A new technique for merging radar precipitation estimates and rain gauge data is developed and evaluated to improve multisensor quantitative precipitation estimation (QPE). Various types of linear and nonlinear techniques have been used to combine rain gauge and radar data. Linear cokriging and its variants, for example, may be considered as the best linear unbiased estimators which minimize the error variance in the unconditional sense. They are, however, subject to conditional biases (CB) that may be unacceptably large for estimation of heavy-to-extreme precipitation. In this work, we develop, apply and evaluate conditional bias-penalized cokriging (CBPCK) for spatial estimation of precipitation using radar and rain gauge data which explicitly minimizes Type-II CB as well. Its univariate version, conditional bias-penalized kriging (CBPK), was shown to significantly improve gauge-only estimation of heavy-to-extreme precipitation in earlier studies. The radar data used are the 7-yr reanalysis of the radar-only National Mosaic and Multisensor QPE (NMQ/Q2). The rain gauge data used are from the Hydrometeorological Automated Data System (HADS). The primary study area is North Central Texas but other areas in the Southeast, Rocky Mountain and Pacific Northwest regions will be considered.