Regional solution derived from the satellite gravimetry is a well-known ill-posed problem in that the downward continuation process is unstable in part due to unobservability causing errors in the high frequency components of the gravity field. Regularization is used to determine the best approximation (closest norm) to the optimal solution. The optimal technique used often warrants a compromise in both space and frequency domains. To study the behaviours of different regularizations, simulated potential differences from the GRACE mission is used as observations in this study. This allows us to evaluate different modelling and different regularization techniques for the optimal regional inversion. In order to closely replicate the realistic GRACE data, observation errors (random error (1)), the geographically correlated high-frequency error resulting from GRACE’s orbital and measurement sampling (2), and various model errors (atmosphere and ocean tide background model errors (3)) are simulated. Three iterative regularization techniques (the iterative Tikhonov regularization, bidiagonalization with regularization, and the iterative updating covariance method) are investigated in this study. Non-iterative regularization using an optimal regularization operator derived from time-varying covariance function is also studied. The latter solution has an advantage over the formers over computational time and its spatial resolution is improved when our derived regularization operator is applied. The RMS differences between given and recovered equivalent water heights over a South Africa region are 3.185, 4.748 and 6.235 cm, for error models 1, 2, and 3, respectively. Regularization solutions over different regions, their results in terms of errors in all domains will be shown.