



LSGI & RILS RESEARCH SEMINAR

Shift of Earth's Spin Axis Driven by Terrestrial Water Storage Changes

25 FEB 2026 (WED)

10:30 AM - 11:30 AM

Z414, POLYU

ENGLISH

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Professor

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ABSTRACT

Climate-driven and anthropogenic changes in the terrestrial hydrological cycle have redistributed terrestrial water storage (TWS) and contributed to global mean sea level (GMSL) variability. While GRACE/GRACE-FO has documented TWS decline since 2002, global-scale hydrological variations remain poorly constrained before the satellite-gravimetry era. In this seminar, I show how Earth's spin-axis shift (polar motion) provides an independent, observation-based constraint on continental-scale water redistribution and its GMSL impact. For 1993–2010, observed polar motion (PM) excitation trends are consistent with predictions from major surface mass-load components only when hydrological contributions are included. Groundwater depletion is the second-largest contributor to the PM trend (4.36 cm/yr toward 64.16°E), and omitting groundwater produces a significant mismatch with observations, highlighting PM's utility for diagnosing historical groundwater loss. We also investigate abrupt early-21st-century hydrological shifts using ERA5-Land soil moisture, which indicates a rapid decline of ~1614 Gt in 2000–2002 and a further ~1009 Gt loss during 2003–2016. This depletion is independently supported by ~4.4 mm of GMSL rise and a ~45 cm pole shift, consistent with large-scale land-to-ocean mass transfer. Together, these results demonstrate that polar motion, available since the late 19th century, offers a powerful record for detecting long-term hydrological change during the past century.

BIOGRAPHY

Ki-Weon SEO is a professor at Seoul National University, where he leads a research group in geophysical geodesy. His work uses satellite gravimetry (GRACE/GRACE-FO) and GNSS to quantify changes in terrestrial water storage, groundwater depletion, ice-sheet mass balance, and sea level. He has participated in three Antarctic expeditions to investigate ice dynamics and variability. His recent publications in *Geophysical Research Letters* (2023) and *Science* (2025) on shifts in Earth's spin axis helped establish polar motion as a new observational tool for diagnosing global hydrological change over the past century. His current research focuses on improving the spatial (vertical and horizontal) and temporal resolution of GRACE/GRACE-FO-derived mass change estimates.

Moderator:

Prof. Jianli CHEN, Chair Professor, LSGI, member of RILS

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