



Splinter Meeting European Dense Velocities

EUREF 2019 Symposium

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Activites since Amsterdam

- Web page (June 2018) <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/index.html</u>
- Questionnaire (June 2018) thanks for the returned feeback.
- Several new / updated solutions!

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- Many improvements on the combination side (as well as graphical support) group mail Feb. 2019
- Current focus for the next 2-3 years:
 - improving the input velocity field coming from the countries.
 - Develop methods to generate velocity grids





Examples from Praxis – how it works

 Poland (Grzegorz Nykiel, Mariusz Figurski) – presented by E. Brockmann due to absence



lots of Polish stations not provided by other ACs !

• ARA + UPA presented by J. Zuruzuza



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Contribution Poland (Gdansk University)

Not once a submission – iterative approach •

| 07-Aug-2018 | NEW | gut14 added |
|-------------|-----|---|
| 08-Aug-2018 | UPD | gut14 updated |
| 02-APR-2019 | NEW | gut14 updated and gut14x extended |
| | | version included (without weight) |
| 14-May-2019 | UPD | gut14x updated (north bias and |
| | | outliers removed) |
| 16-May-2019 | UPD | <pre>qut14 removed (qut14x full weight)</pre> |

- New solution might be added additionally •
 - new solution without weight to the combination -
 - automatically differences are computed (as well as agreement with the combination)



VEL0-SOL018: Velocities in North in mm/y

Cross validations in mm/y

(Sortable table)

70.0 N

65.0 N

60.0 N

55.0 N

50.0 N

45.0 N

40.0 N

35.0 N

30.0 N

| 50L1 | 50L2 | NUM 🔺 | MEAN_N | SDEV_N | MEAN_E | SDEV_E | MEAN_U | SDEV_U |
|-------|--------|-------|--------|--------|--------|--------|--------|--------|
| gut14 | gut14 | 324 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| gut14 | gut14x | 321 | 0.31 | 0.14 | -0.07 | 0.22 | -0.03 | 0.40 |

18

16

14

12 10

-12

-14 -16

-18



- Removed:
 - STIN poorly estimated velocities due to the low quality of the results.
 - MAR6, VIS0 the highest residuals compared to the other solutions.
 - OSMZ, ONSA, KRA1 here the residuals are not dramatically wrong, but we decided to remove these stations to improve estimation of the average velocities.
- We didn't remove the following stations, despite the fact that residuals are quite large:
 - DZIA, GDAN, BIAL, BAIA, KUTN the residuals are large but the residuals from CEGRN solution have similar values but the opposite signs.
 - MDVJ, SOFI, HOBU, POLV, GWWL it is not the worst, so the residuals are burdened with the worse solution.
- We also removed several other stations because of low quality or too short time series. Generally, we removed 15 stations compared to our first solution.



• Before Update

Station residuals in mm/y

(Sortable table)

| STATION | LAT/LON | VN | VE | VU | VH 🔺 | [vv] | NUM |
|---------|--------------------|-------|-------|-------|-------|------|-----|
| [OSMZ] | [+52.798/+021.904] | 0.67 | 0.18 | -1.05 | 0.69 | 1.05 | 4 |
| [TRO1] | [+69.663/+018.940] | -0.64 | -0.20 | -0.18 | 0.67 | 0.18 | 10 |
| [GDAN] | [+54.390/+018.585] | 0.63 | -0.09 | -1.10 | 0.64 | 1.10 | 4 |
| [GRAJ] | [+53.651/+022.455] | 0.52 | -0.24 | -0.21 | 0.57 | 0.21 | 4 |
| [WLOC] | [+52.638/+019.149] | -0.02 | -0.54 | -0.46 | 0.54 | 0.46 | 3 |
| [POZN] | [+52.477/+016.866] | 0.16 | -0.51 | 0.10 | 0.53 | 0.10 | 4 |
| [SASS] | [+54.514/+013.643] | 0.48 | -0.22 | -0.24 | 0.52 | 0.24 | 6 |
| | | | | | | | |

• After Update

| 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 |

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GUT14X (new test contribution)

- It was made based on weekly coordinates and covers longer period of time (1678
 – 2038 GPS weeks). Reference is based on IGS14 (instead IGS08)
- We've also improved time series filtering and we've applied constraints for stations closest than 2 km. This solution should be more stable and reliable

Diff. to combination



GUT14X

GRYF

SLAW

POT A

SARW SZEK RZ

CZAR

TUC

BBOF

NO

STPA

CZ•AR

SB

٠

eur

ss

C

SPESS

Input gut14x

GELSZCZ

Input gut14

GELS7C7

GOL

PYRZ NOPO CHOC

SUCH

GOL

NOPO

CHOC

SUCH

CHOS

CHOS



residual

0.5

0.0

-15

1.5

0.5

0.0

-0.5

-15

-10

-2.0

Wed May 08 19:37:24 2019

9



Station residuals in mm/y

(Sortable table)



8

Current Polish velocity field



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Tectonically pretty stable country and well defined by ETRF2000 reference frame https://test.map.geo.admin.ch/?lang=en&topic=ech&bgLayer=ch.swisstopo.leichtebasiskarte.vt&zoom=0&layers=KML%7C%7Chttp:%2F%2Fpnac.swisstopo.admin.ch%2Fdivers %2Fdens_vel%2Feu_dens_vel_all.kml (2 minutes loading...but then good performance)





Example: KATO





Splinter – European Dense Velocities, EUREF19, E. Brockmann, J. Zurutuza, et al. swisstopo

Wed May 08 19:38:43 2019

lps17 asc08

gn1 ch0

Quick Example 2: EPN Densification





Quick Example 3: ITRF2014

MAN

| *** | MAN: | ACOR | 43.4/ | -8.4 | from | itrf14 | deleted | 1 |
|-----|------|------|-------|-------|------|--------|---------|---|
| *** | MAN: | DYNG | 38.1/ | 23.9 | from | itrf14 | deleted | ł |
| *** | MAN: | KARL | 49.0/ | 8.4 | from | itrf14 | deleted | 1 |
| *** | MAN: | MAD2 | 40.4/ | -4.2 | from | itrf14 | deleted | 1 |
| *** | MAN: | MALL | 39.6/ | 2.6 | from | itrf14 | deleted | ł |
| *** | MAN: | SRMP | 72.9/ | -54.4 | from | itrf14 | deleted | 1 |

OUT

| *** | OUT: | VARS | 70.3/ | 31.0 | from | itrf14 | deleted |
|-----|------|------|-------|------|------|--------|---------|
|-----|------|------|-------|------|------|--------|---------|

RES

| *** | RES: | ANKR | 39.9/ | 32.8 | from | itrf14 | deleted | |
|-----|------|------|-------|-------|------|--------|---------|---|
| *** | RES: | KELY | 67.0/ | -50.9 | from | itrf14 | deleted | , |



Sparse. Not error-free (removing sites on the combination level necessary)

Considered Solutions (ARA)

Daily (RAPID and FINAL): about 350 sites 31 different antenna models used 41 (if the radome is considered)

Latitude varies from 27.5N to 48.3N Longitude varies from 31W to 7.5E

With such latitude variation, the antenna Latitude-dependent model of IGS must be Considered: a simple offset will not work





Considered Solutions (UPA)

RINEX data are polled daily from a variety of FTP repositories in Italy and neighboring areas. **The cumulative solution consist of +600 sites**





Validating Results (all contributions)

At a glance we can see a lot of useful information: <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/000.html#STATIONS</u>

Number of Acs computing certain sites

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Basic statistics of the individual solutions w.r.t. the combined







Statistics w.r.t. the combination





Validating Results (all contributions)

At a glance we can see a lot of useful information:

http://pnac.swisstopo.admin.ch/divers/dens_vel/000.html#STATIONS

Some statistics are also provided for each AC which are useful to help in improving the results!

| NUM | SOLUTION | WEI_N/WEI_E/WEI_U | TRA_N/TRA_E/1 | rra_u | #INI | #DEL | #ORI | #MAN | #OUT | #RES | #FIN | #CMB | MEAN_N | SIG_N | MEAN_E | SIG_E | MEAN_U | SIG_U | MEAN_H | SIG_H |
|-----|----------|-------------------|---------------|-------|-------|------|-------|------|------|------|-------|------|--------|-------|--------|-------|--------|-------|--------|-------|
| 001 | alp08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 498 | 1 | 497 | 1 | 0 | 2 | 494 | 411 | 0.11 | 0.27 | 0.13 | 0.25 | 0.14 | 0.58 | 0.17 | 0.37 |
| 002 | alps17 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 194 | 0 | 194 | 0 | 0 | 0 | 194 | 182 | -0.04 | 0.15 | -0.13 | 0.18 | -0.13 | 0.37 | 0.13 | 0.23 |
| 003 | basc08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 206 | 0 | 206 | 3 | 3 | 0 | 200 | 183 | 0.03 | 0.29 | 0.03 | 0.29 | -0.37 | 0.59 | 0.04 | 0.41 |
| 004 | cat08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 187 | 29 | 158 | 9 | 0 | 0 | 149 | 147 | 0.08 | 0.17 | -0.01 | 0.18 | 0.06 | 0.42 | 0.08 | 0.24 |
| 005 | cgn08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 54 | 0 | 54 | 0 | 0 | 2 | 52 | 51 | 0.03 | 0.22 | 0.03 | 0.25 | -0.08 | 0.55 | 0.04 | 0.34 |
| 006 | cgn14 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 1128 | 0 | 1128 | 3 | 2 | 15 | 1108 | 1025 | 0.07 | 0.23 | -0.05 | 0.23 | 0.06 | 0.58 | 0.09 | 0.32 |
| 007 | ch08 | 0E+00/0E+00/0E+00 | 0.00/ 0.00/ | 0.00 | 213 | 0 | 213 | 2 | 0 | 0 | 211 | 211 | 0.06 | 0.14 | -0.09 | 0.15 | 0.07 | 0.32 | 0.11 | 0.20 |
| 008 | ch081 | 0E+00/0E+00/0E+00 | 0.00/ 0.00/ | 0.00 | 66 | 0 | 65 | 0 | 0 | 0 | 63 | 62 | 0.00 | nan | 0.00 | nan | 0.29 | 0.31 | 0.00 | nan |
| 009 | ch16 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 432 | 0 | 432 | 2 | 2 | 0 | 428 | 260 | 0.00 | 0.10 | 0.02 | 0.14 | 0.06 | 0.30 | 0.02 | 0.17 |
| 010 | epn14 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 237 | 0 | 237 | 2 | 0 | 0 | 235 | 235 | 0.00 | 0.14 | 0.02 | 0.11 | -0.16 | 0.32 | 0.02 | 0.18 |
| 011 | epnd14 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 2014 | 84 | 1930 | 3 | 1 | 4 | 1922 | 1569 | -0.06 | 0.25 | -0.04 | 0.21 | -0.24 | 0.53 | 0.07 | 0.33 |
| 012 | esp08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 341 | 0 | 341 | 9 | 1 | 7 | 324 | 292 | -0.13 | 0.36 | -0.07 | 0.27 | 0.46 | 0.71 | 0.15 | 0.45 |
| 013 | gr08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 179 | 0 | 179 | 1 | 3 | 1 | 174 | 146 | 0.22 | 0.43 | 0.09 | 0.45 | 0.44 | 0.82 | 0.24 | 0.62 |
| 014 | gsrm14 | 5E-02/5E-02/0E+00 | -0.49/-0.48/ | 0.00 | 21428 | 0 | 21428 | 4 | 487 | 5 | 20932 | 1256 | 0.03 | 0.62 | 0.06 | 0.53 | 0.00 | nan | 0.07 | 0.81 |
| 015 | gurn08 | 1E+00/1E+00/0E+00 | 0.00/ 0.00/ | 0.00 | 76 | 0 | 76 | 2 | 0 | 0 | 74 | 49 | 0.08 | 0.17 | 0.05 | 0.21 | 0.00 | nan | 0.10 | 0.27 |
| 016 | gurn08d | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 1329 | 0 | 1329 | 0 | 0 | 0 | 1329 | 122 | 0.02 | 0.08 | 0.05 | 0.13 | 0.05 | 0.37 | 0.05 | 0.16 |
| 017 | gut14 | 1E+00/1E+00/1E+00 | 0.35/ 0.00/ | 0.00 | 336 | 0 | 336 | 0 | 0 | 0 | 336 | 94 | 0.04 | 0.18 | -0.06 | 0.18 | -0.24 | 0.47 | 0.07 | 0.26 |
| 018 | hepos | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 60 | 0 | 60 | 0 | 0 | 1 | 59 | 47 | -0.14 | 0.36 | 0.28 | 0.39 | -0.88 | 0.86 | 0.31 | 0.54 |
| 019 | igs08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 103 | 8 | 95 | 1 | 0 | 1 | 93 | 91 | 0.03 | 0.18 | -0.04 | 0.19 | -0.13 | 0.42 | 0.05 | 0.26 |
| 020 | it08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 663 | 0 | 663 | 53 | 0 | 14 | 596 | 510 | -0.13 | 0.34 | 0.00 | 0.26 | 0.13 | 0.76 | 0.13 | 0.43 |
| 021 | itrf14 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 148 | 0 | 148 | 6 | 1 | 2 | 139 | 136 | -0.02 | 0.15 | -0.02 | 0.15 | -0.31 | 0.32 | 0.03 | 0.21 |
| 022 | nkg03 | 1E+01/1E+01/1E+01 | 0.00/ 0.00/ | 0.00 | 29293 | 0 | 29293 | 0 | 72 | 0 | 29221 | 125 | 0.04 | 0.06 | 0.01 | 0.03 | 0.09 | 0.08 | 0.04 | 0.07 |
| 023 | noqu08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 76 | 0 | 76 | 0 | 0 | 0 | 76 | 75 | 0.04 | 0.14 | 0.03 | 0.16 | 0.45 | 0.48 | 0.05 | 0.21 |
| 024 | rgp08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 544 | 0 | 544 | 184 | 3 | 1 | 356 | 350 | -0.17 | 0.22 | 0.03 | 0.27 | -0.10 | 0.53 | 0.17 | 0.34 |
| 025 | walp08 | 1E+00/1E+00/1E+00 | 0.00/ 0.00/ | 0.00 | 182 | 2 | 180 | 1 | 0 | 0 | 179 | 175 | 0.21 | 0.18 | 0.21 | 0.28 | 0.37 | 0.47 | 0.29 | 0.33 |
| тот | | | | | | 124 | 53707 | 286 | 575 | 55 | 53541 | 2403 | | | | | | | | |

A list of outliers and deleted sites (ARA: basc08) is provided: <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html</u>

Outlier rejections

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| DEL | | | | | | | | | | | | | | | | | | | |
|-----|--------|------|-------|------|------|--------|---------|----------|---|--------|--------|-------|-------|--------|---|-------|--------|------|--------|
| MAI | N | | | | | | | | | | | | | | | | | | |
| ** | * MAN: | ACOR | 43.4/ | -8.4 | from | basc08 | deleted | (VNEU | - | 0.21/ | 2.79/ | -3.02 | mm/y) | | | | | | |
| ** | * MAN: | ALBA | 39.0/ | -1.9 | from | basc08 | deleted | (VNEU | = | -0.21/ | -1.59/ | -7.89 | mm/y) | | | | | | |
| ** | * MAN: | MOLI | 40.8/ | -1.9 | from | basc08 | deleted | (VNEU | = | -2.93/ | 1.54/ | -3.95 | mm/y) | | | | | | |
| ουτ | | | | | | | | | | | | | | | | | | | |
| ** | * OUT: | LAGO | 37.1/ | -8.7 | from | basc08 | deleted | (VNEU | - | 11.68/ | -1.78/ | 0.40 | mm/y, | Median | - | 0.70/ | -2.08/ | -0.7 | 5 mm/) |
| ** | * OUT: | SFER | 36.5/ | -6.2 | from | basc08 | deleted | (VNEU | - | -2.10/ | -0.88/ | 3.74 | mm/y, | Median | = | 0.35/ | -3.96/ | -0.0 | 4 mm/y |
| | * | TERC | 20 7/ | 27.2 | from | h | deleted | (MALE LI | _ | E 10/ | 4 22/ | 0 66 | | Median | _ | 0.04/ | 2 17/ | 36 | E |

In the MANUAL deleted case, the time series are OK: ACOR: well-known A Class with high Eastwards Velocity ALBA: well-known A Class with high Downwards Velocity MOLI: EPN D with high Downwards Velocity

http://www.epncb.oma.be/_productsservices/coordinates/img/FPN_FTRF2014_NF.png







A list of outliers and deleted sites (ARA: basc08) is provided: <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html</u>



Validating Results (AC-level)

Our solutions (ARA: basc08) are compared with other ACs: http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html

Cross validations in mm/y

(Sortable table)

| SOL1 | SOL2 | NUM | MEAN_N | SDEV_N | MEAN_E | SDEV_E | MEAN_U | SDEV_U |
|--------|---------|-----|--------|--------|--------|--------|--------|--------|
| basc08 | alp08 | 1 | -0.14 | nan | -0.15 | nan | -1.38 | nan |
| basc08 | alps17 | з | 0.14 | 0.04 | -0.01 | 0.25 | -0.32 | 0.30 |
| basc08 | basc08 | 200 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| basc08 | cat08 | 45 | 0.01 | 0.29 | -0.03 | 0.40 | -0.64 | 0.70 |
| basc08 | cgn08 | 0 | nan | nan | nan | nan | nan | nan |
| basc08 | cgn14 | 46 | -0.12 | 0.47 | 0.03 | 0.44 | -0.69 | 0.90 |
| basc08 | ch08 | 11 | -0.01 | 0.31 | 0.12 | 0.42 | -0.42 | 0.44 |
| basc08 | ch081 | 1 | 0.00 | nan | 0.00 | nan | -1.04 | nan |
| basc08 | ch16 | 11 | 0.03 | 0.31 | -0.01 | 0.43 | -0.39 | 0.44 |
| basc08 | epn14 | 41 | -0.09 | 0.37 | -0.05 | 0.36 | -0.25 | 0.83 |
| basc08 | epnd14 | 139 | 0.09 | 0.32 | 0.10 | 0.40 | -0.16 | 0.66 |
| basc08 | esp08 | 156 | 0.16 | 0.59 | 0.08 | 0.48 | -0.95 | 1.21 |
| basc08 | gr08 | 1 | -0.24 | nan | -0.25 | nan | -0.58 | nan |
| basc08 | gsrm14 | 89 | -0.17 | 0.74 | -0.29 | 0.51 | 0.00 | nan |
| basc08 | gurn08 | 1 | -0.16 | nan | 0.20 | nan | 0.00 | nan |
| basc08 | gurn08d | 0 | nan | nan | nan | nan | nan | nan |
| basc08 | gut14 | 1 | 0.09 | nan | 0.23 | nan | -0.71 | nan |
| basc08 | hepos | 0 | nan | nan | nan | nan | nan | nan |
| basc08 | igs08 | 10 | -0.01 | 0.31 | 0.01 | 0.53 | -0.05 | 0.75 |
| basc08 | it08 | 2 | 0.12 | 0.06 | 0.06 | 0.01 | -0.34 | 0.25 |
| basc08 | itrf14 | 20 | -0.01 | 0.43 | -0.05 | 0.37 | 0.14 | 0.86 |
| basc08 | nkg03 | 0 | nan | nan | nan | nan | nan | nan |
| basc08 | noqu08 | 1 | 0.02 | nan | 0.19 | nan | -1.43 | nan |
| basc08 | rgp08 | 35 | 0.15 | 0.67 | -0.14 | 0.72 | -0.04 | 1.06 |
| basc08 | walp08 | 14 | -0.17 | 0.38 | -0.53 | 0.50 | -1.11 | 0.99 |
| MEAN | | | -0.02 | 0.38 | -0.02 | 0.42 | -0.52 | 0.72 |
| SDEV | | | 0.12 | 0.20 | 0.18 | 0.16 | 0.47 | 0.29 |
| | | | | | | | | |

Each site (ARA: basc08) can be compared with other solutions: http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html

Station residuals in mm/y

(Sortable table)

| | | | | | | | IS in mm | on of AC | comparis | /elocity o | | | | | | | | | | | | | , | |
|---------------------------|---|-------------|--------------|----------|-----------|-------|--------------|----------------|------------|------------|-------|-----|------|-----------|-------------|-----|--------|------|-------|-------|-------|---------------|-----|---------|
| _ | | · · · | 0 mm/y | 5 +- 0.3 | N: 0.0 | | | | | | | | | | 1.5 | IUM | IVVI r | IVHI | VU | VE | VN | AT/LON | • | STATION |
| | 4 ACs | | | | | | | | | | | | | | 0.5 | 4 | 0.33 | 0.32 | -0.33 | -0.07 | -0.31 | 700/-006.352] | [+4 | [ACNS] |
| | | | | | | | | | | | | | • | | -0.5 | 2 | 0.20 | 0.04 | -0.20 | 0.04 | 0.00 | 04/-003.222] | [+3 | [ADSJ] |
| | | | | | | | | | | | | | | | -1.0 | з | 0.59 | 0.55 | -0.59 | 0.38 | -0.40 | 49/-001.931] | [+4 | [AGRD] |
| | | i il » » | <u> </u> | 4 | | 4 0 | | ∞ 4 | i i ≠ ∞ | 4 4 | 9 | 4 % | | - 6 | -1.5 Li | з | 2.03 | 0.51 | -2.03 | -0.45 | -0.25 | 04/-015.446] | [+2 | AGUI] |
| | | rgp0 | oqu0 | itrf1 | igs0 | gut1 | 0uni 80ui | gr0 | esp0 | epn1 | i i i | ch0 | cat0 | alps1 | alp0 | 3 | 0.49 | 0.37 | -0.49 | 0.19 | -0.32 | 216/-002.274] | [+4 | AJAL] |
| | | > | - | | | | | | | • | | | | - 1 | 15 - | 8 | 0.42 | 0.10 | -0.42 | 0.06 | 0.08 | 339/-000.481] | [+3 | ALAC] |
| | | · · · · · · | 7 mm/y | 7 + 0.1 | E: -0.5 | | | | | | | | | | 1.0 - | 3 | 1.34 | 0.54 | -1.34 | -0.35 | -0.41 | 64/-017.241] | [+2 | ALAJ] |
| | | | | | | | | | | | | | | | 0.5 | 4 | 0.47 | 0.23 | -0.47 | -0.01 | 0.23 | 754/-002.332] | [+4 | ALDA] |
| | | | | | | | | | | | | | | | 0.0 | 2 | 0.22 | 0.41 | 0.22 | 0.04 | -0.40 | 85/-015.780] | [+2 | ALDE] |
| | | | | | | | | | | | | | | | -1.0 | з | 0.39 | 0.20 | -0.39 | -0.05 | 0.20 | 11/-005.444] | [+3 | ALGC] |
| | | | <u> </u> | 4 | | 4 0 | | <u> </u> | | | | | | | -1.5 Li | 2 | 0.04 | 0.14 | 0.04 | 0.11 | 0.08 | 42/-000.067] | [+3 | [ALMA] |
| | | alp 0 | nkg0 pqu0 | itrf1 | igs0 | gut1 | um0 m08 | gr gr | n odsa | epul, | ch0 | ch0 | cat0 | asc0 | alp0 | 6 | 1.34 | 0.29 | -1.34 | 0.20 | 0.21 | 353/-002.459] | [+3 | ALME] |
| | | > | | | | | 6 n | 5 | | ~ a | | - | | e 9 | 30 | з | 0.61 | 0.38 | 0.61 | 0.25 | -0.29 | 706/-004.180] | [+3 | [ALMO] |
| | | | 1 mm/y | 2 +- 0.7 | U: -1.5 | | | | | | | | | | 2.0 | 4 | 0.70 | 0.67 | -0.70 | 0.59 | 0.30 | 863/-002.441] | [+3 | ALMR] |
| | | | | | | | | | | | | | | | 1.0 - | 6 | 0.82 | 0.18 | -0.82 | -0.02 | 0.18 | 392/-002.164] | [+4 | ALSA] |
| | | | | | | | | | | | | | • | _ | 0.0 | 4 | 0.67 | 0.27 | -0.67 | -0.07 | 0.26 | 56/-003.004] | [+4 | AMUR] |
| | | | | | | | | | | | | | | | -2.0 | 4 | 0.35 | 0.25 | 0.35 | 0.18 | 0.17 | 40/-004.030] | [+3 | ANDU] |
| | | i i i | | - | | 1 I | | <u> </u> | | | | | | | -3.0 Li | 3 | 0.30 | 0.29 | -0.30 | -0.24 | -0.17 | 23/-014.014] | [+2 | ANTI] |
| | | ab01 | nkg0 | itrf] | igs0 | gut1. | um0 m08 | gr gr | in lodsa | Inda | ch0 | ch0 | cat0 | asc0 | alp0 | з | 0.53 | 0.21 | -0.53 | -0.07 | 0.20 | 394/-006.565] | [+3 | ARAC] |
| | | \$ | | | | | 0 0 | 5 | | - 0 | | | | <u>م</u> | | 2 | 0.13 | 0.18 | -0.13 | 0.15 | -0.09 | 25/-003.613] | [+4 | ARAN] |
| | | | | | | | | | | | | | 19 | :48:11 20 | 3 Feb 20 15 | 2 | 0.18 | 0.28 | 0.18 | 0.26 | 0.10 | 66/-003.743] | [+4 | ARDU] |
| (print | ACNS | Site · A | | | | | | | | | | | | | | 2 | 0.41 | 0.58 | 0.41 | -0.18 | -0.55 | /61/-015.681] | [+2 | [ARGU] |
| 7/12 Nmax = 1.9 | 2015/07/12 | | | | | | | | | 20 | | | | | | 3 | 0.27 | 0.24 | -0.27 | 0.11 | 0.21 | 07/-005.083] | [+4 | ARSP] |
| Nmin = -2.9 Emax = 3.0 | N:-0.84 | | | | | | | | | 15 | | | | | | з | 0.12 | 0.13 | -0.12 | -0.09 | 0.10 | 57/-006.055] | [+4 | ASTO] |
| Emin = -2.7 | E:0.82 | | | | | | | | | 15 | | | | | | 2 | 0.15 | 0.57 | -0.15 | -0.51 | 0.26 | 64/-004.678] | [+4 | [AVI2] |
| Umin = -6.5 | | | | | | | | | | 10 | _ | | | | | 3 | 1.00 | 0.11 | -1.00 | 0.03 | 0.11 | 66/-005.906] | [+4 | AVLS] |
| raw data | | | <u>∼</u> 1. | 10 | | | | h | | 5 | 8 | | | | | 2 | 0.49 | 0.31 | 0.49 | 0.21 | -0.23 | 394/-006.989] | [+3 | [BADJ] |
| csv data | man man man and man | - A | VN . | mal | NA . | AM | | MM. | | _ | 0 | | | | | 2 | 0.15 | 0.37 | -0.15 | -0.15 | -0.33 | 15/+000.503] | [+4 | BAR0] |
| | Aron Dolling as with prabat wall | - Marine | my | M | all we we | have | N. | my | | 0 | - | | | | | 6 | 0.03 | 0.19 | 0.03 | 0.08 | 0.17 | 05/+002.004] | [+4 | [BCLN] |
| | | www. | | N | 1 1/10 | | my . | Y | | -5 | 00 | | _ | | | 2 | 0.69 | 0.51 | -0.69 | -0.51 | 0.02 | 374/+001.762] | [+4 | [BELØ] |
| | | | | | | | | | | -10 | C | ies | Se | A T | AR/ | 9 | 0.01 | 0.39 | 0.01 | -0.15 | -0.36 | 00/+001.401] | [+4 | BELL] |
| | | | | | | | | | | 10 | | | 00 | | , u v | 2 | 0.23 | 0.05 | 0.23 | 0.04 | -0.03 | 54/-005.881] | [+3 | [BENI] |
| | | | | | | | | 1 | 1 | -15 | | | | | | 7 | 0.41 | 0.20 | -0.41 | -0.19 | 0.05 | 72/-001.537] | [+4 | BIAZ] |
| 10 u 10 | | n 16 | 15 1- | 5 kr1 | lan 1 | 1114 | 14 | 12 1 | L let | | | | | | | 8 | 0.18 | 0.94 | -0.18 | 0.93 | -0.05 | 05/-000.083] | [+3 | [BORR] |
| ia jui ia | Juino Janny Juiny Janno Juino Janne Jui | 1116 J | ID JS | 5 Jui | Jan 1 | ui 14 | 11 14 | 13 J | Jui | | | | | | | 13 | 0.38 | 0.24 | -0.38 | -0.01 | 0.24 | 80/-004.497] | [+4 | [BRST] |

Each site (ARA: basc08) can be compared with other solutions and SORTED by any column: <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html</u>

Station residuals in mm/y

(Sortable table)



Each site (ARA: basc08) can be compared with other solutions and SORTED by any column: <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/003.html</u>

Station residuals in mm/y

(Sortable table)

| STATION | LAT/LON | VN | VE | vu • | [VH] | [vv] | NUM |] |
|---------|--------------------|-------|-------|-------|------|------|-----|---|
| [VALA] | [+41.703/-004.708] | 0.49 | 0.50 | -2.35 | 0.70 | 2.35 | 6 | 1 |
| [AGUI] | [+27.904/-015.446] | -0.25 | -0.45 | -2.03 | 0.51 | 2.03 | з | |
| [MORJ] | [+28.052/-014.360] | -0.28 | 0.06 | -1.92 | 0.29 | 1.92 | 2 | |
| [TNØ2] | [+28.418/-016.551] | 0.01 | -0.14 | -1.86 | 0.14 | 1.86 | 2 | |
| [MADR] | [+40.429/-004.250] | 0.04 | 0.93 | -1.71 | 0.93 | 1.71 | з | |
| [GATA] | [+41.106/-008.589] | -0.65 | 0.19 | -1.65 | 0.68 | 1.65 | 7 | |
| [LLIV] | [+42.478/+001.973] | 0.23 | 0.18 | -1.59 | 0.29 | 1.59 | 10 | |
| [RIBE] | [+43.464/-005.067] | -0.08 | 0.03 | -1.43 | 0.08 | 1.43 | 2 | |
| [ALAJ] | [+28.064/-017.241] | -0.41 | -0.35 | -1.34 | 0.54 | 1.34 | з | |
| [ALME] | [+36.853/-002.459] | 0.21 | 0.20 | -1.34 | 0.29 | 1.34 | 6 | |
| [CORI] | [+39.982/-006.520] | 0.21 | -0.28 | -1.34 | 0.35 | 1.34 | 4 | |
| [BUOS] | [+41.588/-003.068] | 1.14 | 0.23 | -1.33 | 1.16 | 1.33 | з | |
| [VDGO] | [+42.516/-004.011] | 0.29 | 0.35 | -1.26 | 0.45 | 1.26 | 4 | |
| [ZARA] | [+41.633/-000.882] | 0.11 | -0.09 | -1.24 | 0.14 | 1.24 | 9 | |
| [HUOV] | [+37.402/-001.942] | 0.14 | 0.16 | -1.21 | 0.21 | 1.21 | 4 | |
| [LUAR] | [+43.547/-006.528] | 0.14 | 0.01 | -1.16 | 0.14 | 1.16 | з | |
| [VIGO] | [+42.184/-008.813] | 0.16 | -0.09 | -1.10 | 0.18 | 1.10 | 7 | |
| [LENA] | [+43.150/-005.825] | 0.23 | 0.16 | -1.08 | 0.29 | 1.08 | з | |
| [PLAN] | [+41.419/+001.987] | 0.23 | 0.23 | -1.05 | 0.32 | 1.05 | 5 | |
| [LARE] | [+43.405/-003.447] | 0.34 | -0.08 | -1.04 | 0.34 | 1.04 | 4 | |
| [REUS] | [+41.170/+001.169] | 0.21 | 0.45 | -1.02 | 0.50 | 1.02 | 5 | |
| [AVLS] | [+43.566/-005.906] | 0.11 | 0.03 | -1.00 | 0.11 | 1.00 | з | |
| [LAZK] | [+43.035/-002.187] | 0.14 | 0.13 | -1.00 | 0.19 | 1.00 | 5 | |
| [JACA] | [+42.567/-000.727] | 0.09 | 0.19 | -0.99 | 0.21 | 0.99 | 5 | |
| [STJV] | [+41.925/+002.319] | 0.21 | 0.19 | -0.94 | 0.28 | 0.94 | 2 | |
| [CANT] | [+43.472/-003.798] | -0.19 | 0.16 | -0.93 | 0.25 | 0.93 | 8 | |
| | | | | | | | | |

ARA T. Series



In this case, LLIV seems to need some polishing!

Walidating Results (yet another AC)

Similar procedures can be carried out for all the Acs (UPA: it08) : <u>http://pnac.swisstopo.admin.ch/divers/dens_vel/020.html</u>

Station residuals in mm/y

(Sortable table)

| STATION | LAT/LON | VN • | VE | VU | [VH] |
|---------|--------------------|-------|-------|-------|------|
| [CAM3] | [+43.145/+013.067] | -2.21 | -0.49 | -0.13 | 2.26 |
| [MILO] | [+38.008/+012.584] | -2.14 | 0.59 | 0.44 | 2.22 |
| [MGRD] | [+45.975/+012.015] | -1.92 | -0.34 | 0.26 | 1.95 |
| [MITT] | [+46.685/+011.295] | -1.84 | -0.05 | -0.65 | 1.85 |
| [MANT] | [+45.160/+010.789] | -1.51 | -0.30 | 0.05 | 1.54 |
| [BACU] | [+42.364/+020.072] | -1.42 | -1.14 | 1.36 | 1.81 |
| [ROVR] | [+45.647/+011.072] | -1.38 | -0.20 | 0.05 | 1.39 |
| [LODØ] | [+45.287/+009.473] | -1.32 | -0.20 | 0.07 | 1.33 |
| [GNAL] | [+42.584/+013.520] | -1.30 | -0.12 | -1.29 | 1.31 |
| [VLSM] | [+38.177/+020.589] | -1.22 | -0.04 | 0.52 | 1.22 |
| [PONT] | [+38.619/+020.585] | -1.22 | -0.69 | 0.27 | 1.41 |
| | | | | | |

(Velocity CONSTRAINED TO ERIC)

MILO+ERIC span for more than 3 years.... MILO & ERIC should be excluded from the UPA solutions.



Validating Results (last one!)

In most cases, we see agreement:

2D: below 0.5 mm/year level; Vertical: 1 mm/yr in the Up!!!



tasks of Amsterdam-Splinter

- Common web exchange platform
 - Feedback from the combination to the providers partly prepared → web page available
- Visualization tools (kml ?) → test viewer available
- Prototype interface to WG "Deformation" established → values send und used (EGU 2019, EUREF 2019)
- Data input cleaning (current provider): Check solutions, update solutions
- Networking:

 \checkmark

 \checkmark

- Connection to geophysical/seismic community → various institutions extremely interested already, because no longer limited to national borders. Help notifying activity in your country
- Volunteering persons to the WG (provider/user) \rightarrow continue work
- Velocity model: → basic models for data checks, fine models for EU Dense velocity model (long-term goal) – co-workers are welcome