Rangeland Project Documentation

The project, as per my understanding comprised of the following 5 phases:

1. **Initial Discussion & THI:**
    - This phase revolved around the calculation of THI variable (Thermal Heat Stress)
    - The data used for calculating THI was Grid met data.
    - Path for the data in Kamiak: "/data/adam/data/metdata/historical/UI_historical/VIC_Binary_CONUS_1979_to_2019_20200721"
    - Resolution chosen: 16D
    - Formula used for calculation:

      Calculating T_{air}:

      $$T_{air} = {(T_{min} + T_{max})}/{2}$$

      Calculating R_{mid}:

      ```
      df_one['RMID'] = (df_one['RMAX']+ df_one['RMIN'])/2
      ```

      Calculating THI variable:

      RH = Rmid/100

      Projected daily values for average daily temperature (T_{air} in degrees Celsius) and relative humidity (RH) were used to calculate THI as:

      $$THI = 0.8 \times T_{air} + RH \times (T_{air} - 14.4) + 46.4$$

Reference taken from Matt Reeve's paper on Rangelands: Vulnerability of Cattle Production to Climate Change on U.S. Rangelands

2. **Selection of variables:**
    - It was decided that we need monthly aggregation of data to find weather shocks and patterns.
    - Please find below the list of the final variables that were selected for analysis:
        i. County
        ii. State
        iii. Date: Monthly (denoted by last date of each month, January 1979 to December 2019)
        iv. RMIN: Minimum Relative Humidity
        v. TMIN: Minimum Temperature (Celsius degree)
        vi. Emergency: Number of days THI >=84
        vii. Danger: Number of days THI>=79 and THI<84
        viii. RMID: Average Relative Humidity
        ix. TMAX: Maximum Temperature (Celsius degree)
        x. Normal: Number of days THI < 75

xi. RMAX: Maximum Relative Humidity
xii. TMID: Average Temperature (Celsius degree)
xiii. ALERT: Number of days THI>=75 and THI<79
xiv. THI: Thermal Heat Index
xv. PPT: precipitation (mm/month)
xvi. THI_std: Standard deviation in THI
xvii. THI_90: 90th percentile of THI

Reference for THI Threshold Selection:

https://beef.unl.edu/beefwatch/heat-stress-handling-cattle-through-high-heat-humidity-indexes

3. **Selection of Counties:**
   - The final list of the counties was shortlisted after considering the criterion- (Area >50,000 acres) or (Area <= 50,000 and coverage% >= 10%), where Area = Area of county covered by rangelands (in acres) and Coverage% = $\frac{\text{Area of county covered by Rangelands}}{\text{Total area of the county}} * 100$
   - The total number of counties considered: 896+48 = **944.**
   - This accounts for **40%** of the total counties which have at least 1 pixel of their area being covered by rangeland.

Reference for Rangeland grids:

https://data.fs.usda.gov/geodata/rastergateway/rangelands/index.php

4. **Monthly aggregation of daily data:**
   - Total number of grids: 119260
   - The binary files containing the monthly data of each rangeland grid were generated using the binary files with daily data. The script used is present in the Aggregations folder.

5. **Aggregation of monthly data over county, state, and month:**
   - Total Number of counties: 944
   - Final Length of data frame: 64448 rows × 17 columns
   - The monthly data of each grid was aggregated based on the state, county, and month (and year) it belonged to. The aggregation measure used was: mean