

# Remote Sensing & Photogrammetry

## Lecture 13- data integration

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# Agenda

1. Some missing information
2. Projects – past, on going
3. Developed technology in remote sensing
4. Topics
  - GIS
  - Data integration

# Multispectral image processing

1. Correction
2. Enhancement
3. Data extraction

# Correction

## 1. Radiometric

- atmosphere (model, empirical, comparison basing on in-situ spectrometer, DTM)
- Detector (stripping)

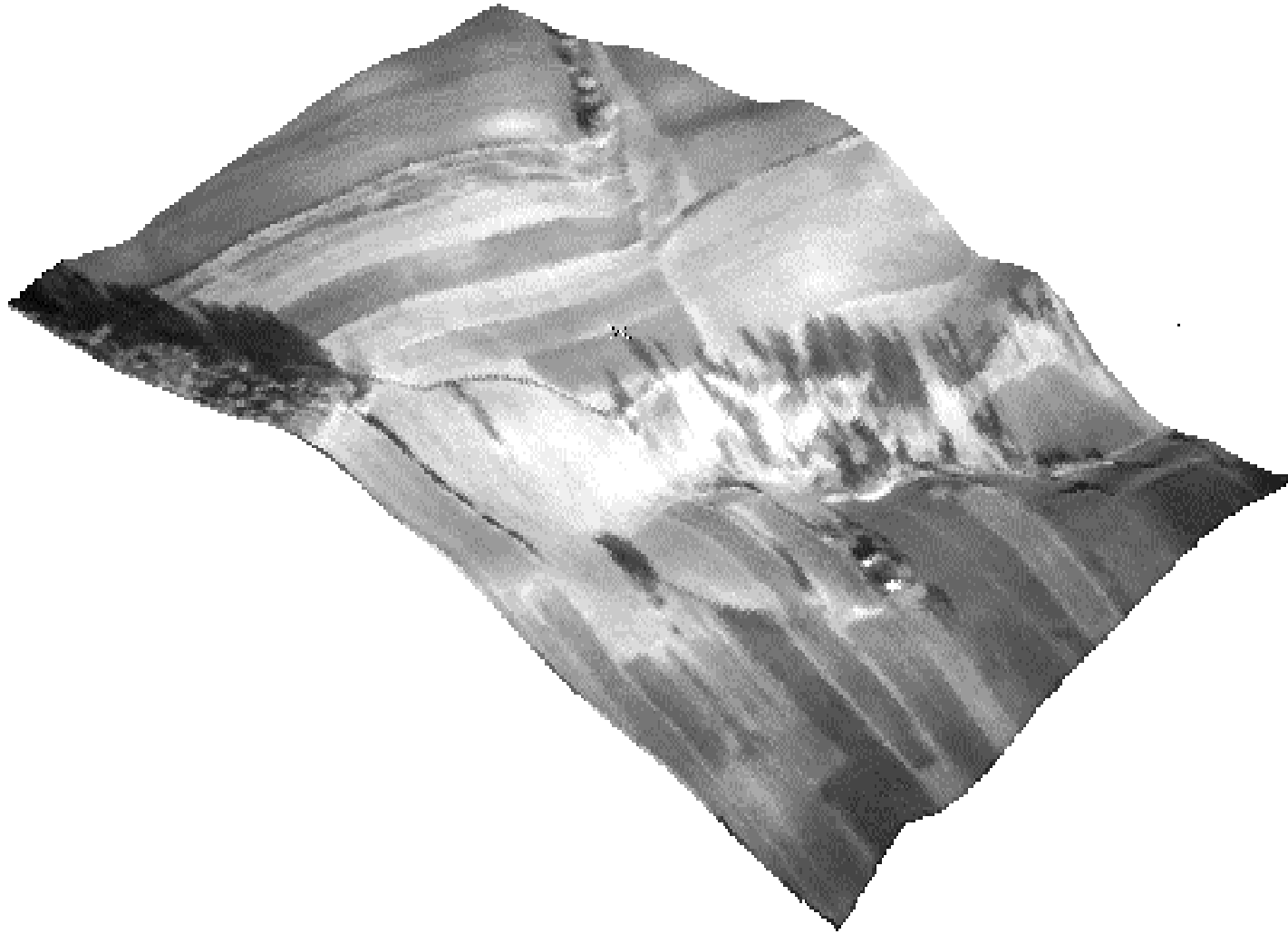
## 2. Geometric

- deformations (Earth rotation, panoramic deformation)

## Removing of the atmospherical effect



## Topographical effect

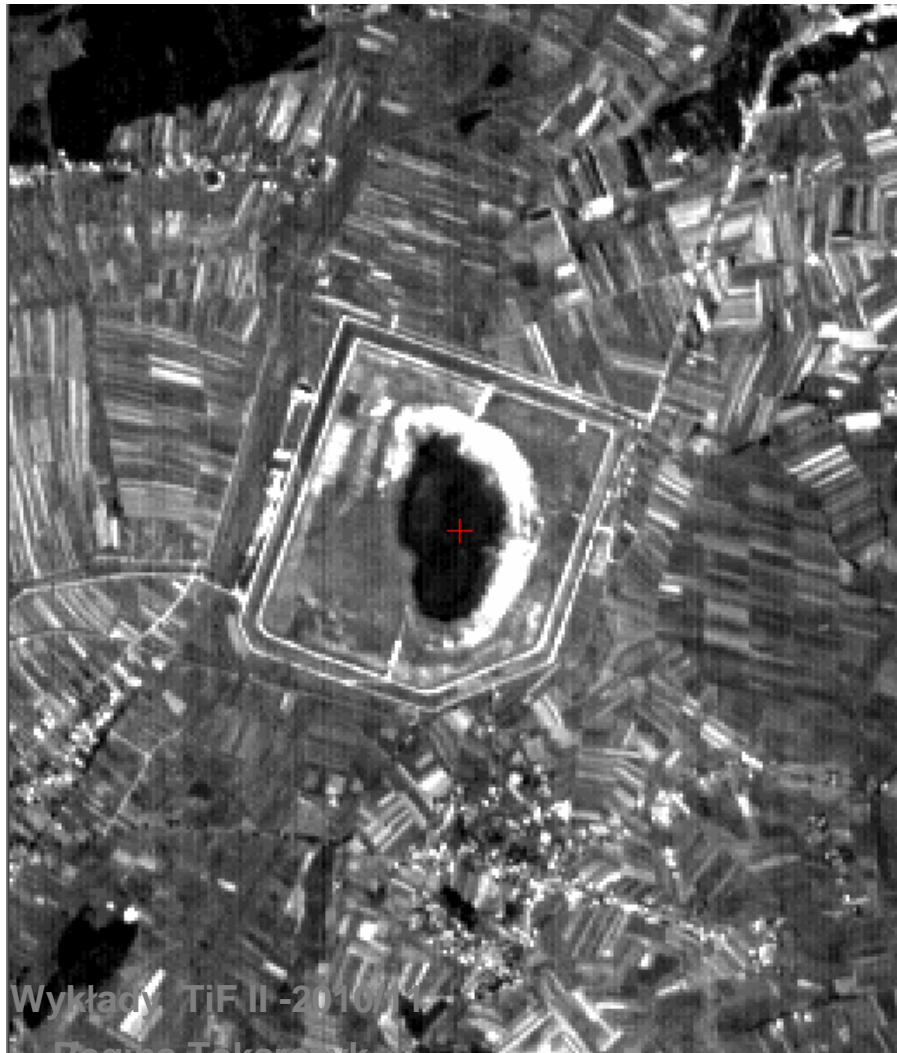


## Topographical effect

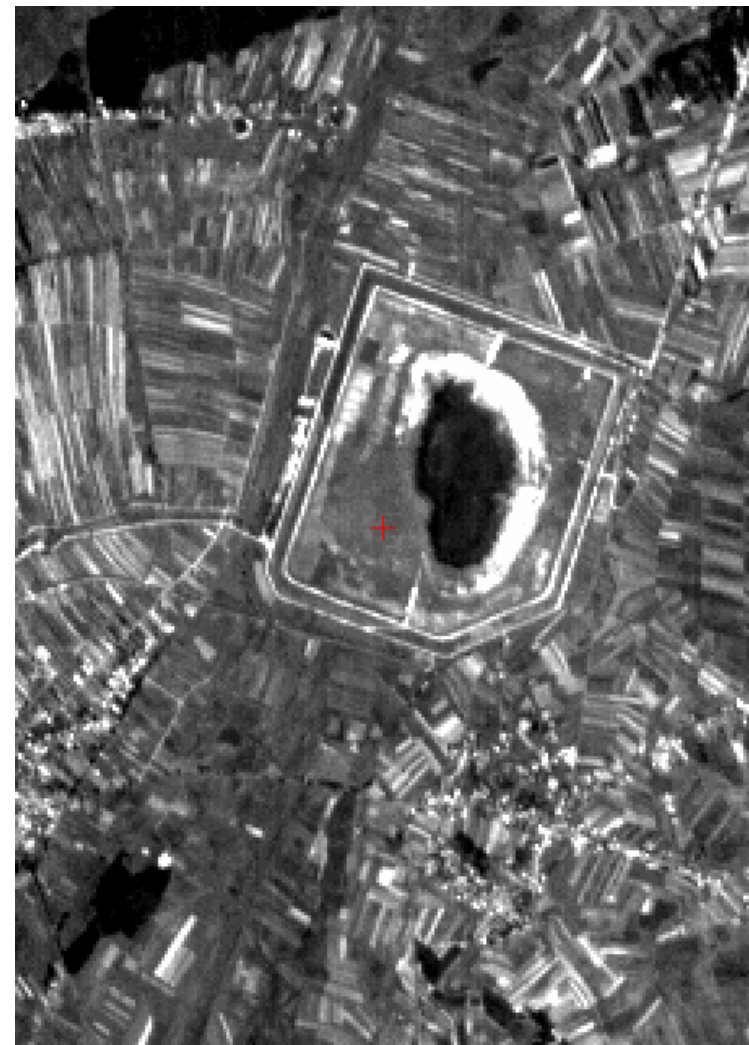


# Destriping

before



after

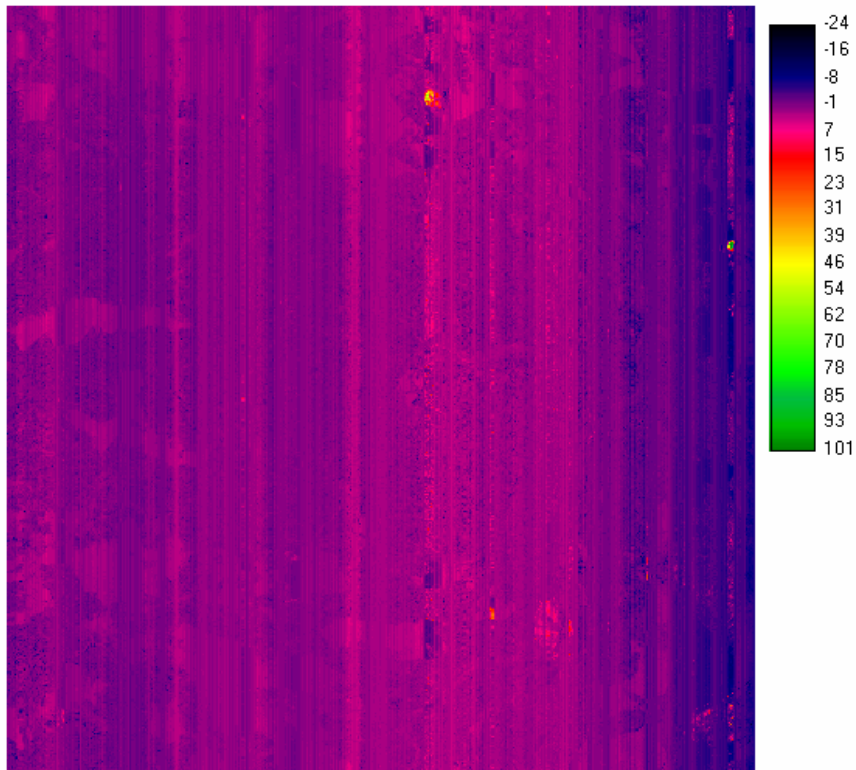




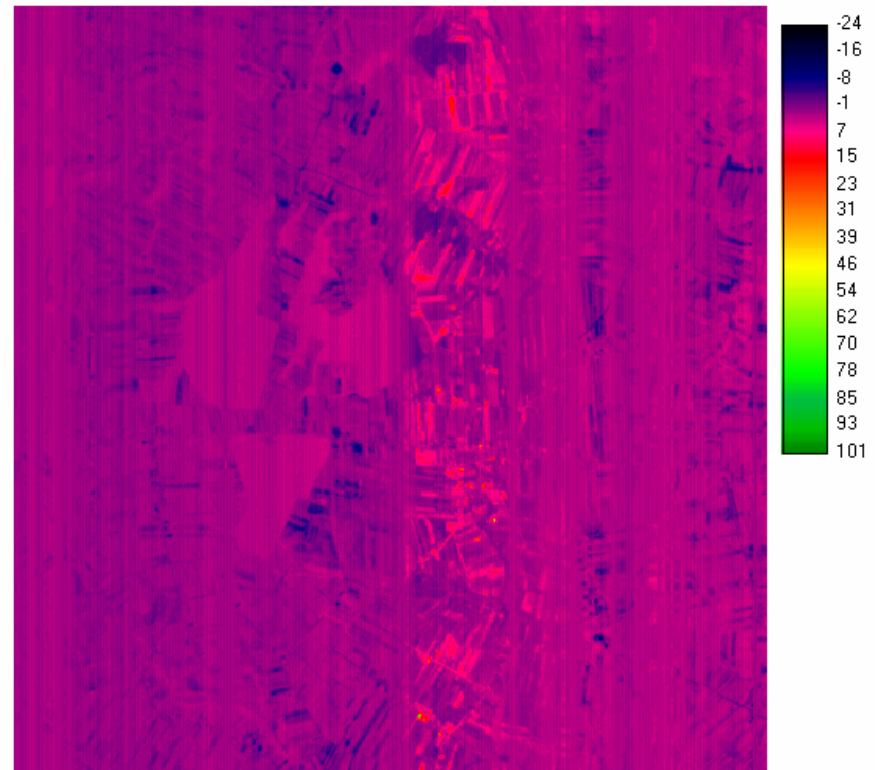
# Destriping

Differences between channels

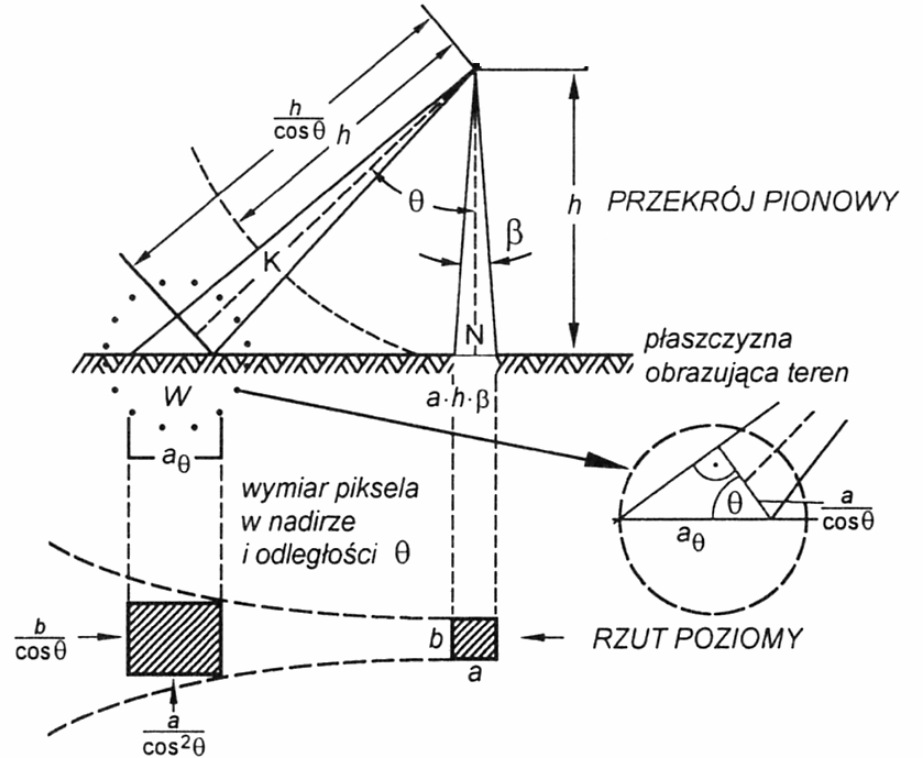
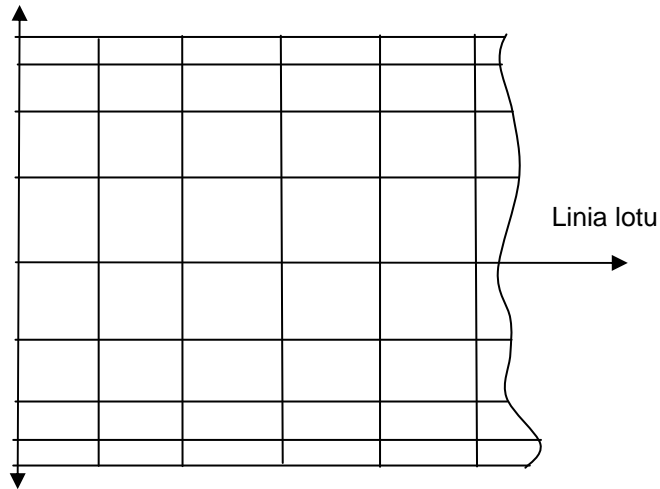
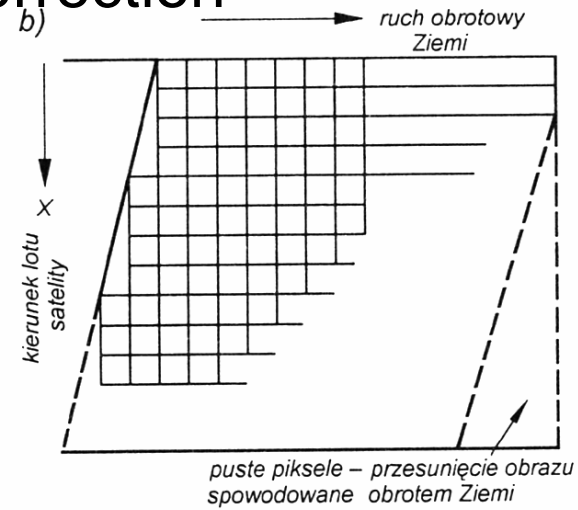
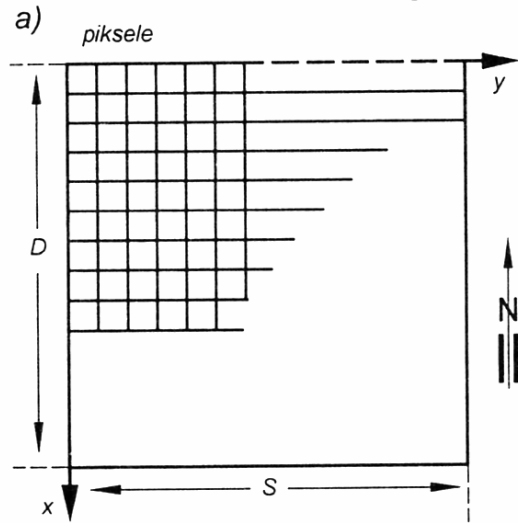
before



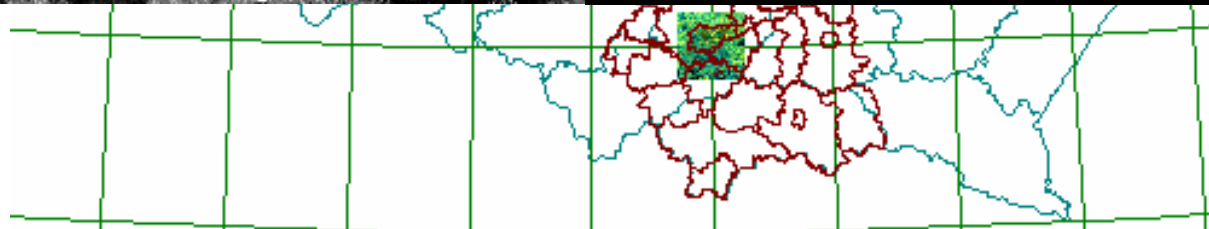
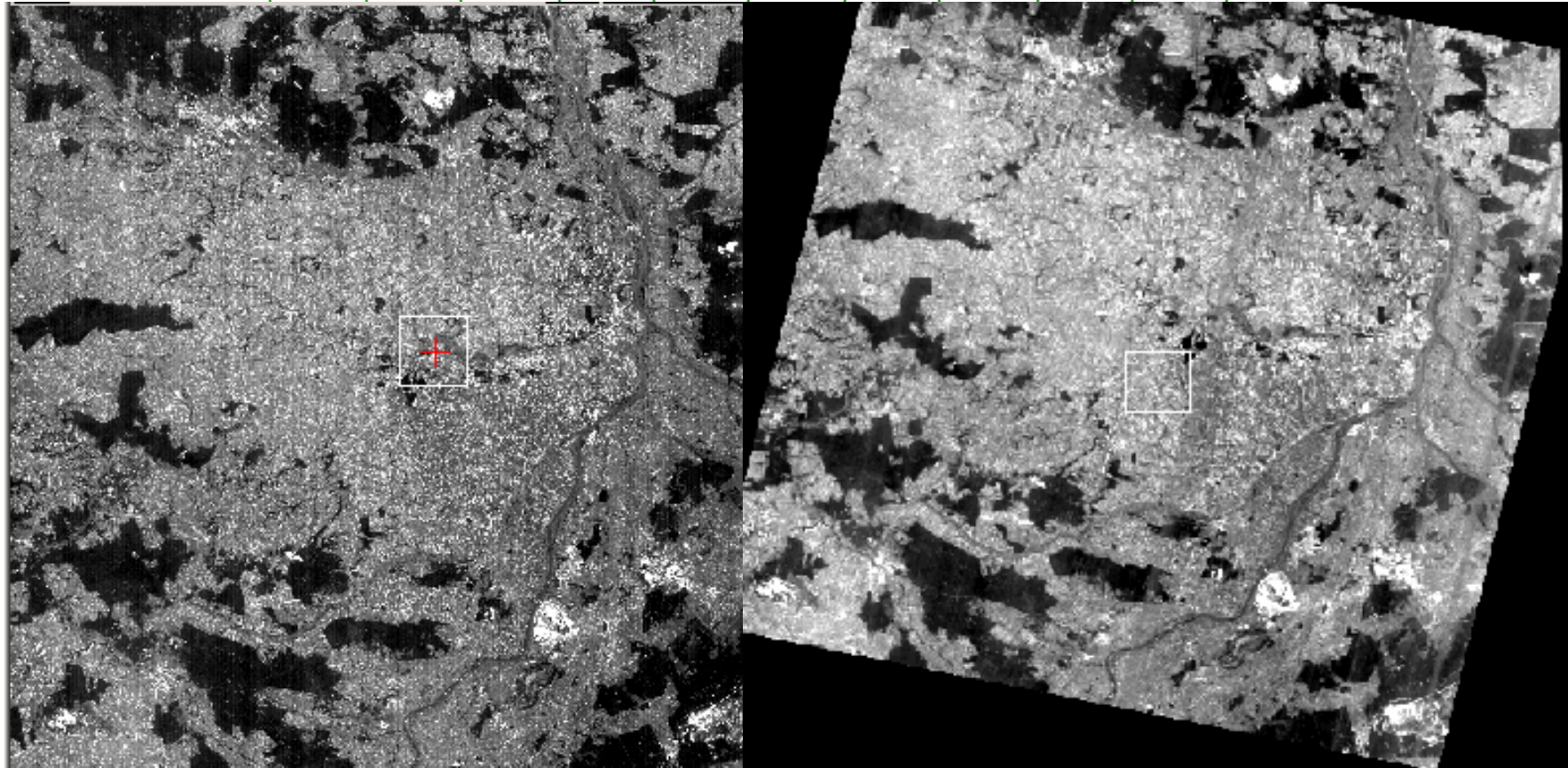
after



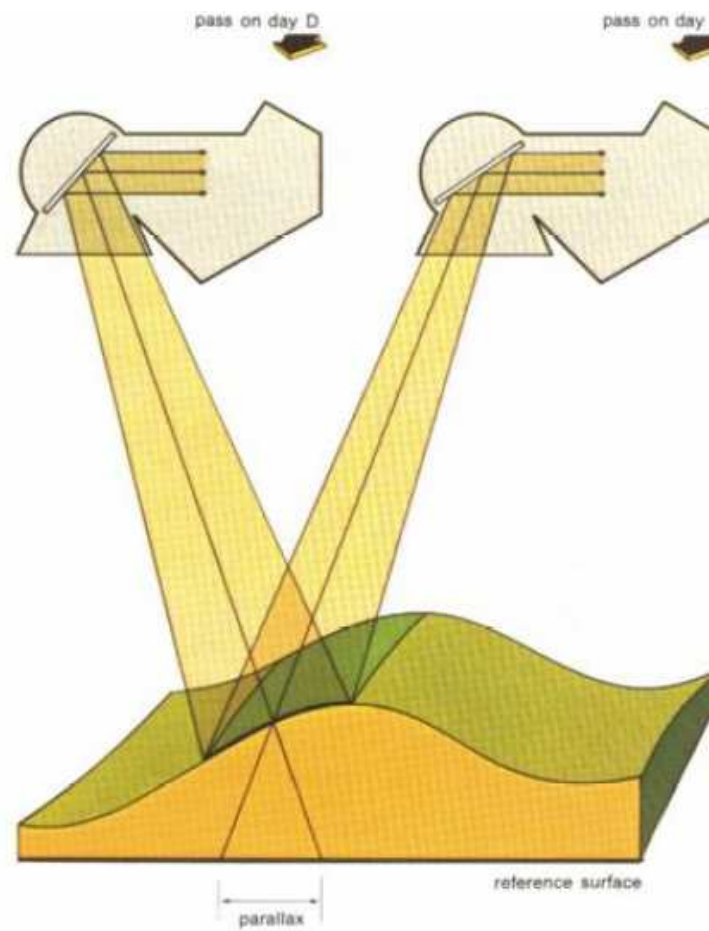
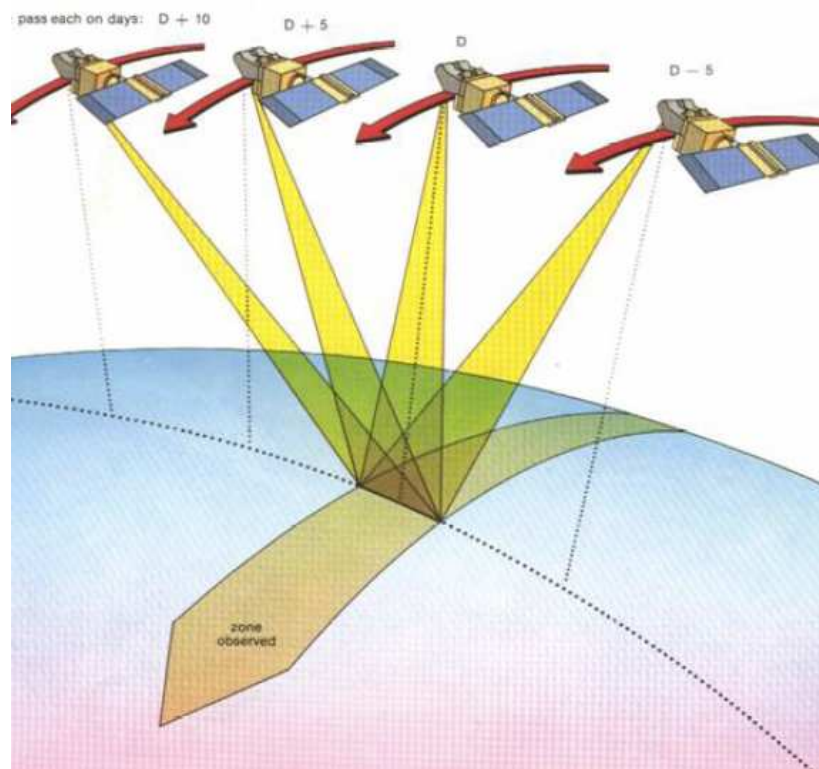
# Geometric correction

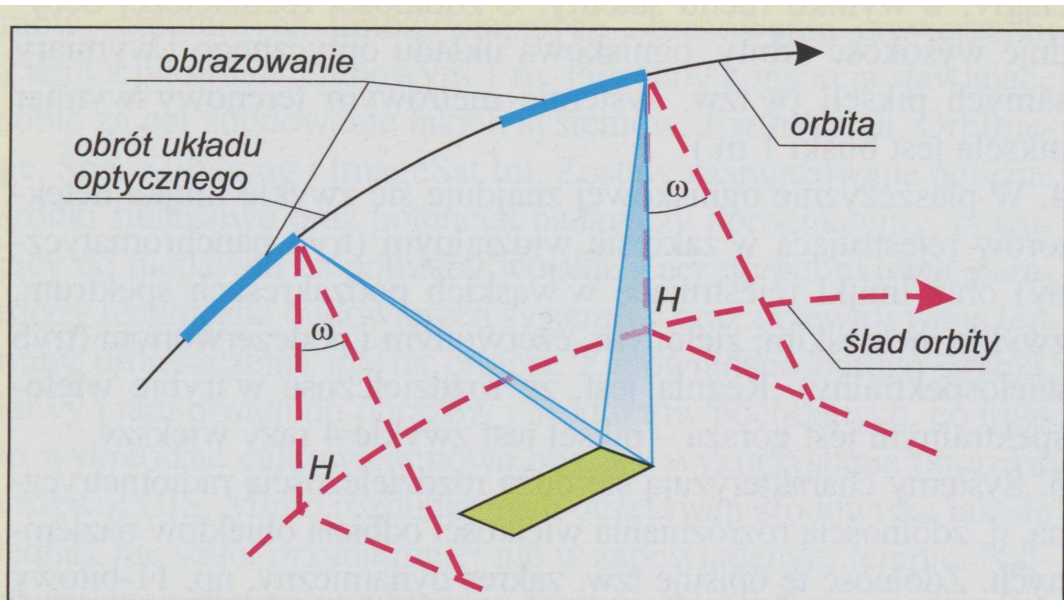


# Transformation orthorectification

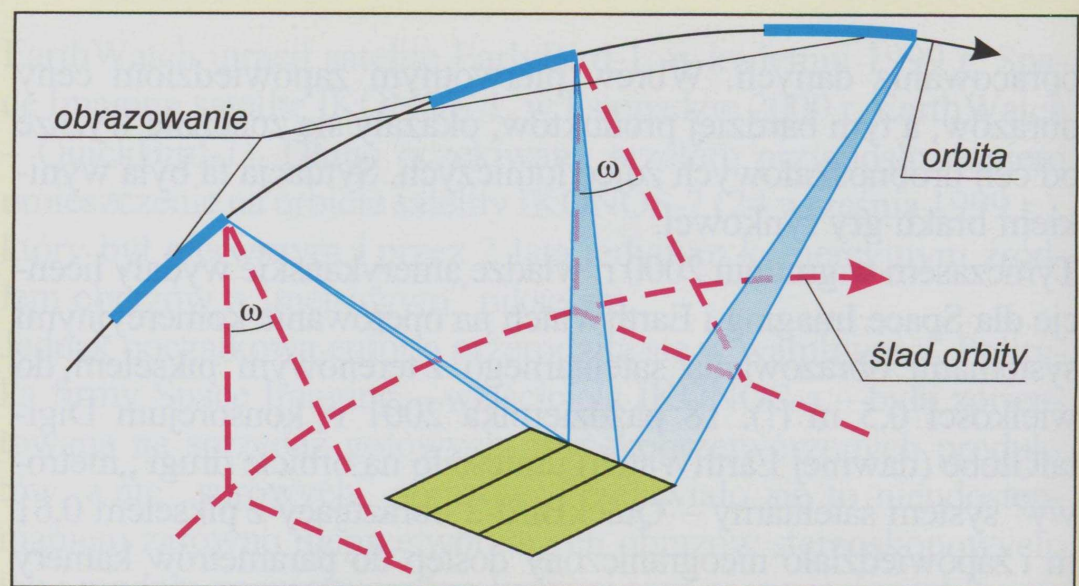


# Stereoa





Rys. 1. Stereoskopia z jednej orbity z wychyleniem układu optycznego wzdłuż i w poprzek



Rys. 2. Obrazowanie kilku pasów terenu z jednego przejścia satelity

## Geometry correction, satellite image transformations:

1. Analytical approach based on polinominals
2. Collinearity approach so called rigid model

### 1. Simple polinomial 2 powers

$$x = a_0 + a_1X + a_2Y + a_3X^2 + a_4XY + a_5Y^2 + \dots$$

$$y = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5Y^2 + \dots$$

### 2. Simple polinomial 3 powers

$$x = a_0 + a_1X + a_2Y + a_3Z + a_4X^2 + a_5XY + a_6XZ + a_7YZ + a_8Y^2 + a_9Z^2 + \dots$$

$$y = b_0 + b_1X + b_2Y + b_3Z + b_4X^2 + b_5XY + b_6XZ + b_7YZ + b_8Y^2 + b_9Z^2 + \dots$$

### 3. (RFP-Rational Function Polynomial, RPC- Rational Polynomial Coefficients)

$$x = \frac{a_0 + a_1X + a_2Y + a_3Z + a_4X^2 + a_5XY + a_6XZ + a_7YZ + a_8Y^2 + a_9Z^2 + \dots + a_{19}Z^3}{1 + b_1X + b_2Y + b_3Z + b_4X^2 + b_5XY + b_6XZ + b_7YZ + b_8Y^2 + b_9Z^2 + \dots + b_{19}Z^3}$$

$$y = \frac{c_0 + c_1X + c_2Y + c_3Z + c_4X^2 + c_5XY + c_6XZ + c_7YZ + c_8Y^2 + c_9Z^2 + \dots + c_{19}Z^3}{1 + d_1X + d_2Y + d_3Z + d_4X^2 + d_5XY + d_6XZ + d_7YZ + d_8Y^2 + d_9Z^2 + \dots + d_{19}Z^3}$$

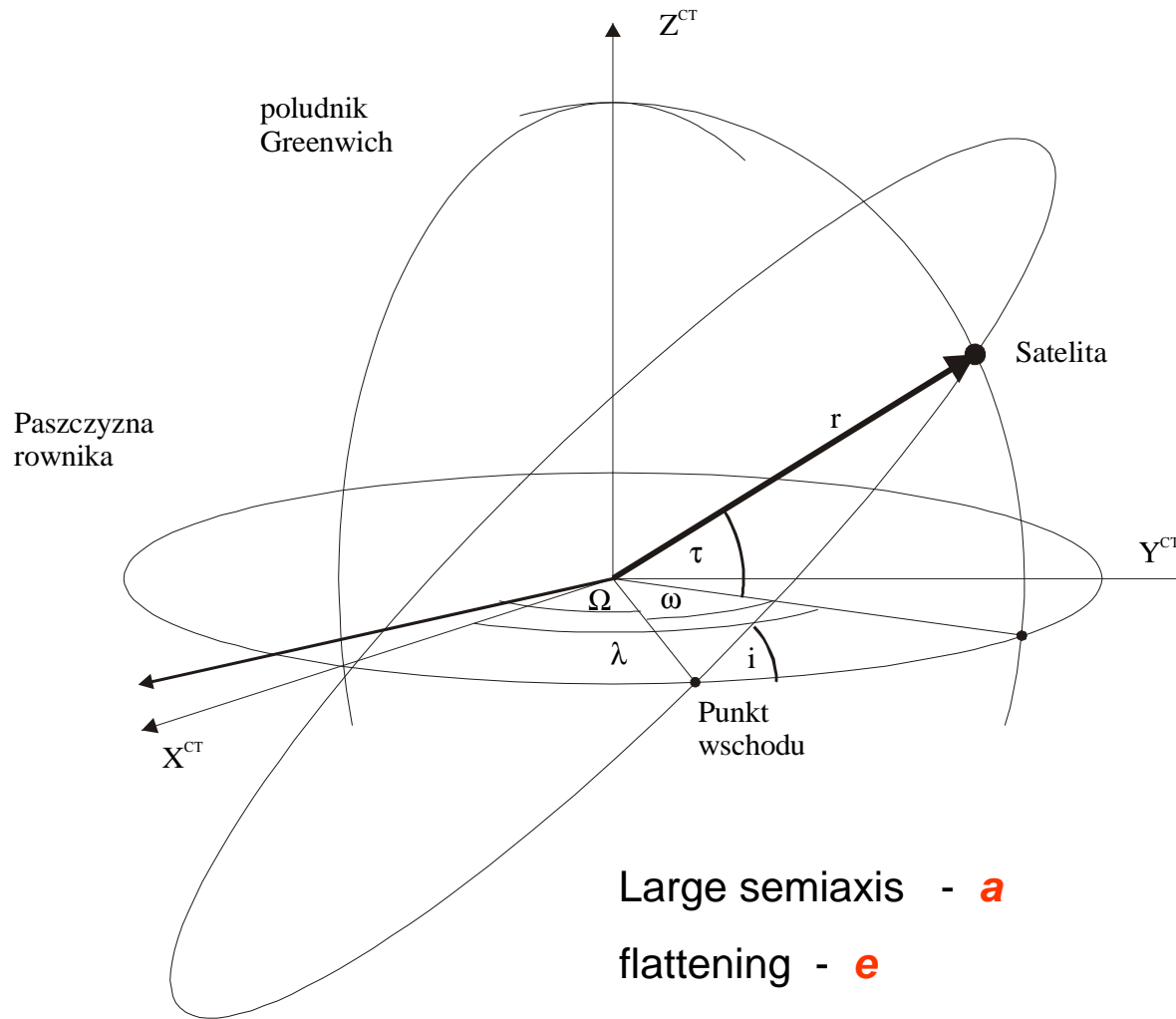
Projective transformation space on plane

Direct Linear Transformation:

$$x = \frac{a_1 + a_2 X + a_3 Y + a_4 Z}{1 + a_9 X + a_{10} Y + a_{11} Z}$$

$$y = \frac{a_5 + a_6 X + a_7 Y + a_8 Z}{1 + a_9 X + a_{10} Y + a_{11} Z} + a_{12} xy$$





Large semiaxis -  **$a$**

flattening -  **$e$**

inclination -  **$i$**

wzniesienie punktu wschodzącego -  **$\Omega$**

Satellite position in given time -  **$\omega$  i  $\gamma$**

Latitude -  **$\psi$**  longitude  **$\lambda$**

## Filtering, tresholding

zamiana obrazu o **wielu** stopniach jasności na obraz binarny (dwa stopnie **0** i **1**)

Easiest filter:

$$L' = \begin{cases} 0 & \text{dla } L \leq a \\ 1 & \text{dla } L > a \end{cases}$$

**L** - before

**L'** - after

**a** - treshold

# Simple filtering

Windows (3x3, 5x5 ...)

-Smoothing

-Sharpening

-Edge detection



# Satellite images

- LANDSAT (15/30/60;7;8), SPOT satellites (2.5/5/10; 5;) , ASTER, IRS
- RapidEye
- IKONOS, QUICKBIRD
- GeoEye-1
- WorldView-2