

# Simulating the field due to prisms

## Define a 3D prism

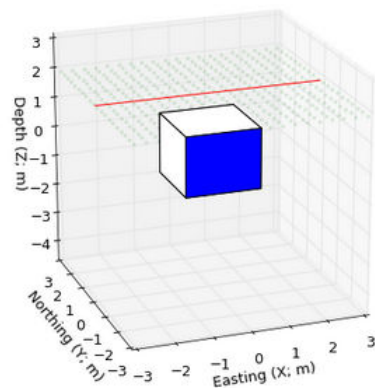
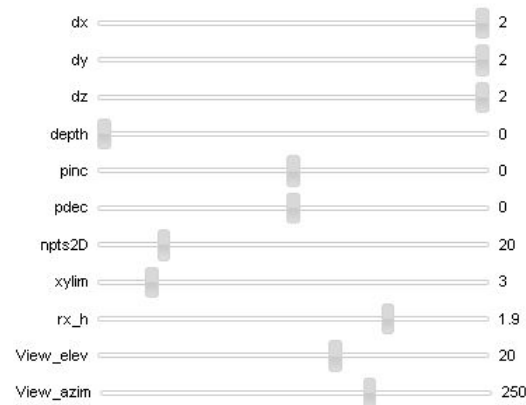
Our model is a rectangular prism. Parameters to define this prism are given below:

- dx: length in Easting (x) direction (meter)
- dy: length in Northing (y) direction (meter)
- dz: length in Depth (z) direction (meter) below the receiver
- depth: top boundary of the prism (meter)
- pinc: inclination of the prism (reference is a unit northing vector; degree)
- pdec: declination of the prism (reference is a unit northing vector; degree)

You can also change the height of the survey grid above the ground

- rx\_h: height of the grid (meter)

Green dots show a plane where we measure data.



## Magnetic applet

Based on the prism that you made above, below Magnetic applet computes magnetic field at receiver locations, and provide both 2D map (left) and profile line (right).

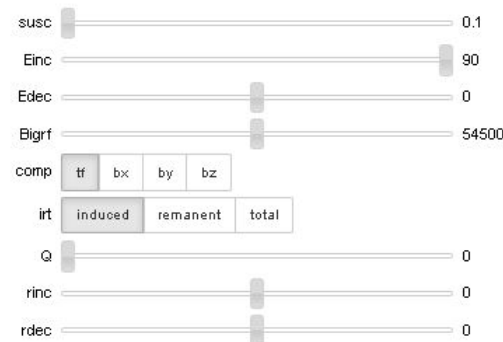
For the prism, you can alter:

- sus: susceptibility of the prism

Parameters for the earth field are:

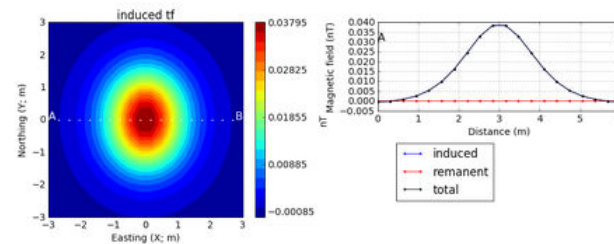
- Einc: inclination of the earth field (degree)
- Edec: declination of the earth field (degree)
- Bigrf: intensity of the earth field (nT)

For data, you can view:



Computing G

Computing G



True

■ [Interactive and live ... click here](#)

# Learning from the applet

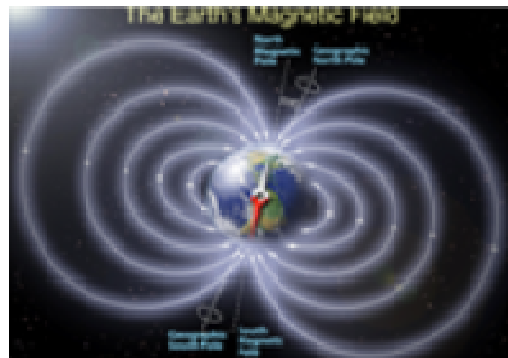
- Locating the prism at the pole and equator
  - Plotting  $B_x, B_y, B_z$  fields (sign convention)
  - Map data
  - Profile
  - Profile over a magnetic dipole.
- Effects of depth of burial (half width)
- Data sampling

# Survey Acquisition (with applet)

- Must sample data sufficiently often to capture the anomaly.
- Want 3-5 points in a halfwidth
- Width of the signal increases with depth of burial.
- Ground surveys generally choose line spacing and station spacing to be equal.

# Magnetic Survey

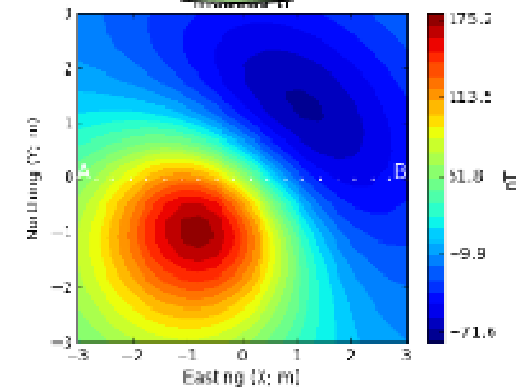
Source



Input energy

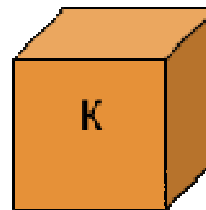
Measured response

Data

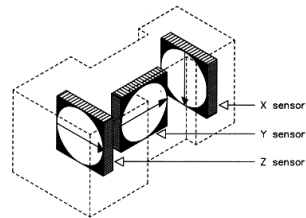
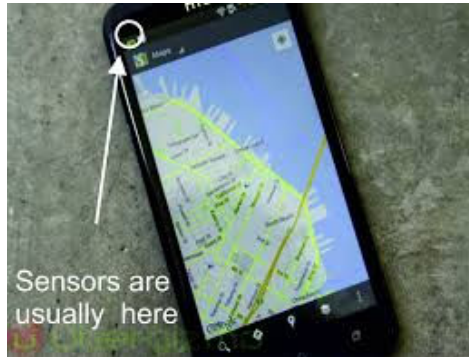
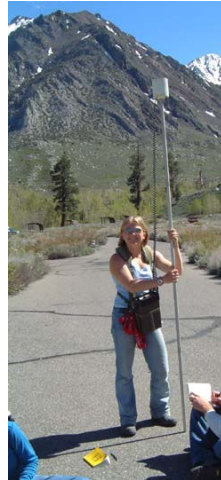


Subsurface

Physical Property:



# Magnetic Sensors to acquire data



# In-class magnetic surveying: Detection

- Magnetic material underneath the table tops.
- NO PEEKING!!!!
- Use magnetic compass on smartphones (download apps if not already done)
- Carry out a survey to detect the magnetic bodies.
- Flag them with tape.

# If the magnet was a UXO

- Magnet:
  - diameter: 6mm;
- UXO
  - 20cm in diameter...
- If our table: ~ 1m X 3m

how large would a survey area equivalent to the table be?

- Length scale ratio ~1:33
- Survey area ~ 10m x 30m



# If the magnet was a UXO





# If the magnet was a UXO



## Team Exercise: Searching for \$1B Cu deposit

- Magnet: diameter: 6mm; height=2mm      vol  $5.65e-8 \text{ m}^3$
- For table size:  $\sim 1\text{m} \times 3\text{m}$
- Price: \$310 USD/lb;    \$684 /kg
- \$1 billion. I need:    ??? Kg
- Density of copper  $8960 \text{ kg/m}^3$
- Need    ???     $\text{m}^3$  of copper
- Assume 0.3% Cu by volume:    ???  $\text{m}^3$
- Scale length of deposit: 1  $\sim$  ????
- Survey area: ?? km x ?? km

## Student exercise

- Magnet: diameter: 6mm; height=2mm vol  $5.65e-8 \text{ m}^3$
- Table: 1m x 3m
- Find a copper resource worth \$1B
- Price: \$3.10 USD/lb; \$6.84 /kg (Note decimal)
- \$1 billion 1,461,305 kg
- Density of copper  $8960 \text{ kg/m}^3$
- Need  $163 \text{ m}^3$  of copper
- Assume 0.3% Cu by volume:  $54,330 \text{ m}^3$  (cube: 38 m on side)
- Scale length:  $(\frac{V_c}{V_m})^{\frac{1}{3}} \simeq 10000$  (1)
- Survey area: 10 km x 30 km



# If the magnet was a billion dollar copper deposit

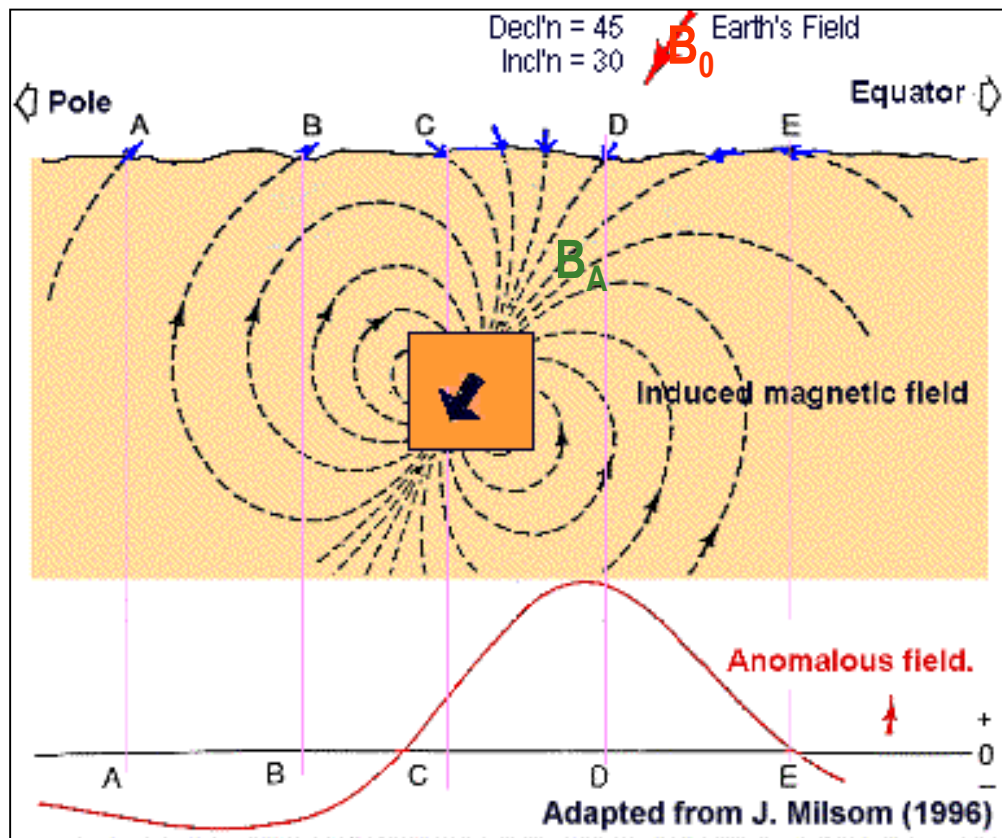


# Readings

- GPG Magnetics
- Lab #2 (see course website)



# The composite field



Composite field:

$$B = B_0 + B_A$$

B is a vector:

$$B = \{B_x, B_y, B_z\}$$

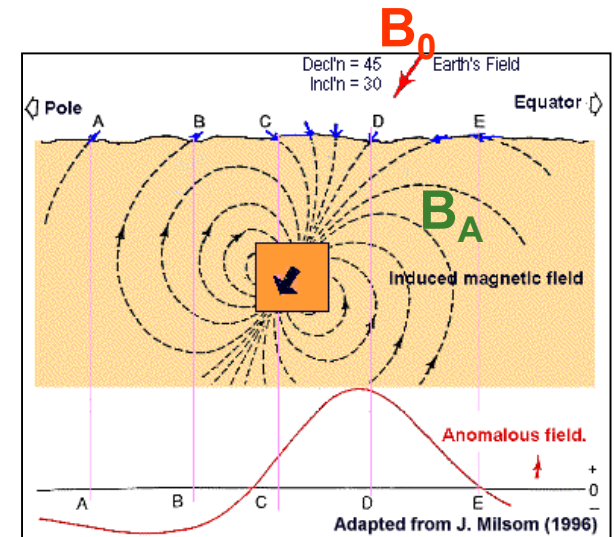
Total field:

$$|B| = |B_0 + B_A|$$

# The Anomalous field

$$\text{Measured field } \mathbf{B} = \mathbf{B}_0 + \mathbf{B}_A$$

[Link to GPG](#)

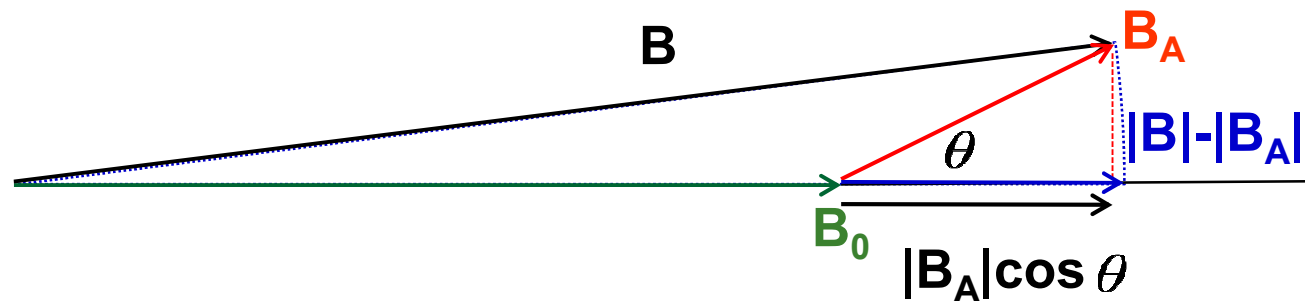


- The *total field anomaly*:  $\Delta \mathbf{B} = |\mathbf{B}| - |\mathbf{B}_0|$
- If  $|\mathbf{B}_A| \ll |\mathbf{B}_0|$  then
- That is, total field anomaly  $\Delta \mathbf{B}$  is the projection of the anomalous field onto the *direction* of the inducing field.

$$\Delta \vec{B} \simeq \vec{B}_A \cdot \hat{B}_0$$

Why is the total field anomaly:  $\Delta \vec{B} \simeq \vec{B}_A \cdot \hat{B}_0$

■ Vector Diagram



$$\begin{aligned} |\Delta \vec{B}| &= |\vec{B}_0 + \vec{B}_A| - |\vec{B}_0| \\ &\simeq \vec{B}_A \cdot \hat{B}_0 \\ &= |\vec{B}_A| \cos \theta \end{aligned}$$

# Data Processing

- Removing time variations of the Earth's field  
(necessity for a base station)
- Removing a regional trend

# Magnetics – Earth's field

