The Stage and Future Plans in Development of Slovak Permanent GNSS Service

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Multi-functional GNSS,
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SLOVAKIA

Capital Bratislava

Area 49 034 sq.km

Population 5,4 mil

Territrory is divided into :

8 regions,
79 districts,
2 834 municipalities,

3 524 cadastral areas

Authorized land surveyors 600,
GPS receivers 150

How is surveying organised in Slovakia

state sector

commercial sector

Geodesy, Cartography and Cadastre Authority

- Geodetic and Cartographic Institute
- Research Institute of Geodesy and Cartography
- Cadastral Institute
- Cadastral Offices

Chamber of Surveyors and Cartographers

Ministry of Defence

- Topographic Institute of Slovak Army

Binding geodetic reference systems

- *since 1927*

  2D – co-ordinate system of Unified Trigonometric Cadastral Network (S – JTSK)

  1D – vertical reference system of normal heights

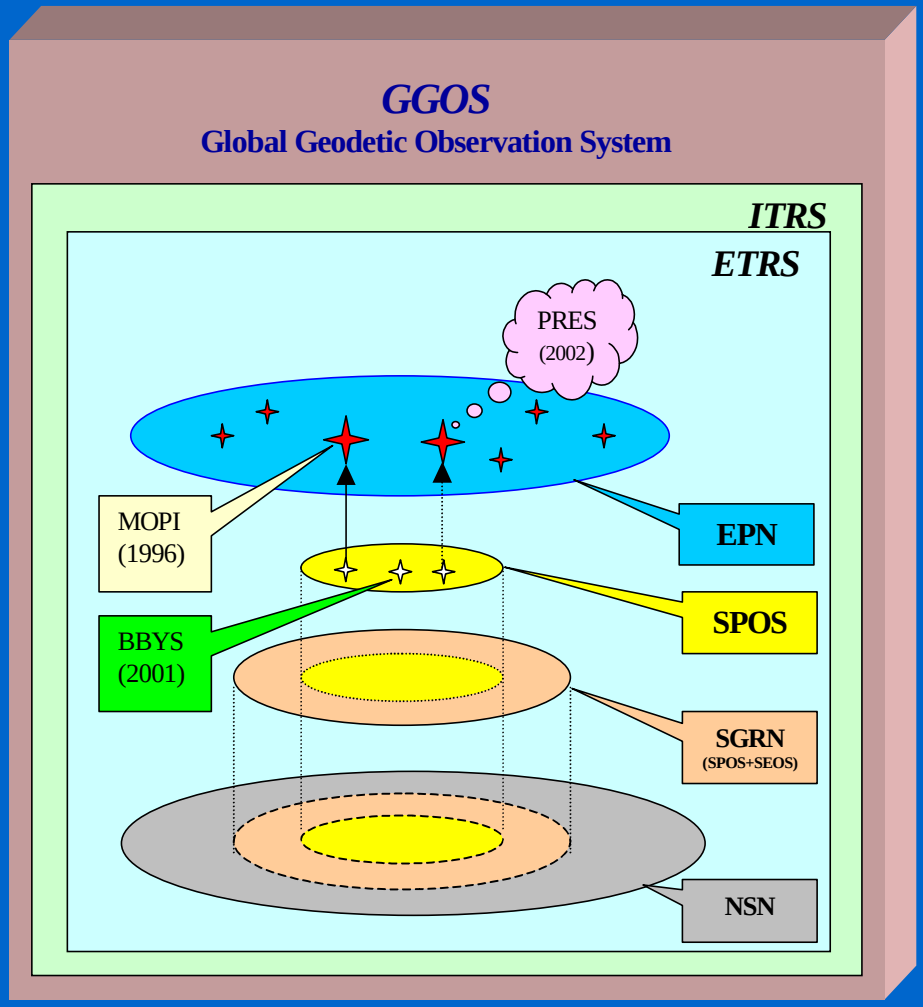
- *since 1996*

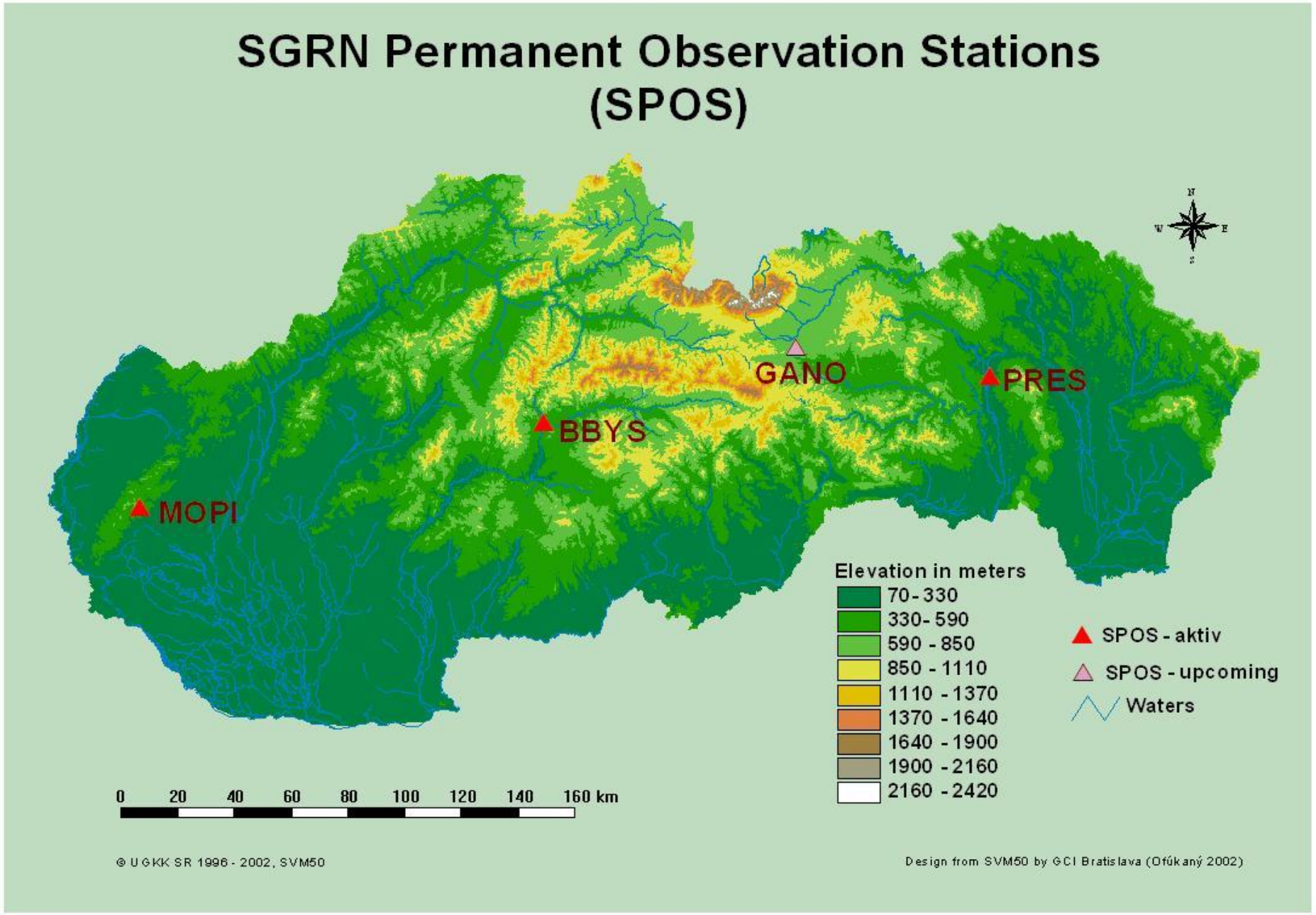
  3D – European Terrestrial Reference System ETRS89

  NSN – National Spatial Network

  (3 – SPOS, 45 – SEOS, 1586 - other points)

Slovak permanent GNSS service for connection of new geodetic control to GGOS




SGRN Permanent Observation Stations
(SPOS)
GANO
PRES
BBYS
MOPI
Elevation in meters
70 - 330
330 - 590
590 - 850
850 - 1110
1110 - 1370
1370 - 1640
1640 - 1900
1900 - 2160
2160 - 2420
SPOS - aktiv
SPOS - upcoming
Waters
0 20 40 60 80 100 120 140 160 km
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Modra Piesok

(MOPI)

X = 4053738,206 m ± 2 mm

Y = 1260571,381 m ± 1 mm
Z = 4744940,656 m ± 3 mm

B = 48 22 21,81459 ± 1,0 mm
L = 17 16 25,95622 ± 1,1 mm

H = 578,978 m ± 3,0 mm

v(B) = 2,3 ± 0,3 mm/year

v(L) = -0.1 ± 0.2 mm/year

v(H) = -0.1 ± 1.2 mm/year

In selecting a site of the monumentation of a point a geologist was co-operate with. Primarily surface rock was selected, with continuously merges into the bedrock so as only tectonic movements be manifested on it.

Banská Bystrica (BBYS)

X = 3980358,919 m

Y = 1382292,014 m
Z = 4772771,890 m

B = 48 45 06,482757 ± 2,1 mm
L = 19 09 03,604789 ± 2,3 mm

H = 487,414 m ± 6,7 mm

v(B) = 20,1 ± 1,1 mm/year

v(L) = 19.6 ± 2.2 mm/year

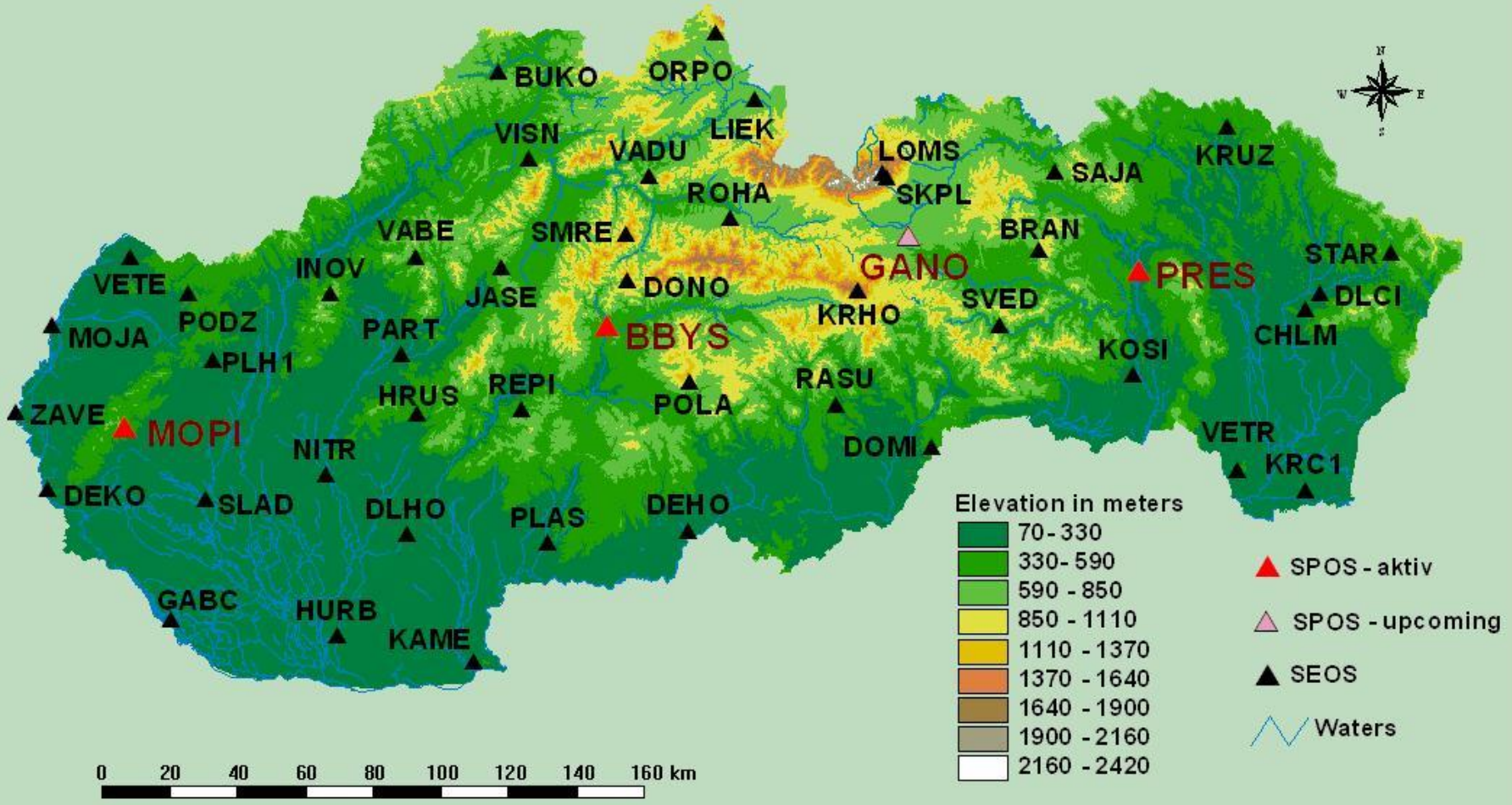
v(H) = -7.8 ± 6.5 mm/year

Rafter into the badrock

Gánovce (GANO)

In selecting a site of the monumentation of a point a hydrometeorologist and other field of the science of the Earth was co-operate with.

Slovak Geodynamic Reference Network
(SGRN = SPOS + SEOS)



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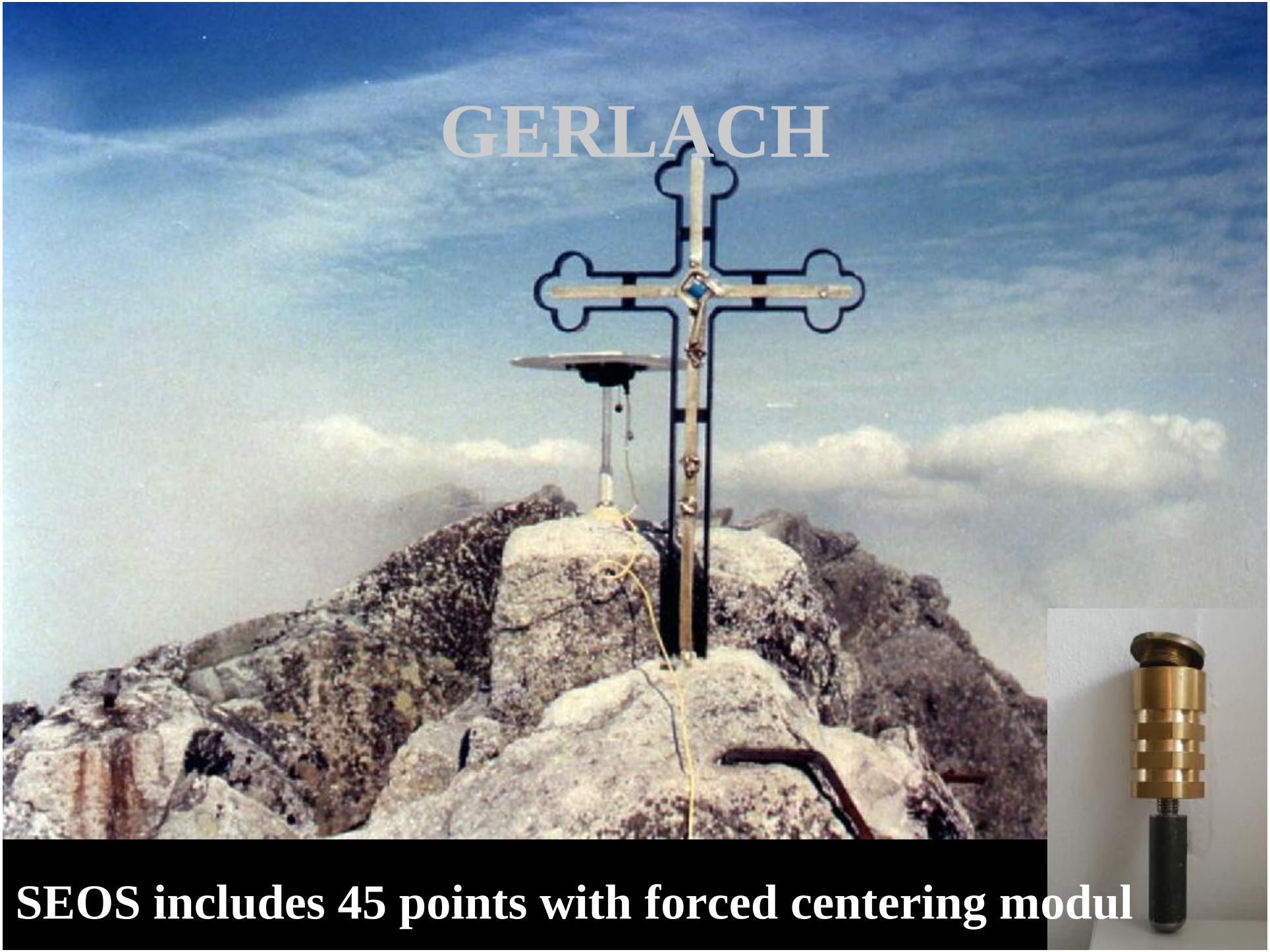
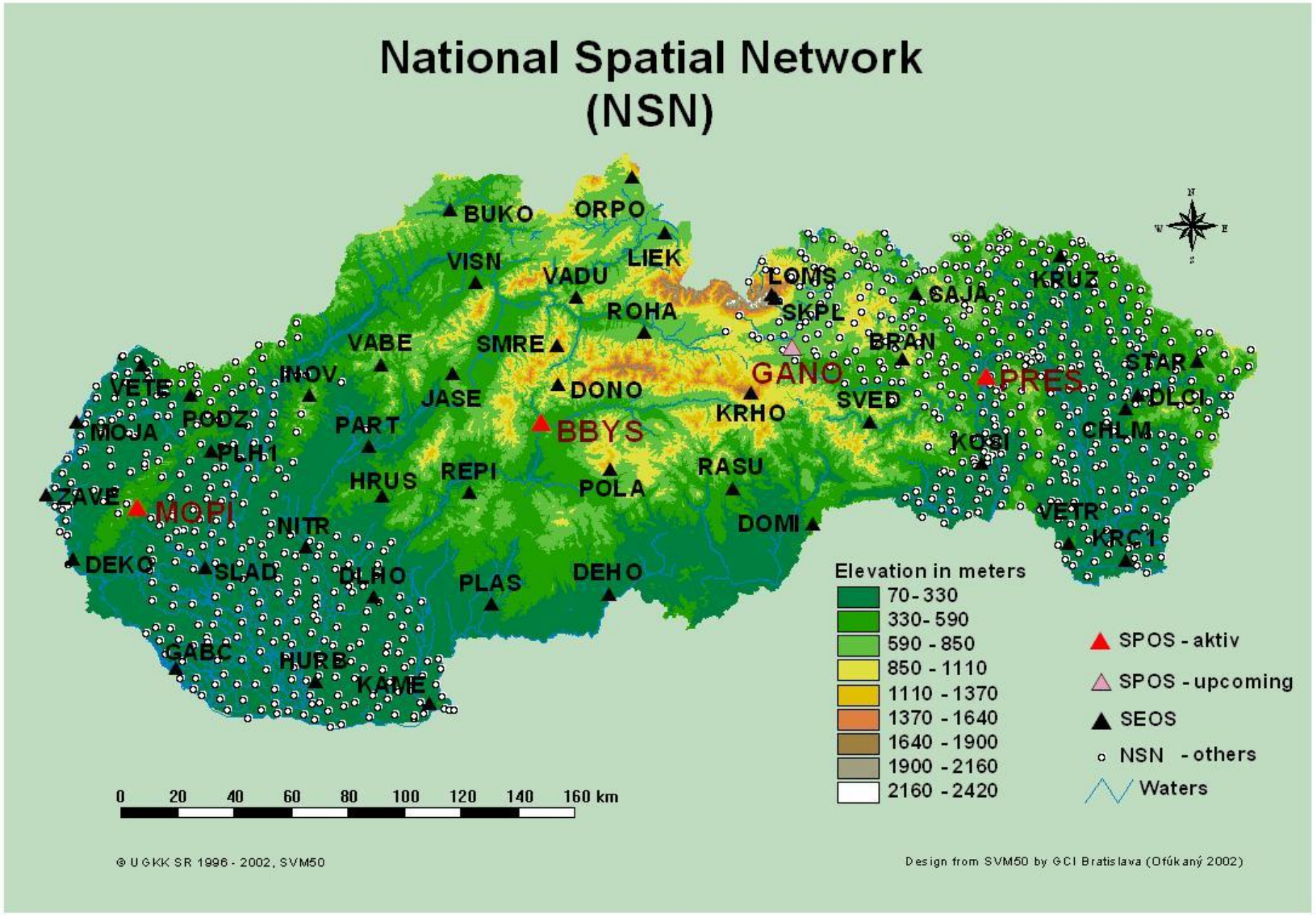


SEOS includes 45 points with forced centering modul


Forced
centering
modul


National Spatial Network
(NSN)
BUKO
ORPO
VISN
LIEK
VADU
LOMS
KRUZ
SAJA
SKPL
ROHA
VABE
SMRE
BRAN
STAR
GANO
PRES
INOV
VETE
JASE
DONO
SVED
DLCI
KRHO
PODZ
PART
BBYS
MOJA
CHLM
PLH1
KOSI
RASU
HRUS
REPI
POLA
ZAVE
MOPI
VETR
DOMI
NITR
KRC1
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SPOS - aktiv
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SEOS
NSN - others
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0 20 40 60 80 100 120 140 160 km
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NSN

Points of the NSN are compound from points of the :

NTN (60%), NLN (30%) and NGN (10%).

Co-ordinate :

XYZ (ETRS 89),

BLH (GRS 80),

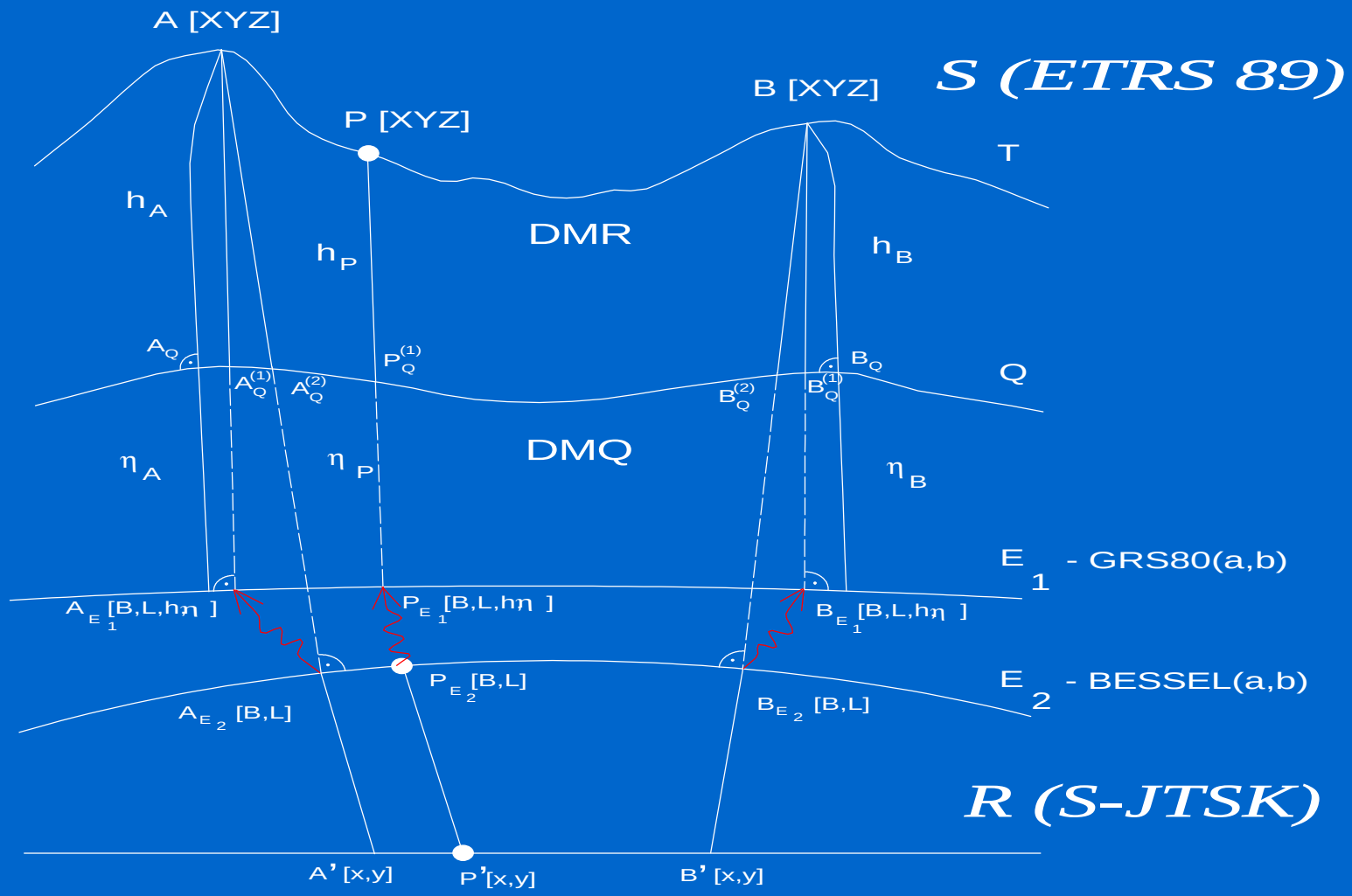
xyh (S-JTSK, Bpv),

g (GrS 95)

NSN - National Spatial Network
new geodetic control of Slovakia in ETRS89 and other activities

campaigns	year	amount
Slovak Geodynamic Reference Network	1993-2001	17 / 48
National Astronometric and Geodetic Network	1996	29
National Trigonometric Network of I order	1997	30
selected control triangulation points	1999	229
building up NSN west part of Slovakia	2000	311
building up NSN east part of Slovakia	2001	425
building up NSN middle part of Slovakia	2002	about 850

Relationship between ETRS 89 and S-JTSK



Base functional relations of the reference systems

S-JTSK → ETRS89

$$P_{JTSK}[x,y] \xrightarrow{f(R_{JTSK},E_2)} P_{E_2}[B,L] \xrightarrow{f(E_2,E_1)} P_{E_1}[B,L] \xrightarrow{f(E_1,Q)} *$$

$$* \xrightarrow{f(E_1,T)} P_Q[B,L,h_P(Q)] \xrightarrow{f(E_1,T)} P_T[B,L,h_P(T)+h_P(Q)] \circ P_{ETRS89}[X,Y,Z],$$

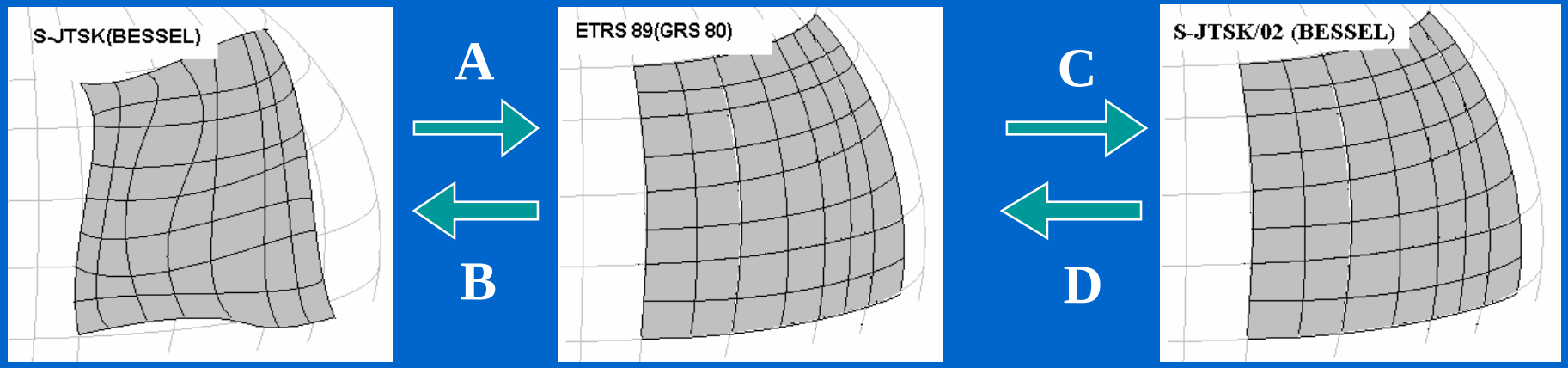
ETRS89 → S-JTSK

$$P_{ETRS89}[X,Y,Z] \equiv P_T[B,L,H] \xrightarrow{f(E_1,T)} P_Q[B,L,H-h_P(T)] \xrightarrow{f(E_1,Q)} *$$

$$* P_{E_1}[B,L,H-(h_P(T)+h_P(Q))=0] \xrightarrow{f^{-1}(E_1,E_2)} P_{E_2}[B,L] *$$

$$* \xrightarrow{f^{-1}(R_{JTSK},E_2)} P_{JTSK}[x,y,h_P(T),h_P(Q)],$$

Reversible transformation of S-JTSK into ETRS89



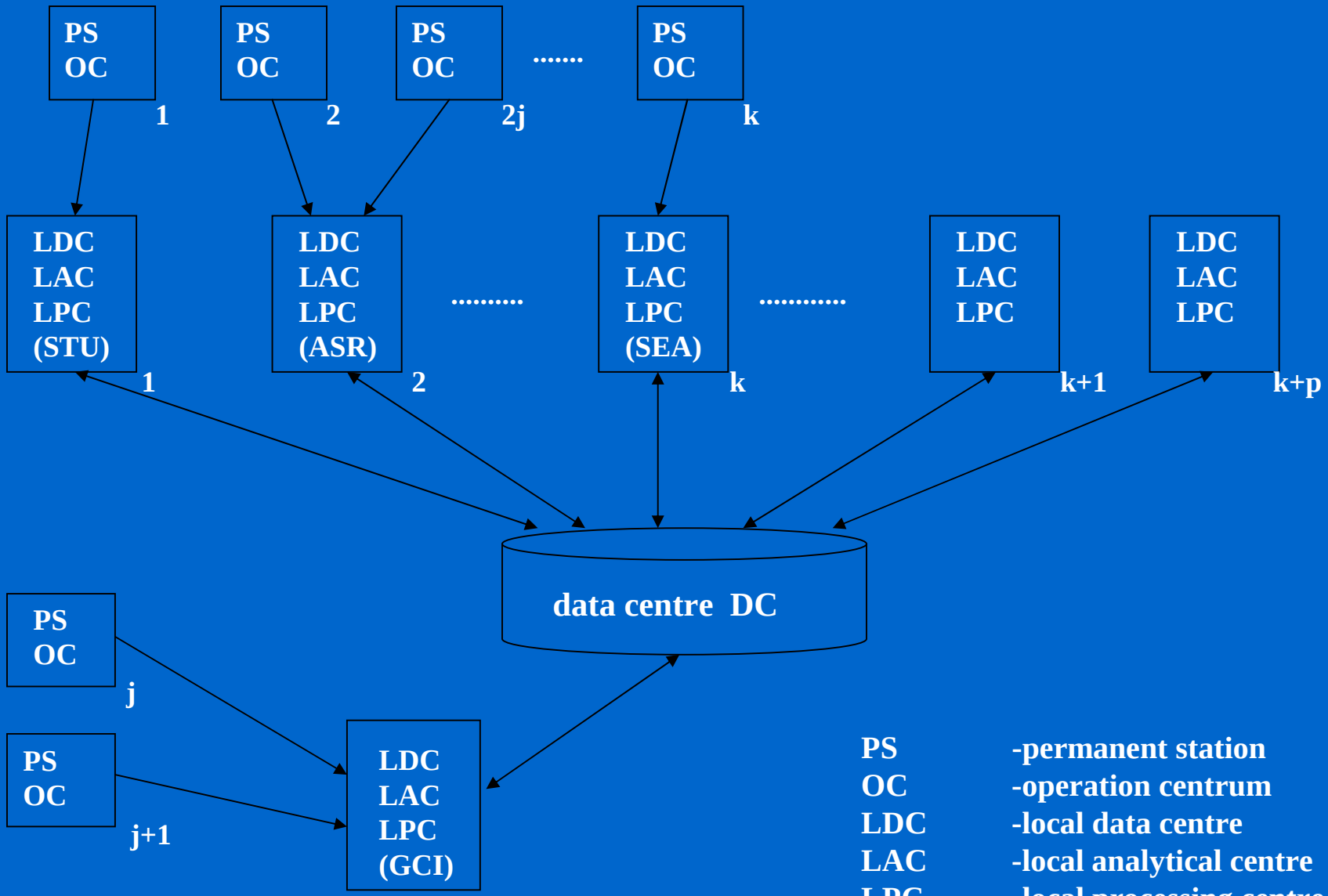
A – *deformed JTSK* into non-deformed ETRS89

B – non-deformed ETRS89 into *deformed JTSK*

C - non-deformed ETRS89 into non-deformed JTSK/02

D - non-deformed JTSK/02 into non-deformed ETRS89

Structure of SPGS



PS	-permanent station
OC	-operation centrum
LDC	-local data centre
LAC	-local analytical centre
LPC	-local processing centre

Conclusion

New co-ordinate system – ETRS 89

New vertical system – EVRS 2000

For :

- Geodynamic,
- GIS ,
- cadaster,
- other

Thank You for Your attention