学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Study on the post-2015 absence of Chandler wobble:
Calculation of the excitation function based on JRA-55 and OFES2
（2015 年のチャンドラー極運動の消失：JRA-55 及び OFES2 に基づいた励起関数の計算）

The Chandler wobble is one component of the Earth's polar motion and is considered to correspond to the free oscillation of the solid Earth. We have found that the Chandler wobble was absent from 2015 to 2021 for the first time in the observational history. Although it is recognised that the excitation sources of the Chandler wobble are the atmosphere, ocean, and land water, the precise excitation mechanism, Chandler period, and the quality factor are still open questions.

In this study, to investigate the cause of the absence of the Chandler wobble and clarify its excitation mechanism, excitation functions were calculated based on atmospheric reanalysis data JRA-55 and ocean model OFES2 data. Furthermore, we integrated the three atmospheric angular momentum including the one based on the JRA-55, two oceanic angular momentum, and one hydrospheric angular momentum to determine their respective contributions to the excitation of the Chandler wobble. The results revealed that the atmospheric contribution including the one estimated from the JRA-55, decreased around the same time as the absence of the Chandler wobble. This result suggests that changes in atmospheric behaviour can be involved in the absence. On the other hand, the contribution from the ocean was found to be inconsistent across the model datasets used, indicating that new data will be required to estimate the oceanic contribution more accurately.

The oceanic angular momentum derived from the OFES2 ocean model was calculated. As a result, it showed a little discrepancy from existing estimates in the velocity term associated with ocean currents. However, the matter term, which reflects the redistribution of the seawater, exhibited an amplitude approximately twice as large as that in other data. For validation, ocean bottom pressure computed from the OFES2 model was compared with that from the ECCO ocean model. The results showed that the two results are strongly correlated overall, whereas weak or even negative correlations were found elsewhere. One possible reason for this discrepancy is that the OFES2 ocean model is not assimilated with observational data, indicating that some form of correction will be required to improve its accuracy.

The quality factor, Q, is a constant on the damping that has not been estimated with high precision. We investigated whether it can be inferred solely from observations of polar motion by taking advantage of the absence of the Chandler

wobble. Assuming the Chandler period and Q value, we performed a deconvolution on the polar motion data to compute the excitation function, and next reintegrated it under the same assumption for comparison with the original observed data to attempt to estimate the Chandler period and Q. The results showed that the residuals between the two did not exceed the estimation error of the annual component, and no significant differences were identified. This result suggests that accurate estimation of the Chandler period and Q requires geophysical data.

In summary, this study computed and analysed new estimates of atmospheric, oceanic angular momentum in order to reveal the excitation and damping mechanisms of the Chandler wobble. In addition, we evaluated a method for estimating the Q value. These results provide new insights into long-standing problems on the Chandler wobble, including ones previously considered to have been resolved.