

Agency For Real Estate Cadastre

BASIC GEODETIC WORKS AND MAPPING ACTIVITIES IN AREC

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Skopje, October 2014



Outline

Basic Geodetic Works in AREC

- Network of Permanent GNSS Stations – MAKPOS
- Passive GNSS Network
- Coordinate Transformation
- Leveling Network
- Gravimetric Network

Mapping Activities in AREC



Department for Geodetic Works

- Unit for Basic Geodetic Works
- Unit for Geodetic Works for Special purposes, State Borderline and Cadastral Classification of the Land
- Unit for Cartography and Photogrametry
- Unit for Storing and Issuing Geodetic Data



Department for Geodetic Works

Responsibilities:

- Establishment, maintenance and development of geodetic reference networks (trigonometric network, network of permanent GNSS stations, passive GNSS network, levelling network, gravimetric network etc ...)
- Maintenance and marking of the Macedonian state border
- Geodetic works of special importance for R. Macedonia
- Geodetic survey
- Land classifications
- Production of digital topographic maps
- Orthophoto productions
- Storing and issuing geodetic data ...



**NETWORK OF PERMANENT GNSS STATIONS IN THE
REPUBLIC OF MACEDONIA**

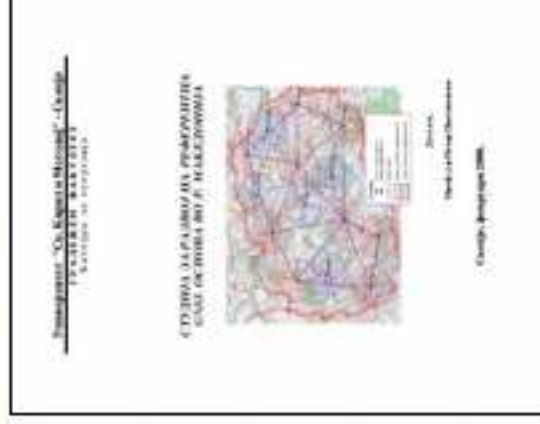
MAKPOS



Basis

“Study for development of GNSS reference frame in R. Macedonia”

University ‘St. Cyril and Methodius’ - Skopje
Faculty for Civil Engineering
Geodesy Department



PROJECT:

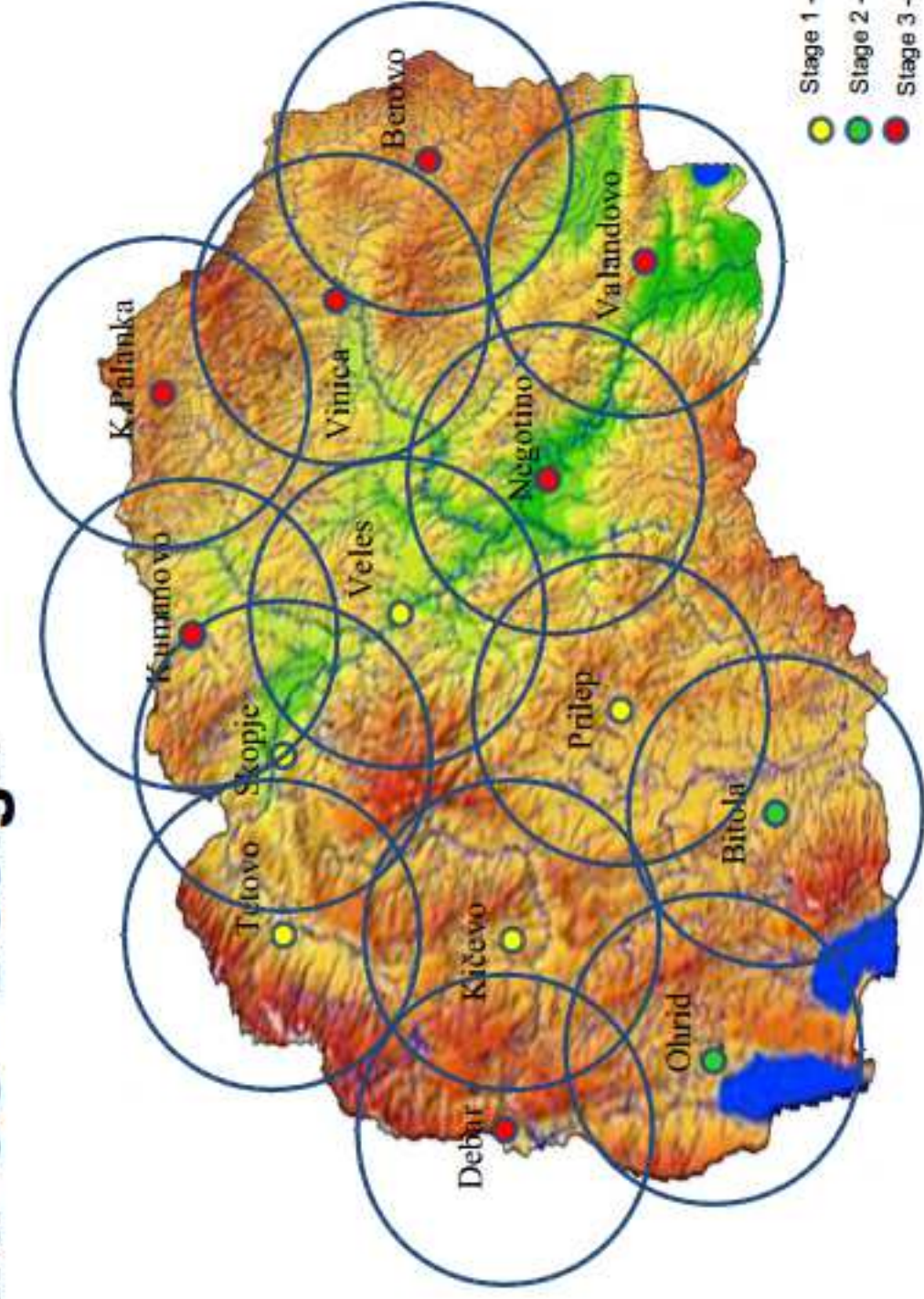
No. of stations:	14
Distance:	~ 50 – 70 km
Analytical centers:	AREC
Communications:	VPN, ADSL
Distribution:	GPRS, Internet



MAKPOS - Logo



MAKPOS - Design



MAKPOS – Reference stations



GNSS Receivers & GNSS Antennas

Leica GRX 1200+ & Leica AR 25 ... 9

Leica GRX 1200 GG Pro & Leica AT 504 GG ... 2

Leica GX 1230 GG & Leica AX 1202 GG ... 3



MAKPOS – Control center



Located in AREC head office - Skopje



MAKPOS – Network software

Leica GNSS Spider

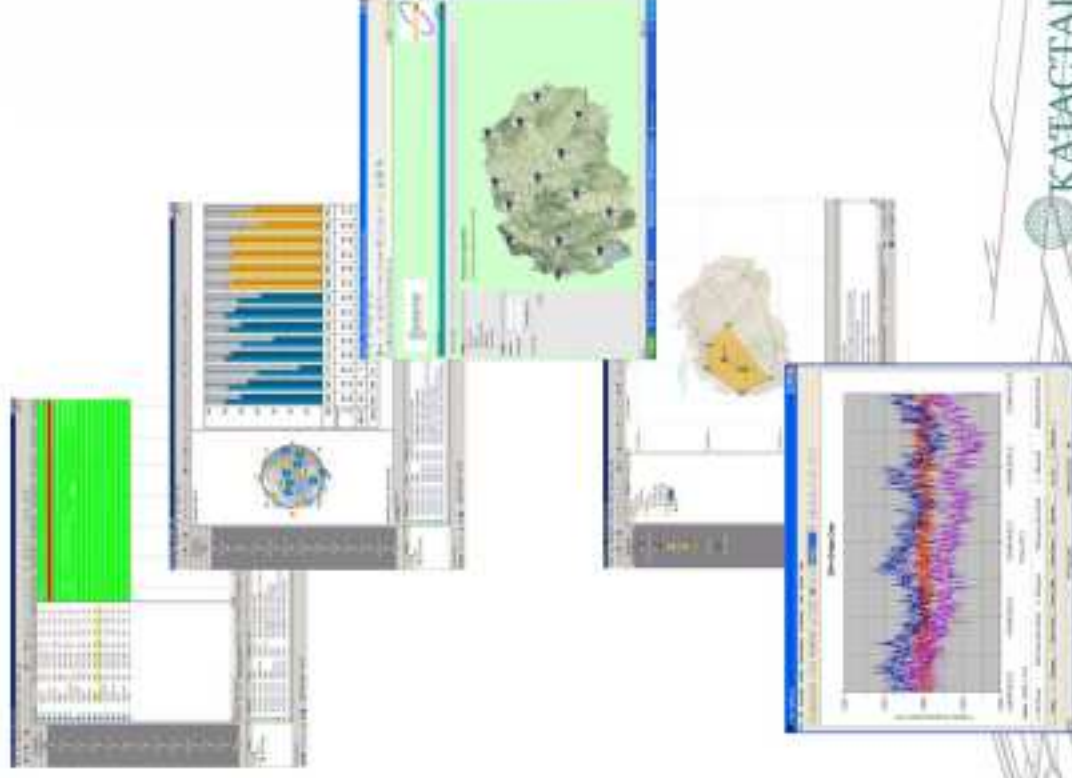
Network control and management
Network corrections (MAC concept)
Products creation
RT Proxy Server and NTRIP Caster
User management

Leica GNSS Spider QC

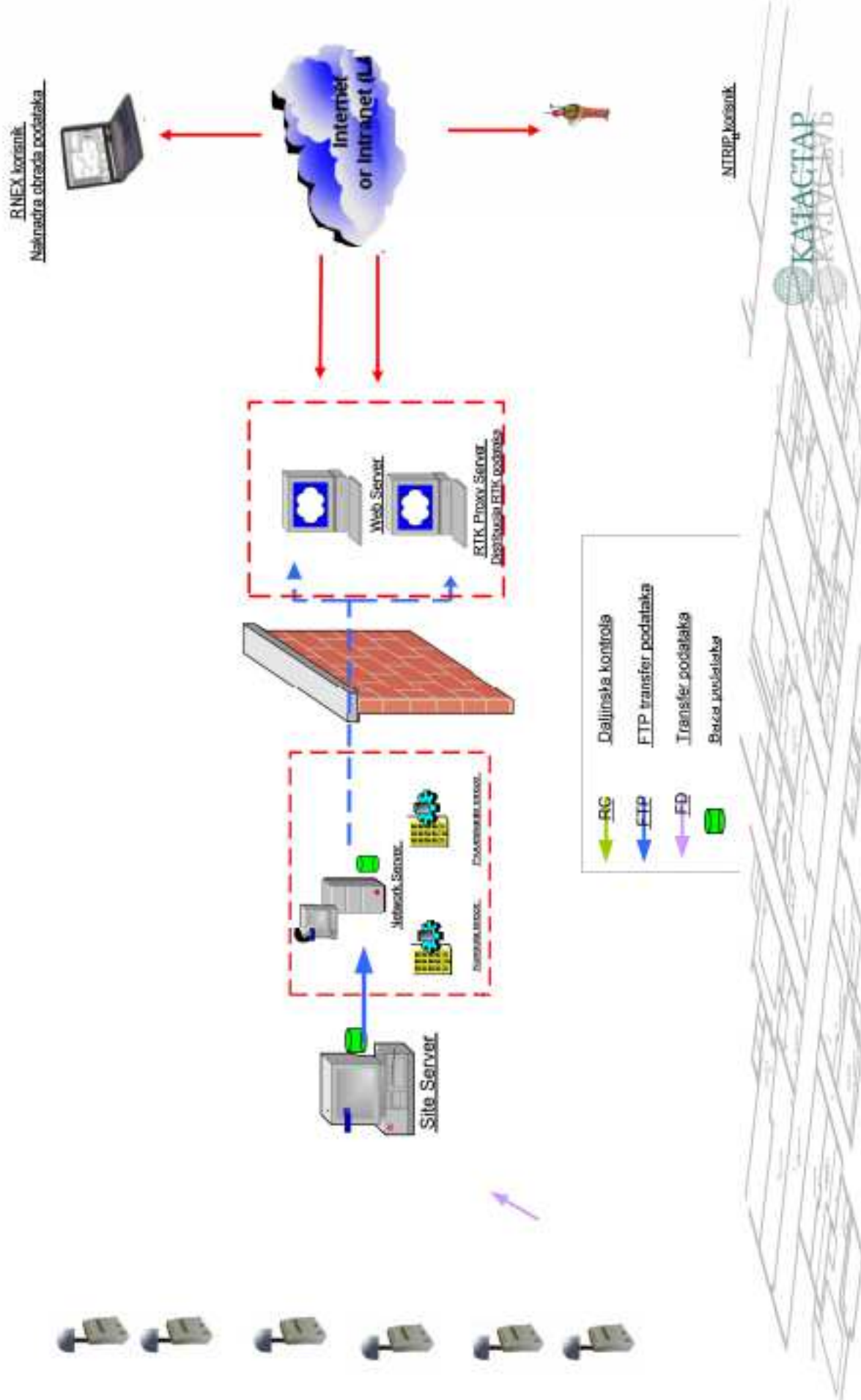
Data quality control
Advanced analysis of the network
points coordinates

Leica GNSS Spider WEB

Distribution of the RINEX products
Calculations service (LGO)



MAKPOS – Architecture



MAKPOS – Services

24/7/365

No.	Description	Service	Accuracy	Data format	Data transfer
1.	Positioning through applying differential methods (DGNSS)	MAKPOS DGNS	0.30 - 0.50 m	RTCM 2.x	Wireless Internet (GPRS) NTRIP protocol
2.	Positioning through applying real time kinematics (RTK)	MAKPOS RTK	0.02 - 0.04 m	RTCM 2.x RTCM 3.x	Wireless Internet (GPRS) NTRIP protocol
3.	Positioning through applying additional data processing (PP)	MAKPOS PP (RINEX)	≤ 0.01 m	RINEX	Internet (FTP, e-mail)

MAKPOS – Prices

Commercial use from January 15, 2012

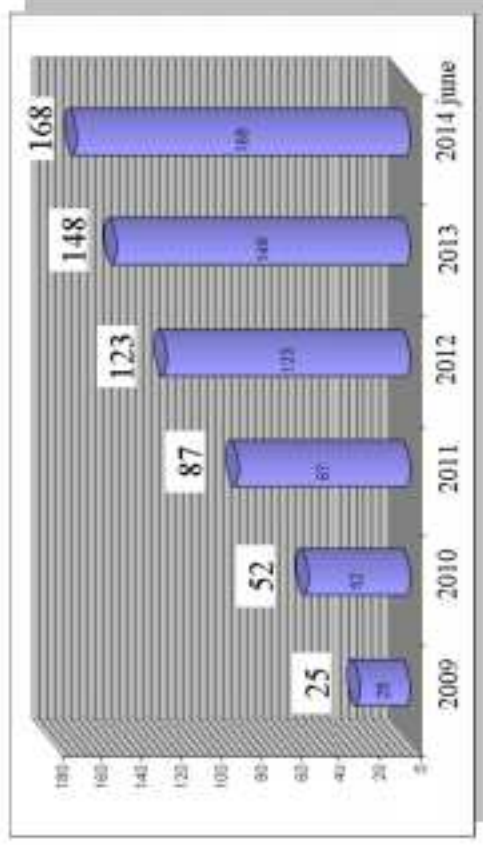
No.	Service	Pricing Model	Price
1.	MAKPOS DGNS	- per year	399 €
2.	MAKPOS RTK	- per month - per year	114 € 980 €
3.	MAKPOS PP (RINEX)	- per minute	0.16 €

* The prices for using the MAKPOS RTK and MAKPOS DGNS services refer to one GPS/GNSS receiver

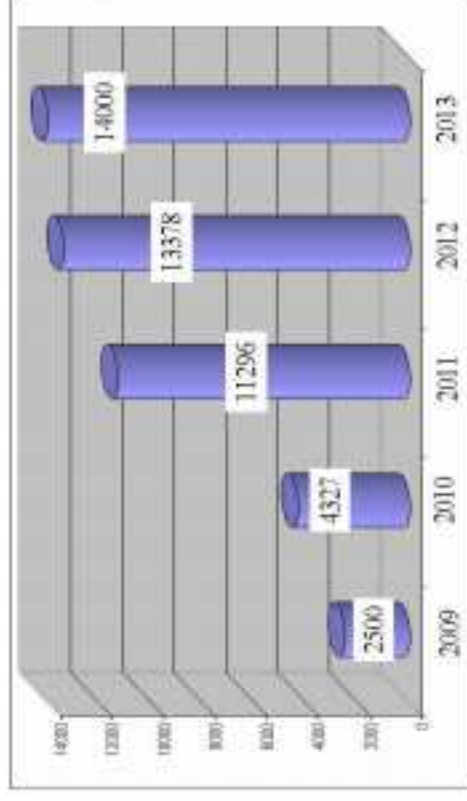


MAKPOS – Users

RTK, DGNSS, PP users



Working hours / year



- Agency for Real Estate Cadastre
- Private Geodetic Companies
- Utility Companies



MAKPOS – EUPOS



- EUPOS – Terms of Reference
- EUPOS – Technical Standards
- EUPOS – Single Site Design
- EUPOS – Reference Frame Fixing
- EUPOS – Cross Border Data Exchange



MACEDONIAN

PASSIVE GNSS NETWORK



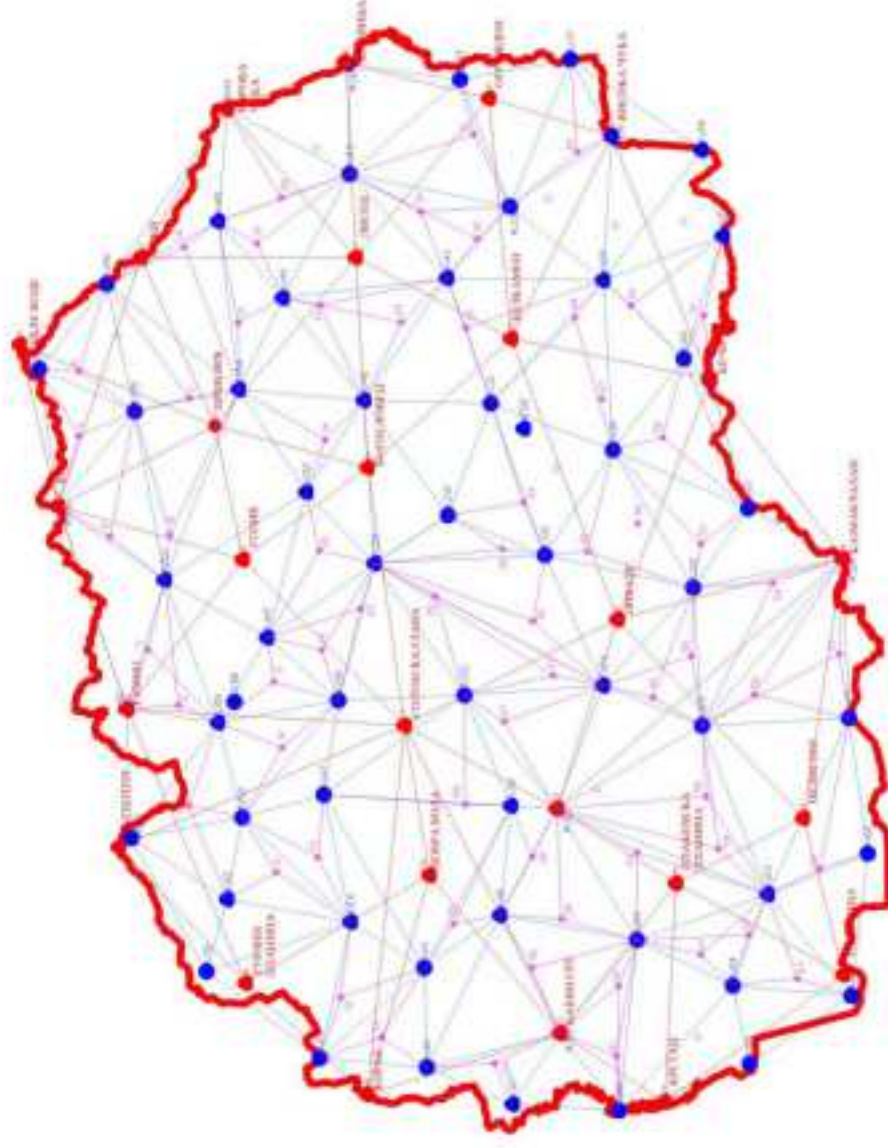
Passive GNSS Network

Phase 1 – 2004

Phase 2 – 2009

Phase 3 – 2010

Total ≈ 200 points



Adjusted in ETRS89

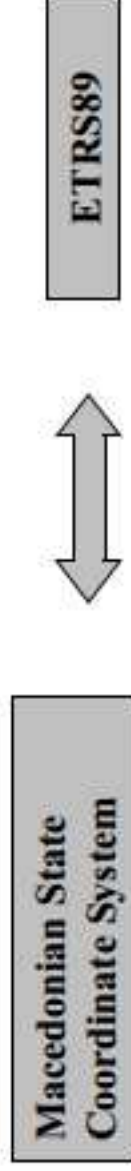


COORDINATE TRANSFORMATION

ETRS89 - MPCS



Coordinate Transformation



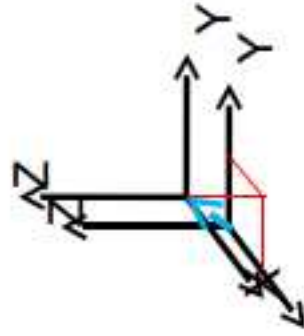
Phase 1 - 2004
Phase 2 - 2009
Phase 3 - 2010

Grid
3 x 3 km
Measured points
2650

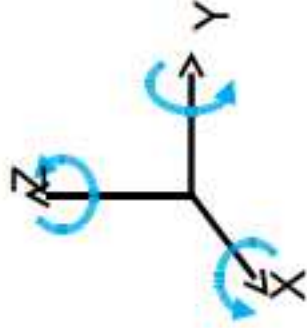


Coordinate Transformation

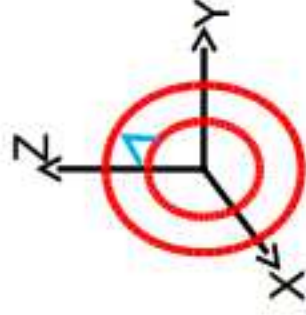
1. Helmert (7 parameter) transformation



X Translation (3 parameters)

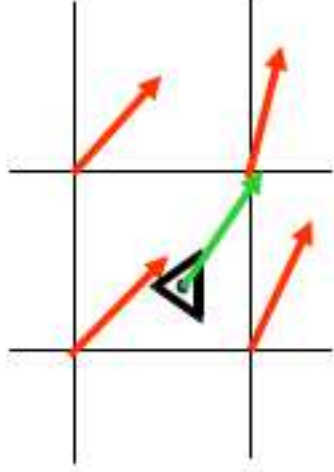
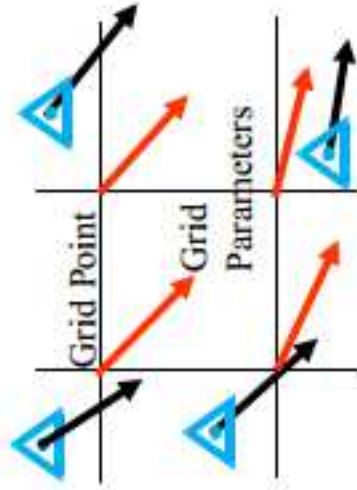


Rotation (3 parameters)



Scale (1 parameter)

2. Grid transformation



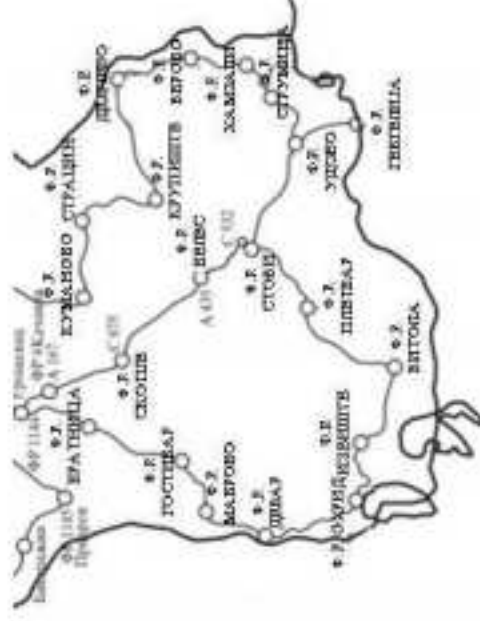
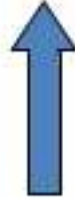
MACEDONIAN

LEVELING NETWORK



Old Leveling Network

High Precision Levelling network in Macedonia



- Vertical datum: *Mareograph in Trieste*

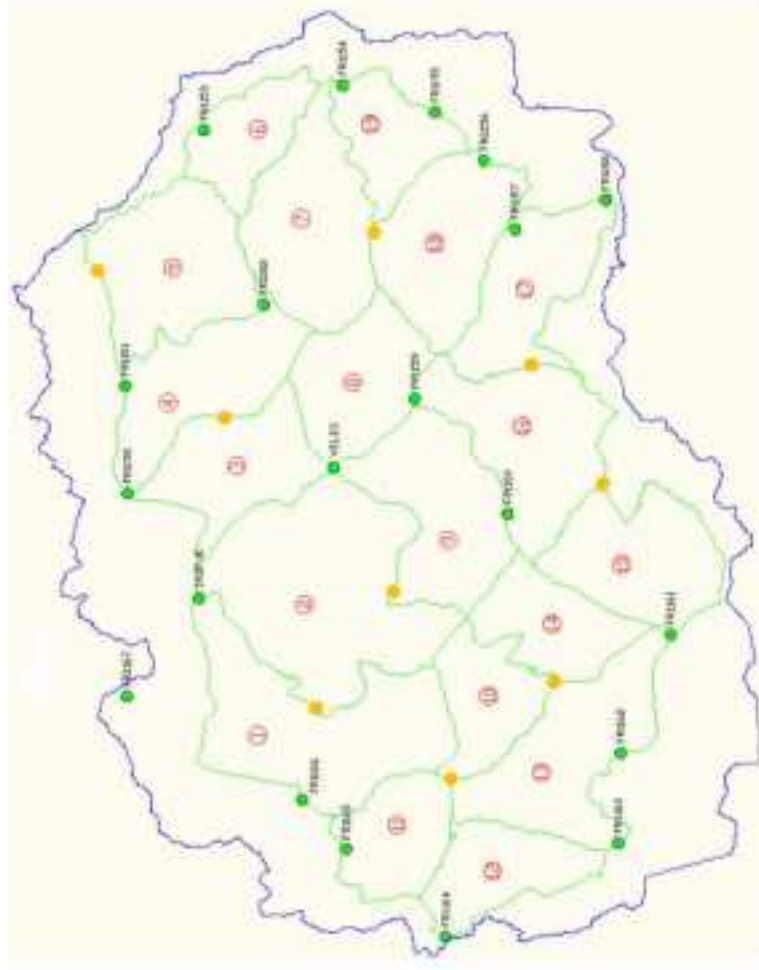
- Poligons: 2

- Fundamental Benchmarks: 19



New Leveling Network

Terrain measurement completed by the end of 2013



Total length of leveling lines	2198
Number of polygons	17
Number of leveling lines	49
Connections to neighboring countries	12
Number of benchmarks – inter distance 2 km	1161

Final calculations planned in 2015 after the realization of gravity measurements

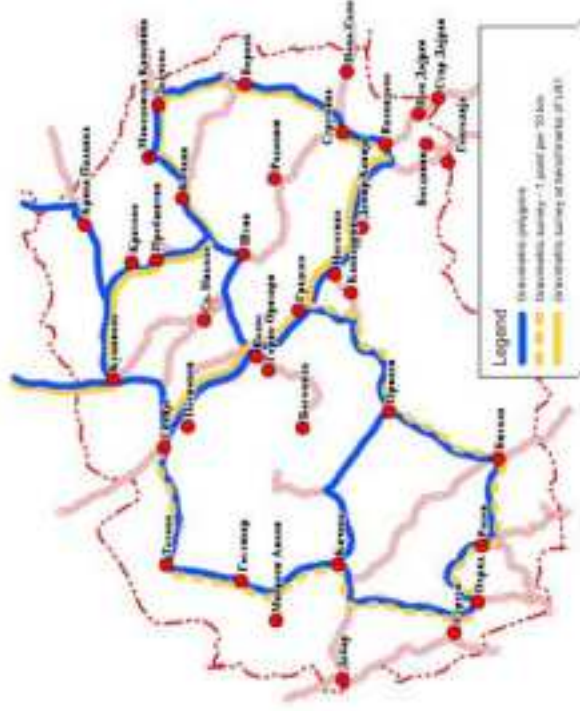


MACEDONIAN

GRAVITY NETWORK

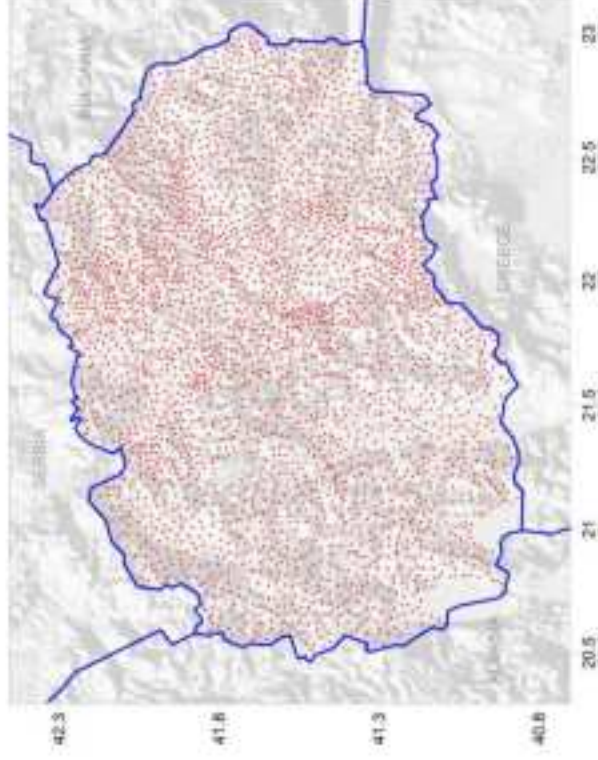


Old Gravity Network



Basic gravimetric network

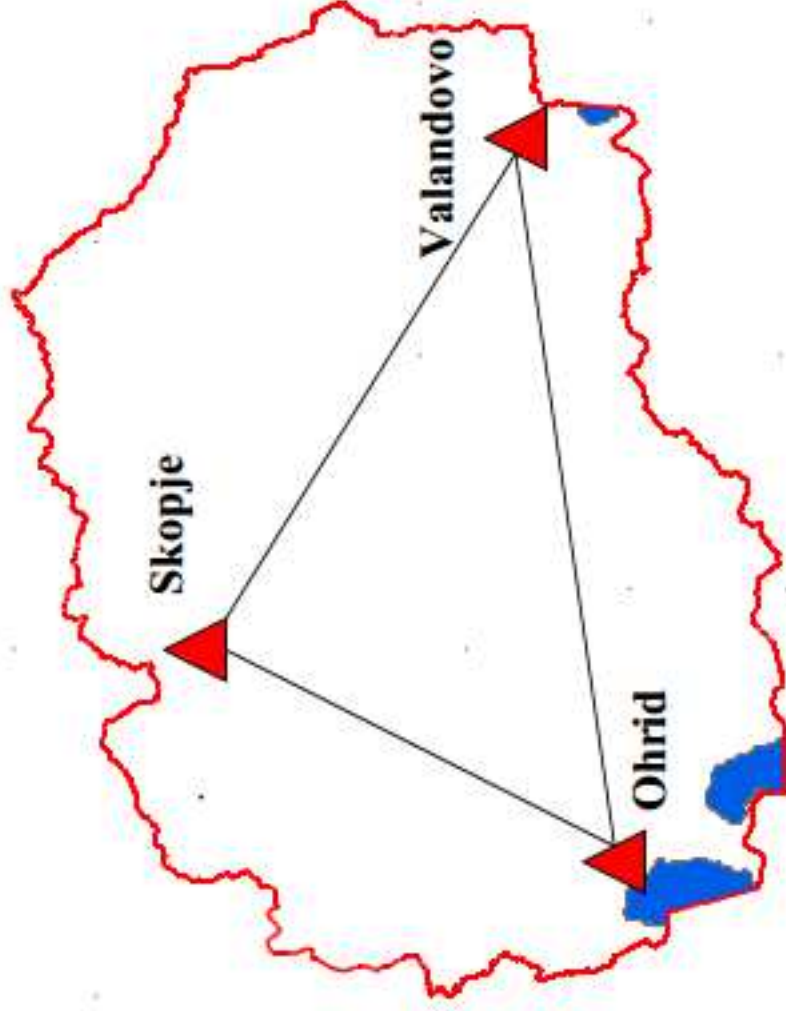
DATA NOT AVAILABLE
(in MGI-Belgrade)



Gravity survey



Absolute Gravity Network



Established in 2010

Station	Height above the point (m)	Gravity, g (μGal)	Approximate standard error, σ_g (μGal)	# of drops used
Ohrid	1.200	980 057 787.9	2	2394
	0.000	980 058 229.7	4	
Valandovo	1.200	980 251 082.9	2	2340
	0.000	980 251 433.0	4	
Skopje	1.200	980 238 061.3	2	2399
	0.000	980 238 303.8	4	



AREC's

MAPPING ACTIVITIES



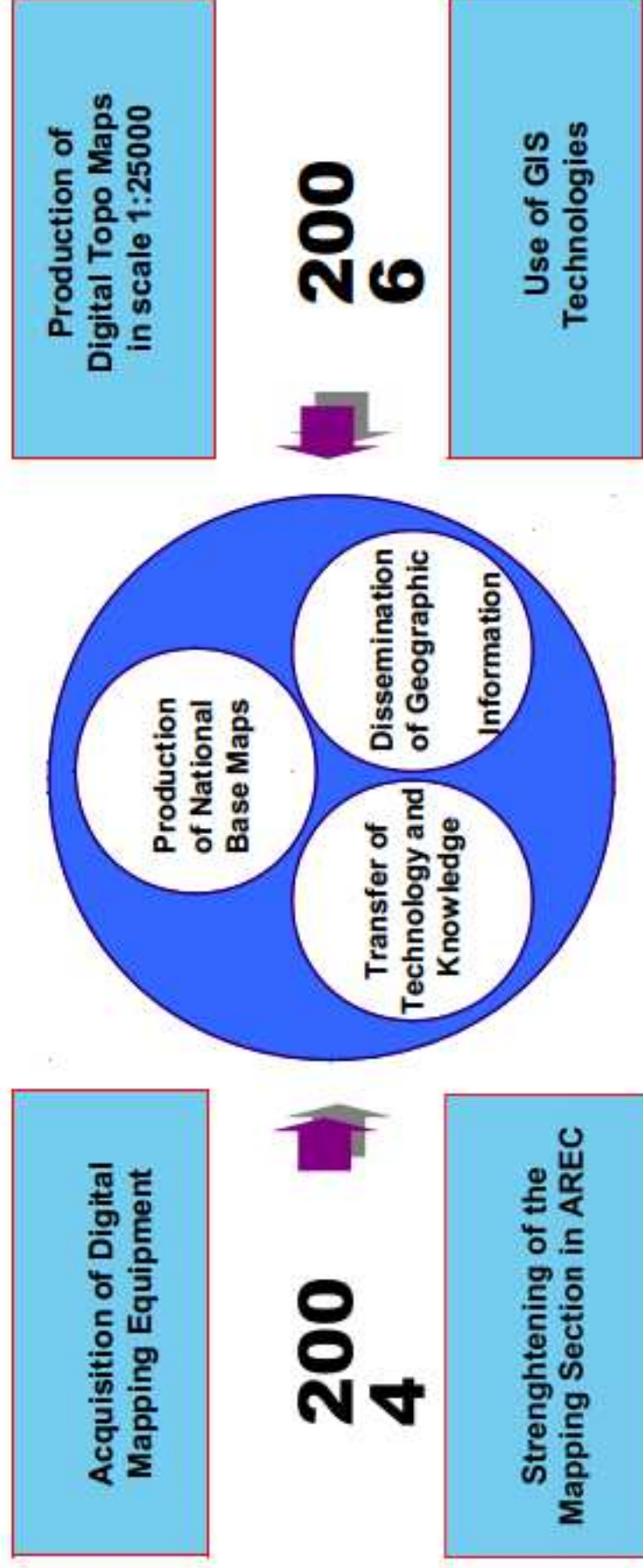
Production of Topo Maps in Macedonia

- **Before 1991**
 - Military Geographical Institute - Belgrade
- **From 1991 till 2004**
 - No activities
- **After 2004 ...**
 - Agency for Real Estate Cadastre
(JICA Mapping Project)



JICA Mapping Project

“Study for Establishment of State Base Maps for GIS
in the Republic Macedonia”



JICA Mapping Project - Activities



Establishment of Photosignals



JICA Mapping Project - Activities



GPS Survey



JICA Mapping Project - Activities



Aerial Photography



KATACTAP
KATACTAP

JICA Mapping Project - Activities



Field Identification



JICA Mapping Project - Activities



Photoarametric Works



JICA Mapping Project - Activities



Cartographic Works



JICA Mapping Project - Activities



Printing



JICA Project – Products & Standards

Mapping Products

- Aerial Photo Images (1:40000)
- Orthophoto Maps (1:25000)
- Printed Maps (1:25000)
- Raster Maps (1:25000)
- Vector Maps (1:25000)
- Digital Terrain Model (20m. grid)

Standards

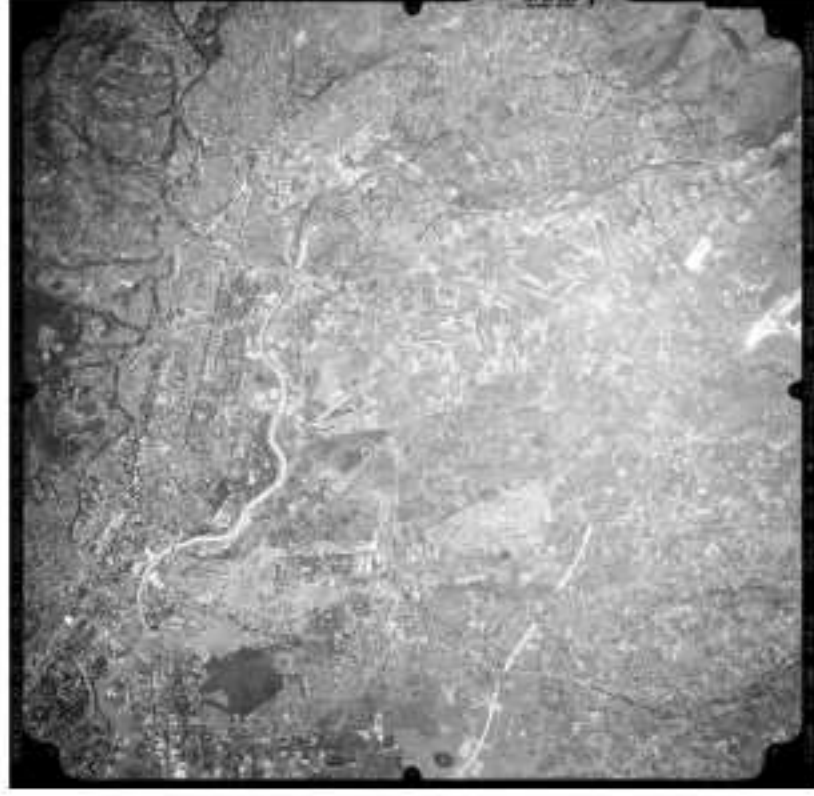
- ISO 19100 - Object based modeling
- ISO 19113 - Geographic information-Quality principles
- ISO 19114 - Geographic information-Quality evaluation procedures
- ISO 19115 - Geographic information- Metadata



Mapping Products

Aerial Photo Images

- Colour: Black/White
- Scale: 1:40000
- Coverage: Entire Macedonia
- Total: 1663 Images
- Pixel Size: 0.6 m. * 0.6 m.
- Resolution: 1693 pixels/inch
- Available Formats: .tiff



Mapping Products

- **Ortho Photo Maps**
- Colour: Black/White
- Scale: 1:25000
- Coverage: Entire Macedonia
- Pixel Size: 0.6 * 0.6 m
- Available Formats:
.jpg/.jgw, .tiff/.tfw



Mapping Products

Printed Maps

- Scale: 1:25000
- Language: Macedonian and English
- Coverage: Entire Macedonia (55% printed, 45 % plotted)



Mapping Products

Raster Maps

- Scale: 1:25000
- Language: Macedonian & English
- Coverage: Entire Macedonia
- Available Formats: .tiff/ .tfw, .jpg/ .jgw



Mapping Products

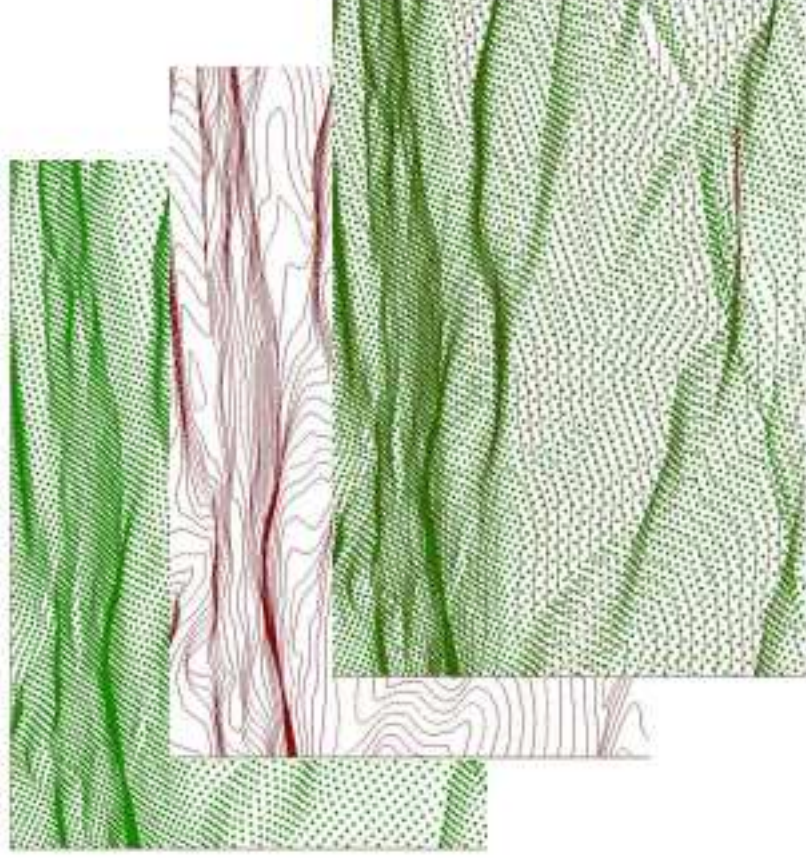
- **Vector Maps**
- **Scale: 1:25000**
- **Language: Macedonian & English**
- **Coverage: Entire Macedonia**
- **Available Formats: coverage, .shp, .dxf**



Mapping Products

3D Grid

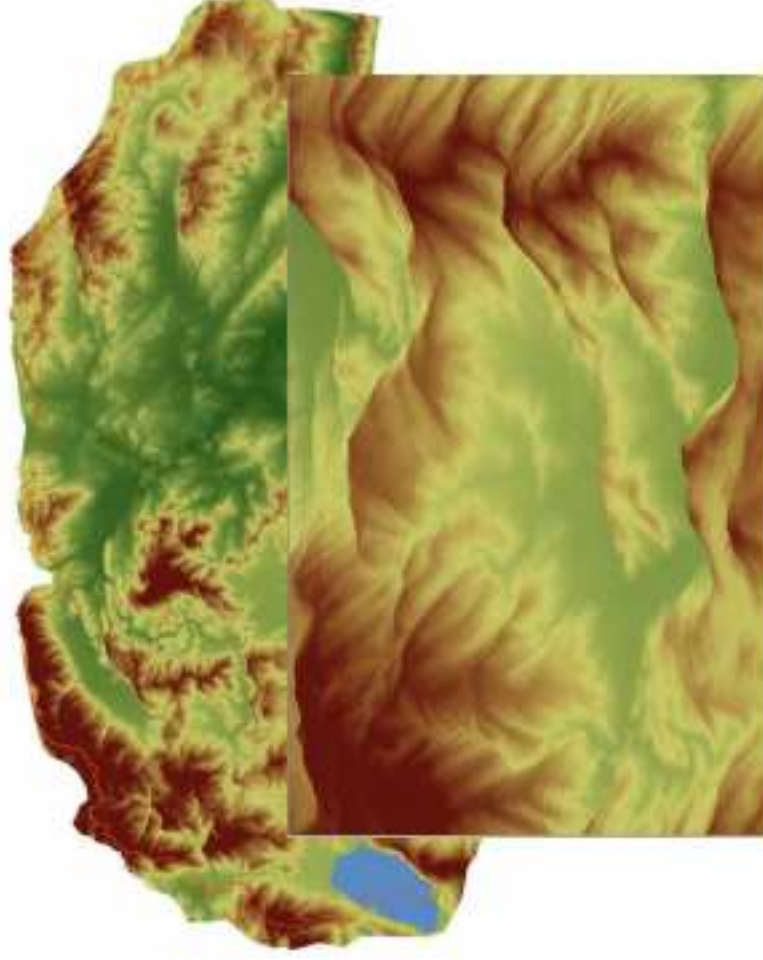
- Resolution: 20 m.
- Coverage: Entire Macedonia
- Available Formats: coverage, .shp, .dxf



Mapping Products

DTM

- Resolution: 20 m. grid
- Coverage: Entire Macedonia
- Available Formats: ESRI Grid, .tiff, .img



Mapping Products – LPIS Project

Colour Orthophoto

Maps

- Scale: 1:25000
- Coverage: Entire Macedonia
- Pixel size: 0.5 * 0.5 m
- Available formats: .jpg/.jgw, .tiff/.tfw



DTM

- Resolution: 5 m. grid
- Coverage: Entire Macedonia
- Available formats: ESRI Grid, .tiff, .img



Old Topo Maps

Produced by MGI – Belgrade

- Topomaps in scale:
1:25000, 1:50000, 1:100000,
1:200000, 1:300000, 1:500000
- Produced:
in '60-ies and '70-ies
- Available formats:
printed, raster (.tiff i .jpg/.jgw)



Mapping Products – Coordinate System

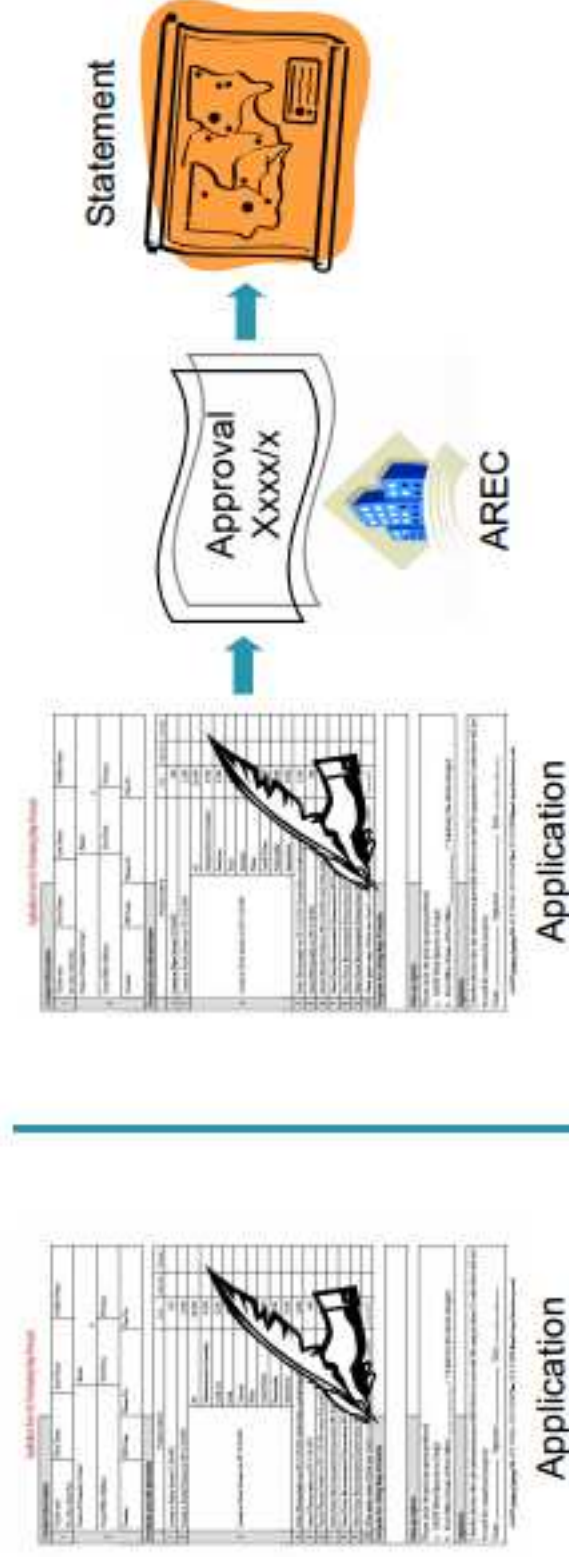
Mathematical Base

- Elipsoid: Bessel 1841
- Proekcija: Gauss-Krüger
- Central Meridijan: 21° 00' 00" E
- Scale at the Central Meridijan: 0.9999
- Shift Y: 500 000 m
- Shift X: 0 m
- Horizontal Datum: Hermanskögell
- Vertical Datum: Mean Sea Level, Mareograph in Trieste



Availability of Mapping Products

The maps become available for everybody, under same conditions, for commercial purposes also



Non commercial use

Commercial use



Pricing Policy

Prices of the Maps are Reduce

144 € → 5.2 € → 3.2 €

- Printed Map (per sheet) ... 3.2 €
- Raster Map (per sheet) ... 9.9 €
- Vector Map (per sheet) ... 173.0 €
- (per layer) ... 28.8 €
- Orthophoto Map (Black/White) ... 8.7 €
- DTM (per sheet) ... 32.3 €
- Aerial Photo Image (per image) ... 2.0 €



Mapping Products on AREC's WEB Page

AREC has published old and new topo maps on the WEB page



Future Plans

- Update of the topo maps in scale 1:25000
- Production of topo maps in medium and small scales: (1:50000, 1:100000, 1:200000, 1:500000)
- Participation in EuroGeographics projects: EBM, ERM, EGM, EGN, Euro DEM
- Production of topo maps according to NATO standards
- Production of thematic maps



THANK YOU FOR YOUR ATTENTION



www.katastar.gov.mk

