On the correlation of Celestial Pole Offsets and geomagnetic field variations (recent achievements)

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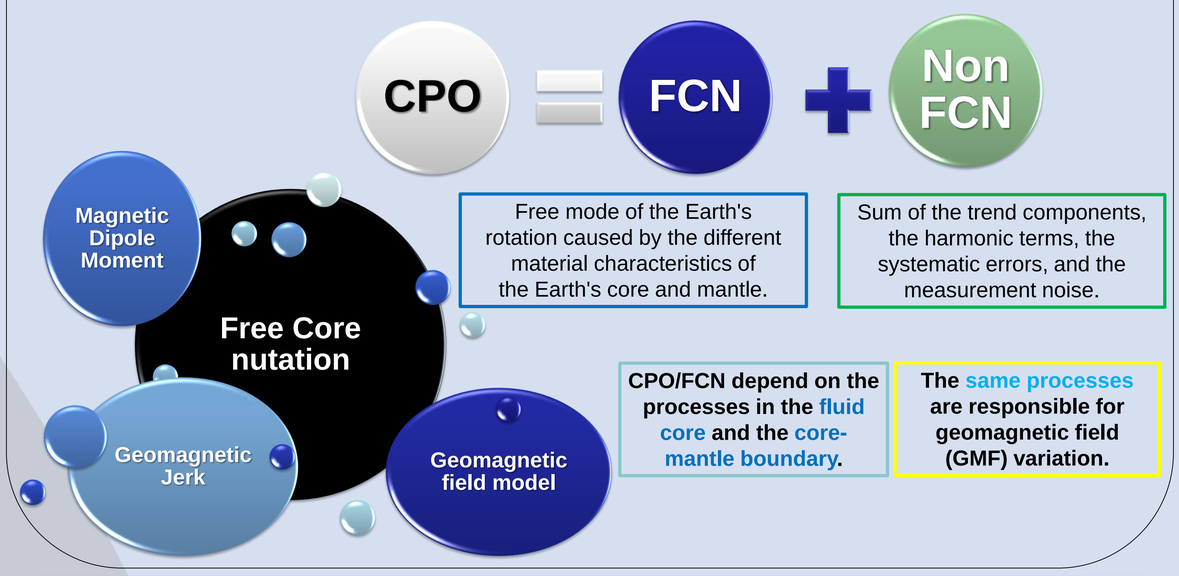
Introduction

The understanding of celestial pole motion (CPM) excitation could bring us significantly closer to meeting the accuracy goals pursued by the Global geodetic observing system (GGOS) of the international association of Geodesy (IAG), i.e., 1 mm accuracy and 0.1 mm/year stability on global scales in terms of the ITRF defining parameters. CPM depends on the processes in the fluid core and the core-mantle boundary. Also, the same processes are responsible for the geomagnetic field (GMF) variations. During the last decade, several investigations have been done to discuss a possible interconnection of GMF changes with the polar motion. However, less attention has been paid to the impact of the GMF changes on the CPO variations.

In this study, we use the celestial pole offset (CPO) time-series obtained from very long baseline interferometry (VLBI) observations and the latest GMF data such as geomagnetic jerk, magnetic dipole moment, and geomagnetic field model to explore the correlation between CPO and the GMF. Our preliminary results revealed some interesting common features in the CPO and GMF variations which show the potential to improve the understanding of the GMF's contribution to the Earth rotation.

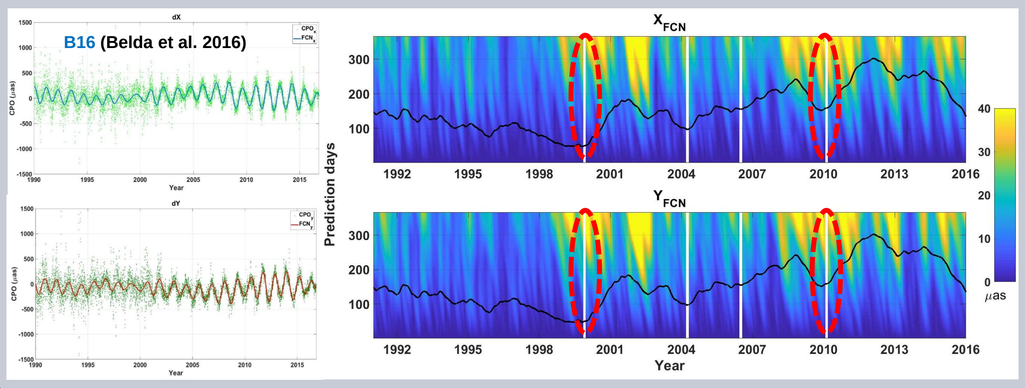
Research Objective

CPO: The differences between the actual coordinates *X* and *Y* of the celestial pole in the celestial reference frame and those predicted by the IAU models.



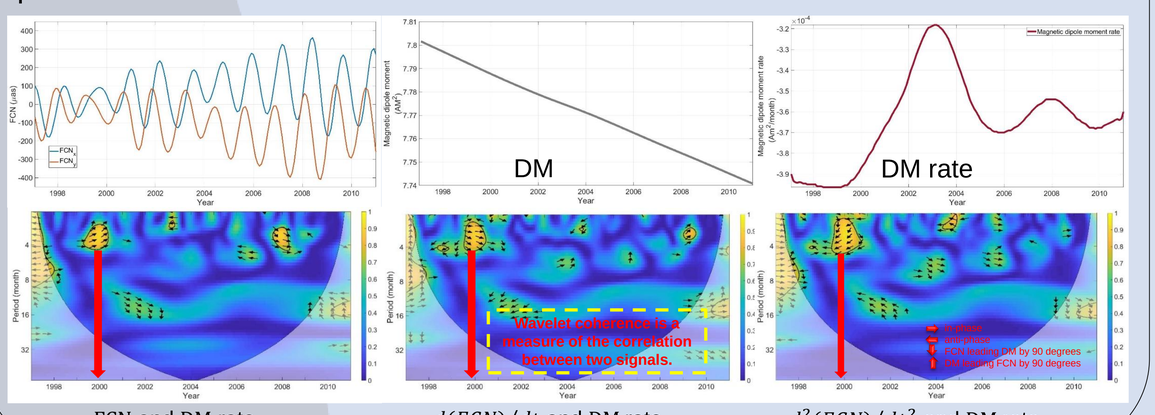
Free Core Nutation and Geomagnetic Jerk

Geomagnetic Jerk (GMJ): Observed as rapid changes in geomagnetic field secular variations. Most likely associated with the motions in fluid core and coupling between the core and the mantle.



Free Core Nutation and Magnetic Dipole Moment

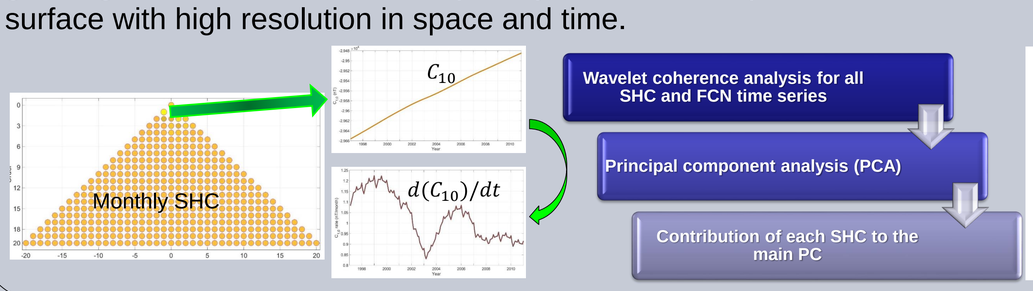
The **dipole** defines an axis that intersects the Earth's surface at two antipodal points.

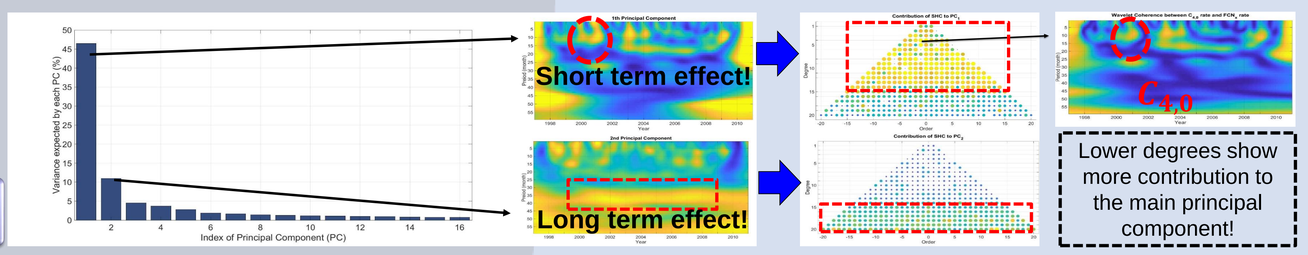


FCN and DM rate | $d(FCN)/dt$ and DM rate | $d^2(FCN)/dt^2$ and DM rate

Free Core Nutation and Geomagnetic Field (GMF) Model

CHAOS-6 core field provides information on time variations of the core generated part of the Earth's magnetic field. It is the latest generation of the CHAOS series of global geomagnetic field models developed by Onsen et al. (2006, 2009, 2010, 2016). The **CHAOS-6** model series aims to estimate the internal geomagnetic field at the Earth's surface with high resolution in space and time.





Conclusion and Outlook

- The understanding of FCN excitation could bring us significantly closer to meeting the accuracy goals pursued by the Global Geodetic Observing System (GGOS) of the International Association of Geodesy (IAG), i.e., 1 mm accuracy and 0.1 mm/year stability on global scales in terms of the ITRF defining parameters.
- Study of GMJ, DM, and GMF model can potentially improve our understanding of FCN excitation mechanisms.
- Short term effects are visible in the main principal component.
- Long term effects are visible in PC2.
- Higher spatial resolution is needed to investigate the long term effects.
- Phase analysis should be investigated, which could improve the FCN prediction.

Acknowledgment

Jose M. Ferrándiz and **Santiago Belda** were partially supported by Spanish Project AYA2016-79775-P (AEI/FEDER, UE).

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