Types of Magnetic Surveys

- **Airborne**
  - Good for large areas

- **Shipborne**
  - Good for placed with water (e.g. the ocean)

- **Ground based**
  - On foot or by vehicle
  - Higher resolution than airborne because person can stop walking

- **2D vs 1D survey**
  - Due to ease of measurement easier to cover areas
Sources of Noise

- Induced fields from ferromagnetic items
  - Pocket knives, magnetite earrings, belt buckle
  - Houses, wire fences, rebar in concrete, cars
- AC power sources
  - Utility lines & transformers
Dealing with Temporal Variations

- Base station looping procedure
  - Figuring out a good reoccupation interval would be hard
  - Brief spikes would be easily missed
- Two instrument method
  - Yields complete record of field variation during survey
  - Lack of drift issues for magnetometers makes this strategy feasible
Correcting for spatial variation

- Only corrections for the main field are done
  - Main field is well known

- Other possible corrections
  - Elevation too small to be important
  - Topography, regional anomalies too poorly constrained to correct for
Correcting for Main Field Variations

- Find latitude and longitude of point of interest
- Enter date of survey
- Choose magnetic model (we will use IGRF)
- Plug into on-line calculator (https://www.ngdc.noaa.gov/geomag-web/#igrfwmm)
- Obtain value for main field strength
Correcting for Main Field Variations

- For areas small compared to main field variation
  - Use linear interpolation from corners
  - Interpolate values for survey line endpoints from corners
  - Interpolate values along line from end points
Magnetic Anomalies

- Shape of signal depends on
  - Distribution of susceptibility in subsurface
    - Shape of anomalous body
    - Orientation relative to cardinal directions (N,S,E,W)
  - Orientation of main field at survey location
Magnetic Anomalies at the Magnetic North Pole

- How is the field oriented at the north pole?

Main field
Magnetic Anomalies at the Magnetic North Pole

- What will the induced field look like?
What will the total field look like?

Some places the total field will have a smaller strength and others a larger strength.
Magnetic Anomalies at the North Magnetic Pole

- Remove main field from survey
- Over high susceptibility body
  - Central positive anomaly
  - Small negative anomalies to side
Magnetic Anomalies at the Magnetic Equator

- How is the field oriented at the equator?

Diagram showing the main field.
Magnetic Anomalies at the Magnetic Equator

- What will the induced field look like?
Magnetic Anomalies at the Magnetic Equator

- What will the total field look like?

Some places the total field will have a smaller strength and others a larger strength.
Magnetic Anomalies at the North Magnetic Pole

- Remove main field from survey
- Over high susceptibility body
  - Central negative anomaly
  - Small positive anomalies to side
Magnetic Anomalies in the Northern Hemisphere

- On one side induced field subtracts and on the other it adds
- Anomaly has both a positive and negative portion
- Anomaly is not symmetric about object

Fe = Earth’s Main Magnetic Field
Fa = Induced Anomalous Magnetic Field
Magnetics Observations (Part I)

- Download 2daysmag.dat
- Perform linear interpolation for base station measurements from 2 hrs to 10 min
  - use simpler procedure to save time
- Plot residuals vs time
- Calculate RMS error for each reoccupation interval
- Plot RMS error as a function of reoccupation interval
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The table above lists the time in hours and the magnetic field in nT for both 2-hour and 1-hour residuals.