Landscape Evaporative Response Index (LERI)

High-resolution monitoring of evapotranspiration across the Contiguous US

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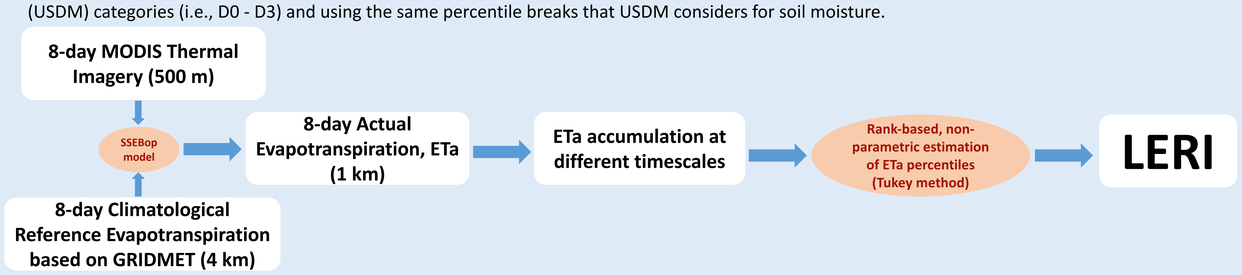
What is LERI?

LERI is an experimental drought-monitoring and early warning guidance tool based on remotely-sensed actual evapotranspiration. LERI estimates percentiles of evapotranspiration for each 1-km pixel indicating the relative evaporative response compared to the period of record. By its design, LERI largely reflects the availability of soil moisture that plays an active role in evapotranspiration at a given location. LERI is available from January 2000 to the present — a period that corresponds to the availability of the MODIS satellite data on which it depends.

LERI represents the anomalous state of land-surface moisture (i.e., soil moisture) that is readily accessible to plants (for transpiration) and the atmosphere (for evaporation from bare soils and water bodies).

How is LERI calculated?

LERI uses a rank-based, non-parametric method to estimate percentiles of the SSEBop Actual Evapotranspiration (ETa) data* compared to the available period of record (January 2000 to present). LERI percentiles are binned into four drought categories (LD0 - LD3) analogous to the US Drought Monitor (USDM) categories (i.e., D0 - D3) and using the same percentile breaks that USDM considers for soil moisture.



*The ETa data on which LERI is based are produced by the U. S. Geological Survey using the operational Simplified Surface Energy Balance (SSEBop) model (Senay et al., 2013). SSEBop combines evapotranspiration fraction (i.e., the ability of the land surface to meet the atmospheric demand for water vapor, expressed as a proportion of that demand) generated from remotely sensed MODIS thermal imagery, acquired every 8 days, with climatological atmospheric evaporative demand as represented by reference evapotranspiration derived using the Penman-Montieth formulation and driven by from University of Idaho's Gridded Surface Meteorological Data (GRIDMET) for that period.

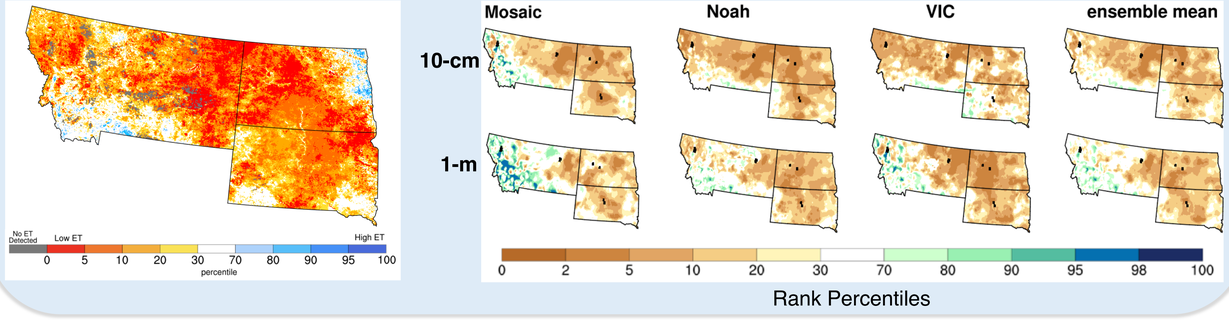
Senay, Gabriel B., Stefanie Bohms, Ramesh K. Singh, Prasanna H. Gowda, Naga M. Velpuri, Henok Alemu, James P. Verdin, 2013. Operational Evapotranspiration Mapping Using Remote Sensing and Weather Datasets: A New Parameterization for the SSEB Approach. Journal of the American Water Resources Association (JAWRA). 49(3):577-591. http://onlinelibrary.wiley.com/doi/10.1111/jawr.12057/full

Why use LERI?

LERI complements other drought-monitoring indices, such as SPI, SPEI, PDSI, and EDDI, and modeled soil moisture products by providing high-resolution (1 km) remotely-sensed estimates of land-surface dryness. LERI is expected to have early warning potential for agricultural and ecological droughts, flash droughts, and wildfire risk.

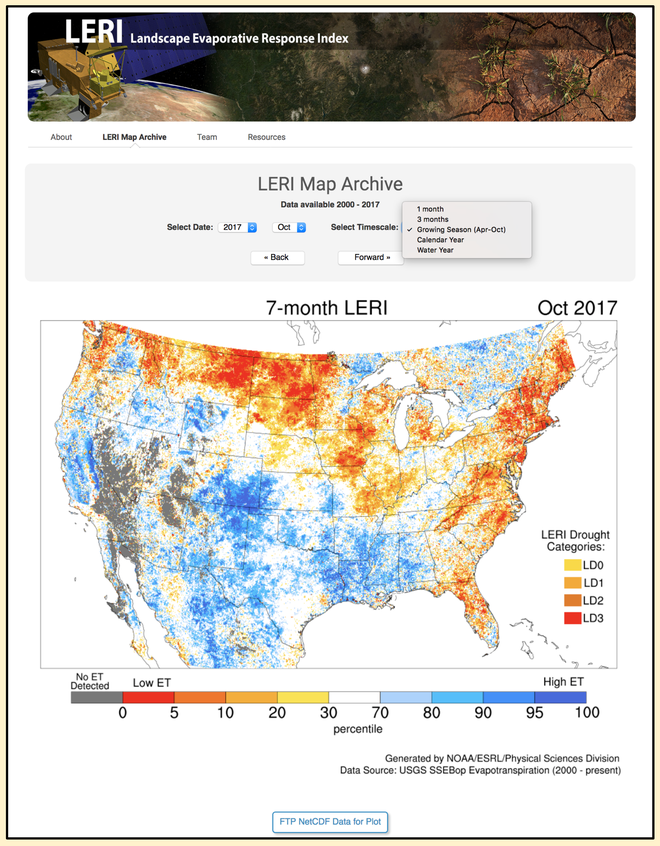
LERI is found to more closely track moisture anomalies in top soil layers

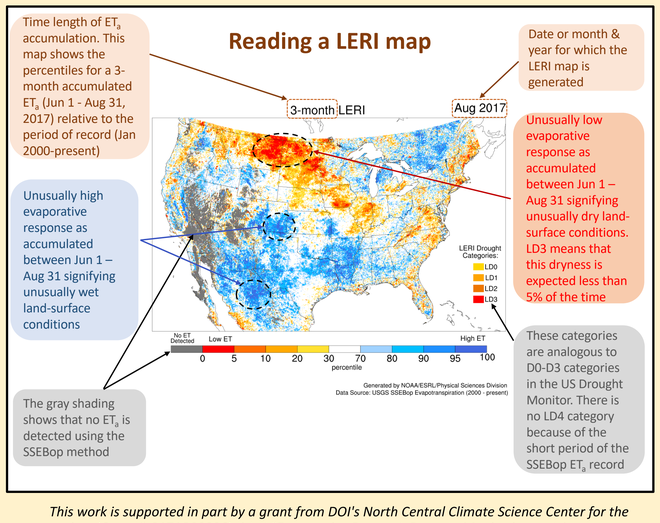
Map Below: LERI compared to NLDAS 10-cm and 1-m (modeled) soil moisture for July 2017



Historical and current LERI maps, and interpretive resources are available at:

https://esrl.noaa.gov/psd/leri/





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Evolution of the 2017 Northern Plains Drought