This dissertation investigates methodologies for incorporating remotely sensed data into coastal hydrodynamic models. In particular, emphasis is placed on the use of remotely sensed data as input to the model for describing the terrain and surface roughness as well as detecting synoptically inundated area to assess the performance of the model in capturing the spatial extent of the wetting front. The major achievements of this work are as follows: (1) A thorough review of numerical wetting and drying algorithms used in contemporary tidal flow models yielded four general categories that can be used to classify these algorithms and assess how well they conserve mass and capture the physics at the wetting front. (2) A method for developing a seamless topographic/bathymetric digital terrain model is presented, including a technique for handling the spatially variable nature of tidal datums such as Mean Sea Level when combining topographic and bathymetric elevation data over a large domain. (3) The current industry standard practice of using published land cover data to parameterize surface roughness was tested by comparing the values of Manning’s n, surface canopy closure, and effective aerodynamic roughness length determined using land cover data to those computed based on field measurements at 24 test sites in Florida. It was shown that the land cover method is deficient on a site by site basis due to misclassification errors and the inherent variability within the land cover data. (4) A newly developed method for detecting inundation area using remotely sensed data, primarily Synthetic Aperture Radar, was applied to a northern Gulf of Mexico tidal model to assess its performance in capturing the extent of the wetting front. Four time periods were analyzed by time-synchronizing the tidal model with the available remotely sensed inundation areas. It was shown that the inundation area detection method corroborates traditional tidal model performance assessment techniques. Using the inundation area detection method as the ground truth data, the tidal model was able to correctly classify pixels as wet or dry over 85% of the time. (5) Lastly, progress was made towards developing a LiDAR point cloud based method for parameterizing surface roughness. A variety of statistics were derived from both the ground and non-ground points within the LiDAR point cloud using total population, moving window and data striping techniques. It was shown that the fit between surface roughness parameters and the point cloud statistics is weak; the fit is substantially better when comparing the point cloud data to the individual terms in the equations used to compute the surface roughness parameters, rather than to the parameters themselves. Future work includes refining the parameterization model using non-linear approaches and hydrodynamic model testing.