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VHF/UHF Imagery of Targets, Decoys, and Trees

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Report Documentation Page

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Physical Scale Modeling Radar Measurements

- The entire VHF/UHF band can be modeled with a 2-18 GHz radar system and carefully constructed scale models and scenes

VHF: **25 MHz - 100 MHz** (using 2-8 GHz and 1/87th scale models)

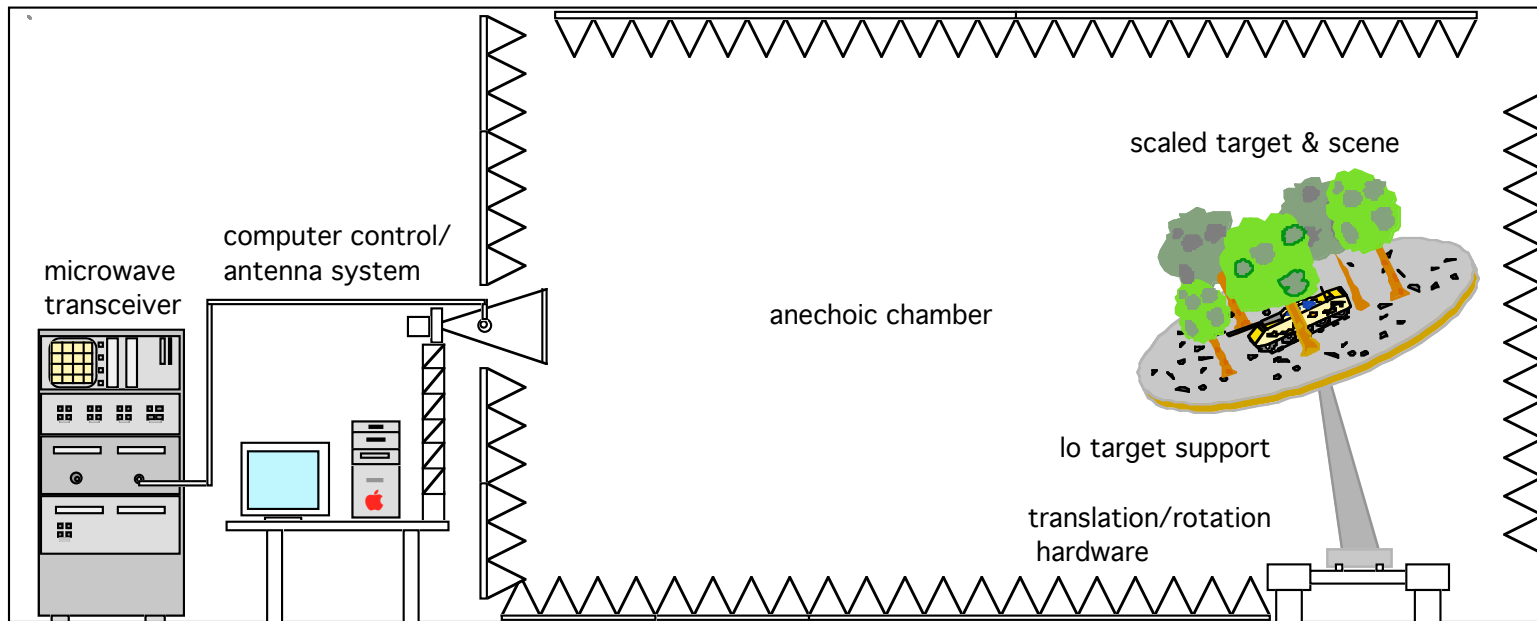
VHF/UHF: **100 MHz - 500 MHz** (using: 3.5-17.5 GHz and 1/35th scale models)

UHF: **300 MHz - 1000 MHz** (using: 4.8-16 GHz and 1/16th scale models)

Advantages of Scale Modeling Radar Measurements:

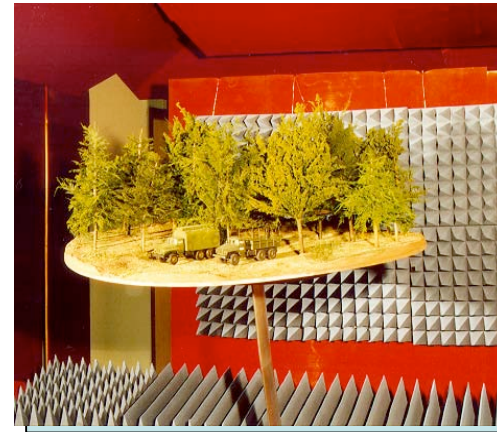
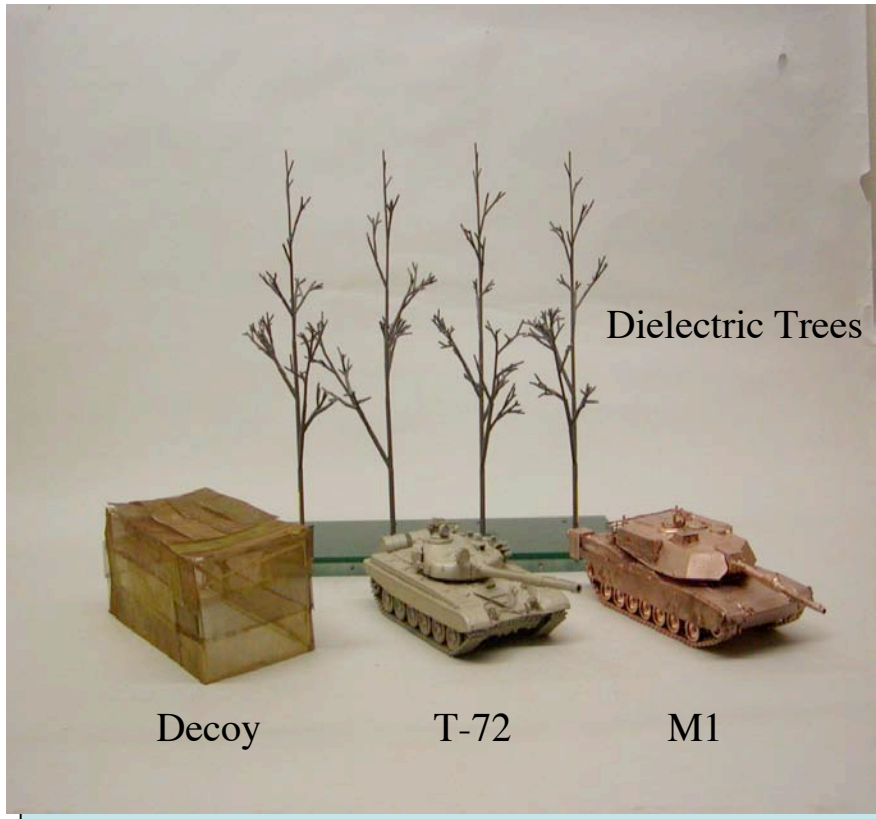
- Rapidly generate calibrated signature libraries
- Controlled, covert environment
- Models built from intelligence data
- Rough ground planes, clutter, trees

Fully-Polarimetric Radar Range



- **2 GHz - 18 GHz Pulsed-cw Radar System**
- **Accurate Positioning of Target, Scene, and Calibration Objects**
- **Pulsing Unit Controls Polarization for Fully-Polarimetric Operation**

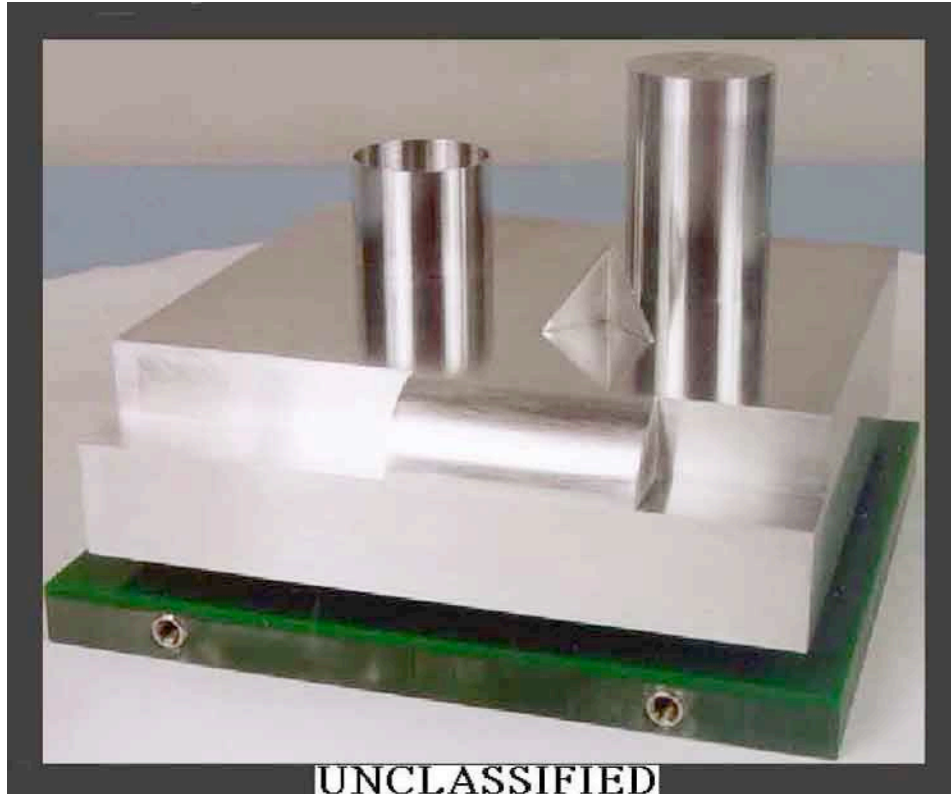
1/35th Scale Vehicles, Terrain and Trees





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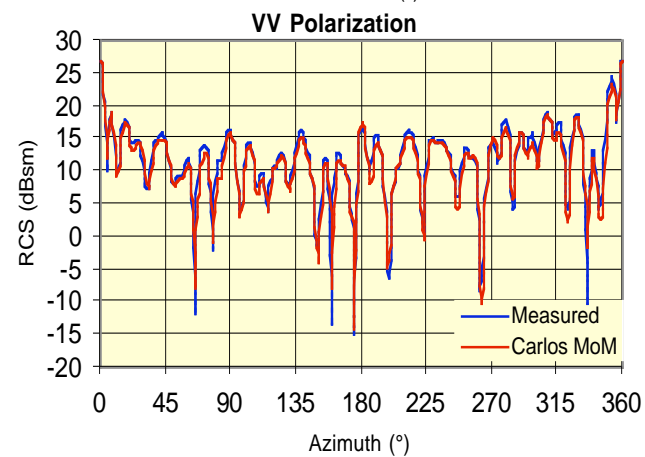
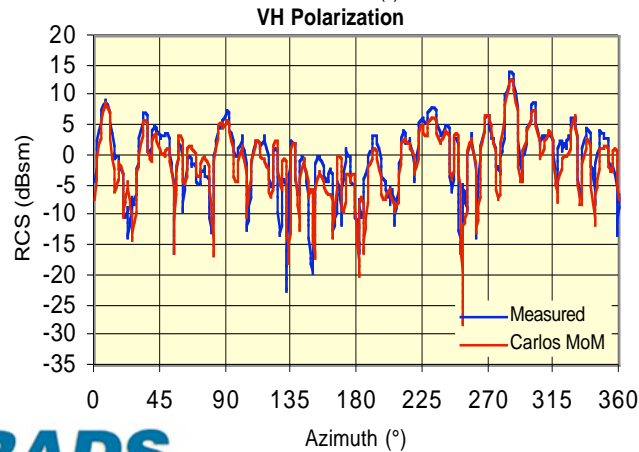
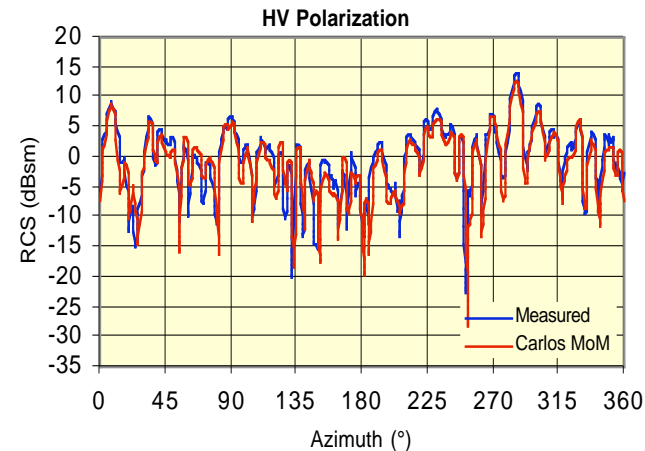
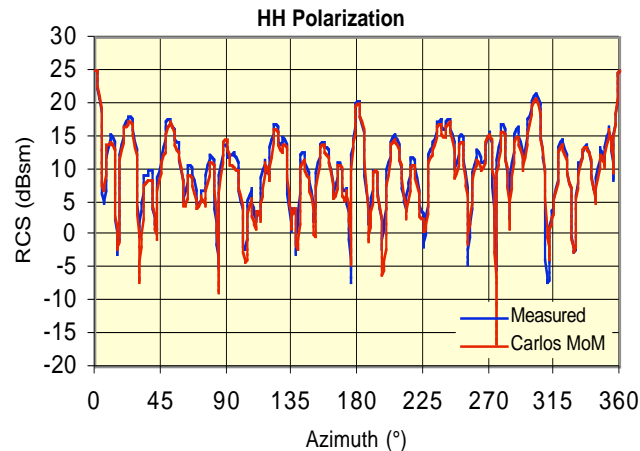
Signature Validation with 1/16th Scale Slicy





VHF RCS of Slicy Compared with CARLOS

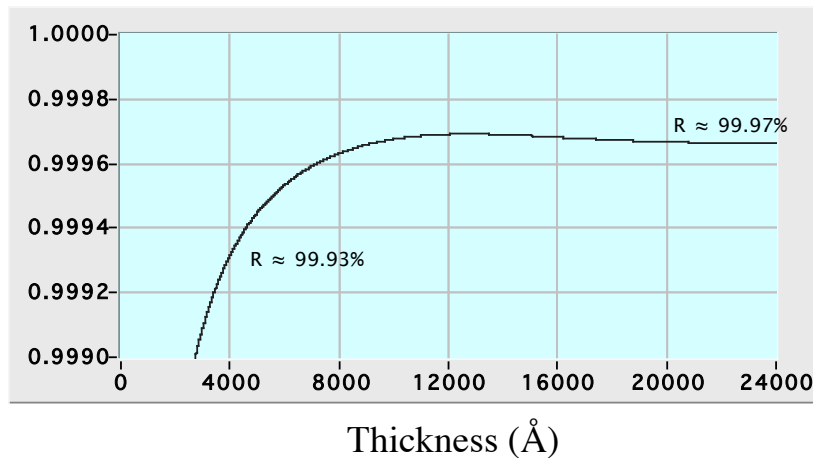
285.7 MHz and 15° elevation



Materials Issues

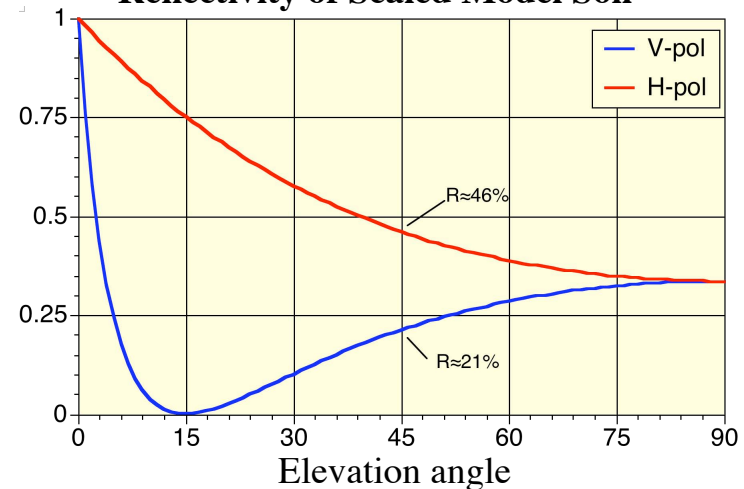
- VHF/UHF dielectric constant of wood ranges from $\epsilon = 13 + i 3$ to $68 + i 20$
 Scale model wood (aluminum-loaded epoxy): $\epsilon = 69 + i 10$
- VHF/UHF dielectric constant of soil ranges from $\epsilon = 3 + i 0.5$ to $24 + i 5$
 Scale model soil (carbon-loaded polyurethane): $\epsilon = 14.7 + i 1.1$

Reflectivity of 1/35th Scale M-1 Coating



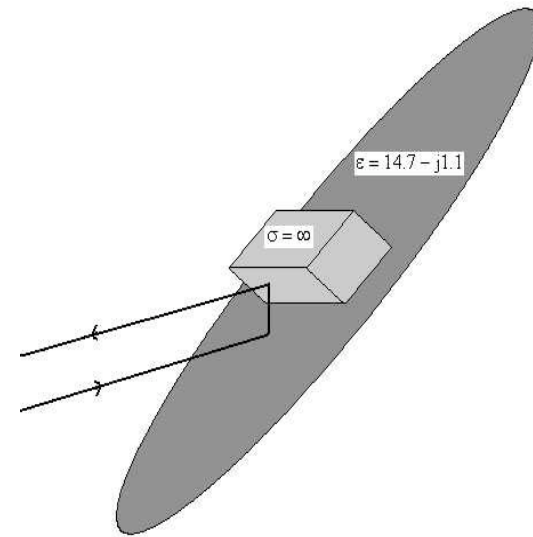
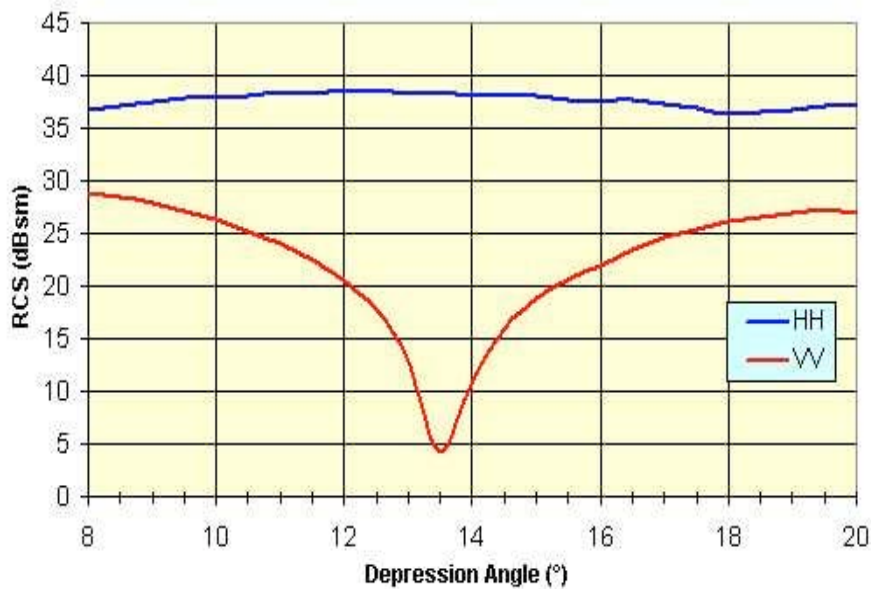
- 4000 Å sputtered Cu coating on M-1 model
- Skin depth of Cu film at 10 GHz = 8000 Å

Reflectivity of Scaled Model Soil



- Brewster angle of soil = 15° elev.

Demonstration of Brewster's Angle at 286 MHz

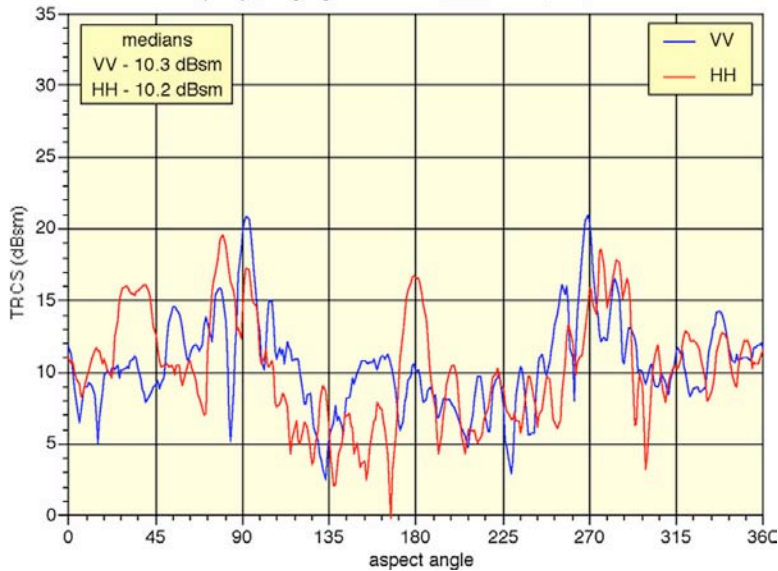


- Dihedral formed between aluminum block and ground plane to demonstrate Brewster's angle
- Ground plane dielectric constant: $14.7 - i 1.1$
- Ground plane models soil with moderate moisture content

VHF/UHF TRCS of M-1 Tank

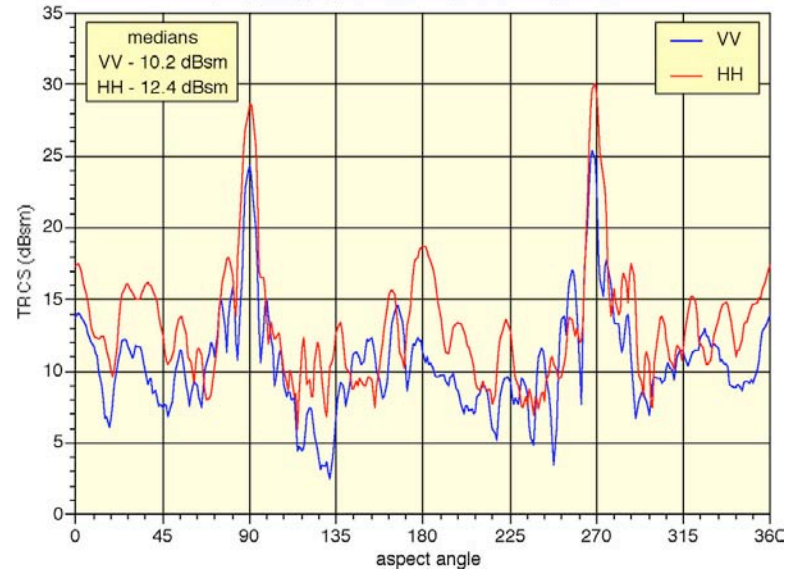
Free-space

VHF/UHF Radar Cross Section of M-1 Tank in Free Space
frequency-averaged geometric median, 200-371 MHz, 45° elevation



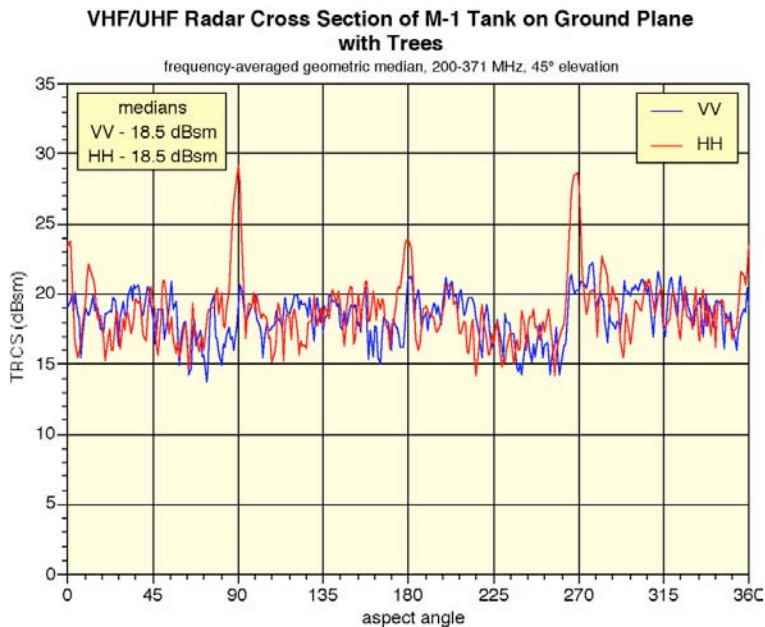
On smooth ground plane

VHF/UHF Radar Cross Section of M-1 Tank on Ground Plane
frequency-averaged geometric median, 200-371 MHz, 45° elevation

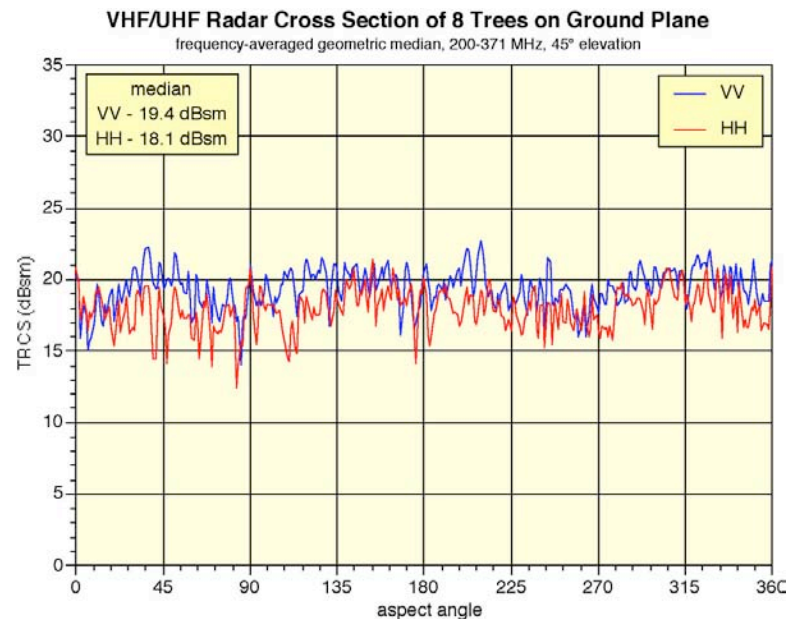


VHF/UHF TRCS of M-1 Tank

On ground plane with trees

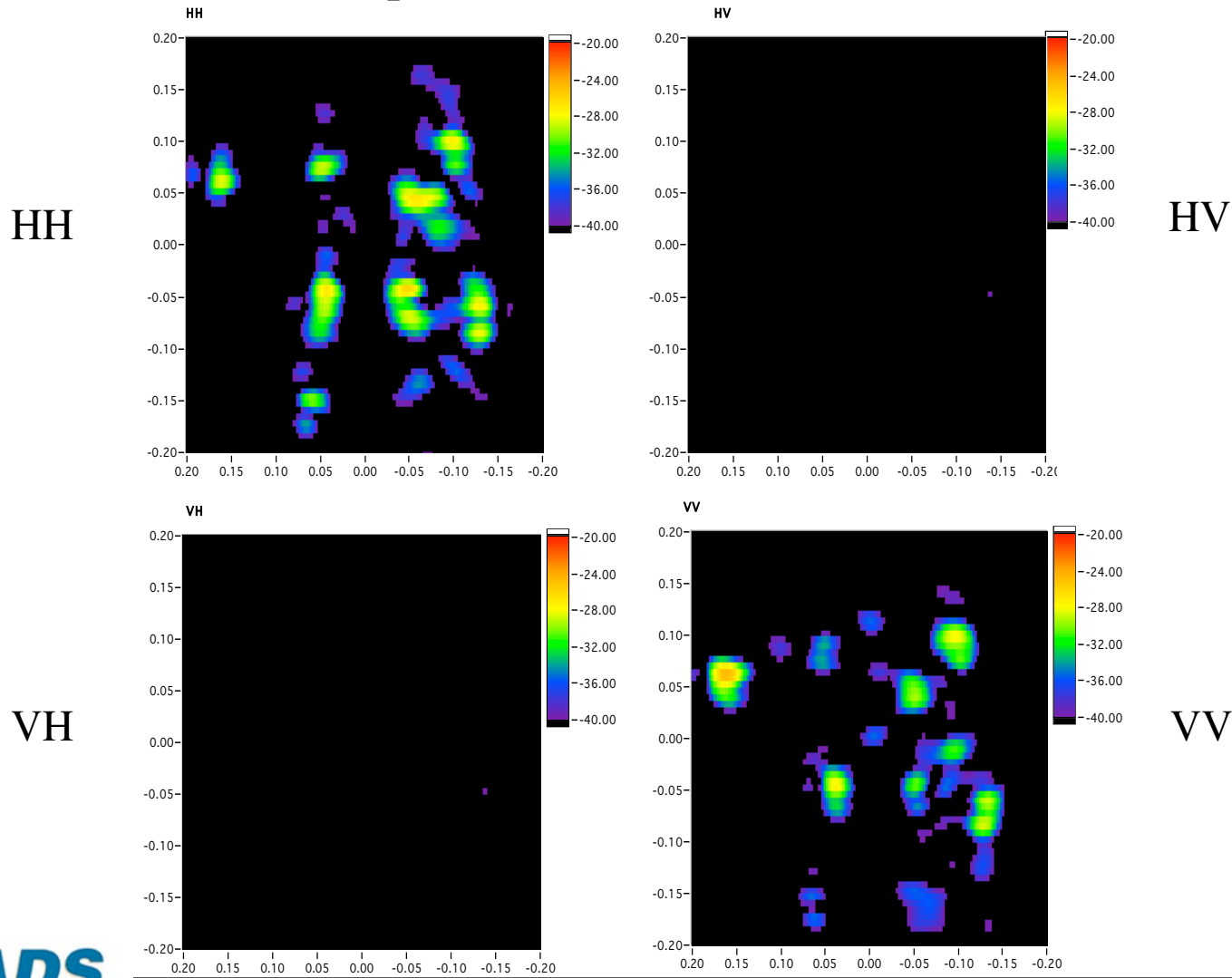


Trees only



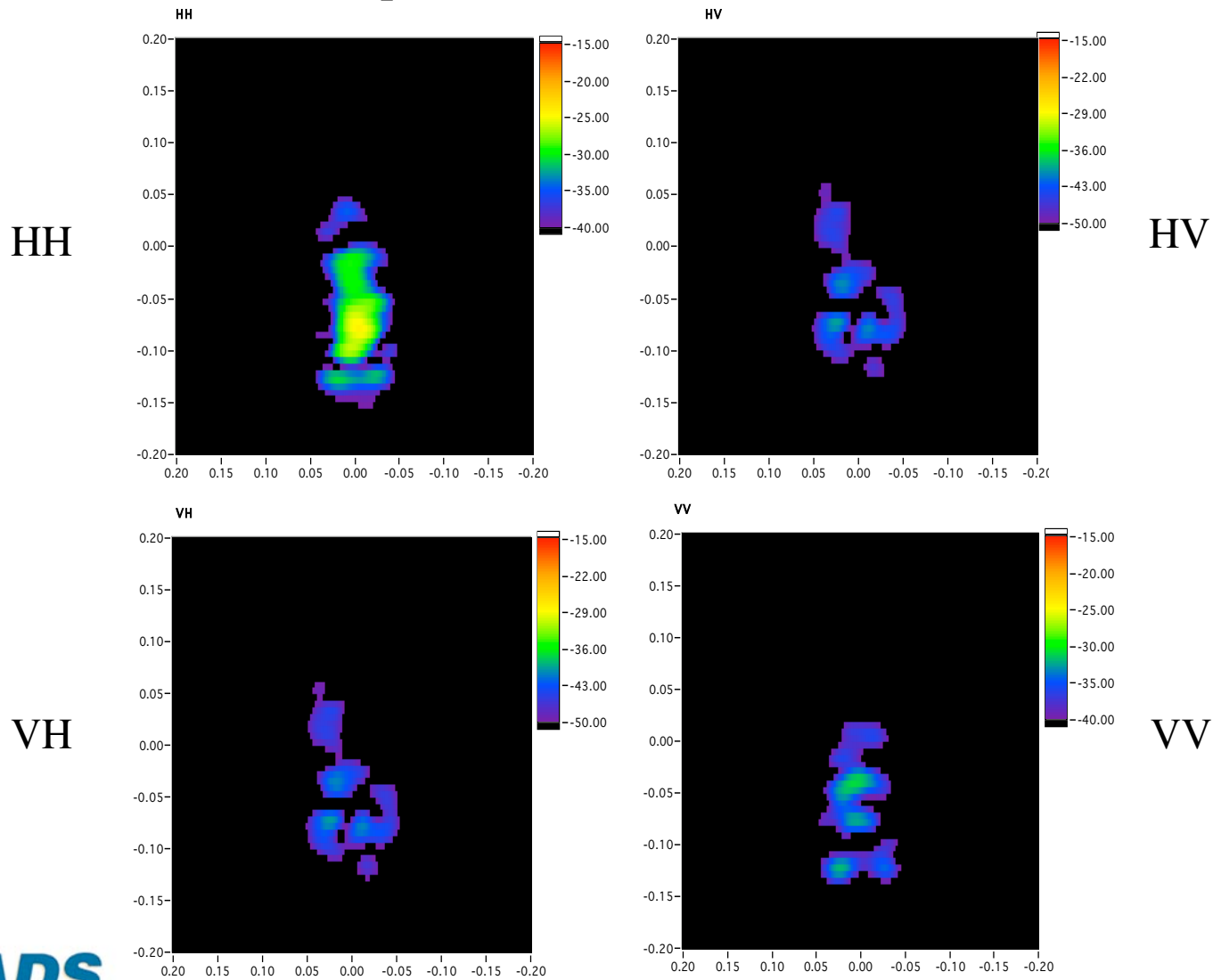
Imagery of 8 Trees on Smooth Ground Plane

0° aspect, 45° elevation, 171-514 MHz



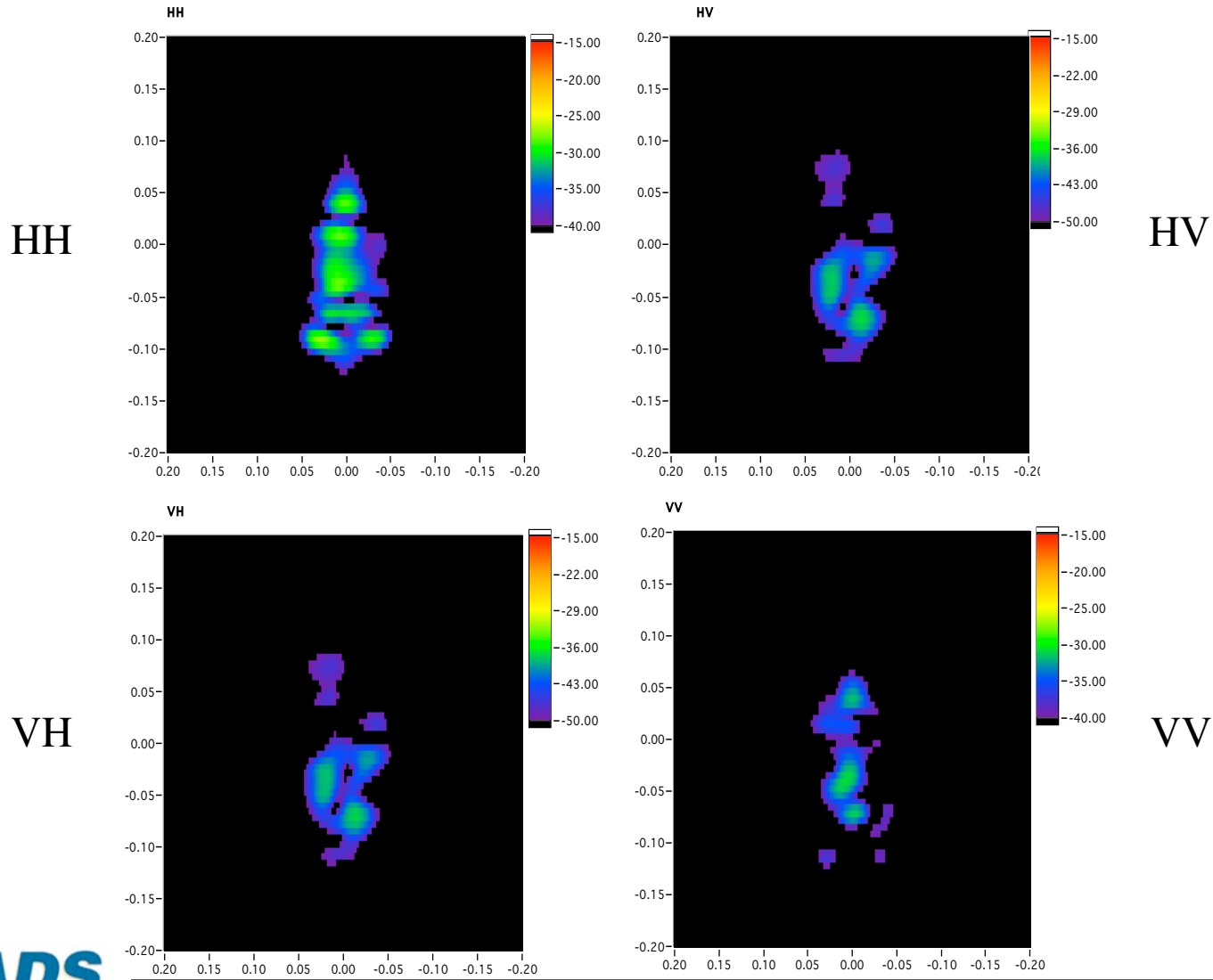
Imagery of M1 Tank in Open Field

0° aspect, 45° elevation, 171-514 MHz



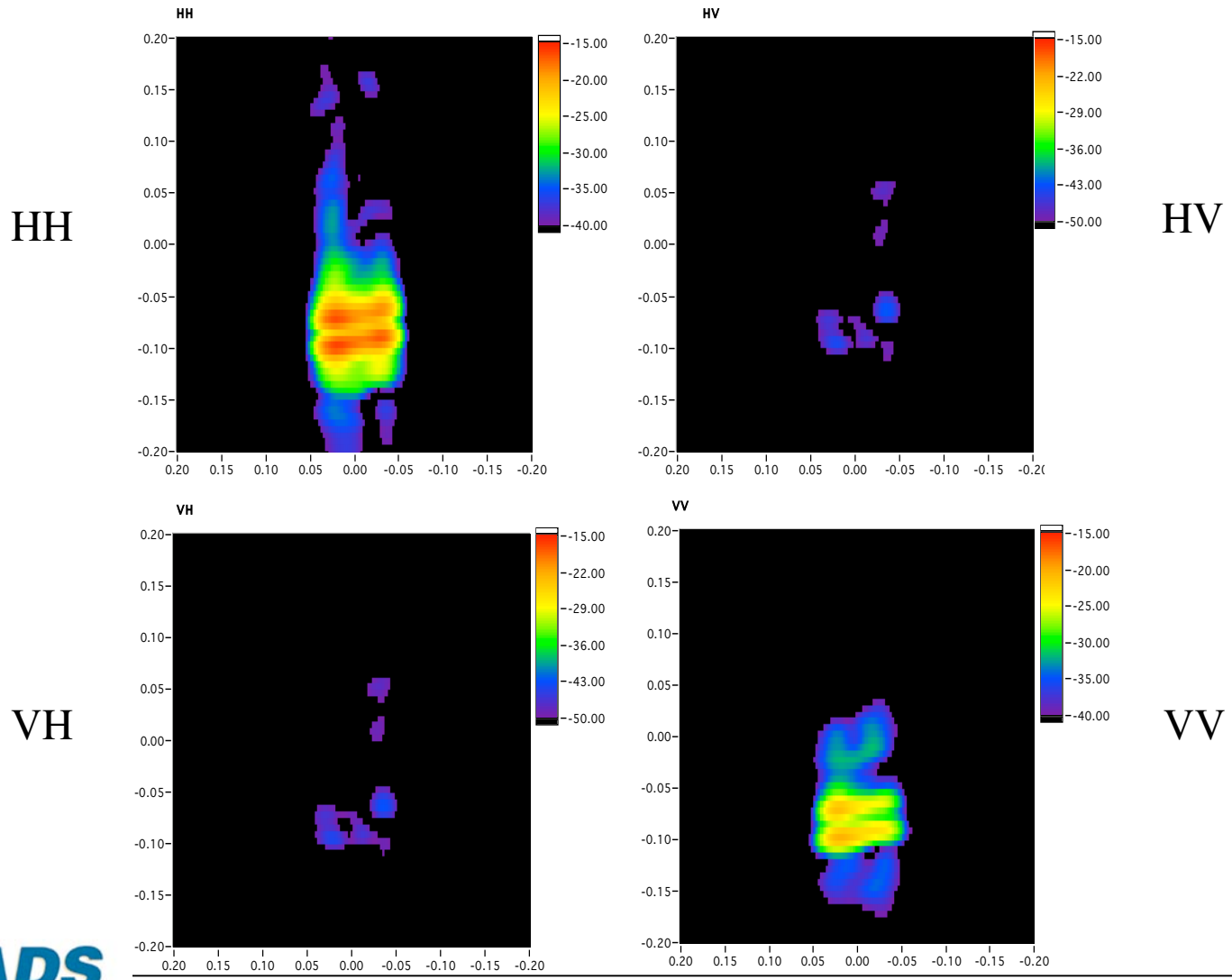
Imagery of T-72 Tank in Open Field

0° aspect, 45° elevation, 171-514 MHz



Imagery of Tank Decoy in Open Field

0° aspect, 45° elevation, 171-514 MHz

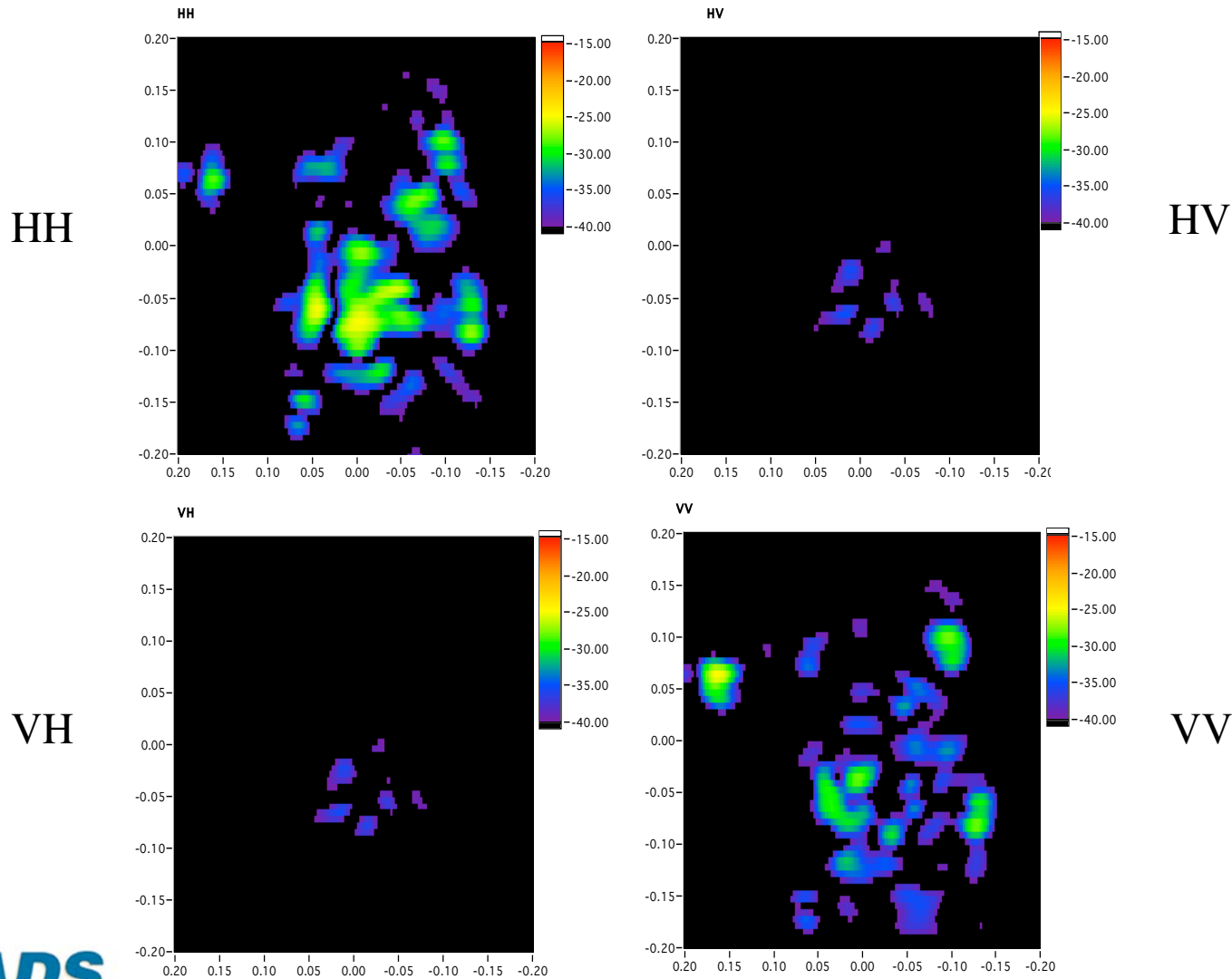




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Imagery of M1 Tank Obscured by Trees

0° aspect, 45° elevation, 171-514 MHz

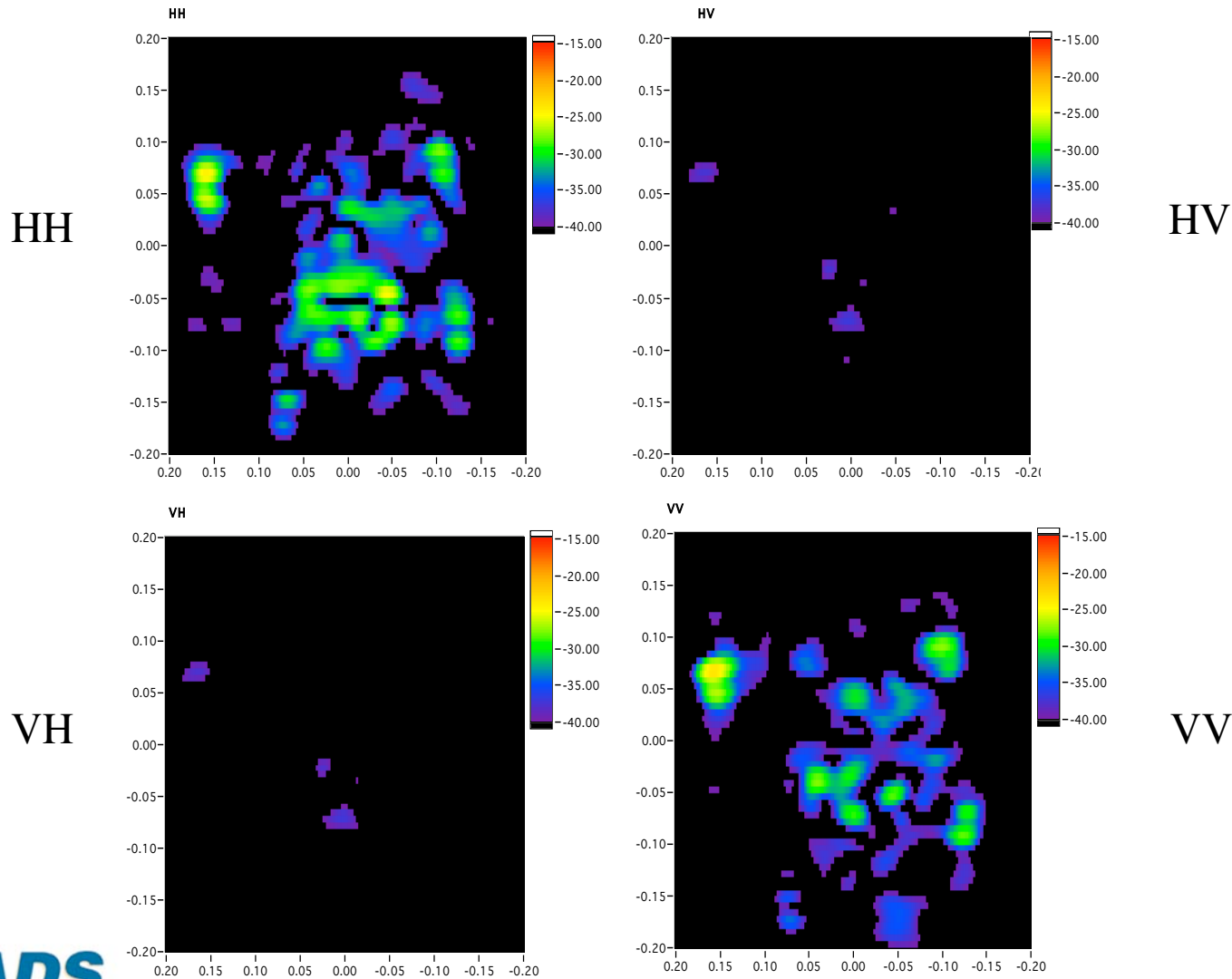




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Imagery of T-72 Tank Obscured by Trees

0° aspect, 45° elevation, 171-514 MHz

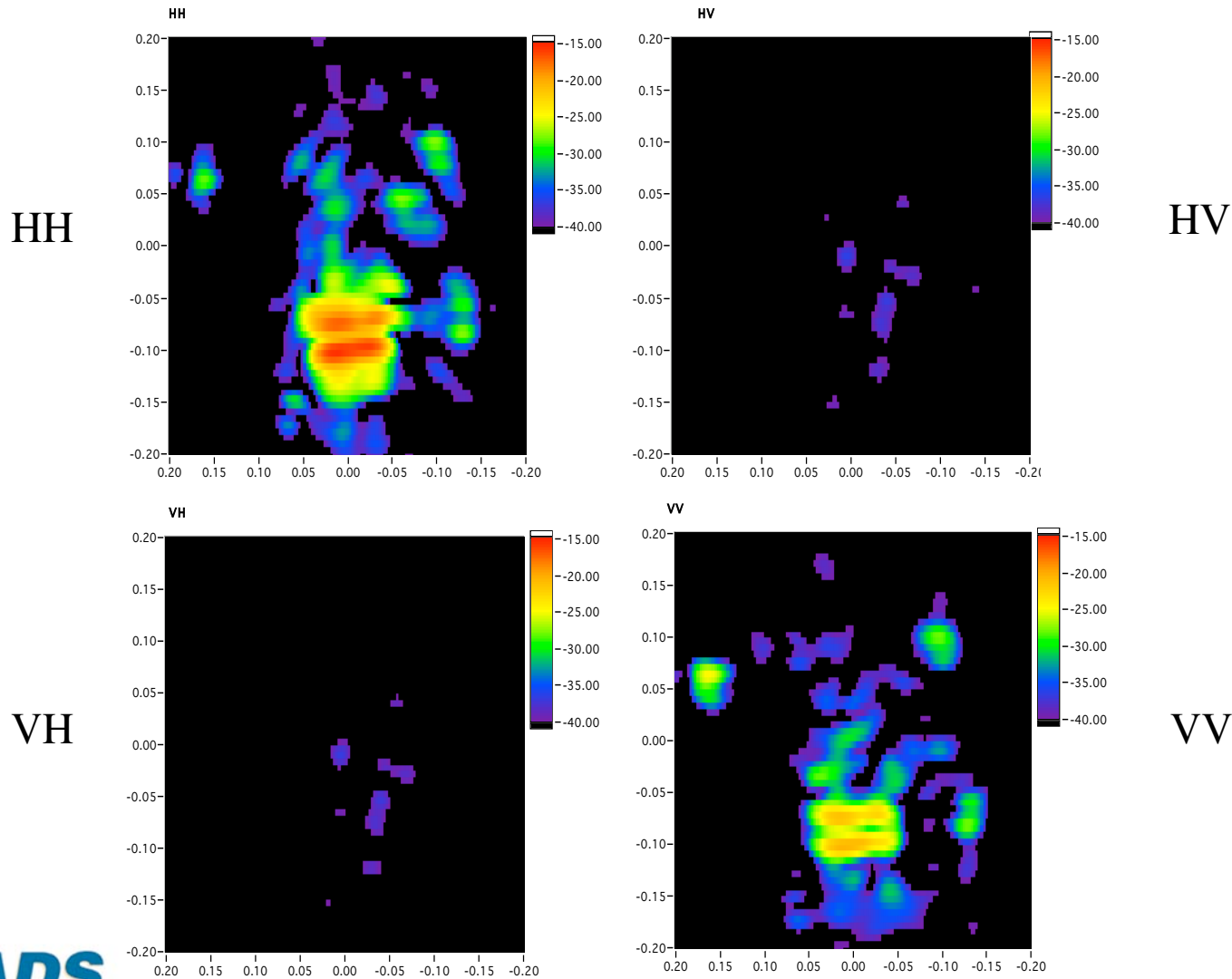




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Imagery of Tank Decoy Obscured by Trees

0° aspect, 45° elevation, 171-514 MHz



UHF & W-band Imagery of BMP-2

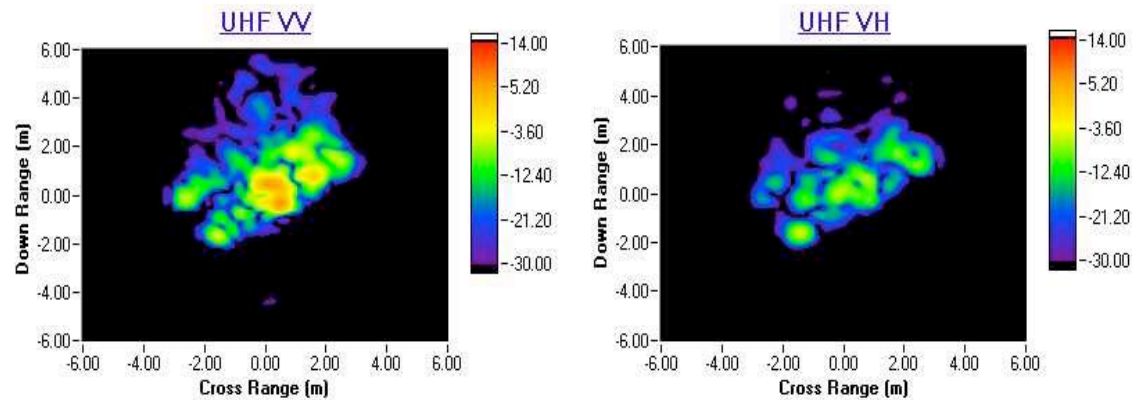
Free-space, 40° elevation, Image center angle 55°

UHF and W-Band Bandwidth: 487.5 MHz --> 0.31 (m) down range resolution

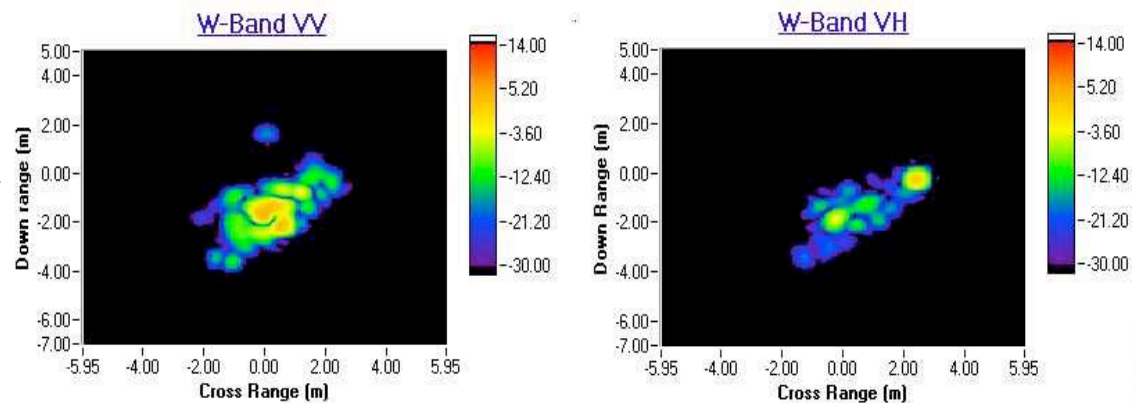
UHF aperture 75 deg --> 0.31 (m) cross range resolution

W-Band aperture 0.288 deg --> 0.31 (m) cross range resolution

UHF Imagery



W-band Imagery





Program Accomplishments

- Established Fully-Polarimetric Pulsed-cw 2-18 GHz Radar Range
- Acquired Calibrated VHF/UHF Signatures of Scale Models in Forested Terrain
- Demonstrated Signature Validation with MoM Code (CARLOS)
- Developed Signal Processing Techniques for FOPEN ISAR Imaging
- Developed Dielectrics to Model Live Wood
- Fabricated Ground Planes Modeling Smooth, Moist Soil Surface