

Towards the use of DESIS for Landscape Archaeology: Identifying Anthrosols around Konya, Turkey

Daniele Cerra¹, Michele Massa², Stefan Auer¹

1. German Aerospace Center (DLR), Photogrammetry and Image Analysis
2. University of Chicago, Oriental Institute

1st DESIS User Workshop

Everybody's home, 1.10.2021

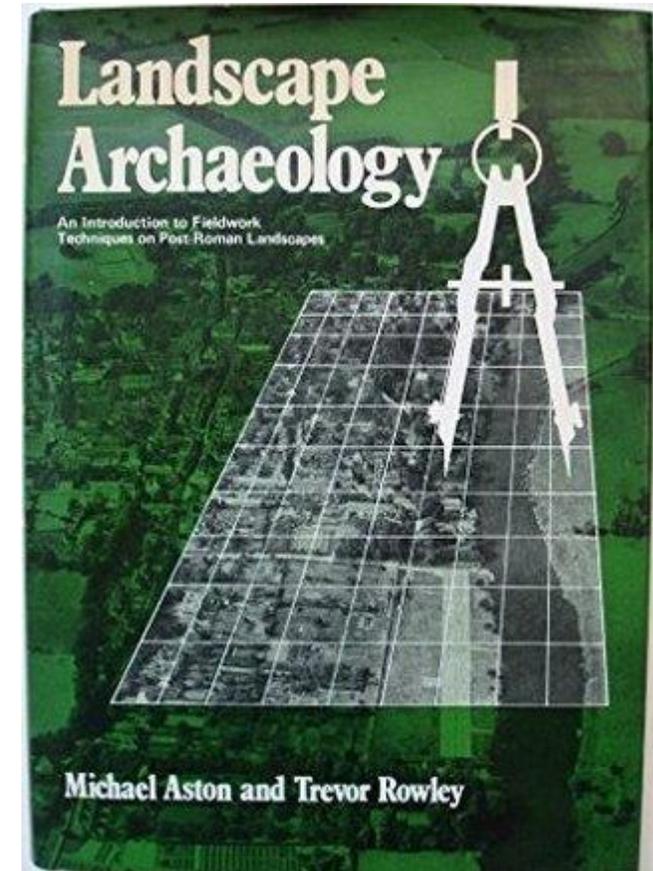


Wissen für Morgen

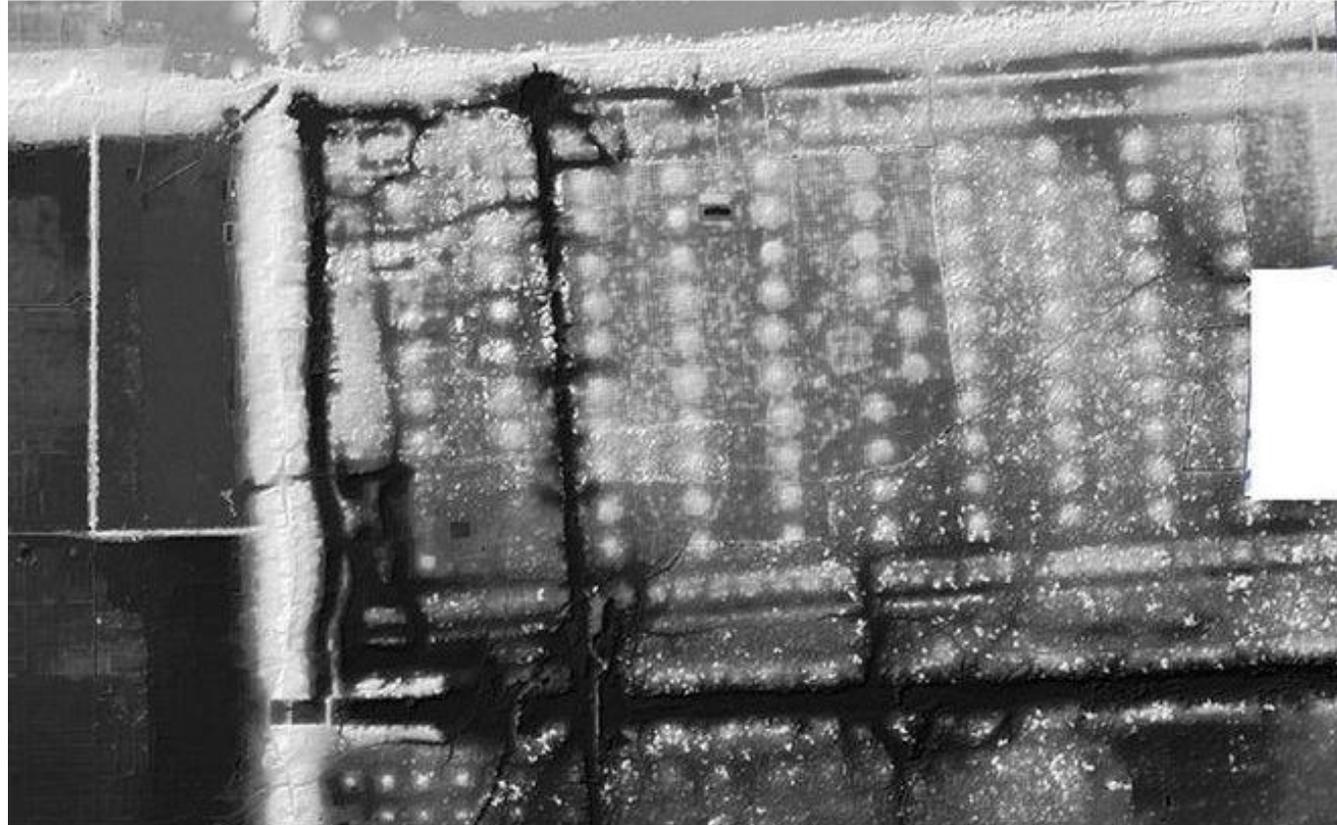


Landscape Archaeology

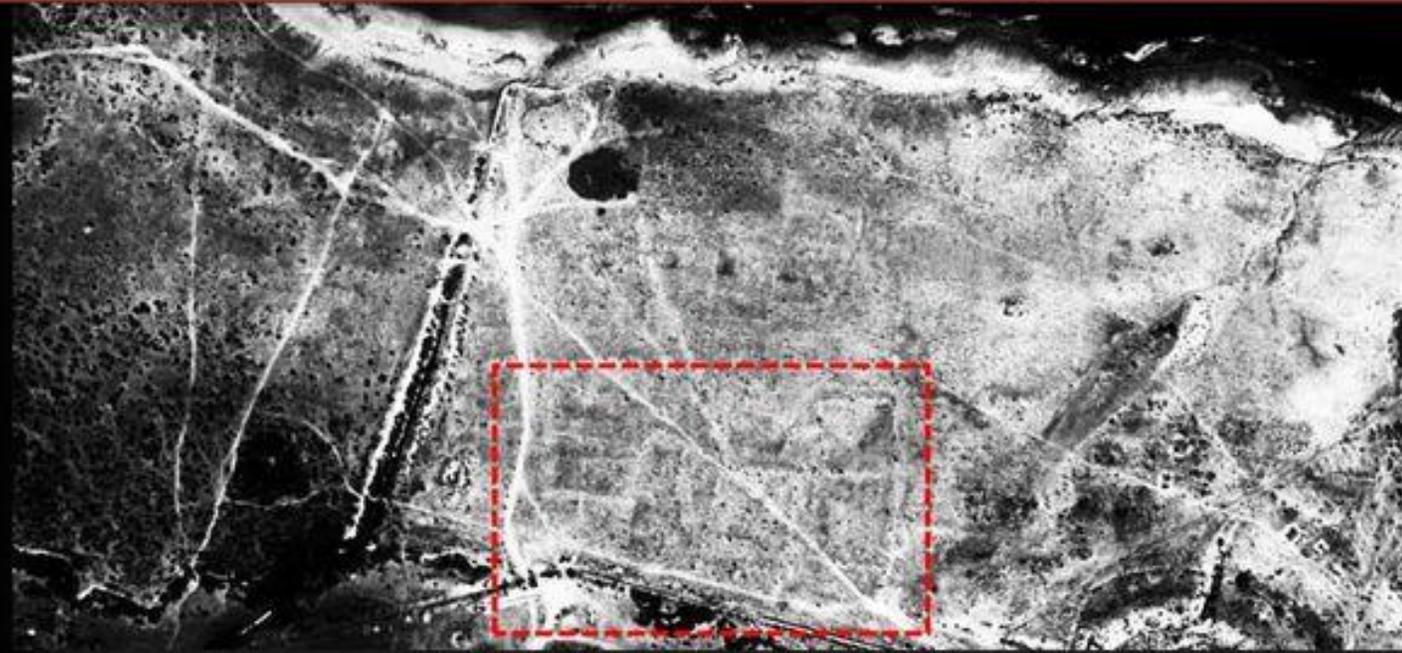
- **Landscape archaeology** analyses broad patterns in archaeological sites at regional level
- Effectively carried out also through remote sensing
 - Optical (especially high resolution)
 - Also amatorial / free & easy (Google Earth)
 - SAR
 - Penetration up to 10 m in dry sand
 - LiDAR
 - Pattern discovery below canopy
- Pattern-recognition algorithms can semi-automatically detect archaeological sites



Regular mounds discovered in Cambodian jungle through Lidar last pulses



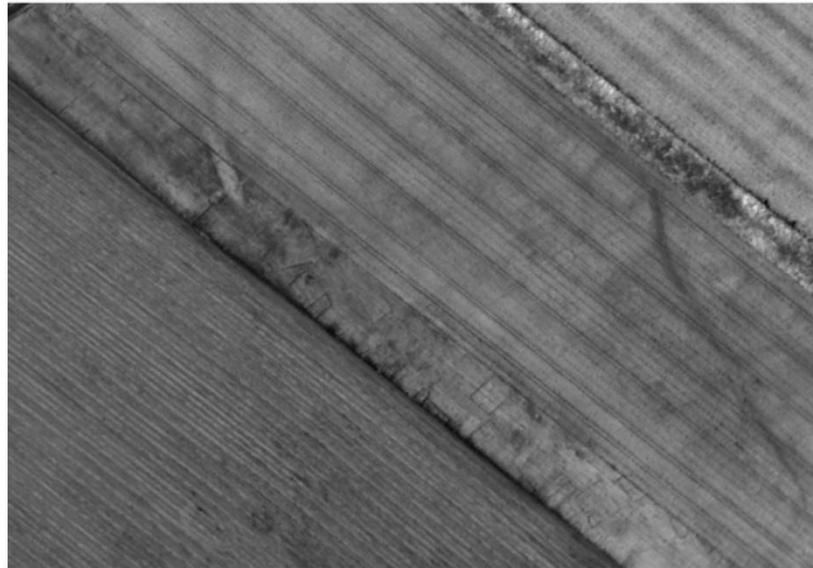
[Cambodian Archaeological Lidar Initiative \(CALI\)](#)



Example with imaging spectrometers: Crop Marks



1 - True Color Combination

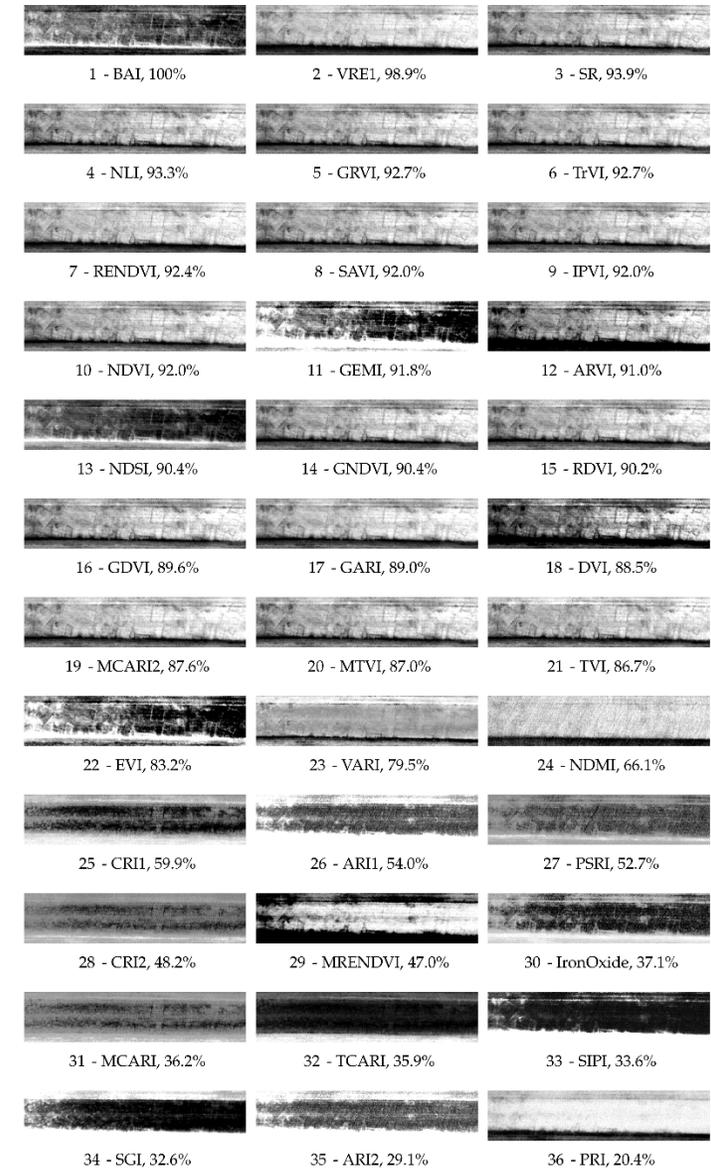
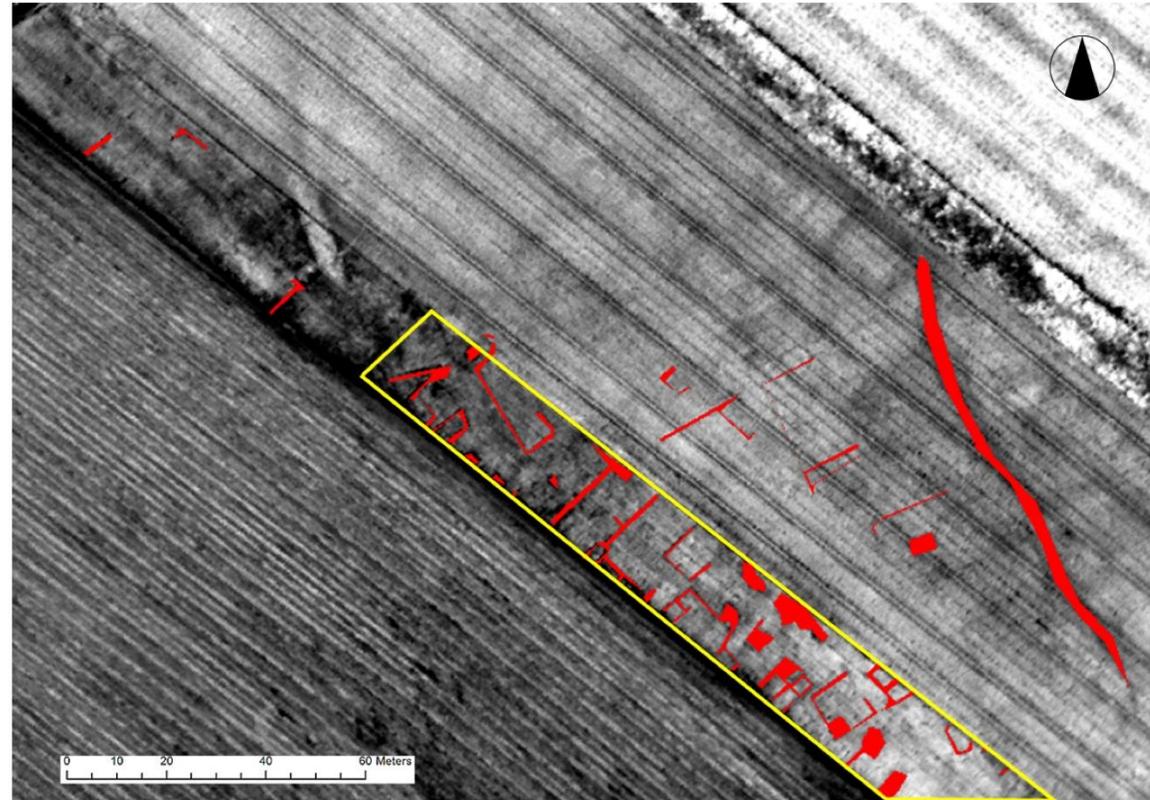


2 - NIR band at 787 nm



3 - PC 1

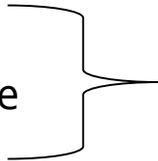
Example: Crop Marks



DESIS for Landscape Archaeology

- DESIS spatial resolution is not adequate for detection of buried structures
 - Ground Sampling Distance ideally < 1 m

- DESIS spectral resolution can be exploited for
 - Target detection
 - Material identification
 - Baythmetry
 - Characterization of area surrounding a CH site

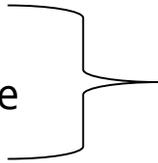


Yesterday's presentation on submerged Cultural Heritage sites

DESIS for Landscape Archaeology

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 - **Material identification**
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Yesterday's presentation on submerged Cultural Heritage sites

Characteristics of sites of interest – Konya plains, Turkey

- Inhabited since the neolithic
- In this area, houses were normally in use for 15-25 years, before a new one was built, often on the same spot for generations, remaining in the same place for hundreds or thousands of years.
- All these converging processes meant that settlements may have grown in elevation in time. From an analytical point of view, mound height is a good correlate of settlement continuity: the taller the settlement, the older it is.
- In later periods, settlements tend to be more dispersed and less compact, creating lower mounds that are sometime not visible in the modern landscape.
- Sites of interest (all often 100 m large in radius or more):
 - Tells (mounded sites)
 - Flat sites
 - Fortified hilltop sites (forts)





Mounds and archaeological areas around Konya, Turkey



Anthrosols

- Anthropogenic soils characterised by a high level of organic content
 - in particular phosphates
 - result of mixture of mudbrick clay with animal and human faeces, discarded rubbish, degraded wood and straw over long periods of time
- **Research objectives**
 - Develop a new method of semi-automated archaeological site detection that would help:
 - identify previously unknown ancient settlements in the Konya Plain region
 - better characterise known and unknown archaeological sites, by providing a more accurate estimate of their size
 - shed light on the category of flat sites, for which there has been traditionally very little investigation in Near Eastern archaeology.



Source: wikipedia

DESIS Acquisition near Konya, Turkey (mosaic, 2 scenes)

2018 - 10 - 19



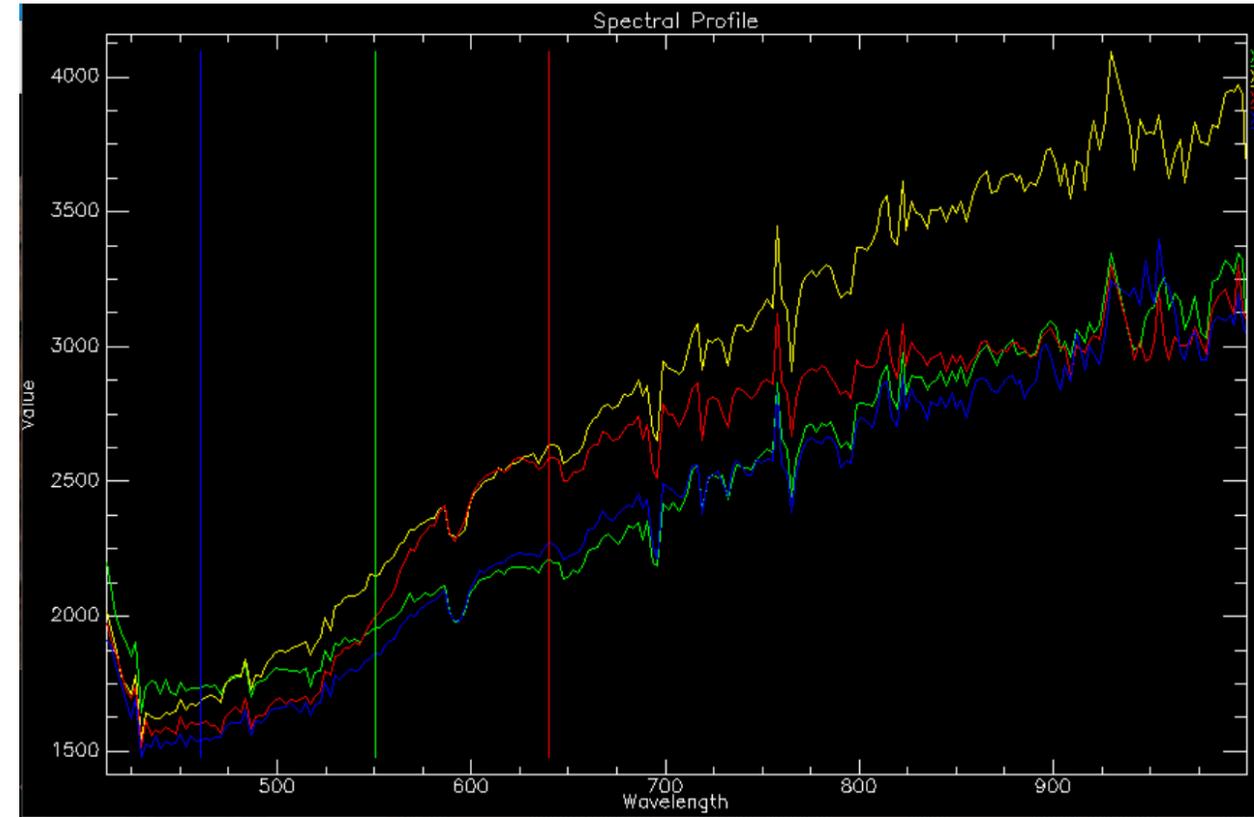
Sample of available ground truth
Vector format



Bands 16, 59, 90
440 nm, 550 nm, 630 nm



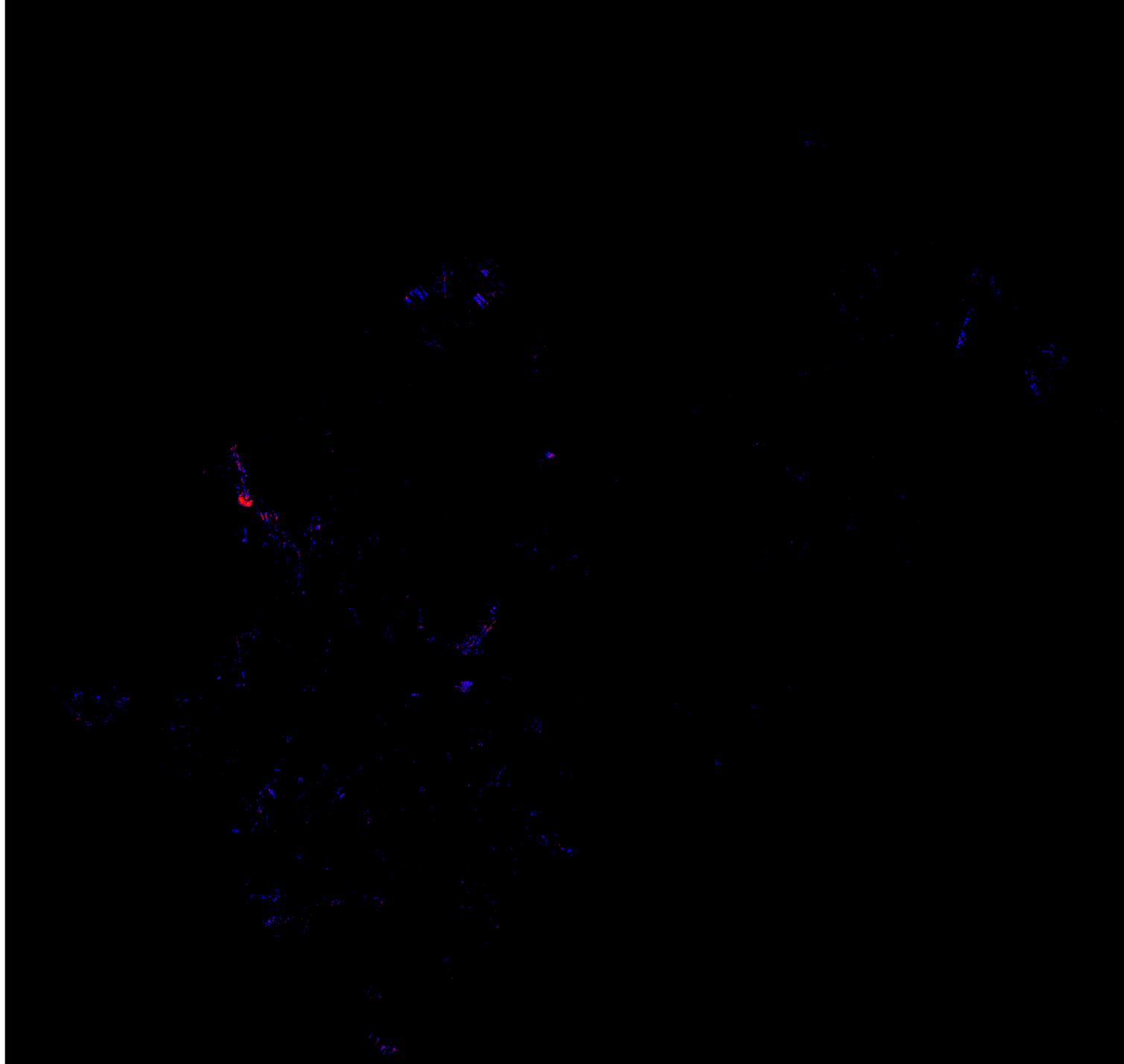
Anthrosols and other types of soils in DESIS



Preliminary analysis

- Test of 10 simple algorithms, including:
 - Spectral Angle Mapper
 - Spectral Unmixing (abundance thresh.)
 - Maximum Likelihood
 - SVM

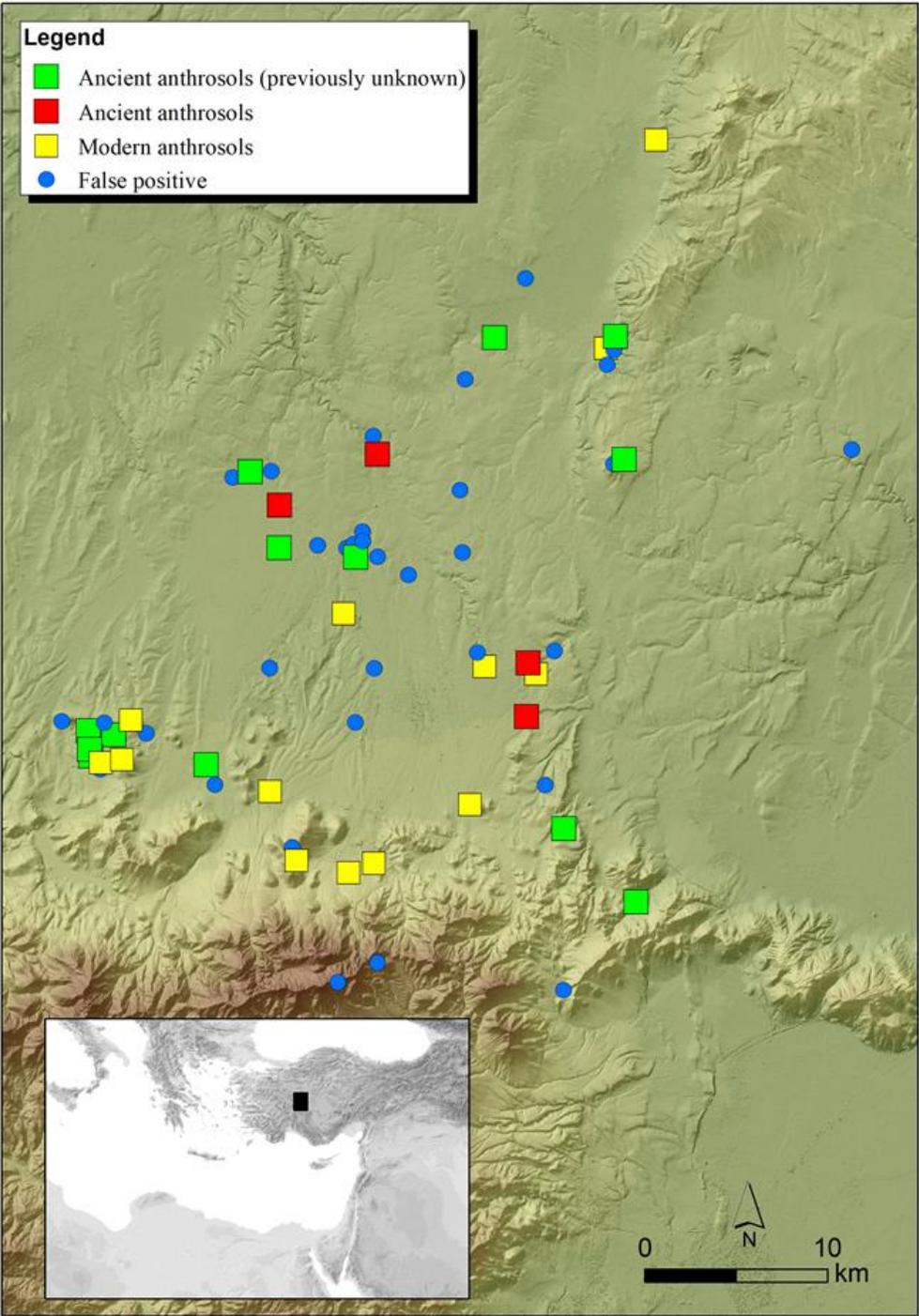
- According to the archaeologist interpretation of results, Maximum Likelihood is yielding the best results
 - Thresholded
 - Morphologically opened & closed
 - Str. el. Disc radius 2
 - Until number of detected objects is manageable (between 50 and 100)

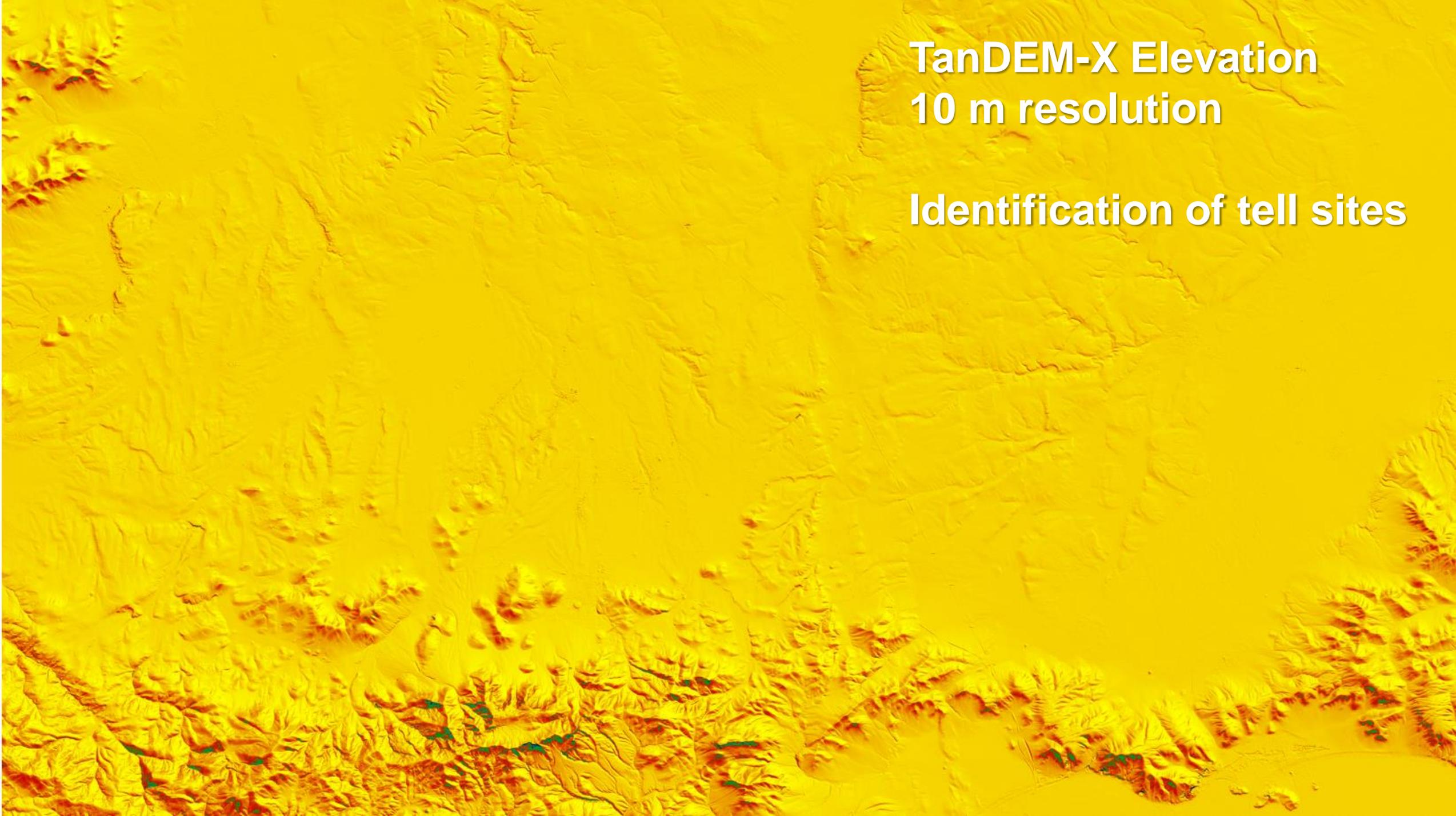


Results

| DESIS Anthrosols Detections | N. of areas |
|-----------------------------|-------------|
| Ancient (known) | 4 |
| Modern | 13 |
| Previously Unknown | 14 |
| False Positives | 31 |

Misdetections: around 50%

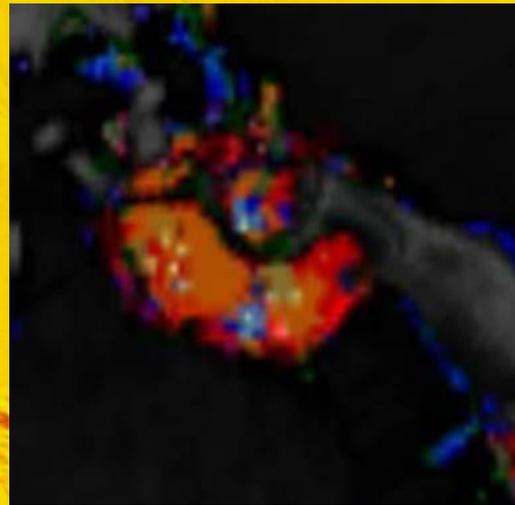
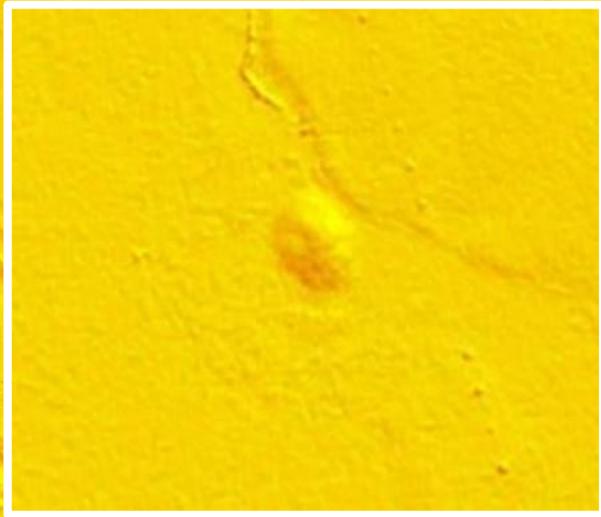




**TanDEM-X Elevation
10 m resolution**

Identification of tell sites

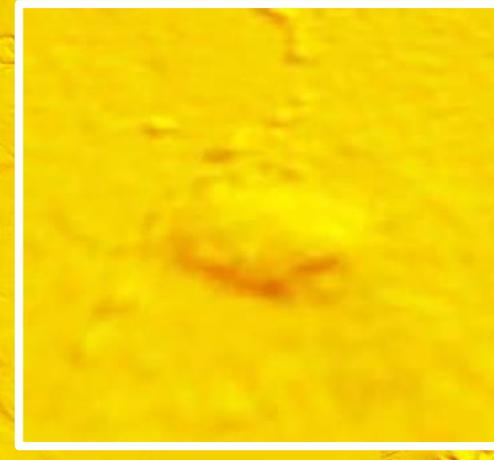
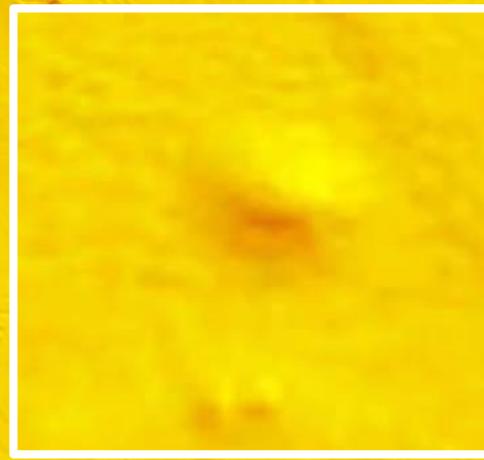
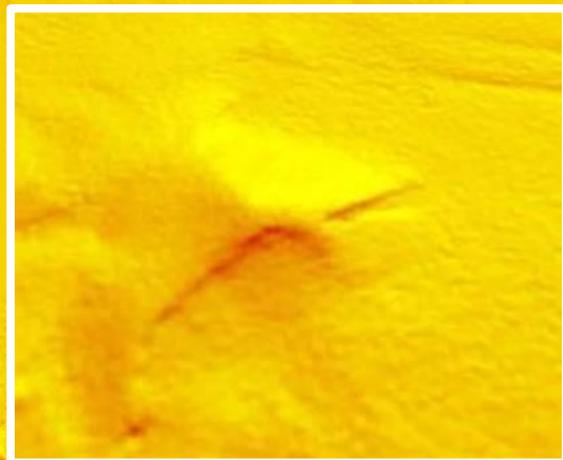
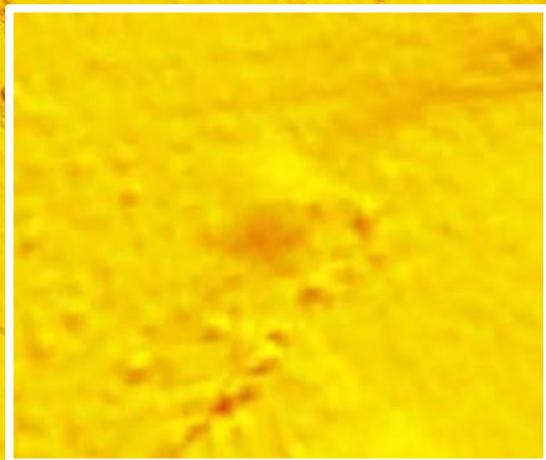
TanDEM-X Elevation 10 m resolution



Probability of anthroposols

TanDEM-X Elevation
10 m resolution

Sites detected by DESIS verified as “POSITIVES” by archaeologist



Conclusions

- DESIS is able to provide a first assessment of an area for landscape archaeology
- For specific anthrosols signatures, an expert can select a training area and retrieve similar soil samples
- In conjunction with other datasets (such as digital elevation models) or sensor types, DESIS can provide complementary information and work in synergy
- Comparisons with multispectral sensors are on the way

Sites of interest:

Tells (mounded sites) ← high resolution DEMs, DESIS

Flat sites ← DESIS

Fortified hilltop sites (forts) ← easier to spot: DEMs, traditional multispectral data