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STATEMENT OF PURPOSE:

This research combines agricultural and ecological drought concepts and represents a multi-stage framework to detect and characterize agricultural droughts considering CO2 uptake for drought recovery. In order to capture agricultural drought, the root-zone soil moisture is simulated using hydrologic models inputting remotely sensed data. Then, the root-zone soil moisture percentile is adopted to detect agricultural drought intensity over the US watersheds of contiguous united states (CONUS), which are delineated based on the USGS 2-digit hydrologic unit codes. Having detected agricultural drought, using soil moisture anomalies, we focus to determine the ecological drought recovery of terrestrial habitats using Gross Primary Productivity (GPP). GPP, representing the sum of the gross carbon (CO2) uptake by plant photosynthesis, which is a key component of the terrestrial carbon cycle. Recovery time for this analysis starts when the soil moisture after a drought episode goes above threshold when is called the termination month. Drought recovery continues until the GPP returns to its pre-drought functional state. The last step is to analyze the ecosystem water-use efficiency (WUE) during agricultural droughts and comparing the changes over different land cover types. Ecosystem water-use efficiency is the ratio of GPP and actual evapotranspiration (ET). The results show that the WUE increases during agricultural drought episodes and the maximum increase happen over dry regions. In addition, the dominant parameter is investigated to determine which factor plays more important role in WUE changes over drought episodes. Therefore, in this research we are going to visualize and address the following questions: • Droughts have complex development patterns, therefore, visualization drought propagation will facilitate taking actions for scientists and stakeholders to mitigate drought impacts. • Analyzing terrestrial ecosystem recovery from an agricultural drought episode, considering the time when GPP revert to its pre-drought condition. Visualising drought recovery will shed light on more vulnerable/resistant regions to drought episodes. • Examining the relationship between ecosystem WUE and land cover types based on the MODIS products over the study period will give the scientists the insight of ecological function of different regions with different climates. It also helps scientists to visualize drought recover duration is correlated with drought severity and land cover. • Identifying the response of WUE to different drought severities in regions with variable, climate; water availability; and management policies.

DESCRIPTION OF DATA SETS:

In this study, we use the monthly Gross Primary Productivity (GPP), monthly evapotranspiration (ET) with 1-km resolution and monthly Soil Moisture (SM) with 1/8˚ resolution from 2000 to 2014. Land Cover (LC) with 0.5-km resolution is also used for this analysis to compare the 3 mentioned data variability over each land cover type. GPP, ET and LC data were retrieved from MODIS. The MODIS GPP product (MOD17A3) was developed based on the light-use efficiency model and its accuracy and reliability are considered to be comparable with station observation. GPP is helpful for natural resources management, global carbon cycle analysis, ecosystem assessment and environmental change monitoring. The Global MODIS ET product (MOD16A3) is estimated based on the Penman-Monteith model, which uses meteorological reanalysis data and vegetation property dynamics (e.g. land cover, Albedo and lead index area) retrieved from MODIS as input variables. Validations of ET product have been carried out using station flux tower data over the USA, which showed a reasonable accuracy. ET dataset can be used to calculate regional water and energy balance, soil water status, additionally, it provides insight into water resource management. The MODIS Land Cover Type product (MCD12Q1) provides data of land cover classification over the Globe. The data is spatially aggregated into different resolutions for 2001 to 2011 years. SM data are simulated using the Variable Infiltration Capacity (VIC) with forcings data obtained from the Phase II North American Land Data Assimilation System (NLDAS-2) (Xia et al., 2012) for the period of 1979 to 2015.