GeoIntelligence 2015

Airborne Low Frequency Radar in the VHF band an enabler for topographical 3D mapping and target detection under foliage

Ground surveillance challenges

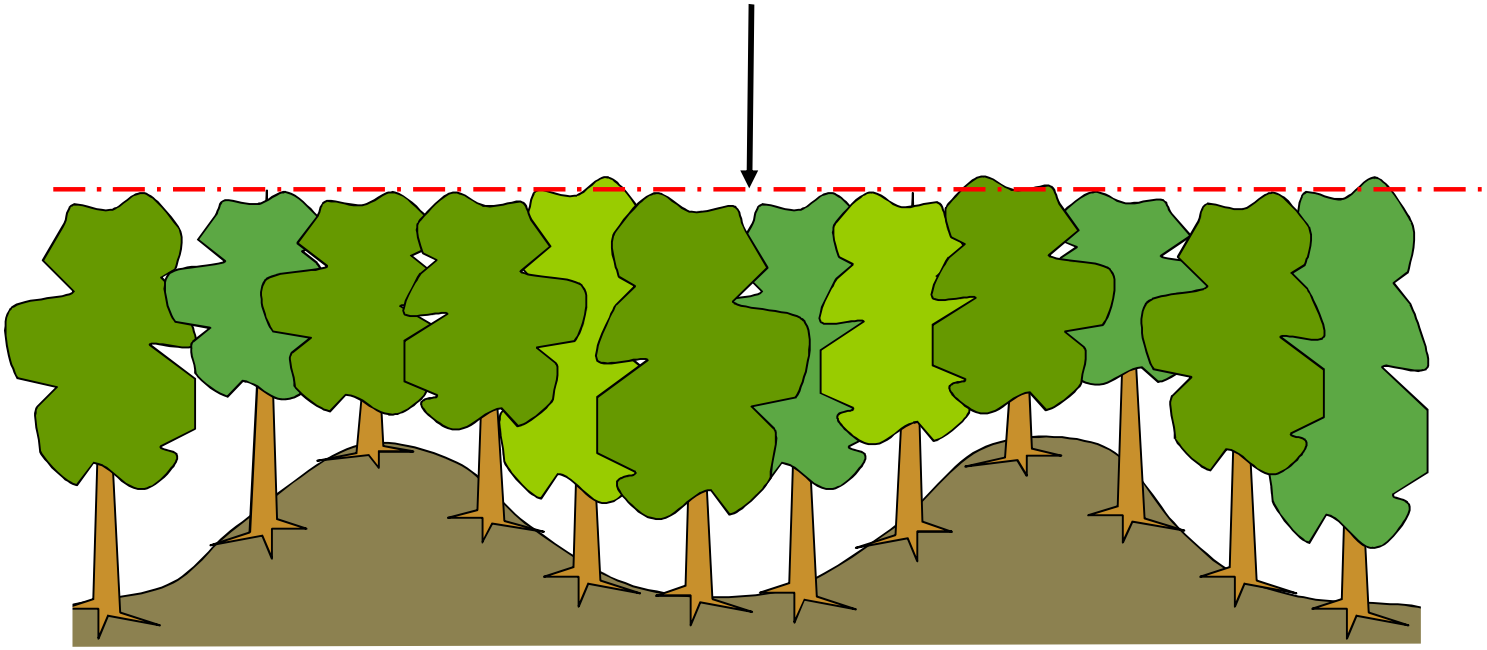
- Many of todays threats deploy and act from deep concealment in forests
- All still-standing military units hide beneath camouflage – also in open terrain
- Relevant objects mixed with irrelevant
- Large areas covered by forest or jungle
- Surveillance must be efficient and give reliable and accurate information

➔ Foliage and Camouflage penetration crucial

➔ Target filtering necessary

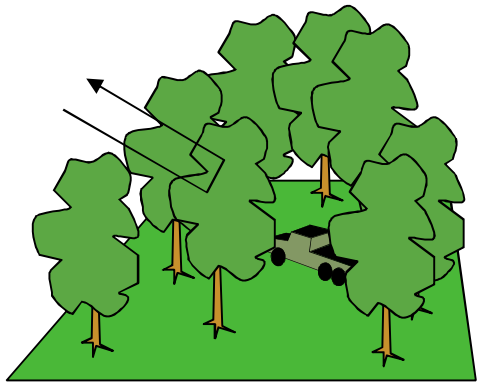
FOREST TOPOGRAPHY

Forest – rain forest in particular – tends to grow so that tree tops reach a common level. It will thus completely mask underlying ground surface topography and the mobility within the forest.



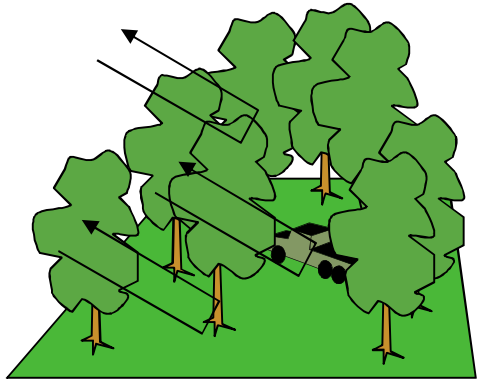
THEY CANNOT HIDE

Radar FOPEN Phenomenology

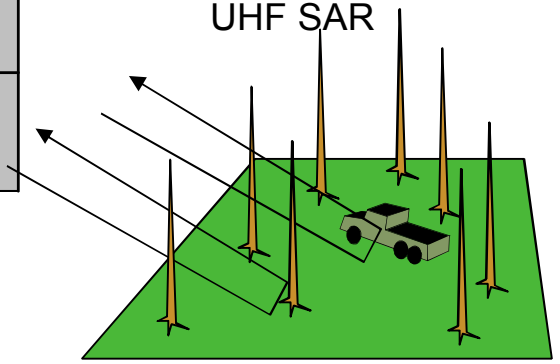


Microwave SAR

Wavelength	Transparency (Leaves, Branches)	Reflectivity (Leaves, Branches)
Microwave $\lambda \approx$ cm	Very low	Low
UHF $\lambda \approx$ dm	Good	High
VHF **$\lambda \approx$ m**	**Very good**	**Very low**



UHF SAR



CARABAS VHF SAR

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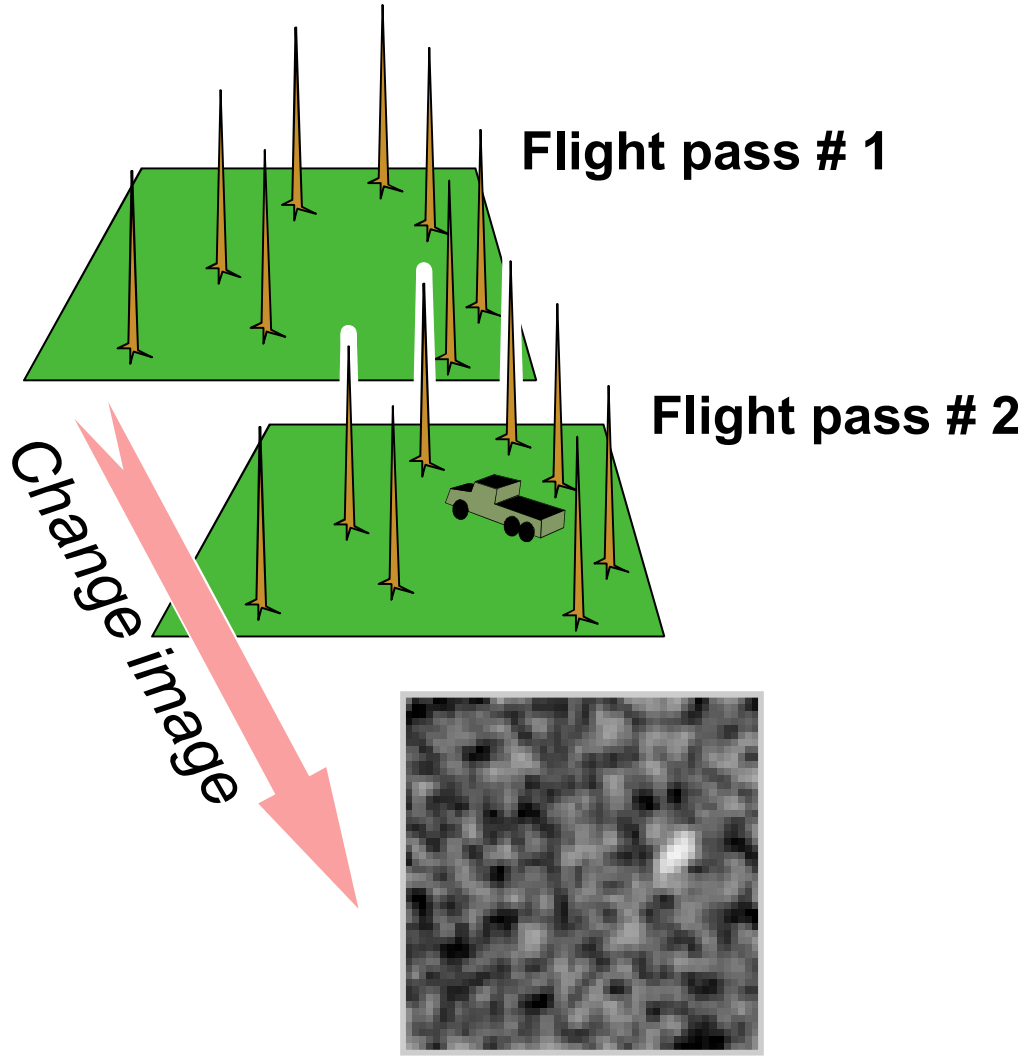
REPEAT PASS CHANGE DETECTION



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Wavelength	Transparency	Reflectivity
X ($\lambda \approx 3$ cm)	Non-existent	Targets, Leaves, Branches, Stems, Ground
UHF ($\lambda \approx 0.5$ m)	Acceptable	Targets, Branches, Stems, Ground
VHF ($\lambda \approx 5$ m)	**Good**	**Targets, Stems**

Primarily VHF senses tree stems

VHF senses also targets if such are deployed

SAAB

The Problem

Optical Image:
no targets seen when covered by trees or camouflage!!

Image is from SAAB's Rapid 3D Mapping sensor

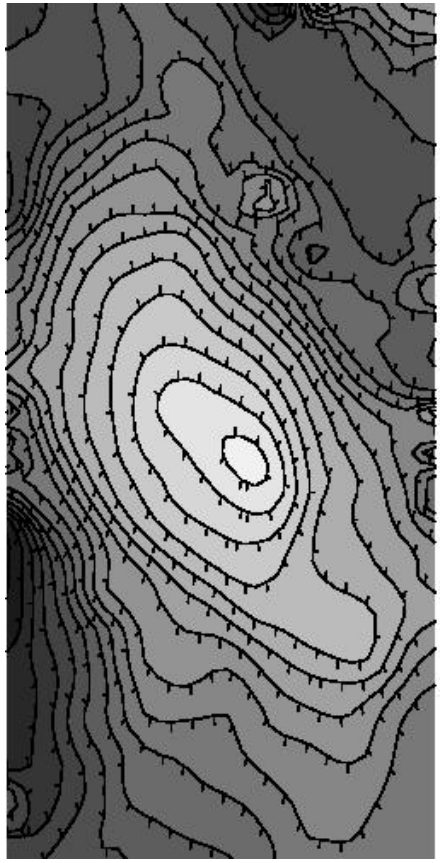
Zoom in and look in all angles in the optical 3D image

In this case the optical image did confirm the target (terrain vehicle). **The target would never have been found without the CARABAS!**

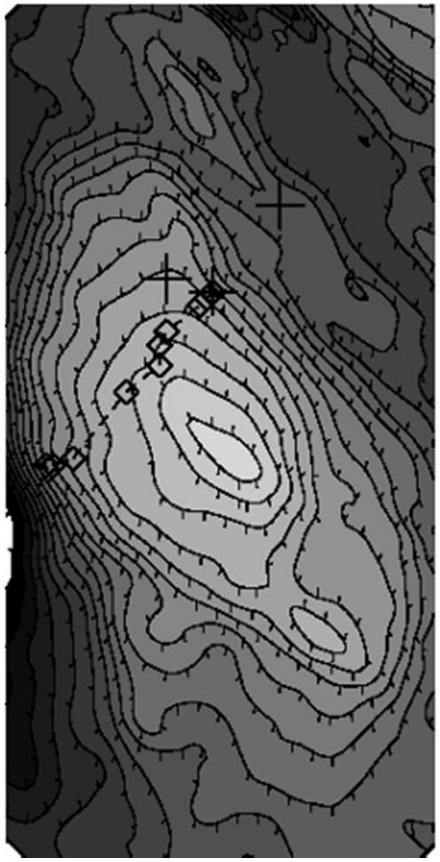
CARABAS FOREST TOPOGRAPHY

Mean error: Δh 0.4 m

Contour lines: Δh 5.0 m



CARABAS



National Land Survey of Sweden

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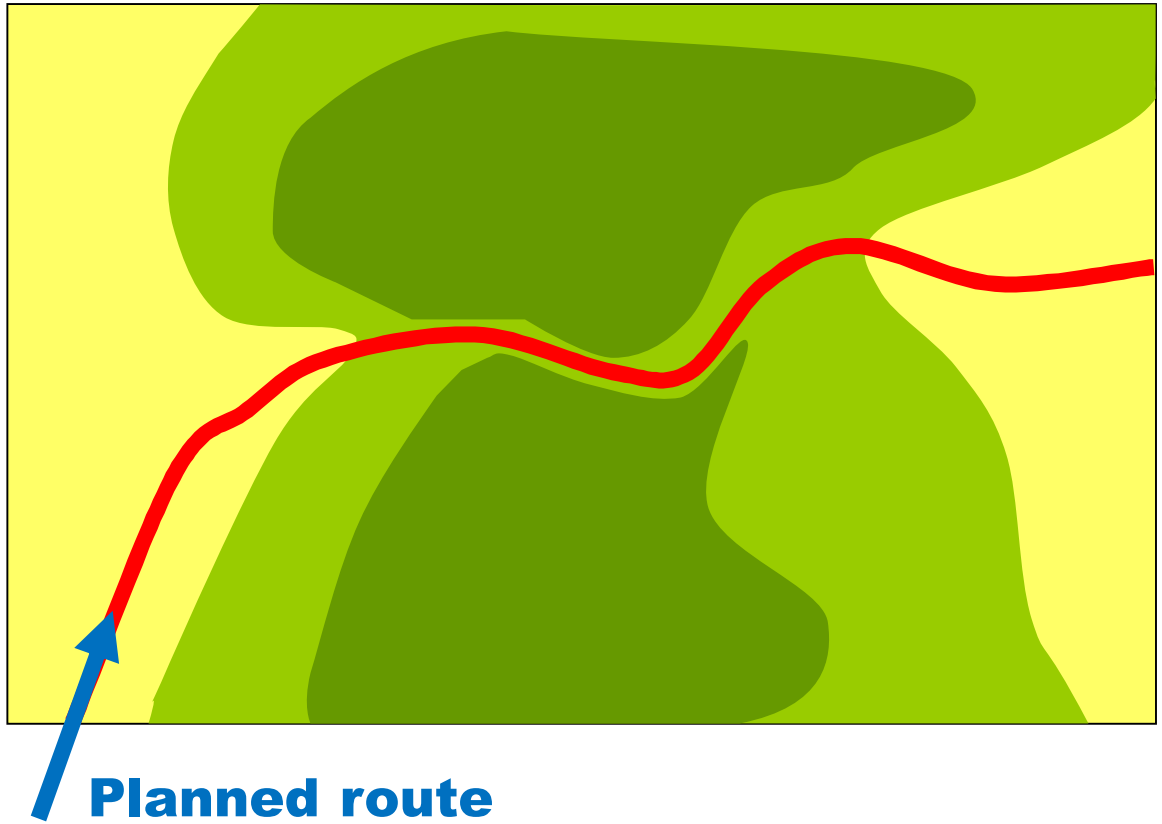
CARABAS FOREST DENSITY

CARABAS provides (within 15%) the forest density



Open

Permeable Forest

Impermeable Forest

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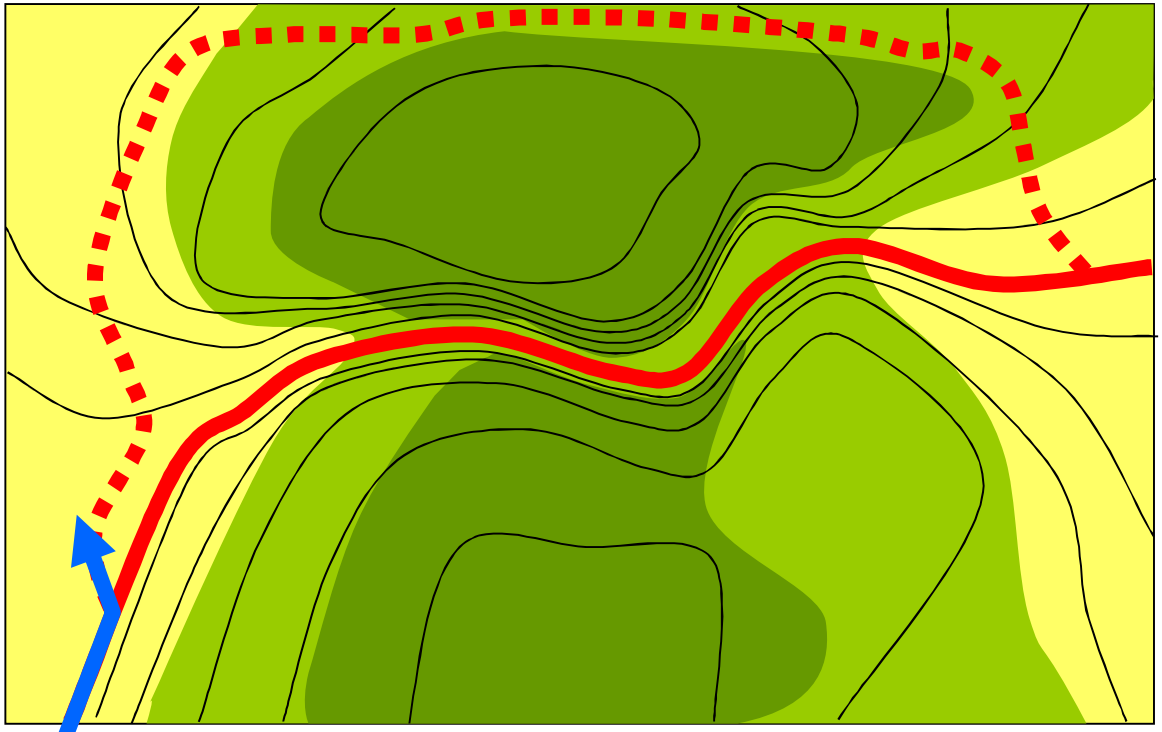
CARABAS TOPOGRAPHICAL MAPPING

In combination CARABAS provides mobility mapping



Possible alternative route

Road

Open

Permeable Forest

Impermeable Forest

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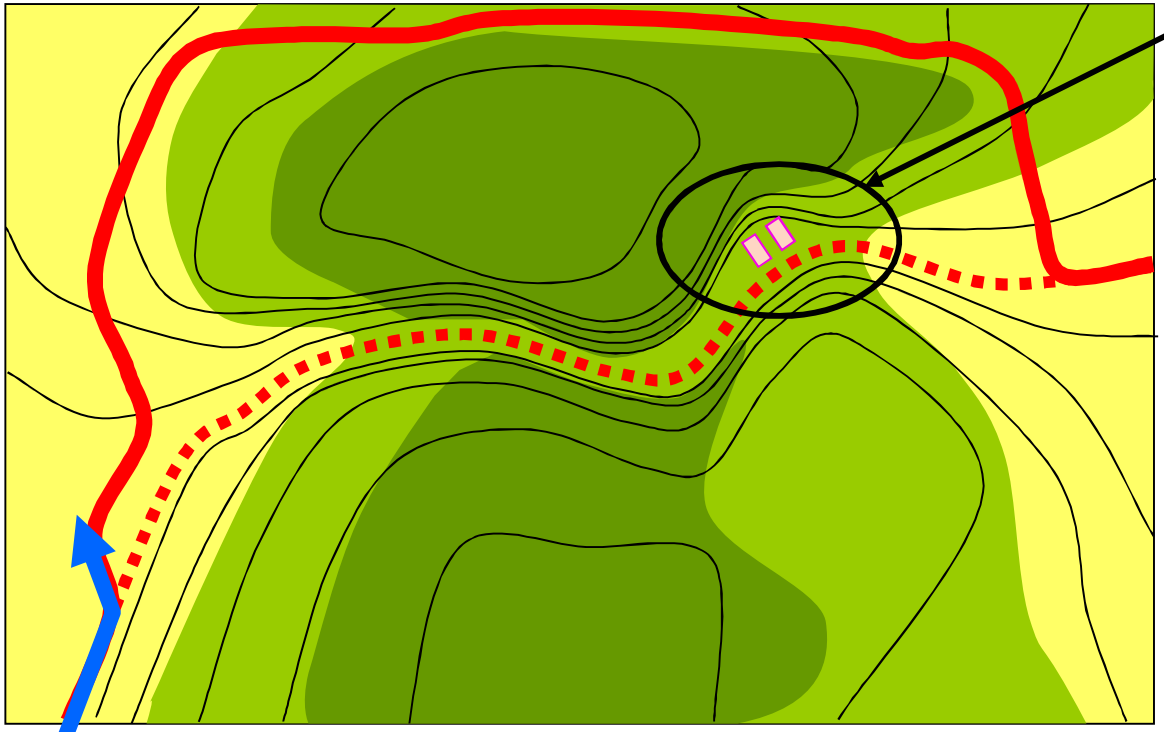
CARABAS TARGET DETECTION

CARABAS provides change detection



Potential ambush threat being detected

Chosen route

Road

Open

Permeable Forest

Impermeable Forest

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CARABAS MAIN APPLICATIONS

- **Target detection under foliage**
  - Deployed units and Dismounts
  - Illegal farming and mining, drug factories, border control
- **Target detection under Camouflage**
  - Deployed units, Ambush and Deep hides
- **Area mapping under foliage**
  - Buildings, infrastructure and jungle/forest floor topography

- Rescue services – Search and rescue, damage mapping

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CARABAS Development > 2005

- Miniaturized to fit also tactical UAVs, light aircraft and small helicopters
- Stand-off distances ranging from 100 m to tens of km
- Capacity extended to small objects
- Flexible integration with data links for real time mapping and target detection
- The basic design can be adapted to most platforms

SAAB

The Carabas FOPEN Demonstrator

- Third generation system – CARABAS FOPEN
- A small tactical FOPEN system ideal for fast, short range surveillance and for small rotary wing aircrafts
- Dual band and dual polarization technology
- Integration on small rotary wing aircraft, concept proven on Schweizer 300C
- Post flight, off-line data processing, <1 h turn-around time, Geo-positioned SAR-images and change detection
- Services package
  - Education & Training package
  - Technical support and maintenance
  - Assistance in setting up trial campaigns

TYPICAL DATA

Operating altitude	≤ 2 km
Stand-off range	≤ 6 km
Swath width	≤ 3 km
Ground speed	≤ 50 m/s
Surveillance capacity	≤ 5 sqkm/min
Frequency low band	20-90 MHz
Frequency high band	140-360 MHz
Antenna dimension/weight	1 × 1.5 m / 11 kg
Antenna mounting platform	ca 50 kg
Electronics volume/weight	30 dm^3 / 10 kg
Power consumption	4A@28V

SUMMARY

- Ground Surveillance has a lot of challenges but are becoming more and more important in todays intelligence work
- Airborne VHF Radar is an enabler for topographical mapping and target detection under Foliage
- SAAB has world class knowledge and experience in the area of VHF and UHF radar systems
- CARABAS is a state of the art Radar Sensor

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