Usage of Laser Scanning Systems at Hydro Technical Structures

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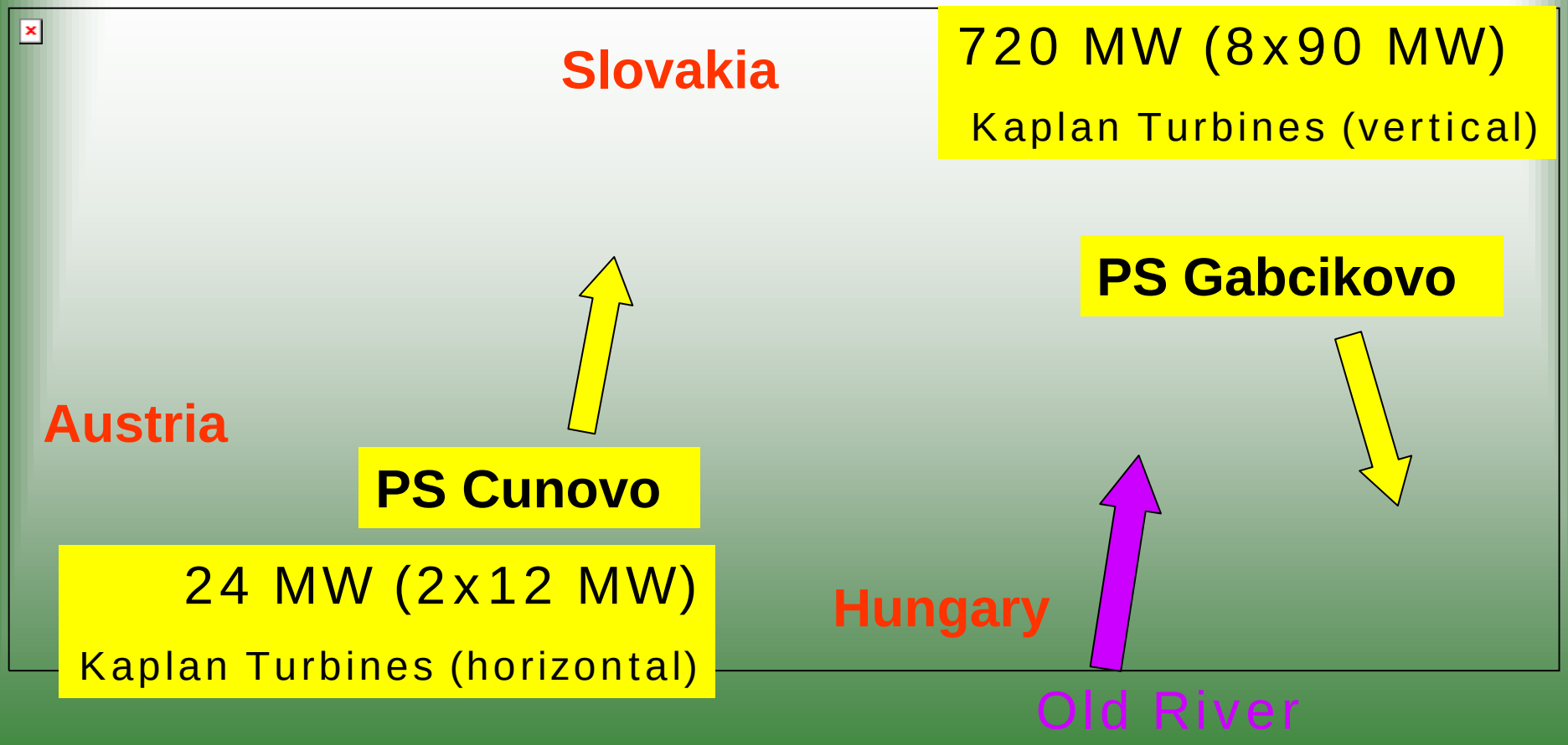
Merits

- ***Kaplan Turbine of Cunovo HPS***

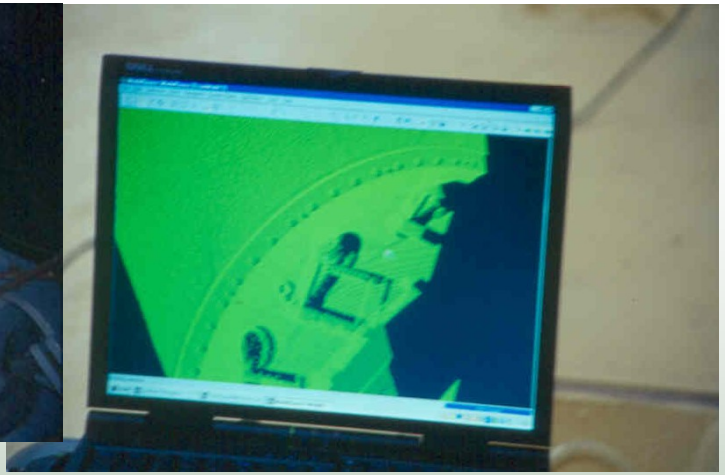
- ***Tail Bay Gate Deformations in Gabcikovo***
  - static mode
  - dynamic mode

"Application of Terrestrial Laser Scanners in Industry" – project supported by DAAD (Germany) TU Munich, Engineering Surv. and Ministry of Education (Slovakia)

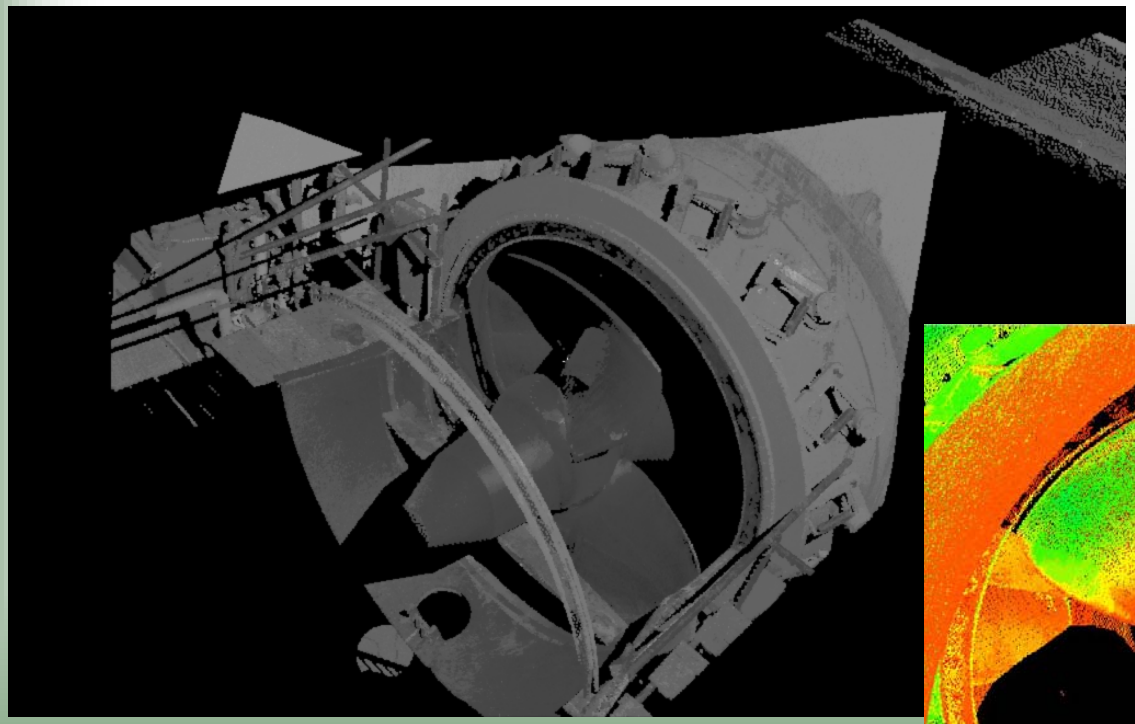
HPS System Gabcikovo-Cunovo

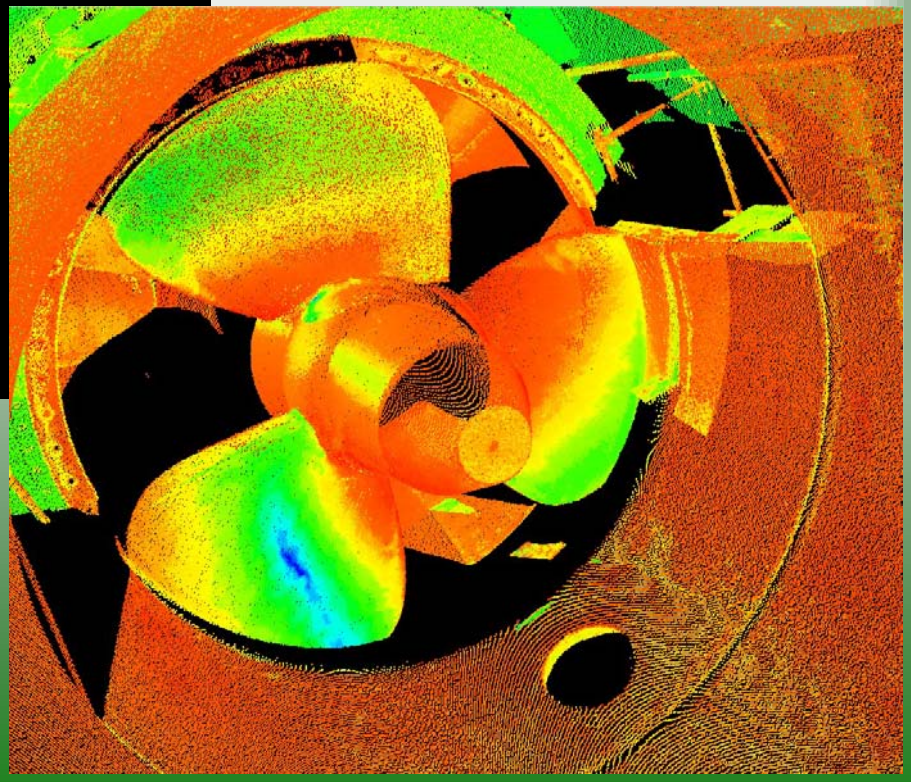


HPS Cunovo – Turbine Scanning

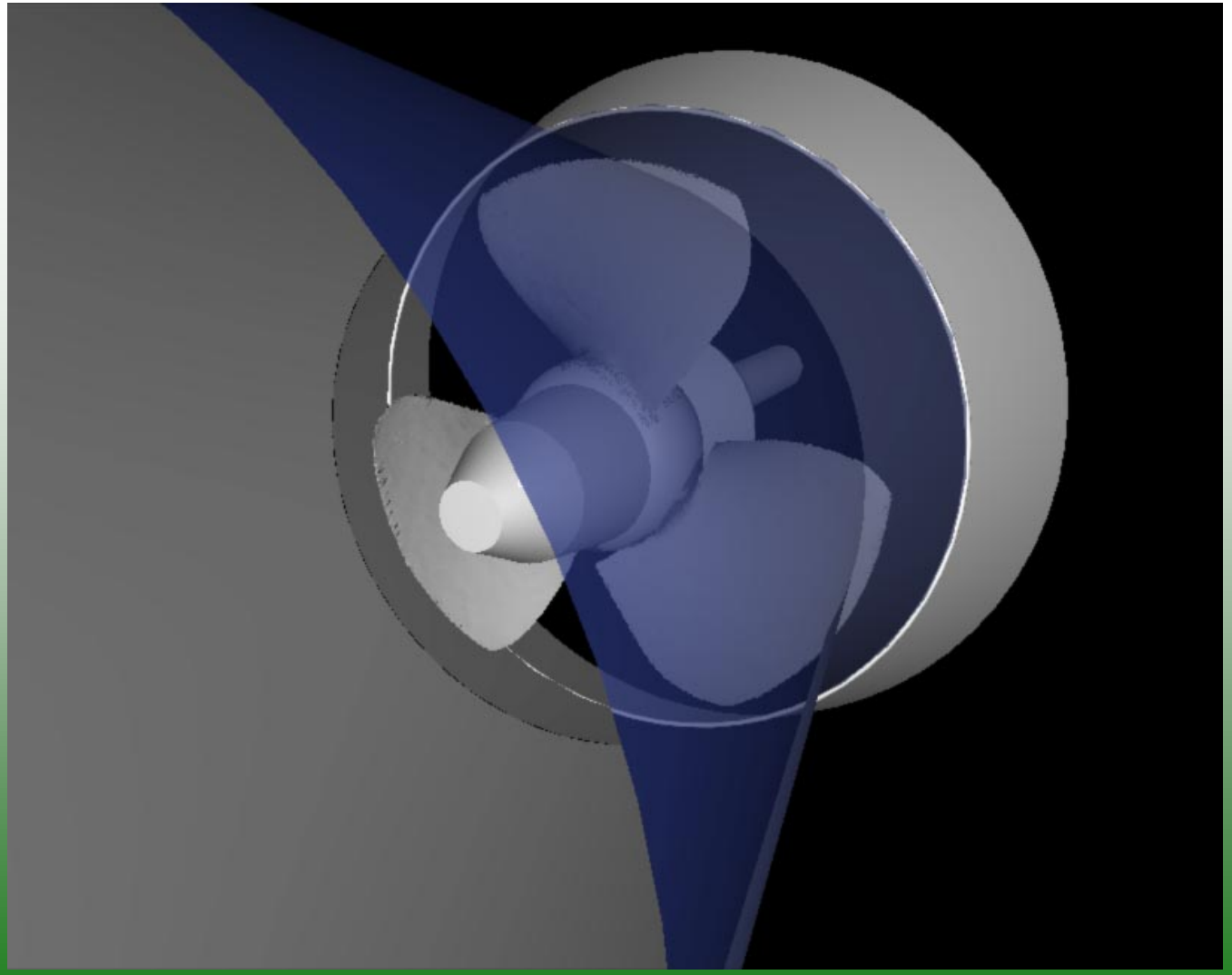


Point Cloud

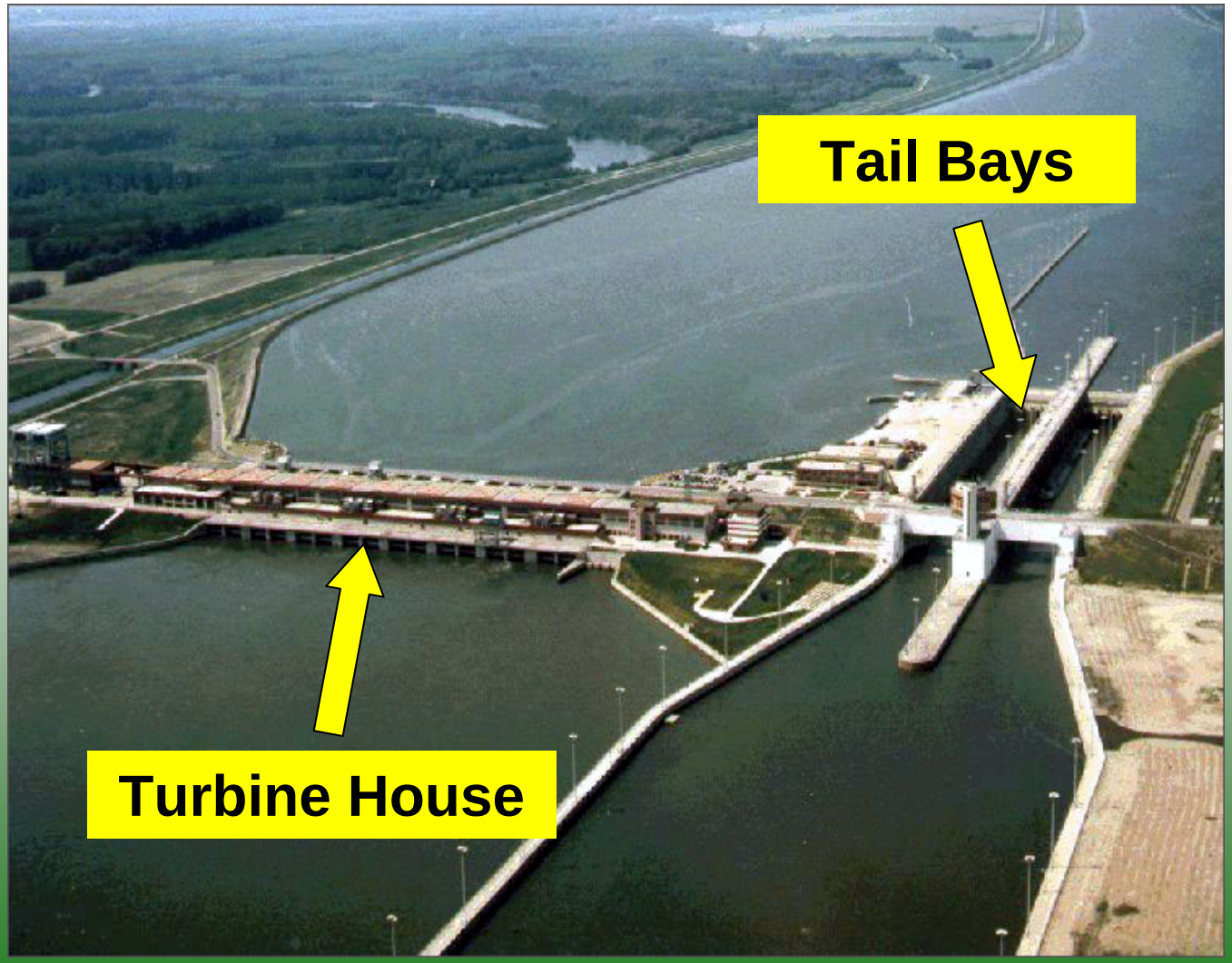




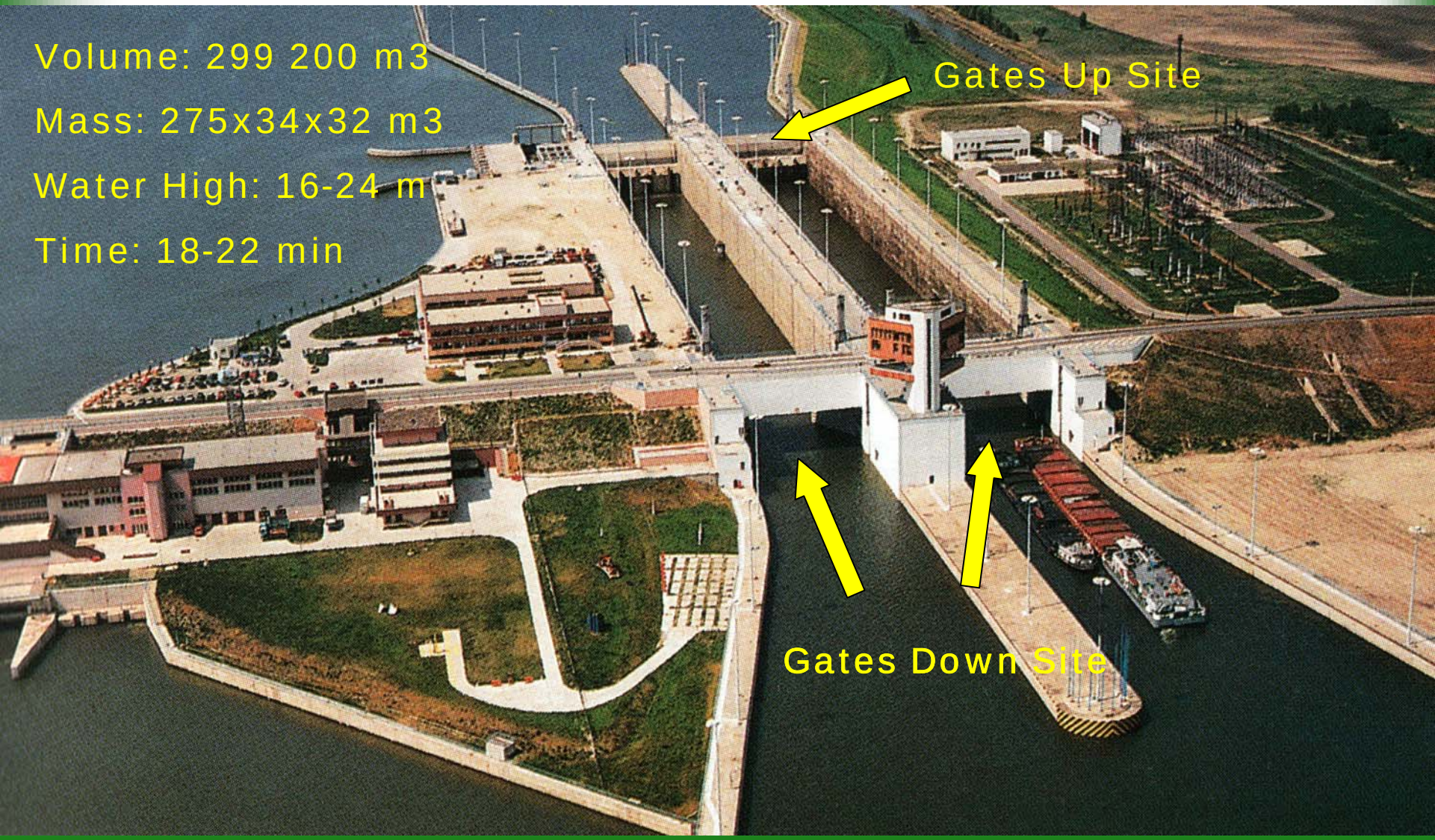
Cyclone Model



Gabcikovo Power Station

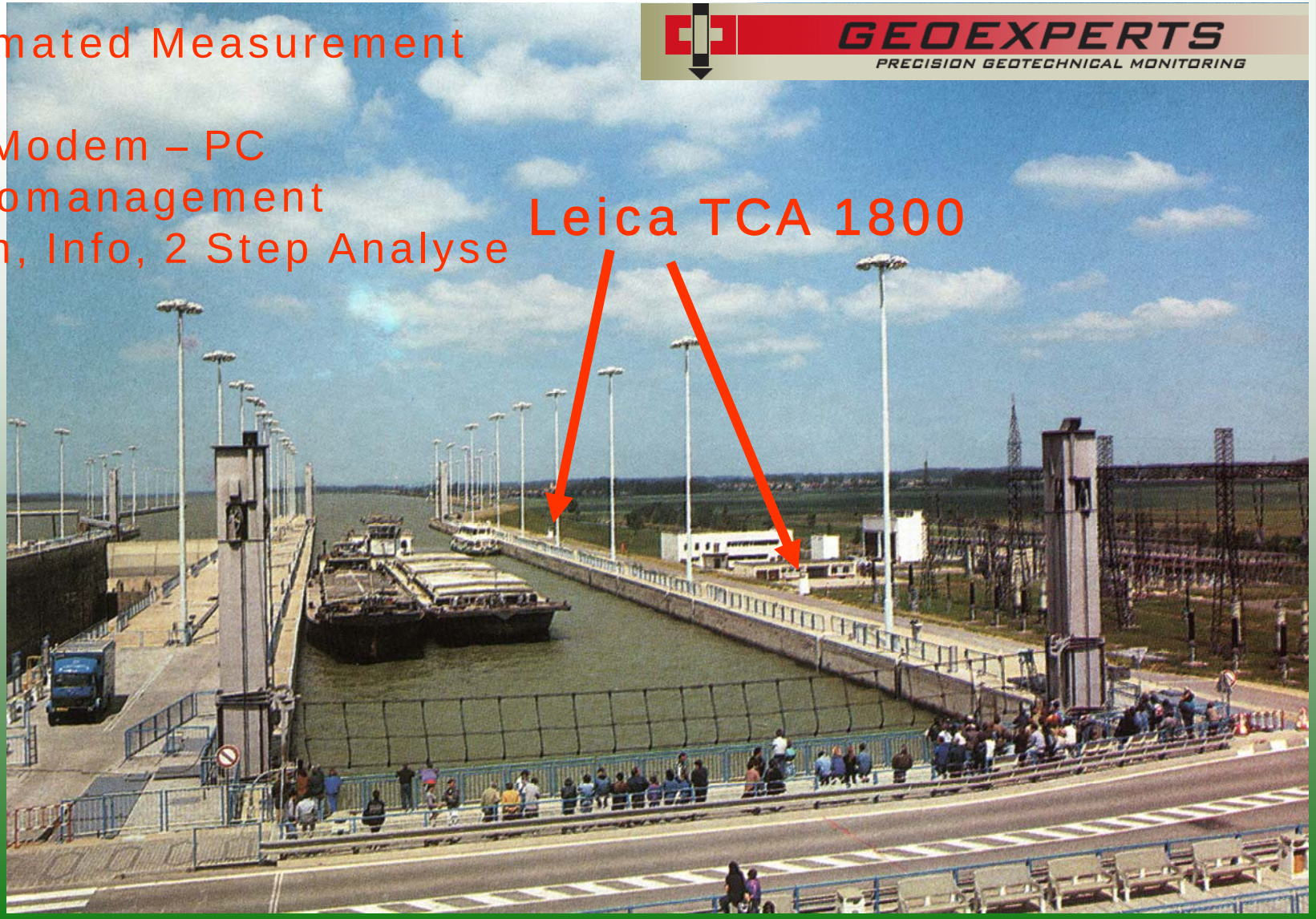


Gabcikovo Bays



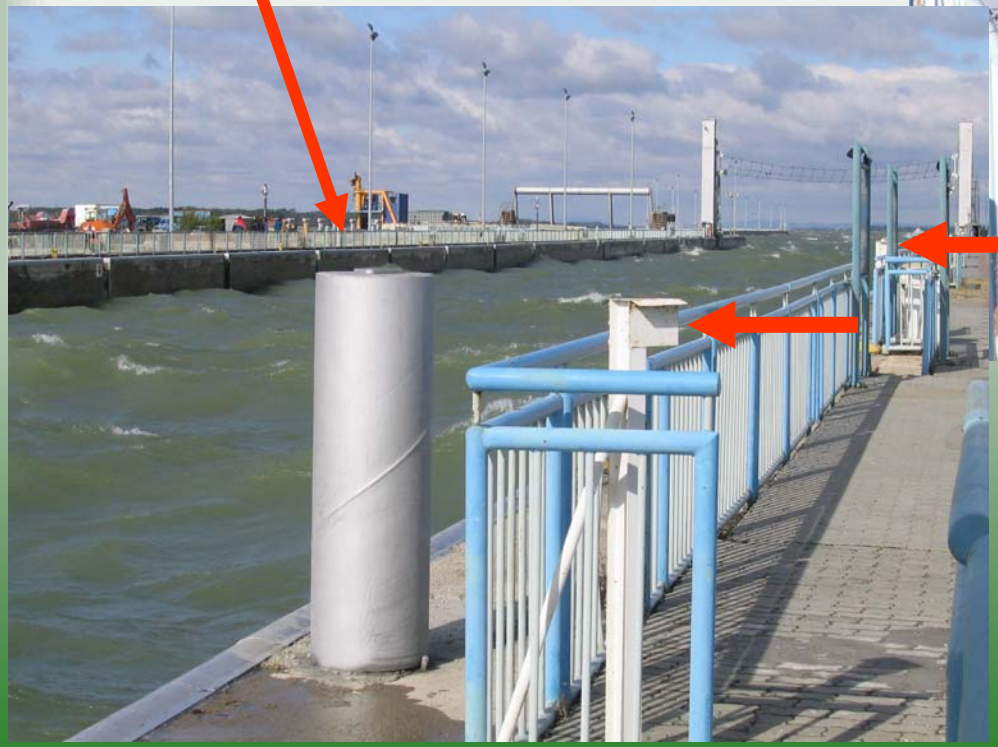
Bays – Deformation Measurement

Automated Measurement
via
PC - Modem – PC
Risikomanagement
Alarm, Info, 2 Step Analyse



Bays – Deformation Measurement

Meas. Pillars
Alignement



64 Prismes

72 Alignement Points

over 300 High Meas. Points

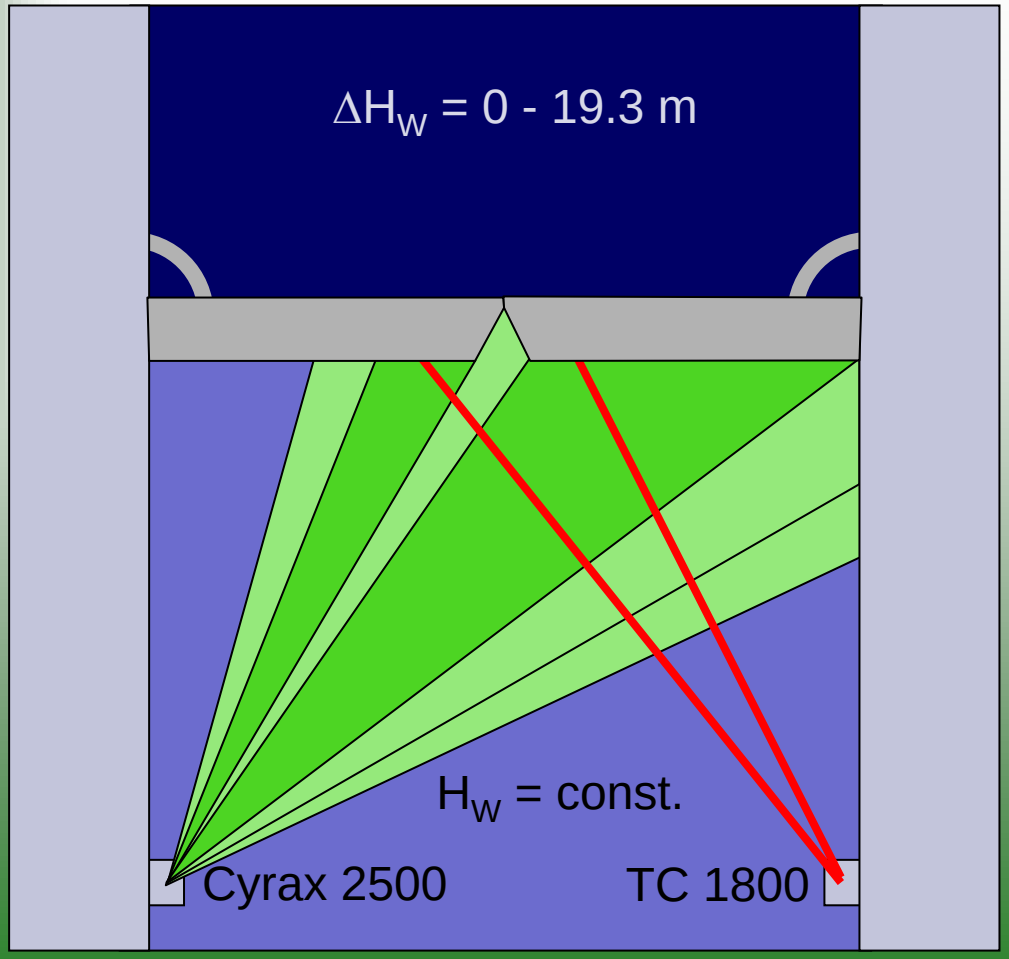
Gate Measurement

Laserscanner Station

Under Gate Dimensions:

Bright: 34 m Thickness: 2 m
High : 22 m Wight: 870 t

Gate - Measurement



1. **„statical“ Measurement**
   Scans of Gates
   (ΔH_W = 0; 4.4; 9.4; 13.0; 19.3 m)
   Point Density:
   ca.10 cm x 10 cm
   Meas. Time : ca.150 Sec.

2. **„dynamic“ Measurement**
   Scans of Central Part of the Gates
   Point Density: ca. 8 cm x 8 cm
   Meas. Time : ca.30 Sec.

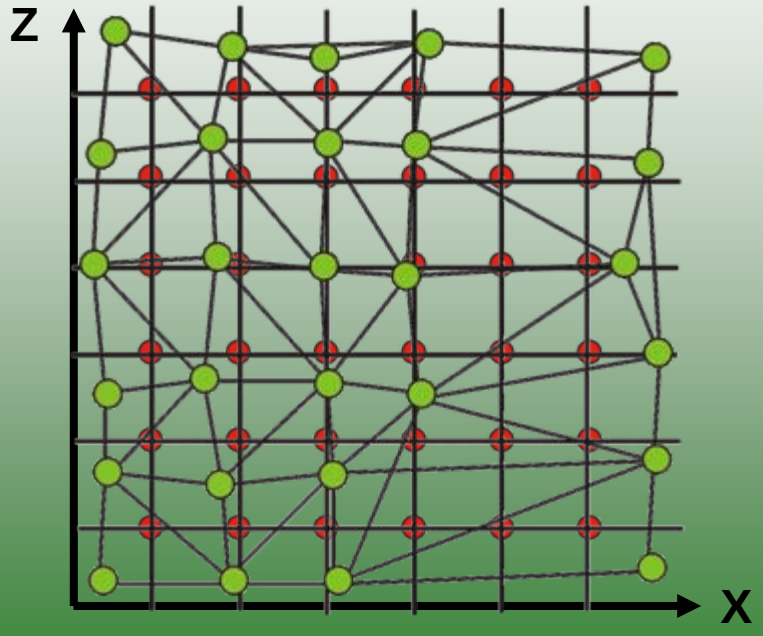
3. **Paralel Control Measurem.**
   by Tachometer
   2 Profiles, with 3 Reflector Folies

Gate – Data Processing

Transformation of non-regular Point Clouds to Grid Data (5 cm x 5 cm)

Delaunay-Triangulation

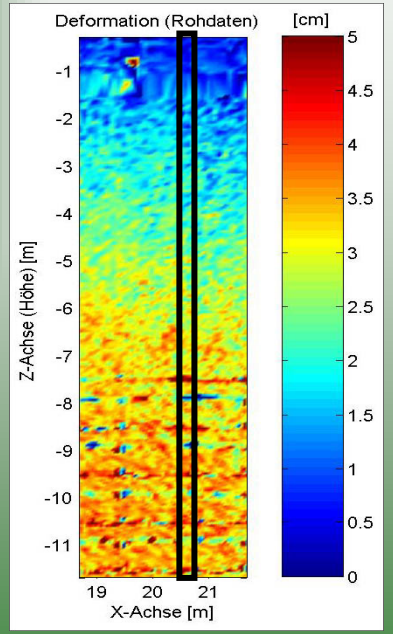
Linear Interpolation of Grid Data

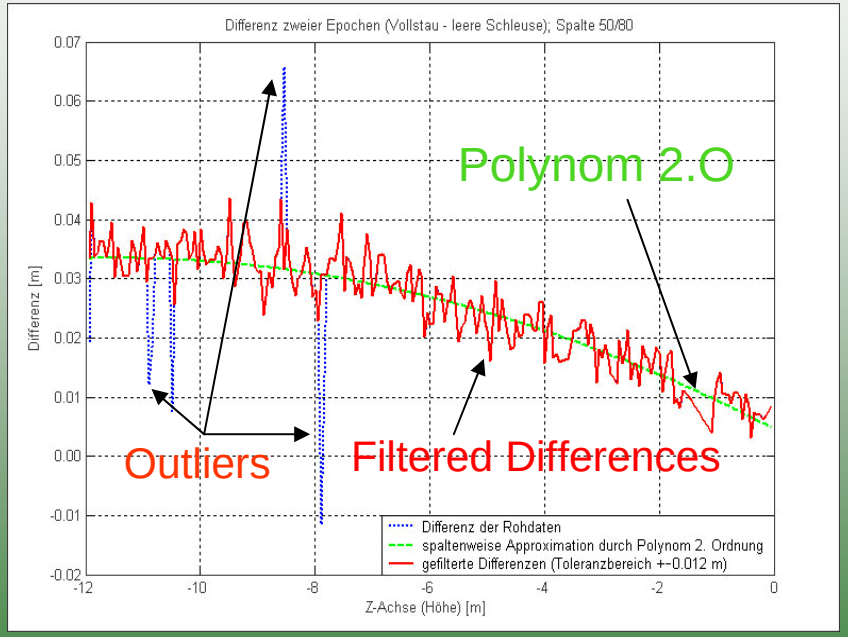


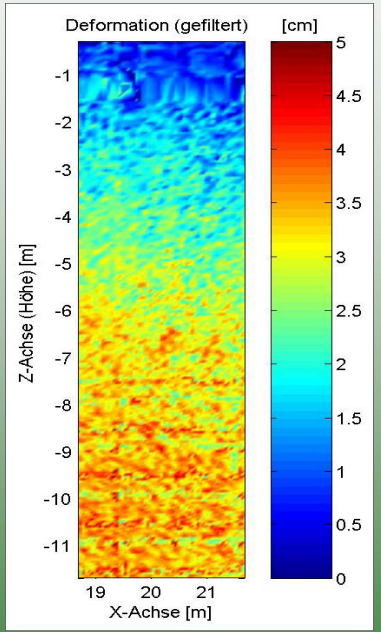
Difference of two Data Sets - Deformation = ΔY

Gate – Data Processing

- Data Control at Original Point Clouds
  - Selection of Gate Parts
  - Filtering of „Waterfalls“
- Filtering of Outliers (Water Drops) of Differenz Data



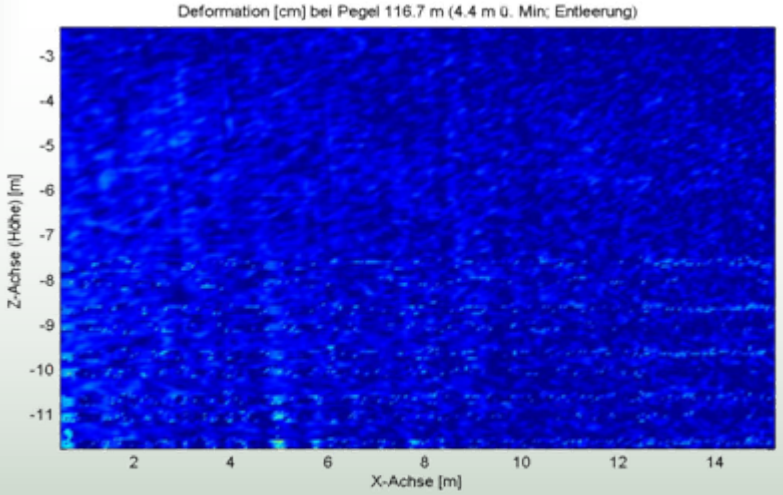




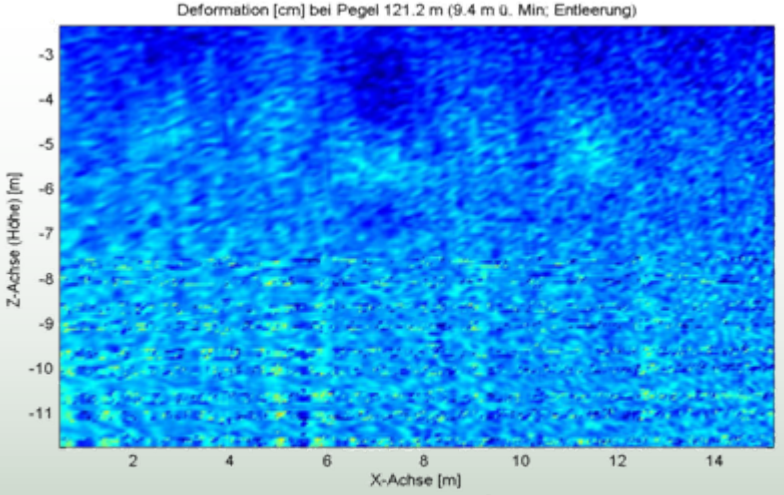
Adjusted Curve (Polynom 2.0)
Max. Variance ± 8.4 mm

Gate - Interpretation

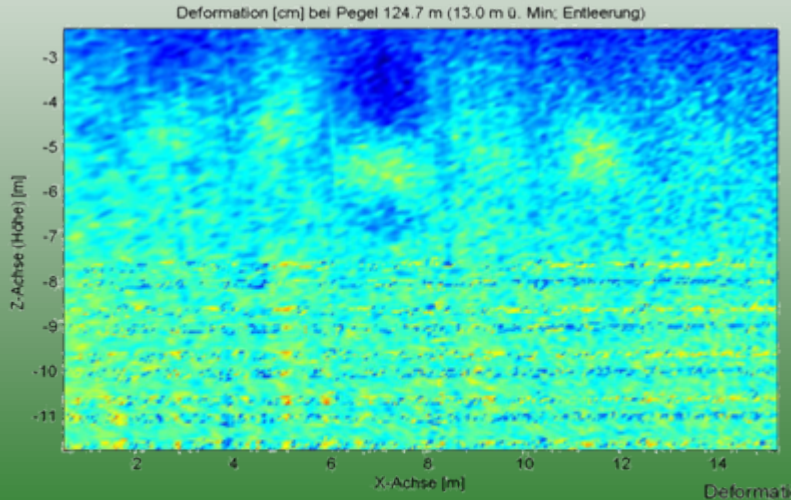
$\Delta H_W = 4.4$ m



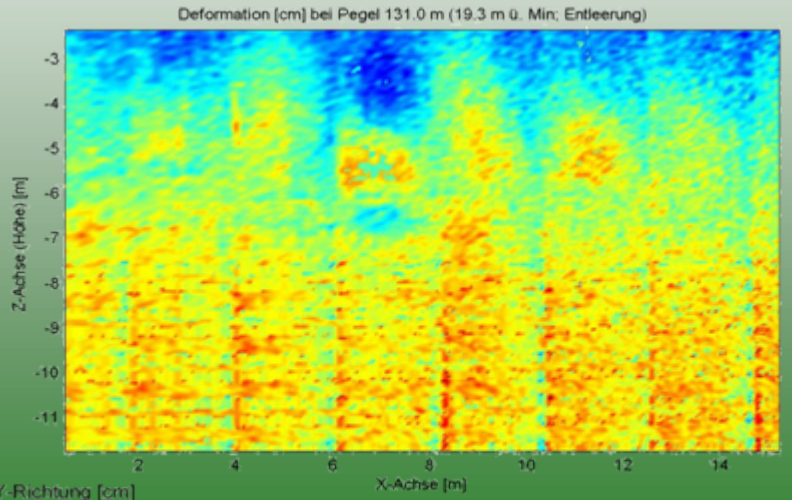
$\Delta H_W = 9.4$ m



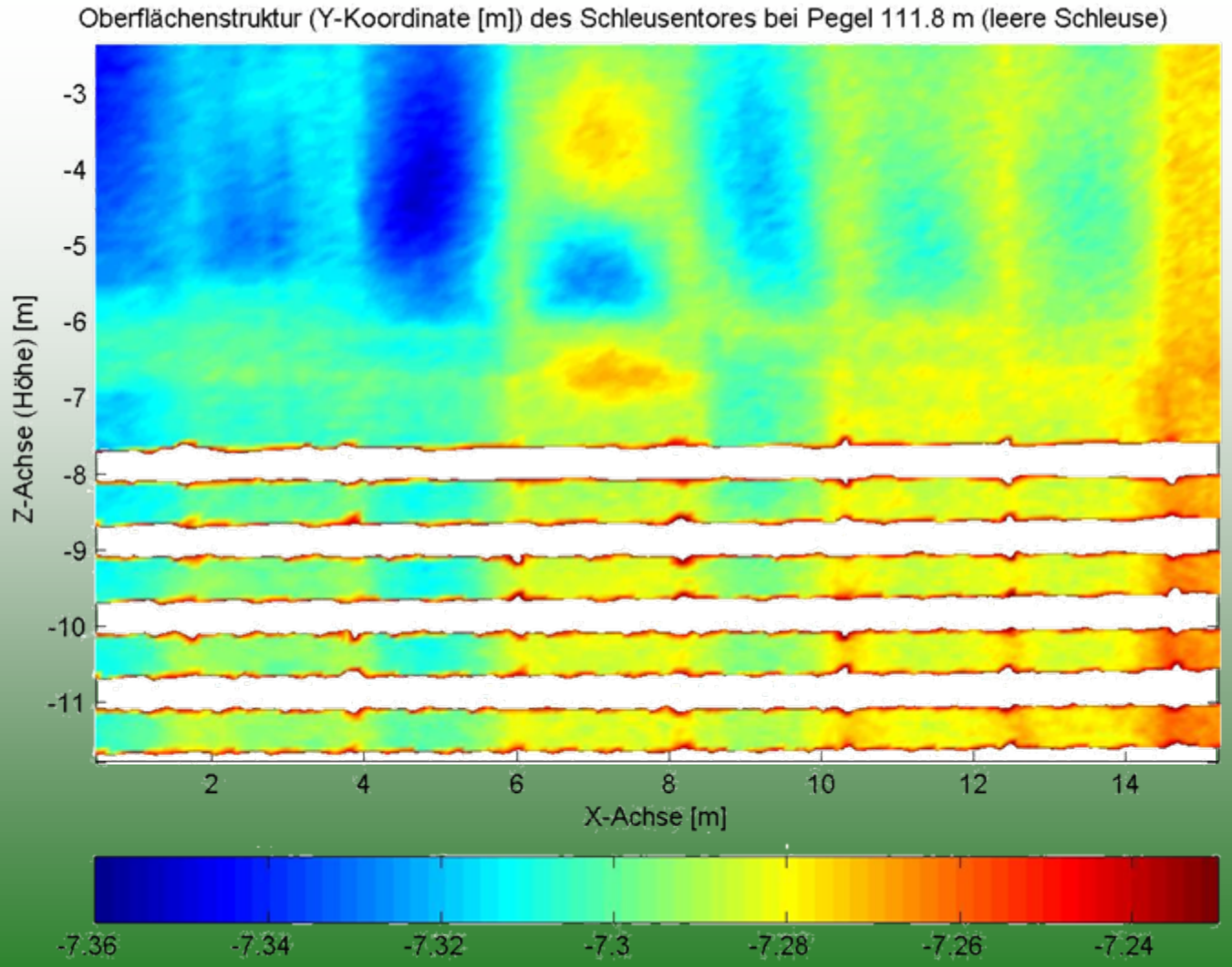
$\Delta H_W = 13.0$ m



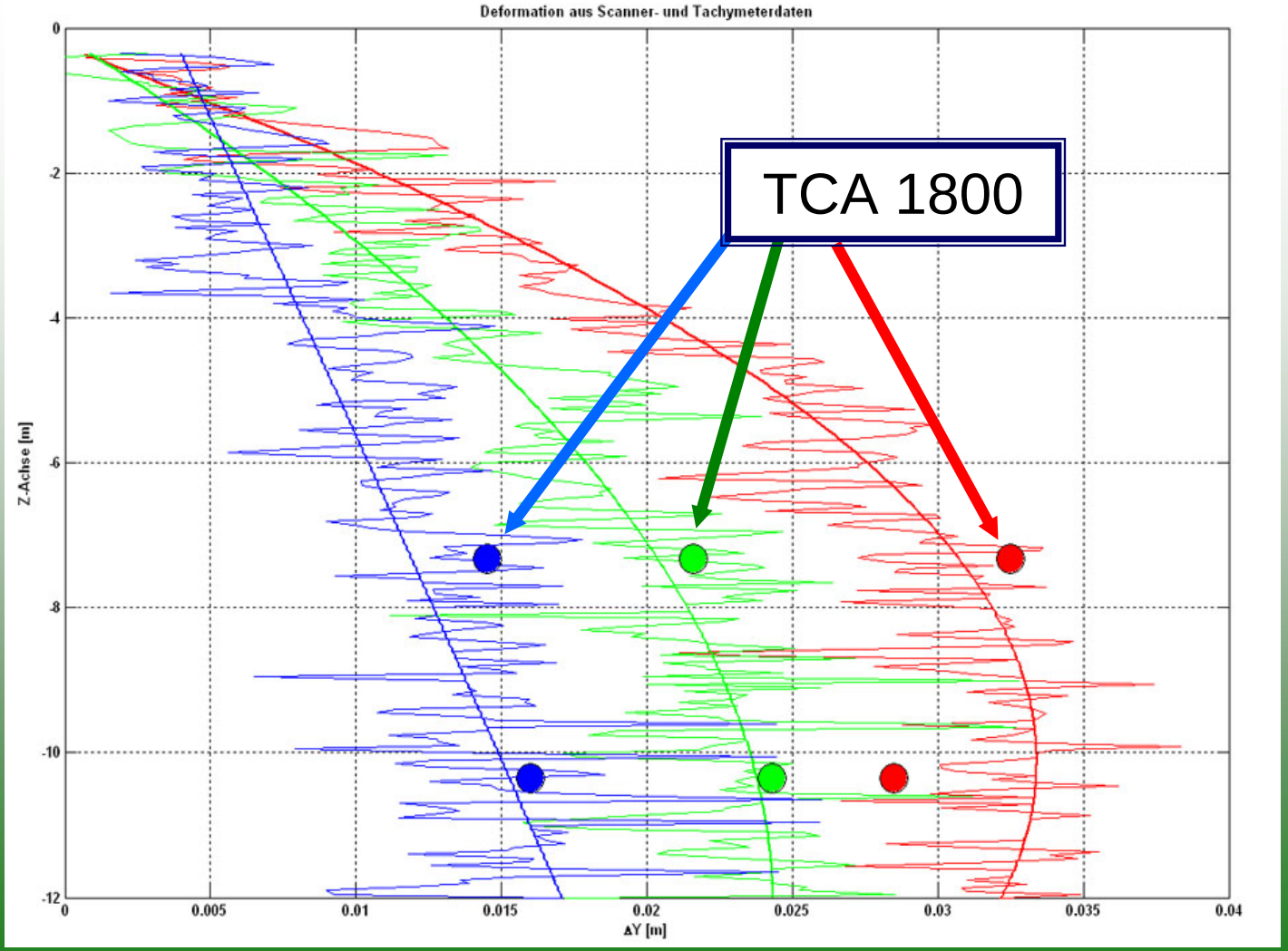
$\Delta H_W = 19.3$ m



Gate - Interpretation

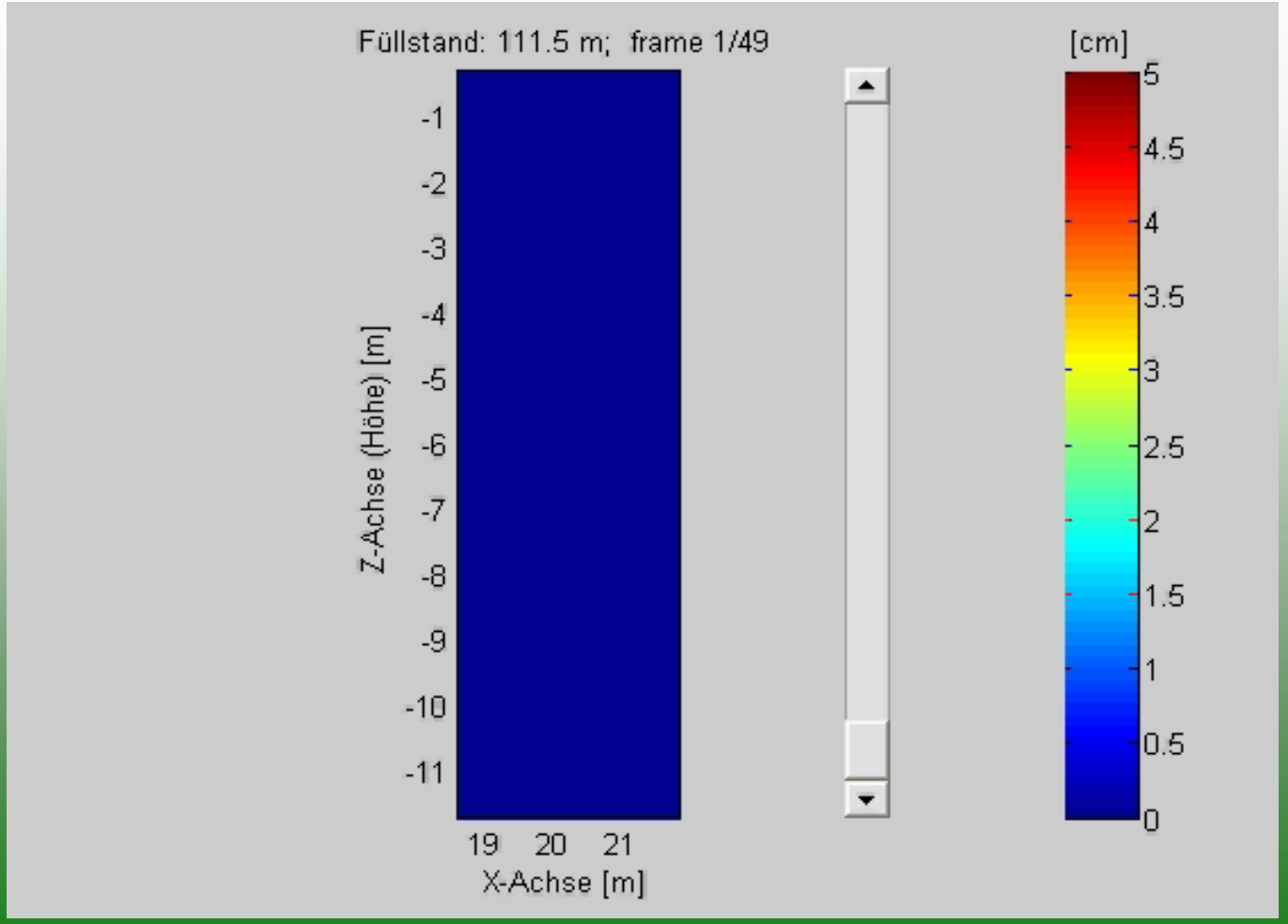


Gate – Data Analysis



Gate – Dynamic Visualisation

Animation created by 49 Difference Pictures of the Bay Filling



Conclusions and remarks to the future

- *TLS are use full for deformation measurement at hydro-technical structures*
- *TLS can measure deformations*
  - static mode 2-3 mm
  - dynamic mo
- *data analysis*
  - errors caus *ater falls”*
  - dark coloured parts (water flaws)
- *industry applications – higher accuracy and calibration*
- *dynamic applications – higher measur. frequency*
- *final valuation – positive*

Thank you for your attention!