Climate Change in Northeast Water Region

Climate change is caused by the emission of excess carbon dioxide and other greenhouse gases into our atmosphere from human activity including the burning of fossil fuels for transportation and energy generation. This excess carbon warms the air and water, and causes a myriad of other dramatic changes including sea level rise, ocean acidification, and increased severity in storms. Climate change is affecting the Hudson-Raritan Estuary on a local level as sea levels and air temperatures are rising and wildlife distribution and migratory patterns are changing (HEP, 2012).

WATER TEMPERATURE

Background

Worldwide, the upper ocean has warmed by 0.2°F every decade since the 1970's (IPCC, 2014). Warming water affects our ecosystem in a number of ways. Even very small increases in water temperatures can affect the growth, behavior, and species distribution of aquatic animals; for example, we are losing species that are at the southern edge of their ranges and species from the mid-Atlantic are migrating northward to the Estuary in response to warming temperatures (Daniels et al., 2005). Warmer temperatures also decrease dissolved oxygen in the water column, and increase biological oxygen demand (Najjar et al., 2000). Warmer temperatures are especially problematic for smaller tributaries and embayments that are less well flushed or more sensitive to summer heat waves.

In the Harbor Estuary, however, the relationship between water temperature and climate change is not so straightforward. Historically, many electric and other utilities released hot water used for once-through cooling systems into waterways. This practice continues today but with greater regulation. Treated wastewater is also a higher temperature than receiving waters due to the bacterial activity that degrades sewage into less harmful components. However, thanks to water conservation measures, new sources of power (solar, wind), federal and state regulation, and electric transmission from out of the region, these injections of warmer water have decreased in volume with time.

Analysis

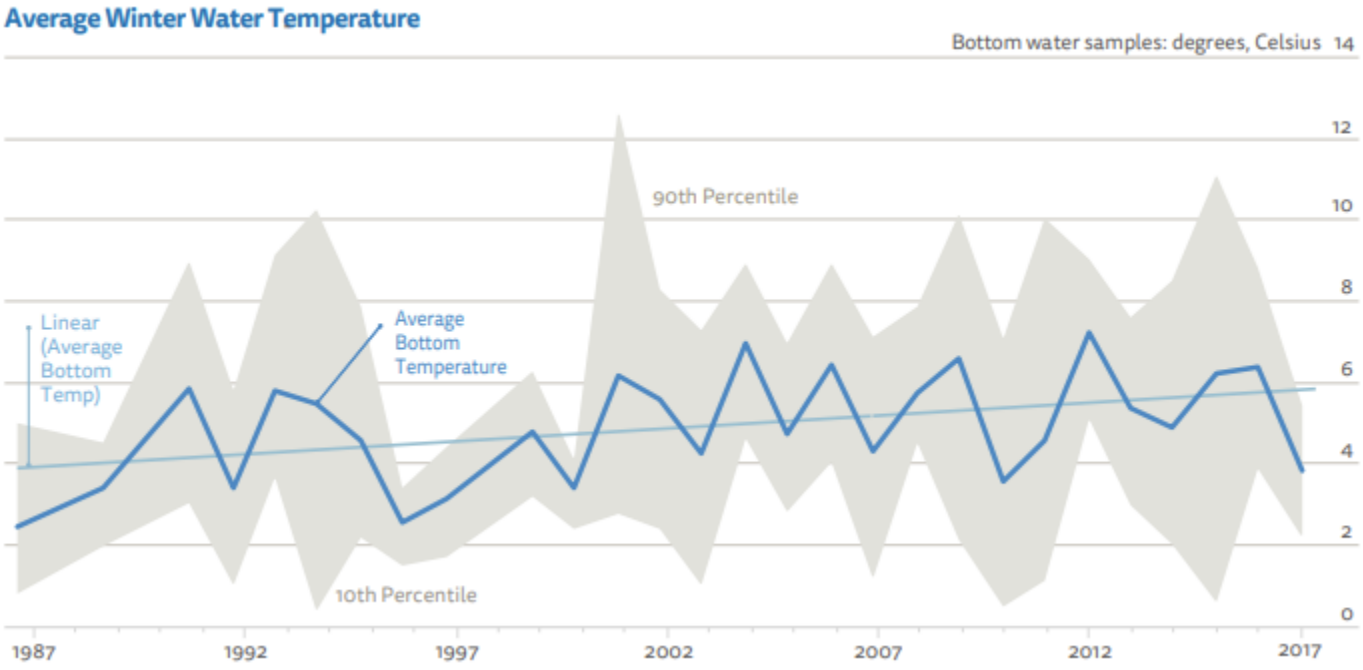
The effects of climate change are seasonally disproportionate: the relative warming is happening much faster during winter than the summer. Therefore, even though it is warmer summer waters that are the most harmful, the winter water temperatures from December – February were used for this analysis because they are more indicative of climate change. Samples taken from both the surface and bottom (just above sediments) of the water column by the NYCDEP and NJHDG Harbor Surveys were averaged and 10th and 90th percentiles were calculated to get a sense of the range of values per winter. Three years (1988, 1990, 1998) were removed from the analysis for quality reasons because there were less than three sampling days per winter. Air temperatures for the same time were also averaged to explore the relationship between air and water temperatures in the Harbor Estuary

Findings

Average bottom winter water temperatures are increasing significantly with time, which indicates a declining trend in environmental health. The surface water temperatures are too variable to determine a trend. While they are not changing significantly, the number of unusually warm samples (the 90th percentile) are increasing with time while the number of cooler samples (the 10th percentile) are staying about the same (although decreasing slightly in the short term). This result, as well as a decline in a statistical measure called the R^2 value (in the averages for both the surface and bottom samples), suggests increasing water temperature variability with time. Average winter air temperatures for the same time period were significantly correlated with the surface average water temperatures.

It is difficult to determine what effect, if any, the reduction in warm water inputs from wastewater and other thermal discharges or the effect that air temperatures may be having on these data. It is possible that the

polarizing influence of the two drivers (climate change and decreasing thermal pollution) could cause increased variability.



HEP (NY-NJ Harbor & Estuary Program). 2018. The State of the Estuary 2018: Environmental Health and Trends of the New York-New Jersey Harbor Estuary

https://www.hudsonriver.org/NYNJHEPStateoftheEstuary.pdf

(HEP, 2012) : HEP (NY-NJ Harbor & Estuary Program). 2012. The State of the Estuary 2012: Environmental Health and Trends of the New York-New Jersey Harbor Estuary.