



EXPLORATION FOR HUMANITY

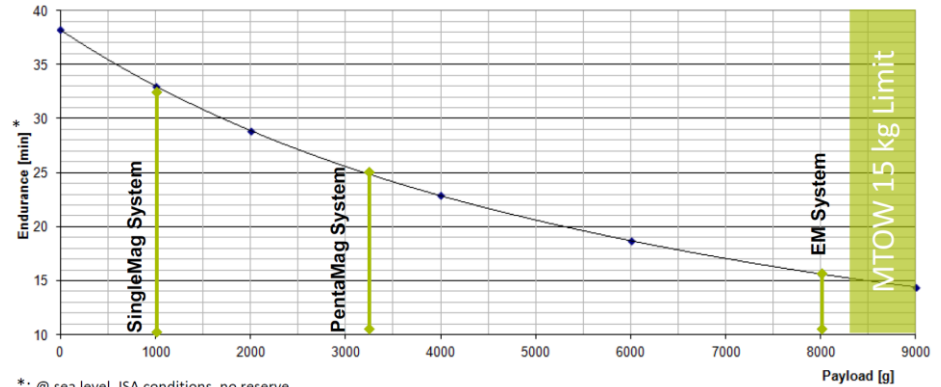


MGT DroneMag5 Landmine Detection System

**Anders Jepsen & Johannes Stoll
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- The PentaMag System – Technical Specs
- Test Flight on a Military Test Site
- Identification of Objects & Detection Threshold
- Conclusion

The Drone Mag 5 System “PENTAMAG”



*: @ sea level, ISA conditions, no reserve

- 8 engines, coaxial configuration
- Endurance: 25 min. @ 3,3 kg payload (PentaMag System)
- Max. speed: vert.: -2 m/s to +5 m/s; hori.: 15 m/s
- Empty weight: 4,1 kg, batteries: 4,4 kg
- Max. payload: 6,5 kg (@ 15,0 kg MTOW)
- Wind: < 8 m/s (17,9 mph / 28,8 km/h)
- Autopilot

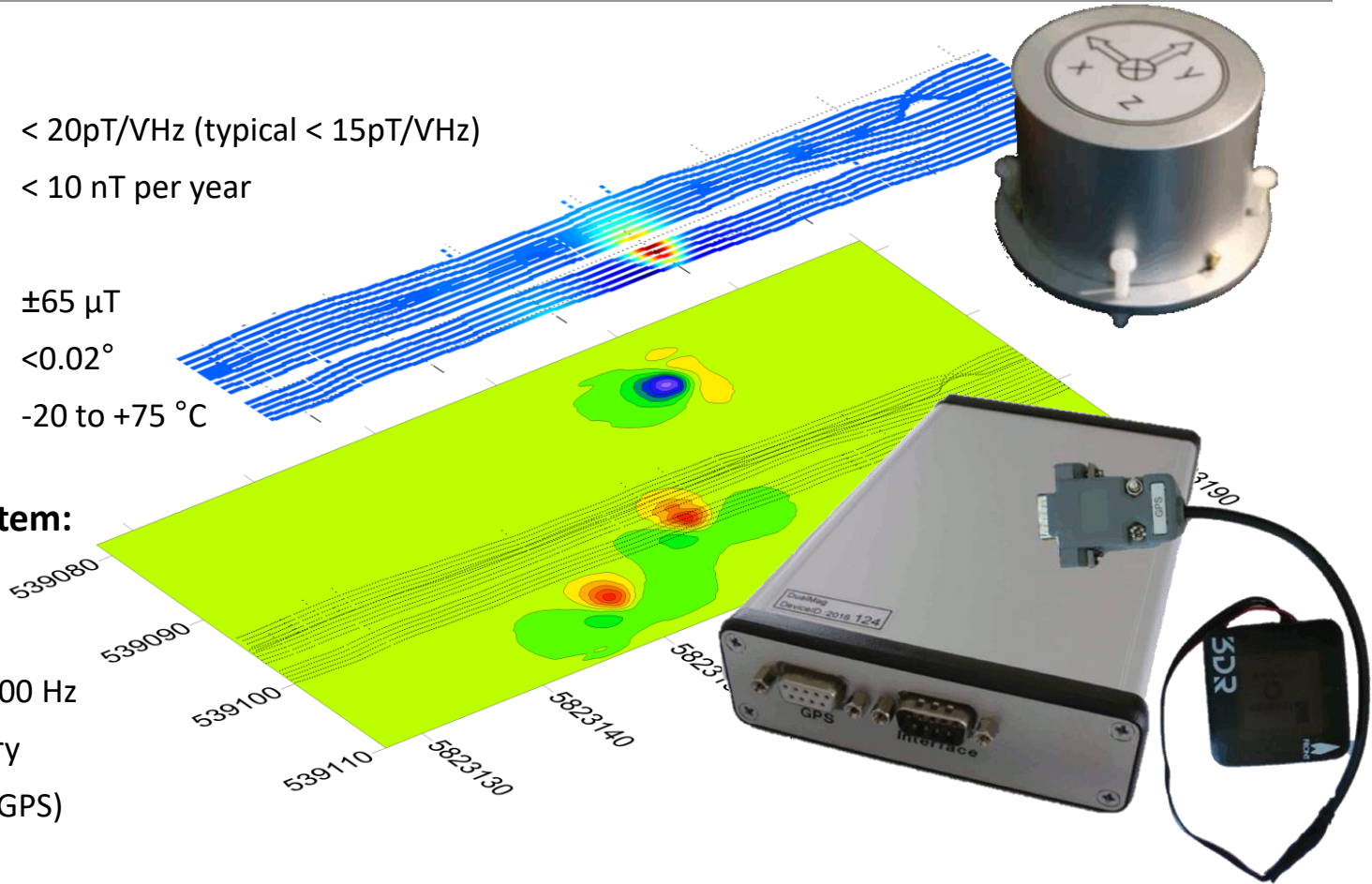
3-COMPONENT FLUXGATE MAGNETOMETER

Sensor:

Noise	< 20pT/VHz (typical < 15pT/VHz)
Long-term stability	< 10 nT per year
Orientation X, Y, Z	
Range	$\pm 65 \mu\text{T}$
Orthogonality	< 0.02°
Temperature range	-20 to +75 °C

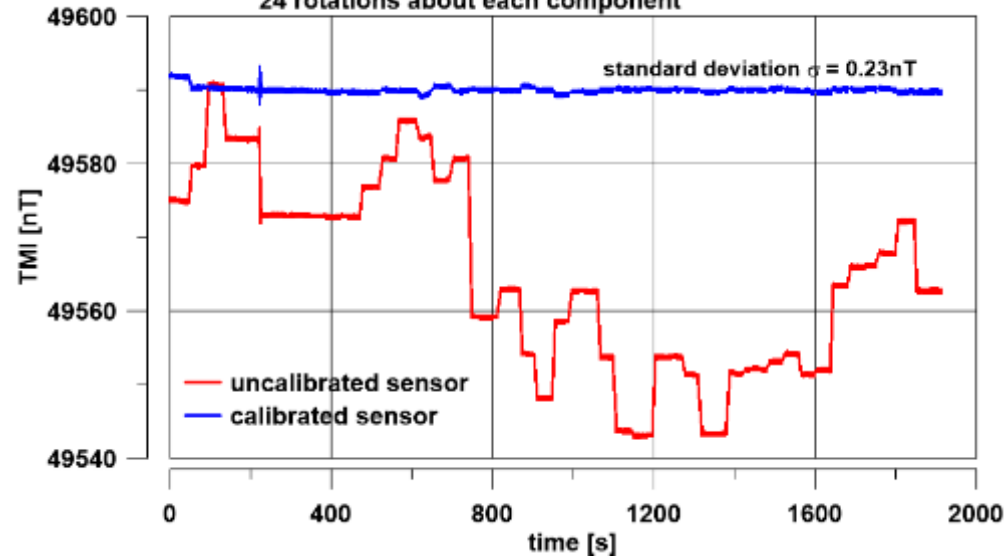
Data Acquisition System:

Field range	$\pm 65 \mu\text{T}$
Resolution	10 pT
sample rate	1, 10, 50, 100 Hz
Data format	ASCII, binary
Time and Position	(RTK GPS)



3-COMPONENT FLUXGATE MAGNETOMETER

Result of 3-component Fluxgate Sensor Calibration
24 rotations about each component



FLUXGATE SENSORS REQUIRE CALIBRATION

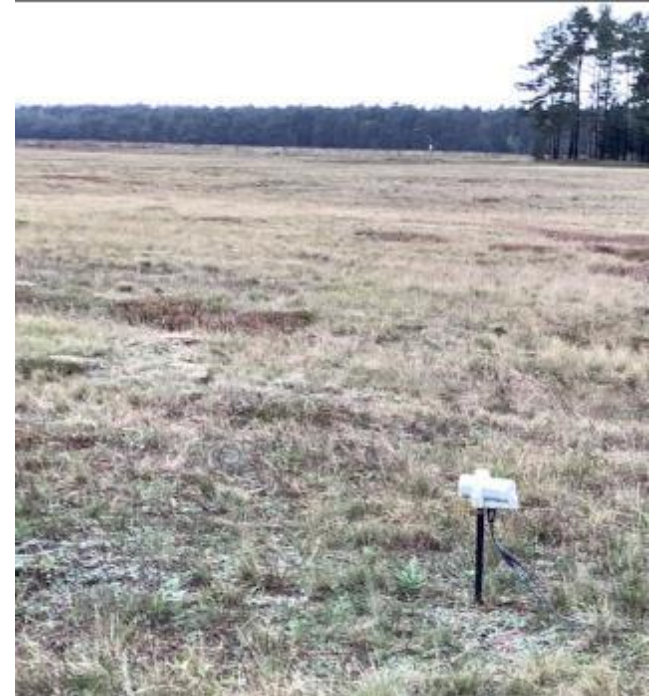
A 3-component fluxgate magnetometer measures the vector of the Earth's magnetic field, but ...

- Needs to be calibrated to get the absolute value
- To eliminate the effects of sensor movement
- After calibration TMI must not depend on sensor orientation

Resolution Test on Military Area



UXO contaminated military area, containing 53 buried objects of different size and depth



magnetic base station

FLIGHT PARAMETERS

FLIGHT ROUTE OVER THE SURVEY AREA

90m x 60 m

0.54 hectare

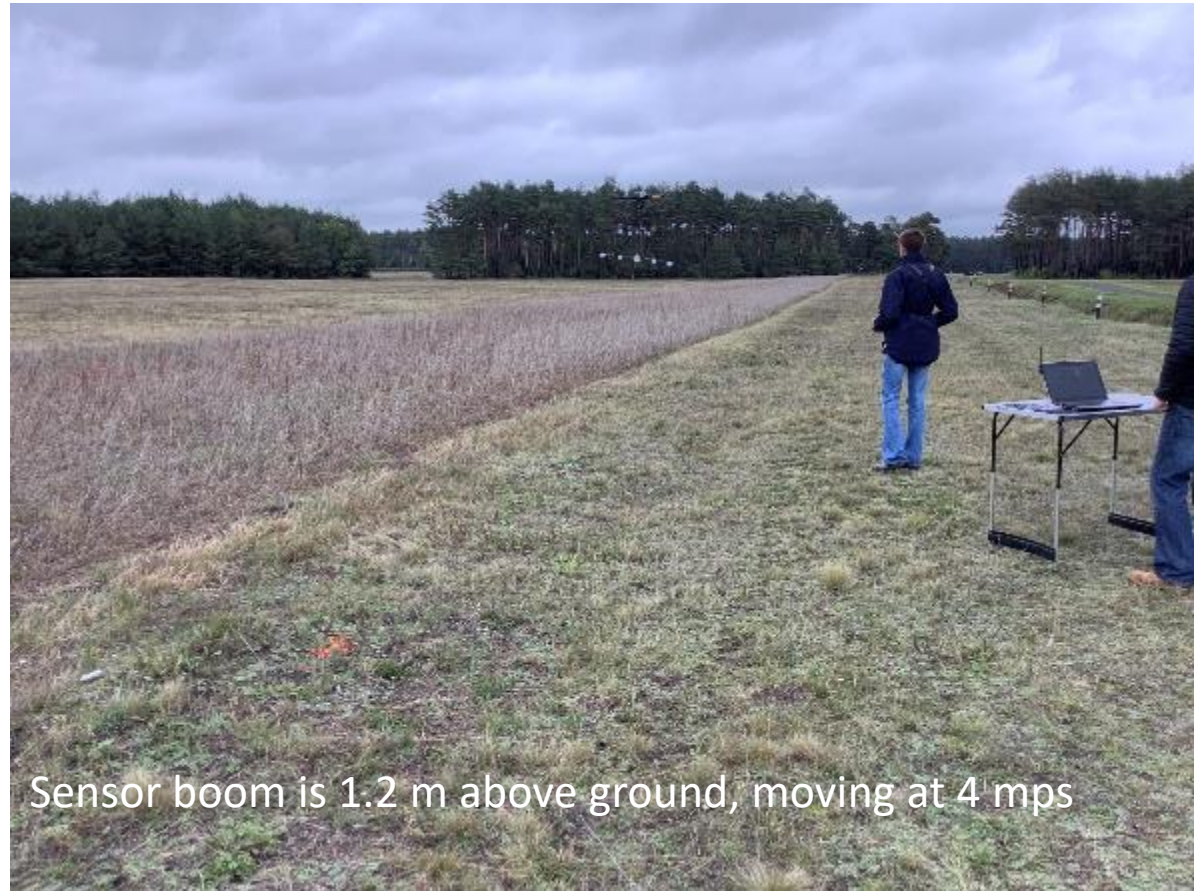
2 m flt line spacing

30 lines, 2 m wide

2700 flt line meters

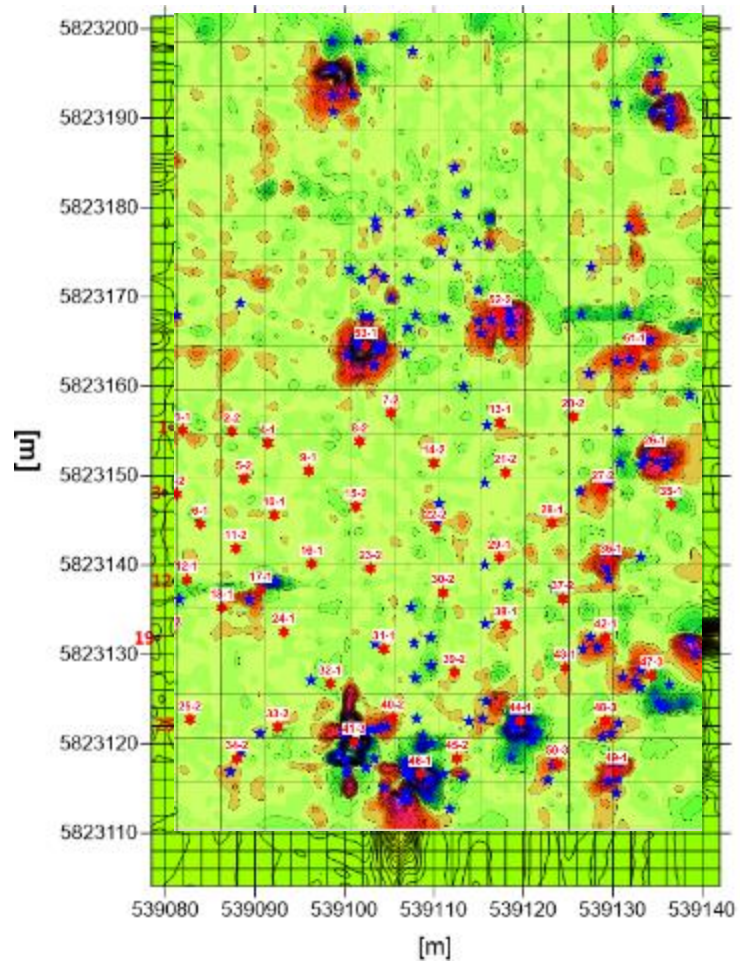
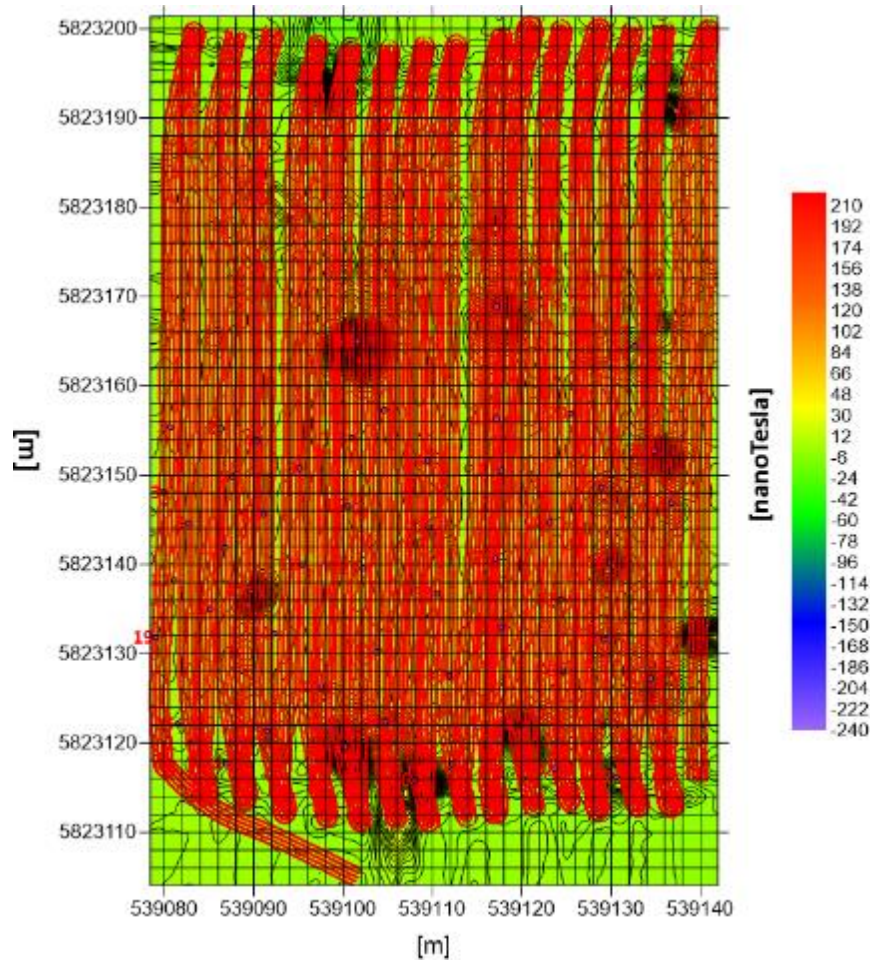
240 meters/min

11 min for 0.54 hectare

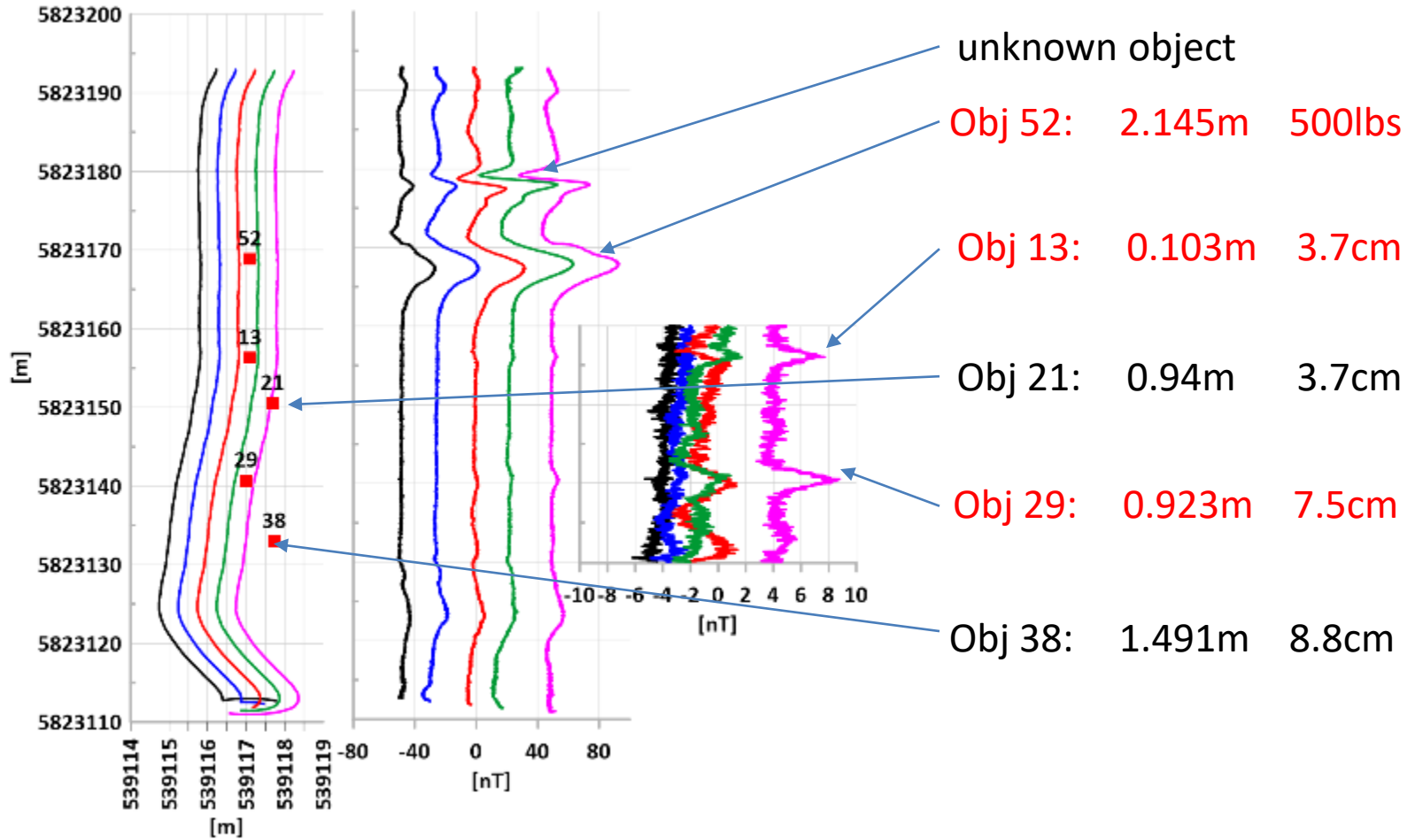


Sensor boom is 1.2 m above ground, moving at 4 mps

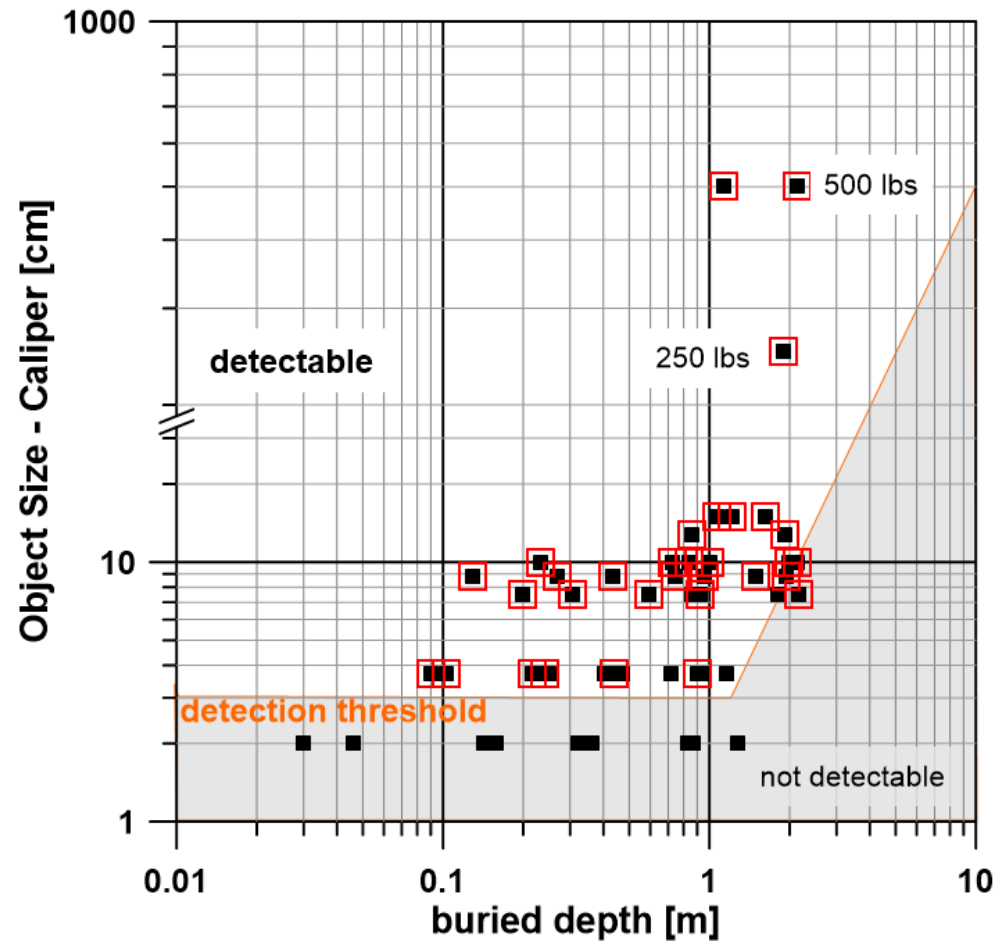
2D ISOLINE PLOT



RESULTS ON LINE 19



GROUND TRUTHING AND VERIFICATION



- Five Fluxgate sensors were successfully integrated on a 10kg Multicopter
- The PENTAMAG System can fly up to 25 min and achieves up to 1ha per flight
- A detection test was undertaken on a military site. 53 objects of different size and depth were buried in the shallow ground
- The test suggest that objects larger than 3.5cm can be detected.

Thank you for your attention

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