

FESC Project Update May 2013

1. Project Description

Title: Database infrastructure for integrative carbon science research

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2. Summary of Progress

Improvements of the TerraC (Terrestrial Carbon Information System) since the last reporting phase are manifold. Several large carbon and environmental datasets were integrated into TerraC and the code for displaying and downloading data had be adapted to accommodate the amount of data to display, search, and store, and download. Large data in web databases are peculiar and required adjustments to the streaming procedures (server-based coding adjustments). In addition we made improvements to the user interface. To that end, the column wizard has been continuously adjusted so that users can build their data tables easily.

In an effort to create a community where users are able to find and understand the data they are looking for to aid their research, new functions have been added at the project level. The first of these functions is a citations list. This list is where project owners can add citations to articles that have been published using the data in their project. The second function added to TerraC is the ability to upload more descriptive PDF documents to each data table so that other users can fully understand project data with one portable document.

The following climate data, extracted to site-specific locations, were added to the TerraC system that complement tier 1 data for which historic tree growth data have been assembled in the system (see below).

PRISM (Parameter-elevation Regressions on Independent Slopes Model)

These data sets were created using the PRISM climate mapping system, developed by Dr. Christopher Daly, PRISM Climate Group director. PRISM is a unique knowledge-based system that uses point measurements of precipitation, temperature, and other climatic factors to produce continuous, digital grid estimates of monthly, yearly, and event-based climatic parameters. Continuously updated, this unique analytical tool incorporates point data, a digital elevation model, and expert knowledge of complex climatic extremes, including rain shadows, coastal effects, and temperature inversions. PRISM data sets are recognized world-wide as the highest-quality spatial climate data sets current l y available. PRISM is the USDA's official climatological data. <http://prism.oregonstate.edu>

Variables representing 1970-2010 included in the PRISM dataset are: Precipitation (average monthly), Minimum Temperature (average monthly), Maximum Temperature (average monthly), Dew Point Temperature (average monthly), Mean Temperature (average of Minimum and Maximum Temperature)(average monthly) , Vapor Pressure (average monthly) .

Idaho Geospatial

This gridded data set was developed by Dr. John Abatzoglou from the University of Idaho. These climate data combines spatial attributes of gridded climate data from PRISM with temporal attributes of a regional-scale and daily gauge -based precipitation. The gridded was based on observations from various weather stations including RAWS, AgriMet, AgWeatherNet and USHCN-2. The dataset is intended for users who require daily climate data to drive ecological or hydrological models as well as other applications. The original files came in a netCDF format . Then these netCDF were reformat ted and imported in ArcGIS.

http://inside.uidaho.edu/webapps/search/epscor_browse.aspx

Variables representing 1979-2011 included in the Idaho Geospatial dataset are: Precipitation (average monthly) , Precipitation(total monthly accumulations), Maximum Relative Humidity (average monthly) , Minimum Relative Humidity (average monthly), Specific Humidity (average monthly), Downwelling Short wave Radiation at Sur face (average monthly) , Wind Direction (average monthly), Minimum Temperature (average monthly), Maximum Temperature (average monthly) , Wind Speed (average monthly) .

NARCCAP (The North American Regional Climate Change Assessment Program)

NARCCAP is a joint international program that aims to produce climate change simulations in order to investigate uncertainties in regional scale projections of future climate and generate climate change scenarios. NARCCAP is a database that hosts climate change projections for North America. NARCCAP dataset are generated by various GCMs (Global Climate Models) , from which, various climate change projections (scenarios) are derived. GCMs use grids of spatial resolution e.g. , 300 km * 150 km grids. These GCMs are downscaled by various RCMs (Regional Climate Models) to spatial resolution of 50 * 50 km grids.

NARCCAP projections have been made for two 30-year time period using each GCM-RCM combination. These are : 1) Current time period of 1971-2000, usually known as the “baseline” projection, and is received by forcing the GCMs with historic CO₂ emissions, till the year 2000. A perfect GCM-RCM combination should simulate a climate almost identical to the climate that was actually observed during the period of 1970-2000. 2) The future time period of 2041-2070 representing projections into the future under various assumptions for scenarios.

The NARCCAP climate variables are projected in a very high temporal resolution. For example, temperature, precipitation and surface pressure are all represented on a 3-hourly time scale. However, other variables such as minimum/maximum surface air temperature are represented on a daily scale (<http://www.narccap.ucar.edu/data/data-tables.html>).

The original data set comes in netCDF format. Ferret (from NOAA) and Cdat (from NCAR) were used to aggregate the data into the monthly scale. Some variables such as the monthly minimum temperature were derived from the NARCCAP daily data. Then these aggregate monthly scales were imported to ArcGIS.

Variables available in the NARCCAP dataset are: Sur face Air Temperature, Precipitation, Downwelling Shortwave Radiation at Surface, Surface Pressure, Specific Humidity, Minimum

Surface Air Temperature, Maximum Surface Air Temperature. PINEMAP has derived the following: Number of Frost Days, Average Minimum Surface Air Temperature, Average Maximum Daily Surface Air Temperature.

3. Funds leveraged/new partnerships created

TerraC is now providing the data infrastructure for a \$20 million integrated research, education, and extension project. This large-scale project funded by the United State Department of Agriculture (USDA) – National Institute of Food and Agriculture (NIFA) – Agriculture and Food Research Initiative (AFRI) Regional Project “PINEMAP: Integrating Research, Education and Extension for Enhancing Southern Pine Climate Change” (2011-2016) allows to populate TerraC and will cross-fertilize several research idea centered around carbon budgets and assessments, carbon change in dependence of global climate change and other stressors, and carbon sequestration and regulation as an ecosystem service. Many other similar synthesis projects will be facilitated through TerraC-PINEMAP.

The PINEMAP project goals are to create, synthesize, and disseminate the necessary knowledge to enable southern forest landowners to:

- harness pine forest productivity to mitigate atmospheric carbon dioxide
- more efficiently utilize nitrogen and other fertilizer inputs
- adapt their forest management approaches to increase resilience in the face of changing climate.

PINEMAP has a multi-tier data structure representing different scales including:

- Tier 1 (historic measurements of tree response in dependence of treatments at about 700 locations across the southeastern U.S.)
- Tier 2 (new base measurements at hundreds of sites across the southeastern U.S.)
- Tier 3 (high-intensity measurements to capture water and carbon cycle at 4 sites)