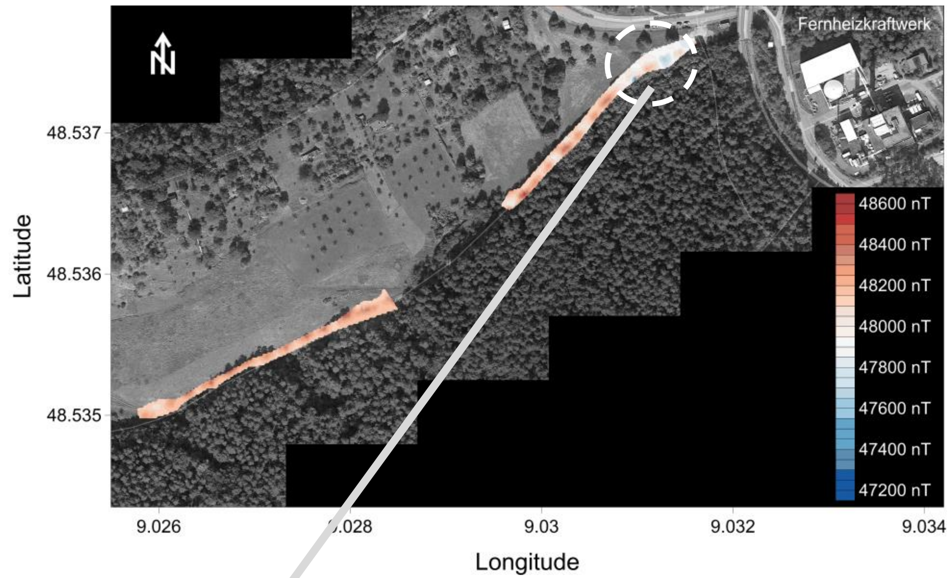
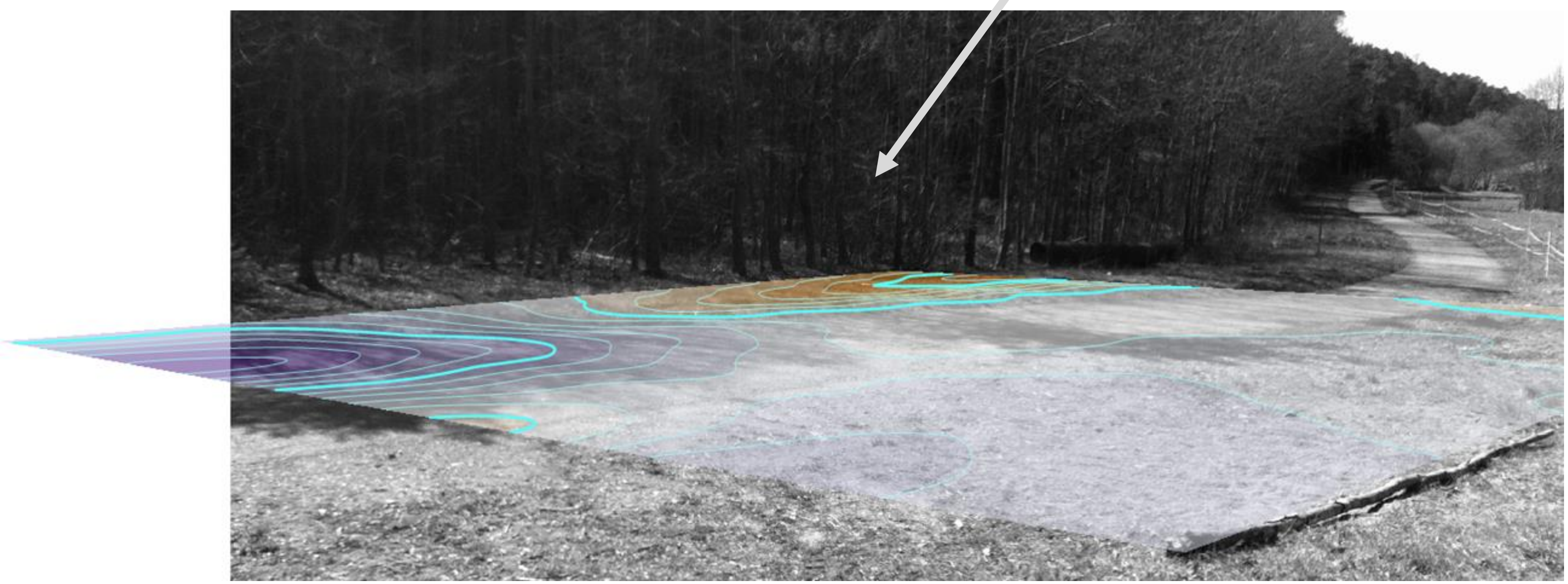
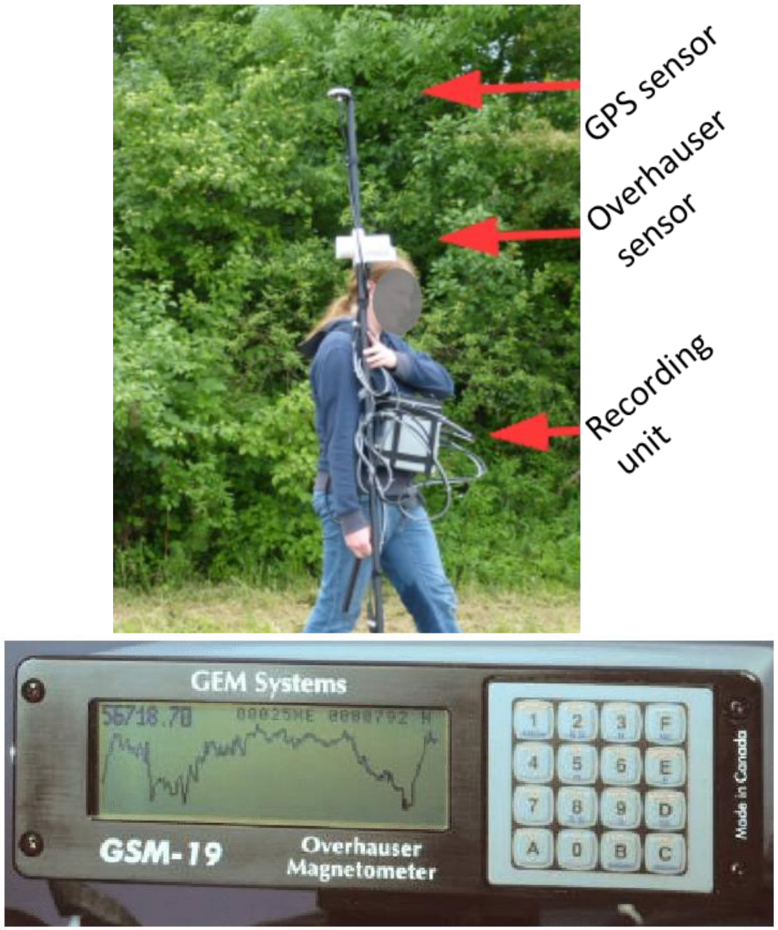
Introduce shortly the study site and the methodology





Introduce shortly the study site and the methodology

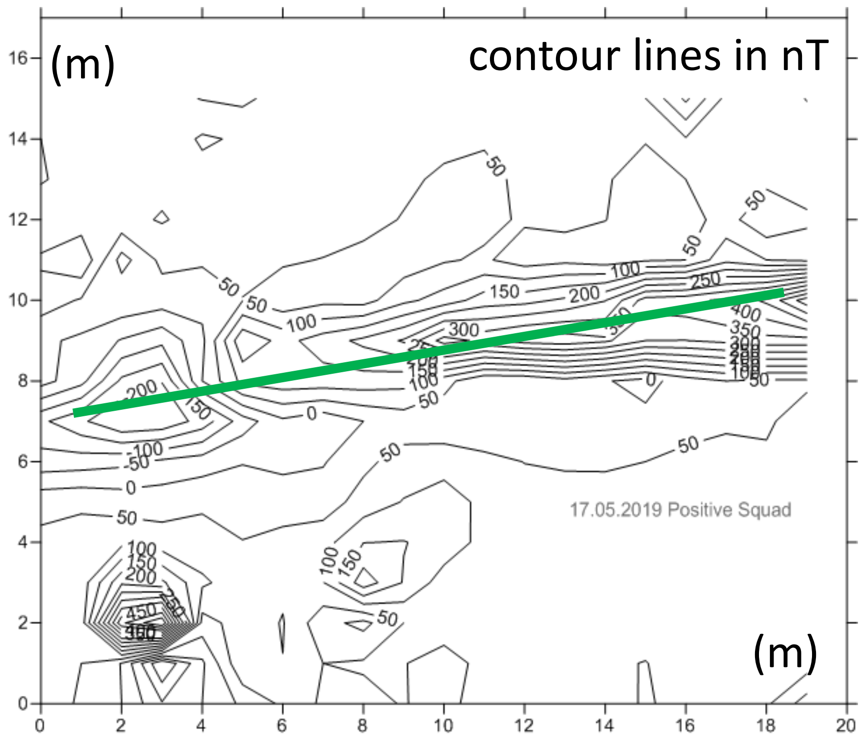


Overhauser magnetometer

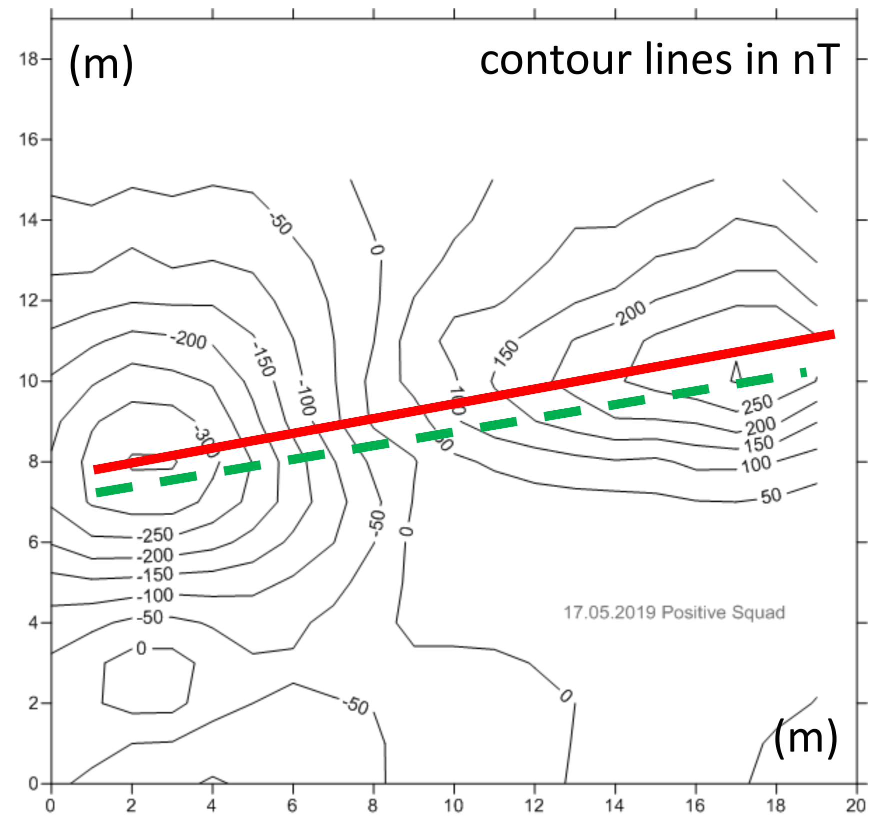
Fluxgate magnetometer

Present the contour plots in an appropriate way
Locate the pipeline on the maps *(sketch it on the contour plots)*

Gradient anomaly
(Fluxgate magnetometer)



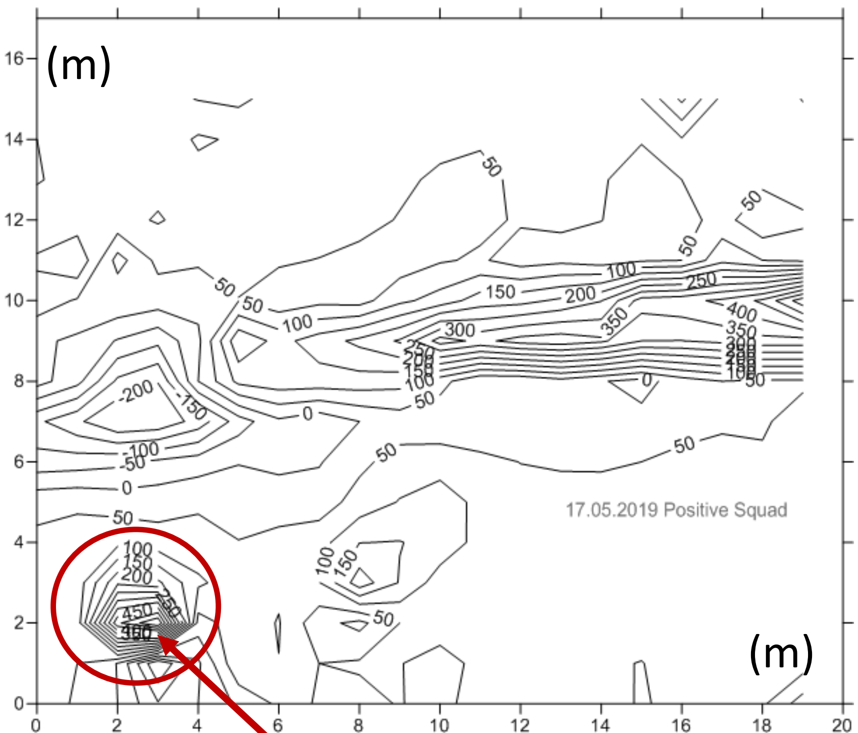
Total field anomaly
(Overhauser magnetometer)

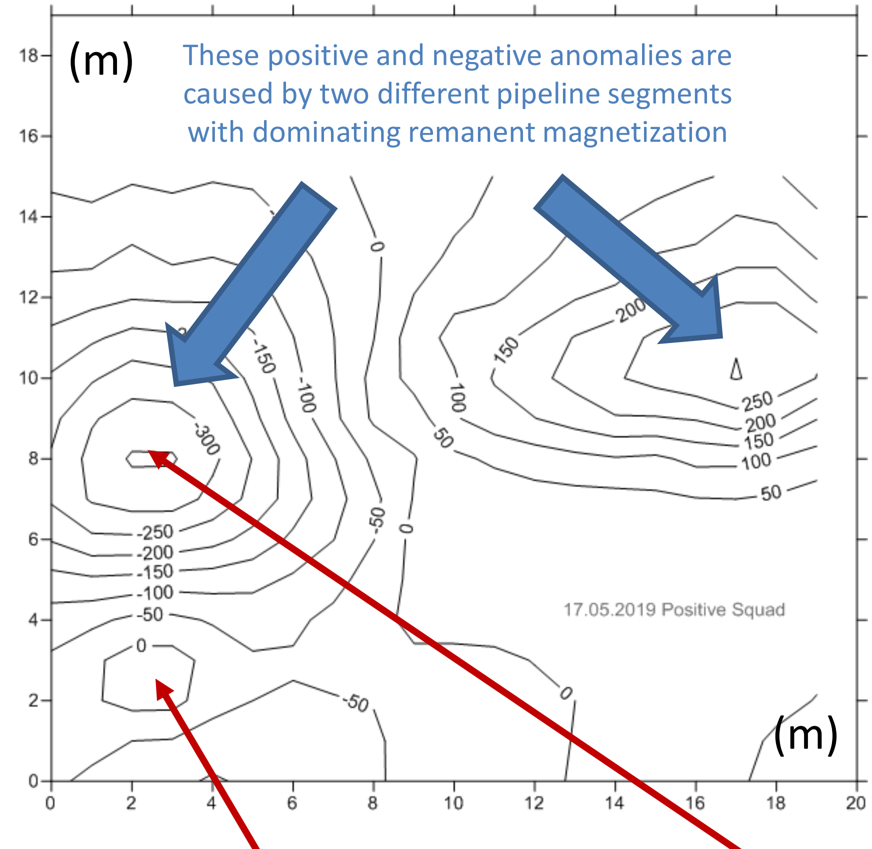


The gradient anomaly is narrower than the total field anomaly
=> better locates the pipeline

Determine the maximum depth of the pipeline

(for this plot meaningful profiles using the data from the contour maps) - explain your result



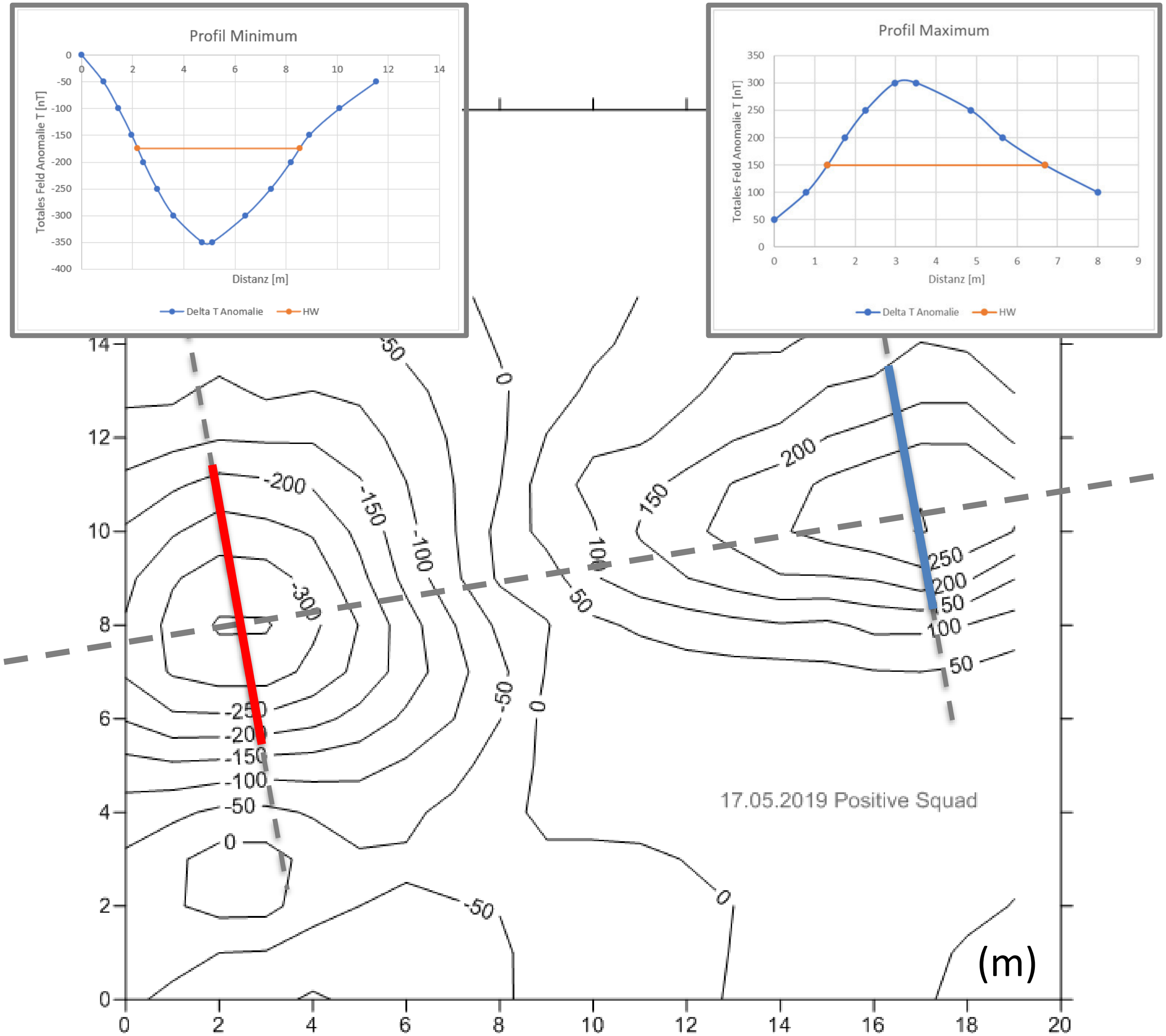


From comparison of the total field result (sensor at 2m height above ground) and the gradient result (sensor close to the ground) It is clear that this anomaly is caused by a very shallow object

This small positive anomaly is not related to this large negative anomaly (not from the same magnetic source)

Determine the maximum depth of the pipeline

(for this plot meaningful profiles using the data from the contour maps) - explain your result



The total field anomaly has to be used

(not the gradient anomaly)

For determining the half-width (HW), we use profiles perpendicular to the pipeline through the extreme values

HW ~6.0 m

HW ~5.2 m

mean HW ~5.6 m

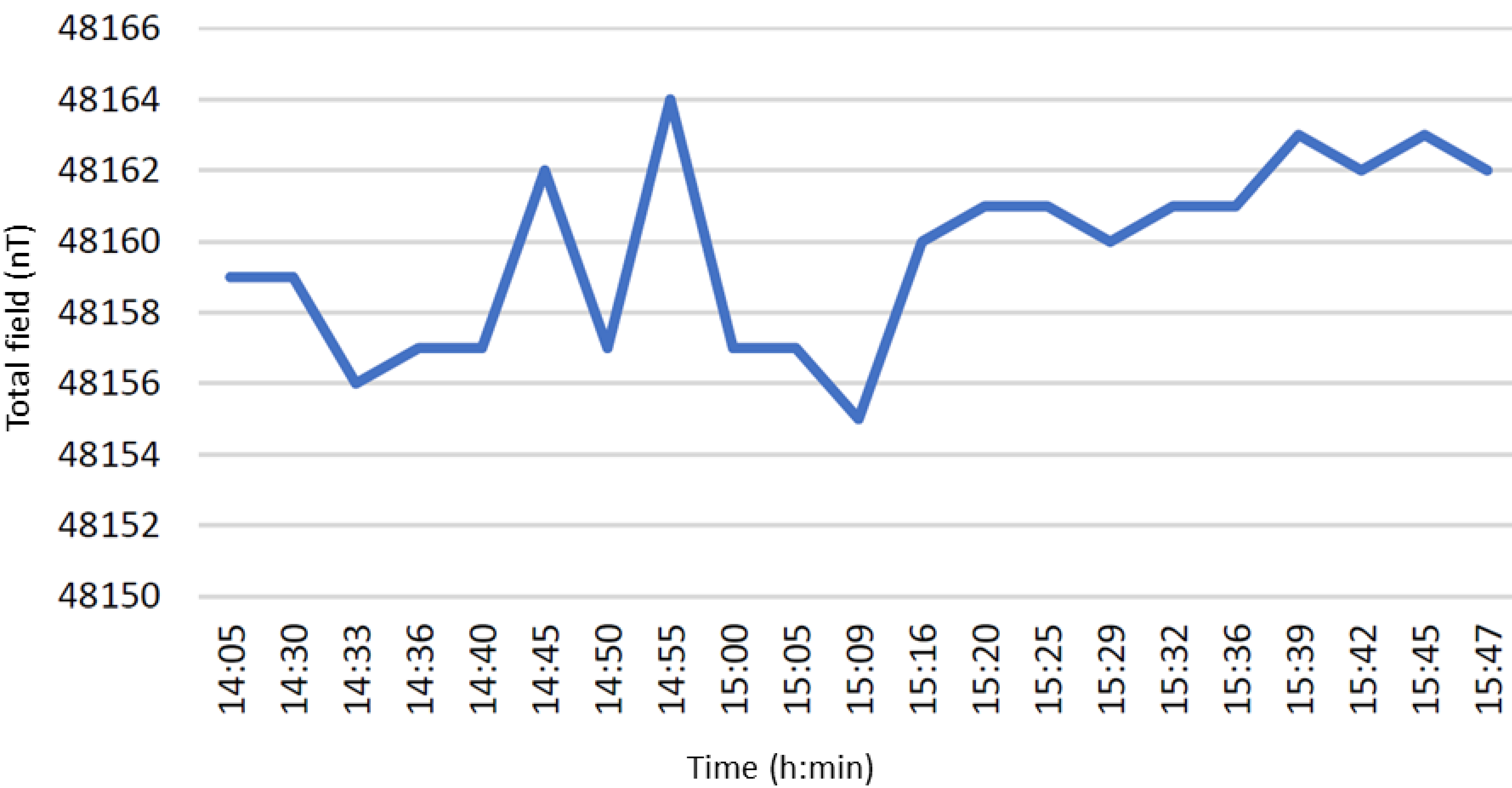
→ **max. depth ~3.6 m**

(sensor 2.0 m above ground)

The pipeline segments are not point dipoles; the HW depends on the length of the pipeline segments, which leads to an overestimation of the maximum depth of the pipeline

Is correction for time variation needed for the total field data?

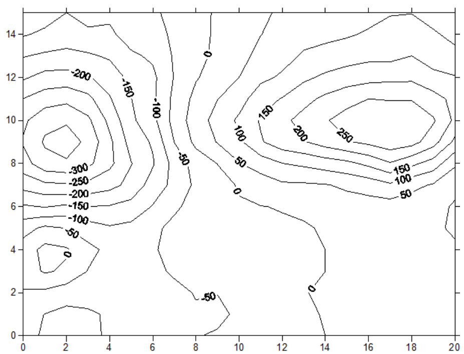
(check the base station data)



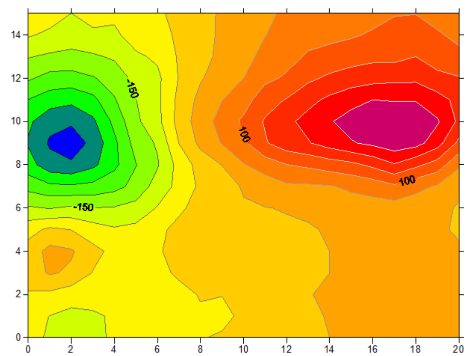
Only about 9 nT variation during the recording time => no correction needed

How to display the data

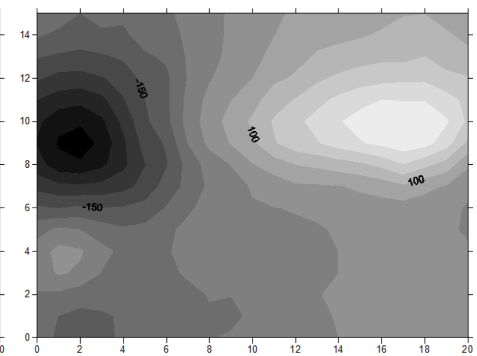
(Overhauser data, SoSe 2015)



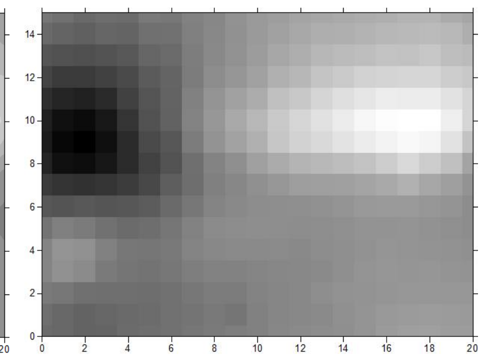
contour lines



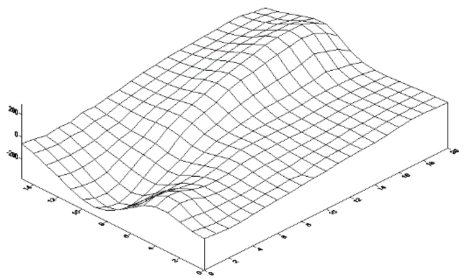
contour lines with color fill



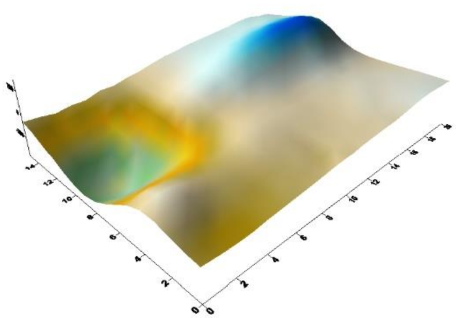
contour lines with b&w fill



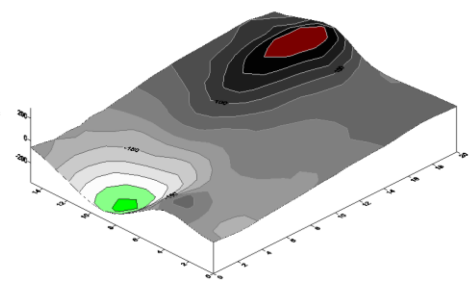
raster (1x1m, as measured)



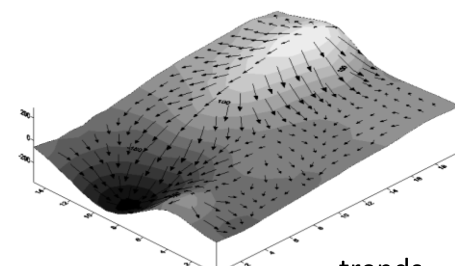
wireframe

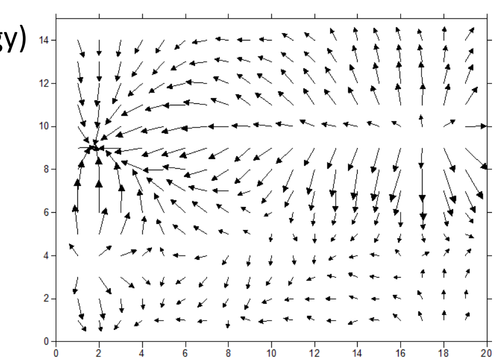


wireframe with color fill

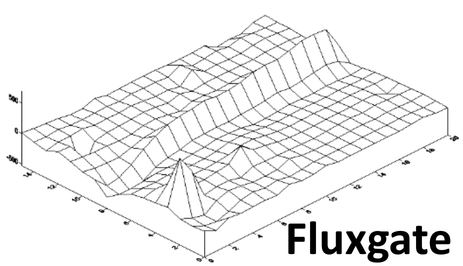


overlays of wireframe and others
(e.g. contour lines, topo maps, geology)





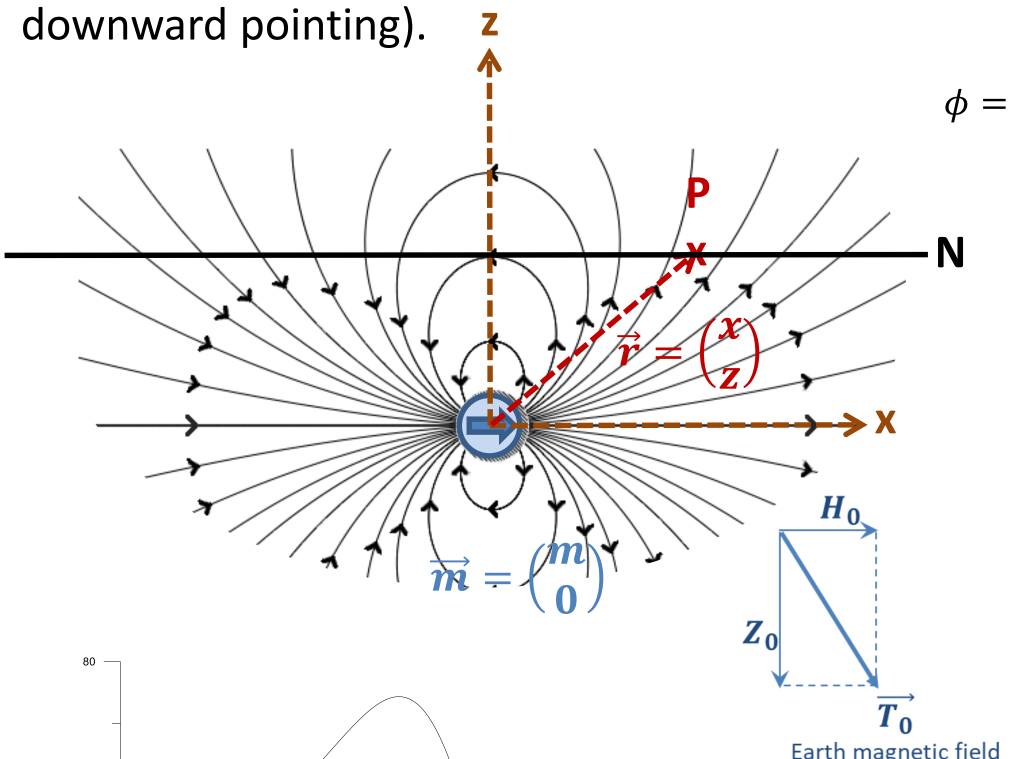
trends



Fluxgate
(for comparison)

TASK E: A **body at 5 m depth** has a **remanent magnetization in horizontal direction** pointing to North; its magnetic **moment is 100 Am²**, and it can be considered as a point dipole.

Calculate and plot the δZ (vertical) anomaly on a North-South profile (Earth magnetic field downward pointing).



$$\phi = \frac{1}{4\pi} \cdot \frac{\vec{m} \cdot \vec{r}}{r^3} = \frac{1}{4\pi} \cdot \frac{m_x \cdot x + m_z \cdot z}{(x^2 + z^2)^{3/2}} = \frac{1}{4\pi} \cdot \frac{m \cdot x}{(x^2 + z^2)^{3/2}}$$

$$\vec{B} = -\mu_0 \cdot grad\ \phi$$

$$B_z = -\mu_0 \cdot \frac{\partial \phi}{\partial z} = -\frac{\mu_0}{4\pi} \cdot m \cdot x \cdot \frac{\partial}{\partial z}\left[\frac{1}{(x^2+z^2)^{3/2}}\right] =$$

$$= -\frac{\mu_0}{4\pi} \cdot m \cdot x \cdot \frac{(-3/2) \cdot 2z}{(x^2 + z^2)^{5/2}} = \frac{\mu_0}{4\pi} \cdot m \cdot \frac{3xz}{(x^2 + z^2)^{5/2}}$$

$$B_z = \frac{4\pi \cdot 10^{-7} \frac{Vs}{Am}}{4\pi} \cdot 100Am^2 \cdot \frac{3x \cdot 5m}{(x^2 + 25m^2)^{5/2}}$$

$$= 1.5 \cdot 10^{-4} Vsm^2 \cdot \frac{x}{(x^2 + 25m^2)^{5/2}}$$

$$\left.\begin{aligned} &= 1.5 \cdot 10^{-4} \cdot \frac{x}{(x^2 + 25)^{5/2}} \frac{Vs}{m^2} \\ &= 1.5 \cdot 10^{5} \cdot \frac{x}{(x^2 + 25)^{5/2}} nT \end{aligned}\right\} x\ in\ m$$

$$-x_{max} \leq x \leq -x_{max}$$