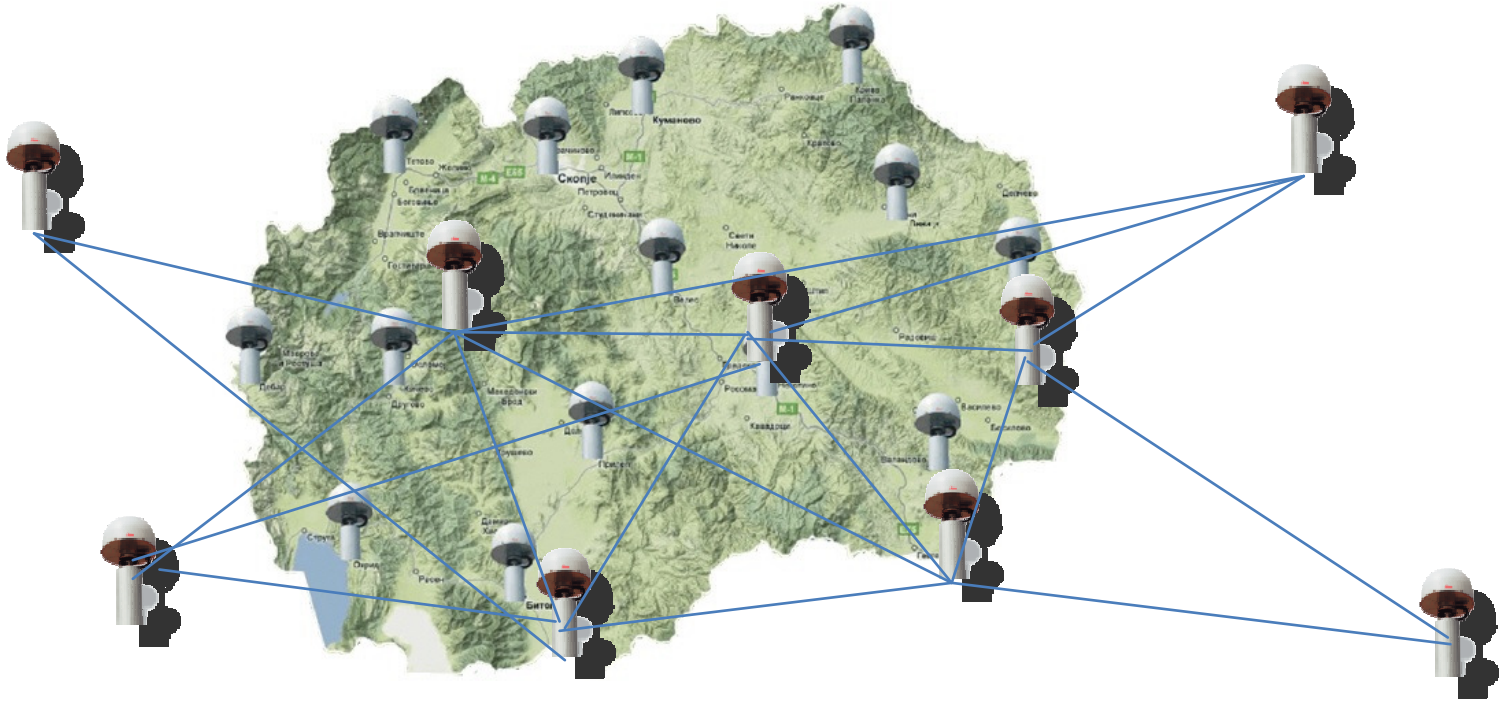
EUREF 2011

EUREF MAKPOS 2010

New realization of ETRS89 in Republic of Macedonia



KATACTAP

SWEDESURVEY

CONTENTS

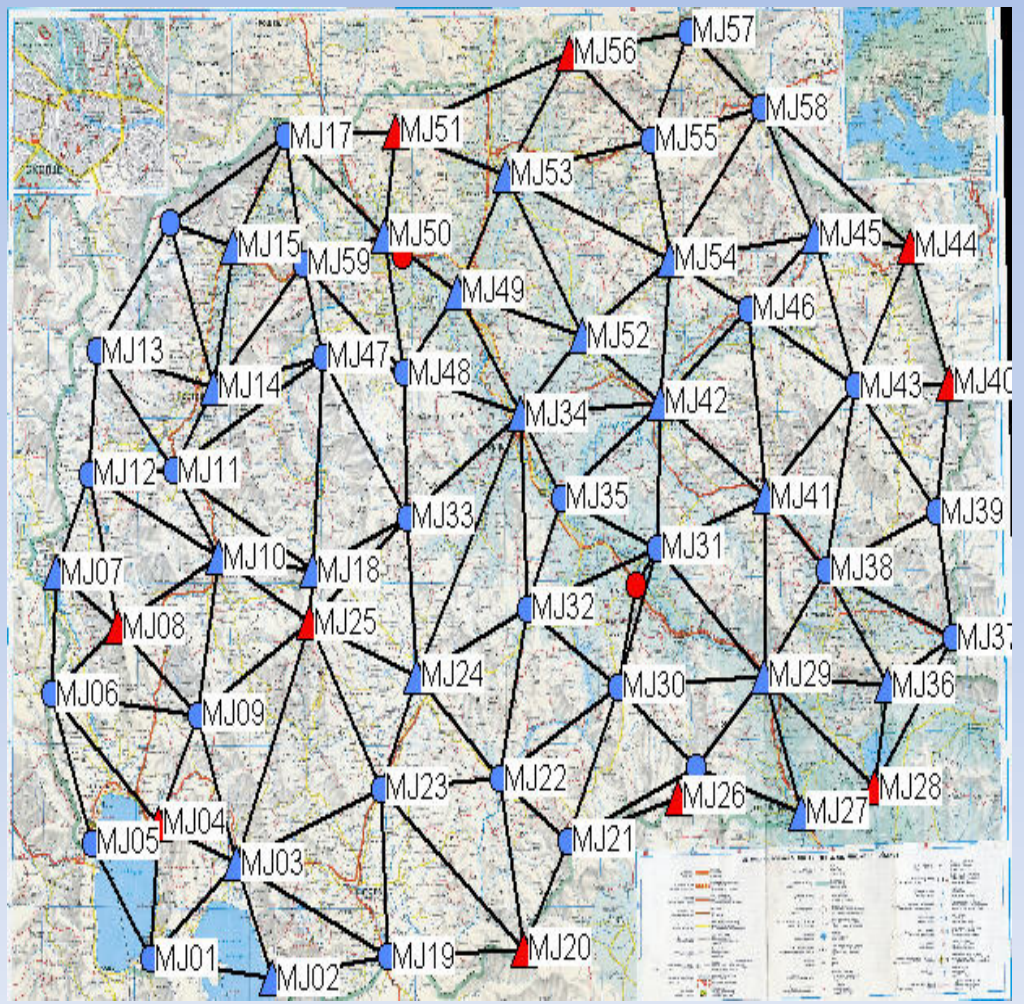
1. INTRODUCTION

1. EUREF-MAK '96

Campaign name	EUREF-MAK
Period	August, 1996
Area	Nationwide
Coordinate System	ITRF94(1996.6) ETRS89 (1989.0)
Observation Period	5 days * 24 hours
Number of Observation Points	25 - 1st order triangulation network + 2 point
Realize ETRS89	7 point
Processing software	Bernese v4.2

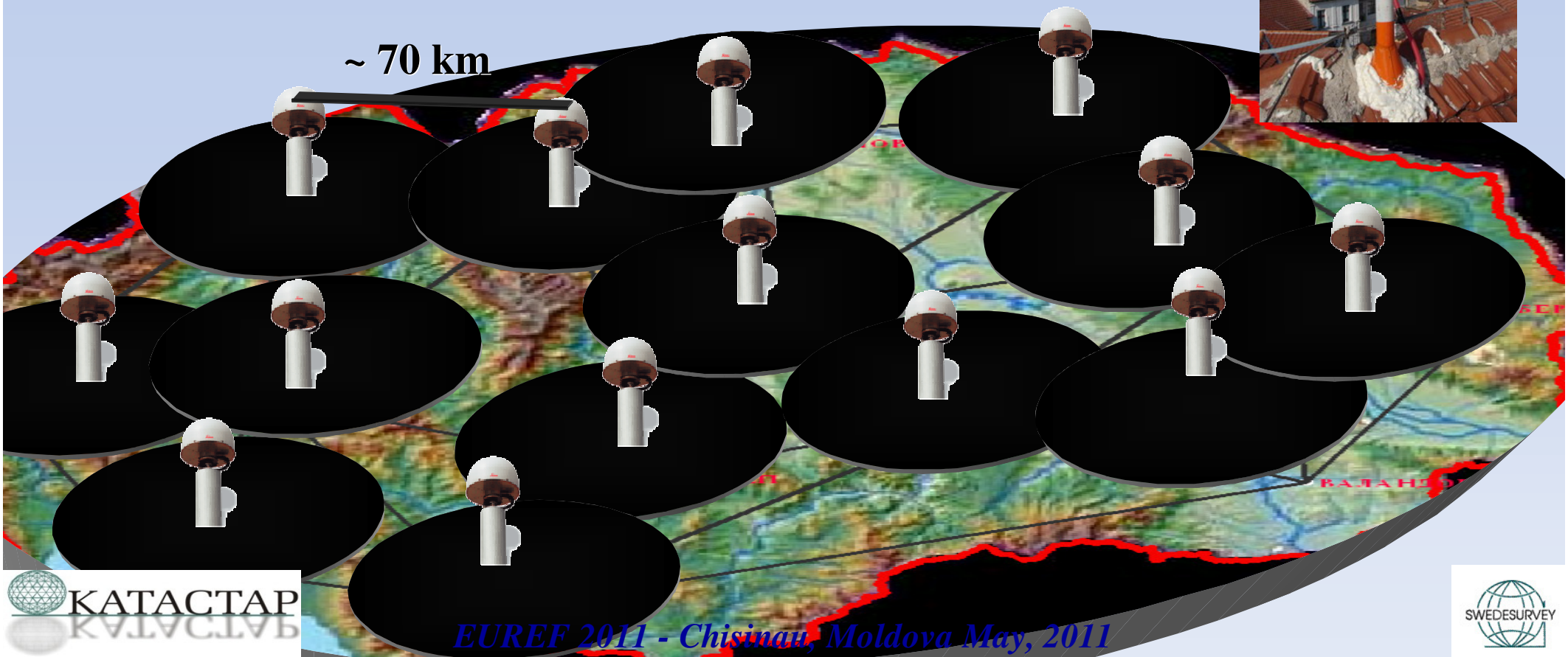
2. JICA PROJECT 2004 – First Passive GNSS network

Campaign Name	JICA 2004
Period	2004
Area	Nationwide
Coordinate System	- ITRF94 (1996.6) - ETRS89 (1989.0)
Number of Observation Points	newly installed points (30) Ohrid IGS/EPN station (1) 1st order triang. points (9) City control points (21)
Connect	4 EUREF point from EUREF-MAK'96



3. MAKPOS
(Macedonian Positionig System)

MAKPOS®
Macedonian Positioning System



1. INTRODUCTION

The reasons for a new implementation of ETRS 89 in Macedonia:

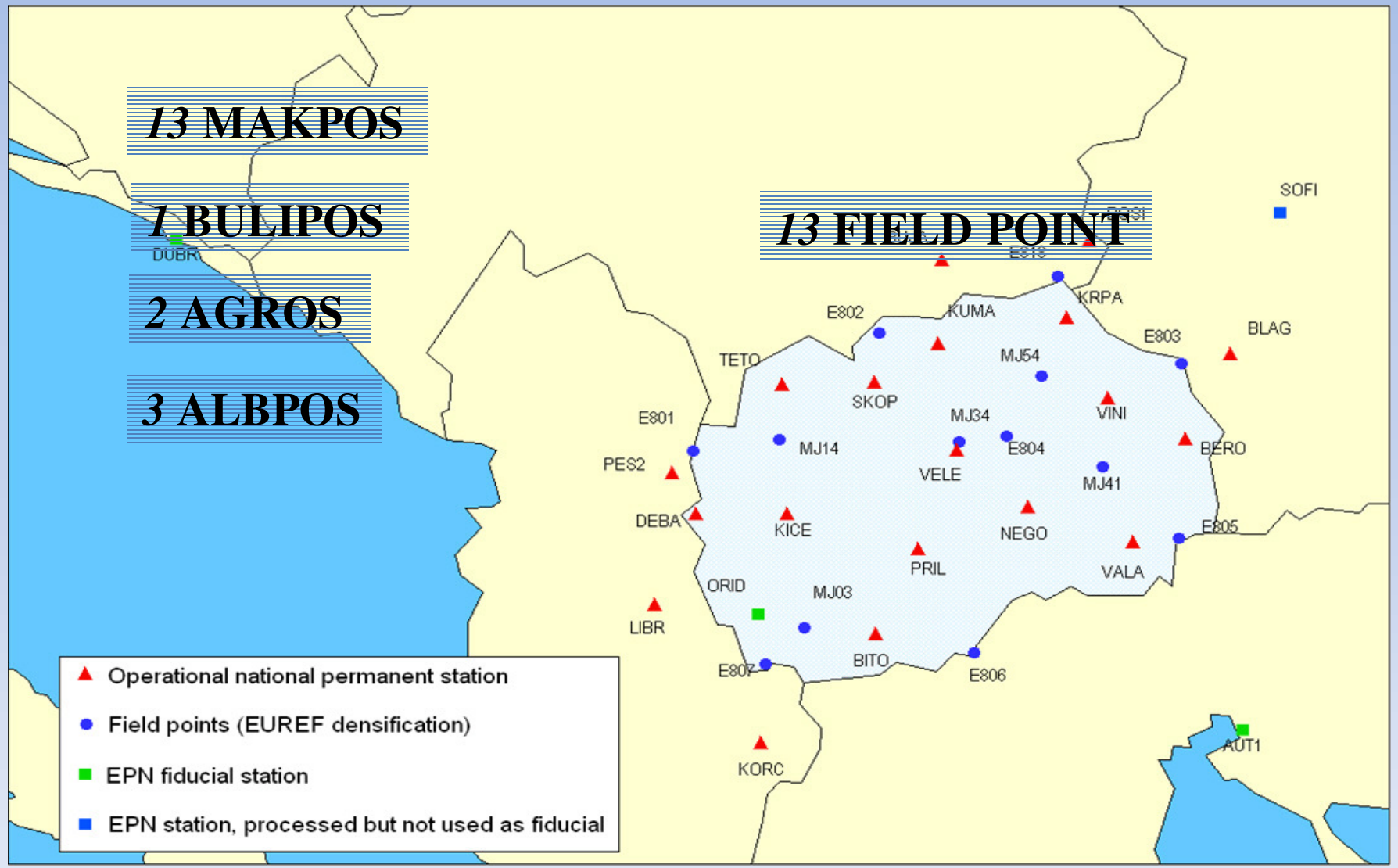
- the seven stations in the EUREF-MAK 1996 campaign are not so easy to occupy;
- the permanent station in Ohrid are not directly connected to those stations;
- the other permanent stations are not connected to the stations in the EUREF-MAK 1996 campaign;
- the JICA network should be better included.

1. BASIC INFORMATIONS OF EUREF-MAKPOS 2010

Campaign name	EUREF-MAKPOS 2010
Period	August 1 2010 till September 4 2010
Area	Nationwide
Coordinate System	ITRF2005 (e2010.631) ETRS89 (ETRF2000, e2010.631)
Observation Time	- 5 weeks - 2 to 5 days * 24 hours sessions (GPS-week 1597)
Included Stations	-20 EPN stations - 19 permanent stations - 13 field points
Software	Bernese v5.0

2. Campaign included totally 52 points

2. Distributions of points in and around Macedonia



2. DESCRIPTION OF EUREF MAKPOS 2010

3. COORDINATE REFERENCE FRAME

ITRF2005, epoch 2005.0. ⇨ **ITRF2005, epoch 2010.631**

4. PROCESSING STRATEGY

-The processing was carried out with the Bernese Software v 5.0.
-Each of 35 daily solution generated a minimally constrained normal equation file.
-An elevation cut off angle of 3°.

5. HANDLING OF AMBIGUITIES

The QIF ambiguity resolution strategy was used to resolve L1 and L2 ambiguities (cut off angel 10°).

2. DESCRIPTION OF EUREF MAKPOS 2010

6. DAILY NETWORK SOLUTIONS

Daily network solutions were minimal constrained on EPN class A stations.

7. FINAL COMBINED NETWORK SOLUTION

All of the 35 daily solutions were combined into a common adjustment.

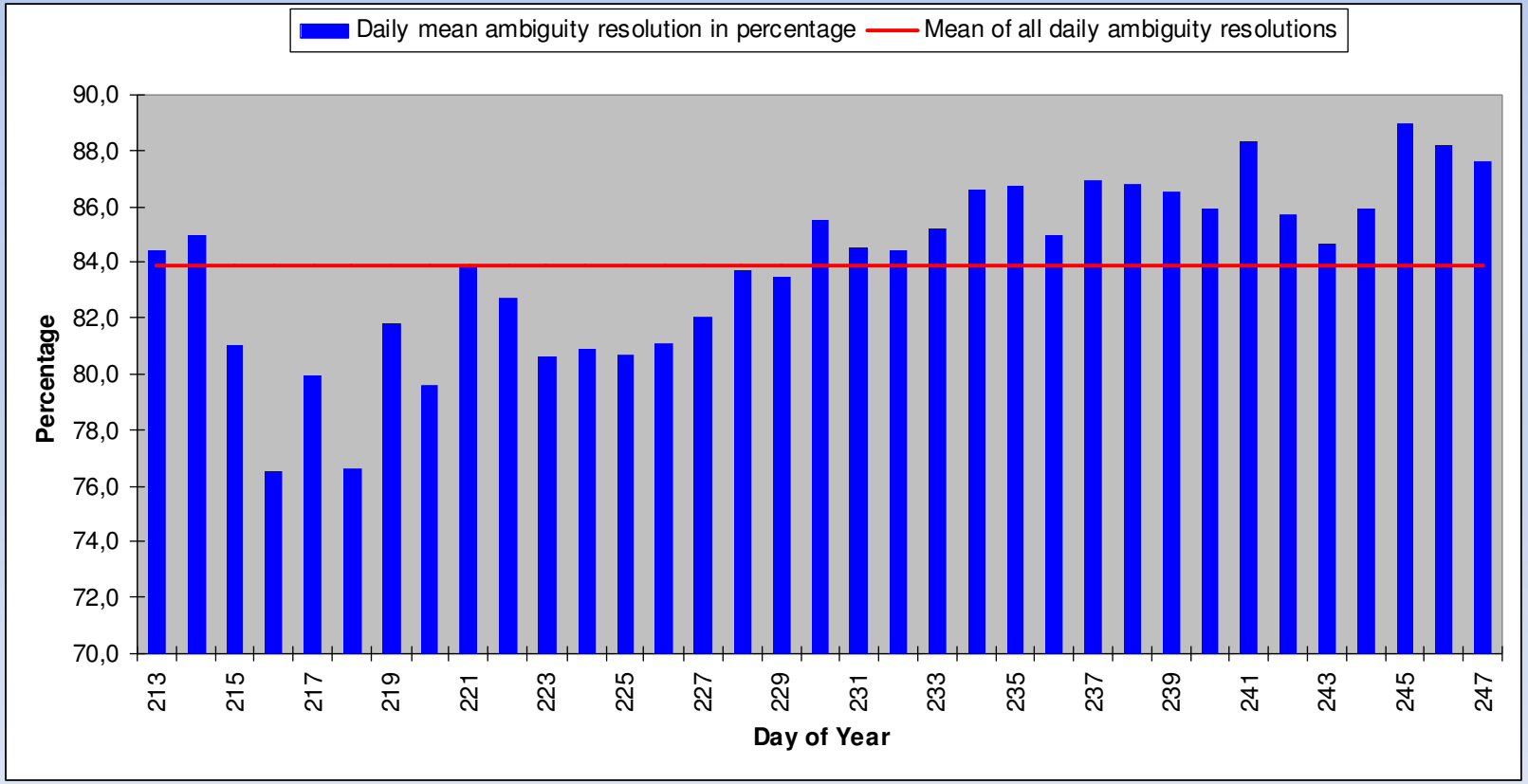
For the final combined network solution just translation minimum constraint was imposed on the fiducial stations.

8. COORDINATE TRANSFORMATION TO ETRS89

Coordinate transformation to ETRS89 was done only to ETRF2000, e2010.631, i.e. no intra-plate velocities have been taken into account.

1. DAILY MEAN AMBIGUITY RESOLUTION PERCENTAGES

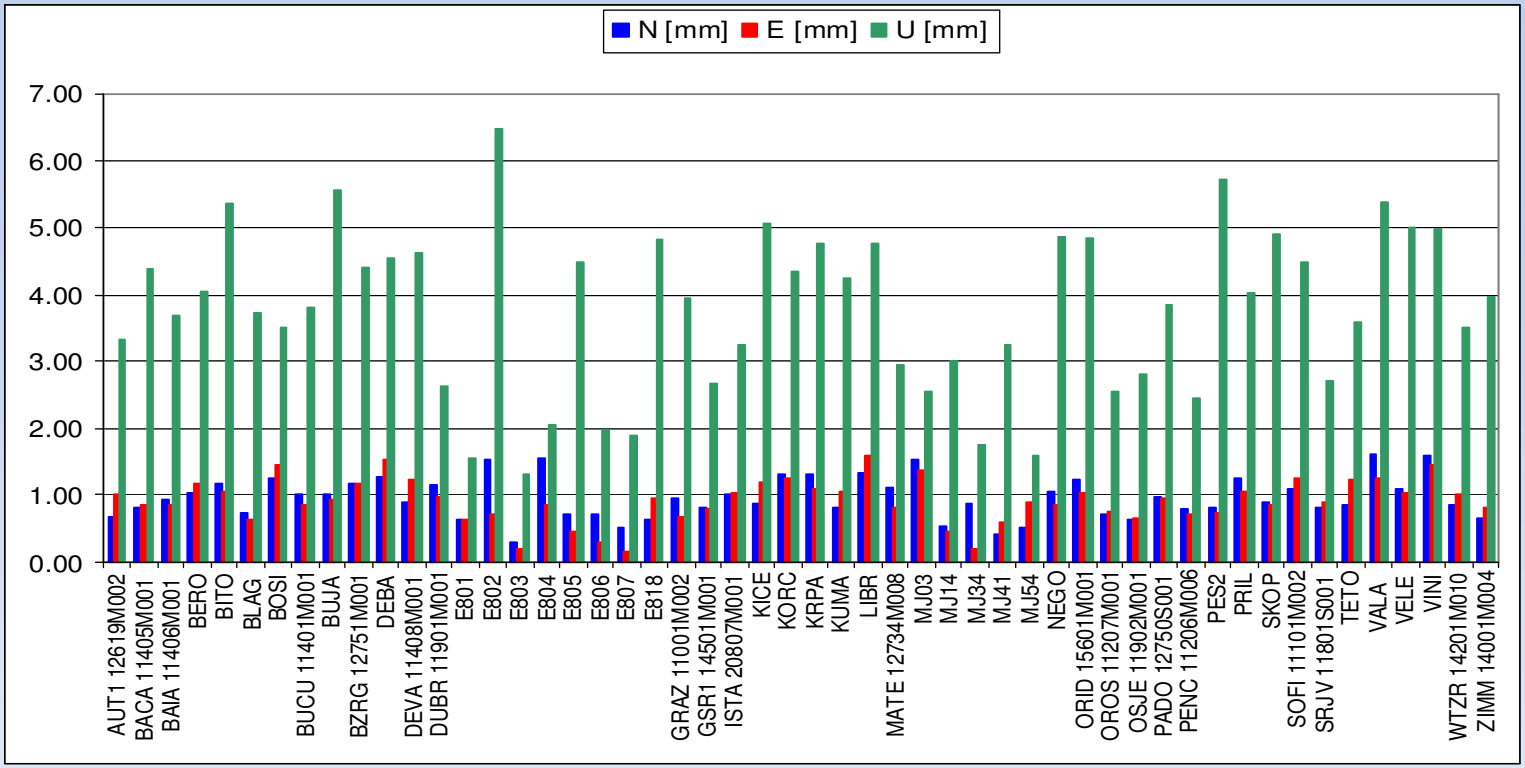
-Average percentage of daily ambiguity resolution was 83.9 %.



2. COMPARISON OF THE DAILY COORDINATES SOLUTIONS

- All stations showed good repeatability with typical values around *1 mm* per horizontal component and *3-5 mm* in height.

- Comparison of coord. was done with estimated ITRF2005 coord.



3. ELEVATION CUT OFF TEST

A test solution with a cut off angle of 25° was produced. This solution was compared to the final 3° solution.

Station	N [mm]	E [mm]	U [mm]
AUT1 12619M002	-0.9	0.1	-3.4
BACA 11405M001	-1.2	-0.7	22.6
BAIA 11406M001	2.3	1.3	5.8
BERO	-2.4	0.4	-26.0
BITO	2.1	-0.4	-23.1
BLAG	-0.8	0.6	-6.2
BOSI	-3.1	2.7	-63.8
BUCU 11401M001	0.3	1.0	13.6
BUJA	-3.2	1.2	36.7
BZRG 12751M001	0.2	0.1	-14.8
DEBA	-2.1	-0.3	-15.1
DEVA 11408M001	1.6	0.1	8.2
DUBR 11901M001	-0.7	-1.7	-9.4
E801	-4.6	-1.5	-1.1
E802	-3.9	1.5	8.9
E803	-1.7	-0.1	-22.5
E804	-1.6	2.2	-18.8
E805	-0.5	1.7	-20.0
E806	-2.2	1.8	1.3
E807	3.9	-1.3	-41.7
E818	-1.6	0.9	6.3
GRAZ 11001M002	0.6	-0.3	-14.3
GSR1 14501M001	1.8	-1.3	-3.2
ISTA 20807M001	-0.4	0.2	12.5
KICE	-2.3	-1.1	-4.8
KORC	-2.7	1.9	8.9

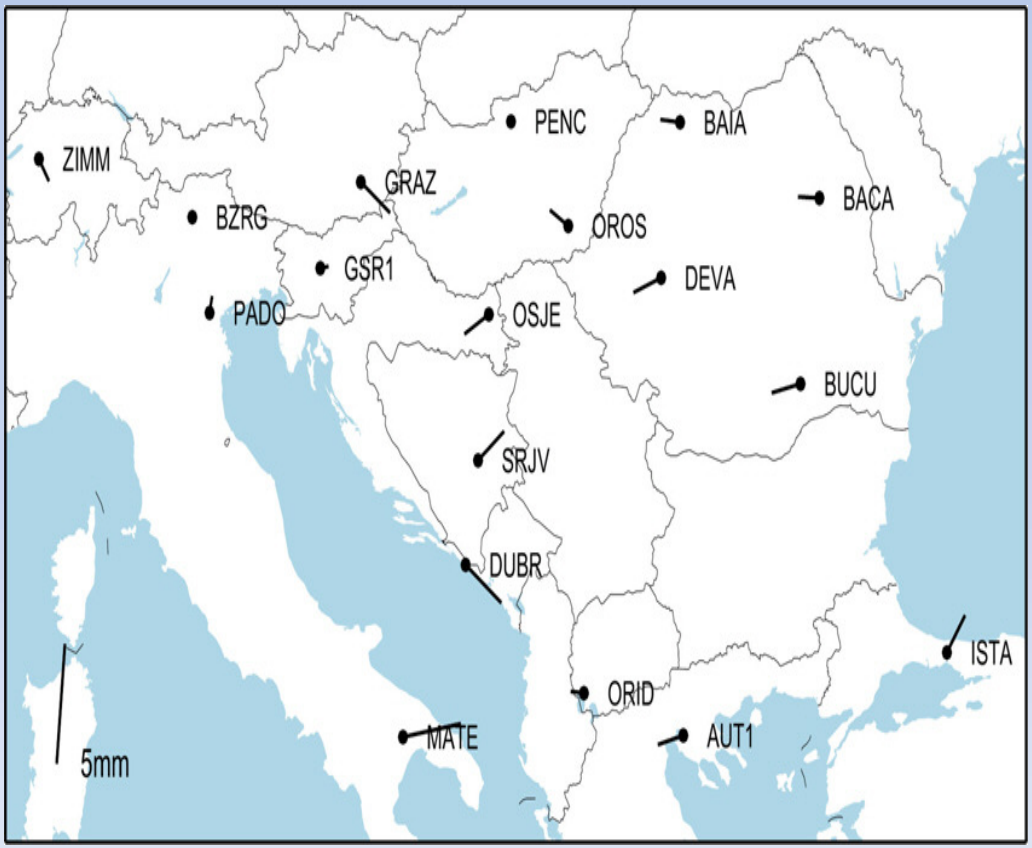
Station	N [mm]	E [mm]	U [mm]
KRPA	-1.0	0.8	-20.8
KUMA	-3.5	1.7	-6.4
LIBR	-4.8	0.5	-2.2
MATE 12734M008	-2.4	-0.6	-1.2
MJ03	-0.1	1.5	-25.2
MJ14	-0.6	2.0	-19.3
MJ34	-1.1	4.7	-18.7
MJ41	3.0	0.6	-28.7
MJ54	-0.6	1.8	2.3
NEGO	-2.9	1.6	-6.6
ORID 15601M001	-0.2	0.8	-5.3
OROS 11207M001	2.7	0.0	-7.8
OSJE 11902M001	-0.1	-1.1	-4.9
PADO 12750S001	-0.5	-1.4	-22.5
PENC 11206M006	1.7	-1.3	-13.4
PES2	-0.6	1.3	1.3
PRIL	-0.7	0.4	7.5
SKOP	-0.5	2.0	-20.1
SOFI 11101M002	-1.5	1.2	-10.2
SRJV 11801S001	-1.9	-0.6	24.8
TETO	0.2	0.0	-35.6
VALA	-1.5	1.4	-26.0
VELE	-3.1	1.0	-15.4
VINI	-0.1	0.4	-19.5
WTZR 14201M010	3.7	-2.7	-29.1
ZIMM 14001M004	-2.4	-1.6	14.1

The result from the cut off test shows different level of accuracy depending on antenna type used and site dependent effects.

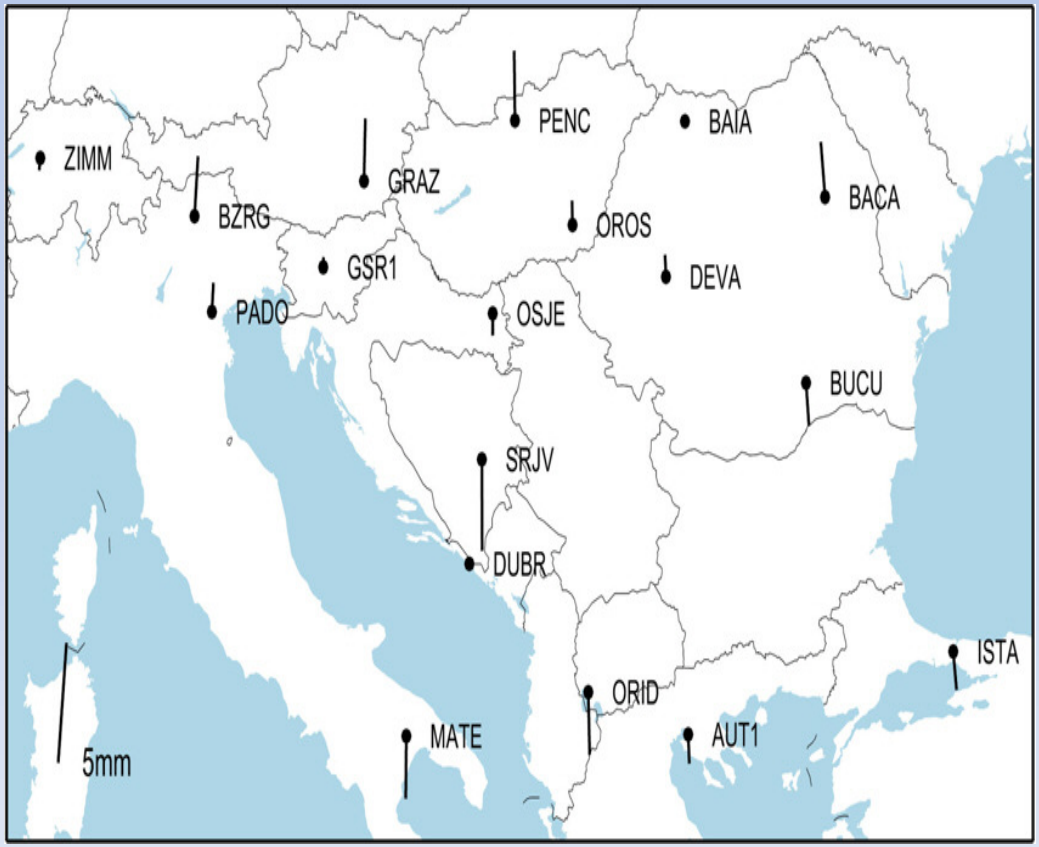
4. Comparison between estimated ITRF2005 coordinates and latest EUREF densification of ITRS *(EPN_A_ITRF2005_C1600.SNX)*.

Station	a plain comparison		
	N	E	U
	[mm]	[mm]	[mm]
AUT1 12619M002	-0.3	-1.6	-1.2
BACA 11405M001	0.2	-1.3	2.3
BAIA 11406M001	0.2	-1.2	0.2
BUCU 11401M001	-0.2	-1.8	-1.8
BZRG 12751M001	0.0	0.1	2.5
DEVA 11408M001	-0.5	-1.7	0.9
DUBR 11901M001	-1.6	2.2	0.0
GRAZ 11001M002	-1.2	1.8	2.6
GSR1 14501M001	0.1	0.5	0.4
ISTA 20807M001	1.4	1.3	-1.6
MATE 12734M008	0.6	3.5	-2.6
ORID 15601M001	0.1	-0.8	-2.6
OROS 11207M001	0.7	-1.1	1.0
OSJE 11902M001	-0.8	-1.5	-0.9
PADO 12750S001	0.7	0.1	1.2
PENC 11206M006	-0.2	-0.1	2.9
SRJV 11801S001	1.2	1.6	-3.8
ZIMM 14001M004	-0.8	0.7	-0.5
RMS / COMPONENT	**0.8**	**1.6**	**2.0**

4. Comparison between estimated ITRF2005 coordinates and latest EUREF densification of ITRS



Horizontal residuals from fiducial station coor. recoveries



Vertical residuals from fiducial station cor. recoveries

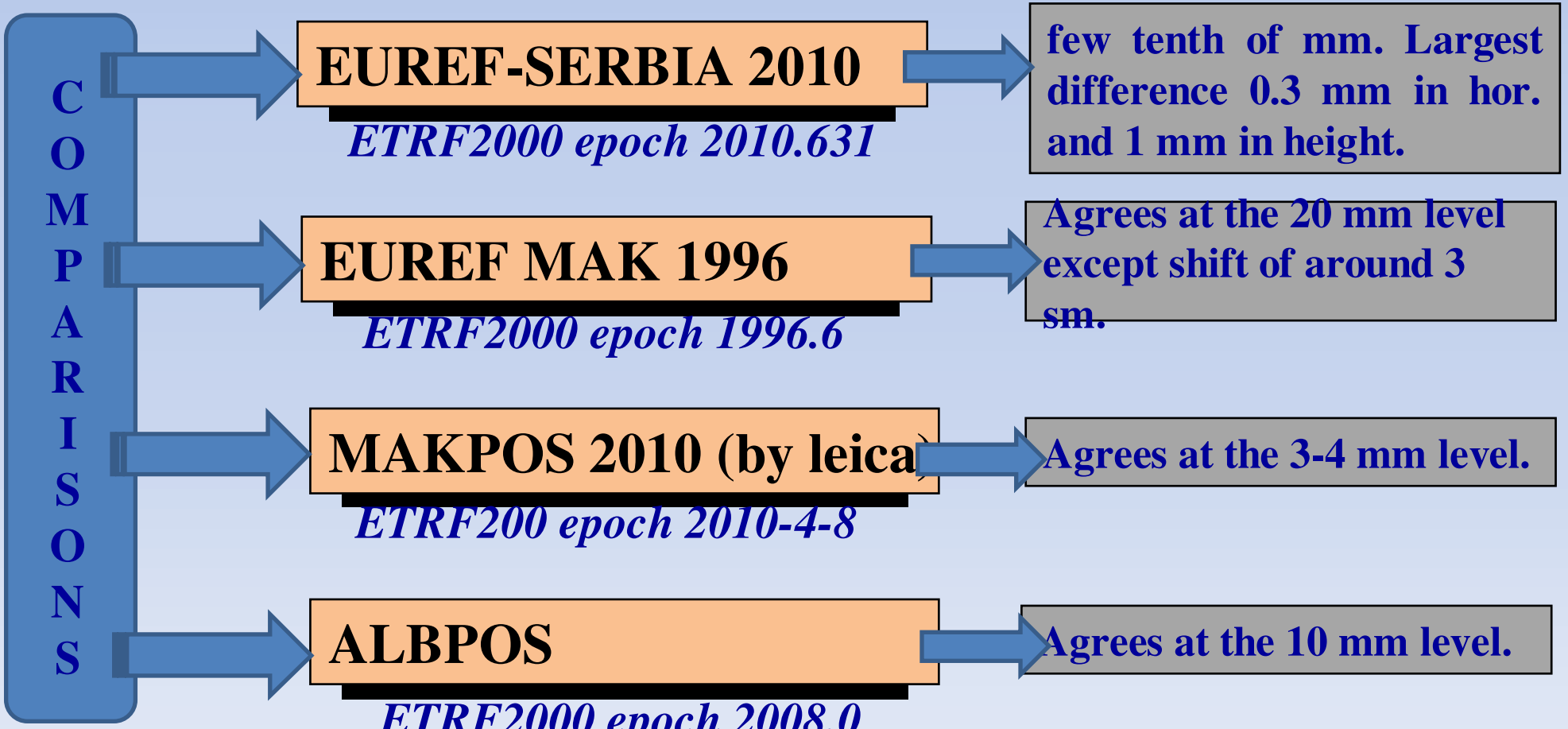
4. CONCLUSIONS

1. The internal quality of the solution is around 1 to 2 mm in N and E and around 3 to 5 mm in U.

2. ITRF2005 for EUREF MAKPOS 2010 is realized to around 2 mm in all three components.

3. Elevation cut off test show different level of accuracy depending on antenna type and site dependent effects.

4. The comparisons of EUREF MAKPOS 2010 (*ETRF2000 epoch 2010.631*) with other realization of ETRS89



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THANK YOU FOR YOUR ATTENTION