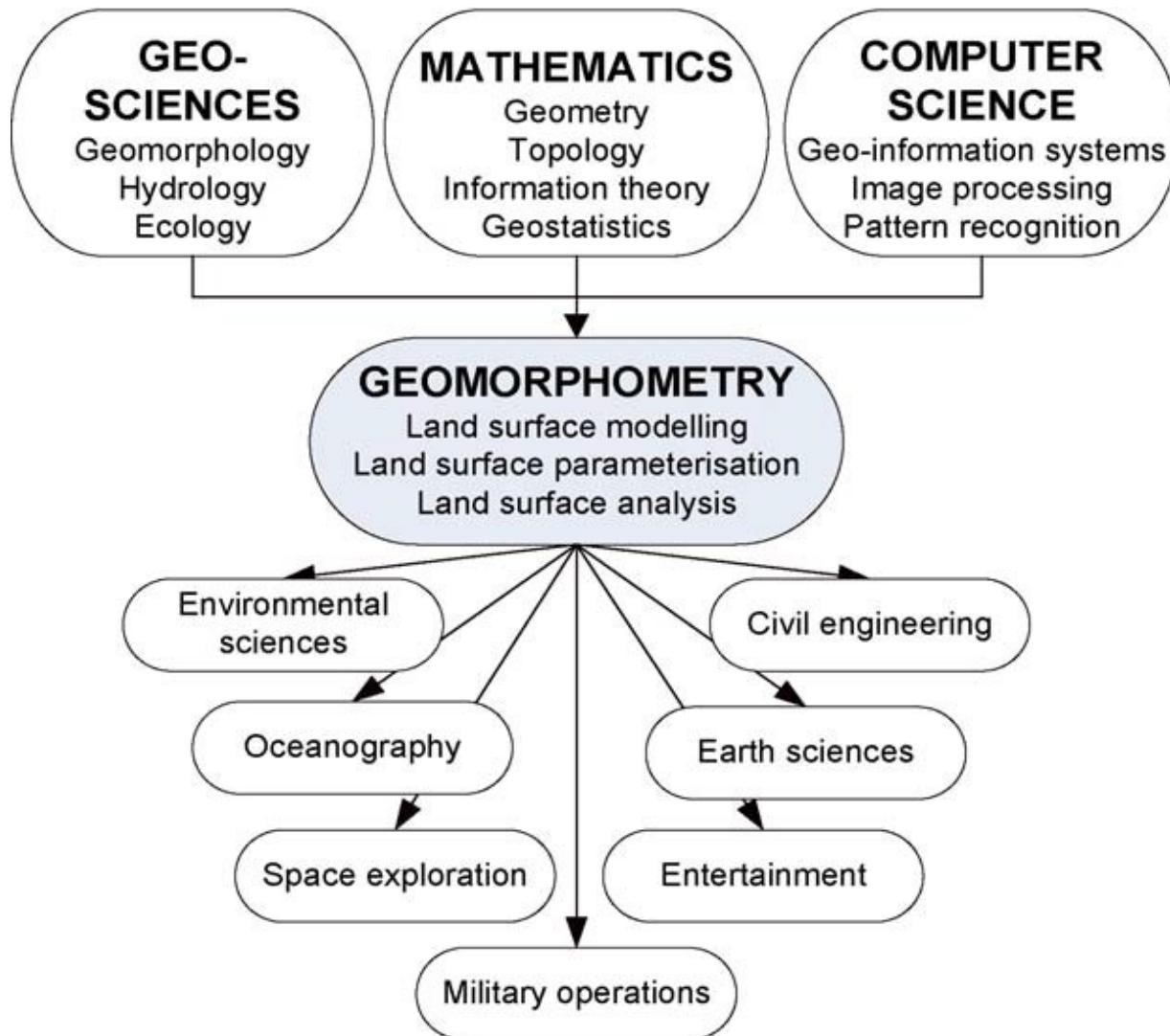




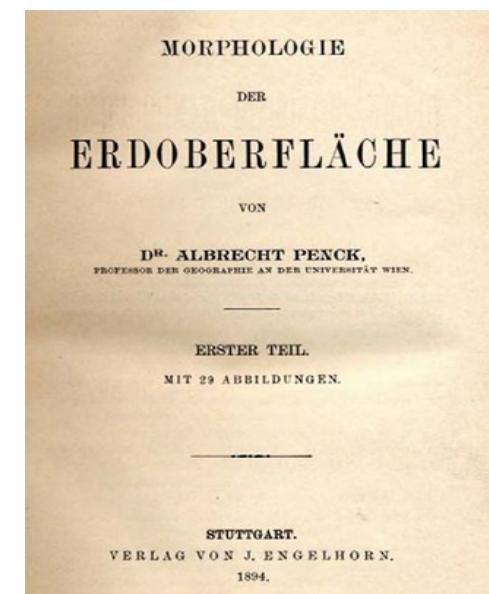
Co to jest Geomorfometria?

Geomorfometria jako nauka



Geomorfometria ogólna i szczególna

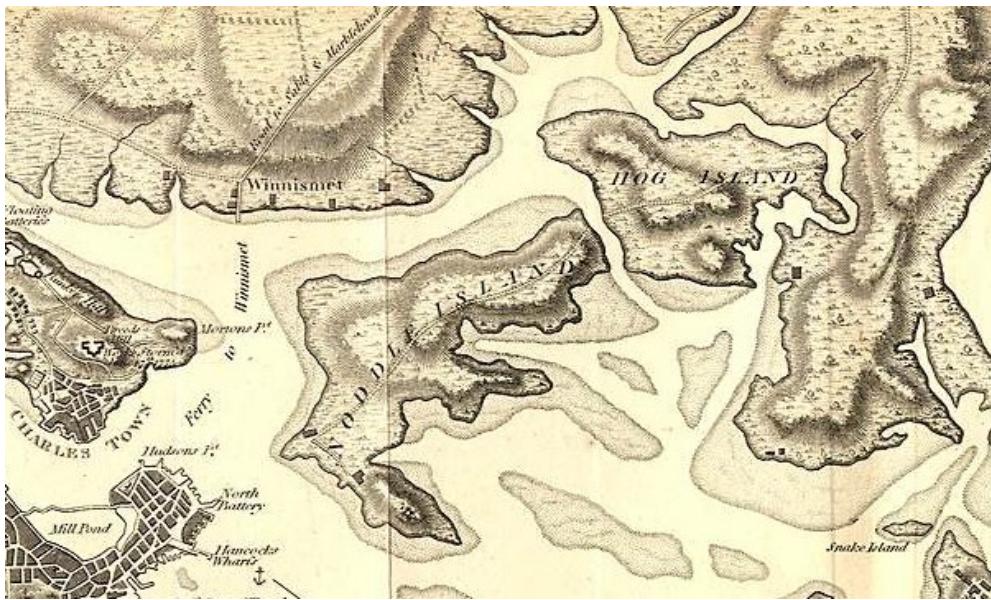
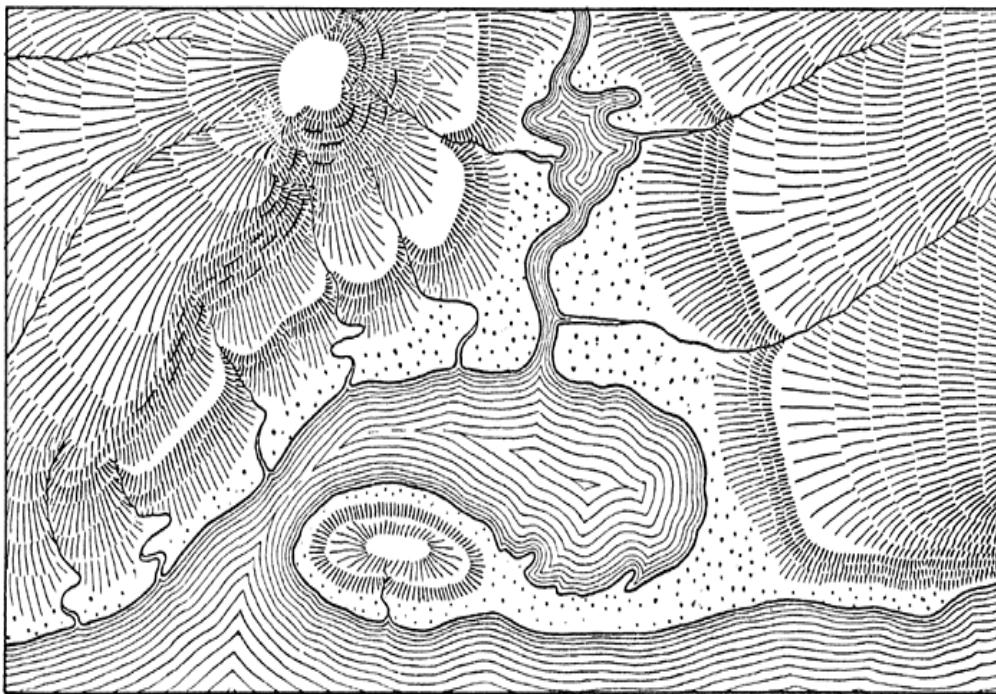
- Kartometria, orometria: Brisson, Gauss, Humbolt, Cayley, Maxwell, Penck, Sonklar, Gutherison, Horton, Strahler, Chorley, Richardson, Mandelbrodt, Hammond, Wood, Shereeve, Gravelius, Hack, Howard
- Geomorfometria ogólna jako ogólny zbiór metod opisu i analizy terenu, traktuje teren jako zjawisko ciągłe (Evans 1972)
- Geomorfometria szczególna geomorfometria poszczególnych typów form terenu (kratery, cyrki lodowcowe, stoki)



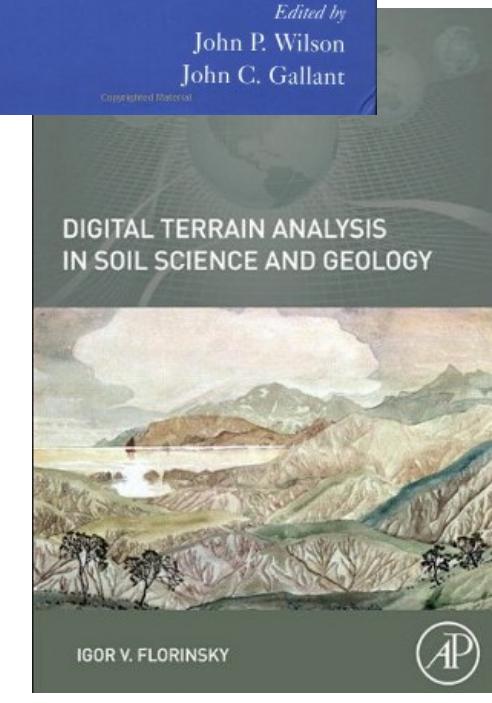
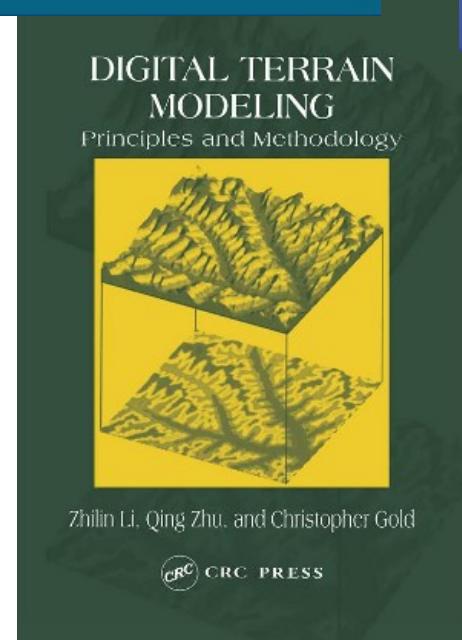
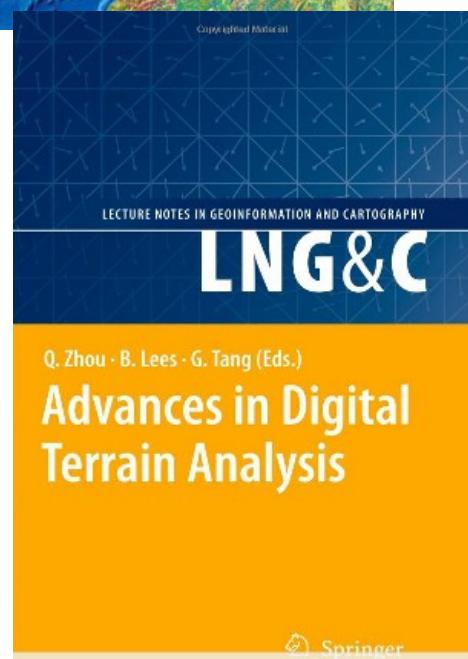
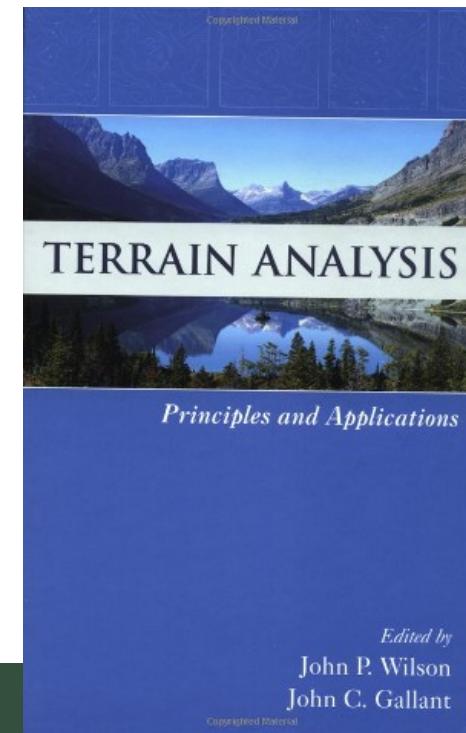
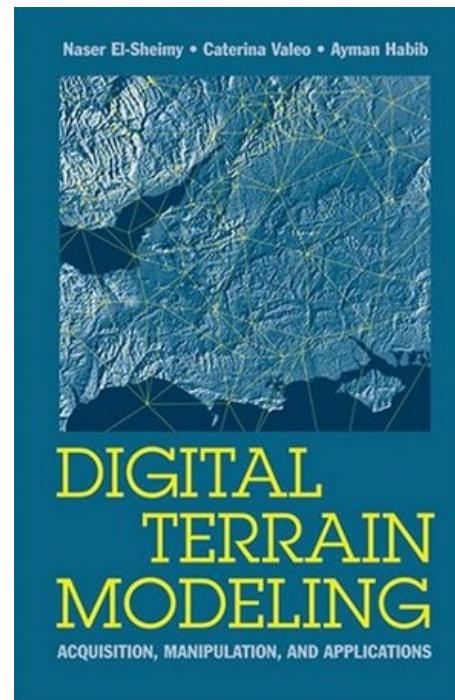
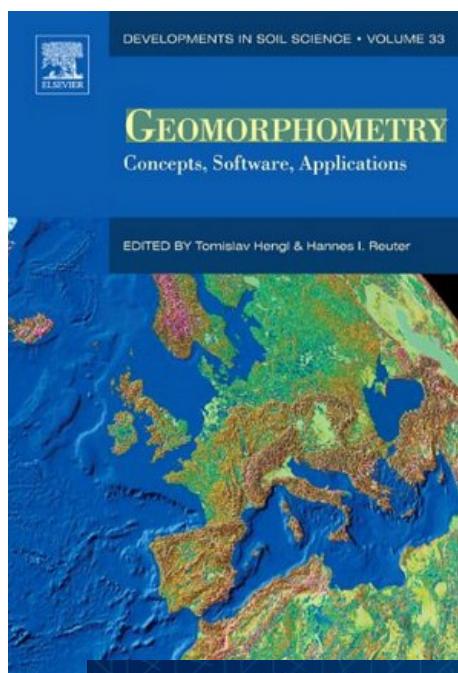
Prezentacja orografii



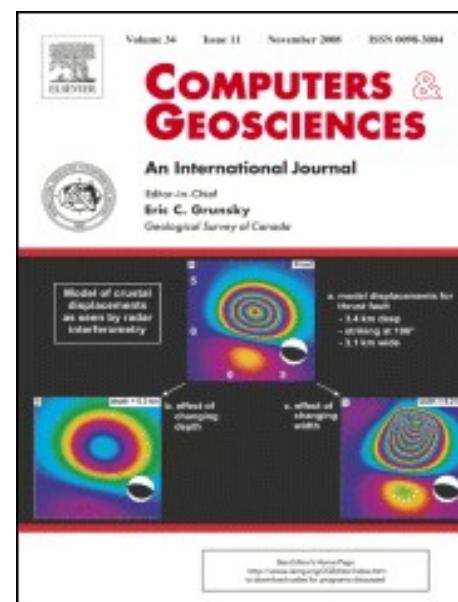
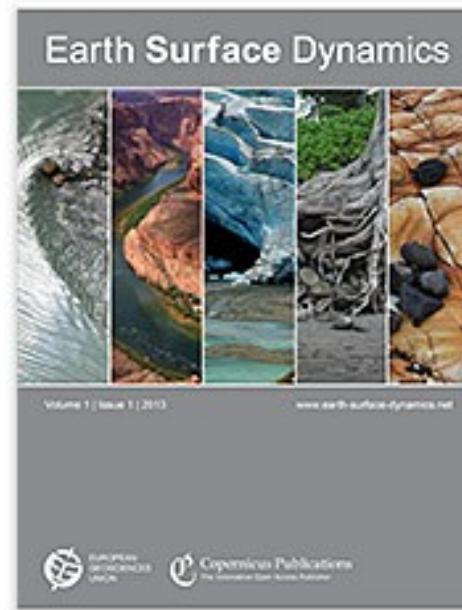
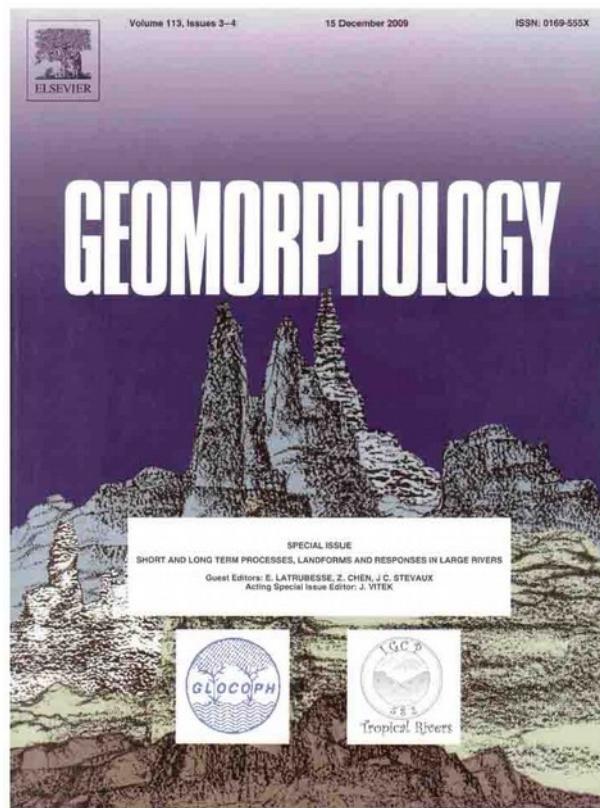
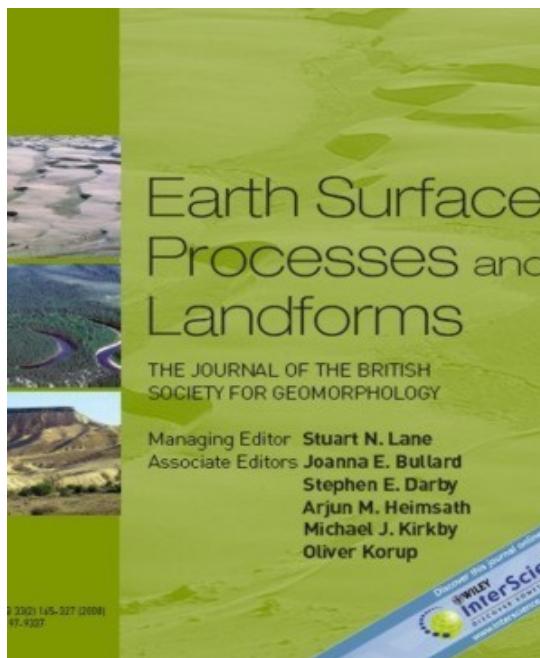
Cieniowanie rzeźby



Podstawowe podręczniki



Czasopisma



A Bibliography of Geomorphometry, the Quantitative Representation of Topography, Supplement 2.0 by P. J. Pike



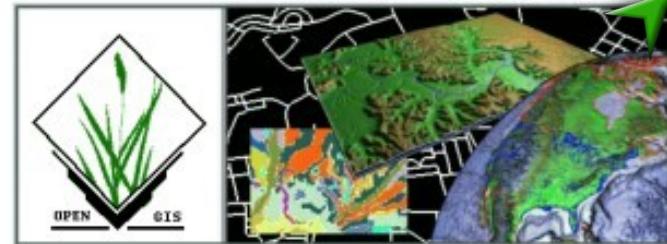
A bibliography of geomorphometry, the quantitative representation of topography, Supplement 2.0: USGS Open-File Report 96-726

P. J. Pike

Oprogramowanie



SAGA
www.saga-gis.org
System for Automated Geoscientific Analyses



Geographic Resources Analysis Support System



MICRODEM

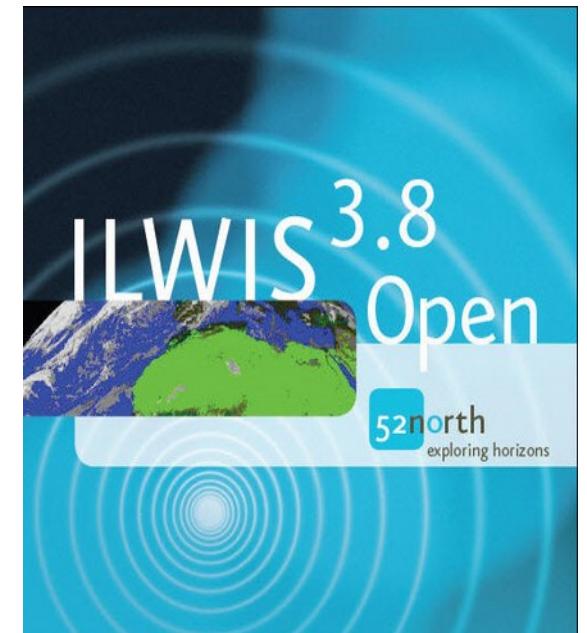
Hebron MICRODEM

Build 2007.12.9.1

Current Known Issues (updated 8/15/2007)

Map overlay management is undergoing major changes. Please report any anomalies. The final

Overview Version 10 changes



SAGA

Graphical User Interface (GUI)

user interaction, visualisation

Module Management

loading, execution

Data Management

tables, vector- and raster data

Module Libraries

the implementation of scientific methods

Library A

Library B

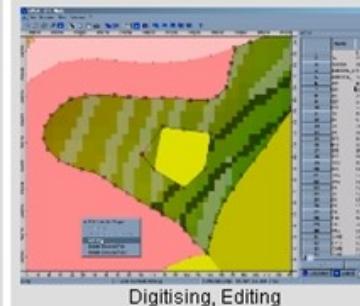
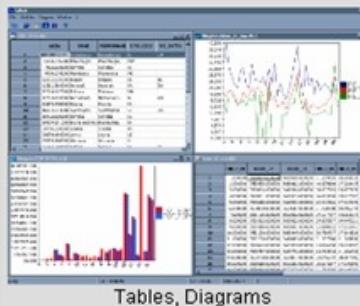
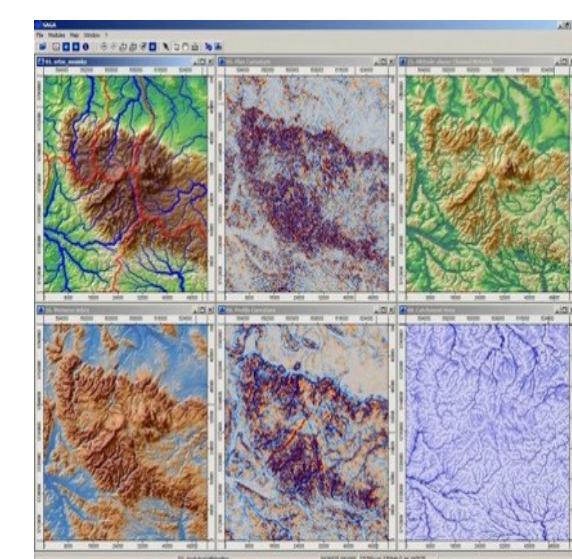
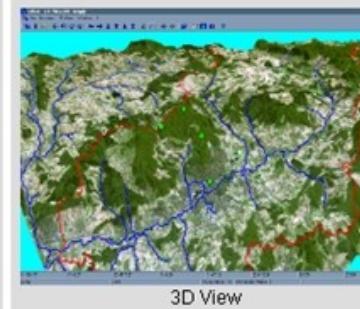
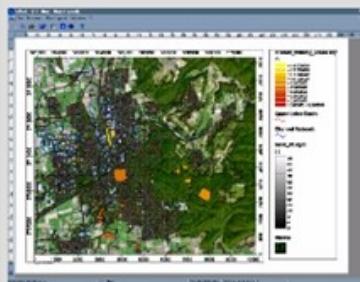
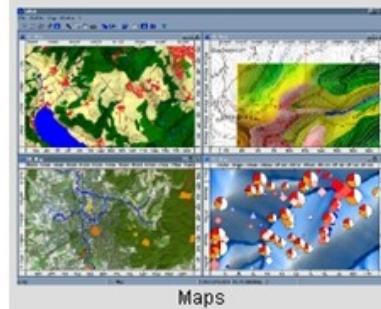
Library C

Library D

Library E

Application Programming Interface (API)

data objects, modules, tools and helpers

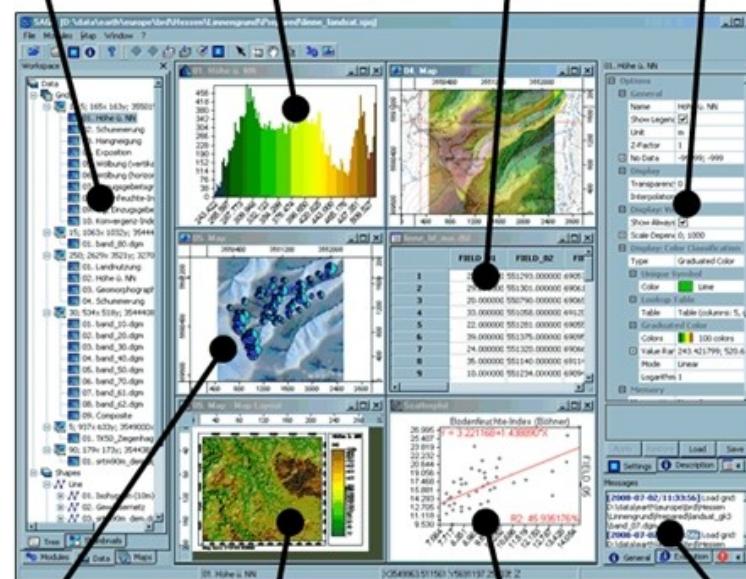


Workspace

Histogram

Attributes

Properties



Map View

Print Layout

Scatter plot

Notifications



Whitebox GAT

Whitebox GAT 3.1 'Iguazu'

1: 227,833.8

Whitebox Scripter: ExampleWorkflowScript.py

File Edit Language Source

```

67 """
68 filledDEMFile = wd + "filled DEM.dep"
69 flatIncrement = "0.001" # Notice that although this is a numeric param
70 args = [demfile, filledDEMFile, flatIncrement]
71 pluginHost.runPlugin("FillDepressions", args, False, True)
72
73 # Calculate the D8 pointer (flow direction) file.
74 pointerFile = wd + "pointer.dep"
75 args = [filledDEMFile, pointerFile]
76 pluginHost.runPlugin("FlowPointerD8", args, False, True)
77
78 # Perform the flow accumulation operation.
79 flowAccumFile = wd + "flow accumulation.dep"
80 outputType = "number of upslope grid cells"
81 logTransformOutput = "False"
82 args = [pointerFile, flowAccumFile, outputType, logTransformOutput]
83 pluginHost.runPlugin("FlowAccumD8", args, False, True)
84
85 # Extract the streams
86 streamsFile = wd + "streams.dep"
87 channelThreshold = "1000.0"
88 backValue = "NoData"
89 args = [flowAccumFile, streamsFile, channelThreshold, backValue]
90 pluginHost.runPlugin("ExtractStreams", args, False, False) # This final
91

```

Search AND App ArcC ArcSi ArcTa Area Aspe Assig Avera CLR

Whitebox GAT v.2.0

Tools Layers

Available Tools

- Conversion Tools
- Data Import/Export
- GIS Analysis
- Hydrological Tools
- Image Processing Tools
- LIDAR Tools
 - Fill Missing Data Holes
 - IDW Interpolation (LIDAR)
 - Nearest-Neighbour Interpolation (LIDAR)
 - Point Density (LIDAR)
 - Remove Off-Terrain Objects**
- Mathematical Analysis
- Raster Creation
- Statistical Analysis
- Stream Network Analysis
- Terrain Analysis

Recent Most Used All 216 tools

Absolute Value Adaptive Filter Add AND ArcCos ArcSin ArcTan Area Aspect Assign Row or Column Number to Cells Average Flowpath Slope From Cell To Div

Ready

Frequency Prob.

Histogram: picton

0.0033
0.0000
4.876,000.5 330,000.5

73.87 158.215

Save Print Refresh Switch to CDF Exit

326,464.6 4.876,000.5

4.872,999.5 330,000.5

326,464.6 4.872,999.5

Whitebox GAT 3.1 'Iguazu'

689,691.9 m

4,908,144.3 m

Whitebox GAT 3.1 'Iguazu'

Tools Layers Features

- File Utilities
- GIS Analysis
- Hydrological Tools
- Image Processing Tools
- LIDAR Tools
 - Bare-Earth DEM (LIDAR)
 - Canopy Model (LIDAR)
 - Convert LAS to ASCII (LAS)
 - Convert LAS to Shapefile (LAS)
 - Fill Missing Data Holes
 - Find Flightline Edge Points
 - Get LAS File Summary
 - IDW Interpolation (LIDAR)
 - Maximum Interpolation (LIDAR)
 - Minimum Interpolation (LIDAR)
 - Nearest-Neighbour Interp
 - Point Density (LIDAR)
 - Remove Off-Terrain Objects
- Mathematical Analysis
- Raster Creation
- Statistical Analysis
- Stream Network Analysis
- Terrain Analysis
- New Feature Request
- Run Plugin In Parallel

Interpolation Parameter: Z (elevation)

Point Return: **All Points** First Return Last Return

IDW Exponent: 2

Max Search Distance (m):

Grid Resolution (m):

Max Scan Angle Deviation: 5.0

Exclude points with the following classification values from the interpolation:

Never Classified

Unclassified

Run Close View Code

IDW interpolation for LIDAR

This tool can be used to interpolate a regular grid raster from a point cloud LIDAR dataset using an inverse-distance-weighted (IDW) interpolation method. The user inputs a LIDAR dataset in LAS file format (.las) and the name of the output raster grid to be created. Although most often this tool will be used to create a digital elevation model (DEM) from the elevation data associated with the LIDAR dataset, the user can also specify a number of other parameters to interpolate including the LIDAR point intensity, classification, and associated red, green, and blue values. Note that not all LIDAR datasets will include each of these parameters. Interpolation can be based on all of the points in the dataset, first return points, or last return points. The user must also specify the IDW exponent, the search radius, and rotation value (if any).

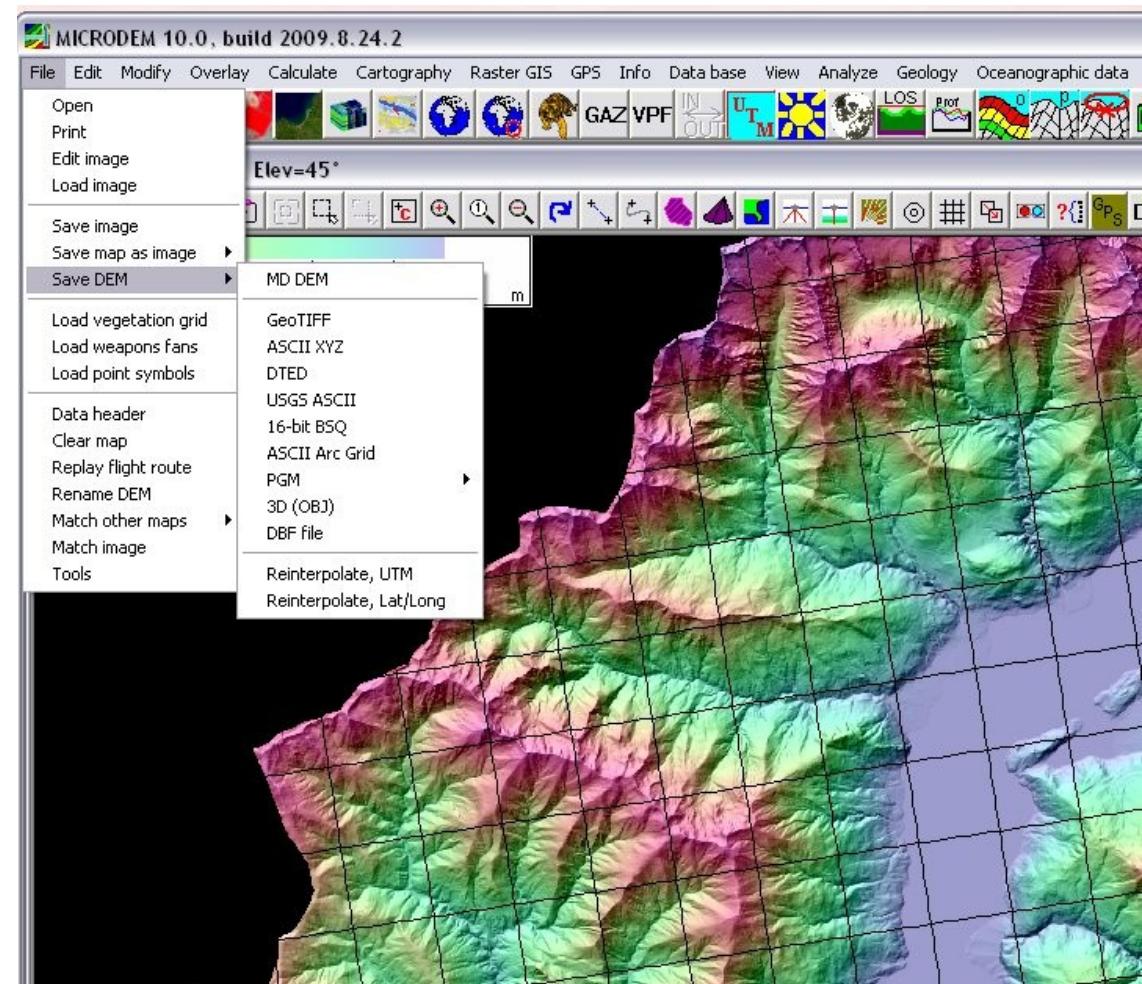
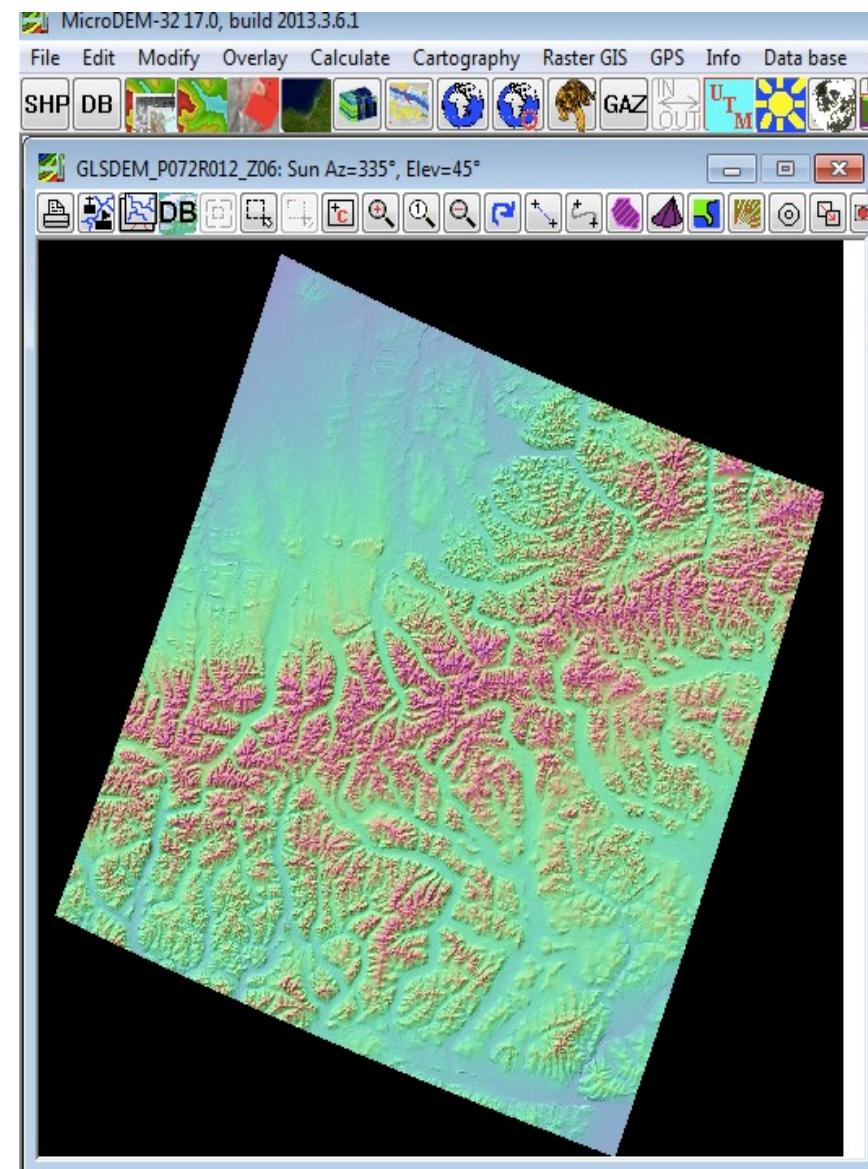
The maximum scan angle deviation parameter can be used to filter points from the neighbourhood around each interpolated grid cell that have scan angles that are larger than the

Modify Help Entry

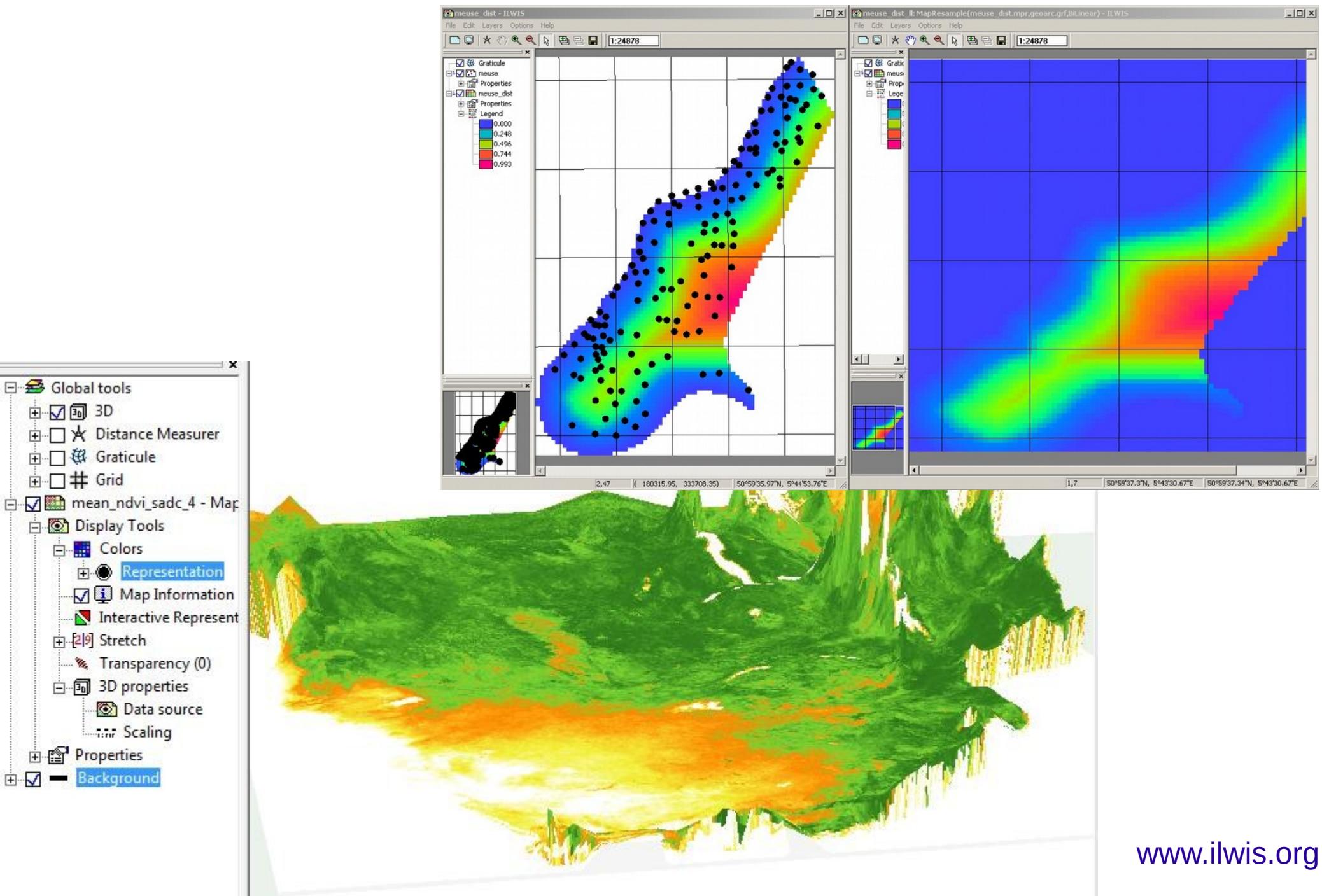
E: ∞ N: ∞ Progress cancel

<http://www.uoguelph.ca/~hydrogeo/Whitebox/>

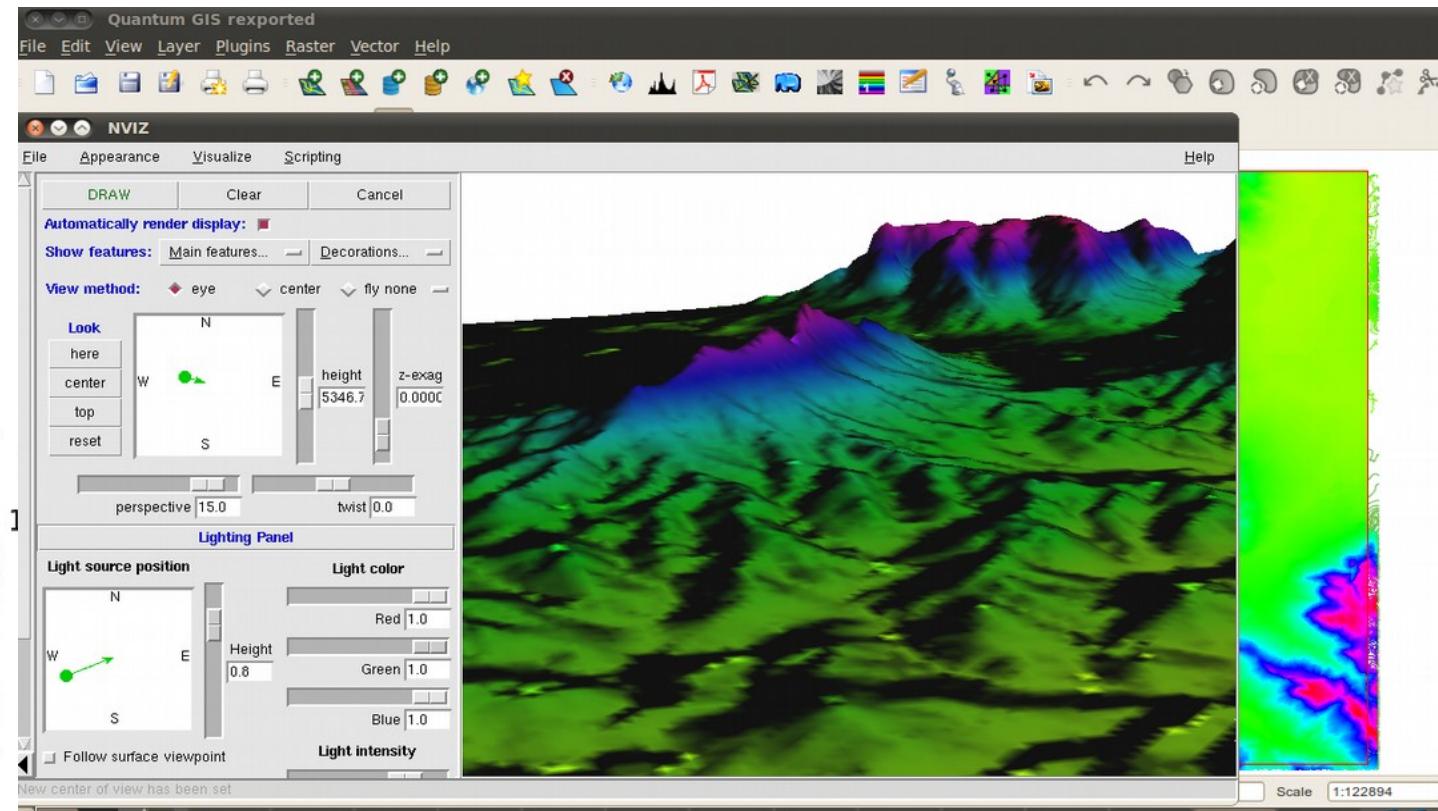
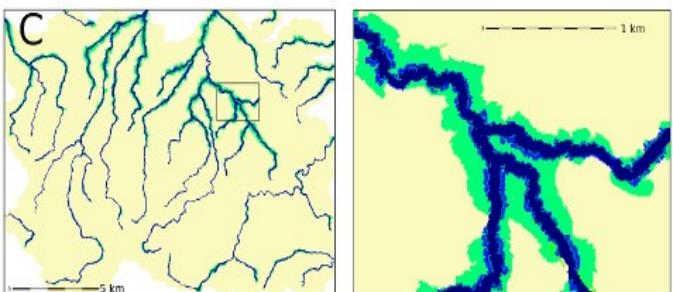
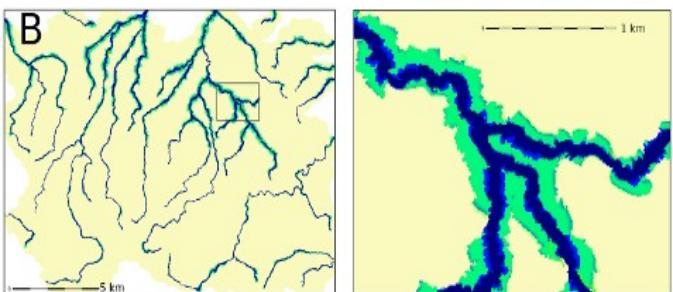
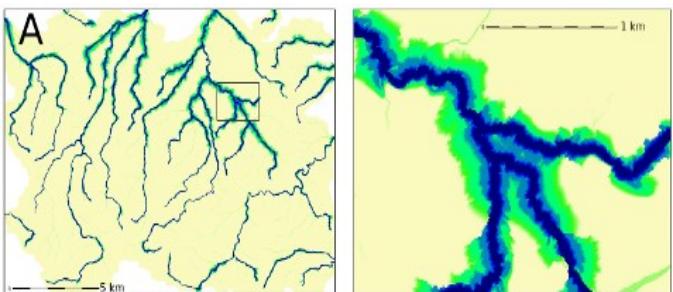
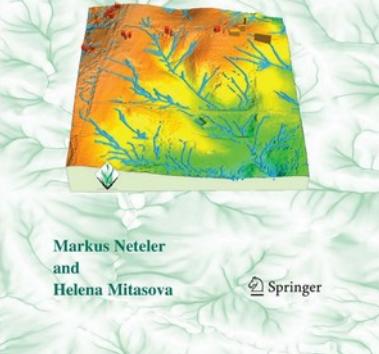
MICRODEM



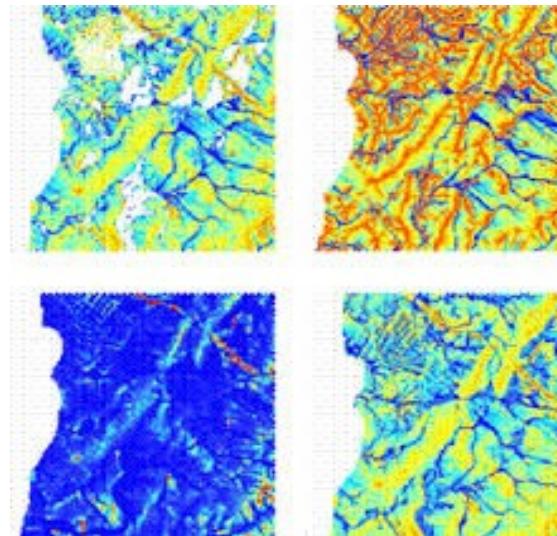
ILWIS



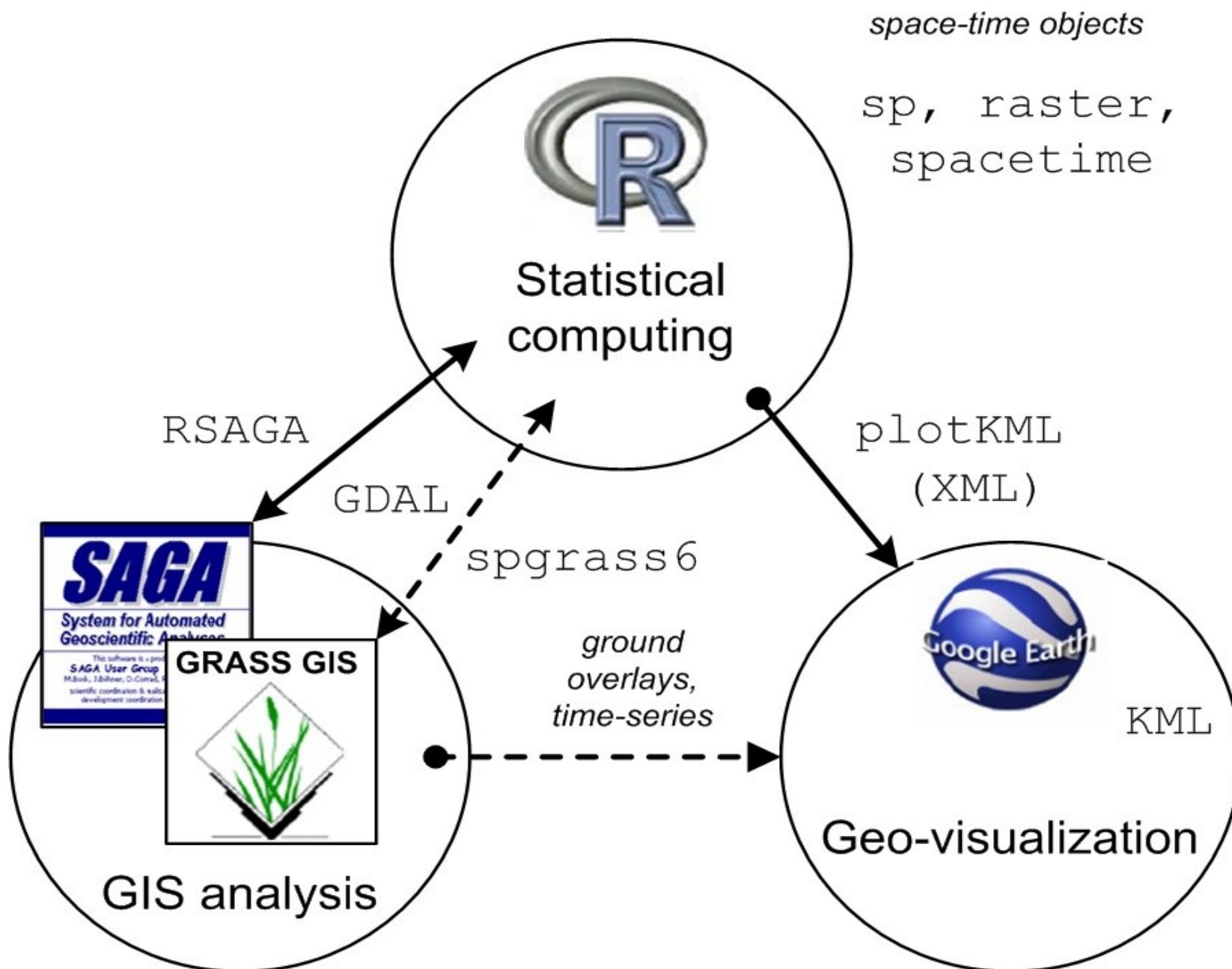
OPEN SOURCE GIS
A GRASS GIS
Approach
Third Edition



60 moderate
40 low
20 none

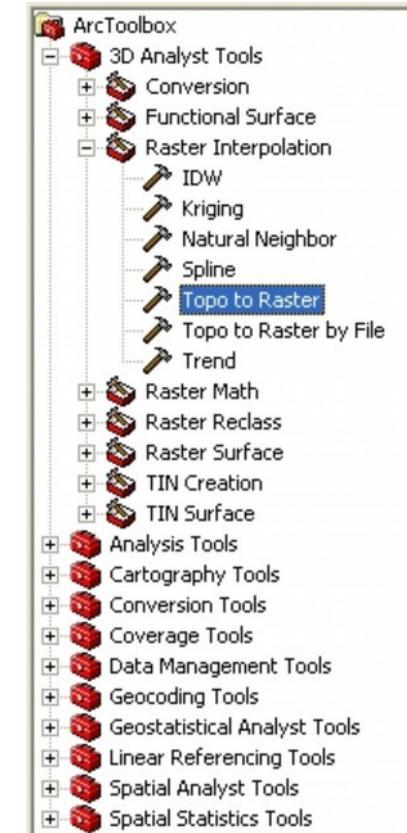


grass.osgeo.org

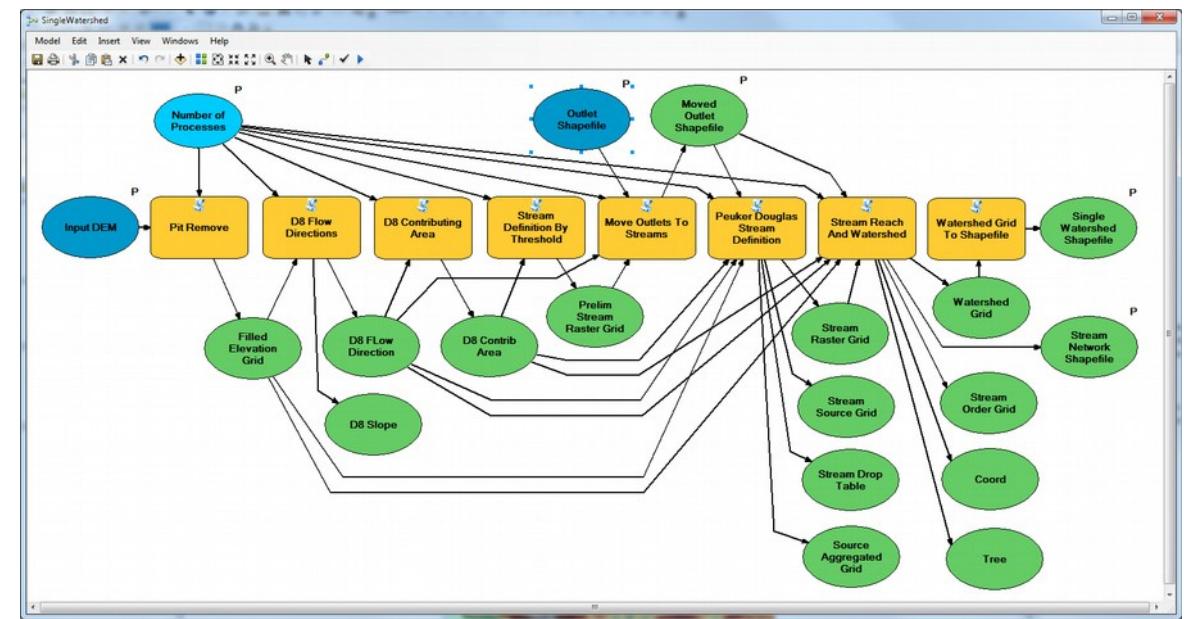


Oprogramowanie płatne

- ANUDEM:
<http://fennerschool.anu.edu.au/research/products/anudem-vrsn-53>
- RiverTools:
<http://rivix.com>
- TAUDEM (Open source, ale wymaga ArcGIS)
<http://hydrology.usu.edu/taudem/taudem5/index.html>



RiverTools is a trademark of RIVIX, LLC. All other marks are the property of their respective owners. © 2013 RIVIX, LLC. All rights reserved.



Konferencje

Nanjing, Listopad 2006

<http://www.geomorphometry.org>

Zurich, wrzesień 2009

Redlands, wrzesień 2011

Nanjing, Październik 2013

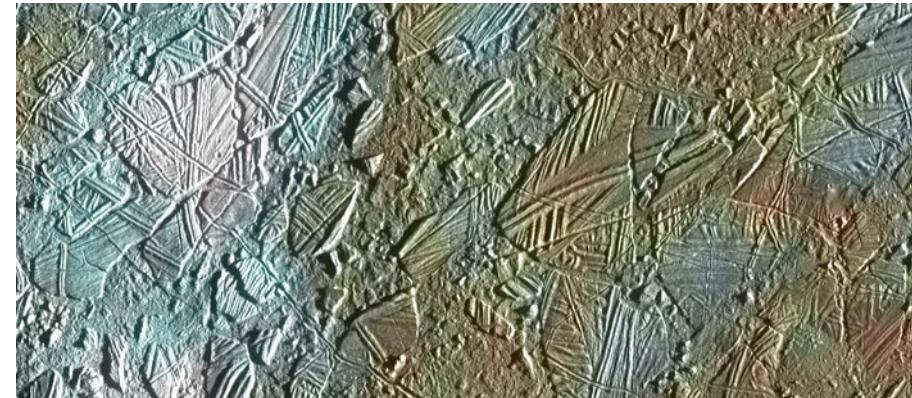
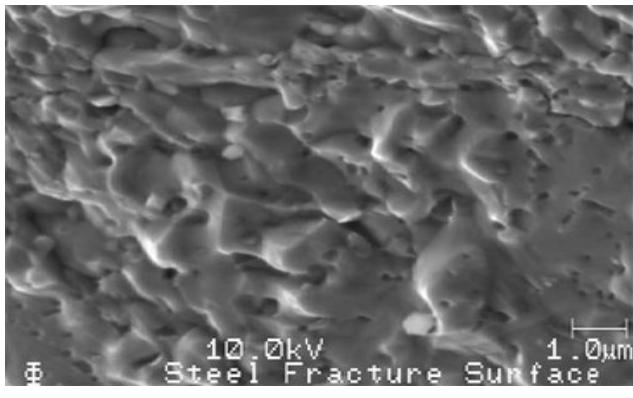
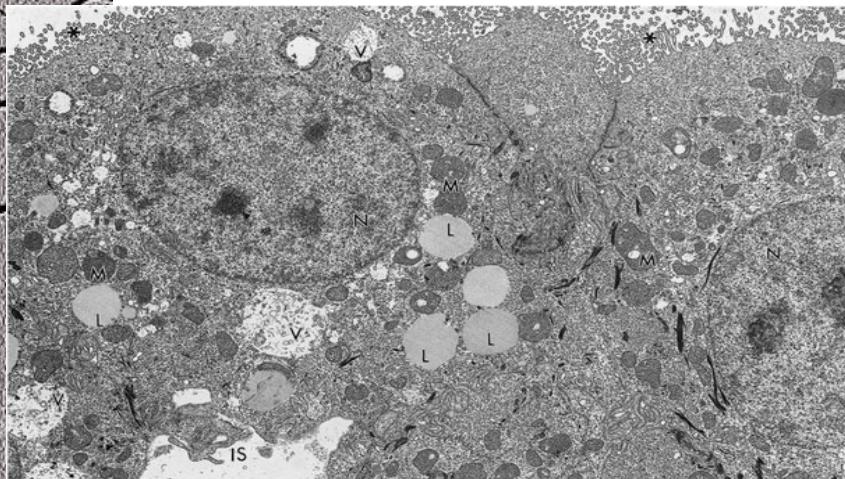
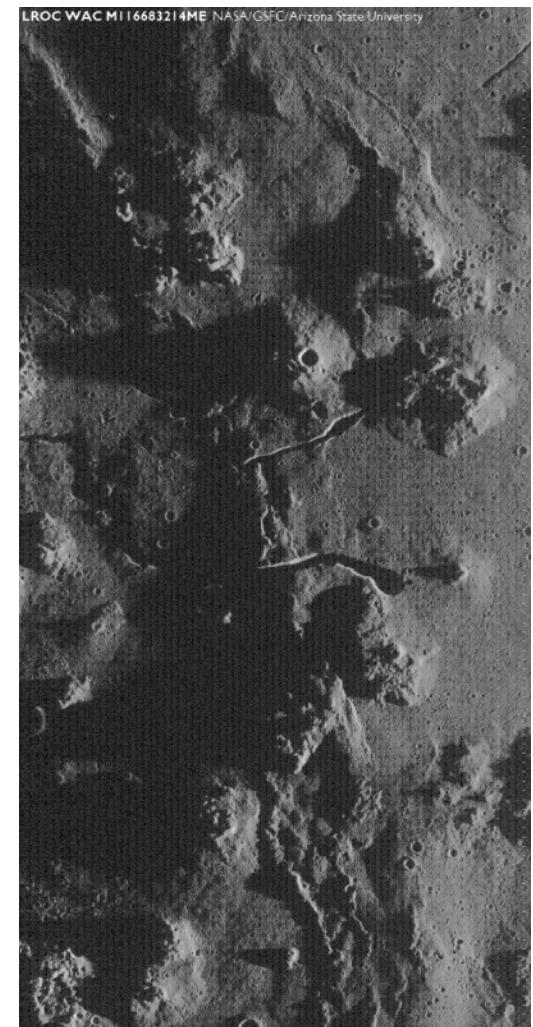
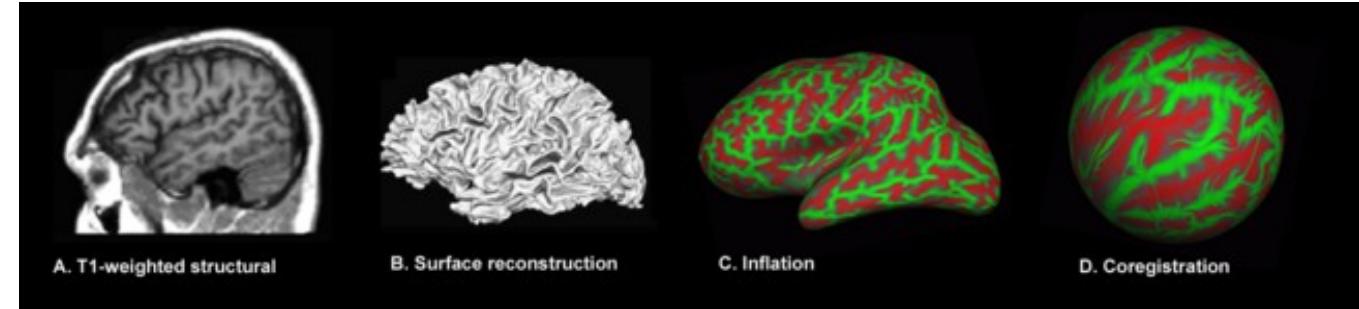
Poznań, Wrzesień 2015



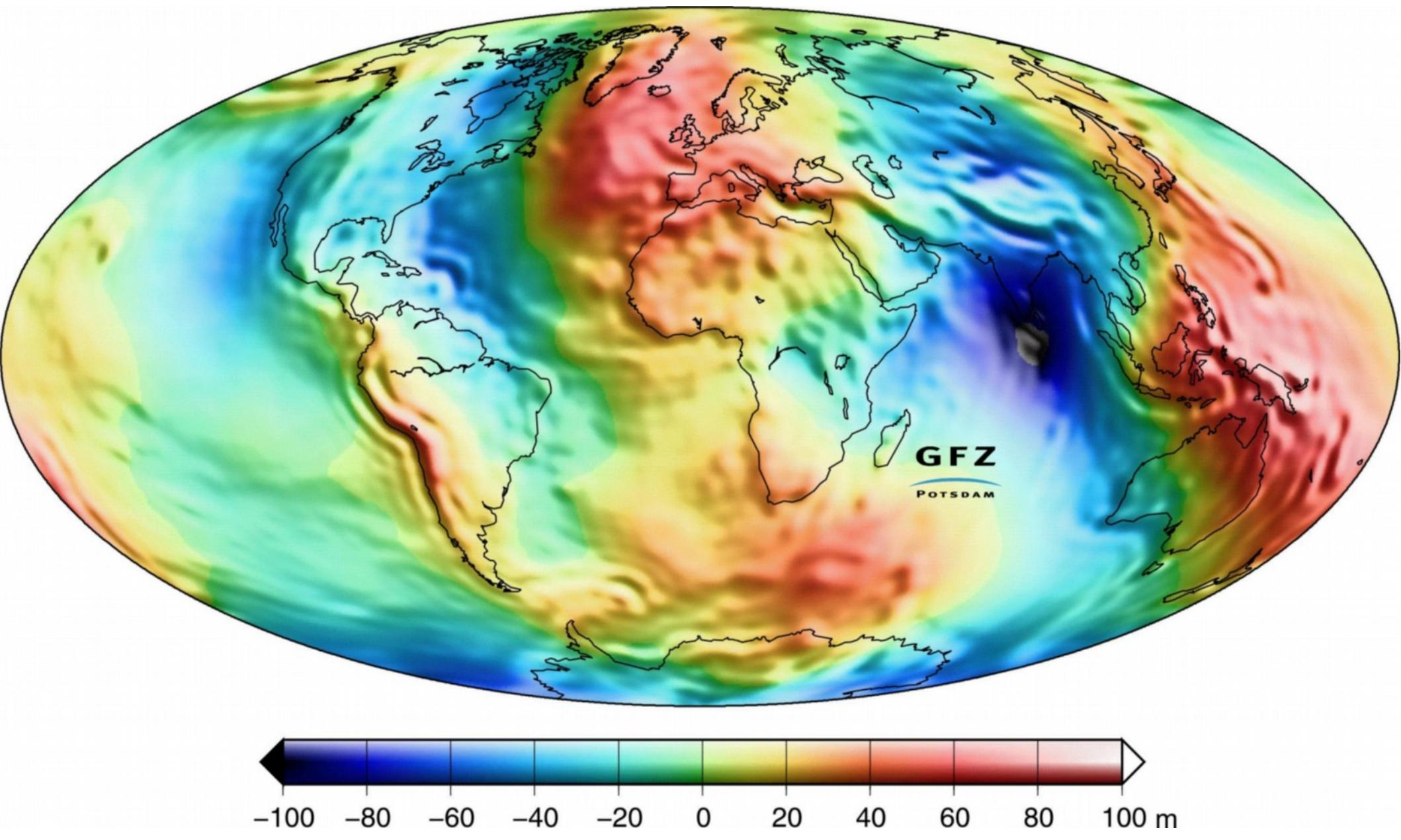


Co to jest powierzchnia?

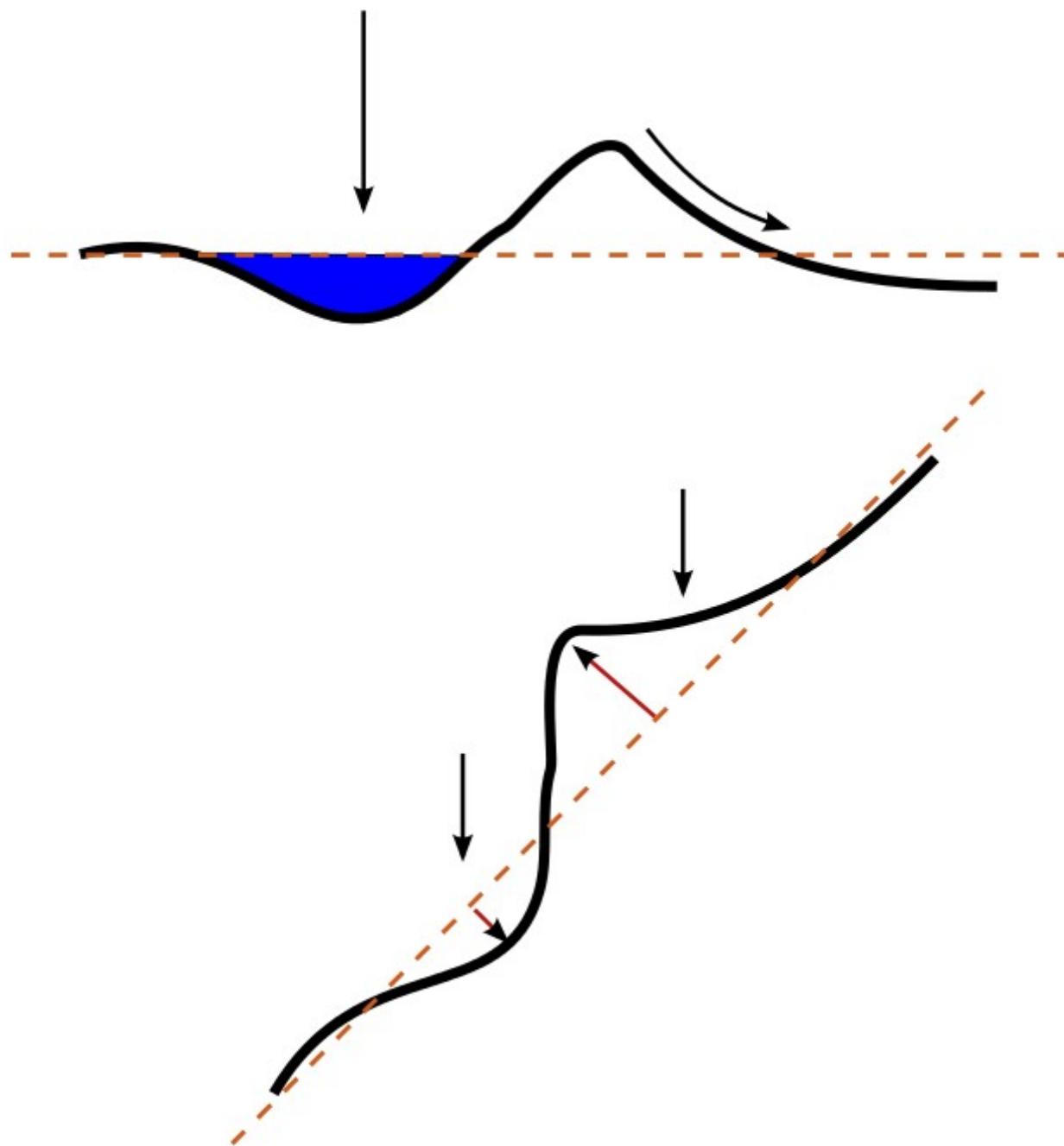
Różne powierzchnie...



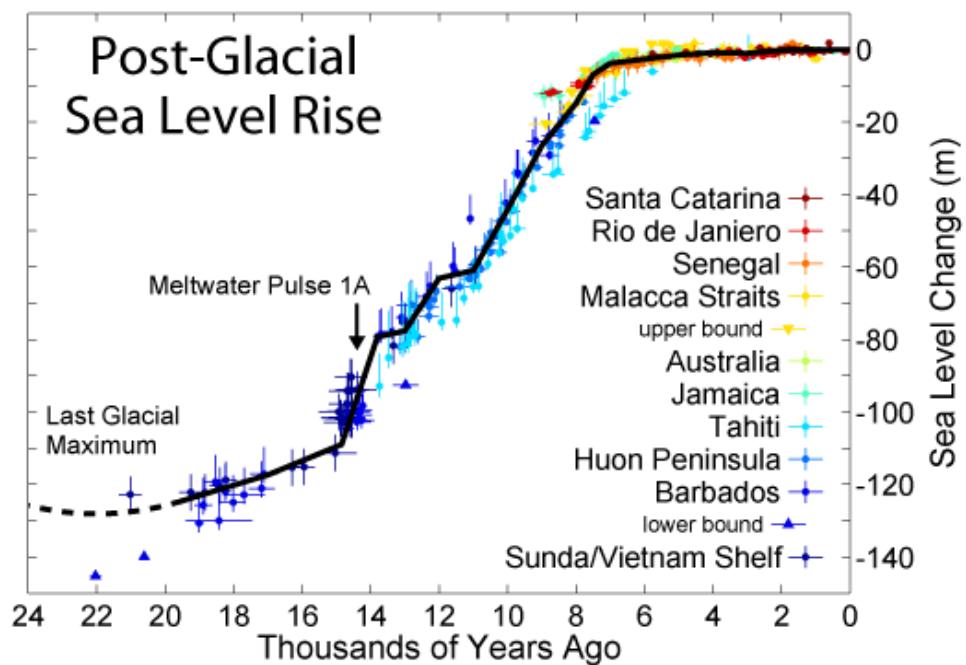
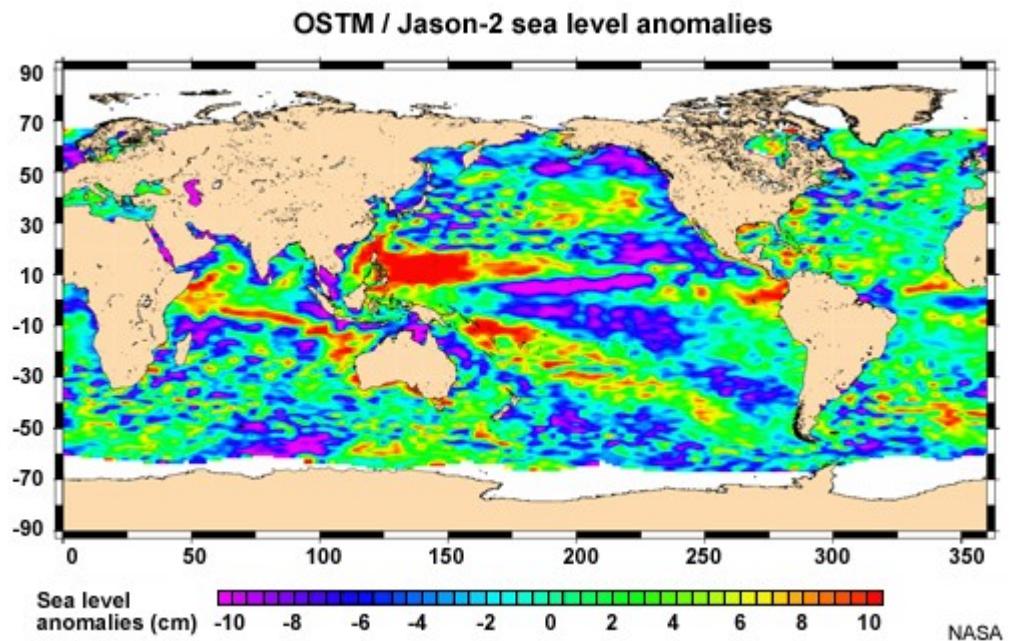
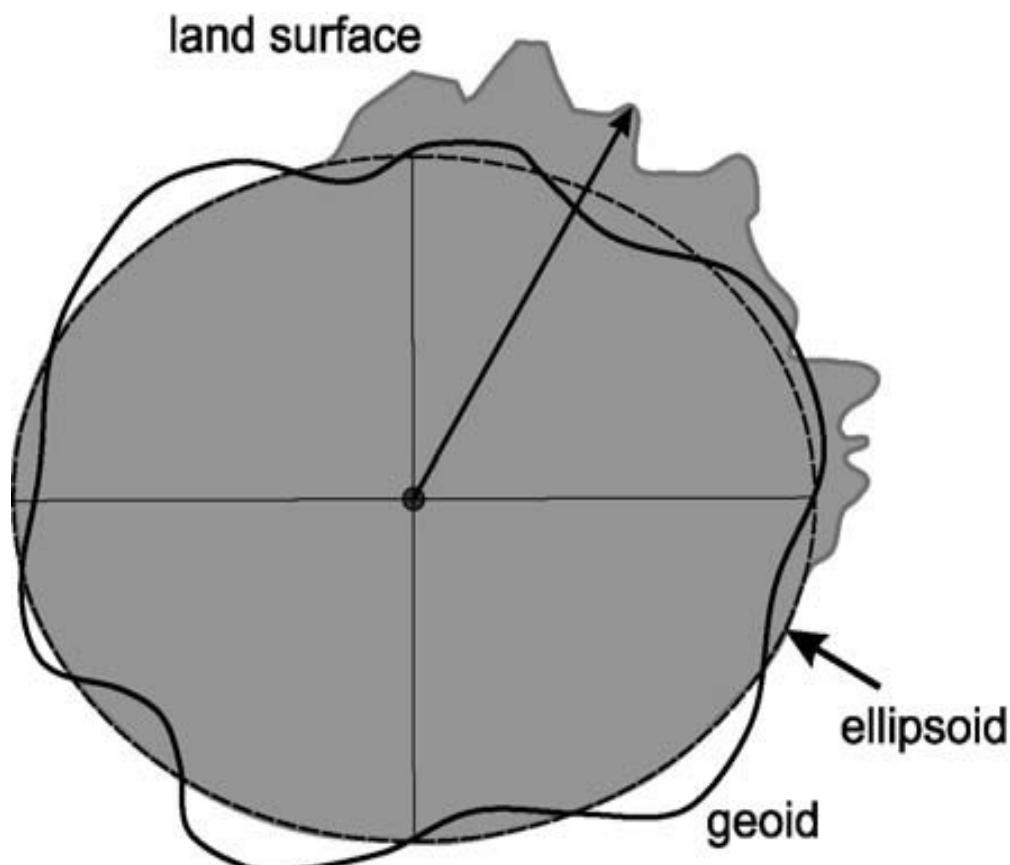
Pole grawitacyjne Ziemi



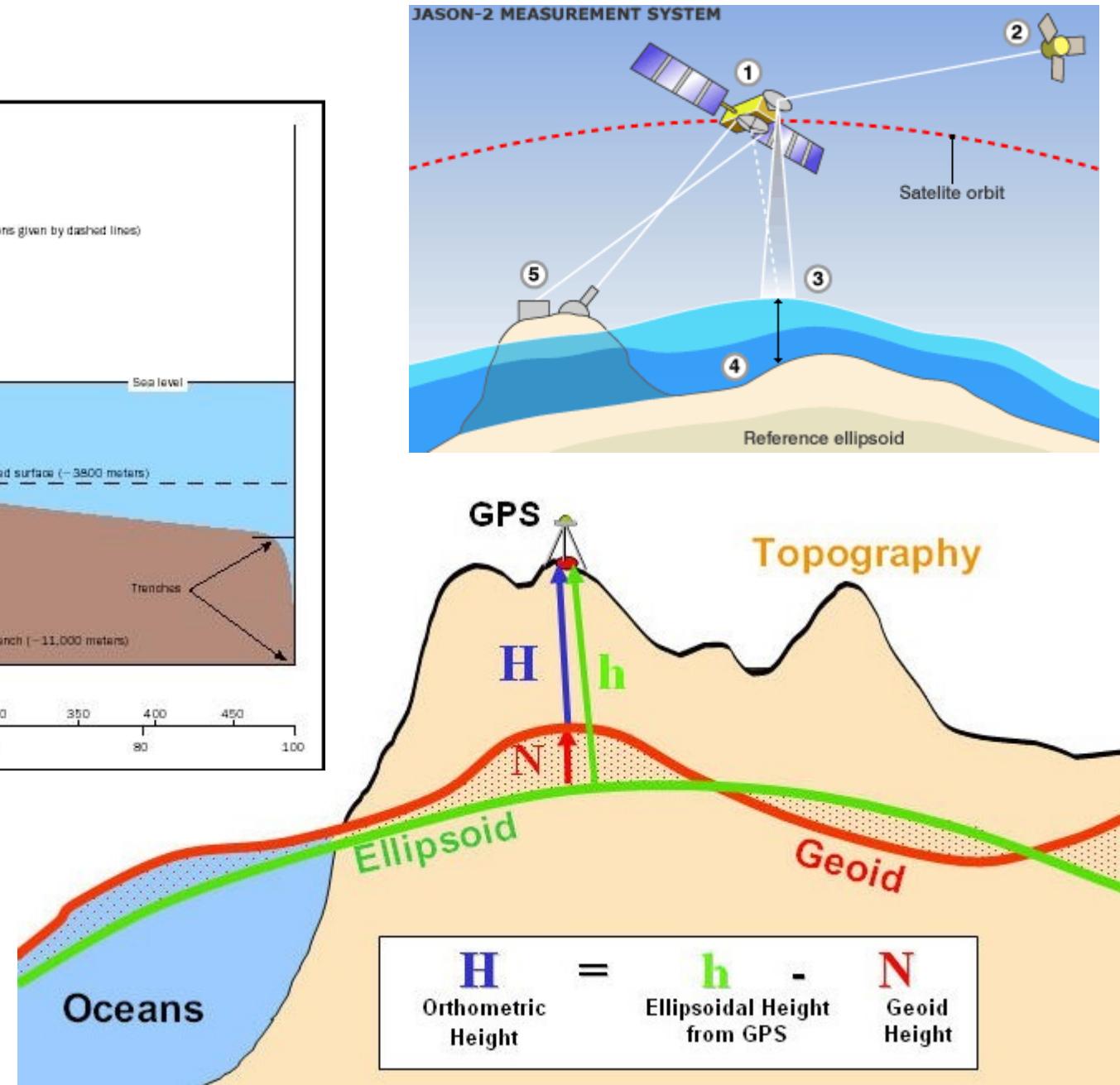
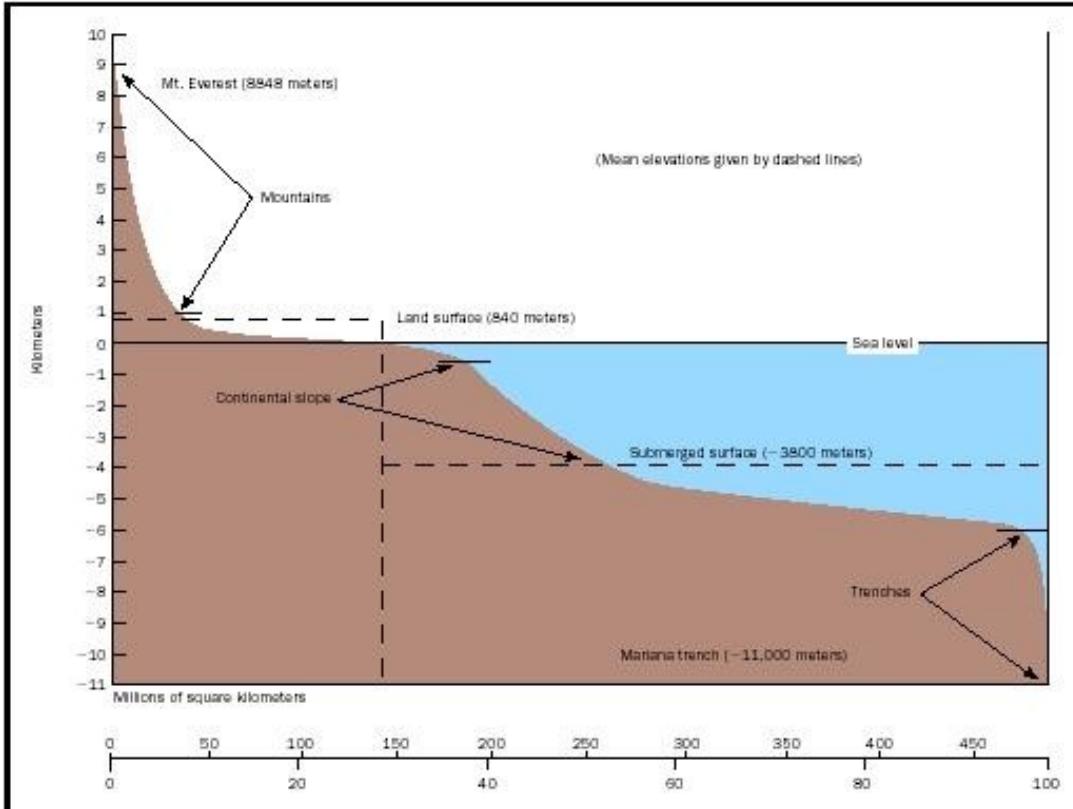
Powierzchnia w polu grawitacyjnym

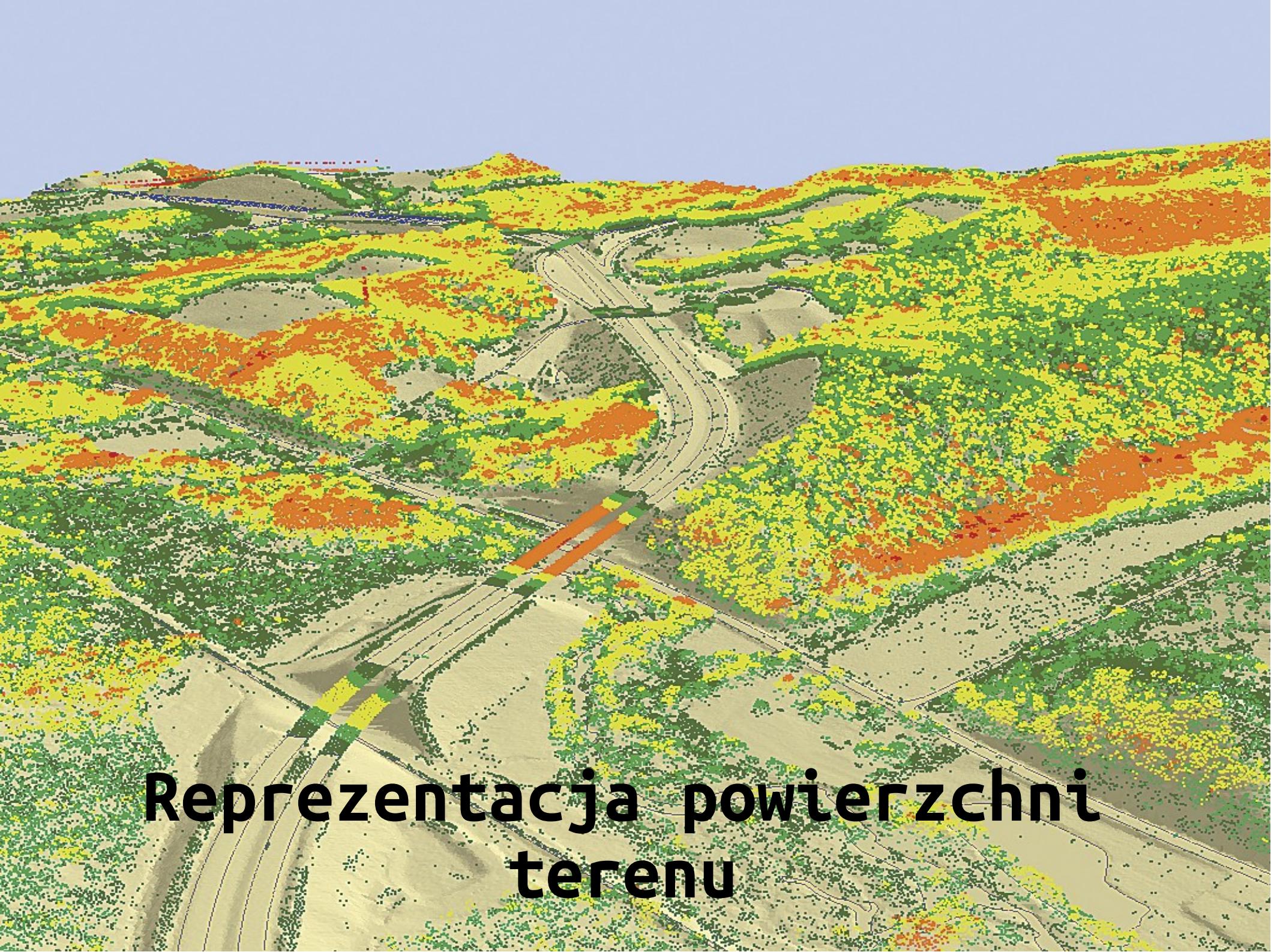


Powierzchnia względem elipsoidy



Nad Poziomem Morza....

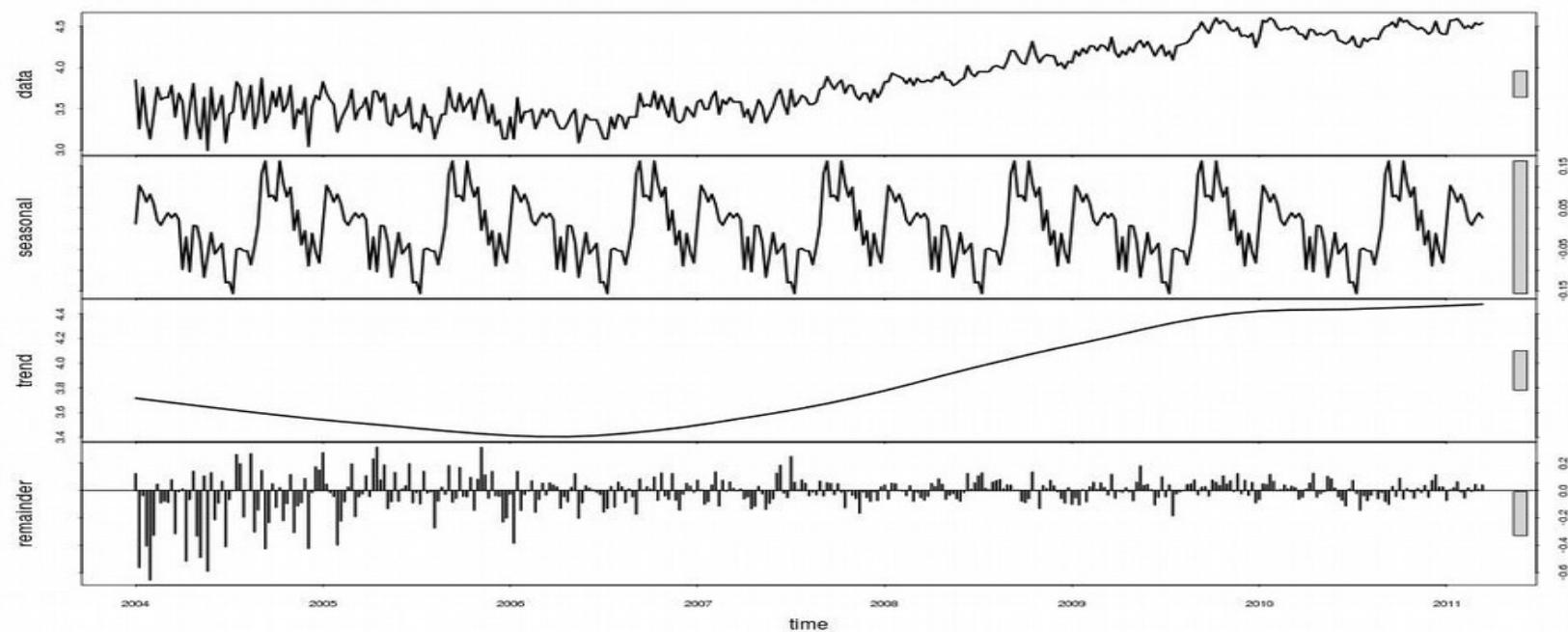
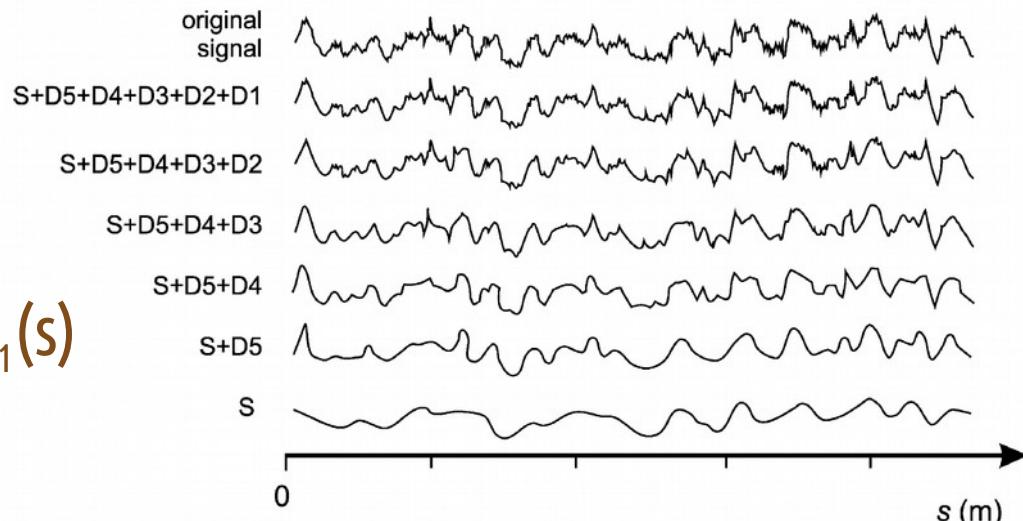




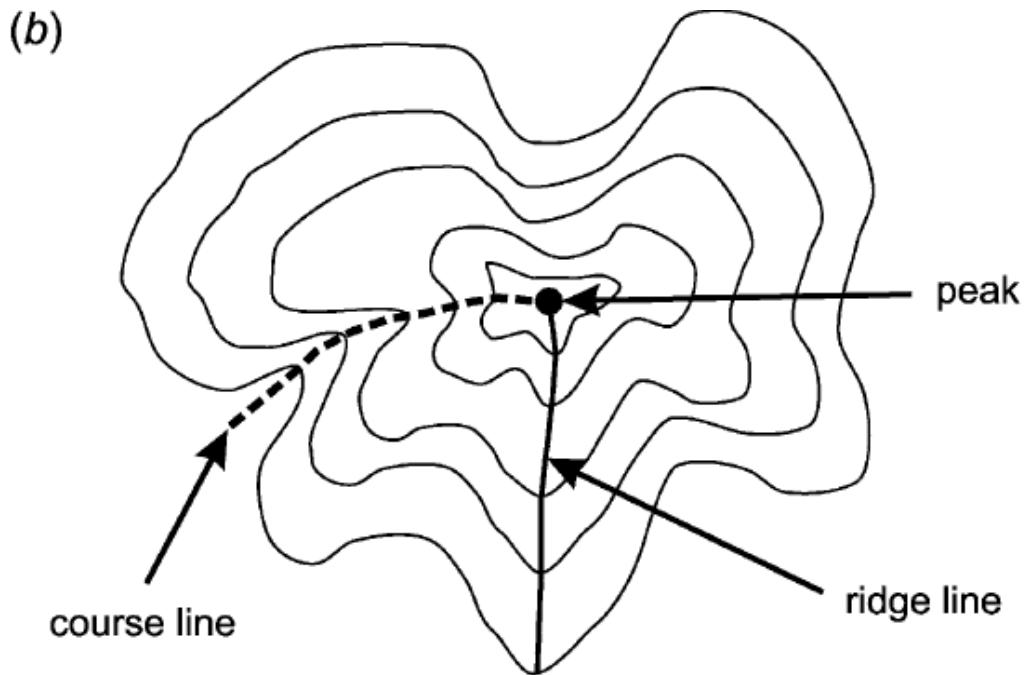
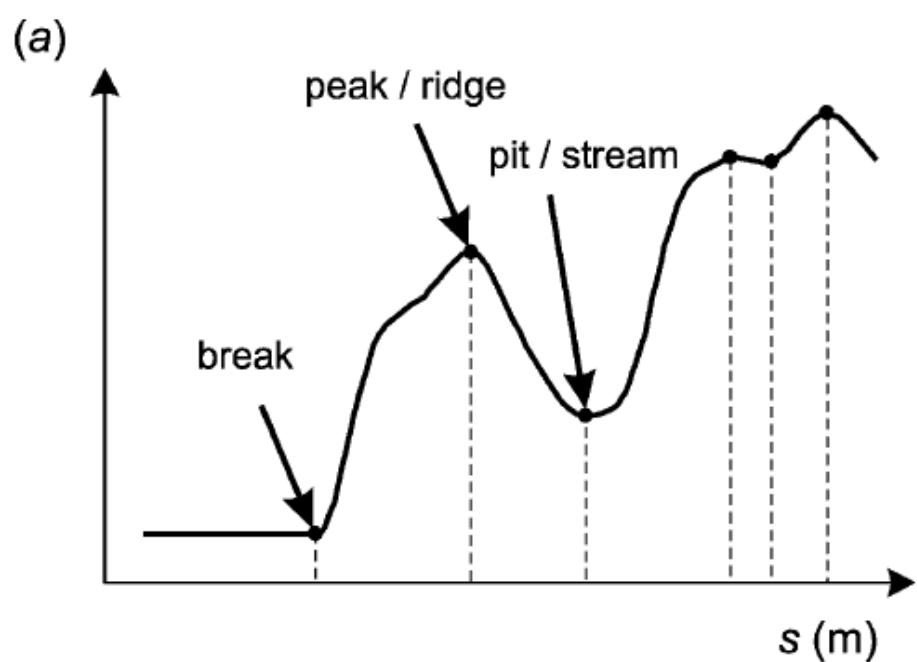
**Reprezentacja powierzchni
terenu**

Matematyczny model powierzchni

- funkcja współrzędnych:
 $z=f(x,y)$, $z=f(s)$
- wielorozdzielczy (multiresolution):
 $z(1.2) * (s) = S(s) + D_J(s) + D_{J-1}(s) + \dots + D_1(s)$
- geostatystyczny:
 $z(s) = z^*(s) + \varepsilon'(s) + \varepsilon''(s)$



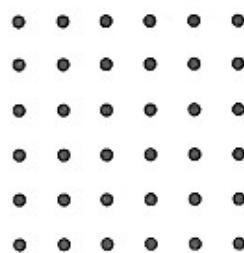
Punkty i linie charakterystyczne



- pits - lokalne minima
- peaks - lokalne maxima
- grzbiety
- cieki
- odcinki
- przełęcze
- załomy
- izolinie
- linie stoków
- równiny

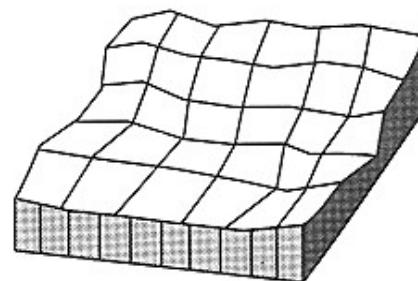
Różne sposoby reprezentacji powierzchni

Sampling points/lines

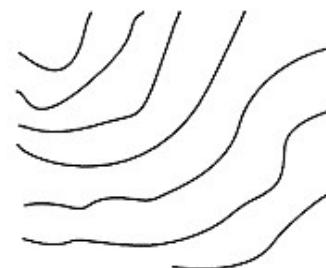


(a) Grid Points

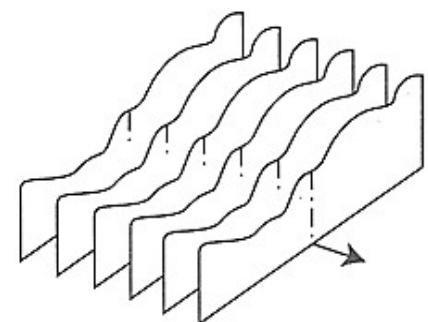
DEM



(c) Contour Lines

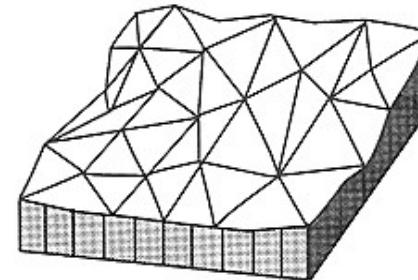


TIN model with Contours

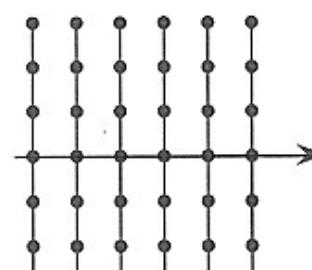


(b) Random Points

Bi - Linear Model



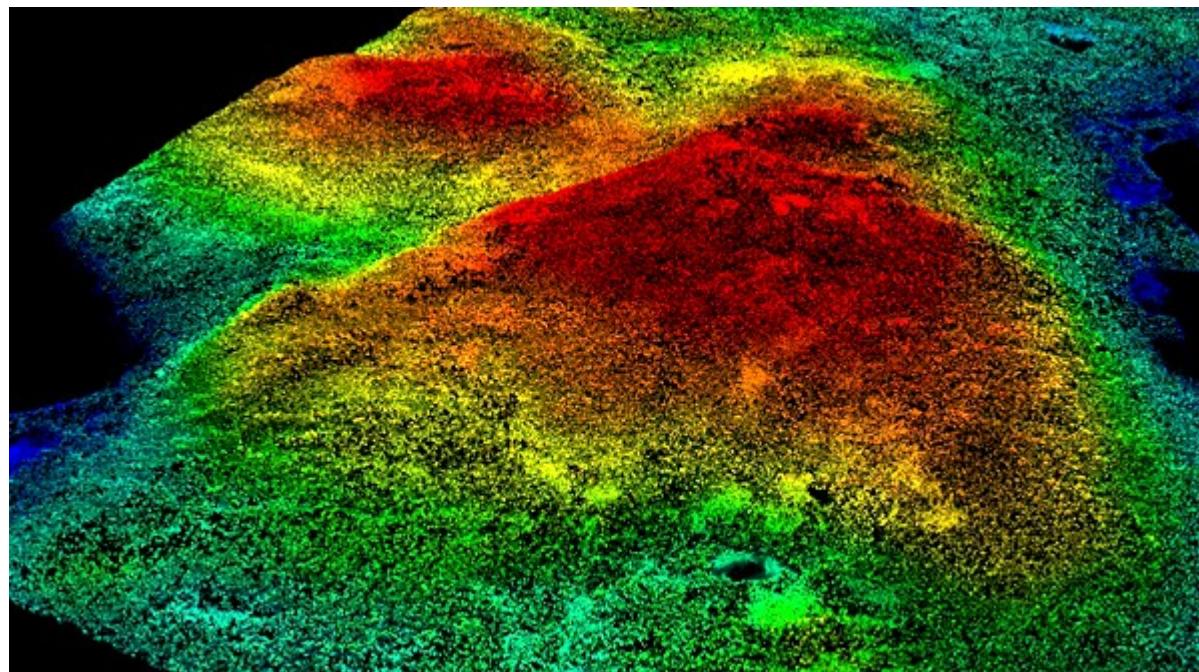
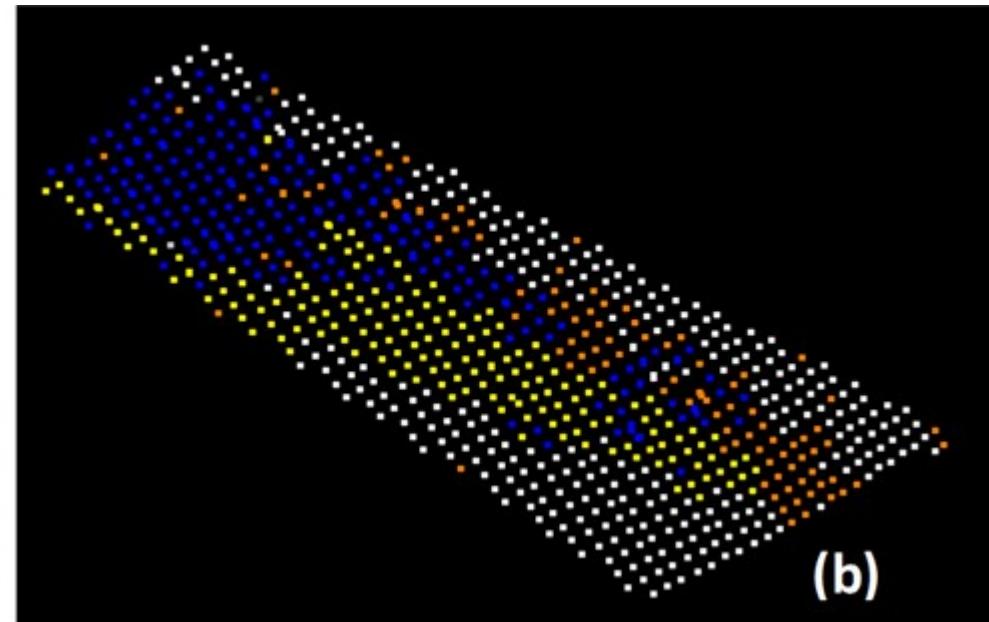
TIN Model



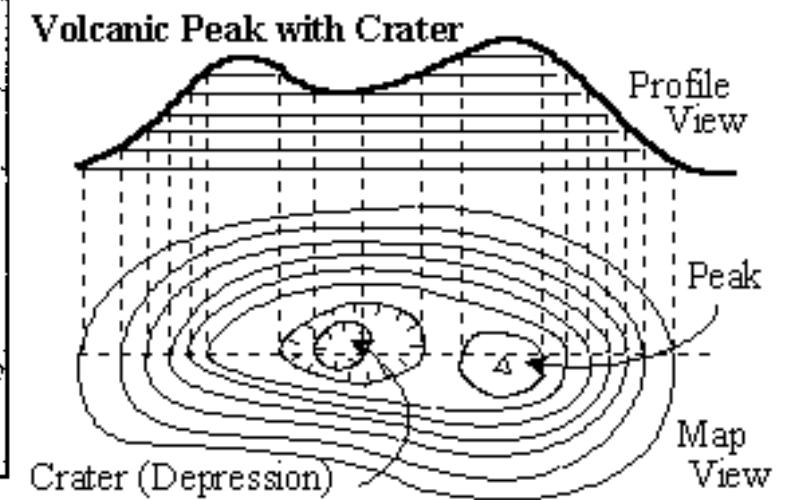
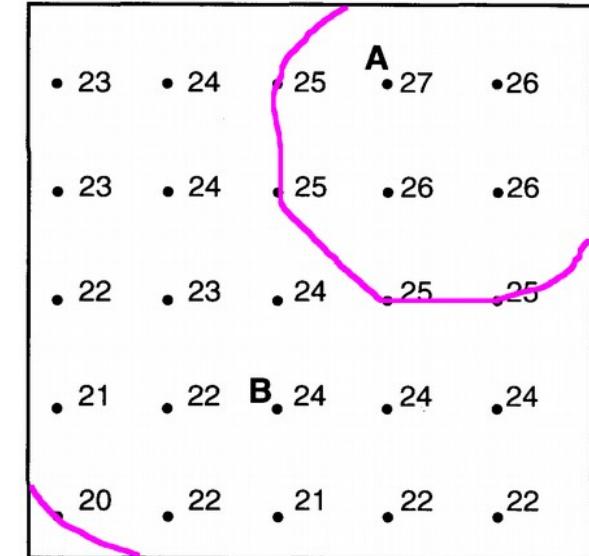
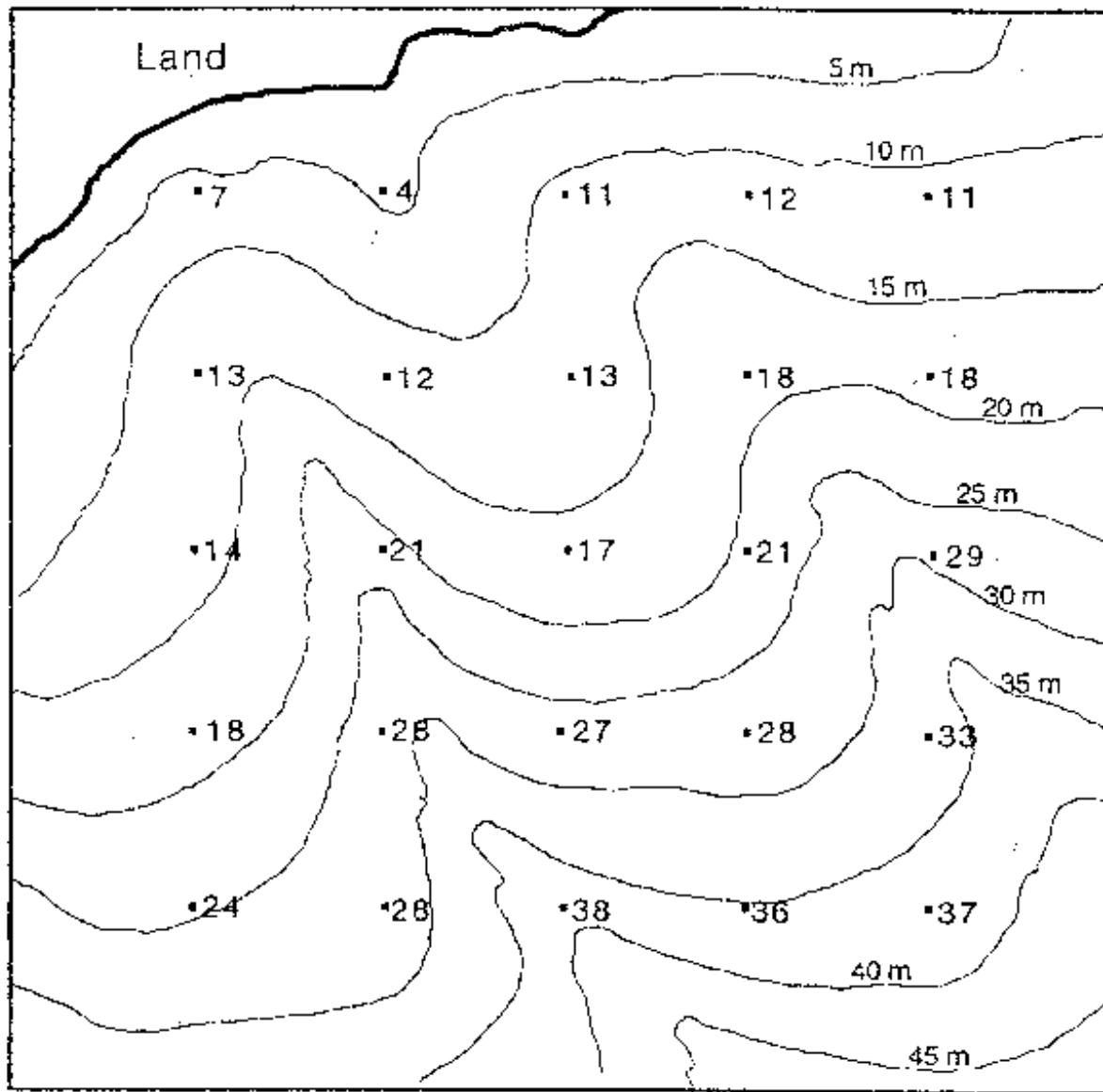
(d) Profile

Bi - Linear or TIN Model

Chmura punktów

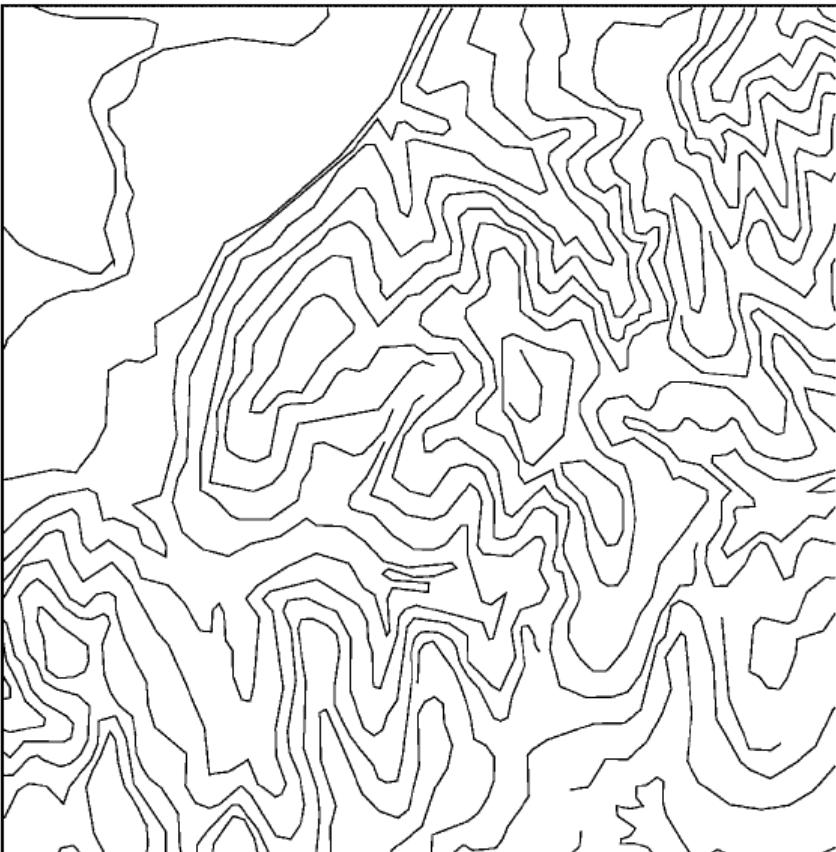


Model poziomiczny (izolinie)

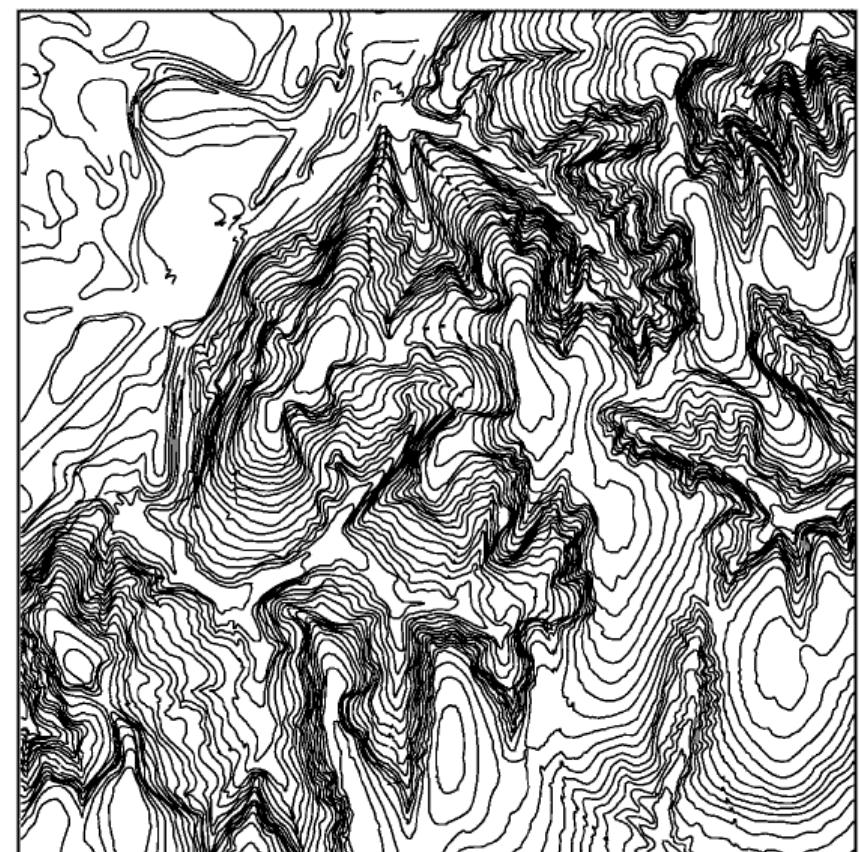


Jakość odwzorowania

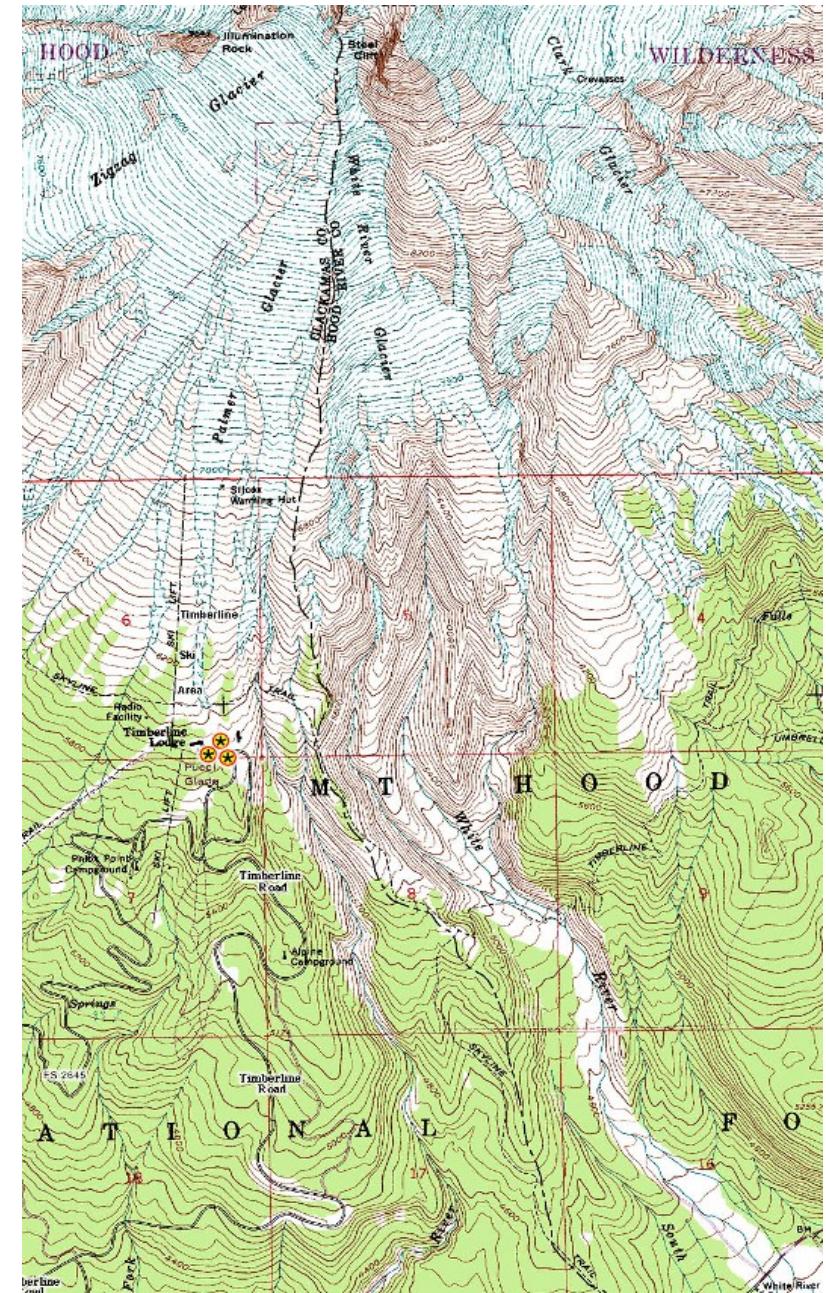
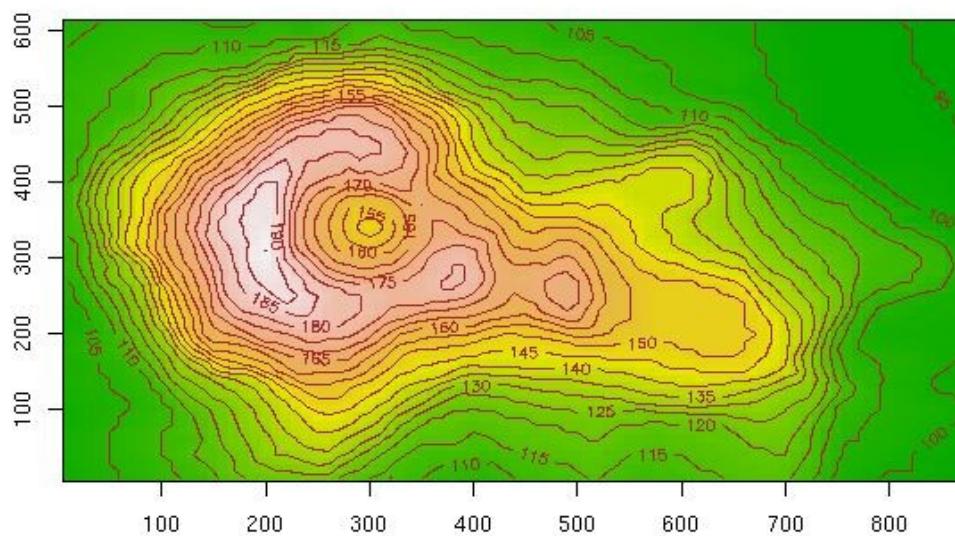
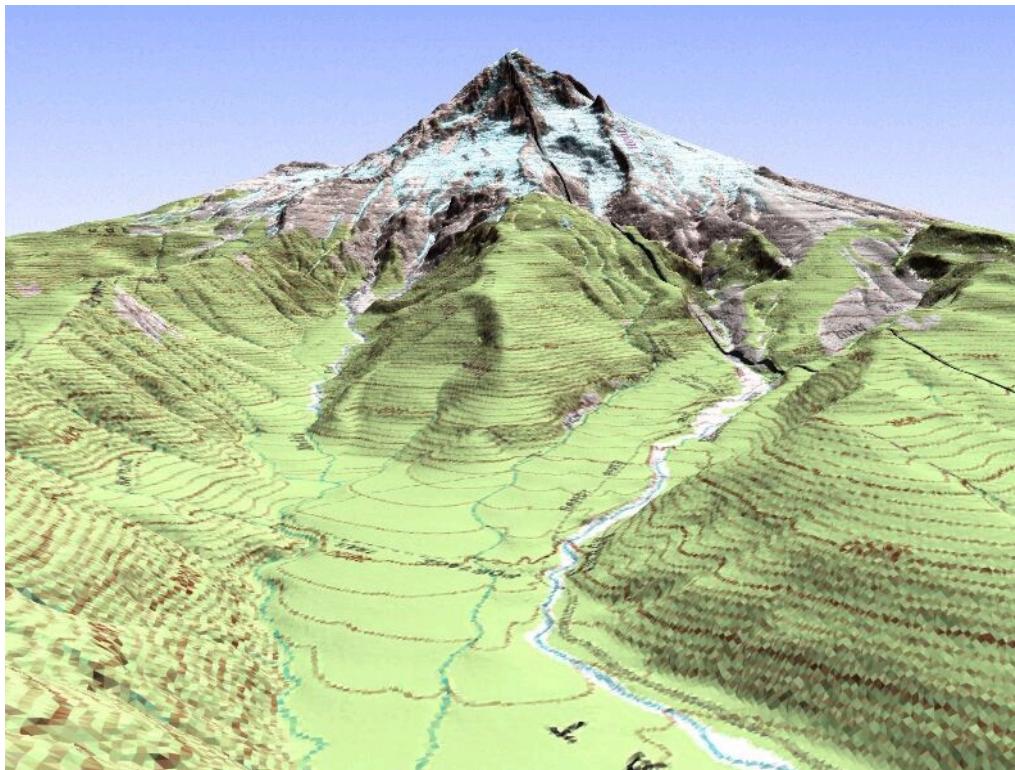
(a)



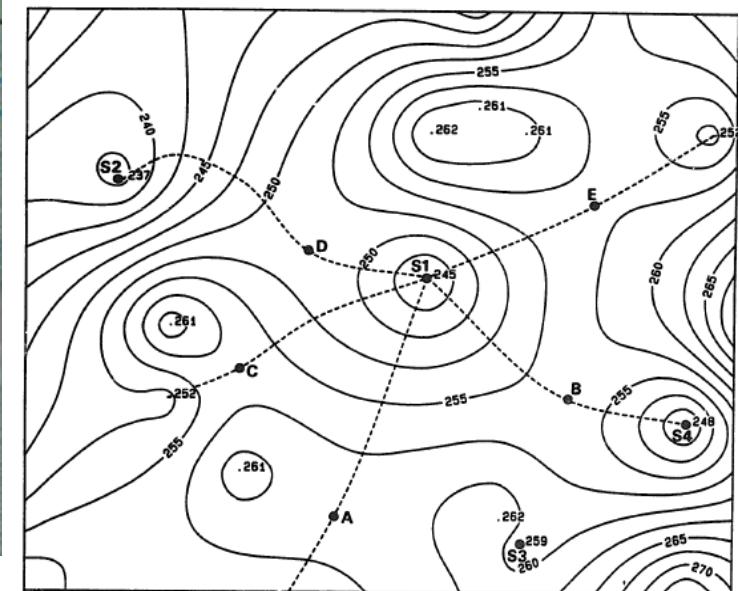
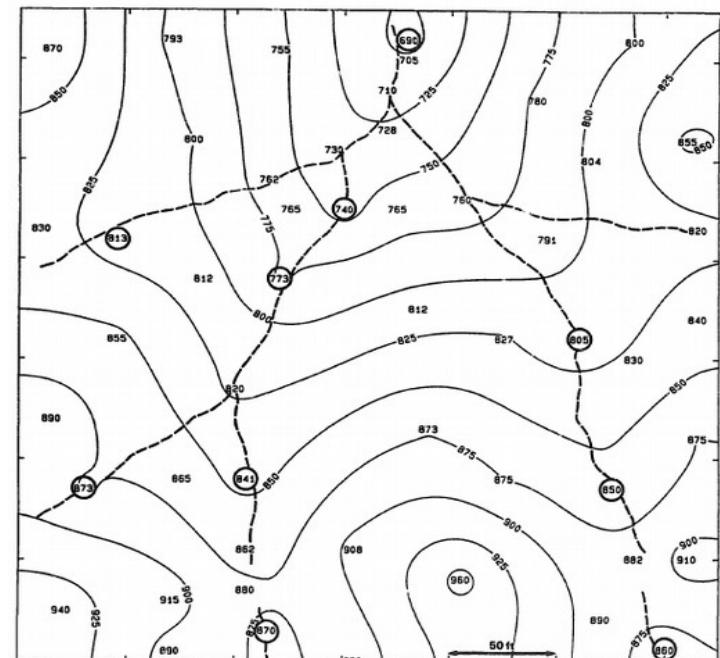
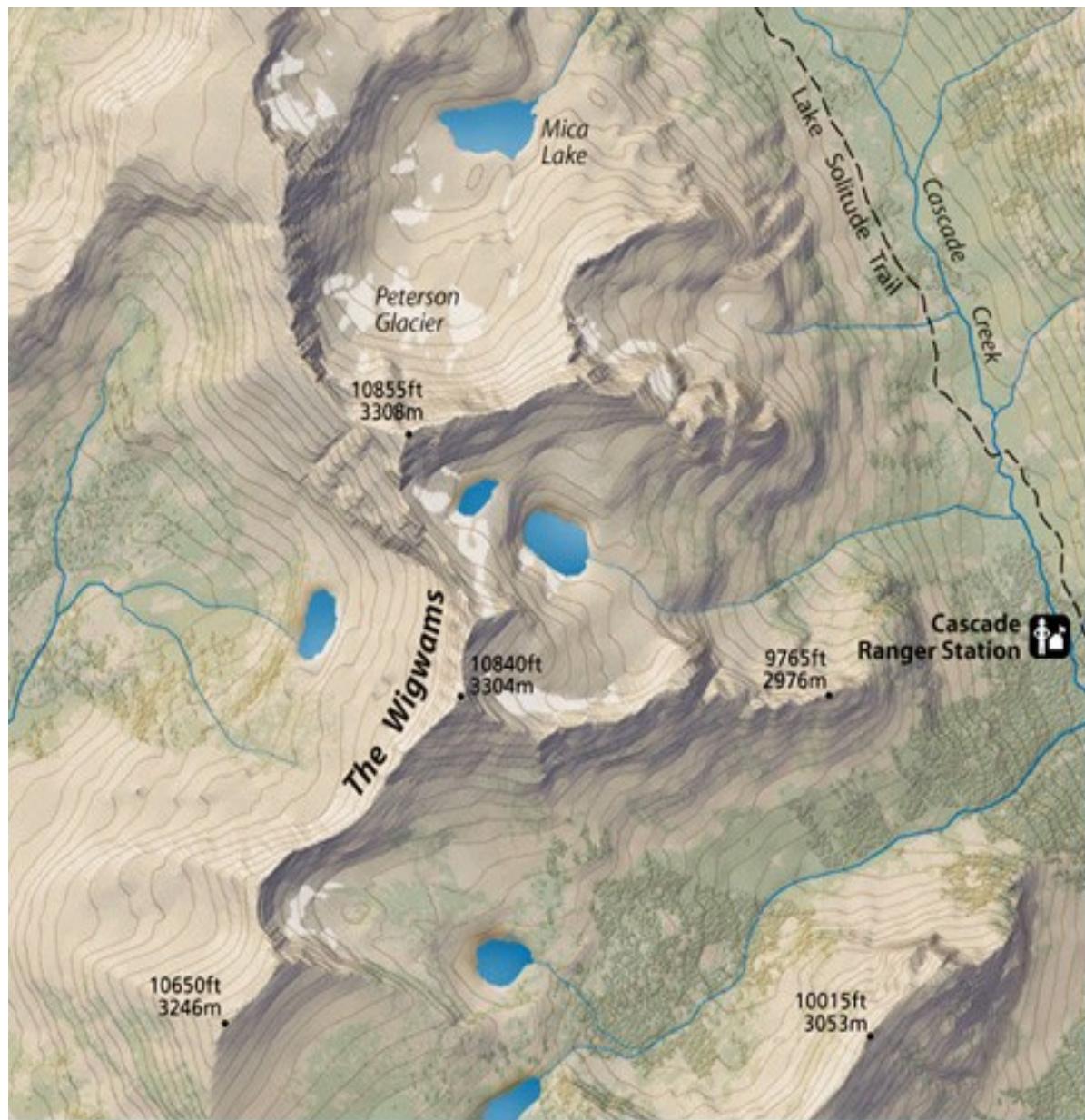
(b)



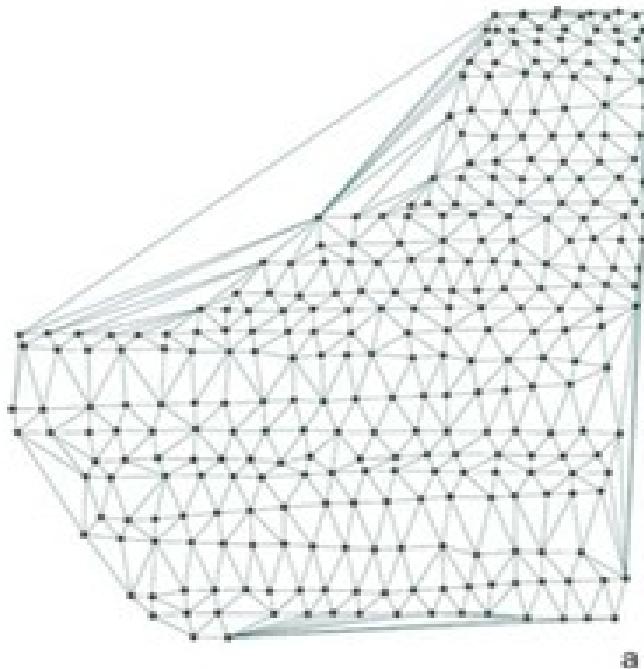
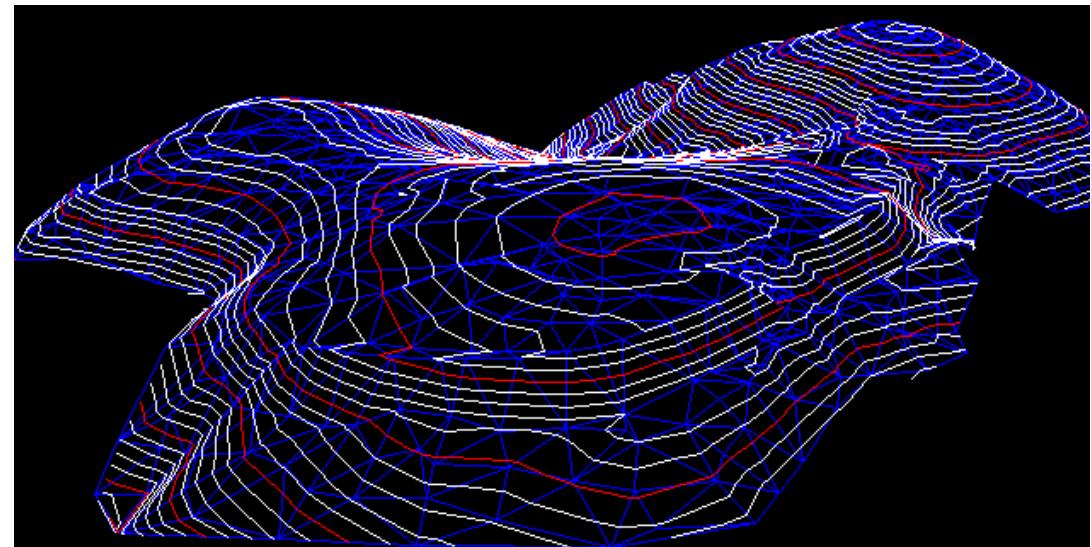
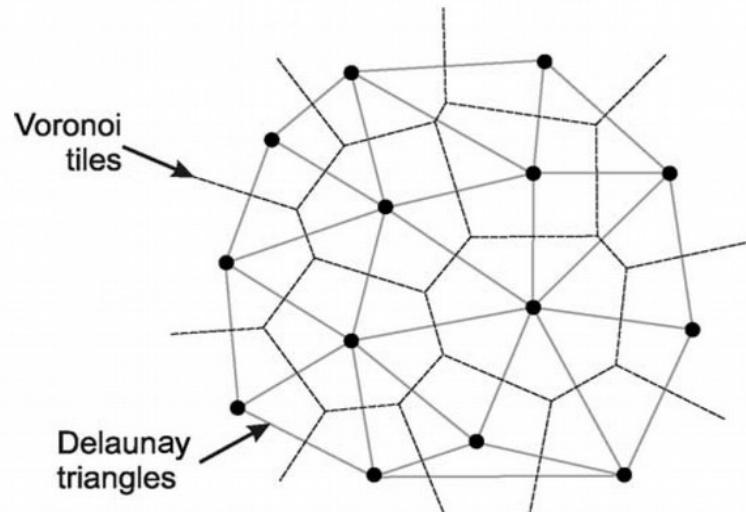
Odwzorowanie powierzchni



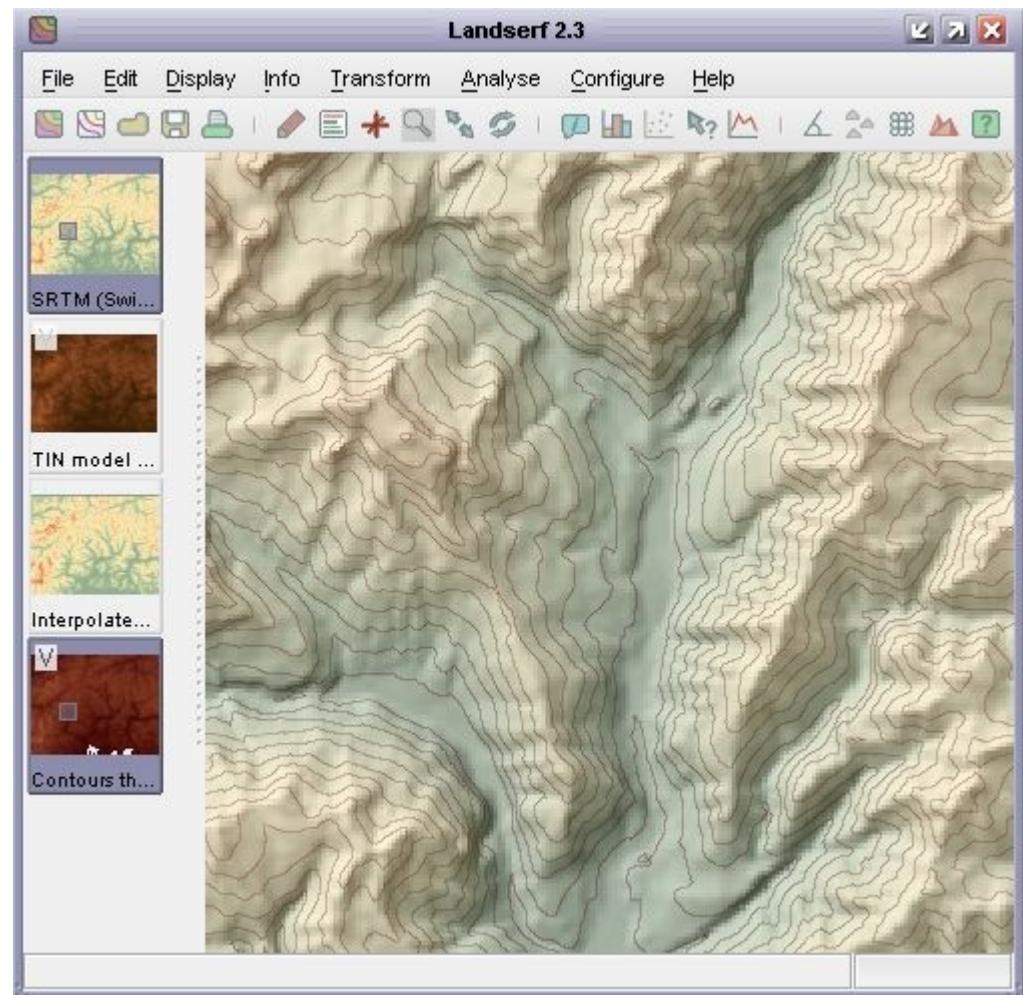
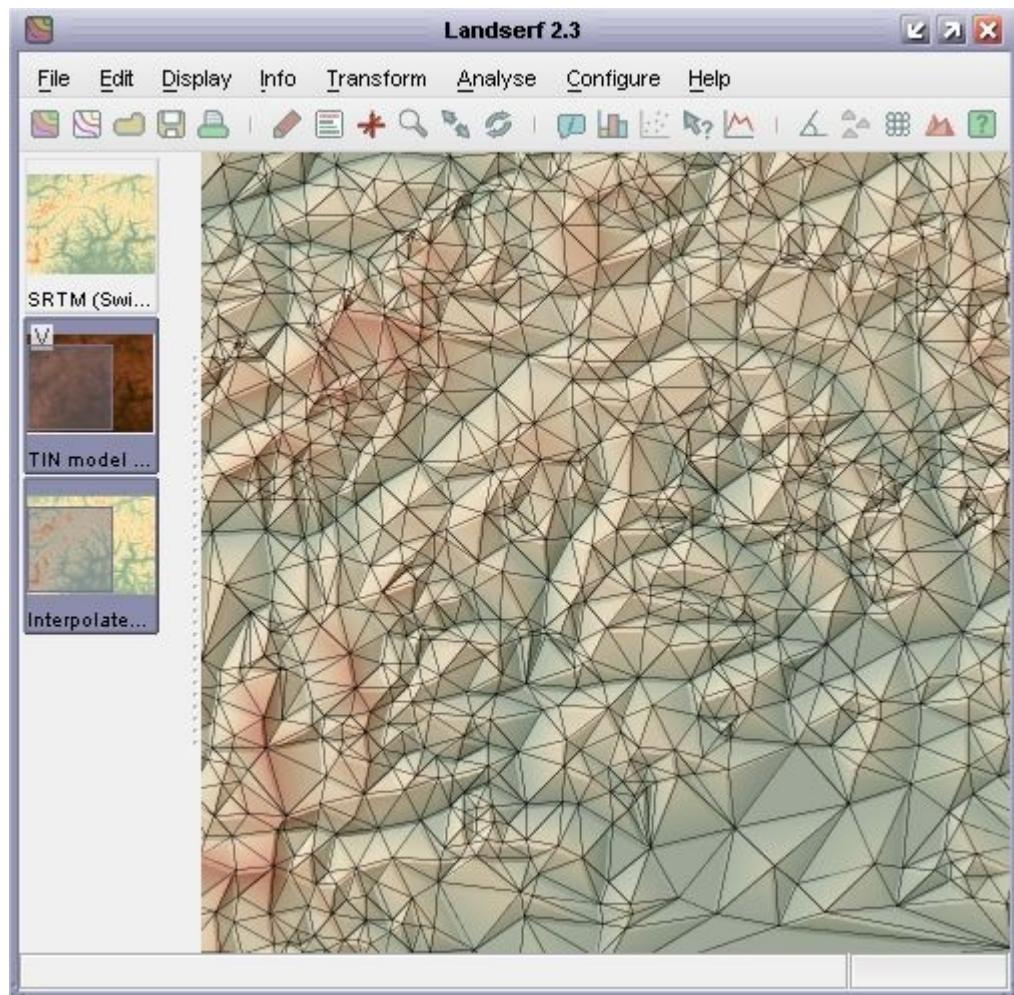
Model poziomicowy z siecią wodną



Punkty i model triangulacyjny

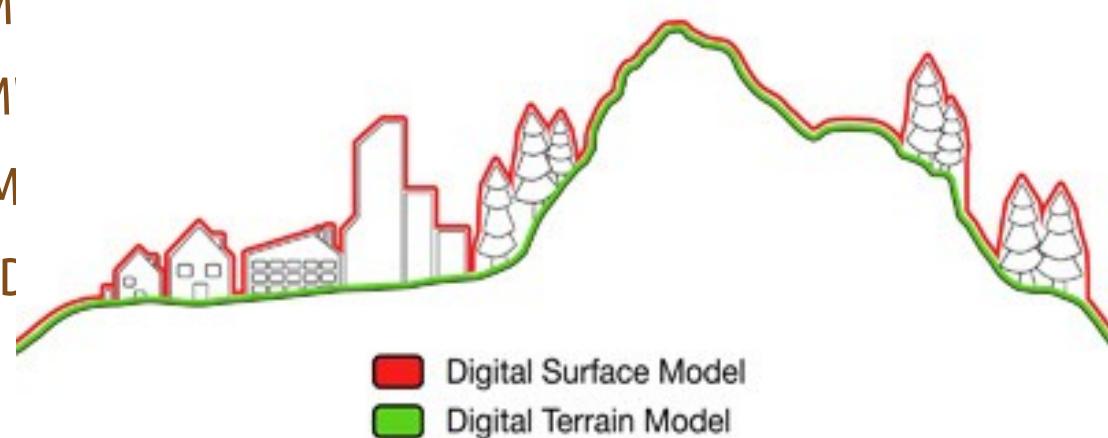


TIN a model poziomicowy

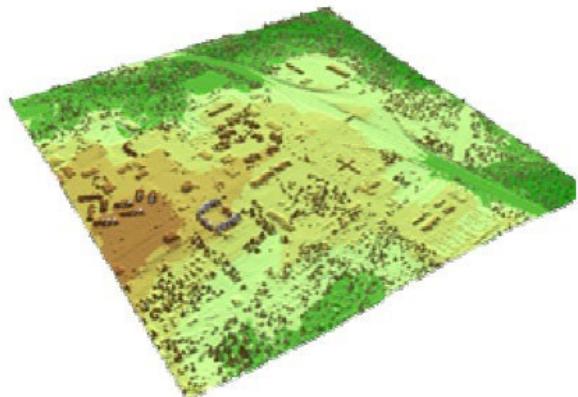


Cyfrowy model....

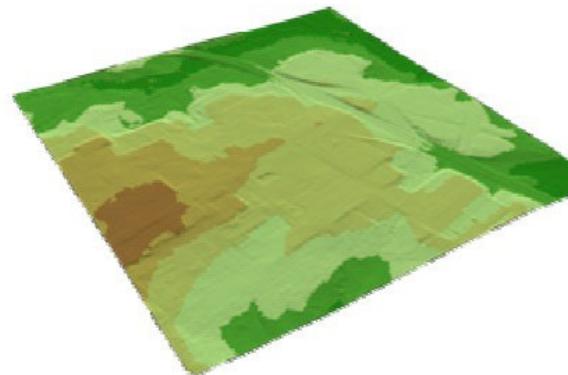
- DTM - Digital Terrain Model (NMT)
- DEM - Digital Elevation Model (NMW)
- DSM - Digital Surface Model (NM[~])
- DHM - Digital Height Model (NM[~])
- DGM - Digital Ground Model (NM[~])
- DTED - Digital Terrain Elevation D



Elevation Products

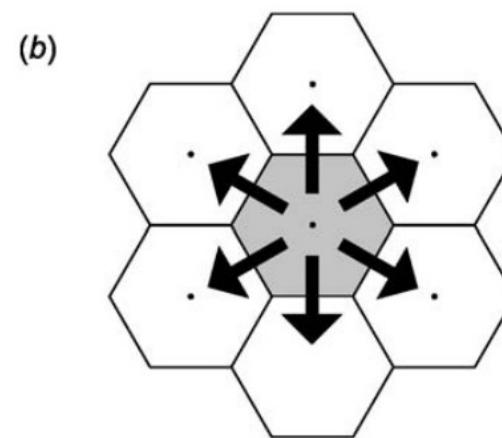
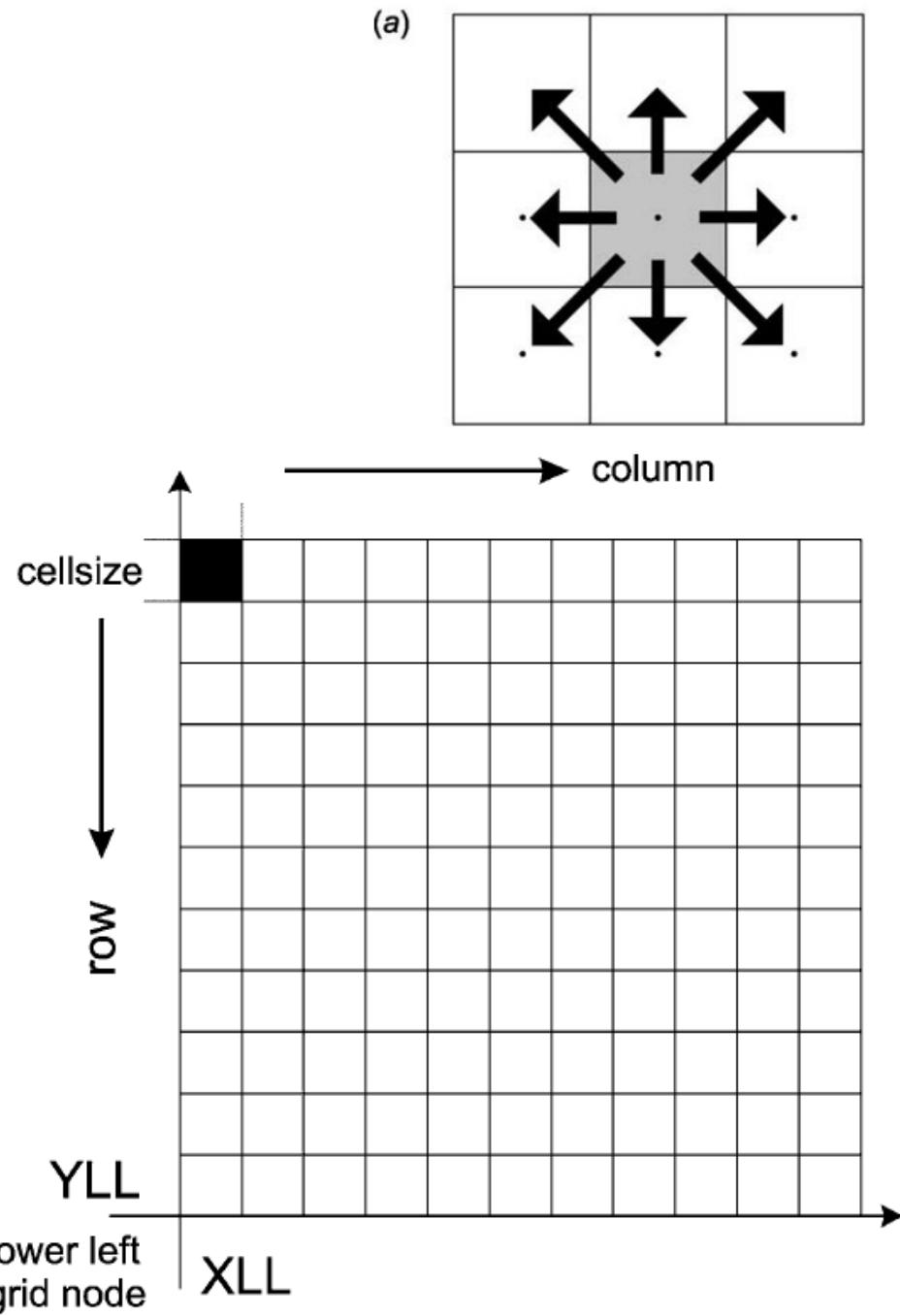


Digital Surface Model (DSM)



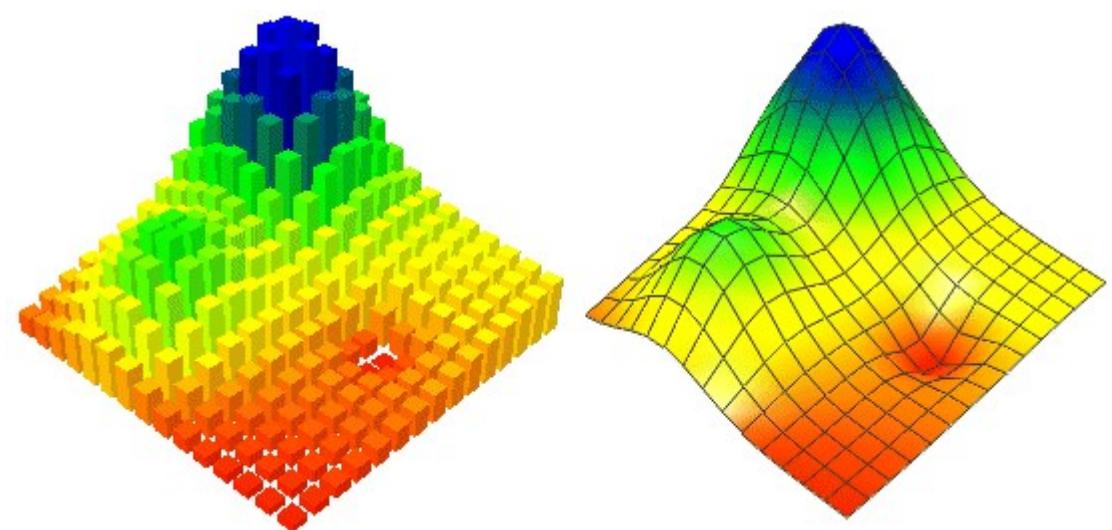
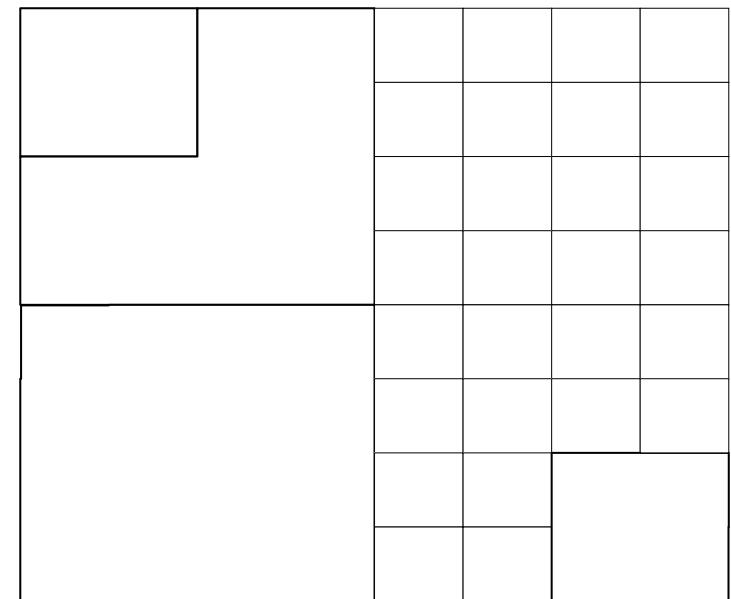
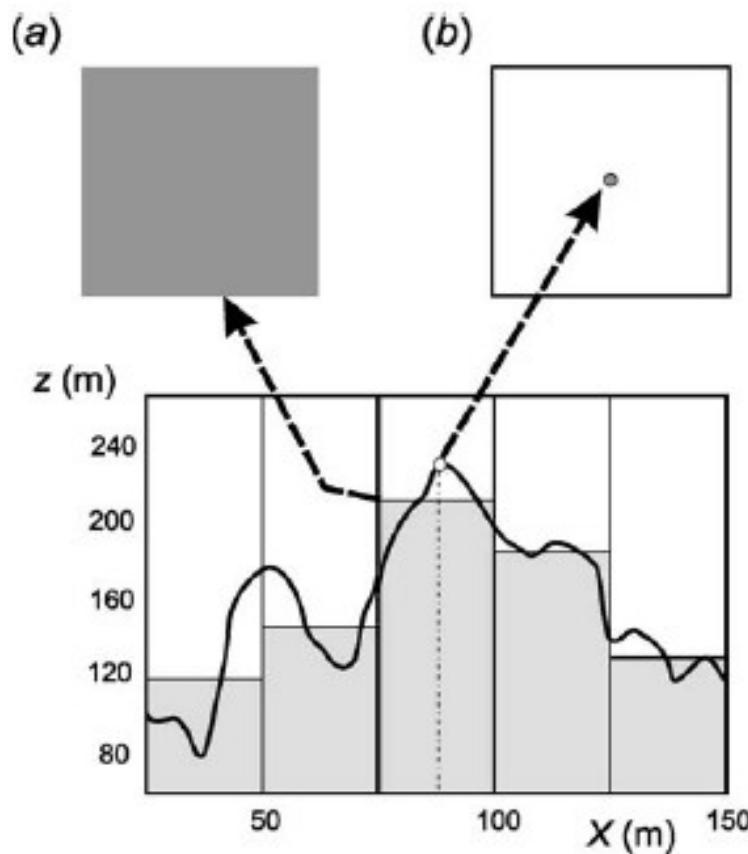
Digital Elevation Model (DEM)

Organizacja danych w postaci siatki



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ncols 6
nrows 6
xllcorner 0
yllcorner 0
cellsize 10.00
nodata_value -32767
10 16 23 16 9 6
14 11 18 11 18 19
19 15 13 21 23 25
20 20 19 14 38 45
24 20 20 28 18 49
23 24 34 38 45 51
```

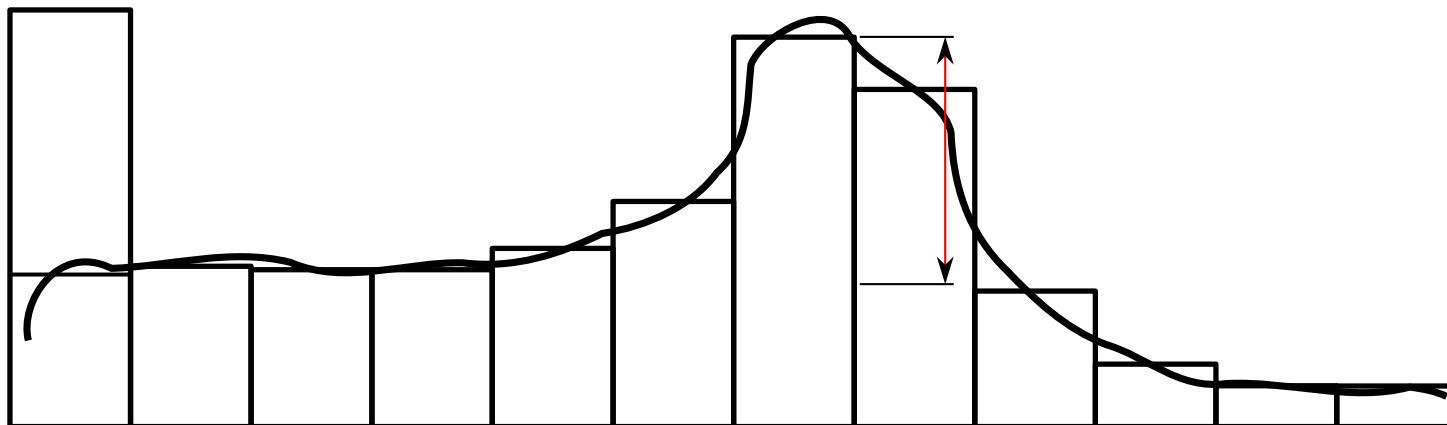
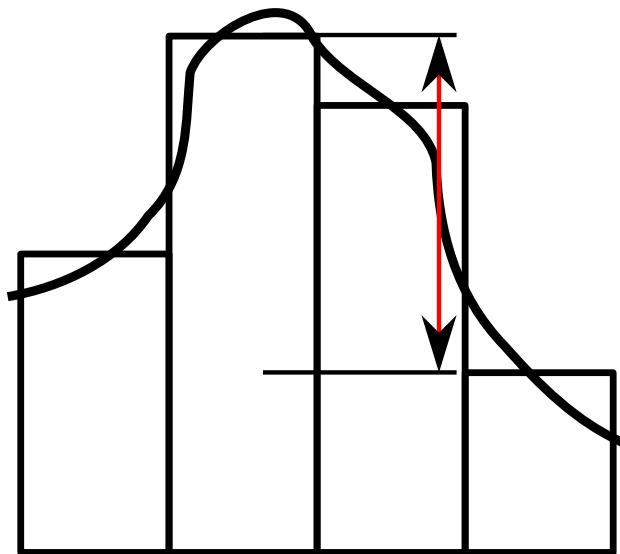
Co reprezentuje komórka?



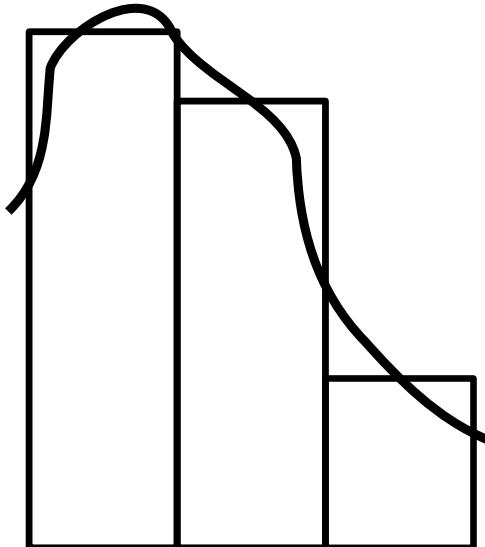
Koncepcja skali. Rozdzielczość

- Opis form terenu w skali „ludzkiej: 2 do 20 metrów na komórkę
- **Rozdzielczość** - określa stopień szczegółowości modelu. Im lepsza rozdzielczość tym bliższe sobie obiekty reprezentowane będą na modelu jako odrębne jednostki
- **Precyzja** - określa sposób zapisu wartości wysokości. Stosuje się: kategorie (klasy wysokości) liczby całkowite (precyzja 1 m) i zmiennoprzecinkowe (precyzja poniżej 1 cm)
- **Dokładność** – stopień zgodności z jakim pionowe i poziome położenie obiektu w rzeczywistości reprezentowana jest w modelu

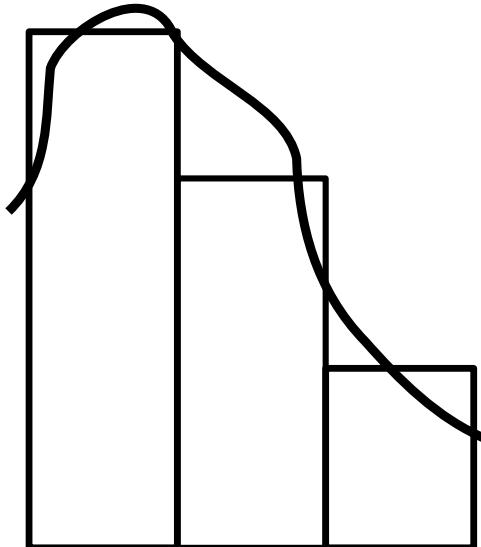
Rozdzielcość pionowa



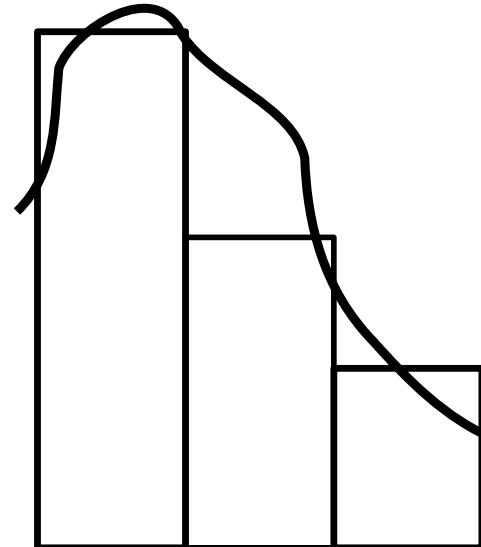
Jaką wartość reprezentuje komórka?



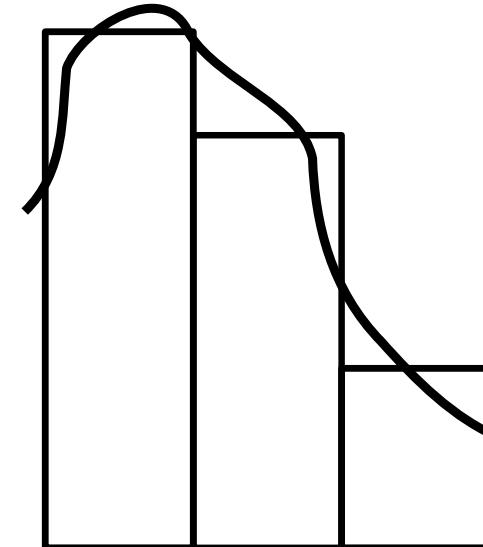
Centralna



Średnia

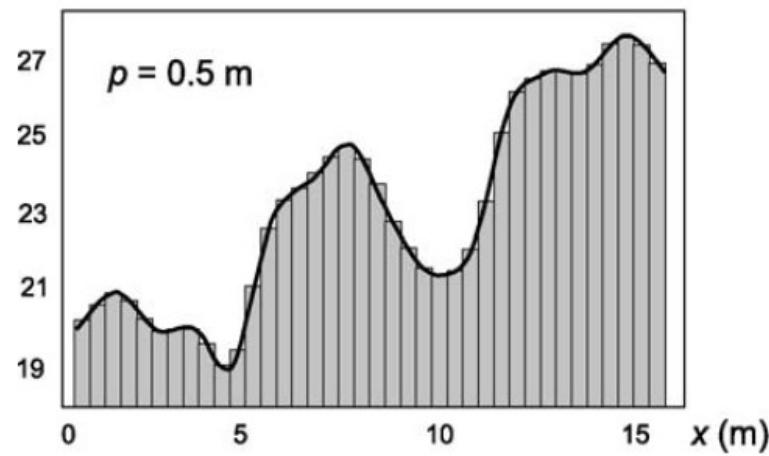
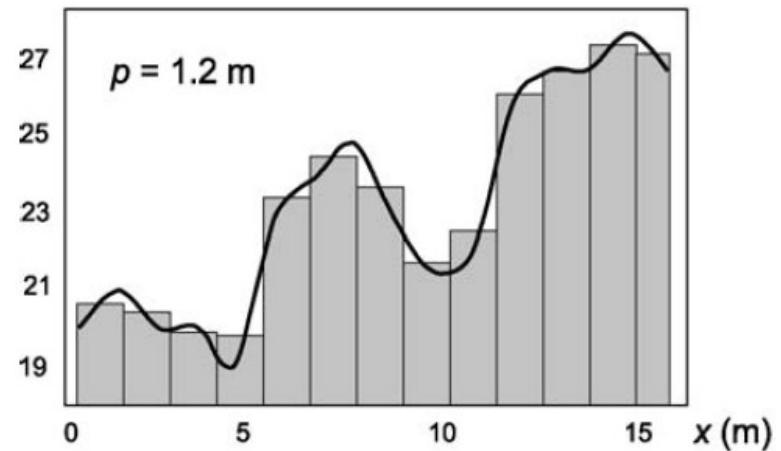
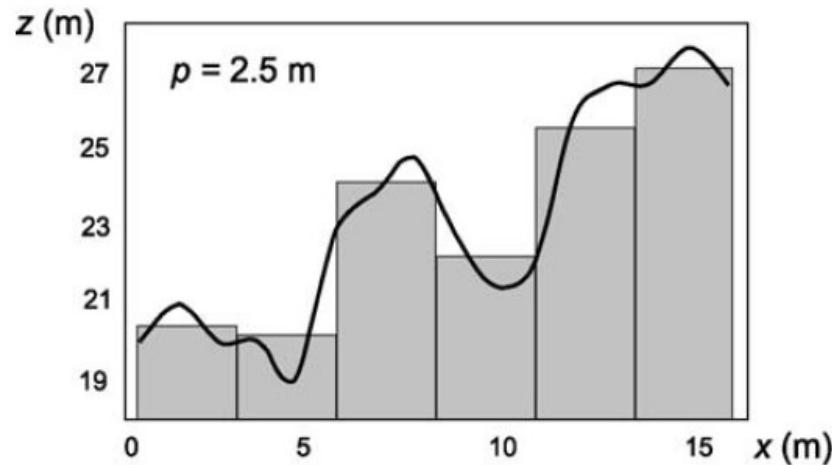


Optymalizowana

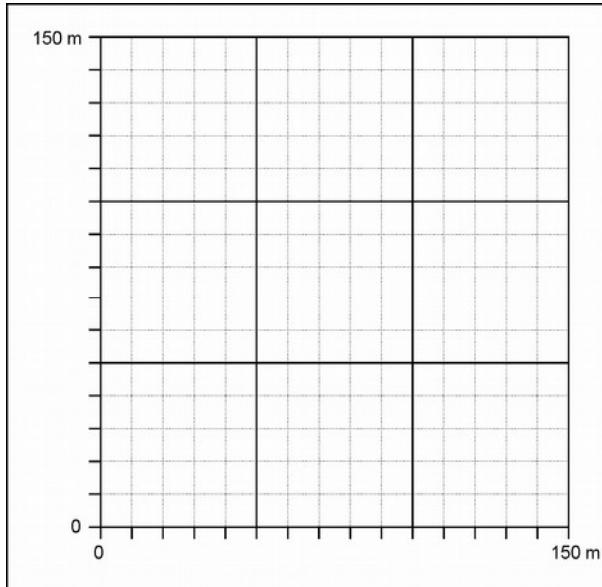
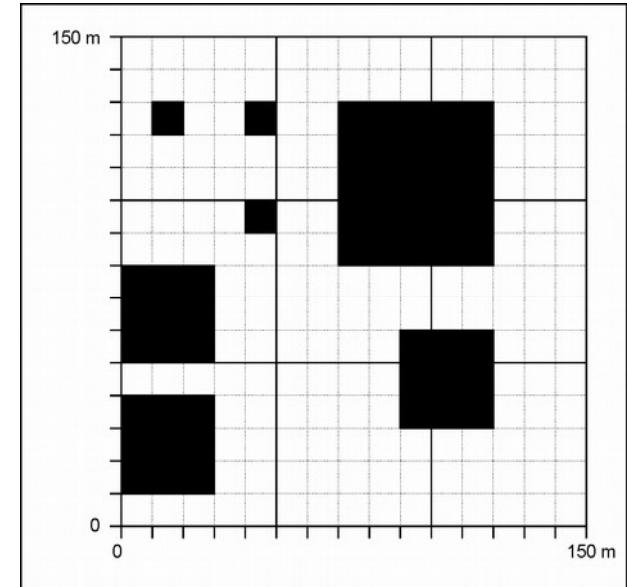
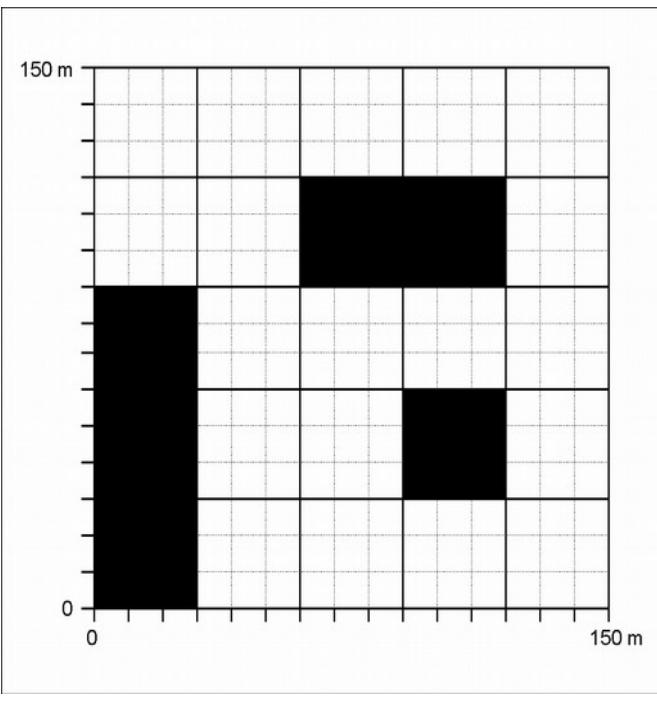
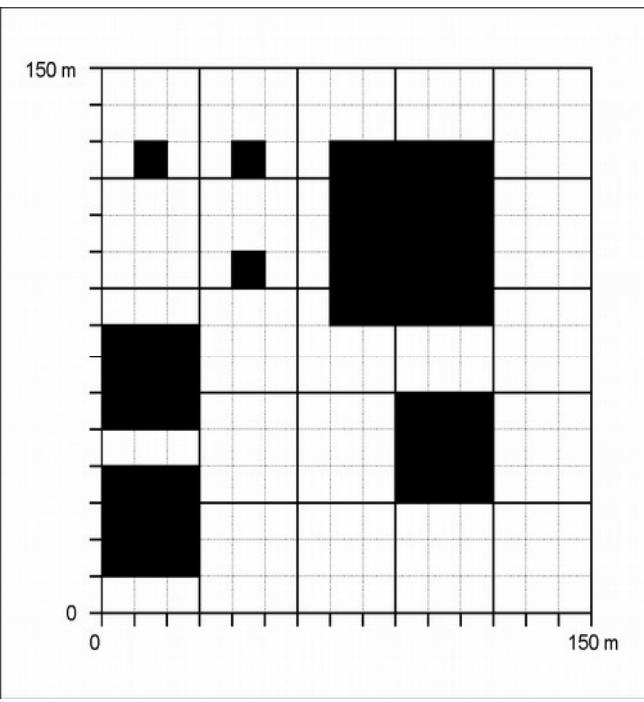


Mediana

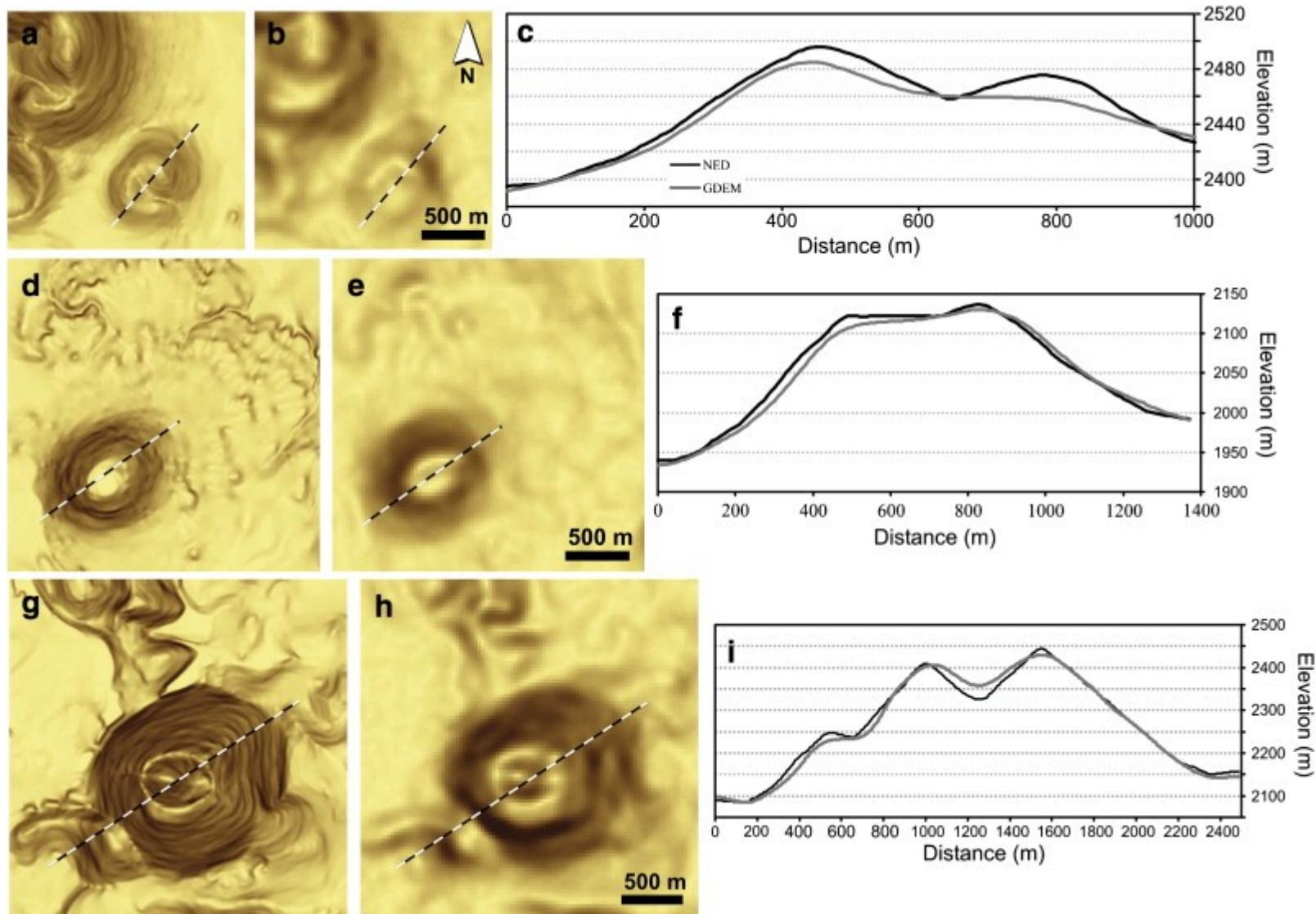
Rozdzielcość pozioma



Wpływ rozdzielczości na zachowanie obiektów



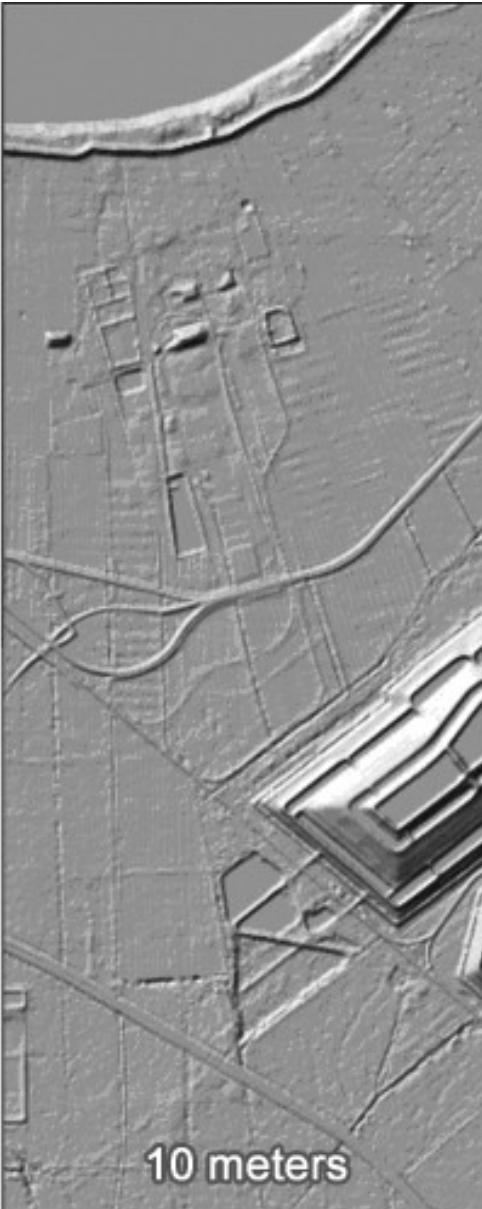
Wpływ rozdzielczości na rozpoznanie form



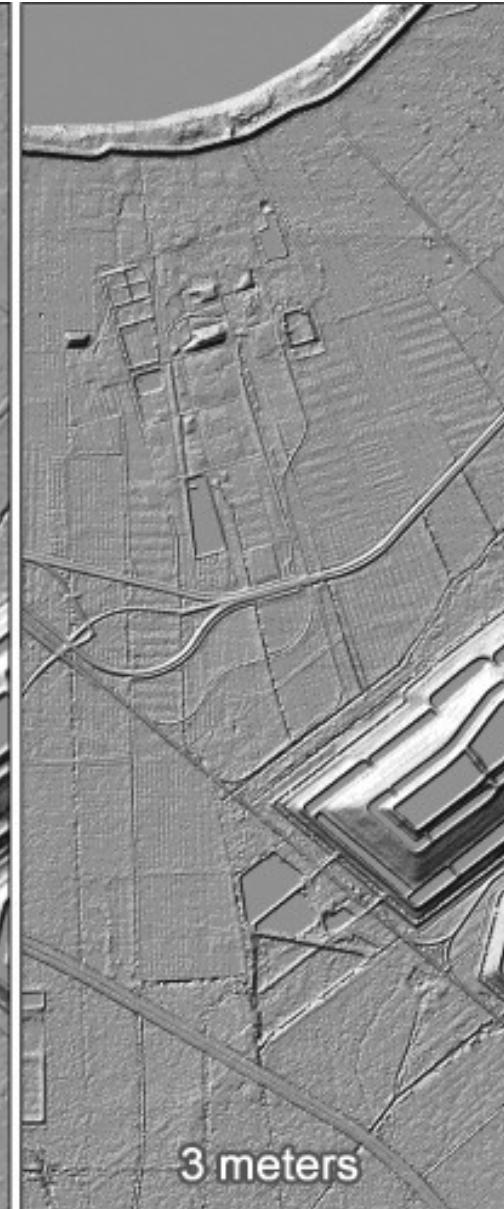
Wpływ rozdzielczości na postrzeganie



30 meters

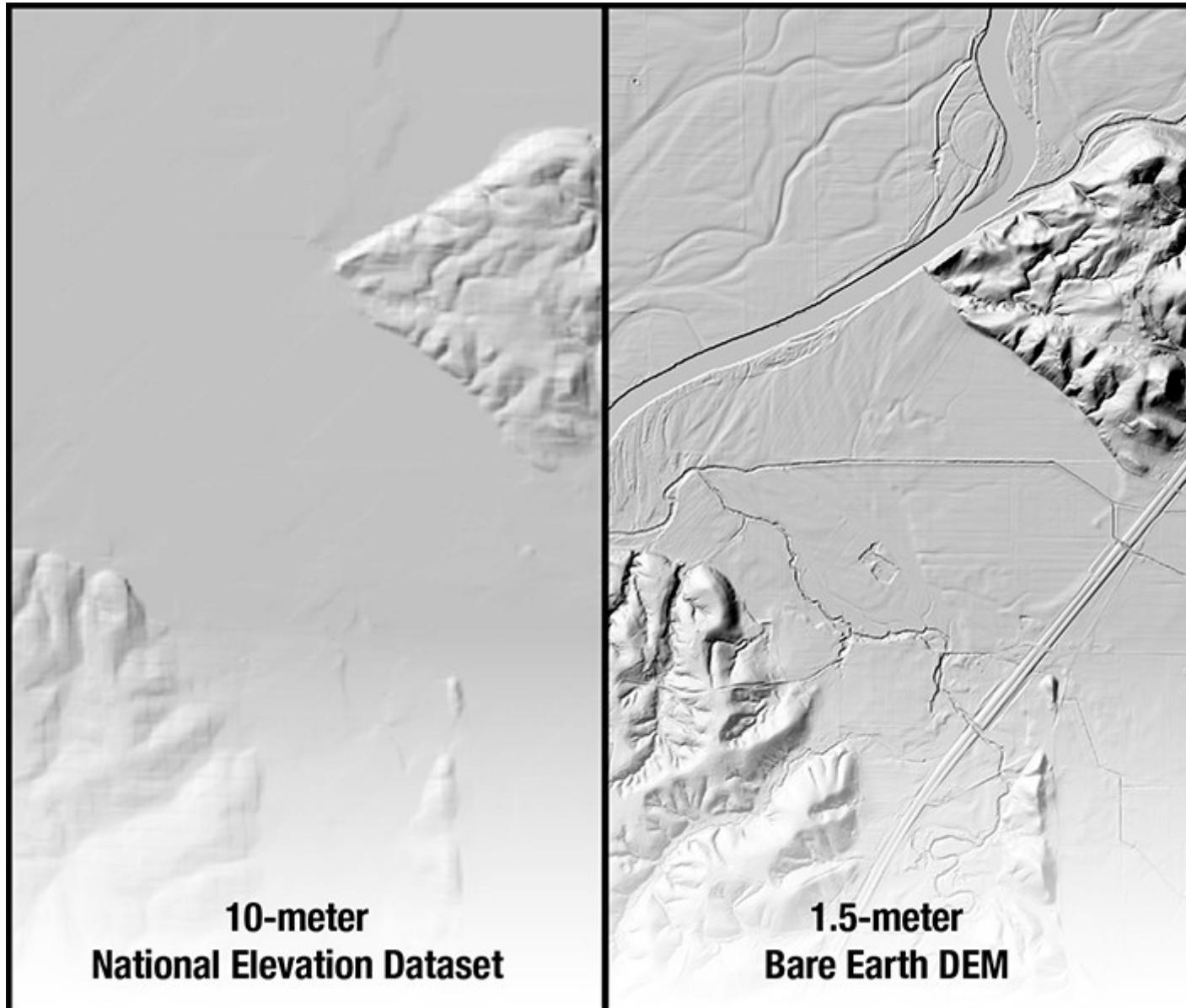


10 meters

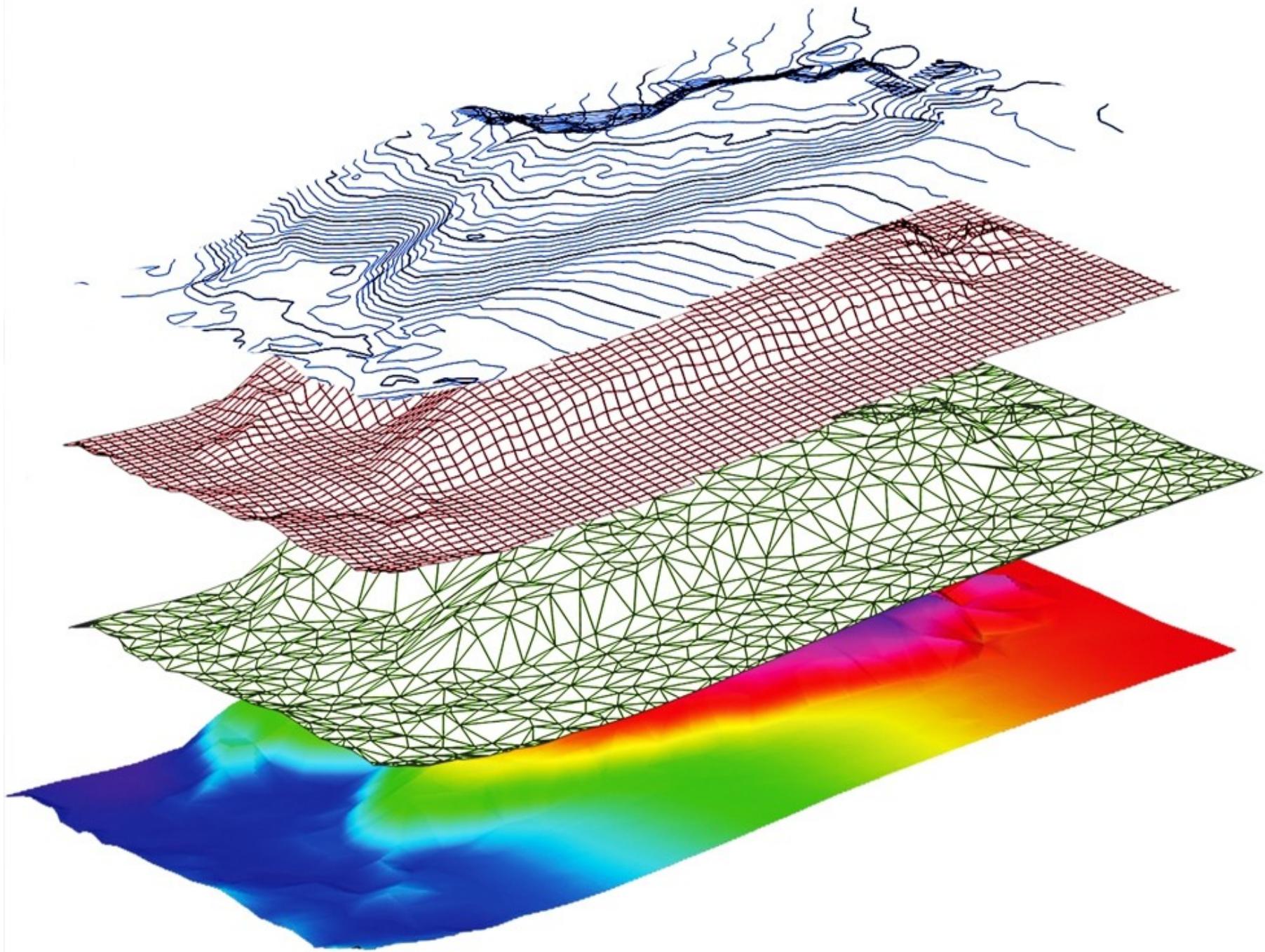


3 meters

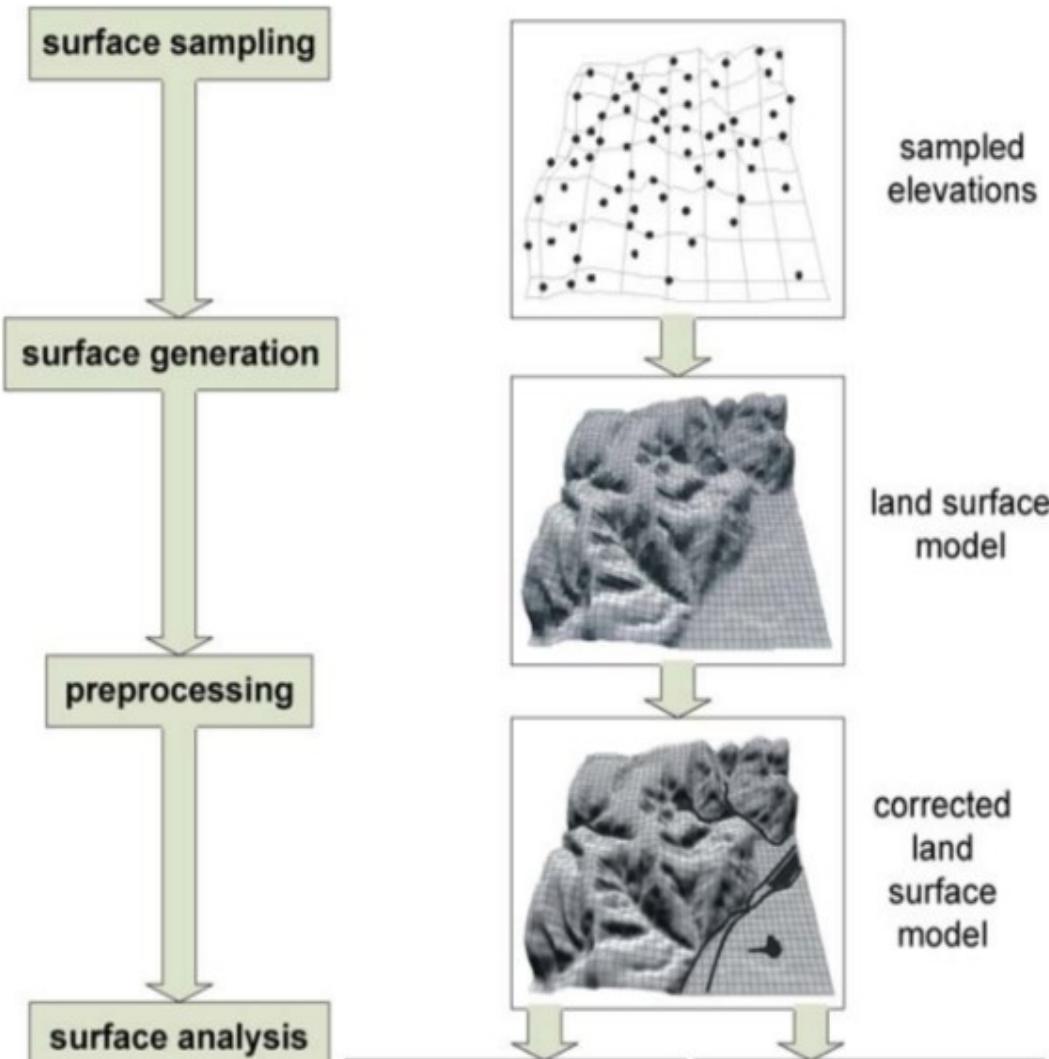
Wpływ rozdzielczości na zachowanie obiektów



Podsumowanie: Trzy metody zapisu powierzchni



Podsumowanie: Tworzenie modelu terenu



ANALIZY TERENU