University of Colorado
Department of Civil, Environmental and Architectural Engineering
CVEN 5333 Physical Hydrology & Hydroclimatology

Hydroclimate Project

Due by December 22, 2022

Diagnostics and Prediction

Brush up your statistical analysis skills – plotting, correlation, regression (multivariate, logistic), prediction skill measures etc. It is a good idea to review topics from CVEN 5454 (http://civil.colrado.edu/~balajir/CVEN5454)

The objective of this project is to explore climate data libraries (IRI, NOAA-CDC) and analysis tools to develop the skills for (i) Diagnosing inter-annual variability in regional hydroclimate variables, (ii) Identifying the potential physical mechanisms for the variability and (iii) Potential long-lead predictability.

1. Select a region/watershed of interest in Western, Southern, Southern Eastern or MidAtlantic region of the US. *If you wish to select an international region come talk to me*. Try to select a streamgage with the least regulation (i.e. as close to the head waters region as possible) and long record (atleast 30 ~ 50 years ending with the current period) in the basin – you can use the USGS site http://water.usgs.gov/ to help you with selecting the gage. Identify key water or resources management issues in the region/watershed so as to motivate your analysis. Use *streamstats* to obtain the drainage characteristics.
2. Obtain basin precipitation and temprature. You can identify the climate division that most contributes to the streamflow at this gage. This site (http://www.cdc.noaa.gov) has the climate division precipitation and temperature for the entire US. Or you can compute a basin average precipitation and temperature from PRISM data or other grided product from IRI data library; for snow you can obtain snow water equivavlent (SWE) from http://www.wcc.nrcs.usda.gov/snow/
3. Obtain and plot the climatology of the flow, precipitation and temperature – thereby, identifying the peak seasons of interest. Some basins might exhibit more than one active season. Identify the runoff mechanism – snow melt, rainfall-runoff or both.
4. Make scatterplots between these variables for the seasons of interest (identified above) and also for key months within them. This will help identify the consistency of the relationships (e.g., more precipitation/snow correlates with more flow; more precipitation/snow correlates with less temperature etc.). Also plot time series of these variables to identify the temporal variability (i.e., trend, quasi-periodic variability, etc.).
5. Diagnose the large-scale climate signal(s) influencing the variability of the streamflow, precipitation and temperature by performing analyses of large scale climate variables using the NOAA CDC or IRI Data library site.
   Via *correlation* and *composite* analyses of circulation variables (Winds, Precipitable water, Relative humidity, IVT, sea sufrace temperatures etc.) identify the potential physical mechanisms causing the variability.

6. Via correlation analysis identify potential predictability and predictors of the seasonal streamflows. Develop a statistical prediction model – linear regression model for the flows; and/or logistic regression model for threshold exceedance etc. – and evaluate the skills.
7. Investigate if the relationships identified from 4, 5 and 6 are non-stationary?
8. Summarize the results in a report – with implications to watershed management. The suggested report format is below (feel free to modify/enhance).

Introduction

- Background of the region/watershed
- Some resource management issues – flooding, drought, water supply, ecology, etc.
- If you read any literature, summarize the state of understanding.
- What aspects need understanding and predicting

Data

- Describe all the data sets used in the study with references/links to the sources

Methodology

- Composite and Correlation analysis to identify the physical mechanisms of variability in the hydroclimate variables
- Regression based models for prediction and skill evaluation

Results (show the figures and describe them)

- Temporal variability – time series
- Consistency between the variables – scatterplots
- Physical mechanism of interannual variability – correlation and composite maps from simultaneous season
- Predictability – correlation maps of flow with climate variables from preceeding season
- Identify predictors – from the correlation maps identify region and create predictors
- Prediction – Statistical models, fitting skill and predictive skill

Summary

- Summarize
    - Causes/drivers of interannual variability in the hydroclimate variables
    - Predictability
    - Suggestions for future work to improve these findings

9. For bonus points, repeat 4, 5 and 6 with other data set (e.g. Stream quality data, stream temperatures, etc.) that is of interest at the location.