Analysis of Changing Climate and Hydrology in the Winooski River Basin, Vermont

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Analysis of more than seventy years (1936 to 2008) of daily discharge and weather data in the 2,704 km^2 Winooski River Basin of northern Vermont shows statistically significant increases in both precipitation and river discharge. We analyzed data from six discharge stations, both on the Winooski River and on its major tributaries, as well as nine weather stations at five locations within the basin. Analysis of historical datasets is of particular value as concern over climate change heightens and questions surrounding the behavior of climate and hydrology (and how they interact) become more pressing.

At all five weather stations average annual precipitation is increasing. At a 95% confidence level, this trend was significant at three of the five locations. Similarly, each of the six discharge stations showed an increasing trend in total annual discharge; half of these were significant at a 95% confidence level. Lowest annual daily flows increased significantly at all stations. In contrast, highest daily discharges for each year increased at some stations while decreasing at others. This inconsistent trend between stations could be evidence of the factors associated with changing landuse, which affects the way the sub-basins respond to storm events. In addition to the overall trends in the data, a linear spline has revealed a ~10-year cyclicity in total annual precipitation and discharge data that is well correlated with the behavior of the North Atlantic Oscillation (NAO).

The relationship between weather and discharge has also been changing on a monthly scale, with precipitation increasing significantly at three stations during March or April, while the discharge is trending downward during those same months. This trend may be indicative of the changing timing of seasonality. If spring comes earlier on average, the increases in precipitation could be buffered from the river by earlier leafing out of the trees, which transpire the added precipitation. It is also possible that earlier snowmelt is reducing spring flows.