

# Impact of the Parameterization of the source positions on the Free Core Nutation

#### ~First results~

#### Maria Karbon









• Parameterization of source positions using the Multi-adaptive regression splines algorithm (MARS, in Karbon et al. 2017)



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- Mitigates source position variations and thus allows the inclusion of 'unstable' sources into the datum definition.
- Leads increase in datum sources per session  $\rightarrow$  more stable geometry
- Leads to an improvement of the CPO of about 10% (wRMS w.r.t. IERS 08C04).



## Data & Datum

- ~4000 'global' sessions 1980-2018
- Datum definitions:
  - ICRF3 def. wo parameterisation
  - ICRF3 def. (param.)
  - ICRF3 def. + SH (param.)
  - Most observed northern & southern sources (152+152, param.)



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  - ICRF3+SH wRMS w.r.t IERS 14 C04 reduced by more than 30% (10%).



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- Are CPO still improved with ICRF3?
  - ICFR3 defining sources are much better distributed.
  - Number of sources can still be increased considerably implementing a Parameterization.
  - ICRF3+SH wRMS w.r.t IERS 14 C04 reduced by more than 30% (10%).
- What is the impact on the FCN?
  - FCN-models









## Methods

- Estimation by 'global solution' (stacking)
  - CPO time-series: dX and dY
- Estimations based on time-series of CPO
  - Empirical model of FCN
  - Amplitude and phase

 $X_{\text{FCN}} = A_c \cos(\sigma_{\text{FCN}}t) - A_s \sin(\sigma_{\text{FCN}}t) + X_0$  $Y_{\text{FCN}} = A_s \cos(\sigma_{\text{FCN}}t) + A_c \sin(\sigma_{\text{FCN}}t) + Y_0,$ 

- Comparisons
  - with each other
  - Established models: Lambert et al. (2007), Malkin (2013), Belda et al. (2016): Common time-span: 01.01.1990 – 31.12.2015)

### **CPO** time series



• ICRF3 def. wo param.

• ICRF3 def. (param.)

 ICRF3 def. + SH (param.)

northern & southern sources (param.)

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#### Inter-comparison



- O Reference solution
- x ICRF3 def. wo param.
  - ICRF3 def. (param.)
- x ICRF3 def. + SH (param.)
  - northern & southern sources (param.)

# Inter-comparison

[µas]	dX			dY		
	mean	std	wRMS	mean	std	wRMS
Reference	-26.7	101.5	61.6	0.7	110.3	52.8
ICRF3 def wo p.	3.7	114.5	57.9	-2.4	116.6	56.5
ICRF3 def p.	7.7	127.3	62.2	0.0	127.2	63.5
ICRF3 def + SH (p)	8.1	117.0	56.9	-1.2	116.2	56.2
North & south (p)	8.1	117.0	56.9	-1.2	116.2	56.2

#### Comparisons

- With established models
  - Lambert et al. (2007)
  - Malkin (2013)
  - Belda et al. (2016)

• Common time-span: 01.01.1990 – 31.12.2015

## Amplitude & Phase



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## Comparison with other models



- x ICRF3 def. wo param.
- $\rangle$  ICRF3 def. (param.)
- x ICRF3 def. + SH (param.)
  - northern & southern sources (param.)
  - Lambert et al. (2007)

Belda et al. (2016)

Malkin (2013)

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## Comparison with other models

[µas]	dX			dY		
	mean	std	wRMS	mean	std	wRMS
ICRF3 def wo p.	50.7	158.9	148.9	-70.6	170.5	153.9
ICRF3 def p.	42.4	169.3	152.2	-68.2	177.3	160.4
ICRF3 def + SH (p)	45.1	163.8	148.8	-75.8	176.2	157.7
North & south (p)	45.1	163.8	148.8	-75.8	176.2	157.7
Lambert (2007)	43.9	176.3	158.4	-77.2	175.9	155.0
Malkin (2013)	45.2	176.8	159.3	-76.5	176.6	155.9
Belda (2016)	26.2	168.6	155.1	-70.0	180.6	179.3

## Conclusion

- Parameterization of source coordinates reduces wRMS of CPO 10-30%.
- FCN empirical models agree with established ones.
- Comparisons difficult, as no independent solution available.
- Further investigations needed.



#### Thank you for your attention!







