Initial combination of our SLR weekly solutions with other Analysis Centers

Fan Shao, Xiaoya Wang

(Shanghai Astronomical Observatory, Chinese Academy of Sciences, 80 NanDan Road, Shanghai 200030, China. Email: fanshao@shao.ac.cn)

Abstract

We combined the SLR weekly solutions of different Analysis Centers (ACs) including ASI, BKG, DGFI, ESA, GFZ, GRGS, JCET and NSGF. The main lines of the combination methodology rely on direct combination of loosely constrained solutions. Then we use rigorous Variance Component Estimation (VCE) to estimate the variance scaling factors for each of the contributed solutions. We compare our combined solutions with individual solution, it shows a real improvement on sites position and EOPs. Then we compare the translation and scale parameters with respect to SLRF2008 with ILRS official combined product (ILRSA) and ILRS official backup combined product (ILRSB), it shows a good consistency between the three. Finally, we compare the translation and scale parameters with respect to SLRF2008 and SLRF2014. It shows that SLRF2014 is more stable than SLRF2008

The Scale factor

We combine the weekly SINEX files of all ACs with rigorous Variance Component Estimation. Figure 1 shows the values, over the period 1993-2017, of the variance factors for each contributing agency. In order to compare the variance factors with ILRSA and ILRSB, we consider the variance factors of ASI as 1. Table 1 shows the statistical result of three different combining solutions.

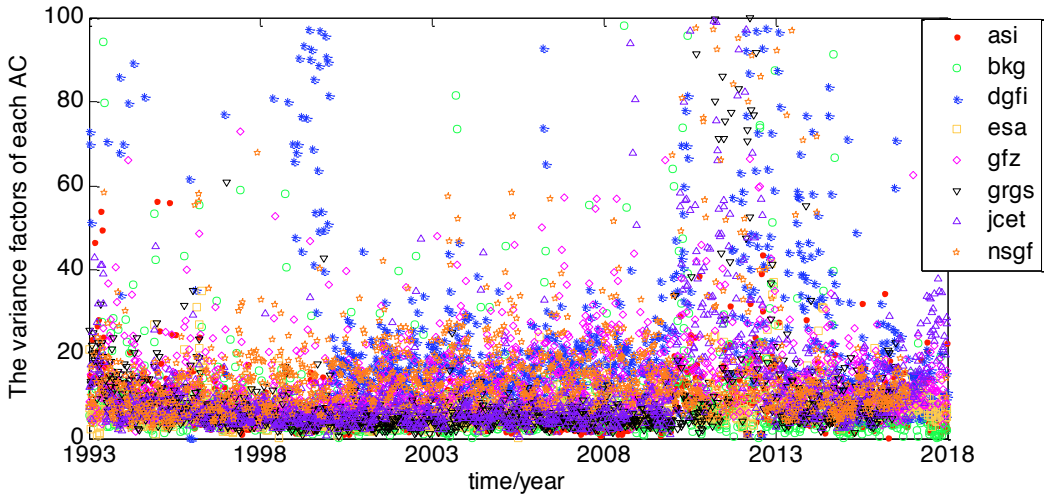

Figure 1 the variance factors of each ACs

Table 1 the variance factors of three different combining solutions

ILRSA	ASI	BKG	DGFI	ESA	GFZ	GRGS	JCET	NSGF

Mean	1.00	1.51	4.06	1.20	1.45	1.80	2.03	2.44
ILRSB	ASI	BKG	DGFI	ESA	GFZ	GRGS	JCET	NSGF
Mean	1.00	1.07	2.06	1.16	1.93	1.22	1.36	2.36
ILRSC	ASI	BKG	DGFI	ESA	GFZ	GRGS	JCET	NSGF
Mean	1.00	1.13	3.19	1.05	1.94	1.10	1.61	2.17

3D RMS

We compare our combined solution and individual solution with respect to SLRF2008 and EOP C04. Figure 2 shows that the combined solutions represents a real improvement, in terms of consistency and dispersion, with respect to the individual AC solutions. The average 3-D residuals with respect to SLRF2008 are below the 1cm level. Figure 3, figure 4 and figure 5 show ILRSC X-pole, Y-pole, and Length of Day (LOD) residuals with respect to EOP C04. Table 2 shows that the combined EOP is more stable than individual solution.

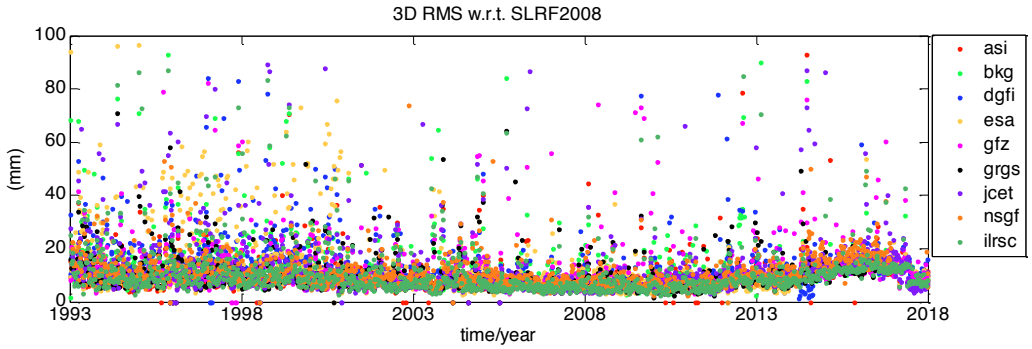

Figure 2 Time series of weekly 3-D residuals with respect to SLRF 2008 for ILRS core sites from individual AC solutions as well as from the combined ILRSC solution

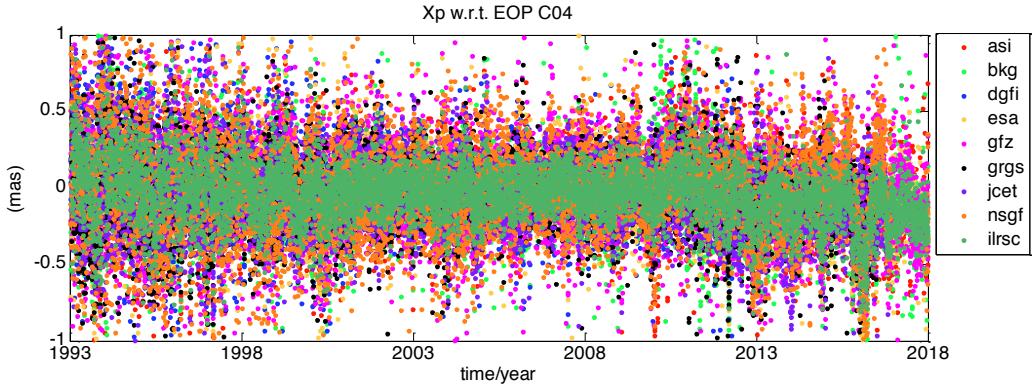

Figure 3 Time series of weekly 3-D residuals for X-pole with respect to EOP C04 from individual AC solutions as well as from the combined ILRSC solution after transformation

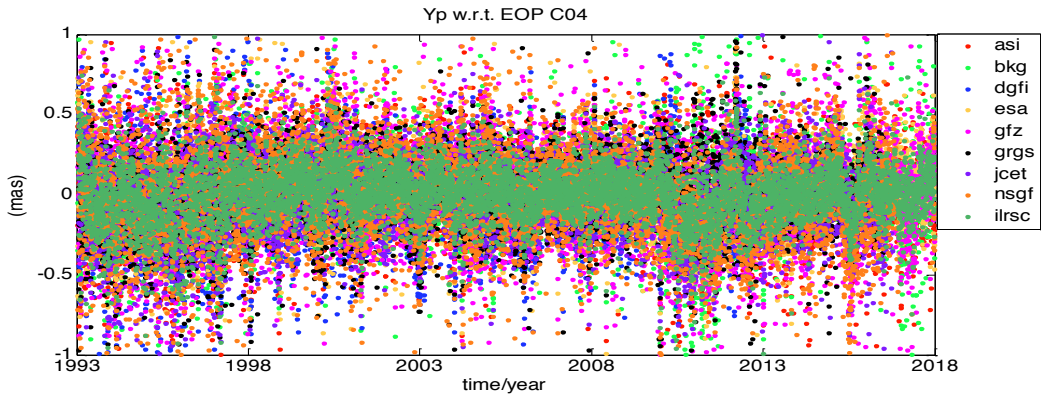

Figure 4 Time series of weekly 3-D residuals for Y-pole with respect to EOP C04 from individual AC solutions as well as from the combined ILRSC solution after transformation

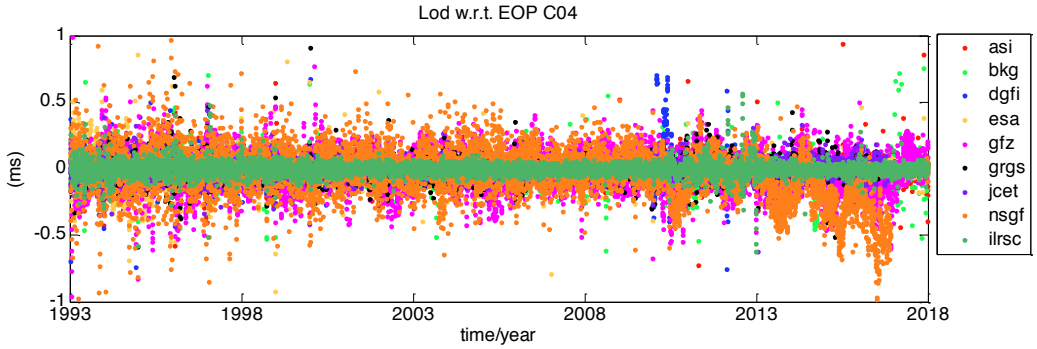

Figure 5 Time series of weekly 3-D residuals for LOD with respect to EOP C04 from individual AC solutions as well as from the combined ILRSC solution after transformation

Table 2 Mean values and standard deviations of weekly 3-D residuals for EOP with respect to EOP C04 from individual AC solutions as well as from the combined ILRSC solution after transformation

	Xp (mm)	Yp (mm)	Lod (mm)
ASI	-0.0343 (±0.2434)	-0.0107(±0.2289)	-0.0055(±0.0629)
BKG	-0.0407(±0.2541)	0.0122(±0.2398)	-0.0017(±0.0713)
DGFI	0.0263(±0.2543)	-0.0466(±0.2466)	0.0012(±0.0737)
ESA	-0.0141(±0.2399)	0.0249(±0.2168)	-0.0085(±0.0853)
GFZ	-0.0151(±0.2878)	0.0078(±0.2792)	-0.0119(±0.1397)
GRGS	-0.0399(±0.2355)	0.0066(±0.2266)	-0.0004(±0.0623)
JCET	-0.0462(±0.2379)	-0.0175(±0.2242)	-0.0020(±0.0552)
NSGF	-0.0155(±0.3030)	0.0014(±0.2910)	-0.0352(±0.1892)
ILRSC	-0.0357(±0.1875)	0.0020(±0.1759)	-0.0012(±0.0485)

Helmert parameter

We transform our combined solution to SLRF2008 by using 7 helmert parameters. Then we compare our translation and scale parameter with ILRSA and ILRSB. Figure 6 represent respectively the X, Y, Z components of the distance between combined weekly origin with respect to SLRF2008. As we can see, the 3 translation parameters derived from our combined solution is consistent with ILRSA and ILRSB. Figure 7 shows that, over the period 1993-2005, our scale parameter is same

with ILRSA, and over the period 2006-2017, our scale parameter is same with ILRSB. Table 3 gives the mean values and standard deviations of the four parameters.

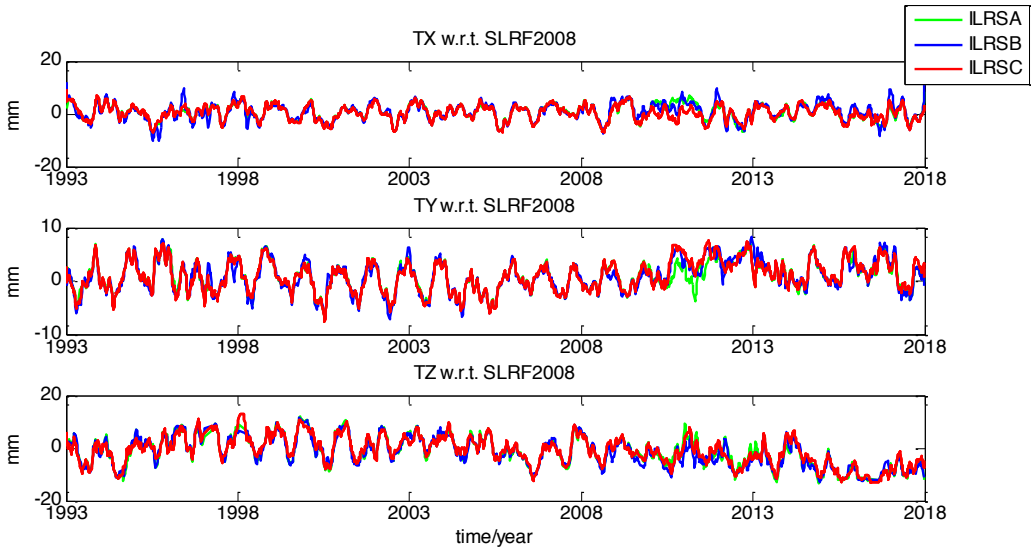

Figure 6 Time series of the translation parameters of our combined solution with respect to SLRF2008 as well as ILRSA and ILRSB

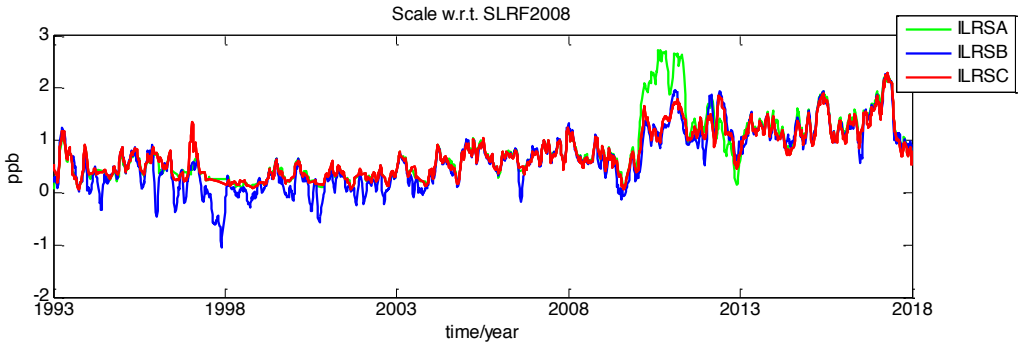

Figure 7 Time series of the scale parameter of our combined solution with respect to SLRF2008 as well as ILRSA and ILRSB

Table 3 Mean values and standard deviations of the translation and scale parameters of our combined solution with respect to SLRF2008 as well as ILRSA and ILRSB

	Tx (mm)	Ty (mm)	Tz (mm)	Scale (ppb)
ILRSA	0.63(±3.80)	0.82(±3.46)	-1.08(±6.57)	0.85(±0.62)
ILRSB	0.75(±4.38)	0.78(±3.85)	-1.51(±8.63)	0.64(±0.63)
ILRSC	0.43(±3.76)	0.94(±3.55)	-0.99(±6.40)	0.79(±0.62)

We make an analysis of our translation parameters and scale parameter. Figure 8 shows the trends of the four parameters. Figure 9 shows the spectrum analysis of our translation parameters and scale parameter.

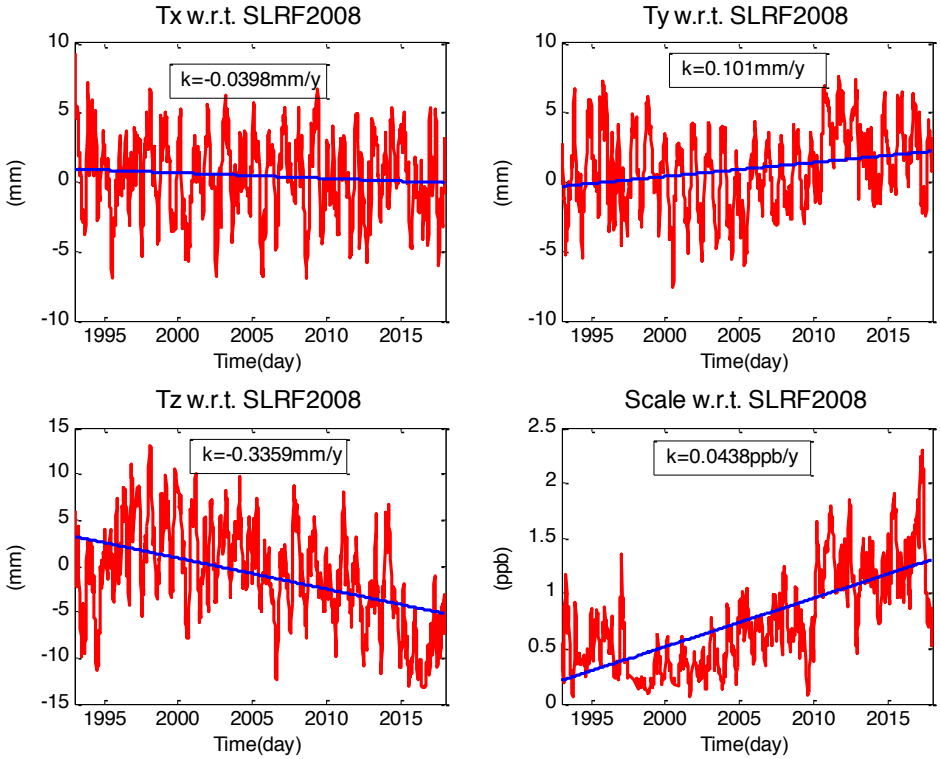

Figure 8 The trends of translation and scale parameters with respect to SLRF2008

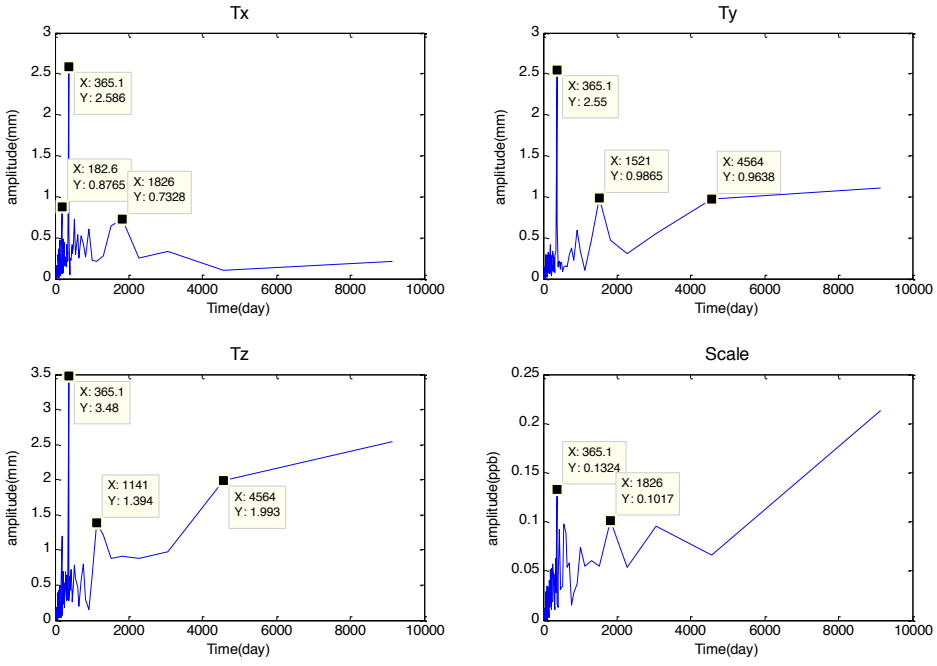

Figure 6 The spectrum analysis of translation and scale parameters with respect to SLRF2008

The plots in figure 10 and figure 11 represent respectively the translation and scale parameters of our combined solution with respect to SLRF2008 and SLRF2014. Figure 12 shows the trends of the four parameters with respect to SLRF 2014. It looks more stable than SLRF2008.

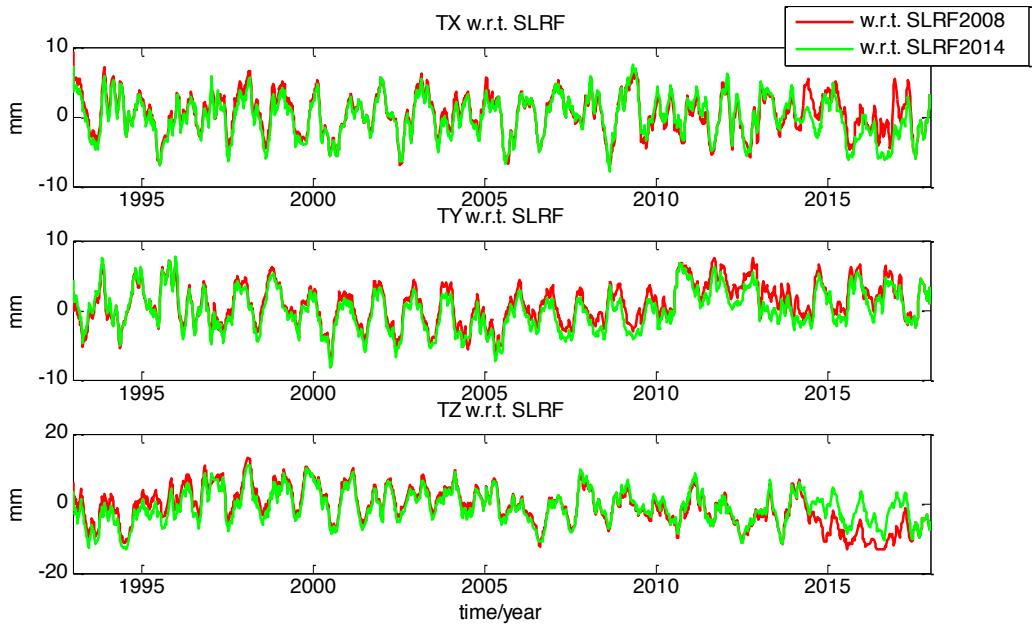

Figure 9 Time series of the translation parameters of our combined solution with respect to SLRF2008 and SLRF2014

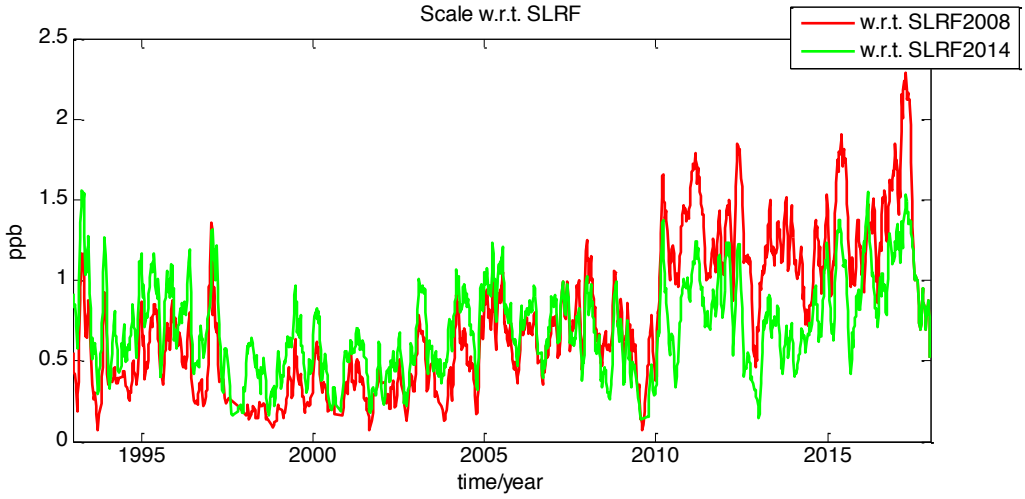

Figure 10 Time series of the scale parameter of our combined solution with respect to SLRF2008 and SLRF2014

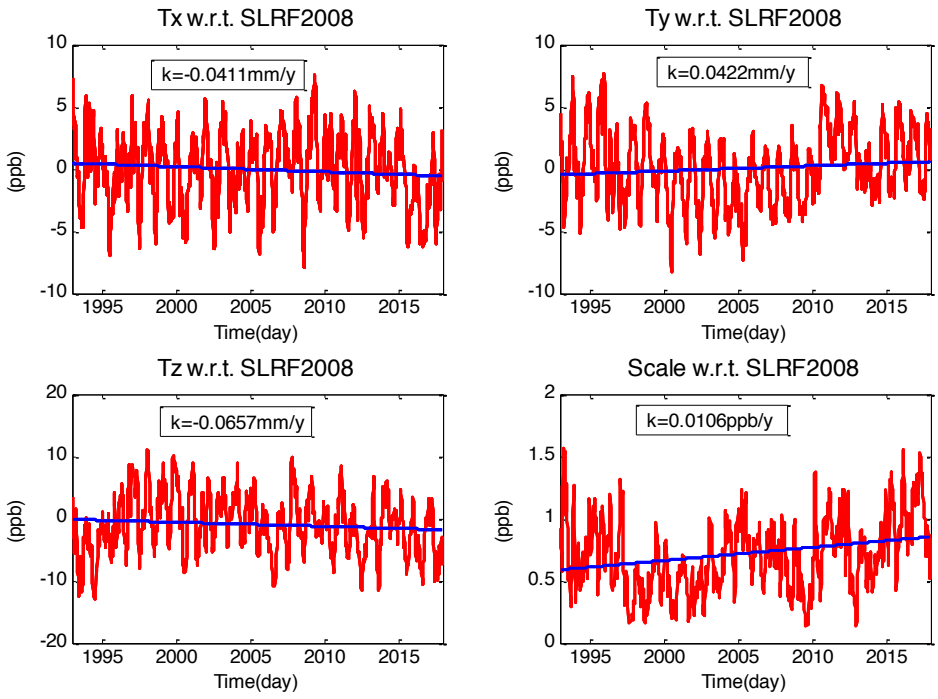

Figure 11 The trends of the translation and scale parameters of our combined solution with respect to SLRF2014