

CoMMa Feature Delineation



Rationale:

The CoMMa delineation tool can be applied directly to a bathymetric DEM and, when the general seascape is otherwise flat, it might be sufficient to isolate and correctly delineate the targeted features. However, if this is not the case, and the interference of sloping topography or other underlying large-scale landforms can distort the signal of the targets, an LTP derivative is used to isolate a specific wavelength thought to best delineate the feature of interest.

The “Boundary-based Delineation” tool, takes advantage of the hydrological algorithm “Fill”. This algorithm will fill up positive or negative enclosed relief, according to the relief of the targeted features. Then the filled output will be subtracted from the original DEM, creating a flat surface with only the potential features of interest. Then a user-defined threshold, the Vertical Cutoff, is used to define the contour line that is going to be the base of the delineation.

Once all the areas of confined morphologies are delineated based on the Vertical Cutoff threshold, a sequence of steps is followed and features that do not satisfy the criteria set by the user-defined thresholds will be excluded. The threshold covers aspects related to the minimum vertical relief and dimensions expected for the targeted feature.

The delineation of some features may fail to include the top of positive features or the base of the negative features, by focusing on areas of change of relief – creating holes within the delineating polygons. If that occurs, the user can choose to have it automatically removed.

Usage:

The input file for this tool can either be a bathymetric DEM or an LTP (Local Topographic Position) or BPI (Bathymetric Position Index) grid. This input name will automatically provide an output name for the polygons delineating the features. It will append the suffix “_Delin” and the parameters used to define the features, so that the user can identify which parameters were used on specific outputs.

The tool can identify features that have a positive or negative profile.

There are five main parameters required for this analysis, plus several other processing options:

- Vertical Cutoff - The value that will be used as the confining boundary and used to delineate the features. This value will be in meters if the delineation is fully based on the source DEM, OR on the derivative unit, if the latter is used. When the targeted features are well disconnected from other features, this value should be as low as possible, to best capture the geometry of the feature’s boundary. However, the user may want to use a higher value to reduce the likelihood of adjacent features being mapped as a conjoined polygon.
- Minimum Vertical Threshold - Only features with a vertical relief greater than the Minimum Vertical Relief value will be mapped.
- Minimum Width - Minimum Width threshold allows to exclude features based on their size. Only features with width greater than the Minimum Width value will be mapped.
- Minimum W/L Ratio - The Minimum Width/Length Ratio threshold allows to exclude features based on their shape. Width and Length are defined by the features’ Minimum

Bounding Geometry (MBG) It should be noted that the Minimum Width/Length Ratio value can range from 1 (for a circle-shaped feature) to almost 0 (for a very elongated feature).

- Buffer to apply to the delineation - The Buffer Distance value is applied to the initial polygons created based on the feature's internal contour line corresponding to the Vertical Cutoff. The Buffer Distance should reflect approximately the distance, in plan view, from the line delineated to the actual rim/edge of the features.
- Level of Smoothing - The user can decide whether to apply smoothing and simplification to the initial (or buffered) polygons. Light, heavy or no simplification and smoothing options are offered. Simplification is calculated using the Retain weighted effective areas (Zhou-Jones) algorithm, with tolerance (T) based on the size of the polygon (light $T = \text{width feature} / 10$; heavy $T = \text{width feature} / 5$). Smoothing is done using the PAEK algorithm with tolerance (T) based on the polygon's size (light $T = \text{width feature} / 5$; heavy $T = \text{width feature} / 2$).
- Geomorphon raster input – can be left blank or a file added. A geomorphon file is created by the geomorphon tool from the DEM or from an LPT-derived raster. Every cell of the geomorphon raster will have an integer value corresponding to a specific landform type: Flat—cell value 1, Peak—cell value 2, Ridge—cell value 3, Shoulder—cell value 4, Spur—cell value 5, Slope—cell value 6, Hollow—cell value 7, Footslope—cell value 8, Valley—cell value 9, Pit—cell value 10.
- Minimum Geomorphons ratio - if a geomorphon file is defined features with a ratio geomorphons area/total area smaller than this threshold will be excluded from the delineation.
- Delete internal holes - when checked, holes inside a delineated feature are removed. The delineation of some features, especially based on some LTPs layers, may fail to include the top of positive features or the base of the negative features, by focusing on the main areas of change of relief – creating holes within the delineating polygons.
- Delete temporary files - when checked all the files within the temp folder will be deleted. It should be noted that some of these “intermediate” files could be useful to understand the reason behind an unexpected output. If the tool is run multiple times the temp files will be overwrite, to avoid excessive use of disk space. If is required to compare the temp files created with different parameters, then different workspaces should be selected.

Output is a single polygon vector shapefile and its default filename is the same as the bathymetry filename with “_Delin” added to the name. Format output is .shp (plus its associated companion files).

Arosio et al. (2024) CoMMA: a GIS geomorphometry... *Geomorph.*, 458, 109227.

[10.1016/j.geomorph.2024.109227](https://doi.org/10.1016/j.geomorph.2024.109227)

