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Chandler wobble changes in 2020s

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We are contemporaries of a unique planetary event, observed once 90 years ago and not yet explained: the disappearance of the Earth's rotational axis wobble with a 433-day period and usual amplitude of ~3-6 m, named after S.C. Chandler, who discovered it in 1891.

The theory of Earth rotation given by the Euler-Liouville equations of rotation of the visco-elastic Earth derives the Chandler frequency as a resonant frequency of the wobble. We do not observe other processes at this frequency in the Earth's shells. It is generally accepted that small random variations in the atmosphere and ocean are responsible for the Chandler wobble (CW) excitation.

At the end of the 1920s and early 30s, CW decayed and changed its phase by 180°. Some specialists believe it was a random event. Recently it happened again. The removal of a trend and annual polar motion from the EOP C01/C04 time series clearly demonstrates that the amplitude of CW has been decreasing since the 1990s, and in 2019–2020, CW disappeared. We found out that in 2021 it appeared again, and by 2024 it made two oscillations with increasing amplitude. But the CW phase changed by 180° with respect to the observed before disappearance (turned upside down).

Researchers from China, Japan, and the USA already started to look for explanations for the amplitude decrease, analyzing atmospheric AAM and oceanic OAM angular momentum, putting forward the ideas that AAM disappeared or that AAM and OAM mutually destroyed each other. Some scientists put forward the hypothesis that processes in the core, or climate change and glacial melting, are responsible.

We discuss this phenomenon, suspecting the Moon and luni-solar tides responsible for the re-occurrence of the observed anomaly not only in CW but in LOD as well. Length of day (LOD) has reached its minima in 2023, making our epoch prominent. Earth rotates quicker than ever since the 1930s.

90-year periodicity is a half-period of mutual reoccurrence of phenomena related to the motion of the nodes and perigee of the lunar orbit. All luni-solar tides change with an 18.6-year cycle of nodal precession and an 8.86-year motion of the line of apses, defining the closest perigee position of the Moon. Ascending node (AN) and perigee meet every 6 years, but the difference between an 18.6-year cycle and a double 17.7-year cycle of rotation of perigee by ~0.9 years makes them meet at different points in the sky. Two loops close after ~10 cycles of nodal precession. If, for example, in 2024 AN and perigee meet at the point of vernal equinox (eclipse 8.IV occurs in perigee) at the equator, such an event occurred around 1838 and will happen around 2210 next time.

Two minima of CW amplitude and LOD separated by ~90 years could happen as a result of the transition of the perigee syzygies occurrence from higher declinations in the northern sky to higher negative declinations in the southern sky. Two events of quadrature: a) AN in the summer solstice, perigee in the vernal equinox in 1927, and b) AN in the summer solstice, perigee in the autumn equinox in 2020, separate these epochs. If it's true, the next CW zero-amplitude crossing will happen around the year 2113.

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