

Terrestrial Water Storage in the Arabian Peninsula: Mid and Late Future Changes

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ABSTRACT

Global water security plays a key role in achieving the 2030 Sustainable Development Goals (SDGs) adopted by the United Nations in 2015. Terrestrial water storage (TWS) – the sum of continental water stored in rivers, lakes, reservoirs, canopies, snow, ice, wetlands, groundwater, and soil – determines water availability, as one of the critical components of global water security. Although previous studies investigated historical TWS variability around the world, future changes in TWS have only been examined in a few recent publications. Hence, assessing both historical and future variations in TWS is significantly important for sustainable development, particularly in regions with severely arid climates and extremely limited water resources, like the Arabian Peninsula (AP). Employing the Gravity Recovery and Climate Experiment (GRACE) satellite data by both global hydrological (GHMs) and land surface (LSMs) models, this study aimed to investigate alterations in TWS throughout the hyper-arid environment of AP during the mid (2030-2059) and late (2070-2099) future under RCP2.6 and RCP6.0 climate change scenarios. Accordingly, significant decreases in the future TWS were mainly seen across the southeast of Saudi Arabia and the east of Yemen. Based on all simulations, however, the northern parts of the Arabian Peninsula (including Kuwait) will interestingly experience increases in TWS during 2030-2099. Generally speaking, the rate of declines in the future TWS was higher for the late- than the mid-21st century, while the rate of increases was almost similar between these two periods. The rate of declines in the future TWS was also higher for the RCP6.0 than the RCP2.6. Such results lay the foundation for developing different water security adaptation and mitigation strategies in the Arabian Peninsula, and thereby acting towards local, regional, and global sustainability.

Keywords: Kuwait, GHMs, GRACE, LSMs, RCP, Saudi Arabia, Sustainability