



Towards an IAG combined global GNSS velocity field

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“Global combined GNSS velocity field”

Main objective: combining and comparing available GNSS velocity fields. GNSS velocities may differ due to discontinuities and nonlinearities in the position series.

In this presentation: status and preliminary results of the IAG combined global GNSS velocity field.
More velocity fields may still join the combination.

Available input GNSS velocity fields

*Solution includes some global sites

Solution	#sites	Coverage	Contributors
APREF	720	Global	John Dawson et al.
EOST	986	Europe	Alexandre Michel et al.
EPND	2391	Europe	https://epnd.sgo-penc.hu
EUREF	351	Europe	https://epncb.oma.be
INGV	594	Europe/Africa	https://gnssproducts.epos.ubi.pt
ITRF2020	901	Global	https://itrf.ign.fr
JPL	2468	Global	https://sideshow.jpl.nasa.gov
LTK	581	Europe/Africa	https://gnssproducts.epos.ubi.pt
NCL	965	Global	Katarina Vardic et al.
NGL	10100	Global	http://geodesy.unr.edu
NGS	1748	Global	Phillip McFarland et al.
NRCAN	593	Canada*	Michael Craymer et al.
SIRGAS	89	Central & South America*	https://www.sirgas.org
SOPAC	978	Global	https://cddis.nasa.gov

Combination method

1. Select sites having constant velocity and at least **5 years** (when known).
2. Check station locations and rename sites (190 sites renamed).
3. Estimate a priori variance factors for each solution from median 3D velocity uncertainty.
4. Align & combine velocities using ITRF2020 as target reference frame.
5. Extract velocity residuals and remove outliers iteratively.
6. Re-estimate a posteriori variance factors from weighted velocity residuals.
7. Combination with a posteriori variance factors.
8. Check for new outliers.

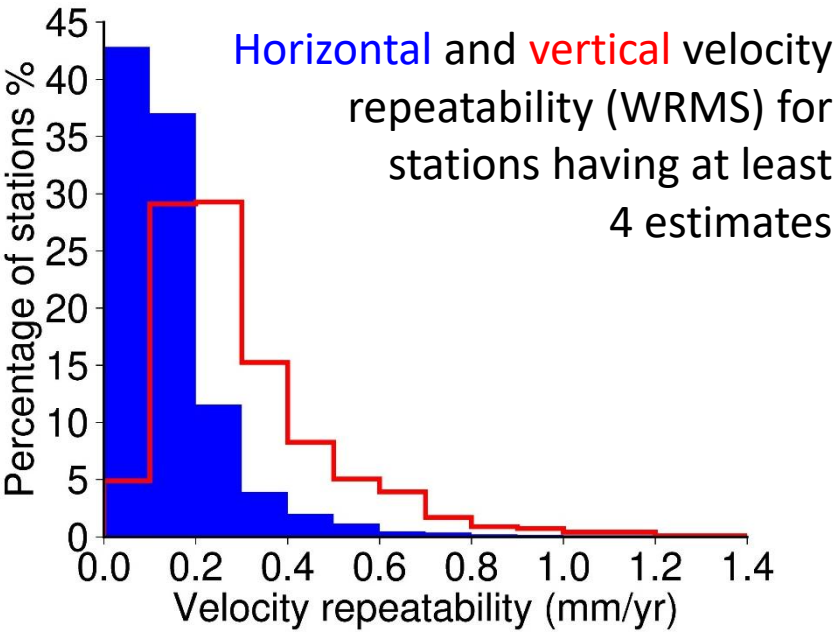
Main software: CATREF (IGN)

Combination results

All solutions contribute almost equally to the combination. The median of the a posteriori 3D velocity uncertainty per solution ranges from 0.2 to 0.4 mm/yr.

Transformation parameters well determined for global solutions and at the level of +/- 0.1 mm/yr for regional solutions (see bonus slides).

Median WRMS of velocity residuals: **0.1 mm/yr** and **0.3 mm/yr** for horizontal and vertical components.

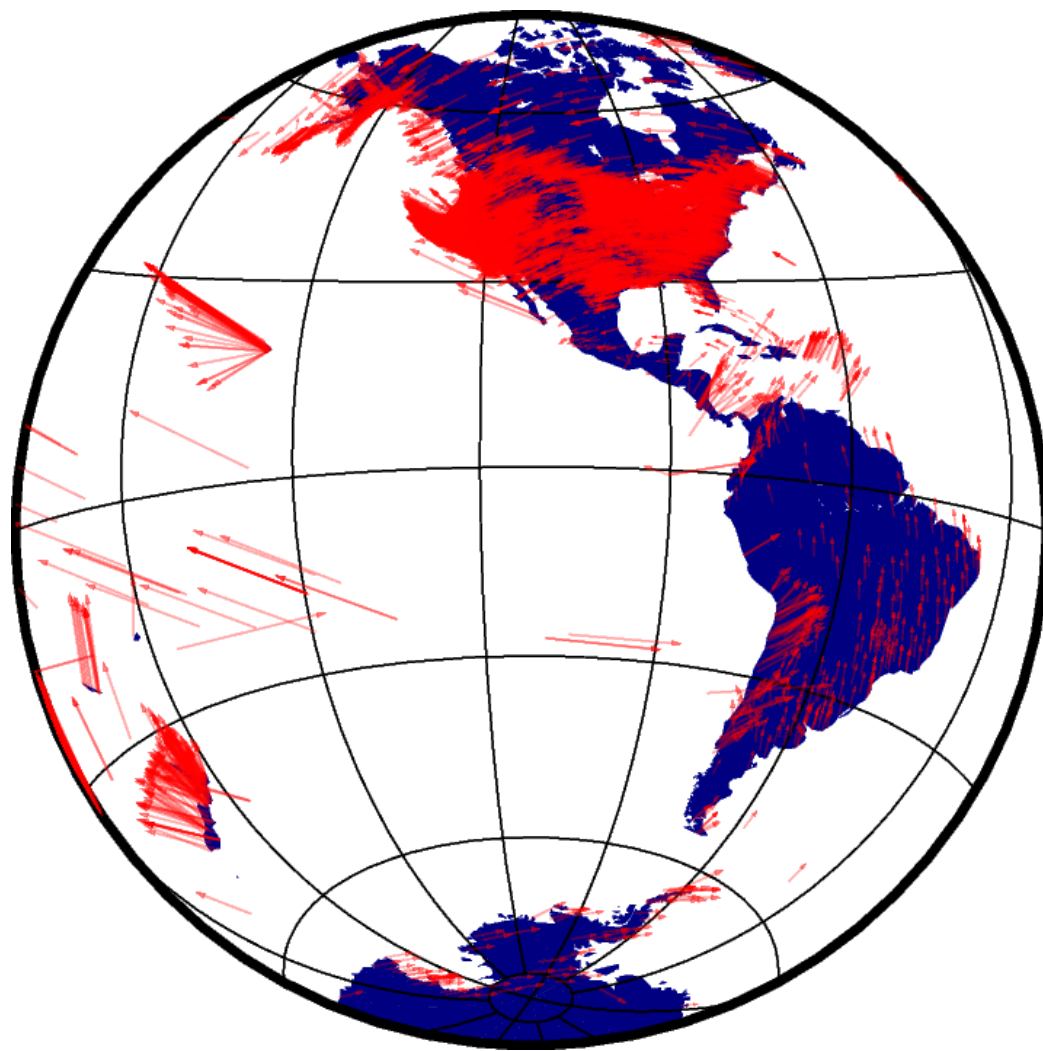
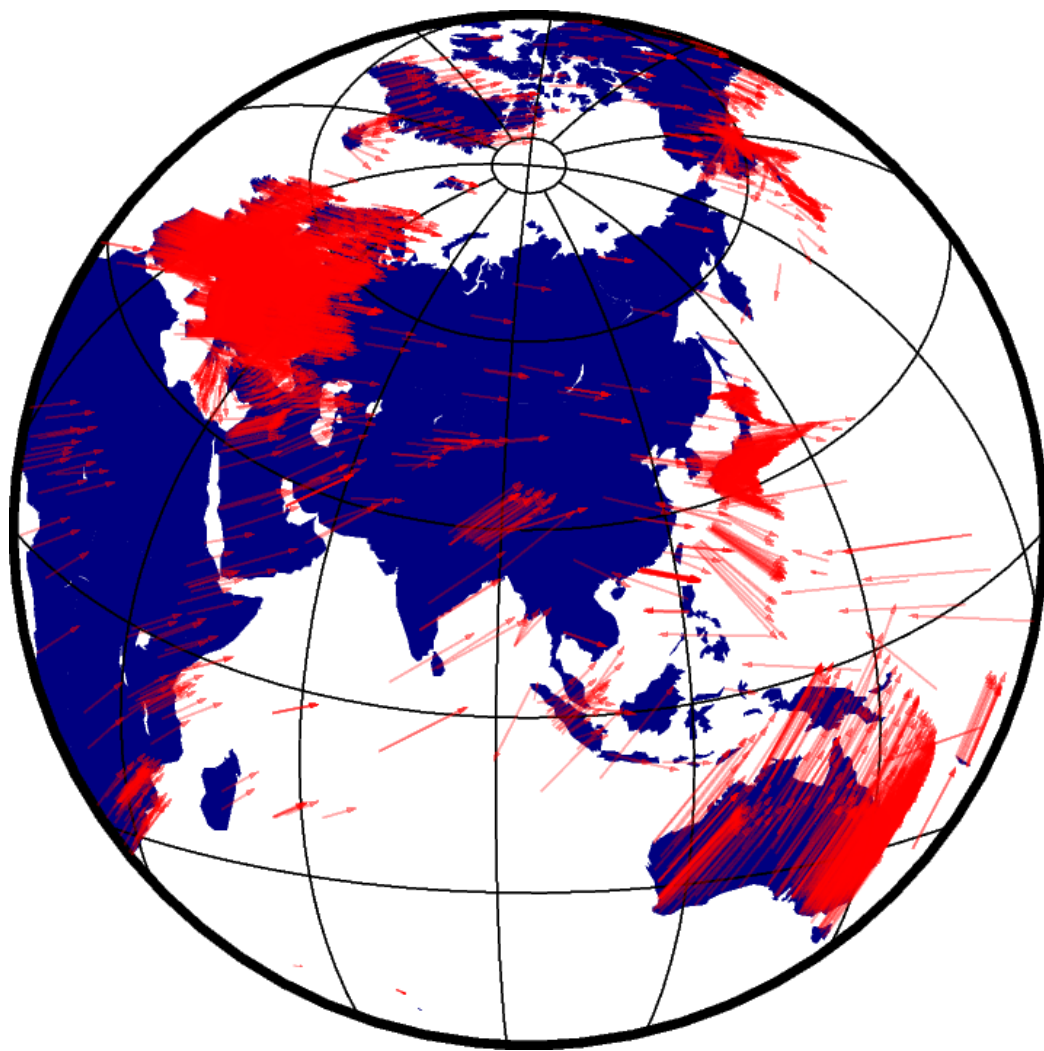


MIL1: WRMS UP = 0.8 mm/yr

Solution	UP velocity
NCL	-4.23 +/- 0.72
NRCAN	-4.21 +/- 0.28
SOPAC	-3.28 +/- 0.29
NGL	-2.96 +/- 0.18
JPL	-1.65 +/- 0.42

Solution	$\sqrt{VF}$	σ_{3D} (mm/yr)
APREF	2.8	0.33
EOST	1.0	0.25
EPND	1.3	0.20
EUREF	7.6	0.19
INGV	0.4	0.22
ITRF2020	1.0	0.27
JPL	0.8	0.30
LTK	3.8	0.31
NCL	0.5	0.42
NGL	0.3	0.20
NGS	0.6	0.33
NRCAN	1.9	0.27
SIRGAS	0.9	0.47
SOPAC	1.0	0.36

Thank you for your attention



Extra slides

Median velocity uncertainty after weighting (in mm/yr)

Solution	σ_{East}	σ_{North}	σ_{Up}
APREF	0.17	0.20	0.23
EOST	0.11	0.14	0.15
EPND	0.13	0.13	0.13
EUREF	0.08	0.15	0.15
INGV	0.07	0.13	0.14
ITRF	0.11	0.15	0.19
JPL	0.14	0.19	0.22
LTK	0.15	0.19	0.19
NCL	0.15	0.24	0.28
NGL	0.09	0.14	0.15
NGS	0.14	0.20	0.22
NRCAN	0.09	0.17	0.19
SIRGAS	0.26	0.23	0.33
SOPAC	0.15	0.20	0.25

Transformation parameters (all in mm/yr)

*A value of 0 means < 0.05 mm/yr

Solution	TX	TY	TZ	S	RX	RY	RZ
APREF	0 +/- 0	0.1 +/- 0	-0.1 +/- 0	0.1 +/- 0	-0.1 +/- 0	0.1 +/- 0	-0.1 +/- 0
EOST	-0.3 +/- 0.1	-0.1 +/- 0.1	-0.1 +/- 0.1	-0.1 +/- 0.1	-0.2 +/- 0.1	0.3 +/- 0.1	0 +/- 0.1
EPND	-0.1 +/- 0	-0.2 +/- 0	-0.3 +/- 0	0.2 +/- 0	-0.3 +/- 0	0 +/- 0.1	0.1 +/- 0
EUREF	-0.2 +/- 0.1	0.2 +/- 0.1	-0.2 +/- 0.1	0.3 +/- 0.1	-0.1 +/- 0.1	0.1 +/- 0.1	-0.2 +/- 0.1
INGV	-0.1 +/- 0	0.1 +/- 0	-0.2 +/- 0	0.3 +/- 0	0 +/- 0	0.1 +/- 0.1	-0.2 +/- 0
ITRF2020	-	-	-	-	-	-	-
JPL	0 +/- 0	0 +/- 0	-0.1 +/- 0	0.2 +/- 0	-0.1 +/- 0	0.1 +/- 0	-0.1 +/- 0
LTK	0.3 +/- 0	0.8 +/- 0.1	-0.2 +/- 0	-0.5 +/- 0.1	0.2 +/- 0	-0.3 +/- 0.1	-0.7 +/- 0
NCL	-0.1 +/- 0	0.1 +/- 0	-0.1 +/- 0	0.1 +/- 0	0 +/- 0	0.2 +/- 0	-0.1 +/- 0
NGL	0 +/- 0	0.1 +/- 0	-0.1 +/- 0	0.2 +/- 0	0 +/- 0	0.1 +/- 0	-0.1 +/- 0
NGS	0 +/- 0	0.1 +/- 0	-0.1 +/- 0	0.1 +/- 0	0 +/- 0	0.1 +/- 0	-0.1 +/- 0
NRCAN	0.1 +/- 0	0 +/- 0	0 +/- 0	-0.3 +/- 0	-0.2 +/- 0	-0.2 +/- 0	-0.1 +/- 0
SIRGAS	0.1 +/- 0.1	0.3 +/- 0.1	-0.2 +/- 0.1	0.5 +/- 0.1	-0.1 +/- 0.1	0 +/- 0.1	-0.3 +/- 0.1
SOPAC	0 +/- 0	0.1 +/- 0	-0.1 +/- 0	-0.1 +/- 0	-0.1 +/- 0	0.1 +/- 0	-0.1 +/- 0

WRMS of velocity residuals from original solutions (no outliers removed)

Solution	East (mm/yr)	North (mm/yr)	Up (mm/yr)
APREF	0.80	0.30	0.52
EOST	0.13	0.13	0.23
EPND	0.14	0.13	0.18
EUREF	0.10	0.08	0.18
INGV	0.10	0.12	0.24
ITRF2020	0.13	0.14	0.22
JPL	0.22	0.18	0.37
LTK	0.17	0.16	0.31
NCL	0.21	0.24	0.54
NGL	0.09	0.10	0.20
NGS	0.17	0.18	0.41
NRCAN	0.16	0.14	0.32
SIRGAS	0.53	0.78	1.04
SOPAC	0.36	0.29	0.41