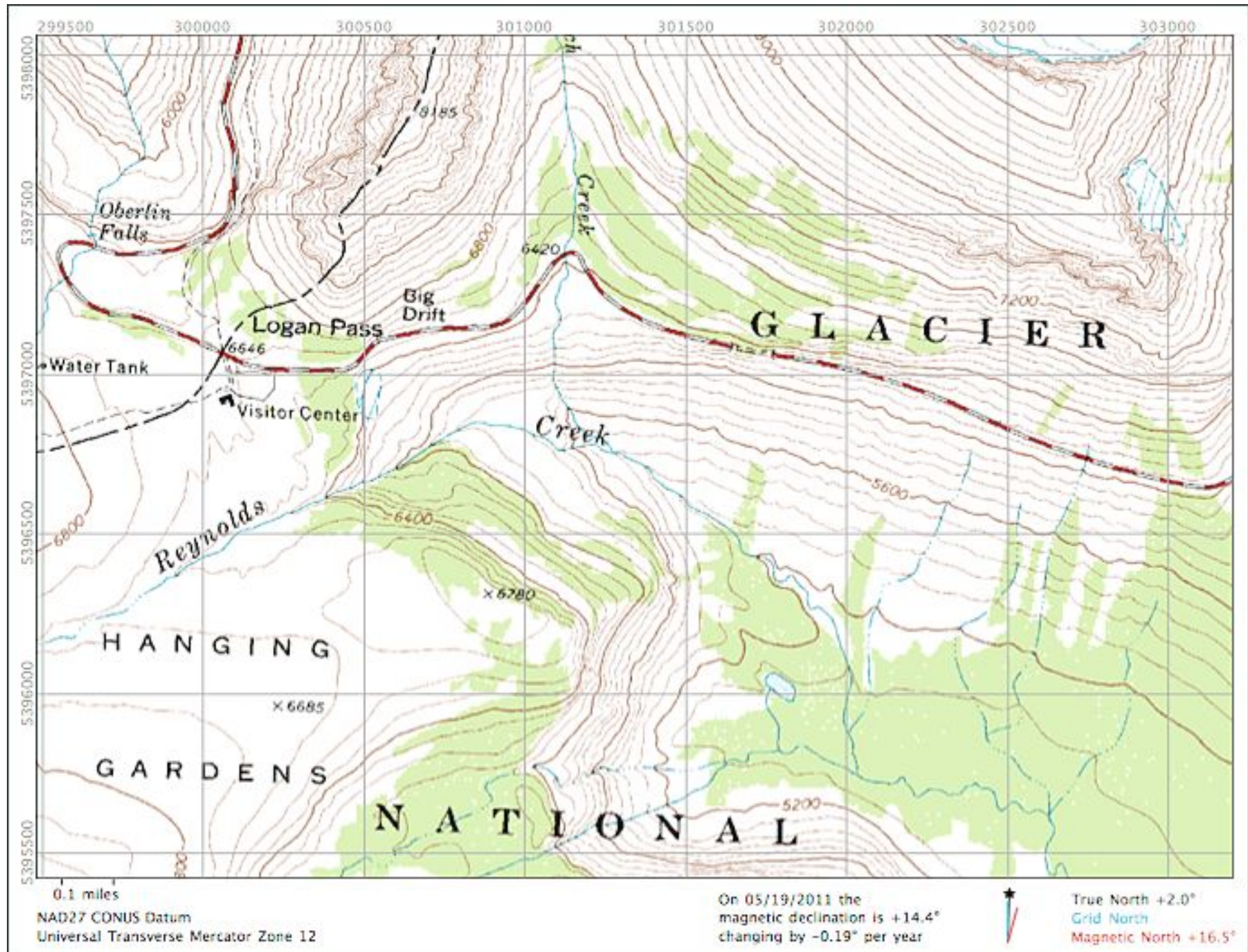


A topographic map showing brown contour lines on a green background. A green rectangle is drawn on the left side of the map. A blue line runs diagonally from the top right to the bottom right. Black dashed lines and small black squares are scattered on the right side of the map. The text "Pozyskiwanie danych wysokościowych" is overlaid in the lower center.

**Pozyskiwanie danych  
wysokościowych**

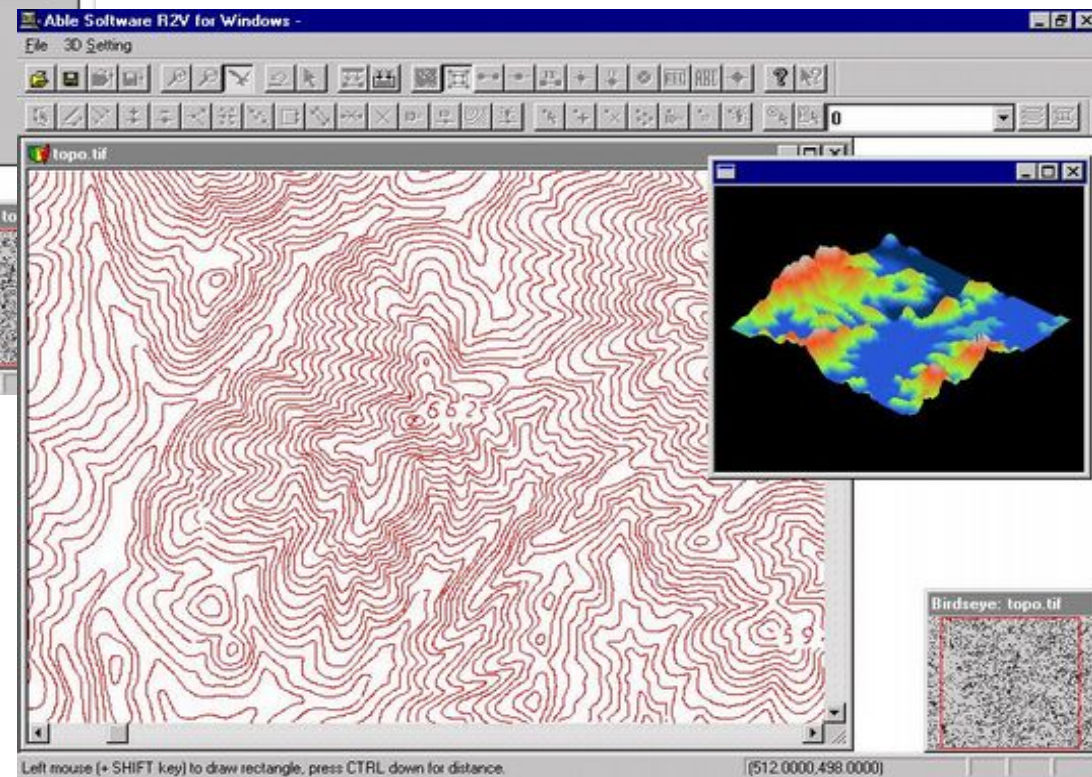
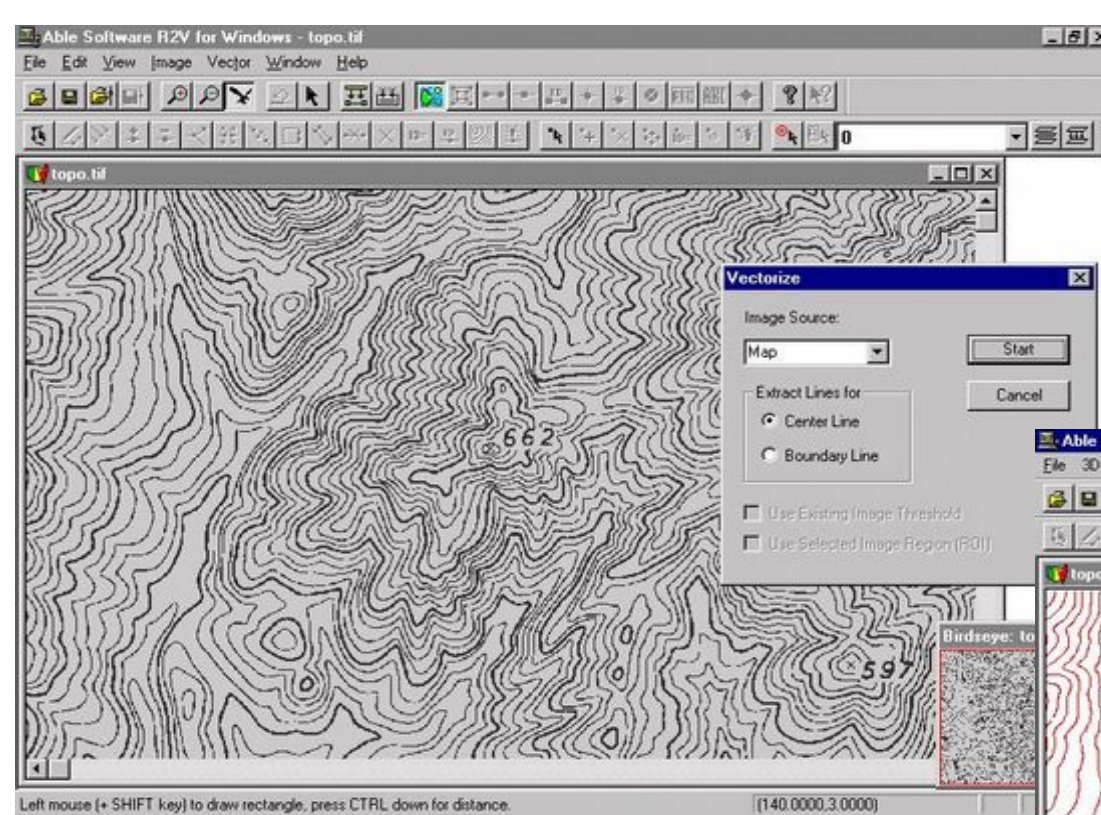


# Mapa topograficzna

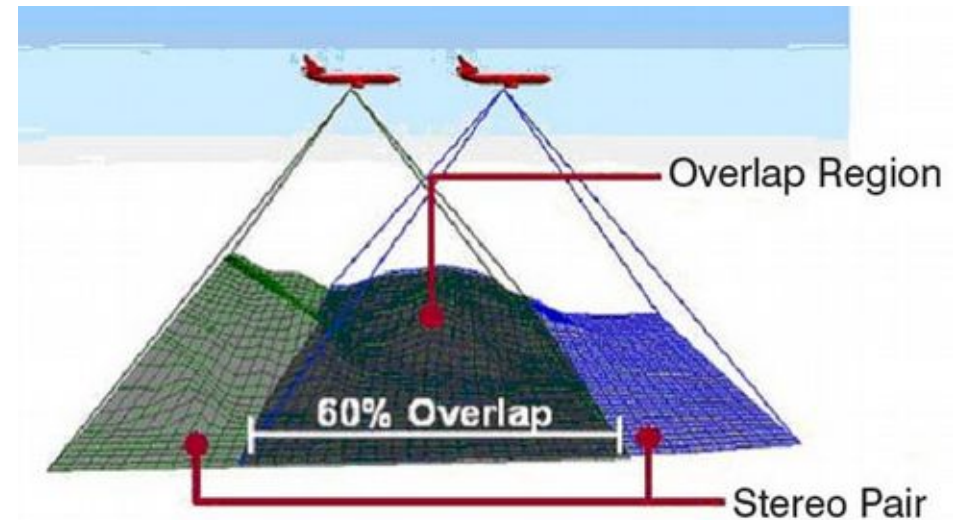
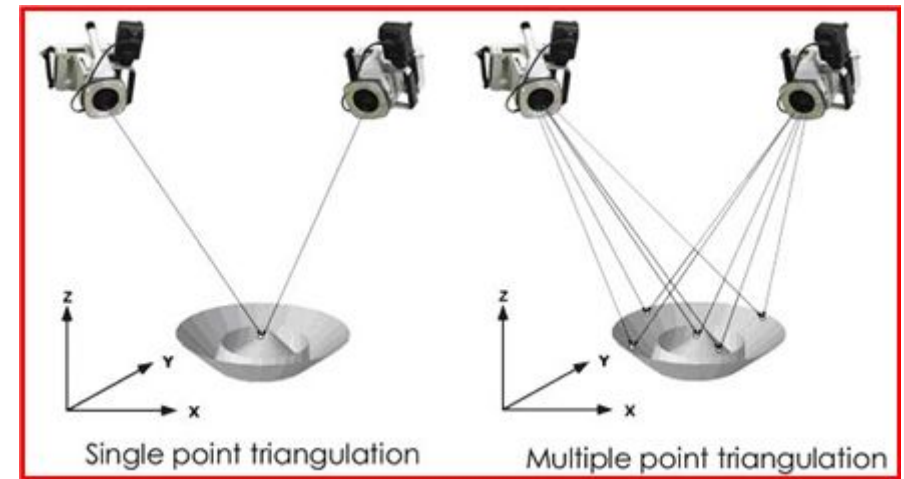
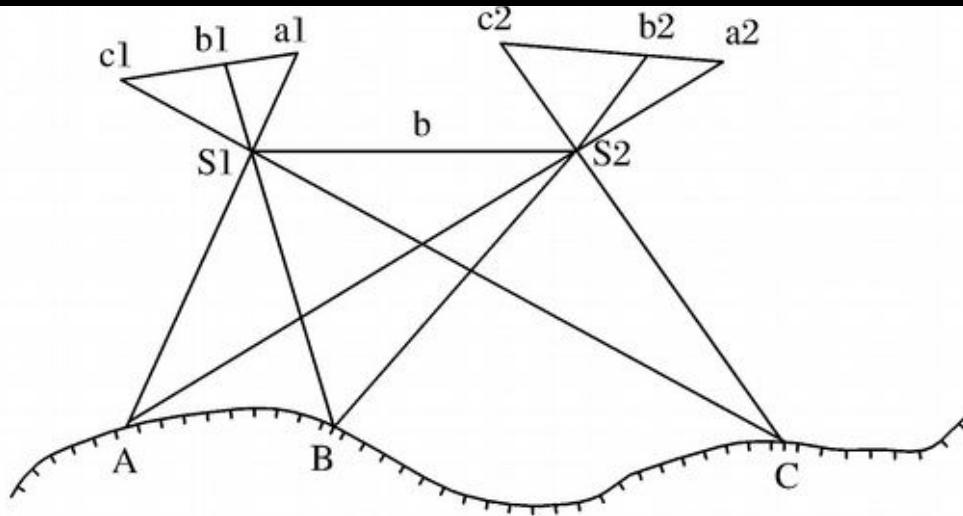
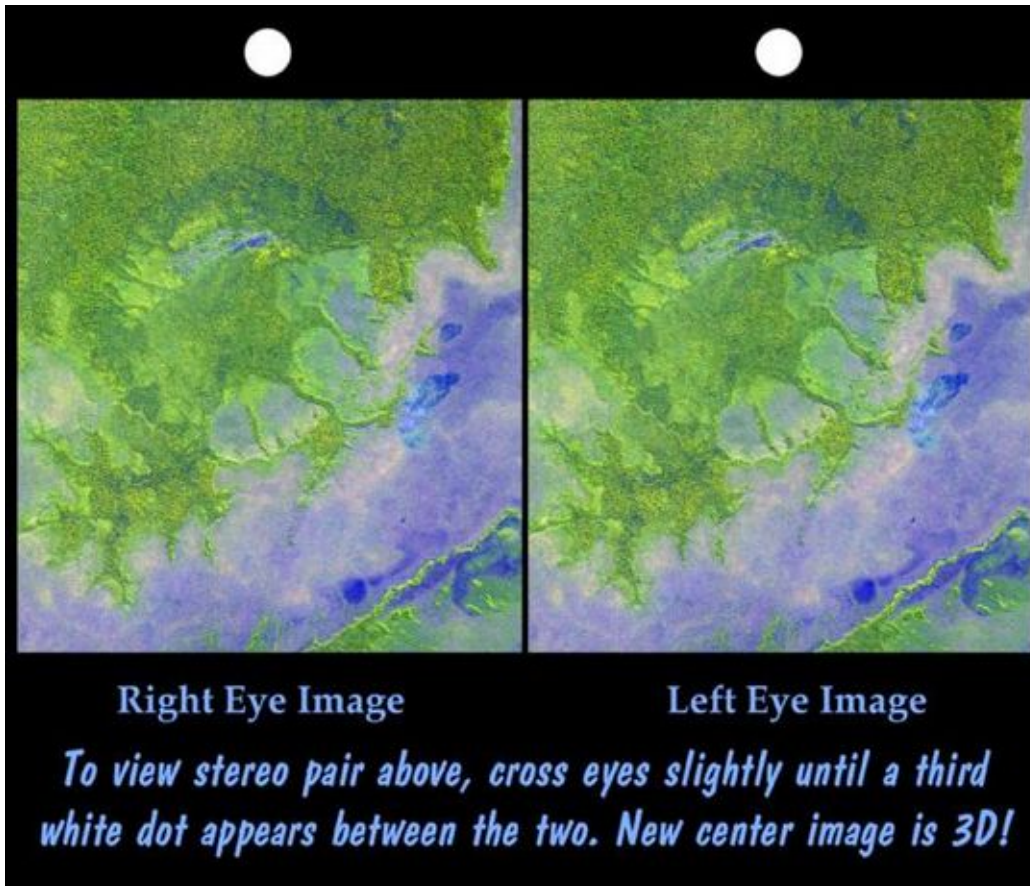




# Dygitalizacja

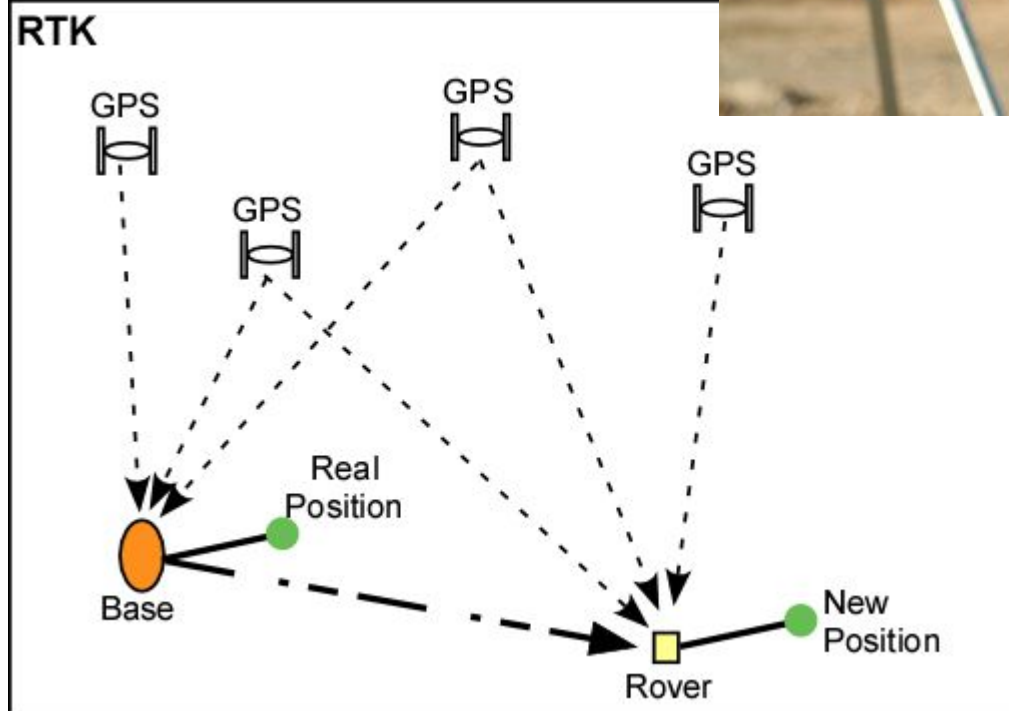
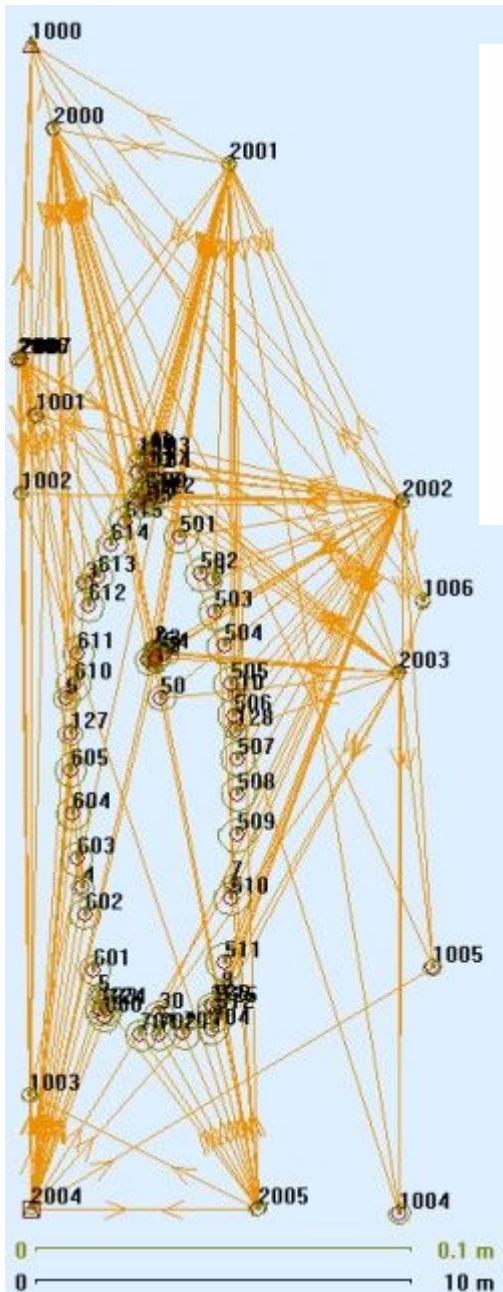


# Fotogrametria

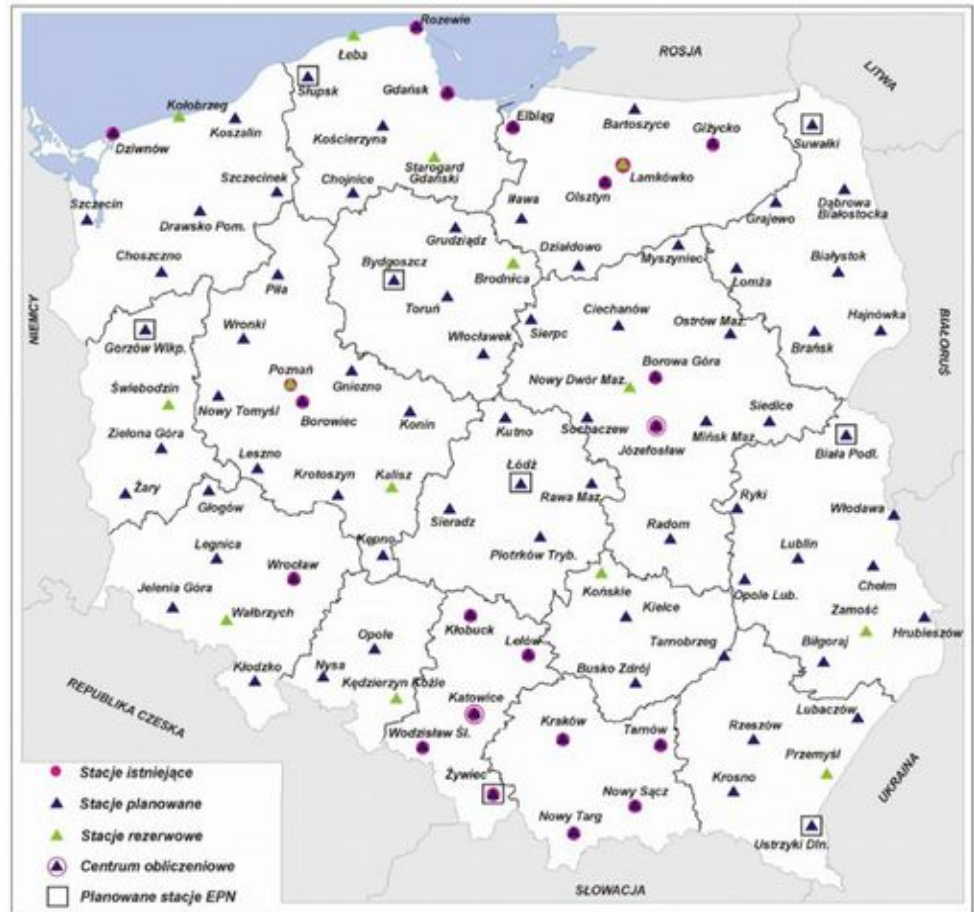
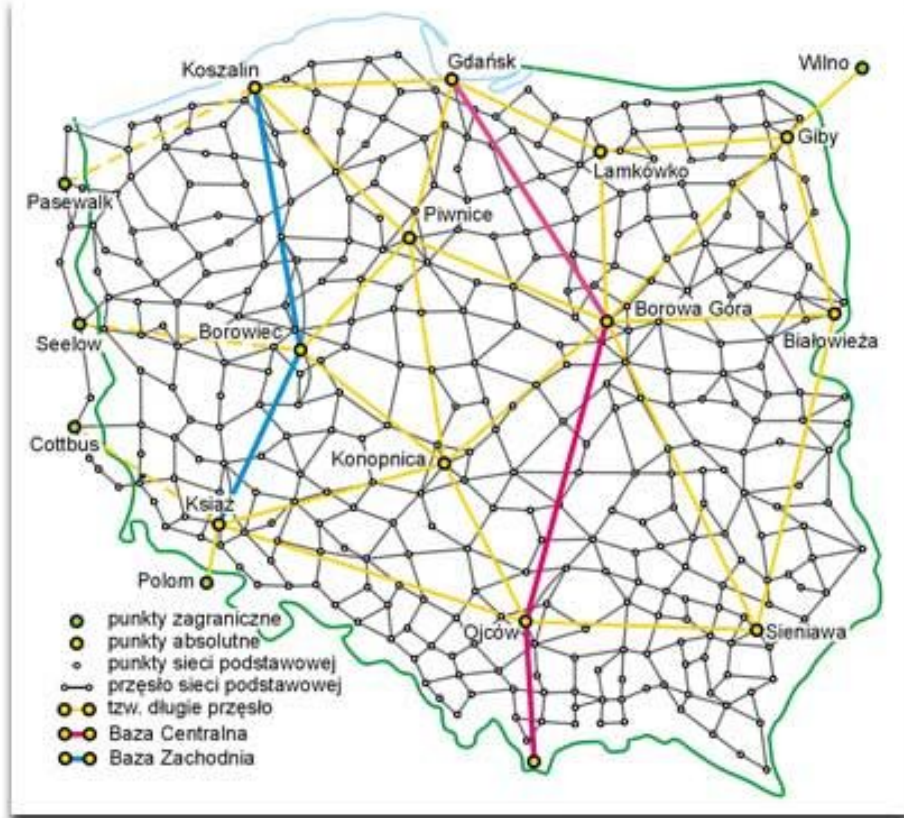




# Pomiary punktowe

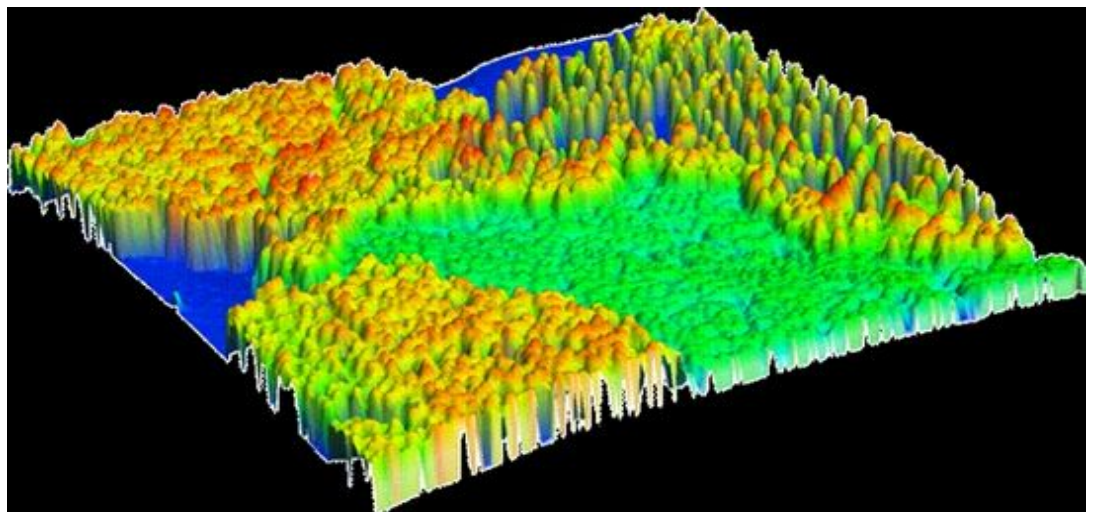
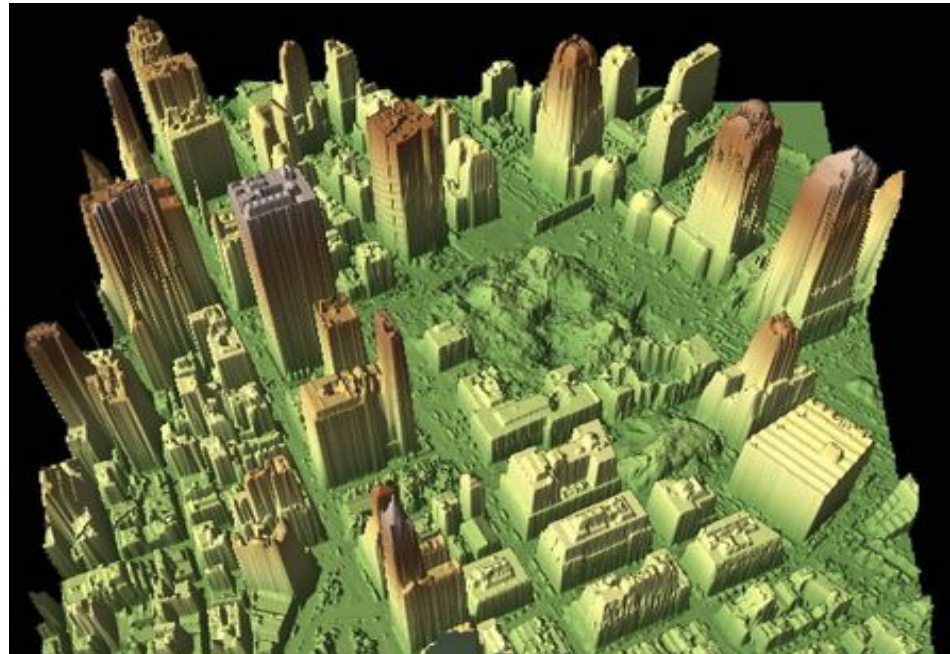
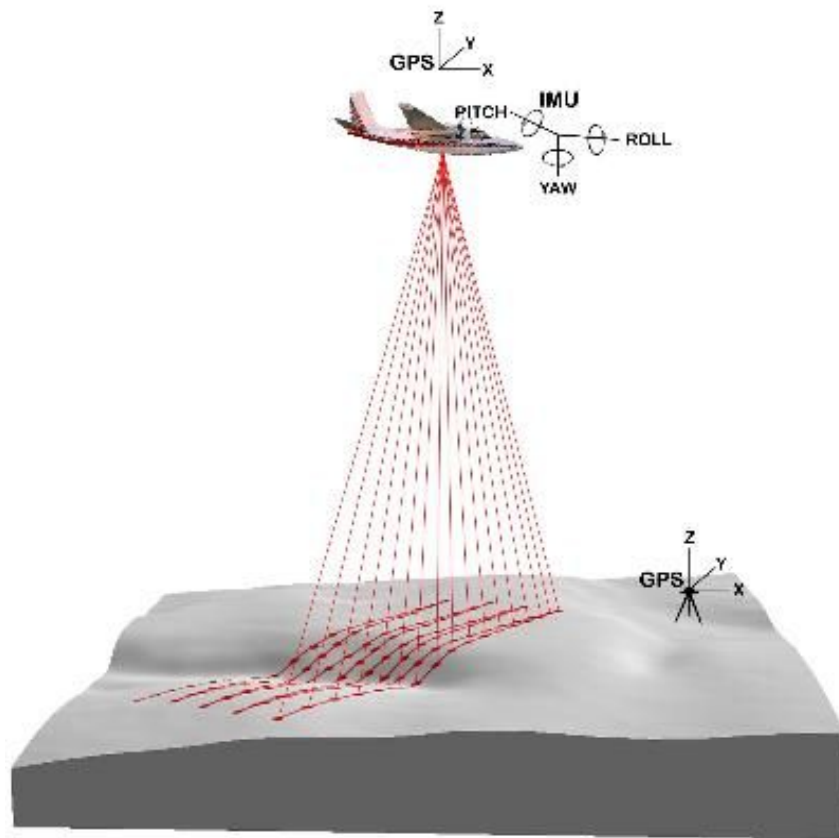


# Sieć podstawowa dla Polski





# Lidar: powietrzny



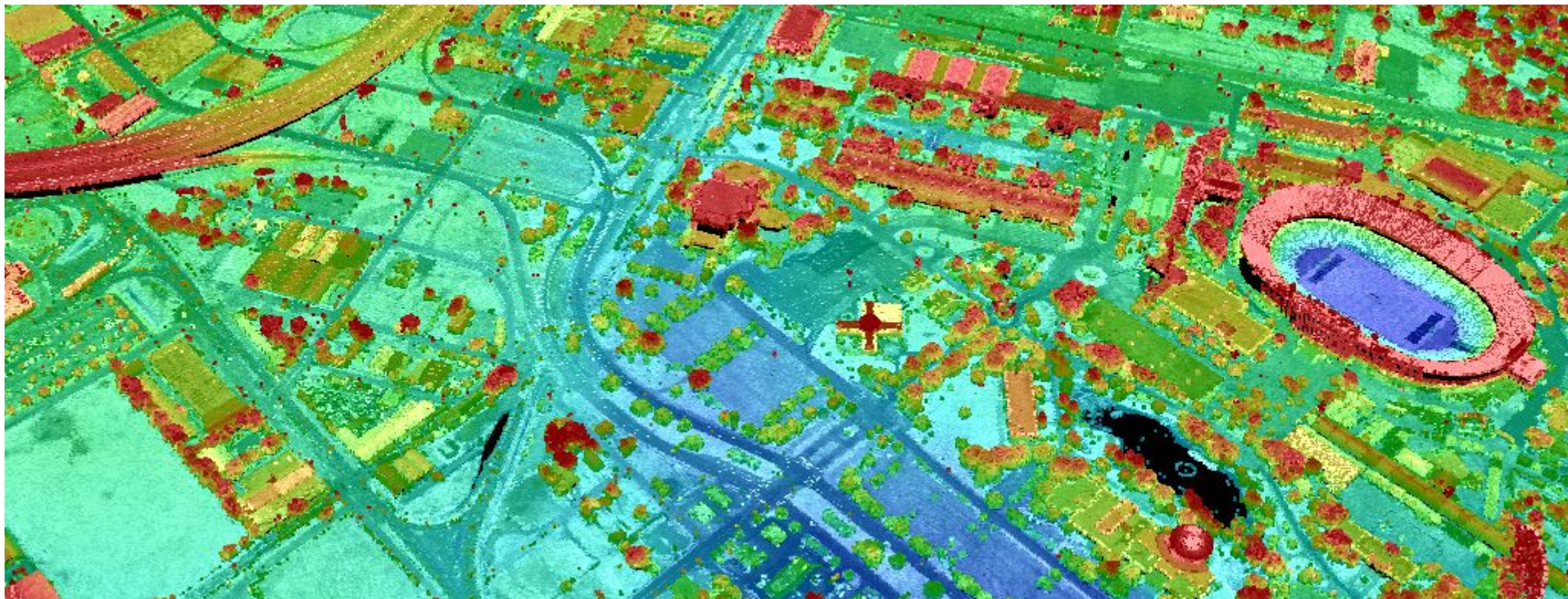


# Lidar: skanowanie naziemne





# Chmura punktów





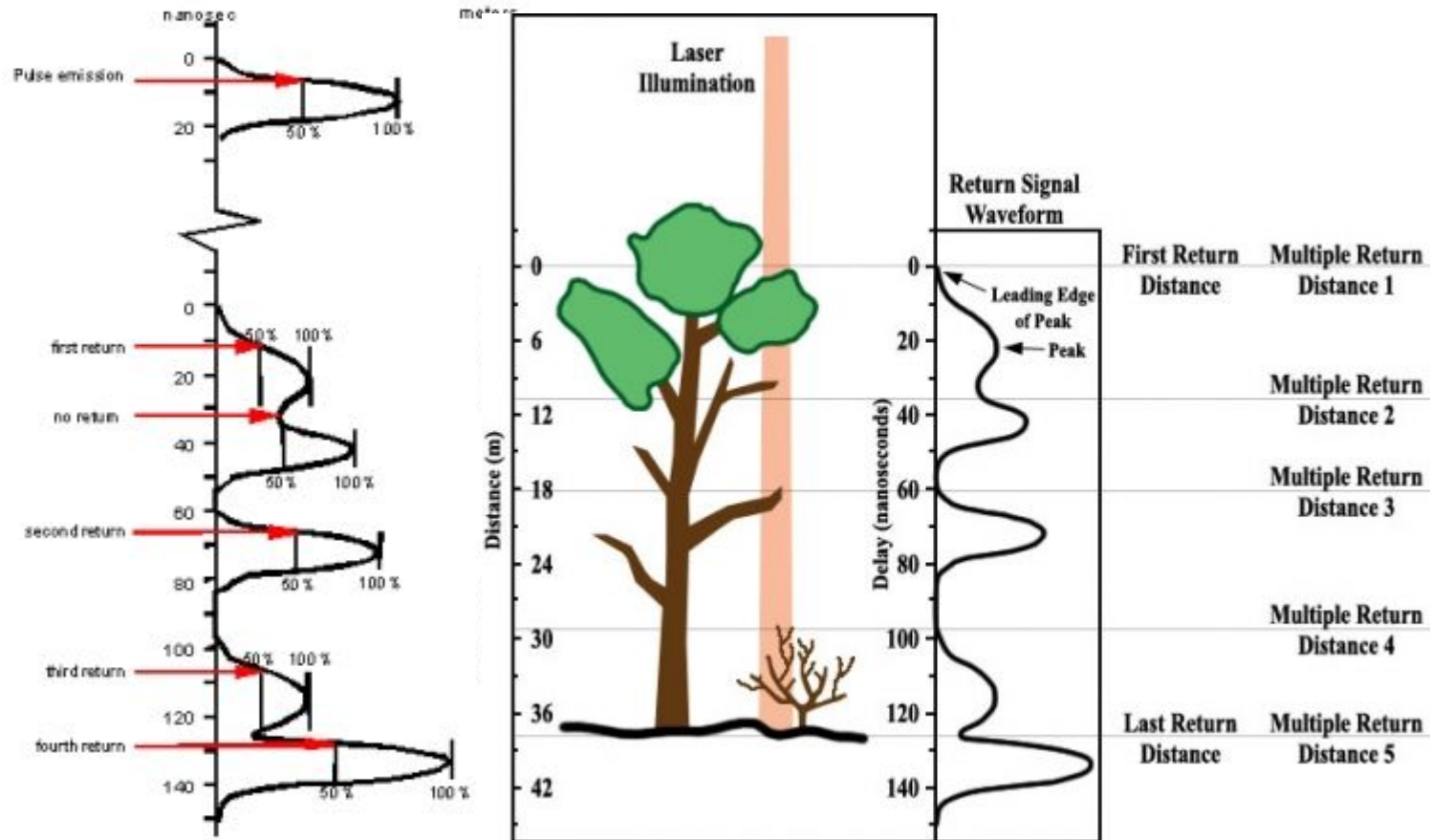
# Atrybuty punktów

- x - x coordinate
- y - y coordinate
- z - z coordinate
- a - scan angle
- i - intensity
- n - number of returns for given pulse (1..n)
- r - number of this return (1..r)
- $[r,g,b]$  - color from imagery
- c - classification
- u - user data (but only 1 byte)
- p - point source ID
- e - edge of flight line
- d - direction of scan flag
- t - GPS time
- s - skip column

Item	Format	Size	Required
X	long	4 bytes	*
Y	long	4 bytes	*
Z	long	4 bytes	*
Intensity	unsigned short	2 bytes	
Return Number	3 bits (bits 0, 1, 2)	3 bits	*
Number of Returns (given pulse)	3 bits (bits 3, 4, 5)	3 bits	*
Scan Direction Flag	1 bit (bit 6)	1 bit	*
Edge of Flight Line	1 bit (bit 7)	1 bit	*
Classification	unsigned char	1 byte	*
Scan Angle Rank (-90 to +90) – Left side	char	1 byte	*
User Data	unsigned char	1 byte	
Point Source ID	unsigned short	2 bytes	*



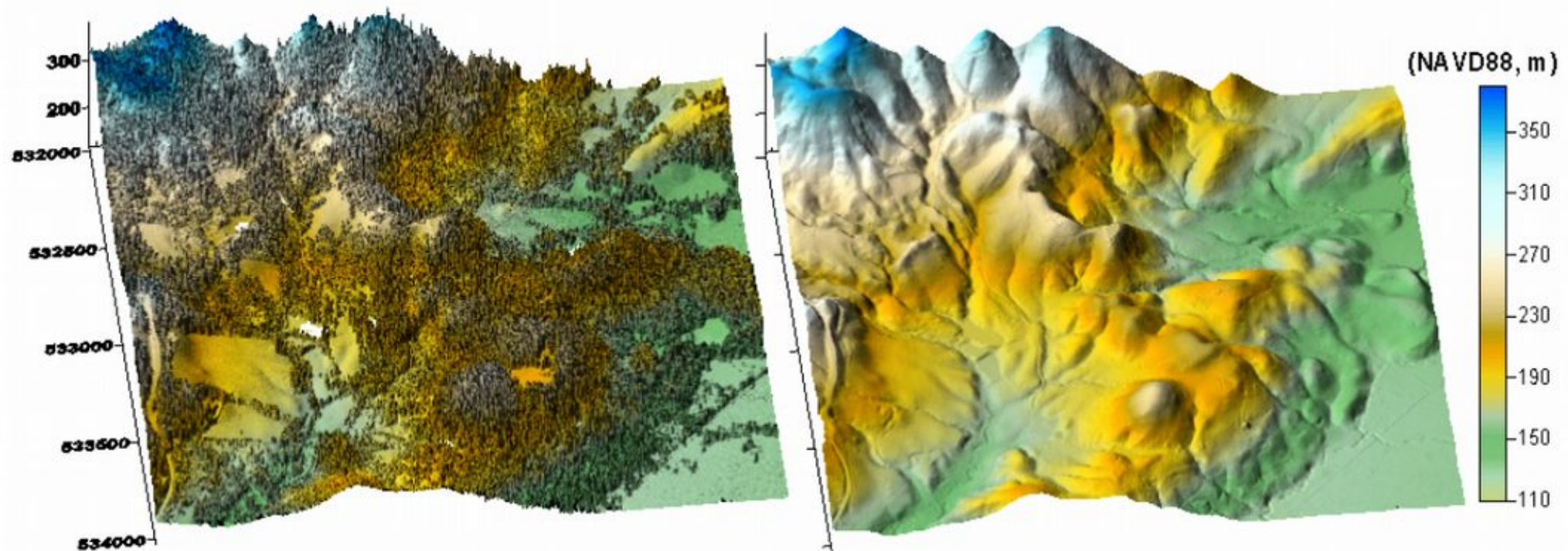
# Odbicia (returns)



- rejestracja do 4 odbić

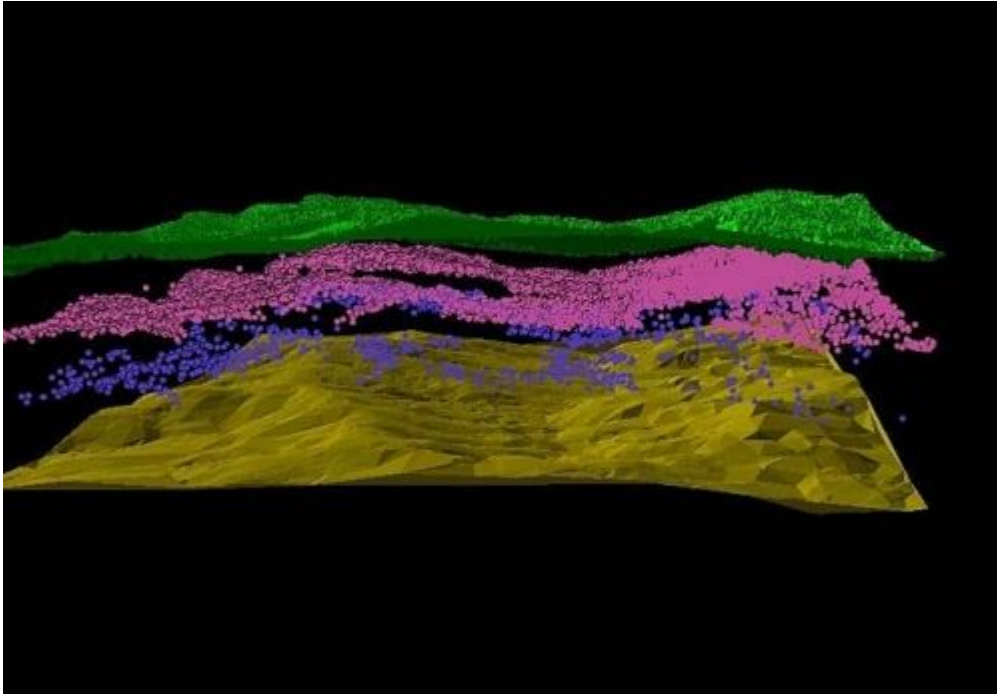


# Jakie dane przechowuje LIDAR?

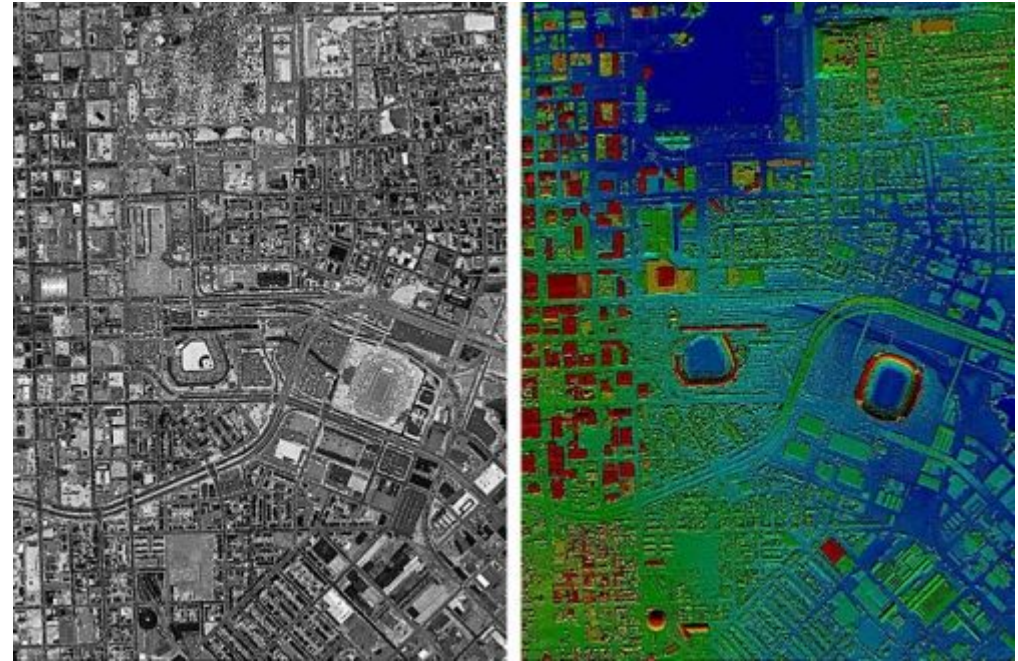




# odbicia a klasy



Numer odbicia



Intensywność odbicia

- Odległość od pierwszego do ostatniego odbicia pozwala rozróżniać typy roślinności
- Intensywność odbicia pozwala odróżnić obiekty o dużej refleksyjności (śnieg, dachy) od małej (asfalt, grunt)



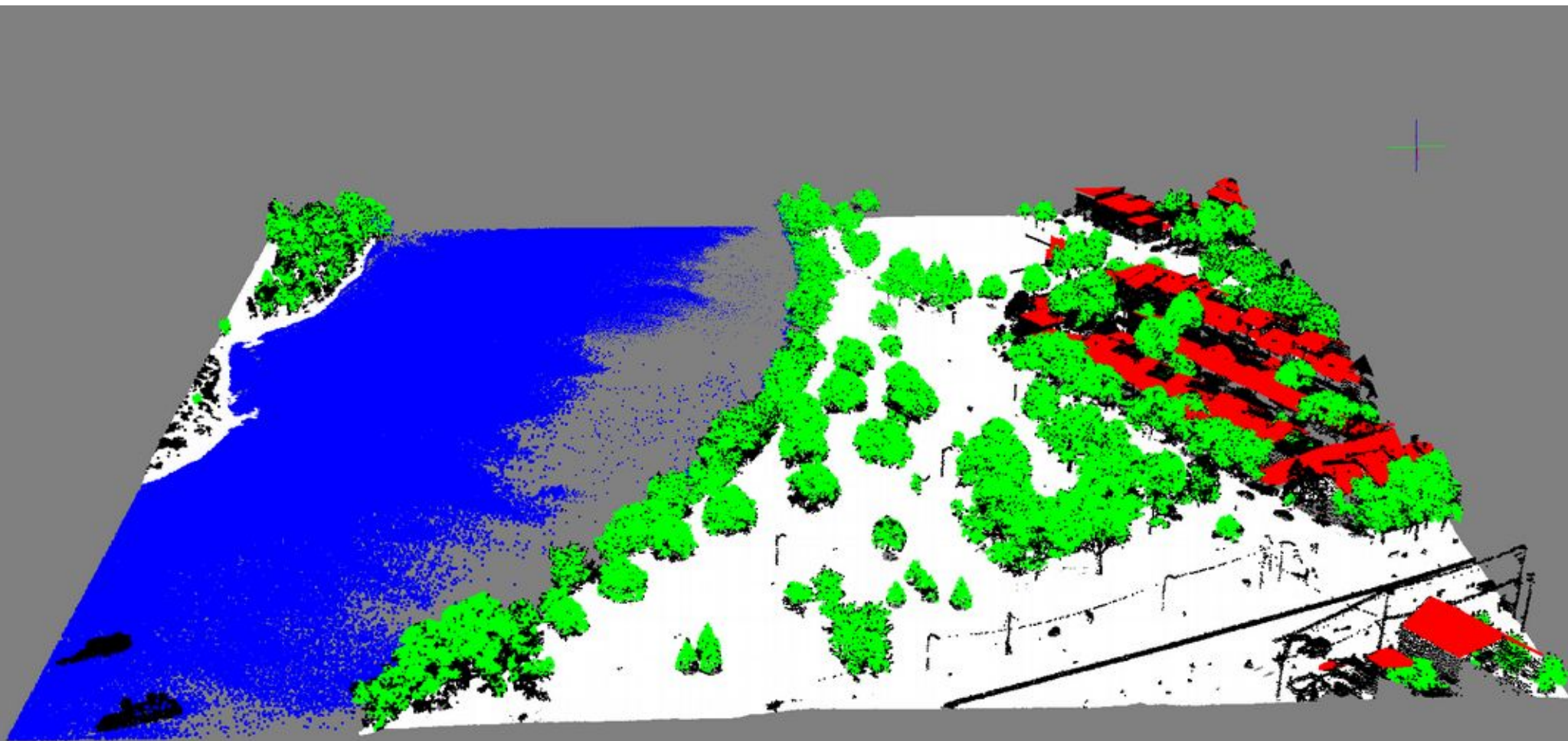
# Klasy punktów

<b>Bits</b>	<b>Field Name</b>	<b>Description</b>
0:4	Classification	Standard ASPRS classification as defined in the following classification table.
5	Synthetic	If set then this point was created by a technique other than LIDAR collection such as digitized from a photogrammetric stereo model.
6	Key-point	If set, this point is considered to be a model key-point and thus generally should not be withheld in a thinning algorithm.
7	Withheld	If set, this point should not be included in processing (synonymous with Deleted).

<b>Classification Value (bits 0:4)</b>	<b>Meaning</b>
0	Created, never classified
1	Unclassified <sup>1</sup>
2	Ground
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation
6	Building
7	Low Point (noise)
8	Model Key-point (mass point)
9	Water
10	<i>Reserved for ASPRS Definition</i>
11	<i>Reserved for ASPRS Definition</i>
12	Overlap Points <sup>2</sup>
13-31	<i>Reserved for ASPRS Definition</i>

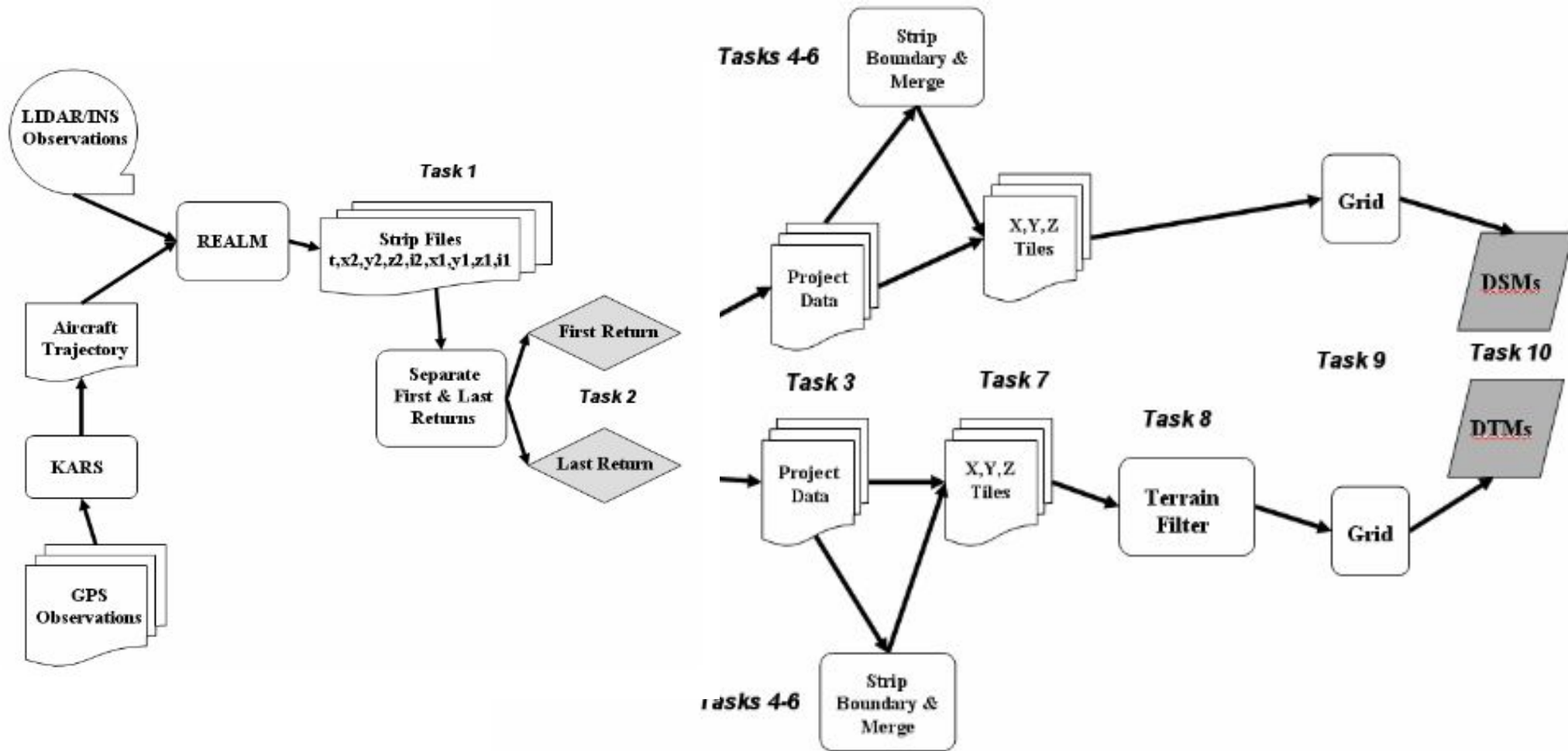


# Klasy punktów - wizualizacja





# Schemat przetwarzania danych





# Lidar Żurawiniec Import LAS

Import LAS Files

Options

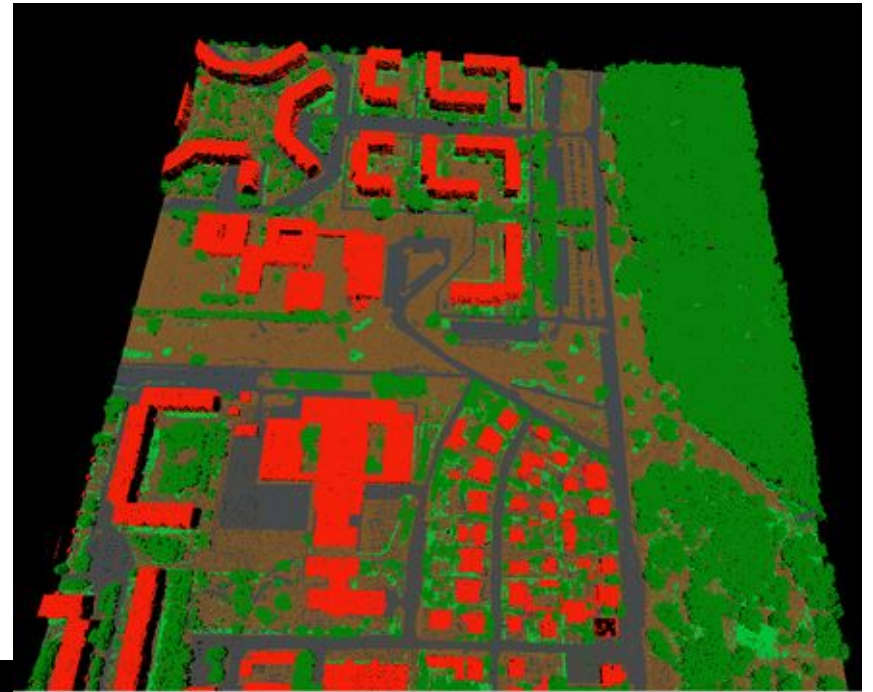
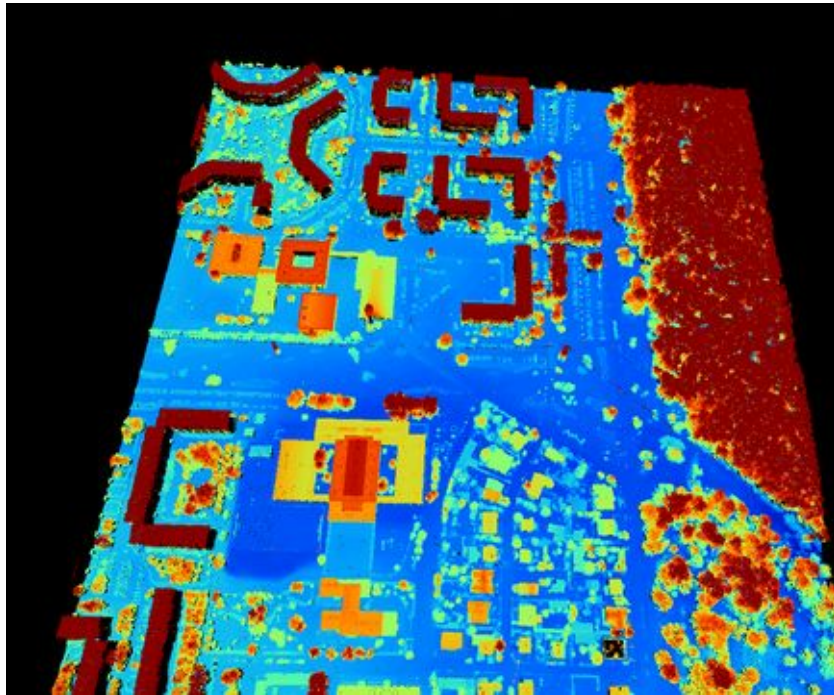
Input File: /home/jarekj/LAS/N-33-130-D-b-3-2-2-1.las

Attributes to import besides x,y,z ...

gps-time	<input type="checkbox"/>
<b>Intensity</b>	<input checked="" type="checkbox"/>
scan angle	<input type="checkbox"/>
<b>number of the return</b>	<input checked="" type="checkbox"/>
<b>classification</b>	<input checked="" type="checkbox"/>
user data	<input type="checkbox"/>
number of returns of given pulse	<input type="checkbox"/>
red channel color	<input type="checkbox"/>
green channel color	<input type="checkbox"/>
blue channel color	<input type="checkbox"/>
edge of flight line flag	<input type="checkbox"/>
direction of scan flag	<input type="checkbox"/>
point source ID	<input type="checkbox"/>
rgb color	<input type="checkbox"/>
Check Point Validity	<input type="checkbox"/>
R,G,B value range	16 bit

Buttons: Okay, Cancel, Load, Save, Defaults

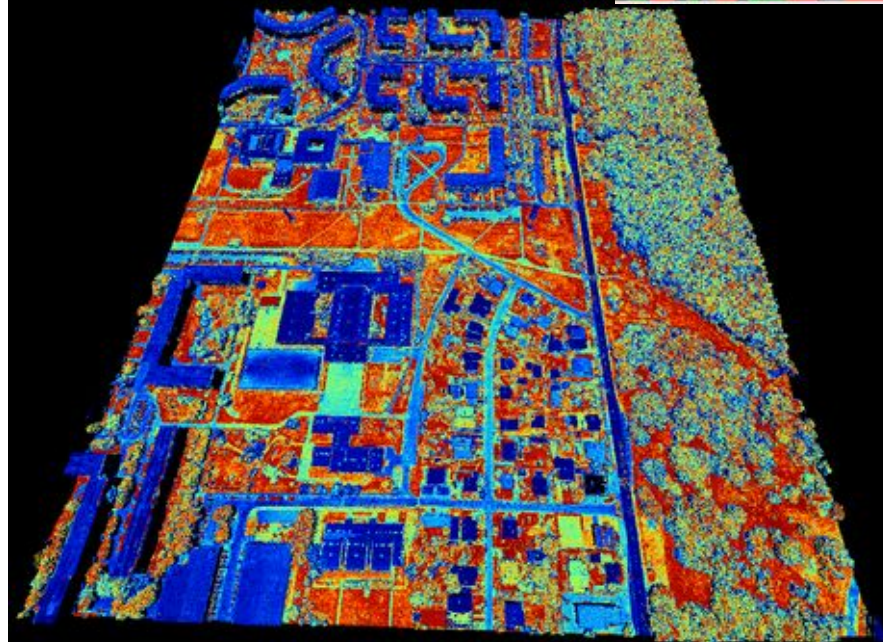
# Lidar Żurawiniec



Wysokość

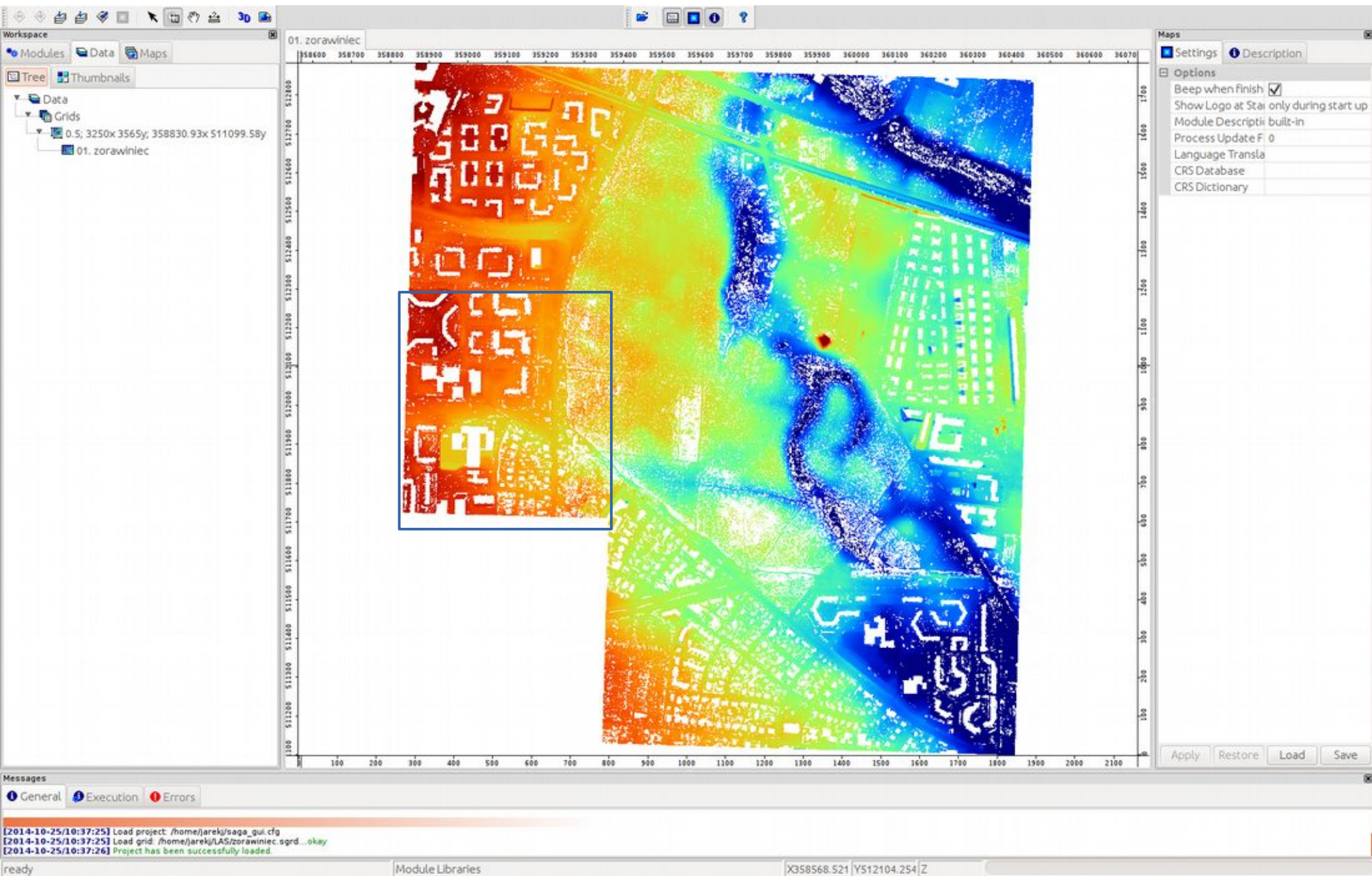
Klasa

Intensywność odbicia

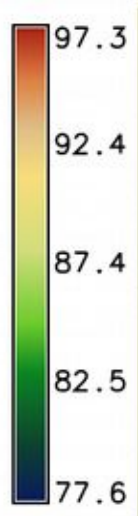
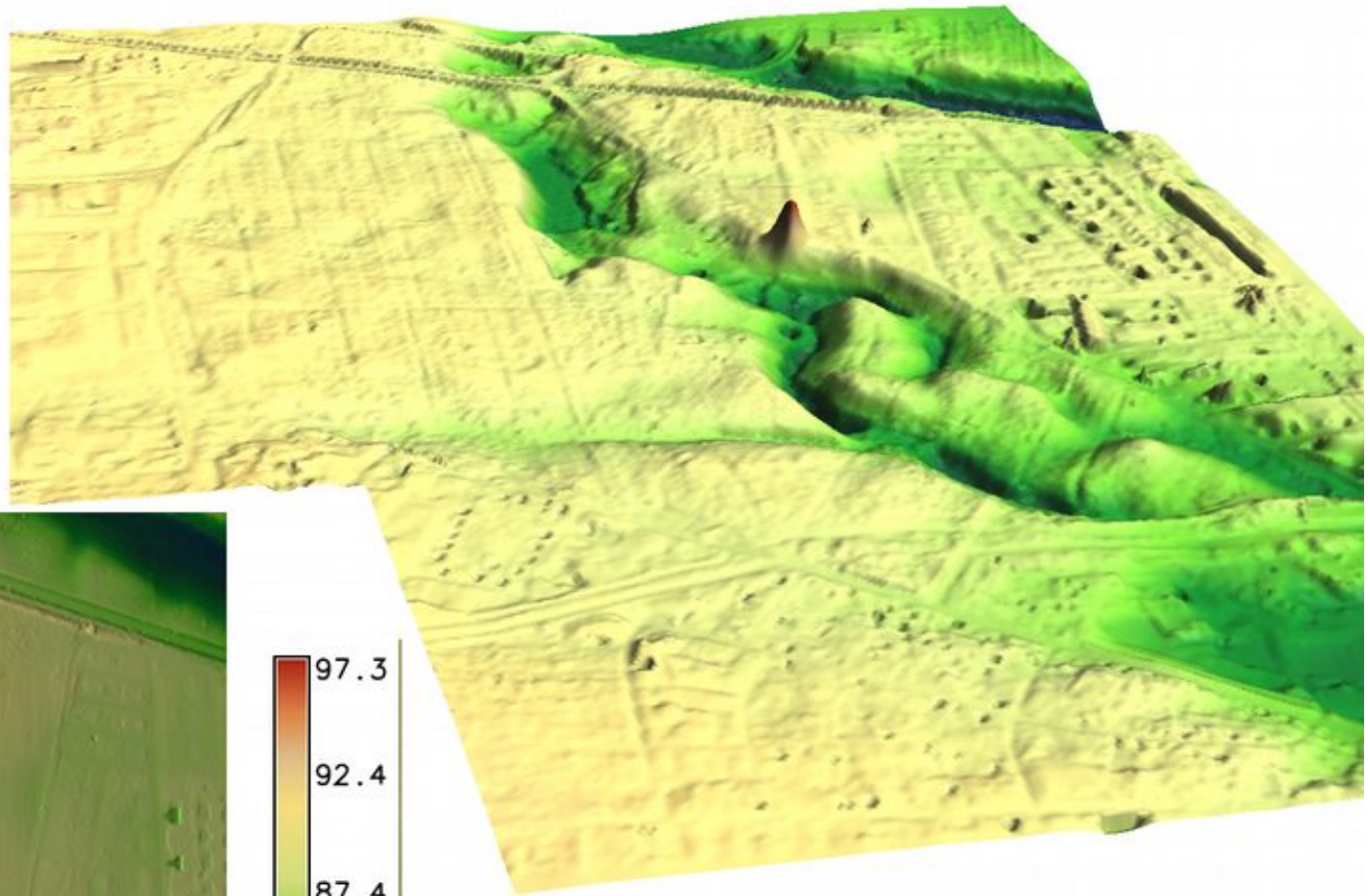




# Lidar - Żurawiniec

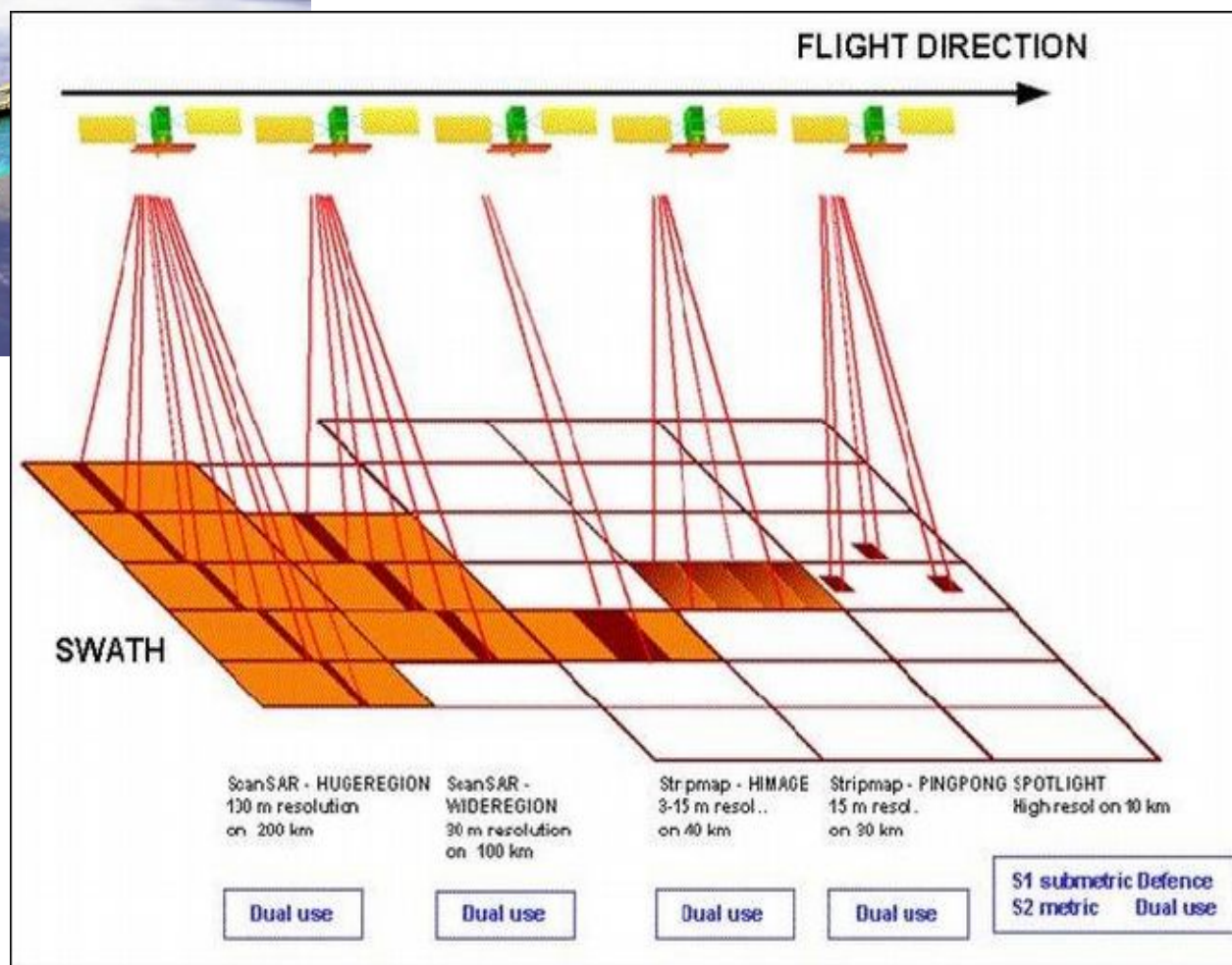
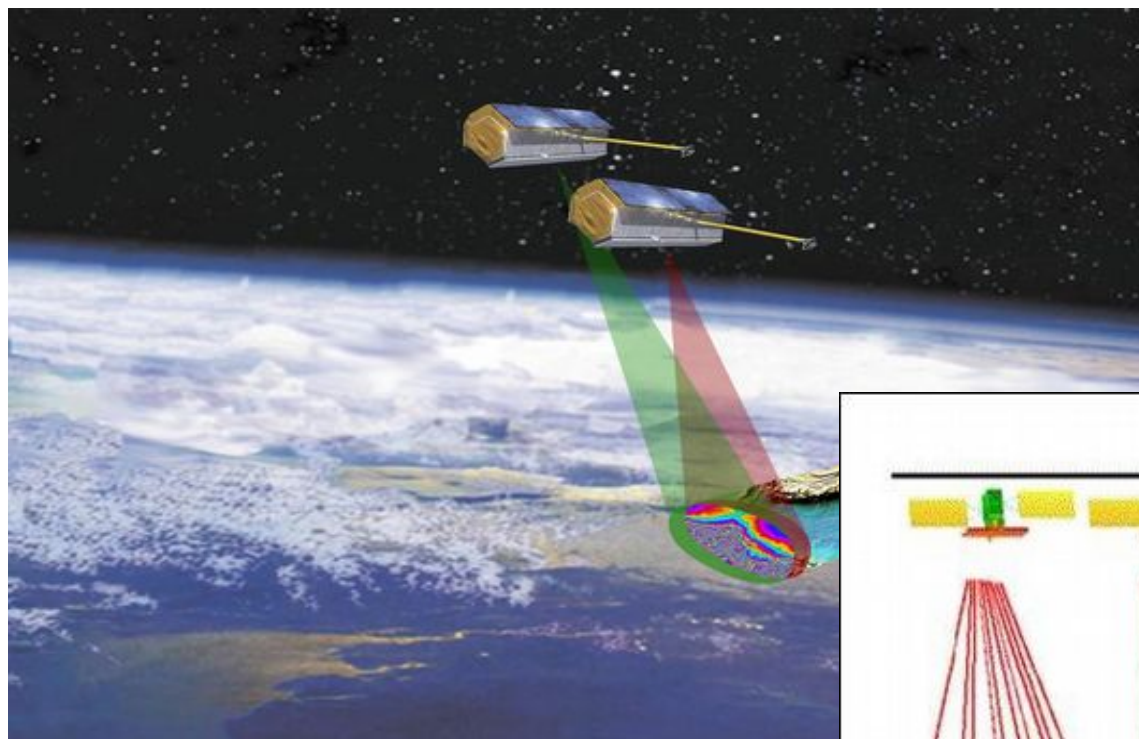


# Lidar Żurawiniec - efekt

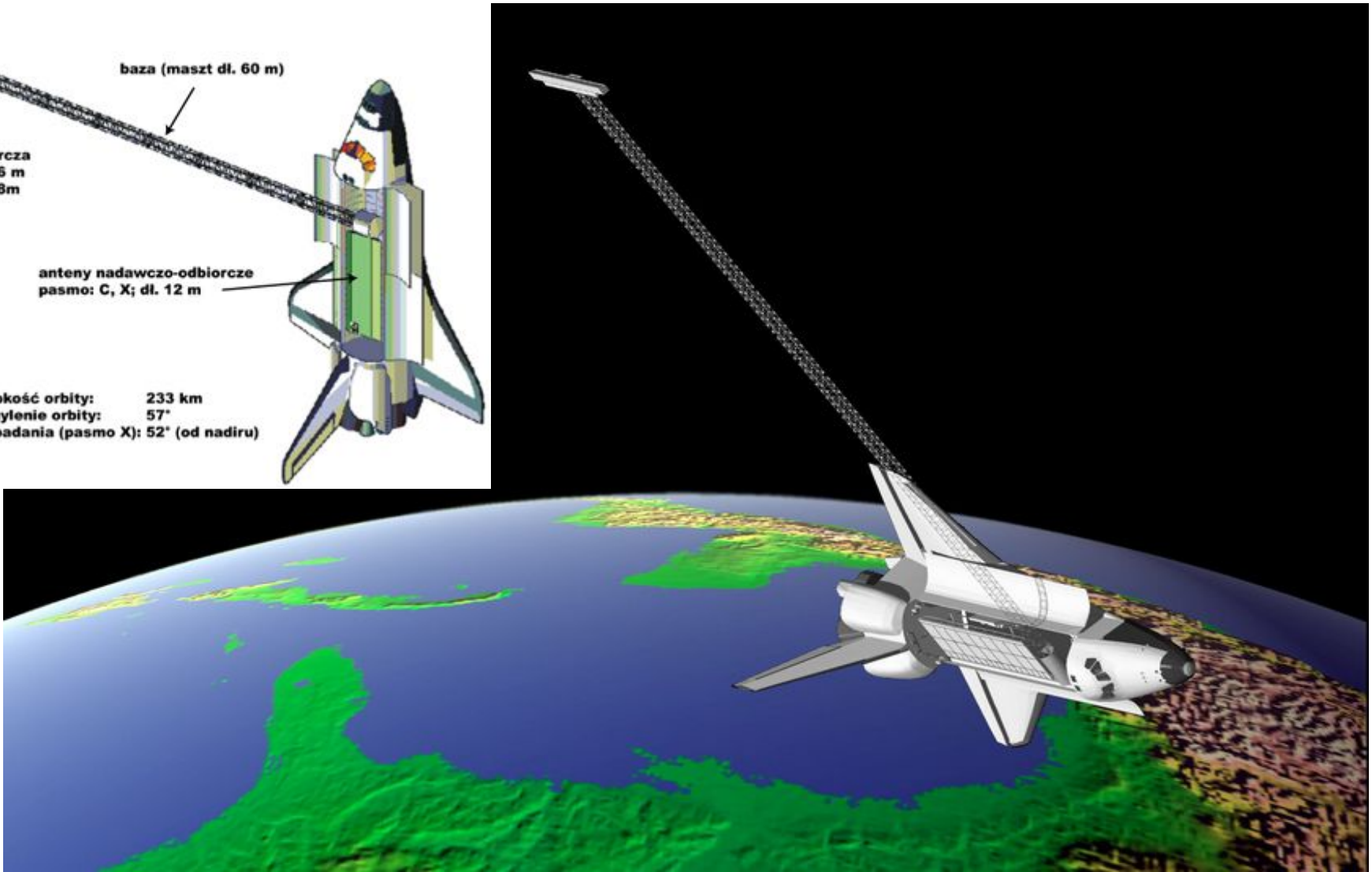
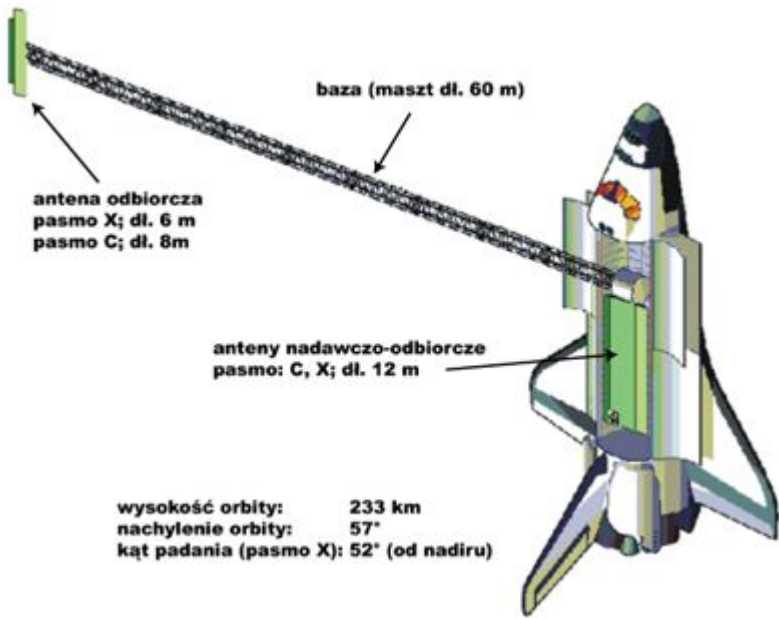




# Skan satelitarny - SAR



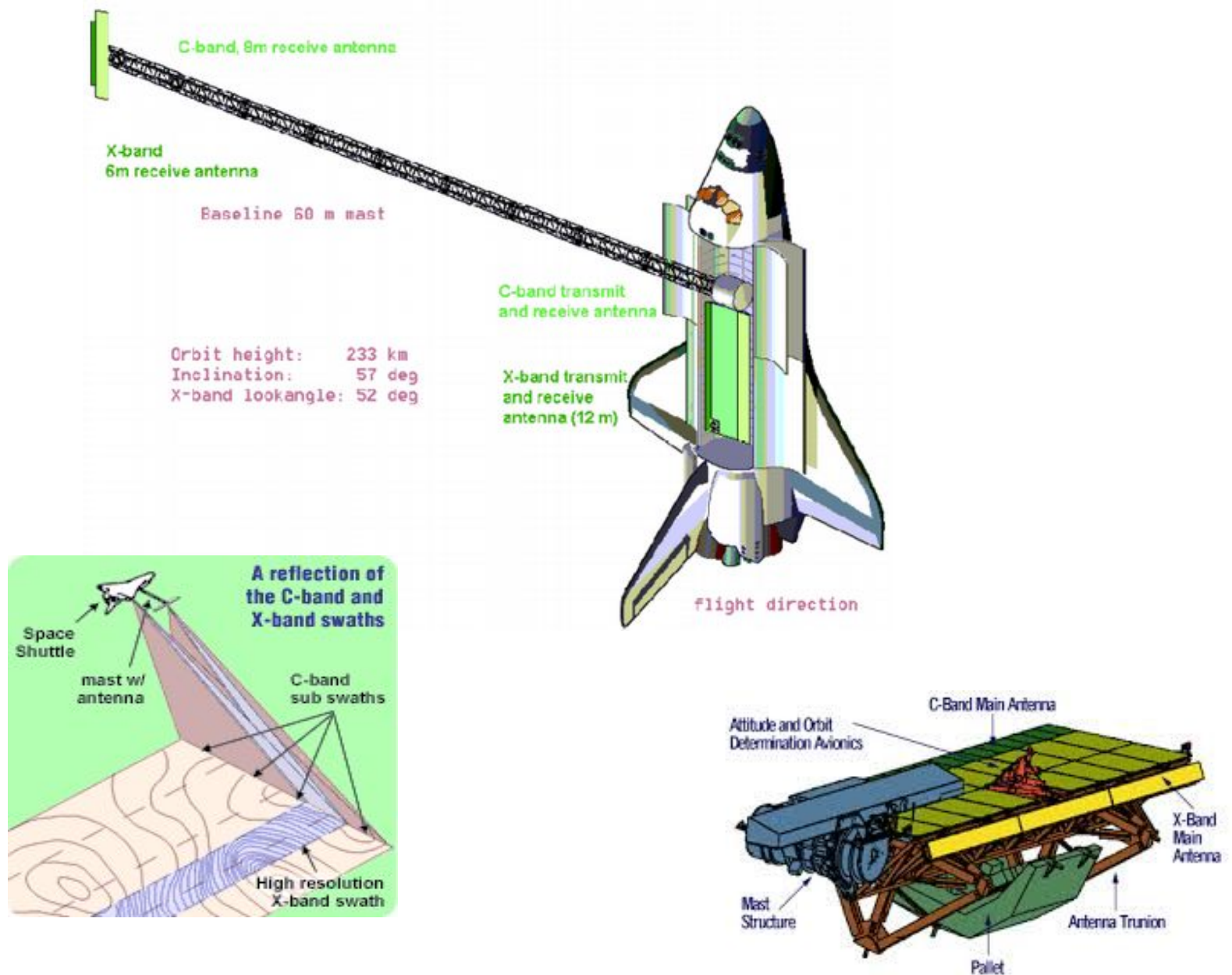
# SRTM Pomiar



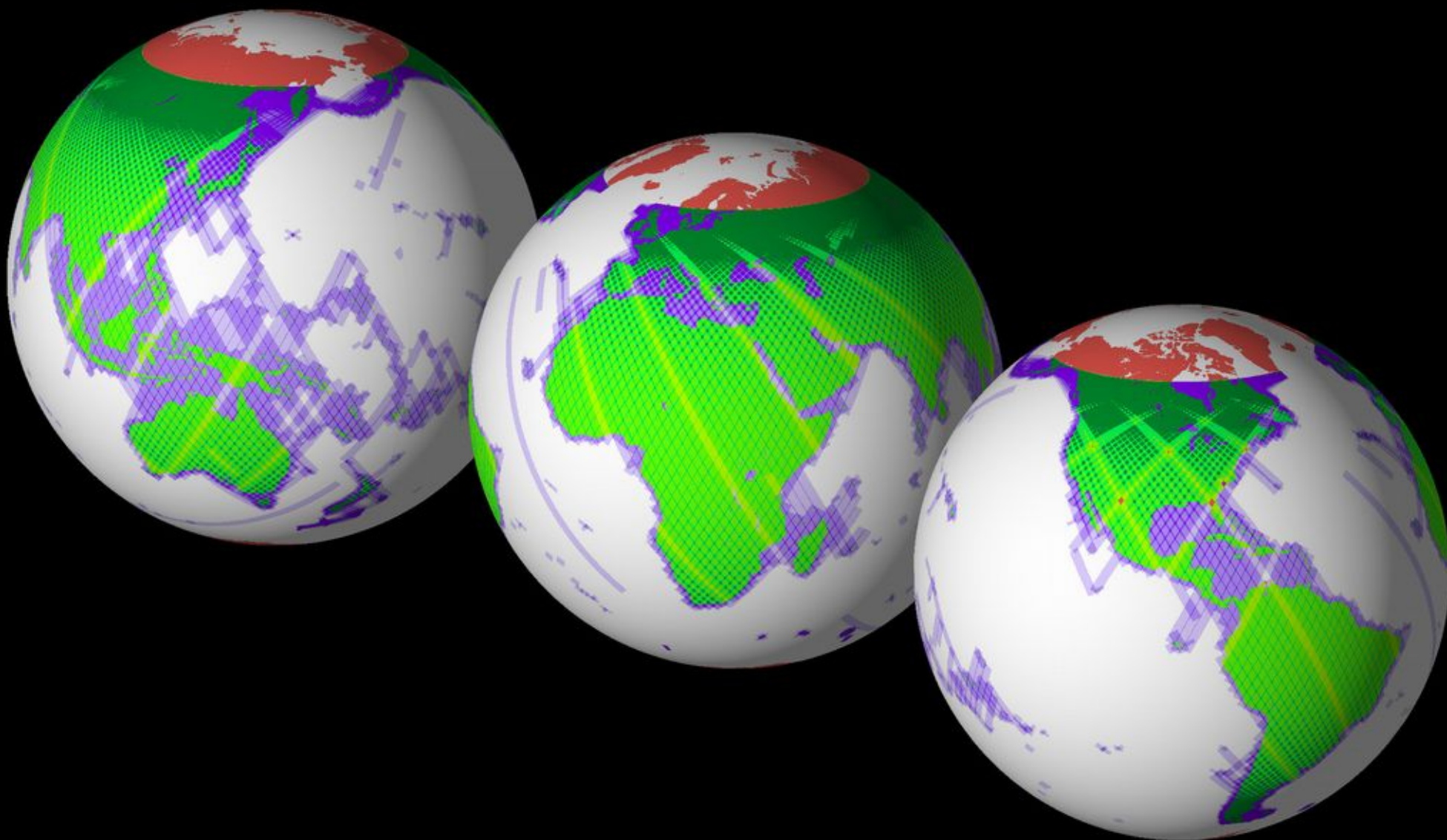
- 11-22 luty 2000, 149 okrążeń Ziemi, 300 TB danych, 5 stacji monitorujących
- Kraje: USA, Niemcy, Włochy, Australia



# Antena i rejestrowane pasma

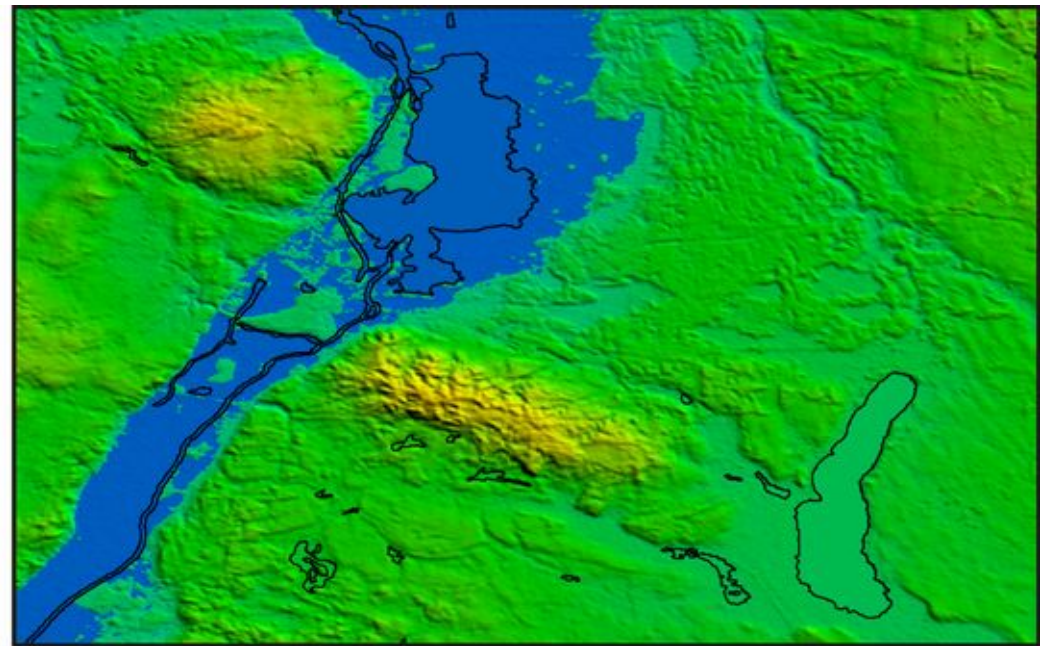
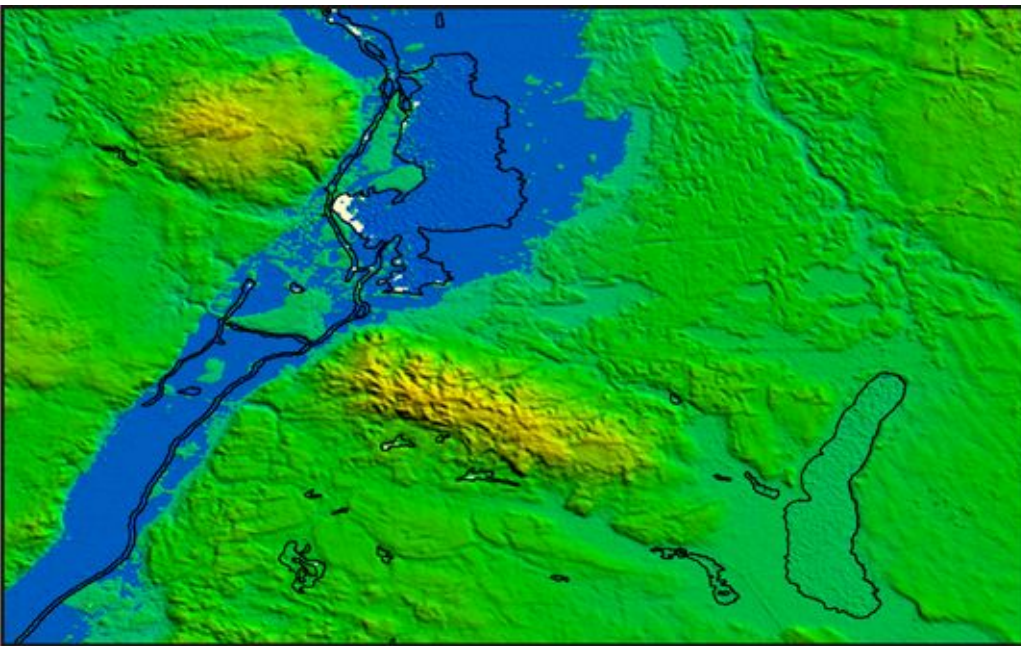


# SRTM Pokrycie

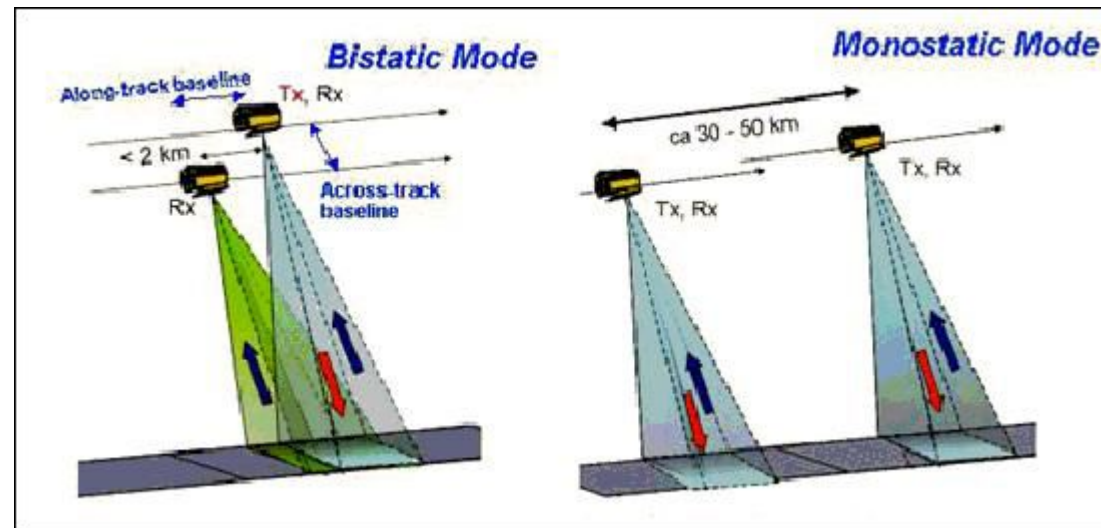
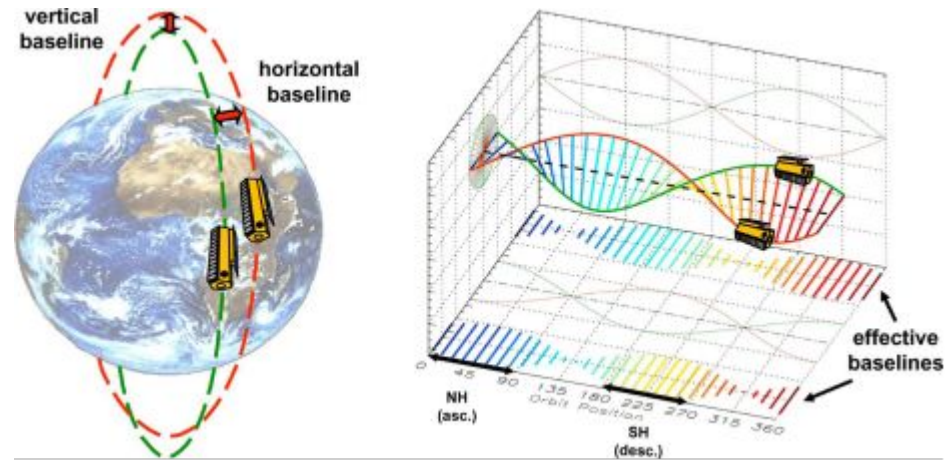




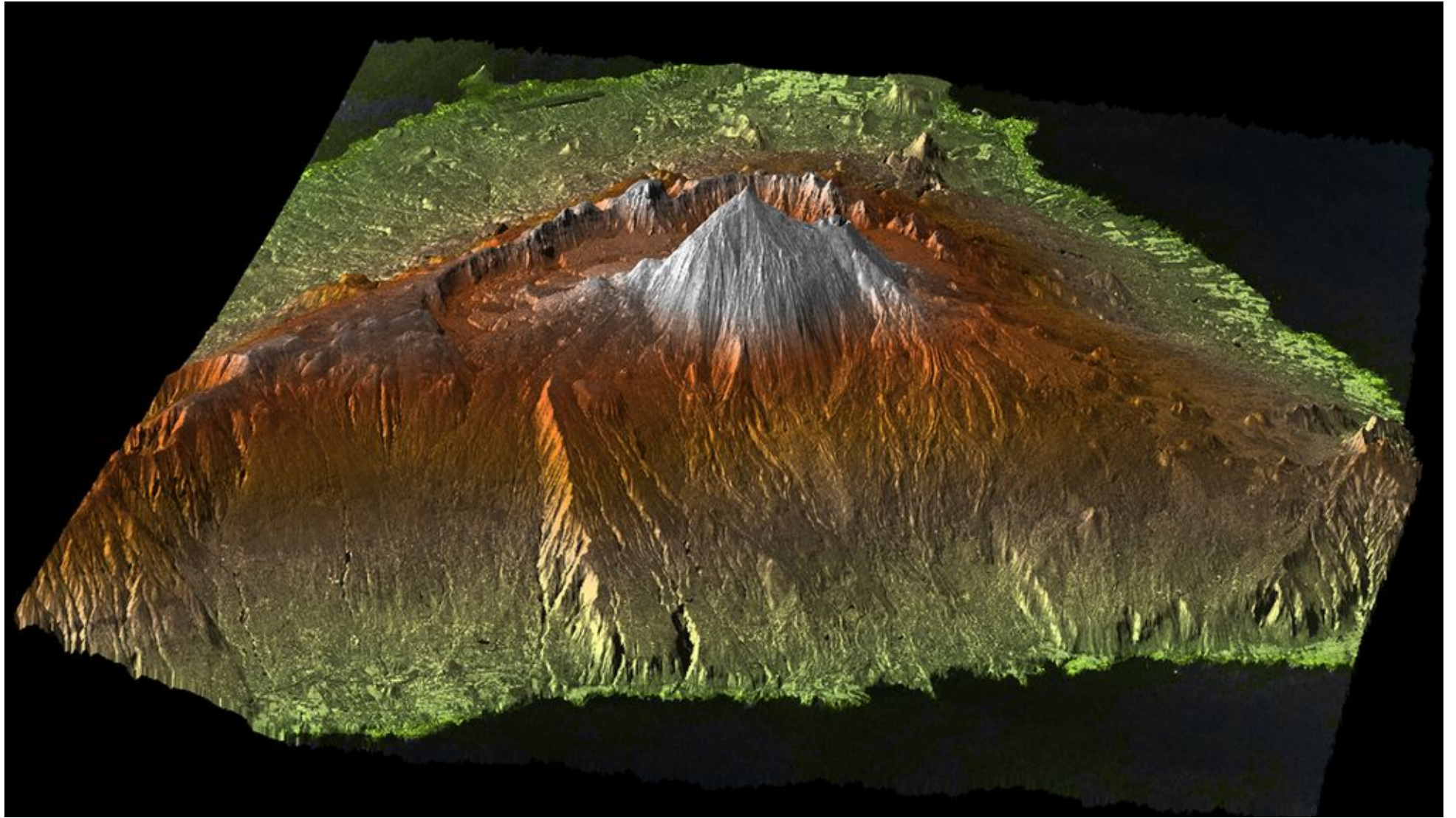
# SRTM 1 i SRTM 2



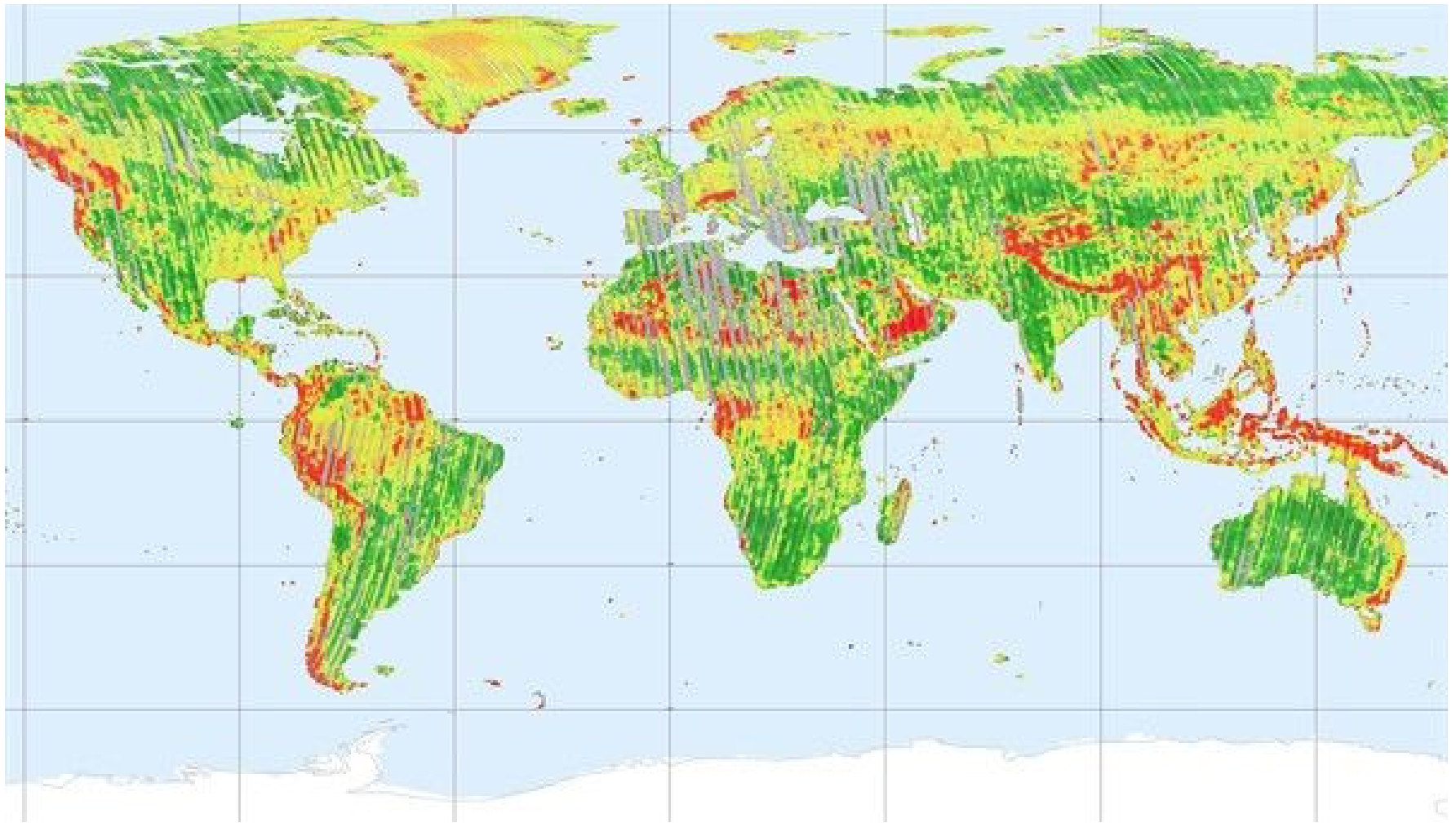
# Terra add-on SAR X (TanDEM X)







# Obszary problemowe dla TanDEM X





# Najważniejsze programy i zbiory danych

- **GDEM: Aster DEM**  
<http://gdem.ersdac.jspacesystems.or.jp/>  
cały świat, 30m (90 rzeczywiste), niska jakość, artefakty
- **tandemX**  
<https://tandemx-science.dlr.de/>  
cały świat, 10 m, wysoka jakość, niedostępny
- **SRTM**  
<http://srtm.csi.cgiar.org/>  
60N - 54S, 90m średnia jakość
- **GTOPO/ETOPO**  
<https://lta.cr.usgs.gov/>  
30" (1 km), tylko lądy (ETOPO również oceany, 1' 2 km)
- **GMTED**  
[http://topotools.cr.usgs.gov/gmted\\_viewer/](http://topotools.cr.usgs.gov/gmted_viewer/)  
kompilacja różnych źródeł, Trzy rozdzielczości: 30, 15 i 7.5'
- **Jonnathan de Ferrati**  
[http://www.viewfinderpanoramas.org/Coverage%20map%20viewfinderpanoramas\\_org3.htm](http://www.viewfinderpanoramas.org/Coverage%20map%20viewfinderpanoramas_org3.htm)  
kompilacja różnych źródeł, 3"
- **Open topography**  
<http://www.opentopography.org/>  
dane udostępnione przez społeczność
- **US National Elevation Dataset**  
<http://viewer.nationalmap.gov/viewer/?p=ned>  
do 1/9 arc second (OK 3 m)

# Porównanie metod pozyskiwania danych

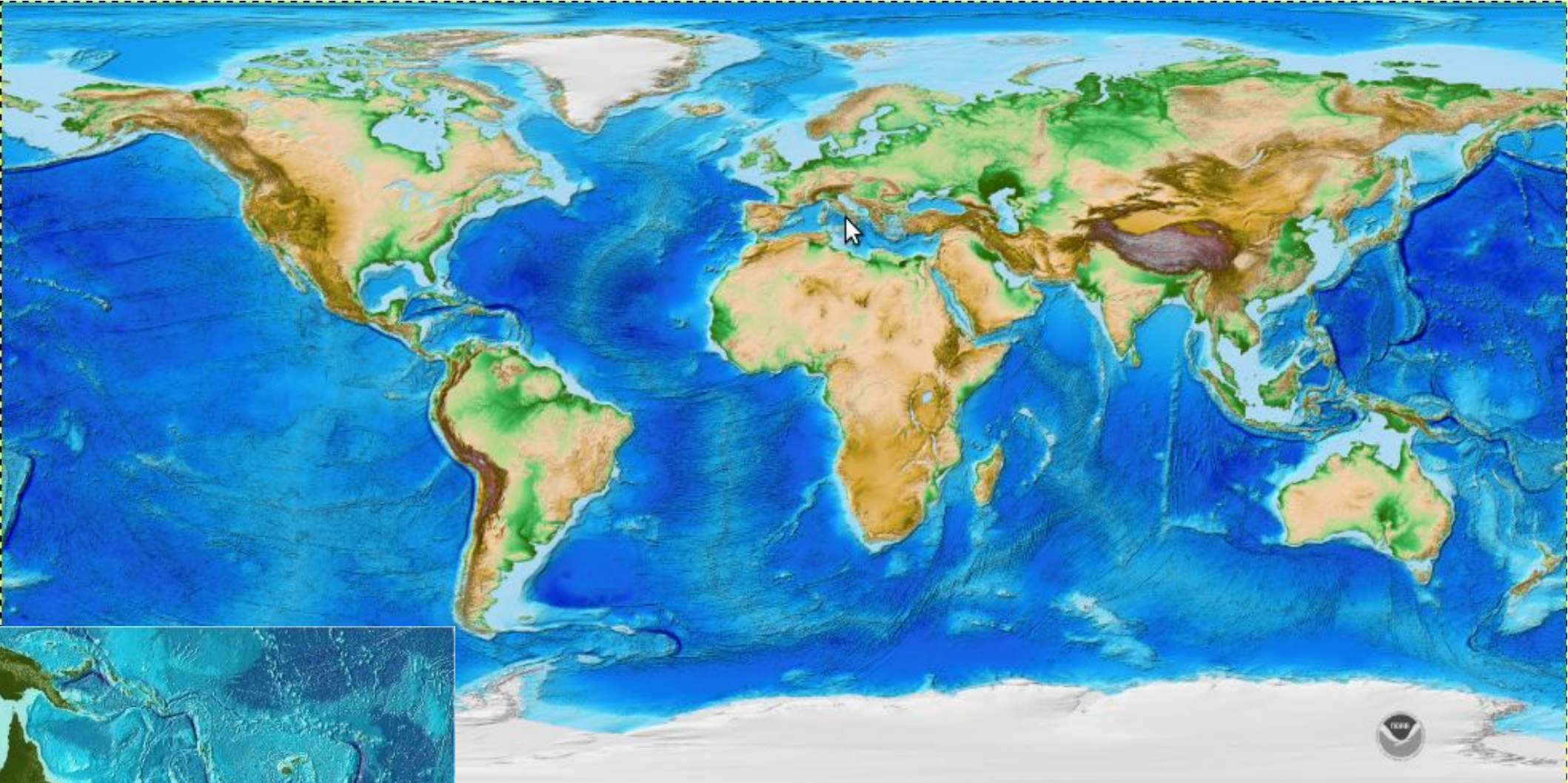
Source	Resolution (pixel size in metres)	Accuracy	Footprint (km <sup>2</sup> )	Cost (in €/km <sup>2</sup> )	Post-processing requirements	Elevation/Surface
Ground survey	Variable but usually <5 m	Very high vertical and horizontal	Variable, but usually small	Very high	Low	Elevation
GPS	Variable but usually <5 m	Medium vertical and horizontal	Variable, but usually small	Low	Low	Elevation
Table digitising	Depends on map scale and contour interval	Medium vertical and low horizontal	Depends on map footprint	–	Medium	Elevation
On-screen digitising	Depends on map scale and contour interval	Medium vertical and low horizontal	Depends on map footprint	–	Medium	Elevation
Scanned topo-map	Depends on map scale and contour interval	Medium vertical and low horizontal	Depends on map footprint	–	Considerable	Elevation
Ortho-photography	<1	Very high vertical and horizontal	–	100 to 200 (depends on required accuracy)	Considerable	Surface
LiDAR	1–3	0.15–1 m vertical, 1 m horizontal	30–50/hour	25–50 (depends on required accuracy)	Considerable	Surface
InSAR/IfSAR	see below	see below	see below	see below	see below	see below



# DIGITAL TERRAIN ELEVATION DATA

- LEVEL0 > 3"
  - GTOPO (100%)
- LEVEL1 3" (ok 90 m)
  - STRM 3" (80%)
- LEVEL2 1" (ok 30 m)
  - GDEM (100%)
  - NEDs (50%, dostępne 20%)
- LEVEL3 1/3" (ok 10 m)
  - NEDs (dostępne 20%)
  - SAR (15%)
  - TandemX (100% niedostępne)
- LEVEL4 1/9" (ok 3 m)
  - NEDs (dostępne 5%),
  - fotogrametria,
- LEVEL5 1/27" (ok 1 m)
  - LIDAR (dostępne 5%)

# ETOPO I GEBCO

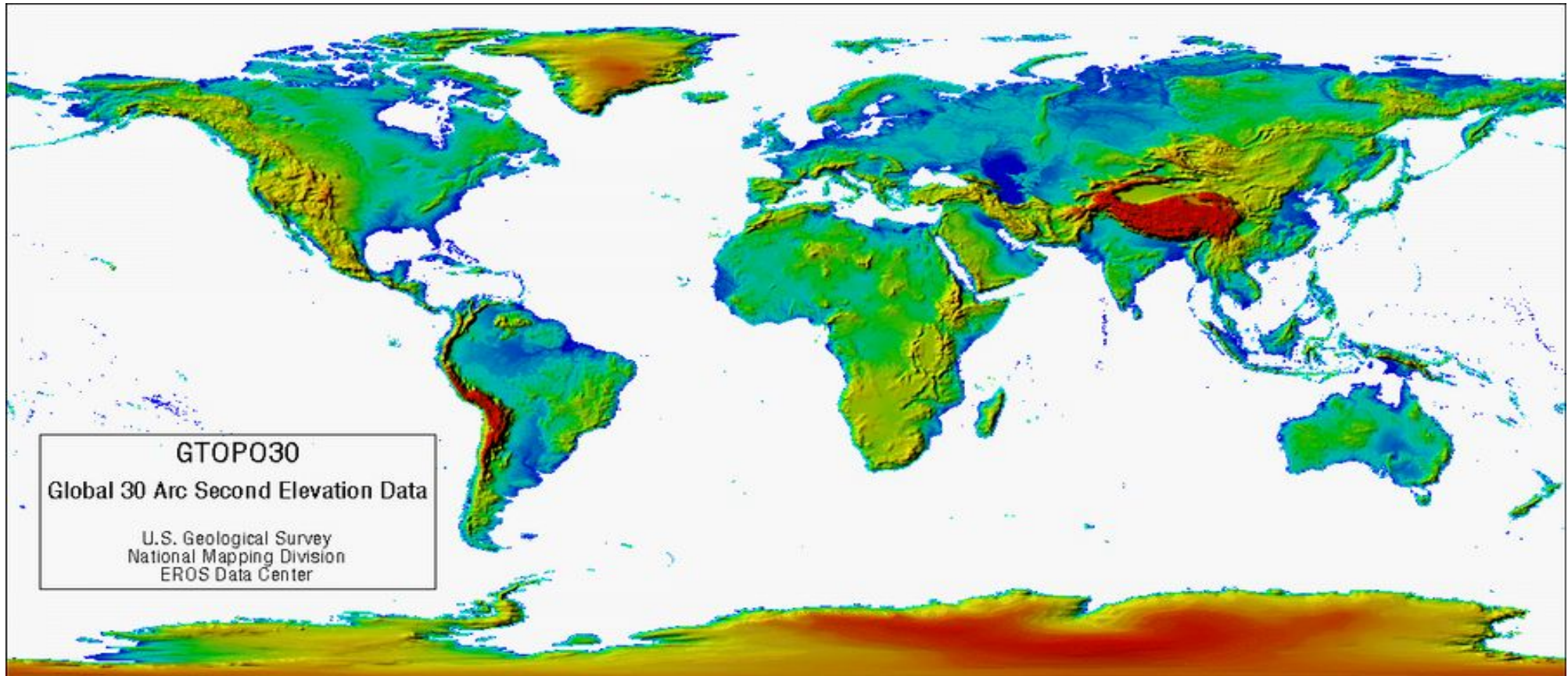


- Global bathymetry data set, występuje w dwóch odmianach: 1' i 30" (GEBCO-08)
- Silnie wygładzony posiada mniej szczegółów niż ETOPO2



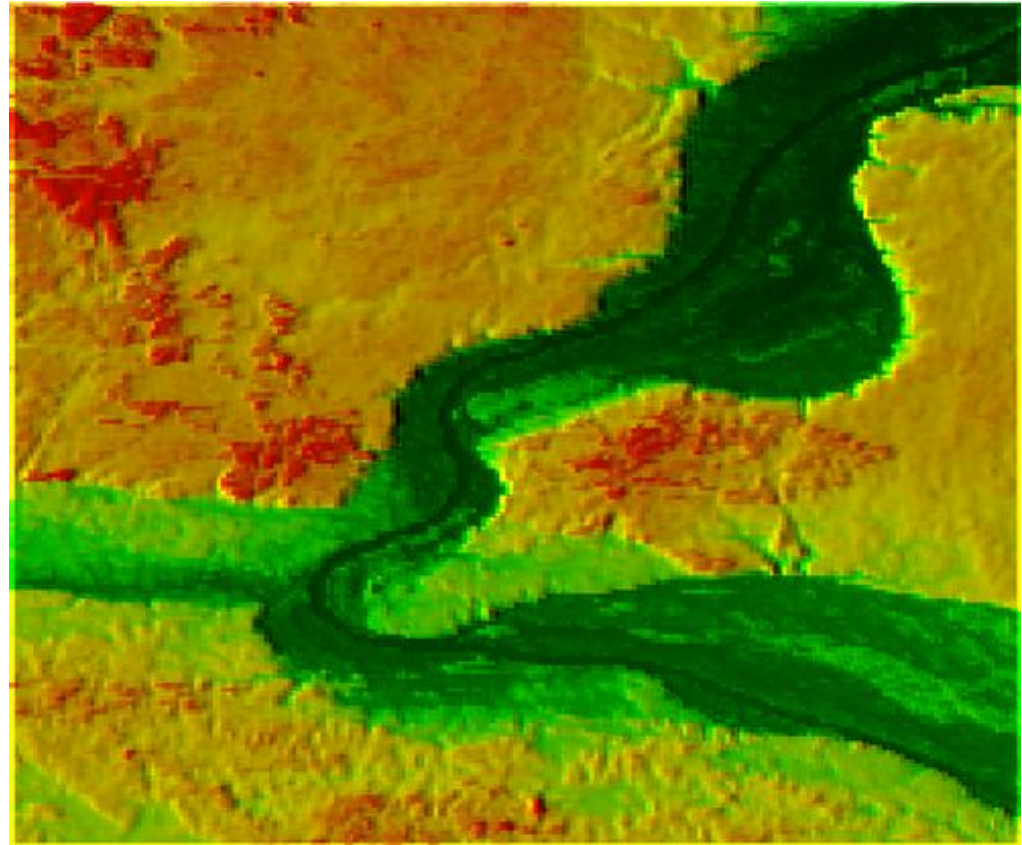
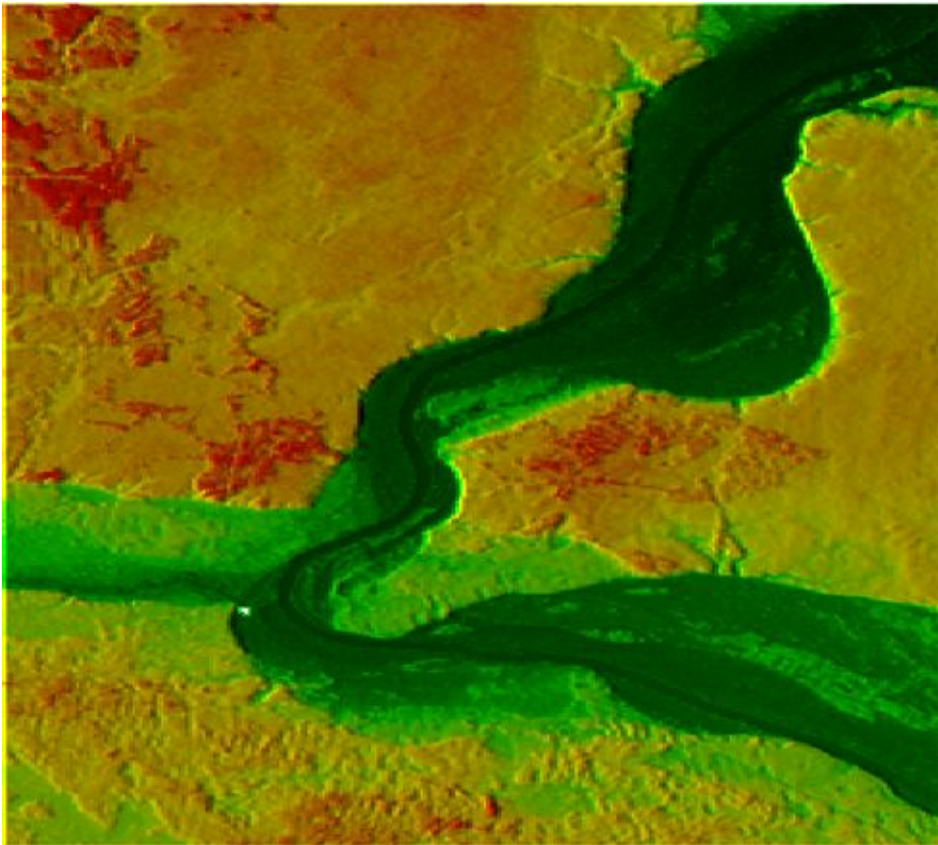
# GTOPO

- GTOPO30 model o rozdzielczości 30'', obejmujący tylko powierzchnię lądów powstał jako kompilacja różnych zbiorów danych
- Alternatywa: NOAA Globe



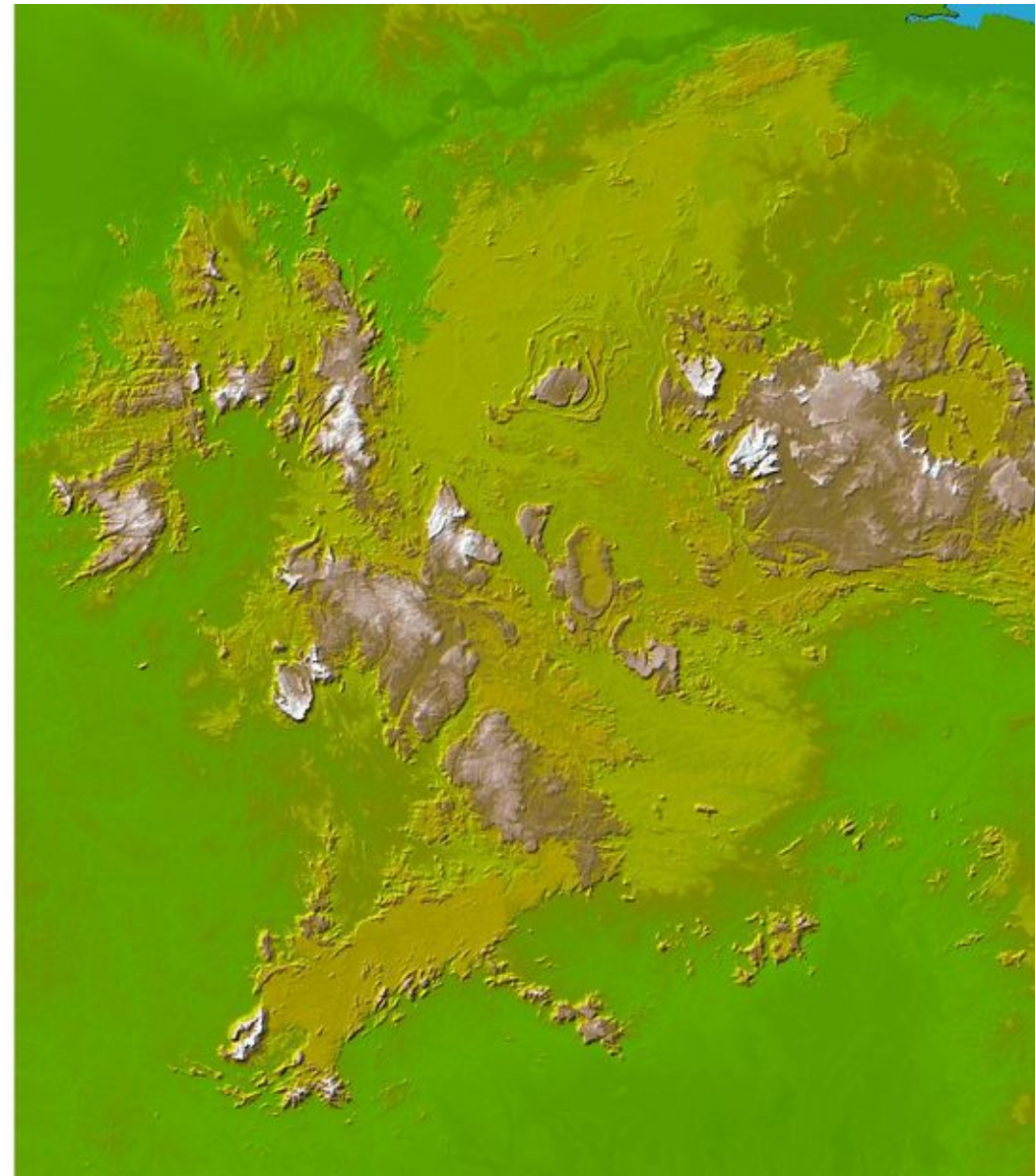
# GMTED

- Kompilacja różnych publicznych źródeł danych
- Trzy rozdzielczości: 30, 15 i 7.5"



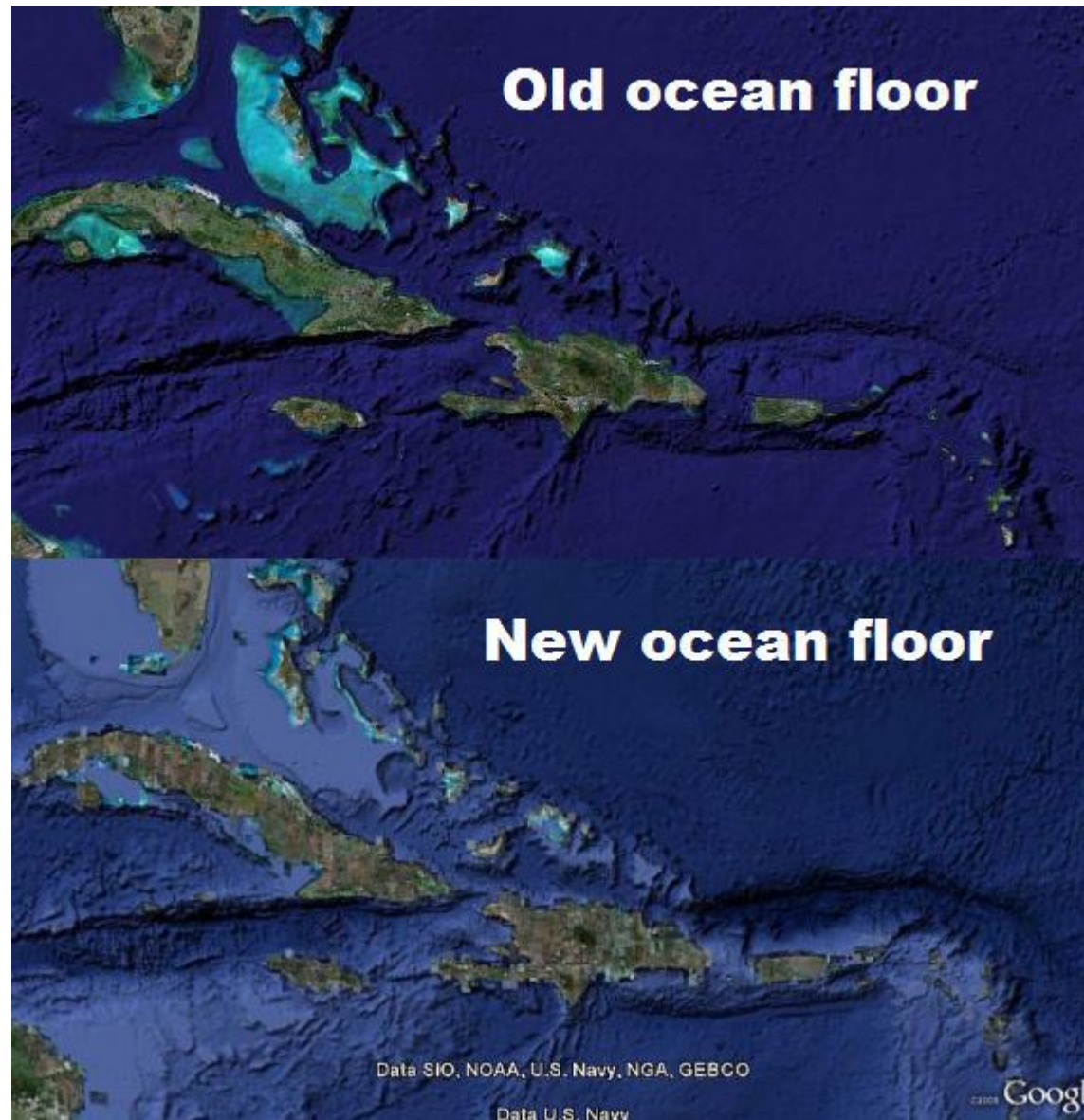


# SRTM30 i SRTM3



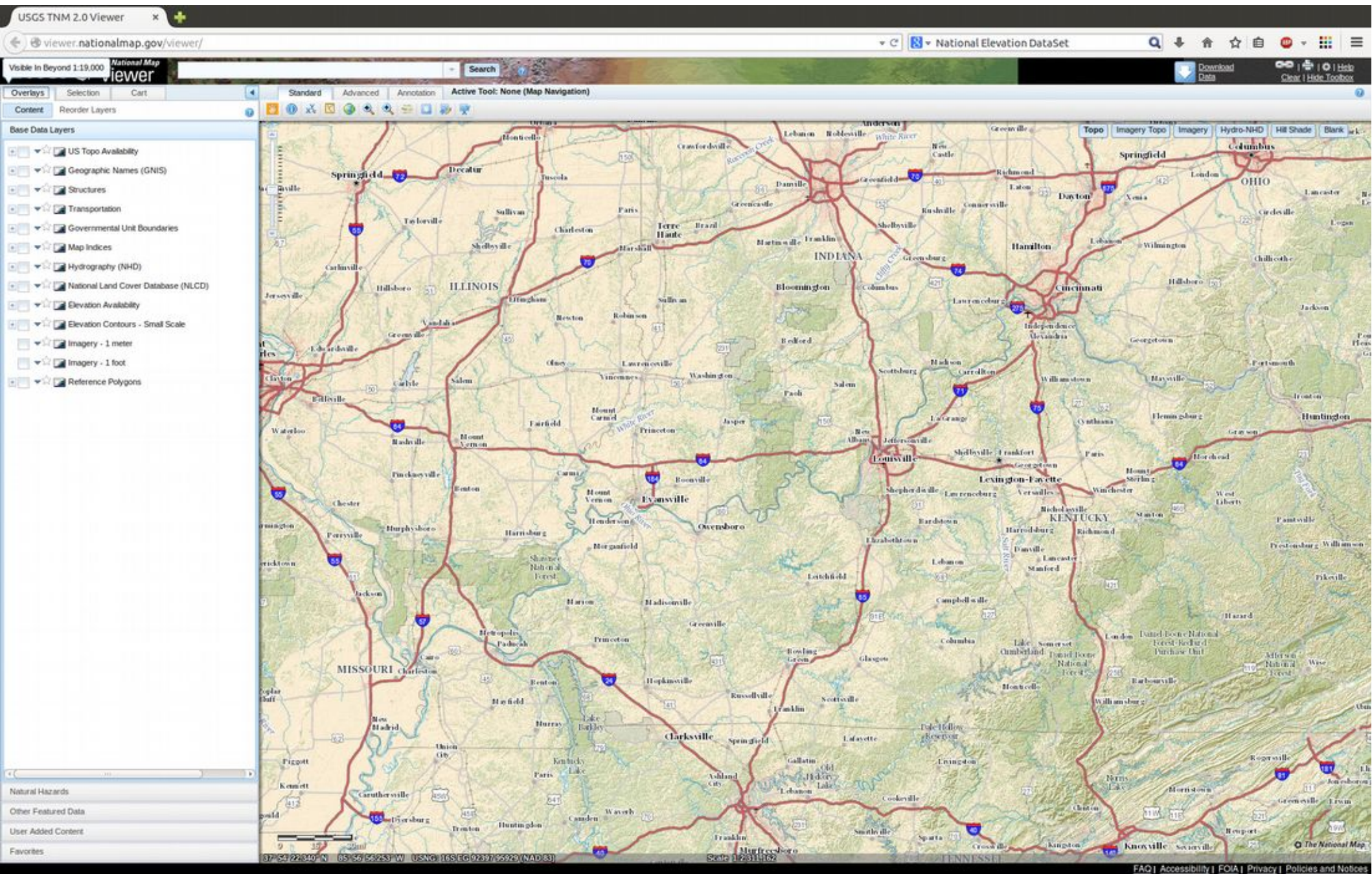
# SRTM30+

- SRTM30+
- Obejmuje model op rozdzielczości 30' zarówno batymetrię jak i powierzchnię terenu





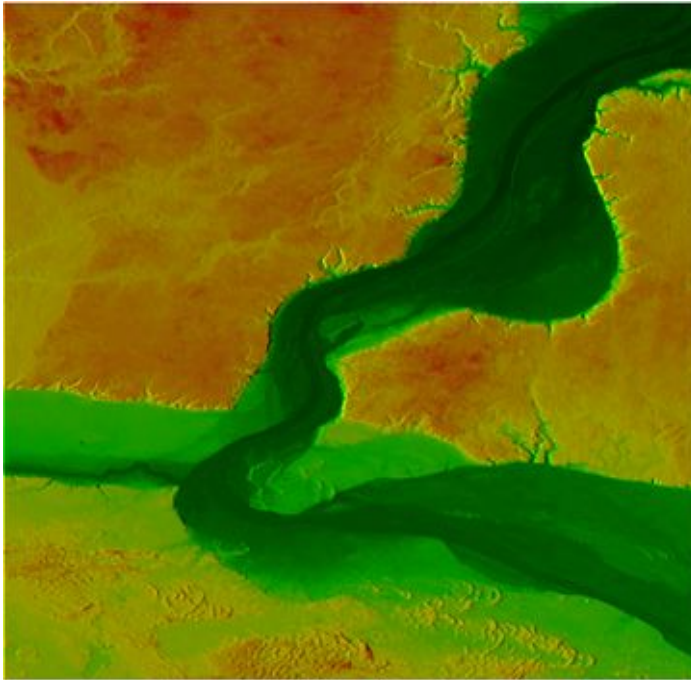
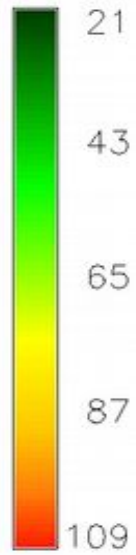
# National Elevation Data Set



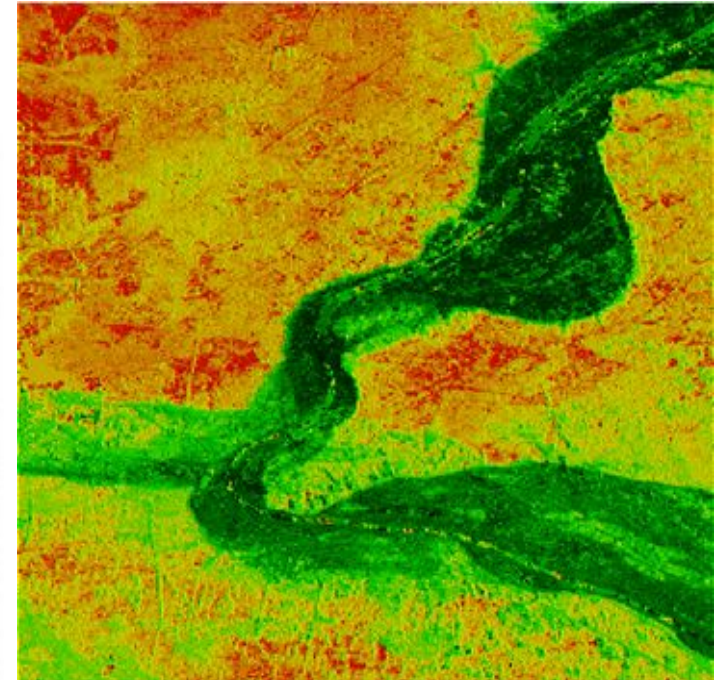
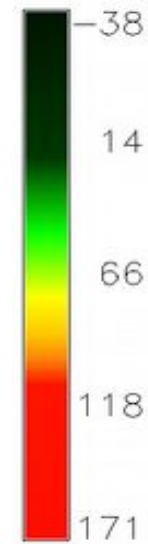


# Porównanie

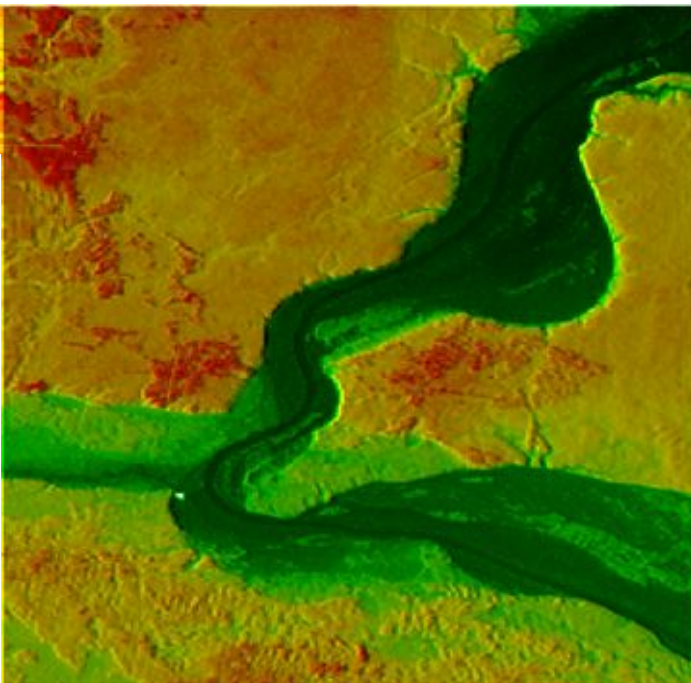
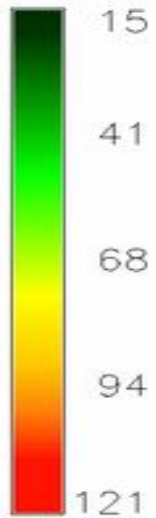
DETD (NED)



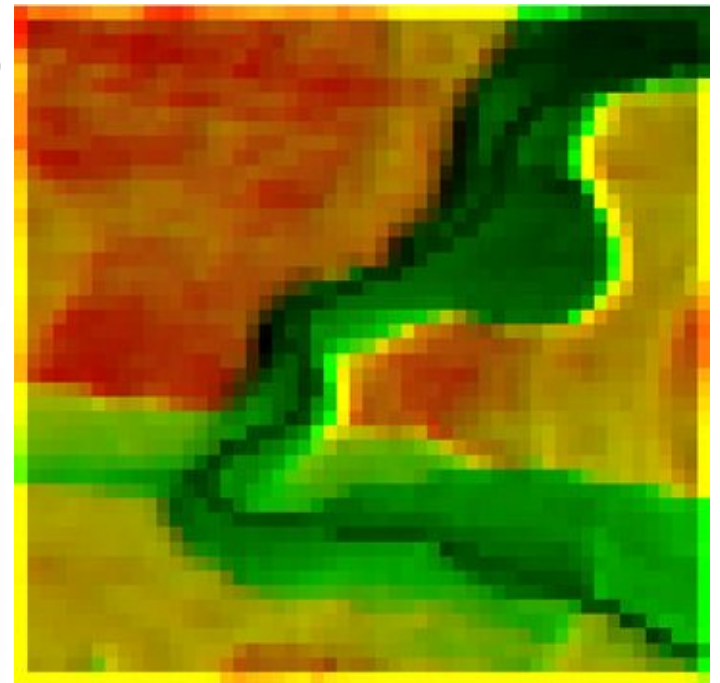
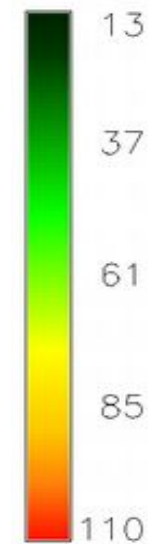
GDEM



SRTM 3

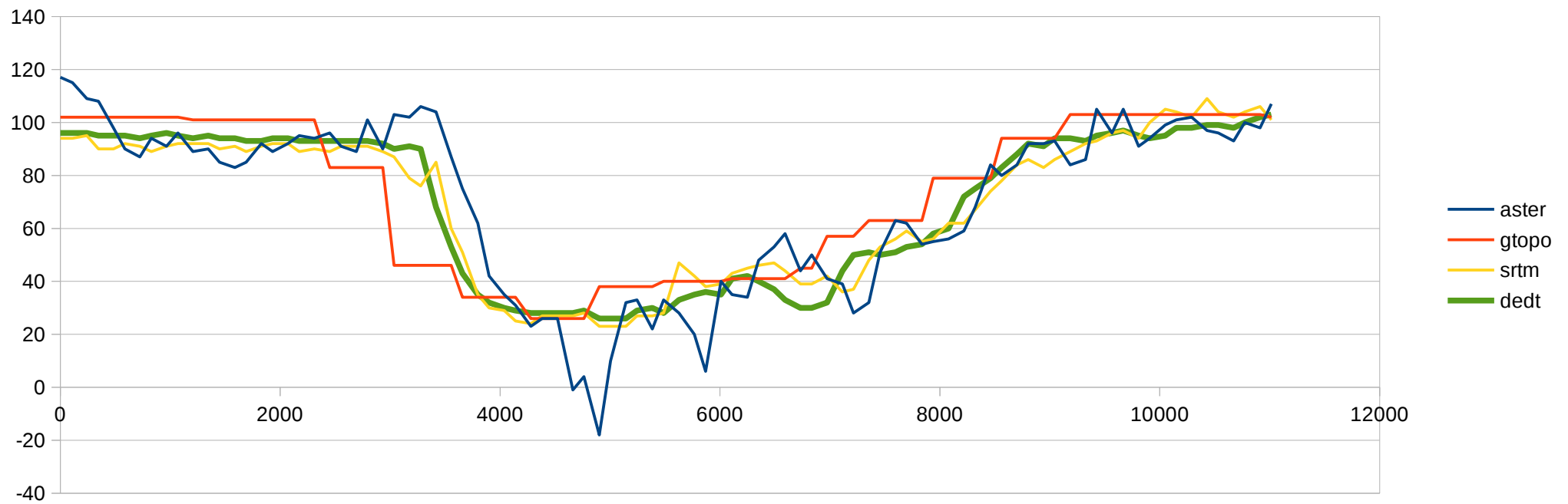
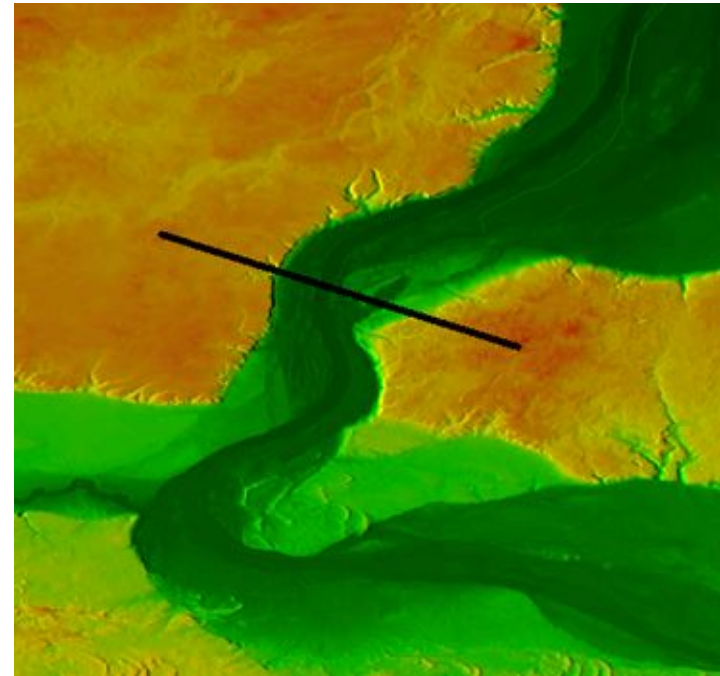


GTOPO





# Porównanie



# TanDEM X ws. SRTM

