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How does regional terrestrial water storage change affect polar motion?

Shanshan Deng (1,2,4), Suxia Liu (1,2,3), Xingguo Mo (1,2,3), Liguang Jiang (4), and Peter Bauer-Gottwein (4)

(1) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), Beijing 100101, China (dengshanshan15@mails.ucas.ac.cn; liusx@igsnrr.ac.cn; moxg, (2) College of Resources and Environment, University of Chinese Academy of Sciences (UCAS), Beijing 100049, China, (4) Air, Land & Water Resources, Department of Environmental Engineering, Technical University of Denmark, Bygningstorvet, 2800, Kgs. Lyngby, Denmark (ljia@env.dtu.dk; pbau@env.dtu.dk), (3) Sino-Danish College, University of Chinese Academy of Sciences (UCAS), Beijing 100049, China

Terrestrial water storage (TWS) is one of the major contributors (along with the solid earth, atmosphere, and the oceans) to excite polar motion. Previous studies on hydrological excitation of polar motion mainly concentrated on the global scale. We started to analyze how regional TWS, e.g. the Amazon River basin, affects polar motion and found it has significant effect on polar motion (Liu et. al., 2018). Given the uneven distribution of terrestrial water storage, the effect of regional water mass change on polar motion remains unclear and needs to be further explored.

The aim of this work is to investigate the effect of terrestrial water storage change on polar motion excitation at regional scale. First, we test how polar motion response to TWS changes in different regions. Synthetic experiments show that the excitation from regional water mass change varies with latitude, and the regions around 35°N and 35°S have the most significant effect on polar motion while the regions close to Equator and Poles have a relatively small effect. Second, we investigate the hydrological excitations of about twenty large river basins at different latitudes using GRACE data. Among selected basins, Amur, Lena, Nile, and Parana river basins have significant contribution to polar motion $\chi 1$ component (along prime meridian) while Mississippi and Ob river basins have significant contribution to polar motion $\chi 2$ component (along 90°W and 90°E). Then, a reconstructed long-term terrestrial water storage change derived from Reanalysis and GRACE data are applied to compute hydrological excitation with different basins to show the true polar motion driven by regional water storage change over decades. Moreover, combined with altimetry, we also investigate the excitation from TWS changes in large lakes. This work is expected to improve the understanding of the relative importance of regional TWSC for polar motion excitation.

Reference:
Liu S, Deng S, Xingguo M O,Yan H. 2018. Indexing the relationship between polar motion and water mass change in a giant river basin. Science China Earth Sciences: 1065-1077