Impact of number of steps used to generate the time series on the results

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1. Introduction

In this note, I study how the number of steps used to generate the global time series affects the assessment of the ICRF3 axis stability. I ran separately a 4-, 8-, 10-, and 20-step solution. Then on the one hand, I estimated the apparent proper motion for extragalactic sources and fitted the global spin of the CRF axis (Sect. 2). On the other hand, I computed the annual mean positions of sources to construct the yearly CRF and estimated their relative rotation and glide wrt. the ICRF3 S/X-band frame (Sect. 3). Some things that may lead to confusions are pointed out here. In some plots, I used ω_x, ω_y, and ω_z, while in others I used ω_1, ω_2, and ω_3. In fact, they refer to the same things. It is the same for the g parameter. Another thing is that I used words "rotation" and "glide" in the title of some figures, but they are not always referred to the same things. Sometimes, the rotation and glide parameters were estimated from the proper motion data, whilst they can also be estimated from the positional offset. I did not spell it out clearly when I made these plots, but you may find the exact information from the captions. They can also be told from the unit.

2. Proper motion and derived spin

First, I considered only the subset of the ICRF3 defining sources, as shown in Fig. 1. For different number of steps, the spin and glide are fully consistent with the error bar. The rotation and glide axis is about 80 deg and 40 deg away from the GC. I think that we cannot make any firm conclusion on relationship between the estimated spin and glide vectors and the GA effect.

Second, I considered all the sources with a determinable apparent proper motion and used the bootstrap sampling technique to estimate the mean spin and glide. For a given sample size N, I randomly picked N sources from the sample to form a subset and estimated the glide and spin based on this subset. This procedure was repeated 1000 times. The mean value and standard deviation of the spin and glide parameters were used as the estimations of mean spin and glide and their uncertainties. The sample size varied from 100 to 1000 with a step of 100. The results are presented in Fig. 3. The noticeable difference occurs to ω_z (or ω_3, they are the same thing.) and g_z (or g_3), which become insignificant when the number of step increases.

I took the weighted mean values of glide and rotation parameters in Fig. 3 as the mean spin and glide. The results are shown in Fig. 2. We can found that the spin around the Z-axis (ω_3 or ω_z) decreases if using more than four steps. Similarly, the glide parameters (g_1 and g_3, or g_x and g_z) also decreases. The glide axis is far from the GC direction, however, the rotation axis direction is very close to that of GC.

3. Orientation of yearly CRF

Figures 4 and 5 present the relative rotation and glide parameters of yearly CRFs with respective to the ICRF3 S/X-band catalog. Only the ICRF3 defining sources were used. I found that the influence of different choices of the number of steps on estimations of these parameters is rather tiny.

Acknowledgements.

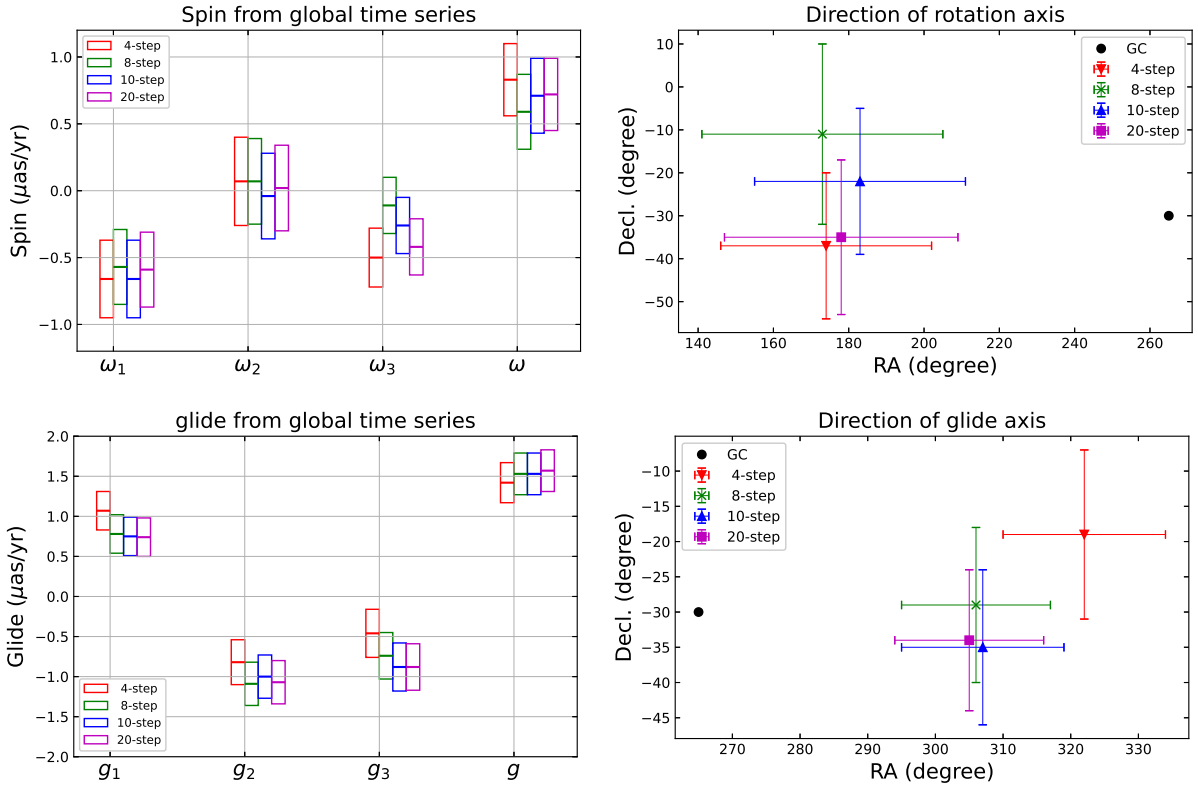

Fig. 1. Rotation and glide parameters from the apparent proper motions of the subset of ICRF3 defining sources.

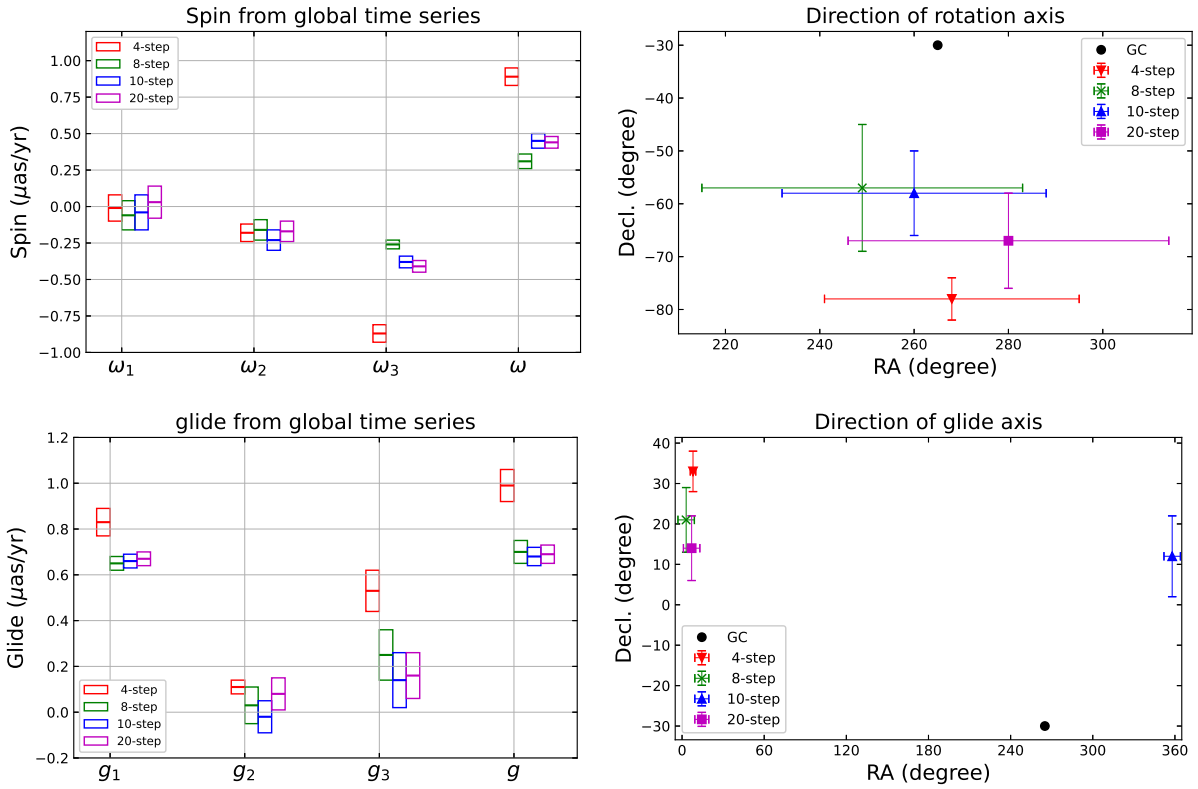

Fig. 2. Rotation and glide parameters from the apparent proper motions of the subset of sources with a determinable apparent proper motion, i.e., number of time series data points ≥ 5.

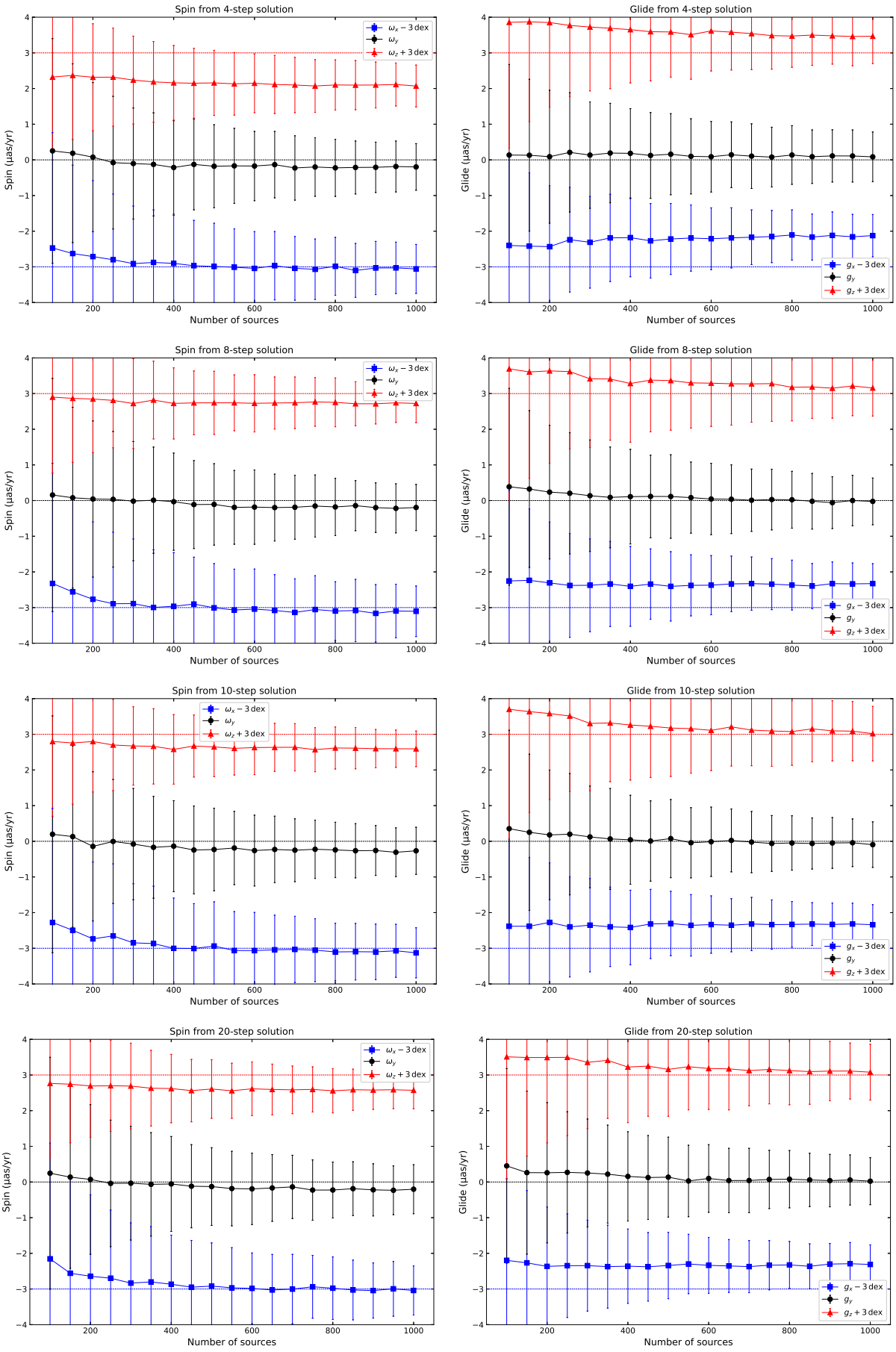

Fig. 3. Rotation and glide parameters as a function of the sample size. These parameters are estimated from the apparent proper motions of sources with a determinable apparent proper motion, i.e., number of time series data points ≥ 5.

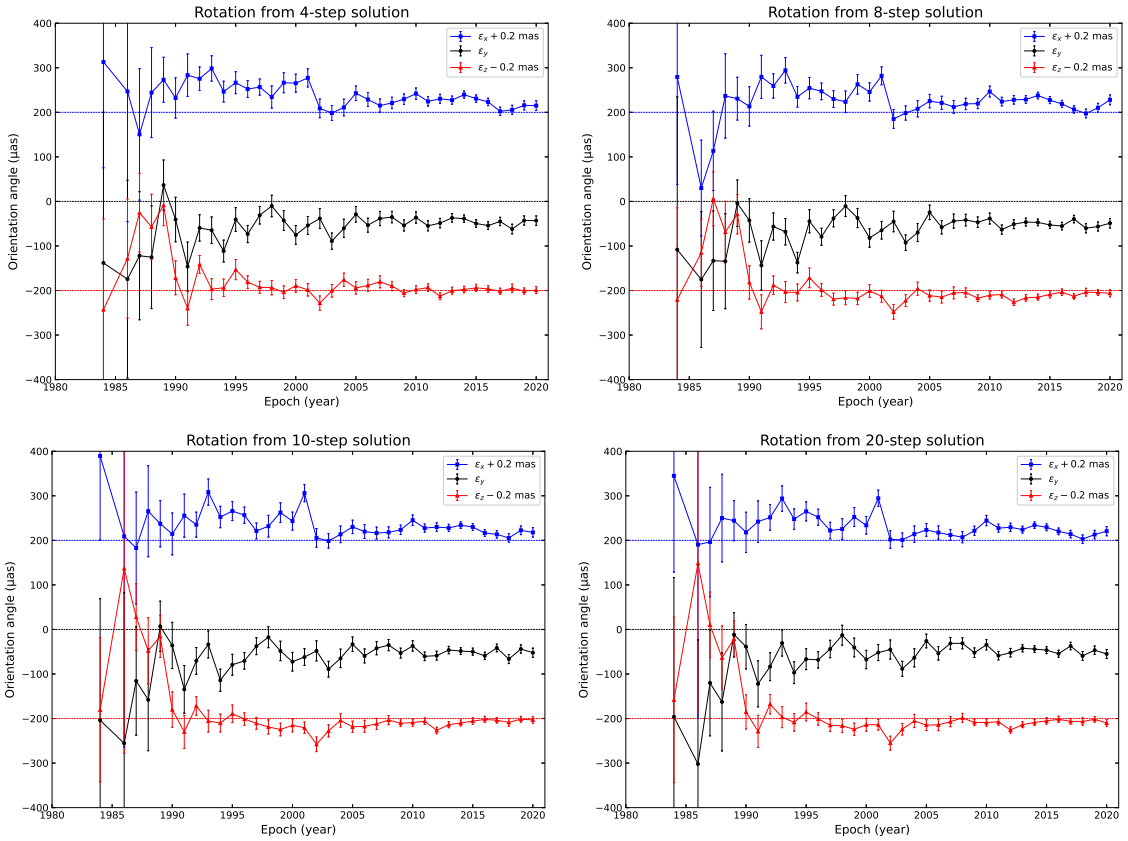

Fig. 4. Rotation parameters of the yearly CRFs wrt. the ICRF3 S/X-band frame based on the ICRF3 defining sources.

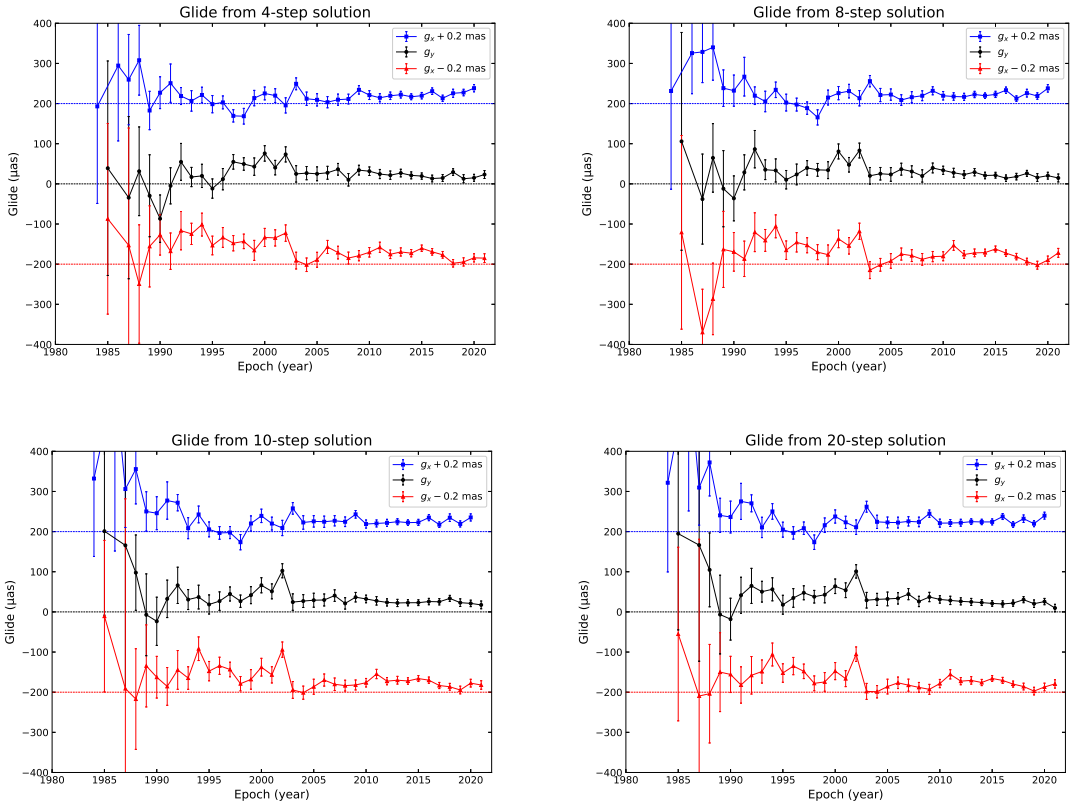

Fig. 5. Rotation parameters of the yearly CRFs wrt. the ICRF3 S/X-band frame based on the ICRF3 defining sources.