Anthropogenic and physical landscape dynamics in large fluvial systems APLADYN

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Aim

- Explore and evaluate the possibilities of a variety of existing and recently developed RS sources and RS analysis methodologies to map the long-lasting interaction between the anthropogenic landscape and the physical environment in large fluvial systems, and the impact of these interactions on the natural and cultural heritage.

Context research

- Large fluvial systems
  - Cradle of many ancient civilizations

Context research

- Large fluvial systems
  - Are very dynamic environments that codetermine human behavior, but that are also shaped by human behavior

Fig. 1. Sketch map showing the Yellow River's course-changes in history (after Ye, 1989)
0. The channel in 2000 B.C., also called the Yuhe Old Channel
1. The channel after the 1st major course-change, 602 B.C.
2. The channel after the 2nd major course-change, 11 A.D.
3. The channel after the 3rd major course-change in 1048.
4. The channel after the 4th major course-change in 1194.
5. The channel after the 5th major course-change in 1494.
6. The channel after the 6th major course-change in 1855.
7. The channel after the 7th major course-change in 1938.

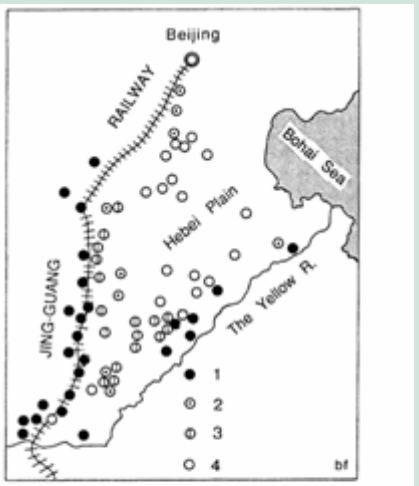


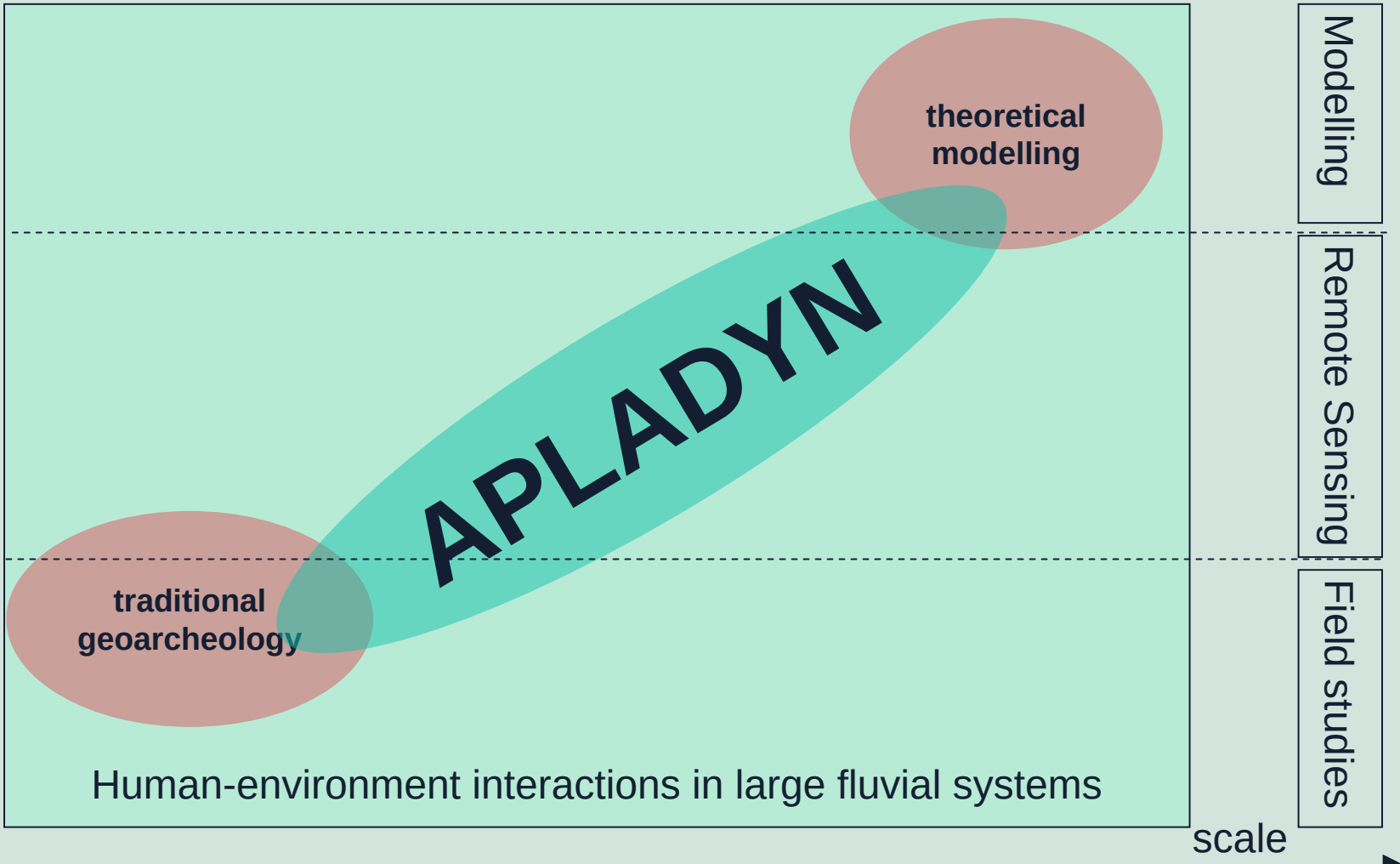
Fig. 3. Sketch map showing the distribution of towns and cultural relics before the Qin Dynasty (221–207 B.C.) in the Hebei Plain (northern part of the North China) (after Tang, 1981).
1. New Stone Age.
2. Shang and Zhou Dynasties (1600–256 B.C.)
3. Spring and Autumn Period (770–476 B.C.)
4. Warring States Period (475–221 B.C.)
For courses of the Yellow River in different historical periods, see Fig. 1.

Channel reconstruction Relation river - sites

Context research

- Large fluvial systems
  - Are even today home to many large and rapidly growing cities which may obliterate cultural heritage

Context research



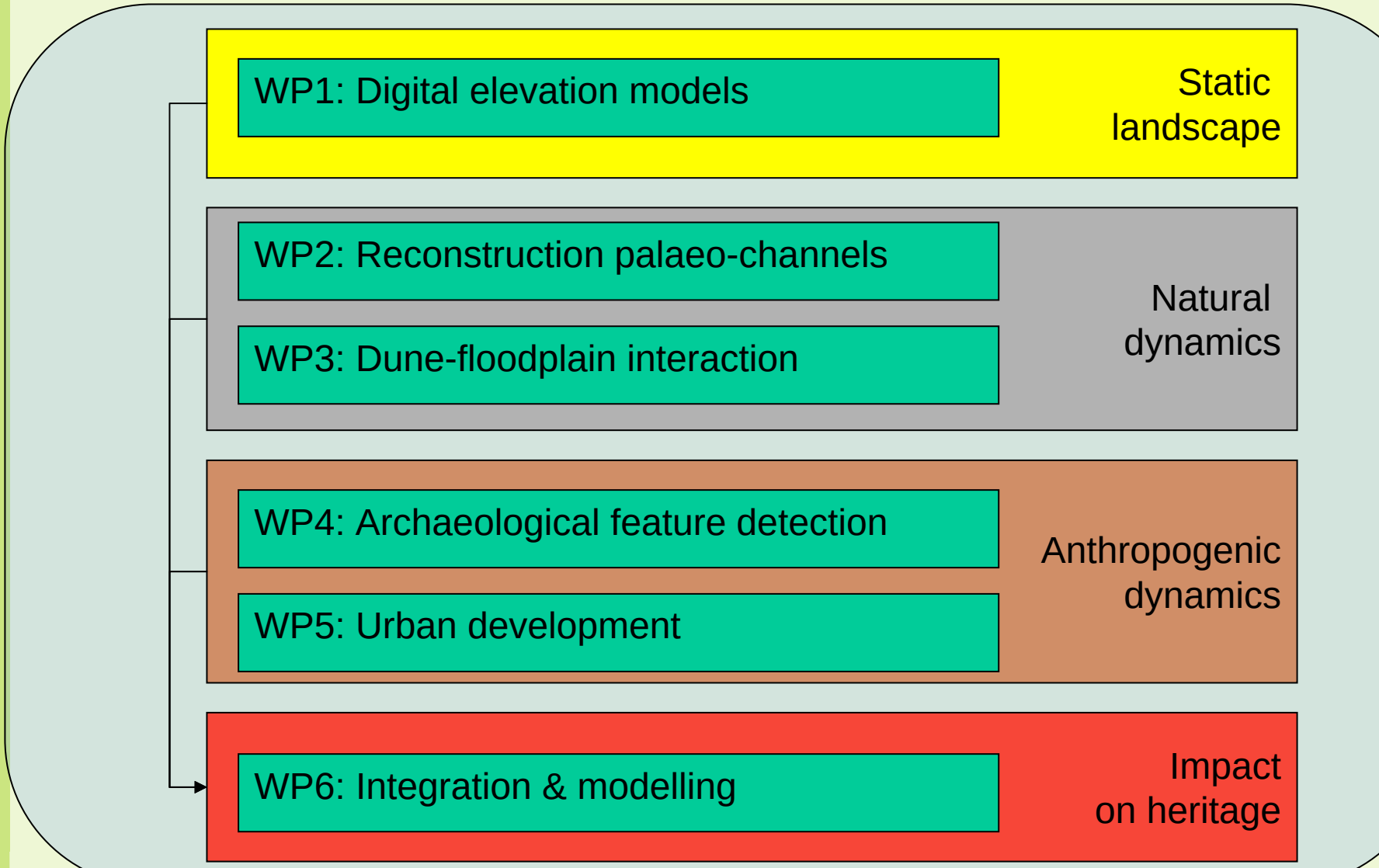
Study area

- Serving as an example, the Nile floodplain in Egypt was chosen as test site
  - Several natural processes in contrasting environmental settings
  - Long-term human impact (>5000 a)
  - Rapid urbanization
    - Threatening cultural heritage (Cairo listed as one of ten most threatened historical sites in the world)
    - Loss of fertile soil
  - Several project partners have research experience in Egypt

Study area – Test sites

- TS1: delta – channel avulsions – geziras – tells – major focus of urban growth
- TS2: Cairo
- TS3: meandering channel – eolian interaction – regional cities and village sprawl

Research themes - WP



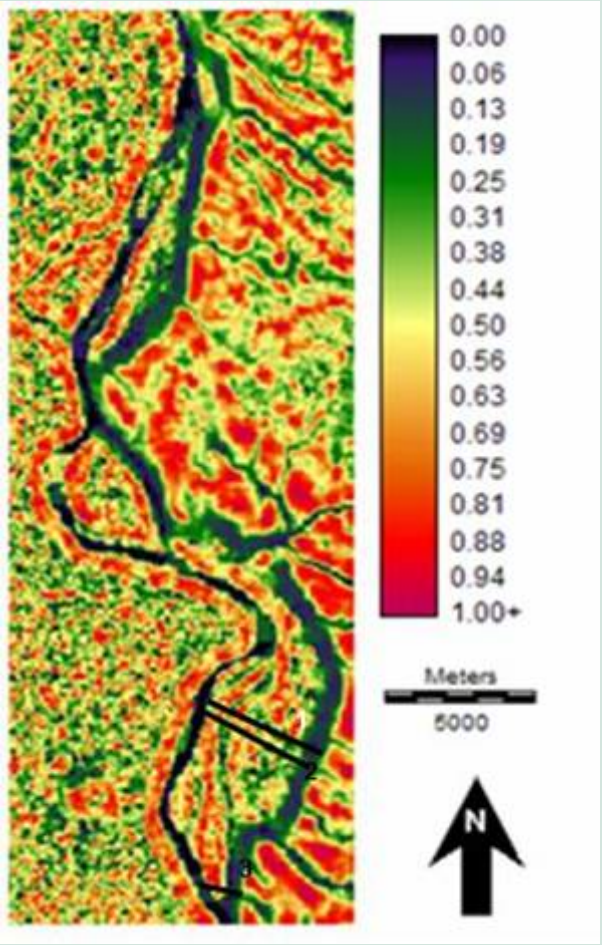
WP 2 palaeochannels: background

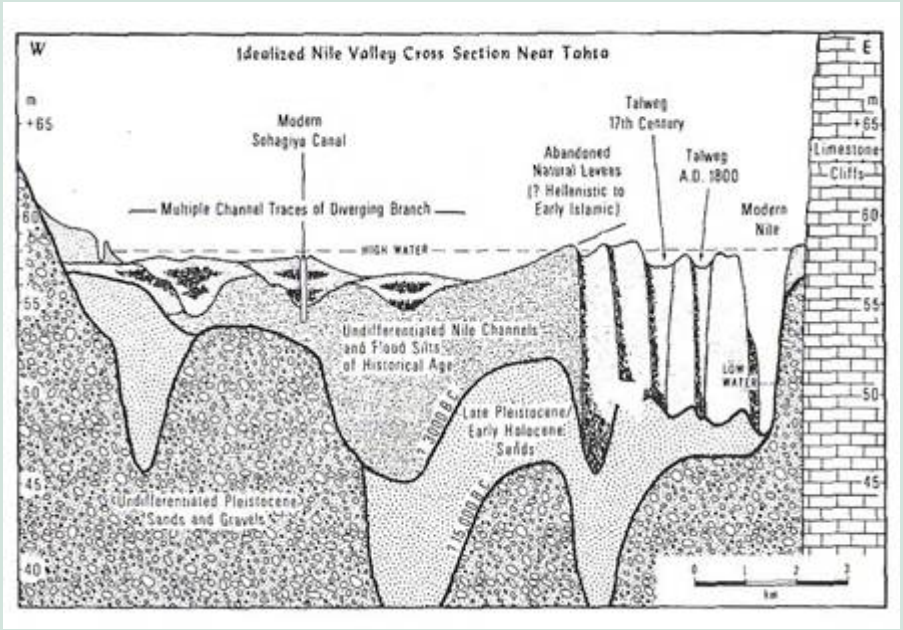
- Changing patterns of channel belts strongly influences human occupation of the floodplain
- Mapping old (palaeo) channels is a must in any geoarchaeological research
  - Provides clues for location of ancient settlements
  - May indicate which parts of the floodplain are of younger age
- Traditionally, this research has been done through fieldwork (coring, geophysics)
  - Time consuming
  - Restricted areas
  - Ok for small rivers, but troublesome for very large rivers…

WP 2 palaeochannels

- Subtle **topographic variations in fluvial systems** reflect morphological attributes
- But, detailed digital elevation models (DEM) for large areas are not available

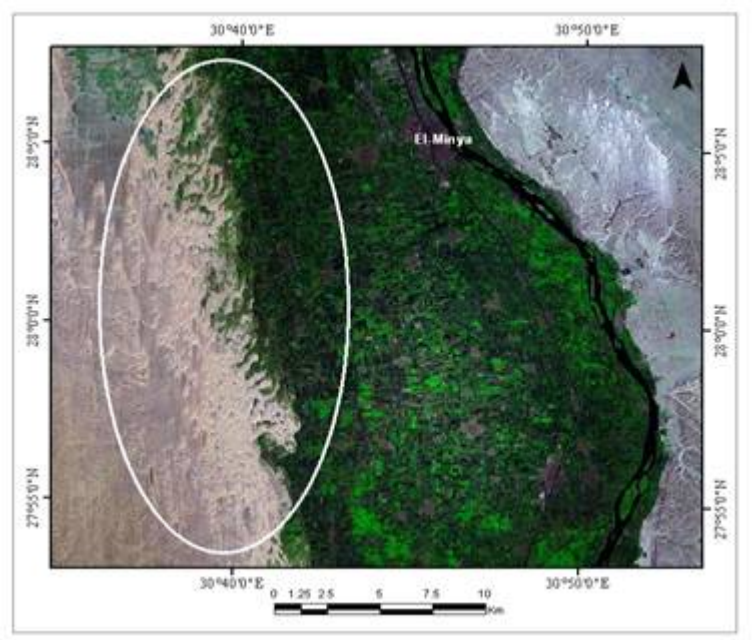
SRTM – 90m - processed





WP 3 Dune-floodplain interaction

- Test site 3: Dune migration into the floodplain
  - Background:
    - Covers monuments
    - Destroys valuable fertile land



WP 3 Dune-floodplain interaction

- Aims
  - To assess dune migration rates & directions using multi-temporal RS-data

  - To assess changes in dune morphology and volume through time (input from WP1)
  - To perform a risk assessment by extrapolating past dune migration rates into the future

WP4: Archaeological feature detection

- Background:
  - Archaeological research has a strong tendency to focus on isolated ‘details’ of the ancient landscape (a temple, a castle, a settlement).
  - RS offers possibilities that conventional archaeological techniques do not have, i.e. to trace human activity patterns over vast areas, based on the spatial distribution of archaeological remains within their landscape setting.
  - RS can be used as a form of heritage conservation, by documenting what is there, and by alerting researchers and authorities to the importance of threatened ‘new’ sites.

WP4: Archaeological feature detection

- Aims:
  - To test the potential of RS data for the inventory of archaeological remains (semi-automatic extraction)
  - Investigating whether RS data provide information on sizes and densities of cemeteries (~pop density)
  - to use RS-obtained inventory for site-location modeling

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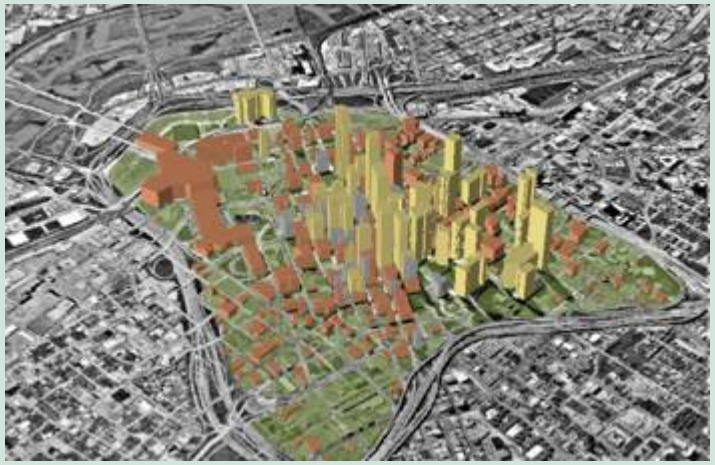
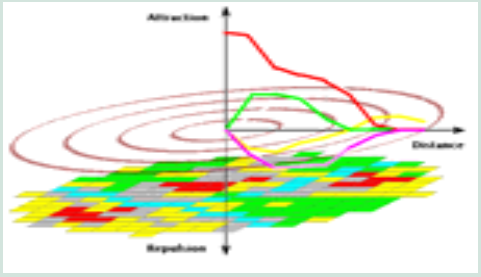
WP5 urban development: background

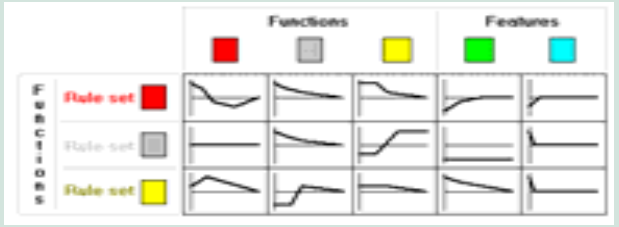
- Urban development threatens the rich cultural and natural heritage
- Especially in developing countries a lack of spatial planning leads to an uncontrolled urban sprawl
  - Population of Cairo: + 100% in 20 years (present-day population: +/- 15 million)
- At present no sufficient spatial and demography data to predict future development of the region

WP5 urban development

- Aims:
  - To **map sub-recent 2D-urban sprawl** patterns at various spatial scales
  - To identify changes in building typology by means of **3D-reconstruction** of the urban topography (from WP1)
  - To calibrate and validate computational **models of urban development** in order to predict possible future urban sprawl patterns







WP6 integration

From WP1-3:

Information on natural dynamics (rates) can be extrapolated

Result: **map** indicating future location of channels & dunes

From WP5:

Information on urban development used to model urban sprawl

Result: **map** showing urban extent in the future

WP6 Integration

Risk assessment for archaeological sites with respect to natural dynamics and urban development

From WP4:

Map with location of archaeological sites in the landscape

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