Using drones in archaeological research: Kasakh Valley Archaeological Survey (KVAS), Armenia

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Purdue GIS Day
November 4, 2016

ARchaeology And Geography of Ancient Transcaucasian States
Project ArAGATS
Վան Անդրկովկասի Պեղումների Հնագիտություն և Աշխարհագրություն

ARISC
American Research Institute of the South Caucasus

Indiana Drones: UAV/UAS in Archaeology

Capturing Complexity

Toward an Integrated Low-Altitude Photogrammetry and Mobile Geographic Information System Archaeological Registry System

Steven A. Wernke, Julie A. Adams, and Eli R. Hooten

SAA Advances in Arch. Practice (2014)

New Approaches to Spatial Archaeometry:

Applications from the Near East

An autonomously-piloted octocopter, a Cinestar8, equipped with a thermal camera, takes off to begin a survey of an archaeological site. Lightweight aerial mapping systems like this one have great potential for archaeological research. Photograph by J. Casana.

Jesse Casana

Near Eastern Archaeology (2014)

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Archaeological aerial thermography: a case study at the Chaco-era Blue J community, New Mexico

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Journal of Archaeological Science (2014)

archaeometry

Archaeometry **57**, 1 (2015) 128–145 doi: 10.1111/arcm.12078

IMAGE-BASED MODELLING FROM UNMANNED AERIAL VEHICLE (UAV) PHOTOGRAMMETRY: AN EFFECTIVE, LOW-COST TOOL FOR ARCHAEOLOGICAL APPLICATIONS*

J. FERNÁNDEZ-HERNANDEZ, D. GONZÁLEZ-AGUILERA,†
P. RODRÍGUEZ-GONZÁLVEZ and J. MANCERA-TABOADA

Department of Cartographic and Land Engineering, University of Salamanca, C/ Hornos Caleros, 50, CP. 05003, Ávila, Spain

Archaeometry (2015)

Indiana Drones: UAV/UAS in Archaeology

- Several price points
  - ✓ ~$500 = home-made UAV
  - ✓ $1000 = 3DR Solo (+ a la cart accessories)
  - ✓ $1300 = DJI Phantom 3 Pro
  - ✓ $3000 = DJI Inspire
  - ✓ $40,000 = Trimble UX5

Indiana Drones: UAV/UAS in Archaeology

- Common applications

  ✓ hi-res aerial photography of excavations (stills, video)

  ✓ site documentation and modeling

  - record hard-to-access sites (e.g., rock art)
  - surface site cataloging
  - remote sensing: LiDAR, thermal imaging, etc.
  - orthomosaics, 3D mapping of sites and landscapes
    - excavation units "structure-from-motion (SfM)"
    - DEM, contour map generation
    - morphometric, volumetric analysis

  ✓ site monitoring (e.g., looting, construction)

  ✓ outreach, education

Indiana Drones: UAV/UAS in Archaeology

- Common applications
  - ✓ field selfies

Analytical applications of drones

- Photogrammetry
  - analysis using geospatial modeling and visualization of landscapes
    - terrestrial: digital photos/laser scanning
    - aerial: balloons/kite images
    - ✓ drones

- Software:
  - ✓ AutoDesk 123D Catch (Free)
  - ✓ PhotoModeler ($1145)
  - ✓ ERDAS Imagine LPS
  - ✓ Agisoft PhotoScan Pro ($550 edu.; $3500 retail)
  - ✓ Pix4Dmapper Pro ($1990 edu.; $8700 retail)

Black Sea

Caspian Sea

GREAT CAUCASUS RANGE

PONTIC RANGE

ANTI-TAURUS MOUNTAINS

Kura River

Arax River

Tigris River

Euphrates River

Mt. Aragats

Mt. Ararat

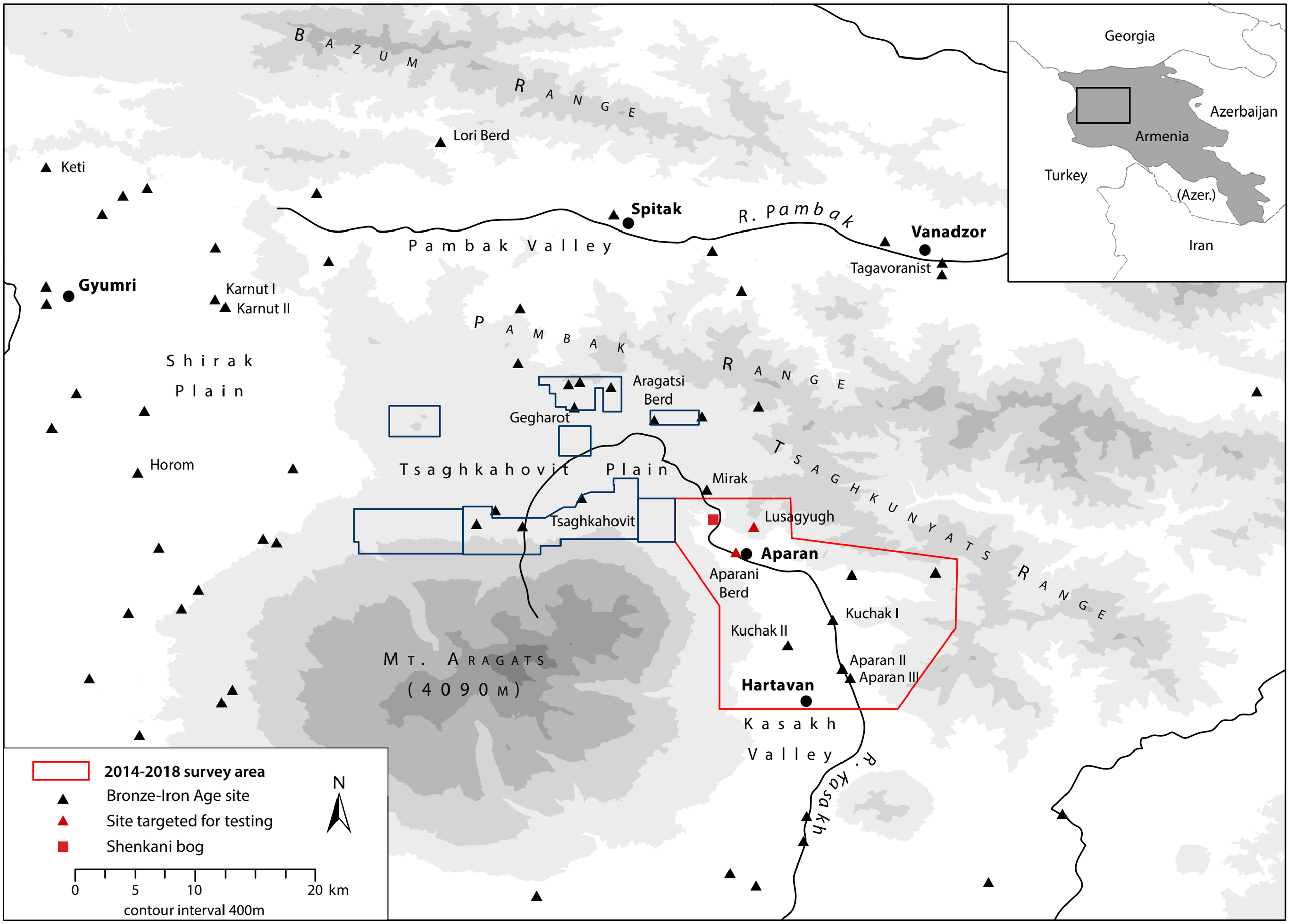
Extent of LBA/Iron 1 Forts in Armenian Highland (1500-800 BC)

0 125 250 km

1:5,000,000

DEM data: SRTM 90
Modern borders: ESRI World Data 2004

Ian Lindsay
Project ArAGATS
March 15, 2014



Project ArAGATS study areas

LBA/Iron 1 Fortresses

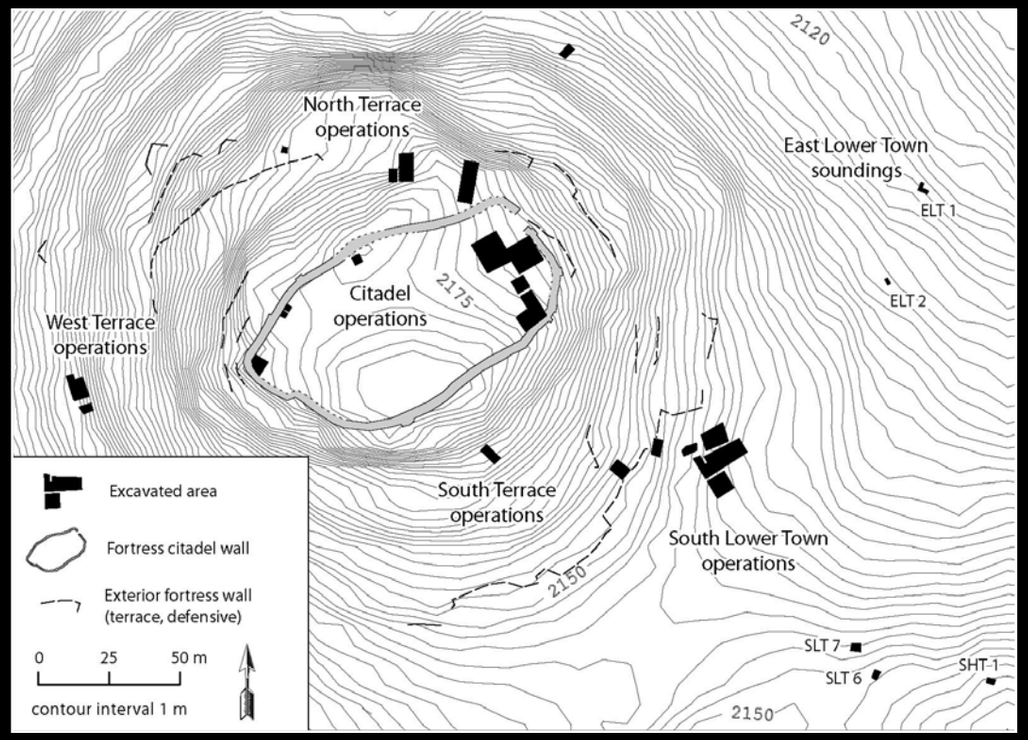
Böyük Qaleh, northwest Iran (Biscione 2009)

Horom, Shirak Plain, Armenia

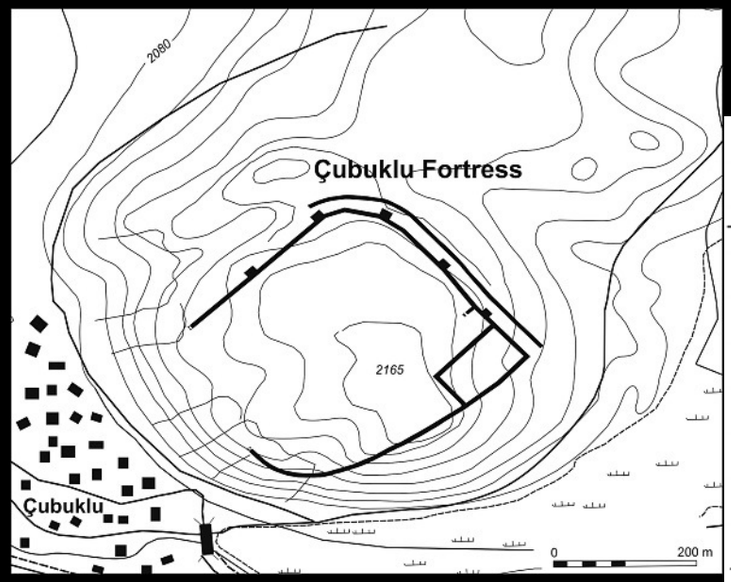
Tsaghkahovit, Tsaghkahovit Plain, Armenia

Aliler Kale, Van basin, Turkey (Sevin 2004)

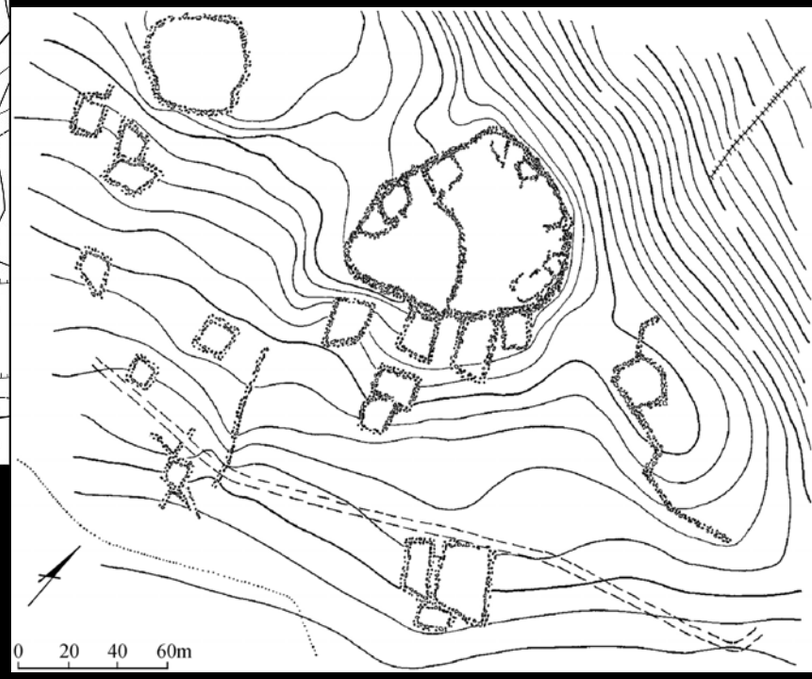
LBA/Iron 1 Fortresses



Tsaghkahovit, Tsaghkahovit plain, Armenia (Lindsay 2011)



Çubuklu, Van basin, Turkey (Özfirat 2009)

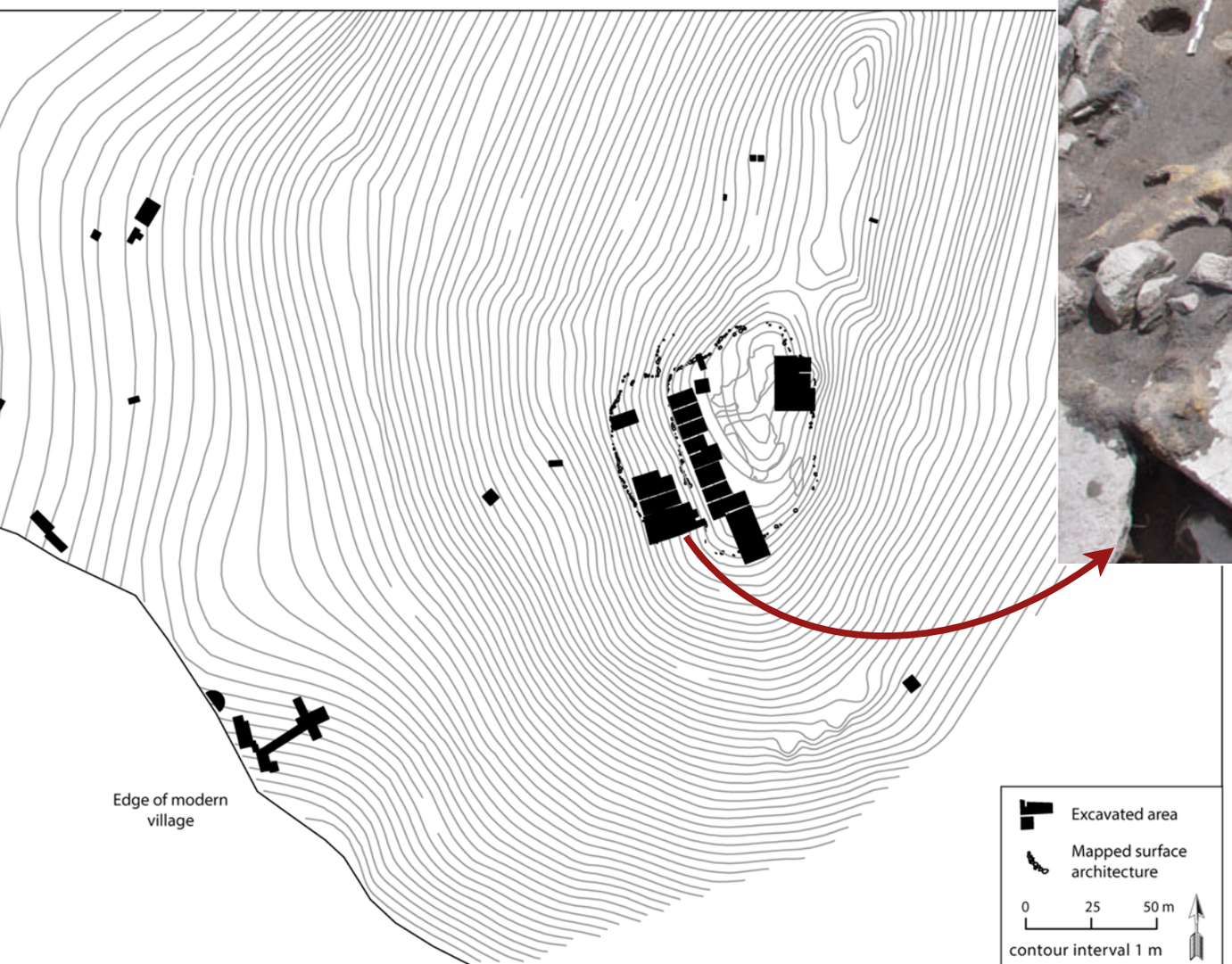


Knole, Georgia (Shanshashvili and Narimanishvili 2012)

Çubuklu, Van basin, Turkey (Özfirat 2009)

Voskevaz, Ararat Valley, Armenia

Gegharot fortress shrine complexes



West Citadel Shrine

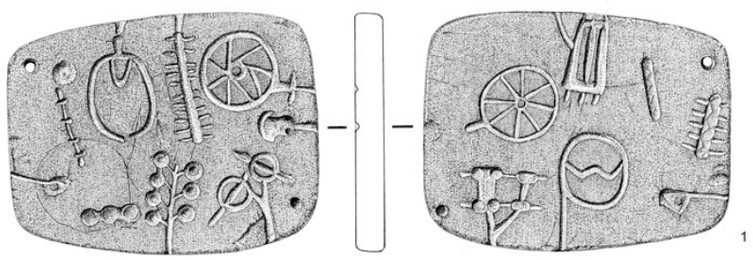
1

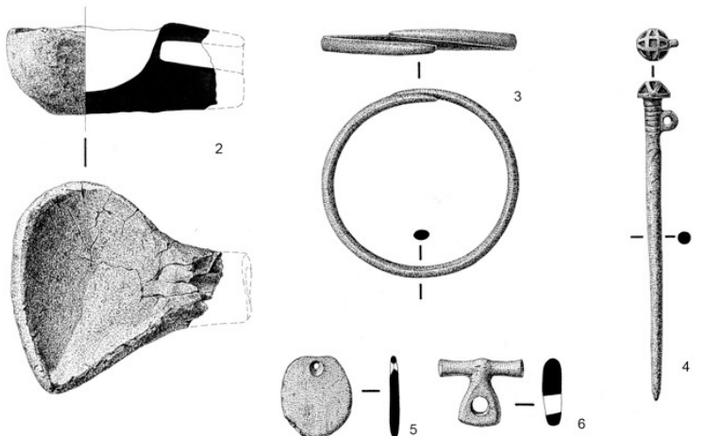
2

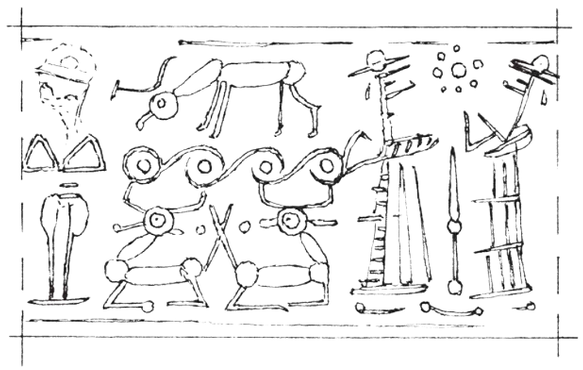
Images of (1) storage area and (2) altar in the East Citadel Shrine at Gegharot

Gegharot East Citadel Shrine

Fortress shrines: ritual, production, storage

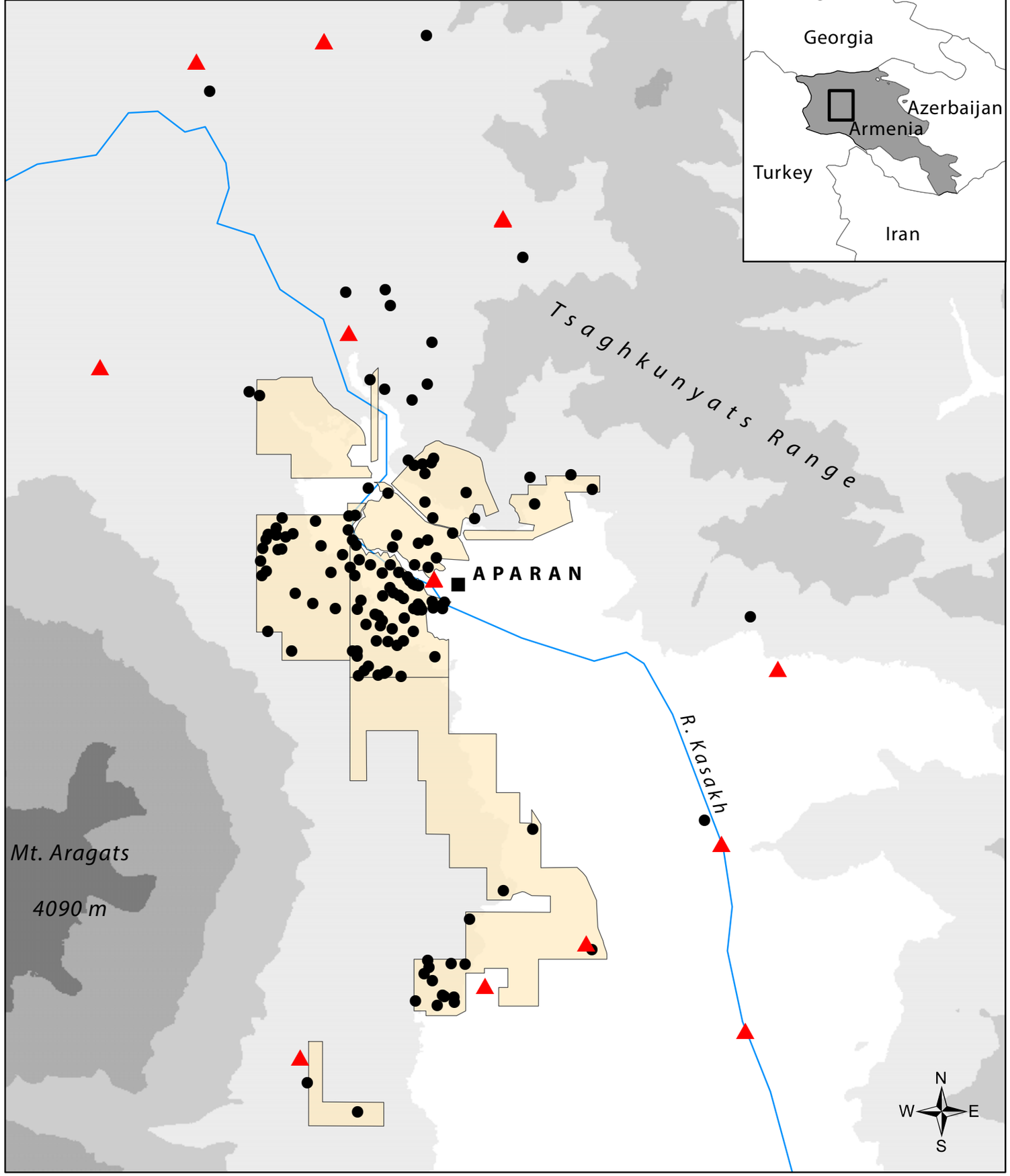






Upper Kazakh River Valley survey area, Armenia

Studying Late Bronze Age fortresses and associated landscapes



Site Type

- Fortress
- Burial Cluster

0 2.5 5 7.5 10 km

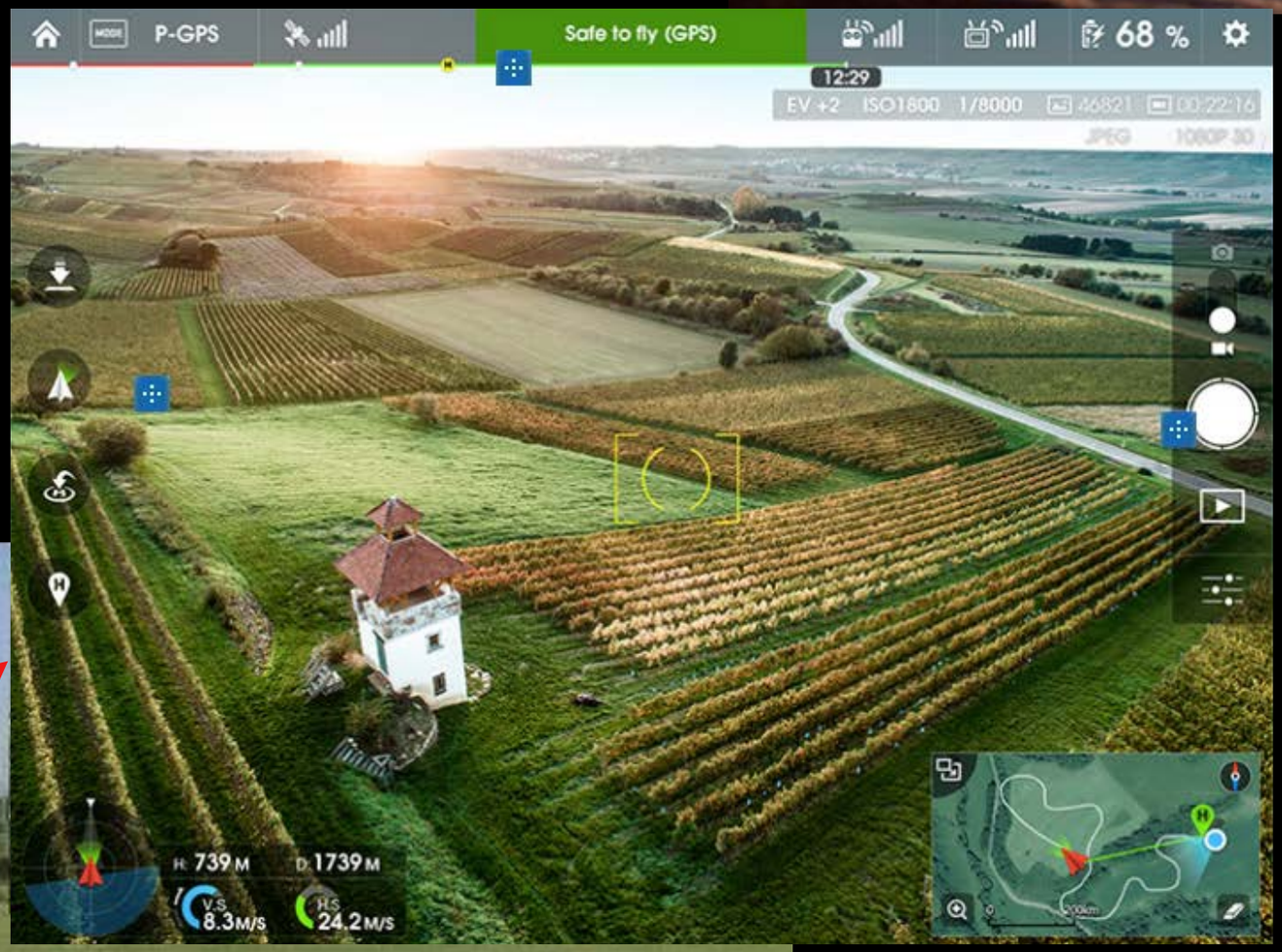
Alan Greene
Project ArAGATS
24 August 2016

Indiana Drones: UAV/UAS in Archaeology

Indiana Drones: UAV/UAS in Archaeology

DJI Phantom 3 Pro

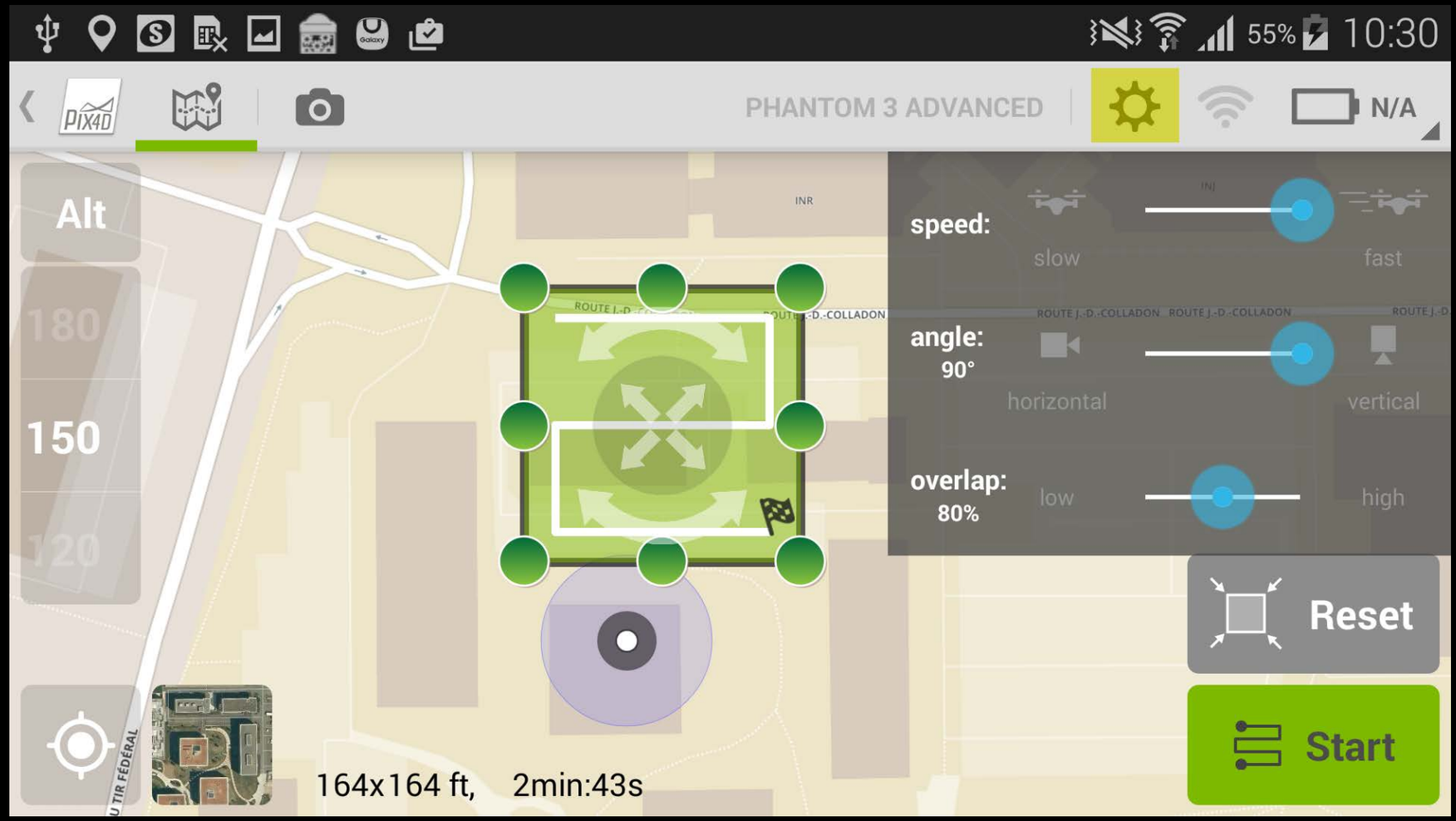
- iOS and Android compatible
- 12 megapixal camera
- 4K video
- 5 km distance
- 20 min battery



DJI Go app on iPhone

DJI Phantom 3 Pro

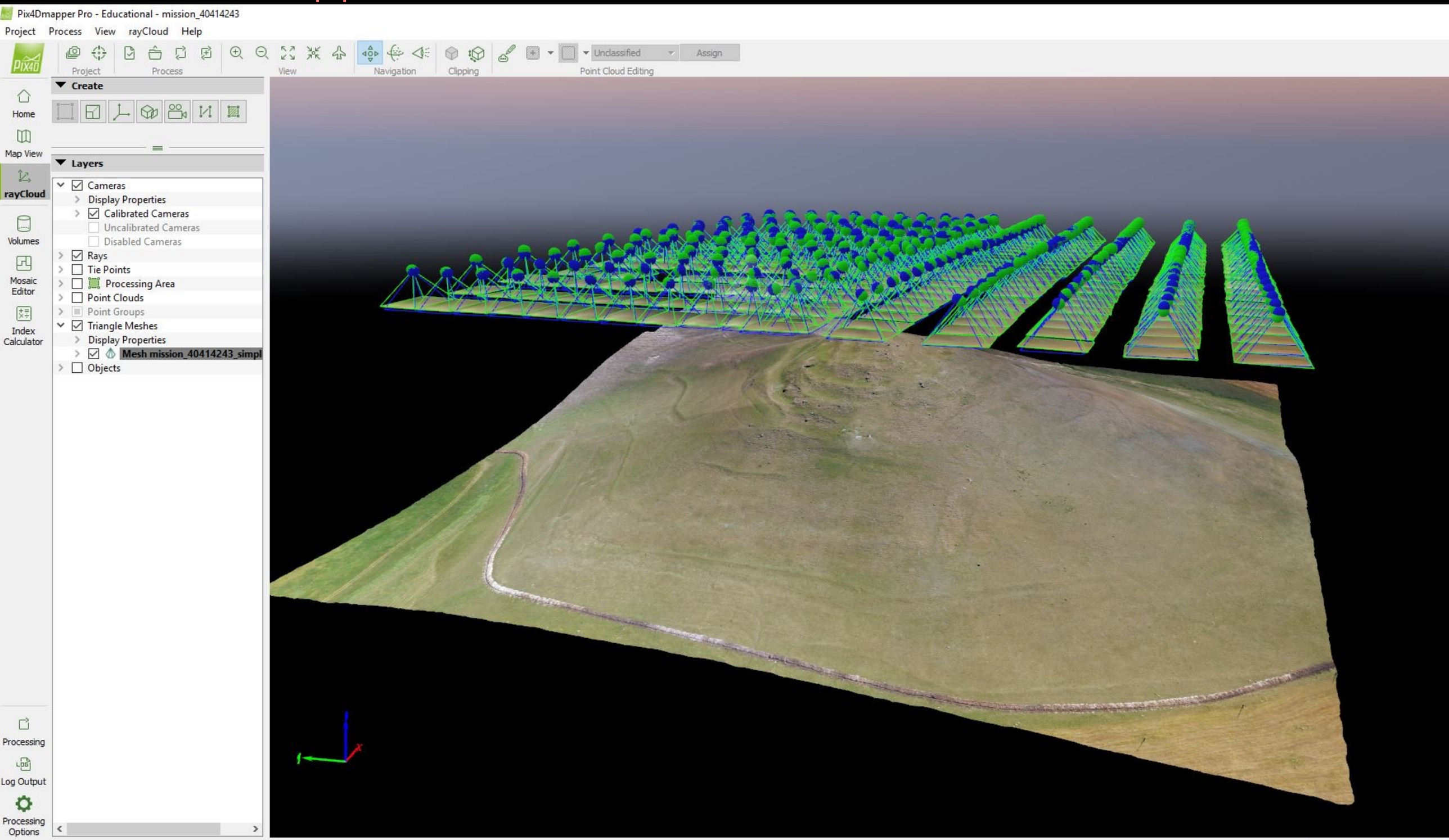
- built in GPS
  - hovers w/in 1m
  - go-home feature
- waypoint programming or pre-program mission grid



Pix4D Capture app

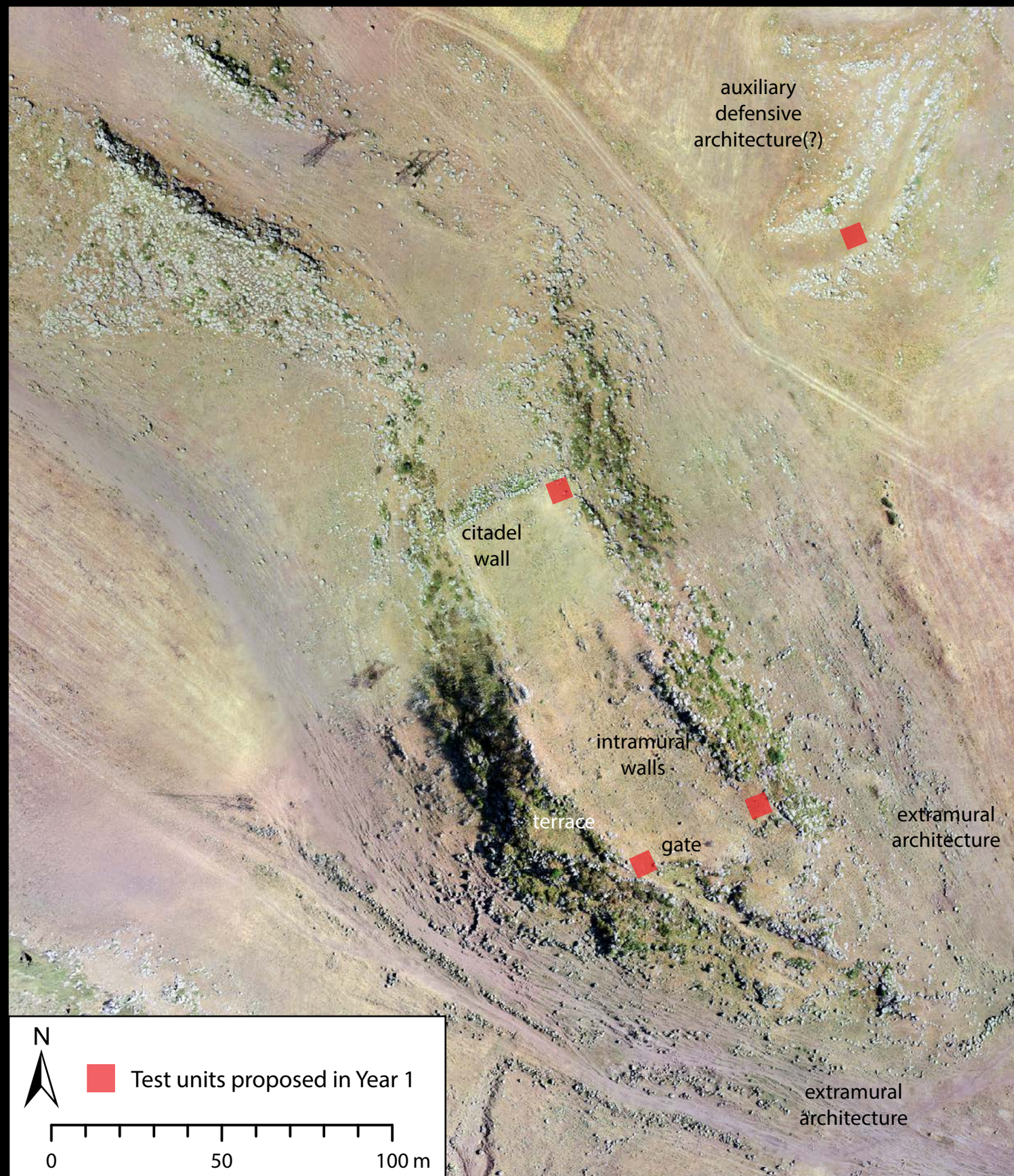
Analytical applications of drones

- Photogrammetry workflow
  - Pix4Dmapper Pro



Analytical applications of drones

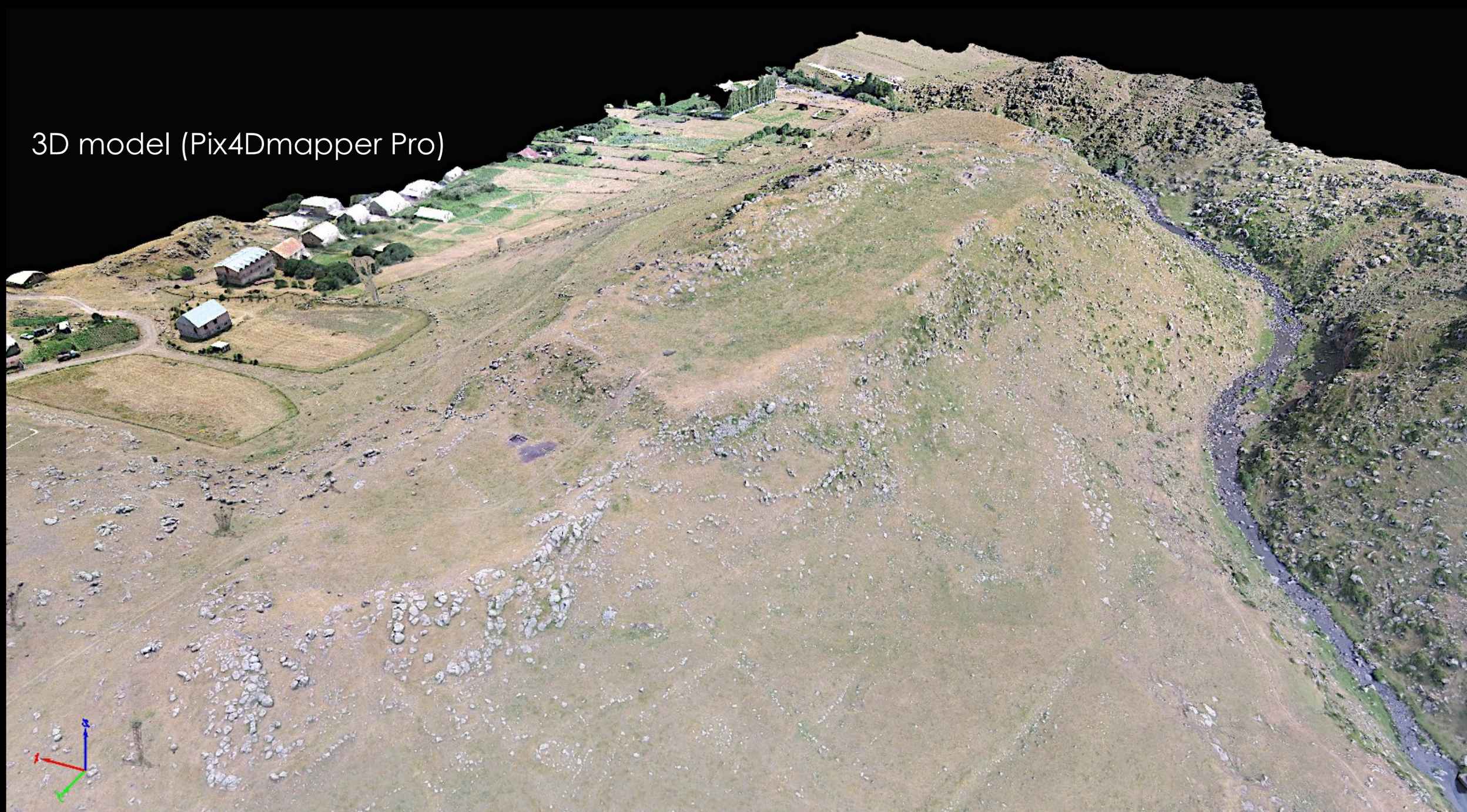
- Photogrammetry
  - Kuchak fortress, Armenia
    - 480 images
  - Hi-res orthomosiac images
    - excavation planning
    - morphometric analysis



Orthomosaic
(Pix4Dmapper Pro)

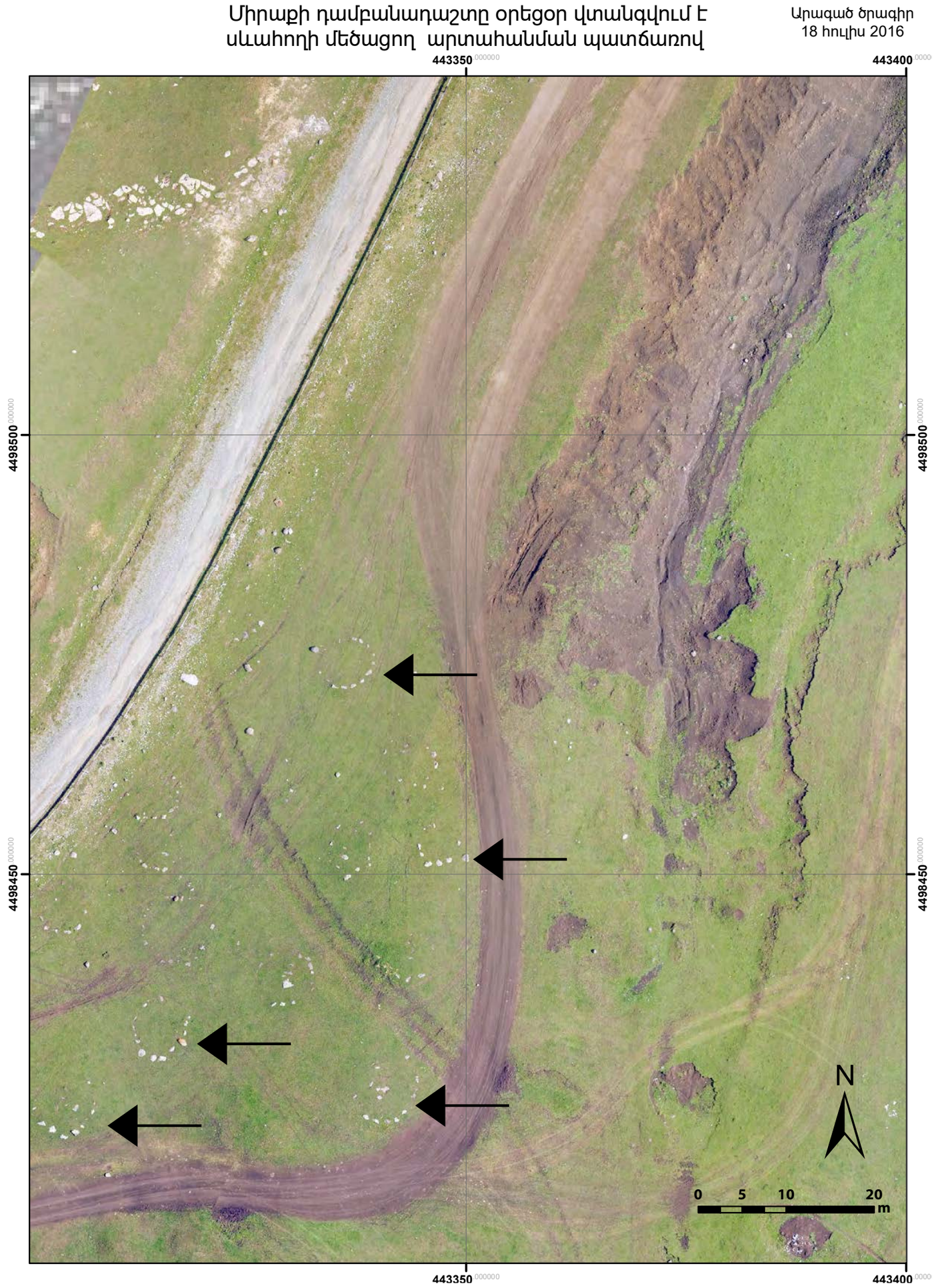
Analytical applications of drones

- Photogrammetry
  - Aparani Berd fortress, Armenia
    - 1000 images



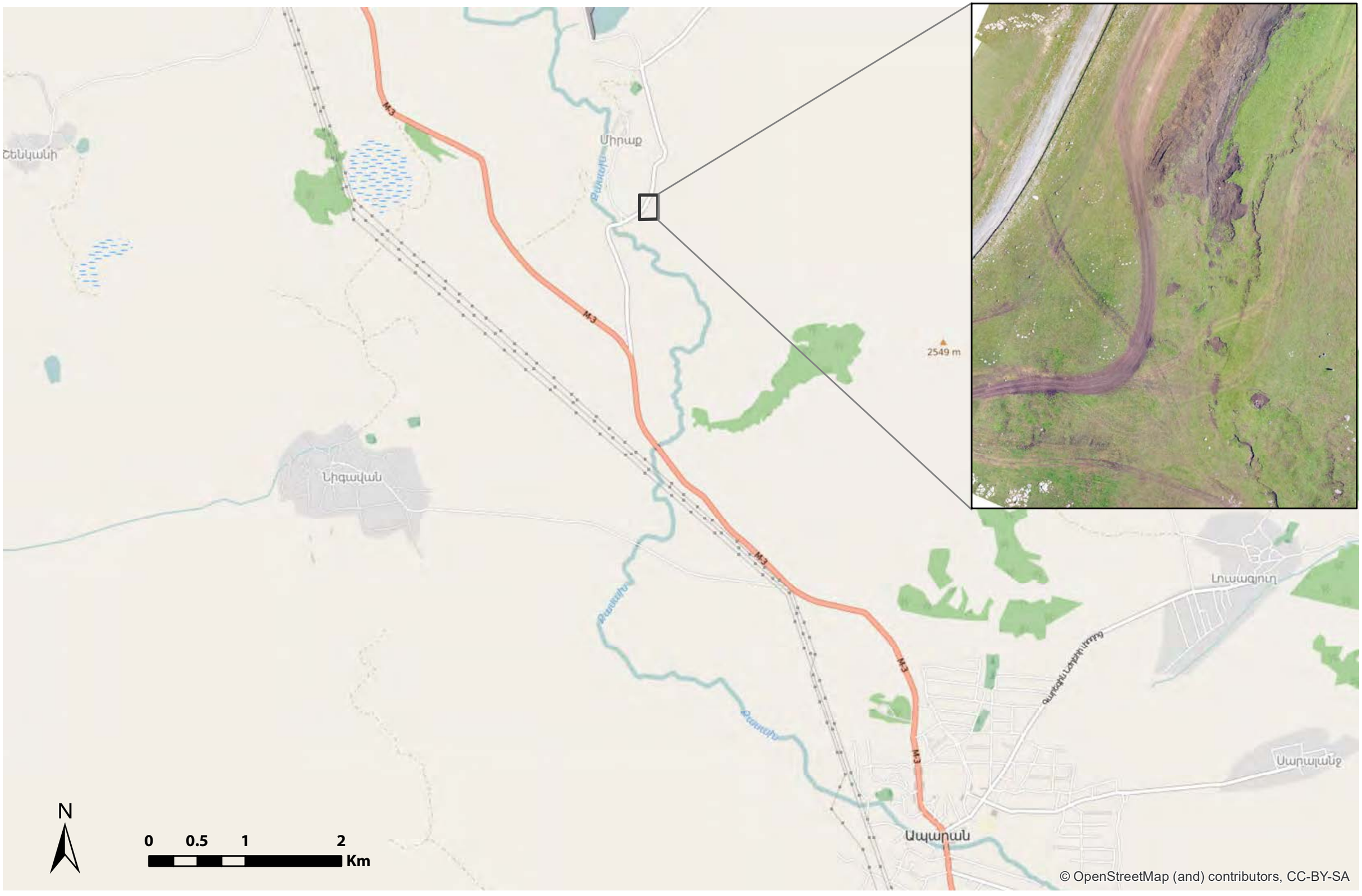
Drones in archaeology: Site monitoring and mitigation

- topsoil mine encroaching on Bronze Age cemetery in rural Armenia



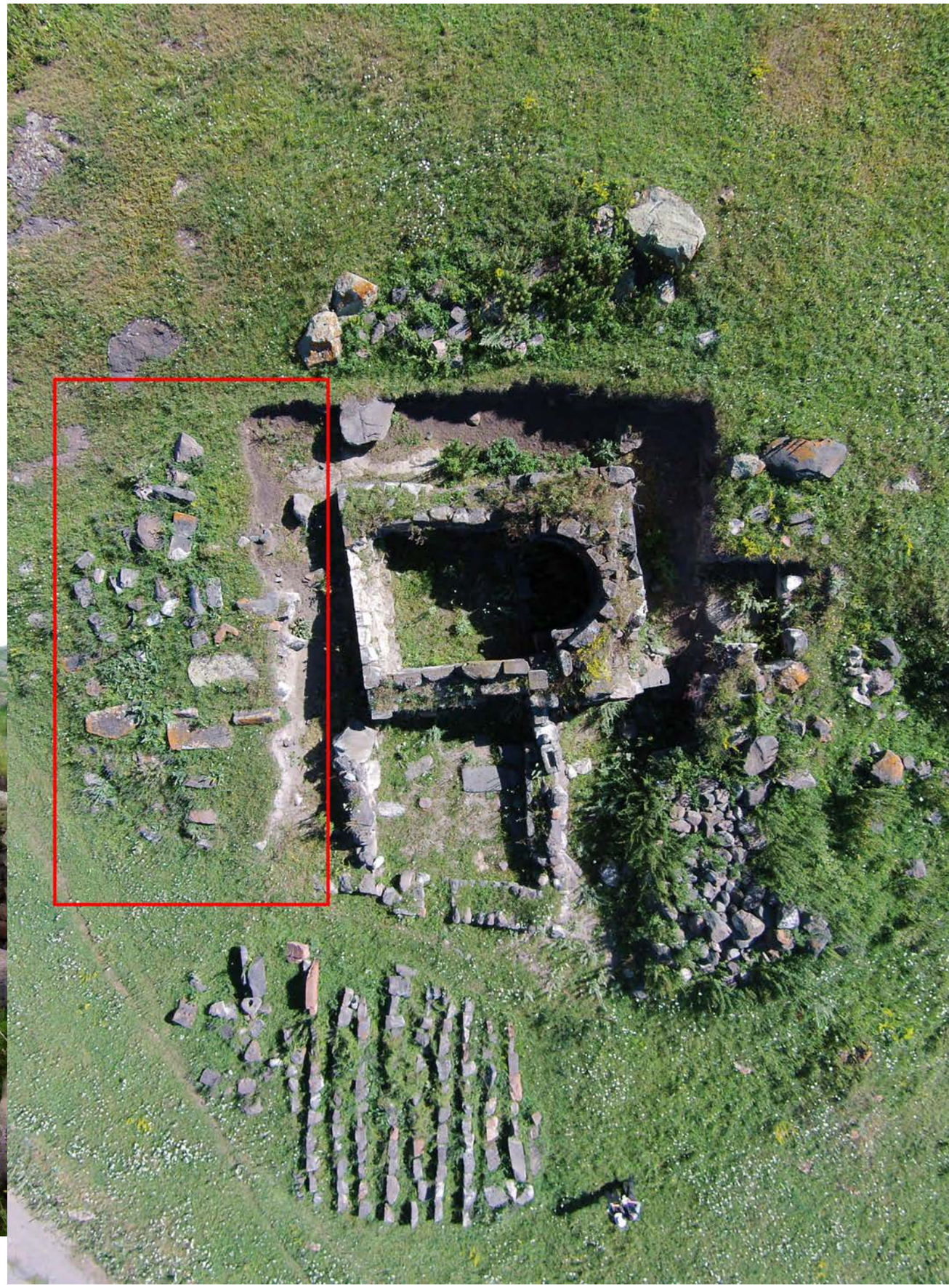
Միրաքի դամբանադաշտը օրեցօր վտանգվում է սևահողի մեծացող արտահանման պատճառով

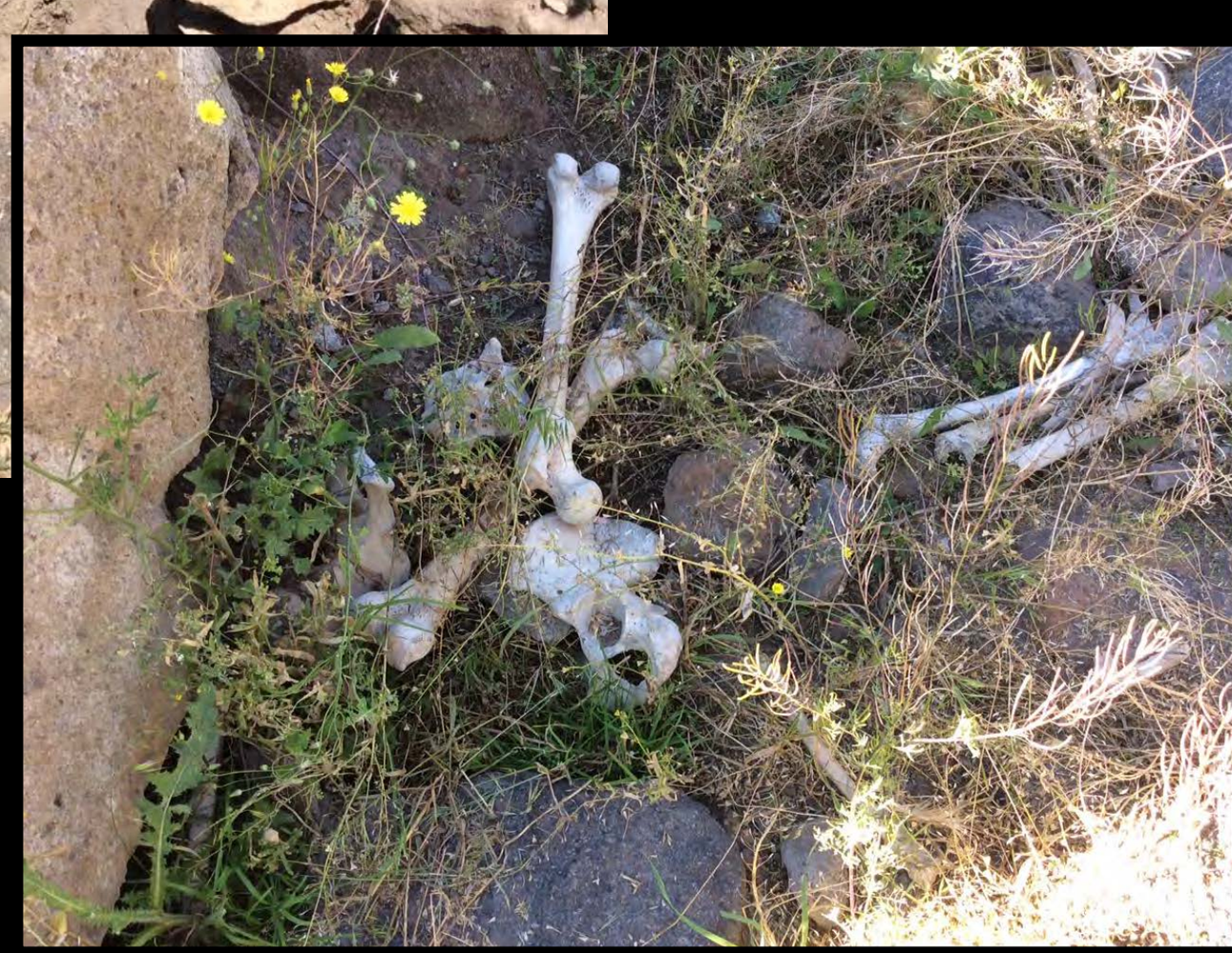
Վրագած ծրագիր
18 հուլիս 2016



Drones in archaeology: Site monitoring and mitigation

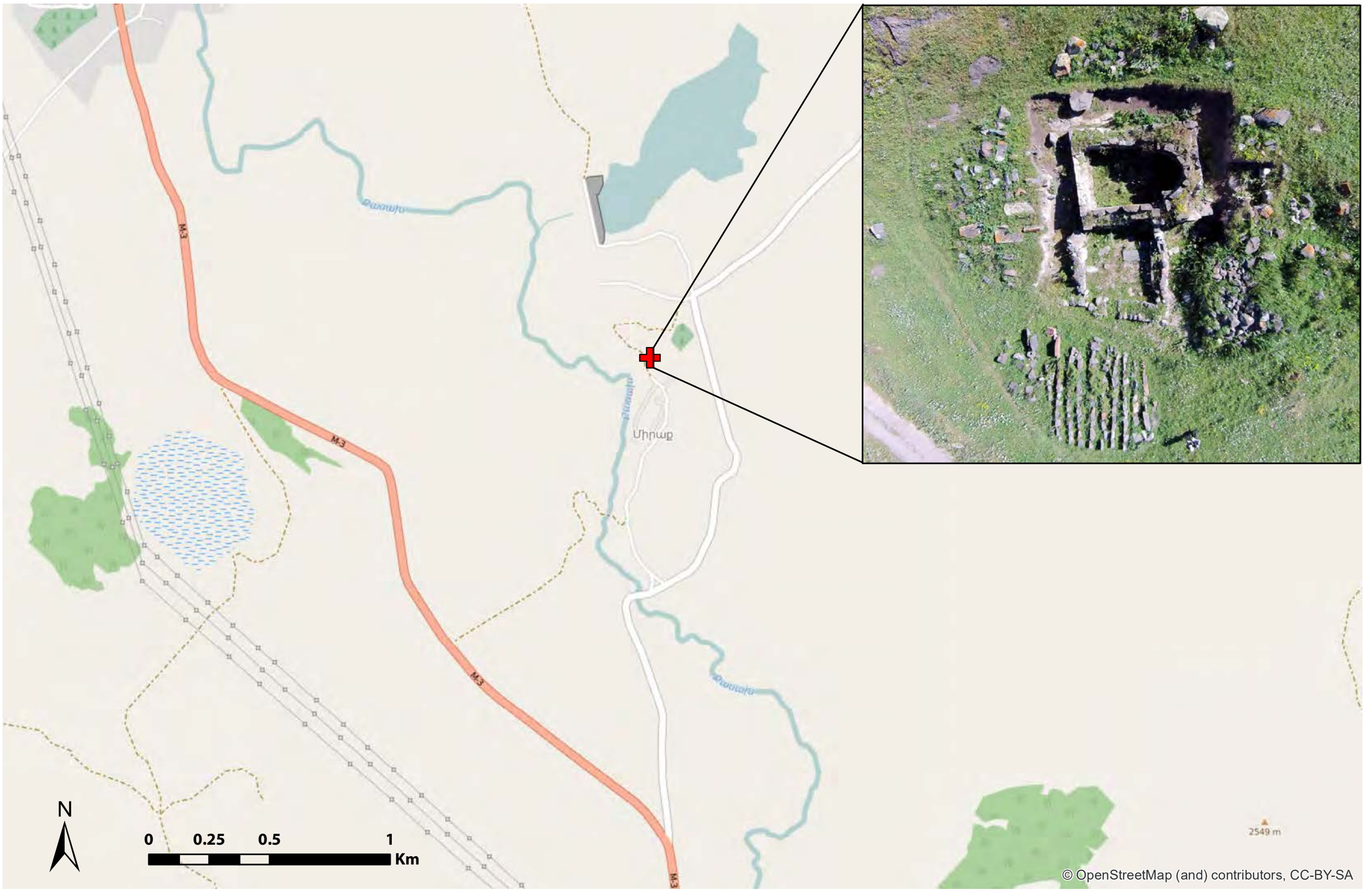
- 13th century medieval Armenian church with eroding cemetery from prior excavations





Միրաքի 2012-2013 թթ□ պեղումների արդյունքում առաջացած կտրվածքի բնական մերկացում

Արագած ծրագիր
25 հուլիս 2016



Drones in archaeology:
Outreach, education, story telling

Drones in archaeology:
Outreach, education, story telling

Thank You

Dr. Nicole Kong and Shirley Yue, GIS Day organizers

Project ArAGATS team members

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