

Understanding Drought Awareness from Web Data -A Computer Vision Approach

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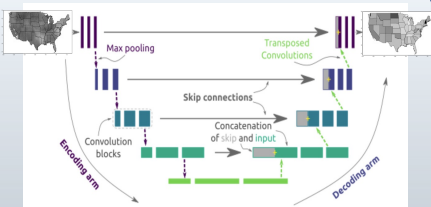
Abstract

We used computer vision (U-Net) model to leverage Standardized Precipitation Evapotranspiration Index (SPEI), Google Trends Search Interest, and Twitter data to understand patterns with which people in Continental United States (CONUS) indicate awareness of and interest in droughts. We found significant statistical relationships between the occurrence of meteorological droughts, as measured by SPEI, and search interest on drought topics over CONUS. SI tends to lag meteorological drought by a period of 2-3 months, however relationships between meteorological drought and corresponding search interest varies significantly over CONUS in both space and time. People in states with increasingly drier conditions generally have become increasingly interested in drought topics. However, with worsening drought conditions in California, public search interest on drought topics in the state has not increased significantly between 2016 and 2020, despite the overall search interest being high. We additionally applied sentiment analysis on 5 million tweets related to droughts and found that public emotions towards drought have become more polarized over time.

Data



UNet Model

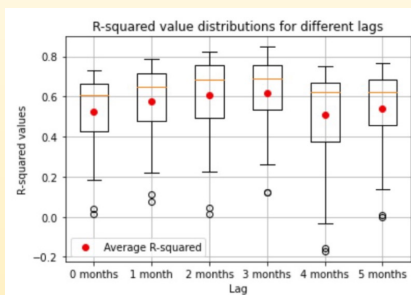


- Two encoder layers analyze images. The first picks up simple details, and the second finds complex patterns
- Decoder Blocks rebuilds the image in detail
- Skip connections link encoder and decoder layers, ensuring no loss of fine details from the original image
- This allows the model to learn nonlinear relationship between inputs and targets

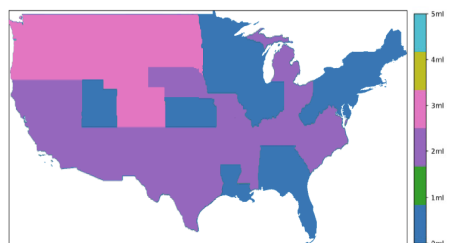
Interested in learning more?
Scan the QR code for a link to our paper or email me: mashman@ucdavis.edu



Do people respond to droughts by searching drought terms on Google and is there a lag?



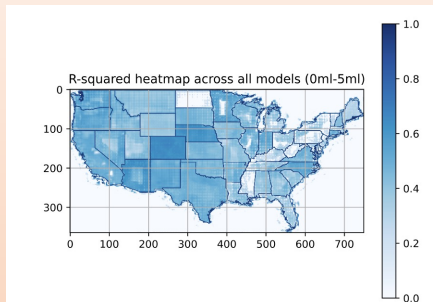
- 6 UNet models trained on lagged SPEI data
- Significant nonlinear correlations found
- The 2 months and 3 months lagged models performed best



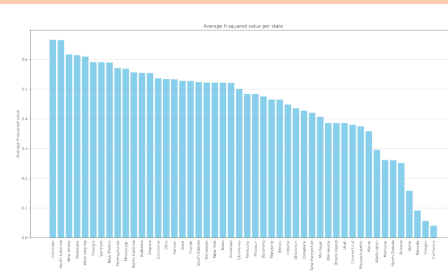
- Distribution of best lag models over CONUS
- 2 and 3 months lagged were the best performing models



Does the relationship between droughts and people's search interest vary over place?



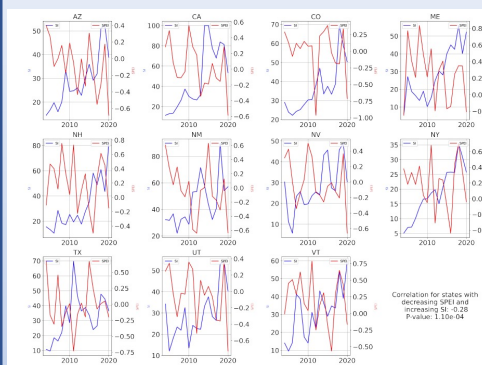
- Model performance (averaged over all models) per pixel over test period (2017-2020) was plotted
- Significant spatial variability in performance was observed
- Nonlinear correlations visualized



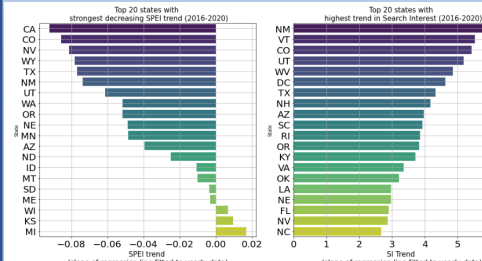
Search Interest is more correlated to droughts in states where droughts are comparatively recent (as indicated by USDM and various other data sources)



Have people in drought hotspots become increasingly interested in droughts?



Search interest has generally risen in states with increasingly dry conditions!

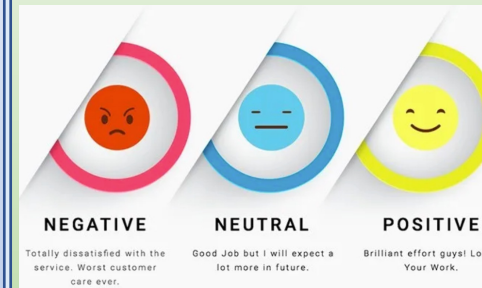


For California, with increasingly dry conditions, search interest did not increase recently!

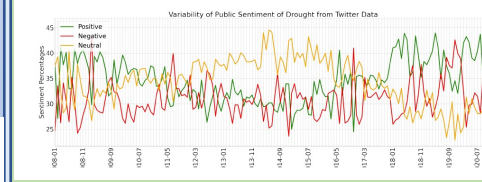


How have people's sentiments about drought changed over time?

Sentiment Analysis of Tweets



NEGATIVE: Totally dissatisfied with the service. Worst customer care ever.
NEUTRAL: Good Job but I will expect a lot more in future.
POSITIVE: Brilliant effort guys! Loved Your Work.



Sentiments are becoming more polarized

Future Directions

- Understanding the underlying mechanisms of change
- Computer vision based global drought prediction models