List of attributes extracted by CoMMa tools to characterise each feature.

Attribute	Tools			
Area	Delineation tool	Basic Descriptors		
Perimeter				
MBG width				
MBG length				
MBG Width/ length ratio				
MBG main orientation				
Vertical relief				
Slope (Min, Max & Mean)				
Local Deviation from Global (LDfG)				
Depth (Min, Max & Mean)				
Polsby-Popper test for circularity				
Convex hull area				
Convex hull-object ratio				
Dissection index				
Depth range				
LDfG variance				
LDfG percentile rank				
Confined vertical relief				
Geomorphons class percent				
Geomorphons peaks or pits number				
Ruggedness (Min, Max & Mean)			Texture	
AVI (Min, Max & Mean)				
Backscatter (Min, Max & Mean)				
Optimal vertical relief				Volume
Volume				

Acknowledgements

Riccardo Arosio (University College Cork) and Joana Gafeira (British Geological Survey) conceived the original idea of the new ArcGIS Pro based on a previous toolbox created by Joana Gafeira, the BGS Seabed Mapping Toolbox (Gafeira, J., 2017). Riccardo Arosio wrote the Python scripts while Joana Gafeira and Laurence De Clippele performed extensive testing.

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Where to find the CoMMA Toolbox

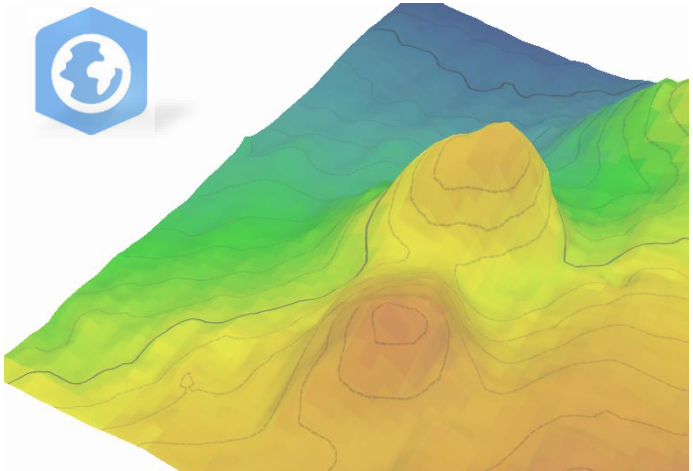
The toolbox and the User Guide is available at:
https://github.com/ricarosio/CoMMa.git

CoMMa Toolbox

The Confined Morphologies Mapping (CoMMa) toolbox is an ArcGIS Pro Toolbox created for **semi-automated morphology mapping.**

It includes a selection of tools for the delineation and description of any type of enclosed features on a DEM, either negative or positive.

The CoMMa Toolbox is made up of individual Python scripts that use a sequence of pre-existing ArcGIS geoprocessing tools and does not require the installation of any new Python package.



CoMMa Data Preparation

The **CoMMa Toolbox** works on **DEMs**, obtained from **multibeam echosounder data** or other geophysical and optical instruments (e.g., Lidar, 3D seismic etc.).

Datasets may be affected by artefacts that can hinder a correct delineation of the features of interest, for example, vessel motion-related artefacts.

A degree of data preparation, such as cleaning the initial data to remove artefacts, could be advised to enhance the performance of both the delineation and characterisation tools.

The **CoMMa Toolbox** includes five tools devoted to data preparation, that can be found within the sub-toolbox CoMMa's Data Preparation.

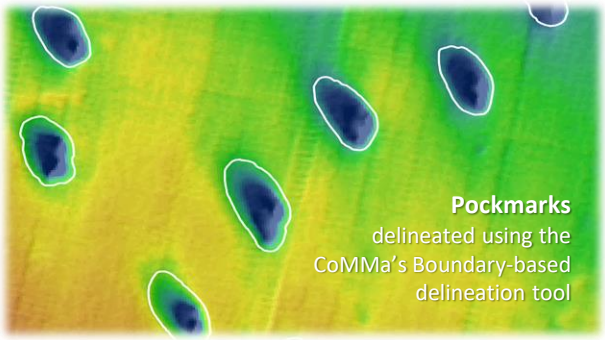
Local Topographic Position (LTP) derivatives	***Mean LTPs***	Local topographic position index metrics based on the absolute and relative mean of the neighbourhood.
	Median LTPs	Local topographic position index metrics based on the absolute and relative median of the neighbourhood.
Pre-processing tools	***Fencing***	This tool creates an artificial containing fence at the boundary of the DEM, preventing the Fill algorithm from spilling out and thus permitting the delineation of landforms that are at the boundary. It must be used in conjunction with the Filter and Clip tool.
	Filter and Clip	This tool removes the flat or featureless areas in the DEM and preserves areas of the seabed where the features are more likely to occur. The application of this tool is particularly useful to remove the effects of broad-scale topography on Boundary-based delineations.
	Smoothing Filters	A series of standard filters are used to smooth the DEM and remove noise and artefacts.

CoMMa Delineation

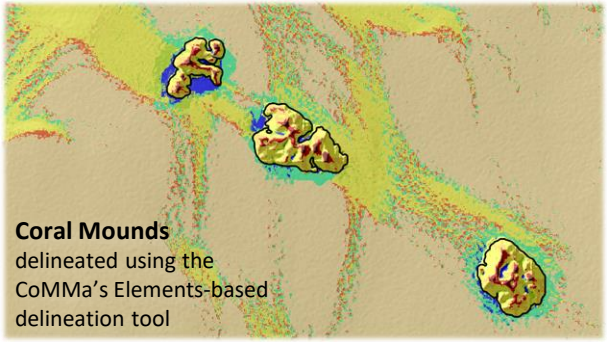
There are two available delineation tools in **CoMMa Toolbox**, the "**Boundary-based**" and the "**Elements-based**" delineation tools.

Boundary-based delineation	Delineates confined landforms using a DEM or a DEM derivative and focuses on recognising the landform boundary.
Elements-based delineation	Delineates confined landforms by aggregating positive or negative land surface elements (geomorphons).

Both negative and positive features can be mapped using the delineation tools.
These tools require a set of **user-defined thresholds** (such as Minimum Vertical Relief, Minimum Width and Minimum Size Ratio) to best delineate the target features.



Pockmarks
delineated using the CoMMa's Boundary-based delineation tool



Coral Mounds
delineated using the CoMMa's Elements-based delineation tool

CoMMa Description

The Description tools in **CoMMa Toolbox** calculate a series of basic geometrical and statistical attributes, additional metrics (such as zonal vector ruggedness and aspect variability index), backscatter statistics and the volume for each shape contained in the delineation shapefile.

These tools can be used to characterise both features that were **mapped automatically** or **manually mapped**.

Basic descriptors	Calculates a series of basic geometrical and statistical attributes for each shape contained in the delineation shapefile.
Texture descriptors	Calculates a few additional metrics, such as zonal vector ruggedness and aspect variability index, and optionally backscatter statistics.
Volume descriptors	Calculates the volume and more accurately the height for each shape contained in the delineation shapefile.