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"HeHai-KIT" initiative: Improving regional water-mass recovery using equal-area flatten tesseroids for monitoring the Earth system

Since 2008, during my PhD exchange at the Geodetic Institute, Karlsruhe Institute of Technology (KIT), I have maintained an informal collaboration with Prof. Heck in terms of idea exchanges and joint publications. More recently, we have named this collaboration "HeHai-KIT", which is an intentional pun using the names of the two universities—that is, the institution in China where I have been working since 2011 as an Associate Professor, Hohai University (河海大学, hé hǎi dàxué), and KIT, where Prof. Heck is an academic. "KIT" could also be seen as an English word meaning, among other things, "a set of tools, equipment etc. that one uses for a particular purpose or activity", while the two Chinese characters 河 (hé) and 海 (hǎi) can be translated as "river" and "sea", respectively. Therefore, the pun with the names of the universities could mean "tools/equipment (kit) for monitoring the hydrosphere (rivers and oceans, etc.)". Observing and monitoring the different components of the hydrosphere (e.g., the hydrological cycle) and its dynamics are essential steps to understand and predict, for example, extreme events such as floods and droughts.

However, in the absence of ground-based measurements as, for example, in Africa and South America, space-borne sensors have offered opportunities to monitor the temporal variations of the components of the water cycle (e.g., precipitable water vapor, surface water, continental water storage). For example, the past US-German mission Gravity Recovery and Climate Experiment (GRACE) and its current successor GRACE-FO (follow-on) offer the unique opportunity to measure continental water storage on a monthly basis at global and regional scales. Yet, further research is still needed on improving the derived products from this mission. For instance, the spherical harmonic coefficients computed from GRACE/GRACE-FO data, which express information on the Earth's gravity field and its functionals, present drawbacks. As regional approaches are preferred instead, we have carried out activities at the Geodetic Institute in order to improve the space domain solutions.

This research, in part, has allowed me to propose an approach based on equal-area flatten tesseroids to parameterize the continental water storage given the gravitational potential (or

gravitational attraction) at the altitude of GRACE/GRACE-FO. My colleagues and I investigated the feasibility of the method, and we demonstrated that the flatten tesseroid solution is a viable alternative to the established methodologies of mass concentration modelling. Follow-up publications have been submitted, and applications for the hydrosphere have been carried out thanks to the support for my research stay kindly provided by the International Affairs, International Scholars & Welcome Office in the framework of the “KIT Research Alumni Reunion Grant”.

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Related Publication

Ferreira, V.G., Montecino, H.C., Ndehedehe, C.E., Heck, B., Gong, Z., de Freitas, S.R.C., Westerhaus, M. (2018) Space-based observations of crustal deflections for drought characterization in Brazil. Science of Total Environment 644:256–273. doi: 10.1016/j.scitotenv.2018.06.277