Journal of Contemporary Researchin the Built Environment ISSN: 2636-4468
Volume 9, Number 1, March 2025

RECONSTRUCTION OF GRACE-LIKE TWSA IN SUB-SAHARAN AFRICA USING GRACE, GLDAS PRODUCTS AND GLOBAL TELECONNECTION PATTERNS

John O. Anwana[1] and Aniekan E. Eyoh[2]
[1&2]Department of Geoinformatics and Surveying, University of Uyo, Akwa Ibom State, Nigeria

ABSTRACT

Purpose: Changes in Terrestrial Water Storage (TWS) are strategic and essential to evaluate water resources, climatic extreme impact and agricultural production. Presently, products from Gravity Recovery and Climate Experiment (GRACE) twin satellites are distinctive method of examining regional to global hydrological fluxes. However, short timeframe (2002 – till date) restricts their use in prolonged climatologically and hydrological projects. Secondly, the occasional temporal gaps in the GRACE products hinder continuity in time series analysis. Progress in artificial intelligence make possible customized learning of inter-relationship between variables in intricate spatio-temporal systems. Nonetheless, the relevance of many deep learning procedures has neither been sufficiently learned for GRACE TWS reconstruction.
Design/methodology/approach: The study develops a reconstruction model for GRACE TWS anomalies (TWSA) based on climate dataset from Land surface model (GLDAS) products. The climate dataset was further optimized by statistical technique of Independent Component Analysis, Principal component analysis and spatio-temporal decomposition technique. The study adopted Deep Belief Network (DBN) deep learning and C4.5 data mining models. Long-term TWSA of sub-Saharan Africa from 2002 to 2022 was simulated and implemented on the above mentioned models and results compared with GRACE-derived TWSA observations. Validation metrics were used to assess the robustness of reconstruction.
Findings: Trained DBN model achieve a range correlation coefficient between 0.789 and 0.92 which was better than that of C4.5 and a range RMSE between 10.98 and 20.19 mm and mean absolute error range between 8.31 and 15.81 lower than that of C4.5 indicating a good agreement with observed GRACE TWSA.
Research limitations/Implications: The limitation and implication is the variation of increased bias and percolation rectification blunders and changes in mountainous and coastal sub-regions.
Practical implications: It is recommended that advance deep learning prediction model be adopted for modeling TWS reconstruction.
Originality/value – The outcome shows that DBN model outperforms C4.5 model. Therefore, this study provides an alternative method required in generating Terrestrial Water Storage signals using climate dataset.

Keywords: Terrestrial water Storage Anomalies (TWSA), GRACE, Deep Belief Network (DBN), GADAS, Sub-Saharan Africa.

[2] Email: aniekaneyoh@uniuyo.edu.ng