Heatwave Impacts on Nuclear Power Plant Operations

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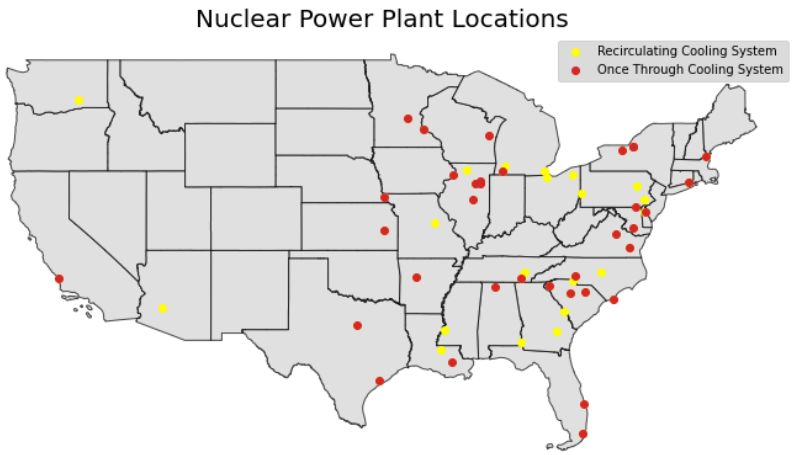


Figure 1: Locations of nuclear power plants identified by cooling system type.

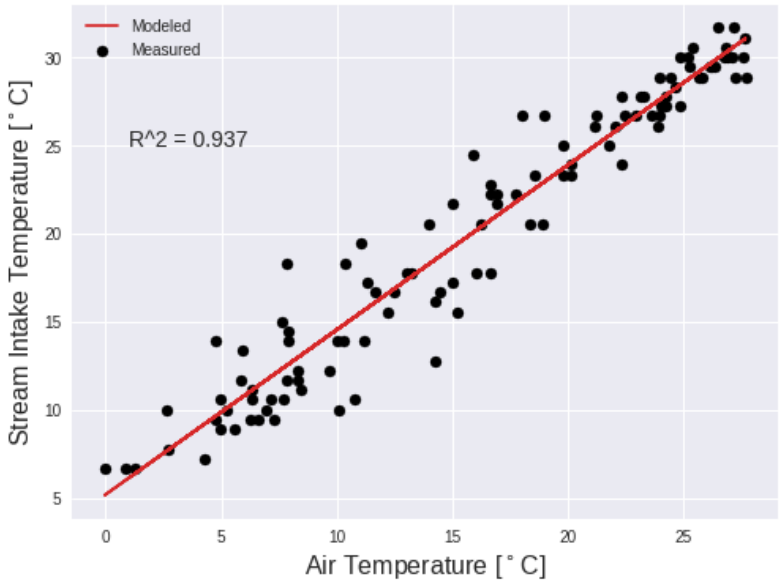


Figure 2: Correlation between monthly average air temperature and monthly average stream intake temperature at Browns Ferry Nuclear Plant. Data sources: EIA form 923 and NREL NSRDB.

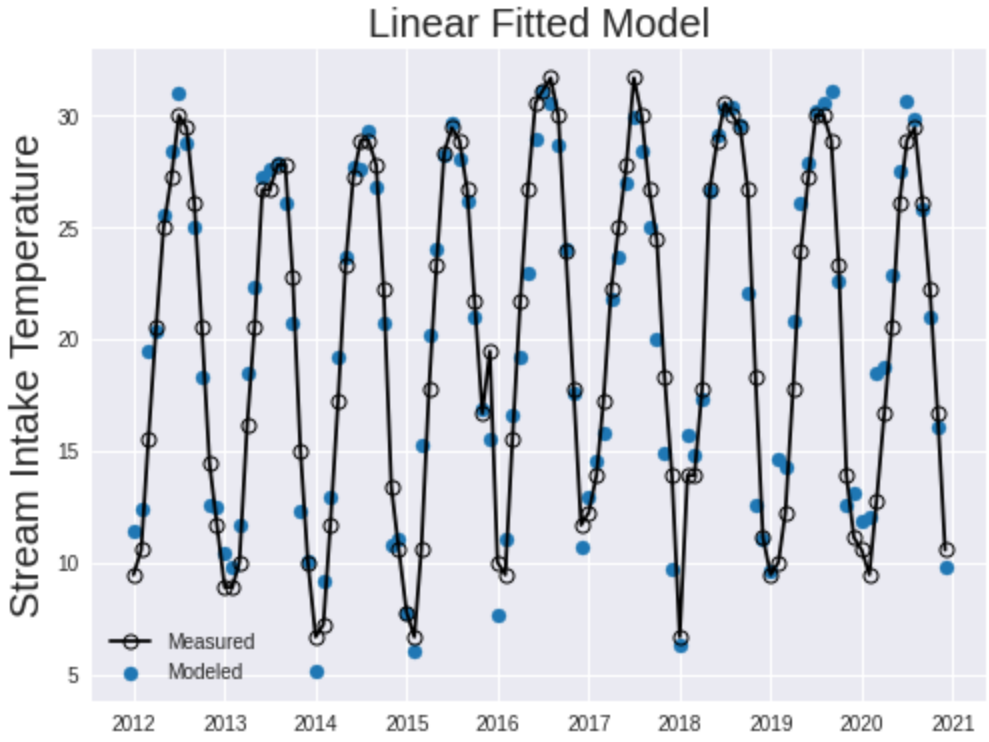


Figure 3: Monthly average power plant intake temperature at Browns Ferry Nuclear Plant with the predicted values from linear regression with ambient air temperature. Data sources: EIA form 923, NREL National Solar Radiation Database.

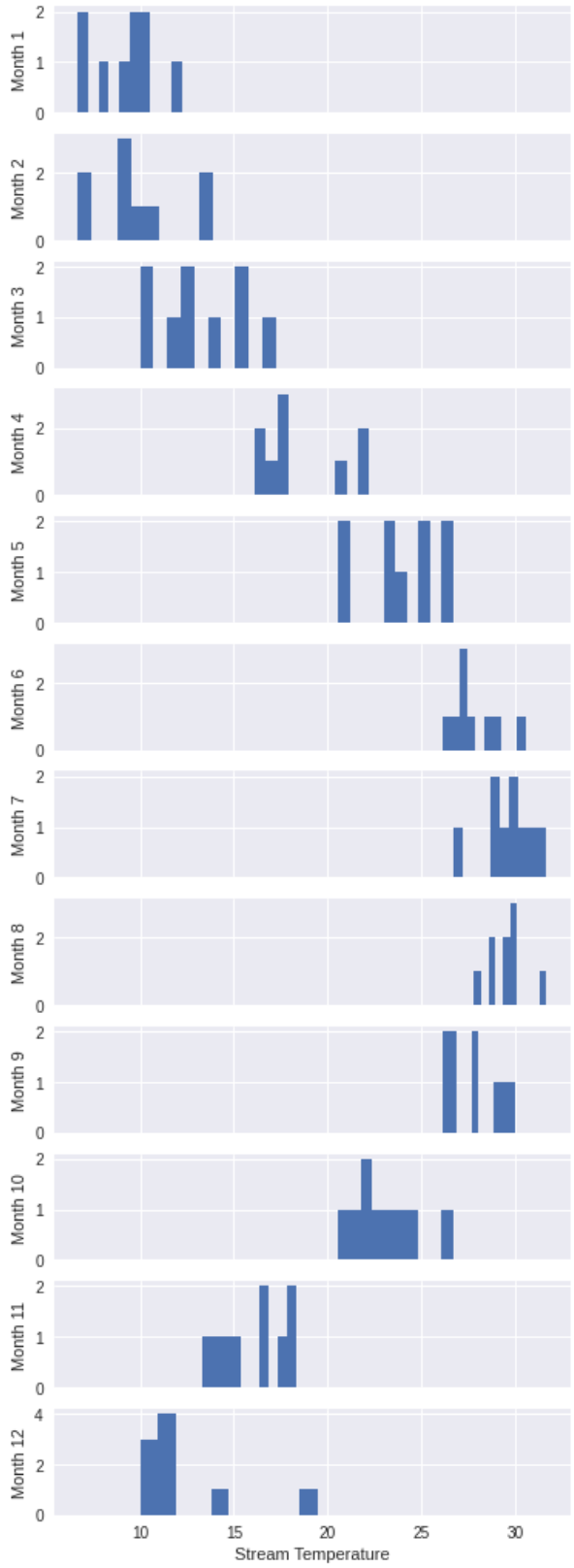
Want:

1) What is the threshold intake temperature where the nuclear plant will exceed effluent temperature limits if operating at full power.
2) Under different climate futures:
    a) The number of days per year or per month that a nuclear plant operating at full power exceeds the effluent temperature limit.
    b) For each day the temperature exceeded the threshold, what power derate is required to meet temperature limits? (Fortunately, constant operating power is a good assumption for nuclear plants, a first-order estimate is a step change).

Have:

1) A linear model that connects air temperature and stream temperature.
2) An energy balance that calculates the effluent temperature.
3) 30-minute resolution temperature data.

Question: Do I have enough data to answer the questions I am asking?



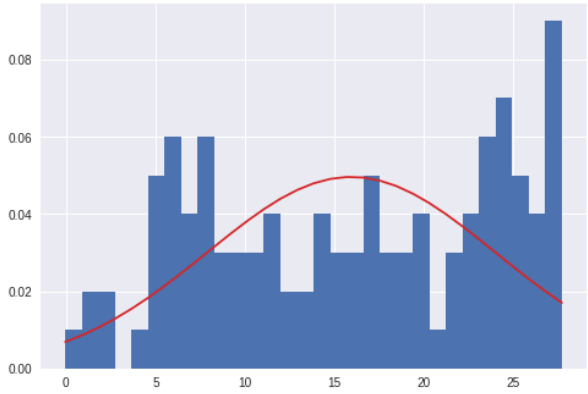


Figure 4: Histogram of all intake temperatures (above). Histogram of intake temperatures by month (left). All data for Browns Ferry Nuclear Plant.

Due to monthly averages, data is very sparse. The mean temperature clearly moves, but I don't think this is enough data to sample from a distribution.

Also, it's strange that the temperatures look bimodal. Not sure what that's about.