Preliminary results of the Italian Rete Dinamica Nazionale (RDN)

of Istituto Geografico Militare Italiano

and its alignment to ETRF2000 (R05)

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Munich, 3 November 2008

Outlook

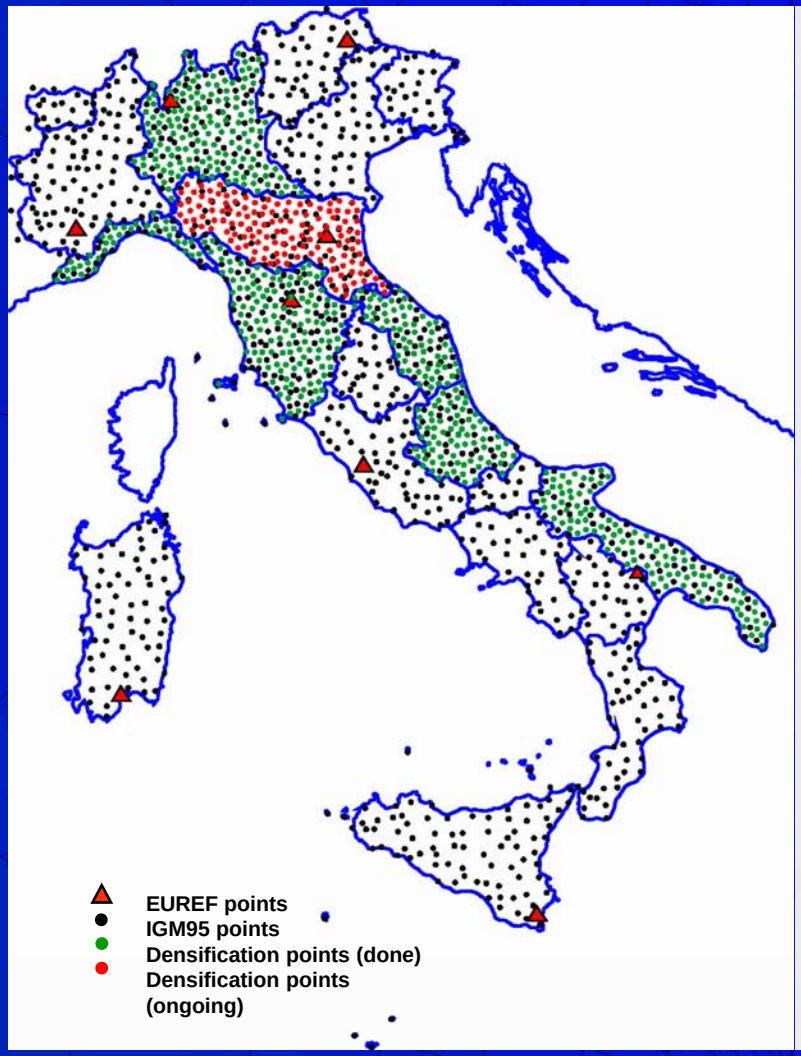
- From IGM95 (ETRF89 at 1996.0) to RDN [ETRF00 (R05) at 2008.0]
- Data and network properties
- Processing
  - Set up of BERNESE 5.0
  - Stability of the 28 daily solutions and repeatibility
  - Alignment to ITRF2005 and Transformation to ETRF00 (R05)
  - Additional tests: use of EPN products; use of PDR2005
- Validation by independent AC's
- Consequences of Datum change: IGM95 → RDN
- Expected lifetime of RDN
- Conclusions

Rete Dinamica Nazionale (RDN)

From IGM95 (ETRF89) at 1996.0 to RDN (ETRF00 (R05)) at 2008.0

IGM95:

- Campaign style,
- 8 EUREF points,
- 4 permanent sites
- No official endorsment from EUREF



RDN:

- Permanent sites only
- 14 ITRF05 sites
- 27 EPN sites
- State of the art processing
- Conforms to INSPIRE
- EUREF endorsment requested

Rete Dinamica Nazionale

100 stations homogeneously distributed

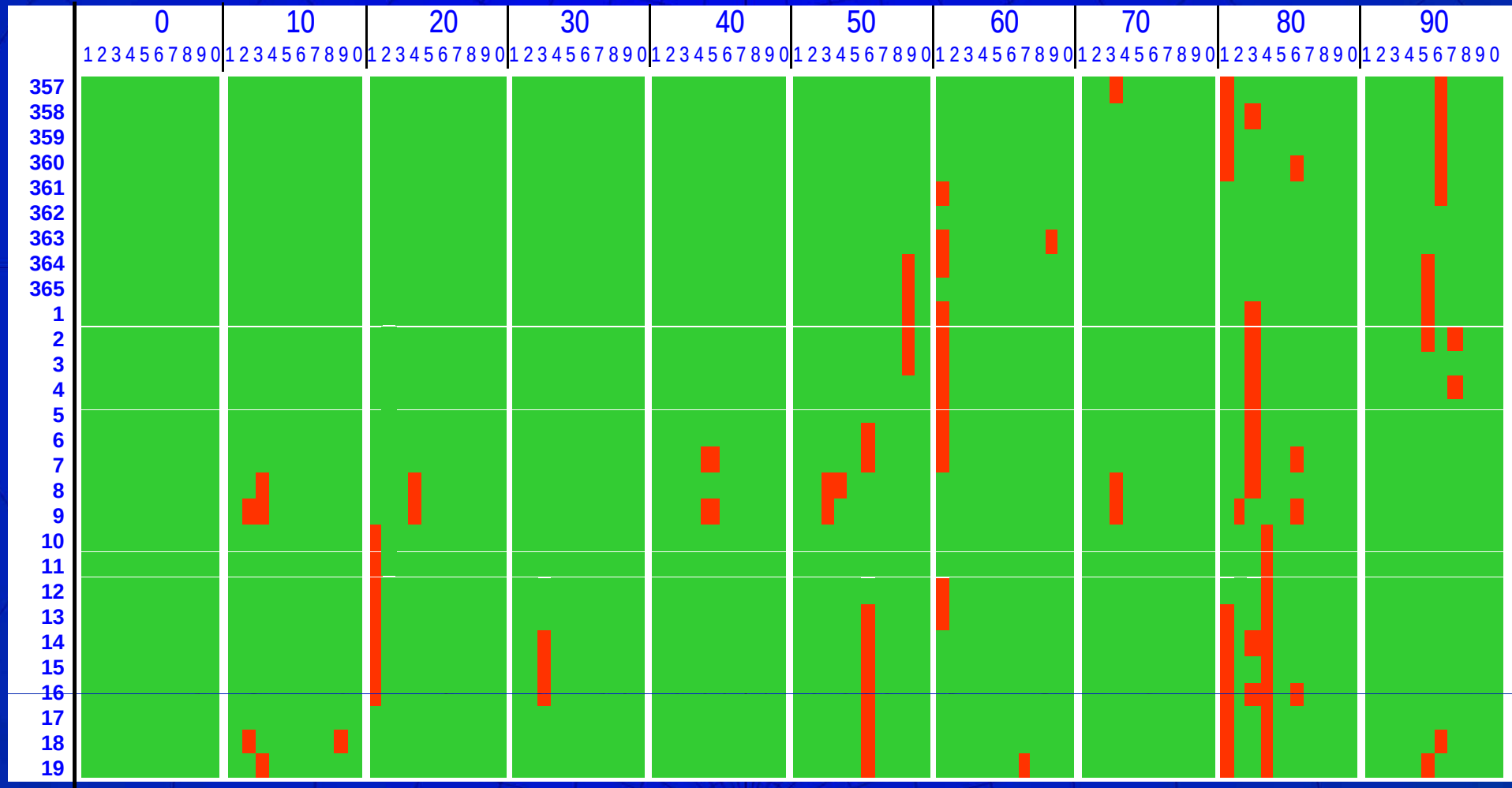
- Mean interdistance 100÷150 km (1 station / 3000 km^2)
- Stations owned by Institutions
- Redundancy; temporal continuity

Choice of stations:

- 14 are listed in the ITRF2005
- 21 (Italian) + 6 (neighbor Nations) are in the EPN
- Monumentation
- Support RTK

Data

GPSweeks 1459, 1460, 1461, 1462 from 23.12.2007 to 19.01.2008; reference epoch 2008.0



RNX2SNX setup according to EPN guidelines

http://www.epncb.oma.be/_organizaton/guidelines/guidelines_analysis_centres.php

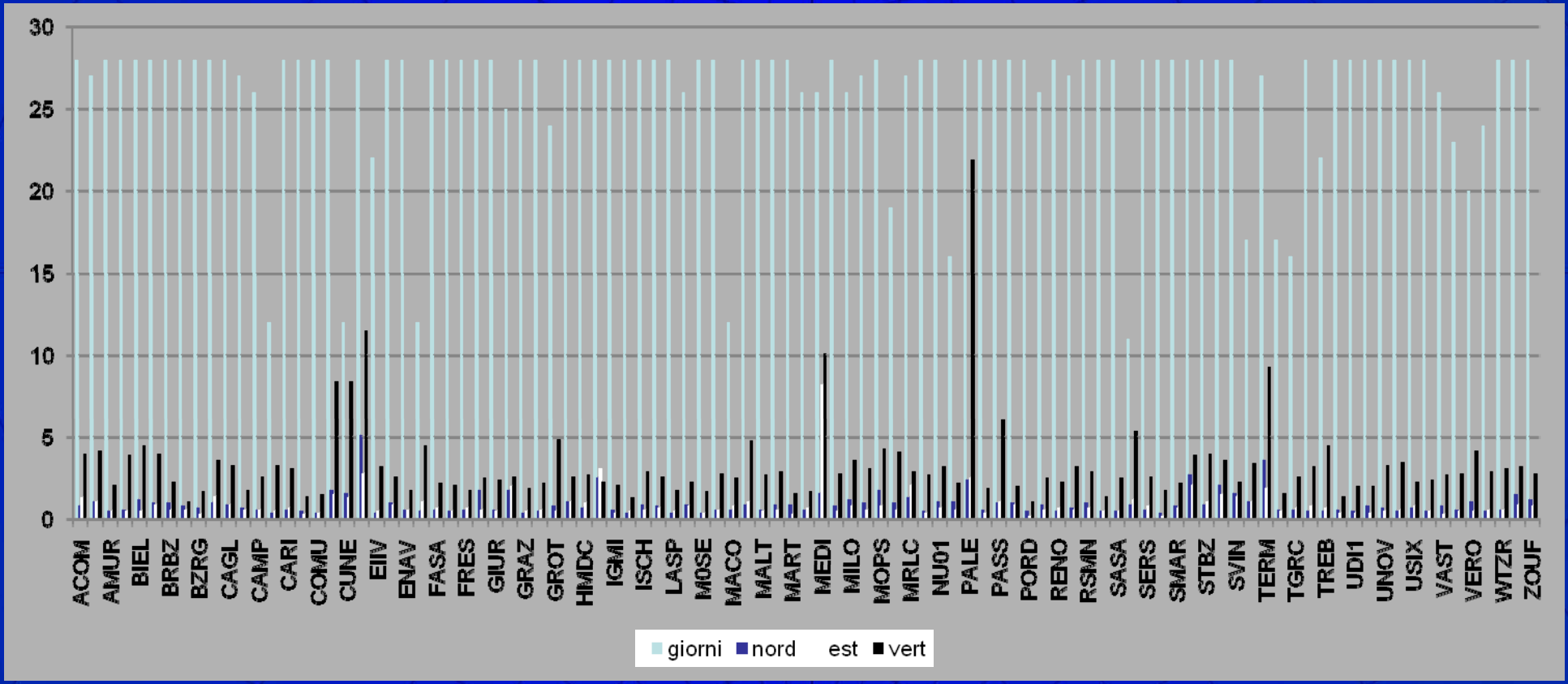
- IGS05 Orbits and EOP
- Absolute PCV's from IGS05.atx
- Ocean tides GOT00.2 (Goddard Ocean Tide Loading)
- Rigorous control of match Rinex header / logsheet

- Computation done at IGM with independent reprocessing at Politecnico di Milano and University of Padova (EPN LAC)

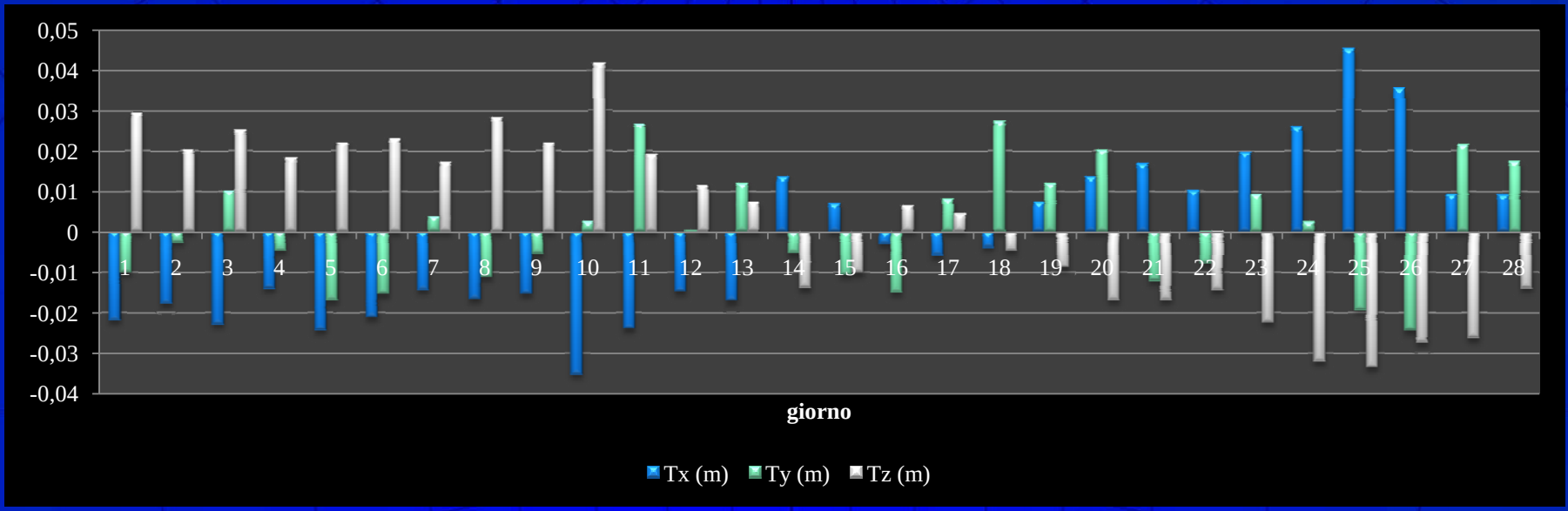
Repeatibility of the 28 daily solutions

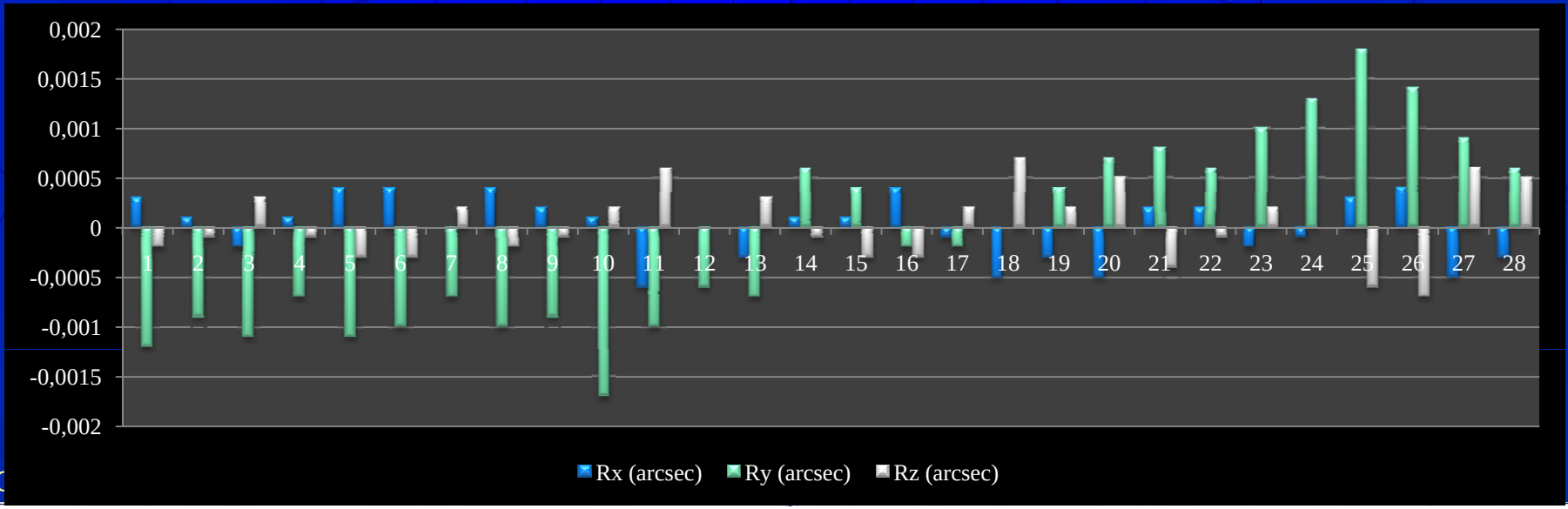
Horizontal repeatibility well below 10 mm

Same for vertical, except Palermo (rf interference)

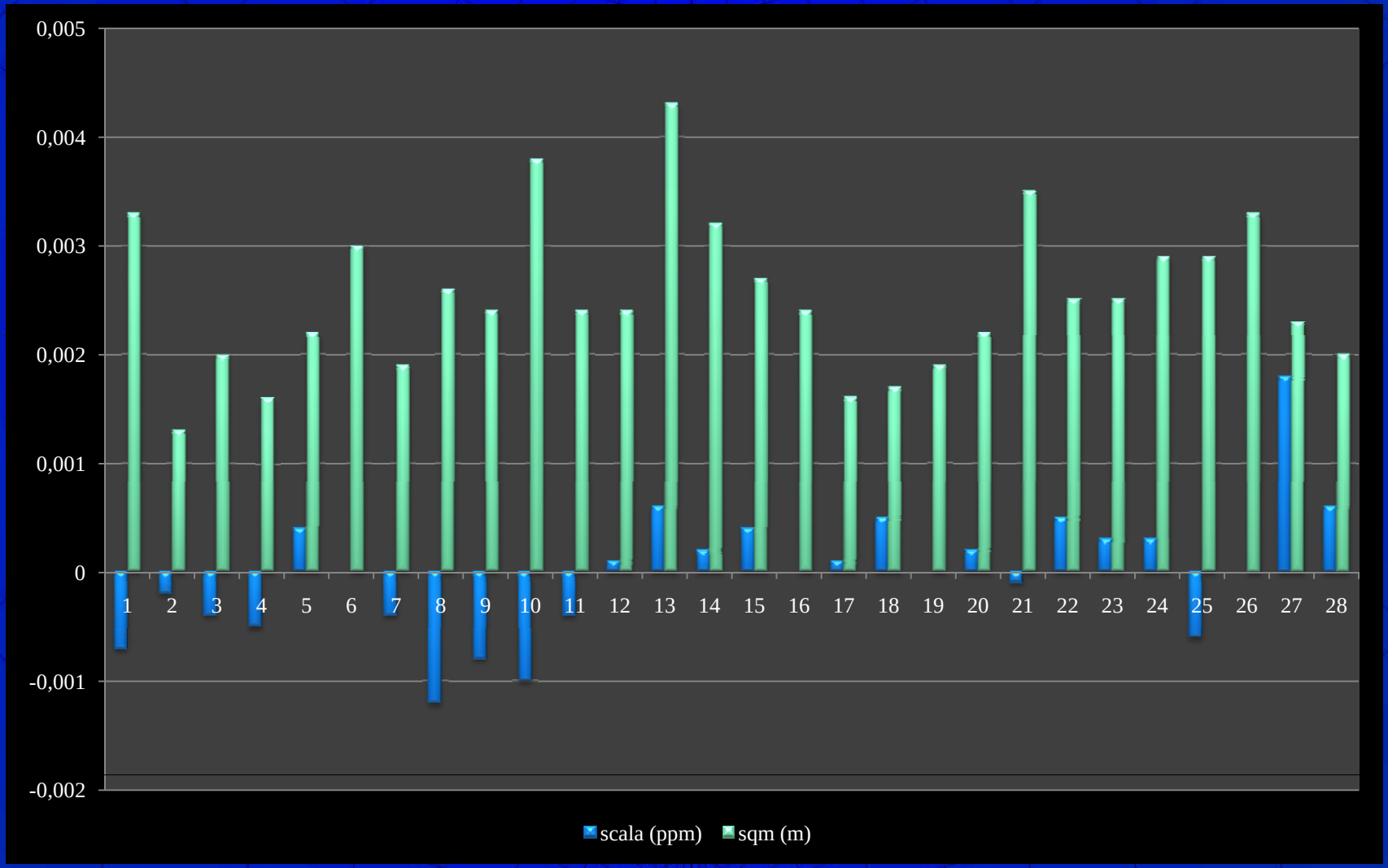


Repeatibility of the 28 realizations of the Reference Frame: Translations and Rotations



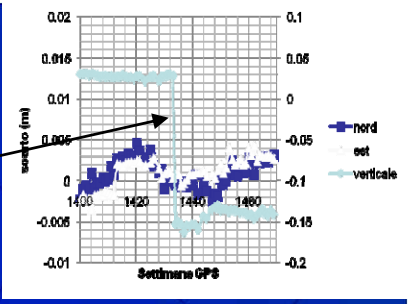


Scale and rms of 7 parameters transformations



Datum Constraints

- 14 ITRF05 stations included in RDN
  13 used (HFLK excluded in MC)



MC on 13
ITRF05 stations

RINEX data
at IGMI

RNX2SNX

28 Daily
NEQ's, MC

LAREG
ftp server

ITRF05.crd

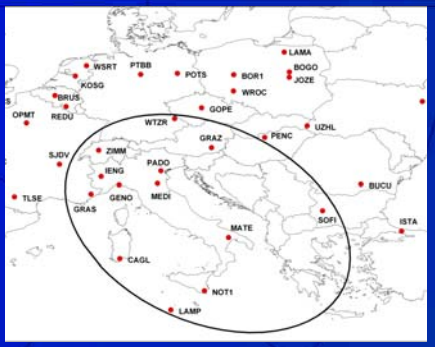
ITRF05.vel

Σ ADDNEQ2,MC

RDN MC
SINEX
(ITRF05)

ITRS

7/14 param
x-form



RDN MC
SINEX
ETRF00(R05)

ETRS

Epoch	*T1*	*T2*	*T3*	*D (10^{-9})*	*R1*	*R2*	*R3*
00:001				0.40	0.891 mas	5.390 mas	-8.712 mas
+	-0.2	0.1	-1.8	0.08	0.081	0.490	-0.792
	mm/yr	mm/yr	mm/yr	1/yr	mas/y	mas/y	mas/y
08:001					1.539 mas	9.310 mas	-15.048
	52.50	51.0	-68.2	1.04			mas

Boucher e Altamimi: memo
V7 2 October 2008

Additional tests

- MC IGS05 coordinates of ITRF05 stations: from EPN SINEX and Linear Regression on the last 52 weeks (*)
- Combine with EUR14590.SNX thru EUR14620.SNX and MC on those 26 sites used by BKG (*)

(*)Gurtner, W., C. Boucher, C. Bruyninx, H. V.D.Marel (1997), The use of the IGS/EUREF permanent network for EUREF densification campaigns , EUREF Publication No. 6, Veröffentlichungen der Bayerischen Kommission für die Internationale Erdmessung der Bayerischen Akademie der Wissenschaften, pp. 50-51, Sofia, Bulgaria, June 2-5 1997.

- Replace ITRF2005 with PDR2005 (10 instead than 14 sites in common with RDN): $T_{y=}$-11.2 mm
- Result: no change at the mm level from Helmert comparison (Tx Ty Tz only) between the different options for MC

Comparison among 3 Analysis Centers

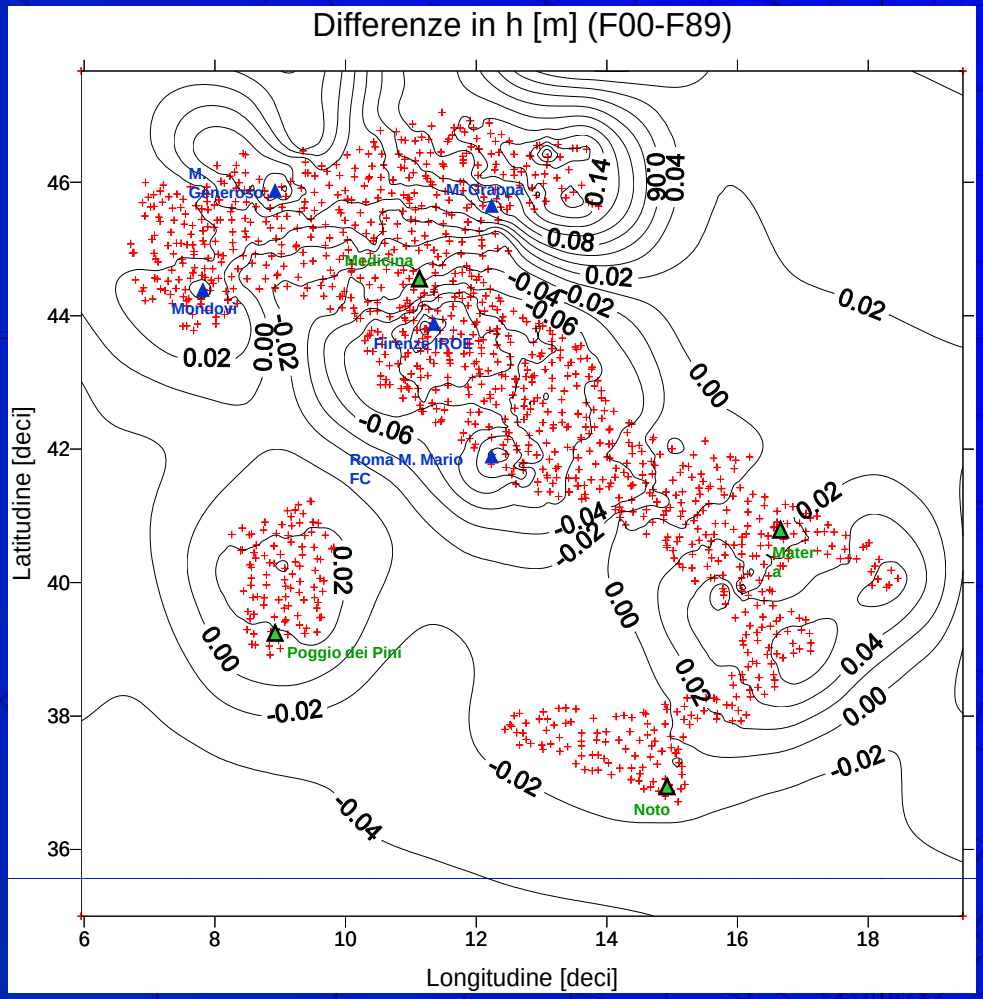
Abs. Mean of the differences between AC and IGM, in mm

staz.	ΔX	ΔY	ΔZ	staz.	ΔX	ΔY	ΔZ	staz.	ΔX	ΔY	ΔZ	staz.	ΔX	ΔY	ΔZ	staz.	ΔX	ΔY	ΔZ
ACOM	0.6	0.6	0.3	**ELBA**	0.0	0.5	0.3	**M0SE**	0.4	0.7	0.5	**PASS**	1.0	0.8	0.7	**TORI**	1.7	0.6	1.5
ALFE	0.5	0.5	0.8	**ENAV**	1.0	0.8	0.9	**MABZ**	0.6	0.7	0.5	**PAVI**	0.7	0.7	0.6	**TREB**	0.8	0.7	0.8
AMUR	3.6	0.5	3.5	**ENNA**	0.1	0.5	0.3	**MACO**	0.1	0.6	0.3	**PORD**	0.3	0.5	0.2	**TRIE**	0.3	0.5	0.2
AQUI	0.3	0.8	0.5	**FASA**	0.3	0.5	0.5	**MADA**	1.0	0.7	1.0	**PRAT**	0.4	0.6	0.2	**UDI1**	0.6	0.1	1.2
BIEL	0.0	0.5	0.0	**FOGG**	0.0	0.5	0.1	**MALT**	4.2	0.6	3.2	**RENO**	0.7	0.7	0.7	**UGEN**	0.1	0.0	0.1
BORM	0.4	0.6	0.1	**FRES**	3.6	0.5	3.6	**MAON**	3.5	0.2	3.5	**ROVE**	0.0	0.8	0.5	**UNOV**	2.8	0.8	2.4
BRBZ	0.0	0.6	0.1	**GENO**	0.3	0.6	0.2	**MART**	0.7	0.7	1.0	**RSMN**	0.1	0.6	0.3	**UNPG**	0.7	0.3	0.2
BRES	0.8	0.7	0.7	**GIUR**	0.4	0.6	0.4	**MATE**	0.2	0.4	0.1	**RSTO**	0.4	0.6	0.6	**USIX**	4.2	0.6	3.8
BZRG	0.2	0.6	0.0	**GRAS**	0.1	1.0	0.4	**MEDI**	4.9	2.1	3.5	**SASA**	0.8	0.6	0.9	**VAGA**	4.5	0.6	4.5
CA06	0.0	0.5	0.1	**GRAZ**	1.0	1.1	0.9	**MILA**	0.2	0.5	0.2	**SASS**	0.3	0.5	0.1	**VAST**	0.9	0.7	1.0
CAGL	1.1	0.7	0.7	**GROG**	0.3	0.5	0.4	**MILO**	3.2	1.3	2.6	**SERS**	4.1	0.8	3.6	**VEAR**	0.2	0.2	0.6
CAME	1.0	1.1	1.0	**GROT**	3.9	0.4	3.6	**MOCO**	4.1	0.6	3.8	**SIEN**	1.5	0.9	1.5	**VERO**	0.7	0.8	0.6
CAMP	0.8	0.7	0.9	**HFLK**	0.6	0.9	0.6	**MOPS**	1.5	1.0	1.5	**SMAR**	0.4	0.3	0.3	**VITE**	0.3	0.6	0.4
CAPO	0.8	0.3	0.7	**HMDC**	2.6	0.0	1.9	**MRGE**	4.0	0.3	4.9	**SOFI**	0.3	0.8	0.3	**WTZR**	1.0	0.7	1.3
CARI	0.6	0.5	0.9	**IENG**	0.6	0.1	0.4	**MRLC**	4.1	0.7	3.9	**STBZ**	0.3	0.6	0.2	**ZIMM**	0.7	0.8	1.1
COMO	0.1	0.7	0.5	**IGMI**	1.2	0.9	0.9	**MSRU**	4.7	0.6	3.7	**STUE**	0.0	0.5	0.5	**ZOUF**	1.2	1.1	1.1
COMU	2.1	0.4	1.6	**INGR**	0.9	0.6	0.4	**NOT1**	3.2	2.2	2.1	**SVIN**	0.7	0.7	0.7				
CUCC	10.7	1.9	7.6	**ISCH**	0.4	0.6	0.7	**NU01**	1.5	0.3	1.7	**TEMP**	0.3	0.4	0.0	**max**	10.7	2.2	7.6
CUNE	0.9	0.7	0.4	**LAMP**	0.1	0.5	0.4	**PADO**	0.0	0.8	1.1	**TERM**	0.5	0.9	0.0	**max -**	4.9	2.2	4.9
DEVE	0.3	1.1	1.0	**LASP**	3.4	0.2	3.8	**PALE**	5.9	1.9	5.0	**TGPO**	0.9	0.3	0.8	**media**	1.3	0.7	1.3
EIIV	0.5	0.6	0.6	**LAT1**	0.7	0.5	0.9	**PARM**	3.3	0.2	4.1	**TGRC**	0.4	0.6	0.8	**st. dev.**	1.7	0.4	1.4

Consequences of Datum Change IGM95 → RDN

- **48 common IGM95 – RDN points**

  The differences between the Italian realizations of ETRF89 and ETRF00 (R05) be estimated at the 1230 original IGM95 points



h ELLIS.		[m]	Point id
max diff positiva		0.220	14801
max diff negativa		-0.168	106905

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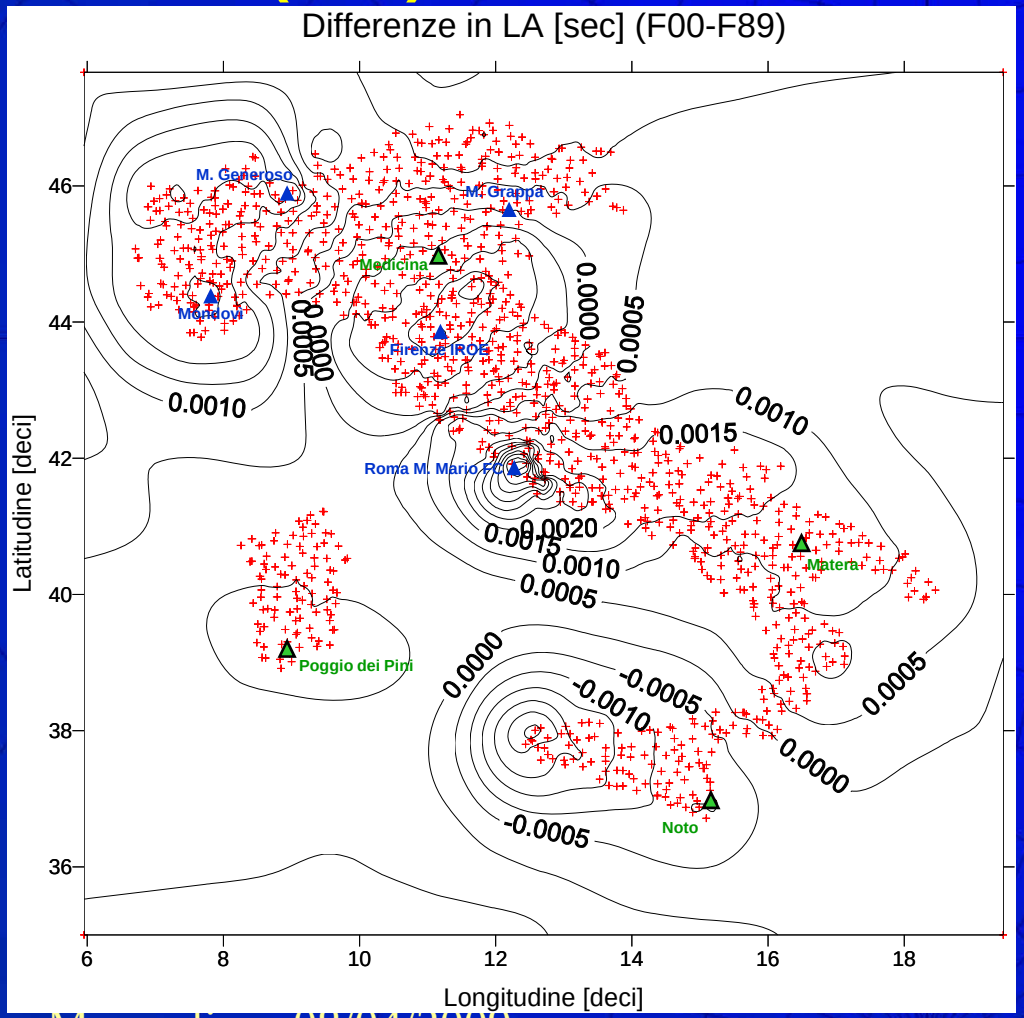

LATIT.	[sec]	[m]	sul punto
max diff positiva	0.0038	0.114	106905
max diff negativa	-0.0010	-0.031	80801

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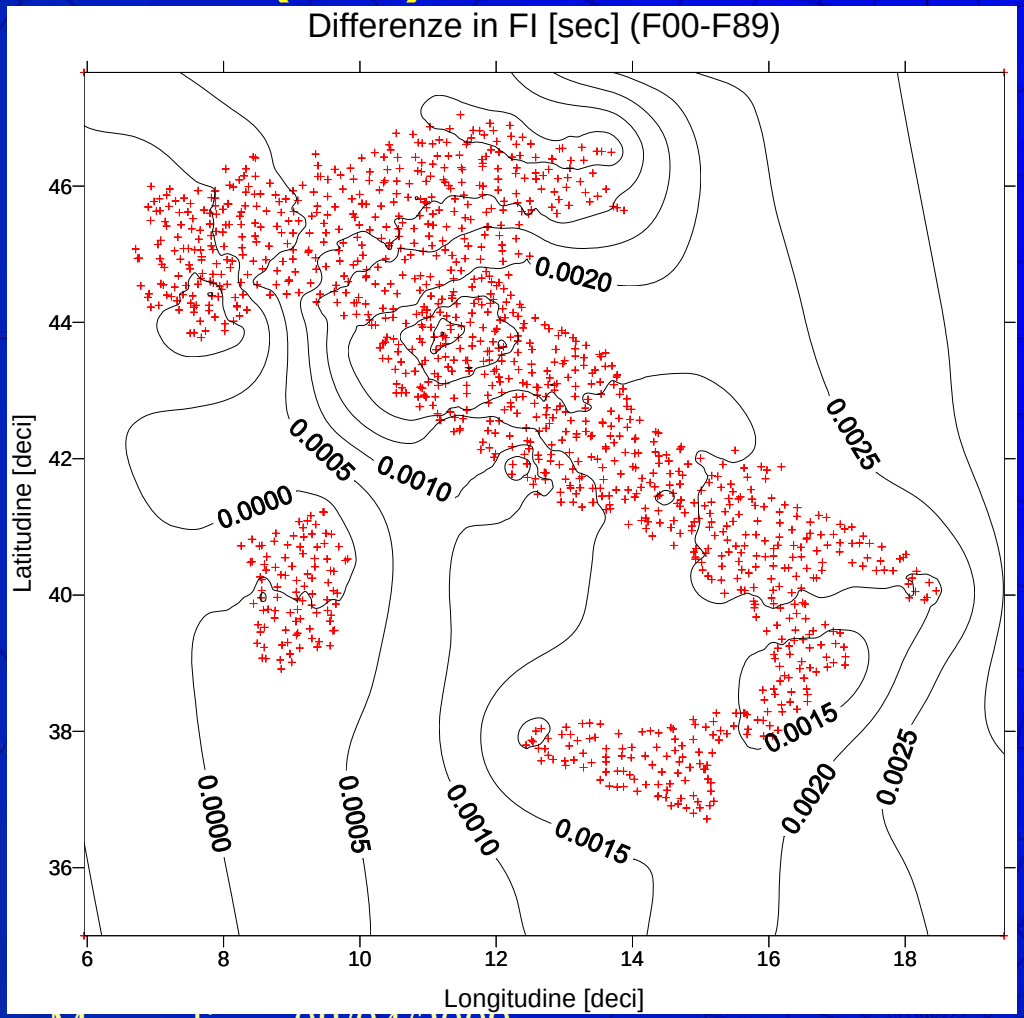


LONGIT.	[sec]	[m]	sul punto
max diff positiva	0.0055	0.166	149801
max diff negativa	-0.0031	-0.093	248901

Densification of RDN

- University of Padova weekly domestic processing includes 29 Italian permanent stations not part of the RDN
- NEQ's with these stations were stacked with RDN NEQ's for the weeks 1459-1462

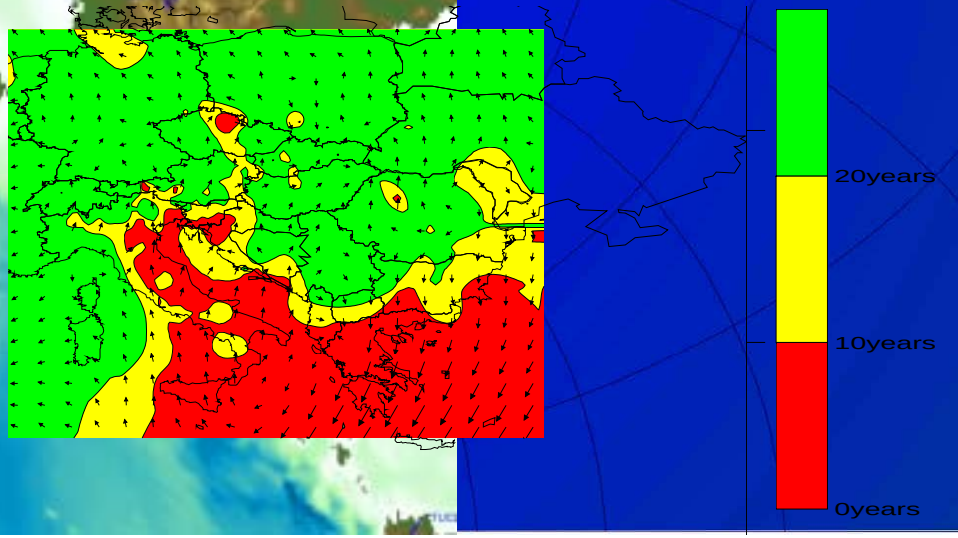
Expected lifetime of RDN
(time to exceed 3 cm relative to ETRF2000 (R05))

Residual velocities of several stations well known relative to the ETRF00 (R05) frame

Positions coincide at 2008.0

Threshold: 3 cm discrepancy

Result:10 years in most areas



Conclusions

- RDN computed according to the specifications for Regional Frame densification
- EPN Guidelines for GPS data processing
- Results independently checked, several options tested for alignment
- mm repeatibility (except PALE in up)
- Plan to adopt RDN officially beginning 2009.0 – In time with expected INSPIRE Implementing Rule
- Request the TWG for activation of procedure for verification and Class assignment