A small handful of OTB remote modules for deep learning

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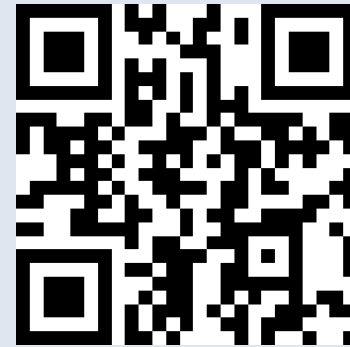
Summary

- What is new in **OTBTF** ?

- OTB **Prefetch**

- OTB **ONNX**

- IRL : ***Qanats mapping with OTBTF***

What is new in **OTBTF** ?

- A big, free, tutorial ! ================>
  - *pyotb,*
  - *pystac,*
  - *planetary_computer*
  - *keras*

- New python stuff
  - *otbtf.layers*
  - *otbtf.ops*

- No-data support in *TensorflowModelServe*

- New « *split* » strategy in *PatchesSelection*

2018-01-03

Spot 6/7 – Sentinel-2 fusion framework
(soon to be released!)

What is next in OTBTF

- Keras 3 support (currently : keras 2)
- Lighter docker images
- Packaging (binaries, pypi, ...)

otb-prefetch

- Pre-fetch the upstream pipeline, in an asynchronous fashion (thank you Bradley Lowekamp from ITK)

- One thread tries to guess the next requested region and populates the output buffer with it

- Available at :
  - https://github.com/remicres/otb-prefetch

otb-prefetch

- Principle
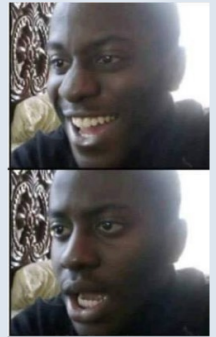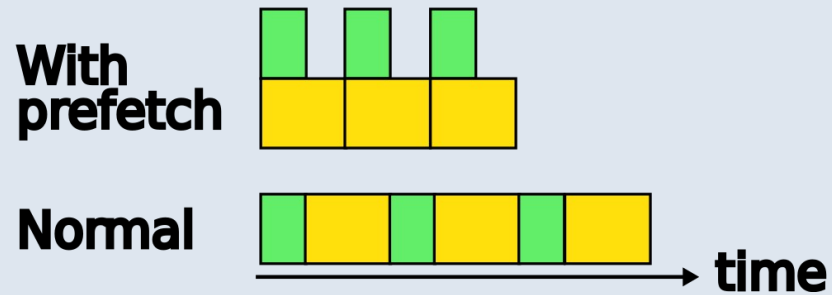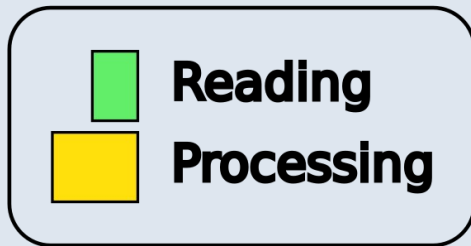
otb-prefetch

- Show me some code !


```python
prefetch_example.py    164 B

1   import pyotb
2
3   # Normal
4   pyotb.BandMathX(img1, exp="im1", out="out.tif")
5
6   # With prefetch
7   pf = pyotb.Prefetch(img2)
8   pyotb.BandMathX(pf, exp="im1", out="/tmp/out.tif")
```

otb-ONNX

- Run deep nets from many deep learning framework

- Relies on ONNX (Open Neural Network Exchange)

- A single OTB application

- Available at :
  - https://forgemia.inra.fr/orfeo-toolbox/otbonnx
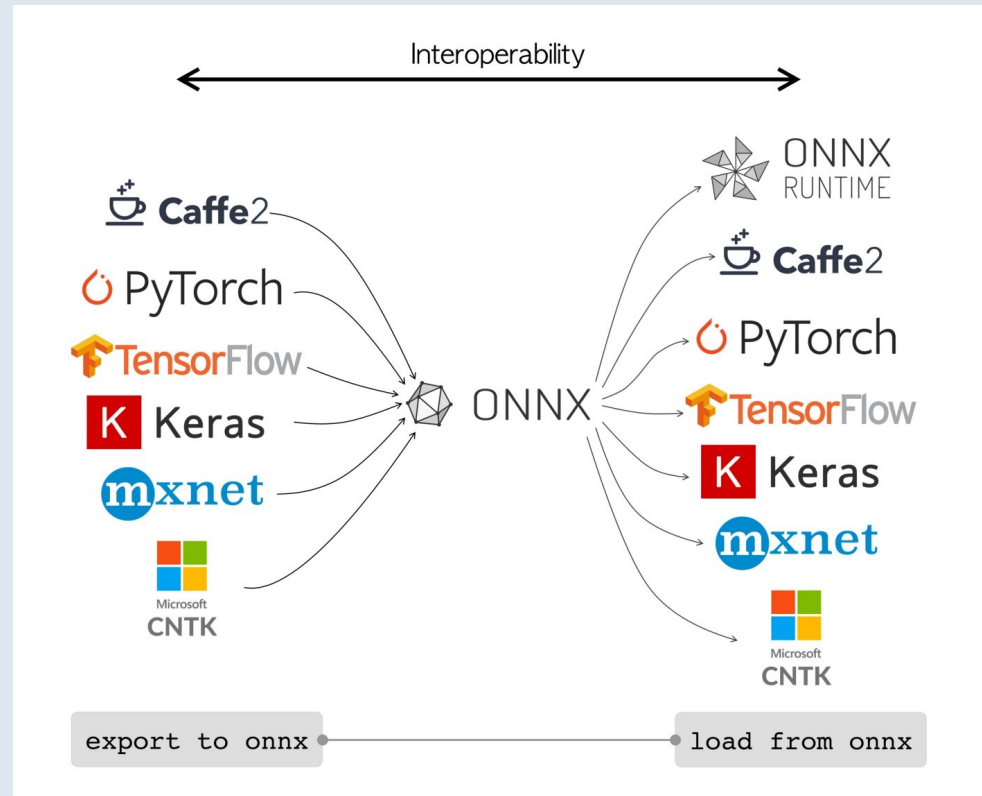
otb-ONNX

- *ONNXInference* is nearly the same code as OTBTF's *TensorflowModelServe*, but using ONNX instead of TF

What is next for otb-ONNX ?

- Packaging !
  - Follow developments in future OTB releases
  - Docker images
  - Binary packages ? Pip packages ?

Qanats mapping with OTBTF

How to virtually study abandoned subterranean qanat systems?

Mehrnoush Soroush
Director of CAMEL Lab

ISAC

Rémi Cresson
UMR TETIS

INRAe

What is a qanat?
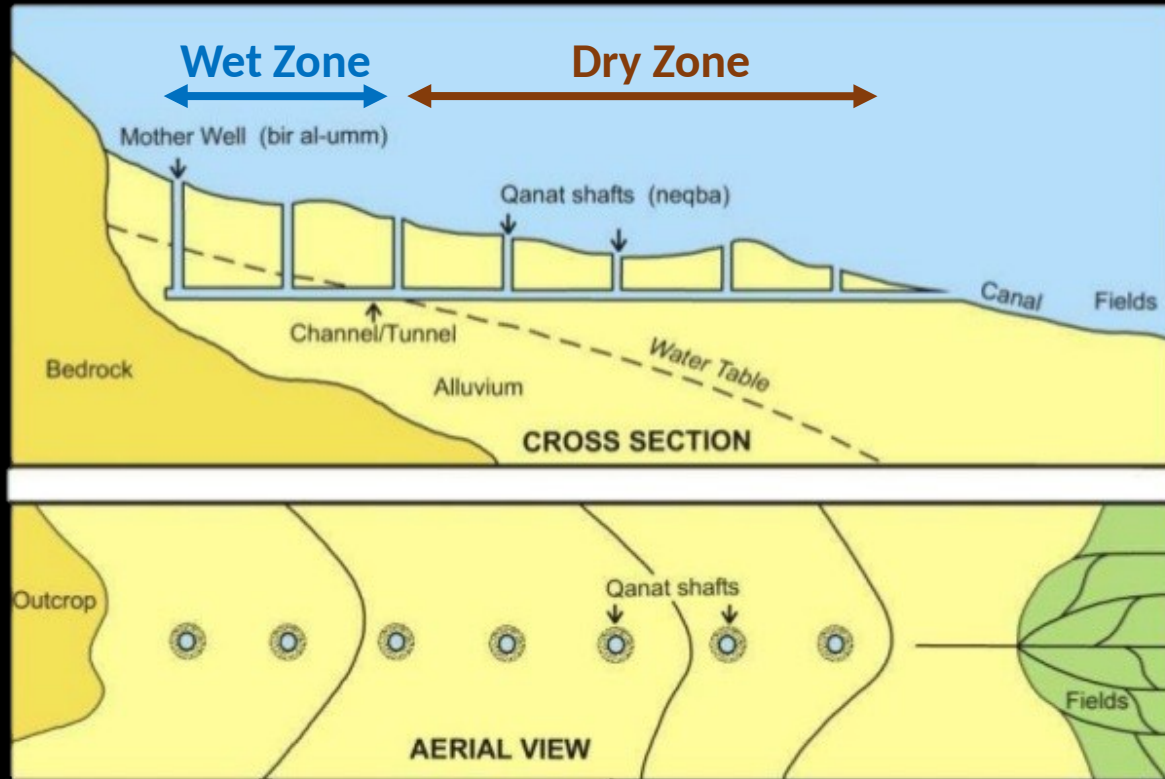
Schematic model of an Infiltration qanat, after Lightfoot 2009

The importance of Qanats

1. Permanent Settlements in arid areas

2. Prioritizing Economic Potential over water access

3. Year-around agricultural production (subsequently systematic summer cropping)

4. Prioritizing capital and expertise over labor.

Worldwide Technology Diffusion
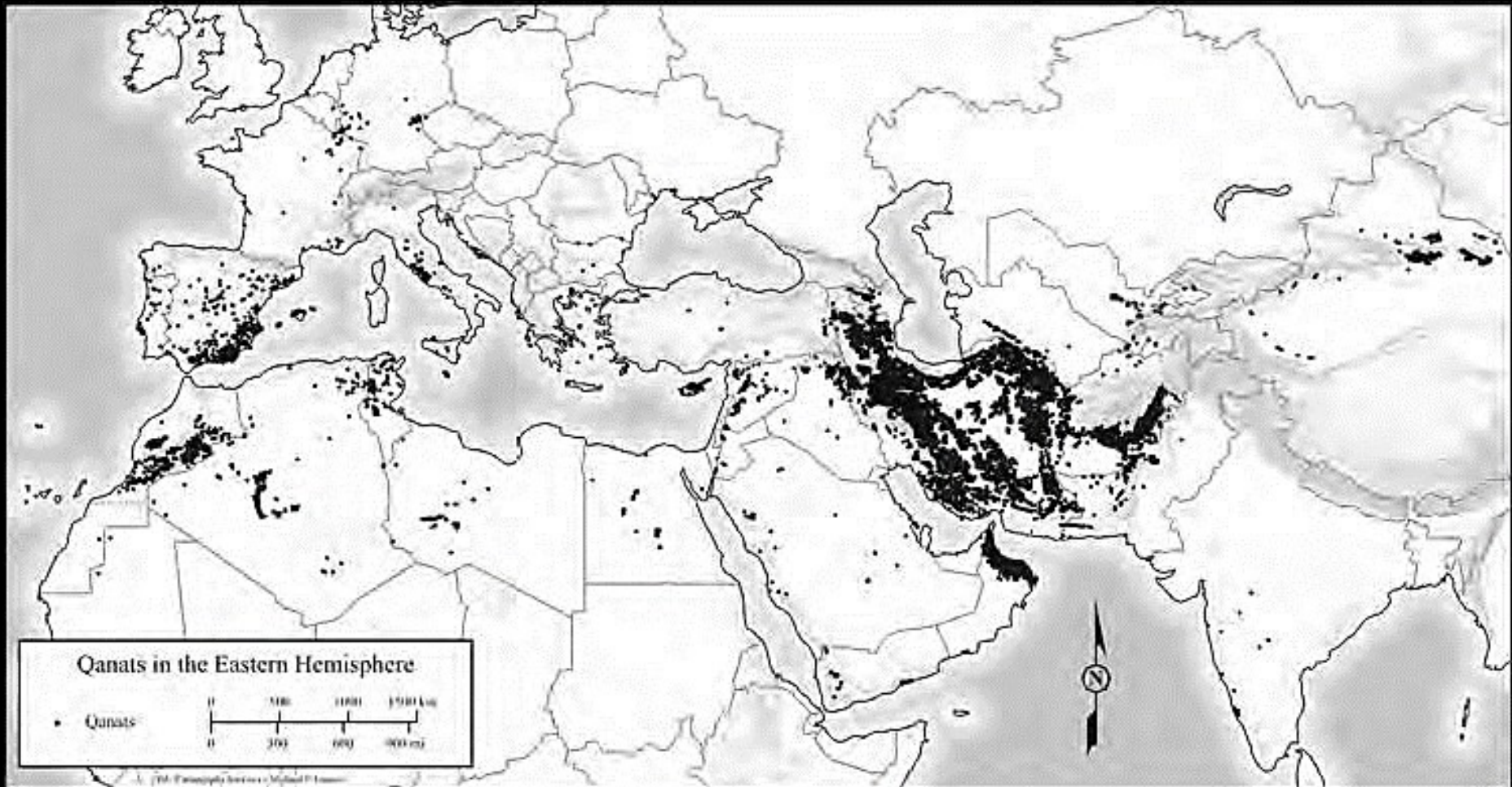
Distribution of qanats across the eastern hemisphere (after Lightfoot 2024)

Qanat: Research Methods

- Archaeological Remote Sensing

- Fieldwork & Geophysical Survey

- Archival Research

- Ethnography

Qanats the Kurdistan Governorate (Iraq)
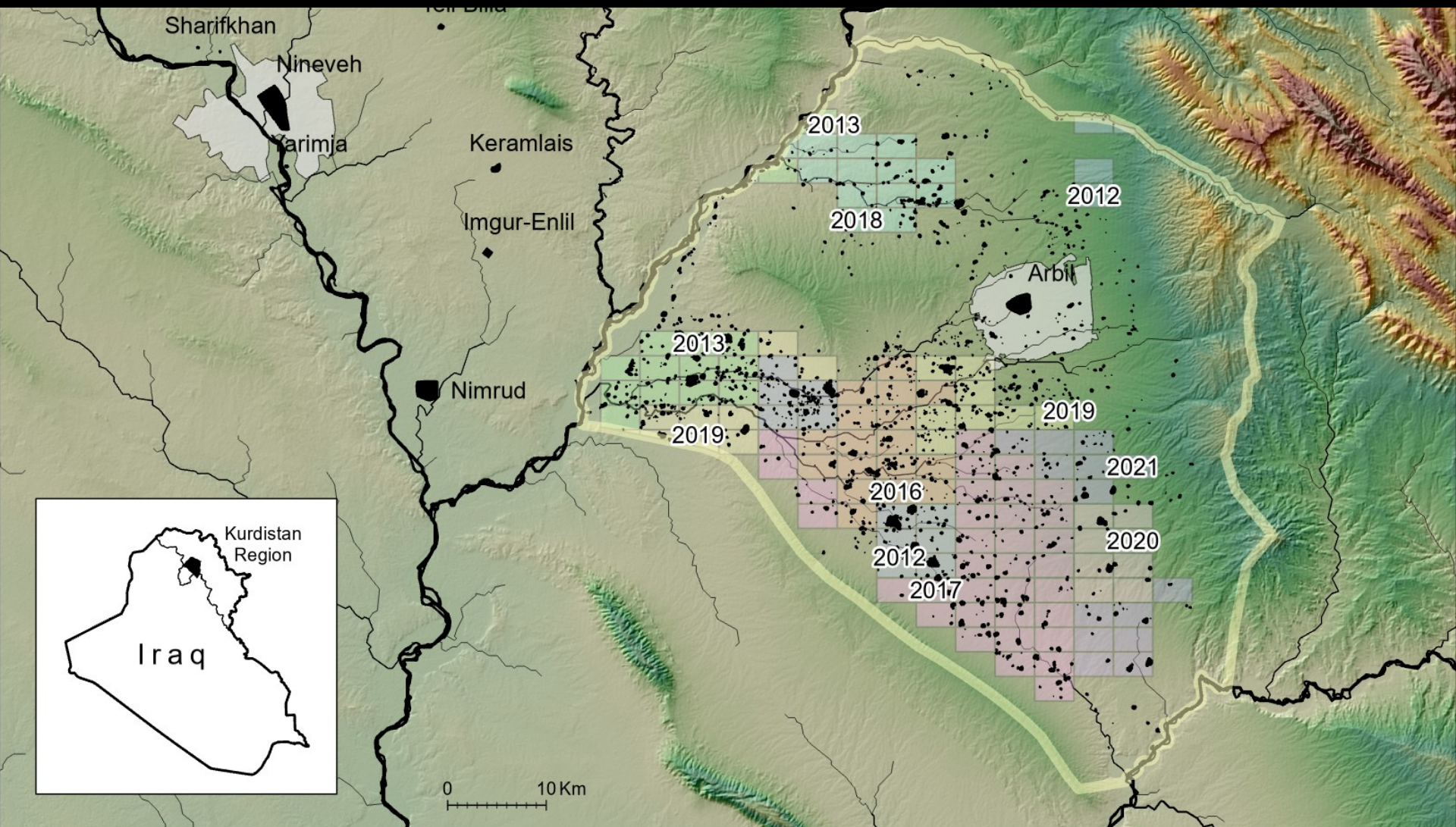
Erbil Plain Archaeological Survey (EPAS), since 2012

UNESCO sponsored survey of qanats 2005-2009
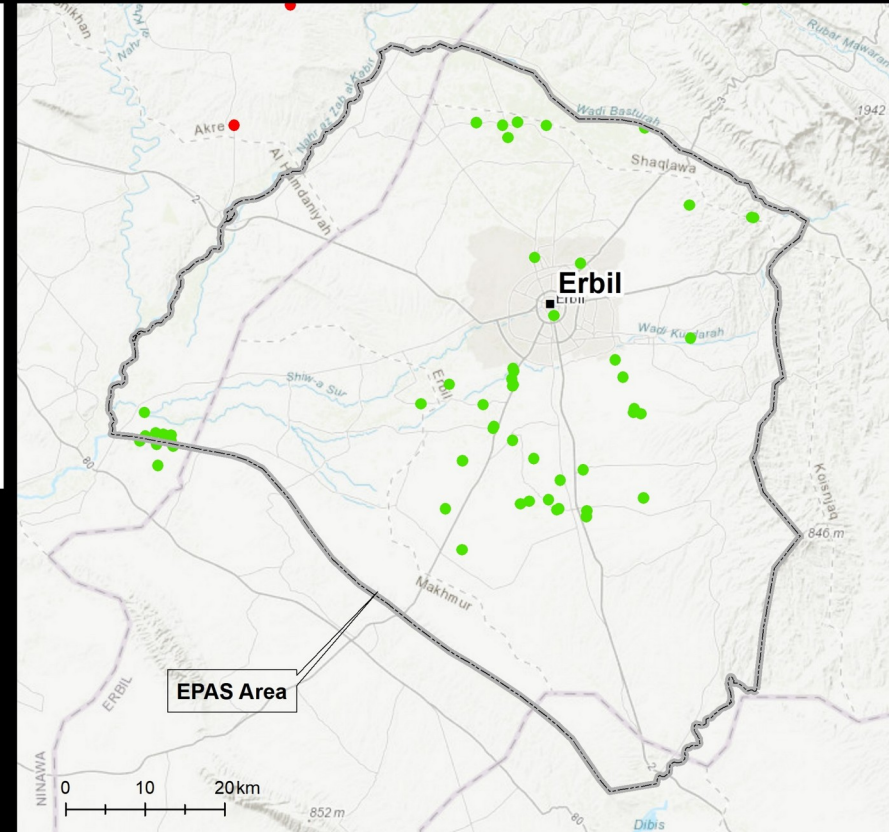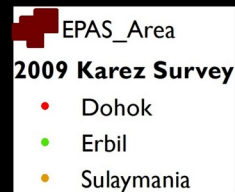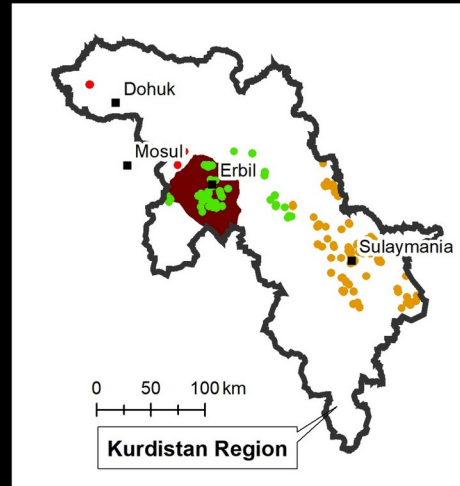
Data from Lightfoot 2009

Remote sensing in archeology

"Pioneers of the Sky" exhibit at the Institute for the Study of Ancient Cultures, University of Chicago
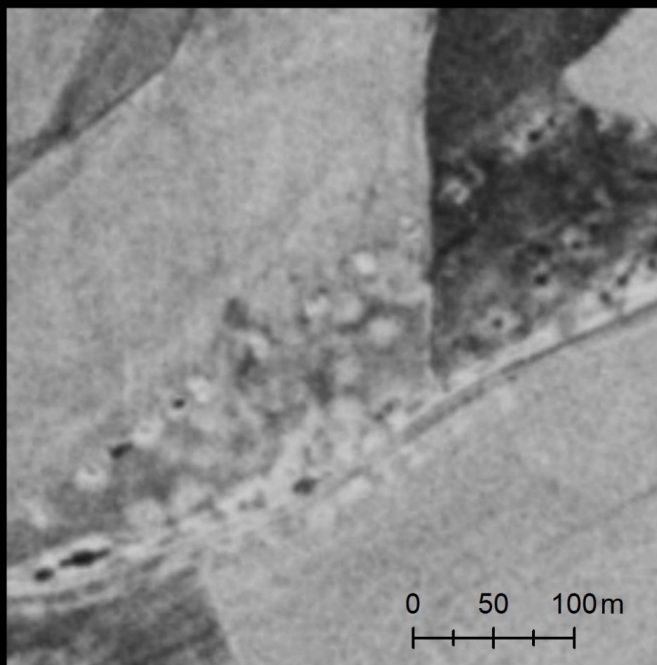
Project Corona: America's 1st photo reconnaissance satellite

- Launch in feb 1959 to spy USSR weapons

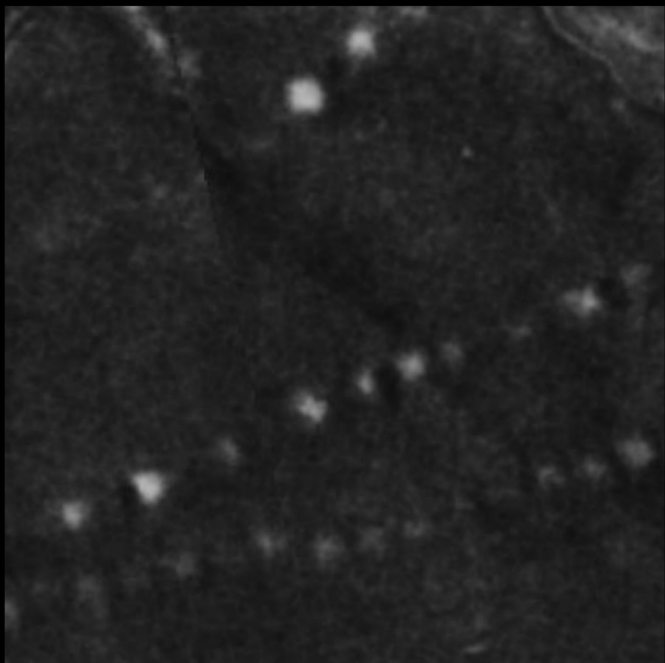- +860,000 images between 1960-1972

- Declassified in 1995

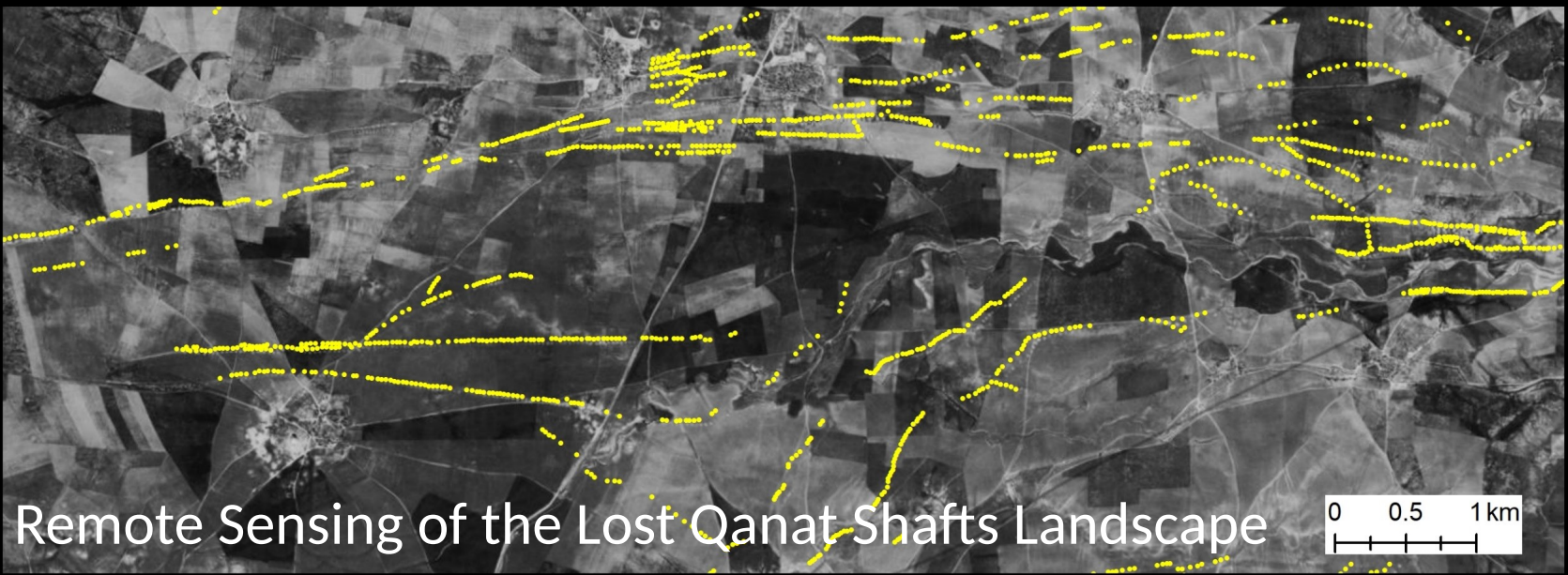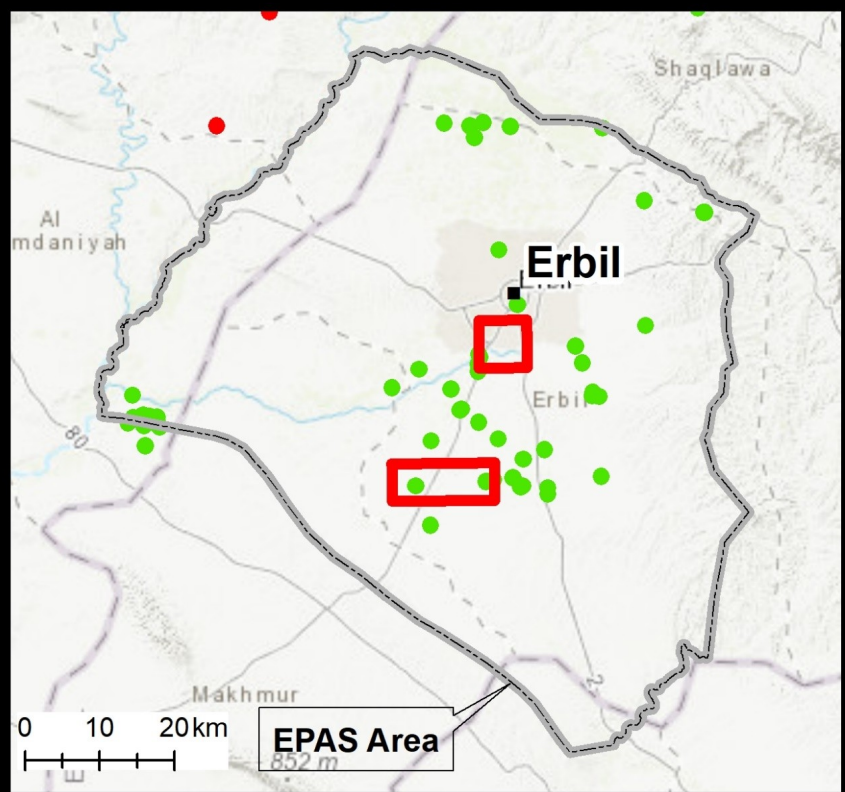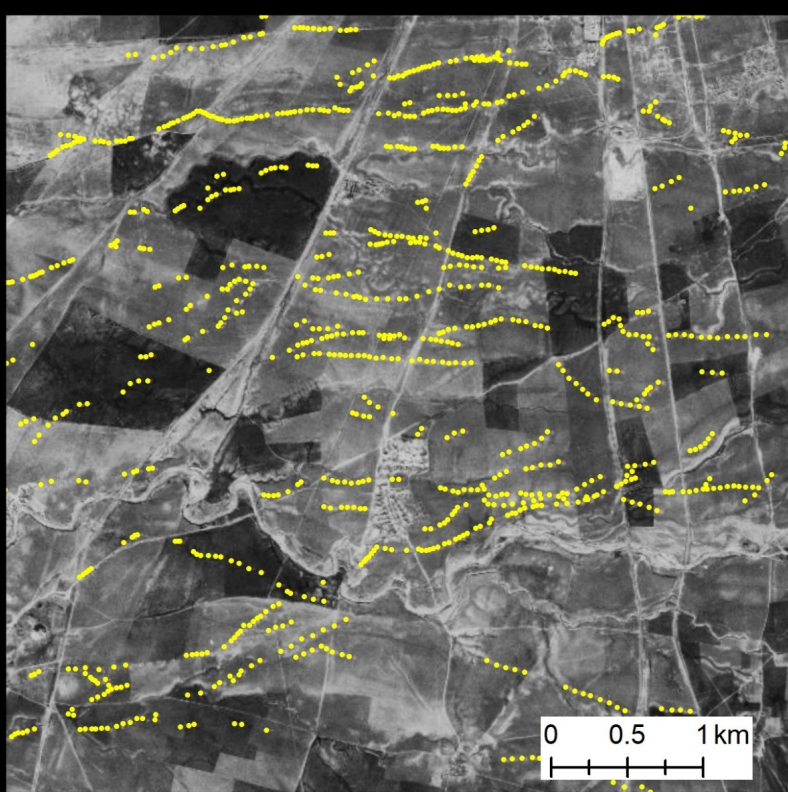Capsule, or "bucket", captured by an Air Force C-119 (CAMEL)
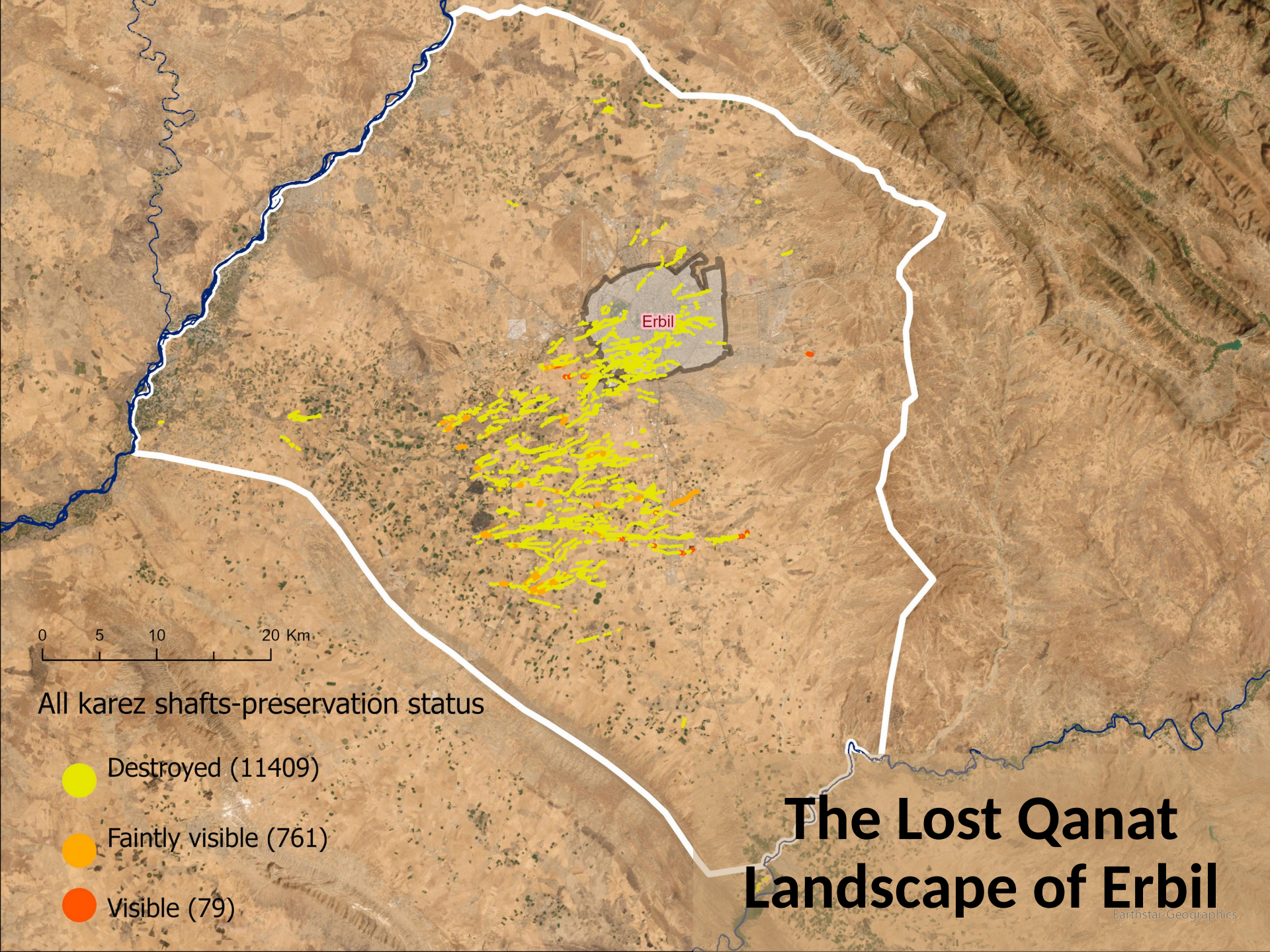
The lost qanat landscape of Erbil

Erbil in 1968

Modern Erbil
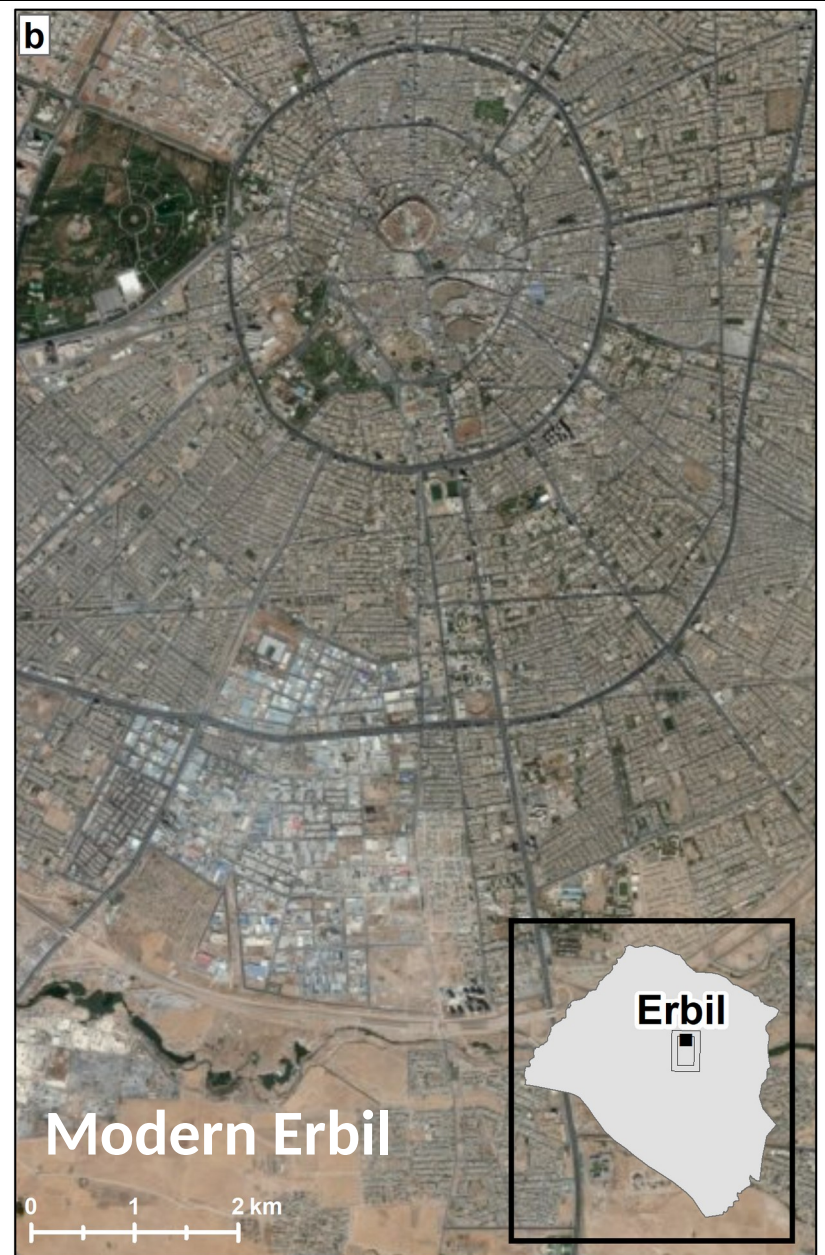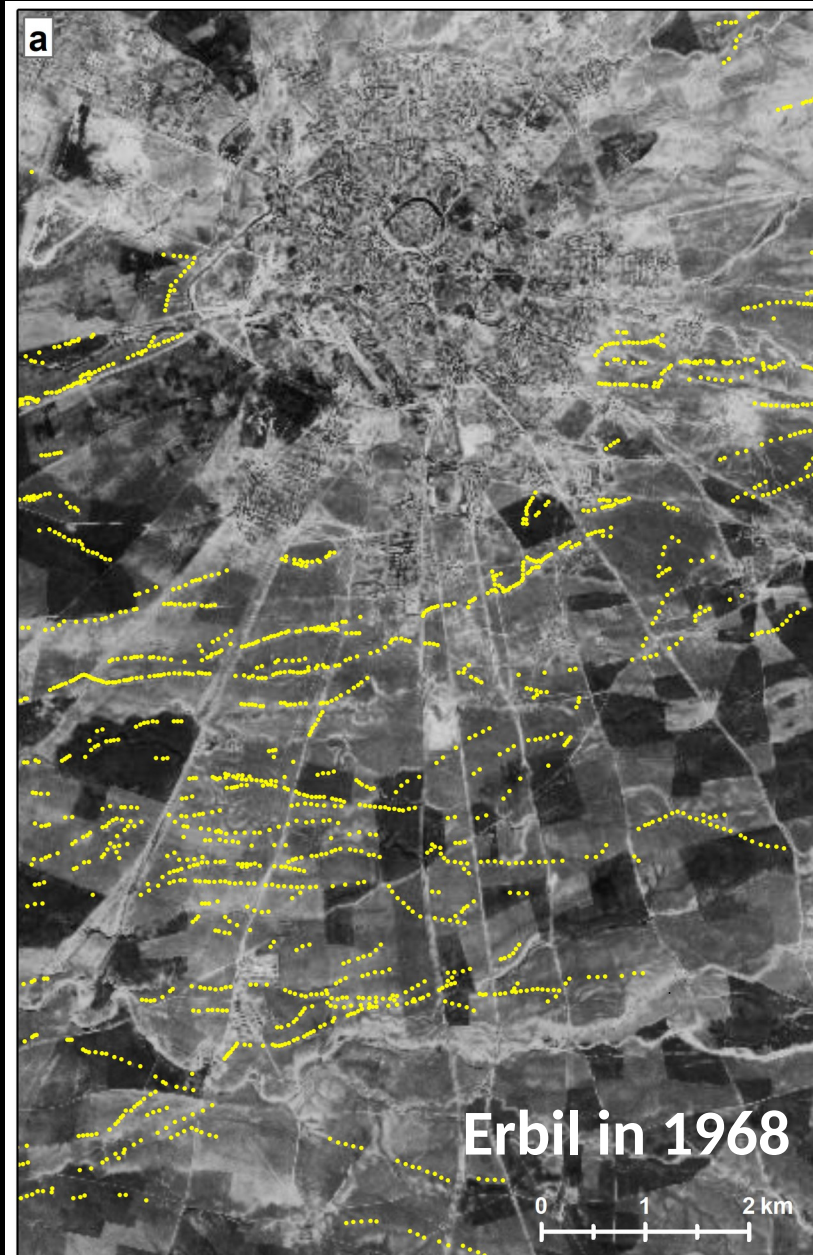
Erbil

Qanat Signature on Corona Imagery

0 50 100m

Erbil

EPAS Area

852 m

0 0.5 1 km

0 10 20 km

0 0.5 1 km

Remote Sensing of the Lost Qanat Shafts Landscape

Erbil
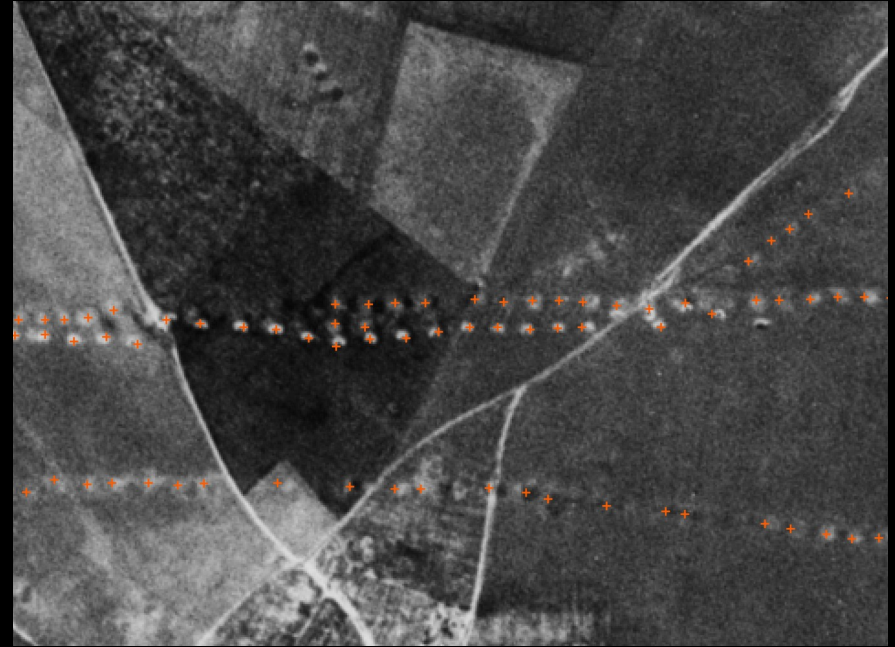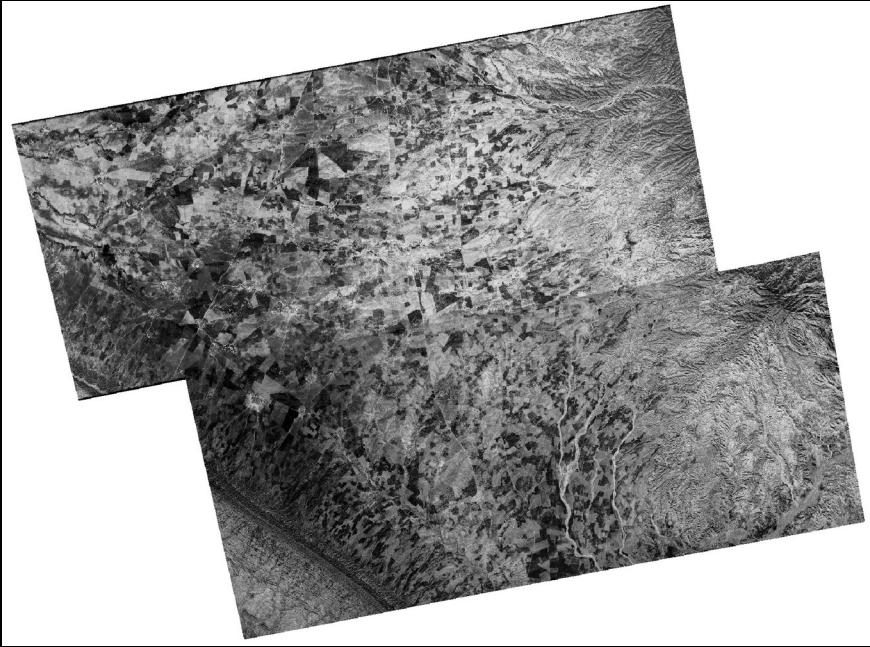
All karez shafts-preservation status

● Destroyed (11409)

● Faintly visible (761)

● Visible (79)

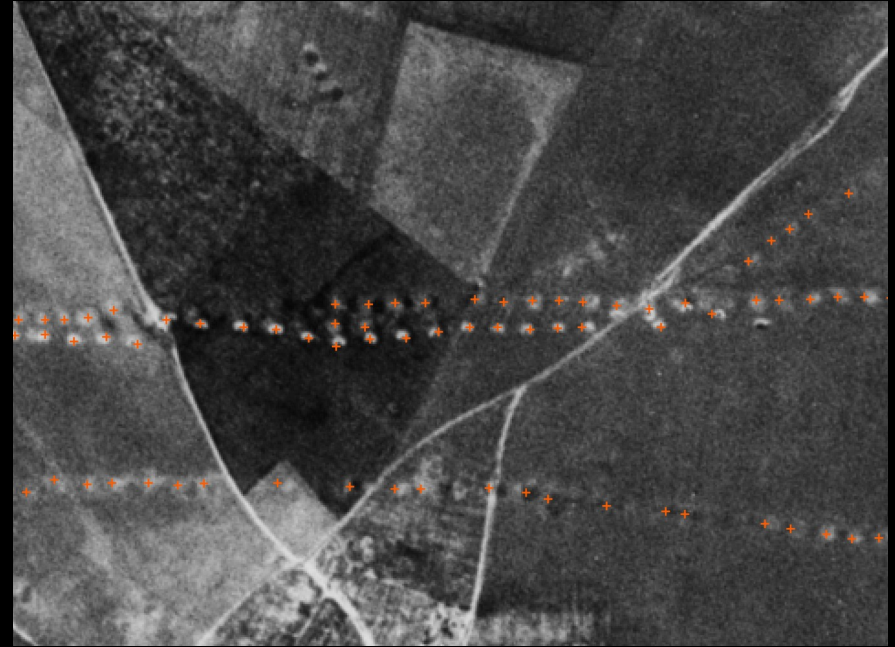0   5   10   20 Km

**The Lost Qanat
Landscape of Erbil**

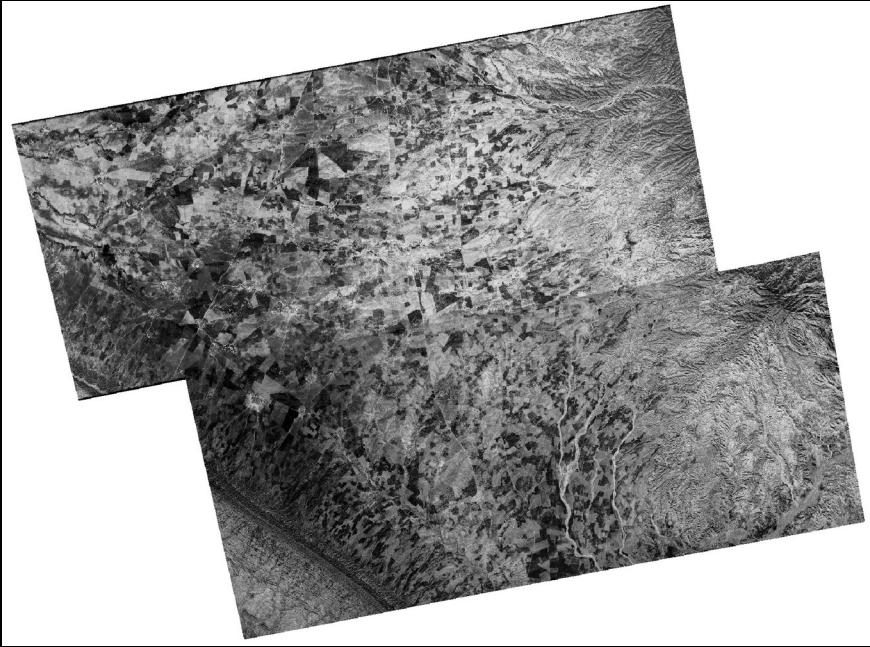Earthstar Geographics

Data

Left: CORONA images (Geotiff, 8 bits, mono-channel), Right:
qanats locations (point cloud, vector data)

Data

Left: CORONA images (Geotiff, 8 bits, mono-channel), Right:
qanats locations (point cloud, vector data)

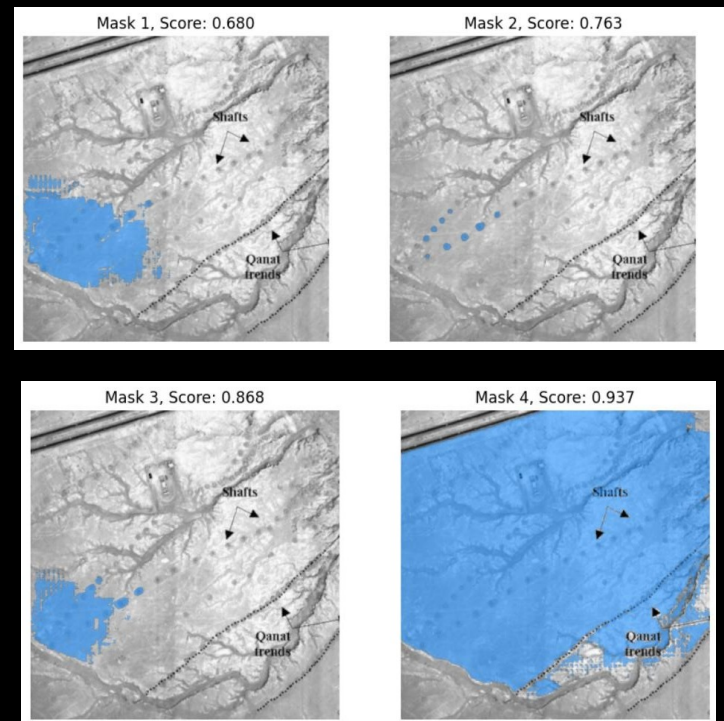How to create training patches for convolutional
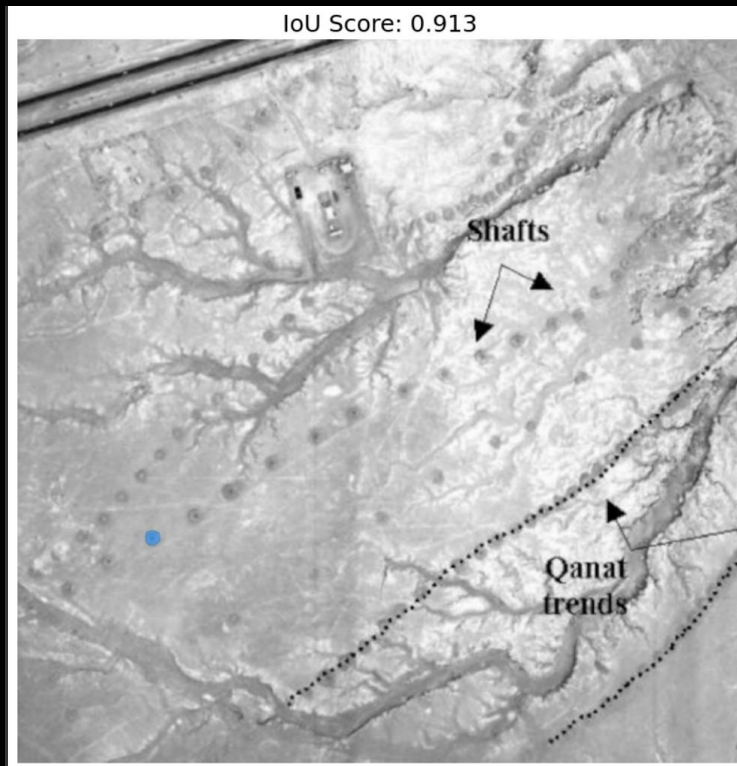neural networks?
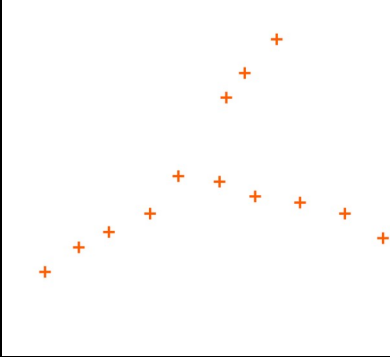
Software

First approach: facebook SAM2

- Solves promptable visual segmentation in images
- e.g. « I am looking for small circular structures, that most of the time are structured in linear pattern » + shaft centers selection
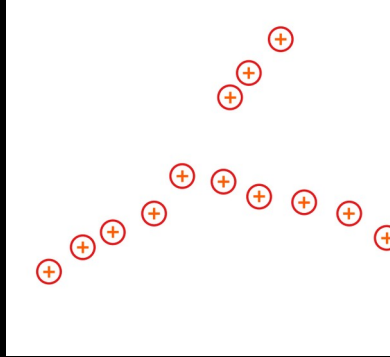

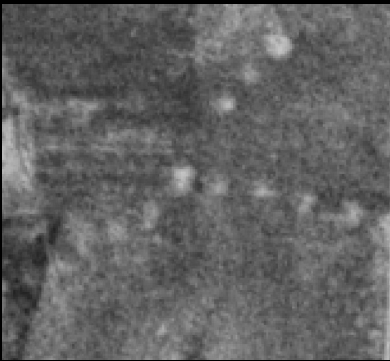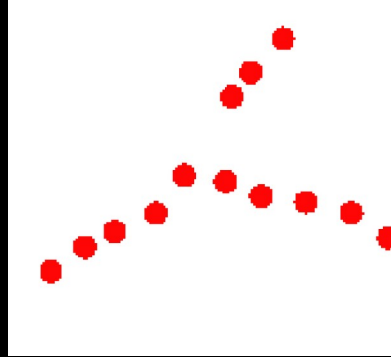SAM2 led to poor shafts segmentation results

Second approach: GIS
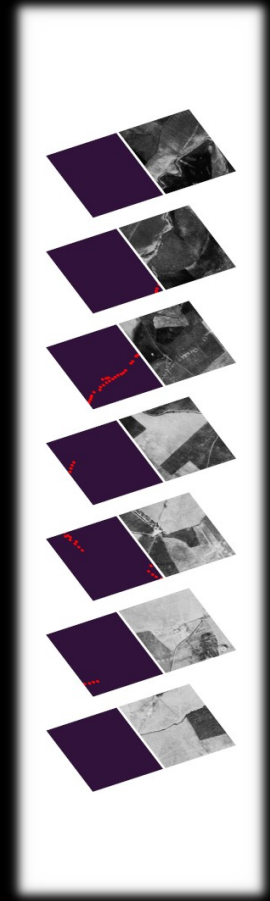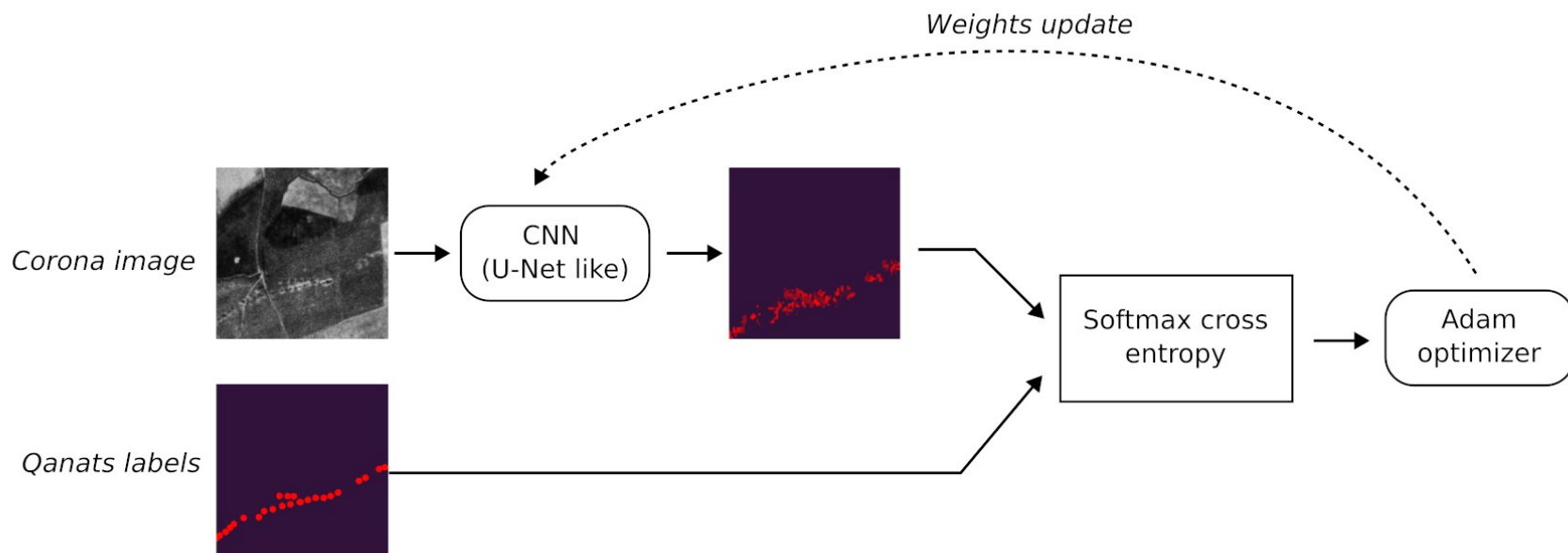

Shafts coordinates

Buffered

Label image

Corona image

Labels and images patches
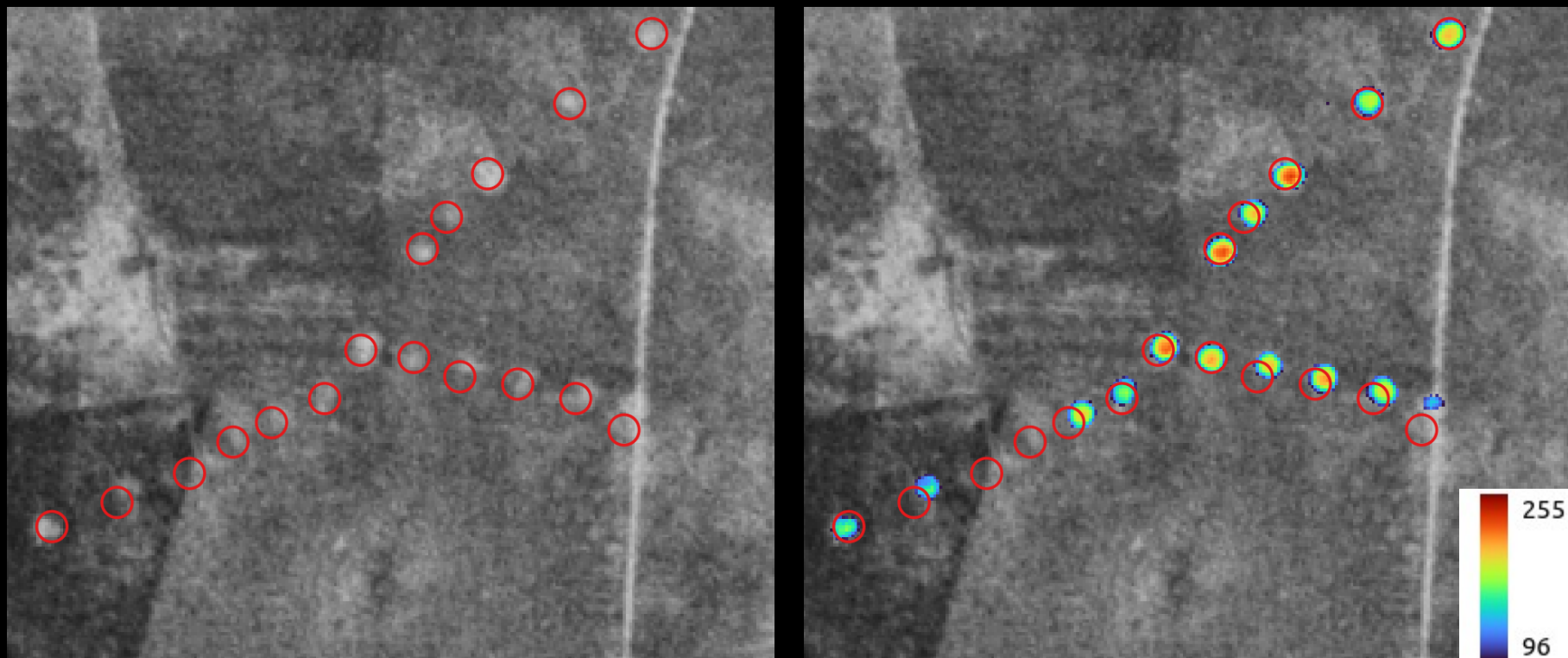
Model training

Train/Valid/Test proportion
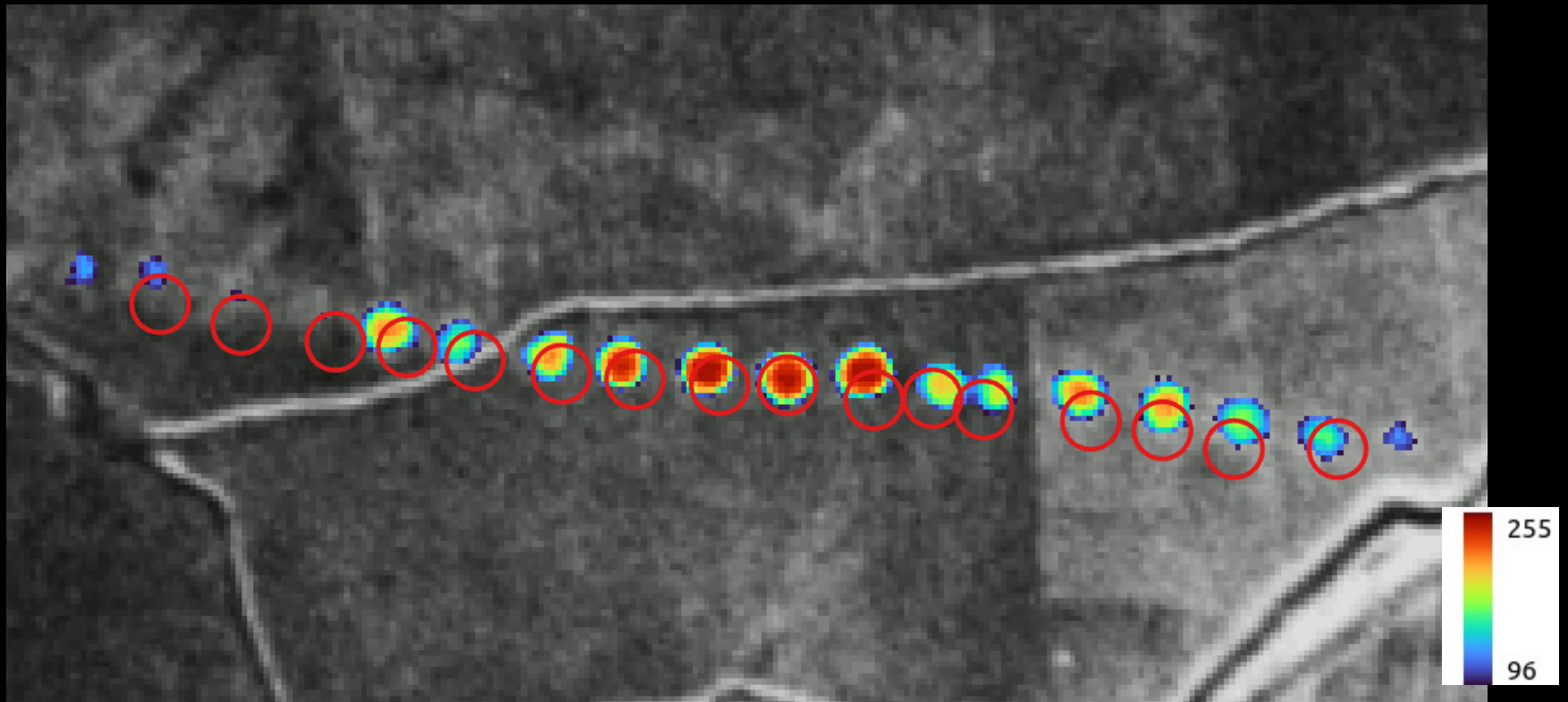80%/10%/10% (total 2478 samples)

Evaluation

- Processing time: 1 hour, single GPU NVIDIA V100
- Metrics (test dataset)
  - Precision: 65.7%
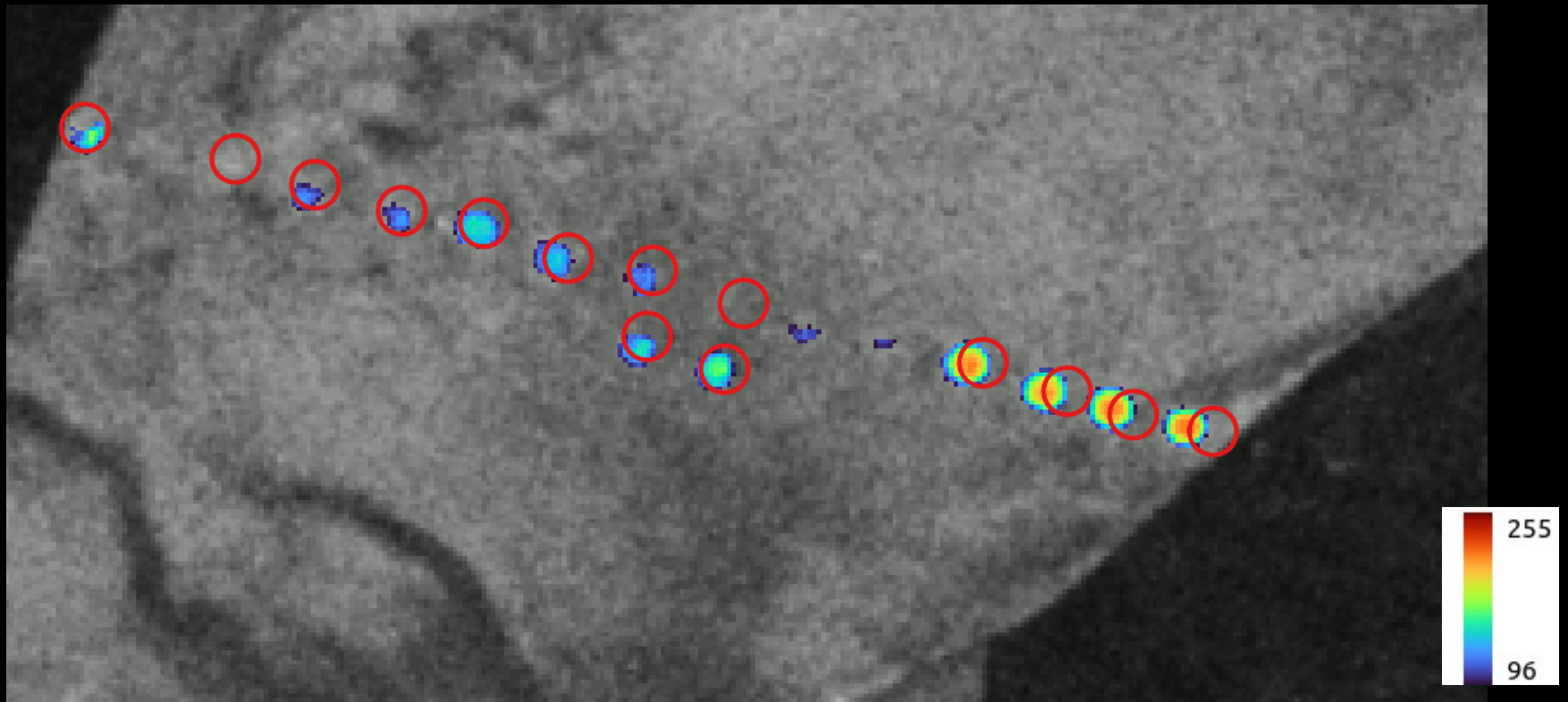 - Recall: 26.4%
 - F-Score: 37.7%

Results

Corona image with buffered shafts locations (red) and inference results (shaft footprint pseudo-probability estimation)

Corona image with buffered shafts locations (red) and inference results (shaft footprint pseudo-probability estimation)

Corona image with buffered shafts locations (red) and inference results (shaft footprint pseudo-probability estimation)
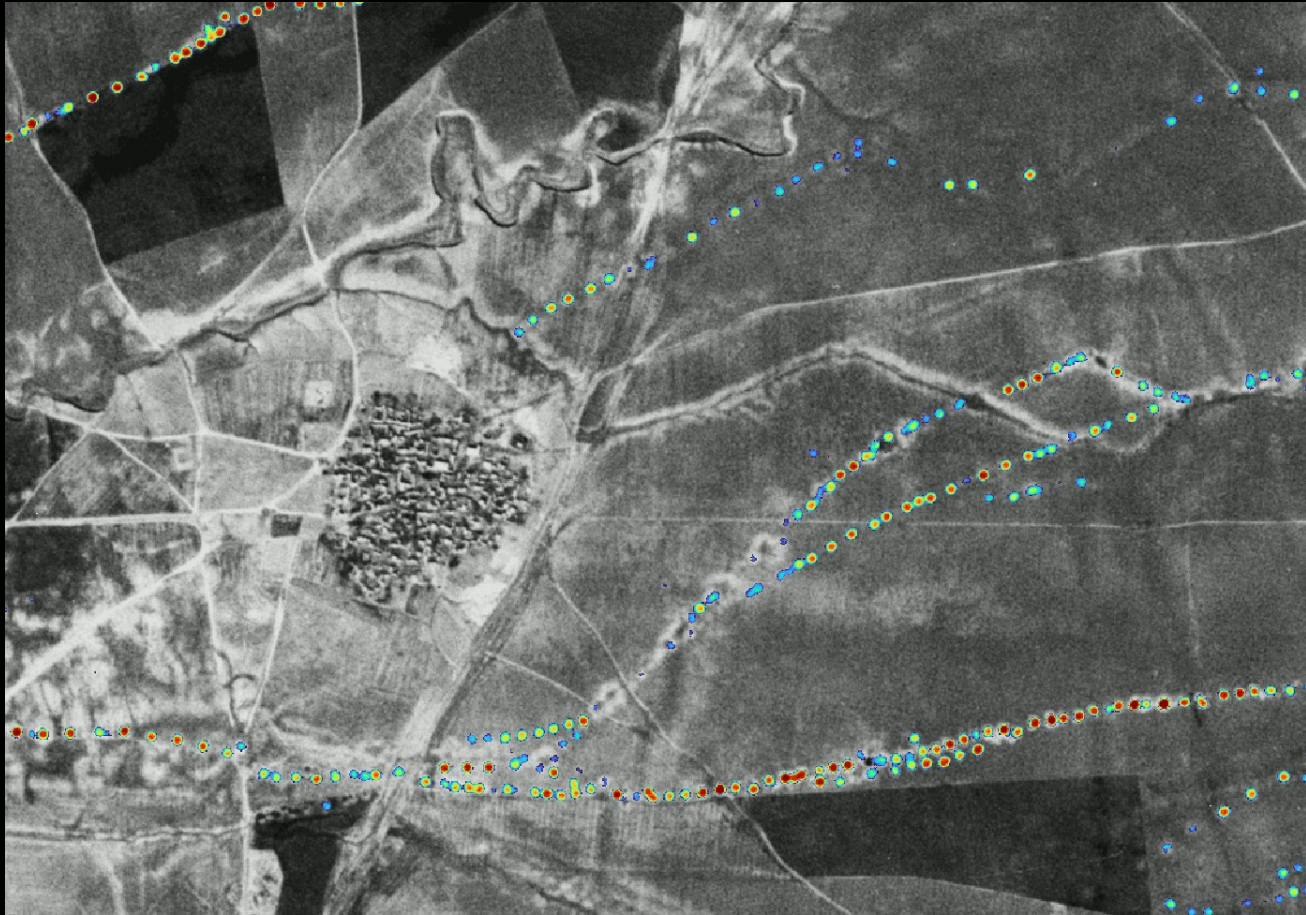
City of Qoritan, near Erbil, Irak
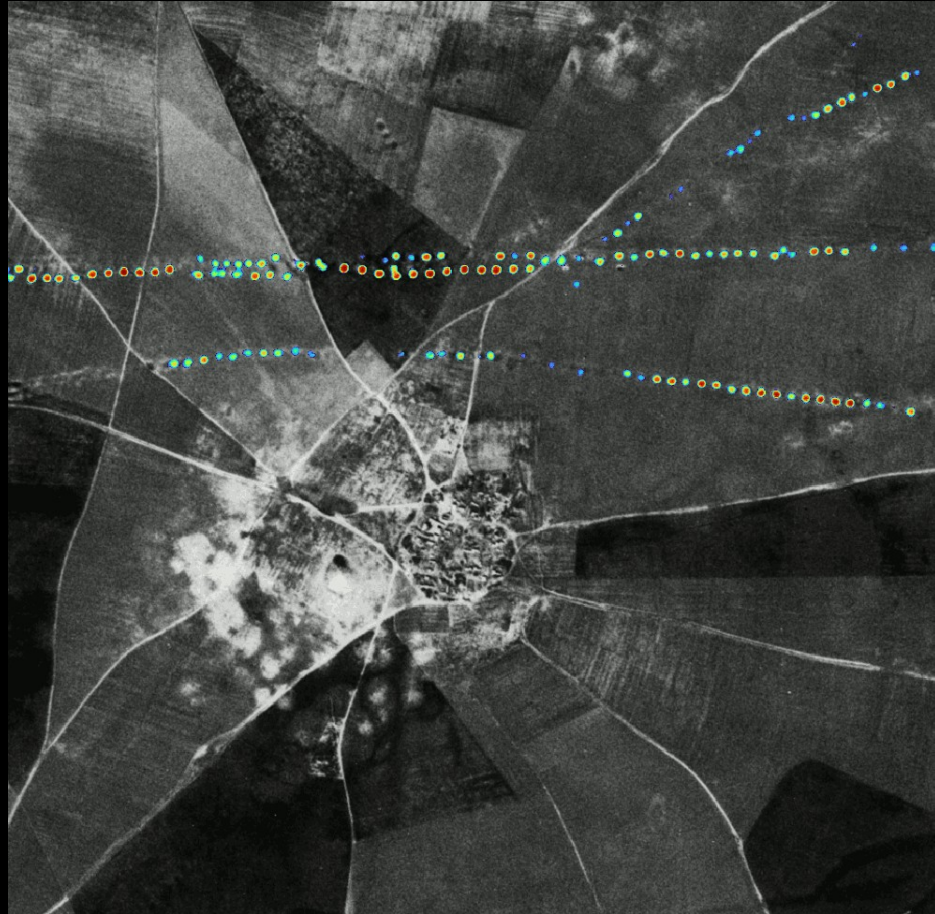
City of Surezha, near Erbil, Irak

Acknowledgements

Mehrnoush Soroush, Emad Khazraee, Dominik Lukas, Parmanand Sinha, Yuwei Zhou, Jiayue Wang, Breanna Maestas