Deriving Data-driven Insights from Climate Extreme Indices for the Continental US

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INTRODUCTION

❖ SRCC - 1/6 National Regional Climate Centers of NOAA
❖ Big Data Repositories - Data Acquisition, Management, Analytics and Visualization
❖ Climate observations, Extremes, Climate models, Derived grids, Products
INTRODUCTION

❖ Types of Data Holdings - Temperature, Rainfall, Snow observations, Tornado/Hail/Wind occurrences, Storm Surge Data, Water Reservoir Data (regional)

❖ ACIS - Applied Climate Information System
  ❖ Big data warehouse, WS API (www.rcc-acis.org)
  ❖ Python, Go, InfluxDB, HDF5, PostgreSQL, Redis, Javascript, Pandas
  ❖ Developed by RCCs.
Motivation

- 3rd National Climate Assessment, 2012.
- Point-based analysis vs Area-based analysis
- Single station vs. climate division based.
Methodology

- ACIS archives 26,000 daily climate measurement sites
- Measurement sites that had a near complete data record - 3210
- Developed a new, extreme event dataset, TEF (Threshold Exceeding Frequency Dataset).
- Redis, Python, Pandas
- Sites grouped into 344 climate divisions
Methodology

❖ Analyzed/compared annual frequency of days above a certain threshold (extreme) for the time periods

❖ Is there an increasing or decreasing frequency of occurrence for each threshold?

❖ 20 different thresholds

❖ 3 non-parametric statistical tests - Mann-whitney, Wilcoxon, Kolmogorov-Smirnov.
Max Temp $\geq 95$ (Wilcoxon)
Min Temp >= 75, Wilcoxon
Min Temp \geq 65, Mann-Whitney
Min Temp $\leq 32$ (K-S)
Min Temp $\leq 10$ (M-W)
Min Temp <= 0 (M-W)
Analysis

- Southern and warmer parts of the US seeing warmer night time temperatures ($\text{min temp} \geq 75$)
- Northern parts known for cooler nights in the summer experiencing warmer nights ($\text{min temps} \geq 65$)
- North-east, mid-west and west of the Rockies - experiencing fewer days with min. temperatures $\leq 32$. 
In general, lower snowfall amounts in areas such as Idaho, Montana, Wyoming, Washington, Oregon and portions along the Appalachian Range.

Rainfall totals - vast portion of continental US - experiencing increased rainfall, but not a significant change.
Outcomes and Future Extensions

❖ High night time temperatures and effect on crop yield
❖ Tourism industry - ski resorts (lower snowfall, less number of days with min temp <=32)
❖ Inland water transportation - drought and shallow water
❖ Load on the energy grid and impact on propane heating industry
❖ Impact on health - pollen/allergies, ecological changes.