

Why do we need to improve co-locations of space geodetic techniques ?

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Outline

- **ITRF Heritage**
- **Current status of technique networks & co-locations**
- **Results from combination tests, with extended time series beyond ITRF2008 data**
- **Conclusion: why do we need to improve co-locations ?**

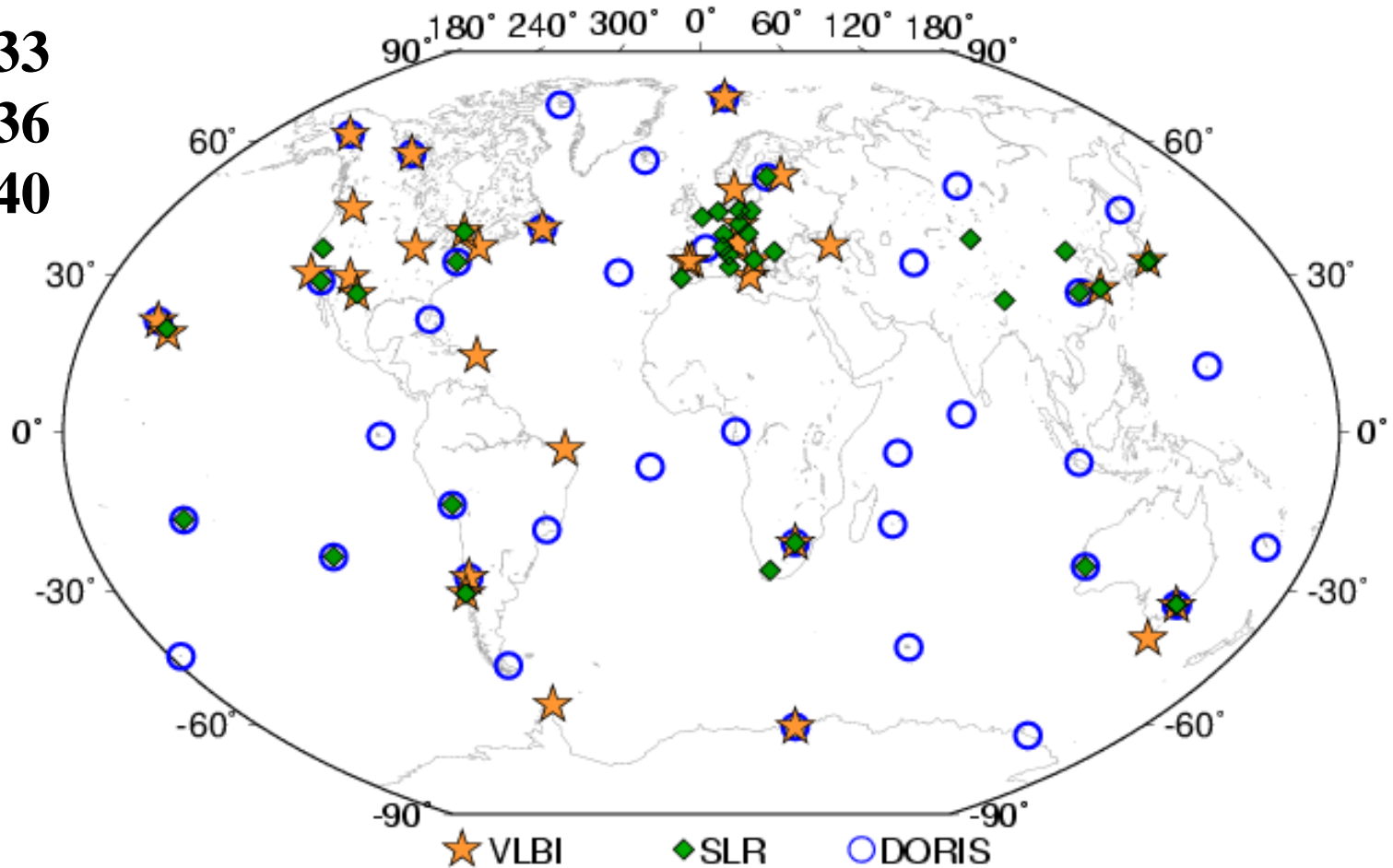
ITRF2008 Co-locations: Via GPS

84 co-locations in total

VLBI: 33

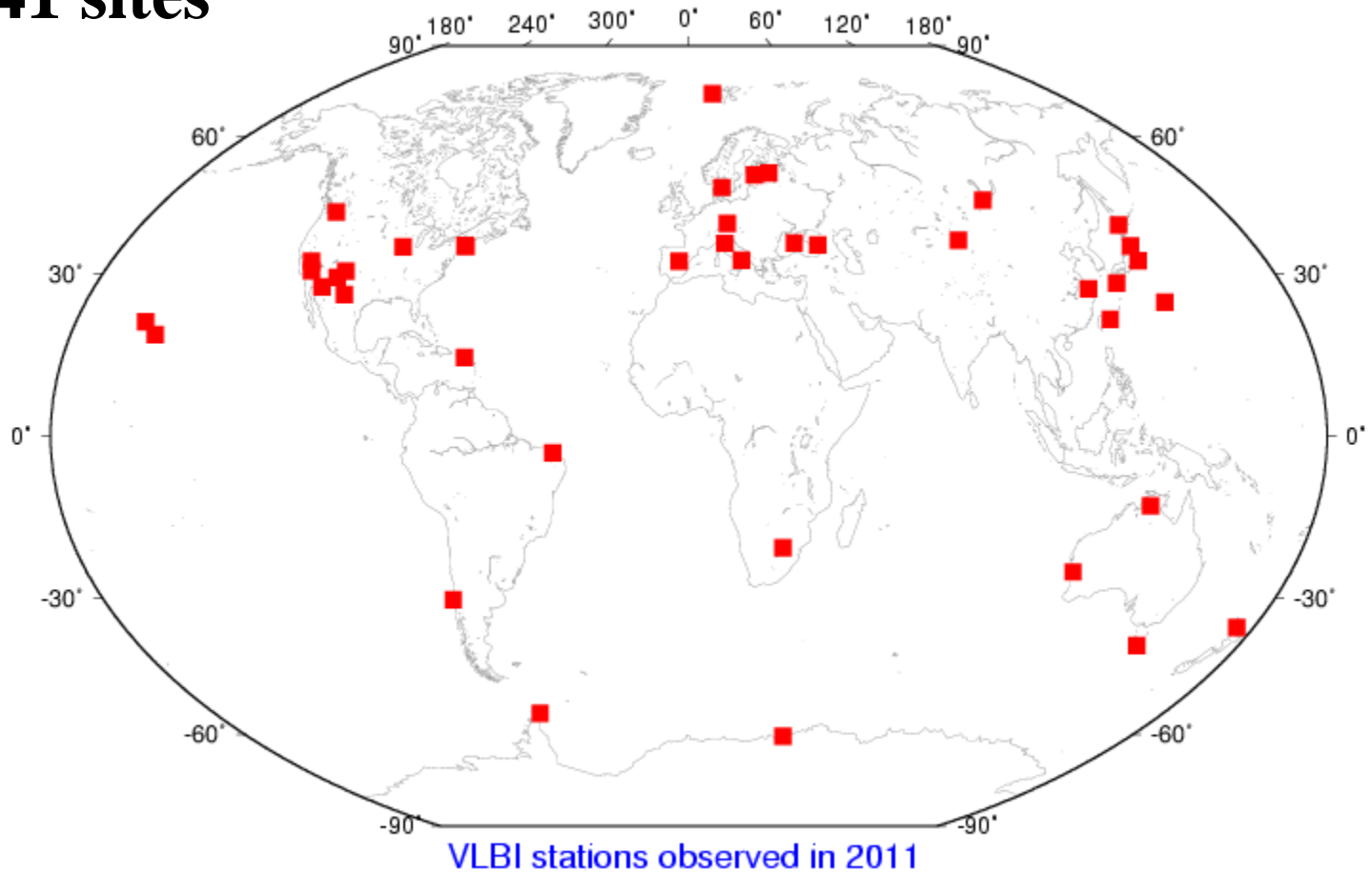
SLR: 36

DORIS: 40



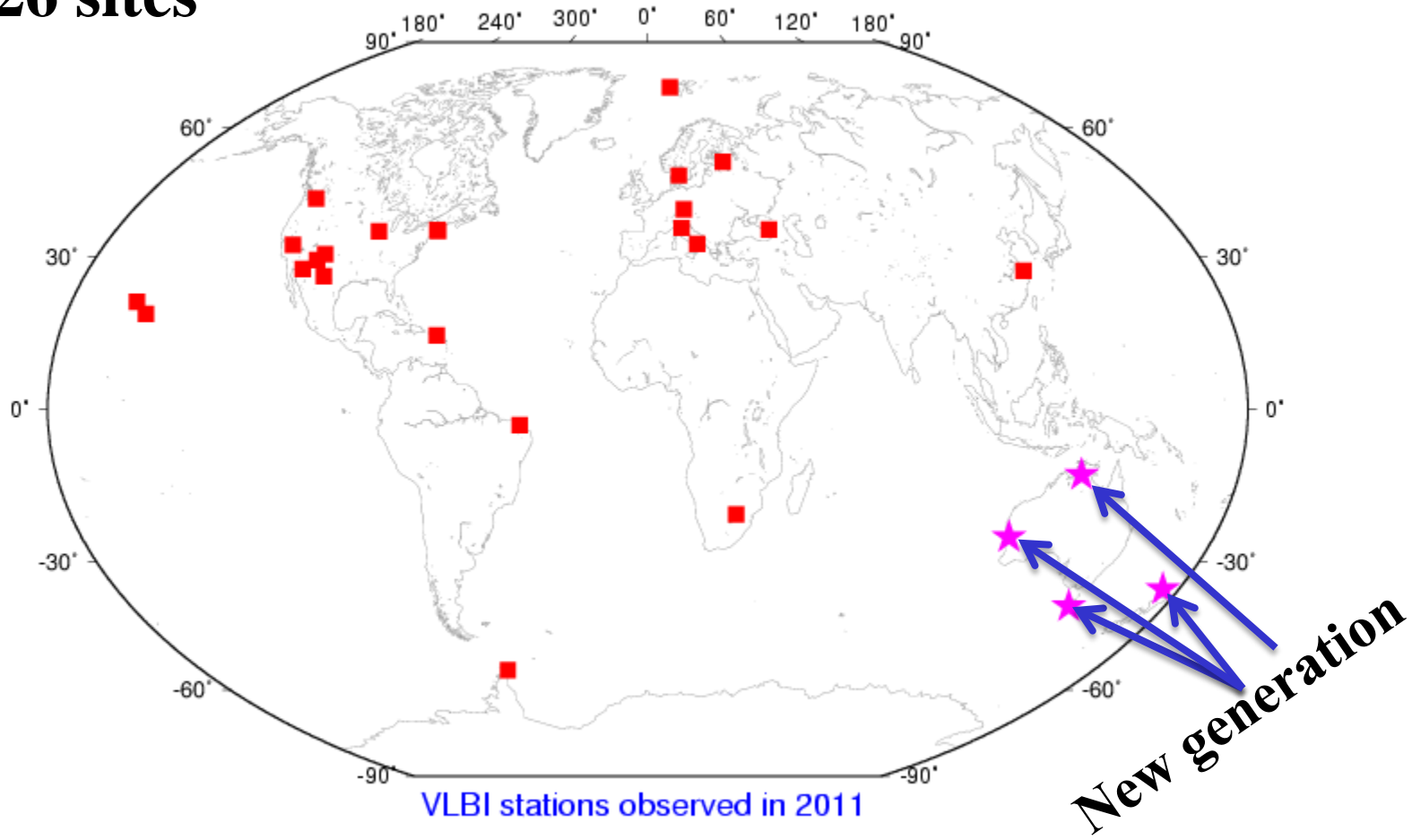
Current VLBI Network Stations observed in 2011

41 sites



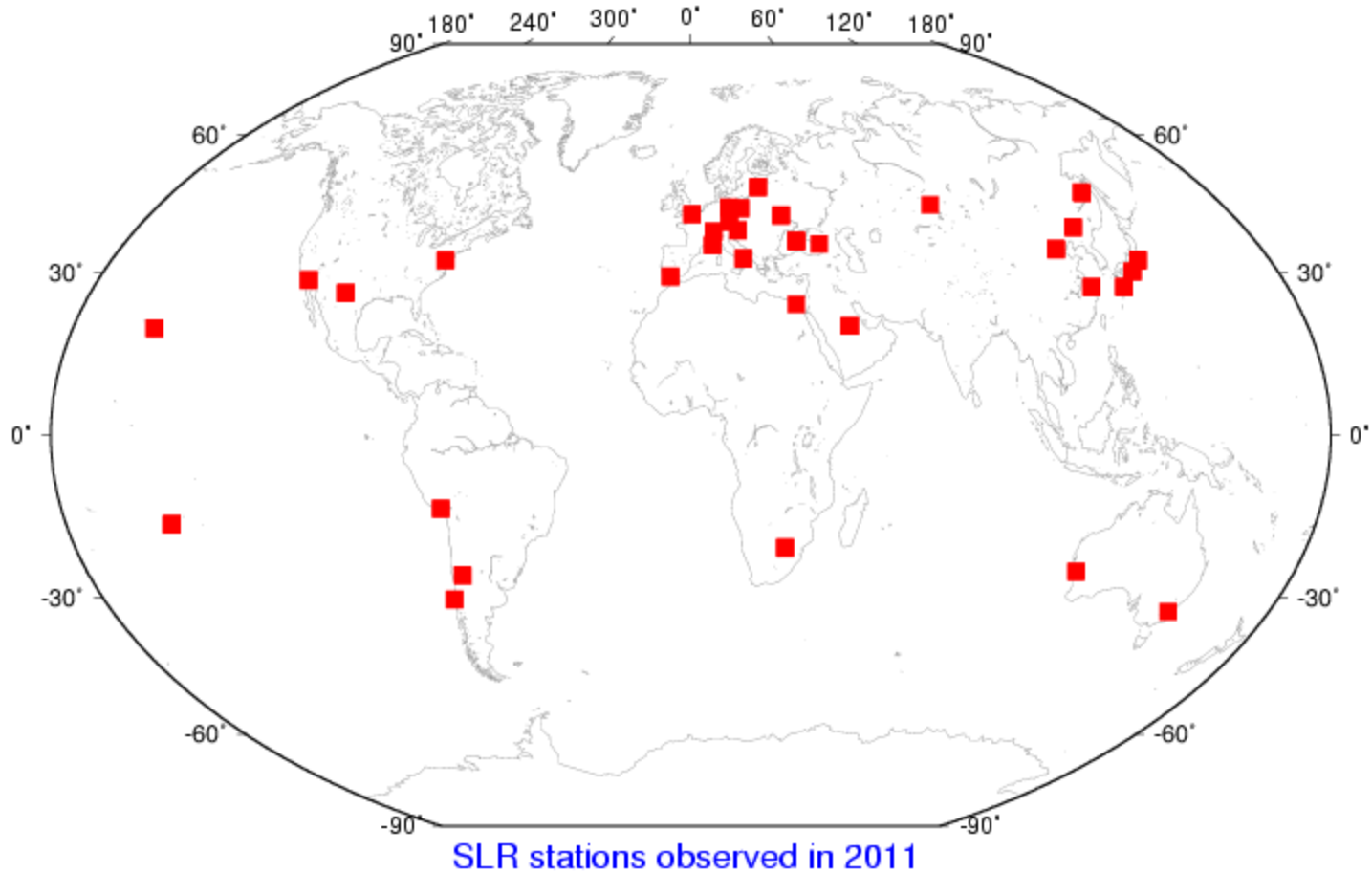
Current VLBI Network (2011): “good sites”

26 sites



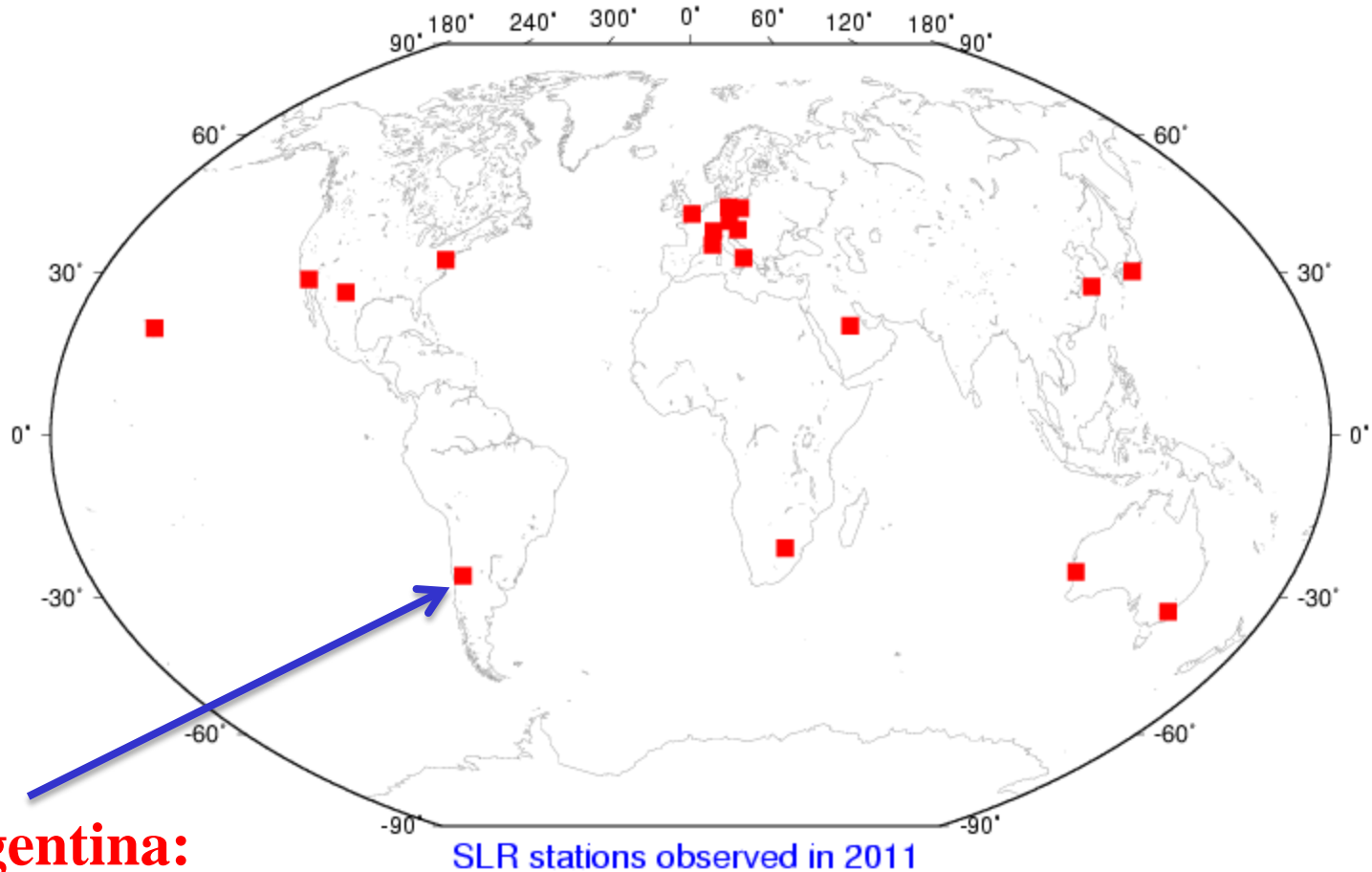
Current SLR Network Stations observed in 2011

32 sites



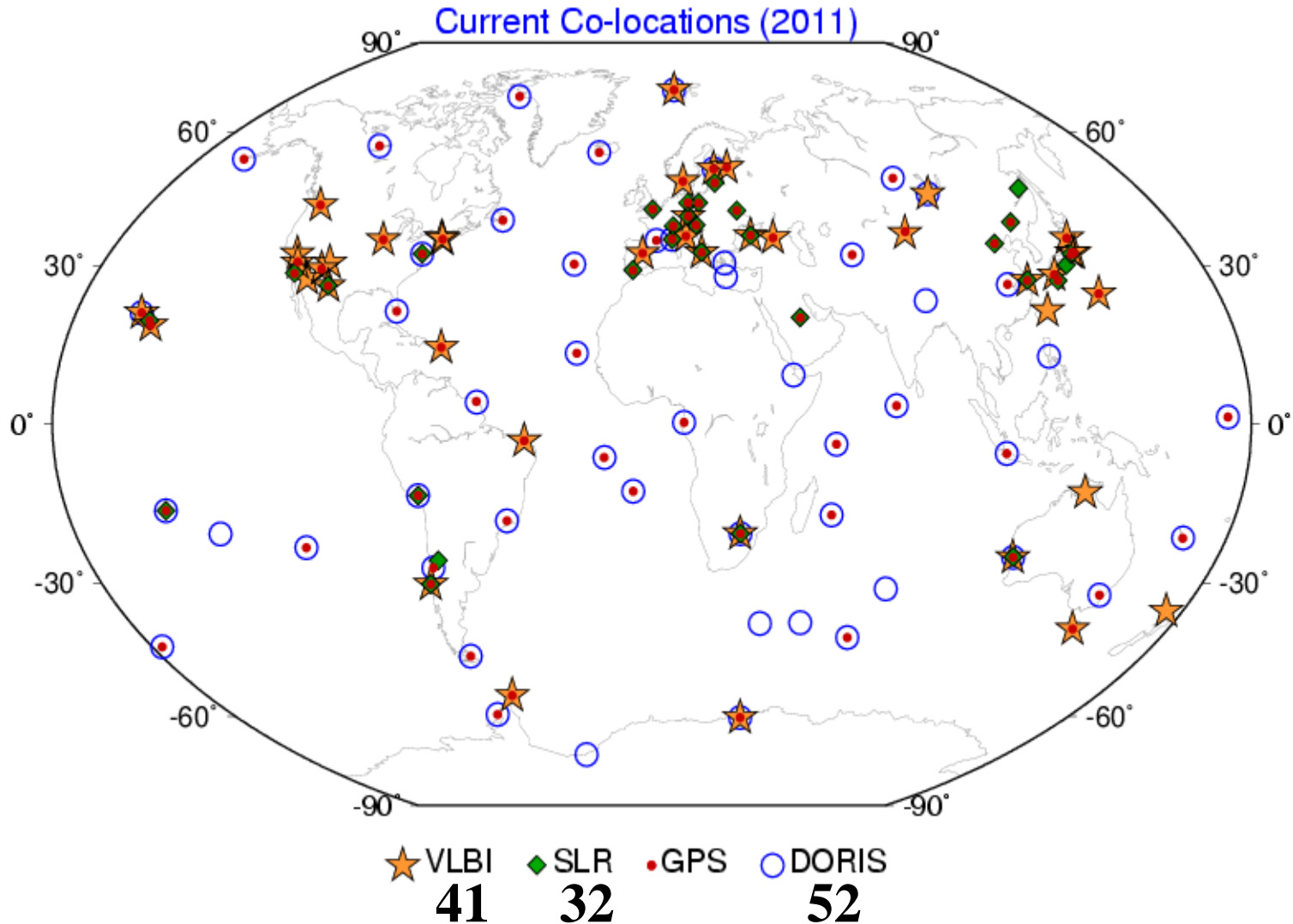
Only 19 SLR “good sites”

Mostly still old generation systems



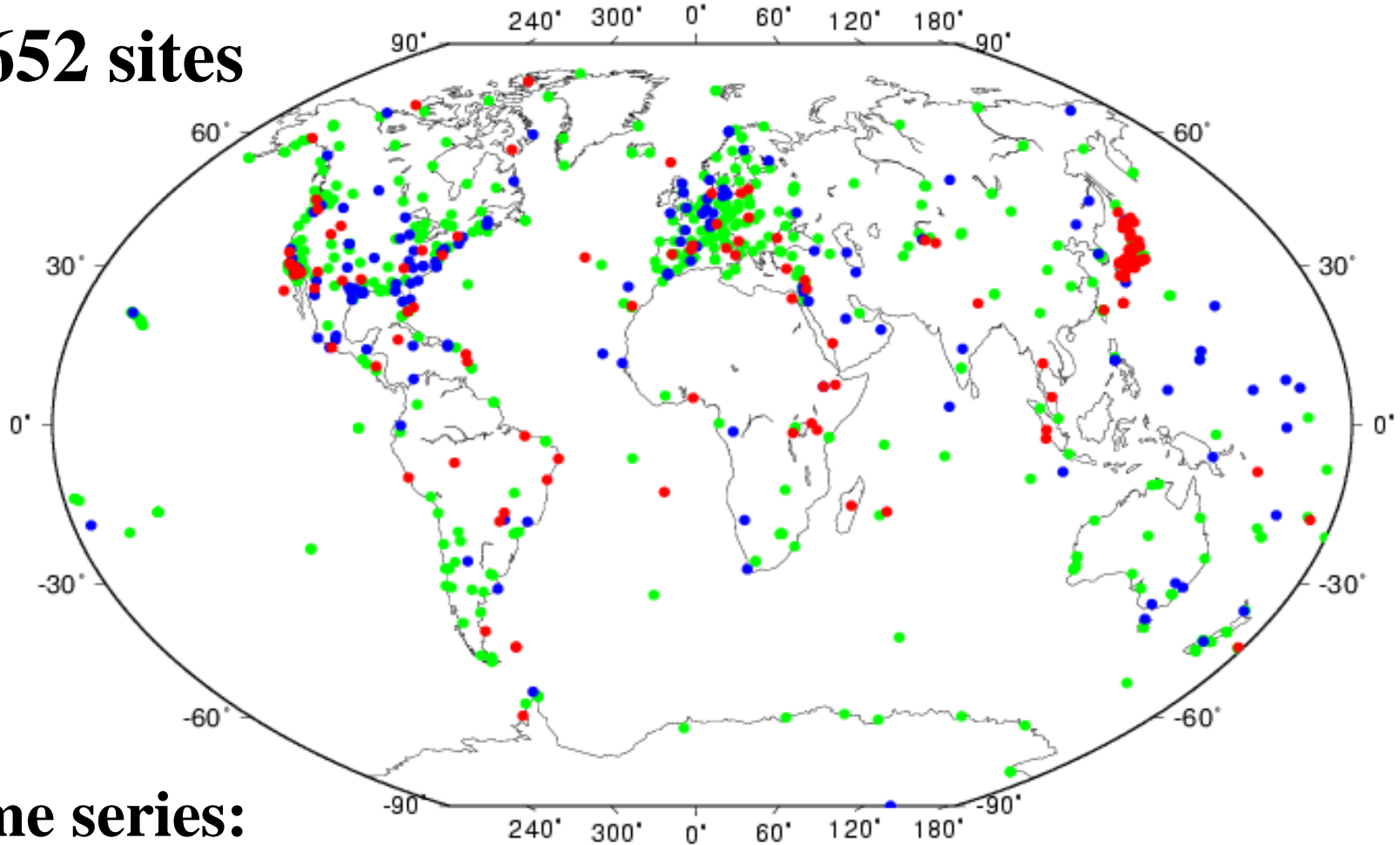
Total # of VLBI, SLR, DORIS sites & their co-locations with GPS

- Poor number of VLBI and SLR sites & their co-locations with GPS



Processed IGS/GNSS sites, since 1994

652 sites

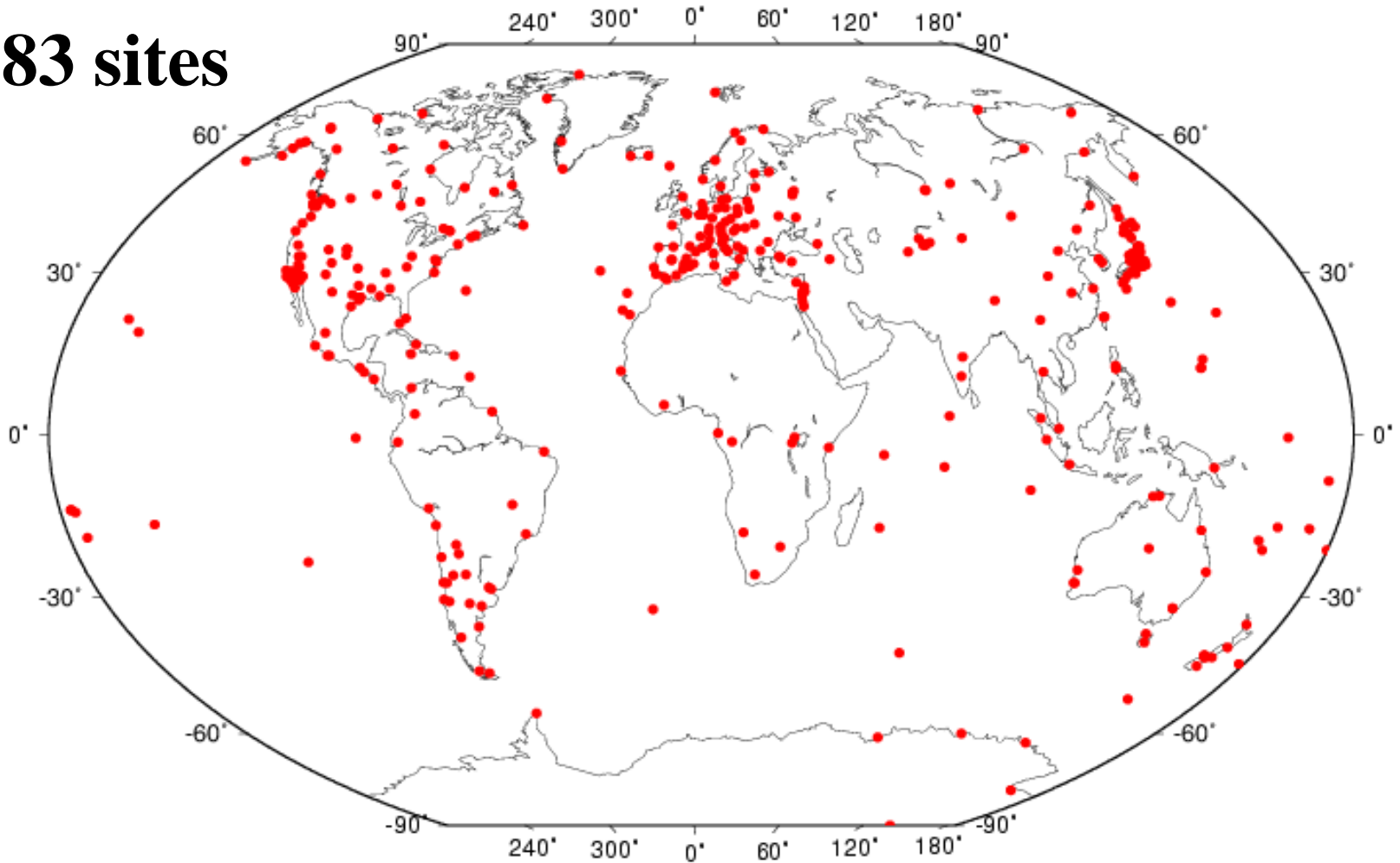


Time series:

Red < 5yrs (118), **Blue** 5-10yrs (138), **Green** 10-18yrs (396)

IGS/GNSS sites with discontinuities

383 sites



Q: how stable is the IGS reference frame ?

Local Tie Accuracy ?

Cannot be better than ~ 3mm because of internal-system biases!



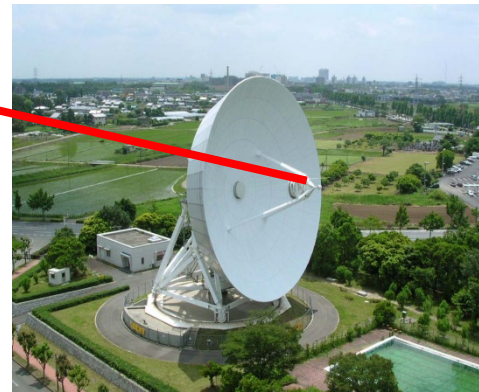
SLR/LLR



GNSS



$$DX_{(GPS,VLBI)} = X_{VLBI} - X_{GPS}$$



VLBI



DORIS

Please, improve co-locations

- Without GPS/IGS, we have:
 - VLBI-SLR : **8 co-locations only**
 - VLBI/SLR-DORIS : **10 co-locations only**
- IGS-GPS **IS** the link between SLR, VLBI & DORIS
- **Is GPS free from site-dependent errors ?**

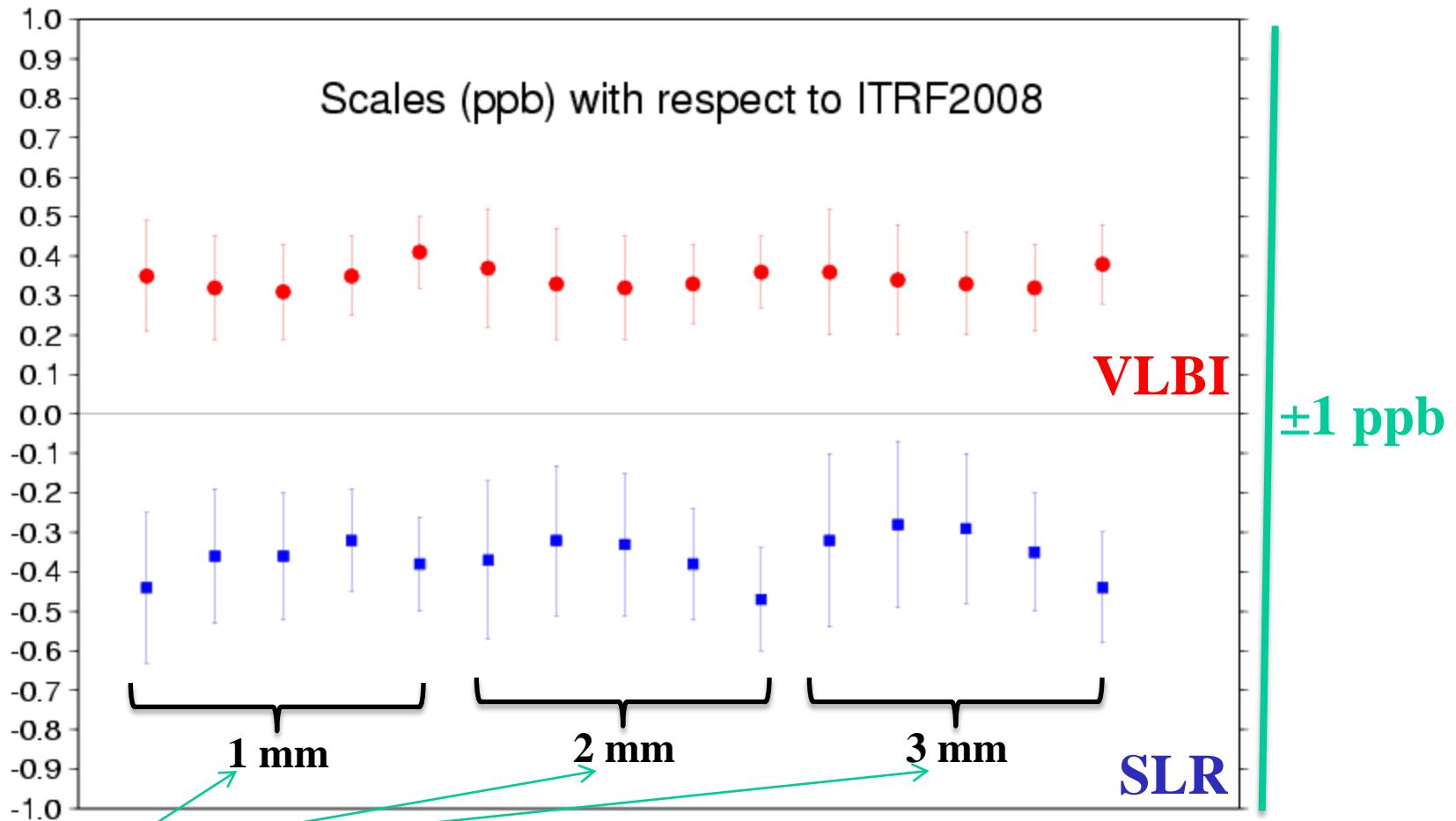
Next ITRF solution (ITRF2013)

- **To be ready in mid 2014:**
 - CFP for ITRF2013 will be issued by end of January 2013
 - Outcome of the evaluation of solutions submitted following the ITRS/GGFC call, with & without atmospheric loading corrections
 - All techniques to submit solutions by Jan-Feb, 2014
- **Expected Improvements & Developments:**
 - Reprocessed solutions;
 - **Revisiting the weighting of Local Ties and Space Geodesy solutions included in the ITRF combination;**
 - Improving the process of detection of discontinuities in the time series;
 - Modelling non-linear station motions.

Revisit the weighting btw local ties and SG solutions

- **Difficulties:**
 - Velocity disagreements btw techniques for some sites
 - Large “tie” discrepancies for 50% of sites
 - Epochs of ties and discontinuities (?)
 - Local tie accuracy (?)
- **Procedure: Estimate variance factors (VF) for SG solutions via velocity fields combination**
 - Add local tie SINEX files and **iterate** (re-evaluate tie VF) until convergence ==> unit weight close to 1.
- **15 test combinations, by varying floor sigmas of:**
 - Local Ties (1, 2, 3) mm
 - Velocity constraints (0.01, 0.05, 0.1, 0.5, 1.0) mm/yr

Scale factors wrt ITRF2008



Tests : Floor σ Ties (1, 2, 3 mm), and σ Velocity (0.01, 0.05, 0.1, 0.5, 1 mm/yr)

Scale factors wrt ITRF2008

Uncalibrated Radome Sites Excluded



Tests : Floor σ Ties (1, 2, 3 mm), and σ Velocity (0.01, 0.05, 0.1, 0.5, 1 mm/yr)

Scale Difference (VLBI-SLR) amplified by 0.2 ppb

Examples of “velocity tie” problems

Site	E mm	N mm	Up mm	Comment
GODE	-3.0	5.2	-6.8	SLR: Total “tie” residuals
	-1.5	3.2	-3.0	Due to velocity discrepancy
MDO1	1.8	-3.0	17.0	SLR: Total “tie” residuals
	0	0	3.5	Due to velocity discrepancy
NLIB	-0.4	1.9	-8.5	VLBI: Total “tie” residuals
	-1.6	2.8	-3.6	Due to velocity discrepancy

Impact of co-location geometry on origin & scale: uncertainties (1σ)

Ties used	TX mm	TY mm	TZ mm	Scale mm
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All ties used	0.6	0.5	0.6	0.6
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Exclude 4 Co-locations from S. Hemisphere	1.4	1.3	1.3	1.3
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Conclusion

- **Most of current VLBI and SLR instruments are old generation**
- **50% of IGS sites have discontinuities**
- **Discrepancies larger than 6mm at 50% of co-location sites**
- **The ITRF accuracy is not better than 1 cm over its time span**
- **==> We obviously need to improve co-locations**