Current Technologies to Better Assess and Monitor Potential Glacial Hazards

Mark C. L. Patterson[1], Jeffrey S. Kargel[2], Gregory J. Leonard[3], Roberto Furfaro[4], and Wolfgang Fink[5]

[1]*University of Arizona, College of Engineering, 1209 East 2nd Street, PO Box 210072, Room 303, Tucson, AZ, 85721, USA. Tel:+1-301-221-8699, Email: mclp@email.arizona.edu*

[2]*University of Arizona, Department of Hydrology and Water Resources, Harshbarger Bldg. Room 224D, 1133 East James E Rogers Way, Tucson, Arizona 85721, USA, Tel:+1-520-780-7759, Email: jeffreyskargel@hotmail.com.*

[3]*University of Arizona, Department of Hydrology and Water Resources, Harshbarger Bldg. Room 224B, 1133 East James E Rogers Way, Tucson, Arizona 85721, USA, Tel: +1-520-626-9971, Fax: +1-520-621-1422 Email: gleonard@email.arizona.edu,*

[4]*University of Arizona, Department of Systems and Industrial Engineering, 1127 East James E Rogers Way P.O. Box 210020 Tucson, AZ 85721 USA, Tel: +1-520-312-7440, Fax: +1-520-621-8191 Email: robertof@email.arizona.edu*

[5]*University of Arizona, Department of Electrical and Computer Engineering, Tucson, AZ 85721, USA. Tel: +1-520-621-8734, Fax: +1-520-621- 8076, Email: wfink@ece.arizona.edu*

Sensors and User Interfaces

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- A broad range of expeditionary sensors currently exist (<3kg)
  - Optical – EO-IR-UV, multi-spectral and hyperspectral, polarization
  - Magnetometers
  - Electromagnetic - conductivity
  - Radar, Synthetic aperture radar (SAR)
  - Gas spectrometers
  - Acoustic and sonar
  - Mass spectrometers, nuclear,
  - GPS
  - Others

- Improvements in data processing and the user interface
  - Data used for process control - hybrid control systems
  - Image mosaicing for large area mapping (pixel and geo-registering)
  - Image topographic reconstruction
    - Digital relief map (DRM)
    - Digital terrain map (DTM)
    - Digital elevation map (DEM

EO Imaging - Mosaic with Detail (TacitView)

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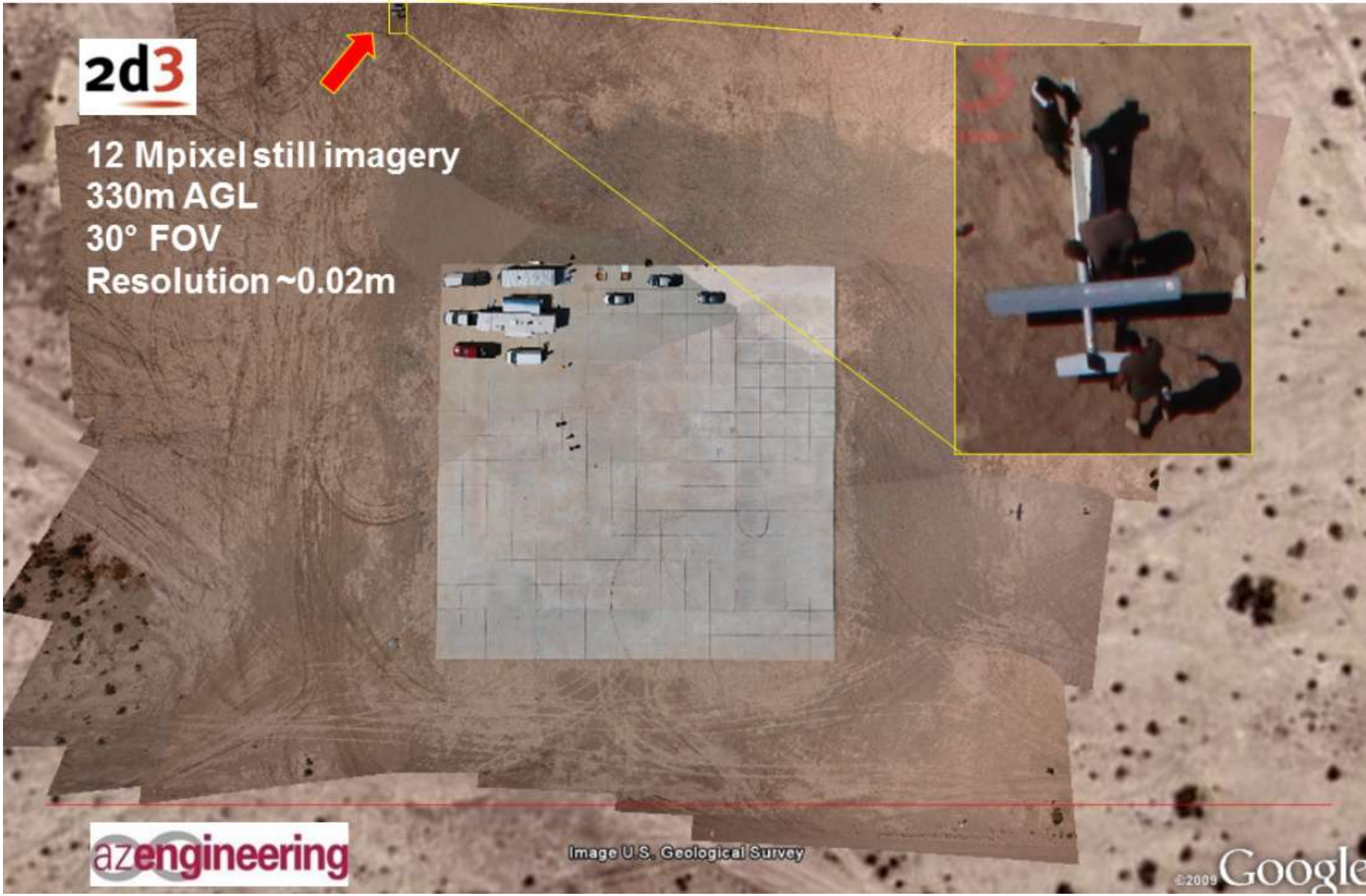
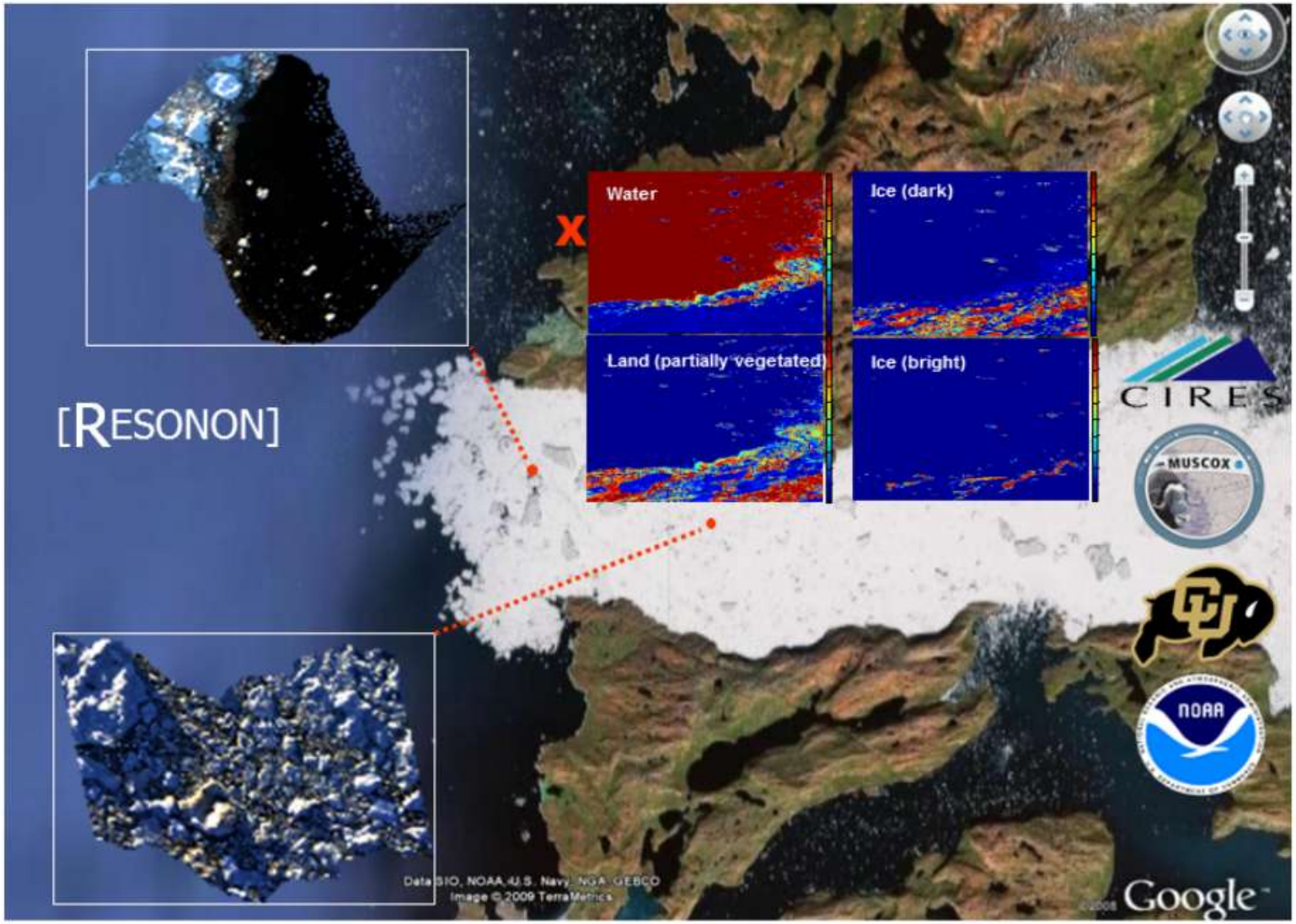


Hyperspectral Imagery - Greenland



Scientific Applications for Small UAV Platforms

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- Mount St Helens, October 2004
- Atmospheric Brown Cloud Campaign
- Maldives (Hanimaadhoo), March 2006
  - 18 missions over Indian Ocean
  - over 125 hours of flight time
  - multiple sensors
  - synchronized stacks of 3 Mantas
  - real-time data access (partial)
- Landmark Campaign for science/UAVs

- Korean Campaign CAPMEX 2008
- Cheju Island S. Korea (flight certification)
- June – September 2008
  - 75 flights, 130 hours over 32 days
  - multiple sensors, synchronized
  - atmospheric conditions "Olympics"
- Dryden April 08 – Jan 09
- Vandenberg November 08
- Sea-air interfacial flux measurements

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Scientific UAV Sensors

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- Greenland, Kangerlassuaq, Aug 2007
- Greenland, Ilulissat Ice Fjord, July, 2008
- Sea Ice and melt pool data collections
  - ➢Hyperspectral
  - ➢Several others

Infer aerosol forcing and ozone radiative forcing on regional scales

- 1. Condens. particle counter (0.87kg) >10nm
- 2. Optical particle counter (0.3kg) - 0.3 - 3µm
- 3. Cloud condens. nuclei counter (3kg)>0.2%
- 4. Aethalometer (0.8kg) - absorbing aerosol
- 5. Cloud droplet probe (1.42kg) - 0.7 - 70µm
- 6. Pyranometer (0.2kg) - 305nm - 2800nm
- 7. PAR radiometer (0.03kg) - 400nm - 700nm
- 8. Spectral radiometer (0.4kg) 350 – 1150nm
- 9. Optical video camera
- 10. Ozone sensor (Korea)
- 11. LIDAR (Greenland)

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Small USV Platforms – Side Scan Sonar

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- EMILY – developed by UA Alumni (Hydronalix)
  - Large interest with media
  - http://www.newslincolncounty.com/
  - Currently undergoing user assessment

- HASS – Hydronalix Autonomous Security Syst.
  - Interest by NOAA – mapping and security
  - Interest by US Navy
  - Interest by DHS for security

- Side scan sonar into HASS for mapping
  - TriTech-StarFish Sonar - streaming
  - Operated through SeeByte software
  - SeeTrack software - georectifies sonar
  - Generates bathymetry data

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Small USV Platforms – Safety and Science

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- University of Arizona is partnering with Hydronalix
- EMILY developed as a life preserver for distressed swimmers
- Tactical capabilities
  - Approximately 1.25m in length
  - Approximately 12kg in weight
  - Duration 2 to 6 hours
  - Fully autonomous or RC

- Integrated light weight, side scan sonar
  - Linear bathymetric readout
- Integrated SeeTrack (SeeByte) software
  - Georectifies sonar
  - High resolution detail – 0.02m
  - 3D bathymetric reconstruction

- Tested in USA, Canada and Scotland

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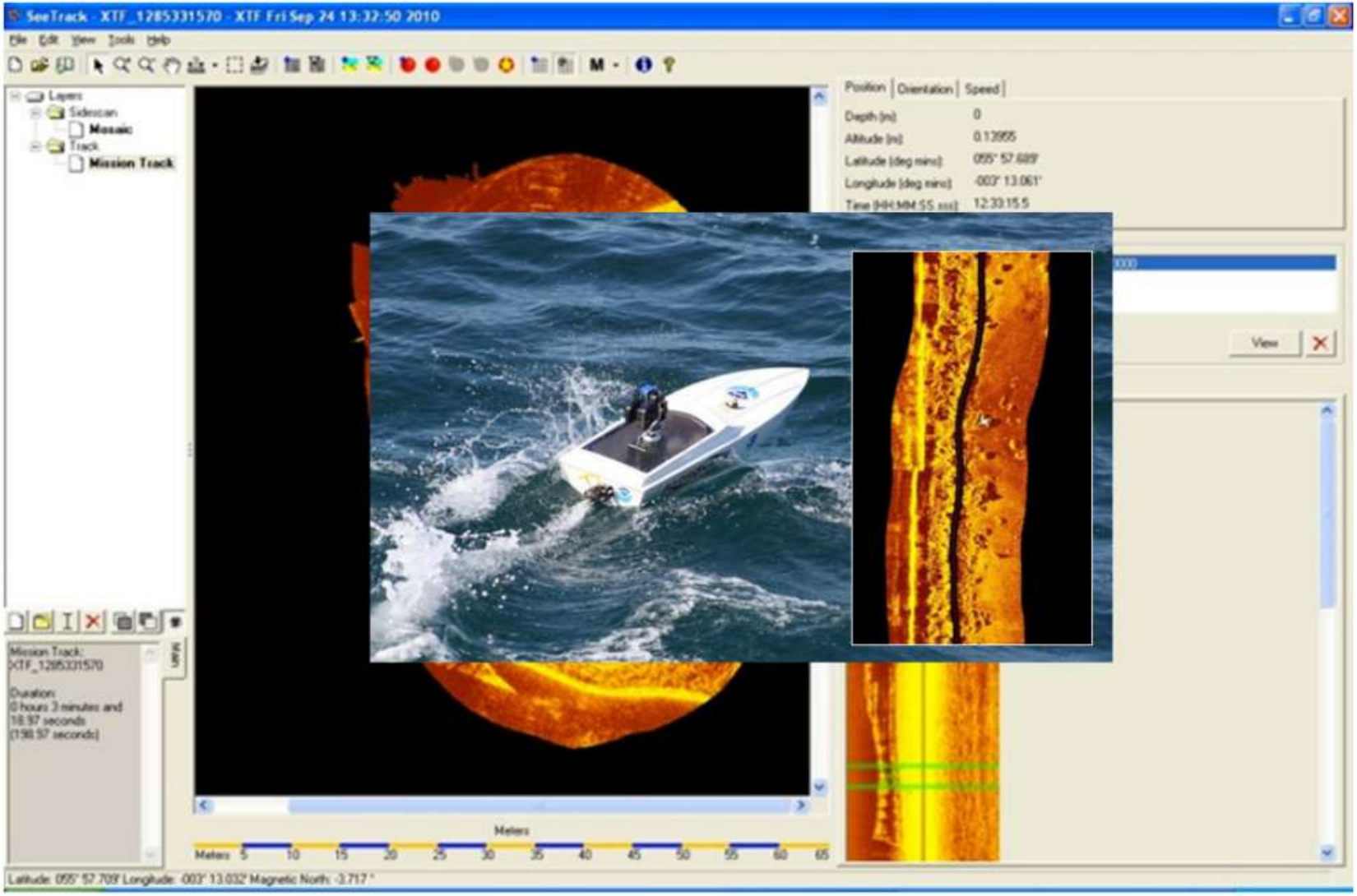
SeeTrack - XTF_1285331570 - XTF Fri Sep 24 13:32:50 2010
File Edit View Tools Help
Layers
Sidescan
Mosaic
Track
Mission Track
Position
Orientation
Speed
Depth (m)
Altitude (m)
Latitude (deg mins)
Longitude (deg mins)
Time (HH MM SS sss)
View
Mission Track:
XTF_1285331570
Duration:
0 hours 3 minutes and
18.97 seconds
(198.97 seconds)
Meters
Meters 5 10 15 20 25 30 35 40 45 50 55 60 65
Latitude: 055° 57.709' Longitude: -003° 13.032' Magnetic North: -3.717 °

Assess Glacial Hazard – Mission 14th and 15th Oct.

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Assess Glacial Hazard – Mission 14th and 15th Oct.

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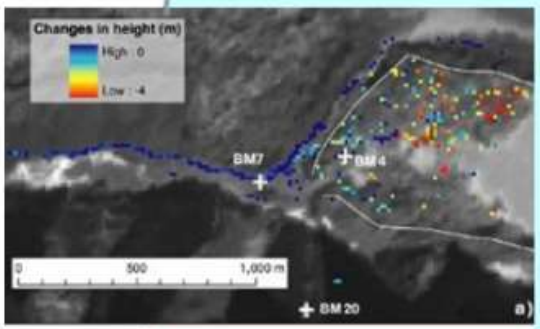
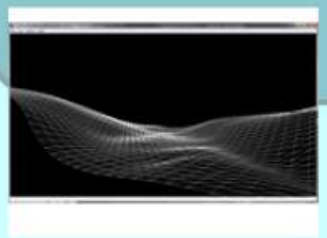
- Mechanisms leading to lake support failure are poorly understood
- Potential GLOF lakes lie in remote, difficult to access environments
- Topographic maps above and below the water will be generated – baseline
- Subsequent missions will map and quantify the rate of change

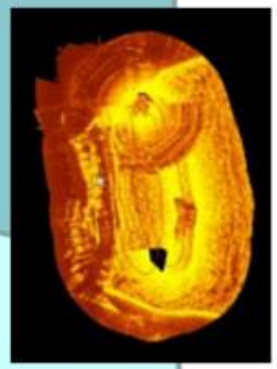
High resolution airborne video

Historical (2002 – 7)



High resolution sonar





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Side Scan Sonar and Software

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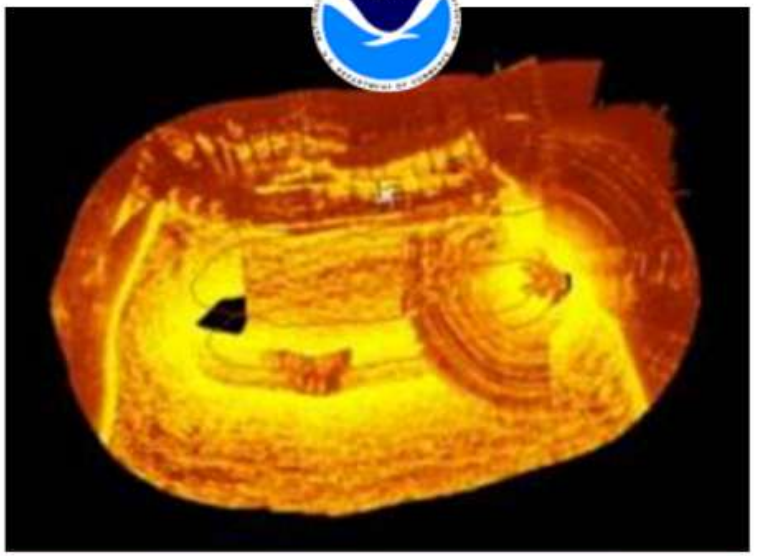
- TriTech Side Scan Sonar
  - 100m range
  - Frequency sweep
  - Resolution ~0.03m
  - Weight about 0.5kg
  - 180 degree sweep

- Integrated by SeeByte
  - Processed through SeeTrack Software
  - Georectified to generate bathymetry
  - WiFi real time data feed



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Ding Boche Village - Mosaic from April 2009

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Ding Boche Village - Grid Generation April 2009

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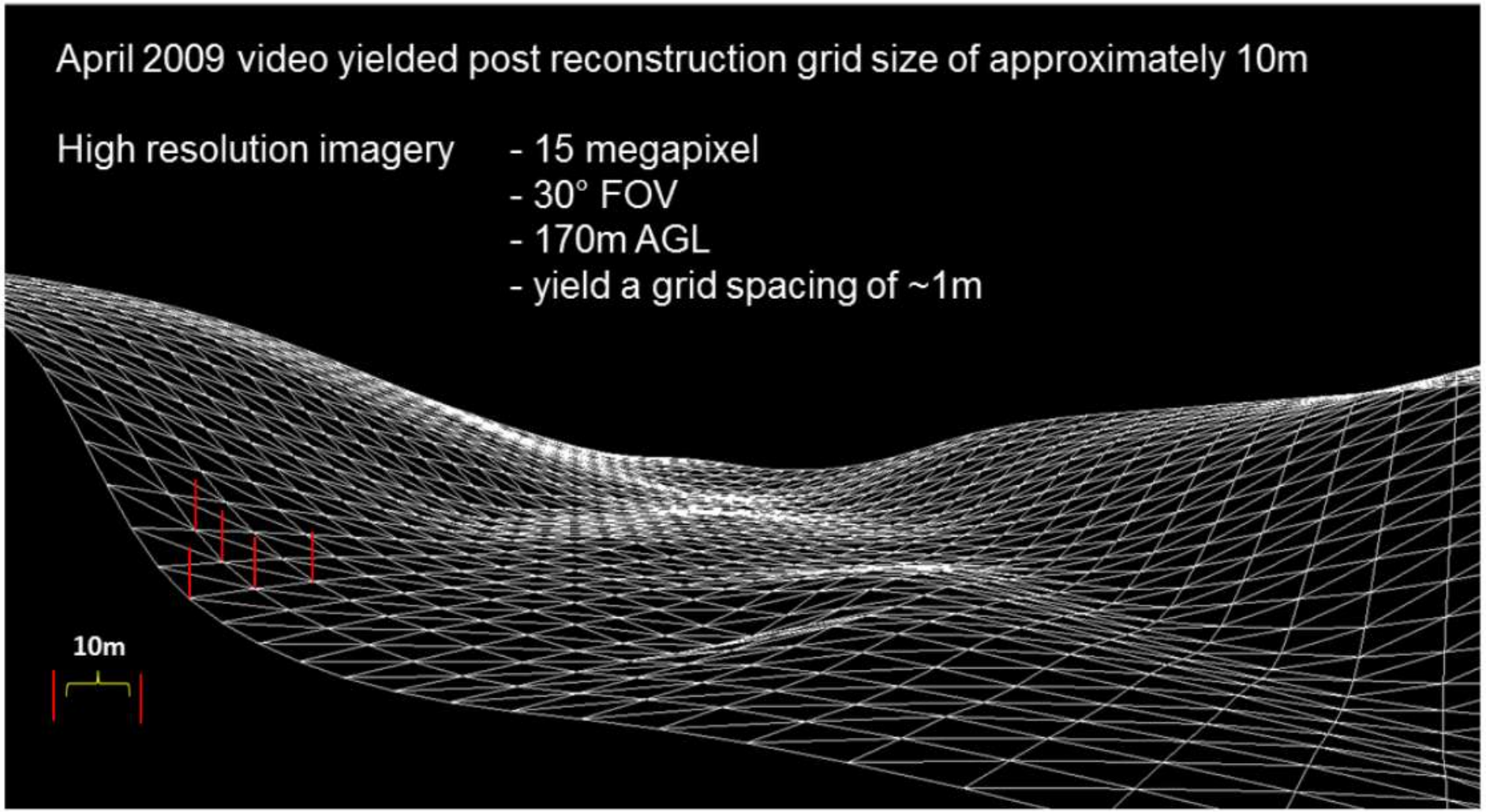

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Ding Boche Village - Grid Population April 2009

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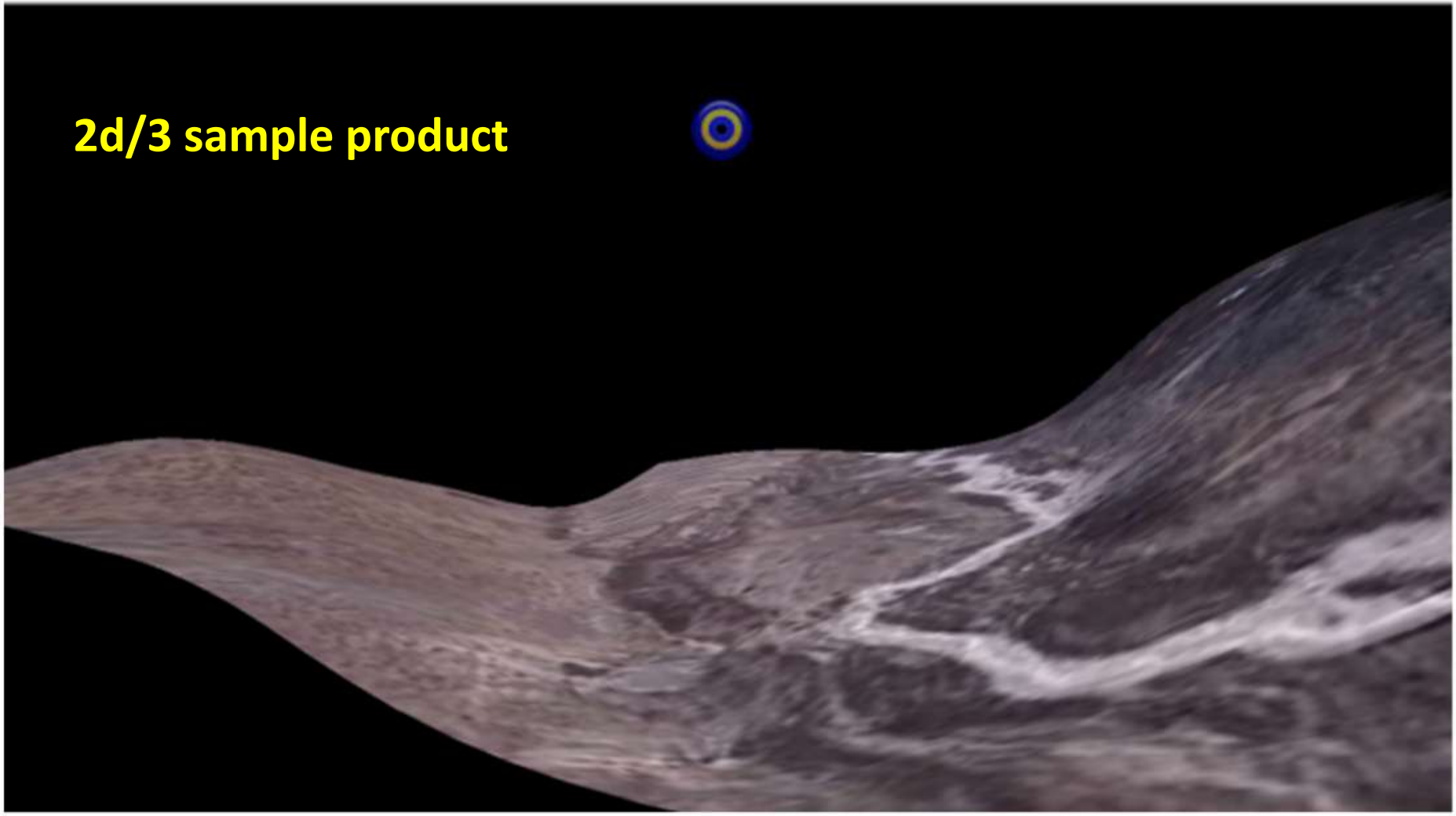

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