Located in Florida’s panhandle, the Apalachicola River is the southernmost reach of the Apalachicola–Chattahoochee–Flint (ACF) River basin. Streamflow and sediment drains to Apalachicola Bay within the Northern Gulf of Mexico, resulting in a direct influence on the ecology of the region, in particular seagrass and oyster production. This study examines the response of overland flow and sediment loading in the Apalachicola River on seasonal and event scales under projected climate change scenarios and land use land cover (LULC) change. A hydrologic model using the Soil Water Assessment Tool (SWAT) was developed for the Apalachicola region to simulate daily discharge and sediment load under present (circa 2000) and future conditions (circa 2100) to understand how parameters respond over a seasonal and event time frame to changes in climate only, LULC only, and coupled climate / LULC. These physically-based models incorporate digital elevation model (DEM), LULC, soil maps, climate data, and management controls. Long Ashton Research Station–Weather Generator (LARS–WG) was used to create stochastic temperature and precipitation inputs from three Global Climate Models (GCM), each under Intergovernmental Panel on Climate Change (IPCC) carbon emission scenarios for A1B, A2, and B1. These scenarios represent potential future emissions resulting from a range driving forces, e.g. social, economic, environmental, and technologic. Projected 2100 LULC data provided by the United States Geological Survey (USGS) EROS Center was incorporated for each corresponding IPCC scenario. Results from this study can be used to further understand climate and LULC implications to the Apalachicola Bay and surrounding region as well as similar fluvial estuaries while providing tools to better guide management and mitigation practices.