Lake Huron Information analysis

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Figure 1: Lake Huron

Context

Lake Huron is one of the five Great Lakes of North America.Lake Huron is the second-largest Great Lake with a surface area of 23,000 square miles – slightly smaller than the state of West Virginia

The Surface Elevation it has is 577 ft

The lake fluctuates from month to month with the highest lake levels in October and November.

Like all of the Great Lakes, the ecology of Lake Huron has undergone drastic changes in the last century for this reason it is important understand and predict Changes in the level, which the lake has above its average or normal level (577 feet above sea level).

For example Lake Huron has suffered recently due the introduction of a variety of new invasive species, including zebra and quagga mussels, the spiny water flea, and round gobies.

A more detailed study could identify more variables such as these in order to generate a more adequate prognosis, it is important to recognize times when there is an abrupt change and to answer the cause of them

Figure 2 shows a graph of the level change (ft) with respect to its average level (577 ft)

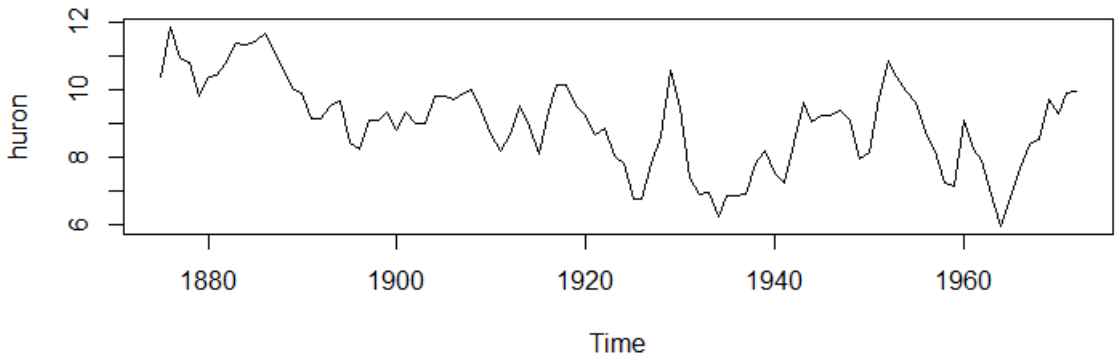

Figure 2: level change (ft) with respect to its average level (577 ft)

The data is provided in a function, from the community of R (see: https://www.rdocumentation.org/packages/artfima/versions/1.1/topics/Huron)

As is evident, there is a steep decline in 1965, but not only in this lake, but also in others, as shown below (Figure 3).

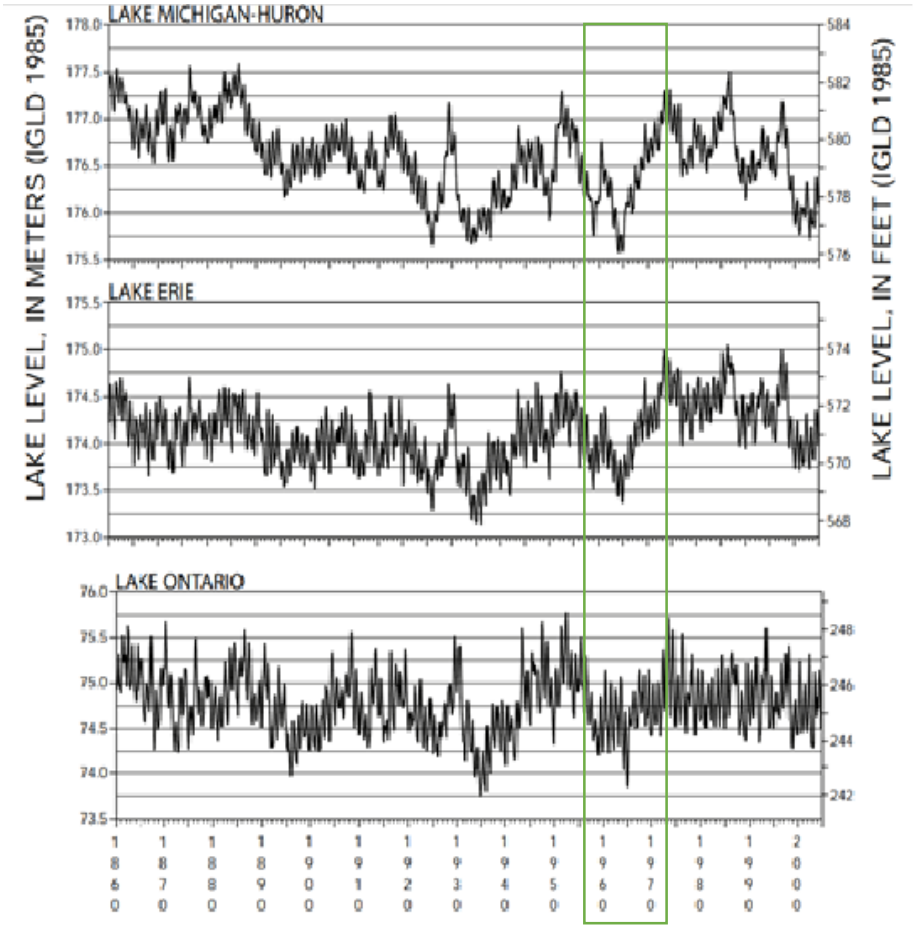

Figure 3: Level change plus elevation above sea level

Since the lakes are not close, it must be a factor that has affected the United States, so think about observing the United States temperature change over those dates

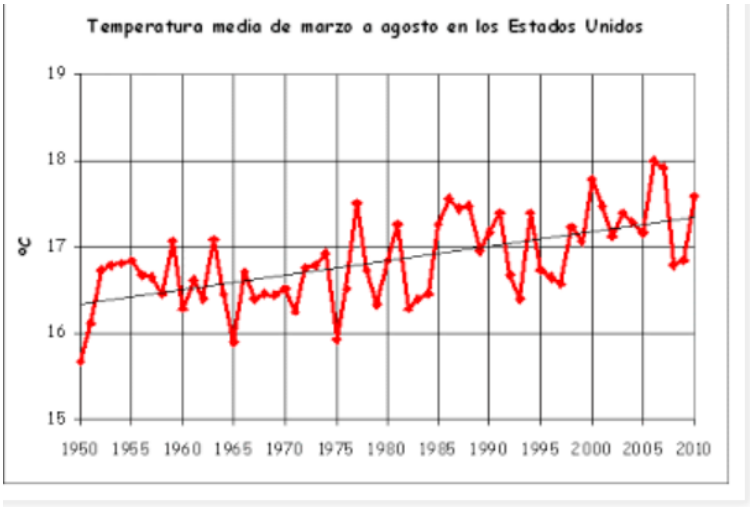

Figure 4: United States Temperature from 1960 to 2010

The temperature in 1965 decreased by just one degree, this could be the reason, however the coefficient of dilatation of water is extremely small at temperature near to 20℃, this is :

$$\alpha = 69 \cdot 10^{-6} K^{-1}$$

So we would have to look for more explanations to know if it is important to take these changes in the model or not.

In case it was an important event we could use *Dummy variables* or *intervention variables*

MODELING

The model constist on use a technique known as: Cubic Spline, this is method based on picewise method, which converts the nonlinear function to linear into pieces that is, we introduce points where the slope of f can change. These points are called knots.

A smoother result can be obtained using piecewise cubics rather than piecewise lines. These are constrained to be continuous (they join up) and smooth (so that there are no sudden changes of direction, as we see with piecewise linear splines) [1].

I Also converted the scales for experimentation, for example to logarithmic

Results:

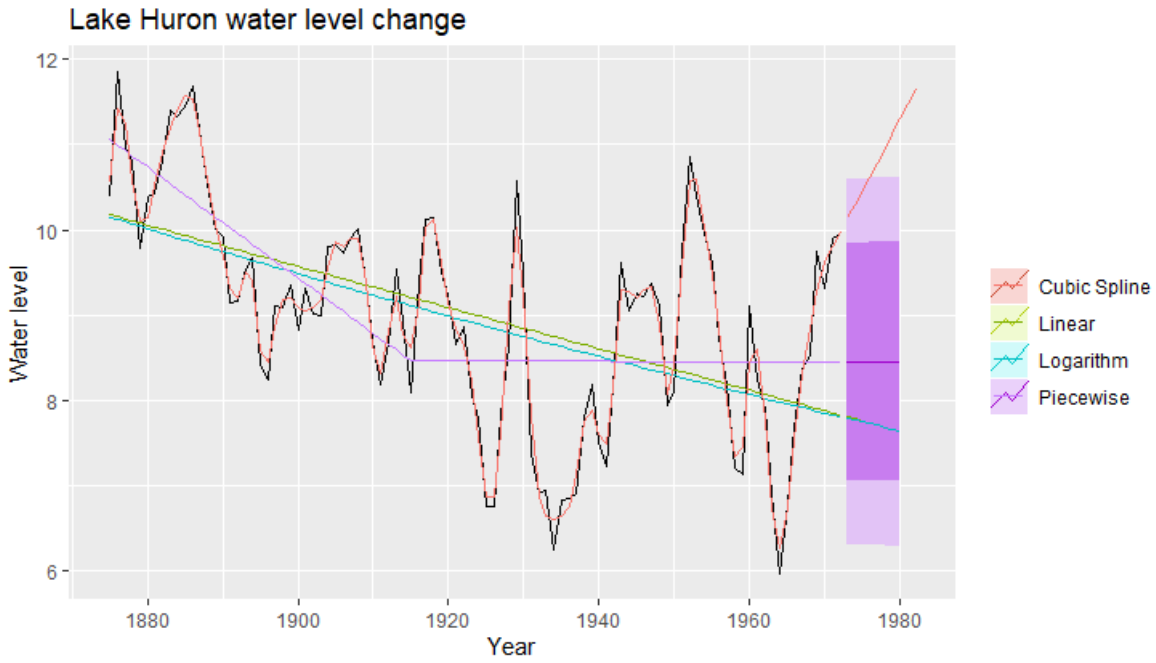

Figure 5: Forecast for 1980 level change, with 4 methods

REF:

[1] Hyndman,R. & Athanasopoulos, G. (2018). Forecasting: Principles and Practice. Australia: Monash University.