Drones

Radai Oy

radai

GEOPHYSICAL SURVEYS AND REMOTE SENSING WITH UAV'S

Radai Oy

- Established in 2013
- Operations in Finland
- 8 private owners

Radai Oy

Provides geophysical surveys – using drones

- Magnetic surveys
- Gas surveys
- Radiometric surveys

Drone characteristics

Trimble UX5

- Terminology: UAV, RPAS, Drone
- Frame type: multicopter, fixed-wing, VTOL
  - Fixed-wing planes→ longer flight times
  - Multicopter can hover → slower flight speed
- Electric vs. combustion engine
- Payloads; 1 – 20 kg (correlates with prices)
- Flight times; 0.5 – 2 hour (typically)

Geodrone X4L

Drone benefits

- Cost-effective surveys
  - No terrain obstacles (swamps, lakes, rivers)
  - Low operational costs
- Versatile survey operations
  - Real-time survey monitoring
  - Dynamic line spacing
  - Flying speed adjustable
  - Multiple Drone’s performing same mission
- No need for strict aviation certificates for pilot and Drone

Drone challenges

- Small payload
  - Survey equipment must be modified light weight.
  - Not possible to perform all surveys.
- Limited flight time
  - Comprehensive survey planning for larger areas.
- Low endurance for rough operational conditions
  - Hard wind
  - Tough terrain types: mountains
- National Drone regulations
  - Variable regulations

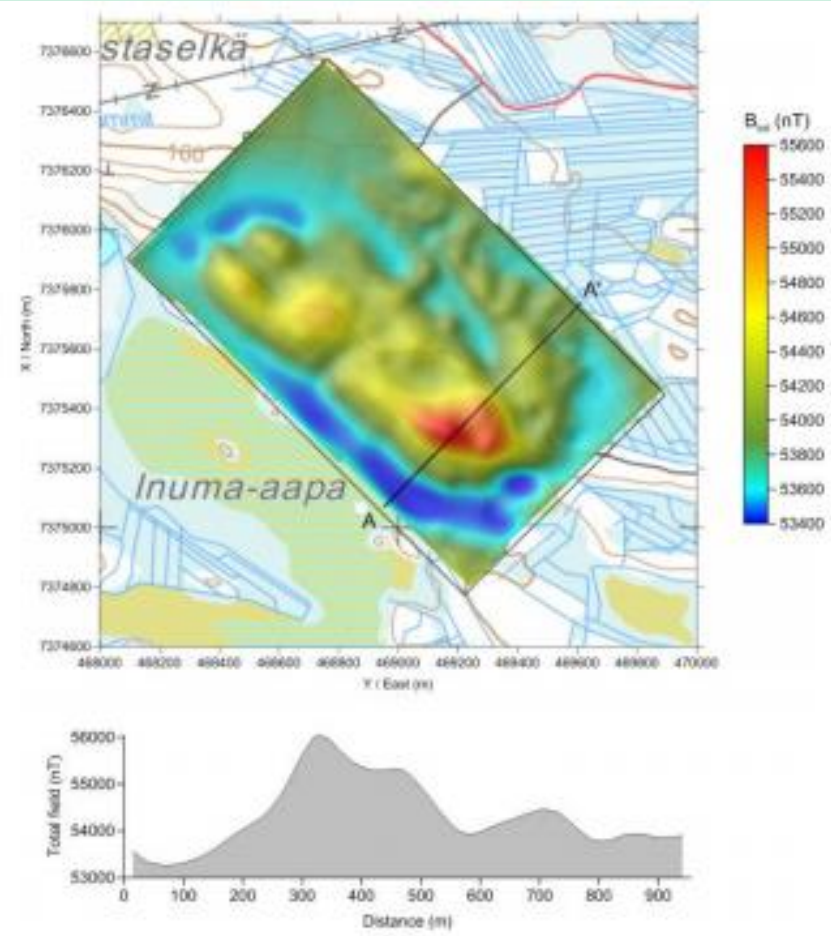
CASE STUDY:
Ryssänlampi Magnetic Survey 2015

- TEKES project of GTK, University of Lapland, and mining companies
- Survey site is located about 35 km NE from Rovaniemi
- Area 1.5 km^2 (c. 31 line-km with 50 m line spacing)
- 56+28 line-km & 40000+20000 points of (edited) data
- Flight time ≈ 2 hours, mean speed ≈ 12.1 m/s

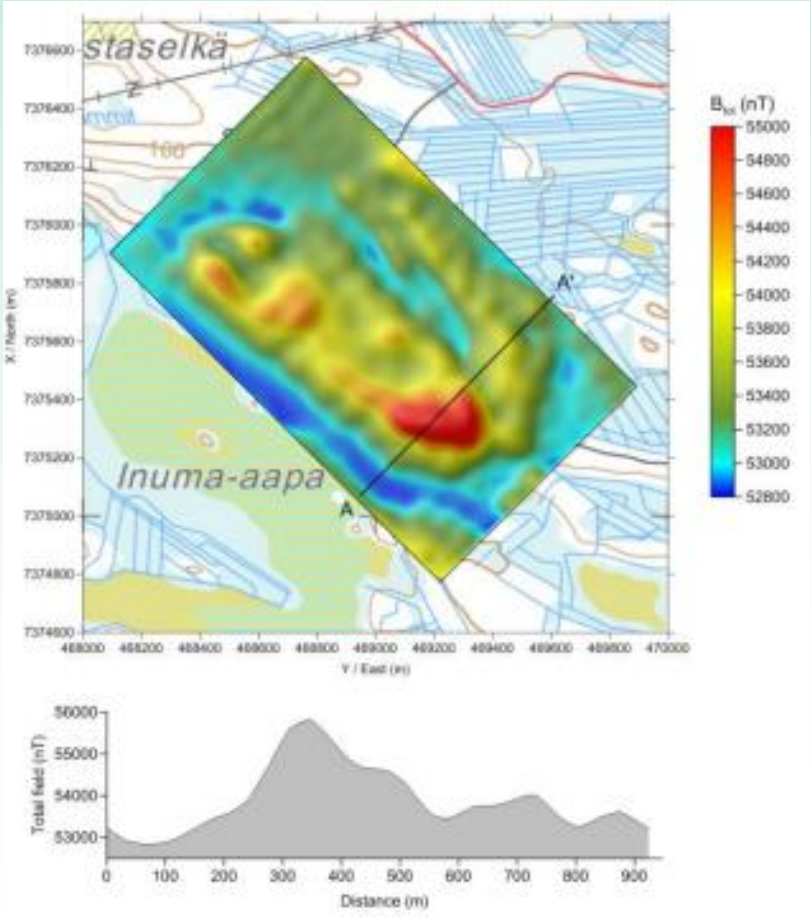
- Full report: http://tupa.gtk.fi/raportti/arkisto/73_2015.pdf

Comparison to GTK's upward continued data

GTK's ground data upward-continued by 30 m



Radai's UAV data computed at the height of 30 m using ELM



CASE STUDY:
Radai gamma radiation system 2016

- Custom-made quadcopter
- Payload 4kg, flight time 40 min
- Autopilot follows waypoints designed for the survey
- Dual Bismuth Germanate (BGO) detector 106 cm3
  - High sensitivity performance
  - Energy response from 25 keV – 3000keV
  - Weight 3.5 kg

Radai gamma radiation system 2016

UAV parameters	Value
Operation mode	Quad-copter
Electric engine	4 x W
Axis span	1.0 m
Propellers	50 cm
Mass	8 kg (10 kg w batteries)
Payload	< 5 kg
Flight speed	0-25 m/s
Flight time	up to 40 m

Fig. 2.1. Radai's Terrain Scout 3.2 UAV.

Gamma radiation survey
Total intensity

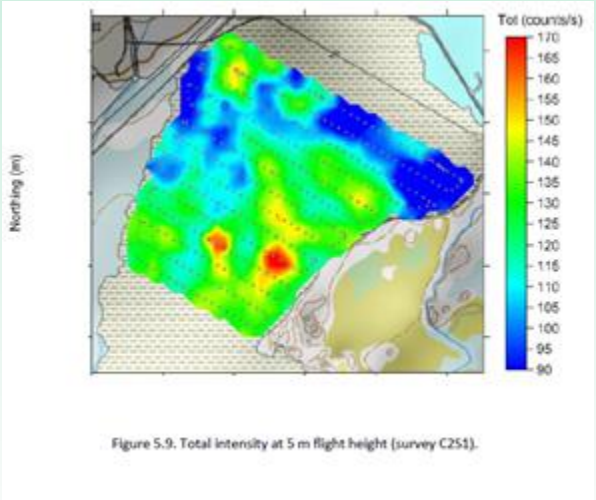


Figure 5.9. Total intensity at 5 m flight height (survey C251).

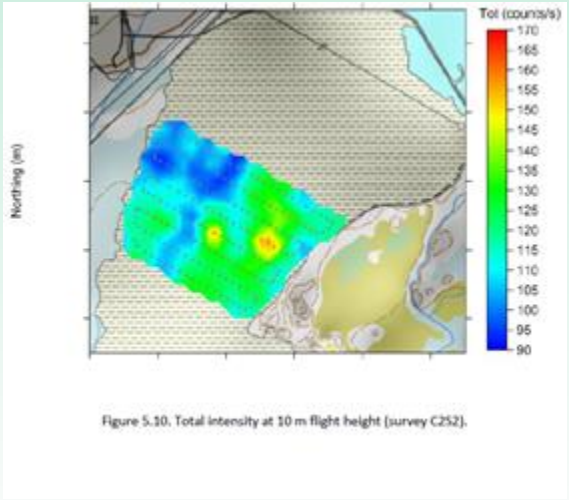


Figure 5.10. Total intensity at 10 m flight height (survey C252).

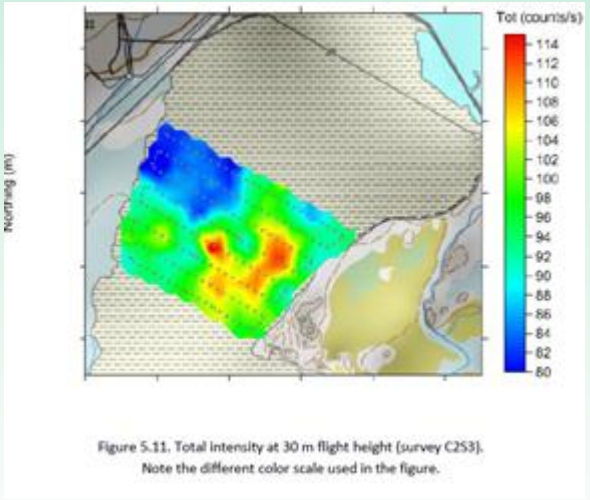
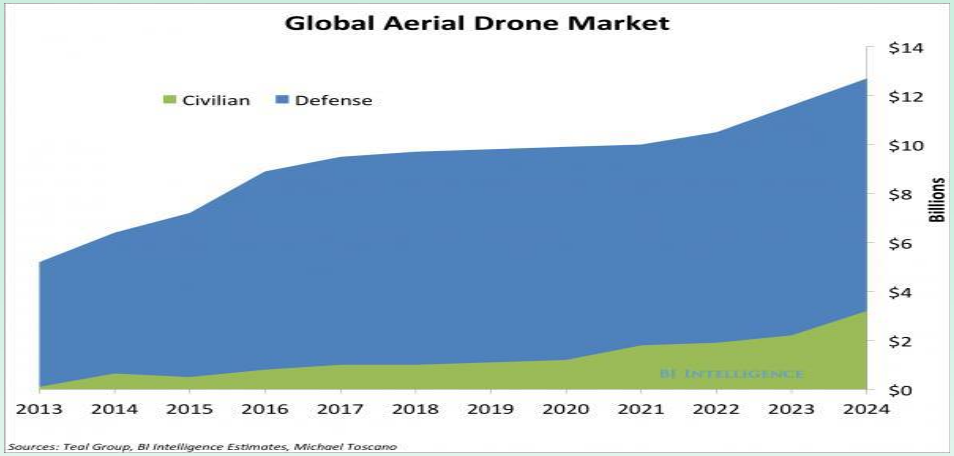


Figure 5.11. Total intensity at 30 m flight height (survey C253).
Note the different color scale used in the figure.

Drone market trends

Drone business global market

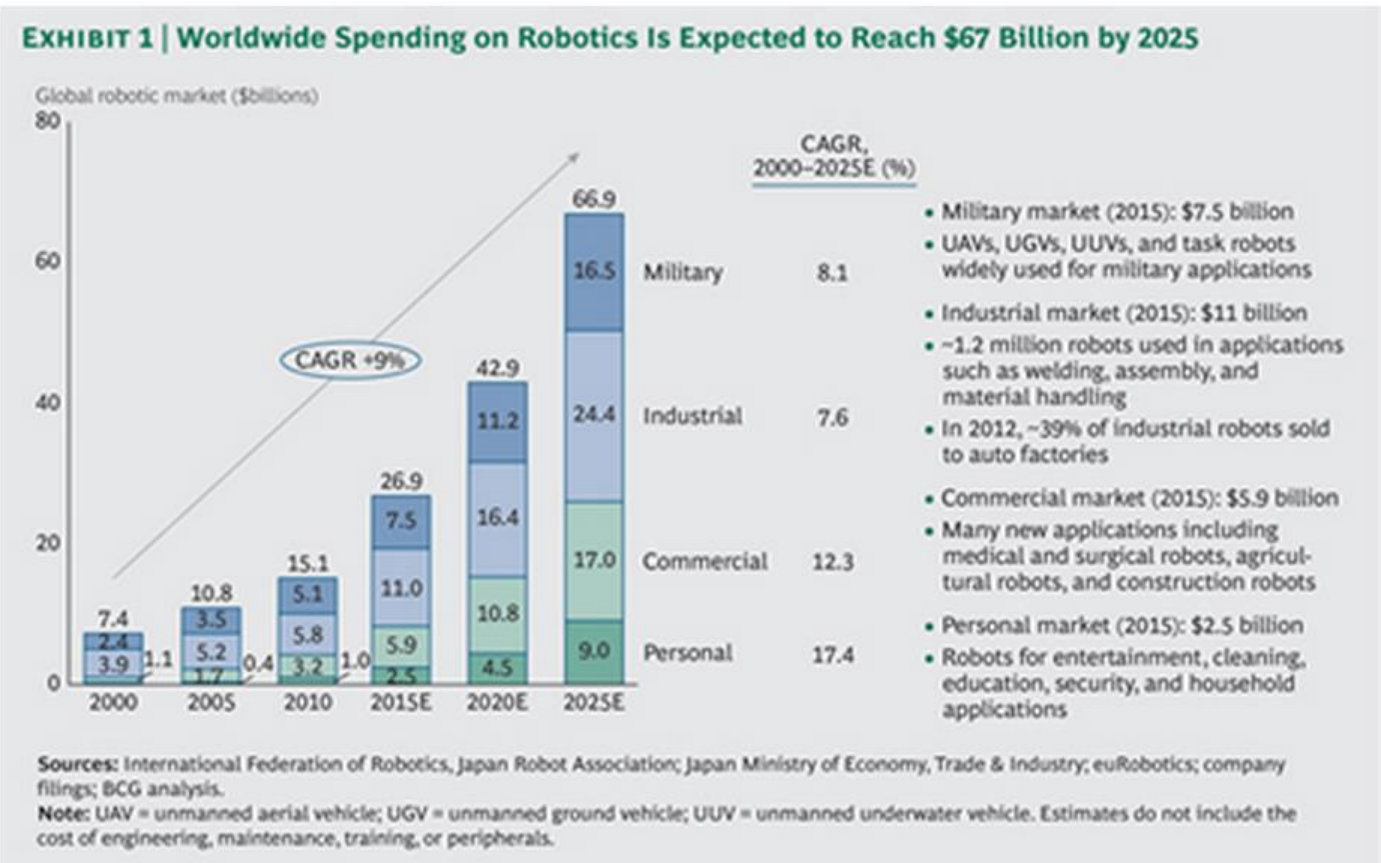
BI intelligence report 2015



- Global market: agriculture, energy, mining industry, construction, media
- Market growth from military industry to civil industry
- National regulations are challenge

Drone business global market

Robotics



Drone regulations in Europe

- European Aviation Safety Agency (EASA) has published a draft version of Commission implementing rules 22.8.2016. “Prototype” Commission Regulation on Unmanned Aircraft Operations
- European nations has own regulations for UAV legislation.
- Differences between national regulations

Aviation Regulations in Finland

- TRAFI is the civil aviation regulatory authority in Finland
- OPS M1-32 rule, active since 1.1.2017
- Limitations for UAVs:
  - Weight < 25 kg, altitude < 150 m, “distance < 500 m”
- Operation modes:
  - VLOS - Visual Line of Sight (always visible)
  - E-VLOS - Extended VLOS (co-pilots see)
  - B-VLOS - Beyond VLOS (closed airspace)
- No need for pilot certification – yet.

Policy challenges for Drone business

- B-VLOS operations are a must for effective Drone operations.
  - Should be allowed in rural areas
  - Comprehensive operational procedure for B-VLOS operations. Geofence, redundant safety systems, emergency options, etc
- Coherent UAV regulations in all European countries. Operational and technical.
- UAV pilot certification system