ANAGHLIA

Integrated Processing And Ground Truthing Of Hyperspectral And LiDAR Images in Archaeology

Véronique De Laet[1], Luc Bertels[2] David Jordan[3], Martijn Van Leusen[4], Yoon Jung Choi[3], Máté Stibrányi[5], Ben Somers[2], Dries Raeymaekers[2], Els Knaeps[2], G. Verstraeten [1]

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Context of the project

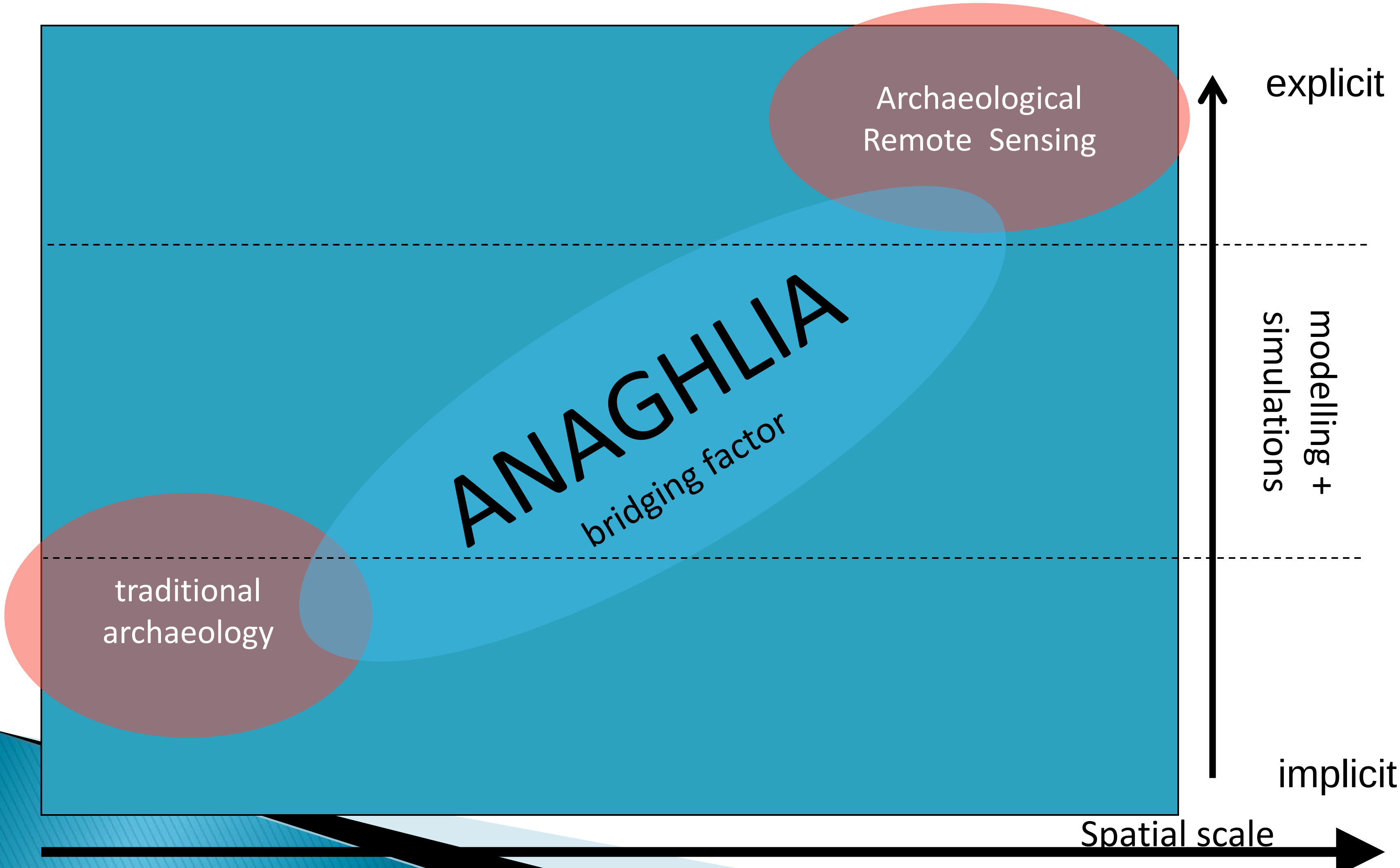
- Heritage landscapes are fragile and once lost, irreplaceable.
  - => Distribution (spatial relation/variation) and state of preservation of sites is important for policies on protection

- RS potentially provides significant added value to identify/inventories archaeological sites

- Current problem:
  - Due to characteristics of the large majority of archaeological sites
    - The spatial and spectral resolution of any RS data must be extremely high
    - Processes producing signatures are not well understood
      - Sensing campaigns cannot be well targeted or designed

- To define the resolution requirements:
  - One must investigate the processes producing remotely detectable geo-archaeological signatures

Context of the project



Aim of the 2-year project

- Spectroscopy for studying archaeological features and deposits and the post-depositional processes affecting the archaeological record.

- Integration of hyperspectral and LiDAR data for the identification of ancient natural and cultural features

- All applied in two different environments:
  - The flat Great Hungarian Plain
  - High mountain relief in Calabria

Work packages ANAGHLIA project

KU Leuven - JGU-MPI

WP1 : EXPERIMENTAL DESIGN
Hyperspectral signatures of archaeological sites and "false positive" phenomena

Field data + target sites:
HNM-NHC - GIA

VITO – KU Leuven

WP2: UPSCALING TO THE RS SCALE
Hyperspectral and LiDAR data for integrated processing

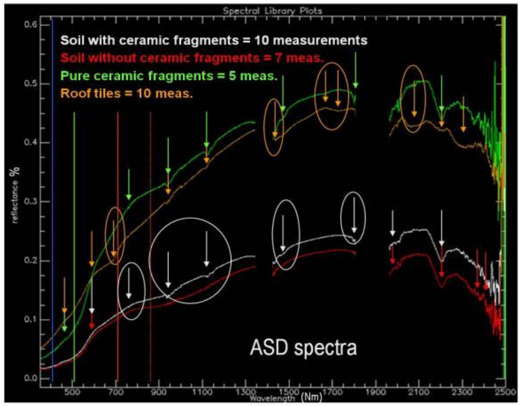
Field verification checks
HNM-NHC - GIA

WP3
Methodology validation
and comparison of different environments

WP 1: Methodology

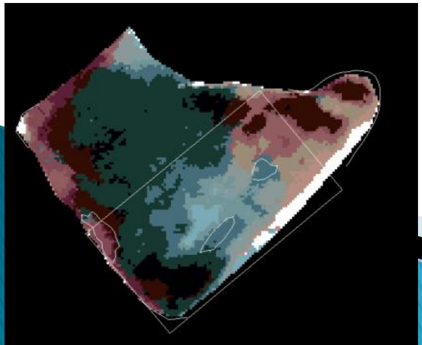
- Phase 1:
  - Analyse surface soil reflectance spectra using
    - Spectral feature analysis
    - Specific absorption feature parameters
  - Record distribution of soils at scale 1:1000
    - Carry out lab analyses
  - Relate surface spectra to the spectra recorded in vertical sections and to the soil characteristics and thus to the origins of the strata.
- Phase 2: Comparing, Modelling and Up-Scaling:
  - Model how well RS systems can distinguish the site spectra from the background signal
    - Simulating density variations
  - Find out at what spatial and spectral resolution, and at what range of wavelengths, a remote system must operate to successfully distinguish each site?
  - Create synthetic models to describe sites of different characteristics, then forward modelling the results of remote imaging spectroscopy (up-scaling)

Measuring reflectance spectra on a prepared soil surface



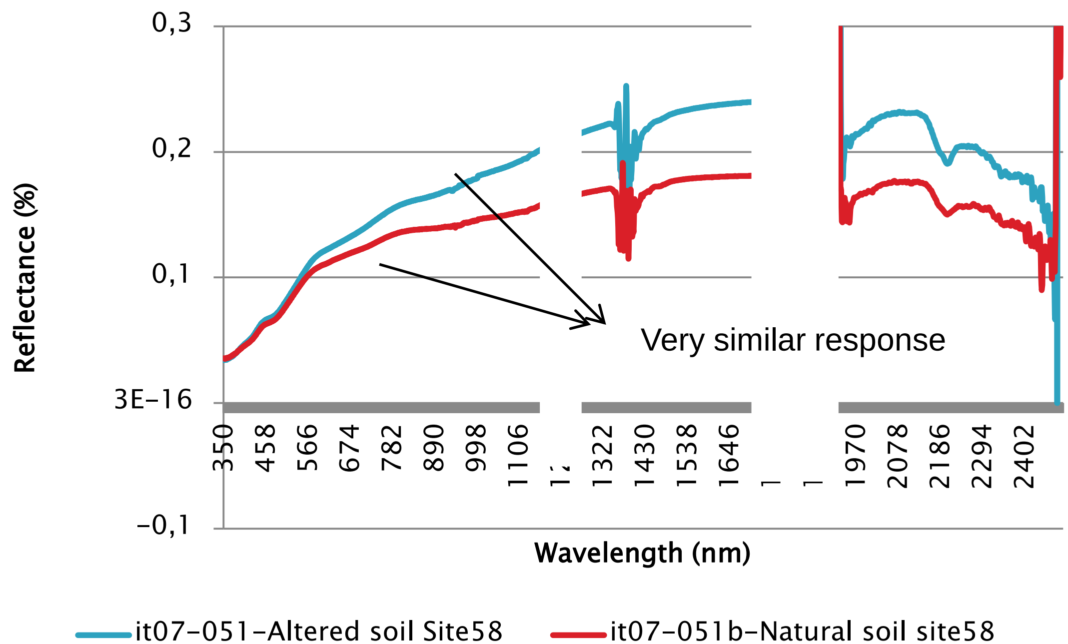
WP 2: Aims & Outcome

- Perform manual (guided) and automatic site detection
  - Potential feature types:
    - Topographic features:
      - Negative/positive topographic features
      - Concentrations of stones and clearance cairns indicating the presence of architectural structures
    - Spectral features:
      - Ploughed-up habitation layers
      - Concentrations of pottery and building material



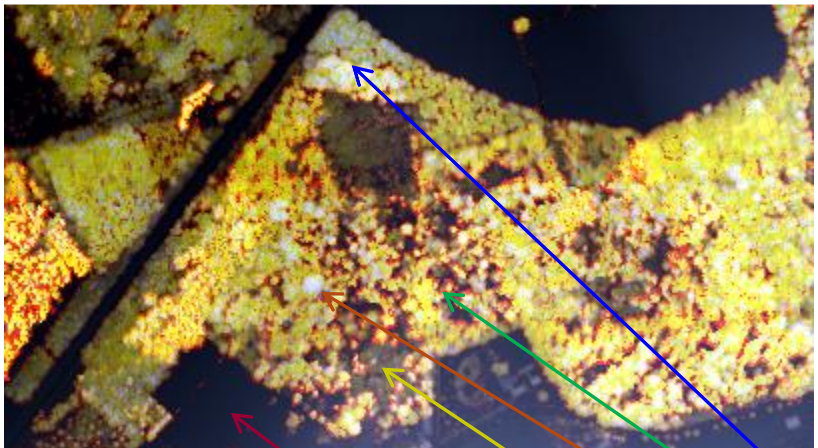
WP 2: Methodology (1)

- Methodology of WP1 supplemented with advanced spectral unmixing (MESMA) (1) and advanced LiDAR processing (2) techniques



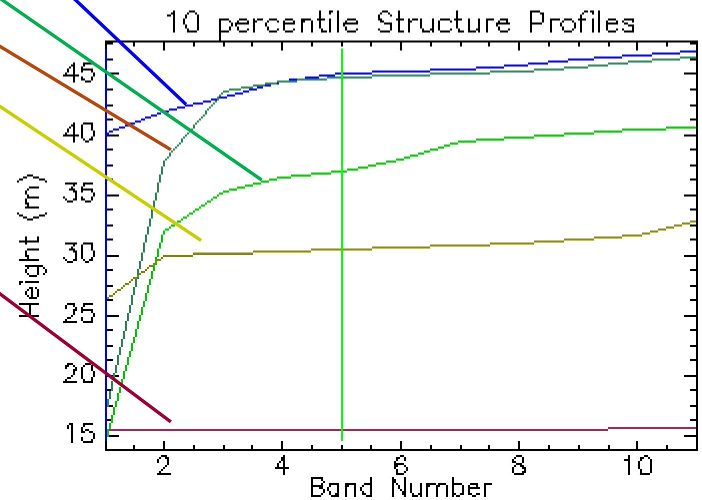
WP 2: Methodology:
2) Advanced LiDAR processing

Extraction of vertical structure profiles from LiDAR data



Visualisation of the 10 percentile height /intensity profile:

100 %	(max height)	(R)
50 %	(median height)	(G)
0 %	(min height)	(B)



WP 3: Background & Aims

- Operational dataset calibrated within the first two WP's needs to be validated using:
  - Appropriate univariate and multivariate statistical analysis
  - Field checking of potential site targets
- Aims
  - Show how good/efficient methods are for detecting new sites and identifying "false positives"
    (= INTERNAL VALIDATION)
  - Evaluate whether methods can be exported to the Hungarian Plain (evaluate how universal they are)
    (= EXTERNAL VALIDATION)
    - Information on the effects of landscape characteristics

Innovative aspects ANAGHLIA project

- Application of hyperspectral and LIDAR RS to a rather unexplored discipline such as archaeology. Especially the integration of both data types is very innovative

- Non-invasive RS techniques have the potential to discover sites prior to further destruction and that are not detectable by other means
  - We can say something about the risk of further destruction

- The comparison of different study areas will make the outcomes (or the procedures?) more robust.

- The application of "external" techniques within archaeology may advance technological development within the discipline itself.

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