



Towards a European Dense Velocities Field as a basis for Maintaining the European Reference Frame

EUREF 2019 Symposium

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Motivation: Example Spain

CRD only



- ETRF2005 as intermediate reference frame chosen (Memo publisned before ETRF2005 was set as "not recommendable")
- no official coordinates for the Iberian Peninsula (various organisations);
 Differences are calculated, but no coordinate values published on EPN web
- New solution in July 2018:
 - SGC Spain (Superior Geographical Commission of Spain) published a new realisation in ETRF2000
 - 4 different ACs in Spain: IGN, Catalonian Institute, ITACYL and IECA. Reference frame ITRF2008 (Apr 2011 to Jan 2017), stablishing outliers, discontinuities and velocities of about 240 stations in Spain (presented al LAC WS 2017)
 - CRD results used for "Official National CRD compare"
 - VEL results used in WG "EU Dense Velocities"



Differences to EPN solution (C1995): Horizontally

Before:



national coordinates can be **reproduced** on (sub-) millimeter level compared to EPN scientific coordinates (at given epoch)

After:



Differences to EPN solution (C1995): Vertically



Before:



After:

national coordinates can be **reproduced** on (sub-) millimeter level compared to EPN scientific coordinates (at given epoch)



Fast-Forward +10 slides –>combined velocity field for Spain

East velocities ~4 mm/yr w.r.t. ETRF + North Spain

Static reference frame 1.1.2017 : < 1 mm May 2019 : < 10 mm – 1.1.2022 : < 20 mm



Contributions

Status "EU Dense Velocities"

Num Solution Analysis Centre	
001 alp08 AlpArray Initiative	
002 alps17 BAdW/DGFI (https://doi.org/10.5194/essd-2018-19)	
003 basc08 update Separtment of Applied Geodesy (ARA)	• Started 2017
004 cat08Cartografic i Geologic de Catalunya (ICGC)	
005 cgn08updatepean GPS Geodynamic Reference Network Consortium (CEGRN): 2016 c	Presentation + Splinter
006 cgn14 newuropean GPS Geodynamic Reference Network Consortium (CEGRN): 2018 M	
007 ch08 swisstppo - Permanent stations	Meeting in Amsterdam (May
308 ch081 new Permanent stations - levelling	2018)
009 ch16 swisstopo - Permanent and campaign stations	2010)
010 epn14 new Sence Frame Coordinator	• Questionnaire + Web page as
011 epnd14 EUREF WG on EPN Densification	foodbook to contributoro
012 esp08 Instituto Geografico Nacional (IGN Spain)	TEEDDACK TO CONTRIDUTORS
013 gr08 Aristotle University of Thessaloniki	started (June 2018):
014 gref08 new gency for Cartography and Geodesy (BKG)	
015 gsrm14 Newrain Rate Map (V3 2016, Nevada Bureau of Mines and Geology)	
016 gurn08 new or Rhine Graben Network (GURN)	
017 gurn08 Rhine Graben Network (GURN) - combined InSAR	
318 gut14iversity of Technology http://pnac.swisstopo.a	admin.ch/divers/dens vel/index.html
019 gut14x new aversity of Technology, extended to 510	
320 hepos Hellenic Positioning System (HEPOS)	
021 igs08 IGS Reference Frame Coordinator	
022 it08 Universita di Padova	
023 itrf14 ITRF Coordinator	
024 nkg03 Nordic Geodetic Commission (NKG) - grid	
025 noqu08 Universite de Montpellier	
326 rgp08 Institut national de l'information geographique et forestiere (IGN France)	
327 svn14Rewand Mapping Authority of the Republic of Slovenia	

Towards a swisstopo

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Feedback web page: Example gut14 (Gdansk University, Poland)

Input field (gridded background)



MOP2 SRG2 SPRN PENC BAIA

Residuals to combination (sortable table)

STATION	Maps LAT/LON	VN	VE	VU	VH ▲	vv	NUM
[TRO1]	[+69.663/+018.940]	-0.61	-0.20	-0.48	0.65	0.48	11
[GRAJ]	[+53.651/+022.455]	0.50	-0.25	-0.22	0.56	0.22	5
[POZN]	[+52.477/+016.866]	0.17	-0.51	0.10	0.54	0.10	5
[WLOC]	[+52.638/+019.149]	-0.03	-0.53	-0.46	0.53	0.46	4

Residuals to combination

OROS

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Tue May 07 17:34:06 201

Key parameter: Status May 2019

- 28 contributions, Weighted average combination
- 3-D GNSS fields (permanent + campaigns), INSAR/Levelling velocities, levelling velocities, global gsrmt set (2D), grids...
- Station identification by site name and approximate position (10 km)
- 2829 sites in > 2 solutions (1987: Oct. 18, 934: May 2018)
- Stations in solutions: ZIMM: 18, GRAS: 16, GRAZ 15, POTS: 14, …







Combination statistics

		x0	x0 –x000 sites common to combination							F	Reference frame alignment								
										[
	NUM SOLUTION	1						#FIN	#СМВ	MEAN_N		1EAN_E	SIG_E	MEAN_U	SIG_U	MEAN_H	SIG_H		
	008 ch081							63	62	0.00		0.00	nan	0.29	0.31	0.00	nan		
	024 nkg03							29221	125	0.04		0.01	0.03	0.09	0.08	0.04	0.07		
	027 svn14							40	7	0.06		-0.06	0.09	-0.61	nan	0.09	0.11		
	017 gurn08d							1322	122	0.02		0.06	0.13	0.04	0.37	0.06	0.16		
deviation	018 gut14							324	322	0.01		-0.02	0.10	-0.03	0.20	0.02	0.13		
	009 ch16							428	260	-0.00		0.01	0.14	0.05	0.30	0.01	0.17		
nm/yr hor.	007 ch08							211	211	0.05		-0.10	0.15	0.06	0.31	0.11	0.20		
	010 epn14							235	235	-0.00		0.02	0.11	-0.17	0.31	0.02	0.18		
nm/yr up	025 noqu08							76	75	0.04		0.03	0.16	0.45	0.48	0.05	0.21		
	002 alps17							194	182	-0.04		-0.13	0.18	-0.14	0.36	0.14	0.23		
	023 itrf14							139	136	-0.02		-0.02	0.15	-0.32	0.31	0.03	0.21		
	004 cat08							149	147	0.08		-0.01	0.18	0.06	0.42	0.08	0.24		
	016 gurn08							74	49	0.08		0.05	0.21	0.00	nan	0.09	0.27		
	019 gut14x							328	326	-0.30		0.06	0.23	-0.02	0.46	0.30	0.29		
	021 1gs08							93	91	0.03		-0.04	0.19	-0.14	0.42	0.05	0.26		
	028 Walp08							179	1/5	0.21		0.21	0.28	0.37	0.4/	0.29	0.33		
	014 gret08							38	38	0.04		0.11	0.17	0.51	0.49	0.12	0.26		
	005 cgn08							52	51	0.03		0.03	0.25	-0.08	0.55	0.04	0.34		
	026 rgp08							300	1025	-0.17		0.03	0.27	-0.10	0.53	0.17	0.34		
	000 cgn14							1020	1573	0.07		0.03	0.25	0.05	0.58	0.09	0.52		
r	001 alp08							1920	1372 A11	-0.00 0 11		-0.04 0.13	0.21	0.24	0.55	0.07	0.33		
ons	003 hasc08							200	183	0.03		0.03	0.29	-0.37	0.59	0.04	0.41		
tootonio	022 it08							596	510	-0.13		0.00	0.26	0.13	0.76	0.13	0.43		
	012 esp08							324	292	-0.13		-0.07	0.27	0.46	0.71	0.15	0.45		
als	020 hepos							59	47	-0.14		0.28	0.39	-0.88	0.86	0.31	0.54		
	013 gr08							173	145	0.22		0.09	0.45	0.43	0.82	0.24	0.62		
L	015 gsrm14							20930	1264	0.05		0.05	0.53	0.00	nan	0.07	0.82		
	тот							53558	2647										
			http	://pnac	.swiss	topo.ad	min.ch/	divers	/den	s vel/	000.ht	ml#S1	ATIS	TICS					

Standard ~0.2-0.3 m ~0.4-0.7 m

> Regio with t signa

Global velocities (w.r.t ETRF)



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Velocity field: Zoom Alps





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Graphical support



Combined station velocities in mm/y

Stations with >=2 observations (not with IE browser)



Stations (>2 ACs)

Map view links

Map view of the network (GoogleMaps api3.0; no IE Browser) Map view of validation stations (Mercator TEST-only web viewer) Map view of all stations (Mercator TEST-only web viewer, more than 2 minutes loading) Map view of validation stations with ellipses (Mercator TEST-only web viewer, 2 minutes loading) Map view of validation stations with ellipses (CH, Geoadmin Viewer) Static plots: Plot Global, hor. | Static plots: Plot Global, hor. | Static plots: Plot EU, hor. | Plot EU, up Static plots: Plot EU, north model | Plot EU, east model | Plot EU, up model | Static plots: Plot Central, hor. | Plot Central, up Static plots: Plot Central, north model | Plot Central, east model | Plot Central, up model | Download kml: kml validation sites | kml all sites



Mercator Viewer



- Swiss data + Openstreetmap data
- Global coverage
- Maps are vector based you can design your map yourself





Mercator Viewer



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Sandi Berk, Klemen Medved



WG mail

8.2.2019

https://test.map.geo.admin.ch/?layers=KML||your_kml_on_web

https://test.map.geo.admin.ch/?layers=KML%7C%7Chttp:%2F%2Fpnac.swisstopo.admin.ch%2Fdivers%2Fkml%2FSV N_ETRF00_Hz_vel.kml&lon=14.3&lat=46.05&lang=en



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Summary

- Thanks to the various individual inputs (> 20) and their good quality a preliminary velocity field for Europe can be generated. Providers have the know-how and partly have velocity generation automated.
- A web system is up and running giving feedback to the provider (sortable tables with outliers, plots, grids, etc.). First successfull viewing possibilities developed.
- Especially in regions of slow motions, some iterations are necessary to remove outliers, instable stations, differences between provider (mainly task of the provider): "Validation first"

Some provider should start this refinement activities using our web...

- On a longer view "Model next":
 - acceptance of "cleaned" velocity fields or velocity grids (e.g. if model is already applied in a country)
 - a velocity model extends the lifetime of the European (and national) reference frames

Thanks to the active WG members ! *Practical examples: Splinter meeting*