Digital Landscape Documentation - a Case Study on how to Create Useful Geographic Information

Hartmut Müller

Urban-Rural Inter-relationship for Sustainable Environment - 2nd FIG Regional Conference
Marrakech, Morocco, December 2-5, 2003
TS 18 – GIS Tools for Applications

Who are we?

University of Applied Sciences, Mainz, Germany
Institute for Spatial Information and Surveying Technology

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University of Applied Sciences, Mainz, Germany
i3mainz, Institute for Spatial Information and Surveying Technology - Fields of Competence

- Digital image processing
- Photogrammetric Imaging
- Remote Sensing
- Digital Cartography
- Surveying
- Databases
- Geographic Information Systems
- Software Development
- Internet Development
- Multimedia
- 3D Visualization

Study Area

Tavium - Capital of the Ancient Hittite Empire
2nd millenium BC

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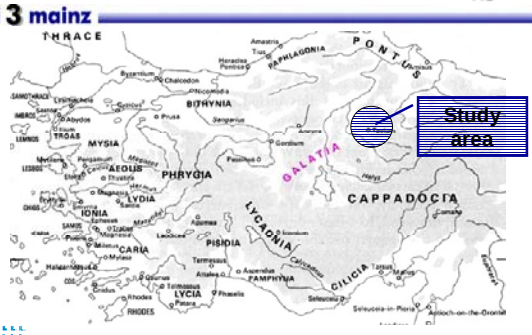

Tavium Research Project

Project Partners

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- Department of Ancient History and Antiquities, University of Klagenfurt, Austria,
- Department of Prehistory and Near Eastern Archaeology, University of Heidelberg, Germany,
- Institute for Spatial Information and Surveying Technology, University of Applied Sciences, Mainz, Germany,
- Turkish local heritage conservation authorities
- and others

The Archaeological Area (1)

Todays Landscape Appearence
Overview

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The Archaeological Area (2)

Todays Landscape Appearence
Overview

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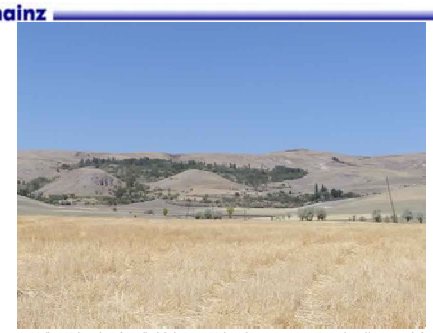

The Archaeological Area (3)

Todays Landscape Appearence
Former Settled Area

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The Archaeological Area (4)

Todays Landscape Appearence
Part of area seen from another view point

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The Archaeological Area (5)

Todays Landscape Appearence
View from top of the former city

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Aims of Presentation

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- use of GPS positioning technology
- local horizontal and vertical reference system
- fusion of spatial data obtained from different sources
- benefits achievable from a digital terrain model
- design and implementation of an Internet presentation

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Local Reference Framework

GPS measurements
Local reference point co-ordinates

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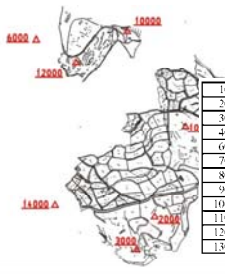

	[m]			[mm]		
1000	10000.000	10000.000	1130.00	0.0	0.0	0.0
2000	9853.615	9570.622	1092.82	3.2	2.8	7.8
3000	9768.449	9419.180	1080.17	3.2	2.8	8.1
4000	8790.385	8922.818	1108.18	2.8	3.1	7.2
6000	9292.813	10415.763	1221.69	2.5	1.9	4.9
7000	9441.799	11058.075	1278.81	2.1	1.7	4.5
8000	10296.378	10332.056	1096.51	1.9	1.7	4.6
9000	10272.821	9833.549	1095.35	1.5	1.2	3.1
10000	9723.471	10454.293	1162.28	2.2	2.3	4.7
11000	11221.836	9928.892	1046.45	6.9	5.3	14.3
12000	9480.751	10308.714	1193.73	2.0	1.5	5.4
13000	10153.024	10080.383	1104.21	1.6	1.2	2.9

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Framework of Map Sheets

Large Scale Maps, scale 1 / 500
Layout Definition and Scheme of Numbering

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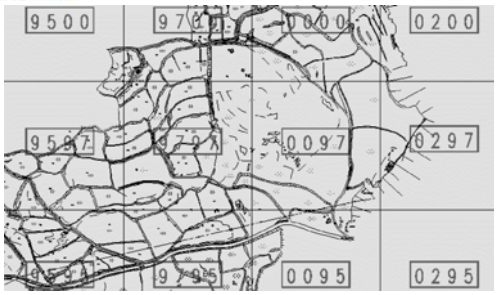

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Contents of Large Scale Maps

Metadata

Orientation data (surrounding map sheets)

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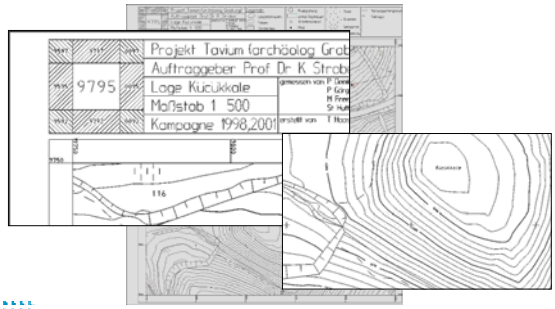

Large Scale Map Application

Overlay map sheet / geomagnetic measurement

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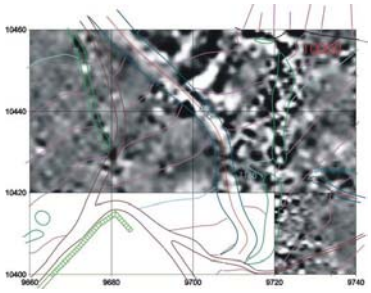

Turkish Cadastral Maps

Scale 1/5000

Basic data for digital terrain model production

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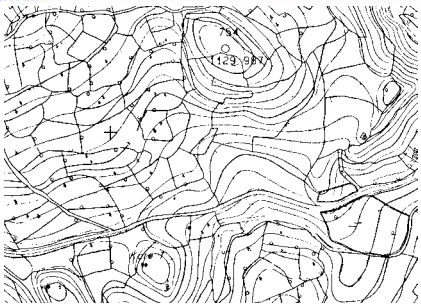

Data Fusion

Large Scale Maps 1/500 <--> Cadastral Maps 1/5000

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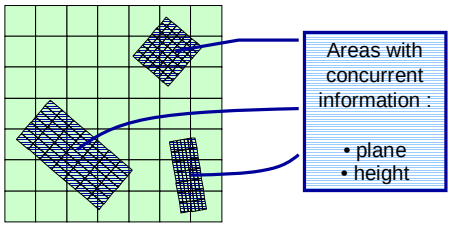

Data Fusion

1/500 Large Scale Maps <--> 1/5000 Scale Maps

Geometrical Transformation with Control Points

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```
Scale (X,Y) = (0.997,0.999)  Skew (degrees) = (0.081)
Rotation (degrees) = (-0.056)  Translation = (-2710.751,-1121.360)
RMS Error (input,output) = (0.888,0.885)

Affine  X = Ax + By + C
        Y = Dx + Ey + F
  A =          0.997   B =          0.002   C =        -2710.751
  D =         -0.001   E =          0.999   F =        -1121.360

tic id        input  x        input  y
              output x        output y          x error          y error
------ ---------------- ---------------- ---------------- ----------------
  1000       12727.471        11147.184
             10000.000        10000.000          -0.662            0.308
  5000       11485.780        10911.637
              8760.518         9766.446           0.864           -0.191
  4000       11516.838        10067.302
              8790.385         8922.818          -0.073            0.057
 11000       13955.460        11076.767
             11221.840         9928.892           1.068           -0.125
  9000       13001.104        10980.450
             10272.820         9833.549          -1.196           -0.049
```


Quality Check of Data Fusion

1/500 Large Scale Maps <--> 1/5000 Scale Maps

Calculation of DHM Height Differences

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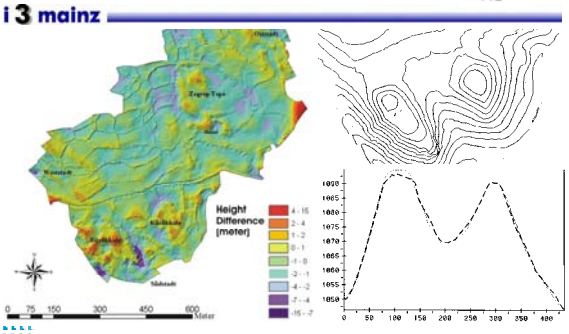

DHM Applications (1)

Volume Calculation, Historical Theatre
DHM Manipulation

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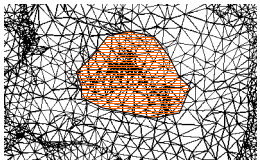
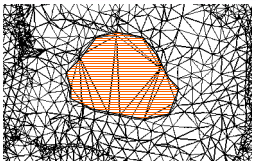


Question: earth mass removal when building the theatre ?



Solution:
remove points inside bounding polygon
--> interpolate surface from surrounding terrain
--> calculate difference between measured and interpolated surface

DHM Applications (2)

Line of Sight Analysis at the Historical Theatre

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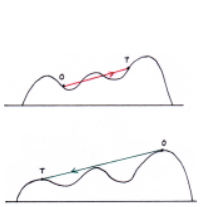

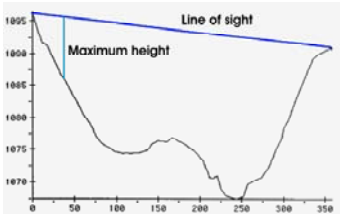

Question: maximum height of theatre scenery to keep the panoramic view which includes the temple on top of the hillock ?

DHM Applications (3)

Visibility Analysis at the Historical Theatre

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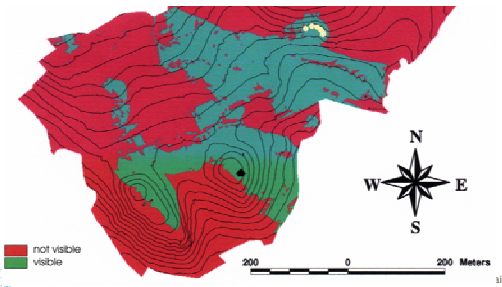

Internet Presentation

Front Page
Currently only available in German

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Website Design (1)

Tavium Research Project

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Front page

Home
- General
- Site map
- Information

News
- Field campaign 2002
- Credits

Project
- Aims
- Management
- Co-workers
- Co-operation
- Sponsors

Region
- Natural environment
- Traffic networks
- Research area

Tavium
- Walk around
- Location
- Research history
- Topography
- General history
- Cults

Category
- *Subcategory*

Website Design (2)

Tavium Research Project

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Research
- Field campaigns
- Surveying and Geoinformatics
- Field research
- Excavations
- Findings
- Results

Images
- Region
- Büyükknefes
- Tavium
- Findings
- Measurements
- Models
- Maps

Literature
- Tavium
- The Galats
- Full texts

Links
- Related websites
- Tips

Contact
- e-mail

Category
- *Subcategory*

Internet Presentation

Comparison of virtual and real scenes

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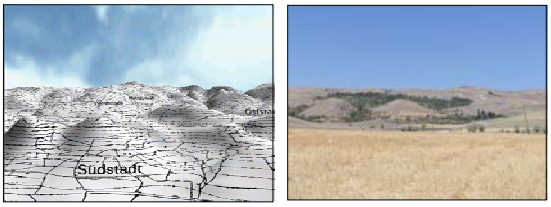

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Internet Presentation

Comparison of virtual and real scenes

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Comparison of virtual and real scenes

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Virtual Flight (1)

Pure DHM, Source: map sheet 1/5000

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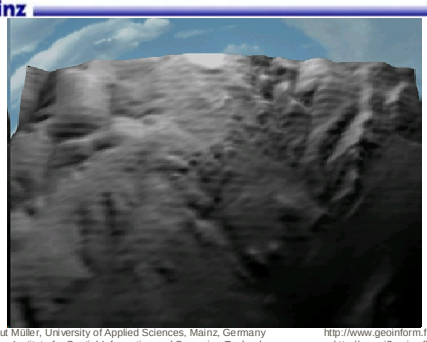

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Virtual Flight (2)

DHM (Source: map sheet 1/5000)
+ Texture (Source: SPOT panchromatic scene)

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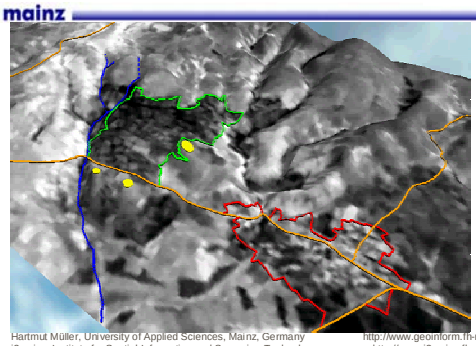

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Virtual Flight (3)

DHM + Texture, Source: map sheet 1/5000

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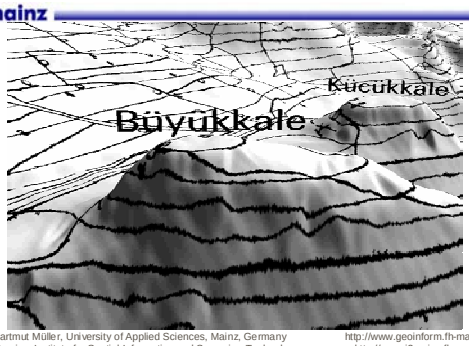

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Conclusions

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- synthesis of spatial data of many kind needs well observed spatial data properties (geometric accuracy, spatial reference system, etc.)
- benefits from state-of-the-art spatial analysis functionality depend on requirements of application
- WWW technology provides a platform for easy information exchange within the community of all involved persons

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