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Analyzing Historical Trends to Determine a Proper Dam Storage Amount

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Abstract

The most pernicious natural disasters are droughts and heat waves. These cause the most loss of money and life, more so than any other natural disaster (in the United States). Unlike other natural disasters and pestilences, droughts occur over an extended area and time period, and can affect their area continuously. Droughts are also the most diverse in what they can affect. The effects of droughts can spread to surrounding areas, which is the first problem. The second problem is that repeated droughts can quickly deplete the water supply. *The flaw in the current indices we have is that while they consider the on-hand water supply while dealing with droughts, they leave out the variable of supplying water to the surrounding areas. Our goal in this project is to create an index that considers all these factors involving water drain to assess the optimal amount of water needed in a dam.* There are two types of data and methods we will be using to achieve our goal. We will be using rainfall data, stream flow data, and a dam inventory. In addition, we will be using a census for crop moisture and crop data in order to determine if a drought is incoming. We will be using deficit and demand algorithms to determine the ideal amount of water and to create the system framework for predicting droughts. The three main applications of this will be water management organizations, forecasting crop yields and optimizing agricultural water use, and supply chain corporate water risk. The main yields from this project will be drought warning and watch rules for reservoir operation, generating a "Crop advisory" and yield predictions, municipal and industrial water conservation strategies, and guidance for investment and insurance industry.

Background

Droughts are an especially dangerous kind of natural hazard because they have a longer duration and wider area of effect than any other natural disaster. In addition, the losses are massive, often in the hundreds of millions of dollars. Droughts are indiscriminate, and hurt all factors of society. What makes them so dangerous is also the fact that we lack a complete understanding of droughts—specifically their long duration and variety of effects. We are hurting ourselves every minute we sit back and reactively deal with droughts, when we could be proactively dealing with and predicting them.

Objective

The goal of the proposed research is to develop a True Drought Index (TDI) that could be formulated to consider all potential demands in aggregate, and also be disaggregated to specific uses using cumulative water deficits as the measure, and to develop a systematic framework for updating drought management plans by *monitoring and forecasting* the proposed drought index up to a season ahead. This can be used to develop proactive management measures such as restrictions and hedging. Given the already customized (sector specific) nature of the proposed drought index and its ability to represent the variability in both supply and demand, the early warning or forecasting of the index would not only be more beneficial over the current early warning systems, but also complement the drought early warning systems in place by the national integrated drought information system (NIDIS).

Methods

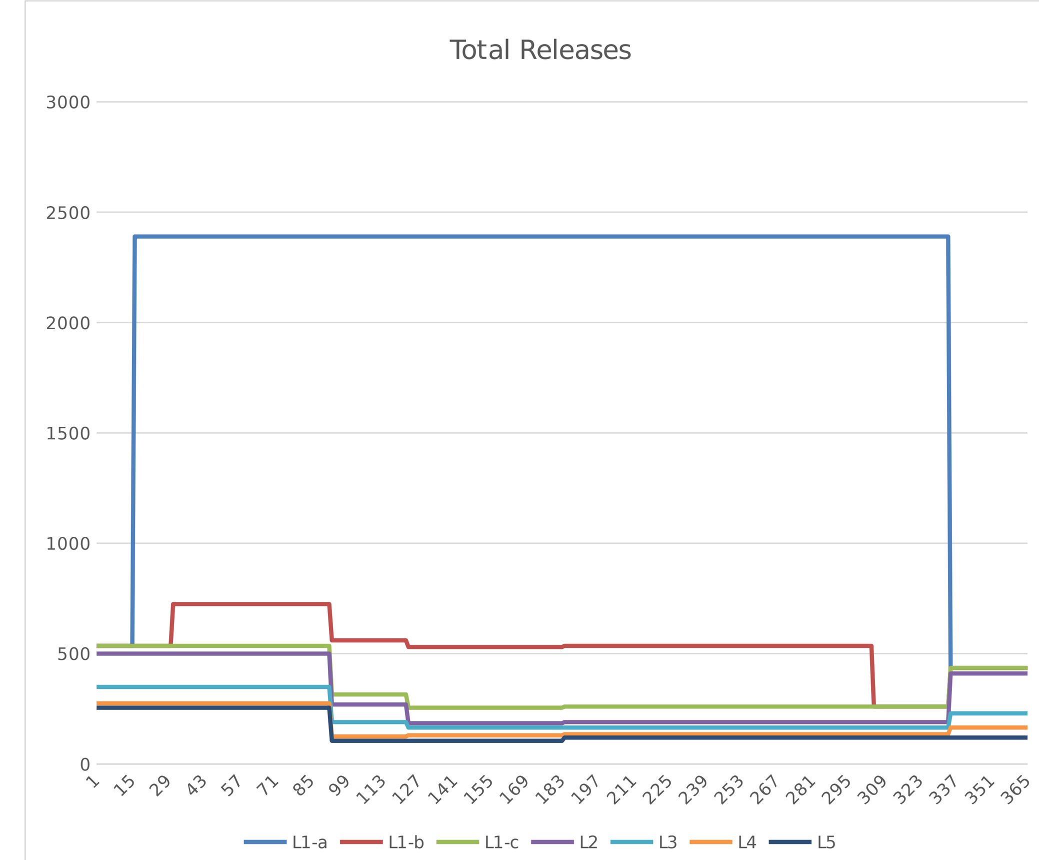
Prior to the start of this project, we had the data, however they were not separated and needed to be organized to be usable. In my case, I took the data and first organized and separated them in Matlab, and then I exported the fixed data tables back to Excel, which I used to make graphs.

Discussion

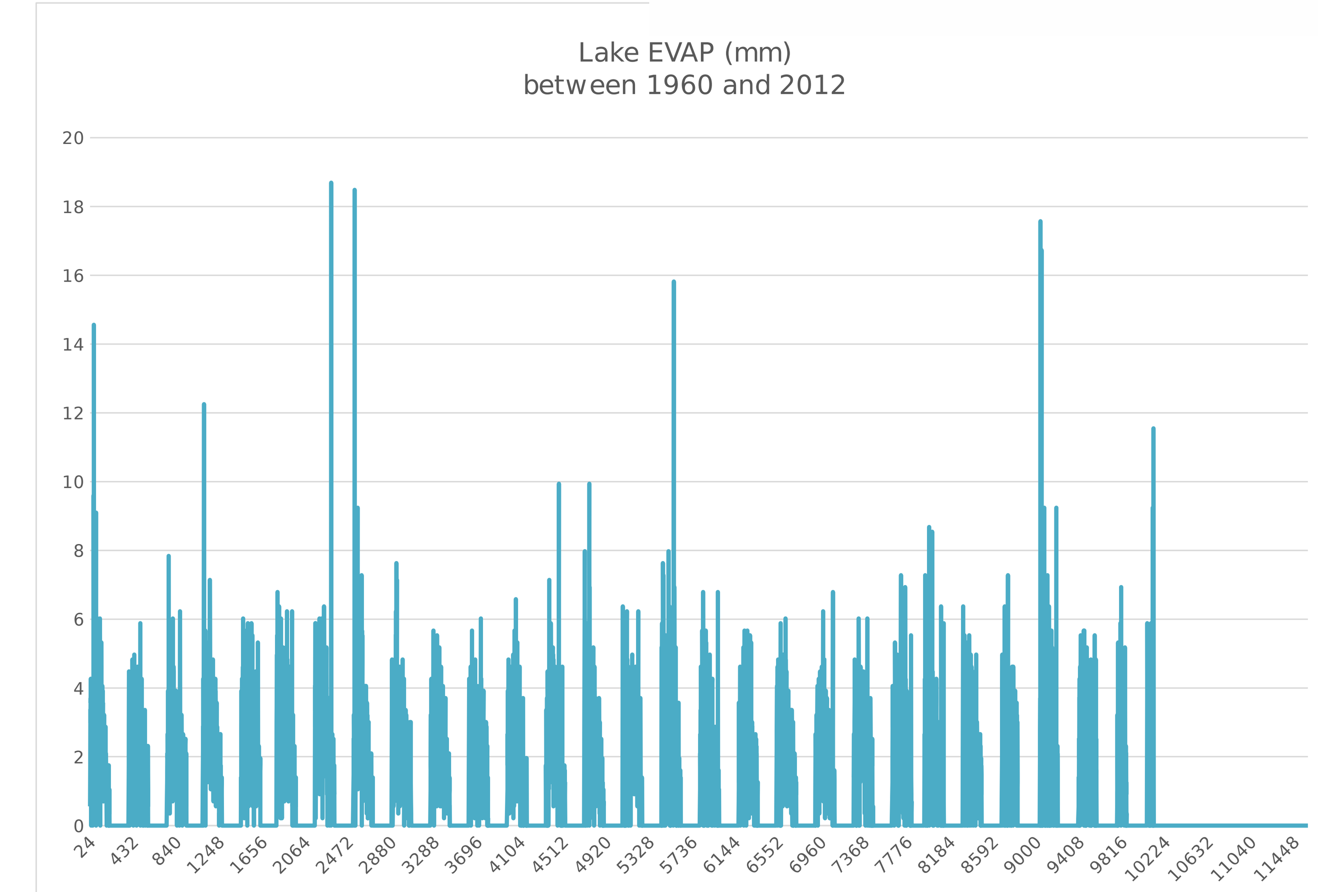
How best can droughts be indexed considering the multi-scale variability in climate and the different potential use patterns for water, while representing both seasonal as well as multi-year droughts? Can one improve the forecast of drought impacts and better inform multi-sectoral management strategies using such indices? What are the organizational constraints and limitations imposed upon the key stakeholders (i.e. water users) in a basin for the use of drought informational products and services?

Conclusion

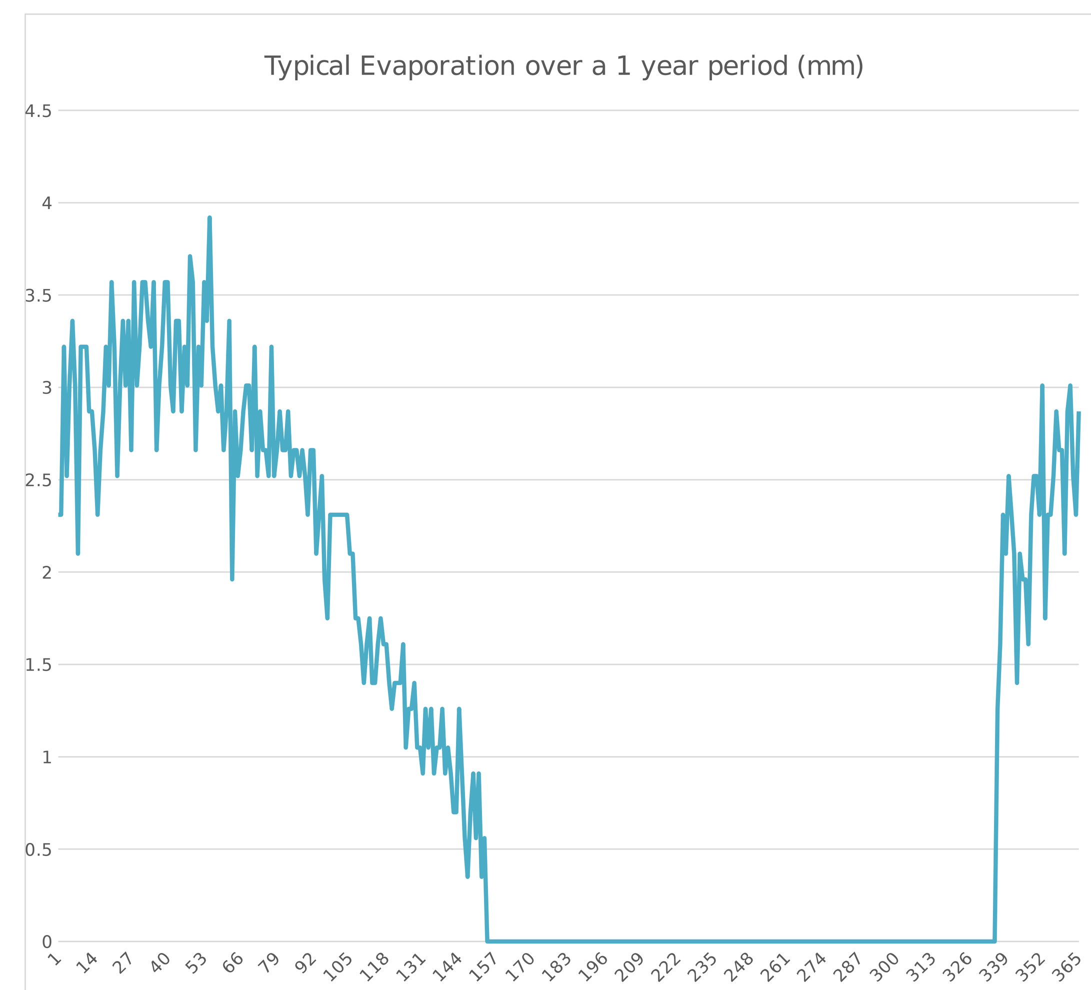
In conclusion, an equation for the creation of a drought index was created by retrieving key information from data tables and plugging them into the mass balance equation.



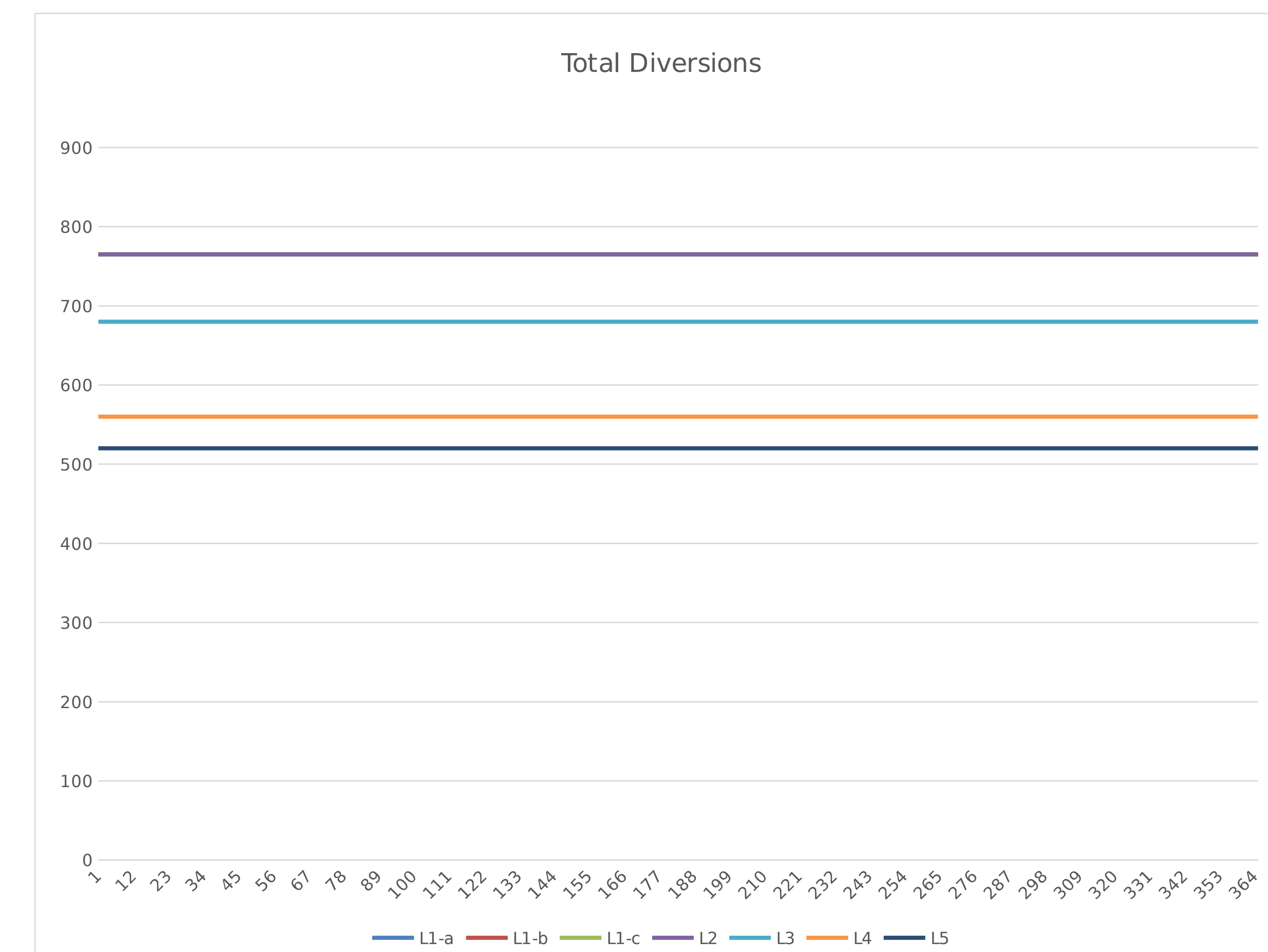
This graph shows the releases of water for all the dams servicing NY



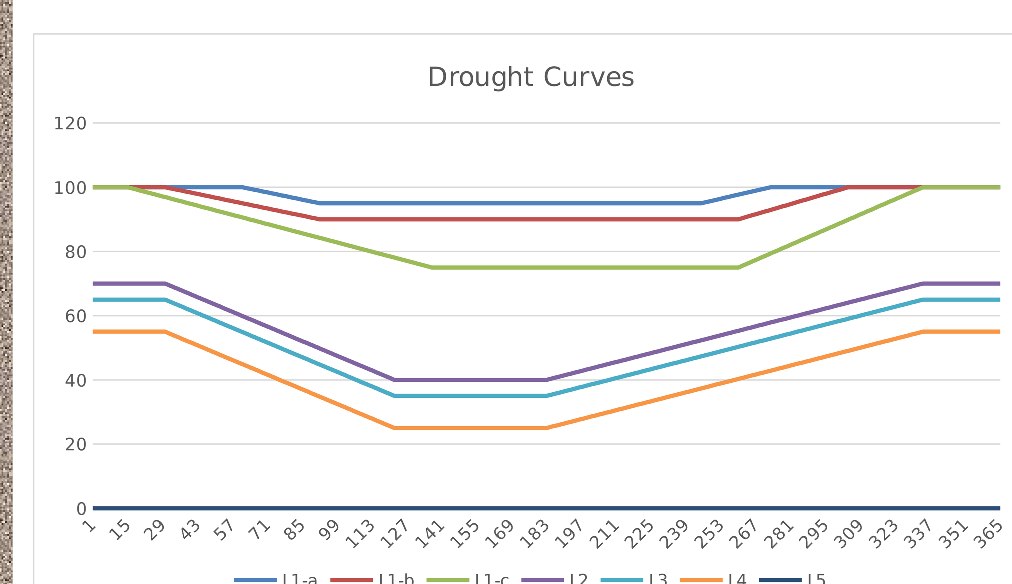
This graph shows an average of all the dams' evaporated water from 1960 to 2012, grouping by amount of occurrences of a certain mm of evaporation.



This graph shows an average of all the dams' evaporated water over a one year period, grouping by amount of occurrences of a certain mm of evaporation.



This graph shows the diversions of water for all the dams servicing NY



This is a graph illustrating the storage capacity of a dam throughout the year

$$TDI_{MY}^{J} = \max_t (deficit^{J/T})$$

This is the mass balance equation for predicting dam storage.

Acknowledgments

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