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Faculty of Natural Sciences and Mathematics

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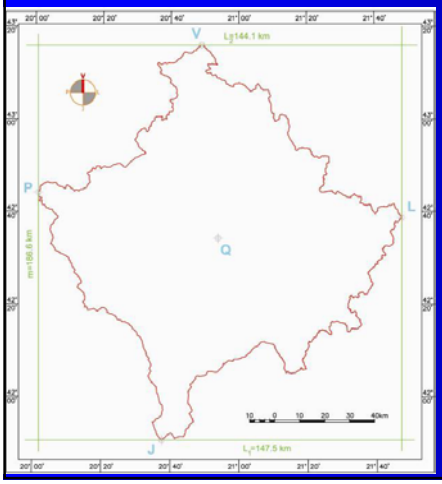
Projecting of territory of the Republic of Kosova in several most used state map projections

Overview:

- *Preface*
- *Defining of criteria's for estimation of map projections*
- *Utilization of most used state map projections for projecting of territory of the republic of kosova*
  - *Projecting of territory of the Republic of Kosova in Gauss-Krűger projection*
  - *Projecting of territory of the Republic of Kosova in stereographic projection*
  - *Projecting of territory of the Republic of Kosova in Lambert conform conic projection*
  - *Projecting of territory of the Republic of Kosova in UTM projection*
- *Area and border line of Kosova in researched map projections*
- *Conclusions*

Some useful data of the Republic of Kosova related to research



Point	Geographic coordinates	
	φ	λ
North	43°16'07.5'' N	20°49'01.9'' E
South	41°50'50.1'' N	20°37'36.8'' E
East	42°38'48.0'' N	21°47'42.7'' E
West	42°44'10.4'' N	20°01'10.9'' E
Center	42°33'28.8'' N	20°54'26.8'' E

Area	10908km^2
Border line	744km
length of the northern parallel	144.1km
length of the southern parallel	147.5km
length of the meridian	186.6km
Number of cities	30

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State coordinate system/s of Kosova from year 1924 up to day

Name:	FryRef 30	KOSOVAREF01
Year of defining:	1924	2001
Period of utilization:	1924-2001	2001-ongoing
Datum:	Harmannskögel	ETRS89
Ellipsoid:	Bessel 1841	GRS 80
Map projection	Gauss–Krüger	Gauss–Krüger
Projecting zone:	7th	7th
Width of the zone:	30	30
Prime meridian:	Greenwich	Greenwich
Central meridian:	210	210
Origin of latitude:	Equator	Equator
False easting:	500000m	7500000m
False northing:	0m	0m
Scale factor:	0.9999	0.9999
Length units:	Meter	Meter
Origin of elevations:	Mareograph "Molo Sartorio" – Trieste, Italy	Mareograph "Molo Sartorio" – Trieste, Italy

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Defining of criteria's for estimation of map projections

Basic criteria's for choosing of the most appropriate state map projection according to all standards from the mathematical cartography are:

- the value of the largest linear deformation (main criteria),
- right dispersion of the linear deformations, and
- adopting of the mathematical module for geodetic calculations;
- the value of mean linear deformations,
- sum of squares of linear deformations,
- mean value of linear deformations in 1km length, and
- the percent coverage with defined deformation.

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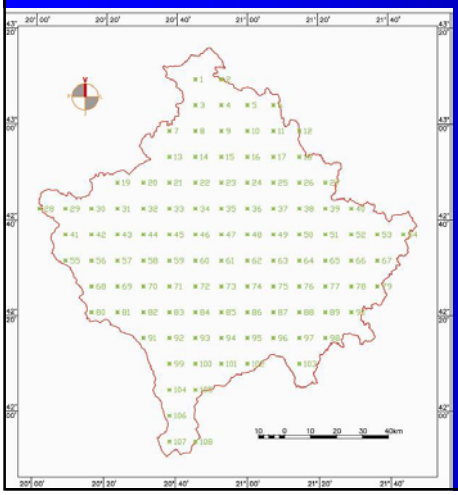
Defining of test models



Utilized map projections

- Gauss-Krűger projection (because of lengthened along the meridians)
- Stereographic projection (because of the form nearness to circle)
- Lambert conform conic projection (because of lengthened along the parallels)
- UTM (because of its international importance).

Methodology of researching

- Tangential variant
- Secant option with value of negative linear deformation equal to half of largest from the tangential variant
- Secant option with value of negative linear deformation equal to average of extreme points from the tangential variant

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Projectiong of Kosova in Gauss-Krűger projection

- Gauss-Krűger within the KOSOVAREF 01 (scale factor 0.9999; -10cm/km)
- Gauss-Krűger in tangential variant
- Gauss-Krűger with secant cylinder (scale factor 0.99996; -4cm/km)
- Gauss-Krűger with secant cylinder (scale factor 0.999967; -3.3cm/km)

	KOSOVAREF01 (m_0=0.9999)	m_0=1	m_0=0.99996	m_0=0.999967
	8.7cm/km	1.3cm/km	2.93cm/km	2.46cm/km
ΣΔdΔd	8440.26 $(cm/km)^2$	452 $(cm/km)^2$	1055 $(cm/km)^2$	746 $(cm/km)^2$
m_0	8.84cm/km	2.05cm/km	3.13cm/km	2.63cm/km
d_{max}	-10cm/km	7.9cm/km	-4cm/km	4.6cm/km
Dispersion of deformations	-2.1 to -10cm/km	0 to 7.9cm/km	-4 to 3.9cm/km	-3.3 to 4.6cm/km
***d* positive**	-	87.30%	7.04%	10.85%
***d* negative**	100%	-	92.45%	88.48%
***d* without deformation**	-	12.70%	0.51%	0.67%

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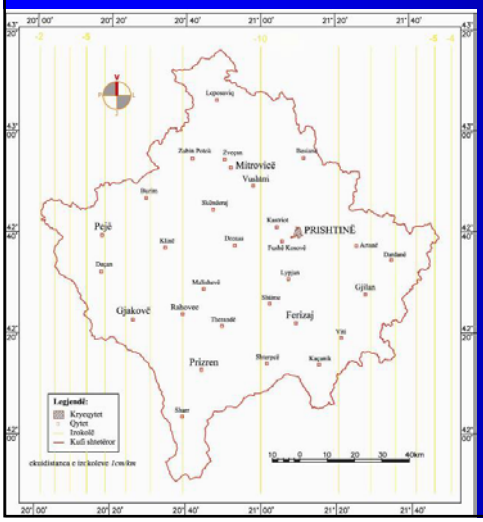
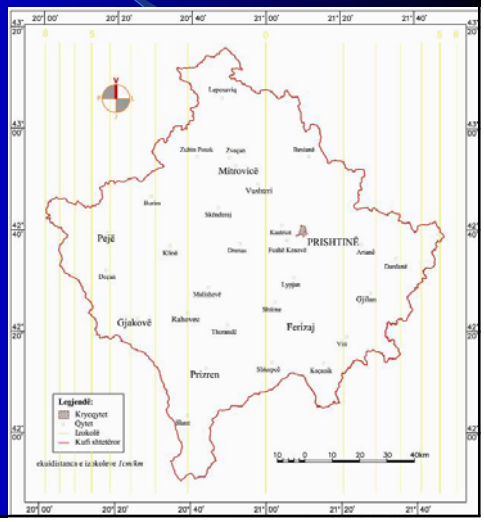
KOSOVAREF 01
(Gauss-Krűger - 0.9999)



Gauss-Krűger – 1.0000



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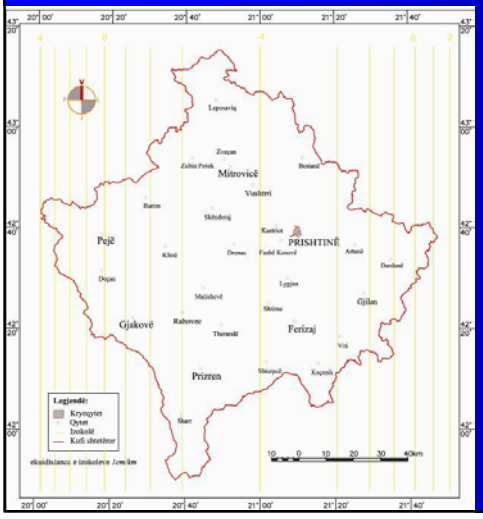
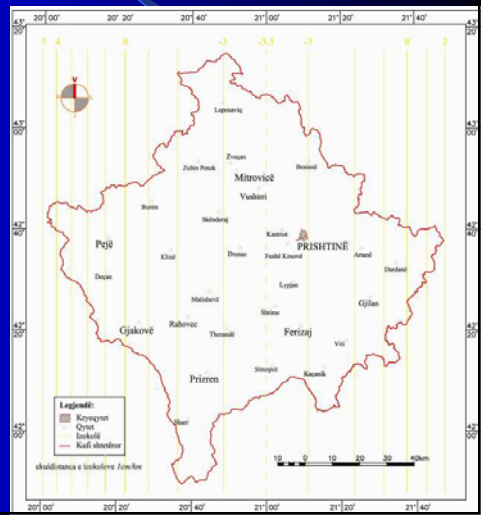
Gauss-Krűger – 0.99996



Gauss-Krűger – 0.999967



Projecting of Kosova in Stereographic projection

- Stereographic projection in tangential variant
- Secant stereographic projection (scale factor 0.999979; -2.1cm/km)
- Secant stereographic projection (scale factor 0.999981; -1.9cm/km)

Geographic and orthogonal coordinates (false easting and northing) of central point in all variants of Stereographic and Lambert conform conic projections

φ_0	λ_0	*Y (m)*	*X (m)*
42º 33'30" N	20º 54'30" E	7500000	4500000

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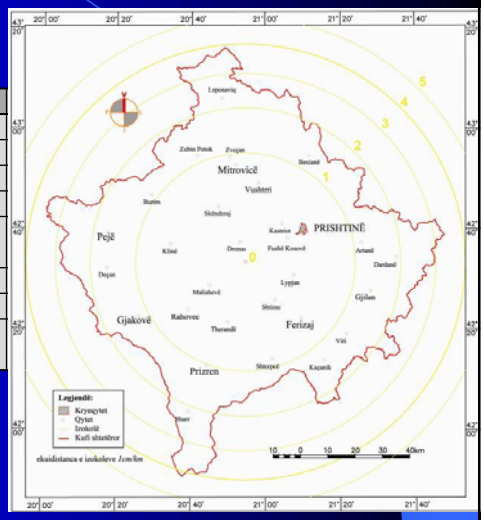
Stereographic – 1

	m_0=1
	1.17cm/km
ΣΔdΔd	219 (cm/km)^2
M_0	1.42cm/km
d_{max}	4.18cm/km
Dispersion of deformations	0 to 4.18 cm/km
***d* positive**	97.67%
***d* negative**	-
***d* without deformation**	2.33%



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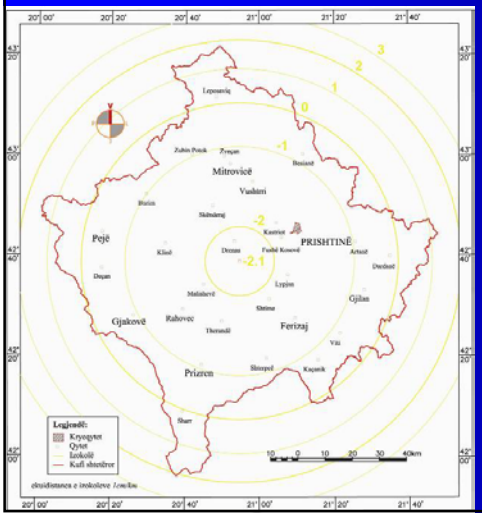
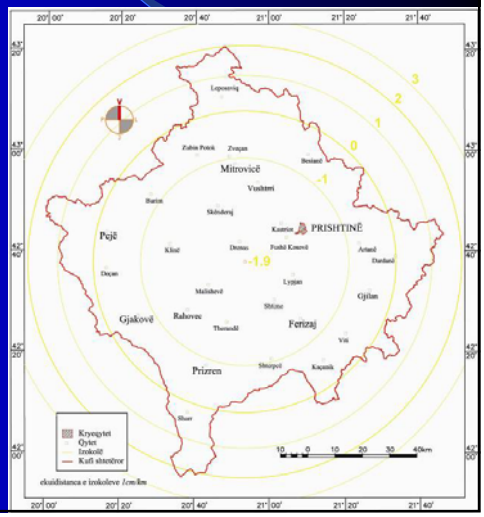
Stereographic – 0.999979



Stereographic – 0.999981



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Projecting of Kosova in Lambert conform conic projection

- Lambert conform conic projection in tangential variant
- Lambert conform conic projection with secant cone (scale factor 0.999962; -3.8cm/km)

	m_0=1	m_0=0.999962
	1.14cm/km	2.85cm/km
ΣΔdΔd	374 (cm/km)^2	993 (cm/km)^2
M_0	1.86cm/km	3.03cm/km
d_{max}	7.69cm/km	-3.8cm/km
Dispersion of deformations	0 to 7.69 cm/km	-3.8 to 3.79cm/km
***d* positive**	84.34%	92.51%
***d* negative**	-	7.11%
***d* without deformation**	15.66%	0.38%

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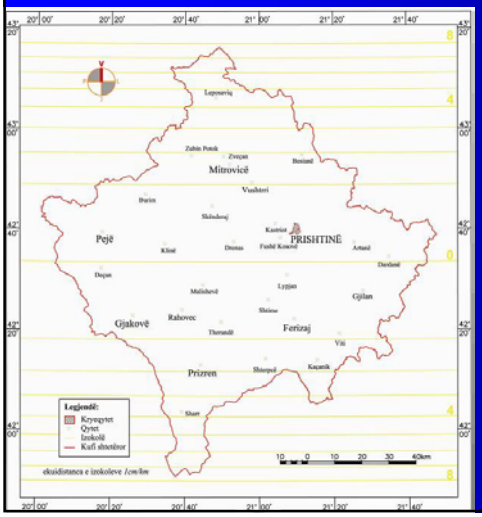
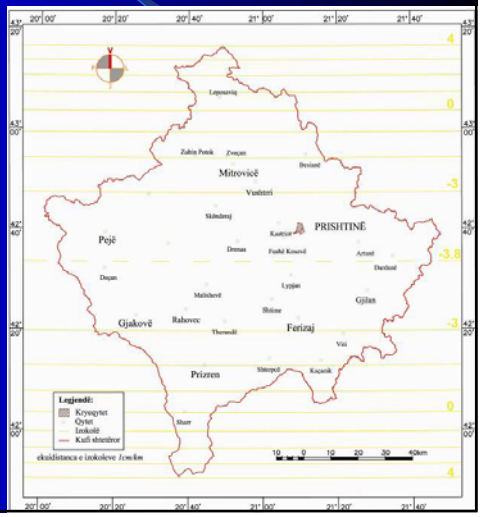
Lambert conform conic– 1.0000



Lambert conform conic – 0.999962



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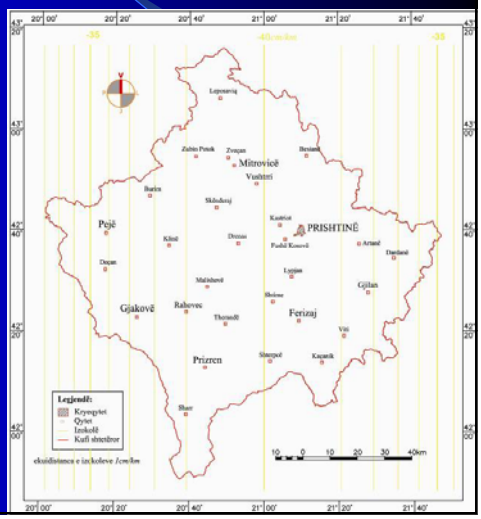
Projecting of Kosova in UTM projection

	m_0=0.9996
	38.7cm/km
ΣΔdΔd	161988 (cm/km)^2
M_0	38.73cm/km
d_{max}	-40cm/km
Dispersion of deformations	-32.11 to -40 cm/km
***d* positive**	-
***d* negative**	100%
***d* without deformation**	-



Area and border line of Kosova in researched map projections

Map projection	Area	Border line
KOSOVAREF 01 (Gauss-Krüger, m_o=0.9999)	10906.05 km²	744.042 km
Gauss-Krüger (m_o=1)	10908.23 km²	744.117 km
Gauss-Krüger (m_o=0.99996)	10907.36 km²	744.087 km
Gauss-Krüger (m_o=0.999967)	10907.51 km²	744.092 km
Stereographic (m_o=1)	10908.23 km²	744.118 km
Stereographic (m_o=0.999979)	10907.77 km²	744.103 km
Stereographic (m_o=0.999981)	10907.81 km²	744.104 km
Lambert conform conic (m_o=1)	10908.20 km²	744.118 km
Lambert conform conic (m_o=0.999962)	10907.38 km²	744.090 km
UTM	10899.50 km²	743.819 km

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Conclusion

… based on above results from research, most appropriate state map projection of the Republic of Kosova for internal use is Stereographic projection with scale factor 0.999979, however utilization of UTM projection for international use is irreplaceable.

Which one to be used:
0.999979, 0.999981 or 0.99998 ☺

In behalf of coauthors,

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THANK YOU FOR YOUR ATTENTION!!!

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RESEARCH FOR DEFINING OF MOST APPROPRIATE STATE MAP PROJECTION FOR THE REPUBLIC OF KOSOVA

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