A Methodology on Natural Occurring Lines Segmentation and Generalisation

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the aim of the project

description of methodology

- segmentation
- line generalisation tools

examples

future outlook

aim:

to develop a model that generalise natural occurring lines
(lines that represent physical features, like rivers, coastlines, etc)

concept:

based on the "philosophy":

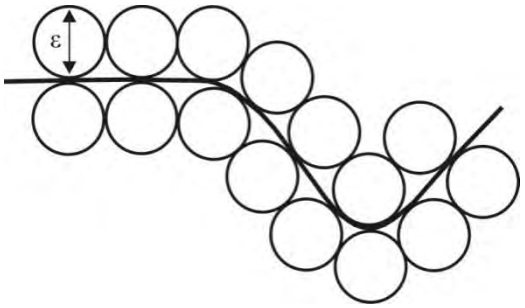
segmentation – analysis – generalisation

Buttenfield 1989, Plazanet et al. 1995, Wang & Muller 1998, Dutton 1999, Mustière 2005, Lecordix et al. 2005, …

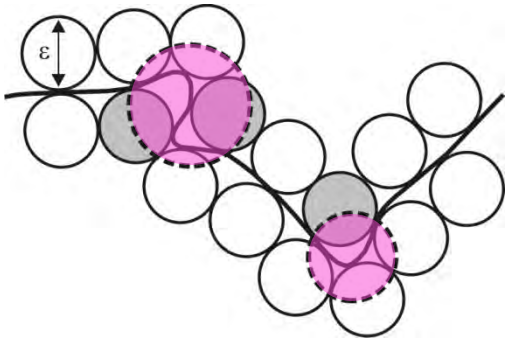
condition:

to preserve the legibility of the outcome

Perkal's rolling disc



ε–convex part of a line



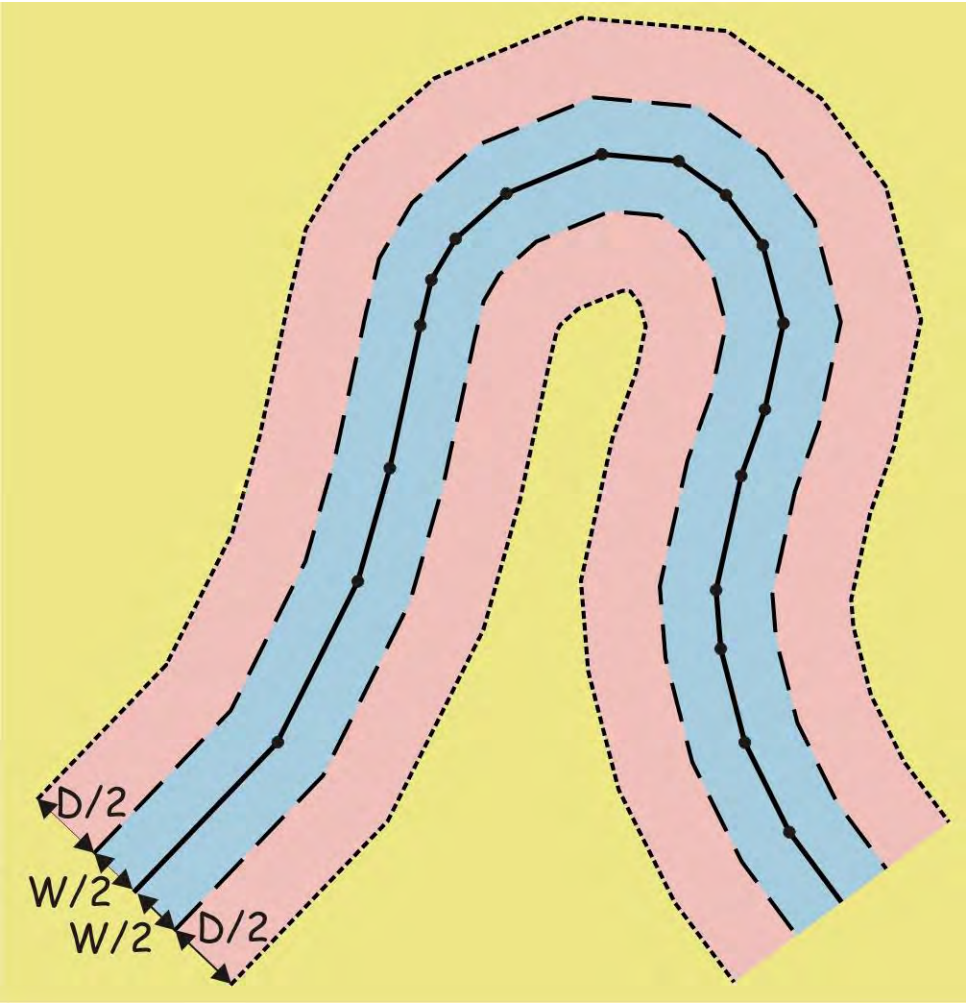
ε–non-convex parts of a line

Perkal 1966

Remark:

Parts of the cartographic line that are more complex in shape (ε–non-convex) have:
significant legibility problems in the target scale under generalisation

ε : is associated with line width and visual discrimination limit at target scale



W : Line width
D : Visual discrimination limit
T : Tolerance

$$\varepsilon = W + D + T$$

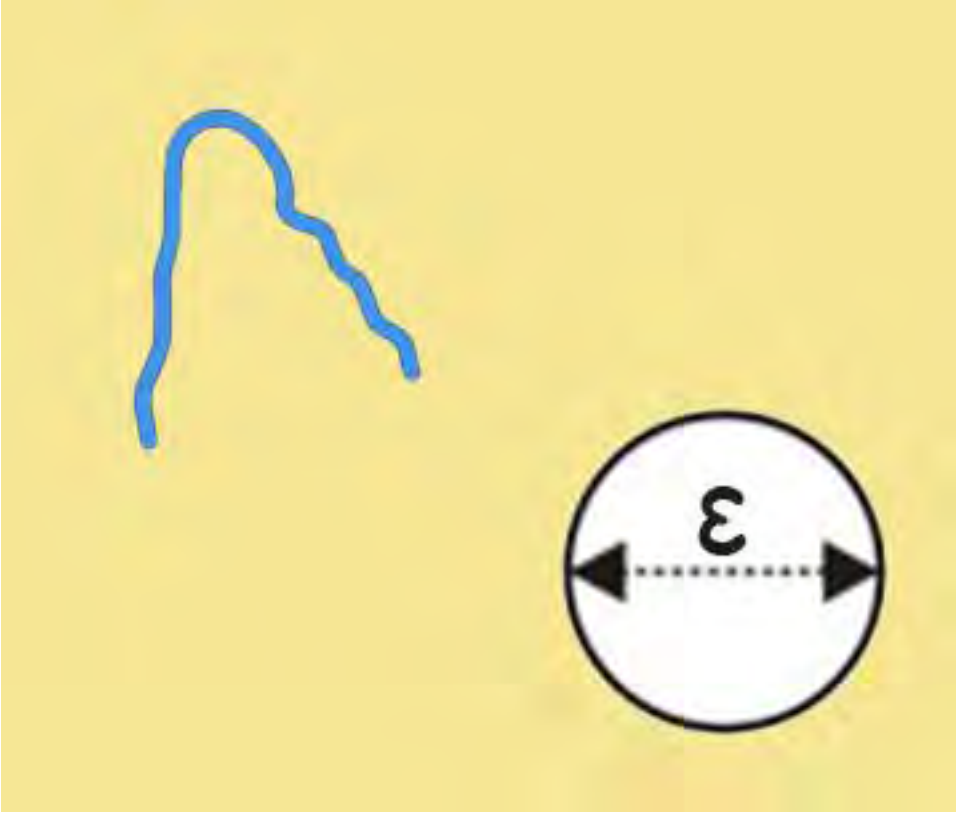
Type A:
Left or right sided ε-non-convex parts

Type B:
Both sided ε-non-convex parts

Type C:
Line coalescence between separated parts

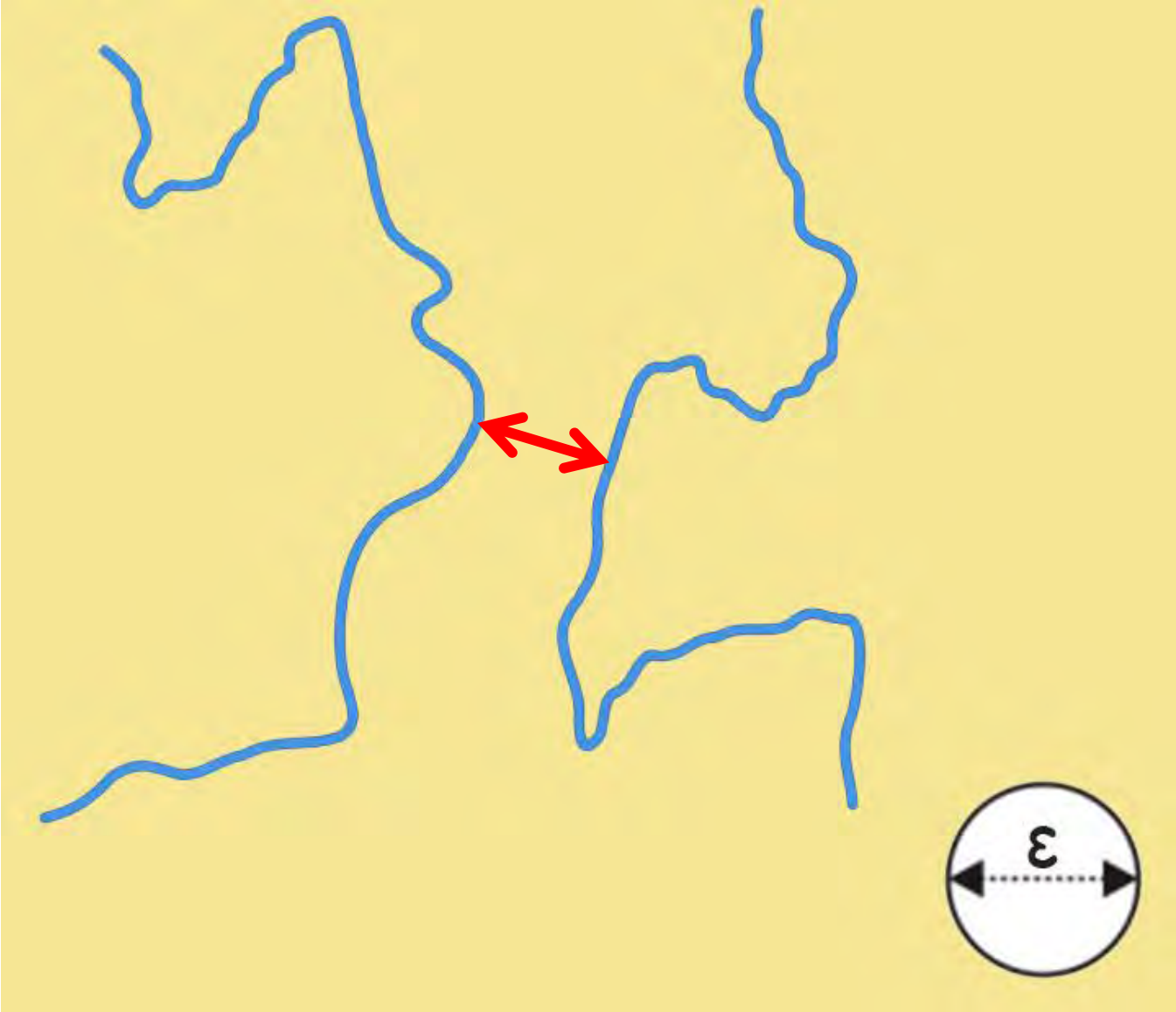
Type D:
ε-convex parts

Type A
Left or right sided ε-non-convex parts

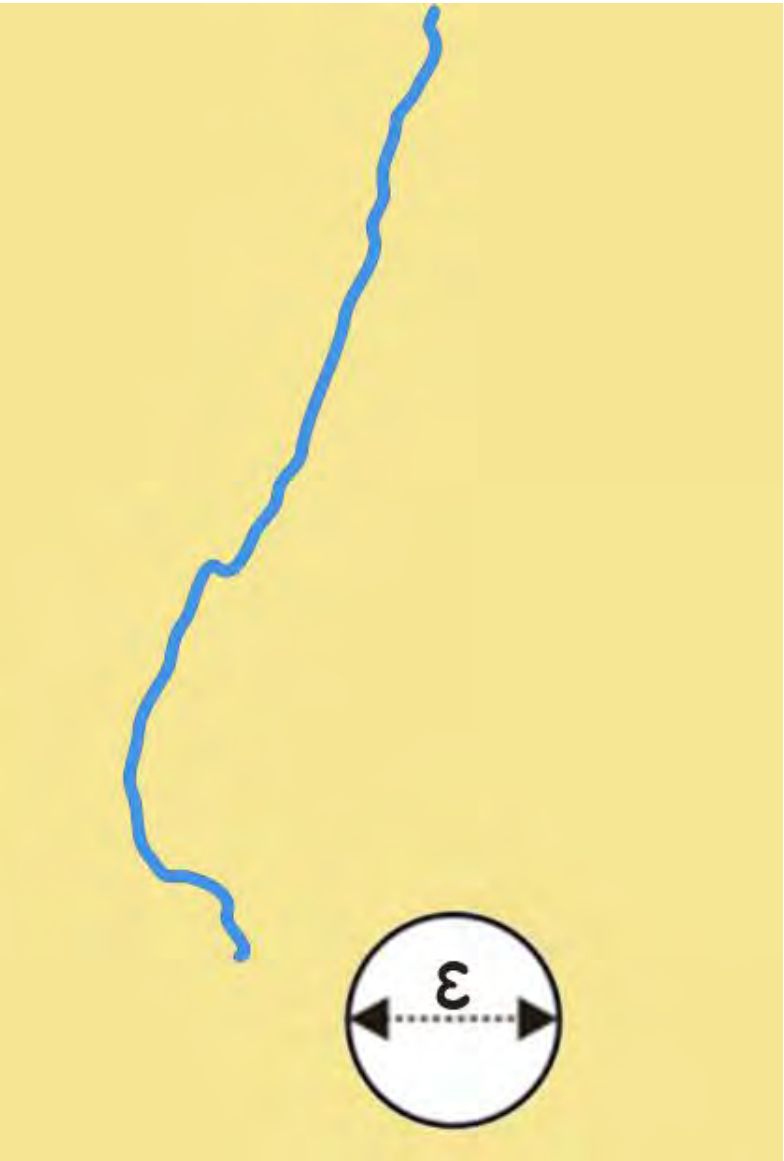


Type B
Both sided ε-non-convex parts

Type C
Line coalescence between separated parts



Type D
ε-convex parts



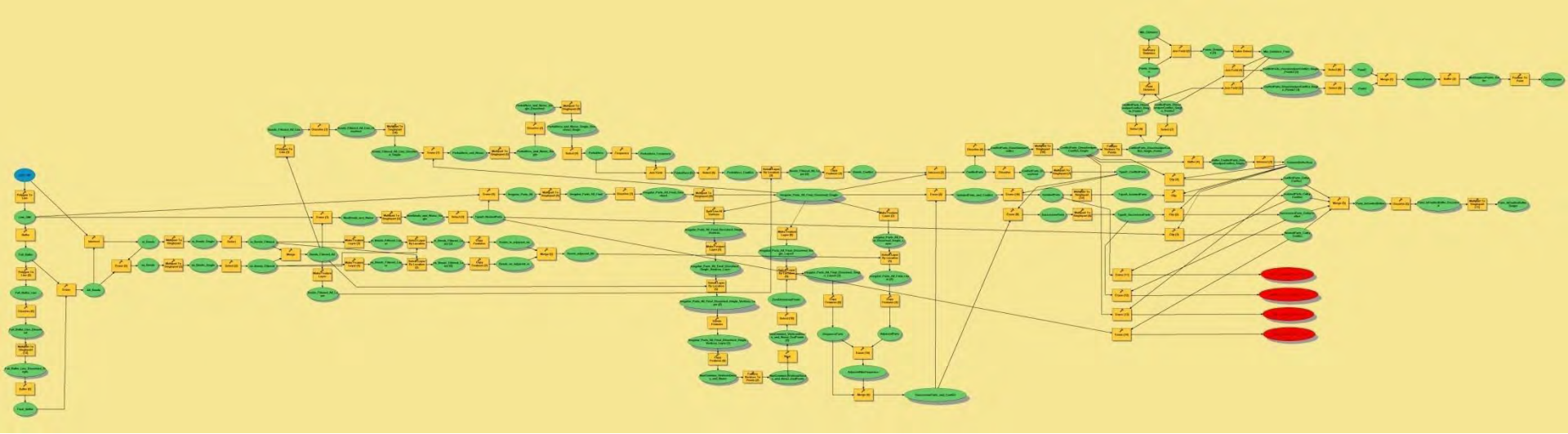
segmentation

Implementation environment:

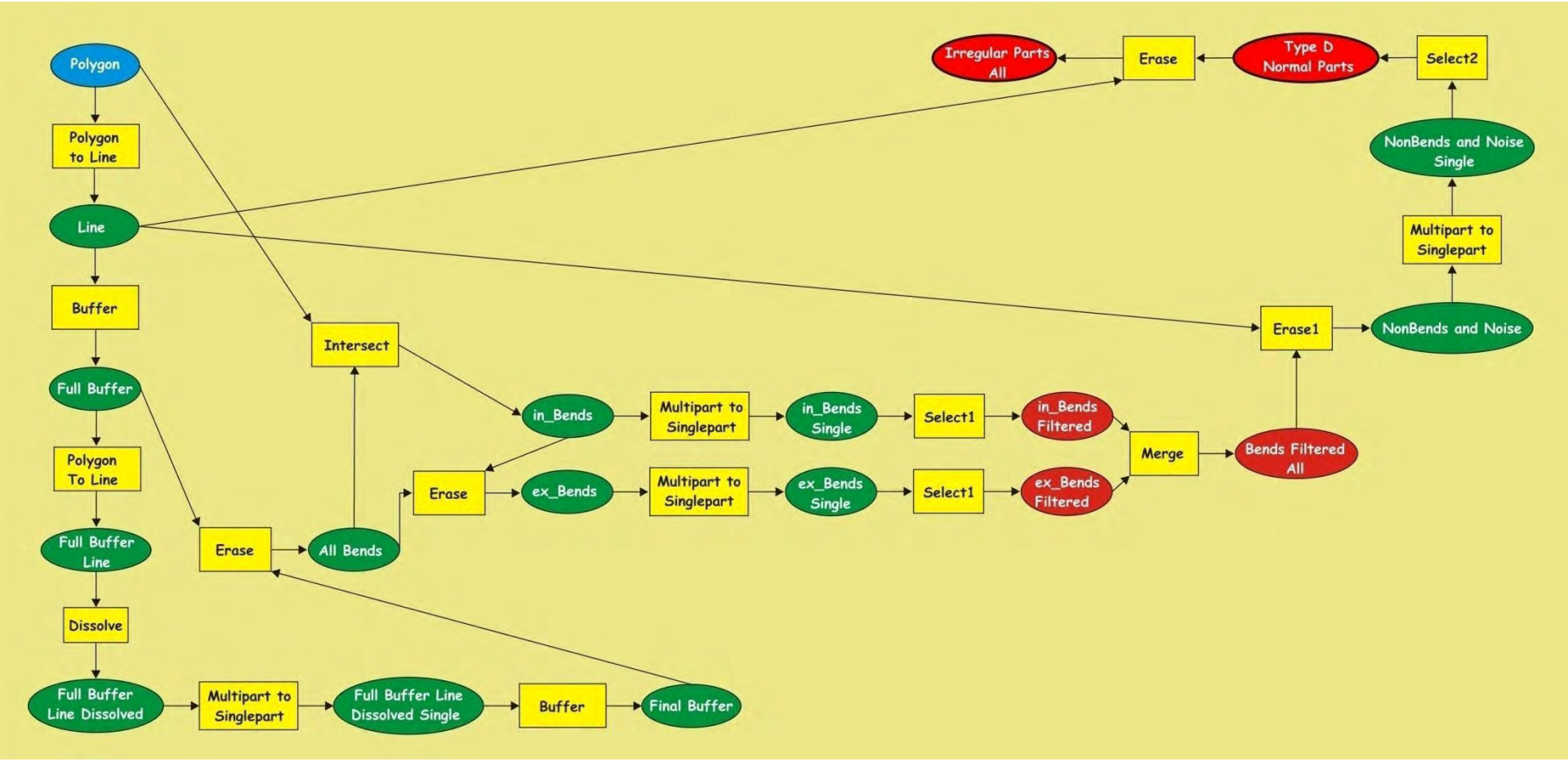
ArcGIS (© ESRI)

Model Builder

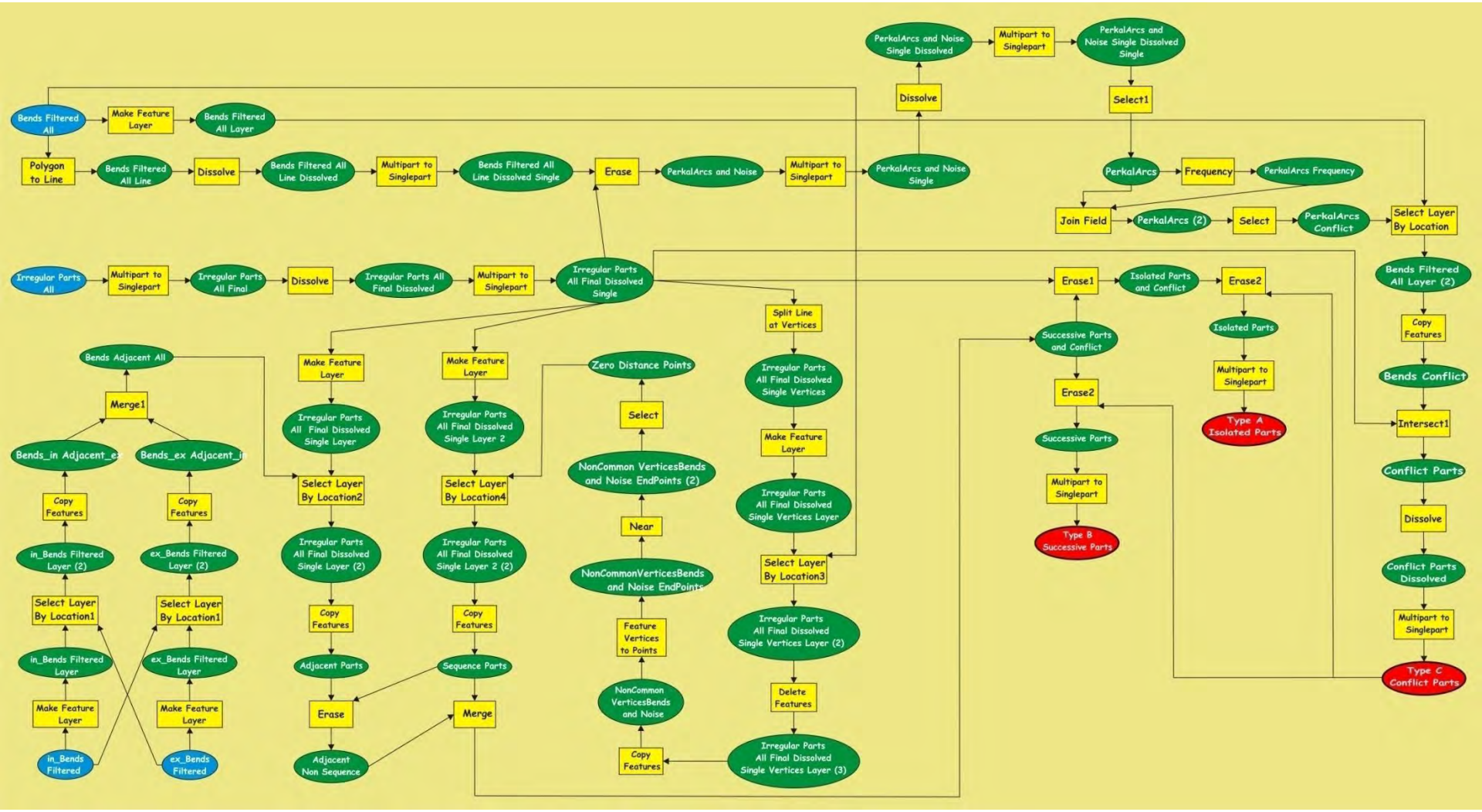
segmentation model (overall view)



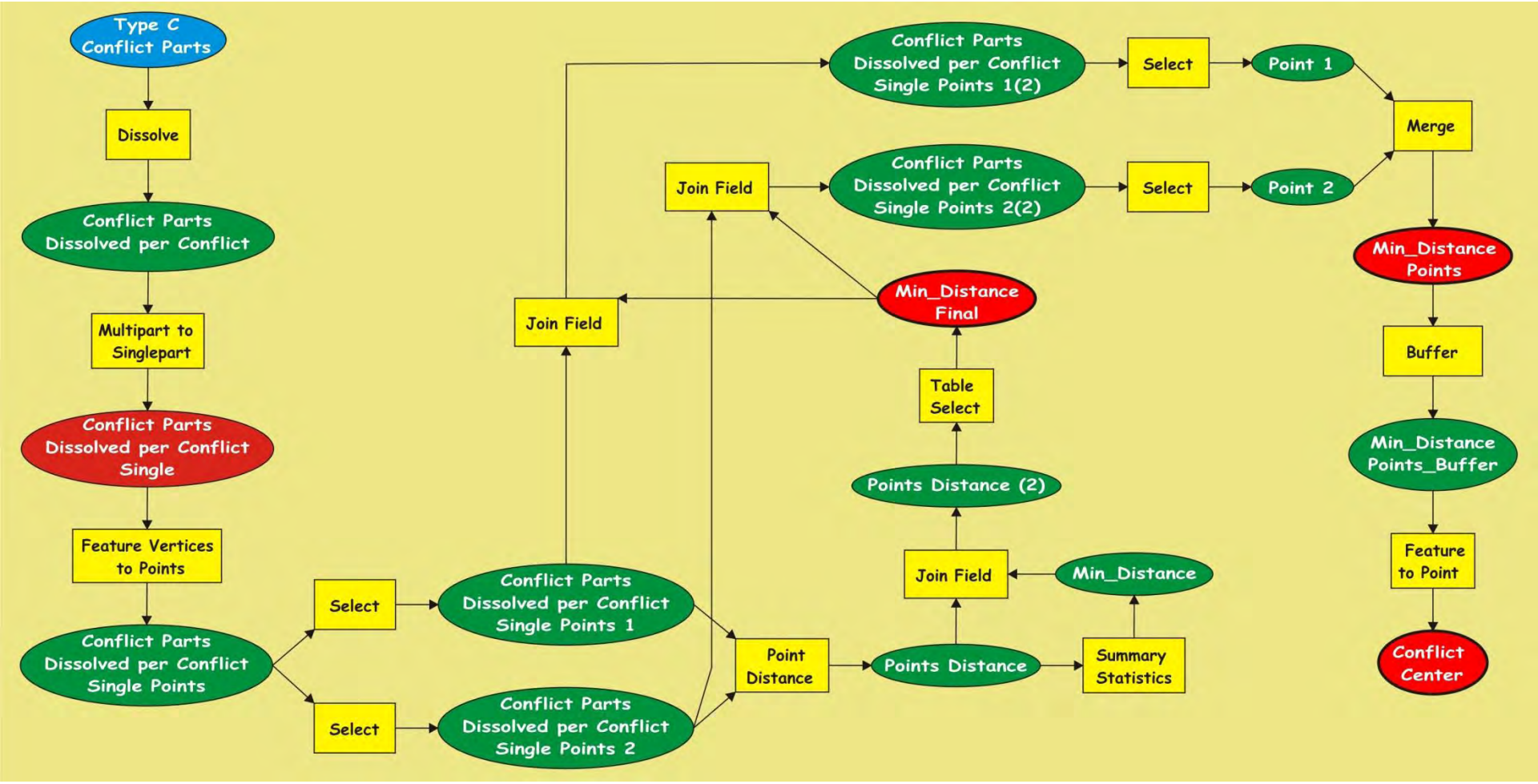
segmentation model (part 1)



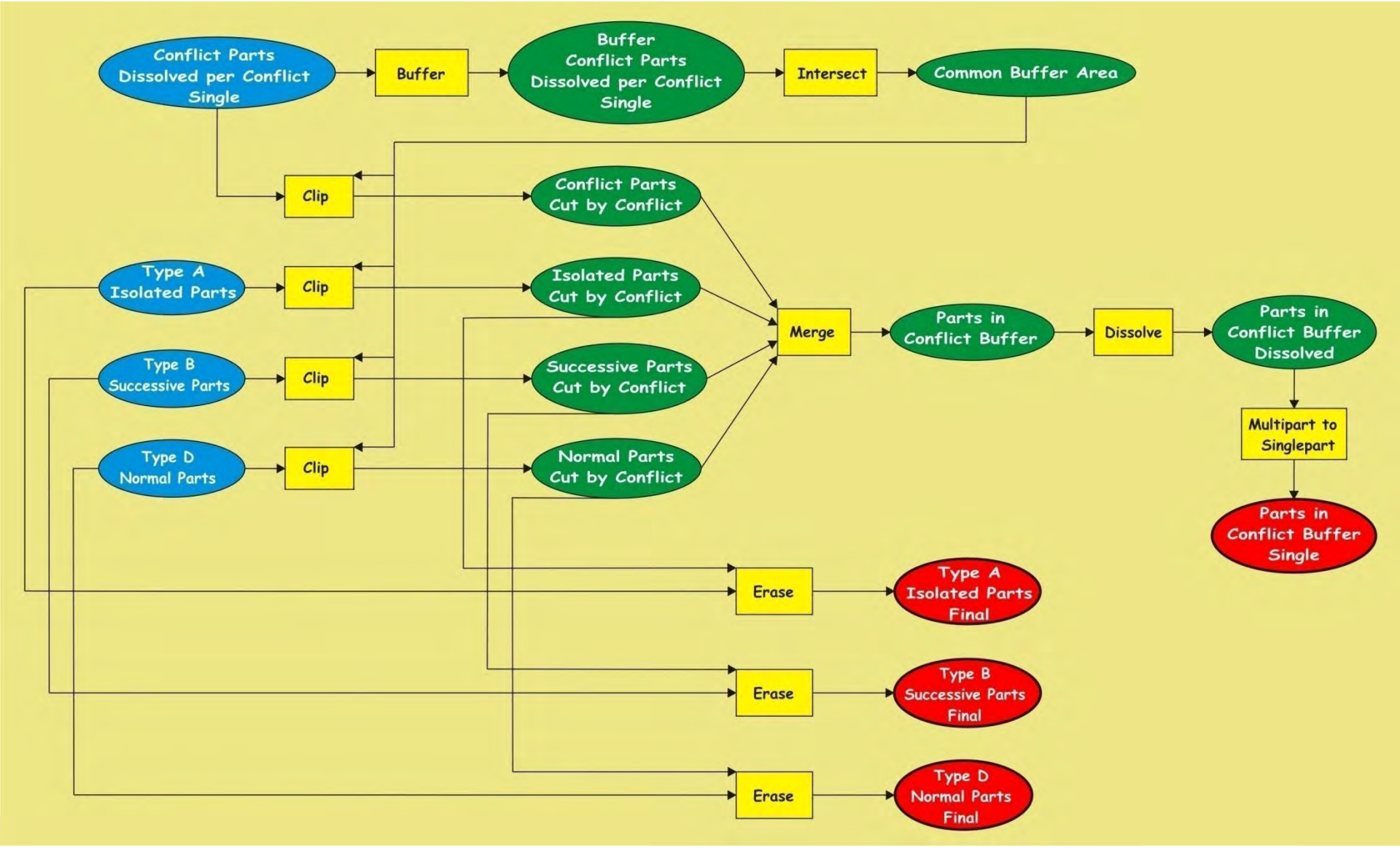
segmentation model (part 2)



segmentation model (part 3)



segmentation model (part 4)



generalisation tools

Gauss filtering (smoothing algorithm)

Fritsch 1997

Balloon (exaggeration algorithm)

Lecordix et al. 1997

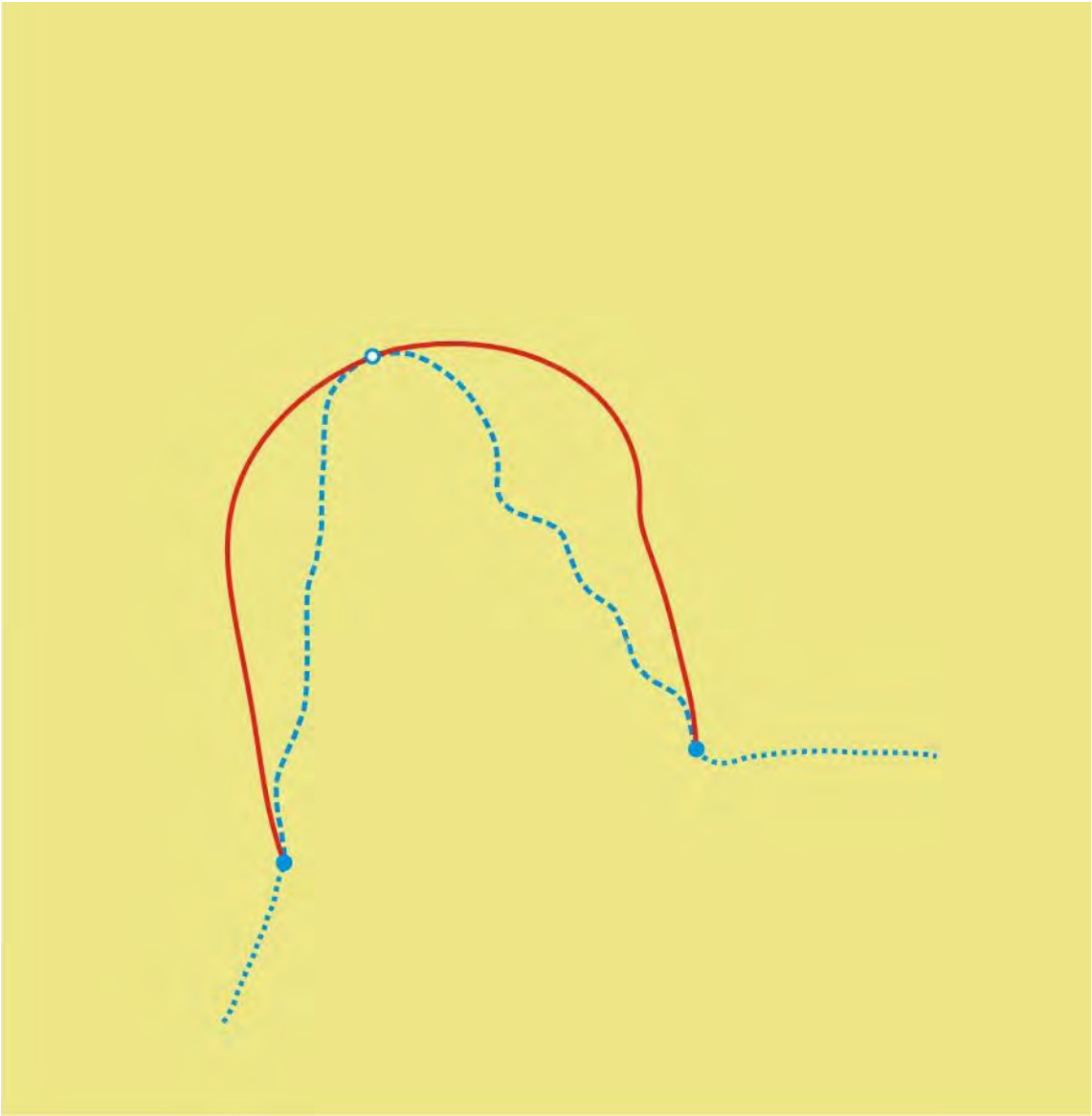
Bend Analysis (detection of inflection points & peeks)

Wang & Müller 1998

Affine transformation (geometric transformation)

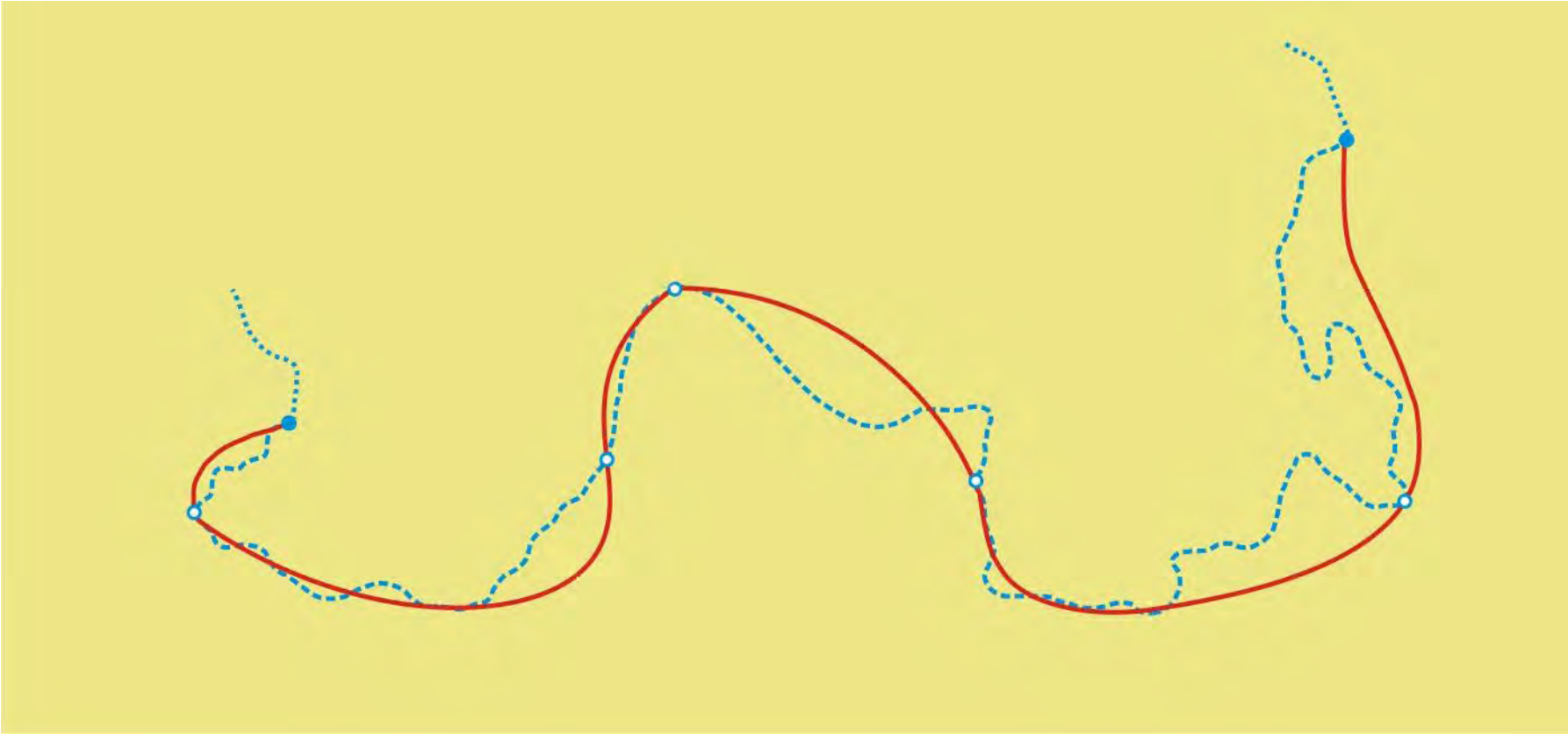
Depress (displacement algorithm)

Implementation environment: MATLAB (© MathWorks)



Type A

$\sigma = 9$



$\sigma = 40$

Type B

Type C

Type D

examples

Peristera Island

generalisation scenarios:

from scale 1:50K to

1:100K

1:250K

1:500K

1:1M

example of segmentation

1:100K

One-Sided ε-non-convex parts

ε-convex parts

example of segmentation

1:250K

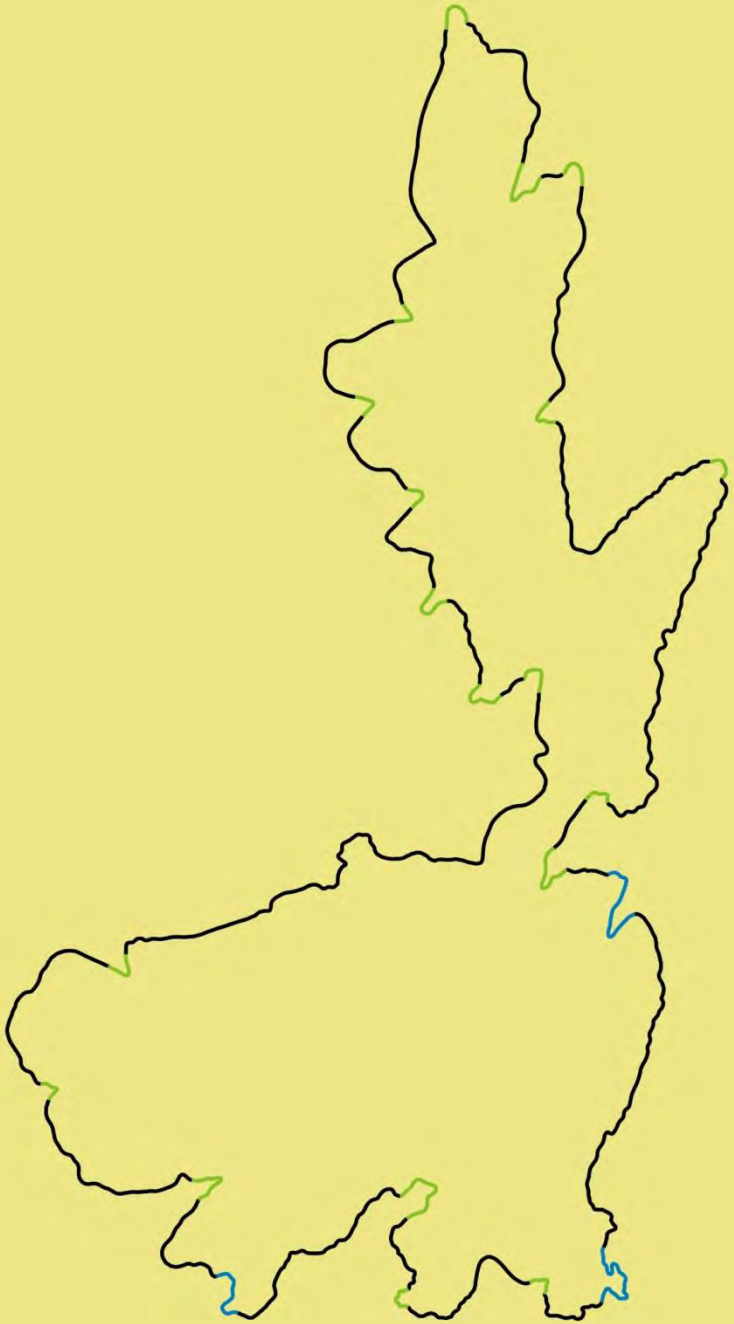
One-Sided ε-non-convex parts

Two-Sided ε-non-convex parts

ε-convex parts

example of segmentation

1:500K



One-Sided ε-non-convex parts

Two-Sided ε-non-convex parts

ε-convex parts

example of segmentation

1:1M

One-Sided ε-non-convex parts

Two-Sided ε-non-convex parts

Parts of Convergence

ε-convex parts

generalisation example (1:50K to 1:100K)

initial line

proposed

generalisation example (1:50K to 1:100K)

analogue map

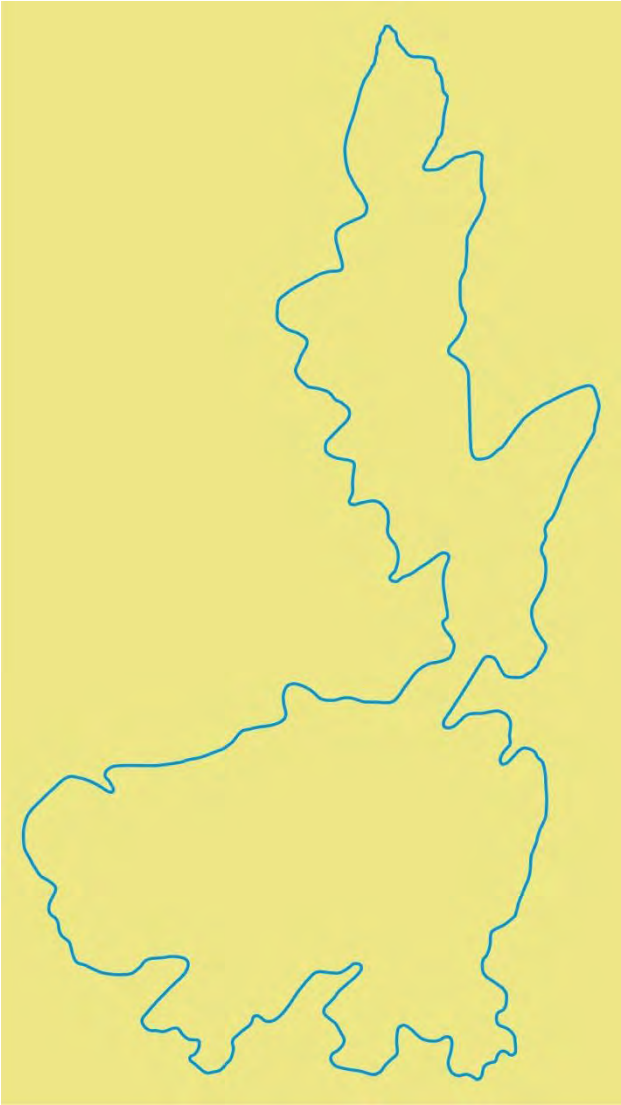
proposed

generalisation example (1:50K to 1:250K)

initial line

proposed

generalisation example (1:50K to 1:250K)



analogue map

proposed

generalisation example (1:50K to 1:500K)

initial line

proposed

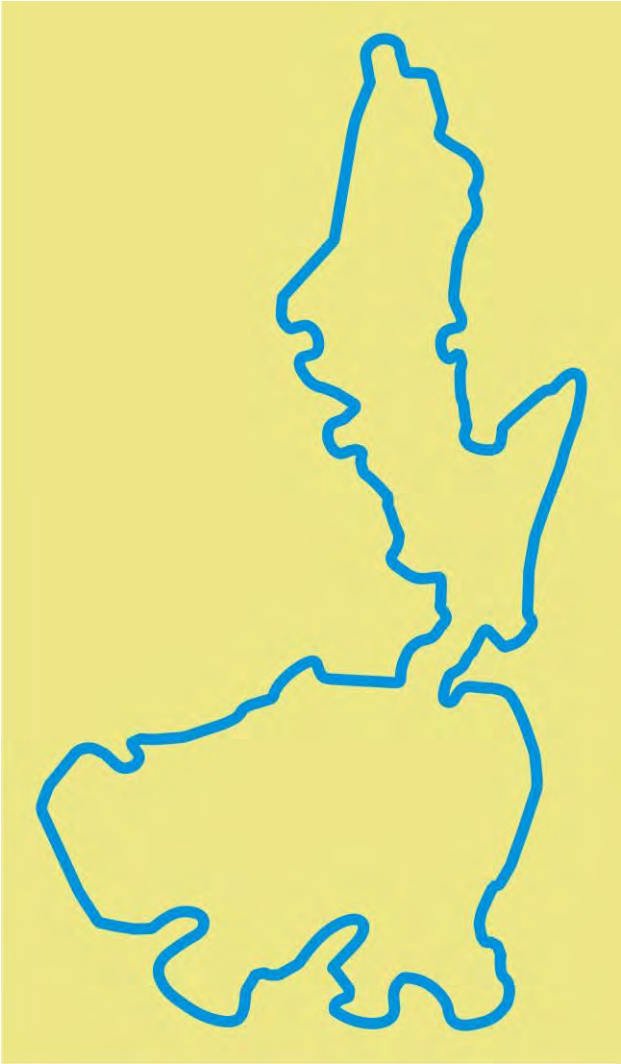
generalisation example (1:50K to 1:500K)

analogue map

proposed

generalisation example (1:50K to 1:1M)

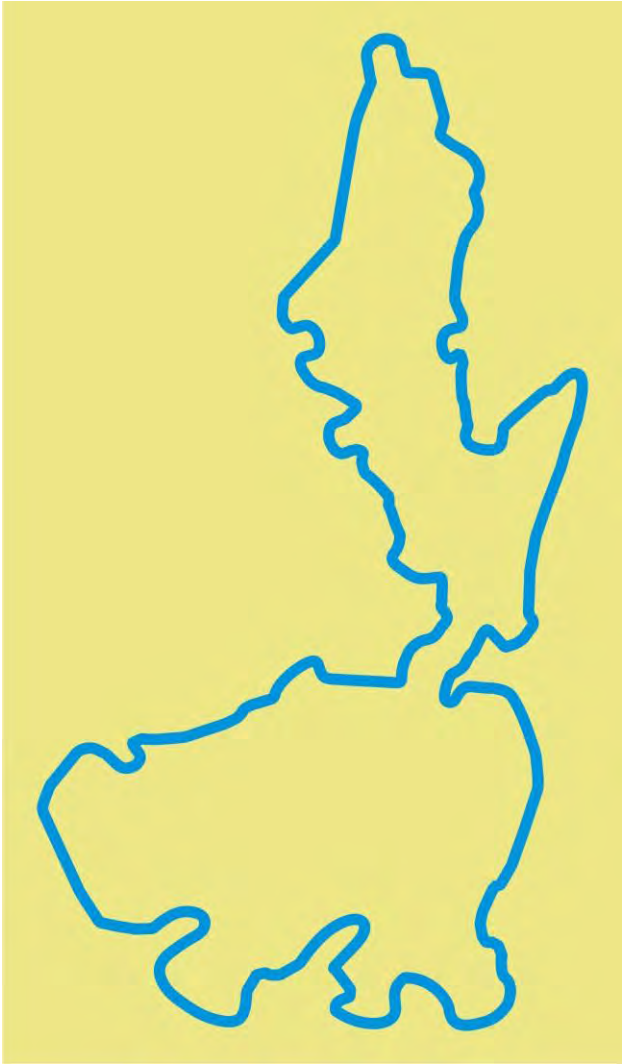
initial line



proposed

generalisation example (1:50K to 1:1M)

analogue map



proposed

future outlook

Depress algorithm with more than two interacting parts

incorporate generalisation tools (MATLAB)
into Model Builder (with Python)

Thank you