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## Towards an European Dense Velocities Field

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# Goal: Reference maintenance of higher accurray

- long-term permanent stations allow accuracies which show that Europe is not a static plate
- from: static reference frame realizations (coordinates at a specific epoch) in Europe

EU dense Velocity field EU (harmonised with countries)

- to: reference frame realizations with a given accuracy at any epoch
- extend successful collaboration from coordinates to velocities
- stake-holder: Mapping agencies and interests/contribution of geophysical institutions (tectonics)

### Combination Methods

- velocities main focus
- densifying: by simply using the velocity vectors
- based on successful presentation San Sebastian 2016
- WG "European Dense Velocities"
- daily/weekly combined solutions +log files of all national stations

ROB \*\*\*\*\*

- densifying: Combination of daily/weekly NEQS of all contributors + all EPN operational/repro SINEX files by an external institution (e.g. EPN)
- WG "EPN Densification"

EUREF PERMANENT NETWORK

(1 AC process all raw data)



N + complemta







**Contribution Classical** 





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#### Combination Methods (2)



### Results presentation SanSebastian

- 4 different velocity fields were evaluated: ITRF08, ITRF14, EPN (1875), CH08 (Switzerland)
- national velocity field agrees (in ETRF2000) on a high level of accuracy



#### Benefits classical/shared approach

• Regional solutions best suited for velocity field determination



- national / continental / International velocity fields agree on an extreme high level of accuracy:
  - Hor.: ± 0.2 mm/yr Vert.: ± 0.4 mm/yr
- detection of errors in international / continental frames
- Benefits of classical aproach:
  - velocity field is directly usable (SNX or ASCII!)
  - no exchange of logfiles for national stations
  - velocities almost independent of modelling GNSS observations (tropo models, antenna PCVs)
  - modelling independent of models used in other countries



#### Benefits classical/shared approach (cont)

- Benefits of classical aproach (cont) ۲
  - countries know their station best + monument. + geology
  - extendable to campign results (national + CERGOP,...)
    - + Levelling combination
- Conclusion / recommendation to NMAs/partners: •
  - coordinates and velocity products are the main task and responsibility for NMAs (and they do that anyway)
  - velocity estimation is a small extra effort compared to daily processing workload
  - more collaboration and direct involvement in final results (as already the case for official national coordinates)
  - nationally derived grids will be adapted -> homogenous national and EU velocity grid
  - many geophysical institutions interested in velocities









#### Europe

#### EU horizontally: <a href="mailto:bit.ly/EU\_VEL\_HOR">bit.ly/EU\_VEL\_HOR</a>

http://pnac.swisstopo.admin.ch/divers/dens\_vel/vel\_eu\_all\_cmb\_dh.jpg

#### EU vertically: <a href="mailto:bit.ly/EU\_VEL\_UP">bit.ly/EU\_VEL\_UP</a>

http://pnac.swisstopo.admin.ch/divers/dens\_vel/vel\_eu\_all\_cmb\_dv.jpg



Identifier	Agency	Region	# stations
EPN08	EPN, Kenyeres	Europe	259
ITRF2014	IGN, Altamimi	Global	148
ITRF2008	IGN, Altamimi	Global	103
СН08	swisstopo	Switzerland	230
GR08	Aristotle Univ. Thessaloniki	Greece	181
CGN08	CEGRN consortium	East Europe	61
IT08	Univ. Padova	Italy	645
ESP08	IGN Spain	Spain	341
BASC08	ARA	Spain	251
RGP08	IGN France	France	544
WALP08	Univ Montp.	West Alps	182
NOQU08	Univ Montp.	West Alps	76
ALP08	AlpArray	Alps, Italy	498
NKG03	NKG	Nordic EU countries	556 (grid)
ARE08	OLG	Austria	117
EGU08	OLG	SE-Europe	181
IUG08	OLG	SE-Europe	47
MON08	OLG	SE-Europe	69
CAT08	ICGC	Catalania	150

### Velocity contribution in ETRF2000

Any format allowed.

RMS-hor ± 0.20 mm/yr for 34 common sites (CH08 in ET00)

RMS-hor ± 0.19 mm/yr for 114 common sites (CH08 in IGb08)

stations : 2272

13 times: MATE, ZIMM12 times: GRAZ11 times: NICO, SOFI, NICO10 times: GRAS, NOT1



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### WG "European Dense Velocities"

- Charter prepared
  - iterated under already participating partners (17 persons)
  - presented to TWG
  - kickoff: All interesting partners are welcome also those which only plan to compute velocities in future!
  - long to-do list
    - evaluation / outliers
    - fomats (SNX || ASCII)
    - map generation
    - grid calculation
    - support for vel. calculation







 INGV; to be published; 1728 stations BSW, Gipsy, Gamit



Figure 2. GPS network arrangement of the combined velocity solution. The following color code of the bullets has been used to highlight the contribution of the three AC: blue (Bernese), green (Gipsy) and red (Gamit).



Let's continue cooperation by extending the success of coordinates to velocities and integrate partners in a shared way!



