Supplement Table 1. All relevant information from the studies investigated in this Master's thesis

Nr.	Reference	Location	RS data	Method/s	Details of method	Variables/Morphometric parameters	OOI	Scale	Software	Access?
1	Menze – Ur – Sherratt 2006	Kabur Pain, Syria	SRTM	*Geometric knowledge-based Machine Learning-based/* PBIA – RFCL	DEM Test sites → elevation data of the surroundings transformed in vector (subtraction of the elevation of the central pixel) = 80 D vector for each site → PLS filters (8 dimensions) → RFCL (10-fold CV)→ mound probability Test on 133 known mounds	Elevation Train: 184 + 50,000 random background	tell mounds	regional	R	n/a
2	Menze – Mühl – Sherratt 2007	Kabur Plain, Syria	Landsat SRTM	*Geometric knowledge-based Machine Learning-based/* PBIA - RFCL	not very detailed; based on Menze – Ur – Sherratt 2006		tell mounds	large scale	R?	n/a
3	Menze – Ur 2007	Kabur Plain, Syria	ASTER	*Geometric knowledge-based Machine Learning-based/* PBIA – RFCL binary classification	Input: raw reflectance (14), vegetation indices (3), correlation with (6) prototype-spectra of the JPL ASTER SpecLib, and time flag (2) → RFCL → CV → results poled using fusion strategies → tested on a different dataset	Reflectance, vegetation indices, prototype-spectra information for each site binary classification: settlement, non settlement	tell mounds	regional	JPL ASTER SpecLib R?	n/a
4	De Boer 2007	Netherlands	ALS 1/16-36 m^2	*Template Matching-based/* Rigid TM	Templates of different sizes constructed for comparison of template and DEM samples by Pearson correlation coefficient_ -1 to +1 of PBM	DEM	barrows	regional	eCognition?	equation
5	Riley 2009	Iowa, USA	ALS 1 m resolution	*Geometric knowledge-based*	DEM → fill sinks = filled DEM → a) Focal range → Relief → reclass → 0, 1, 2 b) Slope → reclass → 20, 30, 10 c) Aspect → reclass → 1-9 (7-8 mound) d) Flow direction → flow accumulation (highest: 0) → extract values (mask) a) + b) + c) → sum raster + d) → extract values → reclassify → majority filter → probable mounds evaluation: comparison with known mounds	Slope, Aspect, Flow direction 0 - not mound 1 - maybe mound 2 - mound	barrows	local	ArcGIS	workflow Section-workflow
6	Menze – Ur 2012	Khabur basin, Syria	ASTER	*Geometric knowledge-based Machine Learning-based/* PBIA – RFCL	Input: raw reflectance (14), vegetation indices (3), correlation with (6) prototype-spectra of the JPL ASTER SpecLib, and time flag (2) → RFCL → CV → results poled using fusion strategies → tested on a different dataset	multitemporal classification strategy binary classification: settlement, non settlement	anthrosols	large scale	R	n/a
7	Menze – Ur 2013	Syria	ASTER	*Geometric knowledge-based Machine Learning-based/* PBIA – RFCL	Input: raw reflectance (14), vegetation indices (3), correlation with (6) prototype-spectra of the JPL ASTER SpecLib, and time flag (2) → RFCL → CV → results poled using fusion strategies → tested on a different dataset	Reflectance, vegetation indices, prototype-spectra information for each site binary classification: settlement, non settlement	anthrosols		R	n/a
8	Caspari – Balz – Gang – Wang – Liao 2014	Altai Mountains	HR Satellite	*Machine Learning-based/* PBIA – Hough-Forests	Training samples as + & - patches; trees are constructed as Hough forests; binary test from the database; classification with certain parameters; majority voting on the patches extracted by sliding a window; thresholds for the majority voting		barrows	regional	n/a	equations
9	Kramer 2015	Avebury, UK	ALS 0,5 m resolution	*a)Geometric knowledge-based + Template Matching-based/*	a) DTM → Slope → template generation → threshold → review target → update template → review verification	Slope, brightness	barrows	local	eCognition	workflows (cognitive, TM, GeOBIA)

				Deformable TM *vs.* *b)Geometric knowledge-based + GeOBIA-based*/MRS + *Machine Learning-based/* PBIA – RFCL + ruleset classification	→ correlation map → evaluation → Classification → verification by database from HE b) DTM → Slope → threshold → iterated segmentation → assign class to test feature → RFCL → apply ruleset → review classification → validate by HE database					segmentation rulesets equations
10	Trier – Zortea – Tonnig 2015	Vestfold, Norway	ALS different points/m^2	*Template Matching-based/* Rigid TM + *Machine Learning-based/* PBIA – MD Classifier	TIN from ALS ground points → DTM with different resolutions → construct templates → convolve DTM with mound templates → threshold convolution → merge overlapping mounds → data augmentation if needed → deviation from ideal mound (thresholds) → remove deviating mounds → confidence levels (MD classifier) → validation by archaeologist	Large mound size range multiple resolution of DTMs deviation from ideal mound: different measures of deviations are computed: RMS, min height, average height, normalized min height, normalized average height, gradient, squared gradient, SD gradient, normalized convolution	barrows	regional	Cultsearcher?	workflow
11	Sevara – Pregesbauer – Doneus – Verhoeven – Trinks 2016	Birka-Hovgården, Denmark Kreuttal, Austra	ALS Birka: 6/m^2 Kreuttal: 4-6 p/m^2	*Geometric knowledge-based + GeOBIA-based*/MRS **vs.** *Geometric knowledge-based + Machine Learning-based/* PBIA–MD/MinD Classifier	DTM → +& - Openness → a) PBIA: training classes → Classification by MD b) OBIA: segmentation and classified by attributes with homogeneity thresholds: ROI & background → classification of the background by fuzzy thresholds	+ & - openness Homogeneity: Openness, Slope, Roundness	barrows	local	OPALS eCognition GIS	workflow
12	Freeland – Heung – Burley – Clark – Knudby 2016	Tongatapu, Tonga, Polynesia	ALS 1/m^2	*Geometric knowledge-based + GeOBIA-based*/MRS **vs**. *Geometric knowledge-based* iMound	**Segmentation**: DTM → LRM → Mean relative elevation in 11:19 radius + Mean relative elevation in 15:23 radius → Segmentation → segmentation rule-set (merging, splitting) → probability map **iMound:** denoised DTM → invert DTM → pit-filling → subtraction→ detrended mound-elevation → separation of results by thresholds/rules → internal validation (F1 score)	**Segmentation:** Scale, Roundness & Compactness, Circularity, Area, Elevation **iMound:** height, mound circularity, minimum area	monumental earthworks	regional	Segmentation: eCognition iMound: R	n/a
13	Cerillo-Cuenca 2017	Extremadura, Spain	ALS 0,5/m^2	*Geometric knowledge-based + GeOBIA-based + Geometric knowledge-based* HCT	DTM → morphometric classification (TPI, UC) → segmentation → morphological filtering (HCT) → prediction → validation	TPI UC HCT	barrows	regional	Python	workflow equations
14	Davis – Sanger – Lipo 2018	Beaufort County, South Carolina, USA	NOAA DEM from ALS 1,2 m resolution	*Geometric knowledge-based + Template Matching-based* Rigid TM + *GeOBIA-based*/MRS	Pre-processing → Template matching → multi-resolution segmentation of the correlation-coefficient maps → morphometric classification (asymmetry, circularity, area, compactness) → validate with land-use map and coefficient map → manual evaluation → ground truthing	Slope Maximal focal statistics Hillshade RRIM Range focal statistics	mounds, shell rings	regional	SAGA eCognition ArcMap	workflow
15	Guyot – Hubert – Moy Lorho 2018	Carnac, France	ALS 14/m^2	*Geometric knowledge-based* + Multi-Scale Topographic Analysis + *Machine Learning-based/* PBIA – RFCL	DTM → Multiscale topographic analysis → Maximum topographic deviation (micro –, meso –, macro-scale) → a) composite image → MSTPI → b) RFC – LHS → probability map → verification	HS, PCA, Slope, LRM, SVF, anisotropic SVF, Openness (+), (-), LD	barrows	regional	RVT WhiteBox GAT R	workflow - LiDAR proc. - general - MSTPI
16	Raun 2019	Lower Franconia, Germany	ALS 1 m resolution	*Template Matching-based/* Rigid TM	DEM → TM → verification by known mounds		barrows	regional	Python OpenCV Numpy	Workflow elsewhere

									matplotlib	
17	Davis – Lipo – Sanger 2019	Beaufort County, South Carolina, USA	NOAA DEM from ALS 1,2 m resolution	*GeOBIA-based*/MRS **vs.** *Template Matching-based/* Rigid TM *vs.* *Geometric knowledge-based* Inverse Stochastic Depression Analysis (IDA) /iMound	**IDA:** inverse DEM → SDA tool → filter result for size → validate with land-use map **MRS**: segmentation → selection of segments based on criteria → elimination of false positives by land-use map overlay → focal statistics → threshold to > 0,5 m → probability map **TM**: templates (+, -) → matching → validate with land-use map → rest compare with negative templates → ground truthing **MRS+TM** see Davis – Sanger – Lipo 2018	**IDA:** area, circularity, asymmetry, compactness **MRS**: circularity, asymmetry, compactness **TM**: elevation, slope, focal statistics, openness	mounds, shell rings	local	eCognition WhiteBox GAT ArcGIS	workflow for TM
18	Caspari – Crespo 2019	Altai Mountains	Google Earth	*Deep Learning-based*/CNN **vs.** *Machine Learning-based/* PBIA random guessing **vs.** linear **vs.** radial basis SVM	100x100 pixel labelled image → CNN (3 convolutional layers + pooling layers (varying)+ fully connected layers + backpropagation) → output vs. Random Guessing; linear SVM; radial basis SVM precision, Recall, F1 score as measure	1212 images of which 169 tombs + 655 synthetic tombs (in training) 75 % training, 25 % testing 0 = if tomb present 1 = tomb absent	barrows	large scale	Python, Keras & TensorFlow	workflow equation
19	Meyer-Heß – Pfeffer – Jürgens 2019	Westphalia, Germany	ALS 1-4/m^2	*Geometric knowledge-based* + *GeOBIA-based*/MRS	DTM/DM → segmentation (scale/shape/compactness) → filtering segments based on the ruleset of the object classes, with subclasses based on the statistics of features	Descriptive ruleset for each object class: scale, homogeneity: shape, compactness → internal statistics of features → descriptors of the relation of features	ridge & furrow, barrows, motte & bailey castles	large scale	eCognition GIS	workflow & ruleset for each ROI
20	Verschoof-van der Vaart – Lambers 2019	Netherlands	ALS	*Geometric knowledge-based* + *Deep Learning-based/* Faster R-CNN WODAN multi-class detector	SLRM → splitted/labelled input images (data augmentation) → Faster-RCNN (RPNs using the VGG16 CNN → BBPs → BBR + Classifier (simultaneously) → output with confidence score → evaluation by recall, precision, F1-score, MaF1-score	SLRM RPN BBPs BBR	barrows, celtic fields, charcoal kilns	regional	Python + Keras library	workflow
21	Kazimi – Malek – Thiemann – Sester 2019a	Harz, Lower Saxony	ALS	*Deep Learning/* Deep Convolutional Autoencoder	DTM →Encoder (unsupervised pre-training) + Decoder (supervised training; semantic segmentation)	38024 unlabelled 2016 x 2016 px	bomb crater charcoal kilns barrows	local	n/a	workflow
22	Kazimi – Thiemann – Sester 2019b		ALS	*Deep Learning/* Mask R-CNN	DTM → Mask R-CNN with ResNet-FPN-101 backbone (ROIAlign + Conv layers)	256x256 pixels	barrows bomb craters charcoal kilns	regional	Python?	flowchart
23	Orengo – Conesa – Garcia-Molsosa – Lobo – Green – Madella – Petrie 2020	Cholistan, Pakistan	Sentinel 1 (SAR) Sentinel 2 (MSI)	*Geometric knowledge-based* + *Machine Learning-based/* PBIA – RFCL binary classification	Multi-sensor/multispectral multi-temporal Aggregate (SAR median, MSI mean – 14 bands) → training data set (n =5) → RFC (3 iterations) → probability map (threshold >0.55) = 337 clusters (71 known)→ vectorization validation with independent validation set (n = 20)	Site Gazetteers Historical Maps Google Bing Worldview 2-4	settlement/tell mounds	large scale	Google Earth Engine R	GEE code flowchart
24	Niculiță 2020	Jijia Hills, NE Romania	ALS 2-6/m^2 0.5 m resolution	*Geometric knowledge-based* + *GeOBIA-based*/WS + *Machine Learning-based/* PBIA – RFCL	DEM → **a)** focal statistics (peaks) → **b)** Convexity → WS → rasterization: segments & seeds → Peaks + segments + seeds → filter to overlay → geomorphometry & descriptive statistics of candidates → RFC	Peaks, Convexity 55 Geomorphometrical variables (Slope, Curvatures, Openness (-,+), TRI, TWI ...) + 17 Shape descriptors (area, perimeter, interior edge ratio, sphericity, shape index,compactness, roundness, elongation ...)	barrows	regional	R (*randomForest, randomForestSRC, randomForest -Explainer, pdp, Boruta, RSAGA* packages)	workflow data code

25	Sărășan – Ardelean – Bălărie – Wehrheim – Tabaldiev – Akmatov 2020	Suusamyr Plateau, Tian Shan	UAV	*Geometric knowledge-based + GeOBIA-based*/MRS	***I Fieldworld & manual mapping*** DSM; Orthophoto + Manual delineation → archaeological reference data ***II Data preparation*** Multiscale Topographic Analysis; Semantic analysis (Aggregation of Geomorphons) ***III OBIA*** MTA + Aggregated Geomorphons = MRS → Image objects → ruleset classification →accuracy assessment (classification + reference data)	DEV = (Z0 – ZD) / SD ESP2 tool MRS segmentation geomorphones: summit, ridge, spur = high - within the burial mounds flat, shoulder, hollow, footslope, valley, depression = low - outside of the burial mounds threefold aggregation based on slope class (high, low, slope)	barrows	regional	ArcGIS eCognition Whitebox	workflow equation rulesets
26	Rom – Haas – Stark – Dremel – Becht – Kopetzky – Schwall – Wimmer – Pfeifer – Mardini – Genz 2020	Chekka, Lebanon	ALS $10/m^2$	*Geometric knowledge-based*	raw data → calculation of a precise trajectory →combination of the trajectory with raw data scan → final strip adjustment → LAS LAS → tiling 50x50 m → Remove Isolated Points → ground classification → DTM (1m cell size) **iMound**: DTM →lowpass filter →inverting DTM →filling sinks → subtraction of the filled model + minimum height & area threshold iMound classification: multi-stage procedure: parameters (visual inspection (a, r), availability of freshwater (D), area (A) & circularity (C), visibility (V)) → iMound score **LCP**: comparison of 4 different algorithms iMound + LCP →exclusion of modern areas	visual inspection: combined shading, slope, + openness, - openness, LRM, SkyView Factor iMound + Classification with a deductive prediction model +LCP iMound score: $S=[(D_{no}+A+C+V_{no}+r)*a]/5$ LCP algorithms: Cost(s)=s V(s)=6e-3.5∣s+0.05∣ $Cost(s) = 1 + (\frac{s}{\check{s}})^2$	tell mounds	regional	PosPac MMS (Applanix) Riegl Riprocess OPALS SAGA Python R	workflow - LAS filtering - spatial analysis FOSS
27	Kazimi – Malek – Thiemann – Sester 2020a	Harz, Lower Saxony, Germany	ALS	*Geometric-knowledge based + Deep Learning/* Mask-R-CNN	DTM + derivatives (128 x 128 pixels) → trained separately, results compared (100 epochs, batch size 4, SGD optimization) →evaluated by mAP + IoU	SLRM, LD, SVF, POS-OP, NEG-OP	borm craters, charcoal kilns, barrows, mining sinkholes	regional	Python Keras	n/a
28	Kazimi – Thiemann – Sester 2020b	Harz, Lower Saxony, Germany	ALS	*Geometric-knowledge based + Deep Learning/* MM-net vs. MM-HR-net	a) **MM-net**: feature extractor → concatenate → convolution →ReLU → Conv2D → Dropout → Flatten → Dense → Dropout → Dense → Dense → Predictions vs. b) **MM-HR-net**: feature extractor →concatenate →Conv2D →Residual Block →Convolutional Block →Conv2D → Classifier	DEM, LD, SLRM, SVF, POS-OP, NEG-OP, RGB, Slope Multi-modal High Resolution Network	fluvial landforms, bomb craters	local, regional	Python Keras	workflow
29	Trier – Reksten – Løseth 2021	Southern Norway	ALS 1, 5, 10 or 12 points/m² DTM 0.25 m/pixel	*Geometric-knowledge based + Deep Learning/* Faster R-CNN	DTM → LRM (600x 600 pixels OOI) →data augmentation →VGG16 DNN + ImageNet dataset (changed class labels, additional training of cultural heritage objects)	LRM	grave mounds pitfall traps charcoal kilns	large scale	Python PyTorch QGIS	flowchart
30	GholamReza and Malian 2021	Farahan, Iran	Landsat 8 OLI and TIRS DEM 10 m	*Geometric-knowledge based + Template matching*/Rigid TM	a) pixel level data fusion (Ehlers) of OLI & TIRS → NDVI + NDWI indices → range filter for anomaly extraction →classification in 3 categories by k-means b)Clay content classification in4 categories (k-means?) c)surface temperature classification 3 categories k-means d)manual determination of weights for each category = map with 3 categories of archaeological potential e) map altitude anomalies in DEM	(NDVI + NDWI + Land surface temperature) + range filter + ordered weighted averaging	ancient hills/tells	local	n/a	n/a

					f) overlay of archaeological potential map & altitude anomalies (d+e) g) template matching of overlay with 3 hill categories					
31	Davis – Caspari – Lipo – Sanger 2021	Beaufort County, South Carolina, USA	LIDAR, Sentinel 1+2	*Geometric-knowledge based + Deep Learning/* Mask R-CNN vs./+ *Machine Learning-based/* PBIA – RFCL	compare results of Mask R-CNN & RF classification for a final detection output and ground validation	LiDAR: DEM, Hillshade, Slope	mounds, shell rings	regional	ArcGIS Pro	flowchart

The OOI of interest were denominated in various forms - to be able to evaluate the information, the terms were simplified and unified where it was needed.

Abbreviations in alphabetical order:
A-DEM – Archaeological Evaluation Model
BBP – Bounding Box Proposal
BBR – Bounding Box Regressor
BNN – Bayesian Neural Network
CDM – Canopy Density Model
CHM – Canopy Height Model
CNN – Convolutional Neural Network
CV – Cross validation
DBSCAN – Density-Based Spatial Clustering
DLM – Digital Land-use Model
DM – Difference Map
DoCG – Direction of Constant Gradient
ESP – Estimation of Scale Parameters
Flowchart vs. Workflow – Flowchart is a more generalised (cognitive) workflow, not depicting actual steps
CPC – Ground Control Point
GeOBIA – Geographical Object Based Image Analysis
GMA – Gradient Magnitude Analysis
HCT – Hough Circle Transform
IDM – Intensity Difference Model
IoU – Intersection over Union
LBR – Location Based Ranking
LHS – Latin Hypercube Sampling
LD – Local Dominance
LoG – Laplausian of Gaussian
LRM – Local Relief Model
L2W – Lenght-to-width
MD – Mahalanobis Distance
MinD – Minimum Distance
mAP – mean Average Precision
MM – Mathematical Morphology
MRS – Multi-Resolution Segmentation
OOI – Object(s) of Interest
OTB – Orfeo Toolbox
PBIA – Pixel-Based Image Analysis
PCM – Percentage Canopy hit Model
PL – Positive Layer
PLS – Partial least squares
RFCL – Random Forest Classification
RMS – Root Mean Square
RPN – Region Proposal Network
RRIM – Red Relief Image Map

SCG – Standard Conjugated Gradient
SD – standard deviation
SDA – Stochastic Depression Analysis
SD CHM – Standard Deviation of CHM
SGD – Stochastic Gradient Descent
SLRM – Simple Local Relief Model
TM – Template Matching
TPI – Topographic Position Index
TWI – Topographic Wetness Index
UC – Unspherity curvature
UNM – Unsupervised Nested Means
WS – Watershed Segmentation
VAT – Visualisation for Archaeological Topography – blends analytical hillshading (HS), Slope, Positive (+) Openness, Sky-View Factor (SVF) into a single greyscale image