Combining X-band SAR interferometry and optical satellite imagery for landscape archaeology

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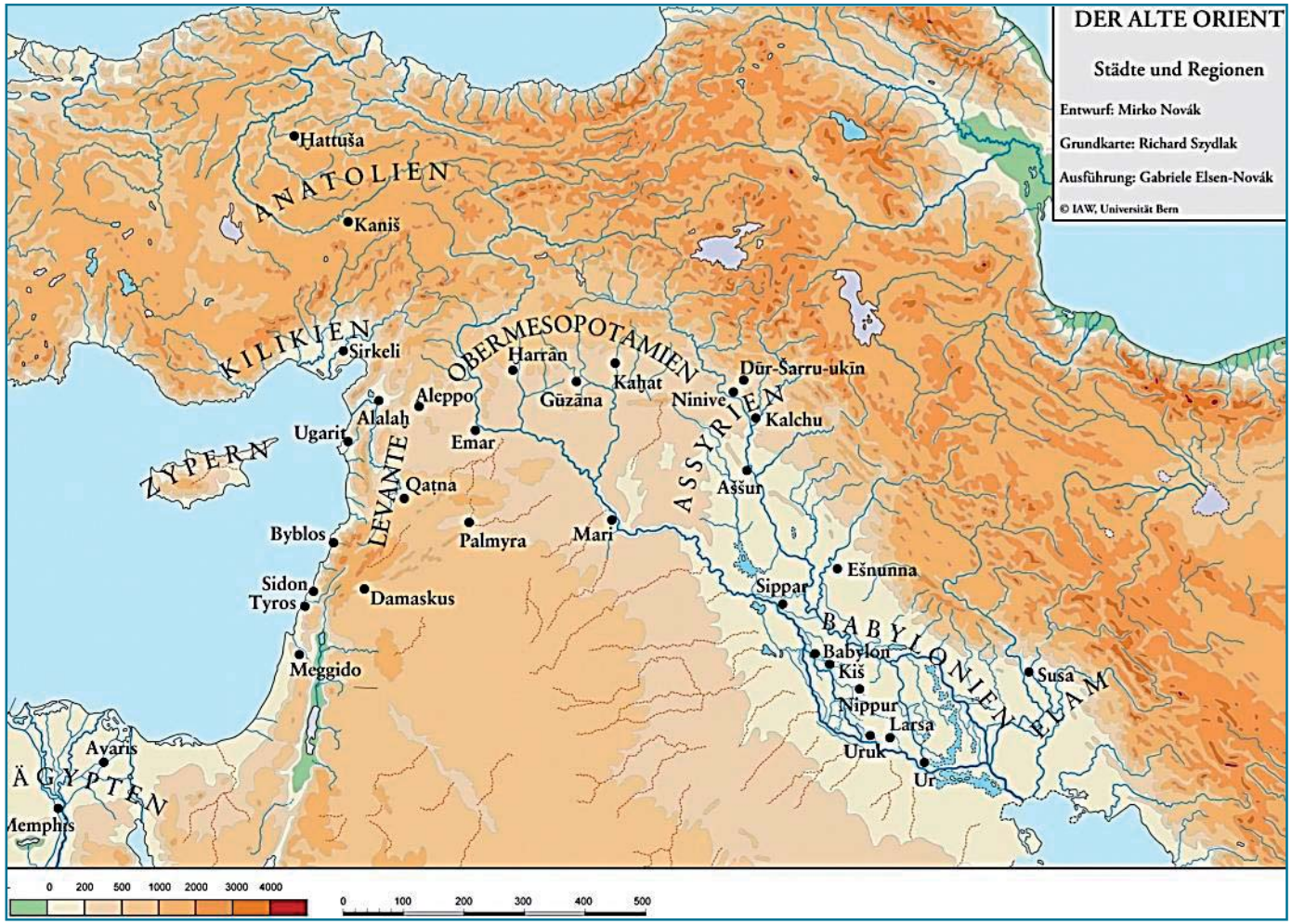
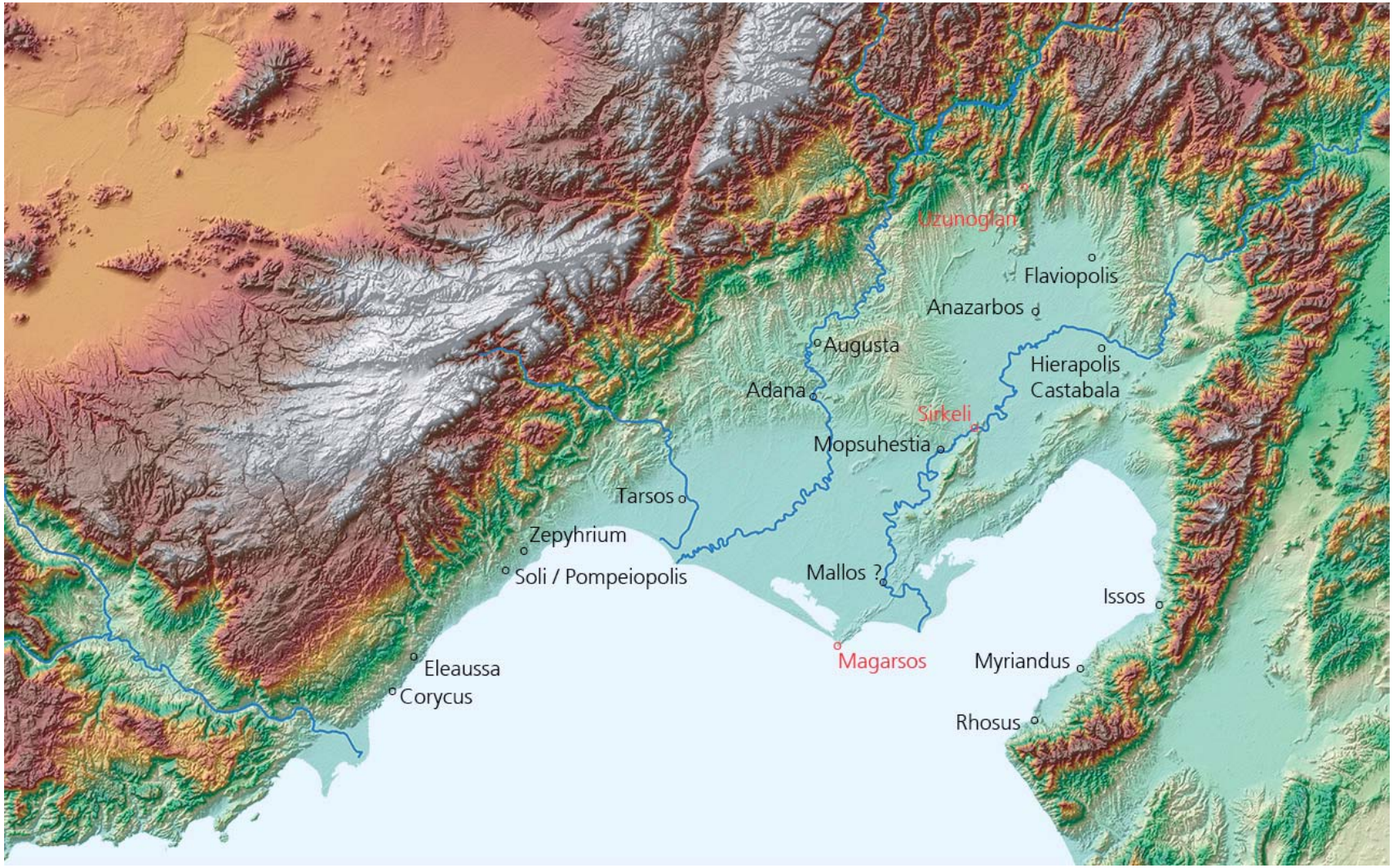
Ancient Near East

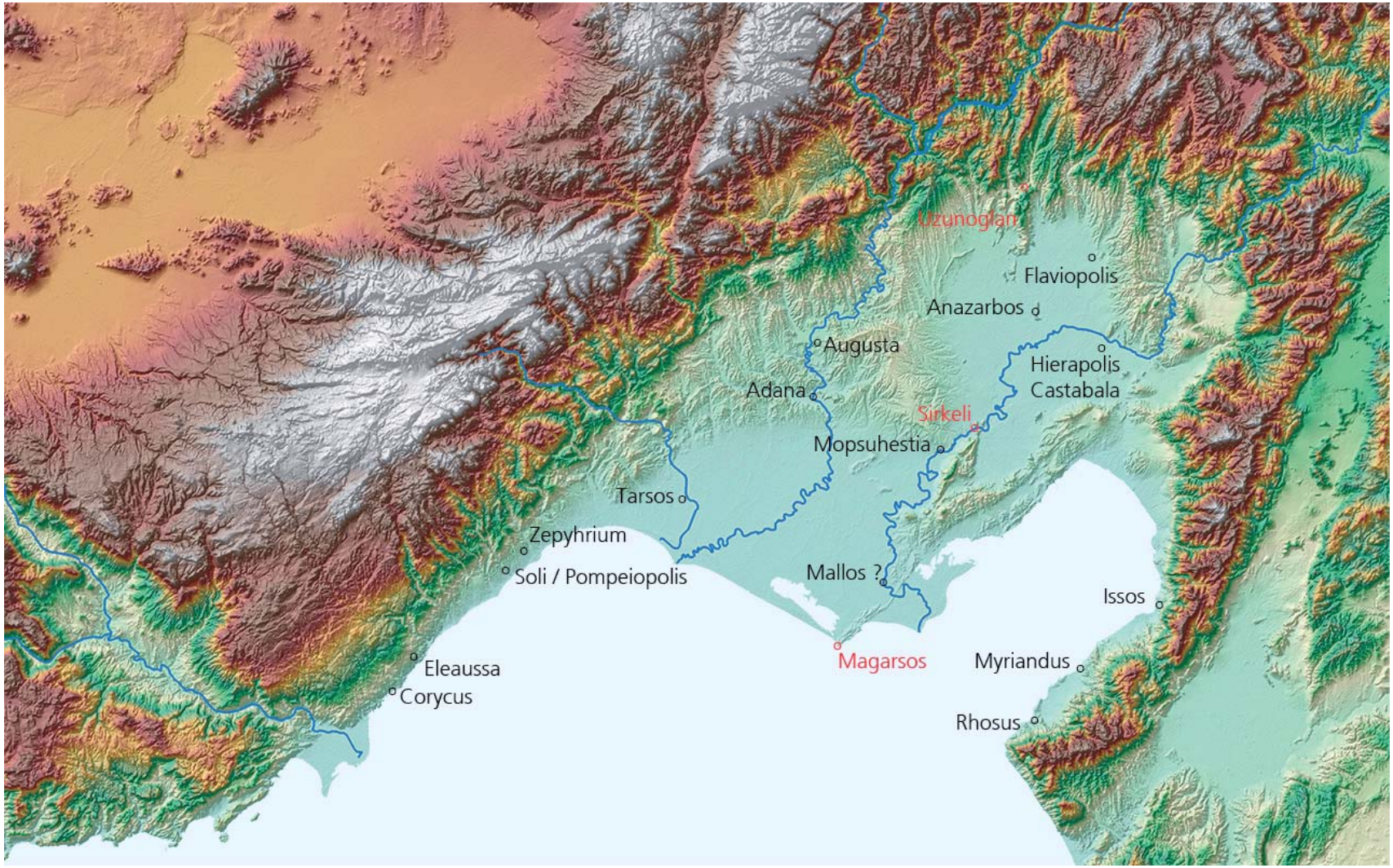


Cilicia Pedias



Between the two settlement cluster (Çukurova and Yukarıova)

Cilicia Pedias



Methods and technics used during the surveys

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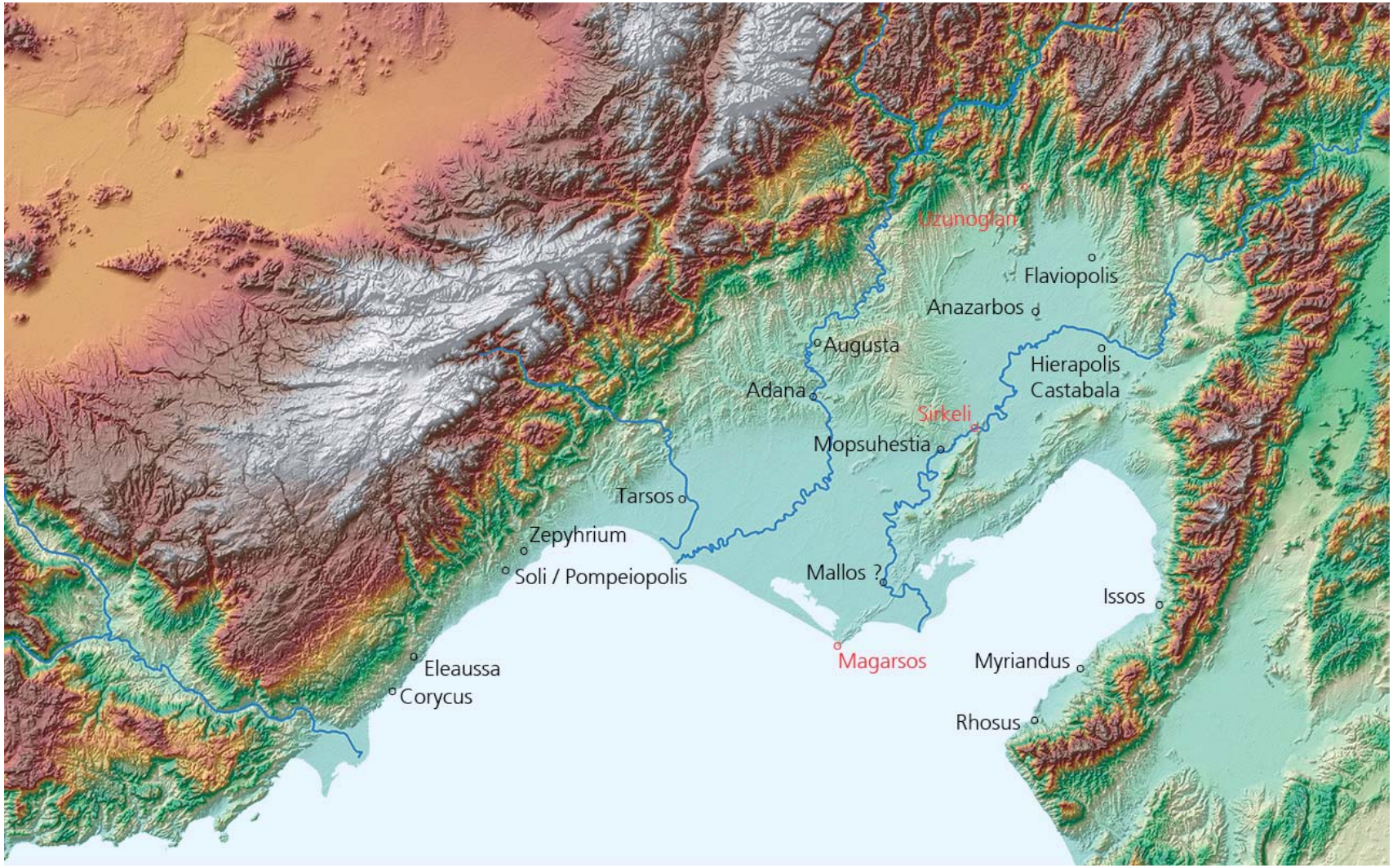
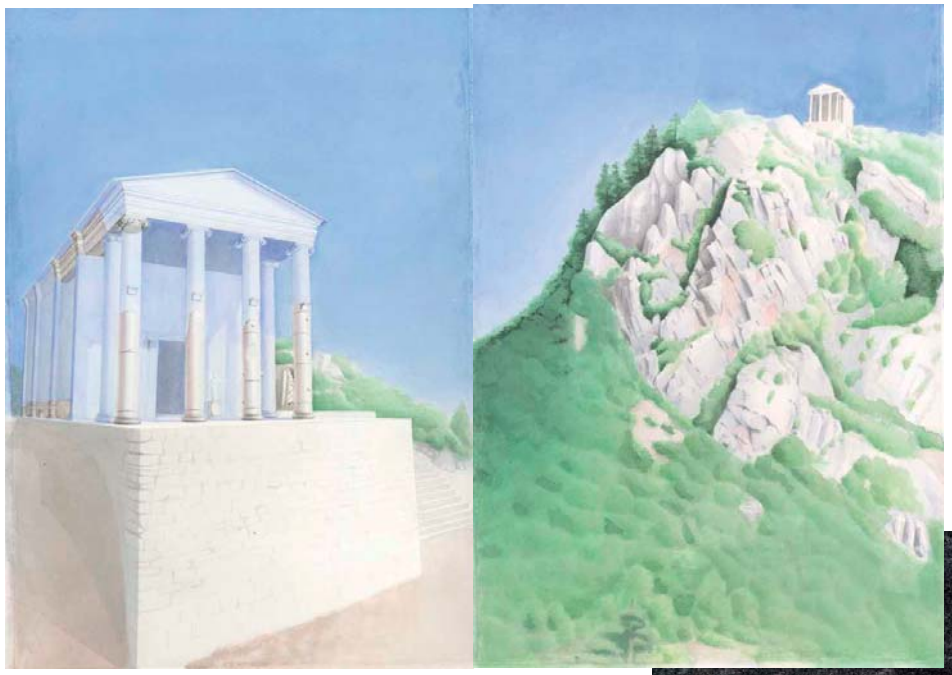
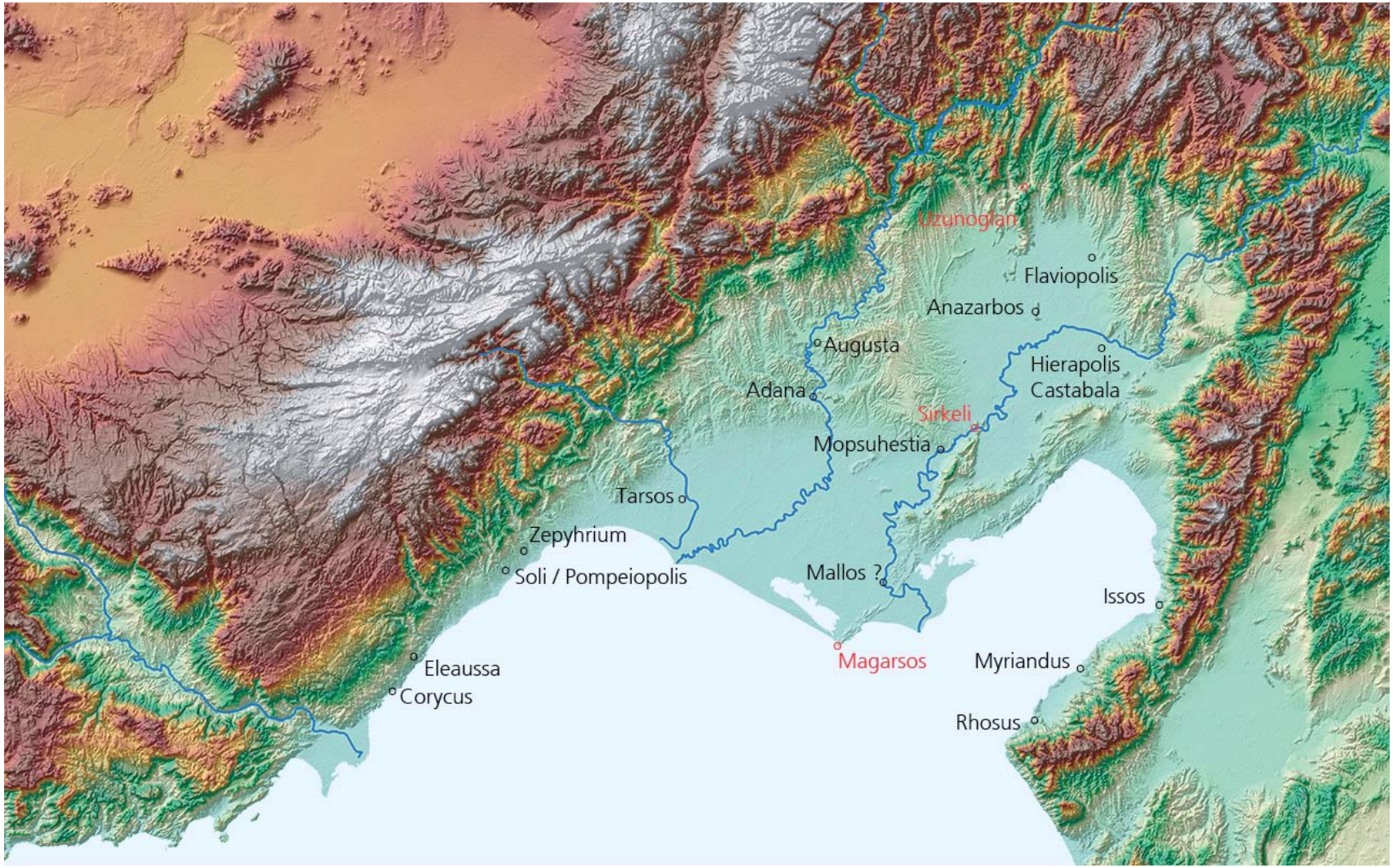
Major TanDEM-X test sites within Plain Cilicia



Major TanDEM-X Test Sites I: Uzunoğlan Tepesi with roman temple

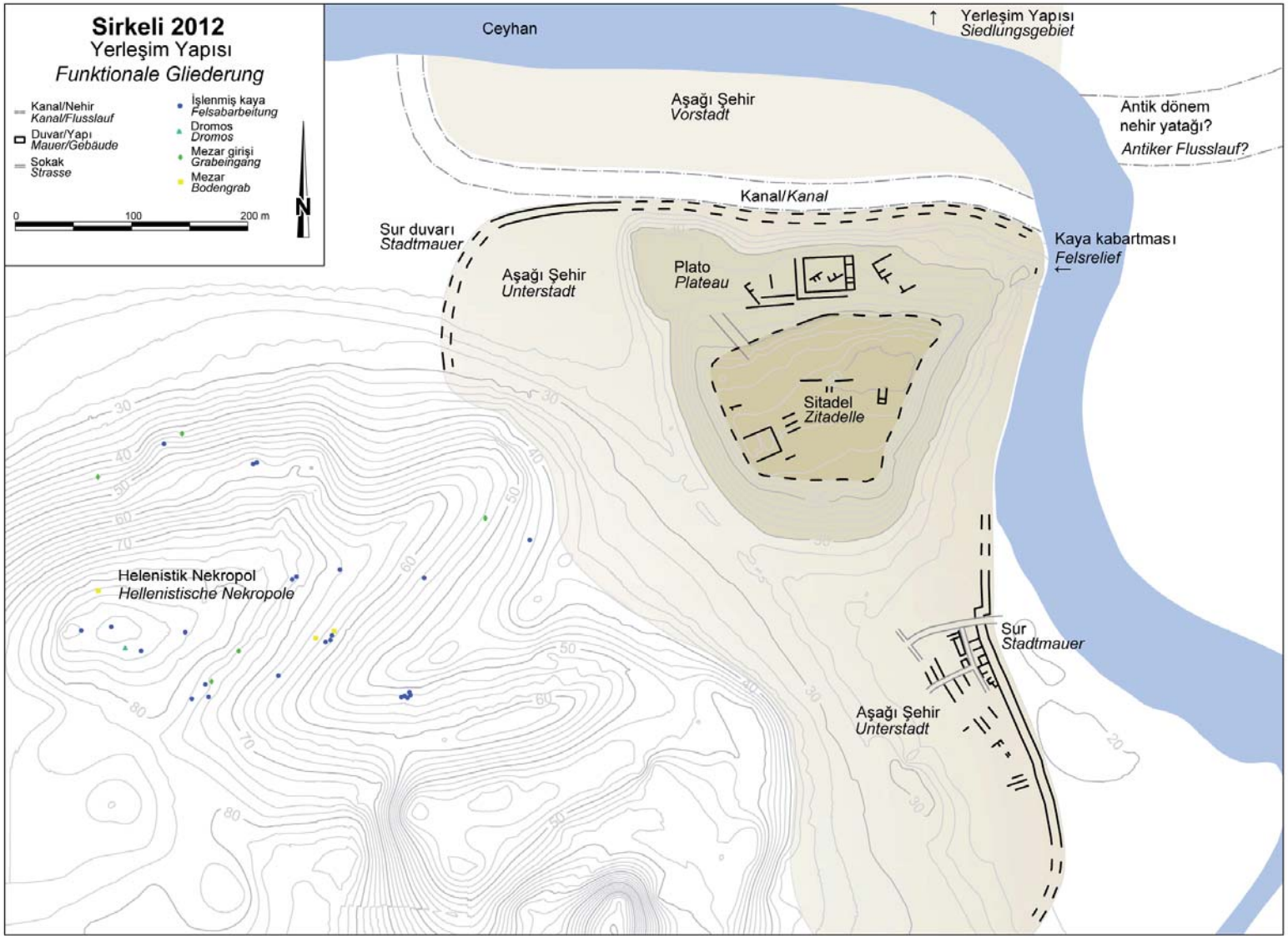


Major TanDEM-X Test Sites: Sirkeli Höyük a Bronce and Iron age mound



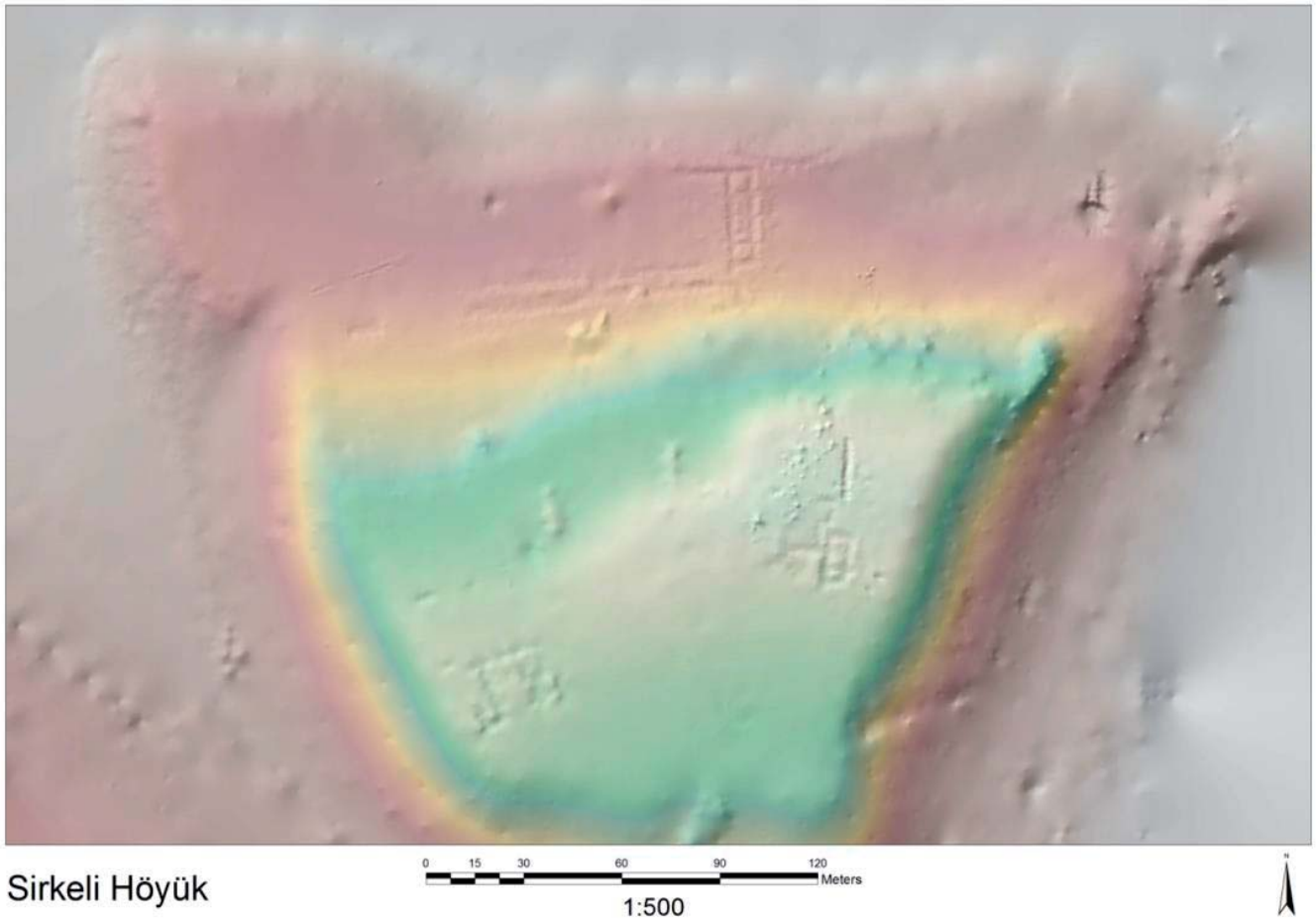
Major TanDEM-X Test Sites: Sirkeli Höyük a Bronce and Iron age mound

Sirkeli Höyük – one of the largest settlement mounds within Cilicia



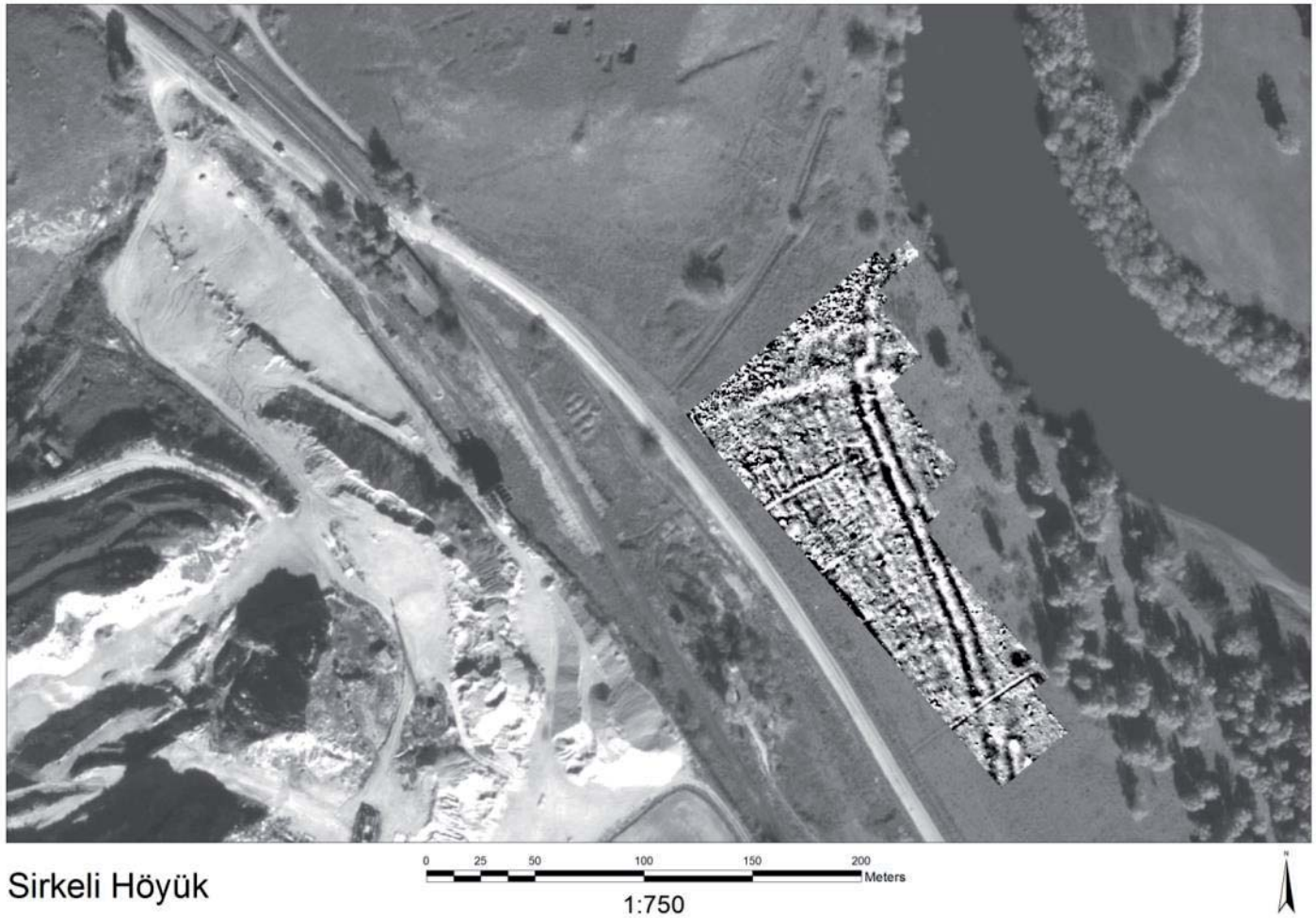
Sirkeli Höyük - clearly visible building structures in WordView1 data

Sirkeli Höyük – DEM of the top of the tellwith ditches from Spoliation

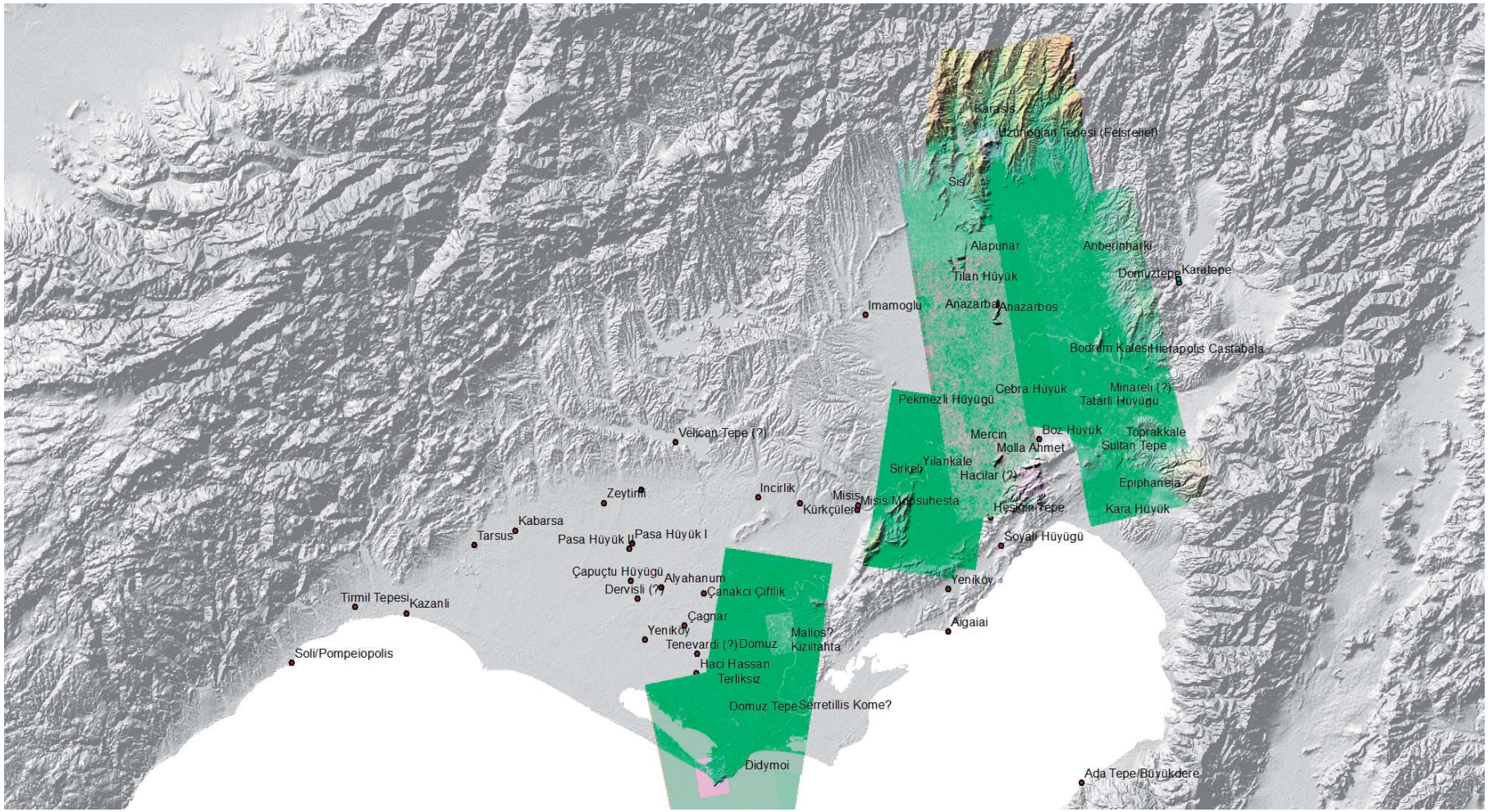


DEM generated from RTK-GPS measurements showing clearly visible archaeological structures

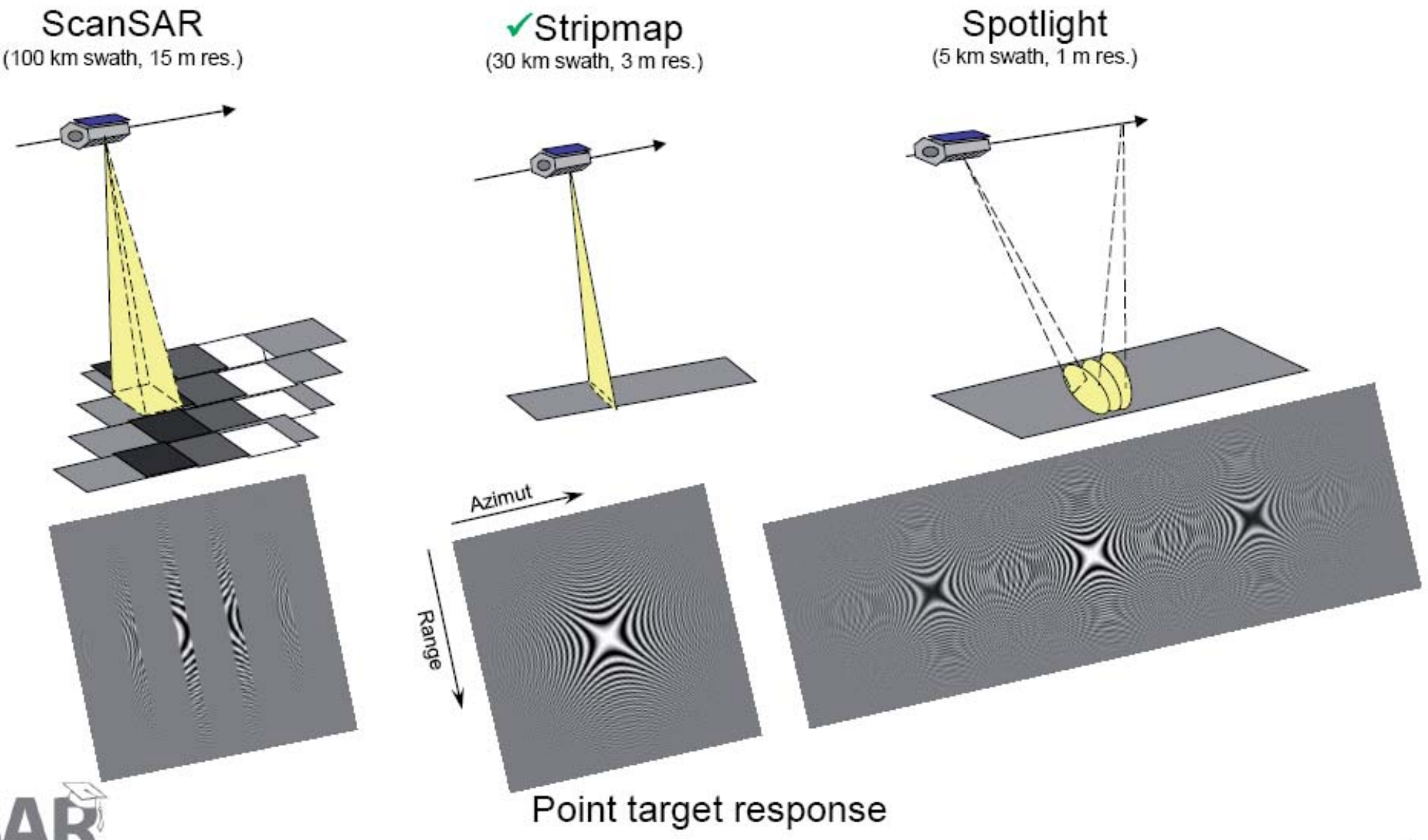
Sirkeli Höyük – magnetic prospection of the lower city with city wall



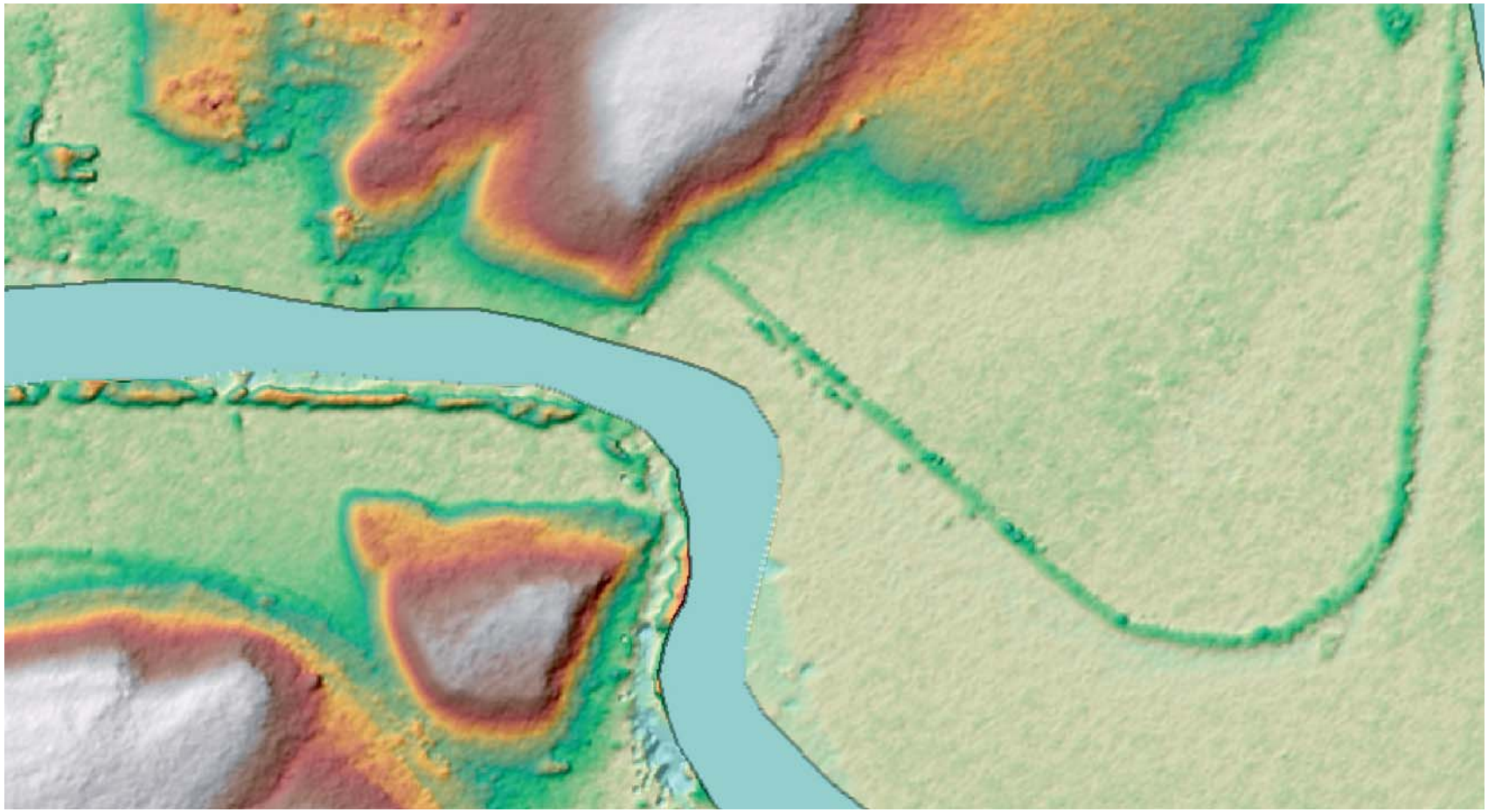
Coverage of TanDEM-X data



Advanced SAR Modes: e.g. TerraSAR-X

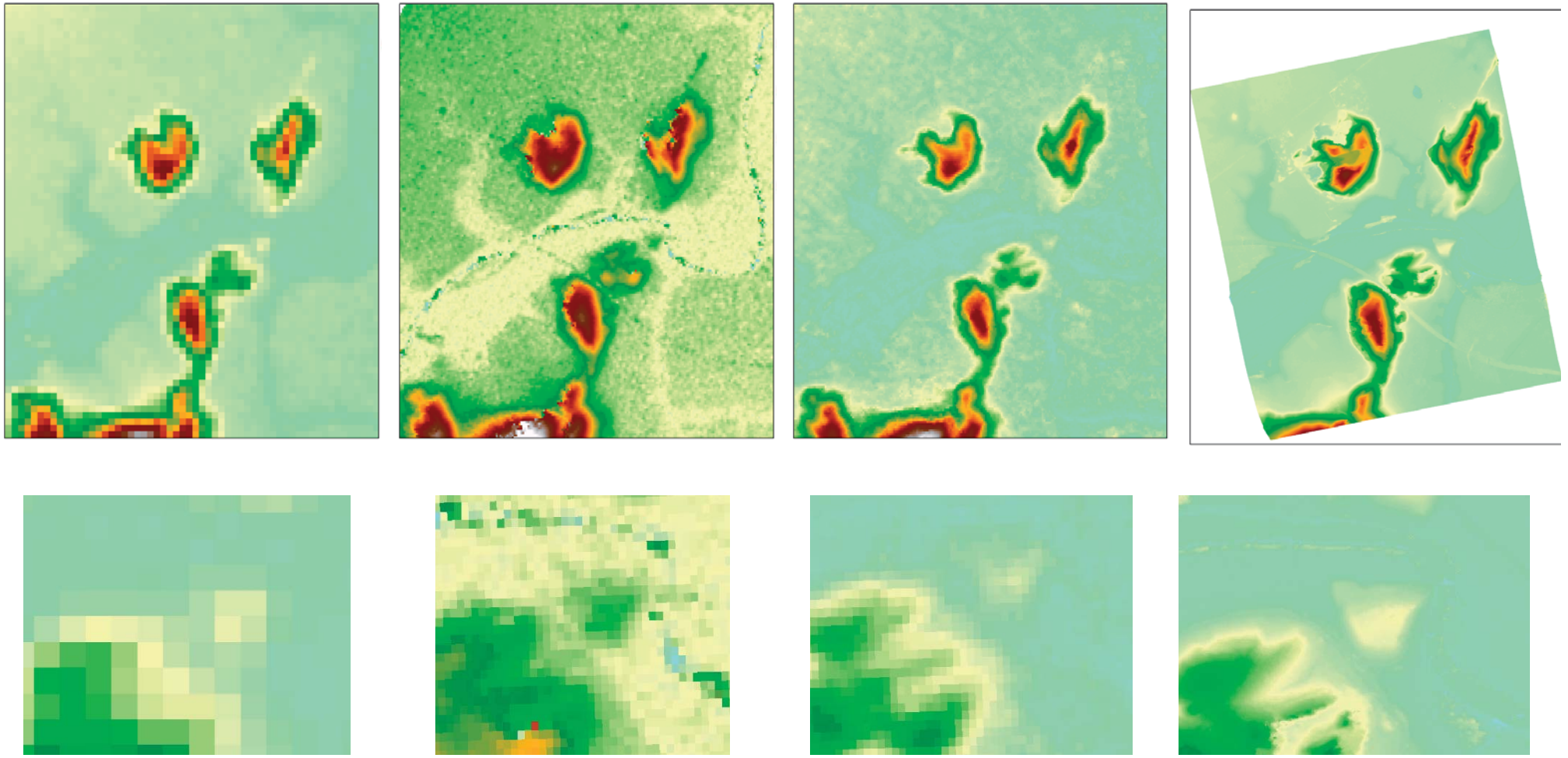


Sirkeli Höyük – digital surface model created with TanDEM-X Spotlight data



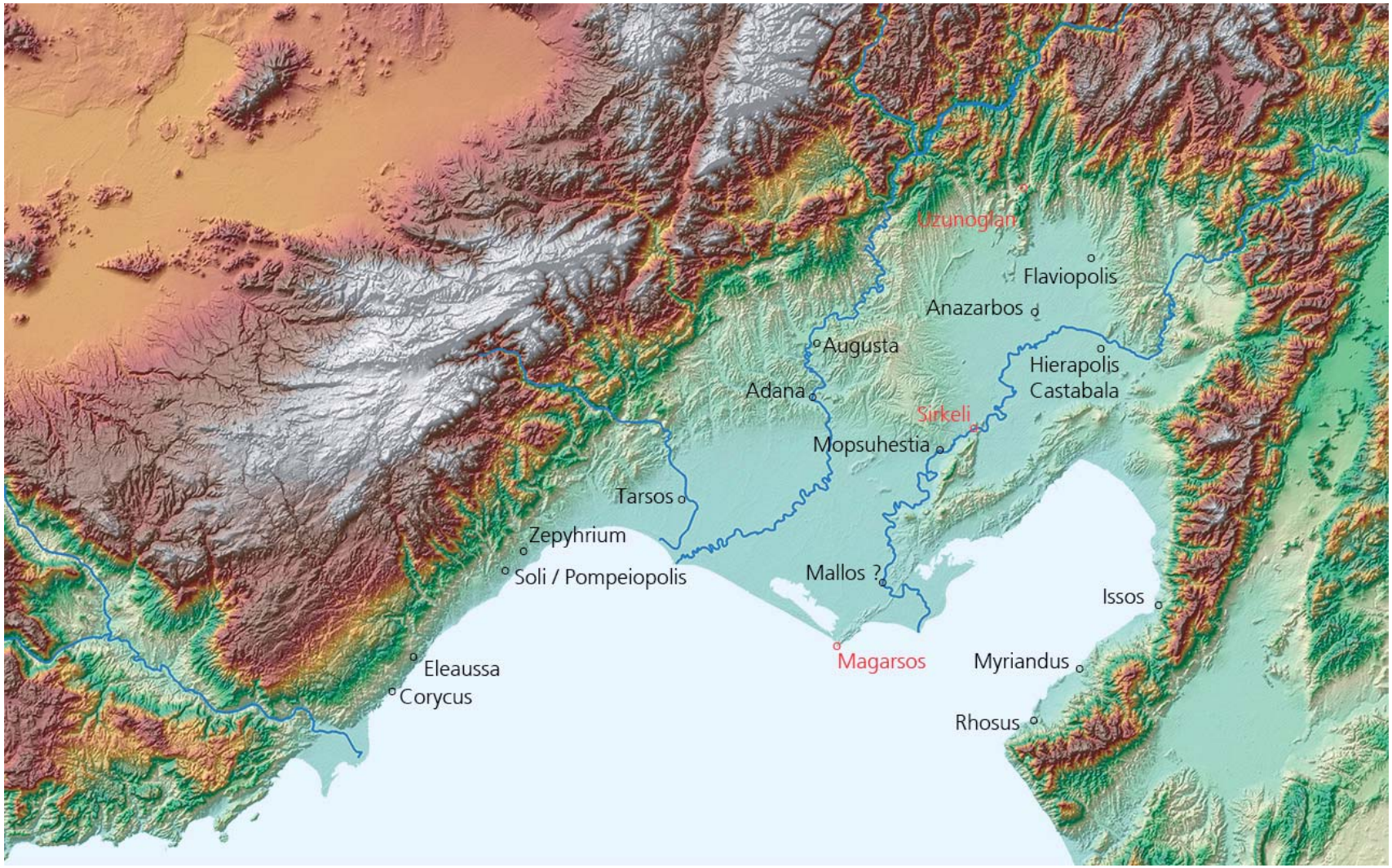
Srkeli Höyük: DEM with 2m spatial resolution generated by HS-Spotlight HH-HH (300Mhz)

DEM comparison

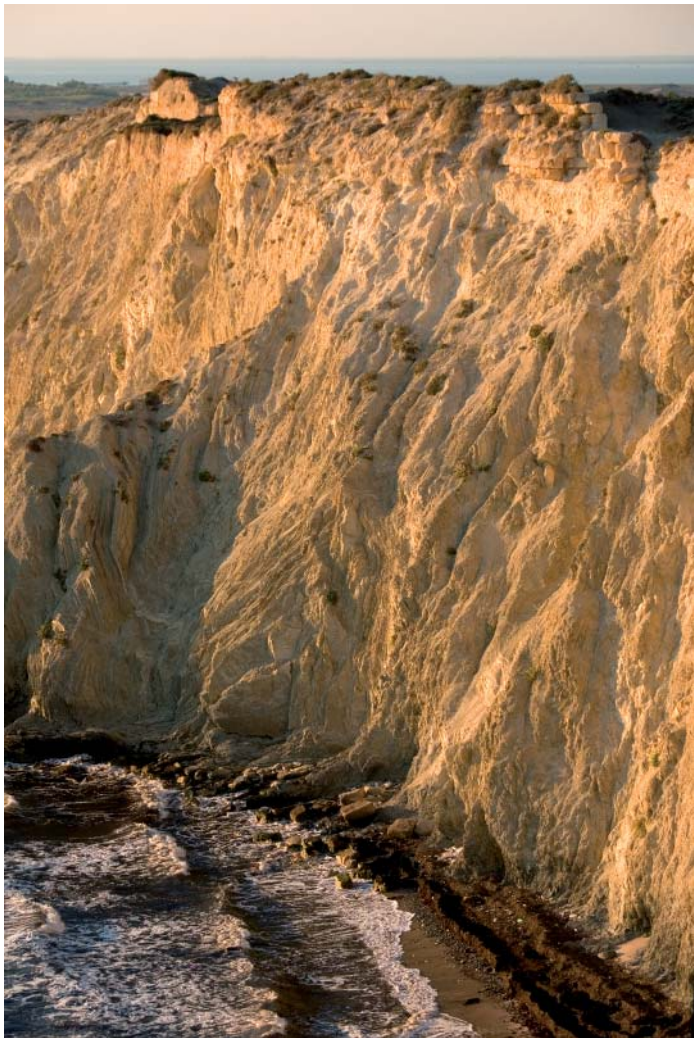


SRTM-C, SRTM-X, ASTER, TanDEM-X

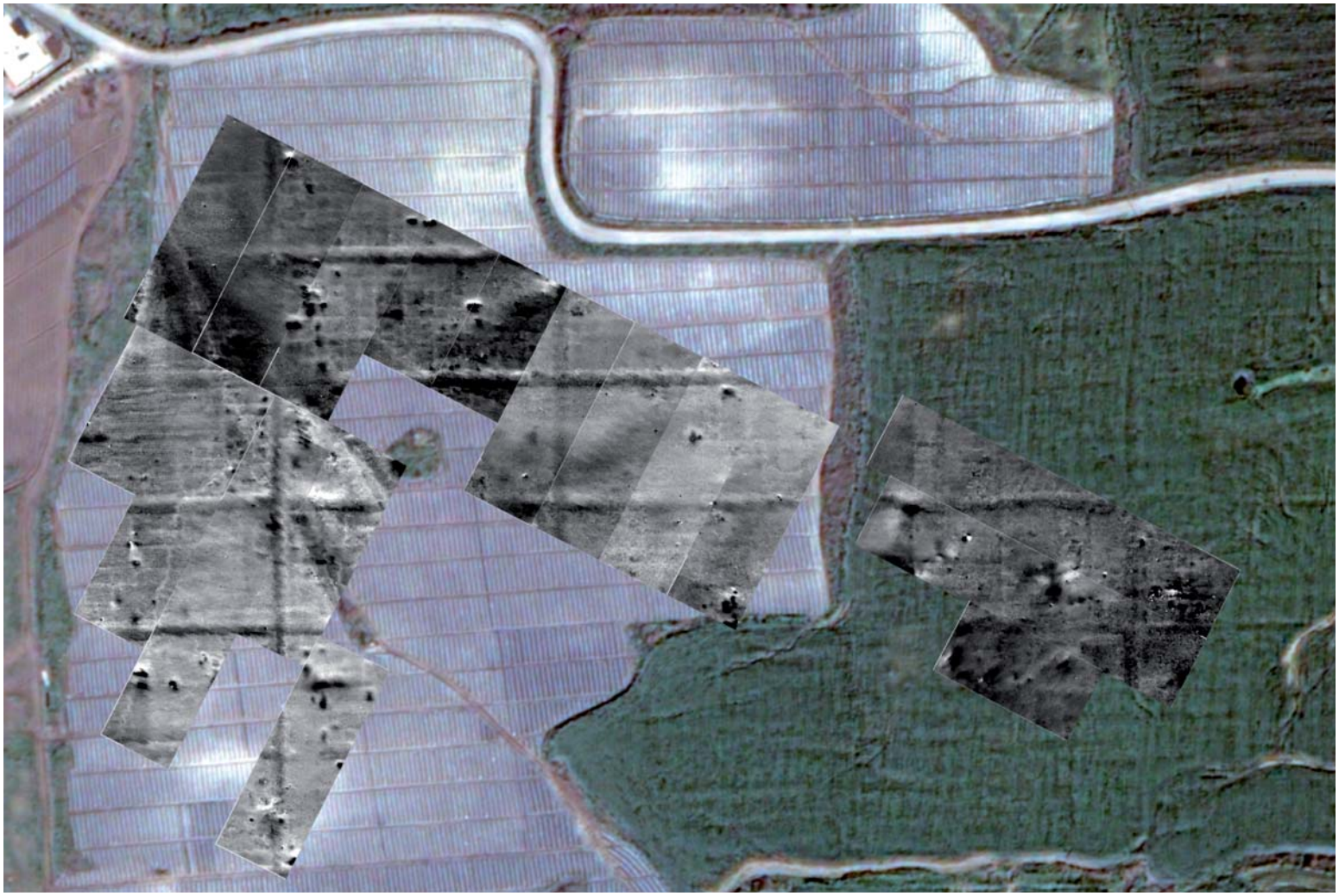
Magarsos – a fortified harbor settlementat the edge of Plain Cilicia



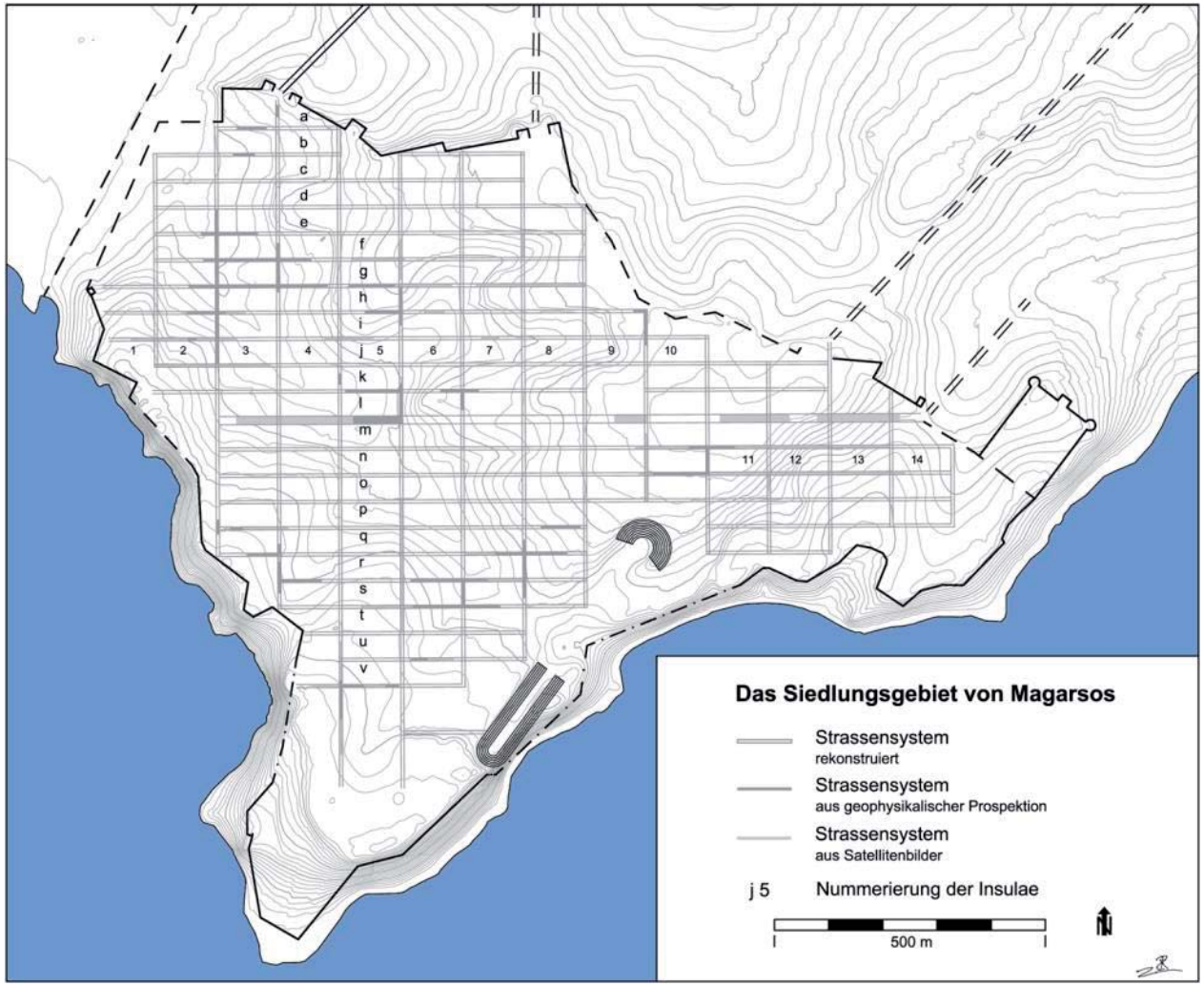
Magarsos – todays scenery



Magarsos – Combination of geophysics and orthorectified satellite image



Magarsos – Reconstruction of the city's layout



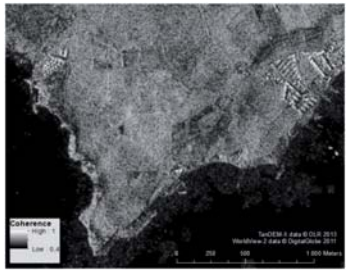
TanDEM-X scenes used for DEM-generation (StripMap & Spotlight)

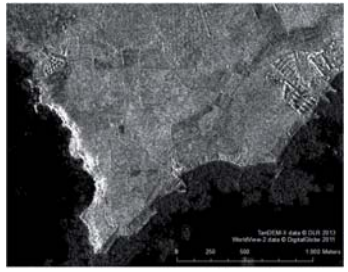
Imaging Mode	StripMap	HS Spotlight
Interferometric Mode	alternating bistatic	alternating bistatic
Polarization Mode	Single (HH/HH)	Single (HH/HH)
Incidence Angle	33,7	57,7
Slant range res. (m)	1,18	0,45
Azimuth res. (m)	2,54	1,13
Acquisition date	16.02.2012	20.08.2012

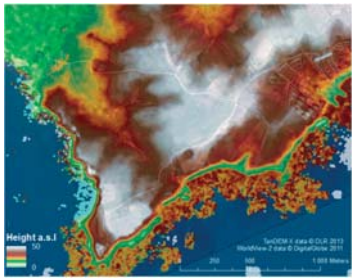
Magarsos – TanDEM-X workflow for DEM generation (SM and HS)

Reference DEM: SRTM-C

TanDEM-X CoSSC StripMap ALT1







TanDEM-X CoSSC StripMap ALT2

Final StripMap Coherence (7m)

Final StripMap Backscatter (7m)

Final StripMap InSAR-DEM (7m)

TanDEM-X CoSSC HS Spotlight ALT1

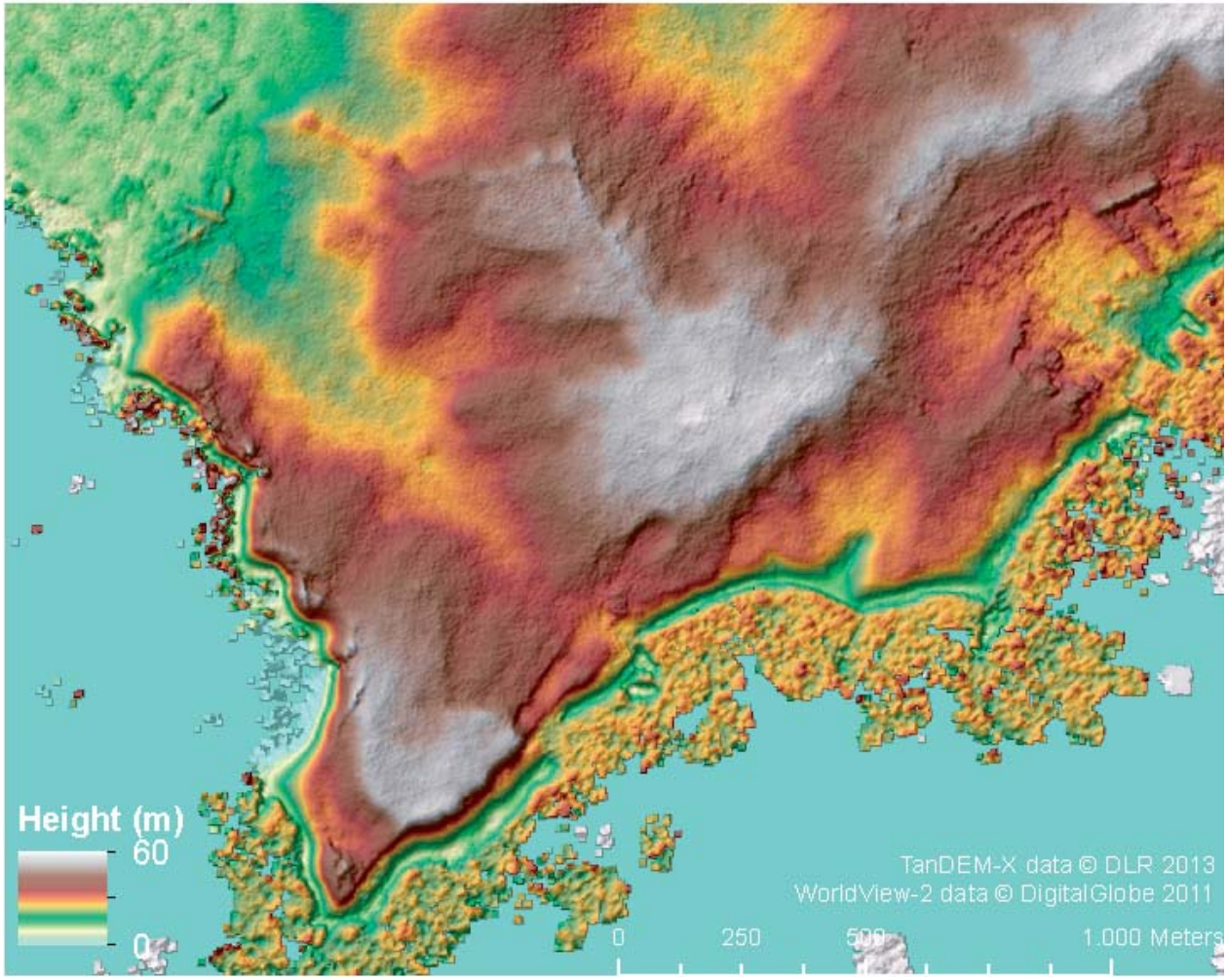
TanDEM-X CoSSC HS Spotlight ALT2

Final Spotlight Coherence (2m)

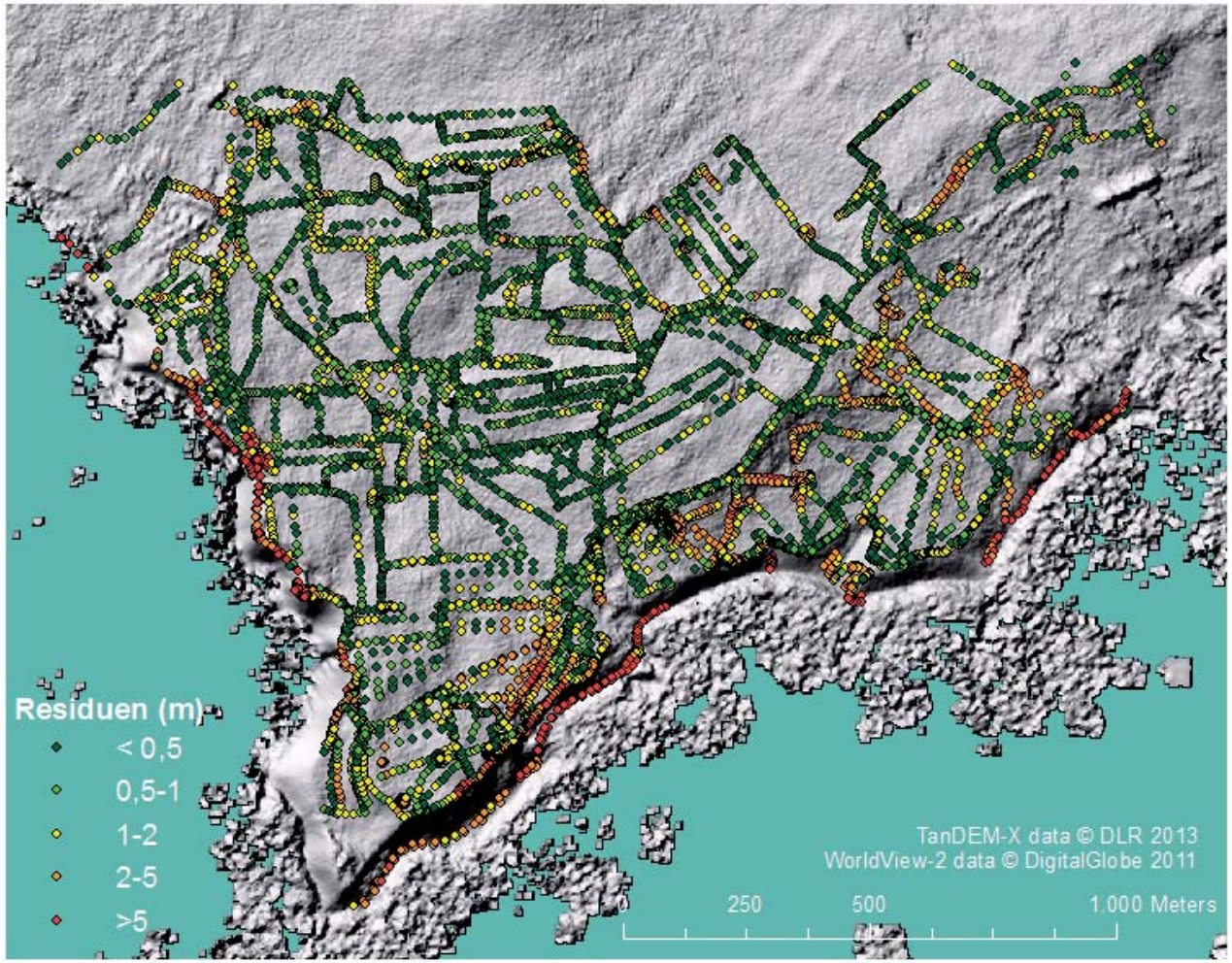
Final Spotlight Backscatter(2m)

Final Spotlight InSAR-DEM (2m)

Digital surface (TanDEM-X Spotlight)with visible archaeological structures

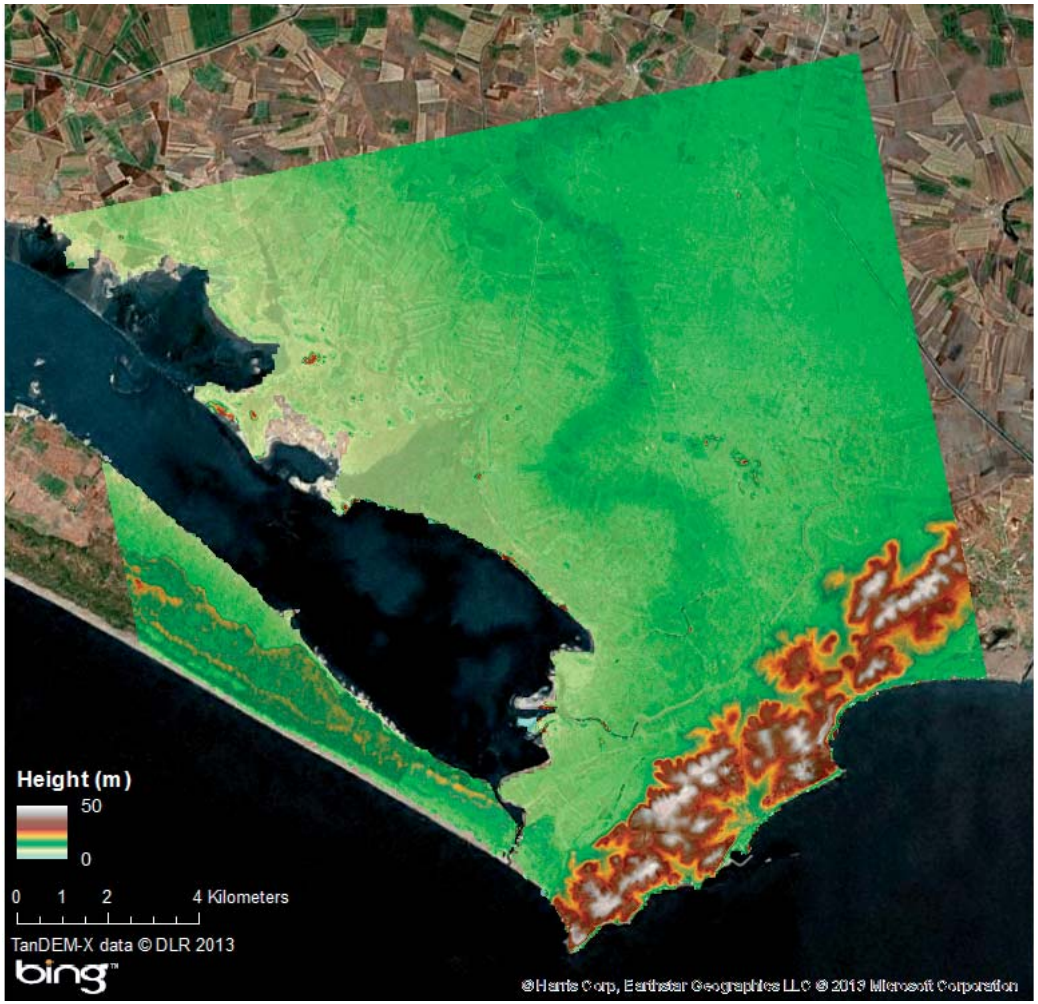


Accuracy of the DEM generated with TanDEM-X spotlight in for Magarsos



	RMSE (all)	RMSE (< 20%)
TDX StripMap alt. bistatic	**1.61**	**1.24**
TDX HS Spotlight bistatic	4.95	4.25
TDX HS Spotlight alt. bistatic	**1.80**	**1.40**

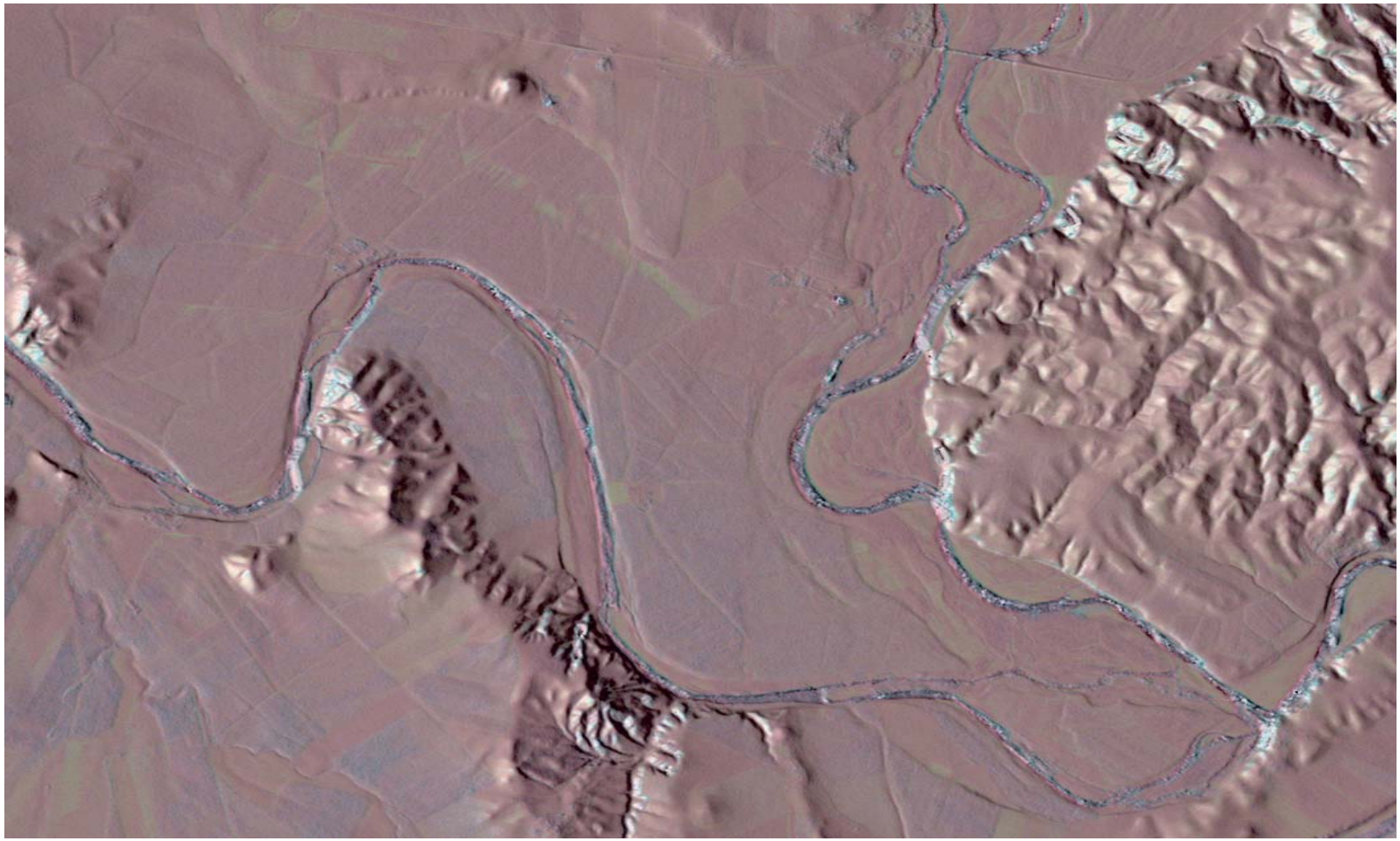
Palaeochannel north of Magarsos (detected by TanDEM-X data)



Conclusion (results from Test site at Magarsos)

- An easy-to-use and stable processing chain for TanDEM-X Alternating Bistatic scenes has been tested an adopted to the special needs of landscape archaeology.
- The HS Spotlight DEMs with 2m resolution offer a very good visual quality, thus providing a perfect base for the interpretation of archaeological features, like buried city walls or streets causing height anomalies on the surface
- The „Alternating Bistatic Merge“ offers a significant improvement of the quality of the DEM (residues / RMSE)
- The choice of the reference DEM plays a crucial role for the interferogram flattening!

Körtik Tepe: a Neolithic key-site at the Tigris (will be destroyed by artificial lake)




21. Dez 2003
Image © 2013 DigitalGlobe


Image © 2013 DigitalGlobe
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Image © 2013 DigitalGlobe
Bildaufnahmedatum: 27. Dez 2003

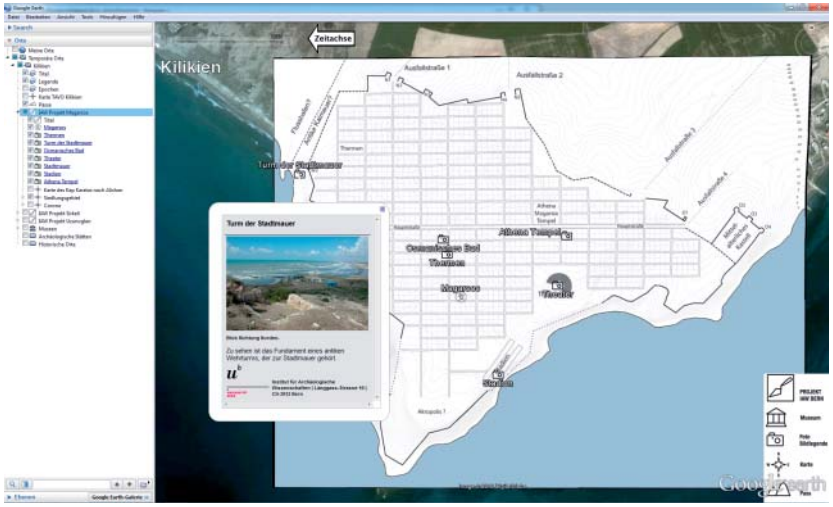

Google
Bildaufnahmedatum: 4. Apr 2012

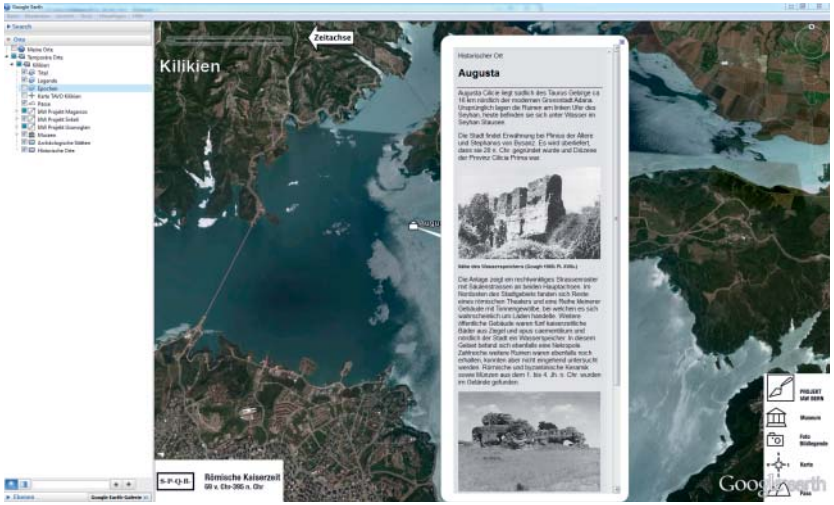
Outlook

- Increasing demand for cultural heritage monitoring due to urban growth, irrigation projects and general land use intensification
- Development of technics for looting monitoring
- Unique Potential of future TanDEM-X modes (as TerraSAR-X Experimental Staring Spotlight Data) and successor missions like (“TerraSAR-X next generation”)
- Synergistic use of multifrequency SAR-Systems (especially ALOS 2 / PALSAR 2 and RADARSAT 2)

The Virtual Cilicia Project

www.arch.unibe.ch/virtual-cilicia





Oct 31 – Nov 2, 2013
Bern, Switzerland

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