Sea surface temperature (SST) is a fundamental quantity to understand weather and climate dynamics. Although sensors aboard satellites provide global and repeated SST coverage, estimates of the errors introduced by the intervening atmosphere are necessary for determining the suitability of SST retrievals in various applications. Guidance on how to derive meaningful error estimates, however, is still being developed. Previous methods estimated retrieval uncertainty based purely on geophysical factors, such as season or “wet or “dry” atmospheres, but the discrete nature of these bins led to obvious spatial discontinuities. Recently, a new approach was tried where retrievals were clustered based on the terms (excluding offset) in the statistical algorithm used to estimate SST. However, this method resulted in over 600 clusters, too many to understand the geophysical conditions that influence SST retrieval error. Using collocated MODIS matchups (2012 - 2016), we explore the use of decision tree classifiers to estimate the error range of SST retrievals. MODIS matchups were first split into three categories of error ranges, error < -0.4 C, -0.4 C <= error <= 0.4 C, and error > 0.4 C. A first finding is that these categories are heavily unbalanced. This can lead to a biased classifier and we therefore rebalance classes using a variety of algorithms, such as SMOTE (Synthetic Minority Over Sampling Technique). We consider a variety of features for the decision tree algorithms and start with regressors from the MODIS SST algorithm, proxies for temperature deficit, and measures of spatial homogeneity such as the range in the 11 um channel over a 25 km^2 area centered on the buoy/retrieval area. These features and a rebalancing of classes led to a decision tree that estimated the error range with an accuracy of 67.2%. To the best of our knowledge this is the first numerical estimate of the error. Furthermore, it was found that these measures of spatial homogeneity are commonly seen as the first splitting variable in the decision tree and ranked as some of the most important features, giving physical insight into the geophysical conditions that affect SST retrieval accuracy. We use this knowledge to enhance the precision and accuracy of error estimates from our decision tree classifier.