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Oklahoma State IEEE Meeting

Cameron Musgrove
Sandia National Laboratories

SAR Applications

October 15, 2008

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Overview of Sandia
Our Business: National Security

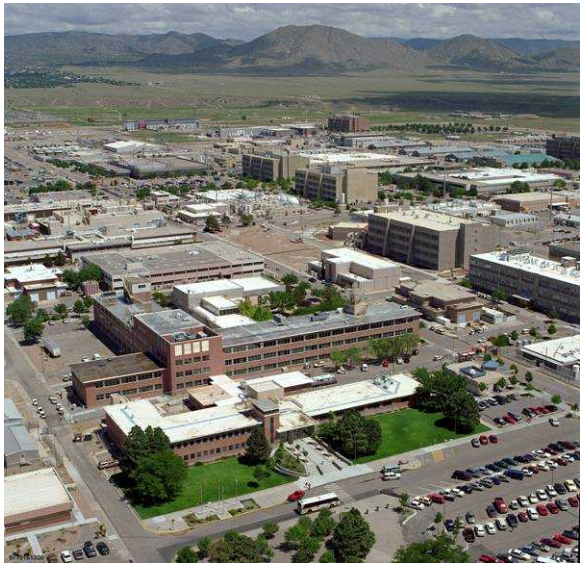
- **Core Purpose: to help our nation secure a peaceful and free world through technology.**
- **Highest Goal: to become the laboratory that the United States turns to first for technology solutions to the most challenging problems that threaten peace and freedom for our nation and the globe.**

Mission-Driven Laboratory

We serve many agencies of the US Government with:

- Design and development: nonnuclear portions of US nuclear weapons
- Production: advanced components
- Safety, security, use control
- Treaty verification, nonproliferation, counterproliferation
- Advanced military technologies
- Energy and environment
- Homeland security, countering weapons of mass destruction

Distributed Facilities to Meet National Needs



Albuquerque,
New Mexico

Kauai Test Facility,
Hawaii

Tonopah Test Range,
Nevada

Yucca Mountain,
Nevada

WIPP, New Mexico

Pantex, Texas

Livermore, California

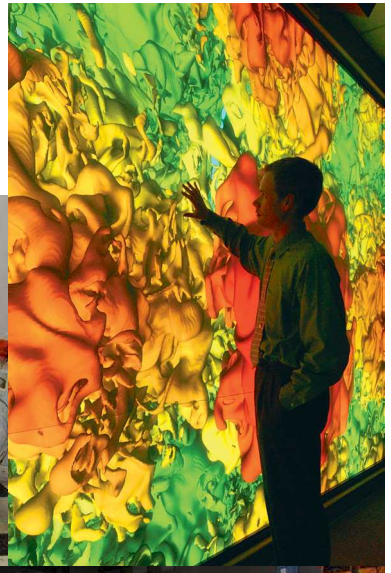
National Nuclear Security Administrationinistration

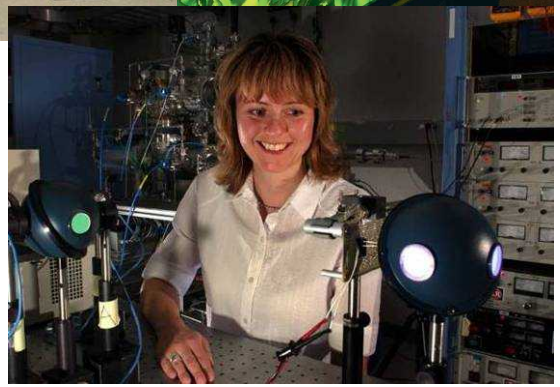
Version Aug 06

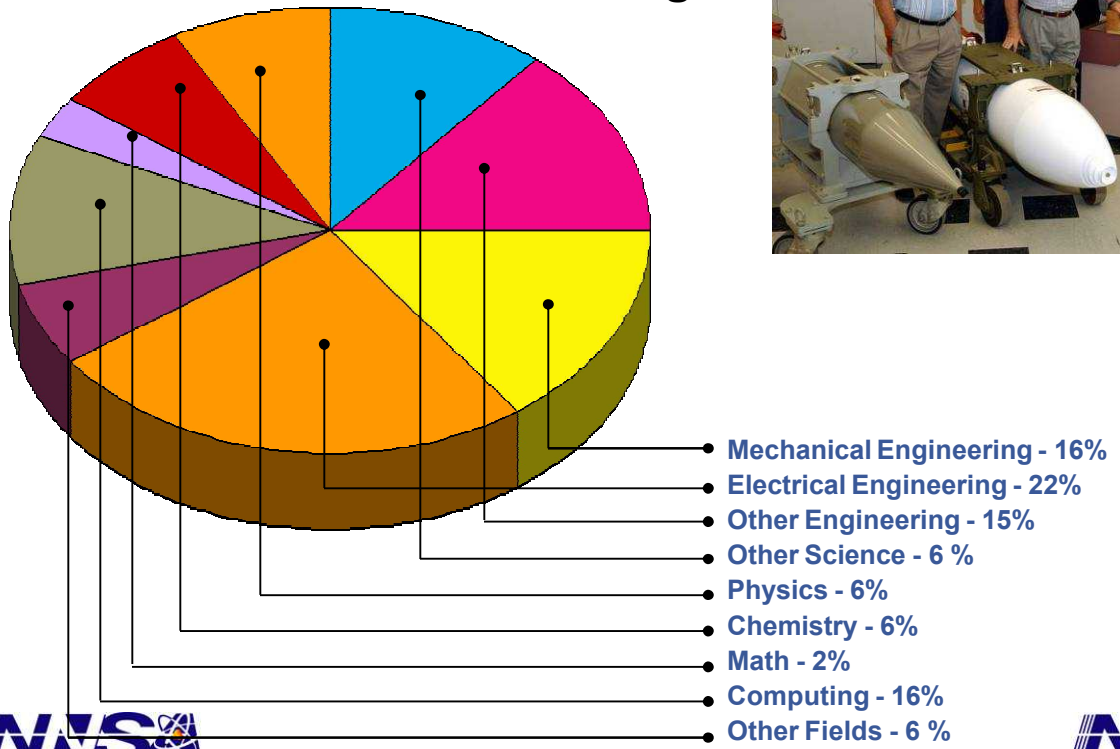
Sandia National Laboratories

Highly Skilled Workforce

- More than 8,600 full-time employees
- More than 1,500 PhDs and 2,700 MS/MAs
- 2,200 on-site contractors
- $2.33 billion FY06 total budget







Four Mission Areas

- Nuclear Weapons
- Defense Systems and Assessments
- Energy, Resources, and Nonproliferation
- Homeland Security and Defense

Provide Exceptional Systems Engineering and Programmatic Support for the Stockpile

- Research, Design, and Development of Non-Nuclear Components (96% of Total NW Parts)
- Life Extension of Nuclear Weapons
- Neutron Generator (NG) Manufacturing
- Stockpile Support – maintenance, military liaison, surveillance, dismantlement, logistics
- Nuclear Materials Protection

Trident Submarine

C4/D5 Missile

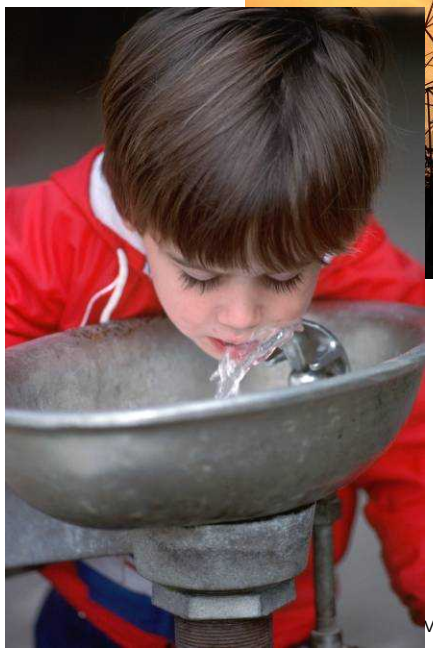
Defense Systems and Assessments

Putting real capabilities in the hands of our customers

Energy, Resources, and Nonproliferation

Energy, Water, and Security Enabled by Science & Technology

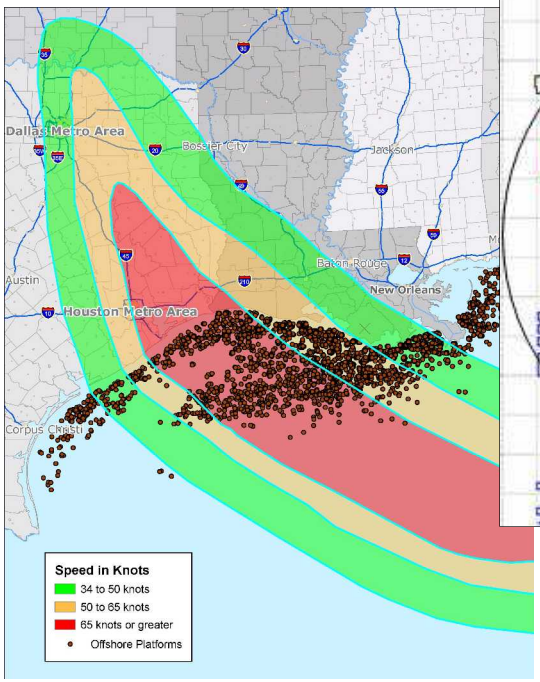
- **Secure energy supplies for national security**
- **Clean, abundant and affordable energy**
- **Water research**
- **Infrastructure protection**

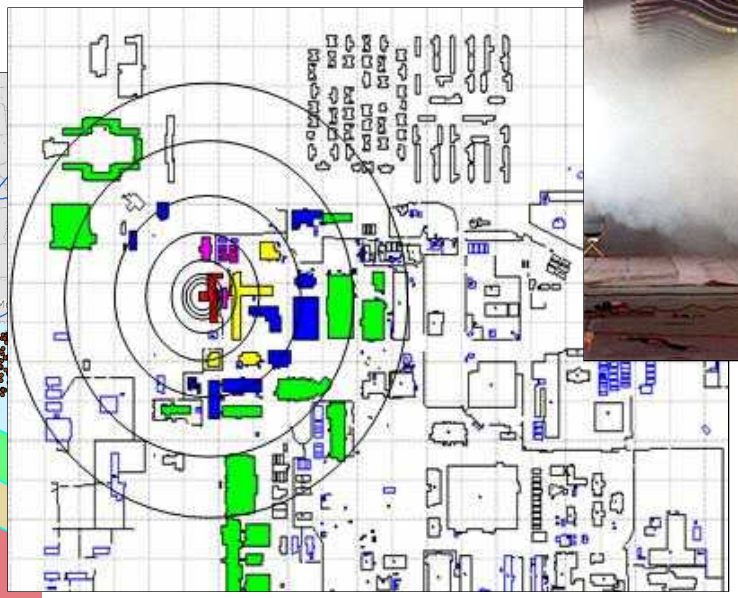


Homeland Security and Defense

Mitigating the risk of catastrophic events and enhancing the nation's ability to respond and recover

Risk Management and Infrastructure Protection





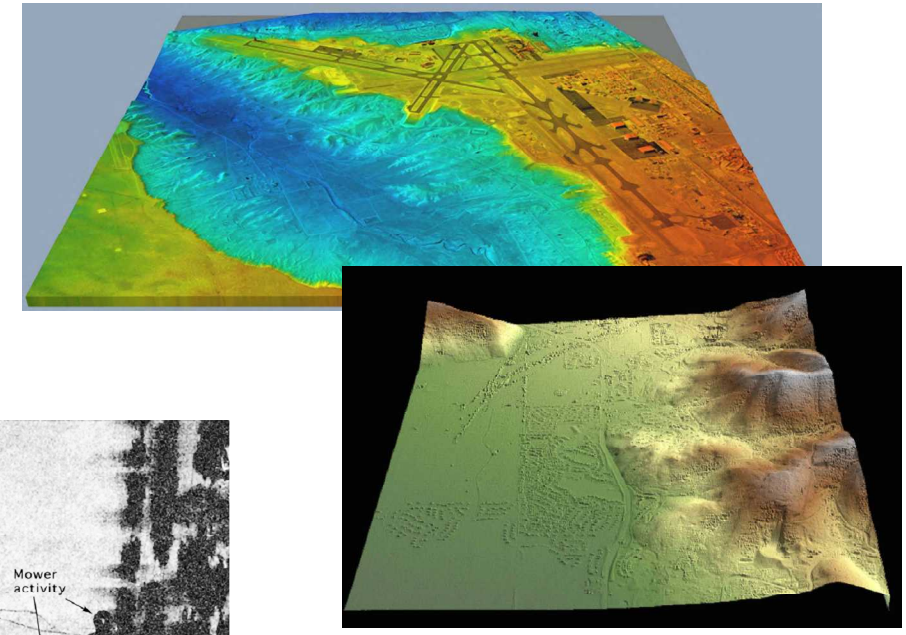
Homeland Defense and Force Protection

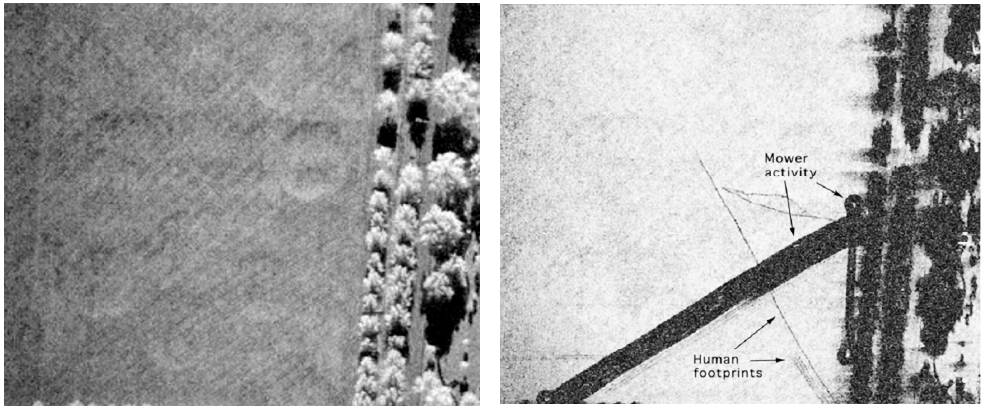
Catastrophic Event Mitigation

Sandia's Science and Engineering Advances

We have revolutionized imaging with synthetic aperture radars

Rapid Terrain Visualization



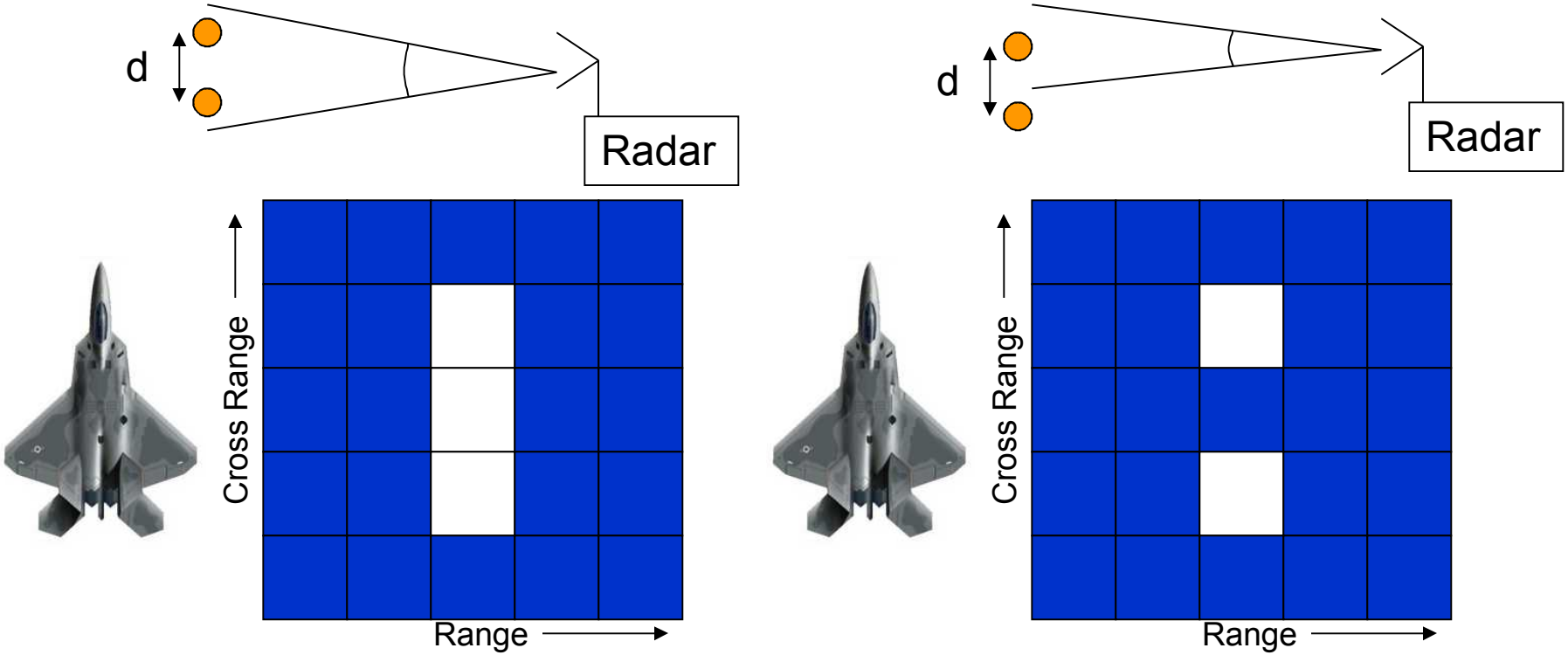


Coherent Change Detection

Synthetic Aperture Radar

Cloud Night Day

Radar Resolution



Resolution – Distance limit for resolving two objects as two separate objects

ΔCR= Range X Beamwidth

$$\text{Beamwidth} = \frac{\lambda}{D_y} = \frac{c}{f}\frac{1}{D_y}$$

http://www.aerospaceweb.org/question/planes/q0163.shtml

Radar Resolution

Limitations on frequency, f
- FCC
- Technology
- Propagation Characteristics

$$\text{Beamwidth} = \frac{c}{f}\frac{1}{D_y}$$

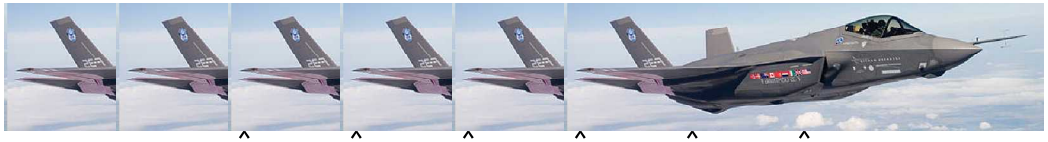
Limitations on antenna diameter, D_y
- Bigger it is, harder to move

For 10km range, 12 GHz:
1m -> 250m
.1m -> 2500m

http://www.vla.nrao.edu/

Synthetic Aperture Radar is a technique that uses a small antenna, moved over an area to simulate a large antenna.

Synthetic Aperture Radar



http://www.visitingdc.com/white-house/white-house-picture.htm

http://www.ois.com/Markets/High-Assurance.html

Antarctica SAR

New York Air National Guard operates LC-130s to provide air service between McMurdo Station and New Zealand.

LC-130s are specially equipped to land on snow and ice.

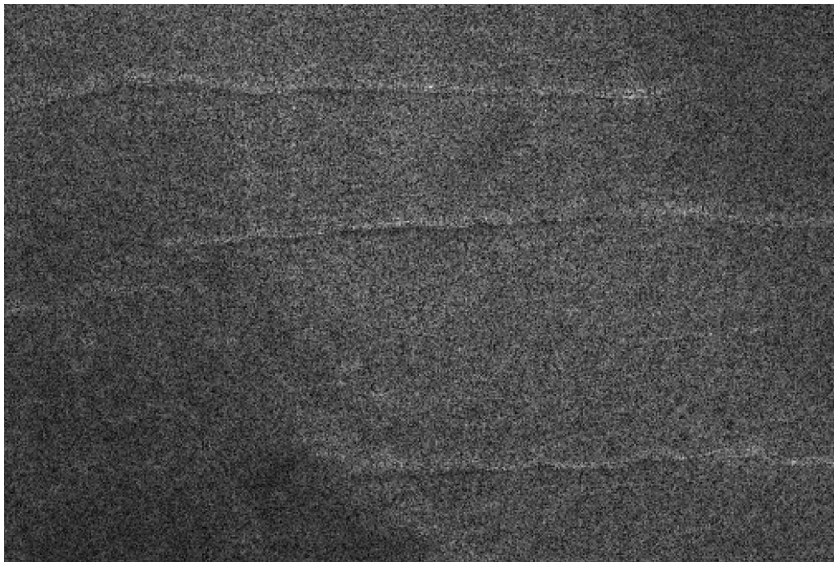
Problem: snow and ice look very similar, but do not hold the same weight!

At left a LC-130 is stuck in a crevasse.

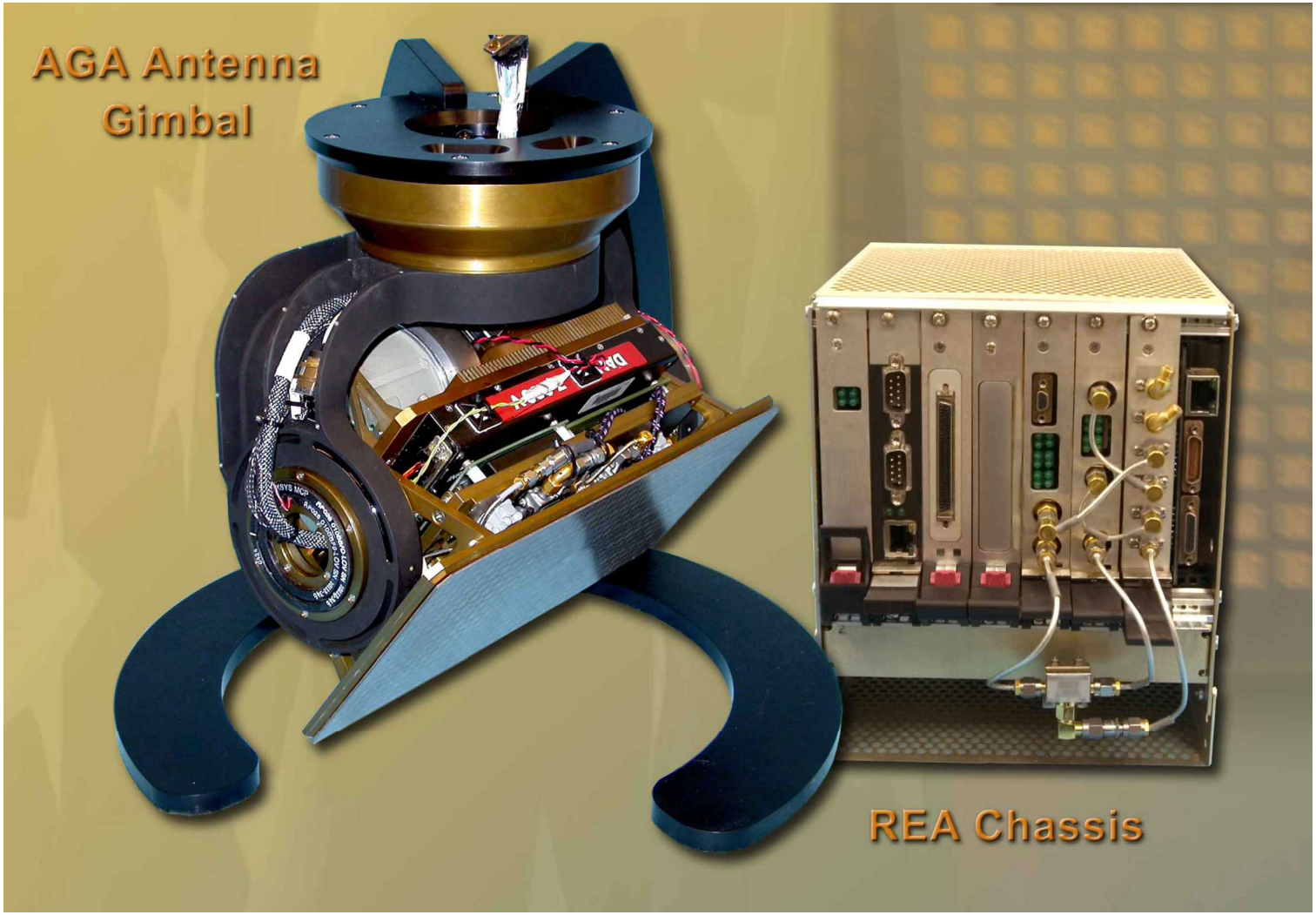
Antarctica SAR

SAR, using microwave energy to image the surface, can detect the difference between snow and ice.

This difference can be used to identify the crevasses, locate their position accurately on a map, and safely land the plane around the crevasses.



MiniSAR

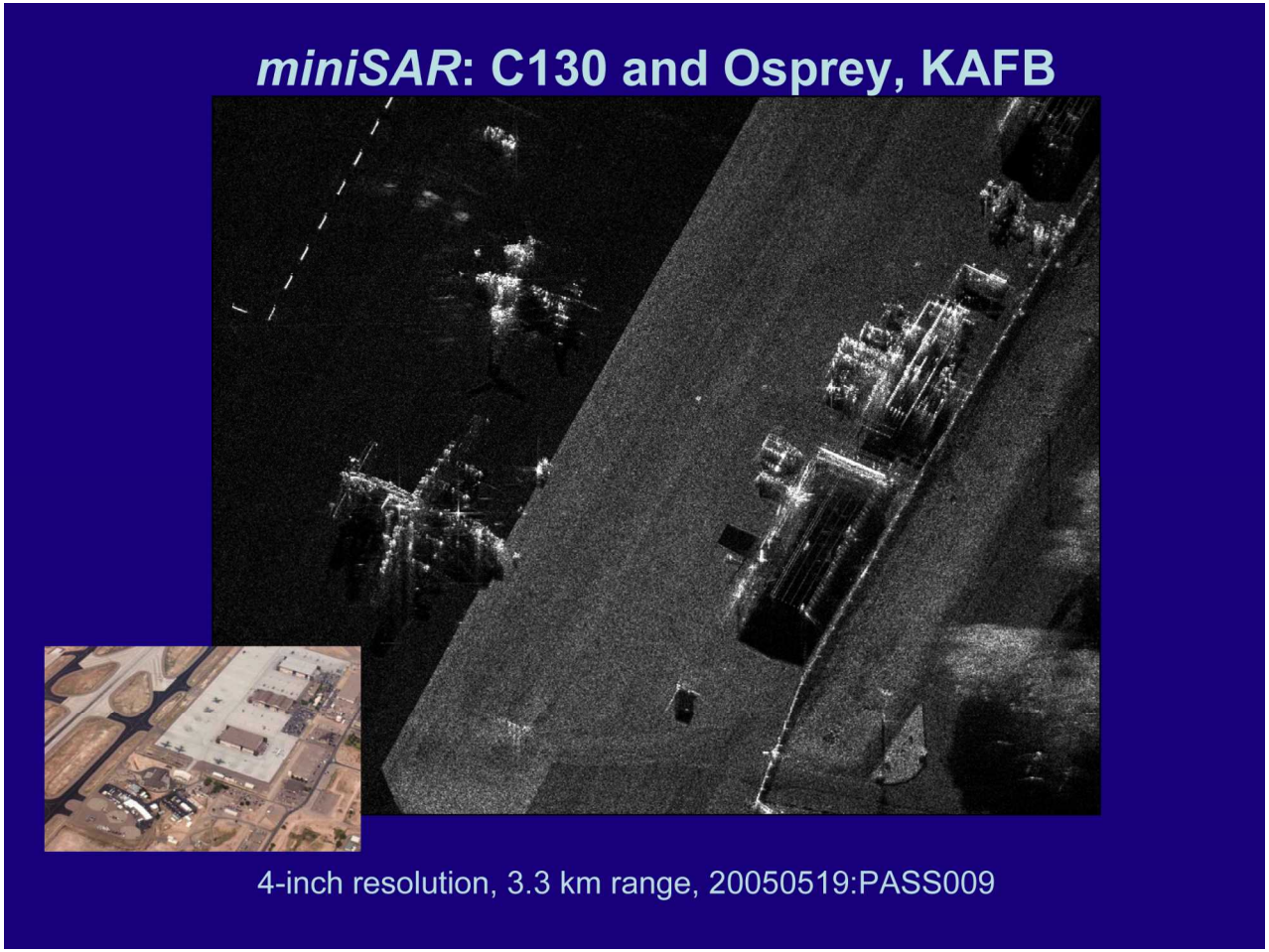


MiniSAR Images

miniSAR: Building 890, Tech Area 1

4-inch resolution, 3.3 km range, 20050520:PASS002

MiniSAR Images



MiniSAR Images