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# User-Oriented Agricultural Drought Information Cluster

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## Introduction

Agricultural droughts, usually due to abnormally high temperature, low precipitation, and insufficient soil moisture, can cause devastating impacts to a region's agriculture. Lack of proper drought warning and assessment systems may lead to enormous decrease in crop production and also in the amount of poultry and livestock, and thus endangering the food security and economics. Thus more and more scientists and researchers have their attention focused onto the cause and outcomes of agricultural drought. And they are yearning for a tool that would enable easy data downloading/accessing, calculation, analysis, and decision-making.

## Problems

Huge amount of satellite data, station-based observations, and drought related statistical information are stored separately in different servers (ftp, http or others) by the data providing agencies or groups. Researchers spend lots of time downloading data, and multiple Terabytes of space storing them. These data are often isolated from each other, and not always reusable (after being calculated or analyzed for a single index). Besides the big data challenge brought to drought researchers, methods that each agency used for calculating drought indices and analyzing drought are different, and most of them have not been known by the general public. There are hundreds of drought indicators in the field, yet not a platform exists for users to view how each of the existing indicators is being formed – we have to look into publications or individual user manuals for the detailed information of the data source, processing methods, calculation formula and other meta-data. A platform that displays how each index is being made at each procedure from data collection to result analysis needs to be urgently sought.

## Solutions

A one-stop self-service drought information cluster can serve as the platform for facilitating farmers and decision-makers, and the general public to have basic understanding of agricultural drought, and build up their own drought indicators from templates. And such a cluster will become an excellent model that carries out partnership and interoperability.

The system is to facilitate users to build up their own drought indicators in 3 steps: (1) Choose Dimension from Vegetation Conditions, Soil Moisture Conditions, Surface Temperature, and Crop Phenology, etc. (2) Choose Indicators from Vegetation Condition Index (VCI), Vegetation Health Index (VHI), Normalized Difference Water Index (NDWI), etc. and (3) Choose verification source.

The goal of agricultural drought information cluster is for users to define drought tailoring their own needs targeted for various applications, and to enable data, technology, and drought information sharing among different groups.

## Summary

The Cluster is a comprehensive monitoring and forecasting system that incorporates all principal components necessary for the analysis of agricultural drought. Thus, users can understand the behaviors of each indicator, and create their own drought indicators.

## Steps to customize drought indicators

(1) Choose dimensions and indicators to be feed into the analysis system.

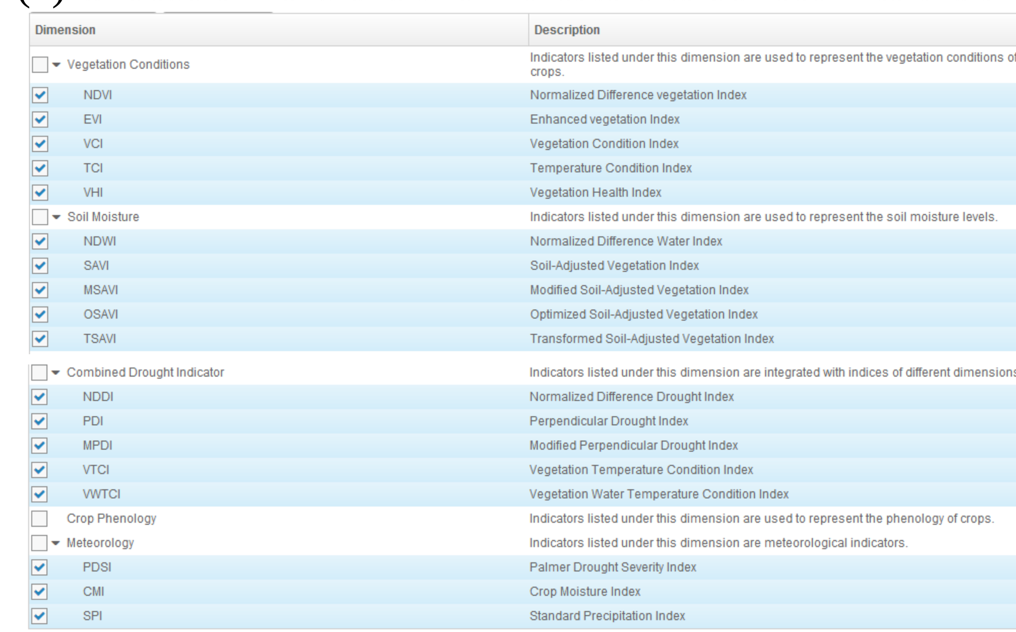


Figure 1. Dimensions to be considered include Vegetation Conditions, Soil Moisture, Combined Drought Indicators, Crop Phenology, and Meteorology. And for each dimension, user can choose none to all indicators for analysis.

(2) Explore the time-series behaviors of indicators, and fit the independent and dependent variables into a. Multi-Variate Linear Regression Model, or b. Least Squares Polynomial Model.

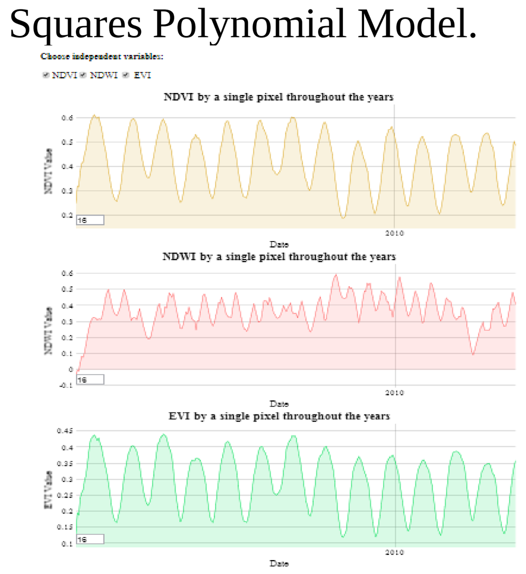
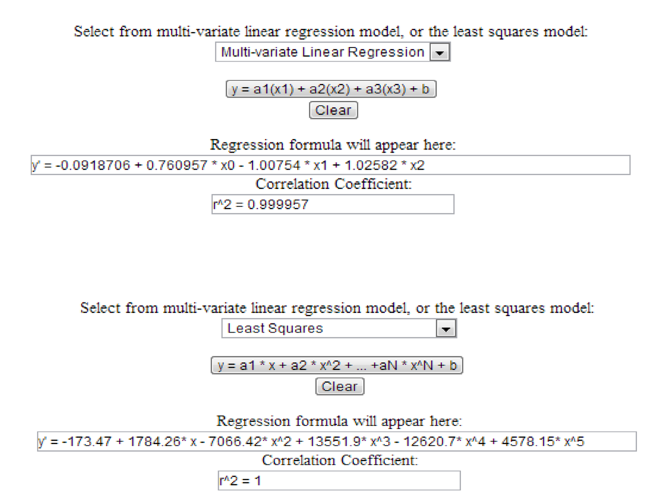


Figure 2 The time-series values for the three indicators chosen by user – NDVI, NDWI, and EVI through the period of observation (from 2005 to 2011). These indicators will then be fed into the correlation analysis model.



Figures 3 & 4. Select from multi-variate linear regression model, or least squares model to fit the chosen independent variables (indicators) to the verification source (e.g. soil moisture observations). A web service is to be invoked to calculate the CC.

(3) Adjust the weights of each indicator, and through linear combination, generate a combined drought index which is user-customized.

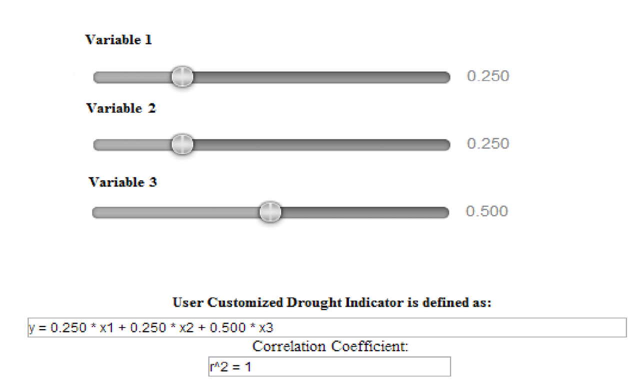
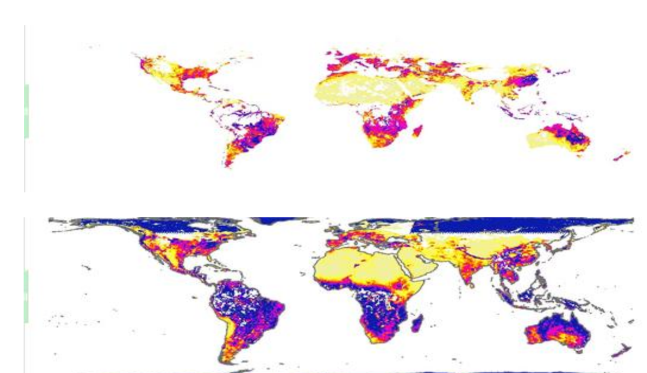


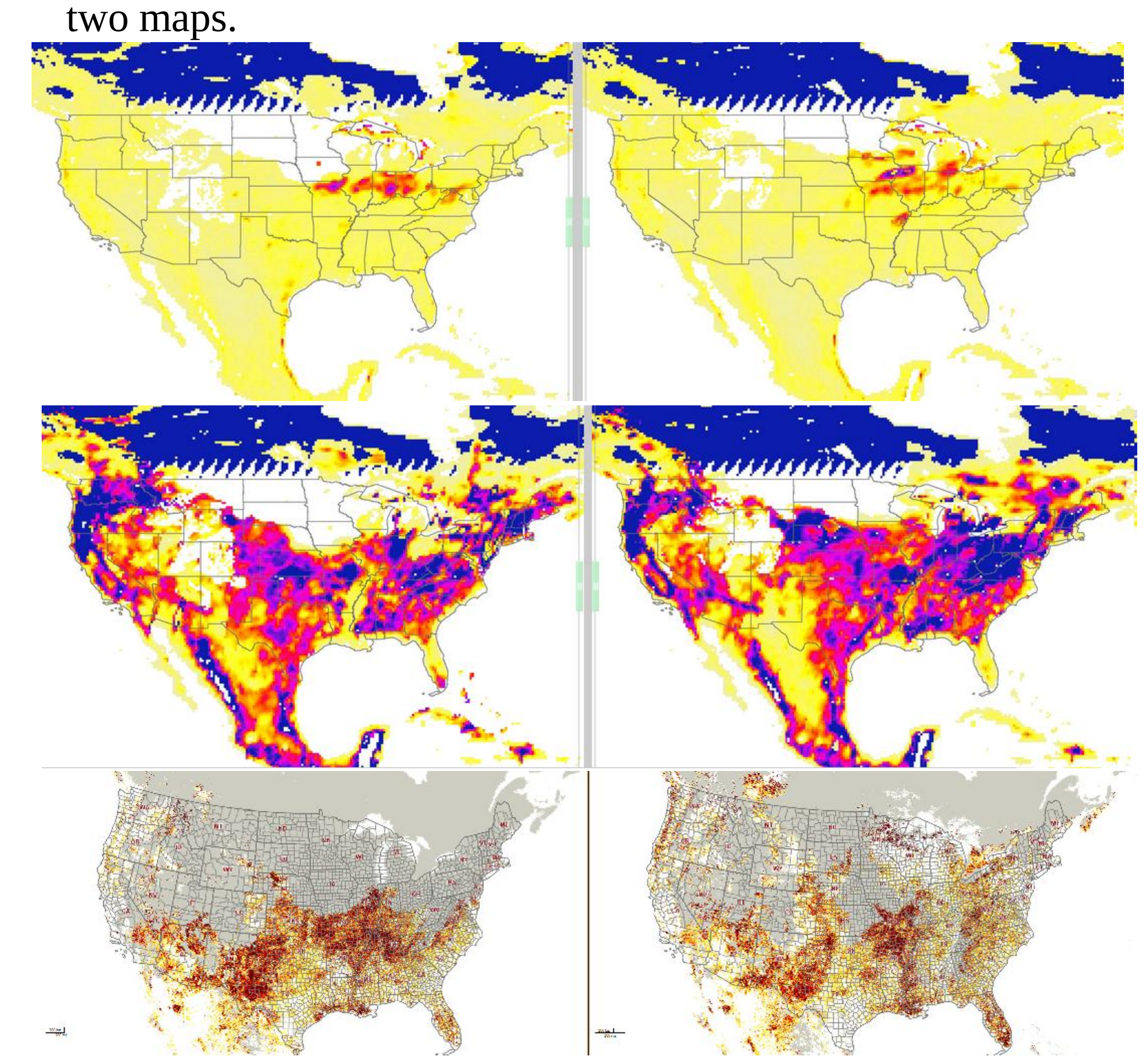
Figure 5. Tune the slider bar to adjust the weights of each variable to be used to define the new drought indicator. User can look at the automatically generated CC to find the most appropriate weights for each variable.



Figures 6 & 7. (top) The global drought map based on the new combined drought indicator #1 which simulates the AMSR-E Vegetation Water Content. (Bottom) combined drought indicator #2 simulating the ECV Soil Moisture.

## Comparison and Results

▪Visually comparing the drought and non-drought patterns between two maps.



Figures 8, 9 & 10. For two periods, 02/18/2010 to 03/04/2010, and 03/05/2010 to 03/20/2010, the continental U. S. is shown to be displaying different drought patterns with various drought indicators: (top) the new combined drought indicator #1 which simulates the AMSR-E Vegetation Water Content. (middle) combined drought indicator #2 simulating the ECV Soil Moisture, (bottom) GADMFS VCI

▪Compare the time-series behaviors of the customized indicator and the traditionally-used drought index by specified area (e.g. country, region, state, ASD, county, or even pixel-level).

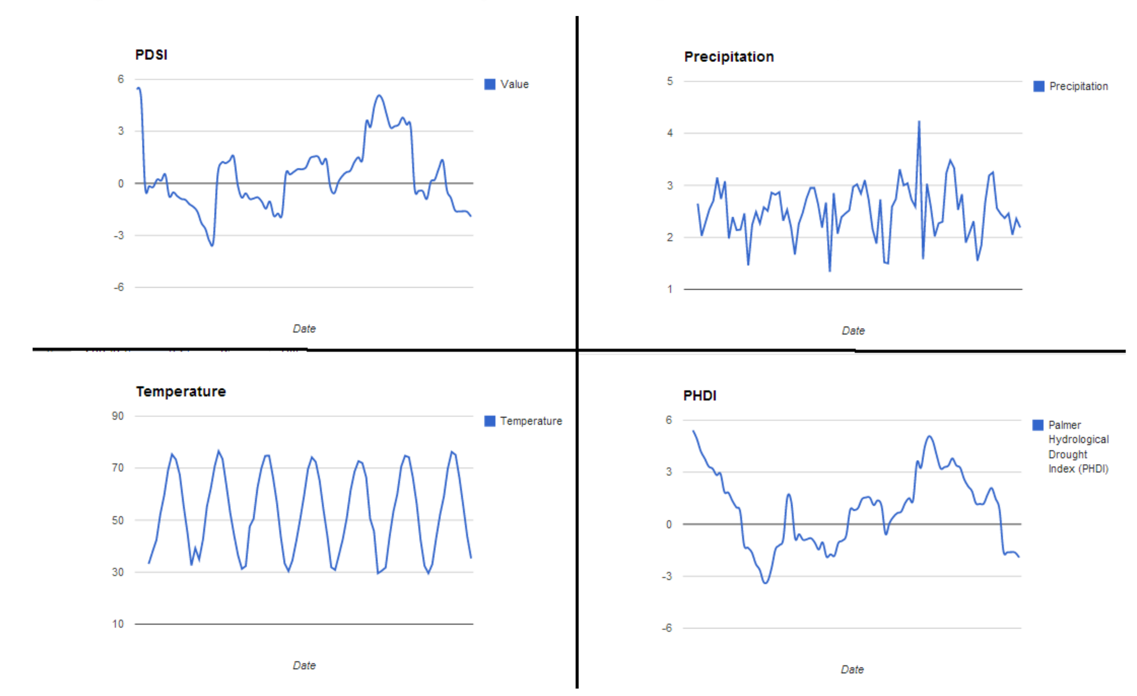



Figure 11. Additional time-series meteorological data provided to compare against the newly generated combined drought indicator.

## Related Publications

Meixia Deng, Liping Di, Ali Levent Yagci et al. (2013). Web-service-based Monitoring and Analysis of Global Agricultural Drought. In Photogrammetric Engineering & Remote Sensing, (in press).

Chunming Peng, Liping Di, Meixia Deng et al. (2012.) Using time-series modis data for agricultural drought analysis in Texas, 1-6. In 2012 First International Conference on Agro- Geoinformatics (Agro-Geoinformatics).