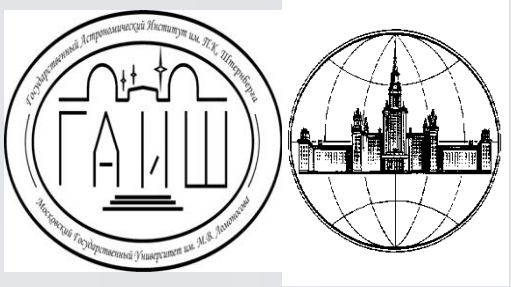

SE05_A009

Anomalies of the Earth's rotation in 2010-2020-s

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[3]SYRTE, Paris Observatory, [4]Hydrometcenter of Russia,
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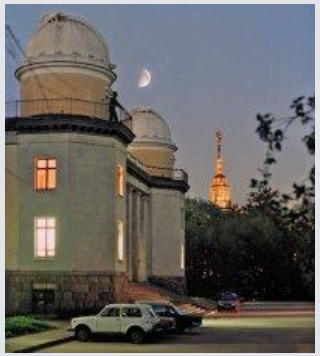
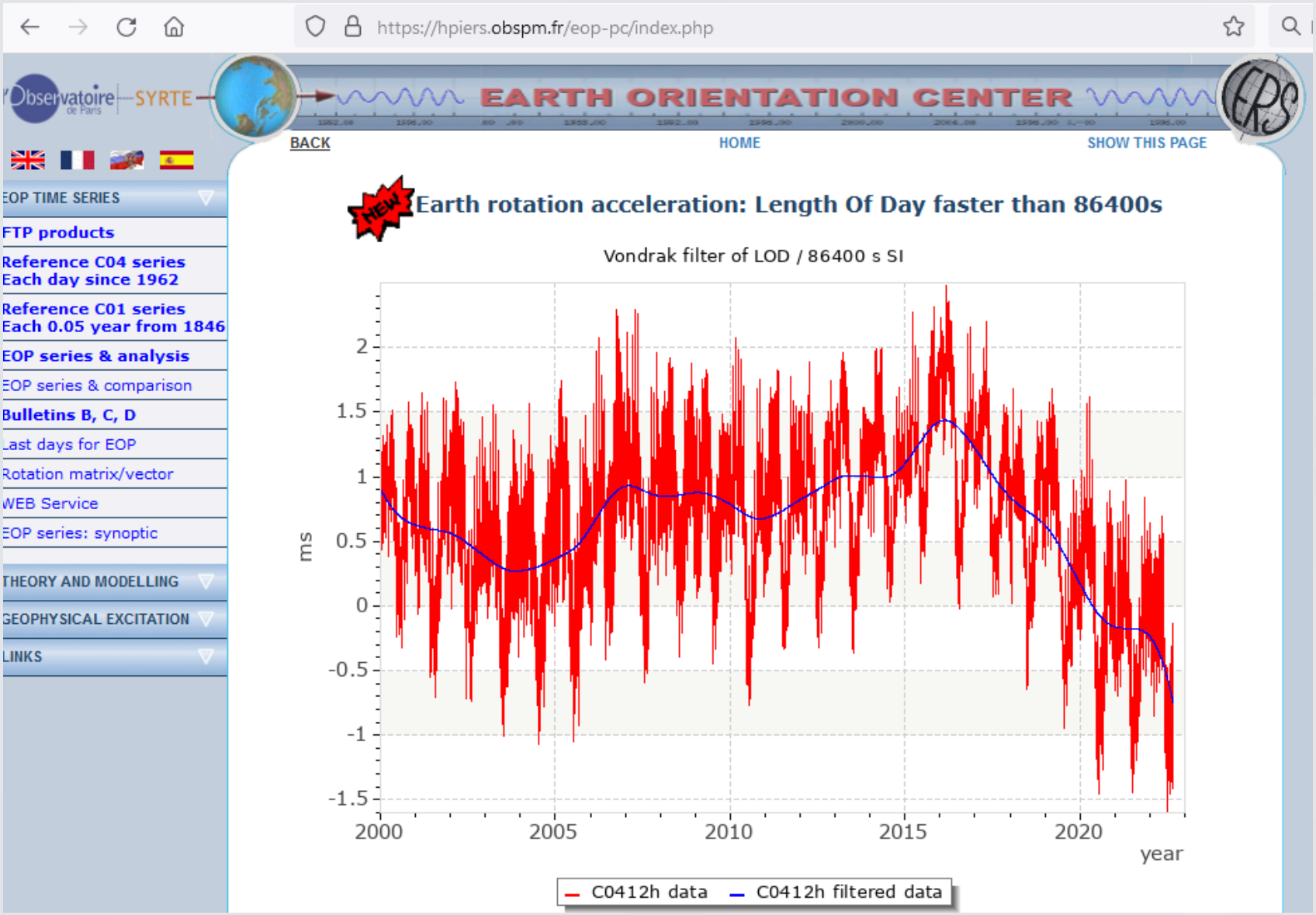


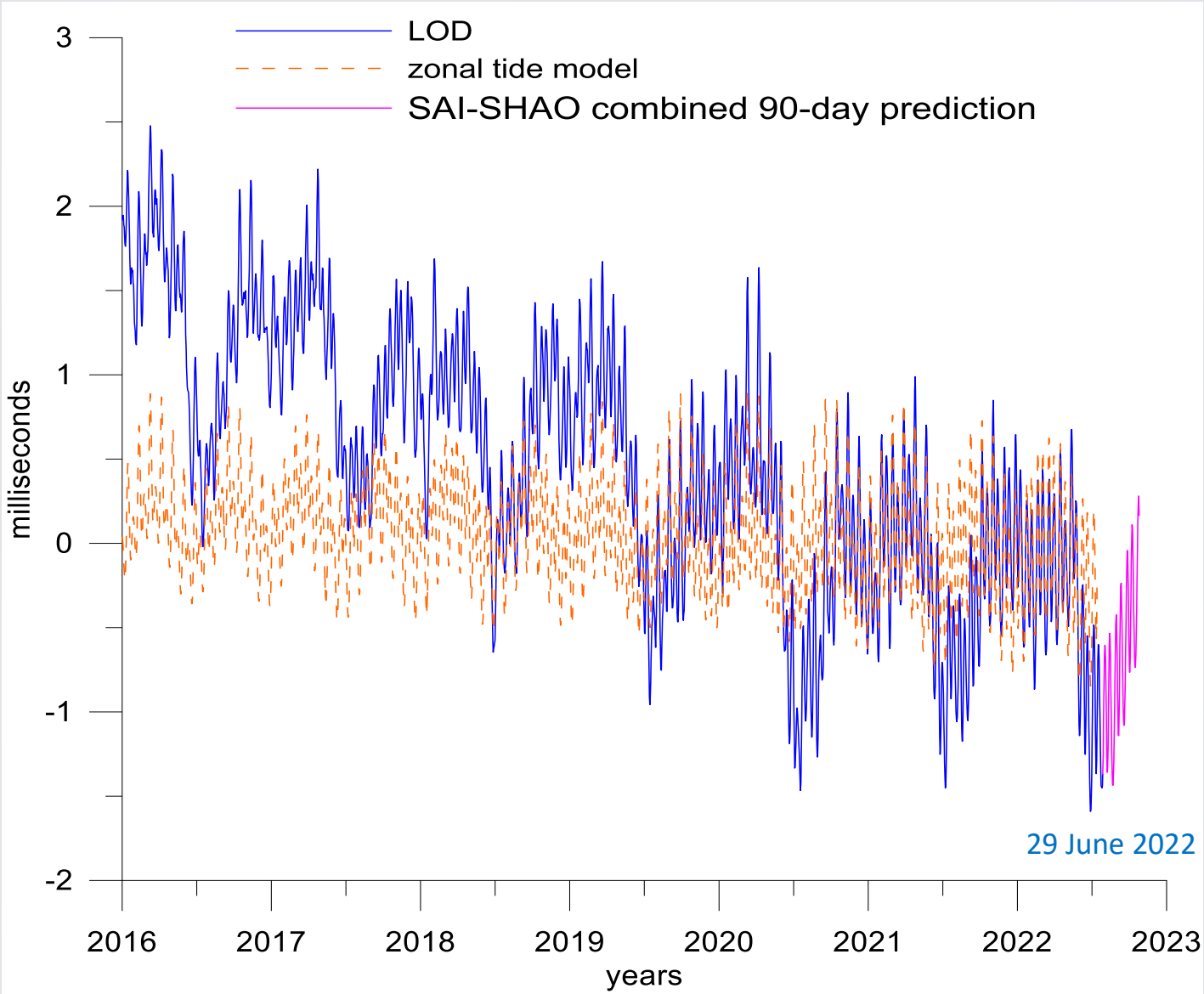
Geokosmos 2022
Snt. Petersburg University

Earth Orientation Parameters Product Center



http://hpiers.obspm.fr/eop-pc

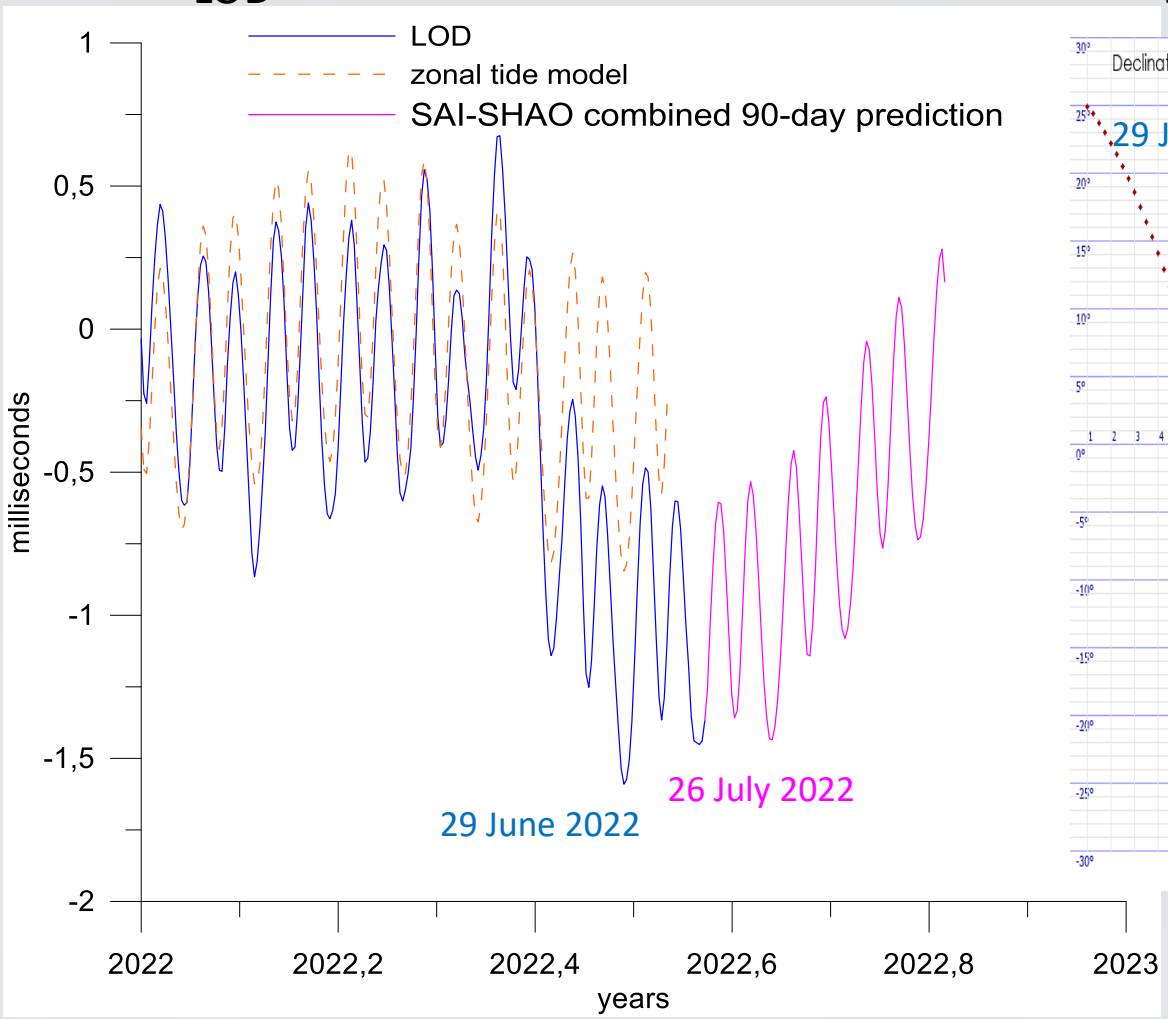
Operational LOD since 2016 and prediction



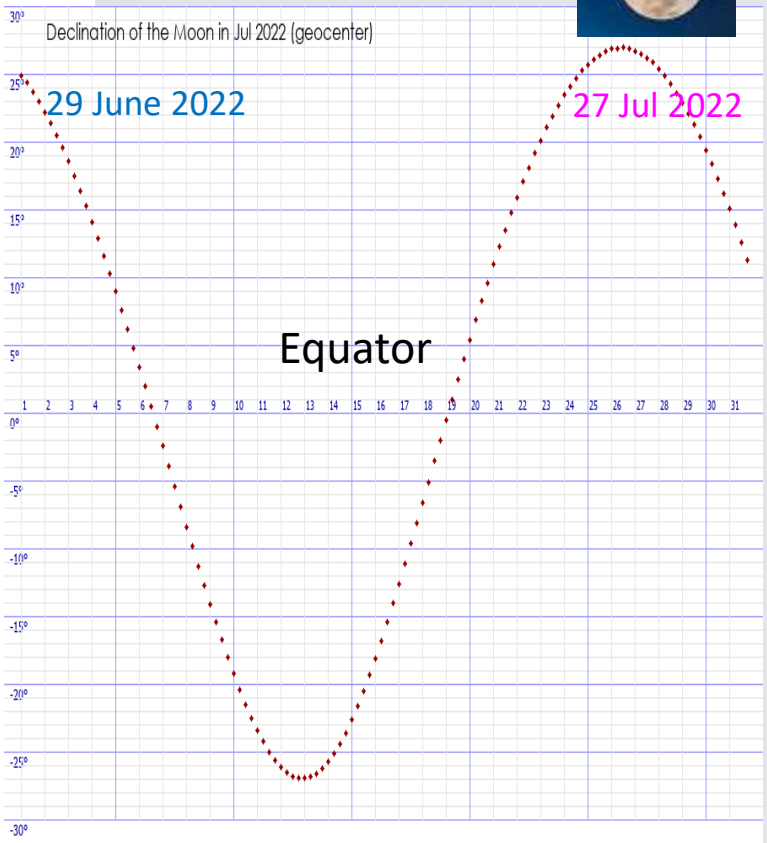
Zotov L.V. et al., Geokosmos, 2022

Zonal tide is related to the moon motion

LOD



Declination of the Moon



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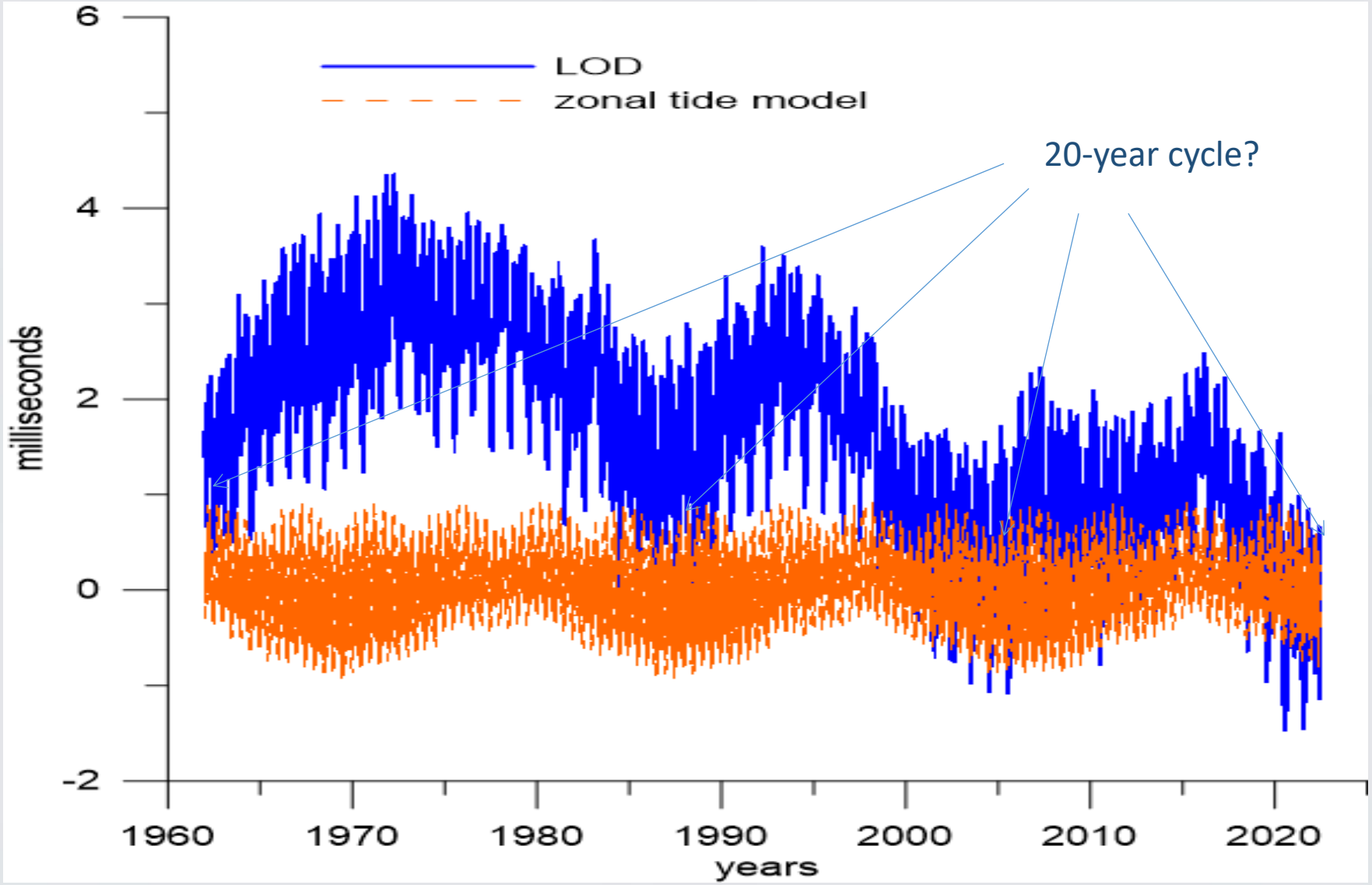
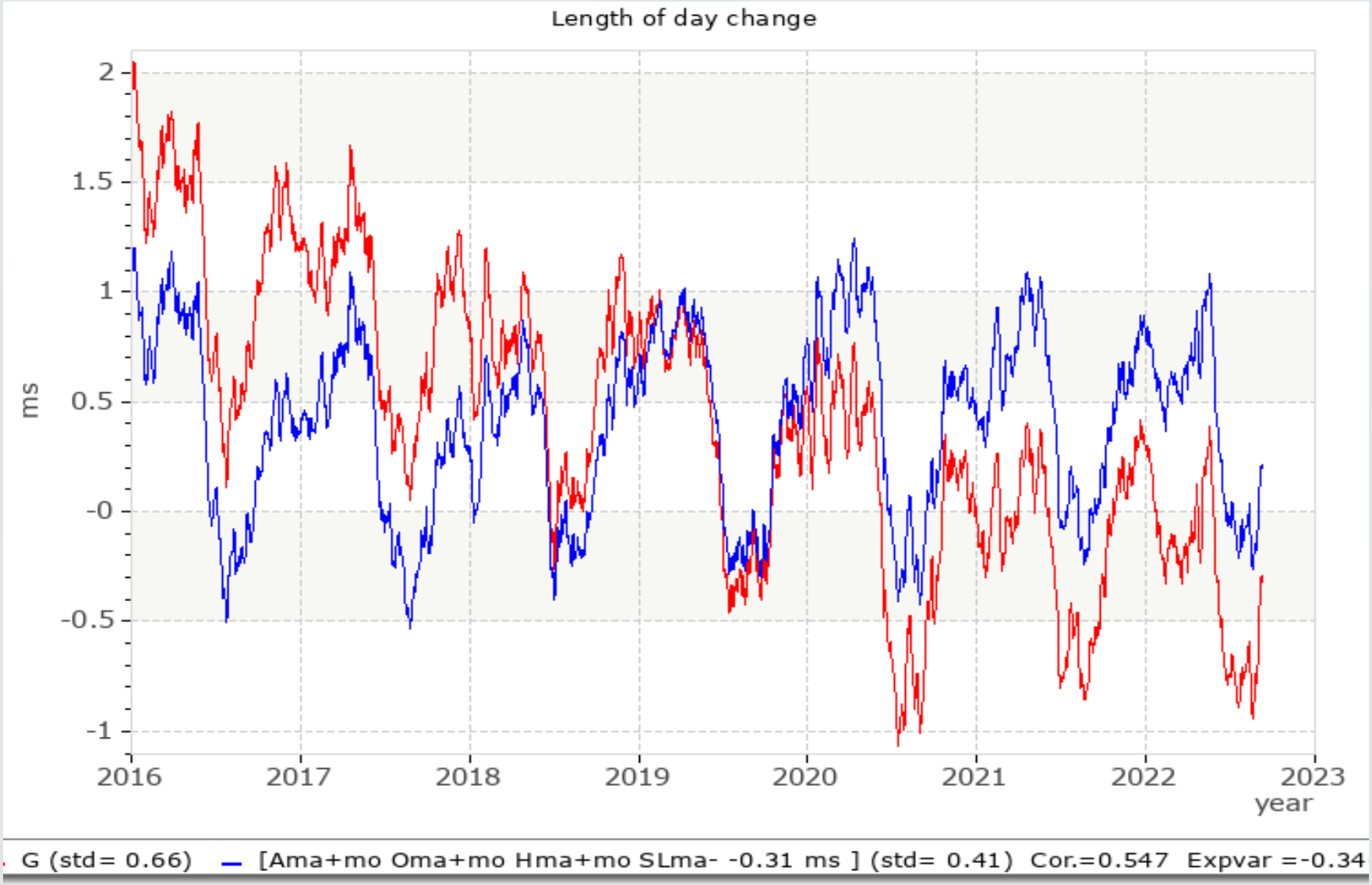
Length of day (LOD) from EOP C04 and zonal tides



LOD trend can not be explained by AAM+OAM+HAM+SL



ECMWF MPIOM LSDM LSDM

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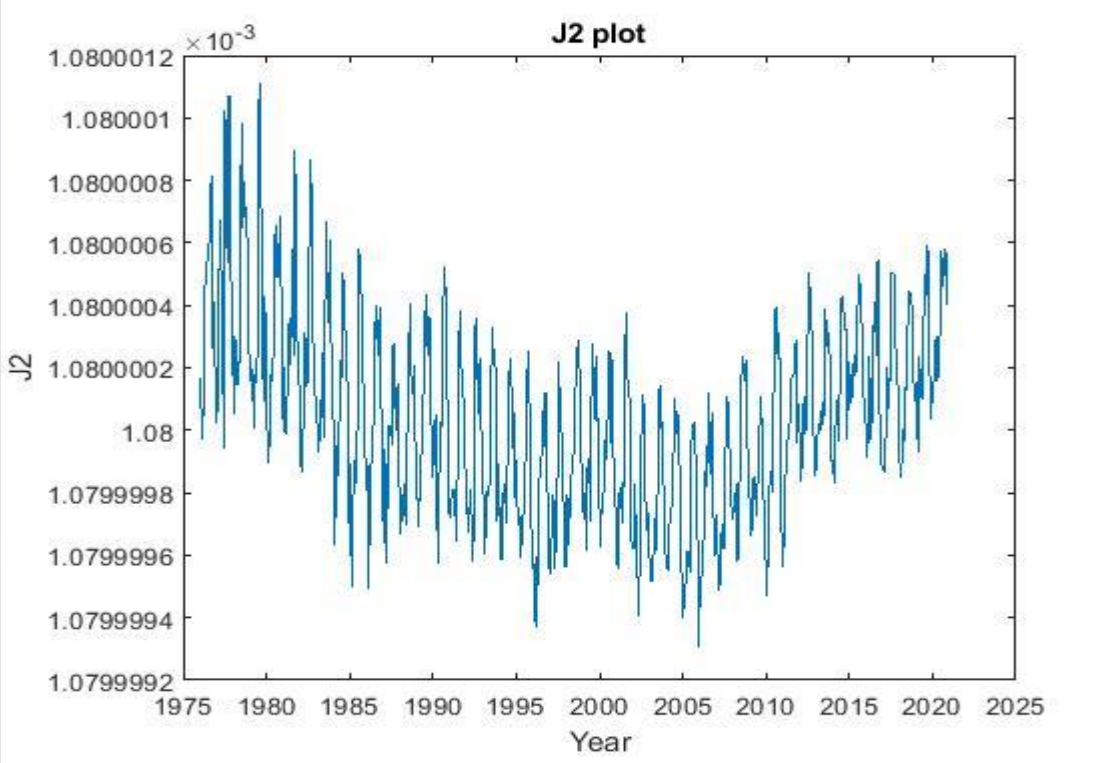
Questions

- Could long-term trend in LOD be related with 18-year lunar tide?
- Could it be caused by angular momentum exchange at the core-mantle boundary?
- Since we do not see something similar in gravity (J2) the mass term is not responsible…
- Was strong El Nino in 2016 a trigger of acceleration, does the epoch of La Ninas follow?
- What if the energy instead of Chandler wobble supplies the acceleration of rotation?



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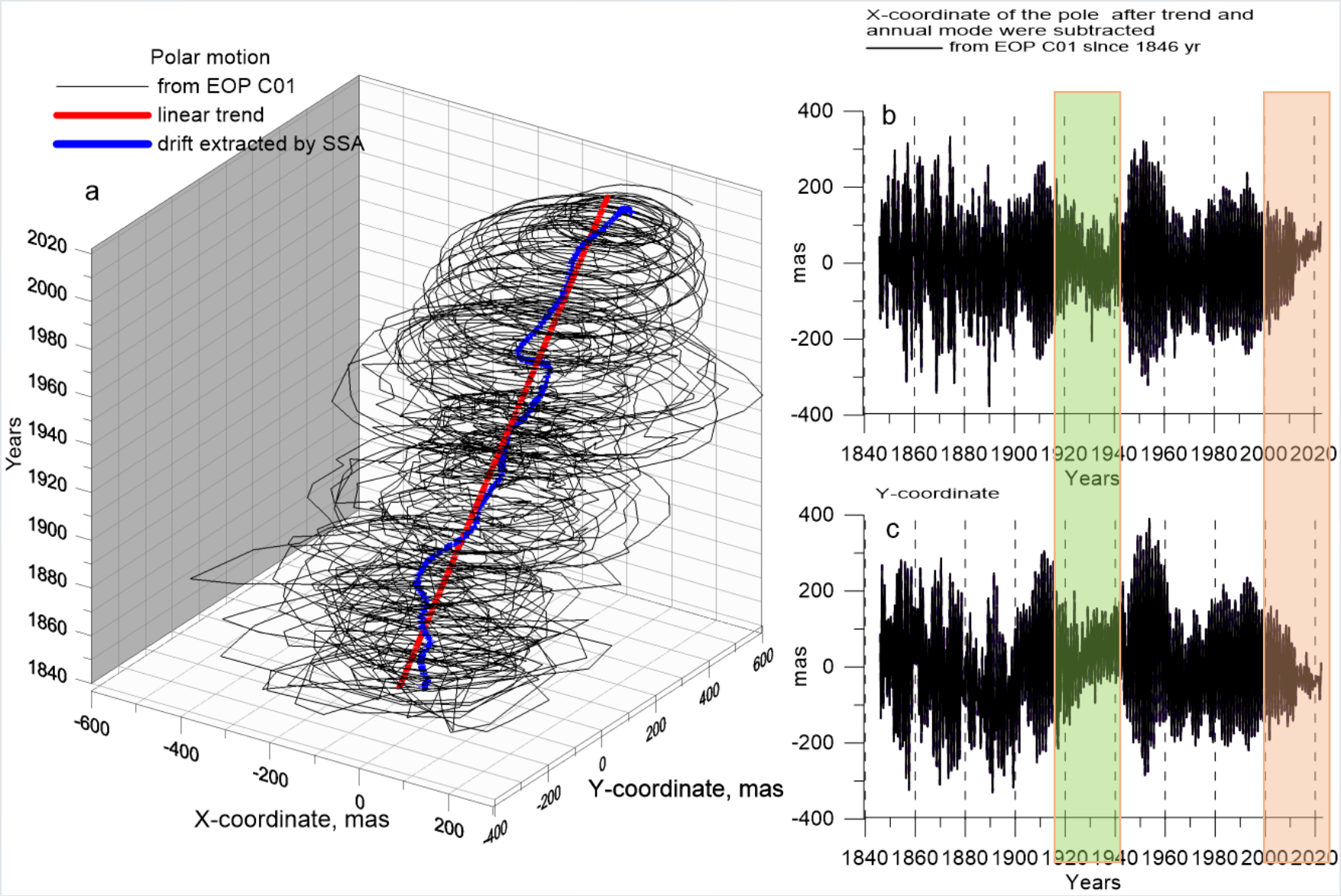
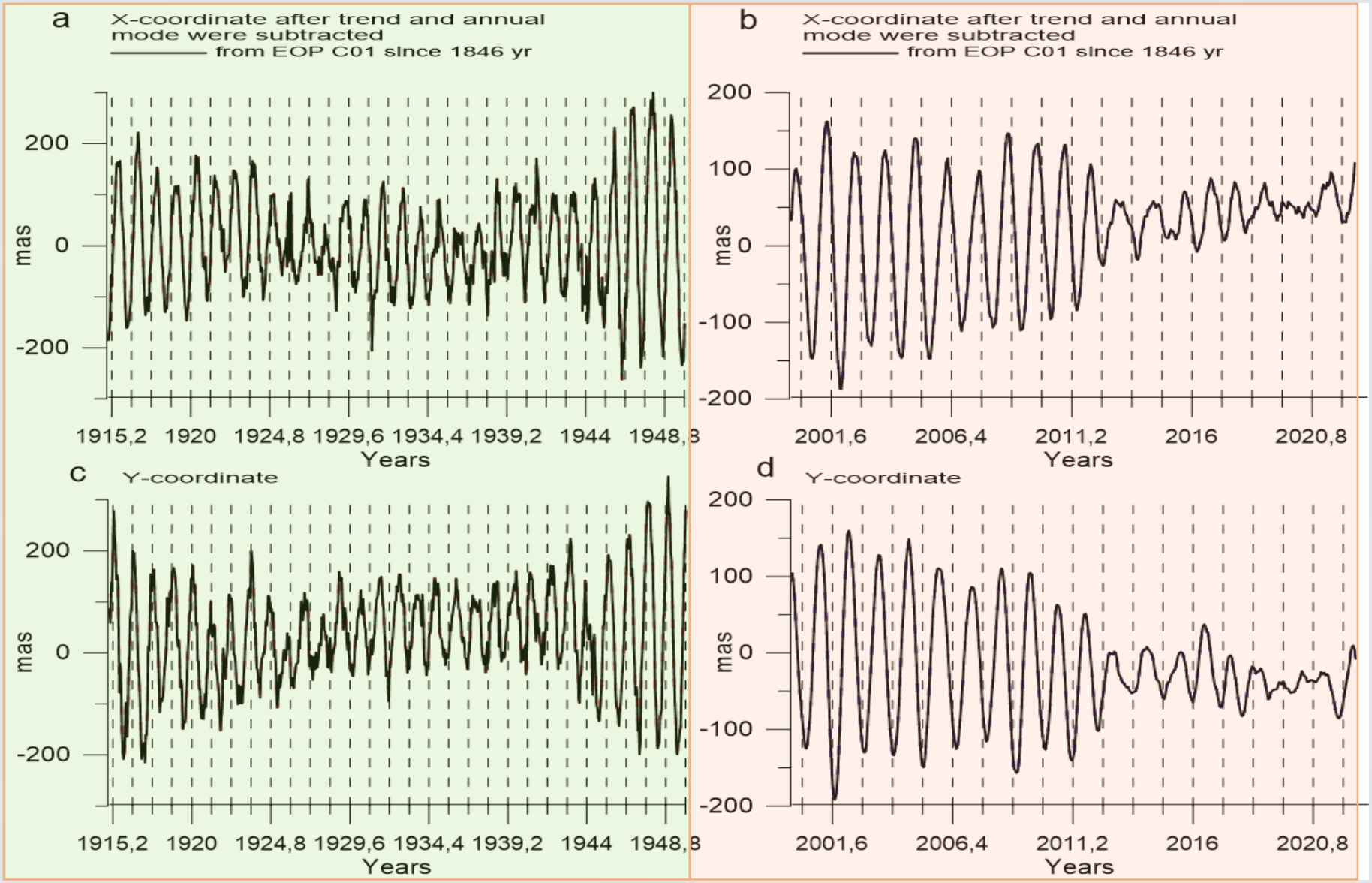
Polar motion since 1846 from EOP C01



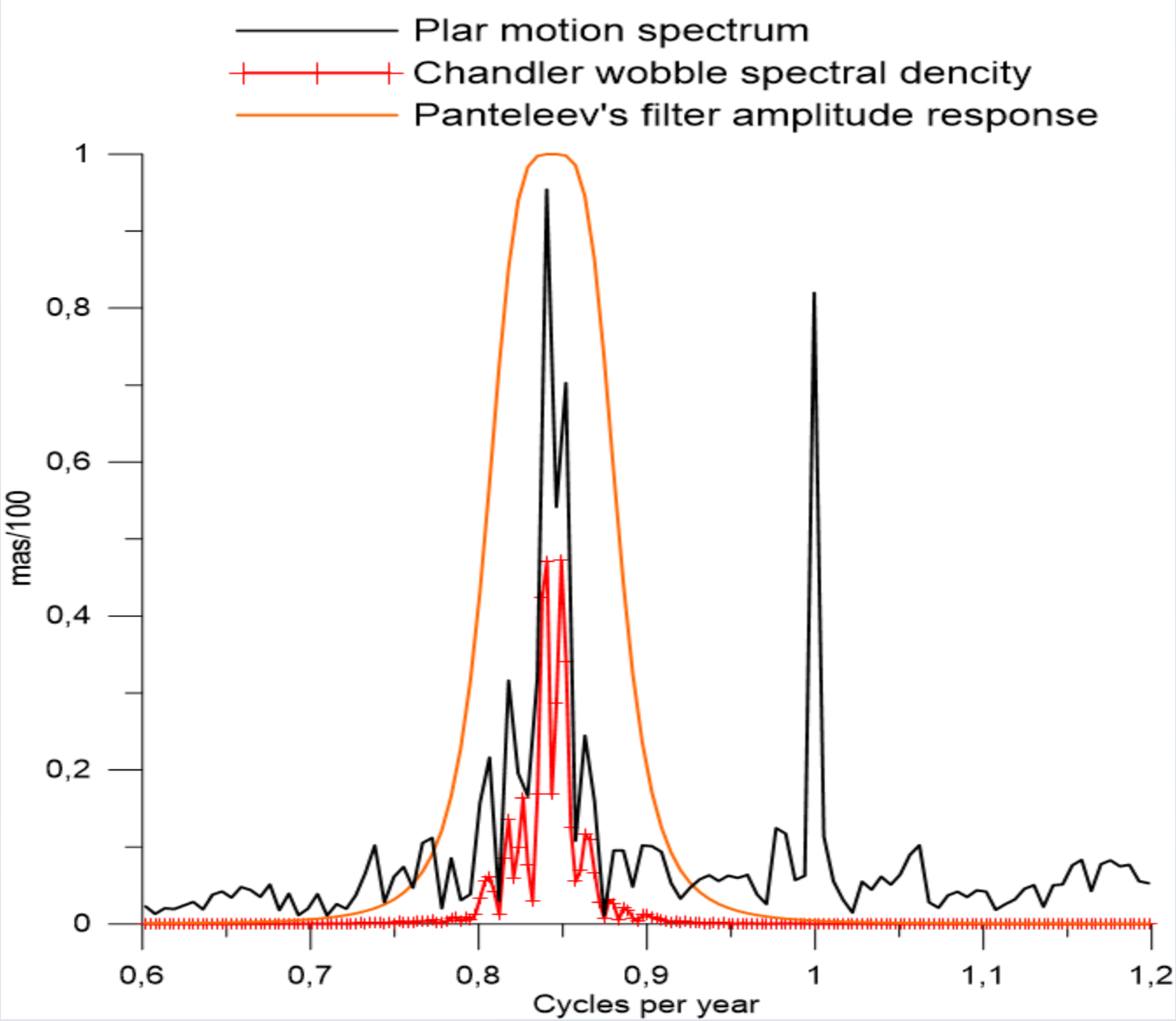
Zotov L.V. et al., Moscow University Physics Bulletin, N3, 2022

Polar motion without annual term for 1930-s and 2010-s



Zotov L.V. et al., Moscow University Physics Bulletin, N3, 2022

PM spectrum and Panteleev’s filter



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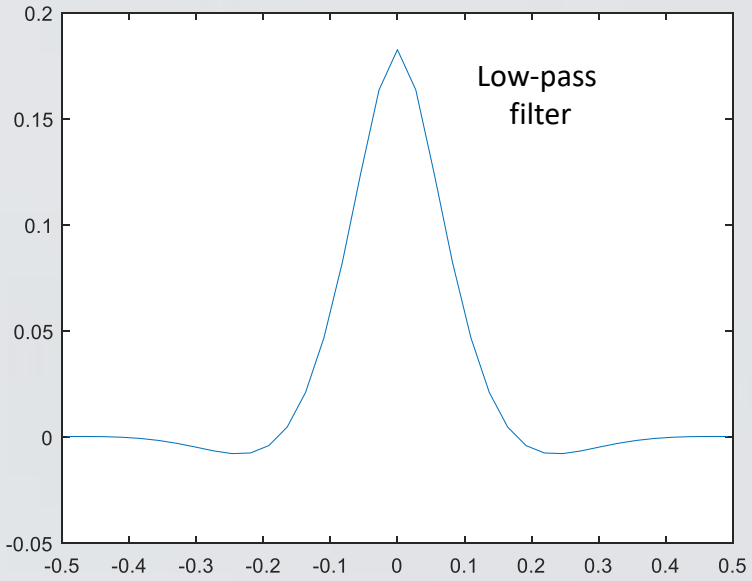
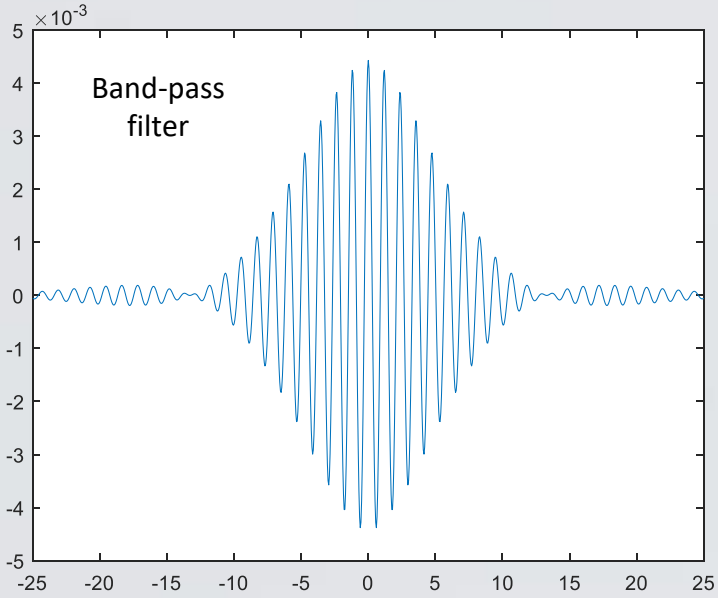
Pantellev's filtering

V.L. Pantellev (04.08.1931-06.03.2021)



Filtering in time domain – convolution with filter impulse response (window)



Filtering in frequency domain– spectrum multiplication by transfer function

$$h(t) = \frac{\omega_0}{2\sqrt{2}} e^{-\left(\frac{\omega_0|t|}{\sqrt{2}} - i2\pi f_c t\right)} \left(\cos\frac{\omega_0 t}{\sqrt{2}} + \sin\frac{\omega_0|t|}{\sqrt{2}}\right),$$

The Panteleev filter in time domain

$\omega_0 = 2\pi f_0$

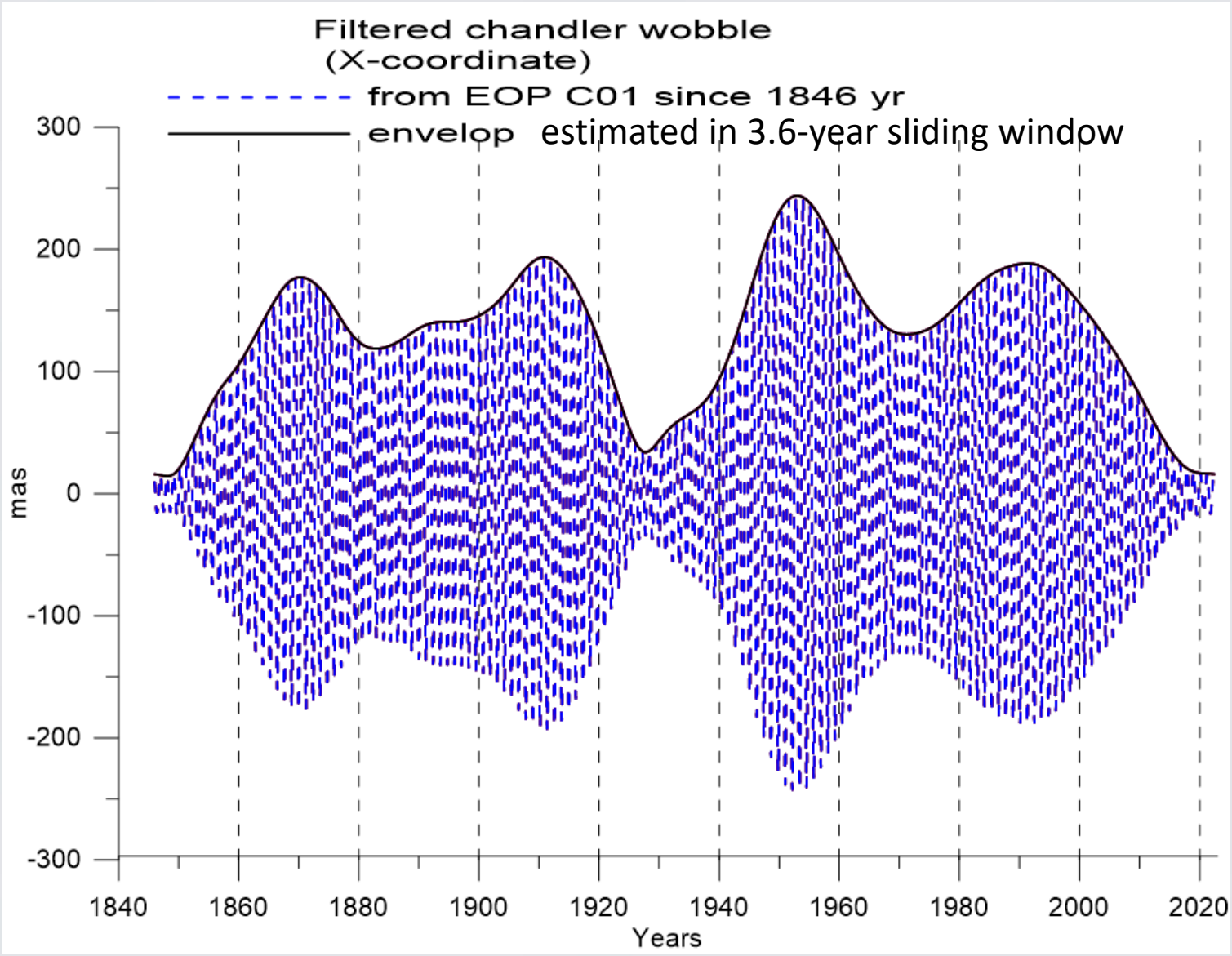
$$L_h(f) = \frac{f_0^4}{(f - f_c)^4 + f_0^4}.$$

The Panteleev filter in frequency domain

$f_c = 0.166$ yrs^{-1}

$f_0 = 0.04$ yrs^{-1}

Chandler wobble amplitude



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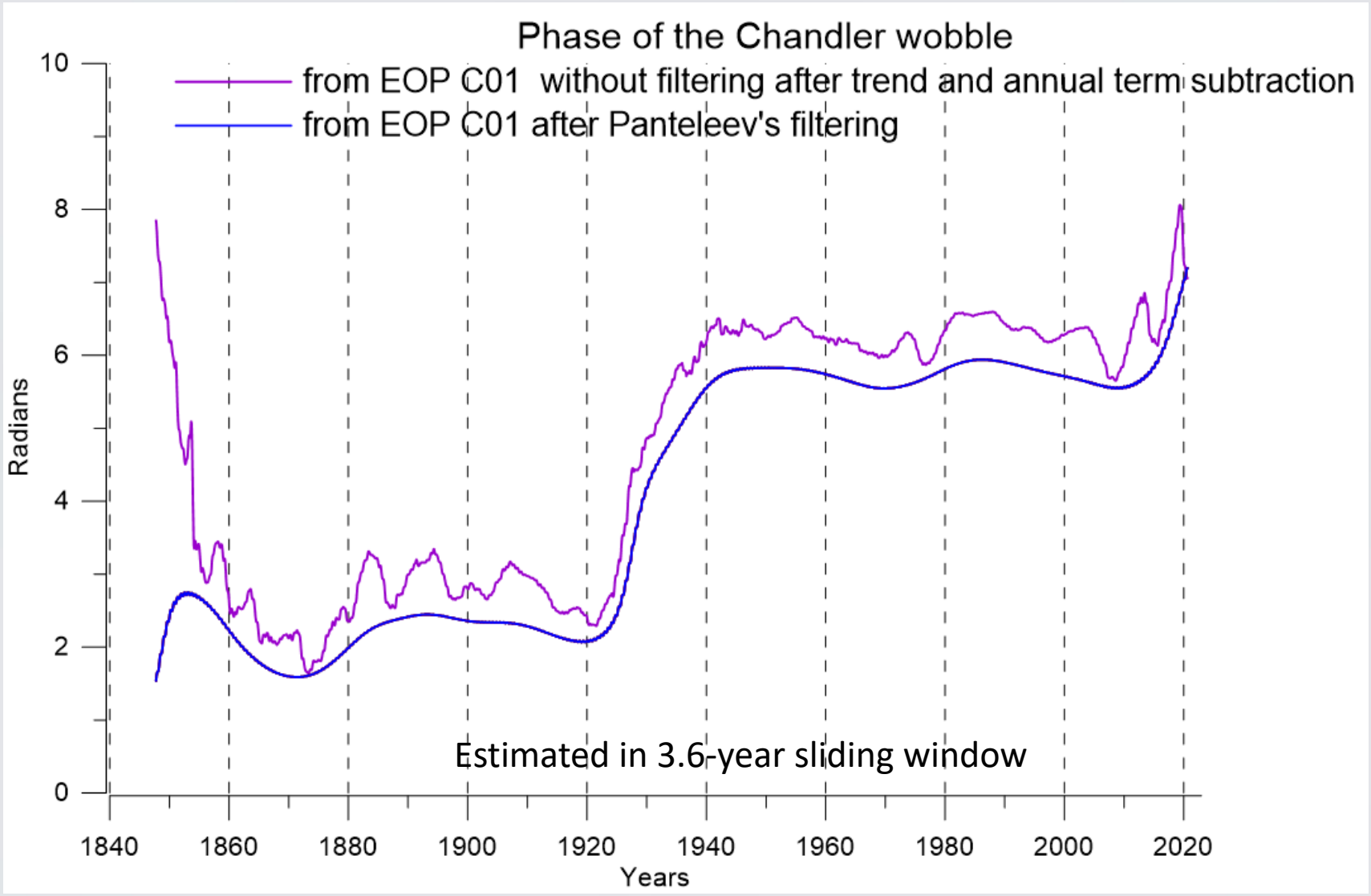
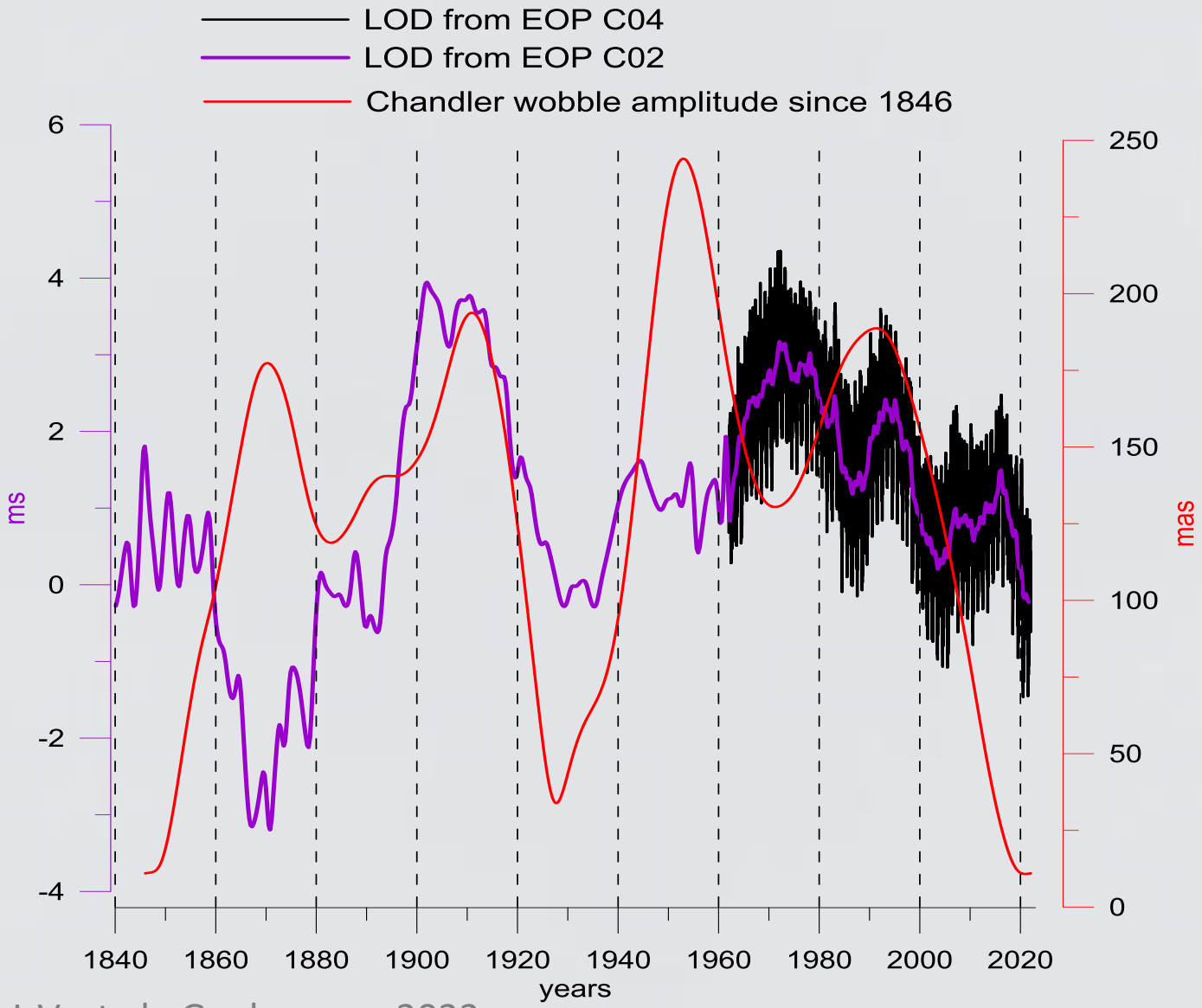
Chandler wobble phase



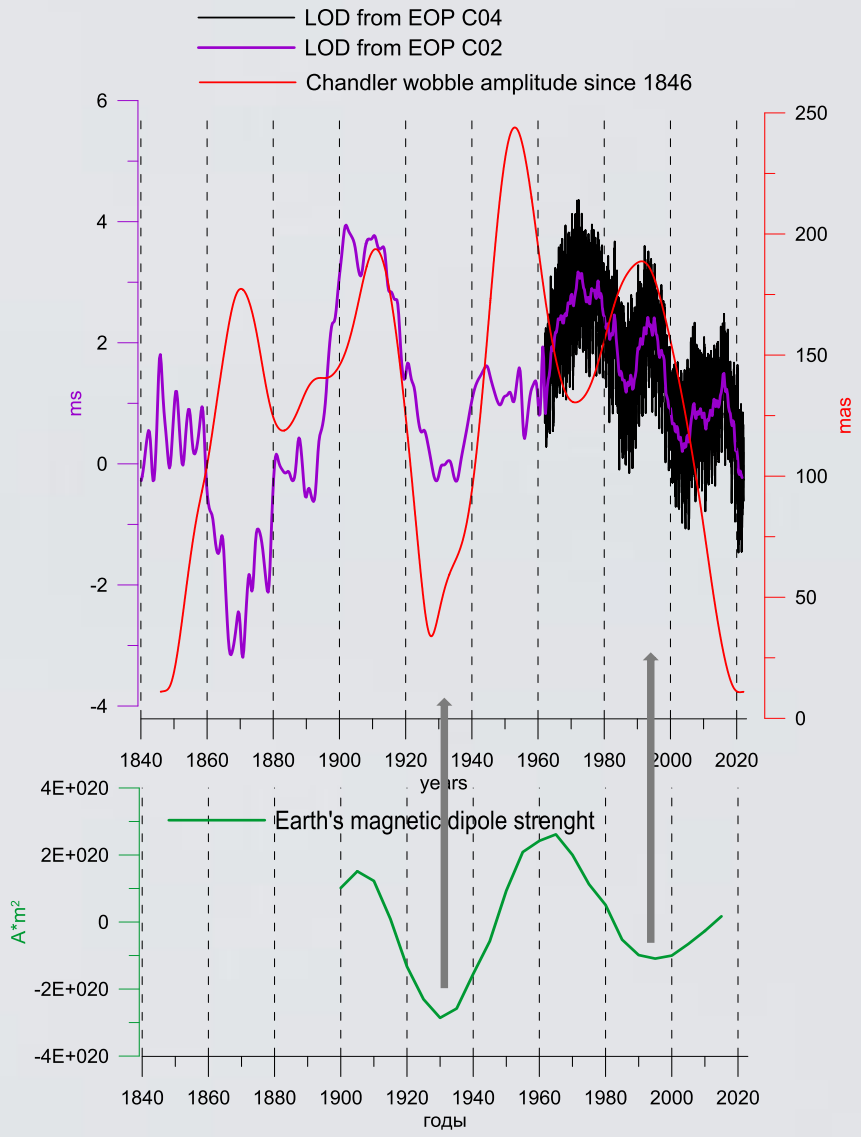
Zotov L.V. et al., Moscow University Physics Bulletin, N3, 2022

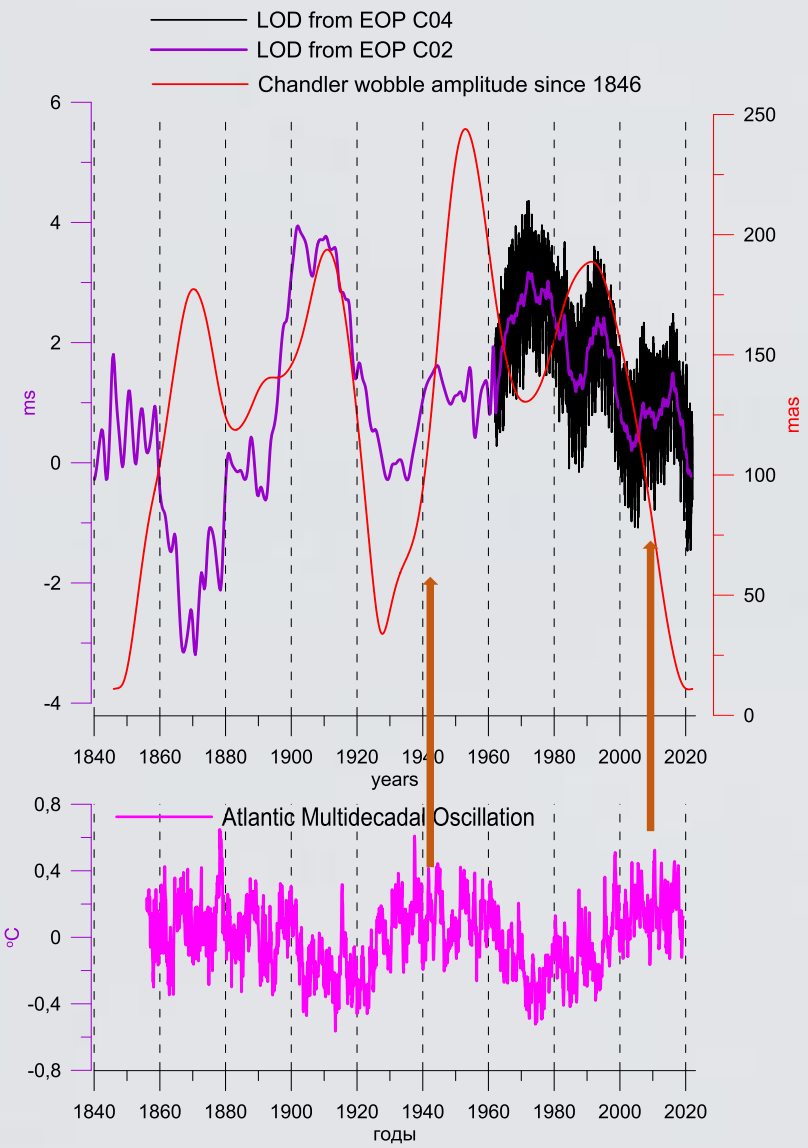
Chandler wobble and LOD since 1840



Zotov L.V. et al., Geokosmos, 2022

Chandler wobble and LOD since 1840 with other factors





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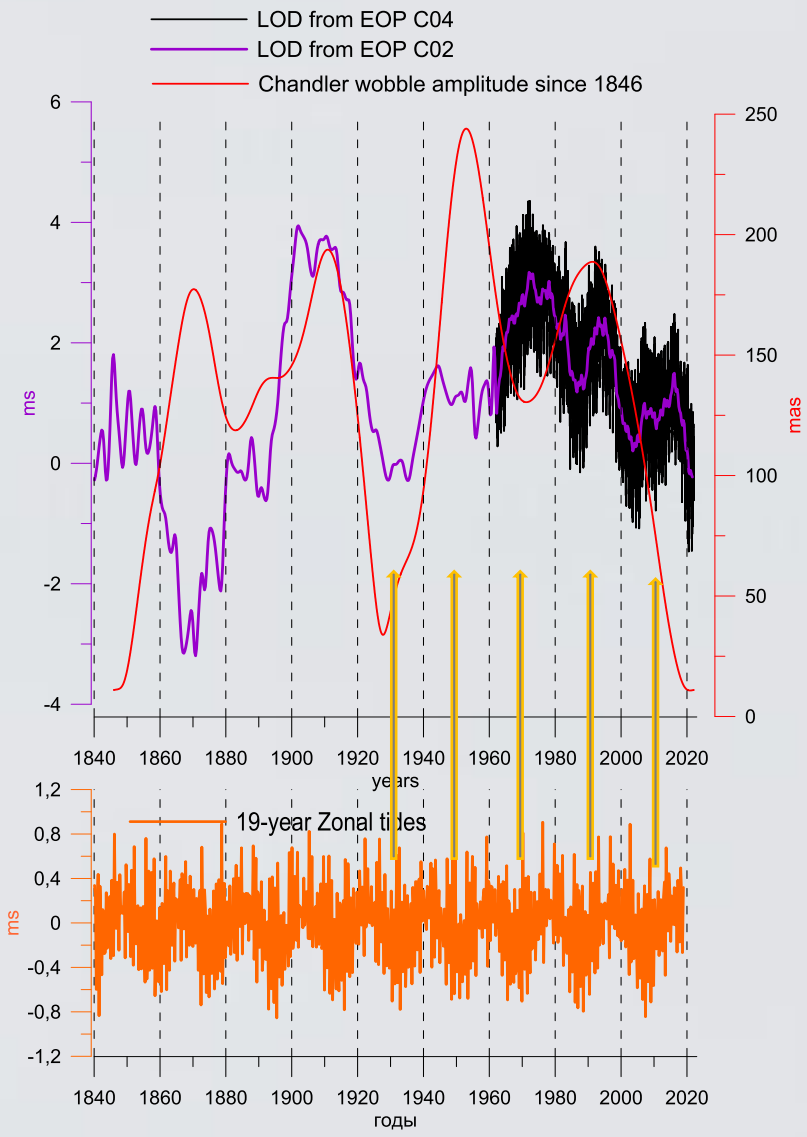
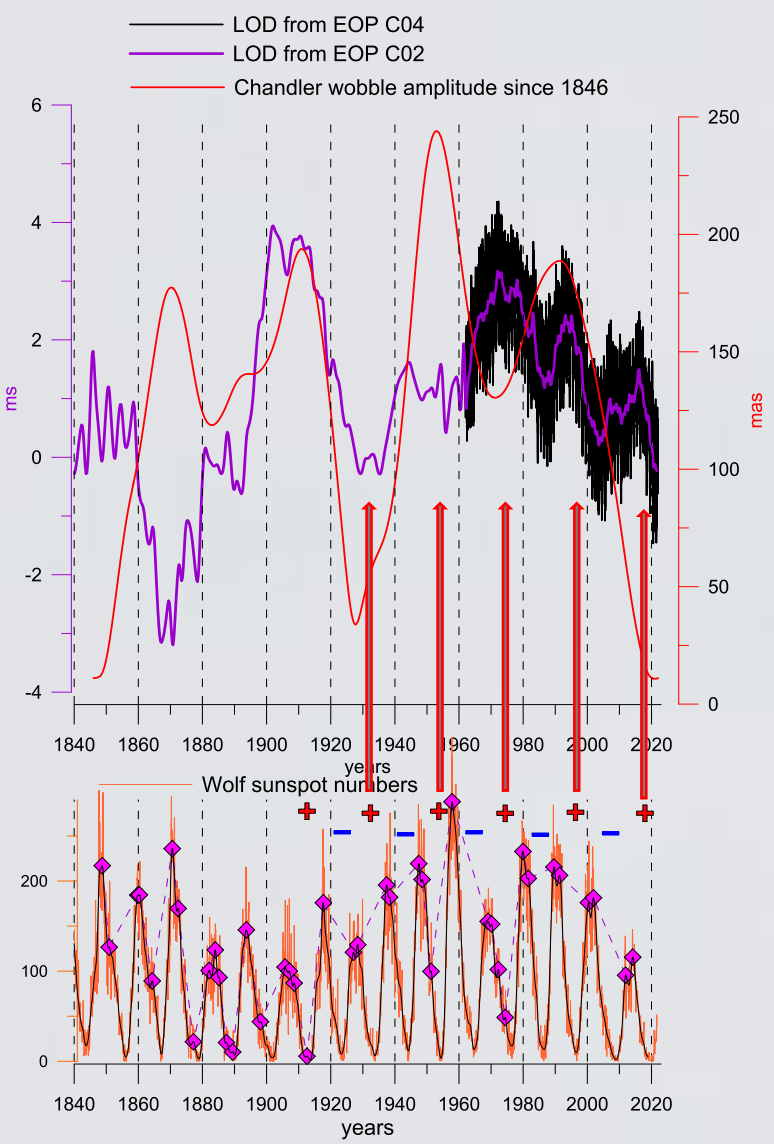
Chandler wobble and LOD since 1840 with other factors





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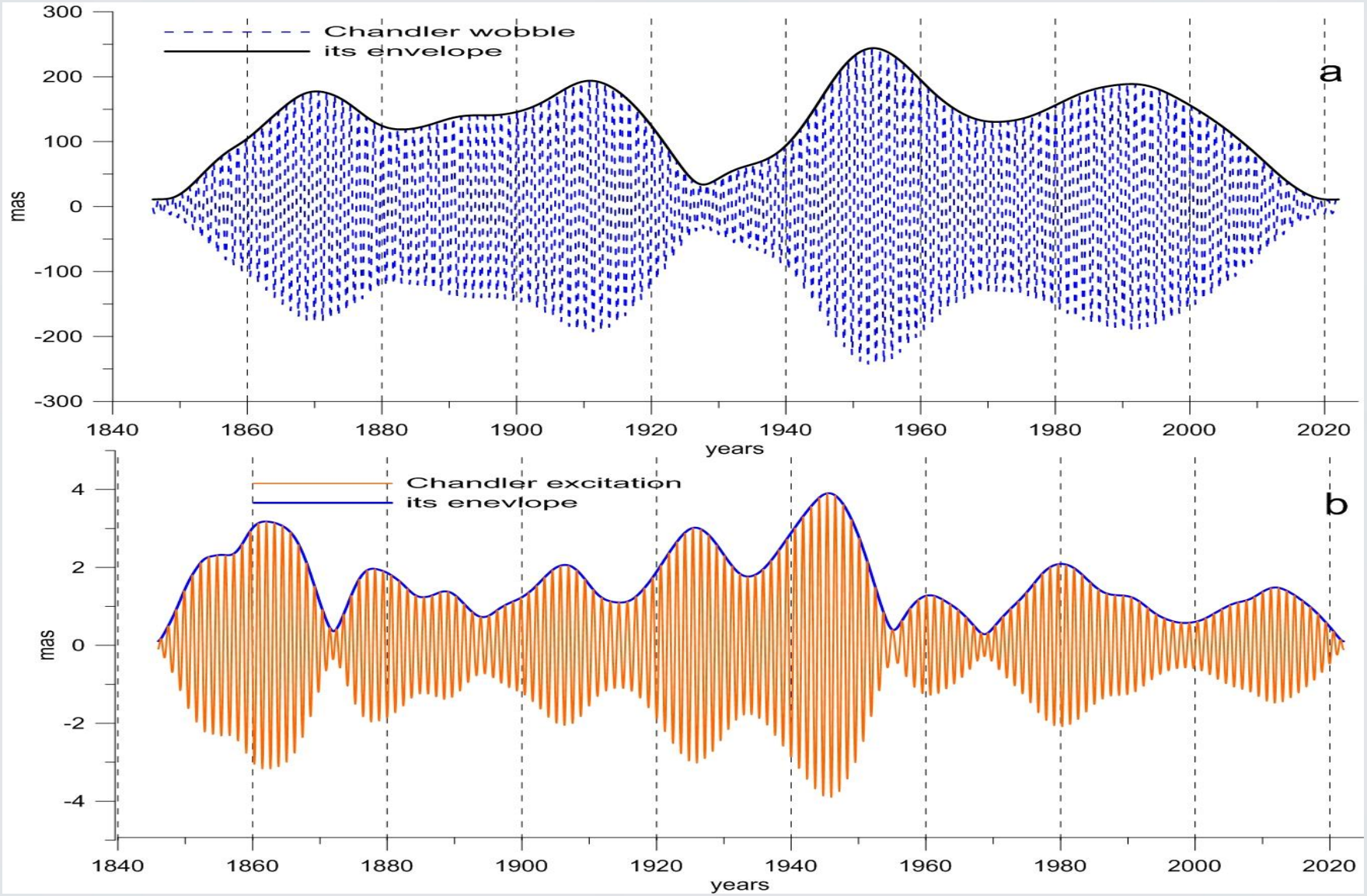
Excitation of the Chandler wobble



Zotov L.V. et al., Geokosmos , 2022

Conclusions

- LOD reached unprecedented minimum on 29 June 2022 (over 80 years)
- Effects of the atmospheric angular momentum AAM (NCEP, GFZ, ECMWF) and ocean angular momentum OAM (ECCO,GFZ) can not explain acceleration of the Earth
- Decadal LOD changes can be related to the oscillations in the core and/or lunar tide
- Chandler wobble disappeared in 2017-2020 and now appeared again
- Chandler wobble phase is now changing like in the 1930-s
- What we observe now – maxima in Earth rotation velocity and minima in Chandler wobble could be a result of regular mechanism
- May be the energy is transferred from polar motion to LOD within 90-year cycle (synchronization)

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ФИЗИКА ЗЕМЛИ, АТМОСФЕРЫ И ГИДРОСФЕРЫ

Аномалии чандлеровского колебания полюса в 2010-е годы

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[4] *SYRTE, Парижская обсерватория, Исследовательский университет PSL, CNRS, Университет Сорбонны, UPMC, Париж 06, Франция*

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Земля вращается неравномерно: положение полюса дрейфует и описывает круги с годовым и чандлеровским (433 суток) периодами, скорость вращения Земли также меняется. В начале 2000-х годов амплитуда чандлеровского колебания начала убывать и в 2017-2020 гг. достигла исторического минимума, сравнимого лишь с минимумом конца 1920-х годов. Мы выделили чандлеровское колебание различными методами (снятием тренда и годового колебания, фильтрацией Пантелеева и др.) из рядов данных по движению полюса EOP C04 и EOP C01 и показали, что с начала 2010-х годов происходит также изменение его фазы. Подобное изменение фазы происходило в 1920–1940-х годах и составило π радиан, в настоящее время оно приближается к 2 радианам. Обсуждаются возможные интерпретации названных явлений, их проявления в спектре движения полюса, вероятные причины.

Ключевые слова: вращение Земли, чандлеровское движение полюса.
УДК: 521.93. PACS: 91.10.-v.

Forbes

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Earth Sets New Record for Shortest Day

By Graham Jones and Konstantin Bikos. Published 27-Jul-2022

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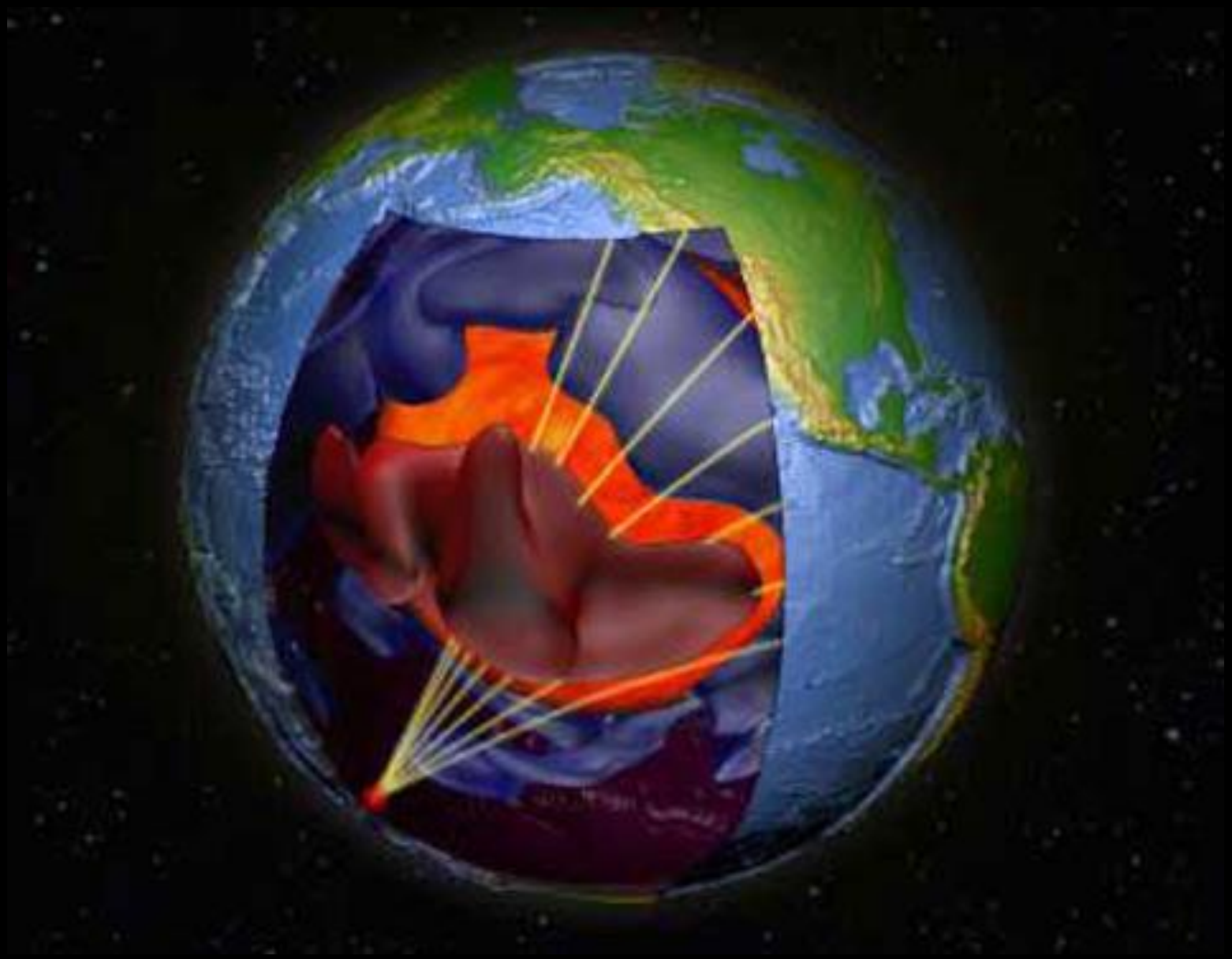
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