From ICRF2 to ICRF3: influence on EOP determined from VLBI observations

Niu LIU[1] , Ibnu NURUL HUDA[2], Sébastien LAMBERT[2], and Zi ZHU[1]
[1]School of Astronomy and Space sciences, Nanjing University
[2]Observatoire de Paris/SYRTE, Université PSL, CNRS, Sorbonne Université, LNE

Introduction

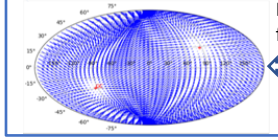
The variation of Earth orientation characterized by Earth orientation parameters (EOPs) is of interest in astronomy and geophysics. EOPs connect the celestial reference frame (CRF) and terrestrial reference frame (TRF) and should be in accordance with realizations of CRF and TRF.

The ICRF3, a new version of CRF, was adopted by the XXX IAU General Assembly. Theoretically, EOP series determined within the frame of the new CRF would differ from the old one from ICRF2.

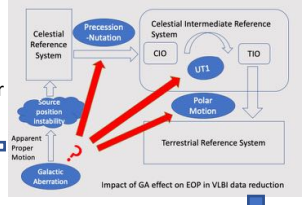
We address the impact on the EOP estimates due to the switch from the ICRF2 to the ICRF3 in the VLBI data reduction.

From ICRF2 to ICRF3

- Nearly 10 year more data
- Galactic aberration modeling



Dipolar field



VLBI solutions

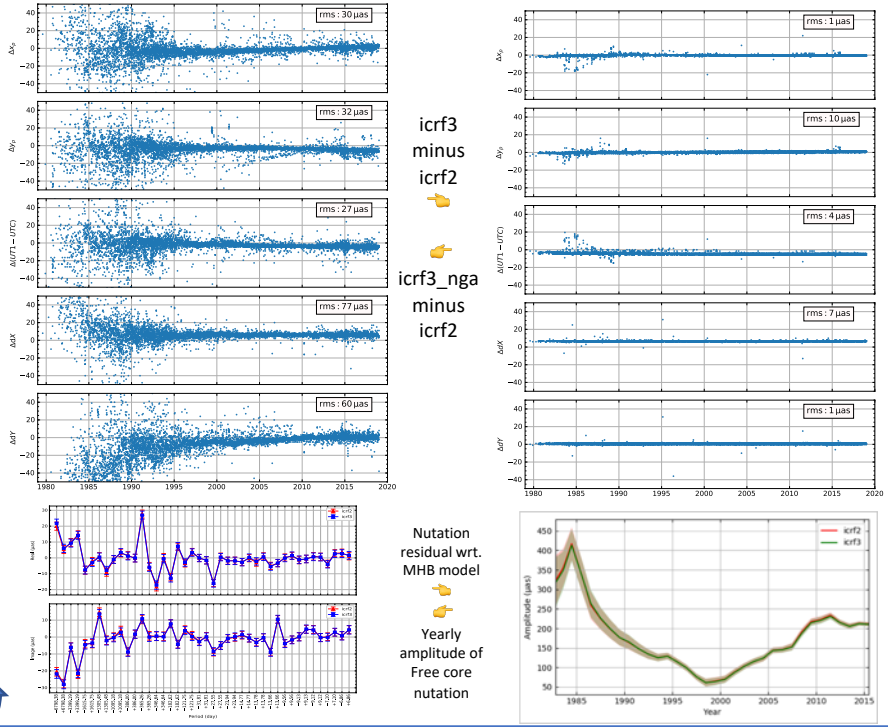
Table 1: Configuration of VLBI solutions.

Solution	GA modeling	A priori radio source position
$icrf2$	No	ICRF2
$icrf3$	Yes	ICRF3
$icrf3\_nga$	No	ICRF3

Global/Independent;
Data span 1979.5-2019.0;
6585 sessions;
~13.5 million delays

EOP differences for global solutions (i)

Differences between EOP time series for three solutions. Unit: μas.

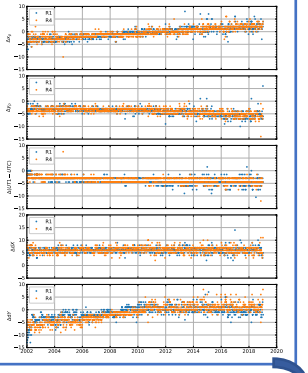


EOP differences for global solutions (ii)

Table 2: Linear drift from EOP offsets of "icrf3-icrf2" (unit: μas/yr).

	Δx_p	Δy_p	$\Delta(UT1-UTC)$	ΔdX	ΔdY
All	+0.2 ± 0.2	−0.1 ± 0.2	−0.2 ± 0.1	−0.0 ± 0.1	+0.4 ± 0.1
R1	+0.3 ± 0.2	−0.2 ± 0.2	−0.2 ± 0.1	−0.1 ± 0.1	+0.2 ± 0.1
R4	+0.3 ± 0.2	−0.1 ± 0.2	−0.1 ± 0.1	+0.0 ± 0.1	+0.4 ± 0.1

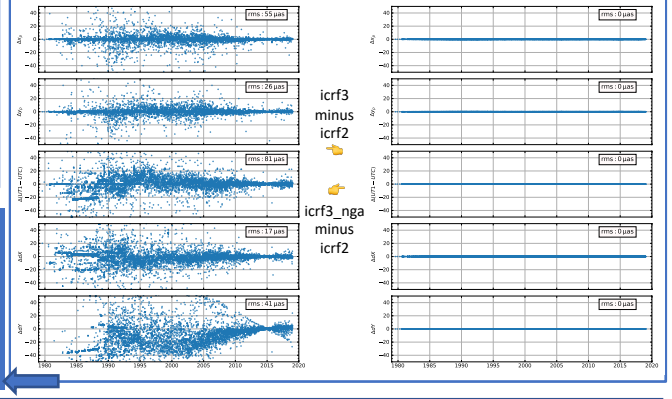
Differences between EOP time series for IVS-R1/R4 sessions of icrf3 minus icrf2. Unit: μas.



- Small scatter <= 10 μas after 1995;
- EOP estimate differences coming mainly from the inclusion of the GA modeling;
- RMS ~ 30 μas in polar motion and UT1 but insignificant wrt. formal errors ~ 100 μas, nearly half of that for nutation offsets;
- Offset ~5 μas in dX difference for nutation;
- Noisier among 2002-2010 but stable within 5 μas after 2010 in dY difference for nutation;
- Nutation residuals in MHB term shows consistent amplitudes between two solution;
- So does the yearly amplitude of the free core nutation modeled by Lambert (2007);
- EOP differences from IVS R1 and R4 sessions agrees well with each other;
- Linear drift could found in dY, ~+0.4 μas/yr;

EOP differences for independent solutions

Differences between EOP time series for three solutions. Unit: μas.



Conclusion

- Generally, for global solution the change from ICRF2 to ICRF3 has tiny influences on polar motion and UT1. On the nutation, there is no significant difference on the MHB nutation terms and FCN. But a linear rate of +0.4 μas/yr will be introduced in dY which should be noticed. Such effects are not sensitive to the network geometry.
- For independent solution, attention should be paid to dY component of nutation in the EOP forecast since the difference increases when it moves far away for the GA reference epoch J2015.0

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