Waves are a primary factor in beach health, sediment transport, safety, internal nutrient loading, and coastal erosion, the latter of which has been increasing along Lake Michigan's western coastline since 2014. The recent coastal erosion may be indicative of changes in the lake's wind-driven waves. This study seeks to examine long-term trends in the magnitude and direction of Lake Michigan waves, including extreme waves and storm events using buoy measurements (National Data Buoy Center Buoys 45002 and 45007) and the United States Army Corps of Engineers Wave Information Studies (WIS) wave hindcast model.

Tests show significant long-term decreases in annual mean wave height in the lake's southern basin (up to -1.5 mm/yr). When wave approach direction was removed and directional bins were tested independently, the coastal extent and rate of the weakening waves was increased (up to -4 mm/yr), and a previously unseen increasing trend in wave size in the northern basin was revealed (up to 2 mm/yr).

Data from the WIS model indicate that storm longevity and strength in the southern basin are decreasing at a rate of -0.085 hr/yr and -5 mm/yr, respectively. A follow-up analysis of the extreme value distribution's shape in the southern basin found a similar pattern in the WIS hindcast model, with the probability of receiving a wave larger then 5 meters decreasing by about -0.0125 yr^{-1}. In the north basin, the probability of receiving a wave of the same size was increasing at a rate of 0.0075 yr^{-1}.

These results indicated that the waves were not increasing in size. Research into these trends revealed the importance of removing temporal- and spatial-within-series dependencies in wave-height data. Lake waves' strong dependence on approach direction, as compared to ocean waves, may result from the relatively large differences in fetch length in the enclosed body of water. Without removal or isolation of these dependencies, significant trends may be lost.