

Heading: Predicting the production of hydroelectricity in Ethiopia using only precipitation and temperature data.

Introduction: Using a hydrological model that translates precipitation and temperature data to river runoff can help predict the energy produced from hydropower source from these rivers.

Main text:

Ethiopia produces a whopping 86% of its electricity from hydropower source, still they tap only about 9% of their hydropower potential. The untapped potential is huge and can help achieve Ethiopia's goal of becoming a lower middle-income country by 2025. Additionally, it could make Ethiopia a reliable regional power hub, through selling energy to neighboring countries when in surplus of energy. An important feature of hydropower is that it usually, but not always, relies on water stored in reservoirs, this characteristic of hydropower can be taken advantage of for irrigation purposes and thus moderate the effects of the frequent drought periods the country is victim to.

Still, Ethiopia is subject to frequent power shortages. Luckily, they are part of the East African Power Pool, so this power shortage is usually made up for by buying energy from other members of the pool. This is where this project is useful: forecasting future production in energy allows Ethiopia to buy energy ahead of time when prices are low, but also to sell any surplus electricity to neighboring countries instead of going to waste. This is the task Refinitiv has set for me to investigate, since they themselves supply hydropower generation forecasts for several countries in the world using a modified version of the HBV model.

To understand how this model works, it is useful to picture a plastic box which has several tiny holes on its upper side so that water can drip through them to the bottom, and one bigger hole on, say, its left side that acts as an exit for said water. If you know how much water gets inside the box and what temperature is it within it, you can tell (roughly) how much water is going to come out of the exit. This is the idea behind the HBV model. Additionally, if you know how much energy was produced, say, by having at the exit a turbine that is set in motion when water flows through it, it is possible to find a relationship between the weather and the energy produced.

One important question remains: what if there is an object inside the box, an object that soaks in water, like a sponge, or maybe even, a human being, thirsty at that, wouldn't the volume of water that gets out of the box be reduced? And the answer is yes! And if there is a way to avoid having to count the number of water-soaking objects in the box, that would save us a lot of time.

This is why to bypass this problem we do something called model calibration. First, we need weather and observed runoff data for the same period, then we use them as input to our (HBV) model. Next, our model comes up with its own computed runoff, and lastly, we start tweaking the parameters of the model until the computed runoff matches closely the observed one.

Since two kinds of weather datasets (CPCP and CFSR) were already provided by the company. I was left to the task of constructing a Q-target series (observed runoff). This also meant that an extensive search for runoff data was necessary. After finding such data and entering it in the model, the model's performance was assessed. The model using CFSR data was found to perform better than CPCP's by a substantial margin. Nonetheless, the results are promising for both models. Suggestions for further work in this subject relate to the quality of the runoff data used, as the data used in this project originated from a secondary source, and missing runoff data was filled in using unknown interpolation equations. For this reason, it is recommended to get the raw data from the primary source, namely the Ministry of Water, Irrigation and Energy. This would allow for greater flexibility during the construction of the Q-target series and therefore a more accurate runoff estimation and by the same token hydroelectricity forecast.