Density covariates

Sea surface temperature (SST) could affect spawning and recruitment success, and so was included as a potential density covariate (Planque and Frédou 1999; Drinkwater 2005; Fogarty et al. 2008; Pershing et al. 2015; Klein et al. 2017). Though most surveys measured and reported SST for every observation, the empirical dataset includes many missing SST values. VAST cannot tolerate missing values in density covariates and removing a large proportion of data was undesirable. Therefore, NOAA’s 1/4° spatial resolution daily Optimum Interpolation SST (OISST) data product was used to fill gaps. OISST daily rasters were pulled from NOAA data sources and SST was extracted at observation locations. OISST values were compared to field measurements, when available, and the two were found to be generally similar.

Before inclusion in model selection, potential density covariates were tested for collinearity. High correlations were found between two pairs: cobble and rock sediment probability, and OISST and bottom temperature. For the first collinear pair, rock sediment probability was removed, and cobble sediment probability was retained in the model. Grab and coring sampling methods (the bulk of sediment samples that support the sediment model) are unlikely to sample large-grain sediments like boulders effectively, and so the lower-quality data that feeds this model will inevitably result in a lower-quality and less reliable model of large-grain sediment distribution (Bachman et al. 2011). For the second pair of collinear variables, OISST was removed as it was expected that the distribution of groundfish like cod would be more directly affected by bottom temperature than sea surface temperature. Once these two collinear relationships were addressed, the remainder of density covariates were not correlated and therefore were tested for inclusion in the final model.

Survey selection

Simple leave-one-out sensitivity tests were run to determine the influence of the bottom longline and jigging surveys on the overall cod indices of relative abundance. Removing the Eastern Gulf of Maine Sentinel jigging survey had little impact on the modeled abundance of all three size classes of cod, so it was excluded from further analysis. Removing the bottom longline survey reduced the abundance of medium and large cod by up to 50% in some years and was therefore retained for further analyses.