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**Group 4: Remote Sensing of Drought Summary Document**

Moderate Resolution Imaging Spectrometer (MODIS) is an instrument aboard the Terra and Aqua satellites as part of NASA’s Earth Observing System (EOS). Both Aqua and Terra are in sun-synchronous orbit, and collect data used to study Earth’s environment and ongoing changes in Earth’s climate. Terra passes from north to south across the equator in the morning (10am; low cloud cover), while Aqua passes south to north over the equator in the afternoon (2pm; maximum solar radiation). Terra and Aqua MODIS have daily imaging frequency at 1,000m, 500m, and 250m spatial resolutions, and collect data from 0.4-14.4μm. Once the satellite records radiance at the sensor, values are converted to digital numbers for communication purposes, back to radiance values at the destination, converted from radiance to reflectance at the sensor, and finally atmospheric corrected to surface reflectance values. At this point, the data is post-processed in a variety of different ways to derive physically meaningful quantities of land surface temperature (LST) and emissivity, normalized difference vegetation index (NDVI), leaf area index, evapotranspiration, and more.

The MOD11C21 eight-day, level 3 LST product used in this project is composite averages of the values from the corresponding eight MODIS daily files, with cloud-contaminated LSTs removed. In a 0.05 (5,600m x 5,600m) degree latitude/longitude Climate Modeling Grid (CMG), this dataset spans March 2000 through the present. To match the temporal resolution of the NDVI data, the eight-day LST product was aggregated to create a sixteen-day LST product. Values range from 7,500 to 65,535 with a fill value of 0 and a scale factor of 0.02.

The MOD13C12 sixteen-day, level 3 NDVI product used in this project is also composite averages, providing values per grid based off the NOAA-AVHRR derived NDVI. From the 1km NDVI product, each grid of this dataset consists 286 tiles that are spatially averaged and quality filtered to produce the 0.05 degree CMG pixels. Similar to LST, this dataset spans March 2000 through the present. Values range from -2,000 to 10,000, with a -3,000 fill value and a 0.0001 scale factor. Qualitatively, high values indicate the presence of live, green vegetation, where low values indicate the absence of vegetation. Negative values are grid cells with water.

Based on the entire 2000-2017 datasets, global baseline datasets were calculated for both LST and NDVI. Using the baselines, NDVI and LST anomalies were calculated as measures of relative normality. A value of LST anomaly at any given grid cell corresponds to how much warmer or cooler that point is than the baseline value. Similarly, values of NDVI at any given grid cell are a measure for how much more or less live, green vegetation is present relative to the baseline value.

The combination of LST and NDVI data provides very useful information for agricultural drought monitoring and early warning systems. LST and NDVI anomalies and associated correlation can be used to detect the agricultural drought of a region.

The Drought Index Viewer app was designed based on the HKH Drought Index Viewer with the goal of visualizing the data described above. The utility functions provided with this app were used to convert NetCDF files to GeoTIFF layers and upload them to GeoServer, as well as concatenate the NetCDF files to facilitate timeseries visualization. Currently, the app can display the global GeoTIFFs and provide timeseries plots at any selected point over the range of the data. Future development of this app should include a map animation feature, as well as support for additional drawing options, such as polygons and multiple features. In addition to drawing polygons, it may be beneficial to be able to upload simple shapefiles to analyze pre-defined areas. Additional statistical data could also potentially be produced and displayed by this app if needed. It should be noted that the primary bottleneck for this app’s potential is the size of the data. Polygon and animation features have not been added yet due to performance issues, however, it may be worthwhile to consider dividing the data up by region, and also providing a lower resolution global view.

References

1NASA LP DAAC, 2015, MOD11C2: MODIS/Terra Land Surface Temperature/Emissivity 8-day L3 Global 0.05Deg CMG. Version 6. NASA EOSDIS Land Processes DAAC, USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota ([https://lpdaac.usgs.gov](https://lpdaac.usgs.gov/)), accessed November 6, 2017, at <https://search.earthdata.nasa.gov/search/granules?p=C194001234-LPDAAC_ECS&tl=1496951354!4!!&q=MOD11C2&ok=MOD11C2>.

2NASA LP DAAC, 2015, MOD13C1: MODIS/Terra Vegetation Indices 16-day L3 Global 0.05Deg CMG. Version 6. NASA EOSDIS Land Processes DAAC, USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota ([https://lpdaac.usgs.gov](https://lpdaac.usgs.gov/)), accessed November 6, 2017, at <https://search.earthdata.nasa.gov/search/granules?p=C194001240-LPDAAC_ECS&tl=1496951354!4!!&q=MOD13C1&ok=MOD13C1>.