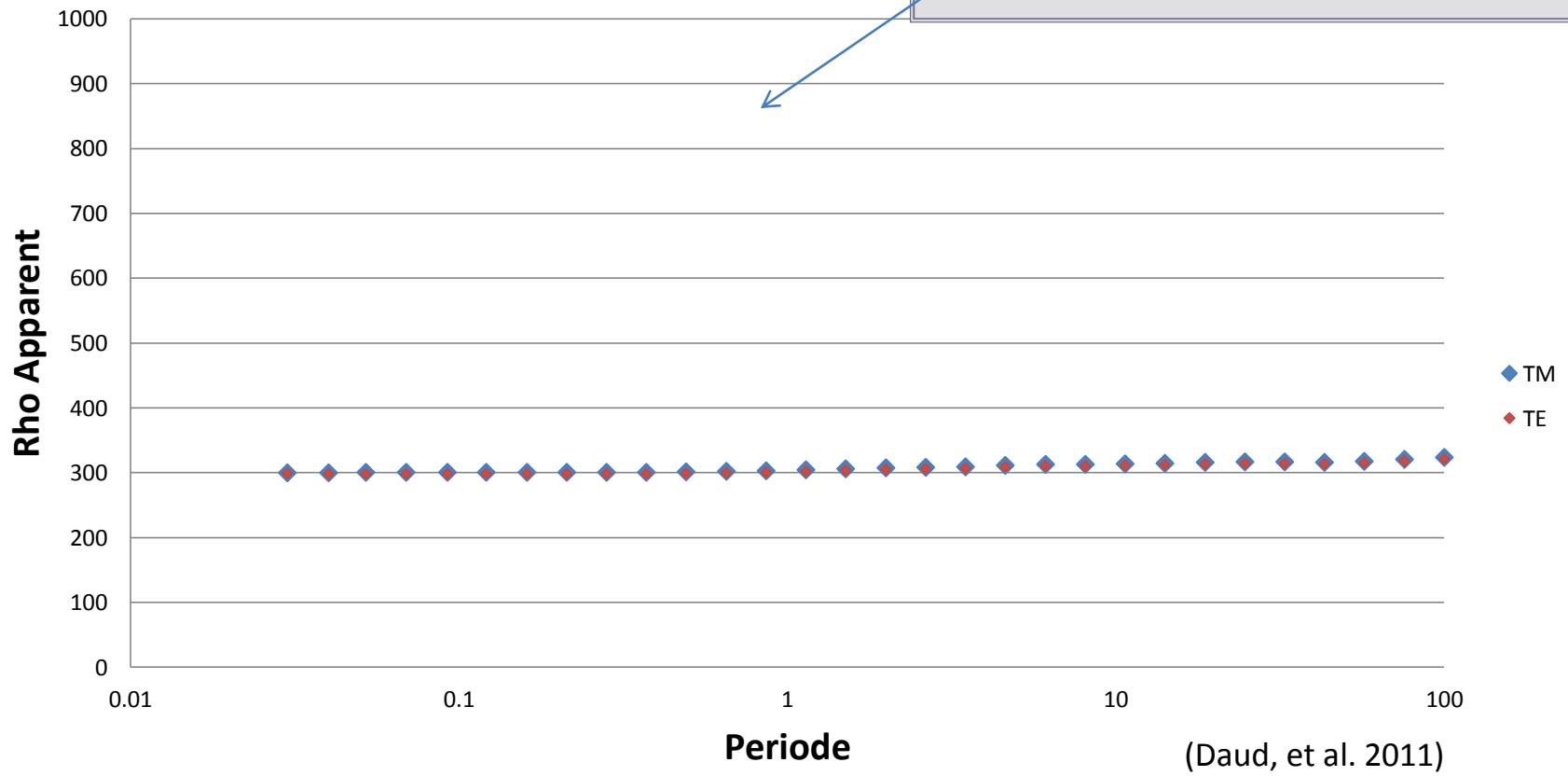


Kurva TE dan TM





## Kurva TE dan TM



(Daud, et al. 2011)



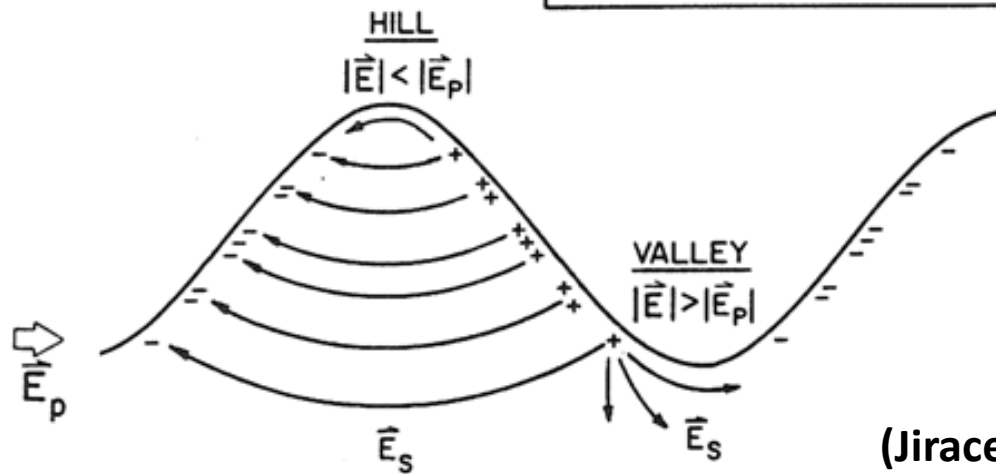
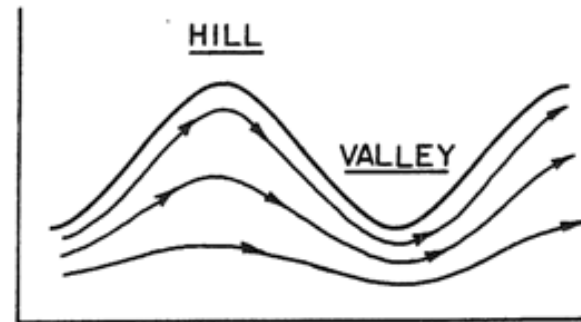
# Static Shift Caused by Topography

a

TOTAL E FIELD =  
PRIMARY E FIELD  
+ SECONDARY E FIELD  
 $\vec{E} = \vec{E}_p + \vec{E}_s$

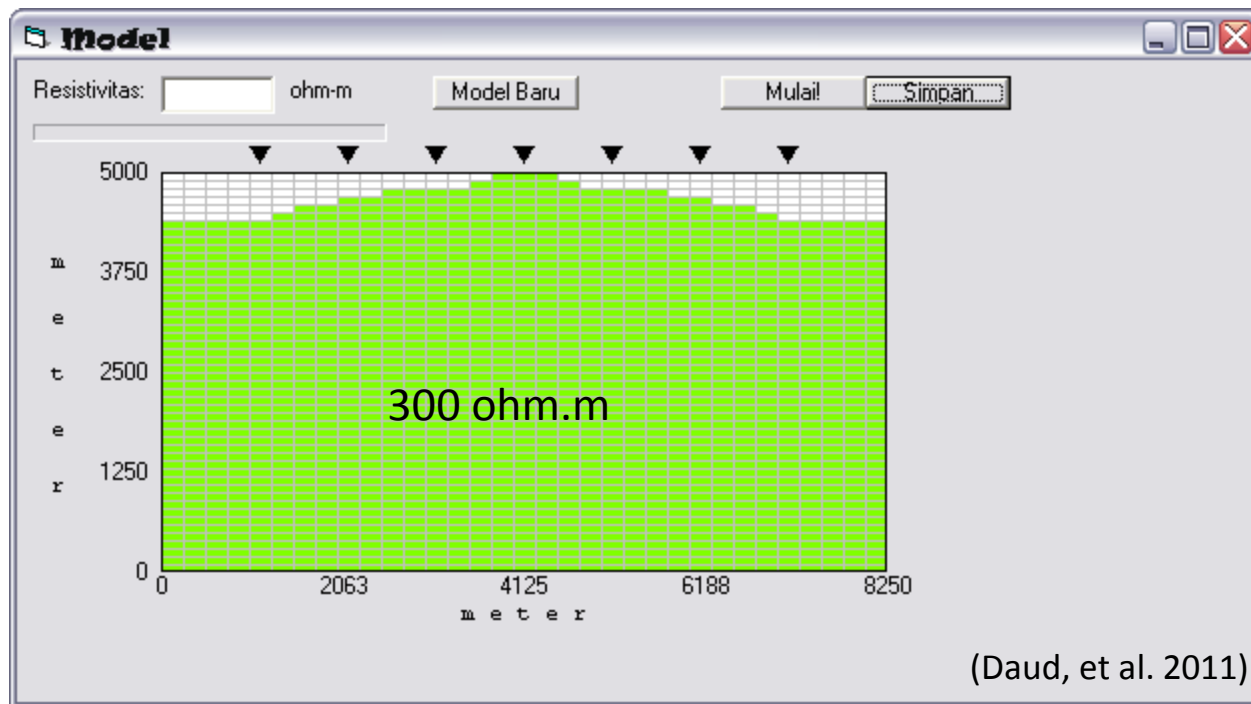
b

TOTAL E FIELD,  $\vec{E}$

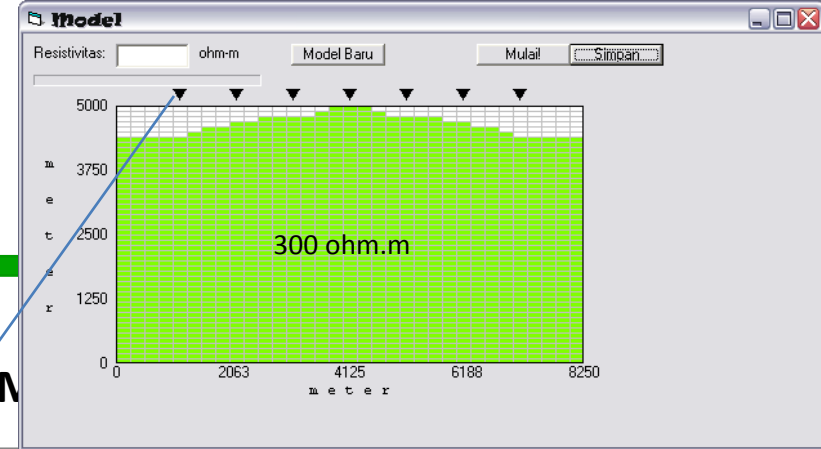
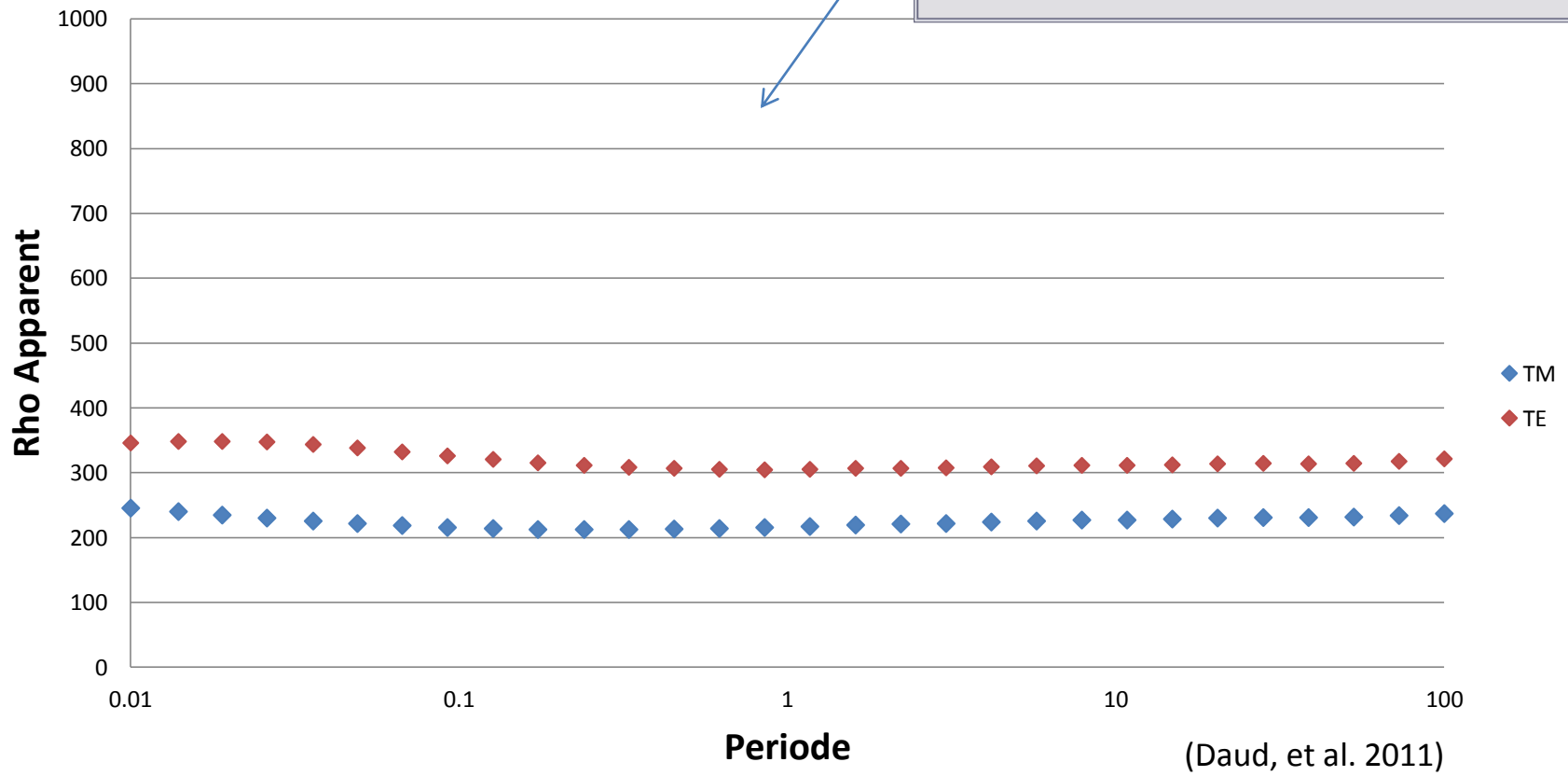


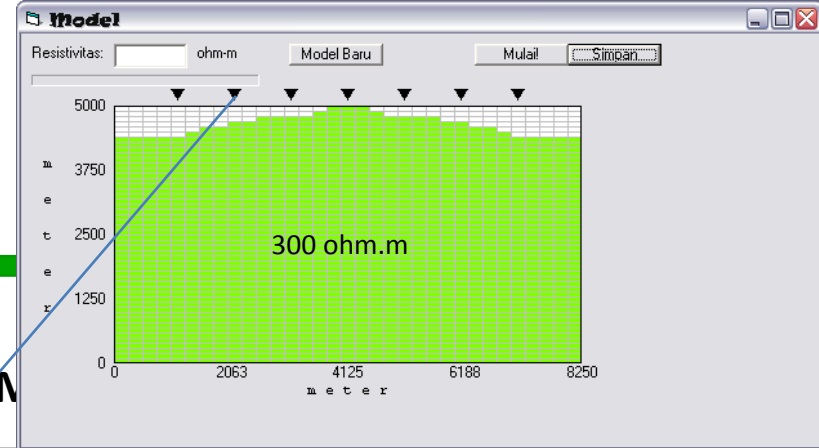
(Jiracek, 1990)



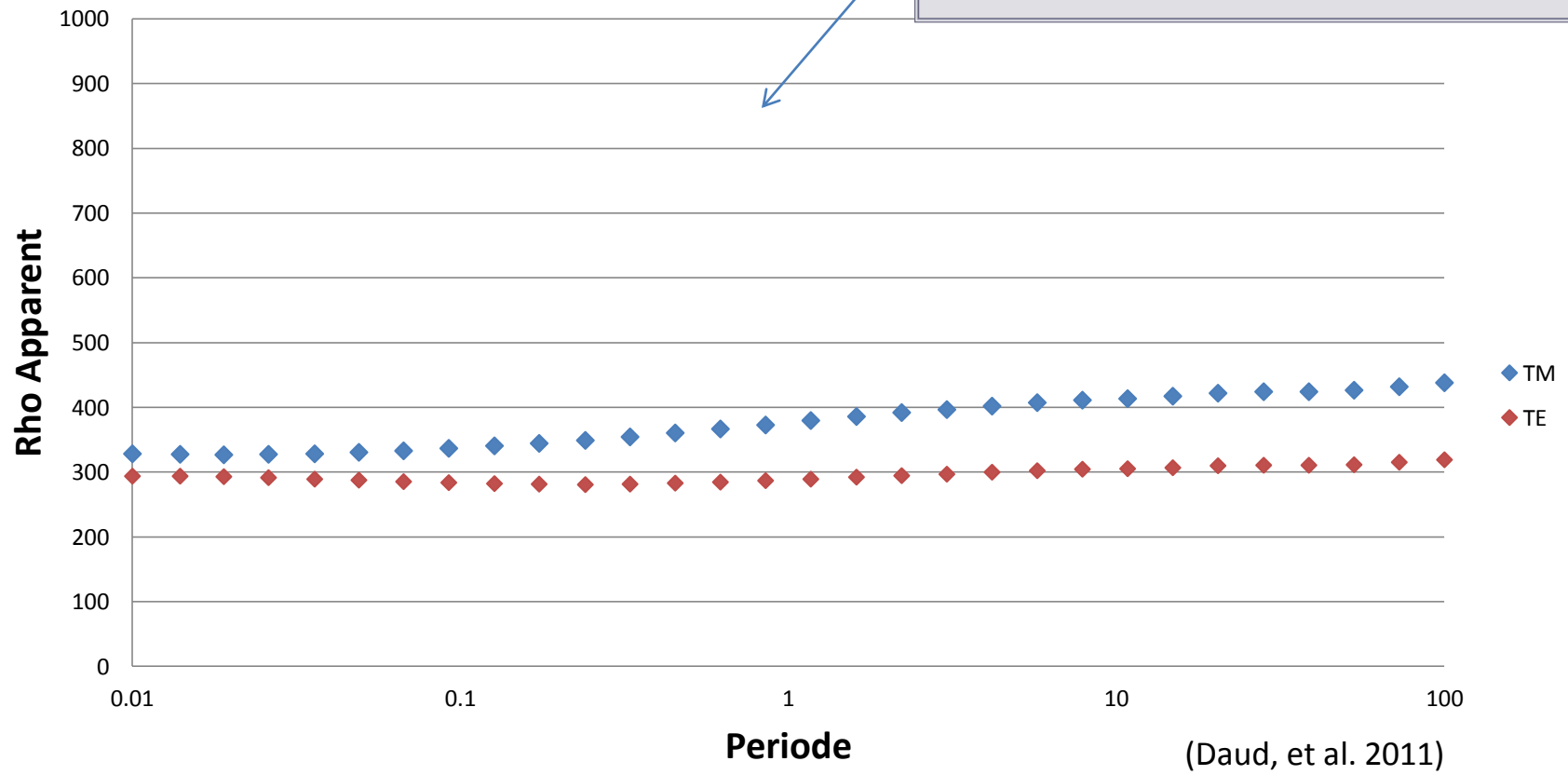


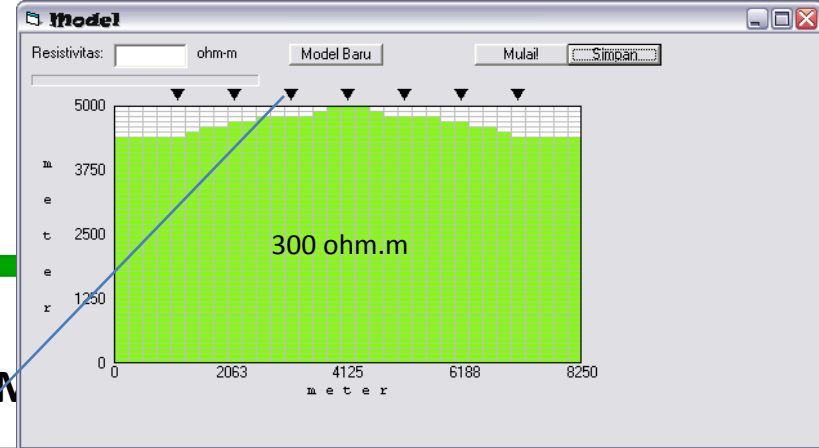
Kurva TE dan TN



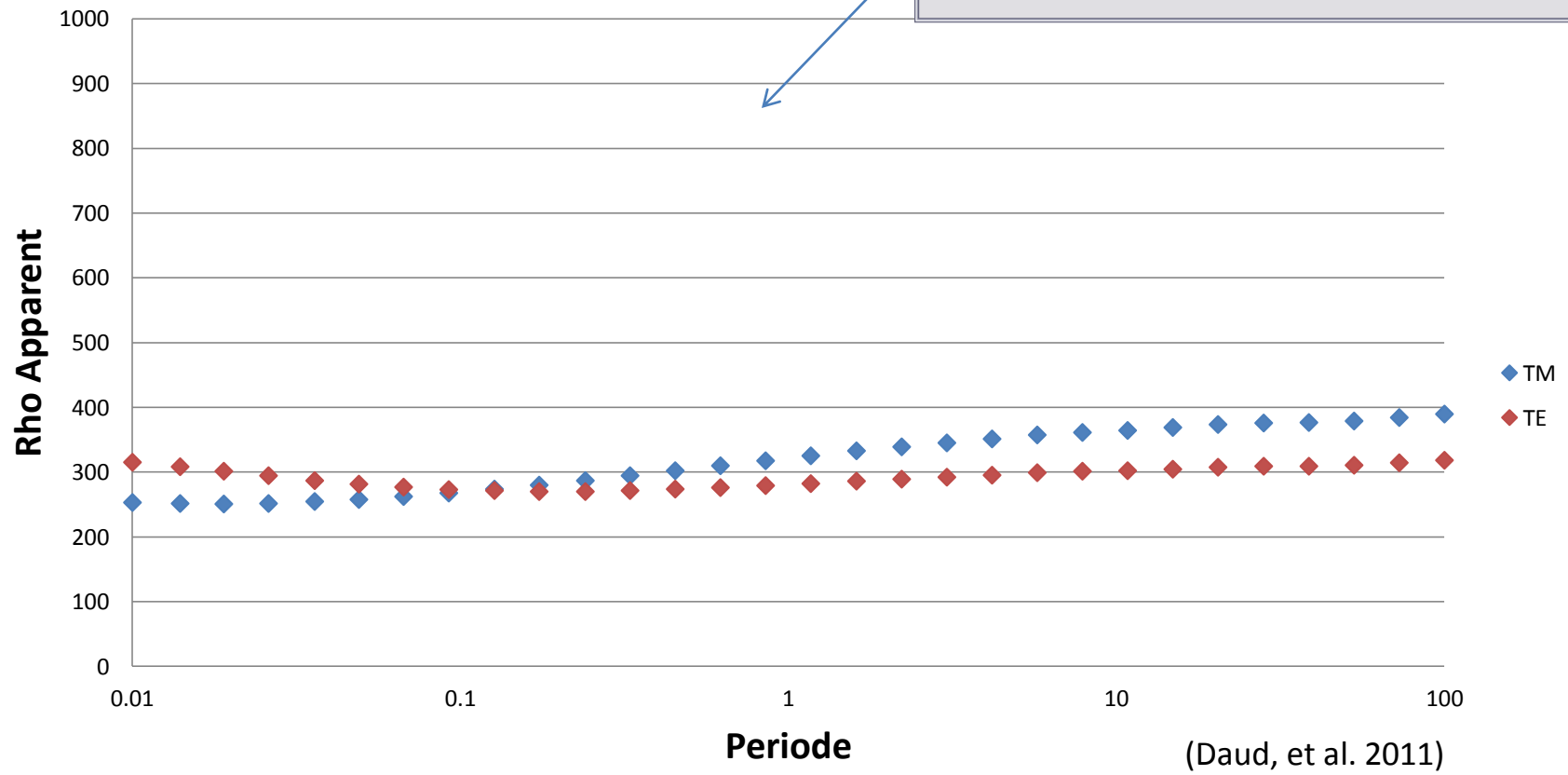


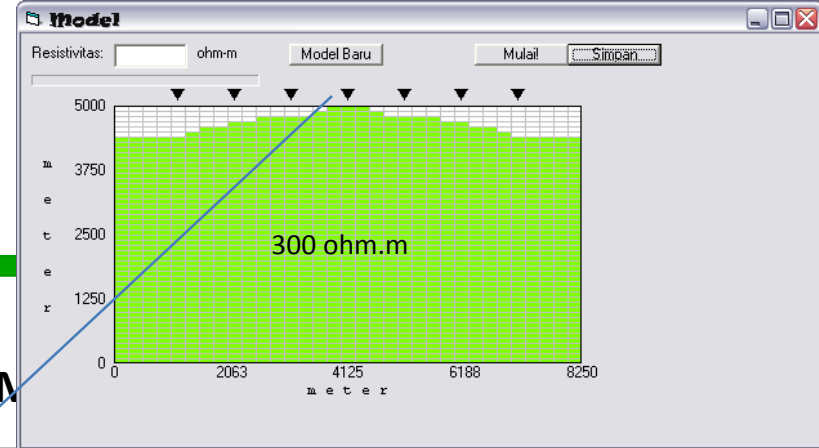
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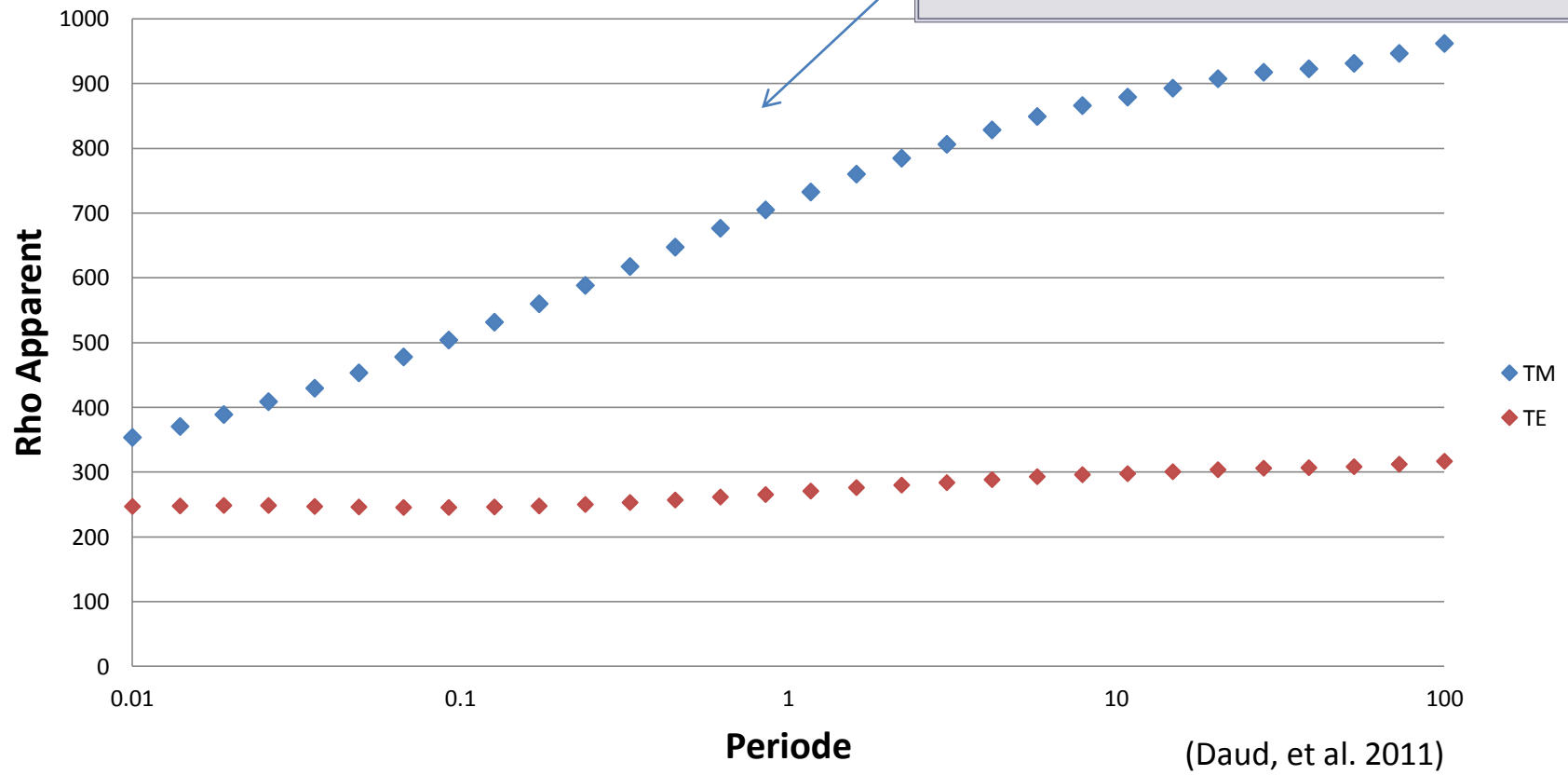


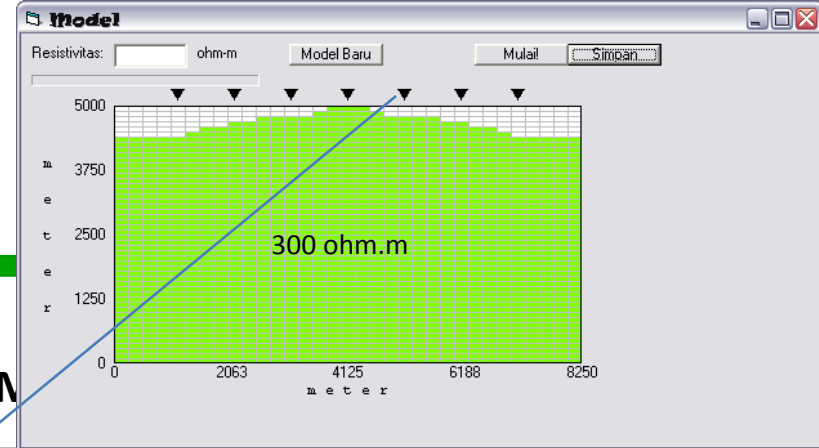
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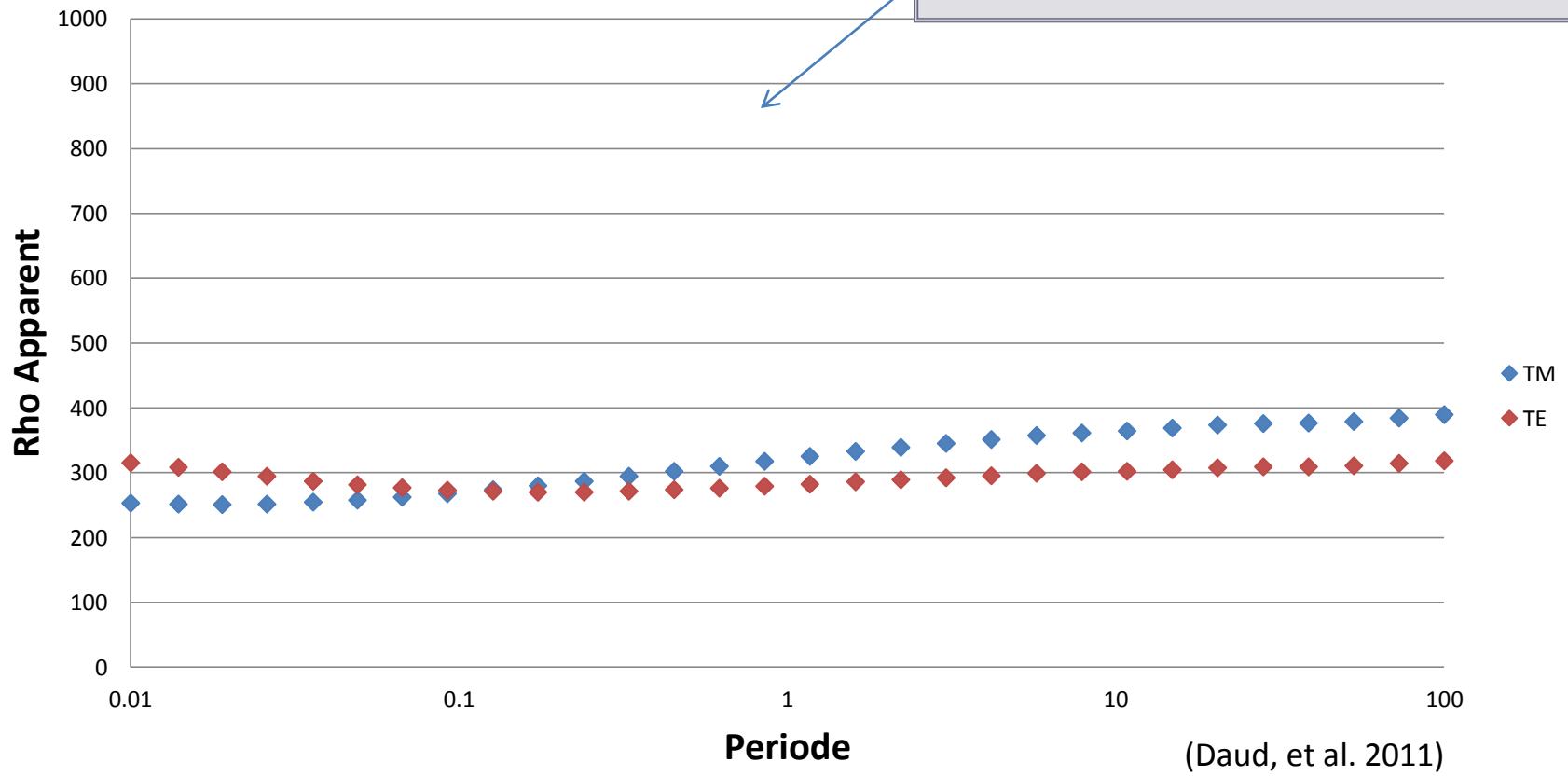


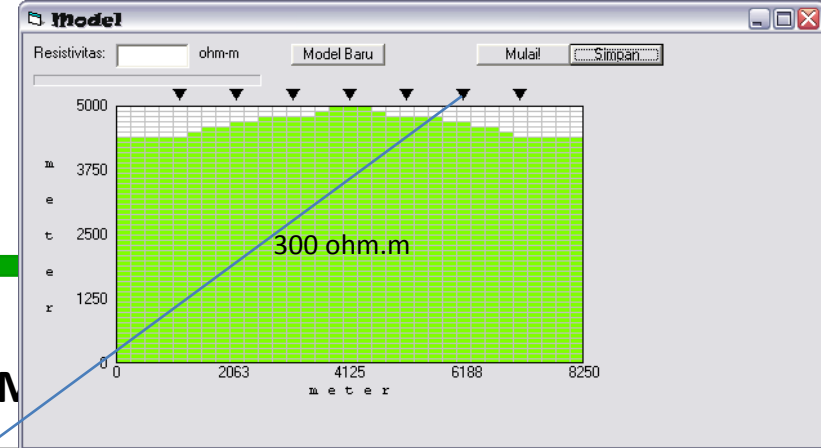
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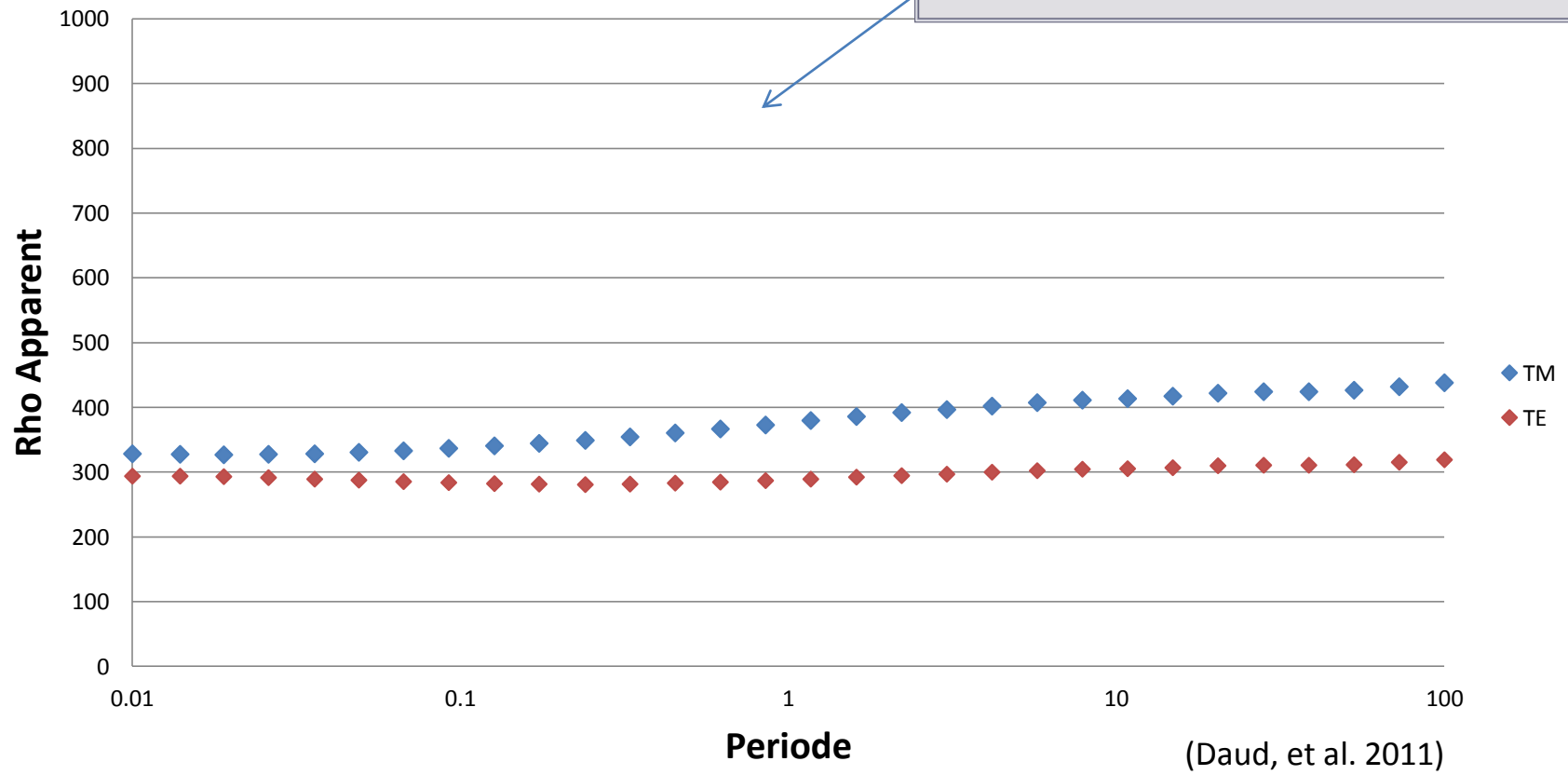


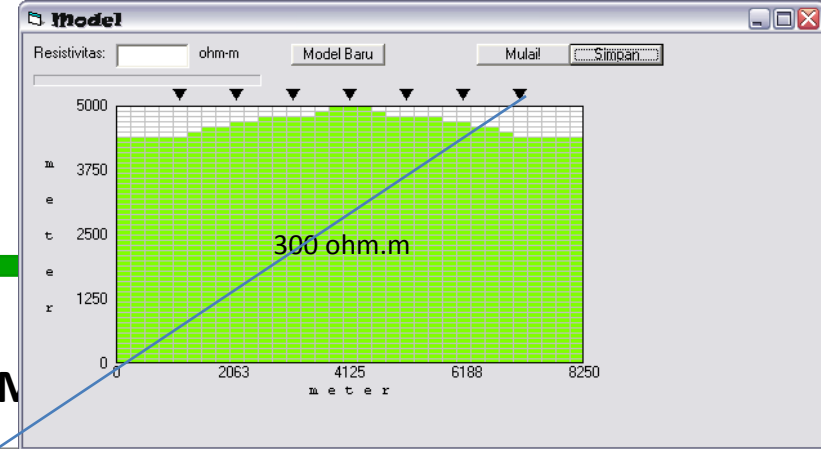
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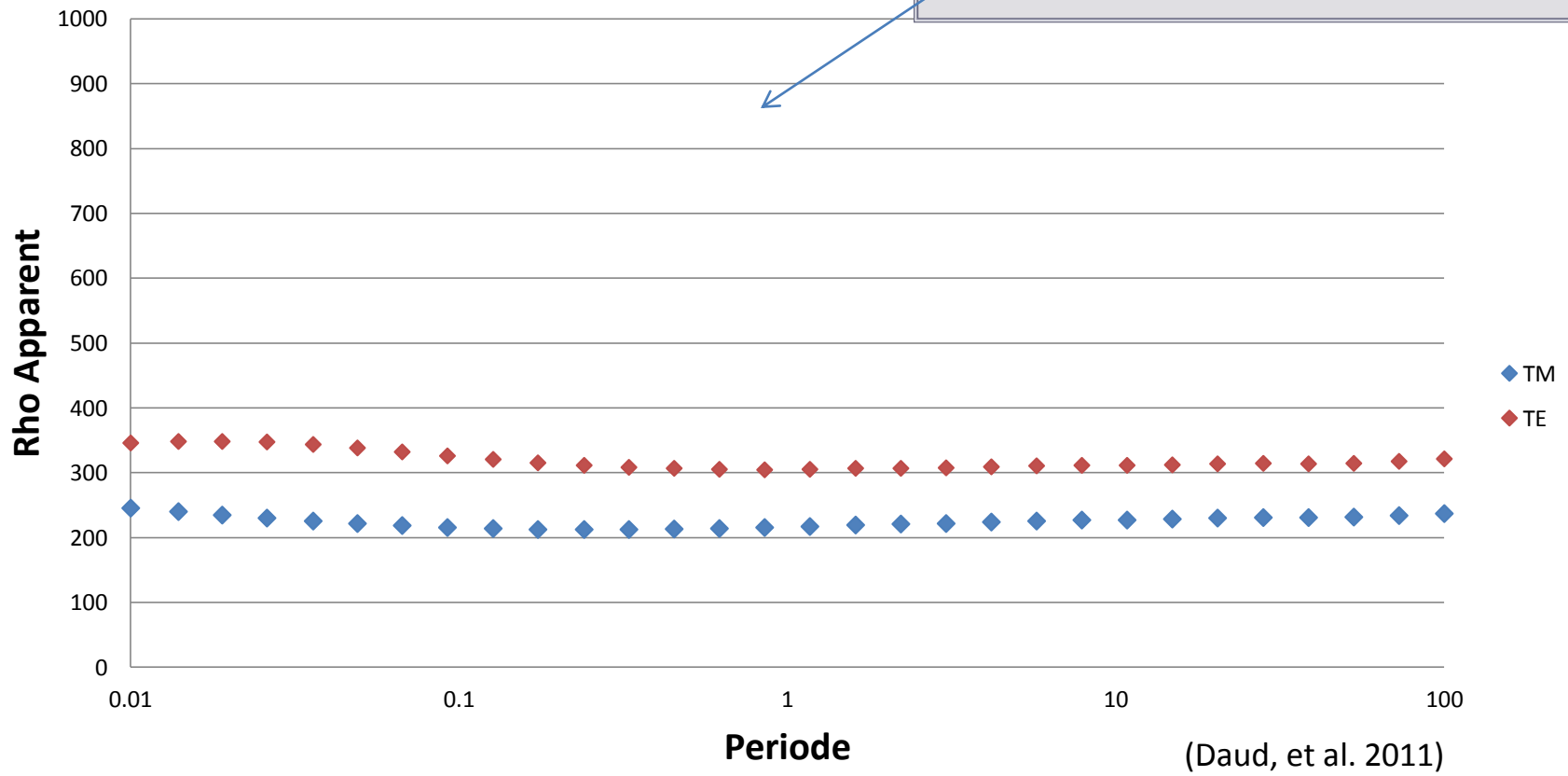


Kurva TE dan TM

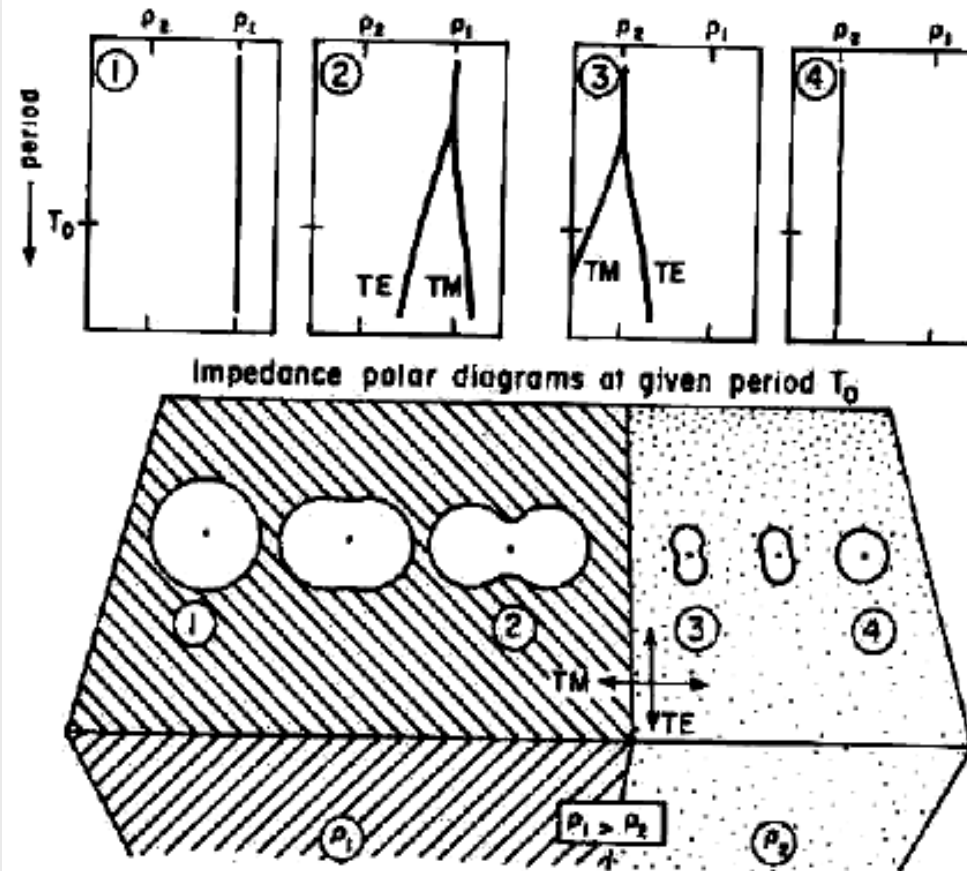




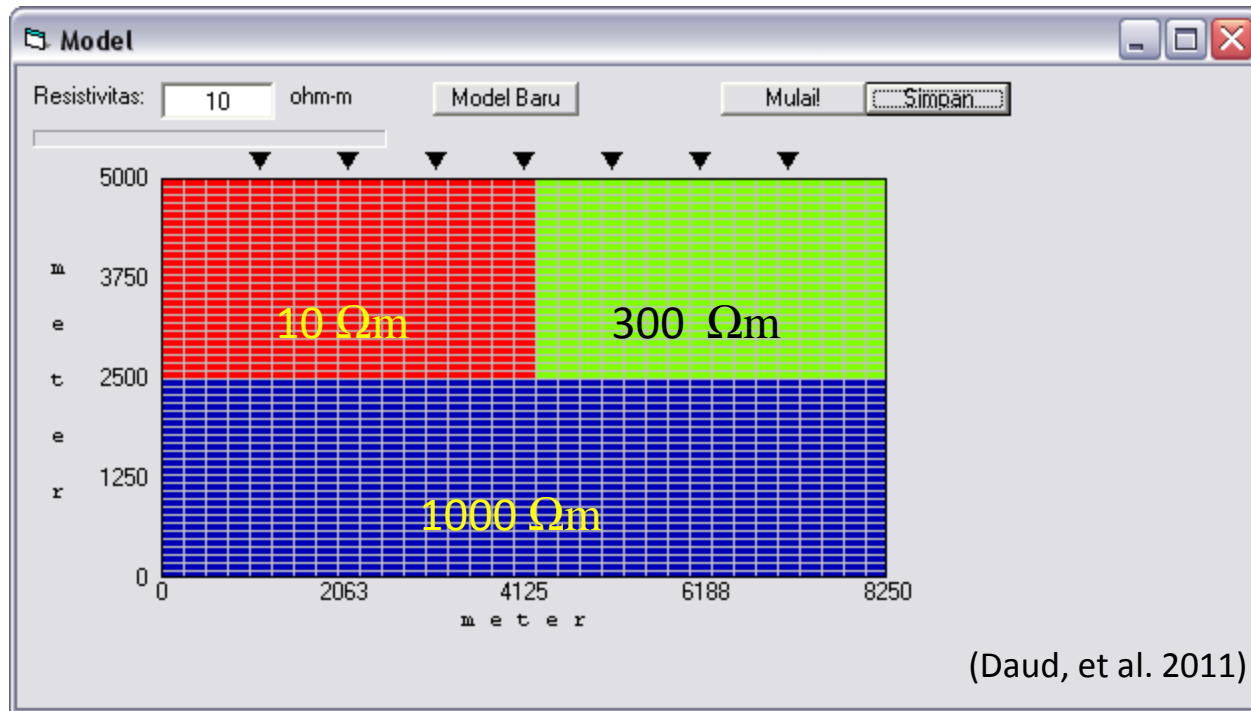
Kurva TE dan TM



# Static Shift Caused by Vertical Contact

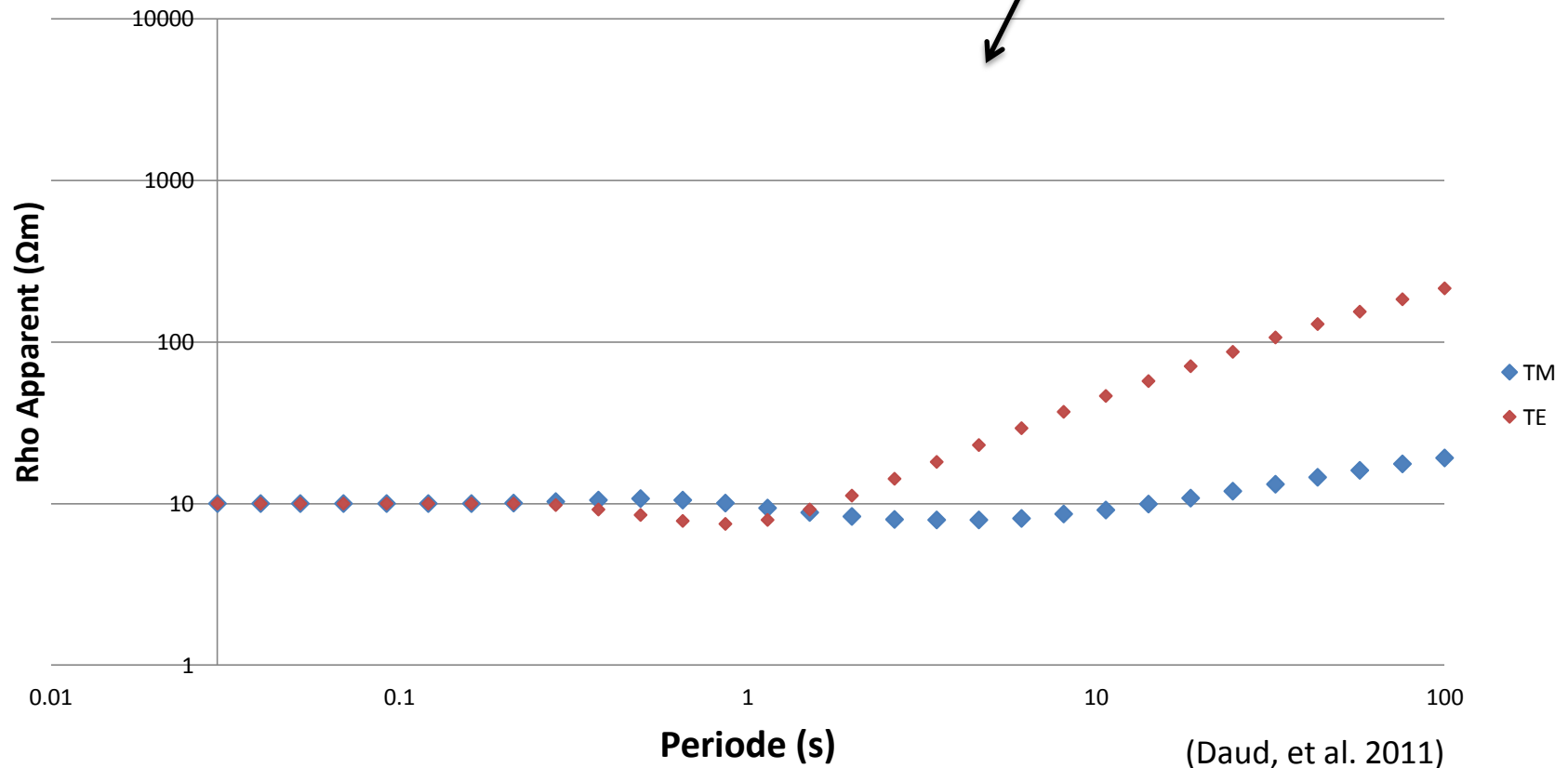
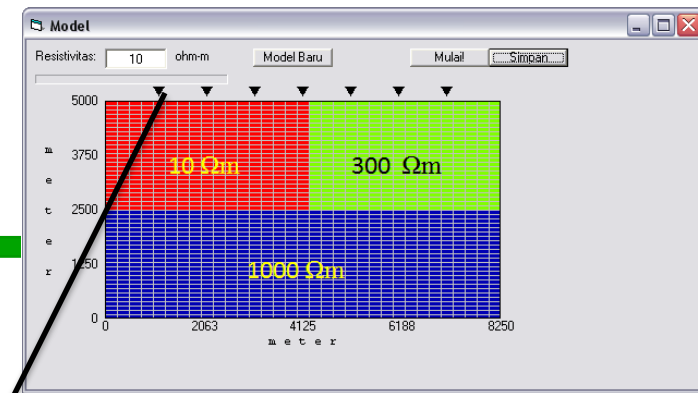


# Vertical Contact Model



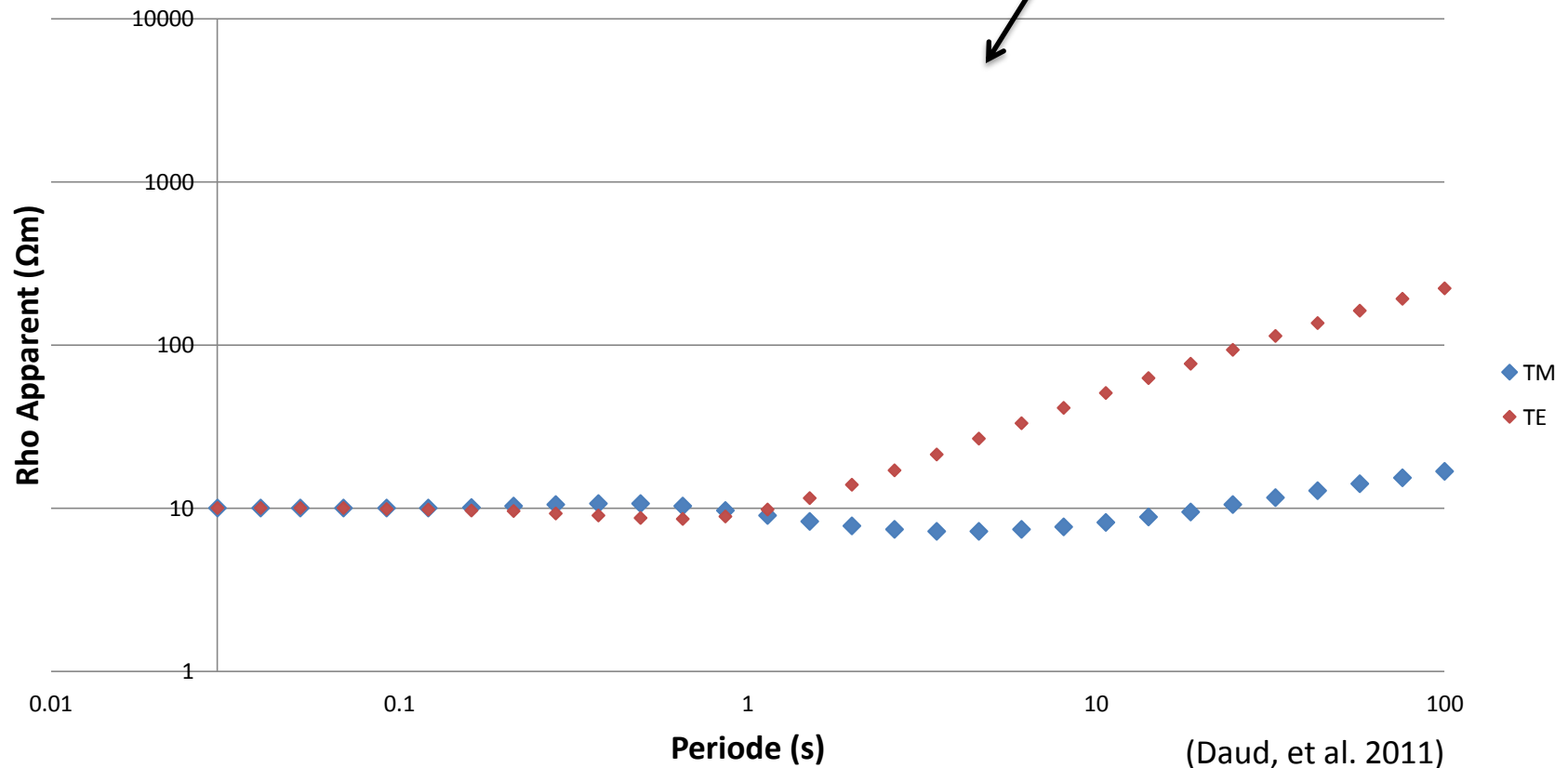
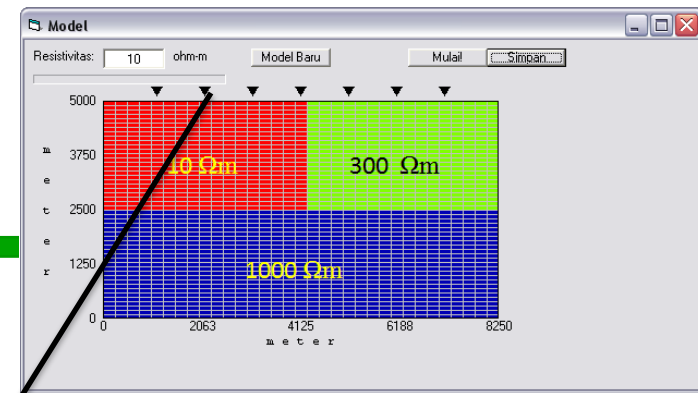
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KURVA TM DAN TE



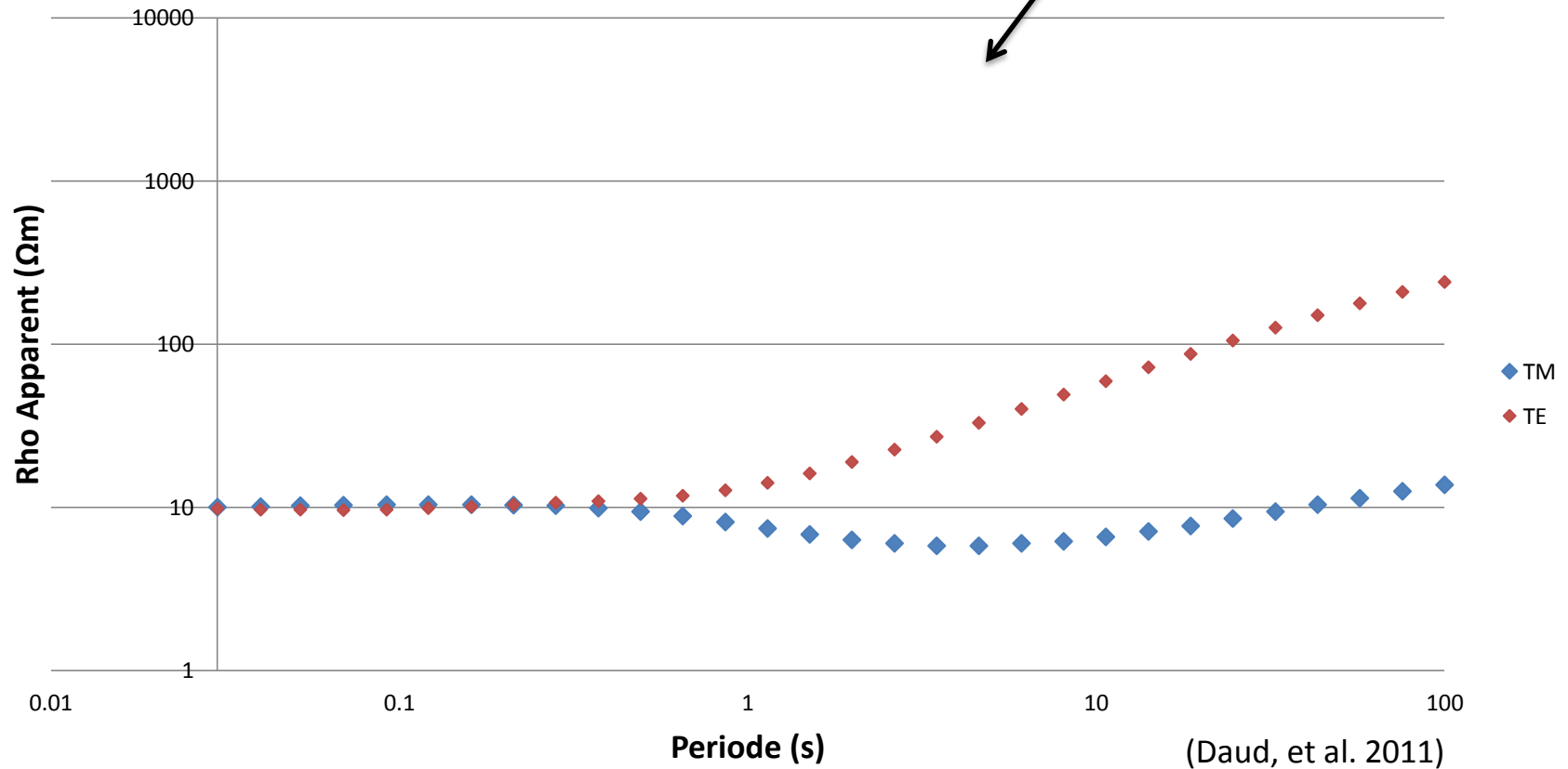
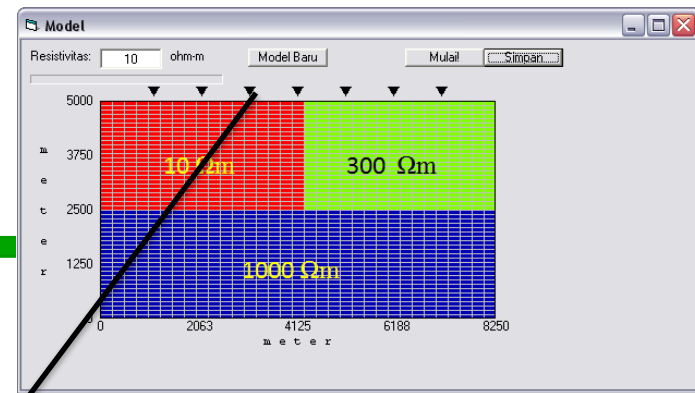
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KURVA TM DAN TE



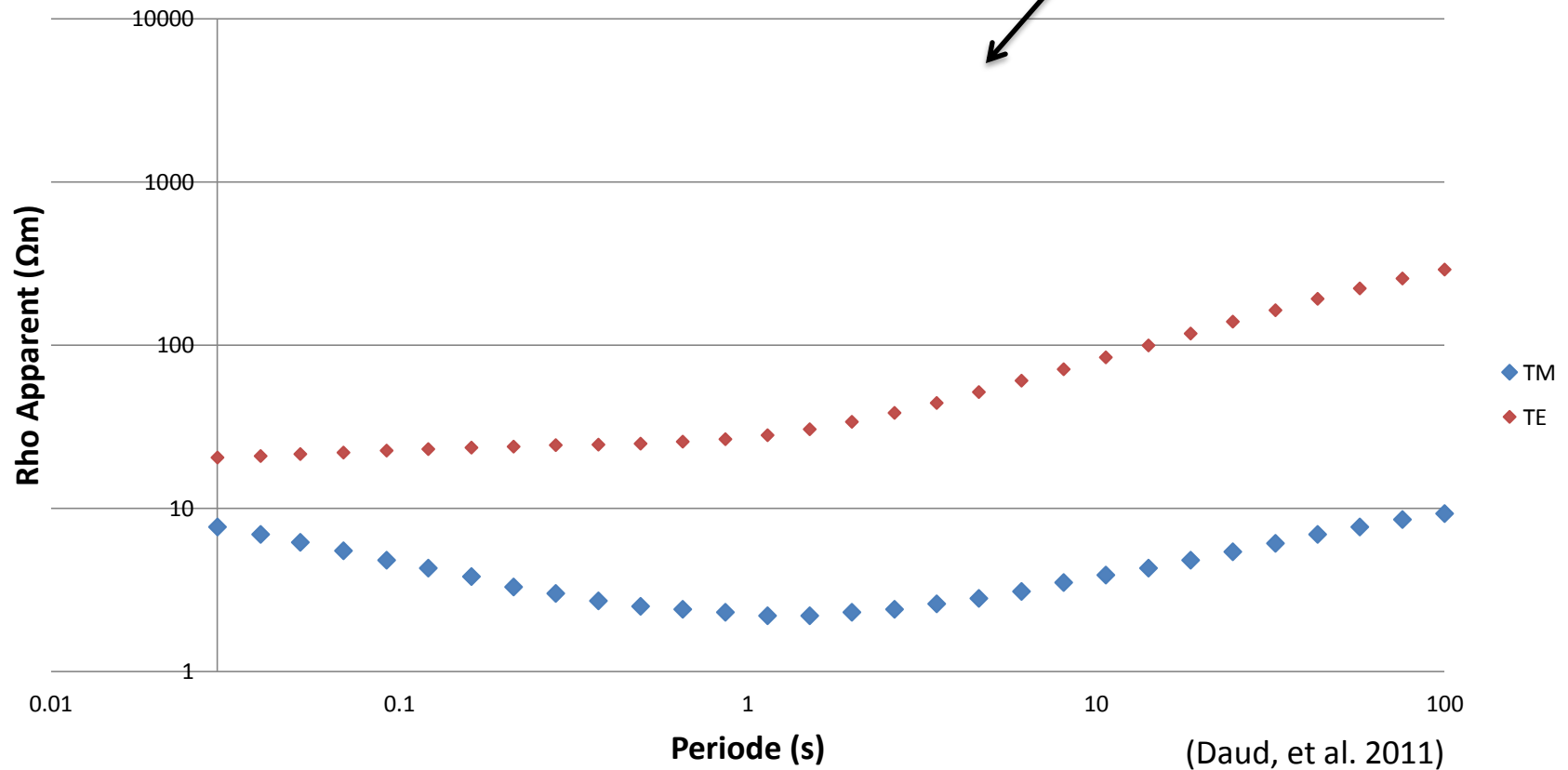
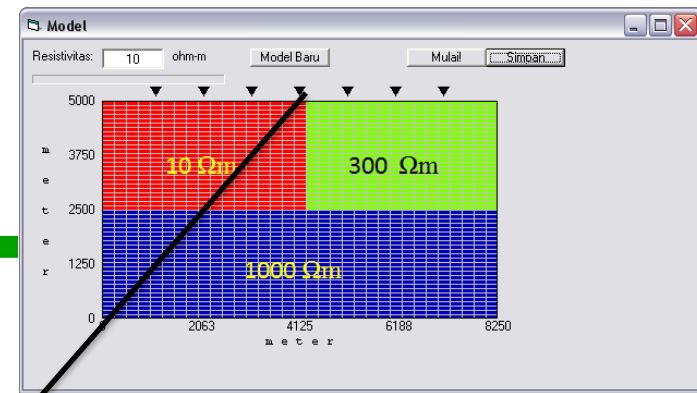
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KURVA TM DAN TE

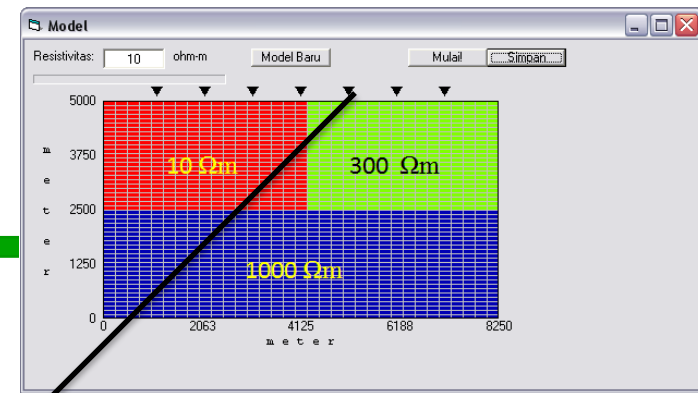


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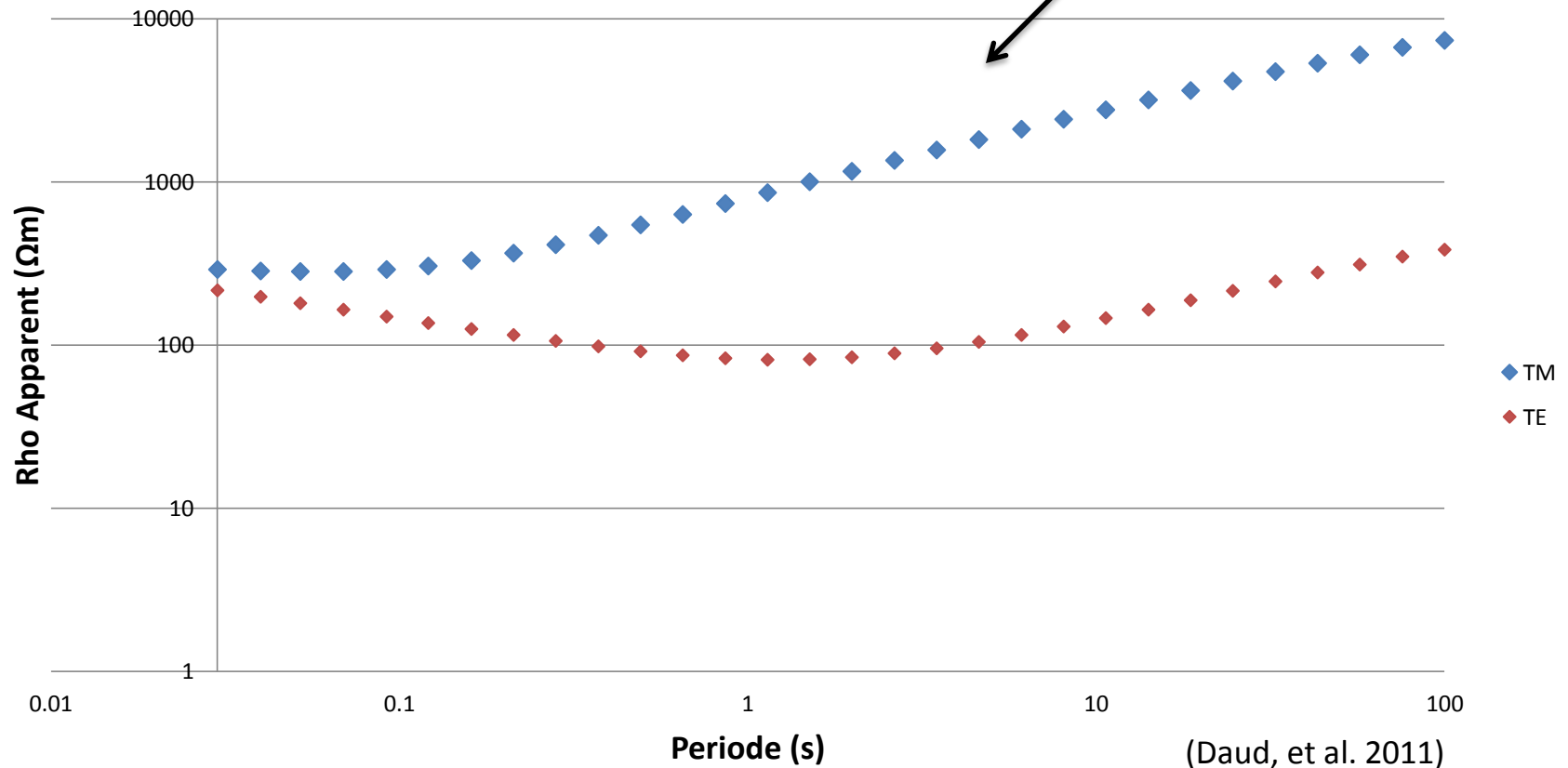
## KURVA TM DAN TE



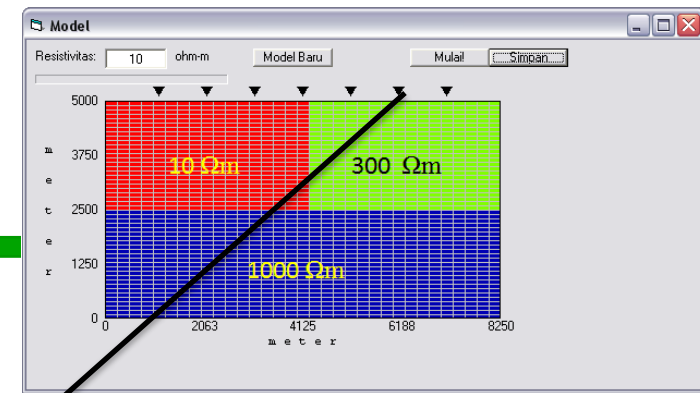
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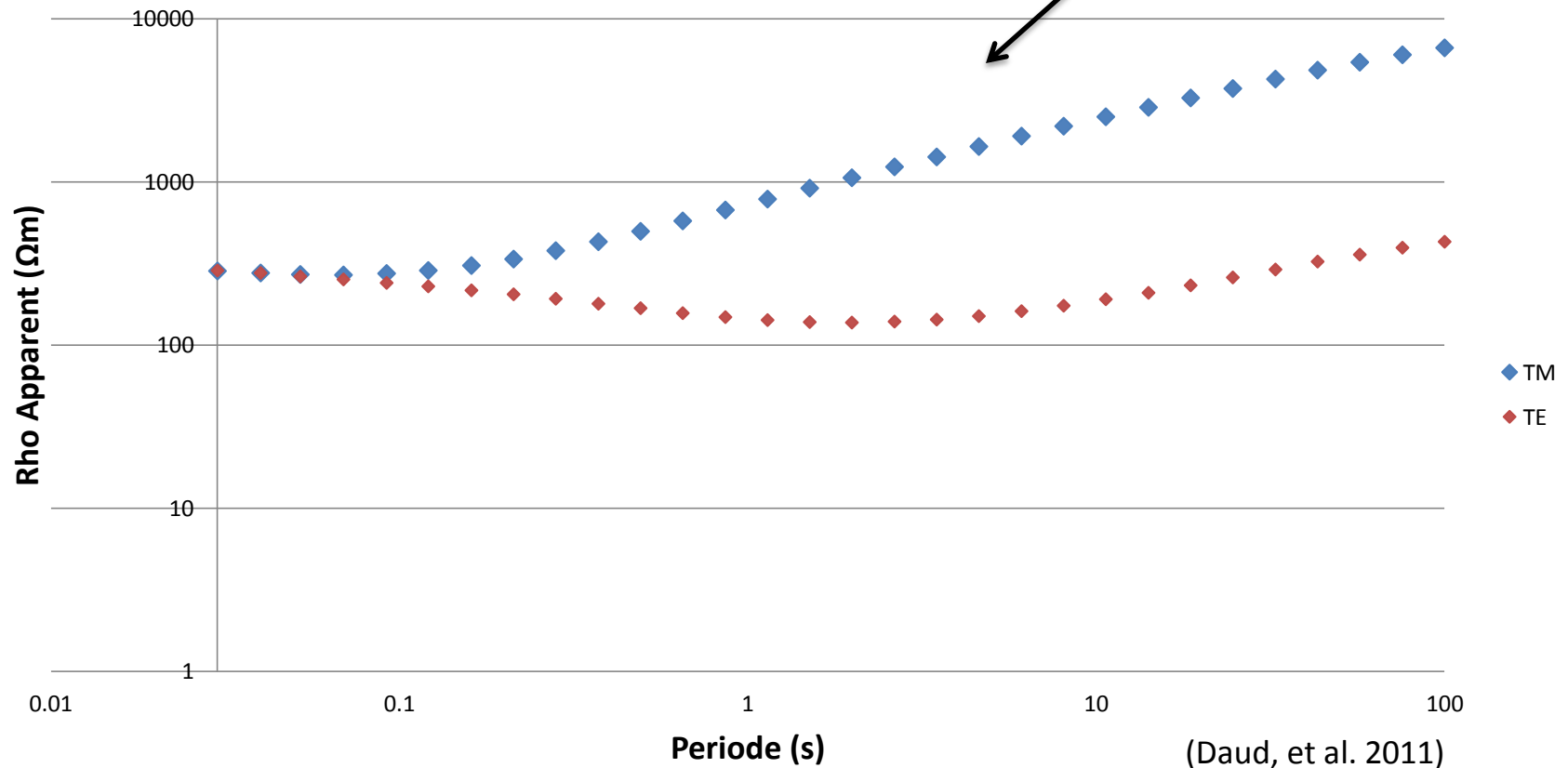
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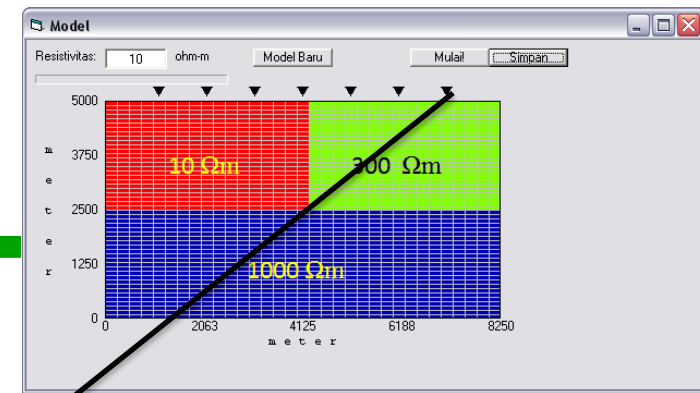
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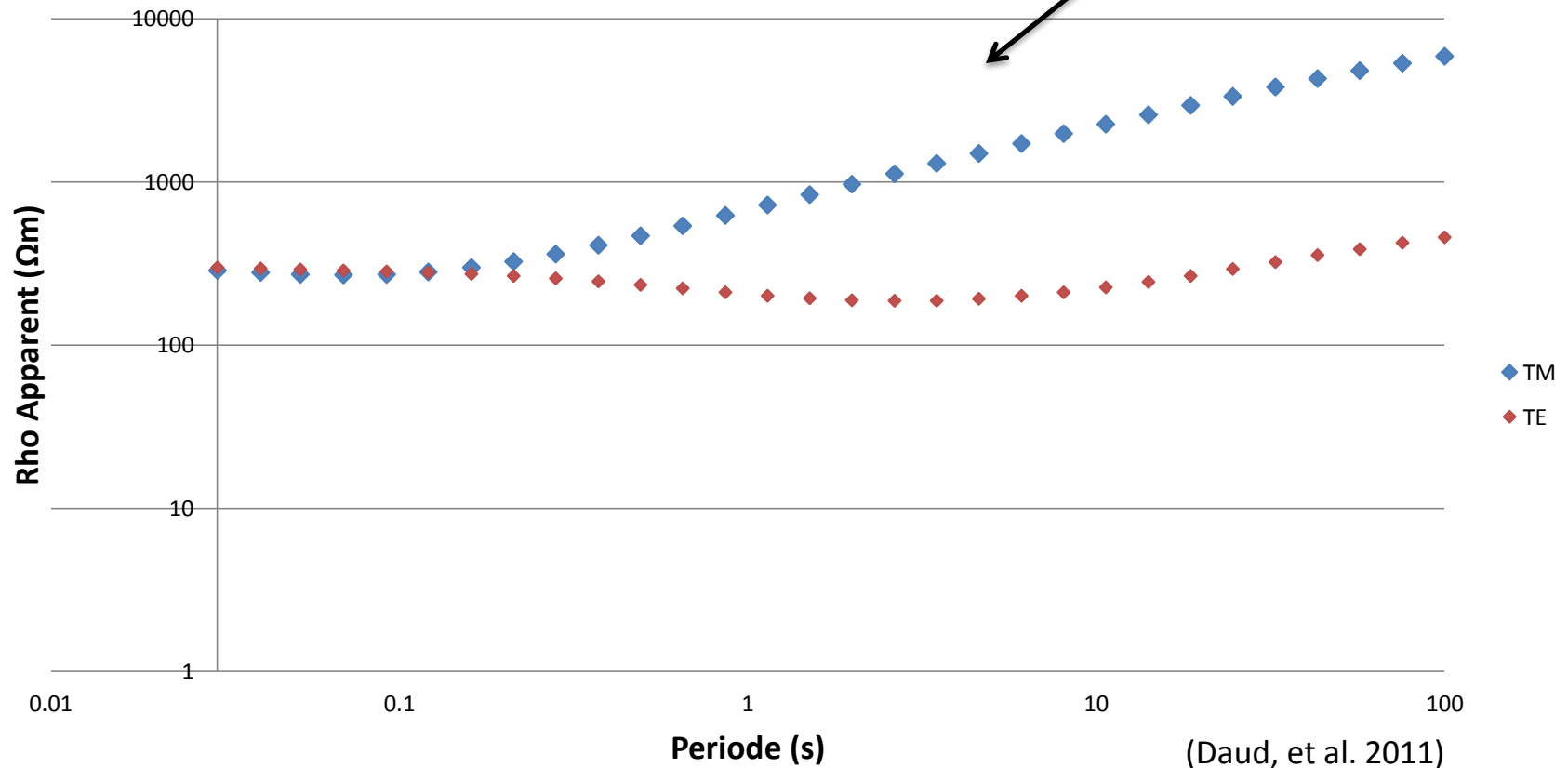
KURVA TM DAN TE



# Stasiun 7



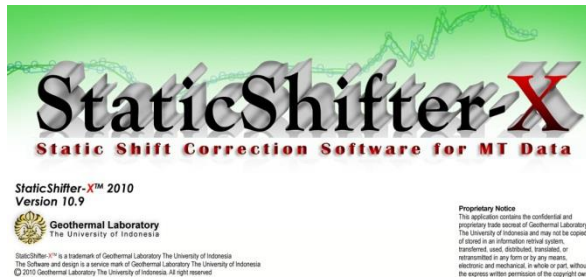
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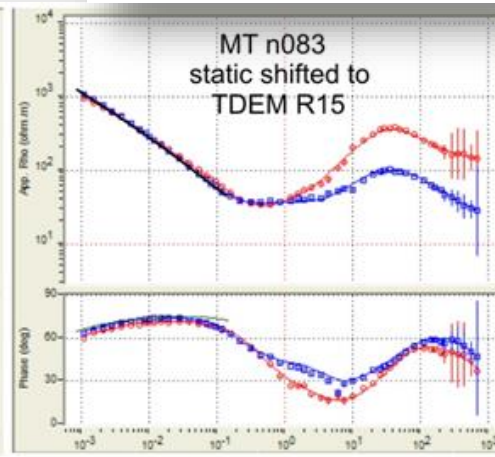
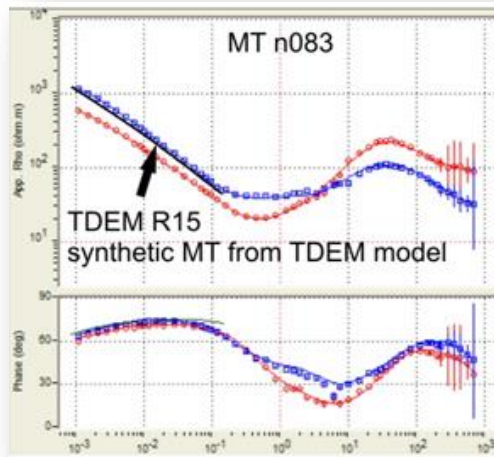
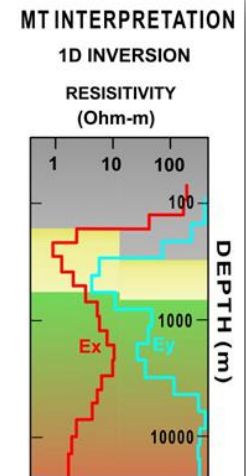
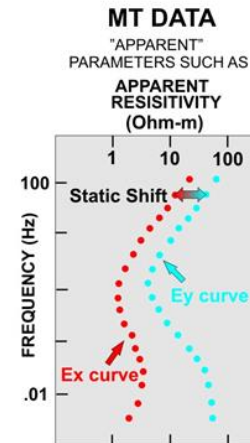
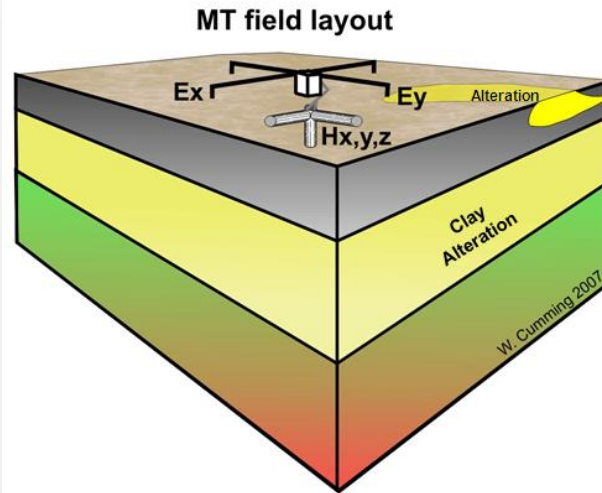
# How to Correct Static Shift Effect

- Utilizing Transient Electromagnetic (TEM) or Time Domain Electromagnetic (TDEM)
- Using mathematical methods: Cokriging, Averaging, Geomagnetic Transfer Function

- Using **StaticShifter-X** Software

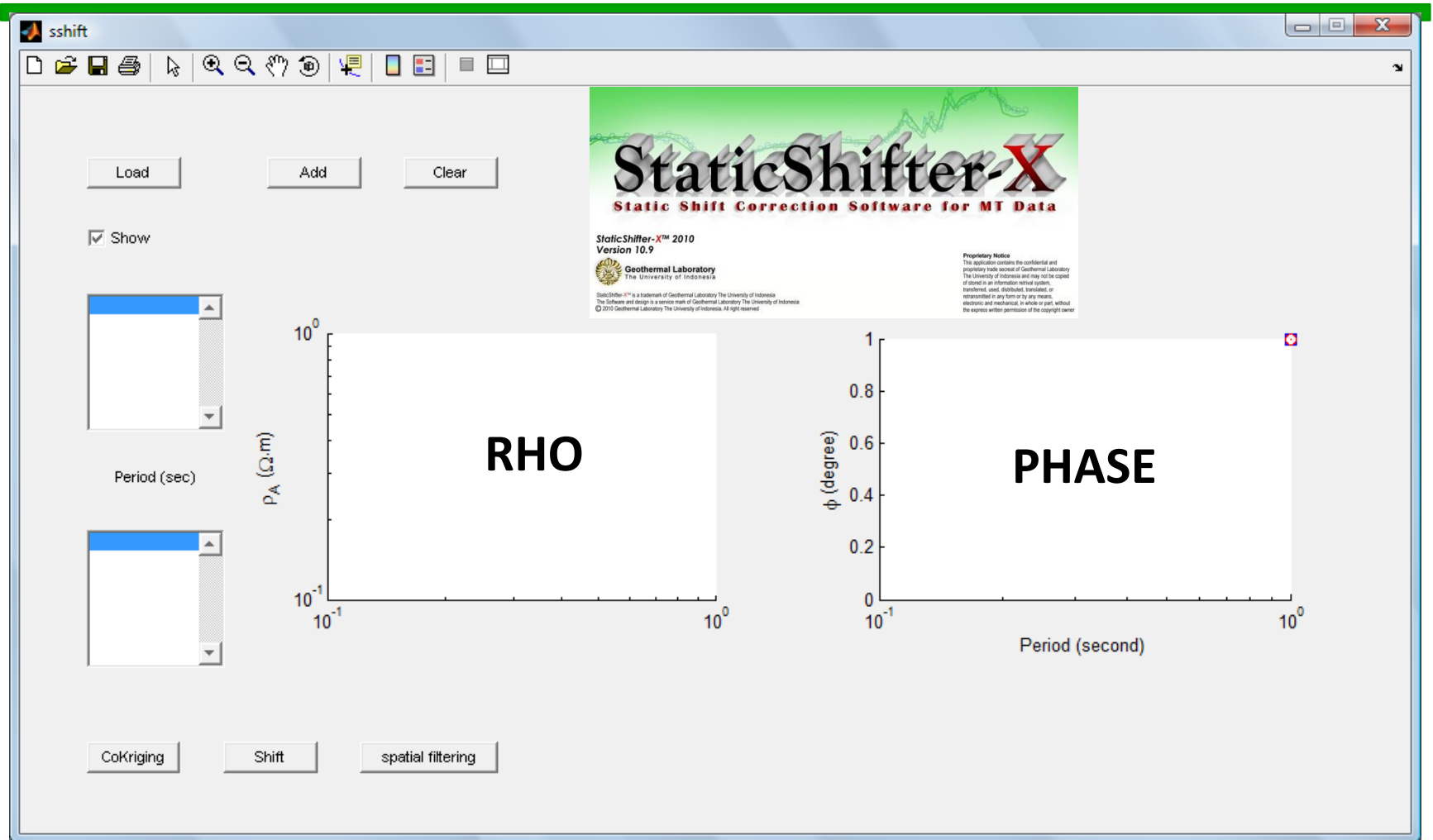


# Static Shift Correction Using TDEM Data

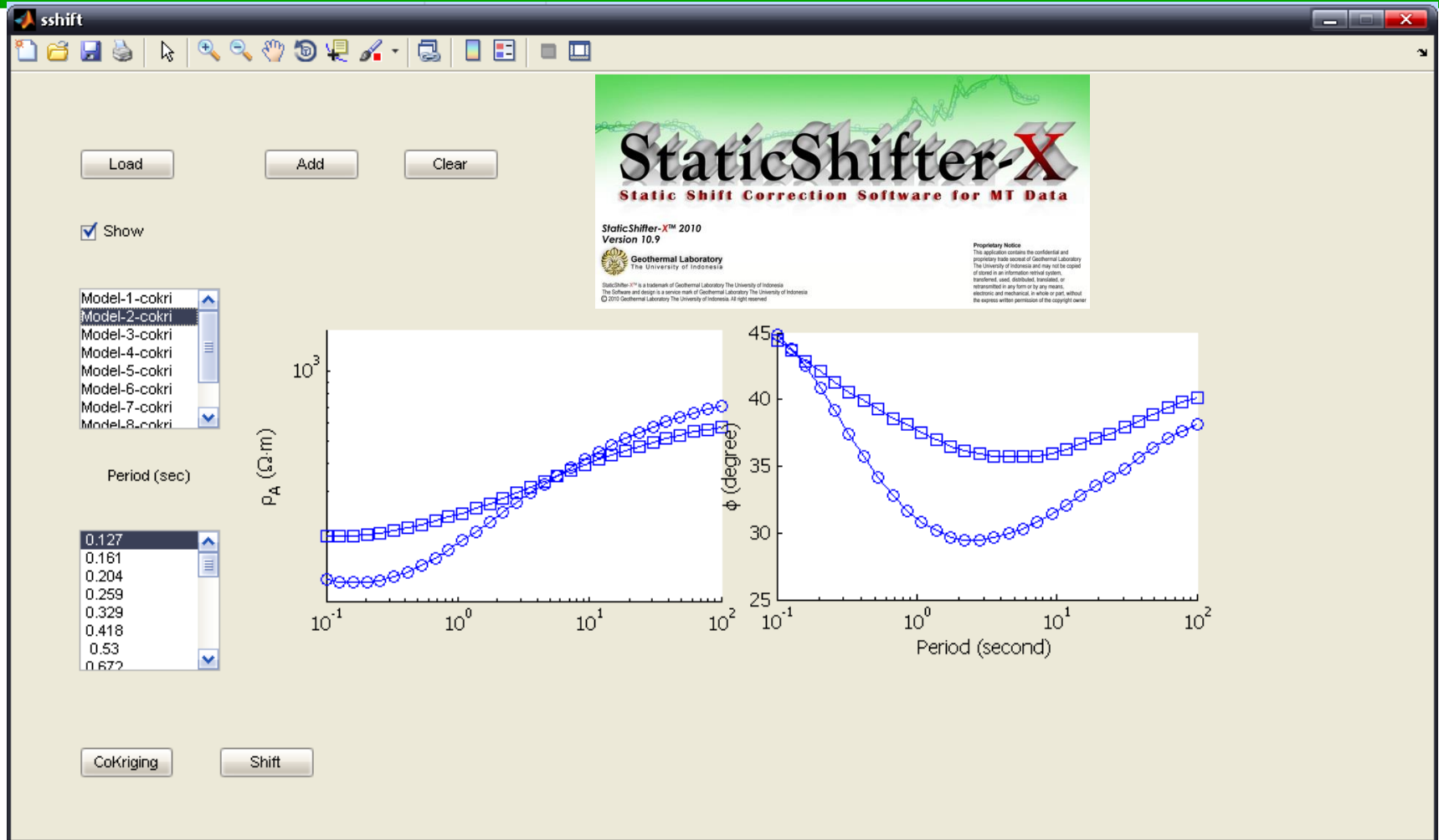


# Correction Using Static-Shifter Software

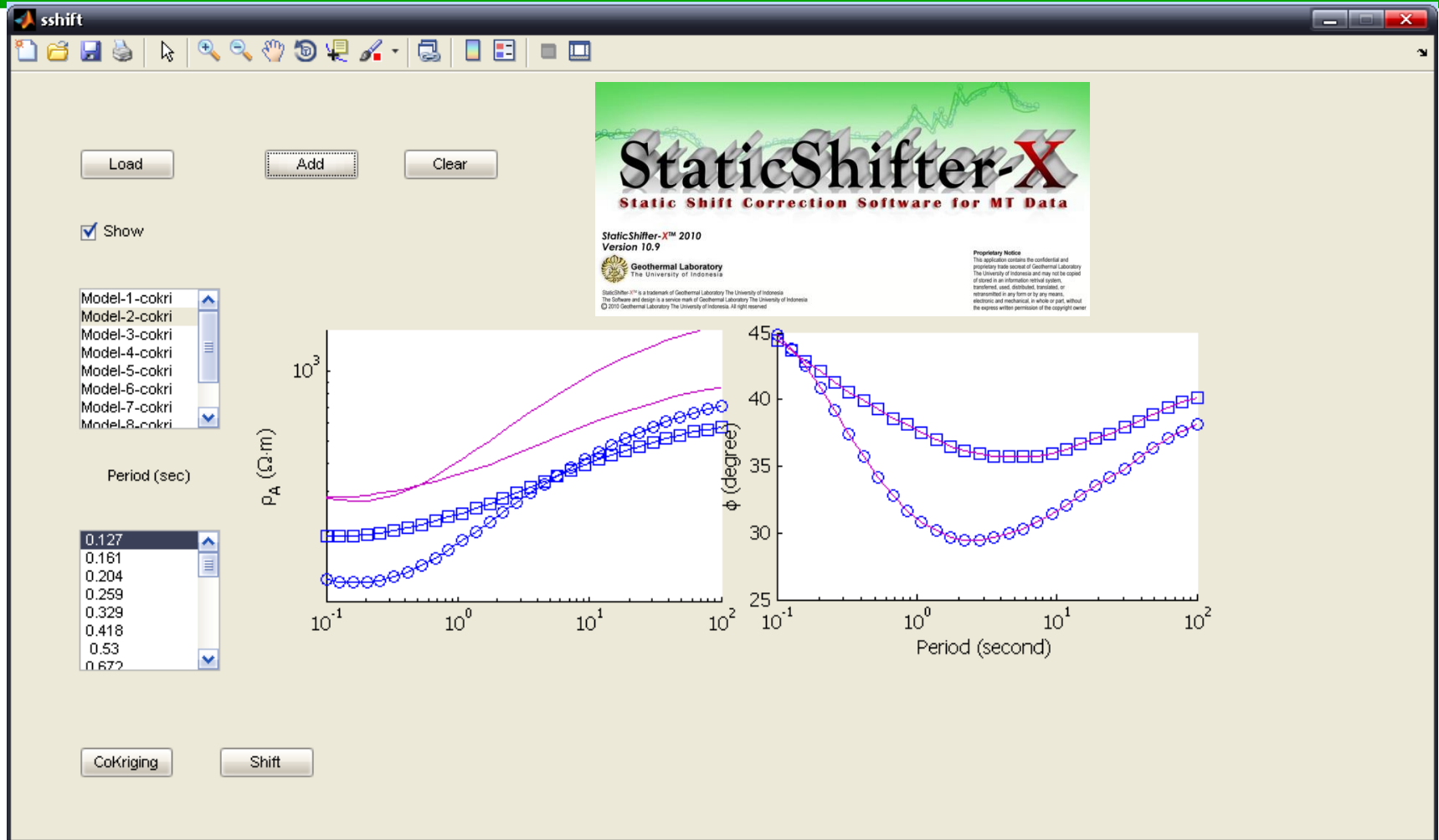




# Before Static Correction



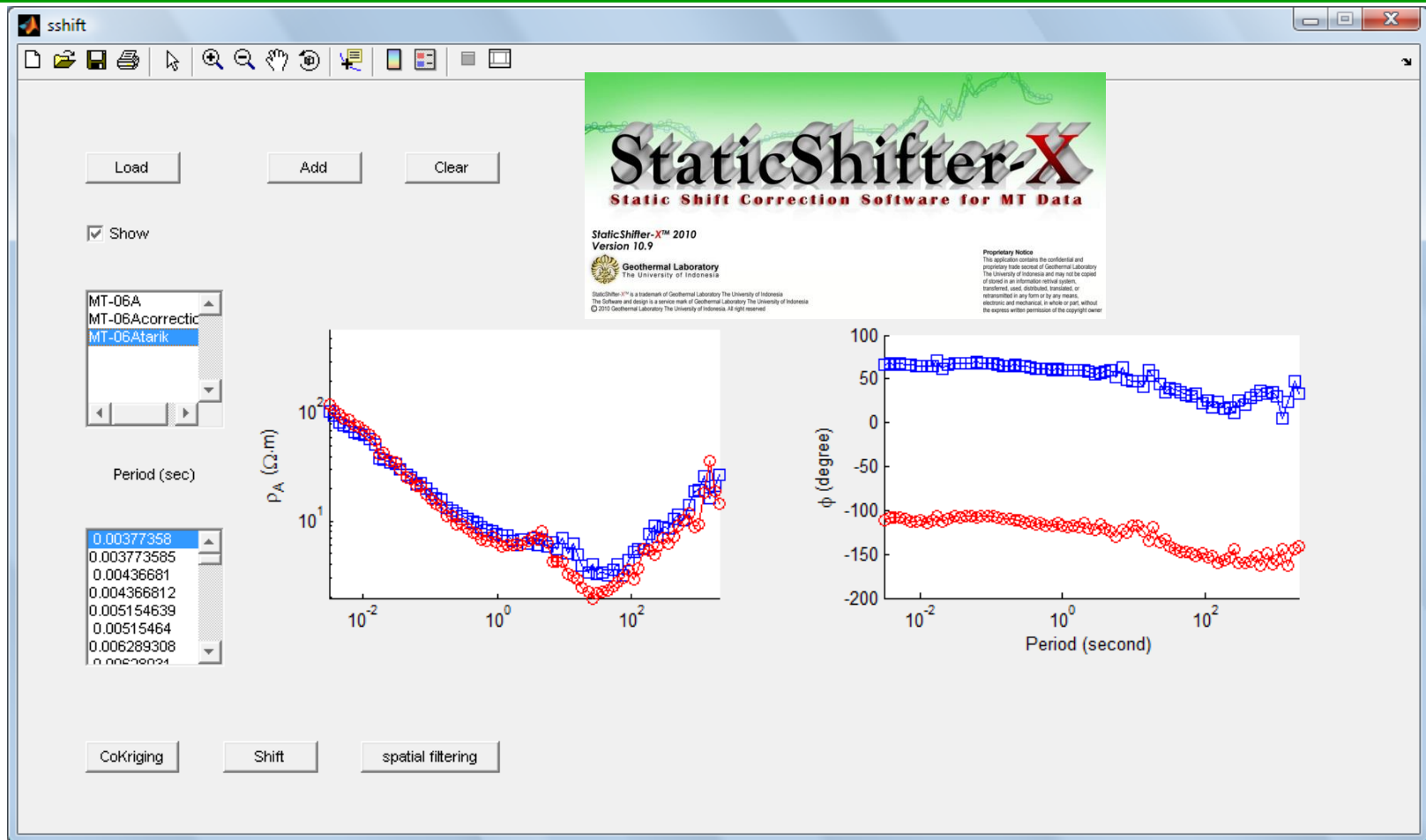
# After Static Correction



# MT06 Before



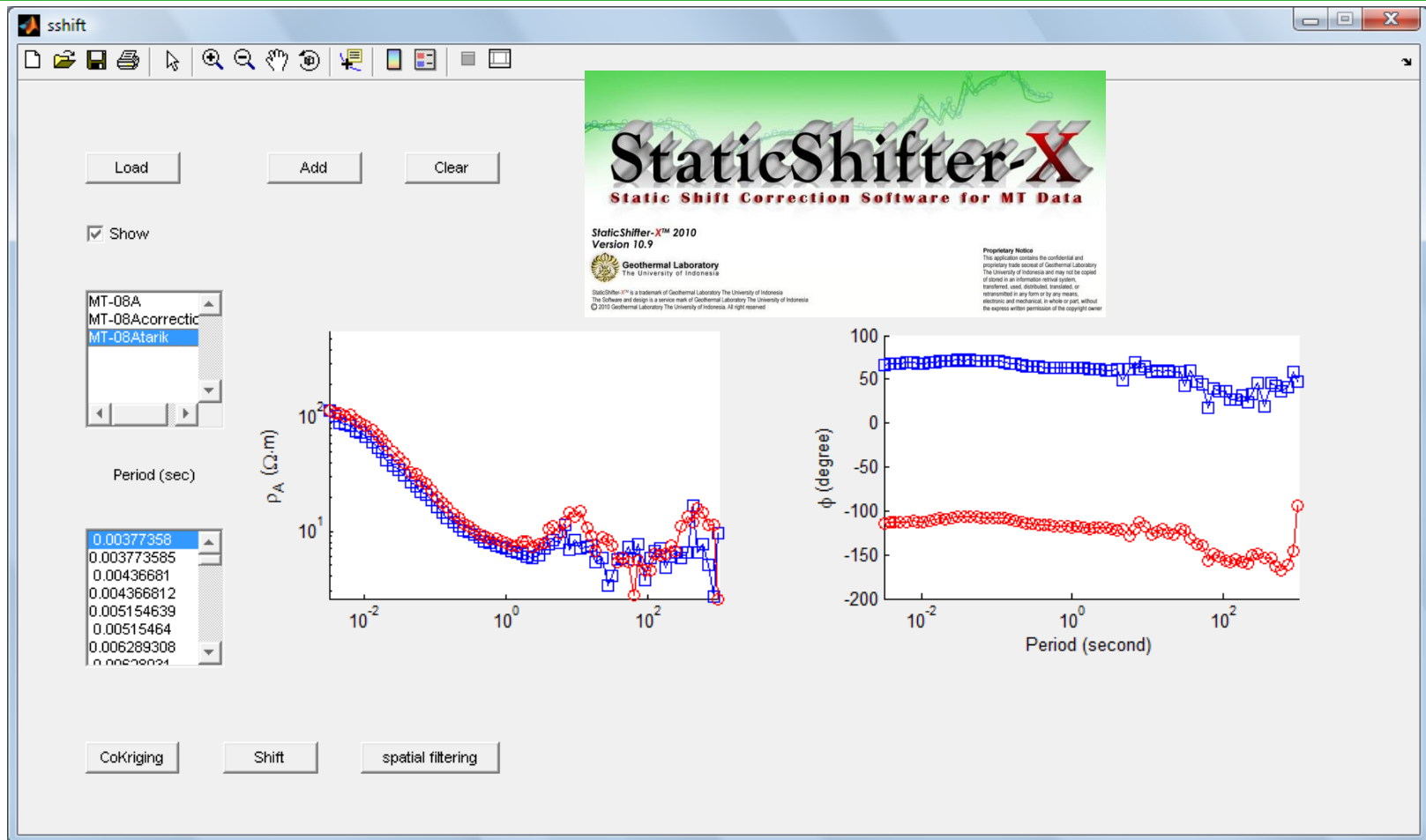
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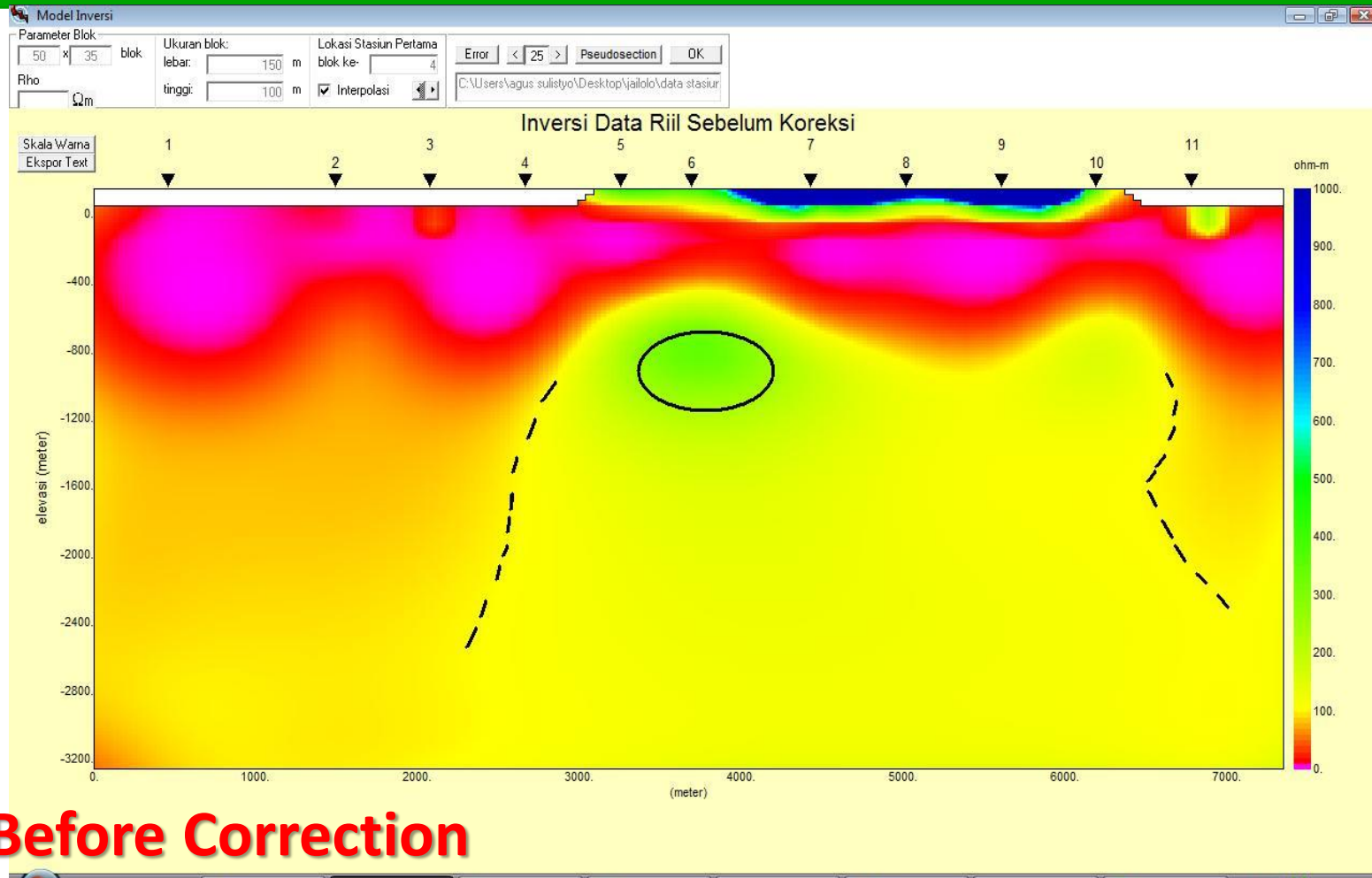
# MT08 Before



# MT08 After



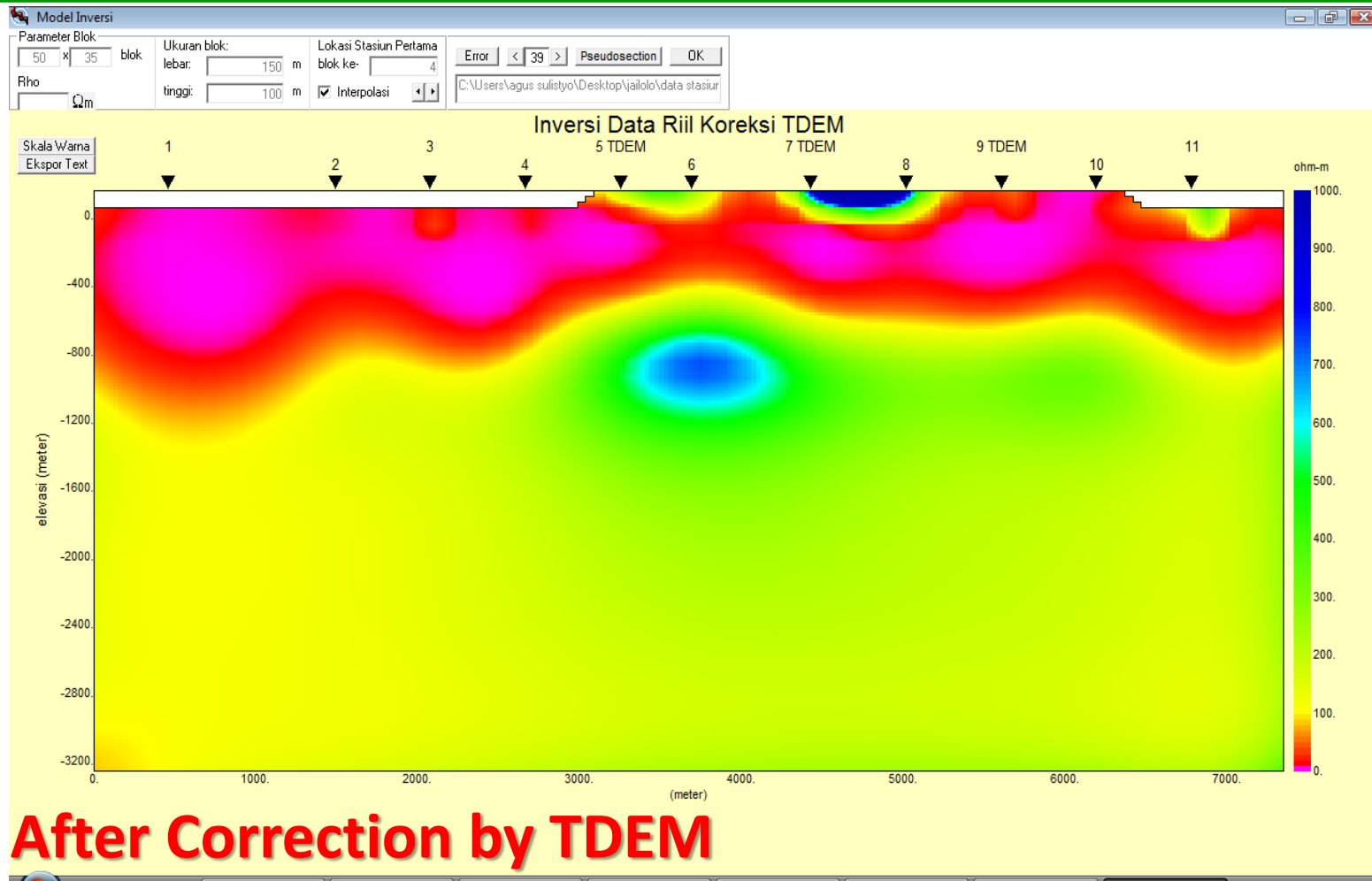
# Static Shift Analysis Using *MT2DInv-X*



**Before Correction**



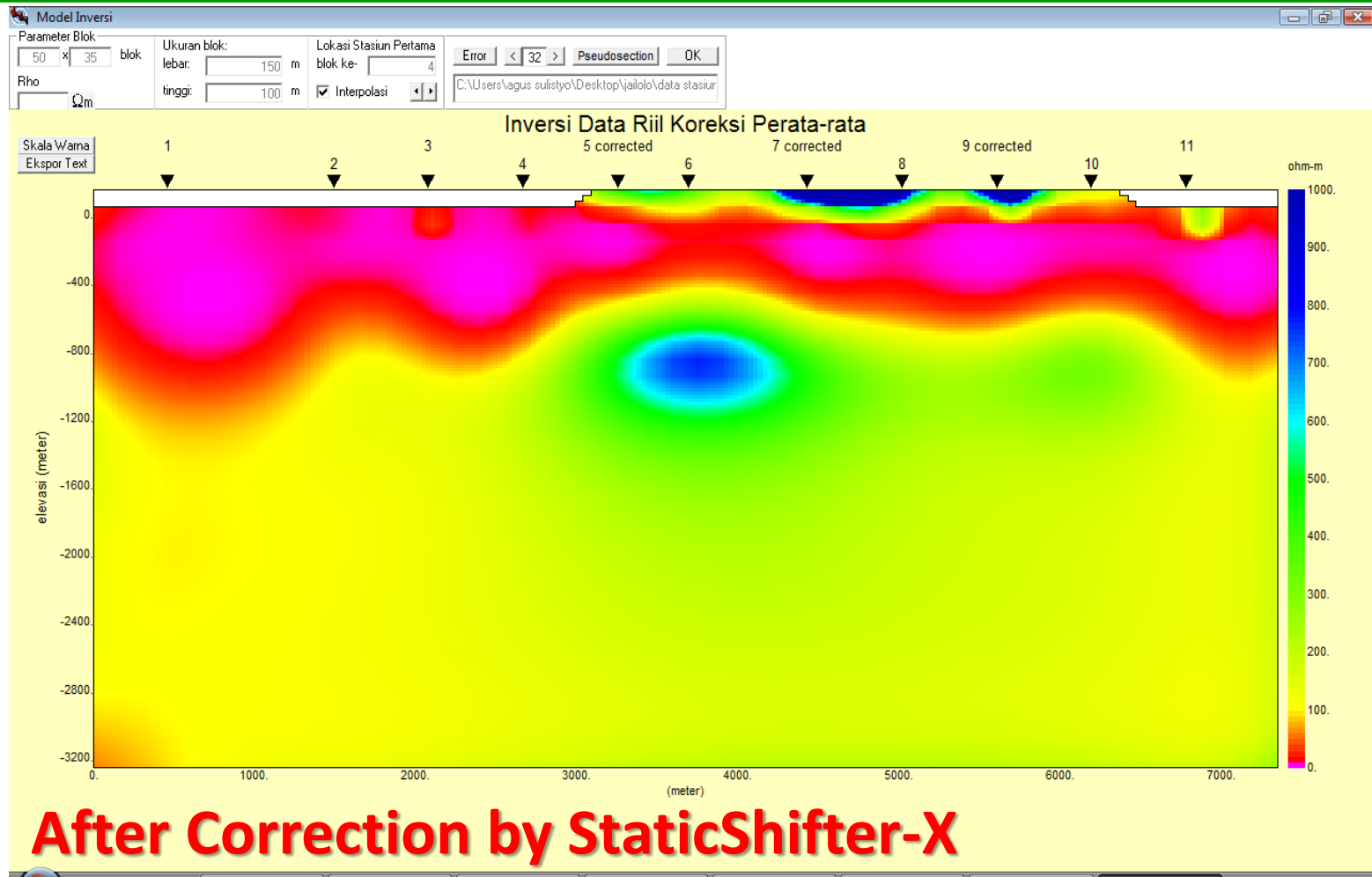
# Static Shift Analysis Using *MT2DInv-X*



**After Correction by TDEM**



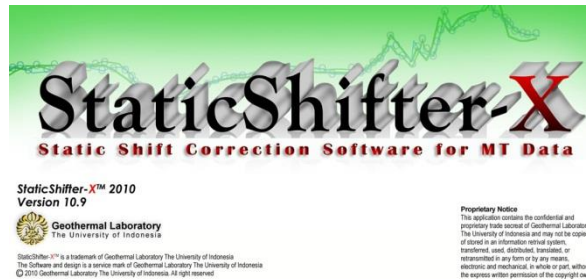
# Static Shift Analysis Using *MT2DInv-X*



**After Correction by StaticShifter-X**



# THANK YOU



**Dr. Eng. Yunus Daud, Dipl. Geotherm. Tech., M.Sc.**