Hydraulic model verification by optical remote sensing

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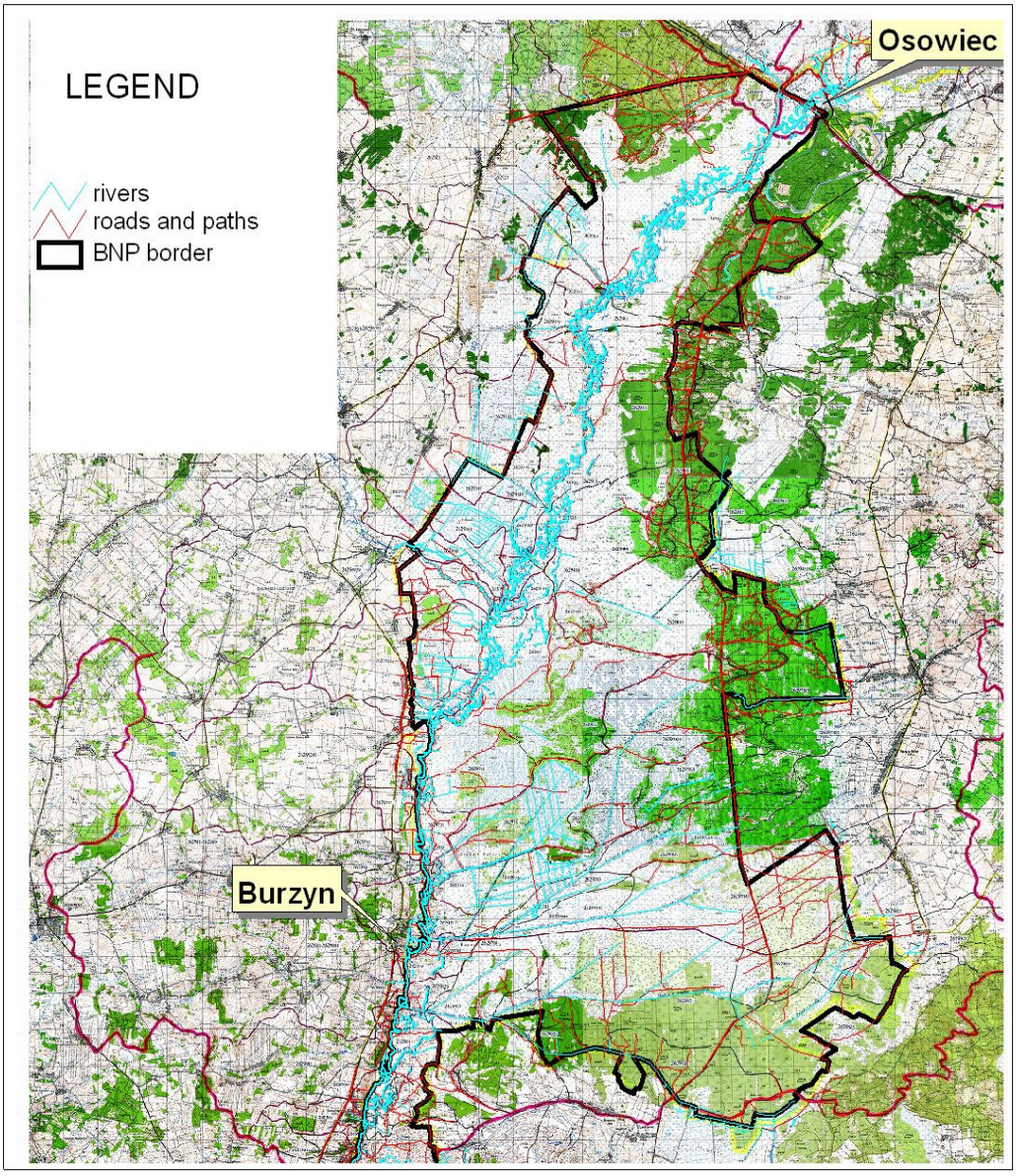
River Flood modeling in Wetlands

- River flood and his ecological impact in wetland (Flood Pulse concept)
- Floodplain - a water storage reservoir
- Analysis of the flood duration and spatial extent of flood determination is very important (specially in the mixed-source wetlands)
- Application of hydraulic model helps in resolving above problems
- Difficulty in model verification

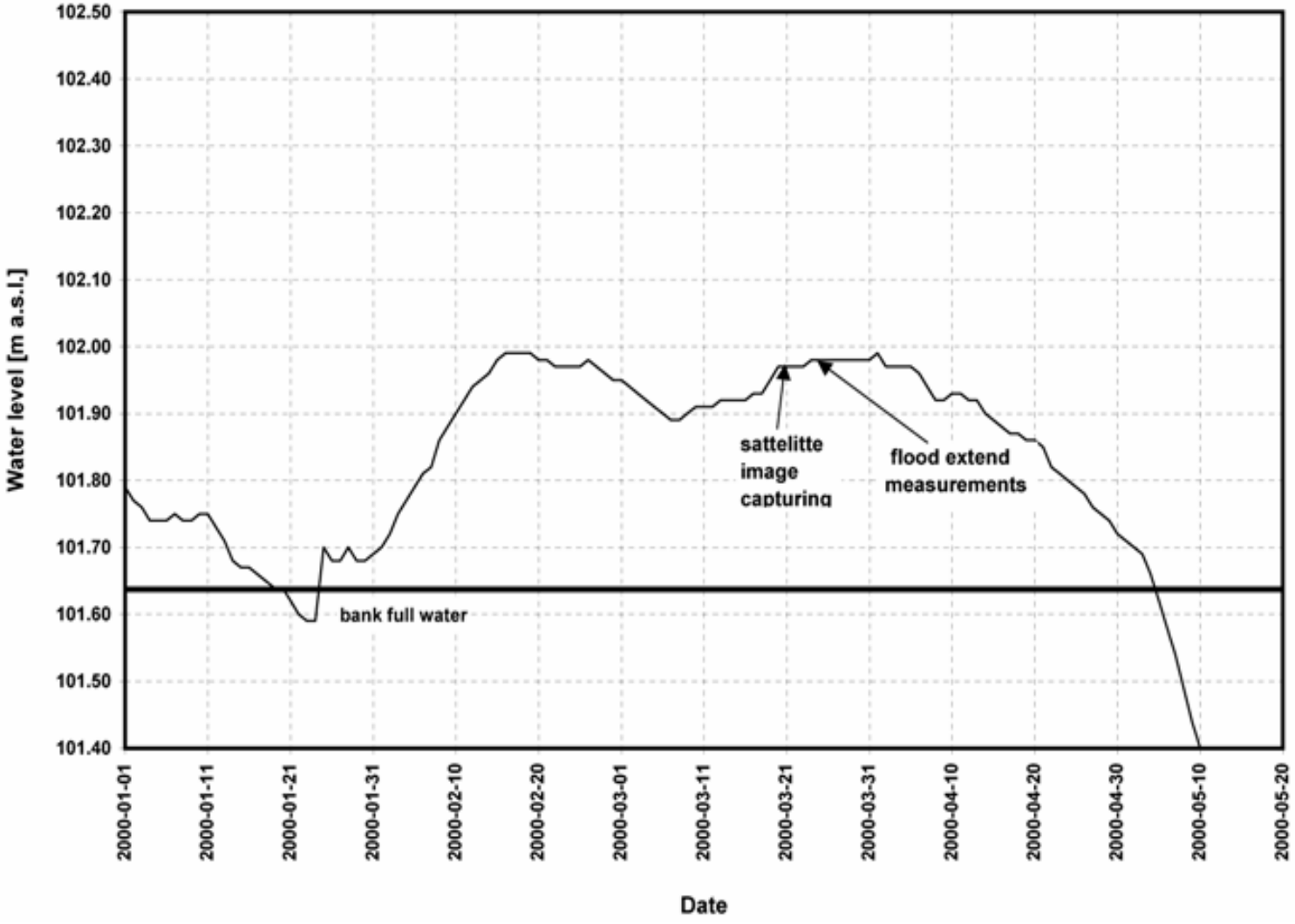
The Biebrza Lower Basin, a research area



LEGEND

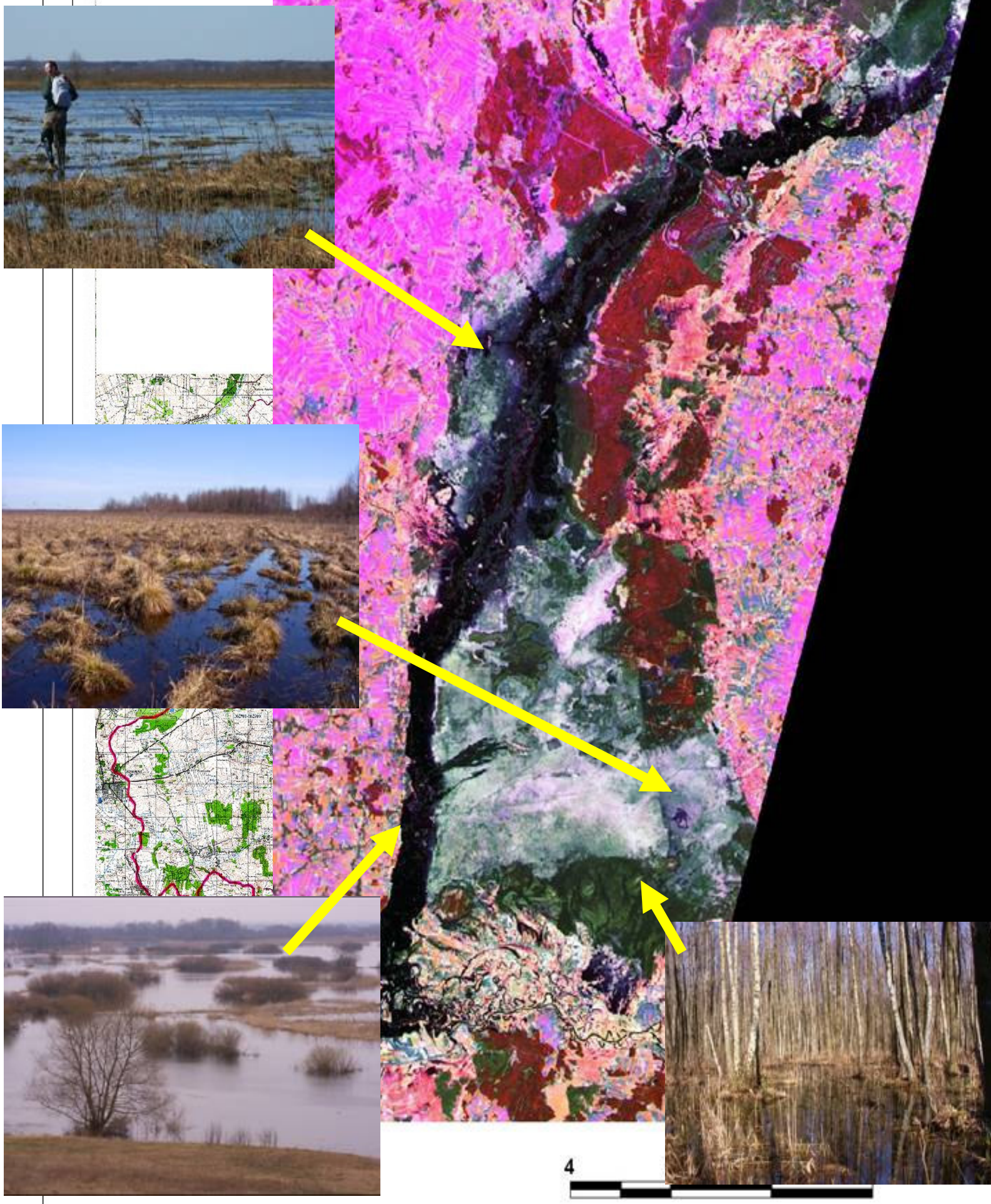
river
road
gauge station
town and village
forest

March 2000 spring flood



Water level observed in Burzyn gauge during a flood in 2000

March 2000 spring flood



Hydraulic model development

- River channel shape
- Floodplain topography
- Hydraulic model

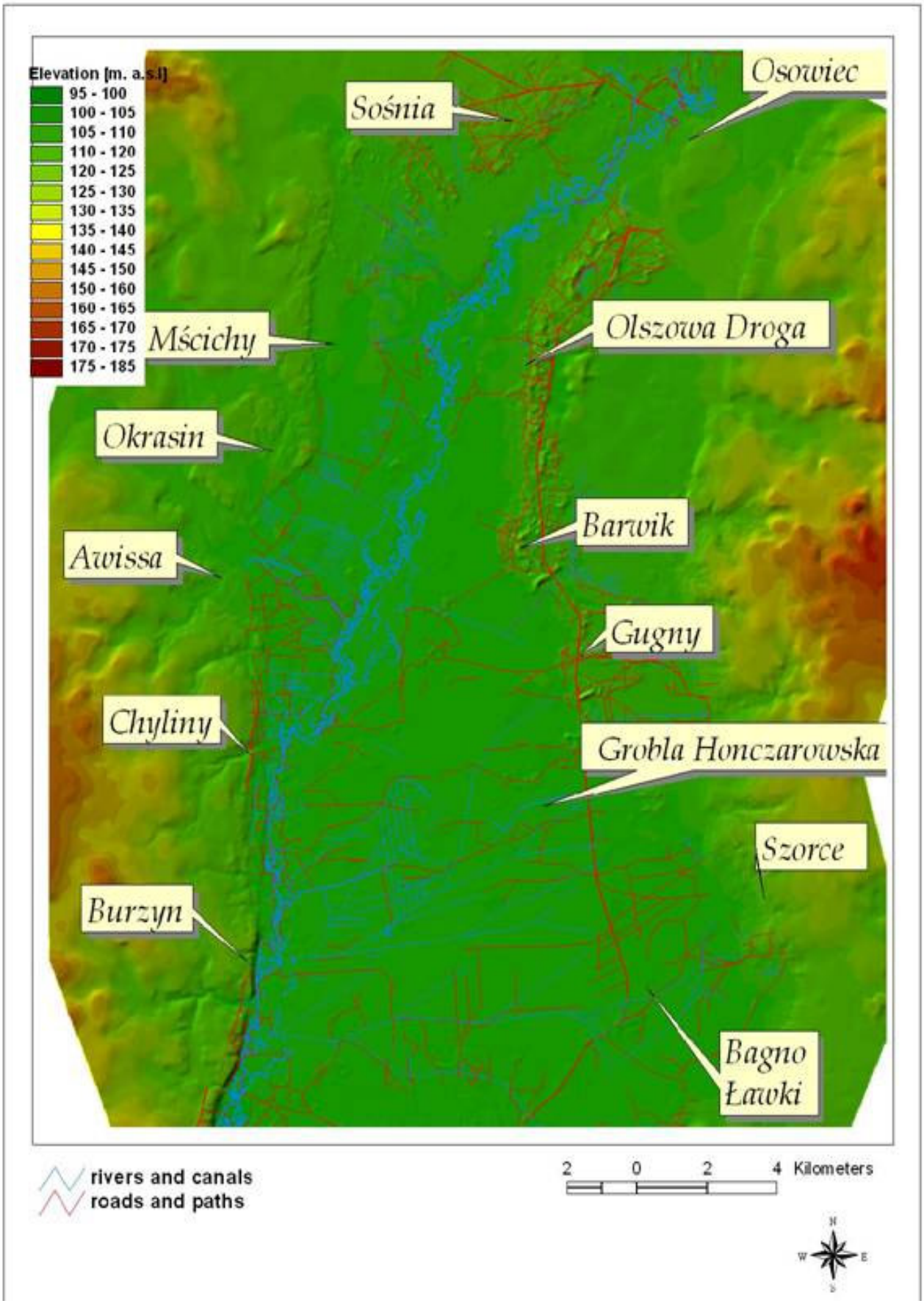
Geometry of the valley. Cross-sections

- The river channel - Manual sonding
- A part of the valley located close to the river channel - Topography measurements
- The rest of the valley - captured from DTM

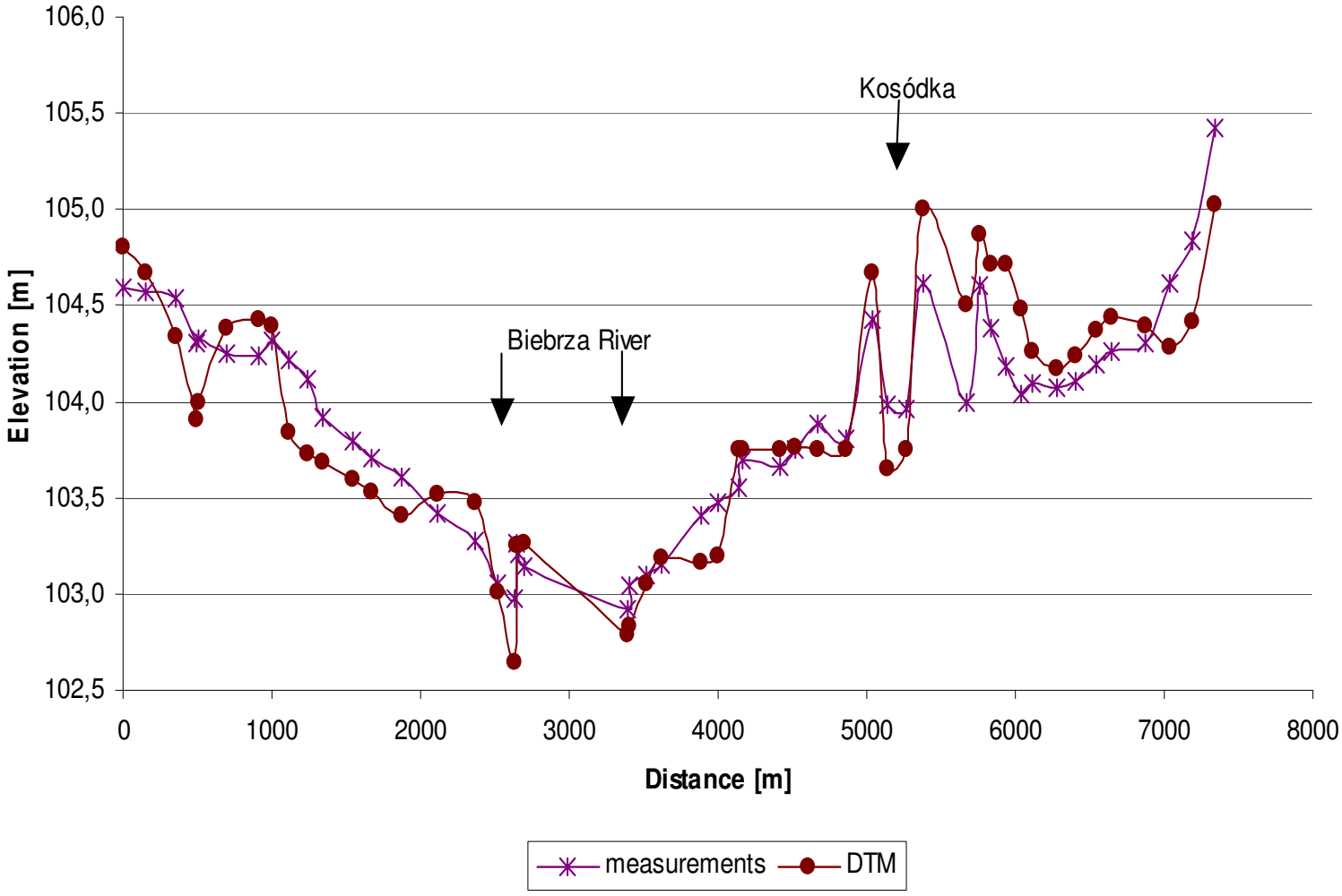
DTM of the valley

- Data:
  - contour and point elevation data source topographic maps scale of 1: 25 000;
  - Measured elevation cross-sections in the river valley;
- Interpolation:
  - TOPOGRIDTOOL an ArcInfo routine
  - existing natural hydrography network used for sinks removal and to enforce known drainage patterns during interpolation;
  - Spatial resolution of DTM - 25 meters

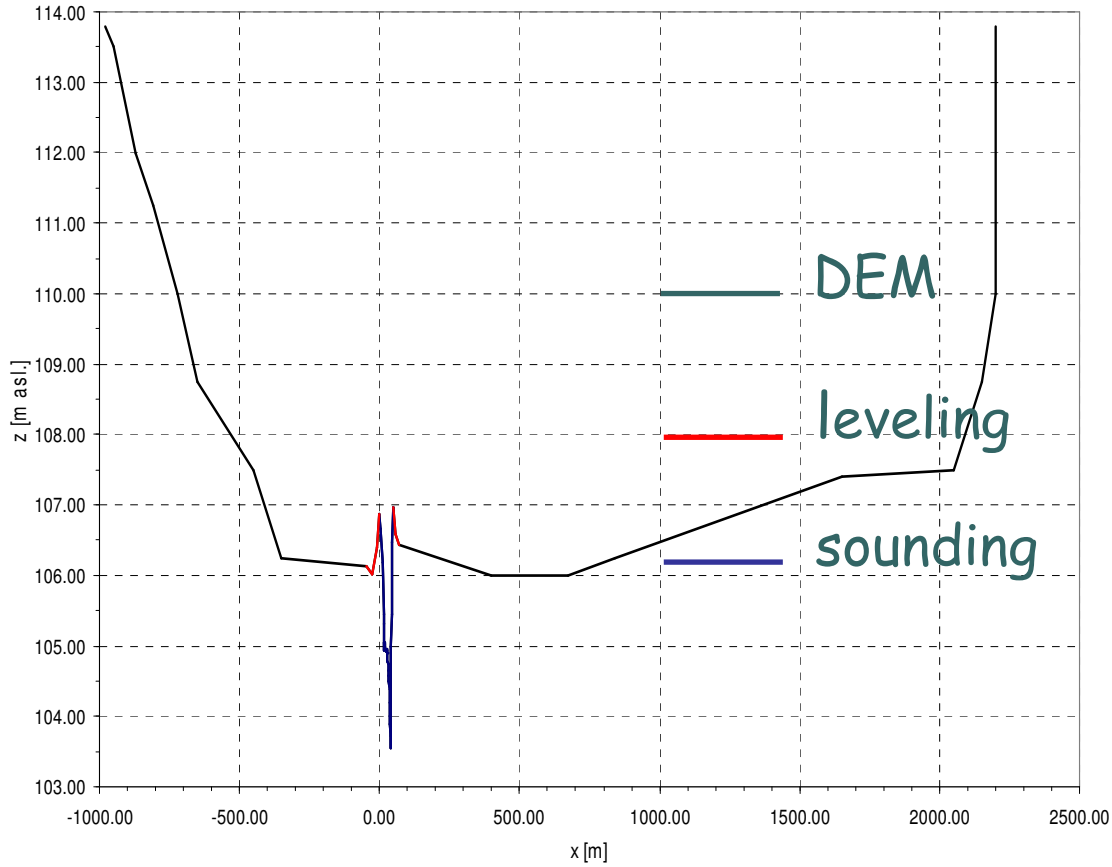
DTM of the Lower Biebrza Basin

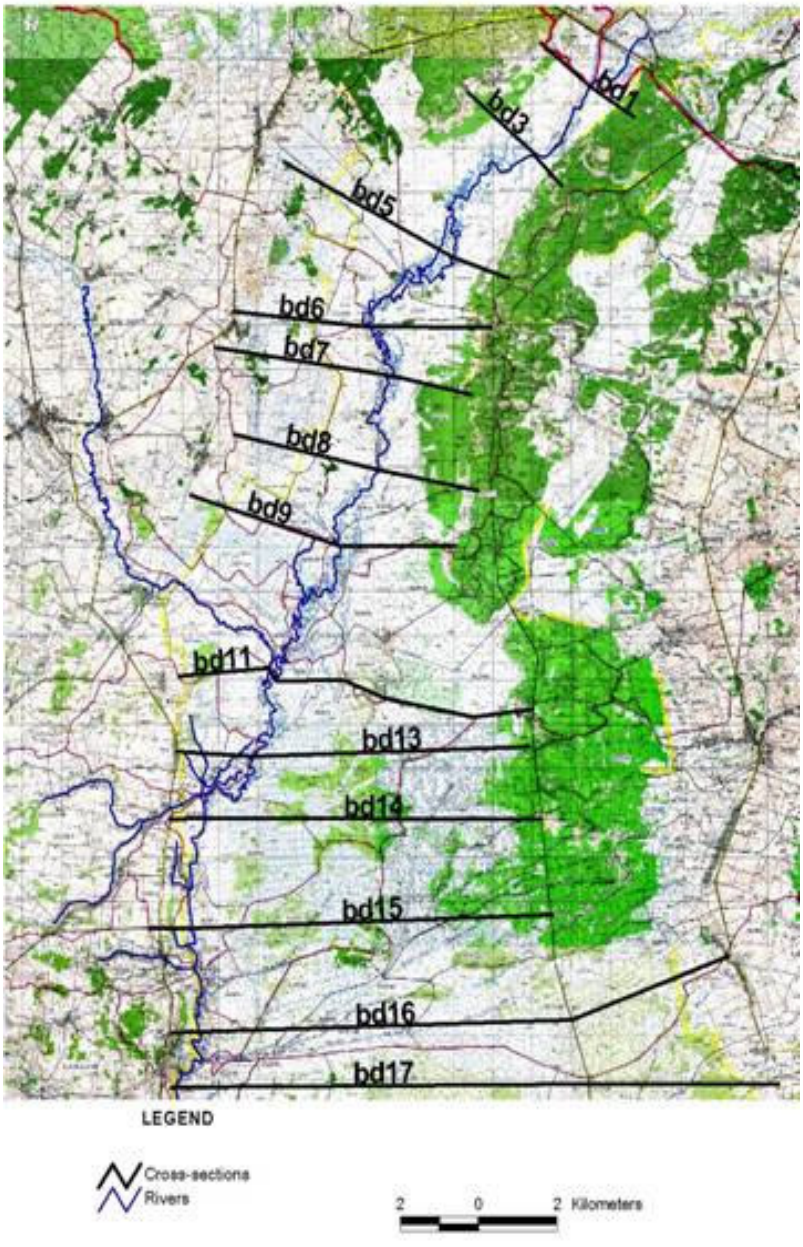


Quality of the DTM



- Model verified by two measured valley cross-section
  - Levelling in 50 meters (90 points in two cross-sections)
  - Verification of DTM (RMS Error = 0,35m)

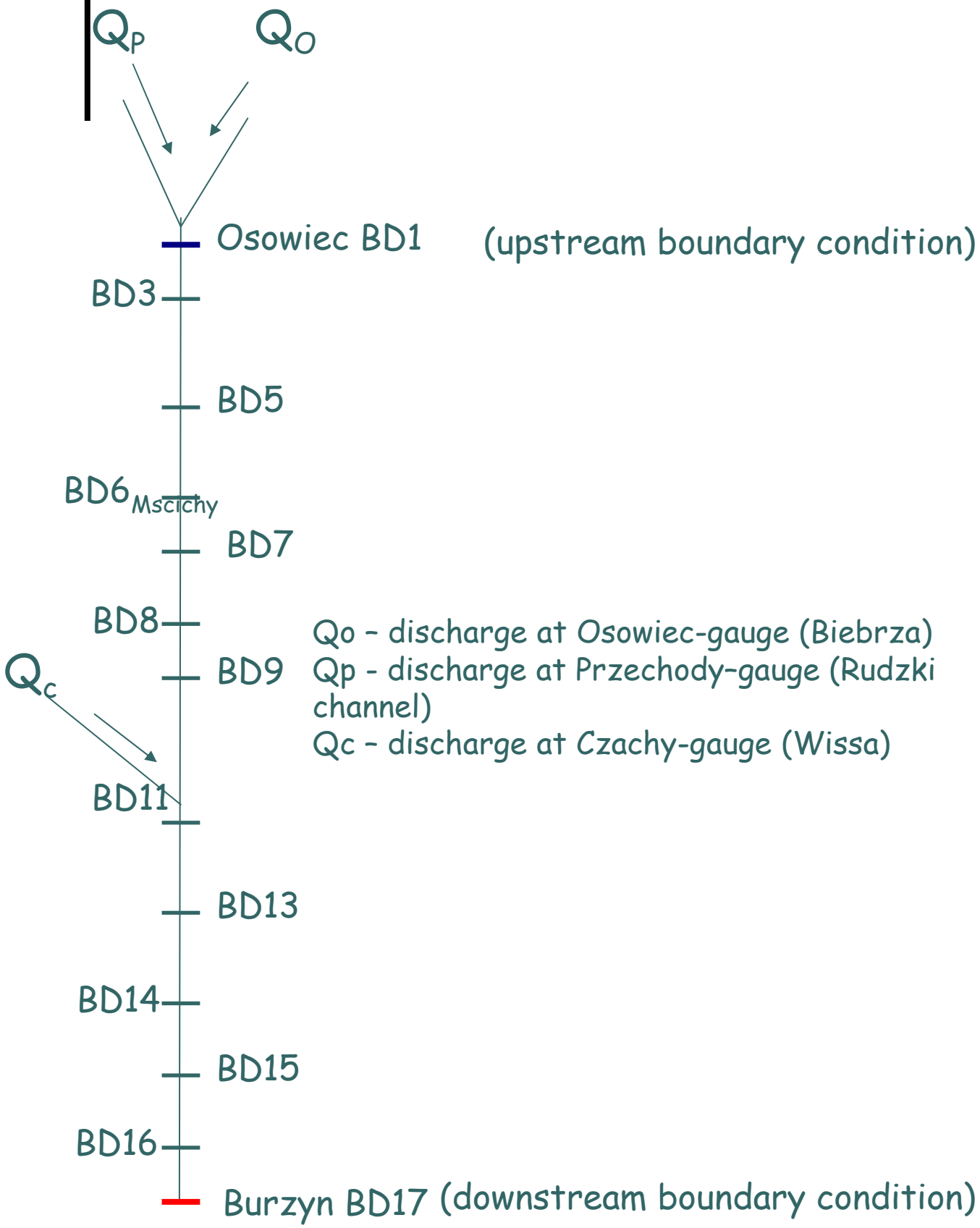




Cross-sections method creation

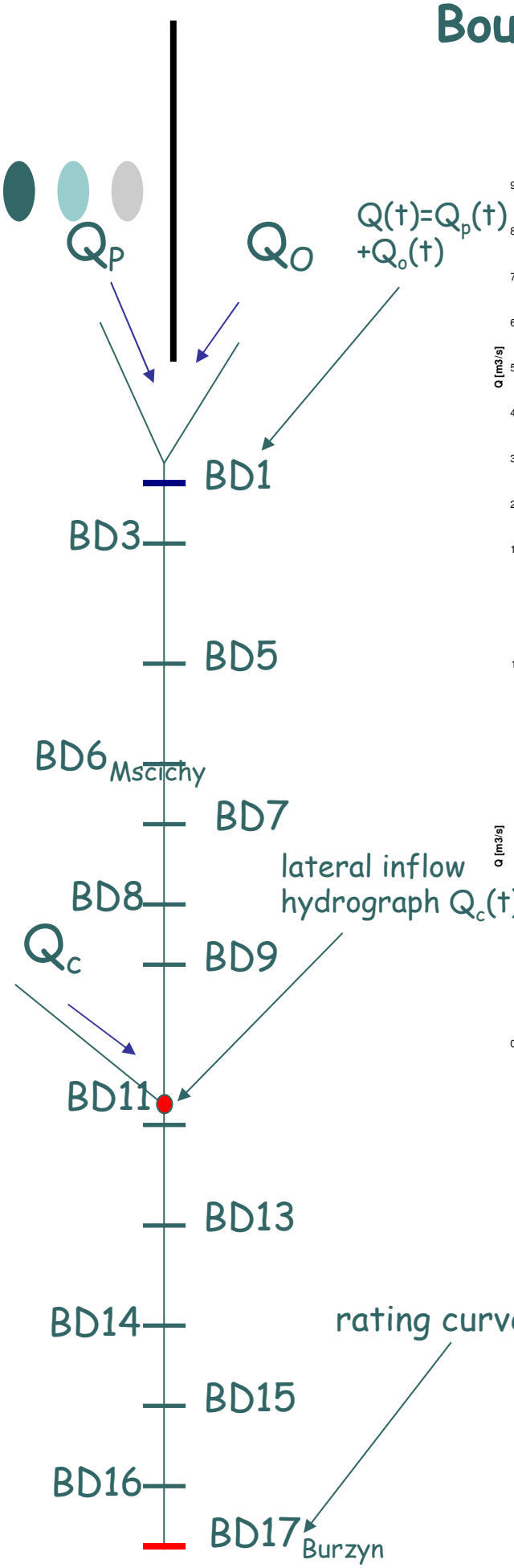
The cross-sections localization in the Lower Basin

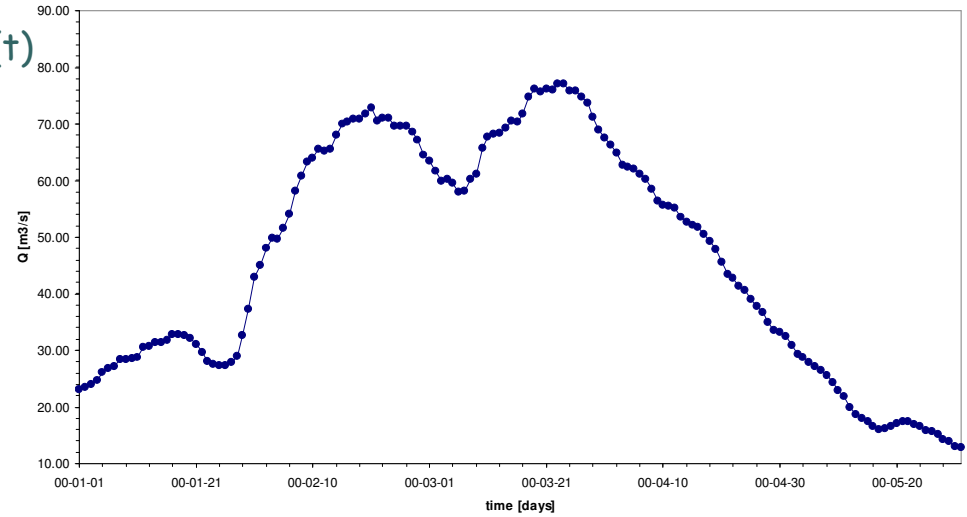
Hydraulic model topological scheme

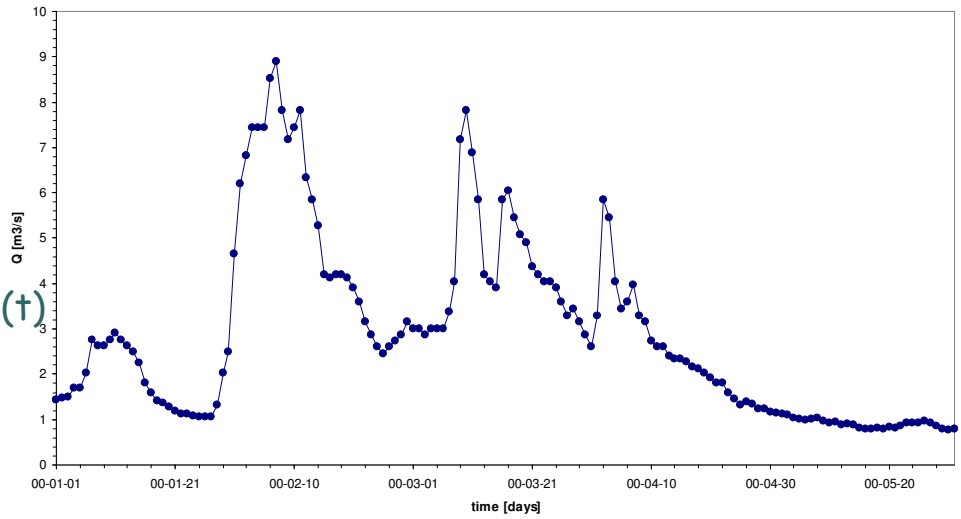


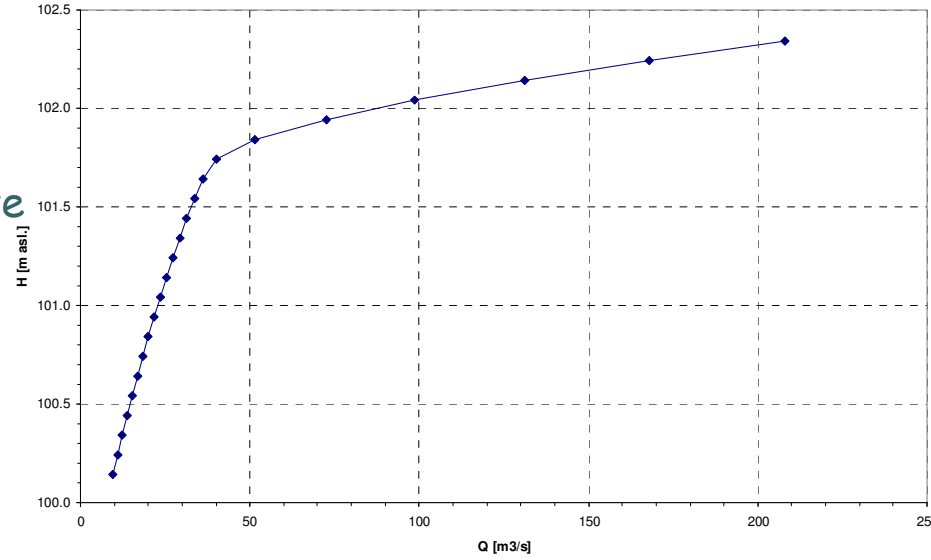
Qo – discharge at Osowiec-gauge (Biebrza)
Qp - discharge at Przechody-gauge (Rudzki channel)
Qc – discharge at Czachy-gauge (Wissa)

Boundary conditions

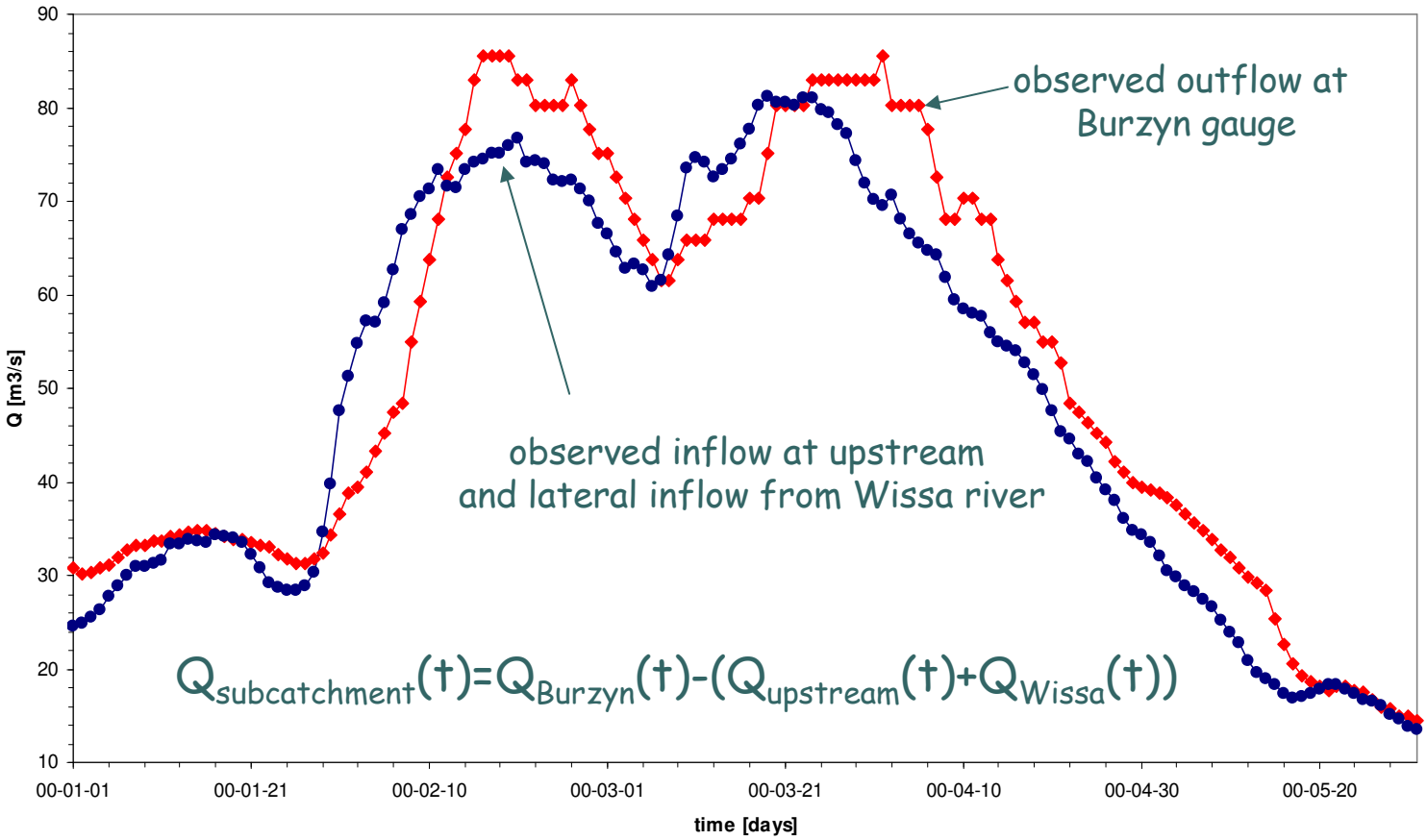




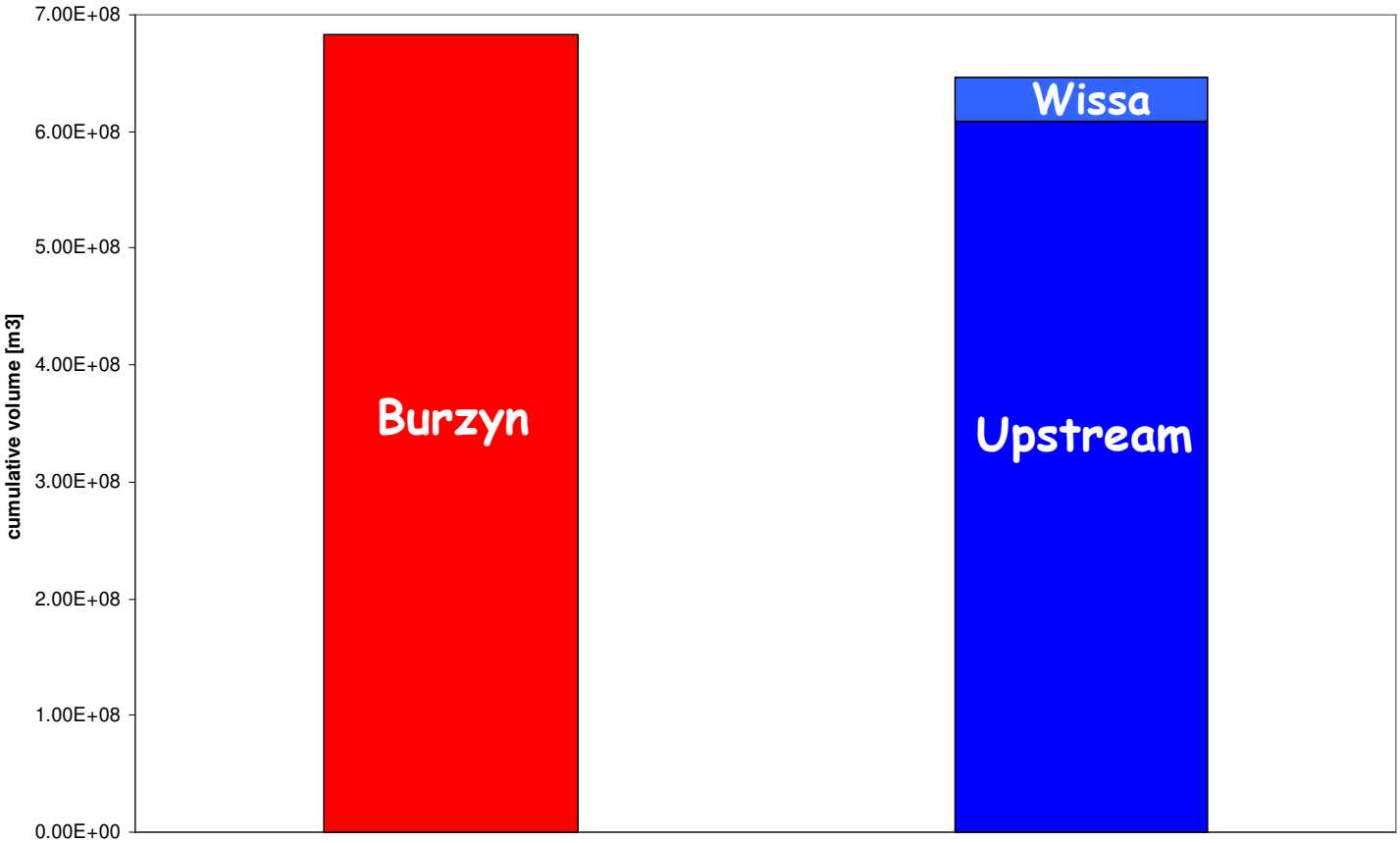




The comparison inflow with outflow for Biebrza River lower basin

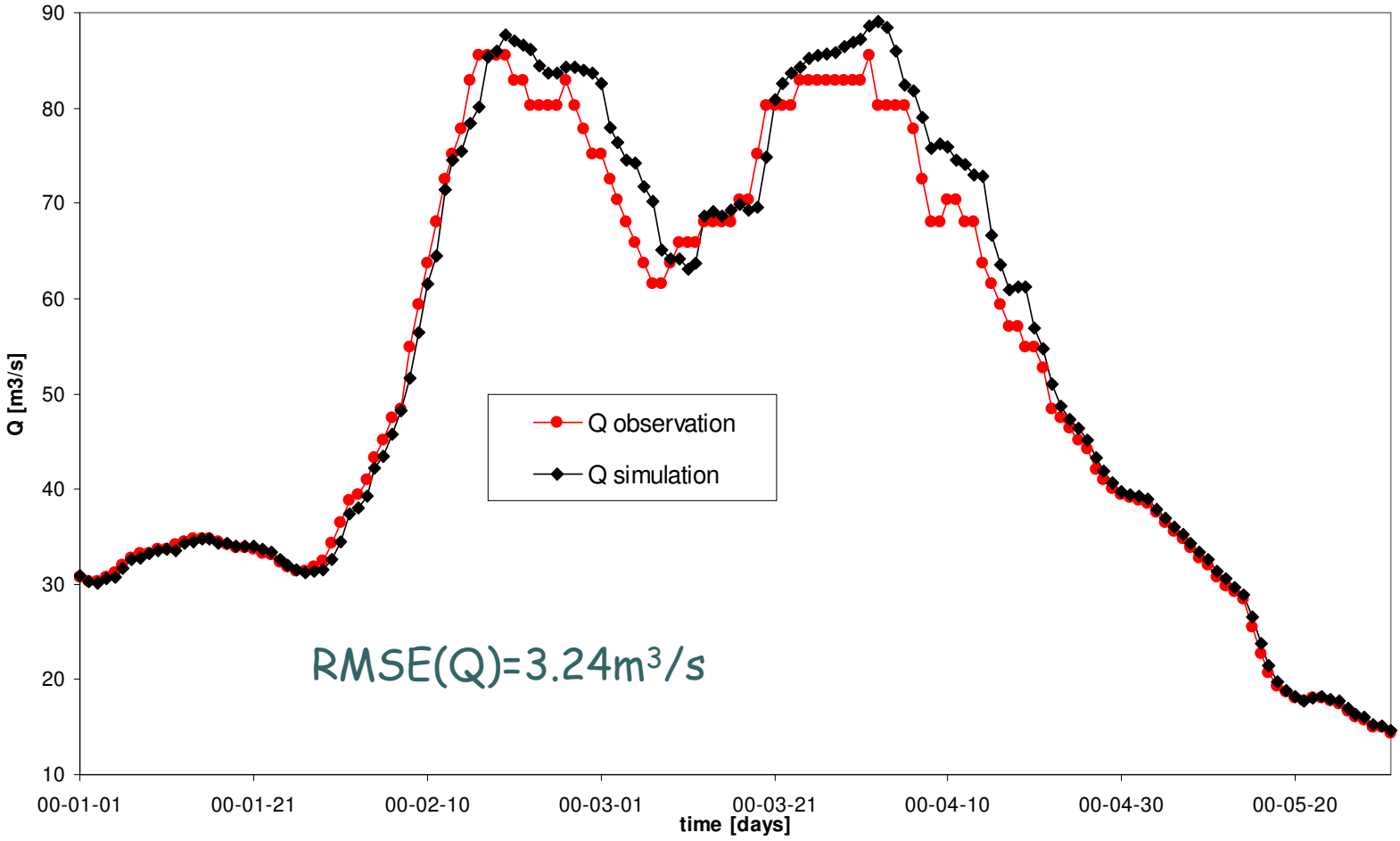


Cumulative water volume for time period 01.01.00-31.05.00

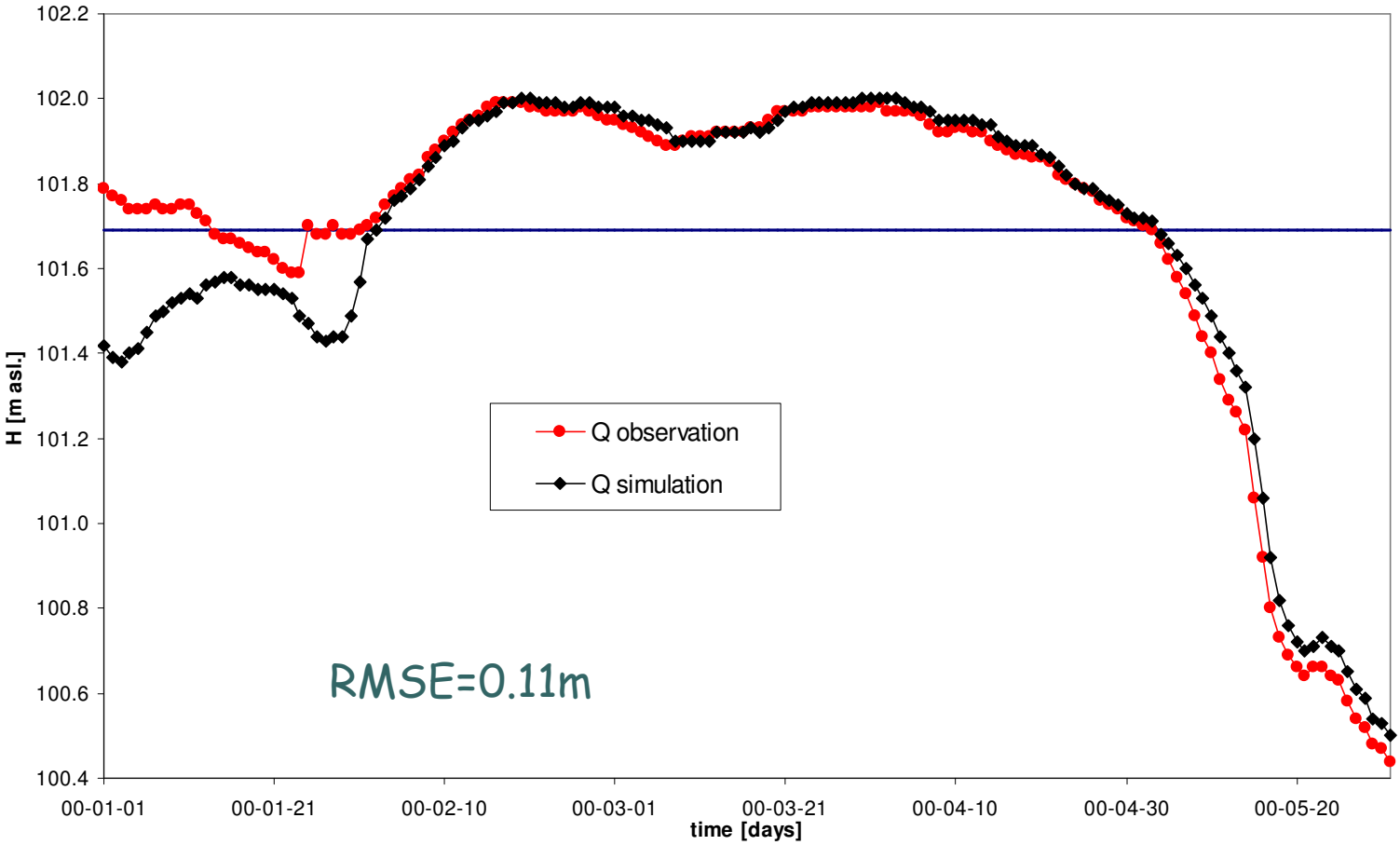


$V_{Upstream}+V_{Wissa}=96\%(V_{Burzyn})$

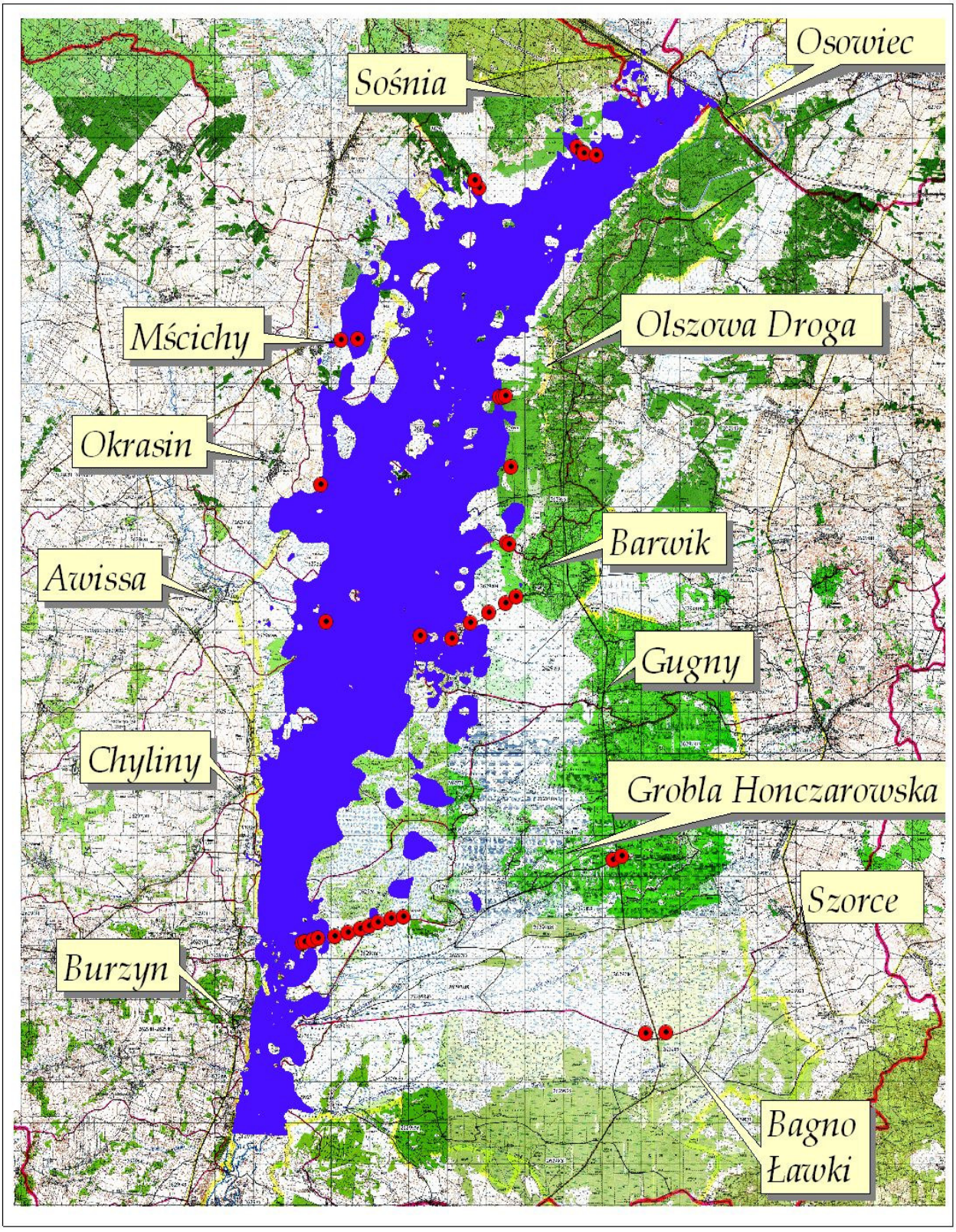
Model validation - discharge hydrograph in Burzyn



Model validation - stage hydrograph in Burzyn



Flood extend calculated by use of hydraulic model



Hydraulic Model verification

The Remote sensing method of the calculated flood extent verification

Remote sensing

- The Landsat TM images were used
  - Low price
  - image captured in the same time as river flood peak
  - Advantage: good registration of wetness and water during leaf-out period

Image processing

- **Rectification, contrast matching and image transformations (PCA, NDVI)**
- **Supervised classification**
  - Training fields (tf) determination
  - Validation of tf
  - Classification
  - Verification
- **Reclassification**
  a) Dry against wet classes
  b) Open water and deep inundated (more then 0.5 m) against rest of wet and dry classes

Image re-classification (a)

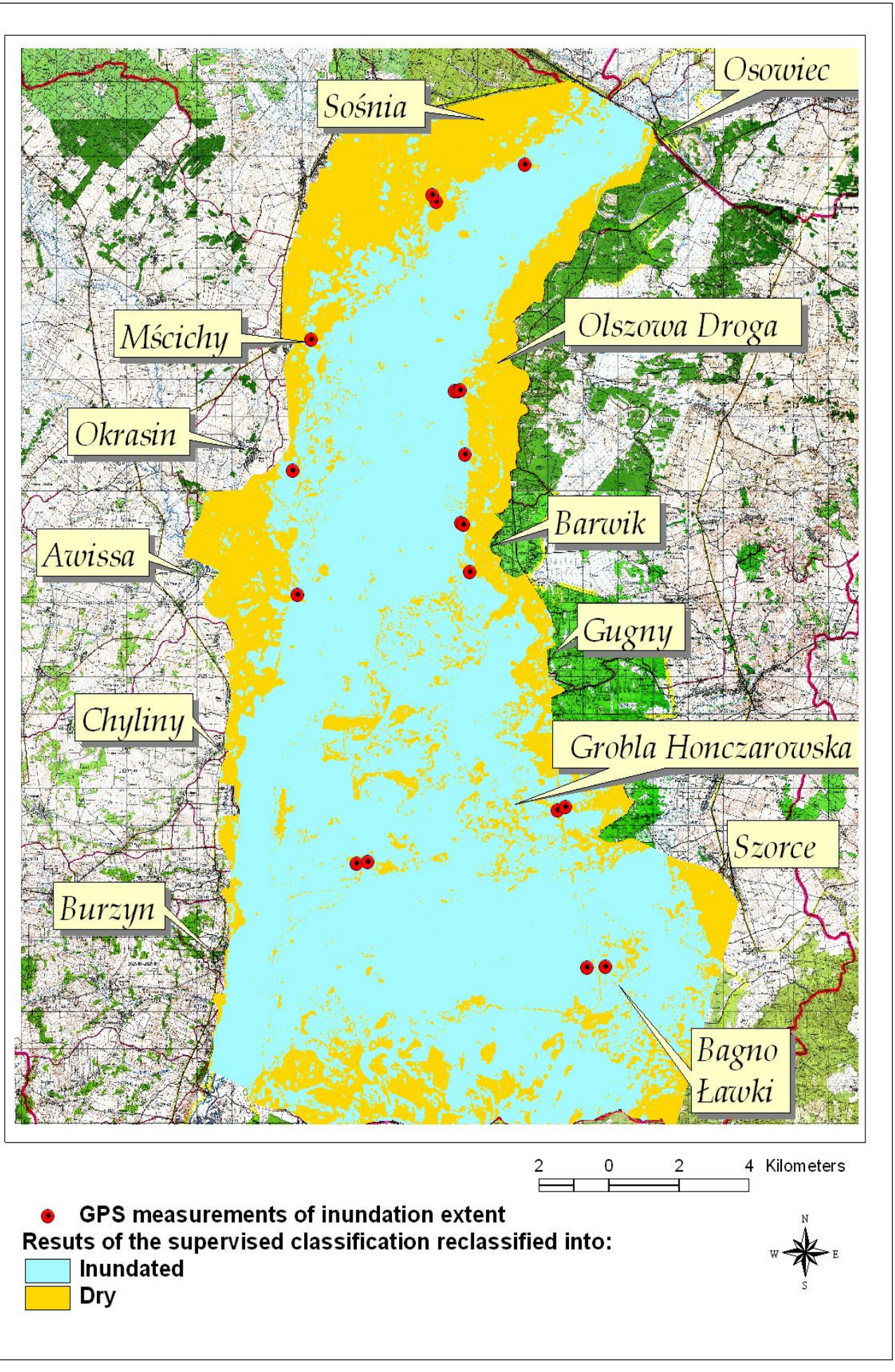
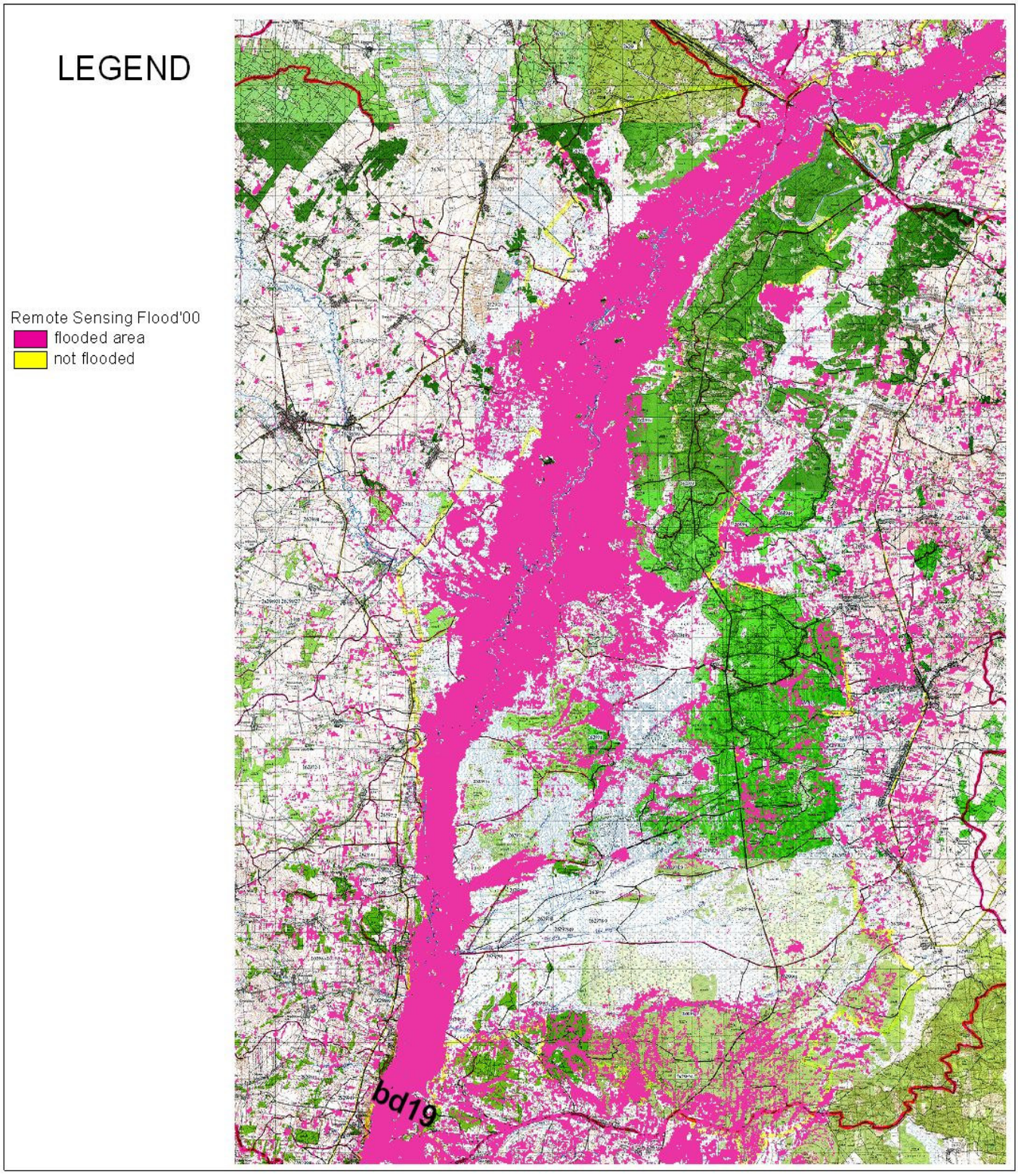


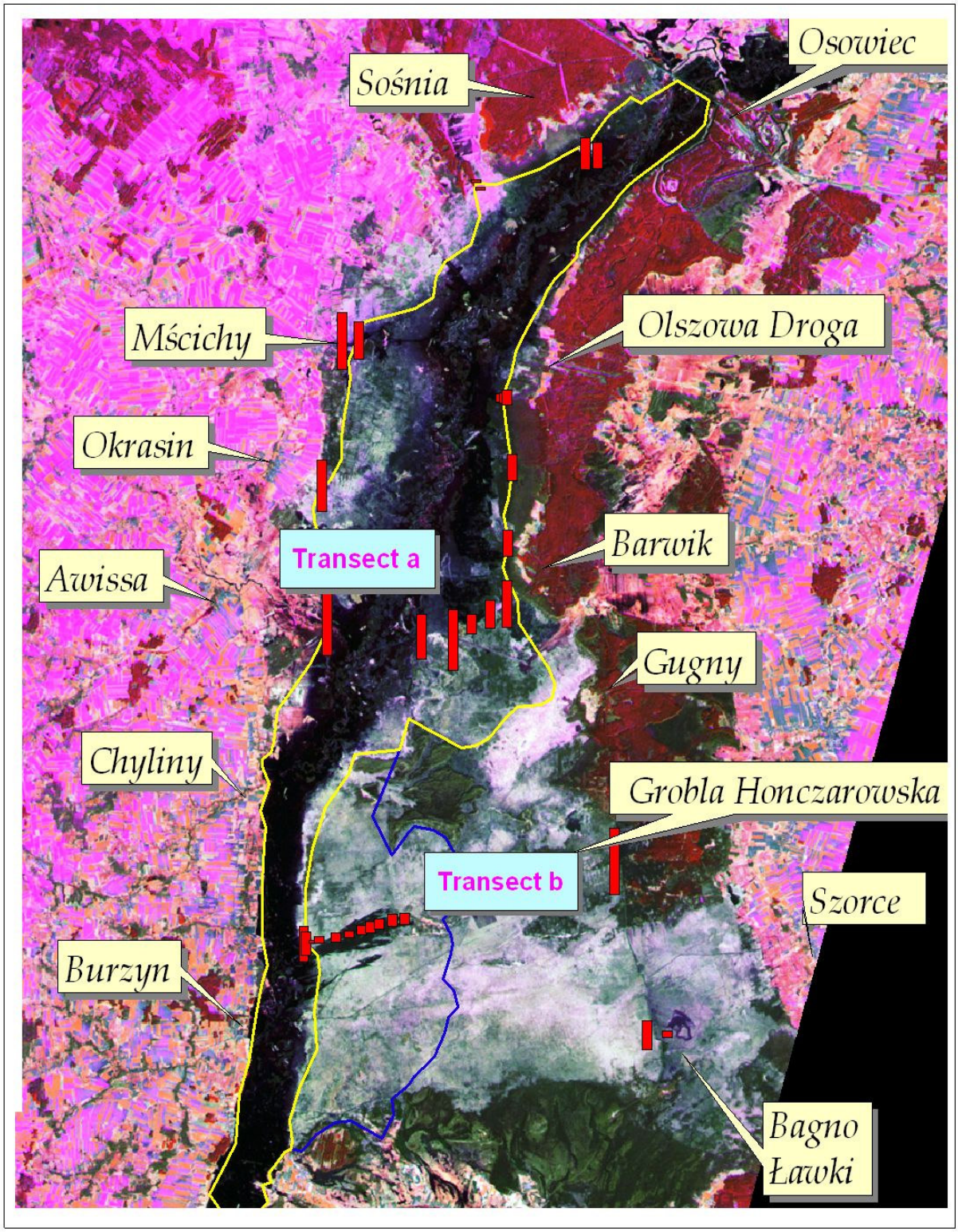
Image re-classification (b)

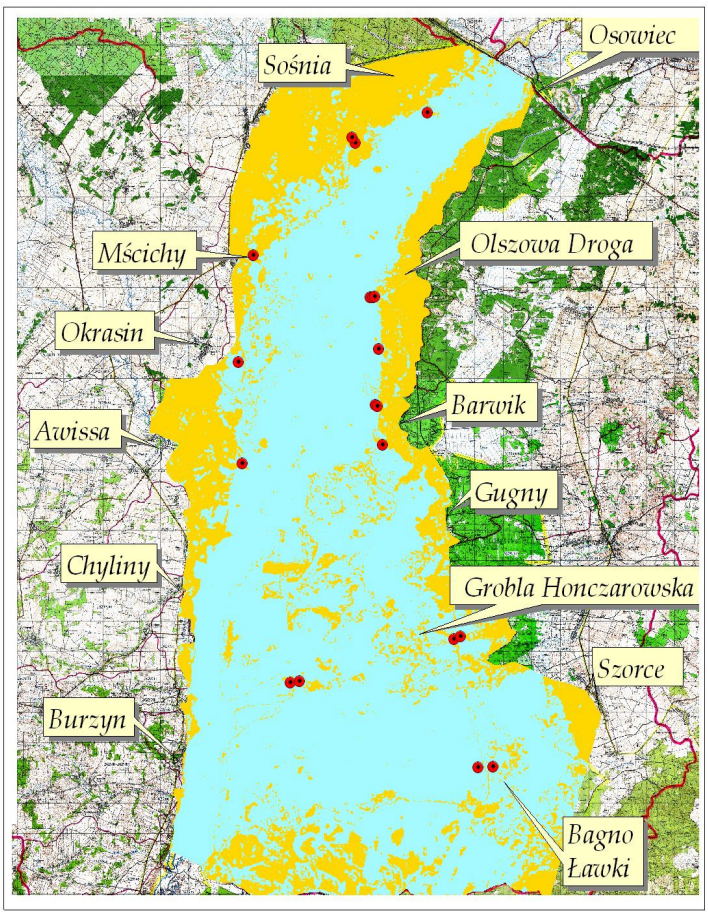


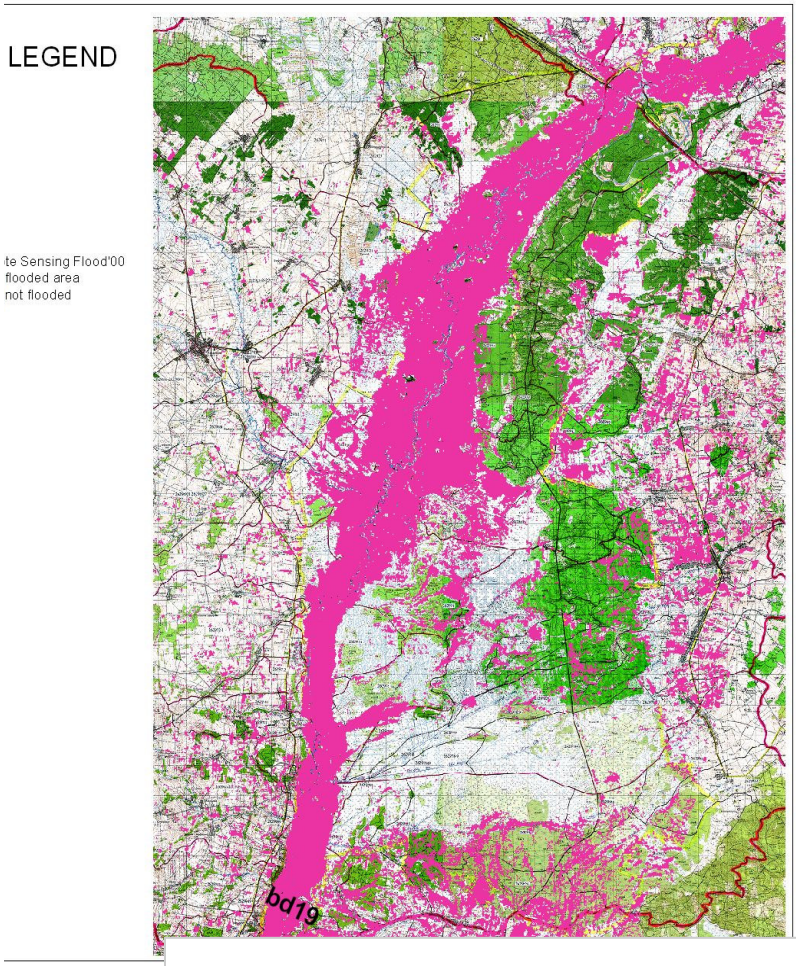
Wetland water sources

- Chemical properties as an indicator of the source of water
- The measurements of EC used for water source detection
- The river water, groundwater and snow melt water are separated from the „by river” flooded area

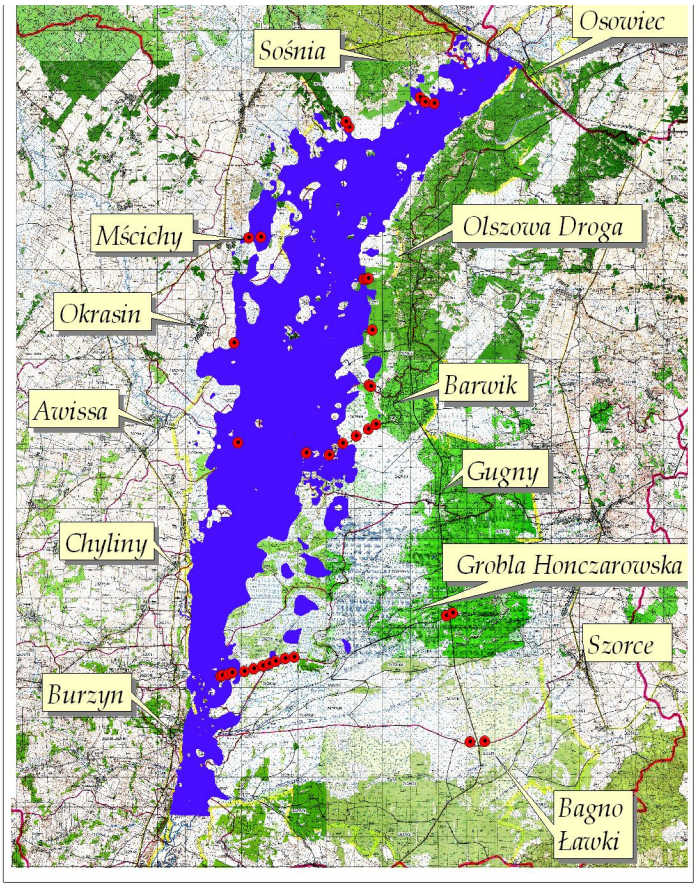
Water chemistry and visual interpretation of sattelite images




Osowiec
Sośnia
Mścichy
Olszowa Droga
Okrasin
Barwik
Awissa
Gugny
Chyliny
Grobla Honczarowska
Szorce
Burzyn
Bagno Ławki
2 0 2 4 Kilometers
GPS measurements of inundation extent
Resuts of the supervised classification reclassified into:
Inundated
Dry


LEGEND
te Sensing Flood'00
flooded area
not flooded
bd19

Discussion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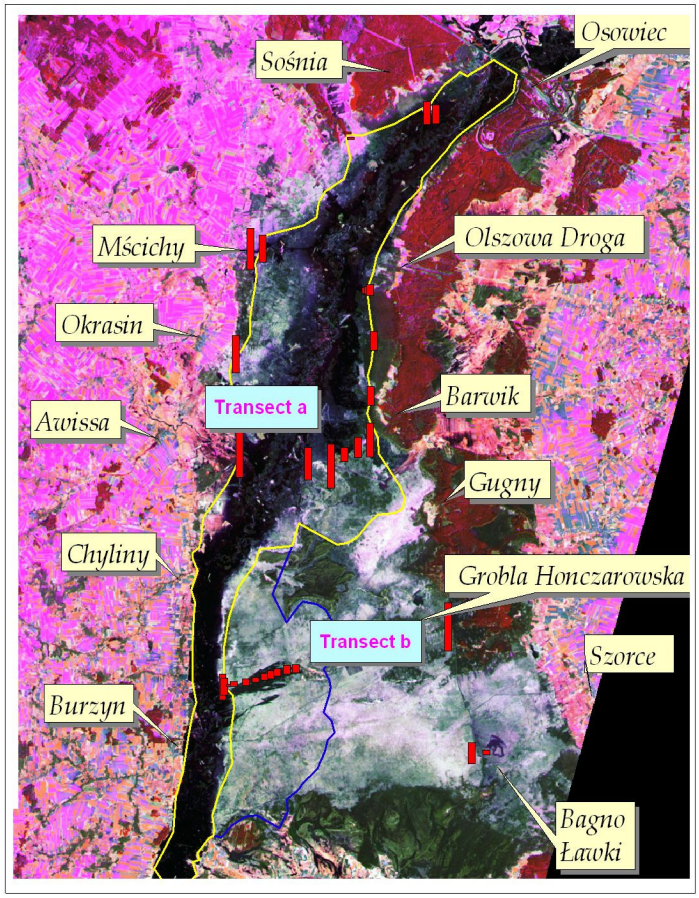
2 0 2 4 Kilometers
GPS measurements of inundation extent in 2000
Flooded area obtained by use of the GIS method for flood 2000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Transect b
Szorce
Burzyn
Bagno Ławki
2 0 2 4 Kilometers
Ec
Flood zone determination in 2000
flood border by use the GPS method (version same as in 1999)
flood border by use the integration method

Conclusion

- Remote sensing methods cannot be used for hydraulic model verification in wetlands in fully automatic way
- These analysis give not sufficient results in mixed-source wetlands
- Including a water chemistry analysis could help in determination of the river flooded from rest of inundated valley


THANK YOU