Using geospatial information for agricultural climate change analysis

ESRI 2014 Users Conference

Palouse region, Northern Idaho

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Overview

The Regional Approaches to Climate Change project is a five year, $20M coordinated regional agricultural project, funded by the National Institute for Food and Agriculture to improve the long-term profitability of the cereal production systems in the Pacific Northwest under ongoing and projected climate change, while contributing to climate change mitigation by reducing emissions of greenhouse gases.

REACCH includes efforts in research, extension, and education that integrates diverse elements including climate modeling, cropping systems modeling, economics, agronomy, crop protection, and others in a trans disciplinary manner.

www.reacchpna.org
The REACCH project effort is divided into ten functional objective teams (listed to the left), with lead investigators for each area, examining:

- the relationship between climate change and cereal crops, primarily winter wheat
- how climate change might affect cereal crops
- how production practices might contribute to or help mitigate climate change
- what farming methods might help these crops withstand climate change
- factors that influence decisions about crop management
Overview

- Agriculture, Climate Change and Cyberinfrastructure
- Scientific research collaboration using data analysis tools
- Methods for heterogeneous systems/tool integration

REACCHPNA Goals
- Climatic data storage and access
- Climatic science integrative research
- Climate Science value to the public and regional stakeholders

REACCH PNA Analysis Tools
- Extensible Data Cataloging
- Interactive Python
- THREDDS
- ArcGIS Server
- PostgresQL
Agriculture and Climate Change

- Inland Pacific Northwest (IPNW) is a critical agricultural region
- Diverse research efforts abound – UI, WSU, OSU, UW, USDA/ARS, NSF, NOAA
- Clear connection between climate change and agriculture processes
Agriculture and Climate Change

- Agricultural efforts are extremely data-oriented, and geospatial
  - Fields, plots, tillage, rotations, organic gas emissions, soils, hydrology, biotics – all can be geographically oriented.
  - Interaction between systems can be examined in a geographic context.
Agriculture and Climate Change

• Human interactions are also geographic
  – Farmer practices
  – Economic development and agriculture
  – Sociological examinations (i.e. surveys, evaluations)
Agriculture and Climate Change

- Climatic Modeling integration with other research efforts is paramount
  - NETCDF formats
  - Gridded model dataset outputs
  - Gridded meteorological datasets
  - Over 20TB for western US

- [http://nimbus.cos.uidaho.edu/MACA](http://nimbus.cos.uidaho.edu/MACA)
- John Abatzoglou/University of Idaho
The new NSF policy states: “Acceptable products must be citable and accessible including but not limited to publications, data sets, software, patents, and copyrights.” By contrast, previous policies allowed only “patents, copyrights and software systems” in addition to research publications in the biography section of a proposal, and considered their inclusion to be a substitute for the main task of listing research papers.
THREDDS – Thematic Realtime Environmental Data Distribution Services – developed by UCAR. Aggregation and interrogation of netcdf datasets

Geoportal Server. Metadata Cataloging – modified to allow data uploading.

IPython – Interactive Python. Python in a web browser! Can be used to compile and document research processes.

ArcGIS Server – web server technology used for geospatial mapping processes

PostgresQL – open source enterprise DB
REACCH Data Library

- Library can be accessed at data.reacchpna.org
- Based on ESRI’s geoportal server software
- Linux/tomcat/java
REACCH THREDDS Server

- Thematic Realtime Environmental Data Distribution Services (THREDDS)
- Developed by UCAR
- Aggregates and subsets multi-dimensional datasets (NetCDF)
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REACCH Data Analysis Library

- Use of geoprocessing services for analytics
- Climate time series
- Subsetting and aggregation
- Integrative data queries (e.g., Biotics and climatic data)
- More applied tools:
  - GGD
  - Crop buffering
Interactive Python Server

- IPython Notebook server available [ipython.reacchpna.org](http://ipython.reacchpna.org)
- Useful for collaboration and informal scientific analysis
- Allows for arcpy integration
REACCH REST api data search for "anthromes"
Create and annotate the graph of the sine wave that we created before.

```python
import datetime, timedelta

vector = linspace(0., 2.*pi)
today = datetime(2015, 7, 16)
t = array([])
for dt in range(50):
t = append(t, today-timedelta(dt))

figure(figsize=(8,1))
plot(t, sin(vector), s, cos(vector))
alabel('Date')
ylabel('Sine and Cosine of Data')
title('Example showing the Sine and Cosine of some simple data')
legend(['sine', 'cosine'], 'best')
```

Example showing the Sine and Cosine of some simple data
Data Policy Structure

• REACCH Research Data Policy in place
  – Policy narrative
  – General Use Data Agreement
  – Restricted Use Data Agreement
  – Terms of Service

• ~30% of REACCH users have accepted the REACCH General Use Data Agreement
  
  policy.reacchpna.org
- REACCH Research Data Policy defines four levels of data access
- Data access levels enable restricting information from the public as necessary
Data Management Metrics

REACCH Data Library Datasets by Objective Team
March 7th, 2014

Currently in Data Library?

To be Included in Data Library?

D. Meyer, BSU – REACCH Qualitative Survey Year 3
Data Management Metrics

REACCH Data Library Datasets Totals
March 7th, 2014

Currently in Data Library?
To be Included in Data Library?

D. Meyer, BSU – REACCH Qualitative Survey Year 3
Data Management Metrics

How would you rate your current understanding of the REACCH data library hosted at reacchpna.org?

- Inadequate
- Poor
- Satisfactory
- Good
- Excellent
- Don't Know/NA

2.8788 .95297

My team has the knowledge and resources needed to prepare our data for upload into the REACCH PNA.org data library.

- Strongly disagree
- Somewhat disagree
- Not sure
- Somewhat agree
- Strongly agree
- Don't Know/NA

3.8065 1.00554

D. Meyer, BSU – REACCH Qualitative Survey Year 3
Data Management Metrics

D. Meyer, BSU – REACCH Qualitative Survey Year 3

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**REACCH Presentation takeaways**

- Large scientific projects are enhanced tremendously by bridging the gap between raw data, publications, and decision-making analytics that can be used by researchers and citizens.
- Climate change and agriculture efforts are better understood thru analytic toolsets that are coupled.
- Critical areas of importance for successful agricultural research data integration:
  - Metadata interconnectivity
  - Consumable web services
  - Adaptive programming technologies that connect toolsets with raw data
REACCH Information Access

www.reacchpna.org

data.reacchpna.org
analysis.reacchpna.org
policy.reacchpna.org

research.reacchpna.org
education.reacchpna.org
extension.reacchpna.org
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dictionary.reacchpna.org
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Questions?