Comparison of MultiLoop III's Geotem/Megatem Responses for a Thin Plate

In this review, MultiLoop III is used to calculate the response of a thin plate to a Geotem/Megatem system operating at 90 Hz. The results are compared with results from programs PLATE and EMIGMA which were provided by Richard Smith of Fugro Airborne Surveys, and are gratefully acknowledged. The MultiLoop III files used in this comparison are in the MultiLoop III distribution folder Demos/MlpIII Comparison/Geotem-Megatem.

The responses of two plates were modeled for a 90 Hz waveform and a 2 msec pulse. The plates were at depths of 0 and 100 meters respectively, were 500 meters square with a strike perpendicular to the line and a dip of 90 degrees. The MultiLoop III model consisted of a mesh with 511 nodes.

Figure 1 illustrates the basic modeling setup used in the deeper PLATE simulation; the depth of 220 meters refers to the depth of the deeper plate below the transmitter. Since the Geotem/Megatem plot point is at the receiver, in the MultiLoop III model, reference to the line is made with respect to the receiver point. Hence, the line is at and altitude equal to the receiver, or 70 meters high, and the assembly (the plate) is at a depth of either 0 or 100 meters.

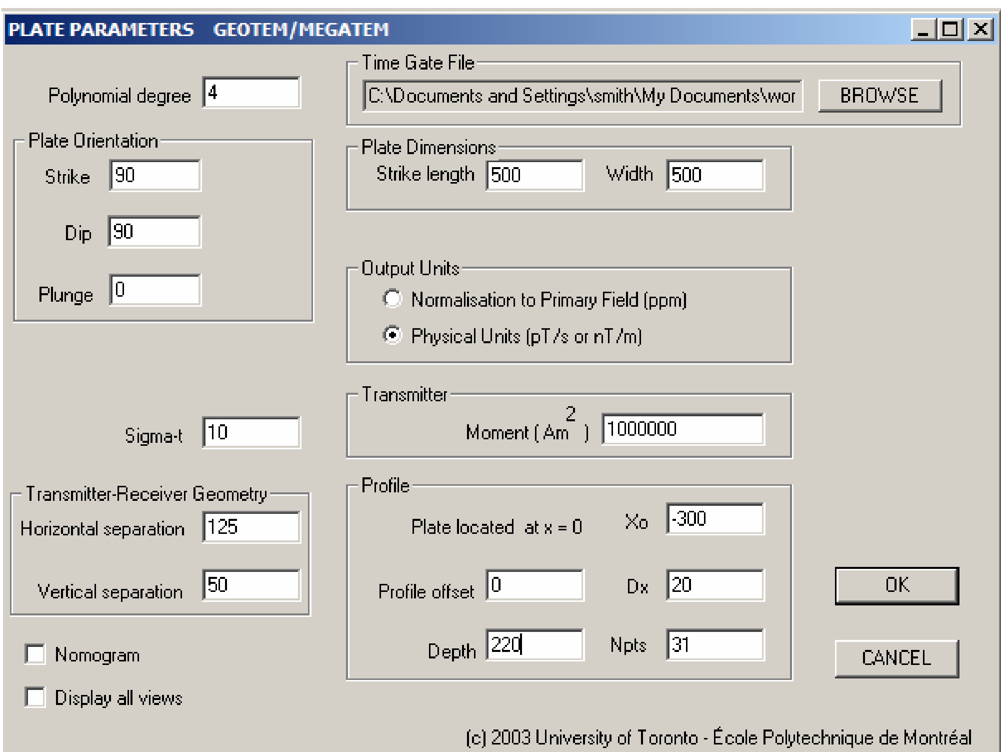
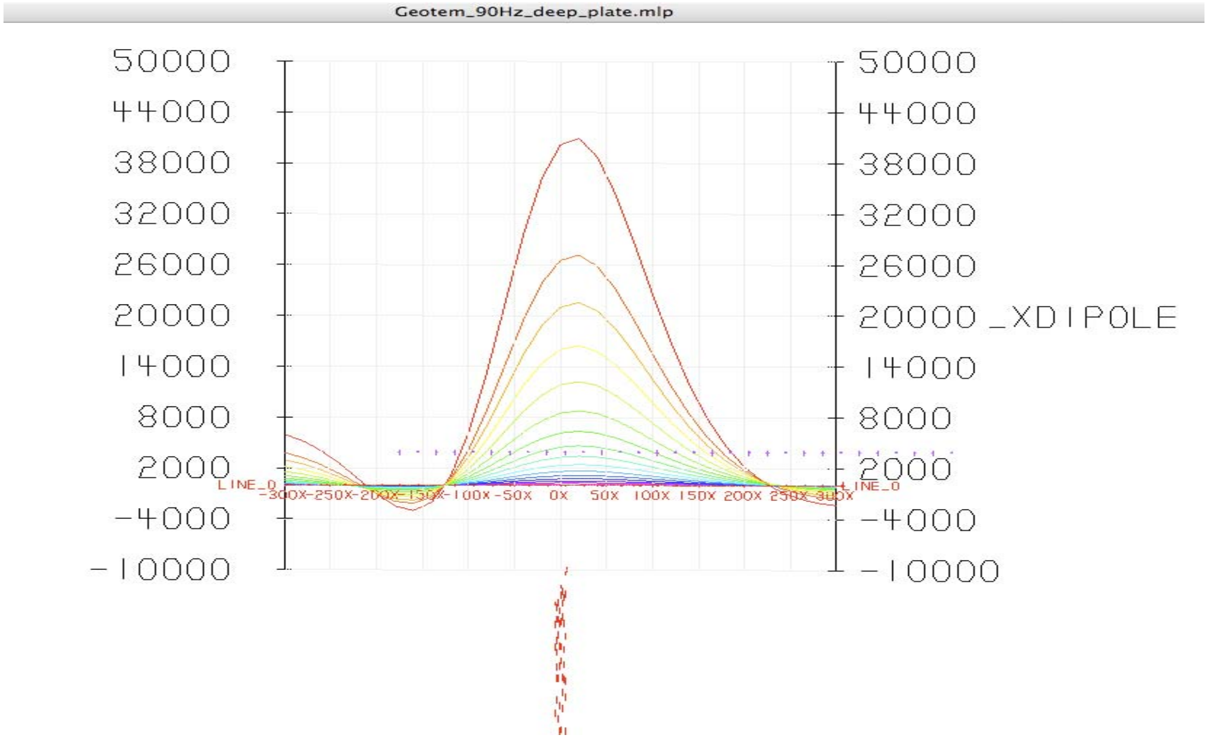
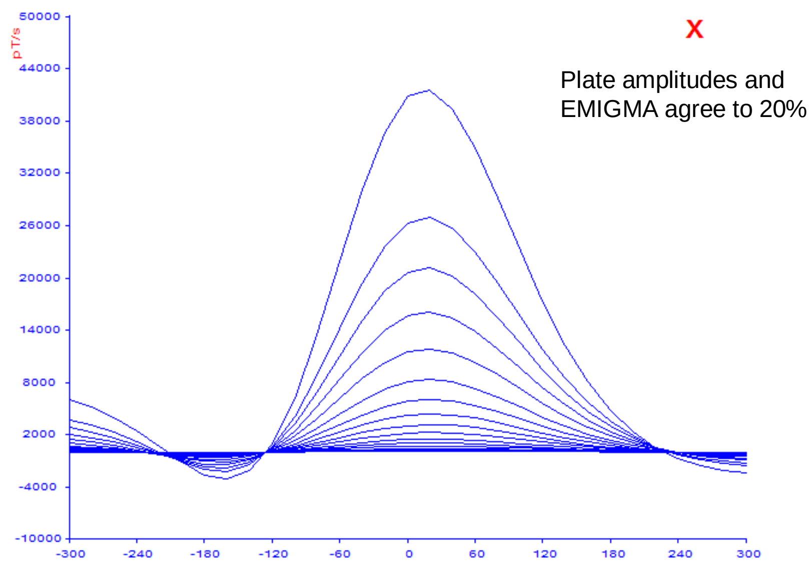


Figure 1: Summary of model parameters used in PLATE.

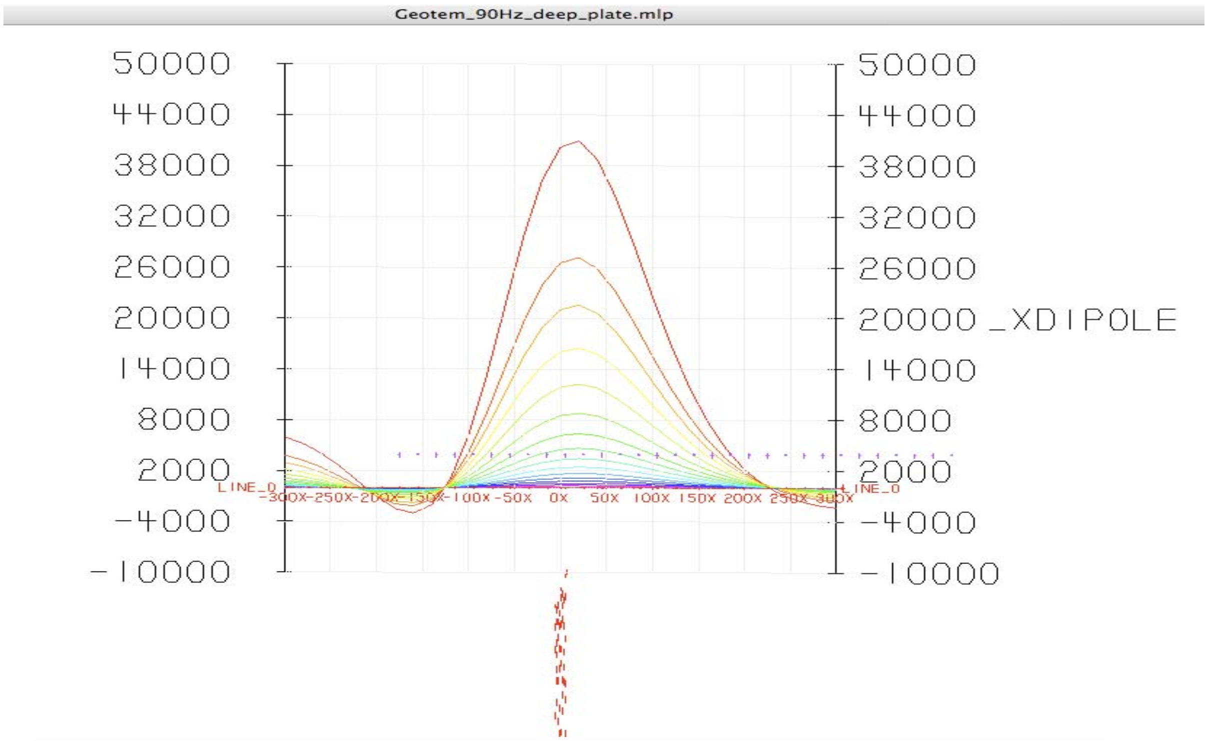
In the MultiLoop III models that follow, the response is calculated in pT/sec using a transmitter with an NIA of 1,000,000 Amps.

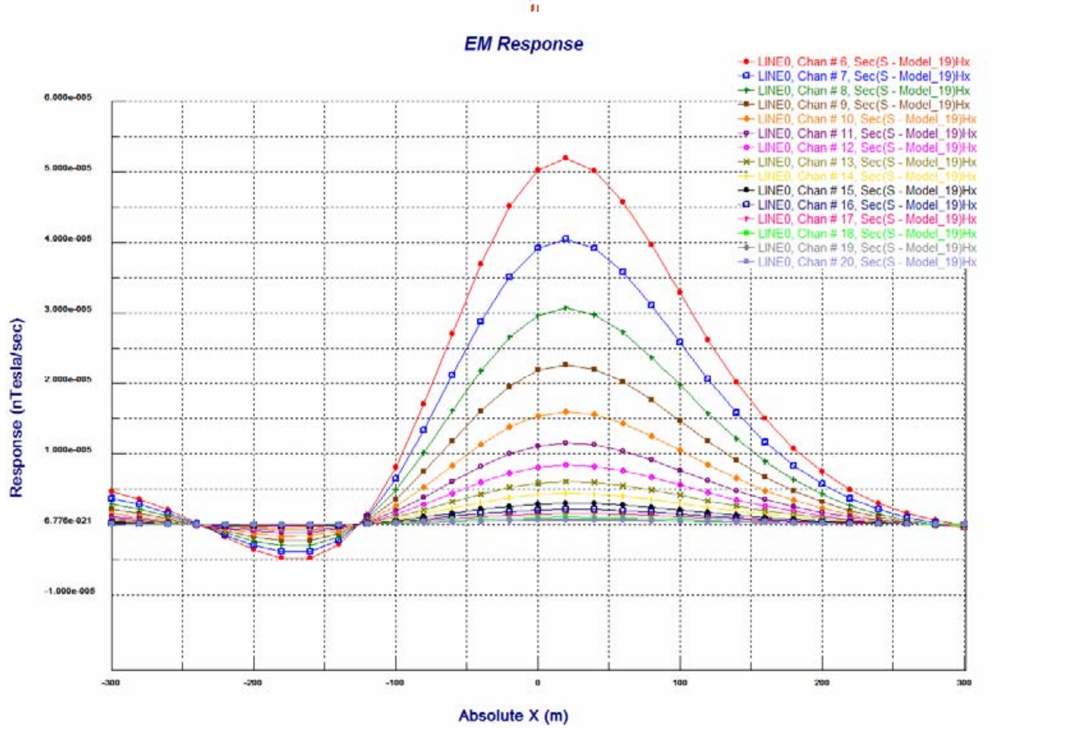
Deep Plate Comparison (1): Top: MultiLoop III, Bottom: PLATE. The two solutions compare well. The y-axis is labelled in pT/sec.



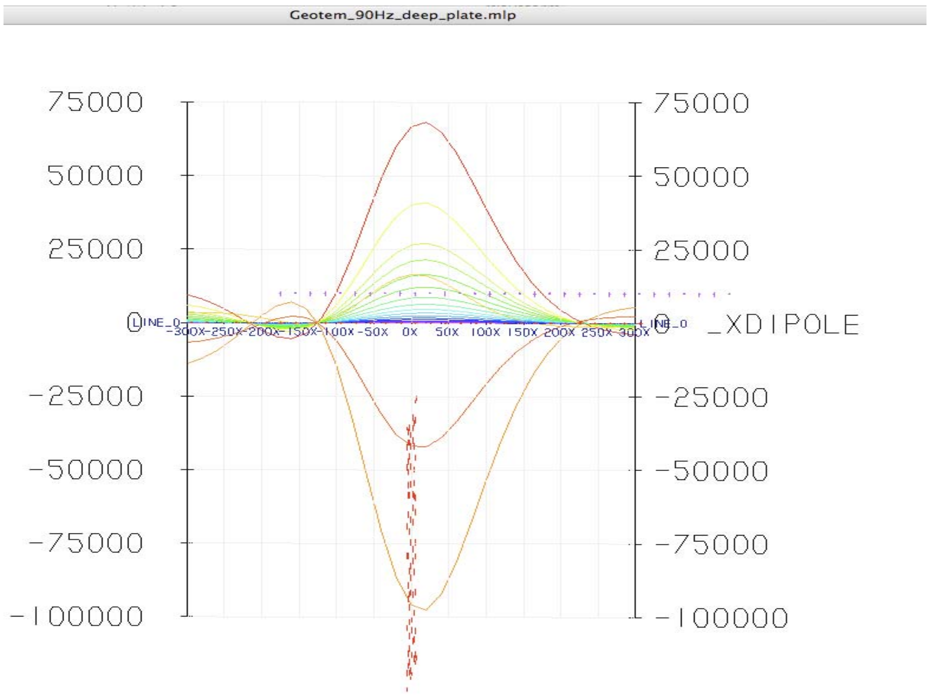


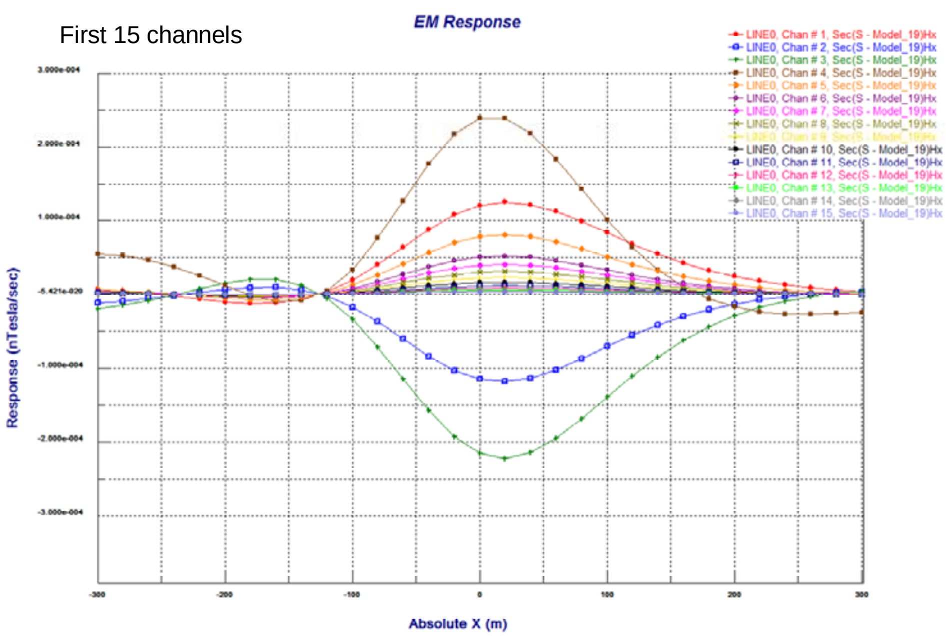
Deep Plate Comparison (2): Top: MultiLoop III, Bottom: EMIGMA (last 15 channels) in nT/sec. The two solutions compare less favourably than the MultiLoop III – PLATE comparison. The Emigma plot uses a label interval of 1e-5 nT/sec, with a maximum of 6e-5. Emigma calculations are in nT/sec with a unit NIA, and require multiplication by 1e9 to convert to the illustrated PLATE / MultiLoop III results.



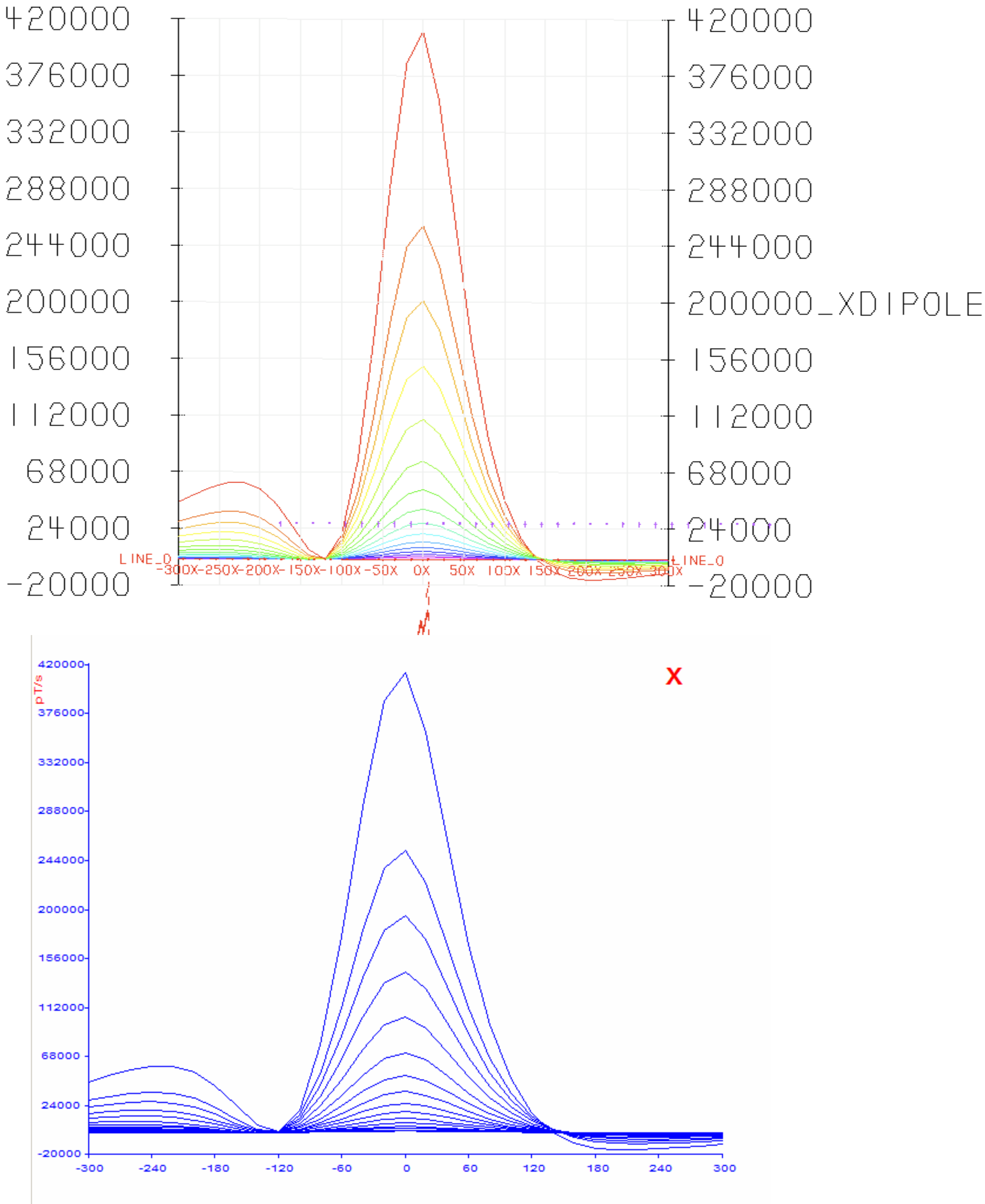


Deep Plate Comparison (3): Comparison of the computed on-time channels. Top: MultiLoop III, Bottom: Emigma. Emigma y-axis is labelled in intervals of 1e-4 nT/sec with a maximum of 3e-4 nT/sec. When converted to equivalent scales used in the PLATE/MultiLoop III plots, Emigma's on-time channels have approximately twice the amplitude of MultiLoop III's.

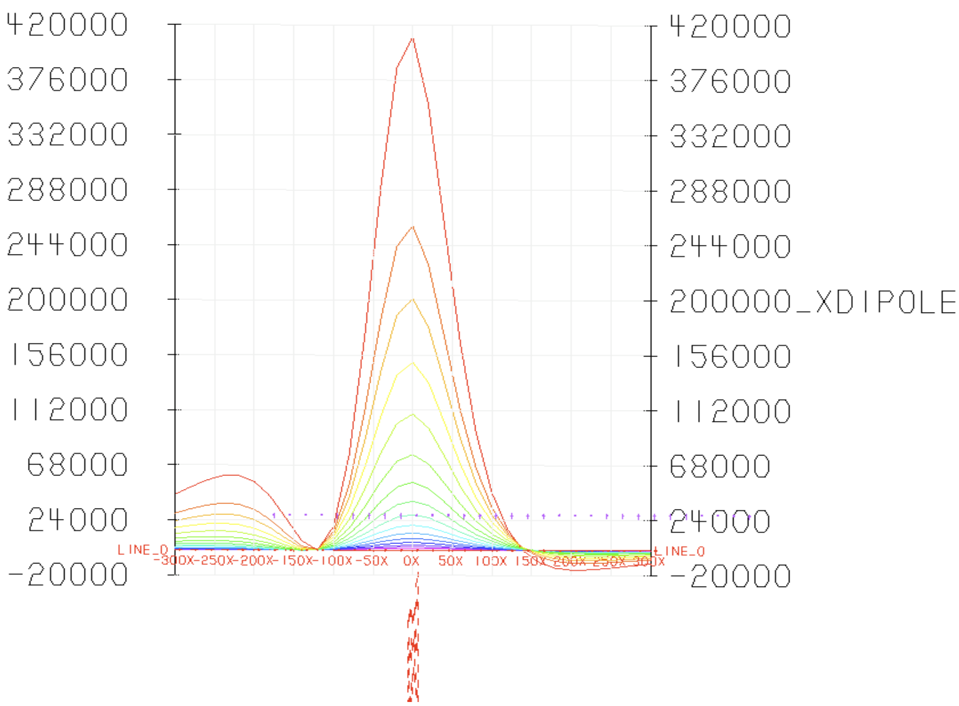


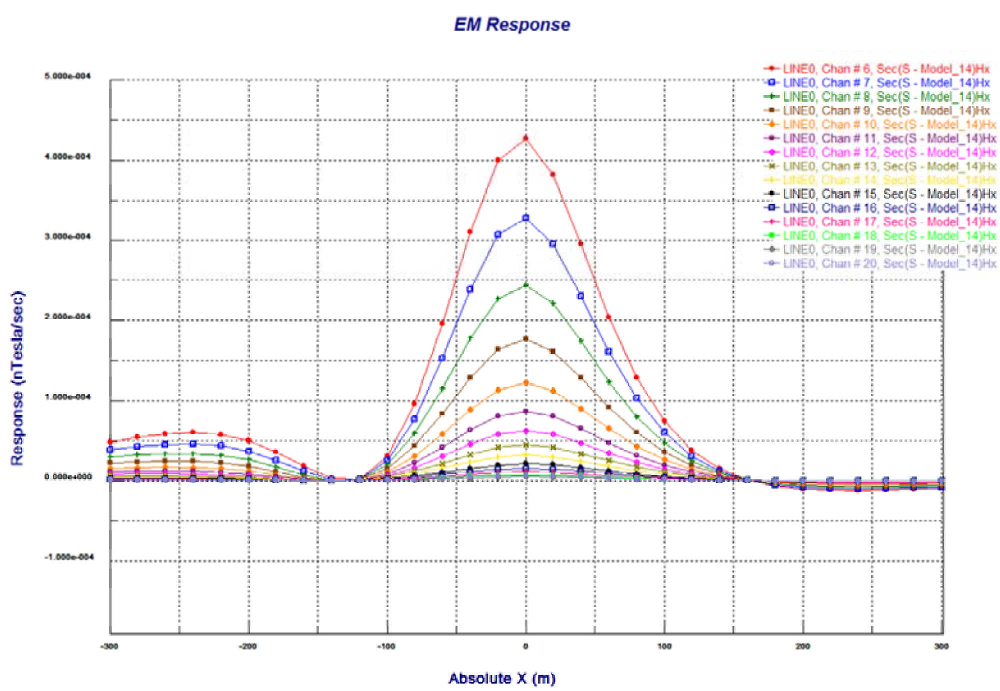


Shallow Plate Comparison (1): Top: MultiLoop III, Bottom: PLATE. The two solutions compare well (y-axis units in pT/sec).



Shallow Plate Comparison (2): Top: MultiLoop III, Bottom: PLATE. In the shallow case, all three solutions compare well. Emigma's y-axis label interval is 1.0e-4 nT/sec. When converted to common units, the peak Emigma response is approximately 42,000, while the peaks of PLATE and MultiLoop III are closer, and under 42,000.

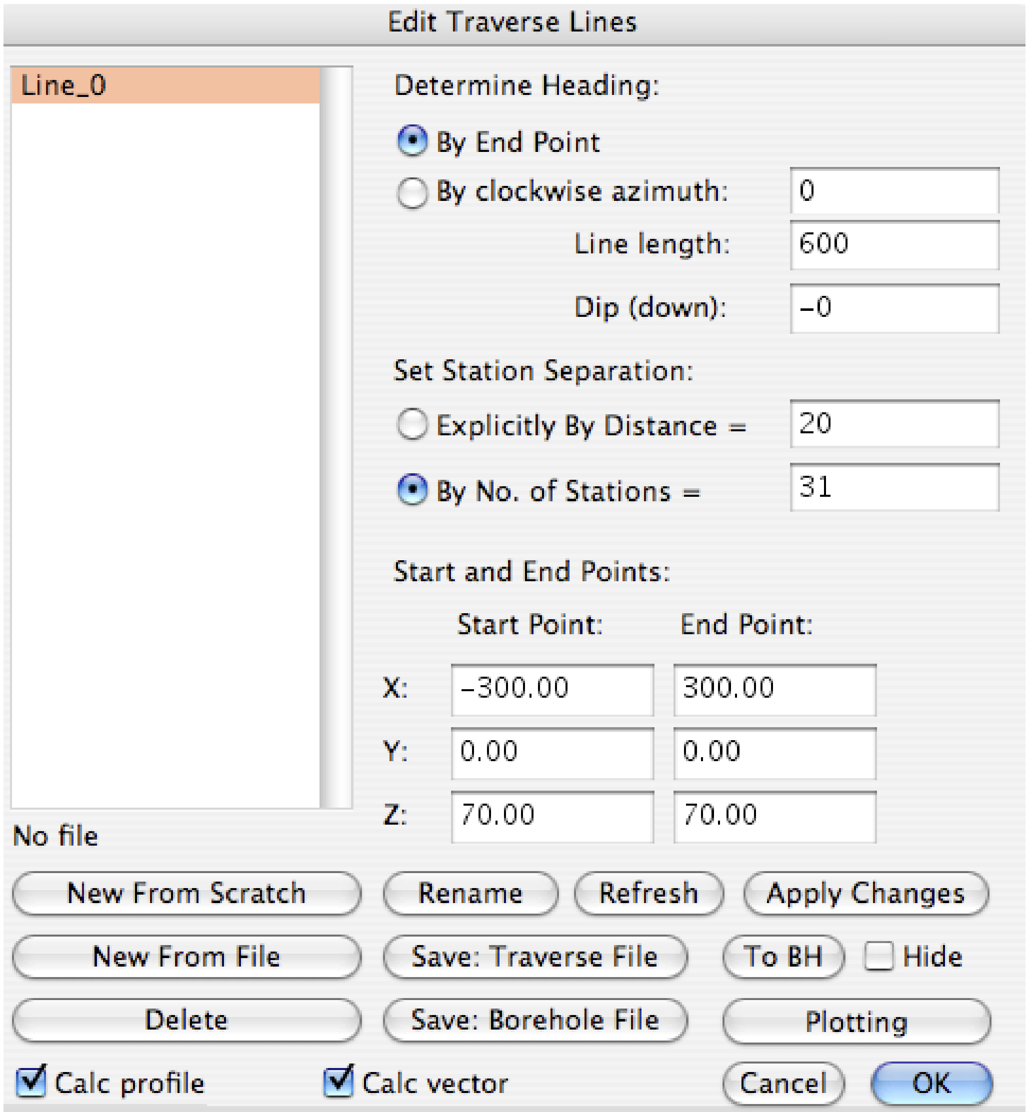




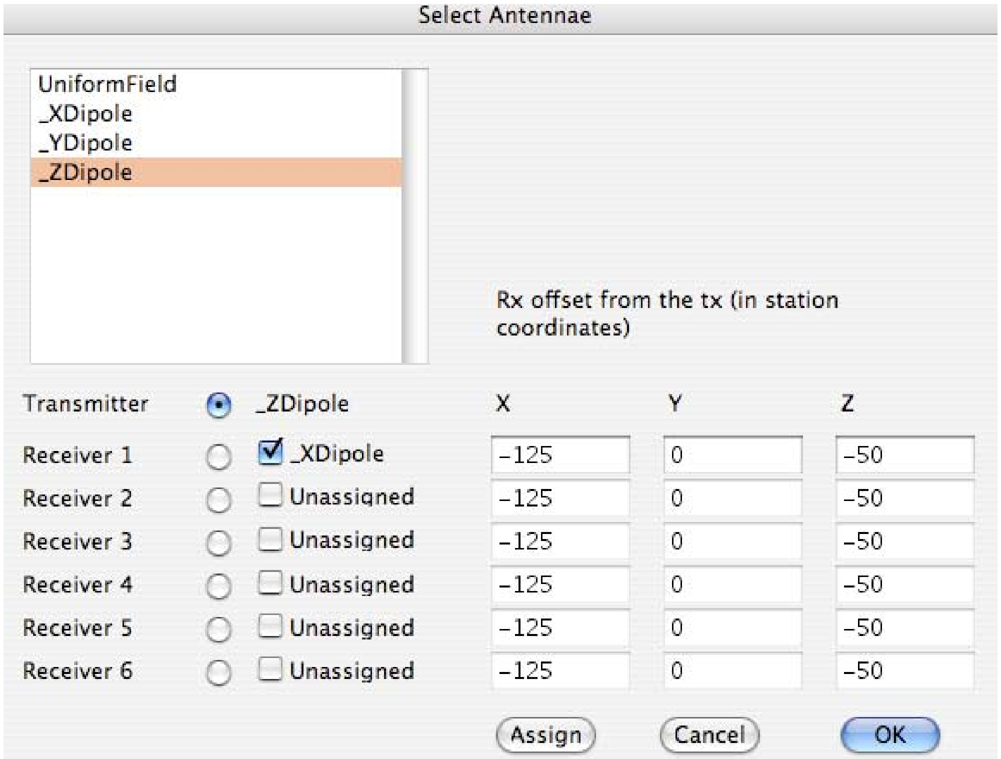
This is the emigma case at surface, which has the same amplitudes as PLATE.

MultiLoop III Modelling Setups:

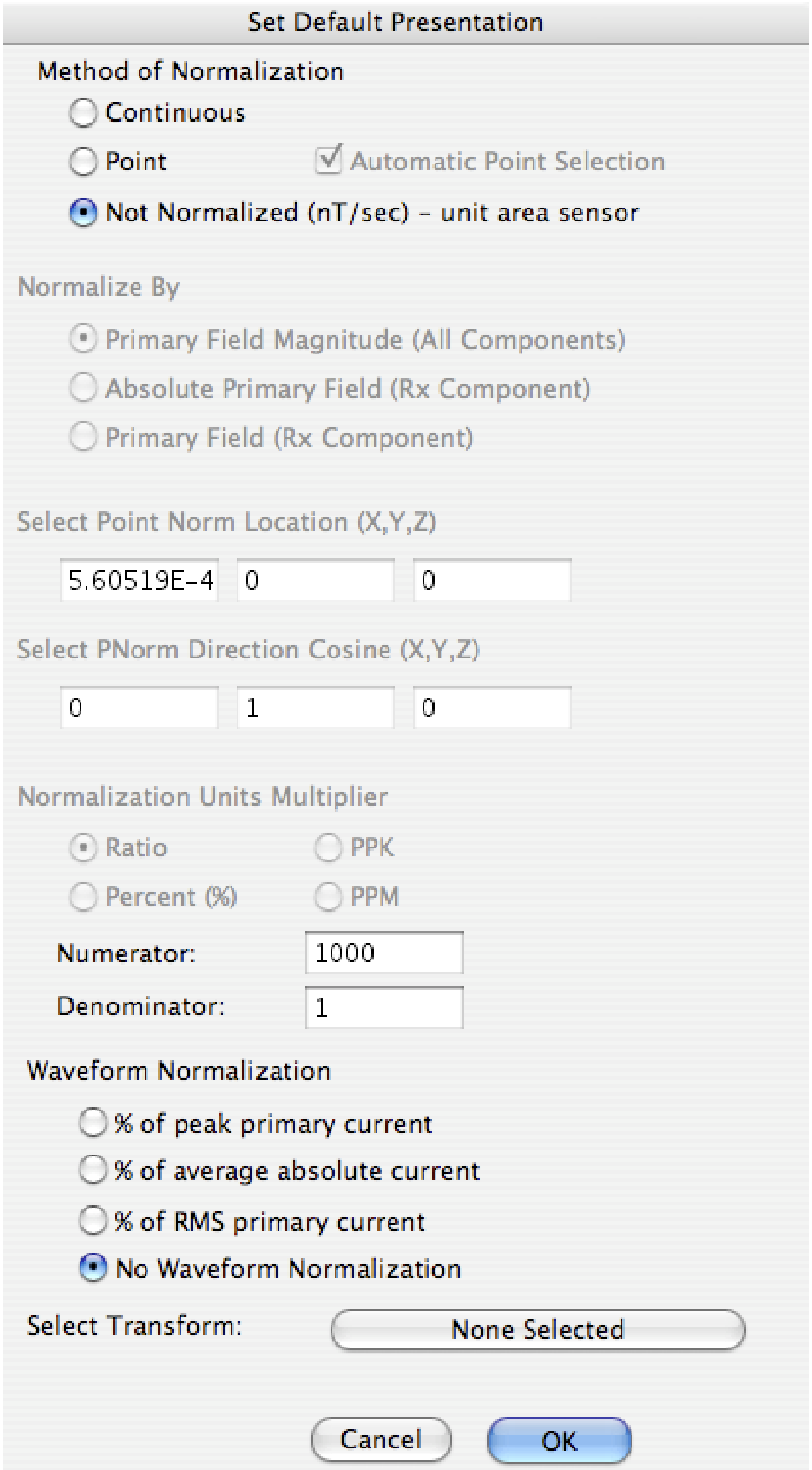
1. Traverse Lines: When using the receiver as the plotting location, ensure that the line is at the elevation of the receiver.



2. Antennae: A z-dipole is used for the transmitter, and an x-dipole is used for the receiver. The receiver lags the transmitter by 125 m and is 50 meters below it.

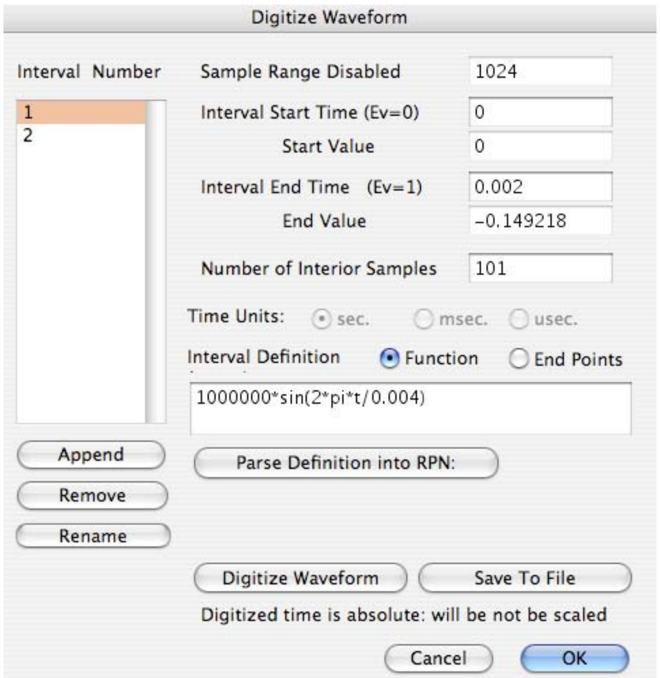


3. Presentation: No waveform or field normalization is used. Results are converted from nT/sec to pT/sec by multiplying by 1000.

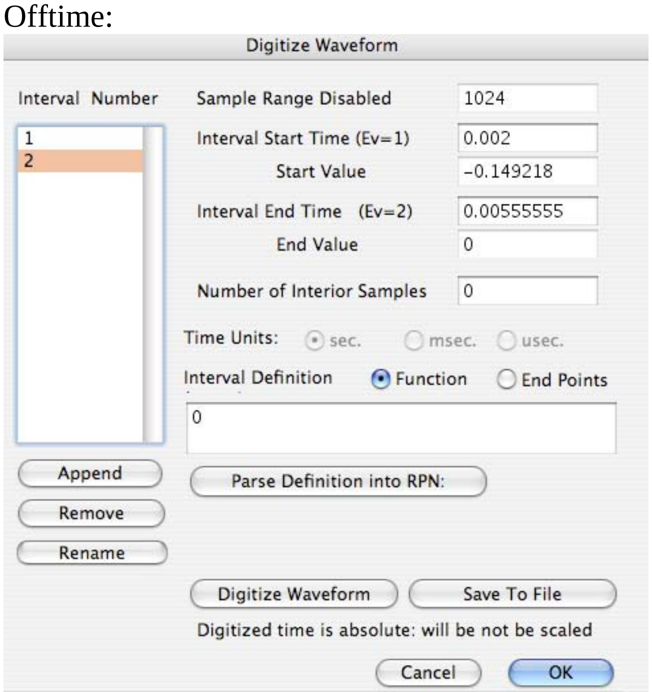


4. Waveform Shape: The 2msec half-pulse is defined by the function in the edit box below. The sin function is multiplied by 1,000,000 to generate the required dipole moment for Megatem. Event 0 corresponds to the start of the waveform, and pulse. Event 1 occurs at 0.002 seconds and corresponds to the end of the pulse. The off-time is defined by a function 0 and runs from events 1 to 2. There are 3 events (function discontinuities) defining the waveform, and the sin function is digitized into 102 intervals to represent the waveform.

Pulse:



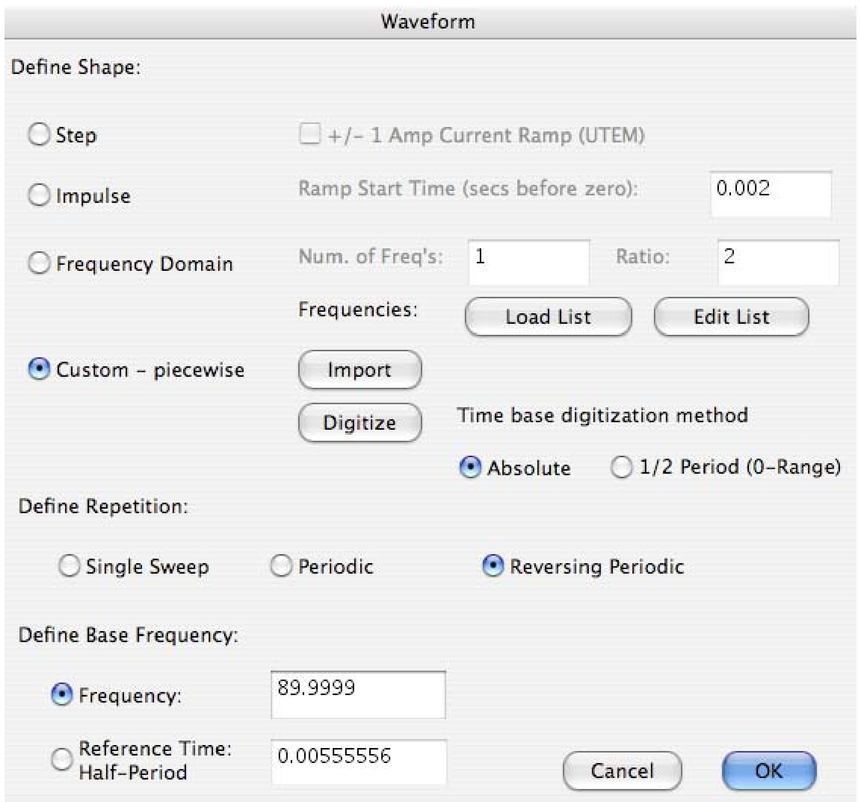
Offtime:



5. Waveform: The Megatem waveform is a custom waveform defined by piecewise functions (see item 4 above). Here, the piecewise functions are defined in absolute time; alternately, the waveform can be defined in terms of the number intervals the half-period is divided into.

The waveform is reversing periodic, meaning that the polarity of the current is reversed each half cycle.

The base frequency used was 90 Hz.



6. System Geometry: The Megatem system consists of a moving transmitter and receiver pair. The reference point for plotting is at the receiver.