DORIS on Galileo

Contribution of DORIS on board the Galileo constellation in terms of positioning

Proposed simulation

1. It is assumed that the Galileo satellites will be equipped with DORIS receivers, receiving signals from a global network based on the CNES REGINA network.

2. It is assumed that the Galileo-GNSS phase measurements are of homogeneous quality with future Galileo-DORIS measurements.

3. The number of DORIS channels available on-board Galileo (to be specified) will limit the number of measurements available on each date for each satellite.

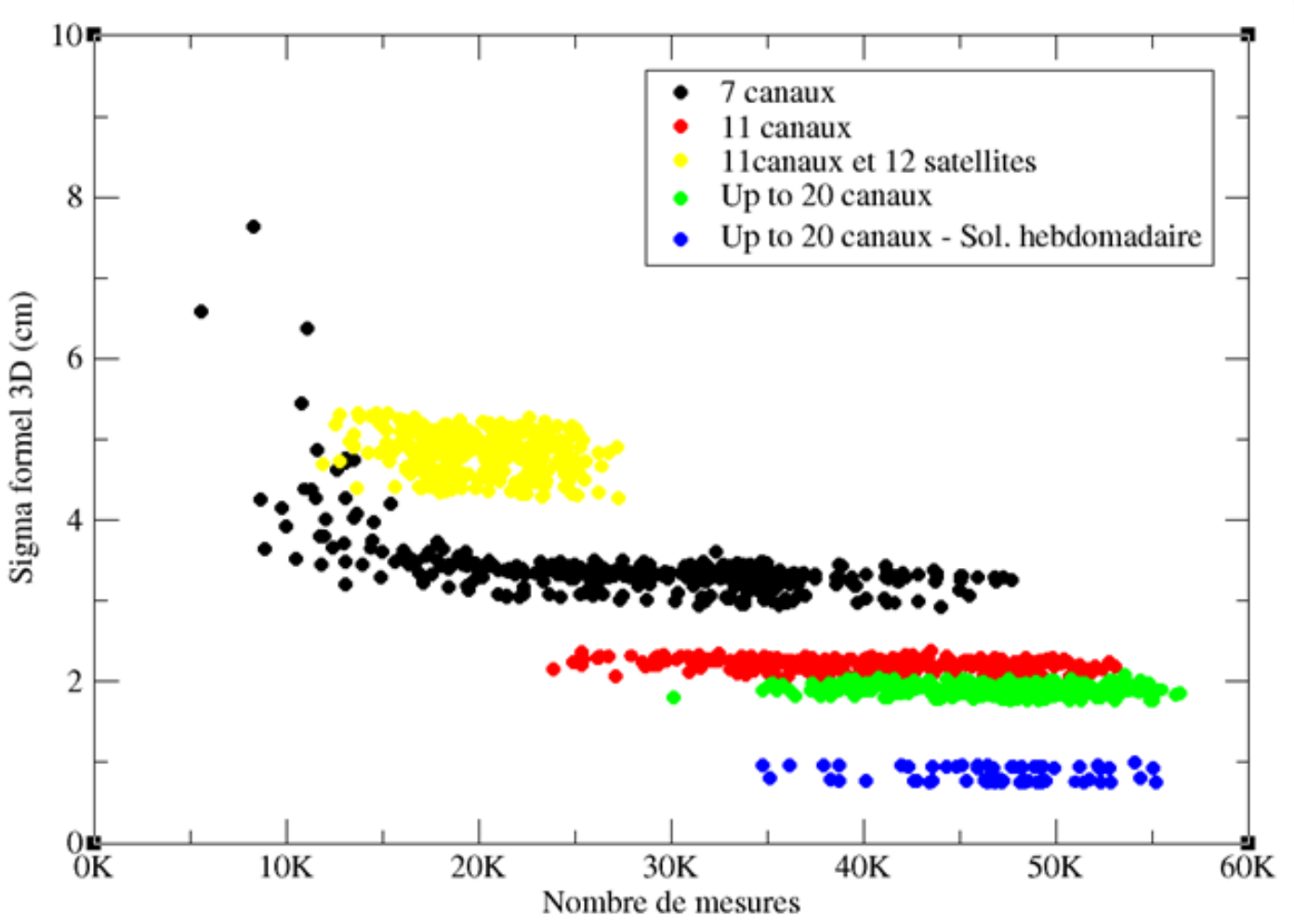
4. Integer ambiguities of phase measurements will not be fixed.

REGINA network

Temporal series and scenarios

Serie	Technique	Solution	Commentaires
CA1REG	GNSS	Daily	Number max. of channels
CA2REG	GNSS	Daily	7 channels
CA3REG	GNSS	Daily	11 channels
CA4REG	GNSS	Daily	11 channels – 12 Galileo satellites
CA7REG	GNSS	Weekly	Number max. of channels
43	DORIS	Weekly	7 canaux – Contribution to the ITRF2020.

Standard deviation vs. Number of measurements



Evaluation of solutions

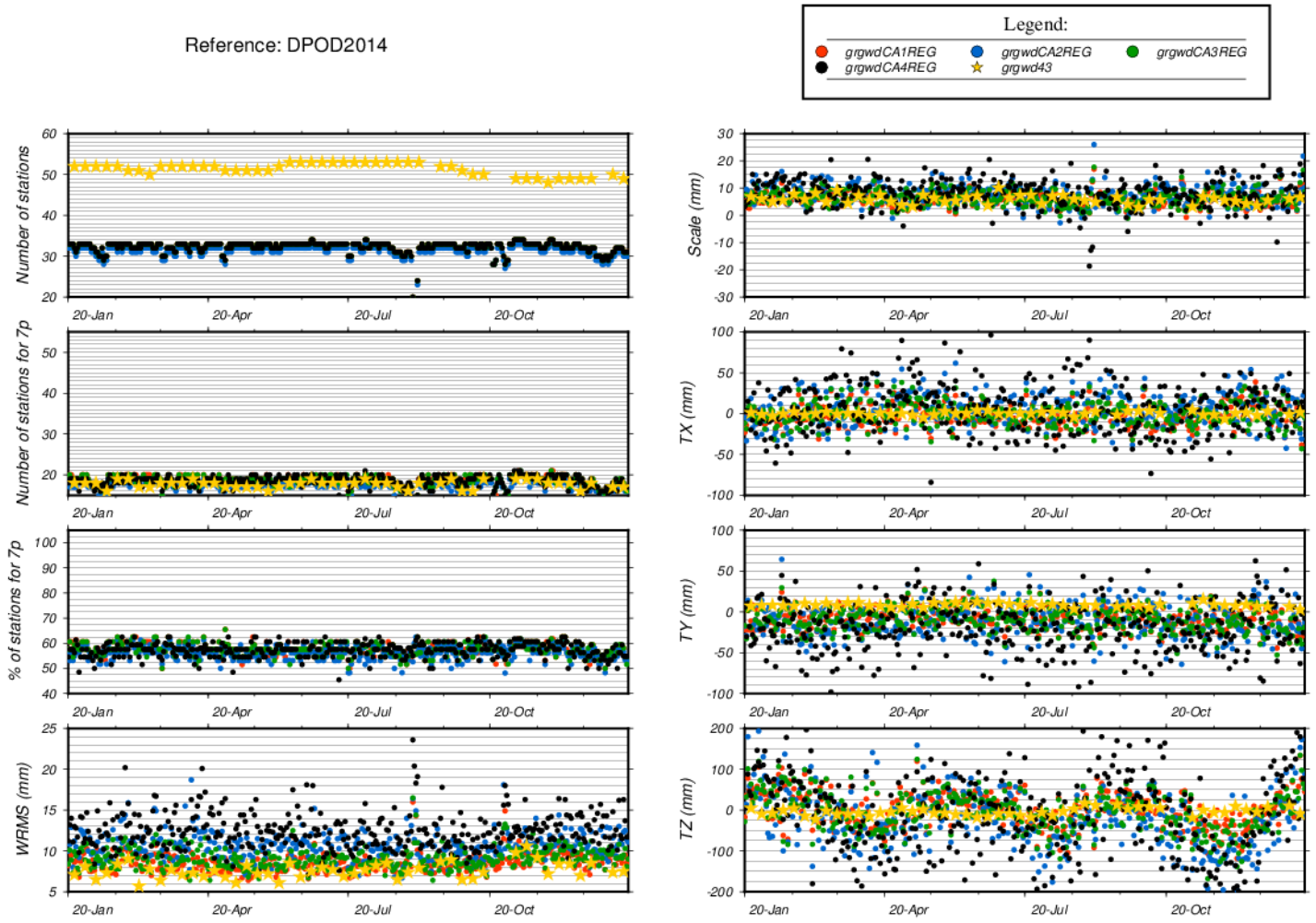
- From all GNSS solutions, the CA7REG scenario (weekly solution, max. number of channels) seems to have the best solution.

- To convert GNSS sinex to DORIS sinex, we will apply the IGN local ties between DORIS and GNSS for all common sites (34 out of 39).

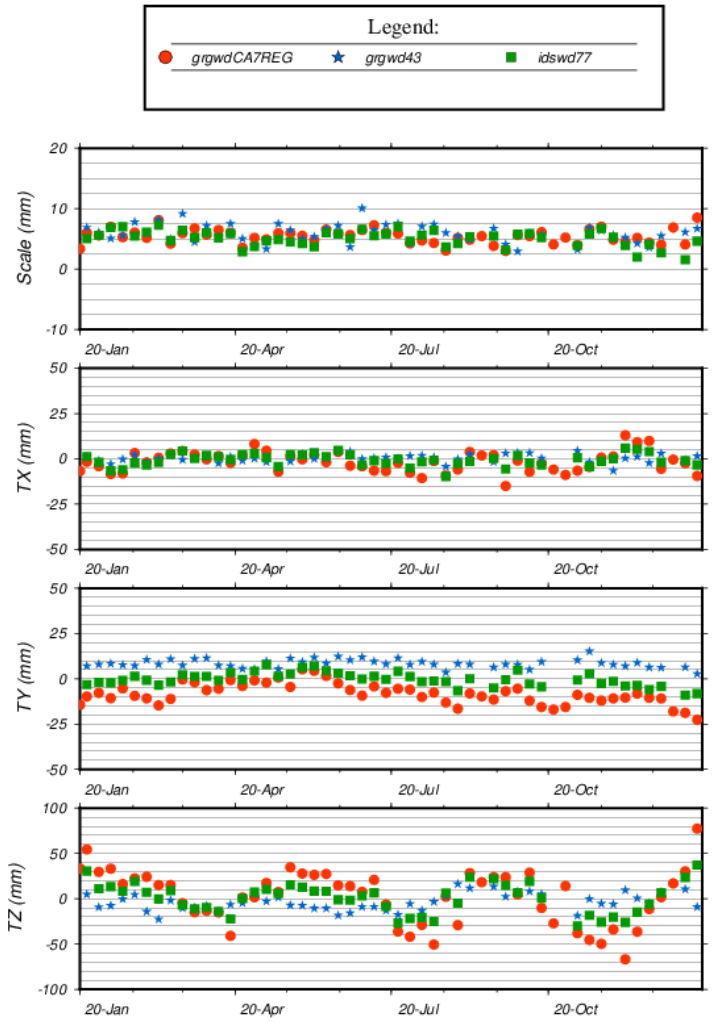
- Evaluation of station positioning residuals and Helmert parameters w.r.t. DPOD2014 (version 5.4) done via CATREF :

  - All scenarios CAXREG.
  - Solution grg43 of the CNES/CLS IDS Analysis Center.
  - Solution ids77 : combination of the CA7REG and grg43 solution.

Evaluation of all daily scenarios vs. DORIS grg43 solution



Origin and scale w.r.t. DPOD2014 (v5.4)

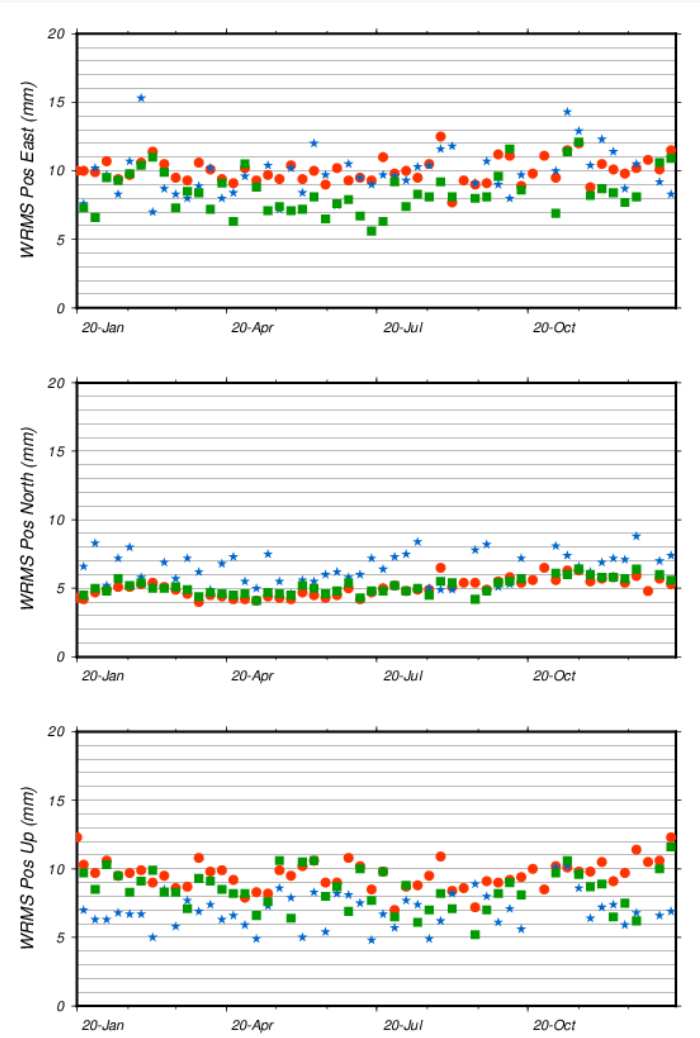


Unit = mm

Serie	Scale Factor	Tx	Ty	Tz
CA7REG	5.40 ± 1.20	-1.72 ± 5.62	-8.31 ± 5.83	2.16 ± 29.89
IDS 77	5.06 ± 1.30	-0.57 ± 3.33	-0.35 ± 3.73	0.45 ± 16.53
GRG 43	*5.90 ± 1.55*	*0.23 ± 2.30*	*8.43 ± 2.38*	*-3.82 ± 9.32*

- Good agreements on the scale factor.
- Better centering of IDS 77 in Ty and Tz due to opposite values for GRG 43 and CA7REG.

Station positioning residuals w.r.t. DPOD2014 (v5.4)



Unit = mm

Serie	WRMS Est	WRMS Nord	WRMS Up	WRMS 3D
CA7REG	10.02 ± 0.89	5.04 ± 0.65	9.58 ± 1.07	7.43 ± 0.60
IDS 77	8.47 ± 1.53	5.13 ± 0.59	8.46 ± 1.44	6.84 ± 0.79
GRG 43	9.78 ± 1.71	6.51 ± 1.12	6.97 ± 1.27	*7.61 ± 0.98*

In terms of positioning, the combined solution offers the best performance in the plane (east and north) and slightly worse than the pure DORIS solution along the vertical.

Conclusions & Perspectives

Scenarios

- The greater the number of channels, the better the performance (stability of Helmert parameters and positioning residuals).
- Reducing the Galileo constellation deteriorates performance.
- Better performance of a weekly solution, with a very good agreement on the scale factor with the DORIS solution.

Combination CA7REG – grg43 DORIS

- Positive impact of Galileo on the coherence of the scale factor.
- Better centering of the geocenter.
- Improvement of the positioning performances in the plane, in particular in the East which is the worst direction observed by DORIS.

Perspectives

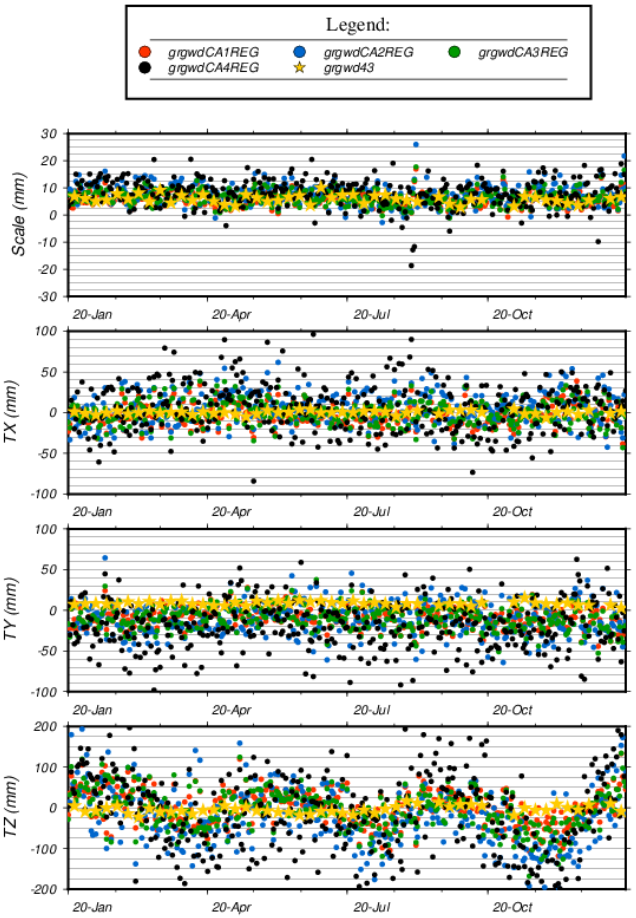
- Extension of the study period over 4-5 years (2017-2021) for a more detailed analysis, adding a frequency analysis.
- Extension of the GNSS network in order to use all IGN DORIS-GNSS local ties.

Thank you for your attention

Evaluation of all daily scenarios vs. DORIS grg43 solution

Unit = mm

Serie	Scale Factor	Tx	Ty	Tz
CA1REG	5.88 ± 2.50	-2.33 ± 13.06	-8.53 ± 12.38	0.98 ± 43.49
CA2REG	7.51 ± 3.70	5.01 ± 18.93	-10.31 ± 19.32	-25.56 ± 69.06
CA3REG	6.35 ± 2.74	-0.24 ± 14.38	-9.85 ± 13.87	-6.65 ± 49.54
CA4REG	8.09 ± 5.34	6.94 ± 31.24	-18.41 ± 31.03	-18.13 ± 104.79
43	*5.90 ± 1.55*	*0.23 ± 2.30*	*8.43 ± 2.38*	*-3.82 ± 9.32*



Evaluation of all daily scenarios vs. DORIS grg43 solution

Unit = mm

Serie	WRMS East	WRMS North	WRMS Up	WRMS 3D
CA1REG	11.77 ± 2.03	5.62 ± 1.03	11.22 ± 1.83	8.57 ± 1.15
CA2REG	14.89 ± 2.91	6.21 ± 1.36	13.97 ± 2.84	10.59 ± 1.69
CA3REG	12.83 ± 2.20	5.62 ± 1.12	11.68 ± 2.12	9.02 ± 1.25
CA4REG	16.60 ± 3.59	7.33 ± 1.69	17.36 ± 3.96	12.44 ± 2.22
43	9.78 ± 1.71	6.51 ± 1.12	6.97 ± 1.27	*7.61 ± 0.98*