Sea surface temperature (SST) is a fundamental quantity to understand weather and climate dynamics. Modern ocean observing systems monitor SST using multiple platforms and instruments – including satellite-borne sensors. Satellite-borne sensors provide global and repeated SST coverage but errors are introduced by the intervening atmosphere. Estimates of the error are required for the integration of SST observations from multiple sources and determining the applicability of SST retrievals. Guidance on how to derive meaningful error estimates, however, is still being developed. A single pair of bias and dispersion values for the entire globe is not adequate, as satellite SSTs clearly show error patterns that vary in space and time, and that may even partially cancel each other when an overall statistic is calculated. Previous methods, such as the ‘hypercube’ developed for SST retrievals from the MODIS infrared radiometers aboard the Terra and Aqua satellite, estimated retrieval uncertainty based on geophysical factors such as season, latitude, viewing geometry, surface temperature, and “wet” or “dry” atmospheres. However, the discrete nature of these bins lead to obvious spatial discontinuities. Recently, Petrenko et al. (J. of Atmospheric & Oceanic Technology 33: 345-358, 2016) proposed an alternative approach, in which SST retrieval errors are instead segmented based on the values of regressors, i.e., the terms (excluding offsets) in the statistical algorithm used to estimate SST. Using collocated MODIS-Aqua observations and in situ SST measurements in the MODIS Matchup Database (2002 to mid-2016), we explore the nature of these errors and identify variables that influence error magnitude with an ultimate goal of classifying retrievals into estimated error ranges. We use decision trees to classify matchups as either having a good (-.4 <= error <= .4), bad low (error < -.4), or bad high (error > .4) error range. A first finding is that these groups are not balanced and this leads to a biased classifier. We use binary rebalancing techniques such as ROSE and SMOTE to rebalance data classes and then fit decision trees. We consider a variety of features for the decision tree algorithms and start with algorithm 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. A preliminary finding is that these measures of spatial homogeneity are commonly seen as the first splitting variable in the decision tree. We use this knowledge to build a decision tree classifier that estimates the error range for any SST retrieval.

Alternatively, a ‘hypercube’ approach was proposed for SST retrievals from the MODIS infrared radiometers on the Terra and Aqua EOS satellites. Retrieval uncertainty was estimated separately for ‘hypercube bins’ defined by the combination of season, latitude, viewing geometry, surface temperature, and "wet" or "dry" atmospheres. A disadvantage was the appearance of obvious spatial discontinuities in mapped uncertainty fields. Recently, Petrenko et al. (J. of Atmospheric & Oceanic Technology 33: 345-358, 2016) proposed an alternative approach, in which SST retrieval errors are instead segmented based on the values of regressors, i.e., the terms (excluding offsets) in the statistical algorithm used to estimate SST. This approach sought to characterize SST errors with a limited number of arguments, regardless of how many physical variables influence the values of algorithm terms. Using collocated MODIS-Aqua observations and in situ SST measurements in the MODIS Matchup Database (2002 to mid-2016), we explore the nature of these errors and identify variables that influence the magnitude of this error. We start by using algorithm regressors

The integration of observations from multiple sources, however, requires that SSTs from each

instrument or measurement system have associated estimates of systematic errors (bias) and variability

(dispersion). Guidance on how to derive meaningful error properties, however, is still being developed. A

single pair of bias and dispersion values for the entire globe is not adequate, as satellite SSTs clearly show

error patterns that vary in space and time, and that may even partially cancel each other when an overall

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physical variables influence the values of algorithm terms. Using co­located MODIS­Aqua observations and in

situ SST measurements in the MODIS Matchup Database (2002 to mid­2016) we explore both segmentation

approaches. An initial finding is that, in both approaches, only a small portion of the multivariate space is

occupied by MODIS matchups determined to be cloud­free. Another finding was that it was difficult to predict

whether satellite SST retrievals would have low or high differences with respect to in situ measurements.