



## Preliminary Adjustment of New Coordinate System S-JTSK/05

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### Realization of the new cadastral positioning system: **S-JTSK/05**

System consists:

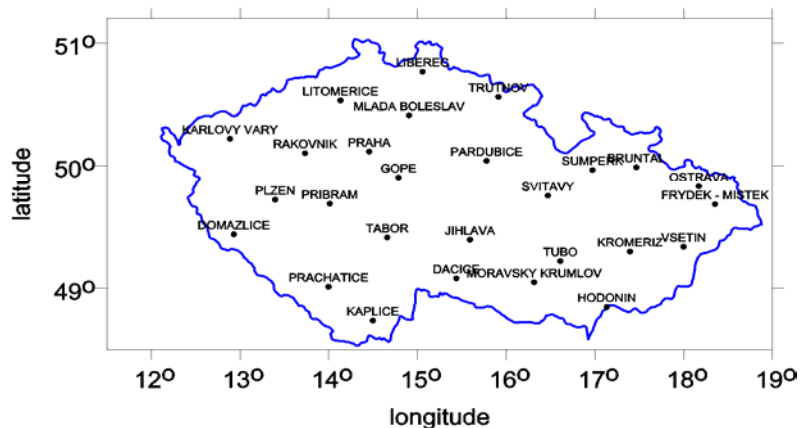
- Elipsoidal coordinates  $B, L, H$  in ETRS89 (2005) system
- Planar coordinates  $Y, X$  in special Czech cartographic “Krovak projection”
- ***Exact mathematical relation exists between both type of coordinates.***
- Normal heights  $h$  in “Balt” system

## System is densification of ETRF89 (2005) in CR

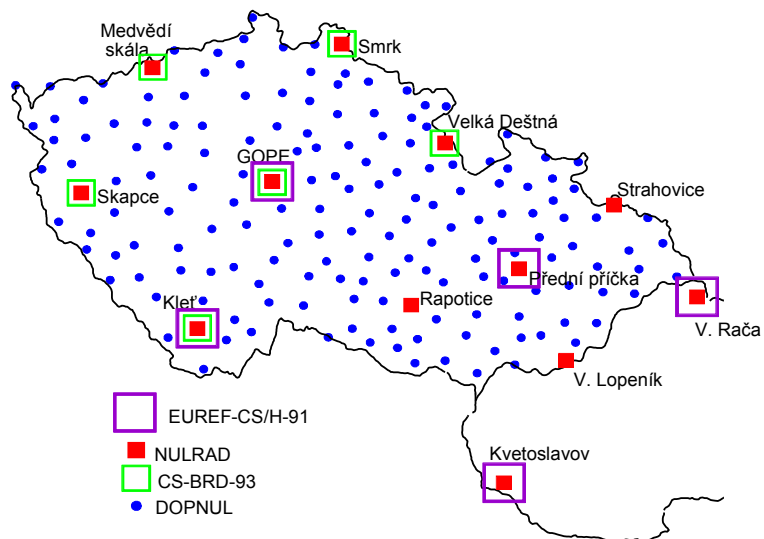
- New measurement – GNSS technology
- using:
  - CZEPOS network
  - remeasurement of “old” DOPNUL network
  - results of “selective maintenance” campaign – Survey office Praha (1996-2006)
  - results of „densification” project – Cadastral Offices (1994-2007)
- New evaluation

## CZEPOS network

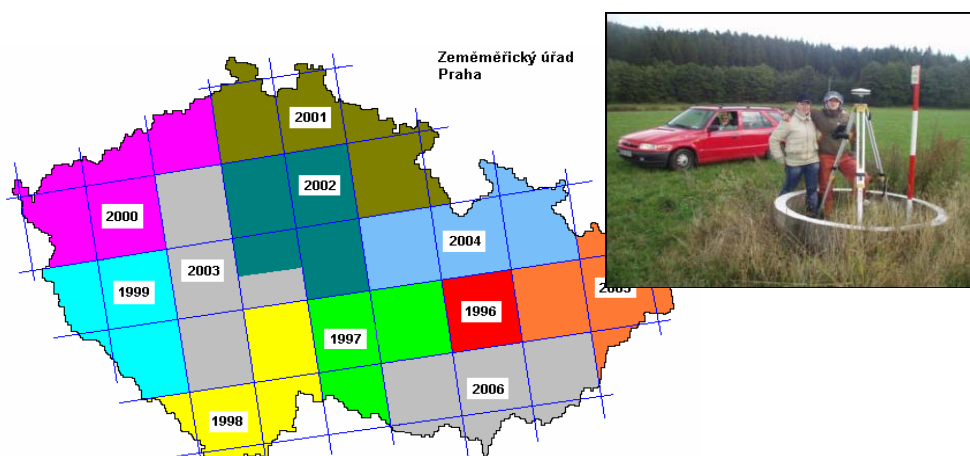
**Stations of the CZEPOS GNSS permanent network  
- status December 2006**



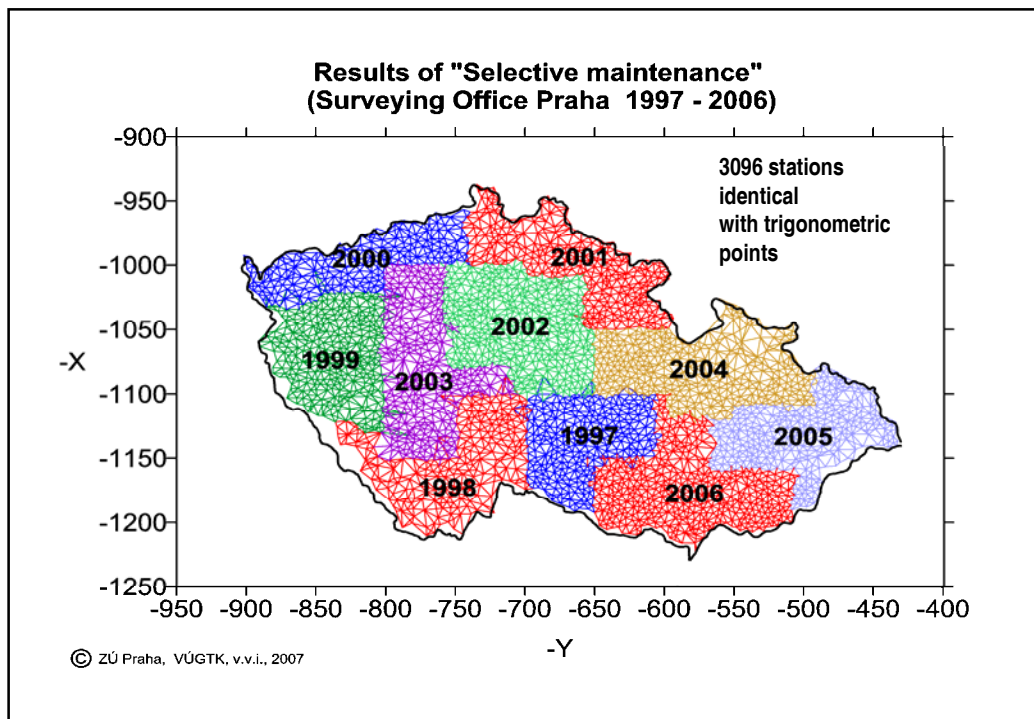
## DOPNUL network remeasured 2006



## Plan of “selective maintenance” measurements



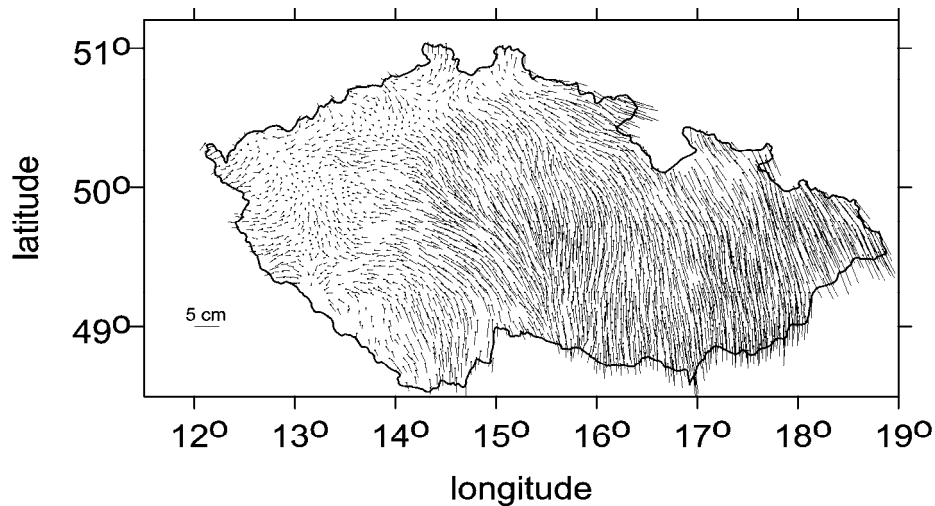
**aim: 4 point in one triangulation section (10 x 10 km)**



### Evaluation by GNU GAMA software developed at Czech Technical University

- network adjustment of GPS vector is defined as a mathematical model of adjustment on ellipsoid
- numerical solution of the sparse matrix of normal equations is implemented using a simple *envelope* memory model
- adjustment of observations with generally non-diagonal (banded or full) covariance matrix
- both inputs and outputs in XML format
- database system PostgreSQL
- for checking adjusted station coordinates we used an older result of adjustment of the DOPNUL stations (by M. Skala, software GPSurvey 2.35 and TRIMNET Plus 92.11c and height transformation by WGJT2ZU).

Fixed of DOPNUL points, other free  
 Positional differences while first adjustment with  
 erroneous coordinates of some fixed points



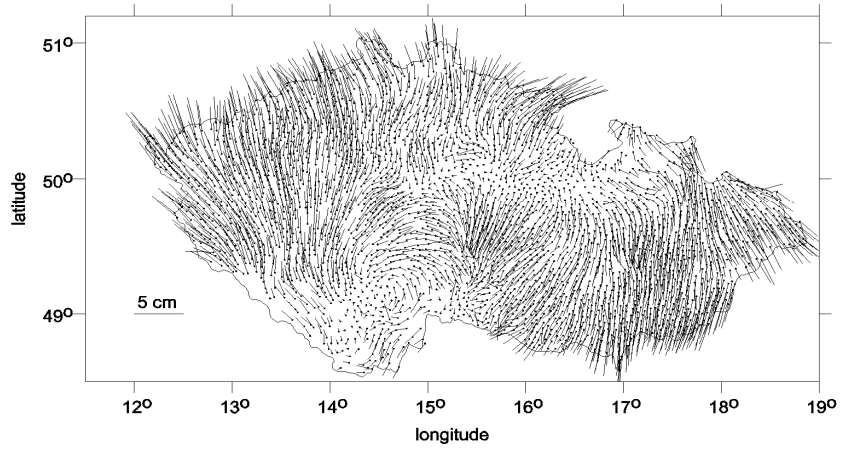
## Free network adjustment

Table:

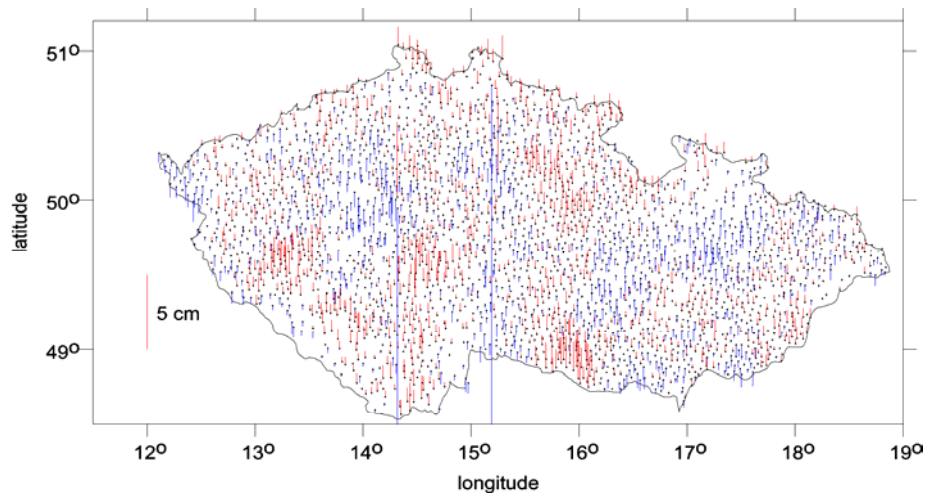
NUMBER OF PARAMS	9291
NUMBER OF EQUATION	28626
DEFECT OF SYSTEM	3
REDUNDANCY	19338
SUM OF SQUARES	9.82001e+10
APOSTERIORI VARIANCE	5.07809e+06
TIME OF CALCULATION	164 sec.

## Positional differences

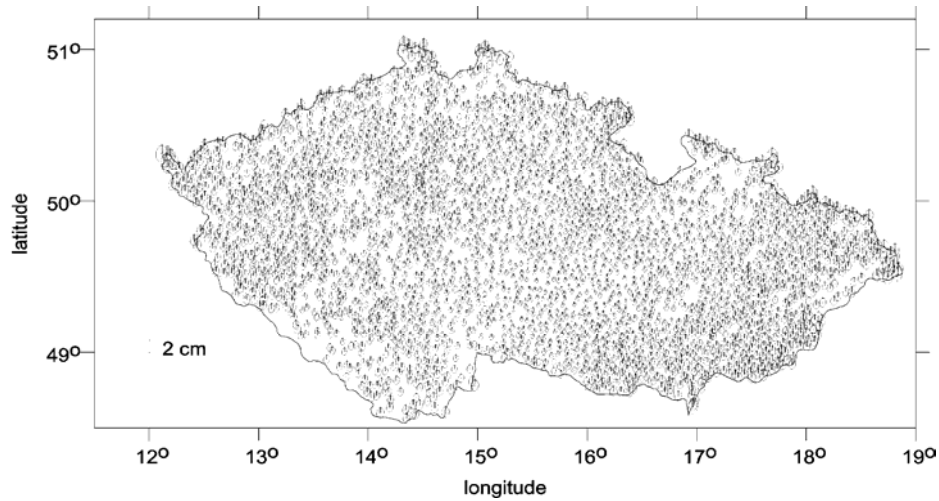
ZU vs. free network



## Differences in altitude



## Error ellipses



## Fixed DOPNUL points, other points free

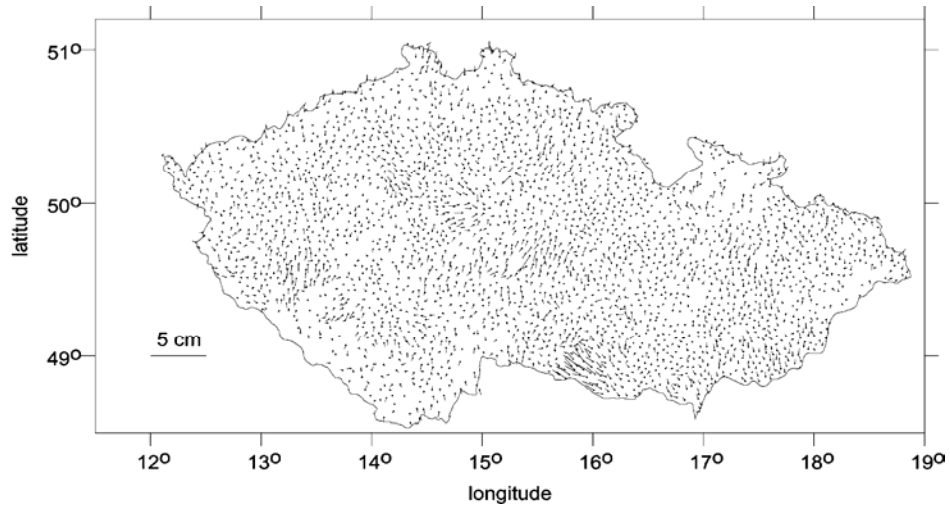
- **Table:** Basic Parametres of Adjustment

NUMBER OF PARAMS	8775
NUMBER OF EQUATION	28626
DEFECT OF SYSTEM	0
REDUNDANCY	19851
SUM OF SQUARES	1.33012e+11
APOSTERIORI VARIANCE	6.70050e+06
TIME OF CALCULATION	32 sec.

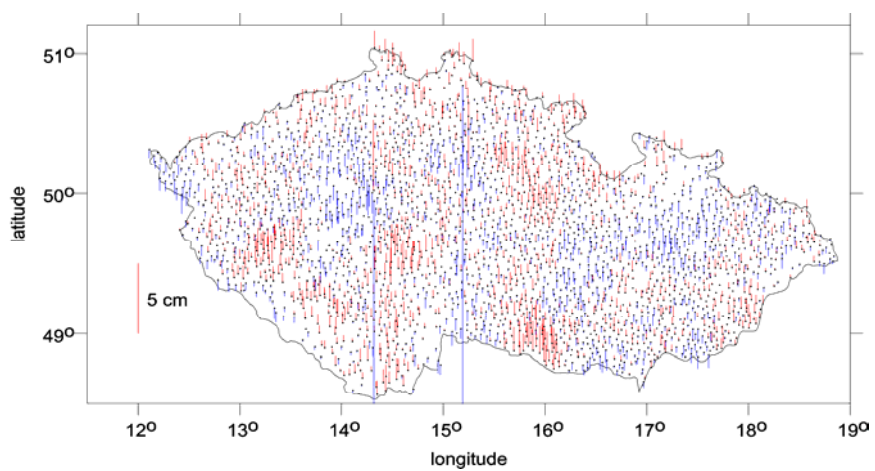
- **Example:**

```
<point><id>06050250</id>
  <n-free/><dn> 6.692</dn><ind>1</ind>
  <n-free/><dn>-0.369</dn><ind>1</ind>
  <n-free/><dn>-4.067</dn><ind>1</ind>
```

### Positional differences after comparison with ZU preliminary results

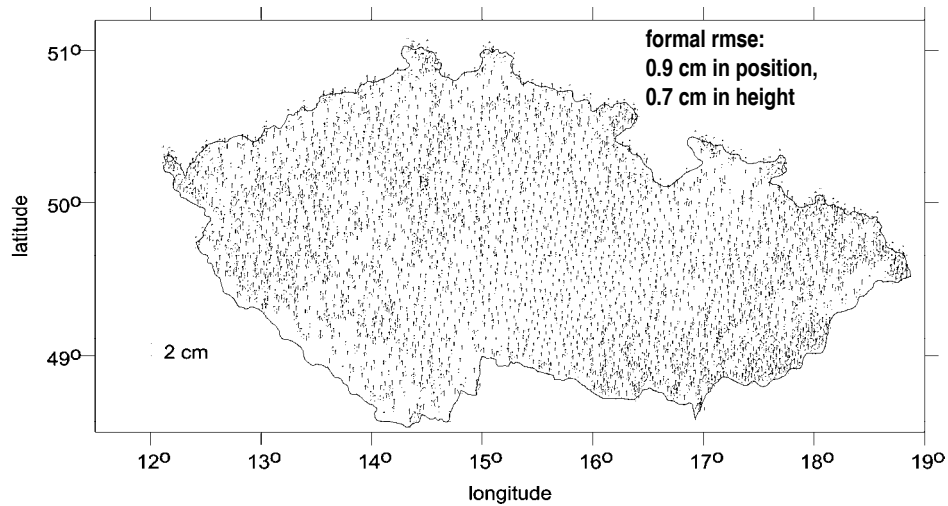


### Differences in altitude



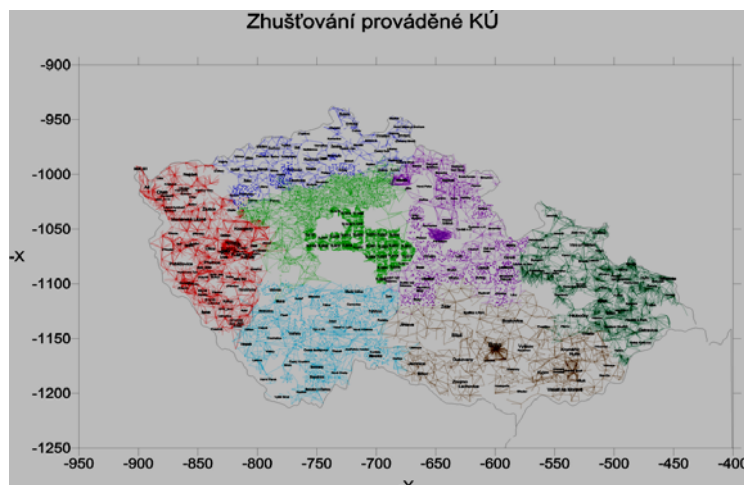


## Preliminary results of densification



## Further densification

Project „densification“, approx. 30000 GPS points connected with “selective maintenance”

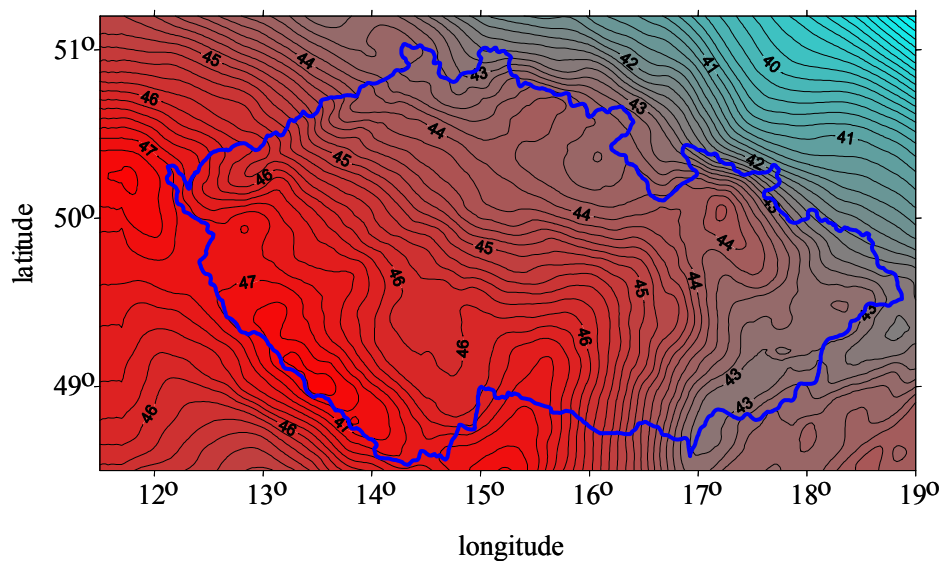


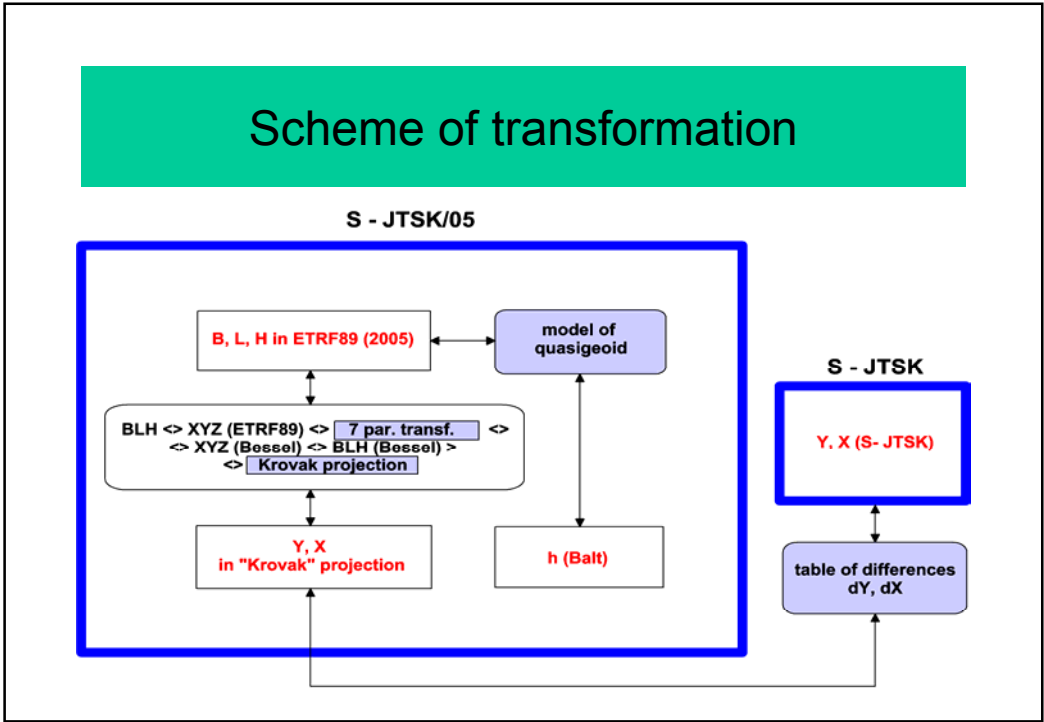
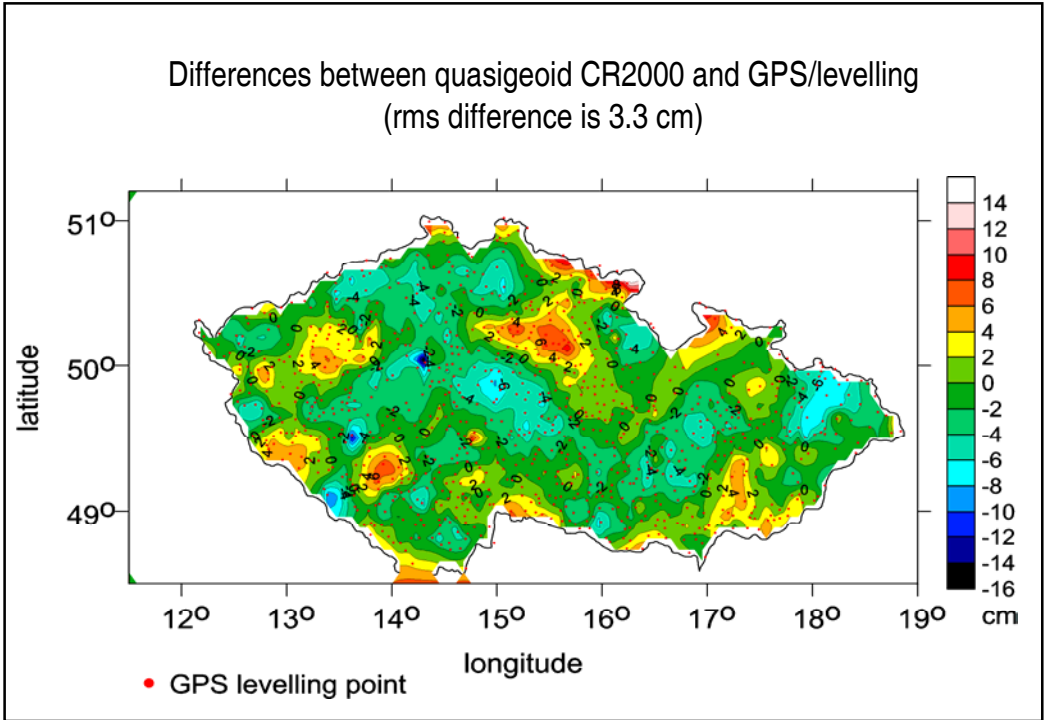
## New cadastral system S-JTSK/05

- connection of ETRF89 (2005) coordinates by 7par transformation and cartographic projection with planar coordinates Y,X in special Czech “Krovak projection”
- relation with old system S-JTSK by table of differences (dY, dX)

### Heights

Gravimetric quasigeoid - solution CR2000  
(isolines in meters with respect to ellipsoid GRS80  
in coordinate system ETRF89)





## Conclusions

- S-JTSK/05 – supposed **homogenous, precision 1 cm/5 km, no local deformations** (old S-JTSK has 1 cm/1 km + local deformations)
- Main advantage – direct transformation between ellipsoidal coordinates (GNSS) in ETRF89 and planar projection coordinates Y, X
- useful for practical geodetic application of high precision

Thank you