REACCH
Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

www.reacchpna.org

Using geospatial information for agricultural climate change analysis

ESRI 2014 Users Conference
July 2014

Palouse region, Northern Idaho

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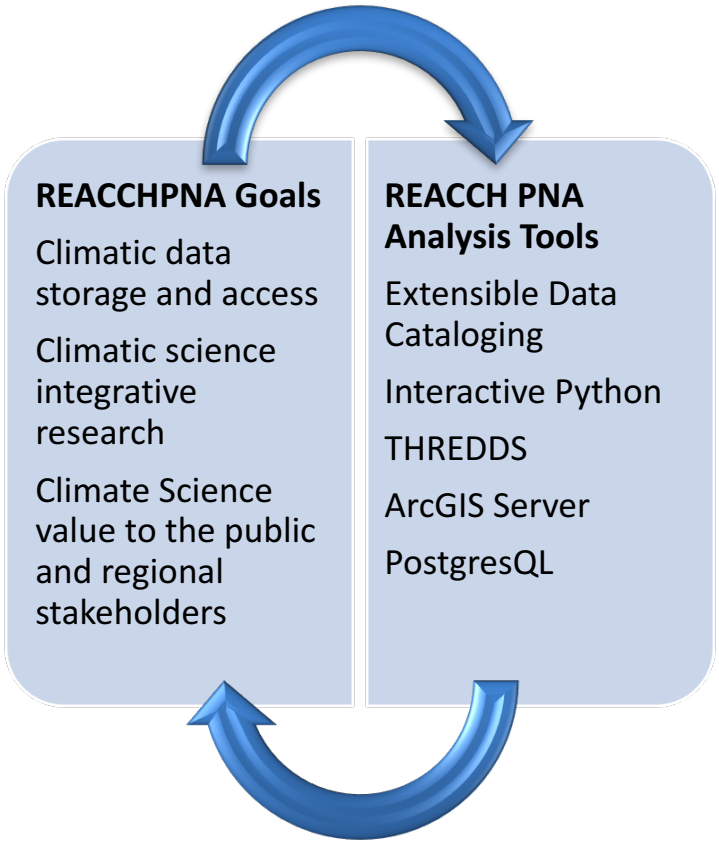
Overview

- Agriculture, climate change and cyberinfrastructure
- Scientific research collaboration using data analysis tools
- Methods for heterogeneous systems/tool integration



Overview

The **Re**gional **A**pproaches to **C**limate **Ch**ange project is a five year, $20M coordinated regional agricultural project, funded by the National Institute of 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.

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Focused Project Overview: REACCH

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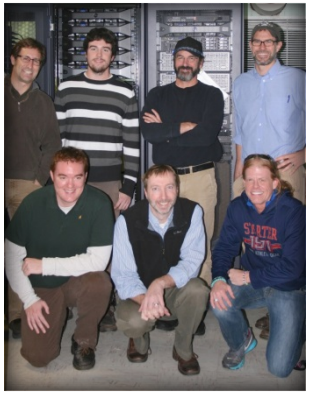
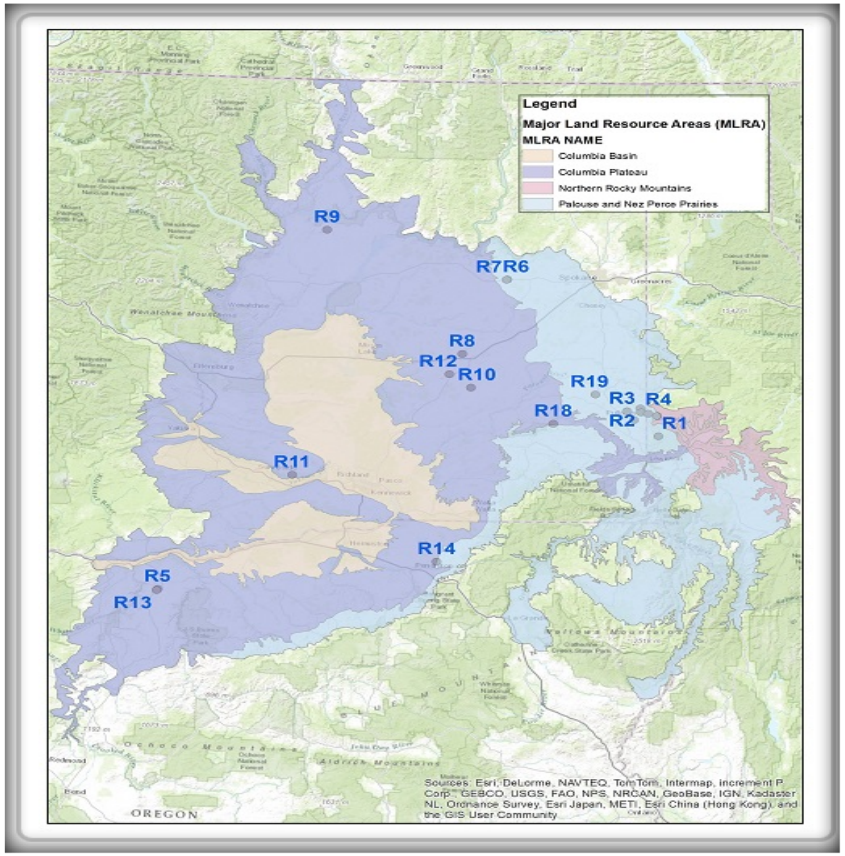
- Inland Pacific Northwest (IPNW) is a critical agricultural region
- Diverse research efforts abound – UI, WSU, OSU, UW, USDA/ARS, NSF, NOAA
- Clear connection between climate change and agricultural processes





Boulder Workshop Summer 2014

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Focused Project Overview: REACCH

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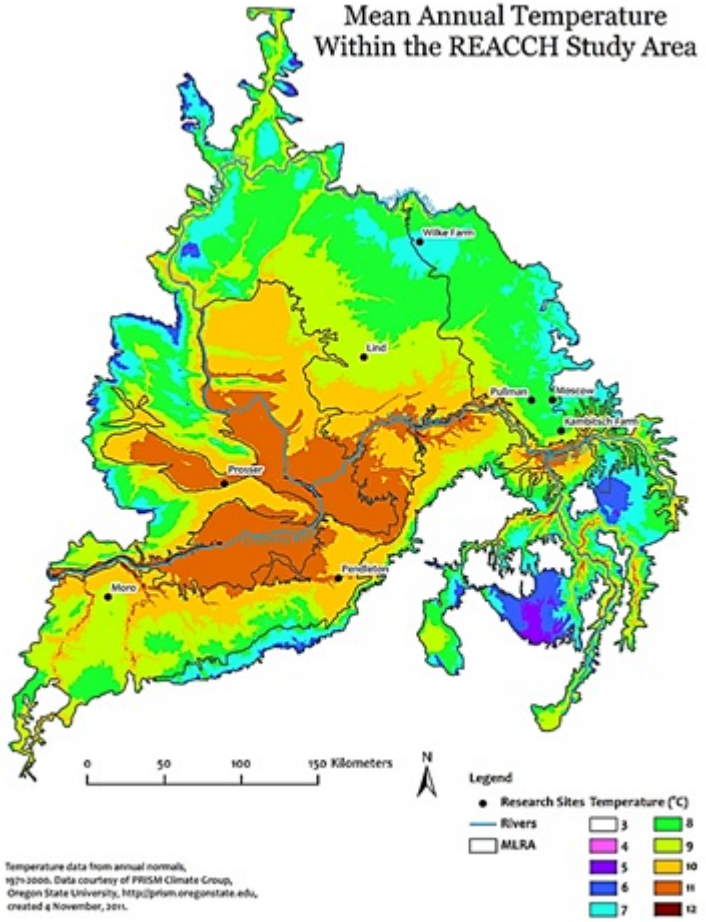
Climatic modeling integration with other research efforts is paramount

- NetCDF formats
- Gridded model dataset outputs
- Gridded meteorological datasets
- Over 20TB for western US

- http://nimbus.cos.uidaho.edu/MACA
- John Abatzoglou/University of Idaho



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Focused Project Overview: REACCH

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The REACCHPNA project 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

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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

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Agriculture and Climate Change

- Human interactions are also geographic
  - Farmer practices
  - Economic development and agriculture
  - Sociological examinations (i.e. surveys, evaluations)

REACCH Regional Approaches to Climate Change – PACIFIC NORTHWEST AGRICULTURE

Annual Meeting 2013 *Speed* Science Presentations

http://reacchpna.org

ASSESSING PROFIT MAXIMIZATION STRATEGIES FOR WHEAT PRODUCTION IN ANTICIPATION OF CLIMATE CHANGE: A Case Study Approach Using *AgTools™*

Clark Seavert, OSU

AgTools™

AgTools™ is a body of information designed to help agricultural producers make short, medium and long-run capital investment and management decisions. The software has been developed by a group of faculty at Oregon State University (lead institution, Clark Seavert), UC-Davis, University of Arizona, Washington State University, and University of Idaho.

AgTools™ consists of:

- a suite of software programs: *AgProfit™*, *AgLease™*, and *AgFinance™*
- budget files containing return and cost information for crops and livestock,
- educational programs such as *AgTools™* Academy,
- online grower training courses with video instruction modules.

Most of these tools and programs are free-of-charge at www.agtools.org. It is used for both agricultural business decisions and as a learning tool for students interested in the business dimensions of agricultural and food systems. For the REACCH project it is being developed into a web-based format with direct links to policy and environmental factors, including climate change.

AgTools™ is being piloted with wheat producers and used to explore future capital investment decisions and their impacts on profitability of alternative cropping systems. It is designed to assist agricultural producers make long run decisions on a whole farm and ranch feasibility basis, centered on financial ratios and performance measures. We anticipate linking spatial information on climate change and yield changes.

This presentation was given at REACCH 2013 Annual Meeting. This handout and supplemental video are available at reacchpna.org. Funded through Award # 2011-68002-30191 from the USDA National Institute for Food and Agriculture.

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REACCH/NKN Systems Model

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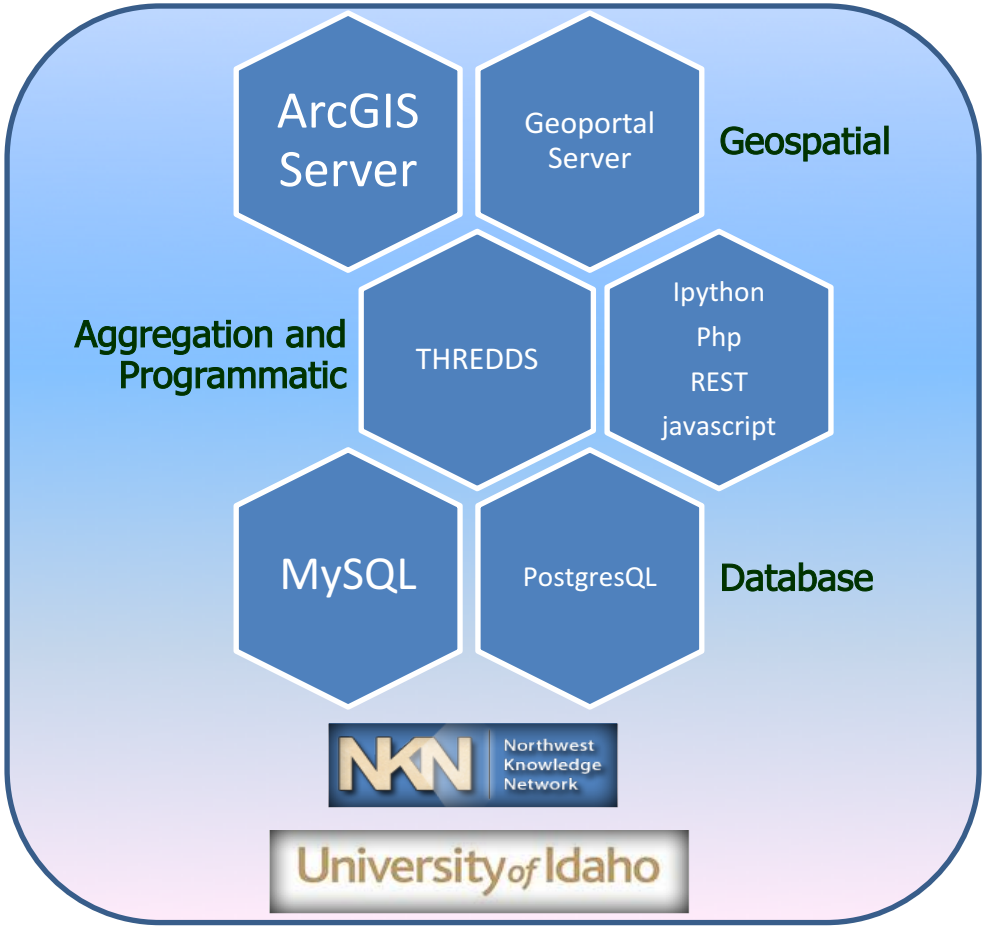
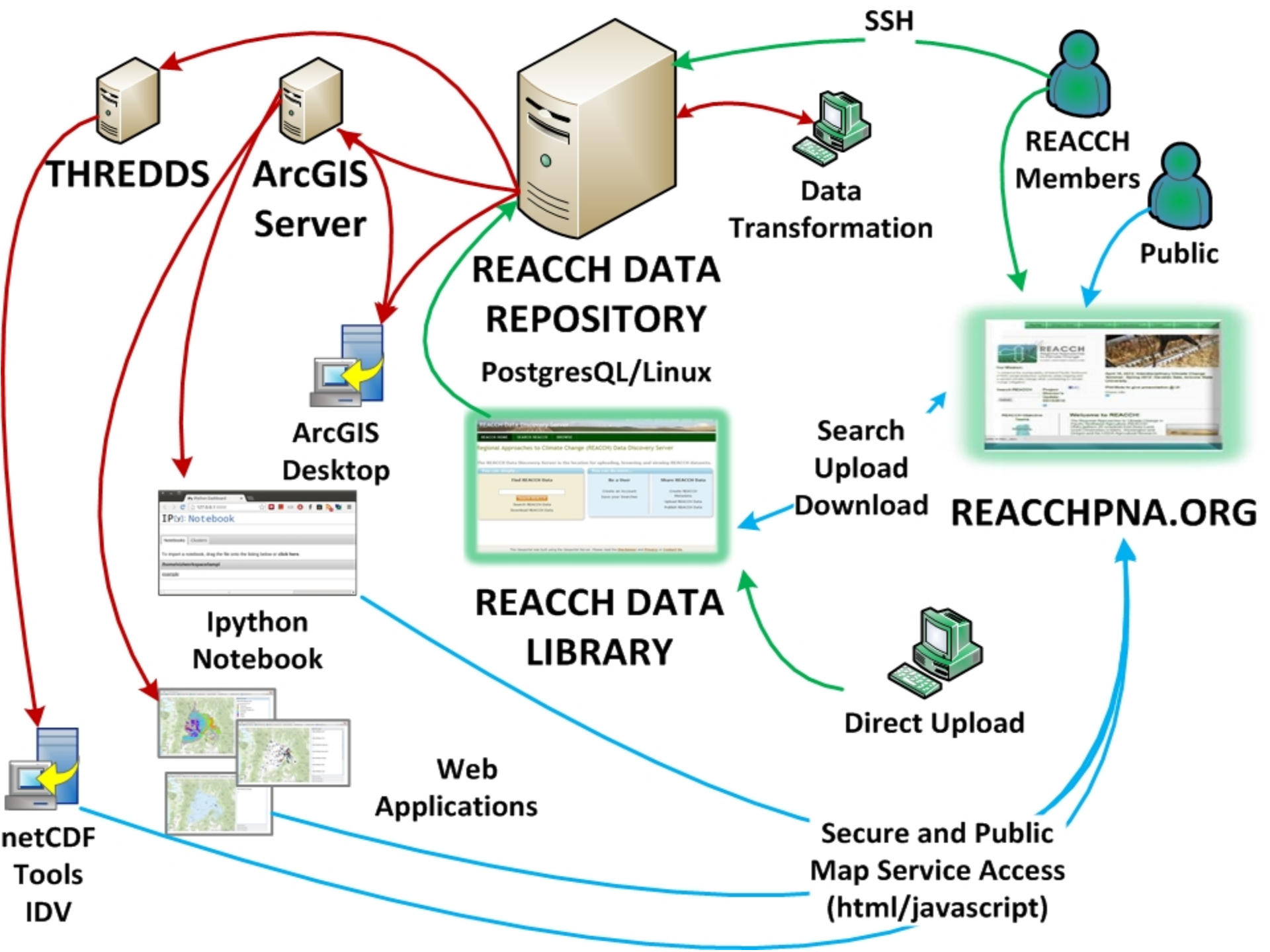


THREDDS –Aggregation and interrogation of NetCDF datasets
Geoportal Server. Metadata Cataloging – modified to allow data uploading
IPython – Interactive Python. Python in a web browser! Can be used to compile and document research processes
ArcGIS Server – web server technology used for geospatial mapping processes
PostgresQL – open source enterprise DB


SSH
THREDDS
ArcGIS Server
Data Transformation
REACCH Members
Public
REACCH DATA REPOSITORY
PostgresQL/Linux
ArcGIS Desktop
Search
Upload
Download
REACCHPNA.ORG
REACCH DATA LIBRARY
Ipython Notebook
Direct Upload
Web Applications
netCDF Tools IDV
Secure and Public Map Service Access (html/javascript)

REACCH Data Library

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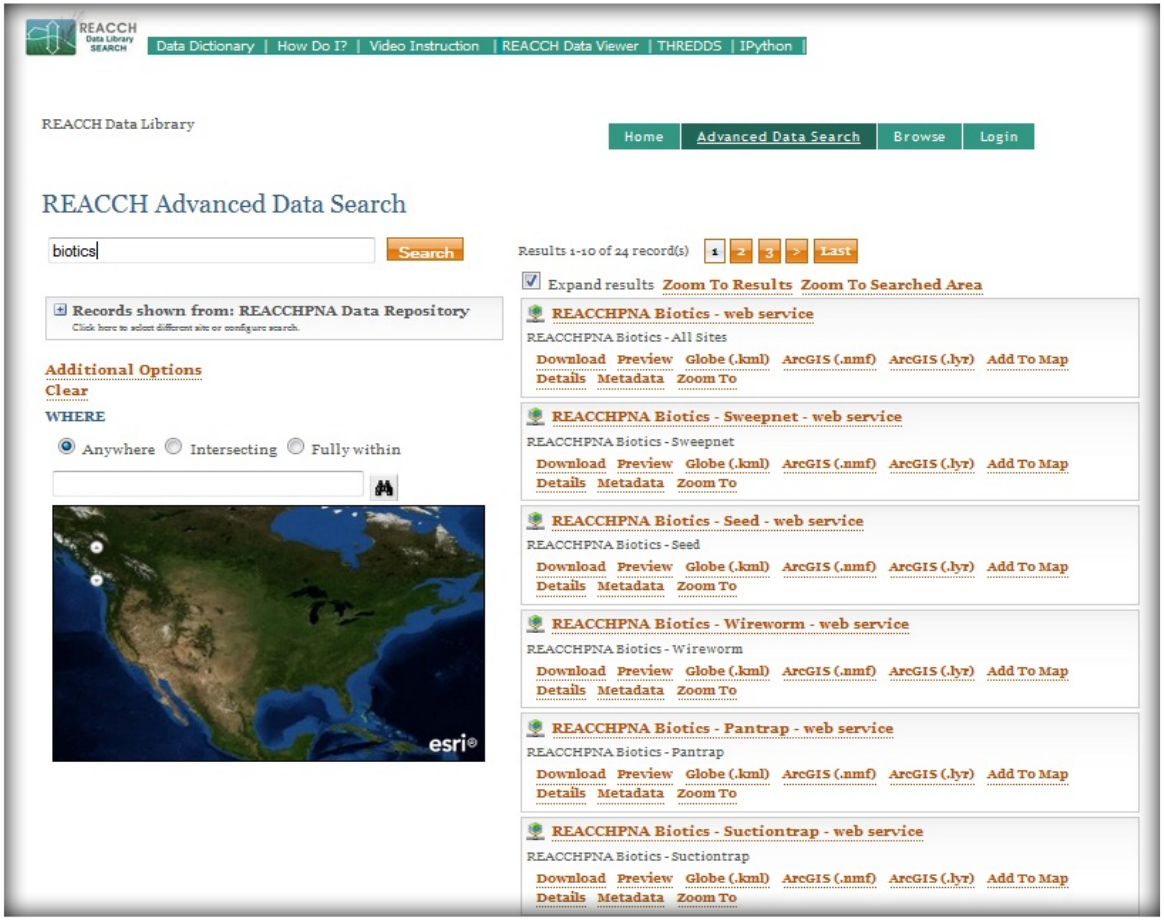

- Based on ESRI's geoportal server software
- Pubs connected to data
- Linux/tomcat/java
- Library can be accessed at

data.reacchpna.org

REACCH THREDDS Server

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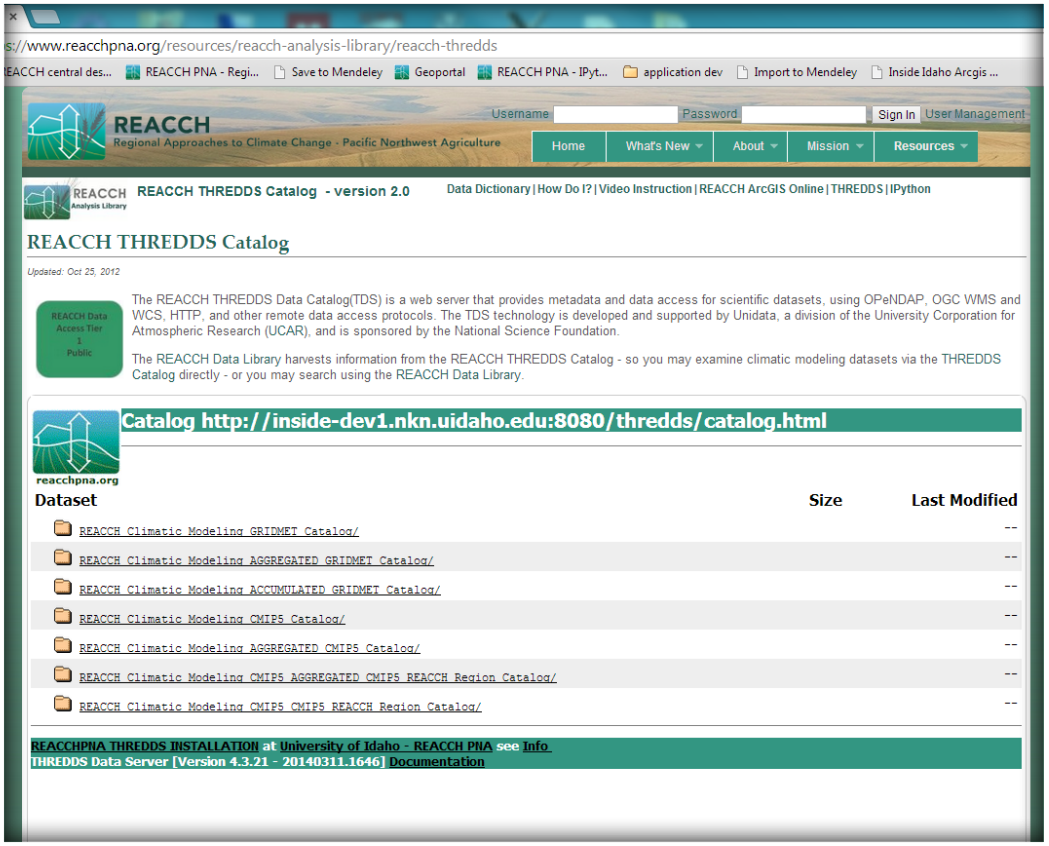

- Thematic Realtime Environmental Data Distribution Services (THREDDS)
- Developed by UCAR
- Aggregates and subsets multi-dimensional datasets (NetCDF)

thredds.reacchpna.org

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REACCH Data Analysis Library

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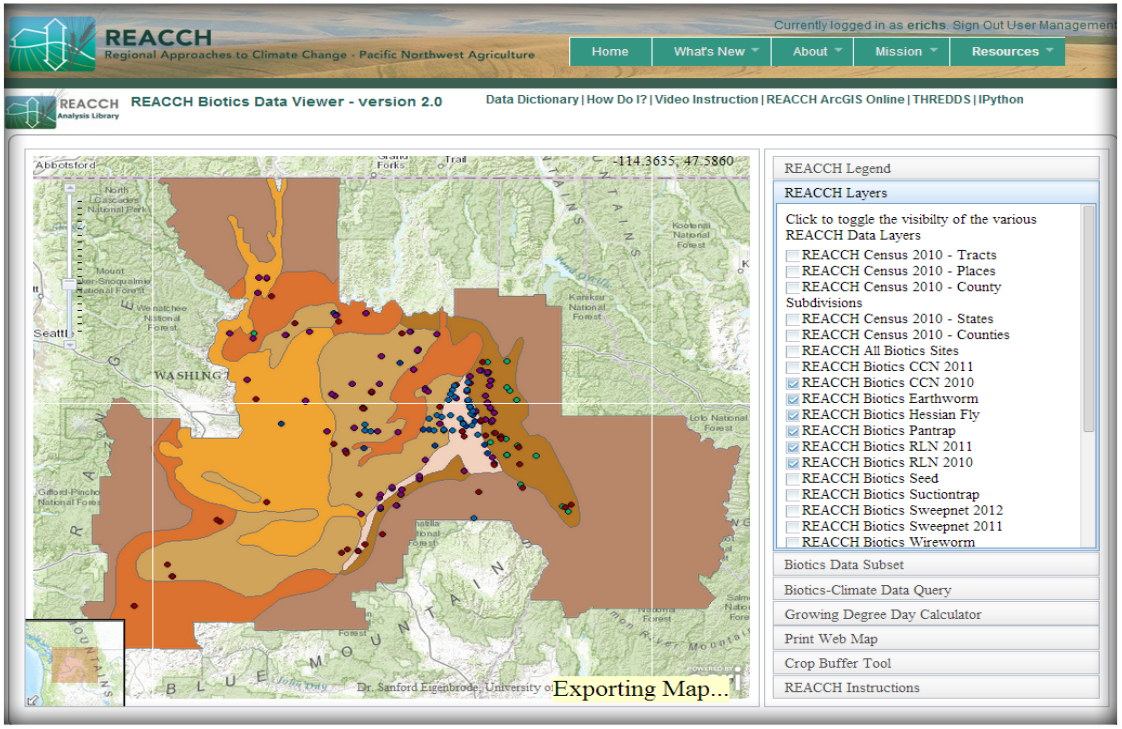

- Use of geoprocessing services for analytics
- Climate time series
- Subsetting and aggregation
- Integrative data queries (eg. Biotics and climatic data)
- More applied tools:
  - Growing Degree Day analysis
  - Crop buffering

analysis.reacchpna.org

Integrative Analysis Tool Examples

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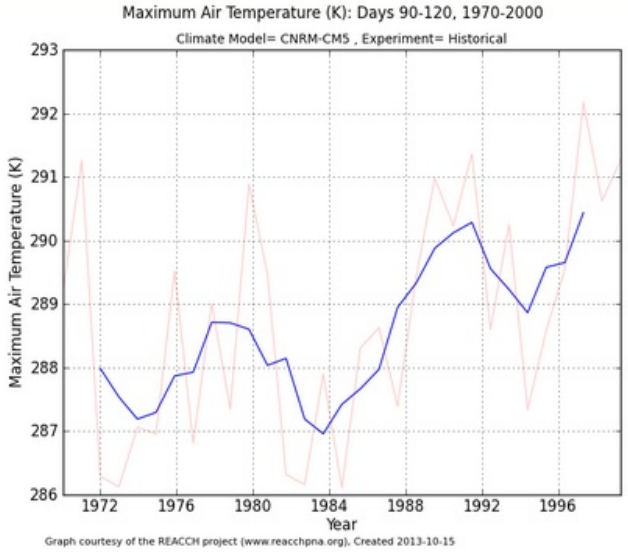
Climate_Graph.png (800×600) - Google Chrome

inside-dev2.nkn.uidaho.edu:6080/arcgis/rest/directories/arcgis



-115.9009, 45.3208

Dawson Creek
Grande Prairie
Prince George
Jasper National Park
Kamloops
Whistler
Kelowna
Spokane
Olympia
Kennewick
Portland
Salem

Results

Climate Model: CNRM-CM5
Climate Experiment: historical
Day 1: 90
Day 2: 120
Year 1: 1970
Year 2: 2000

Click here to download the data

NRCAN, AAFC, NHD Plus, NPS, Esri, DeLorme, FAO, USGS, EP...

REACCH Legend

REACCH Layers

Growing Degree Day Calculator

Climate Normals Query

Compare Climate Normals

Climate Time Series Query

and a link to download the data either as a text file, or as ArcGIS rasters for each year specified will be made available.

Select Climate Model: ?

CNRM-CM5

Select Climate Scenario: ?

historical

Select Climate Variable:

Maximum Near-Surface Air Temperature

Enter First Day (1-365):

90

Enter Last Day 1-365):

120

Enter First Year (1950-2100):

1970

Enter Last Year (1950-2100):

2000

Draw Bounding Box

Select Point

Select Polygon

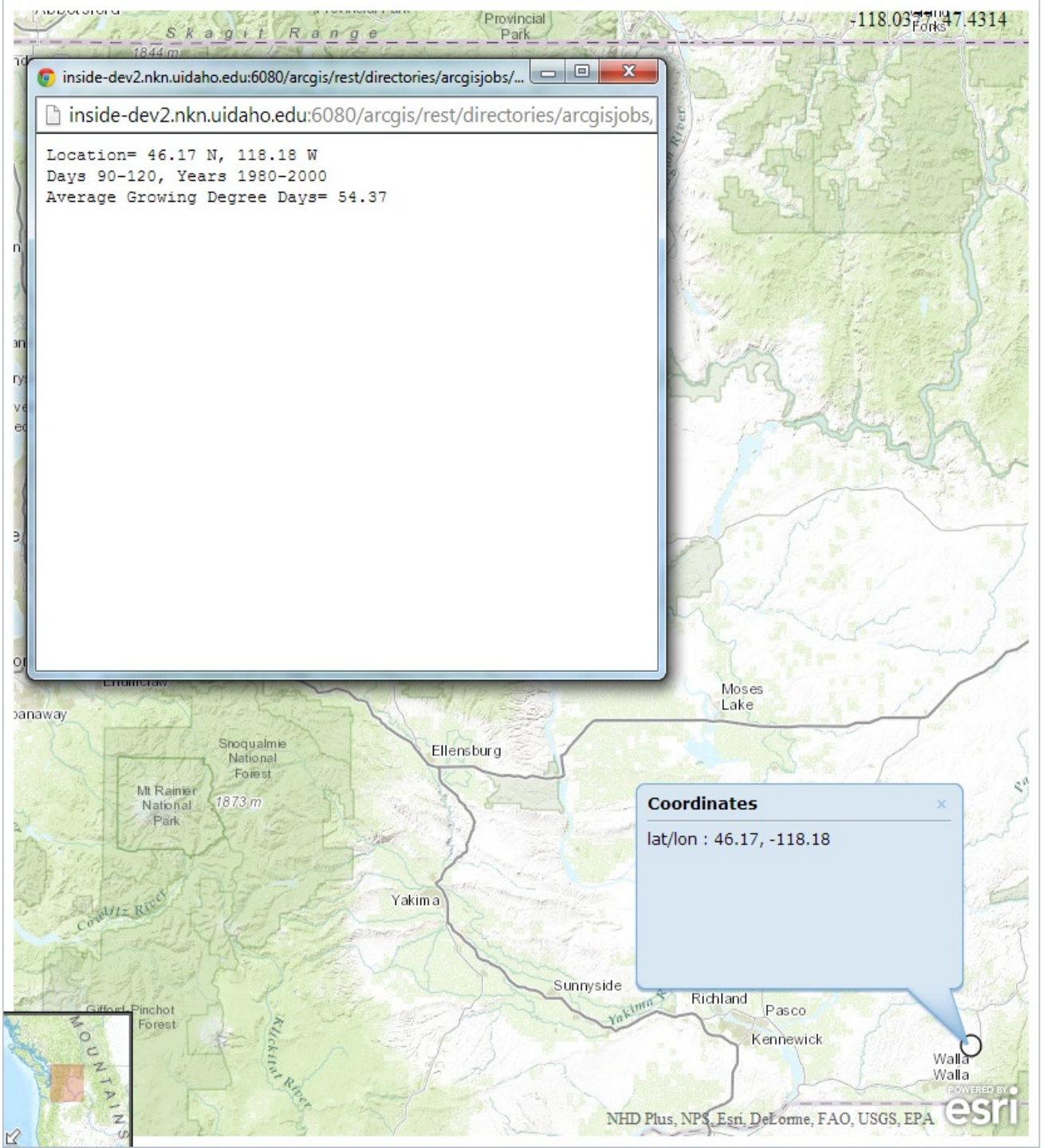
Save data as rasters

Draw or click on map after filling out all parameters

Climate Models Comparison

MACA Data NetCDF Subset

REACCH Instructions



REACCH Legend

REACCH Layers

Growing Degree Day Calculator

Choose a location to calculate the average number of growing degree days over for a specified set of days within the year. An average will be created from all of the years within the range specified.

Select Climate Model: ?

CNRM-CM5

Select Climate Scenario: ?

historical

Enter First Day (1-365):

90

Enter Last Day (1-365):

120

Enter First Year (1950-2100):

1980

Enter Last Year:

2000

Enter Base Temperature:

10

Draw Bounding Box

Select Point

Draw or click on map after filling out all parameters

Climate Normals Query

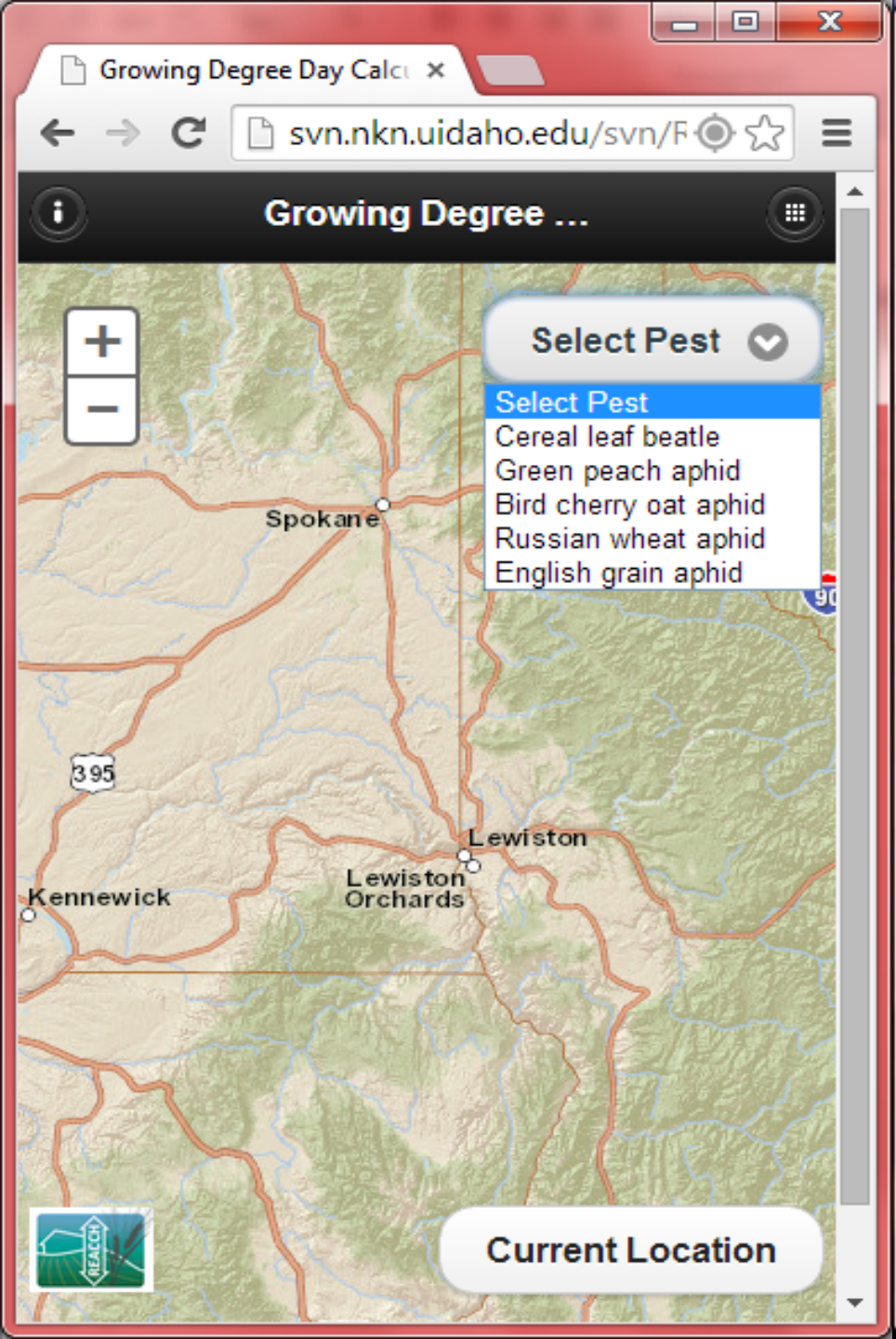
Compare Climate Normals

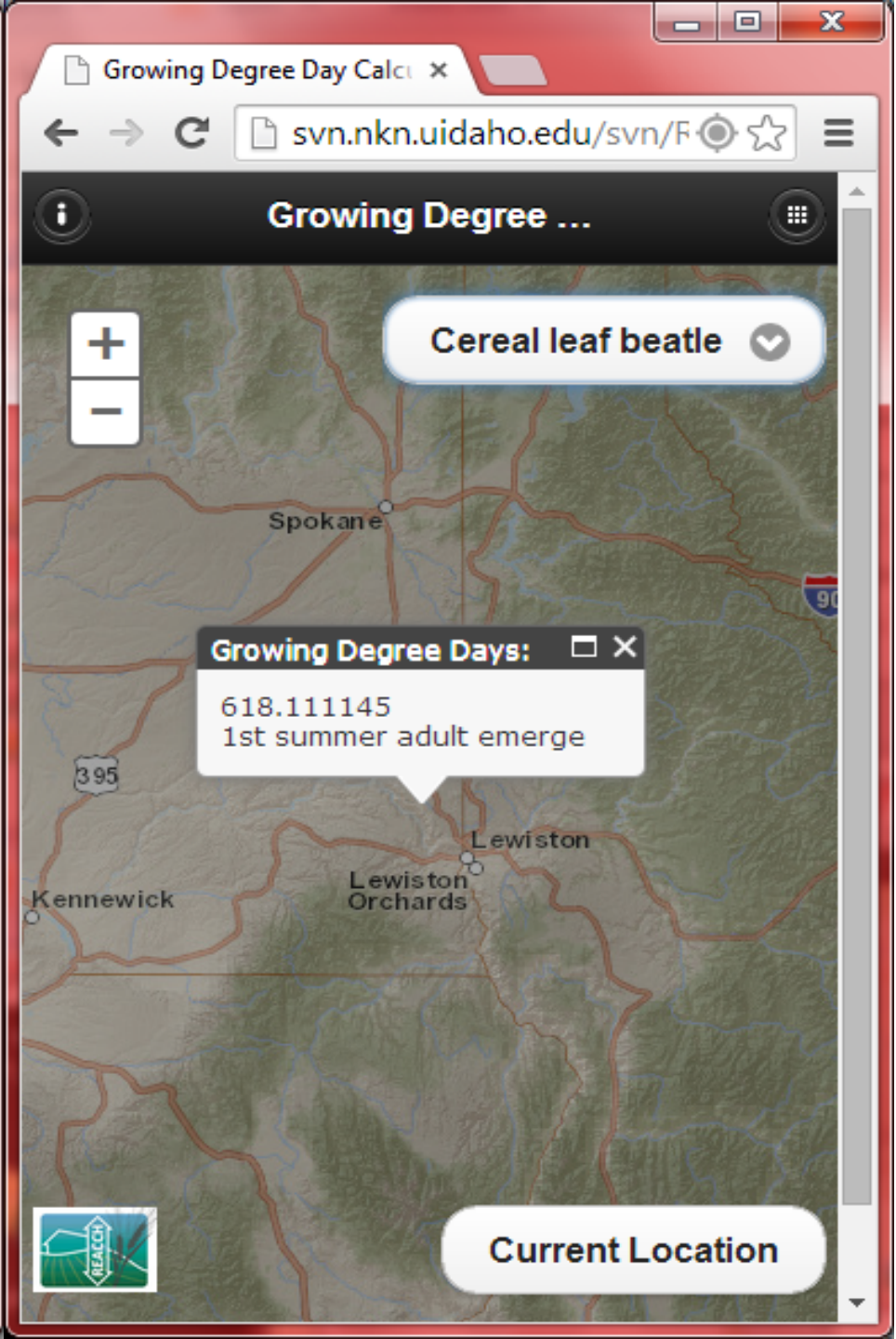
Climate Time Series Query

Climate Models Comparison

MACA Data NetCDF Subset

REACCH Instructions


Growing Degree Day Calc
svn.nkn.uidaho.edu/svn/F
Growing Degree ...
Select Pest
Select Pest
Cereal leaf beatle
Green peach aphid
Bird cherry oat aphid
Russian wheat aphid
English grain aphid
Spokane
90
395
Lewiston
Lewiston Orchards
Kennewick
Current Location


Growing Degree Day Calc
svn.nkn.uidaho.edu/svn/F
Growing Degree ...
Cereal leaf beatle
Spokane
90
Growing Degree Days:
618.111145
1st summer adult emerge
395
Lewiston
Lewiston Orchards
Kennewick
Current Location

Interactive Python Server

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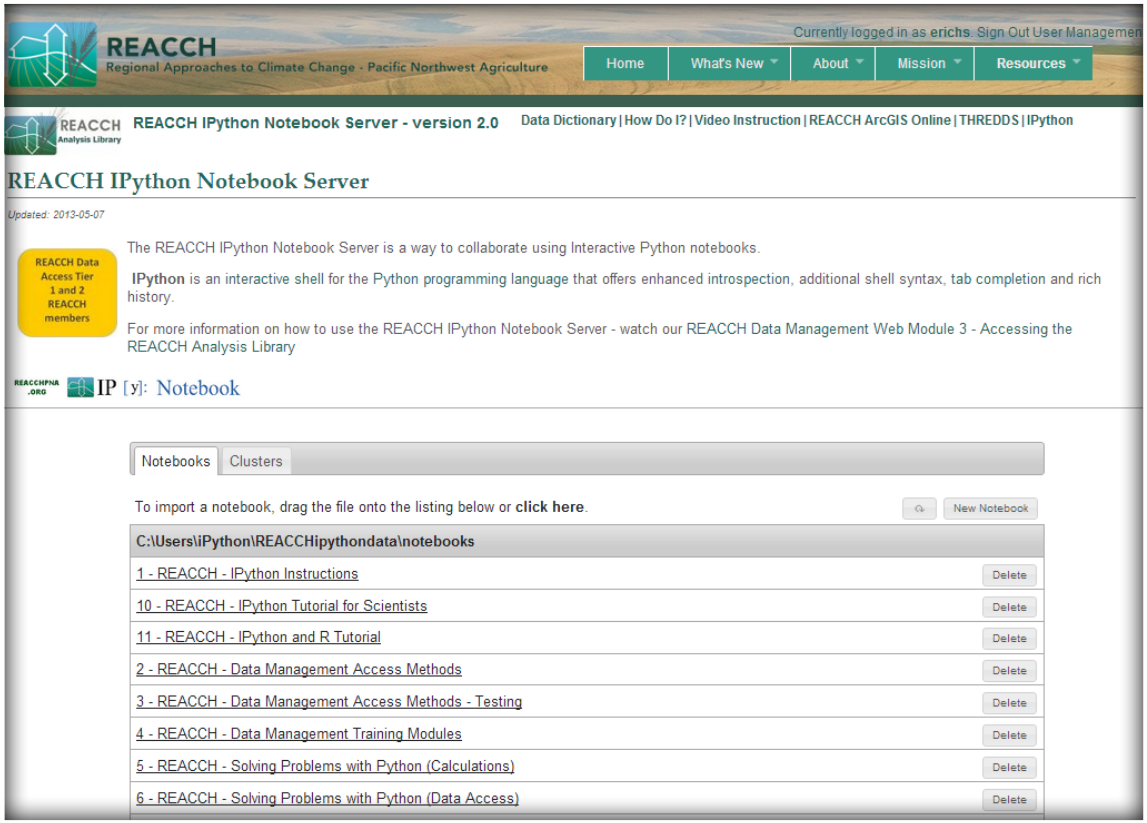


- Useful for collaboration and informal scientific analysis
- Allows for arcpy integration
- IPython Notebook server available

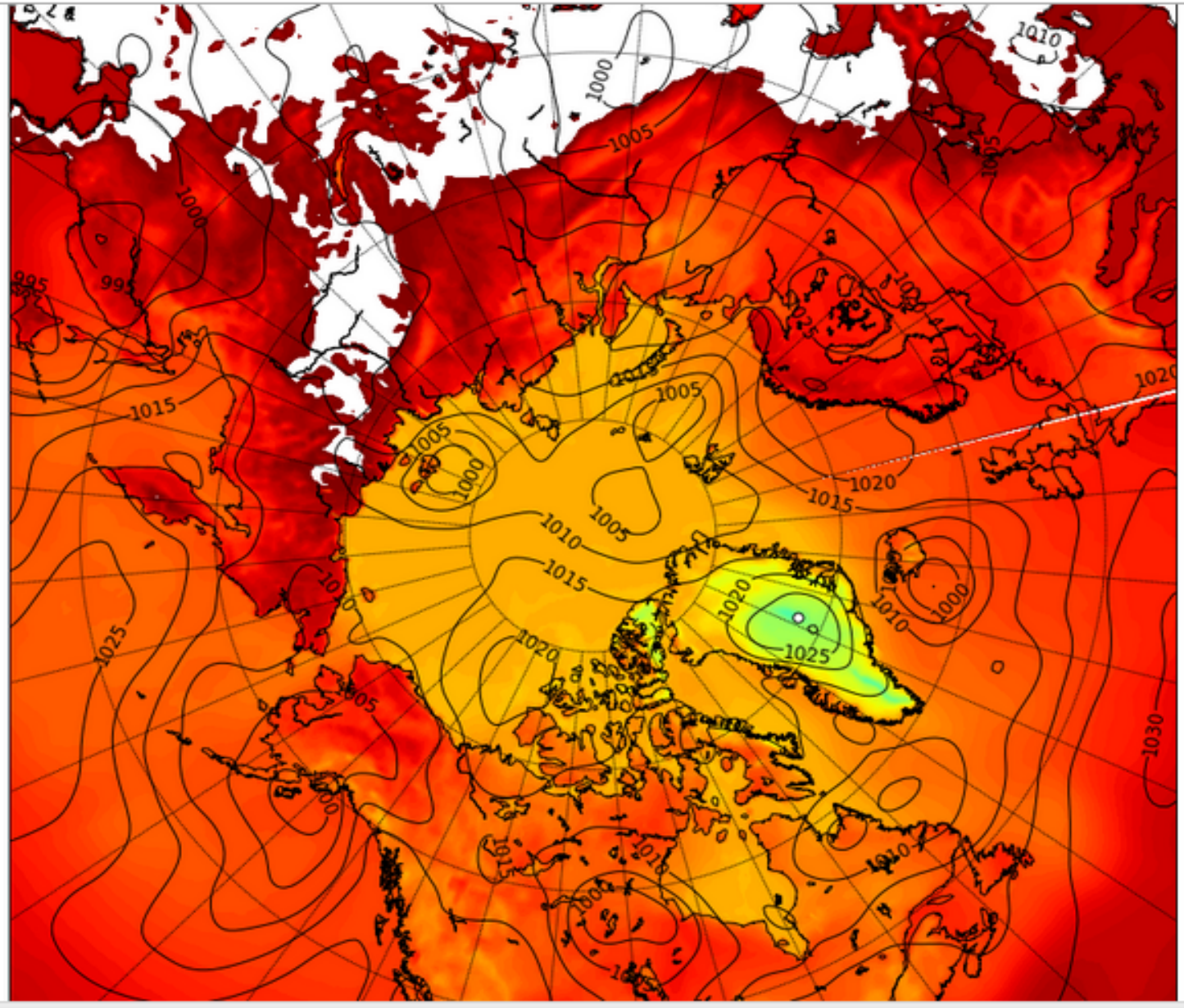
ipython.reacchpna.org

REACCH REST api data search for "anthromes"

In [7]:
```
from IPython.core.display import HTML
HTML('<iframe src=http://reacchapp2.nkn.uidaho.edu:8080/geoportal3/rest/find/document?searchText=anthromes&start=1&max=10&f=html&dojo.preventCache=1371676252313 width=1
```

Out[7]:

REACCHPNA Models - Anthromes 2008
REACCHPNA Models - Anthromes 2008
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Anthromes 2011
REACCHPNA Models - Anthromes 2011
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Anthromes 2010
REACCHPNA Models - Anthromes 2010
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Anthromes 2009
REACCHPNA Models - Anthromes 2009
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Anthromes
REACCH Models - Anthromes
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Anthromes 2007
REACCHPNA Models - Anthromes 2007
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Cropland Data Layer 2010
REACCHPNA Models - Cropland Data Layer 2010
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Cropland Data Layer 2010
REACCHPNA Models - Cropland Data Layer 2010
Download Preview Globe (.kml) ArcGIS (.nmf) ArcGIS (.lyr) Add To Map Details Metadata
REACCHPNA Models - Cropland Data Layer 2009


1010
1000
1005
995
1015
1020
1025
1030
20
10
0
−10
−20
−30
−40
−50
−60
−70

Data Policy Structure

REACCH
Regional Approaches to Climate Change – Pacific Northwest Agriculture

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REACCH PNA Research Data Policy

University of Idaho
Regional Approaches to Climate Change for Pacific Northwest Agriculture (REACCH PNA)
Updated as of: *August 2013*
Version 11.0

Table of Contents

Introduction 3
REACCH Research Data Policy Common Terms and Definitions 4
Terms and definitions that will be used as part of this document: 4
REACCH Research Data Policy Overview 4
Data Management defined 5
REACCH PNA Structure regarding data access, management and oversight 6
Data Management Plan 7
REACCH PNA Data User Agreements 9
REACCH Data Types 9
REACCH PNA Research Data Policy Statements 12
Communications and Consultation Policy Statement 12
Researcher Accountability and Additional Responsibilities Policy Statement 12
Timeliness of Data Contribution Policy Statement 12
REACCH PNA Metadata Requirements 13
REACCH PNA Researcher Expectation of Infrastructure Policy Statement 13
Research Data Citation Policy Statement 14
Compliance with Federal and State Privacy Regulations 14
Consideration of Additional Policies 14
APPENDIX A 15
Potential Barriers to Sharing Data and Procedures for Policy Compliance 15
Barrier A. Inadequate resources to upload and provide QA/QC for data 15
Barrier B. Lack of training in data preparation 15

http://www.reacchpna.org ~ 1 ~ http://www.fb.com/reacchpna

- 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

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COMMENT

Value all research products

A new funding policy by the US National Science Foundation represents a sea-change in how researchers are evaluated, says **Heather Piwowar**.

What a difference a word makes. For all new grant applications from 14 January, the US National Science Foundation (NSF) asks a principal investigator to list his or her research "products" rather than "publications" in the biographical sketch section. This means that, according to the NSF, a scientist's worth is not dependent solely on publications. Data sets, software and other non-traditional research products will count too.

There are more diverse research products now than ever before. Scientists are developing and releasing better tools to document their workflow, check each other's work and share information, from data repositories to post-publication discussion systems. As it gets easier to publish a wide variety of material online, it should also become easy to recognize the breadth of a scientist's intellectual contributions.

But one must evaluate whether each product has made an impact on its field — from a data set on beetle growth, for instance, to the solution to a colleague's research problem posted on a question-and-answer website. So scientists are developing and assessing alternative metrics, or 'altmetrics' — new ways to measure engagement with research output.

The NSF policy change comes at a time when around 1 in 40 scholars is active on Twitter[1], more than 2 million researchers use the online reference-sharing tool Mendeley (see go.nature.com/x63cwe), and more than 25,000 blog entries have been written about peer-reviewed research papers and indexed on the Research Blogging platform[2].

In the next five years, I believe that it will become routine to track — and to value — citations to an online lab notebook, contributions to a software library, bookmarks to data sets from content-sharing sites such as Pinterest and Delicious. In other words, to value a wider range of metrics that suggest a research product has made a difference. For example, my colleagues and I have estimated that the data sets added to the US National Center for Biotechnology Information's Gene Expression Omnibus in 2007 have contributed to more than 1,000 papers[3,4]. Such attributions continue to accumulate for several years after data sets are first made publicly available.

In the long run, the NSF policy change will do much more than just reward an investigator who has authored a popular statistics package, for instance. It will change the game, because it will alter how scientists assess research impact.

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.

Still, the status quo is largely unchanged. Some types of NSF grant-renewal applications continue to request papers alone. Indeed, several funders — including the US National Institutes of Health, the Howard Hughes Medical Institute and the UK Medical Research Council — still explicitly ask for a list of research papers rather than products.

"Altmetrics give a fuller picture of how research products have influenced conversation, thought and behaviour."

Even when applicants are allowed to include alternative products in grant applications, how will reviewers know if they should be impressed? They might have a little bit of time to watch a short video on YouTube demonstrating a wet-lab technique, or to read a Google Plus post describing a computational algorithm. But what if the technique takes more time to review, or is in an area that is outside the reviewer's expertise? Existing evaluation mechanisms often fail for alternative products — a YouTube video, for example, has no journal title to use as a proxy for anticipated impact. But it will definitely receive a number of downloads, some 'likes' on Facebook, a few Pinterest bookmarks and discussion in blogs.

TRACKING TRENDS

Many altmetrics have already been gathered for a range of research products. For example, the data repositories Dryad and figshare track download statistics (figshare is supported by Digital Science, which is owned by the same parent company as *Nature*). Some repositories, such as the Inter-university Consortium for Political and Social Research, provide anonymous demographic breakdowns of usage.

Specific tools have been built to aggregate altmetrics across a wide variety of content. Altmetric.com (also supported by Digital Science) reveals the impact of anything with a digital object identifier (DOI) or other standard identifier. It can find mentions of a data set in blog posts, tweets and mainstream media (see go.nature.com/yche8g). The non-profit organization ImpactStory (http://impactstory.org), of which I am a co-founder, tracks the impact of articles, data sets, software, blog posts, posters and lab websites by monitoring citations, blogs, tweets, download statistics and attributions in research articles, such as mentions within methods and acknowledgements[5]. For example, a data set on an outbreak of *Escherichia coli* has received 43 'stars' in the GitHub software repository, 18 tweets and two mentions in peer-reviewed articles (see go.nature.com/dnhdgh).

Such altmetrics give a fuller picture of how research products have influenced conversation, thought and behaviour. Tracking them is likely to motivate more people to release alternative products — scientists say that the most important condition for sharing their data is ensuring that they receive proper credit for it[6].

The shift to valuing broad research impact will be more rapid and smooth if more funders and institutions explicitly welcome evidence of impact. Scientists can speed the shift by publishing diverse research products in their natural form, rather than shoehorning everything into an article format, and by tracking and reporting their products' impact. When we, as scientists, build and use tools and infrastructure that support open dissemination of actionable, accessible and auditable metrics, we will be on our way to a more useful and nimble scholarly communication system. ■

Heather Piwowar *is a postdoctoral research associate in informatics at the National Evolutionary Synthesis Center, Duke University, Durham, North Carolina, USA. She is a co-founder of ImpactStory.*
e-mail: heather@impactstory.org

1. Priem, J., Costello, K. & Dzuba, T. *Figshare* http://dx.doi.org/10.6084/m9.figshare.104629 (2012).
2. Fausto, S. *et al. PLoS ONE* **7**, e50109 (2012).
3. Piwowar, H. A., Vision, T. J. & Whitlock, M. C. *Nature* **473**, 285 (2011).
4. Piwowar, H. A., Vision, T. J. & Whitlock, M. C. *Dryad Digital Repository* http://dx.doi.org/10.5061/dryad.j1fd7 (2011).
5. Oettl, A. *Nature* **489**, 496–497 (2012).
6. Tenopir, C. *et al. PLoS ONE* **6**, e21101 (2011).

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.

10 JANUARY 2013 | VOL 493 | NATURE | 159

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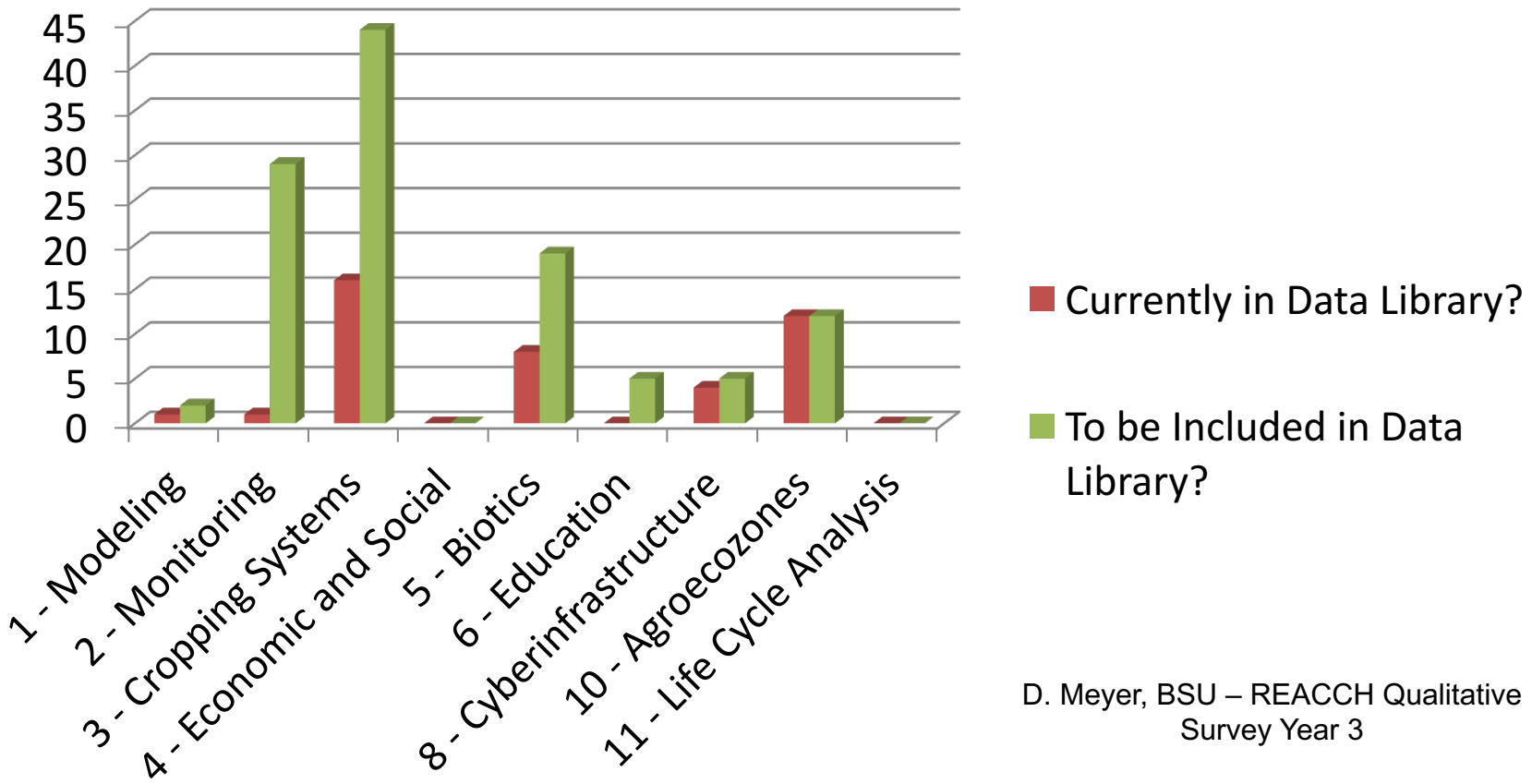
Data Management Metrics

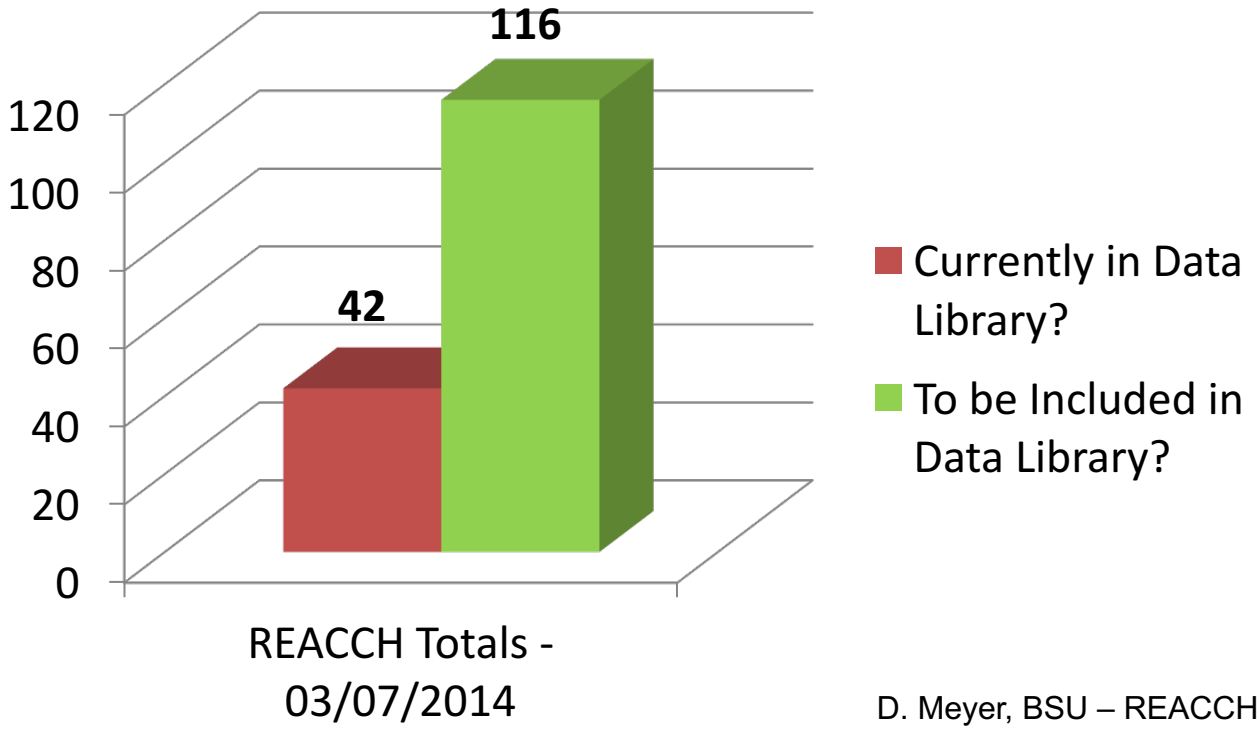
REACCH Data Library Datasets by Objective Team
March 7th, 2014



D. Meyer, BSU – REACCH Qualitative Survey Year 3

Data Management Metrics

REACCH Data Library Datasets Totals
March 7th, 2014



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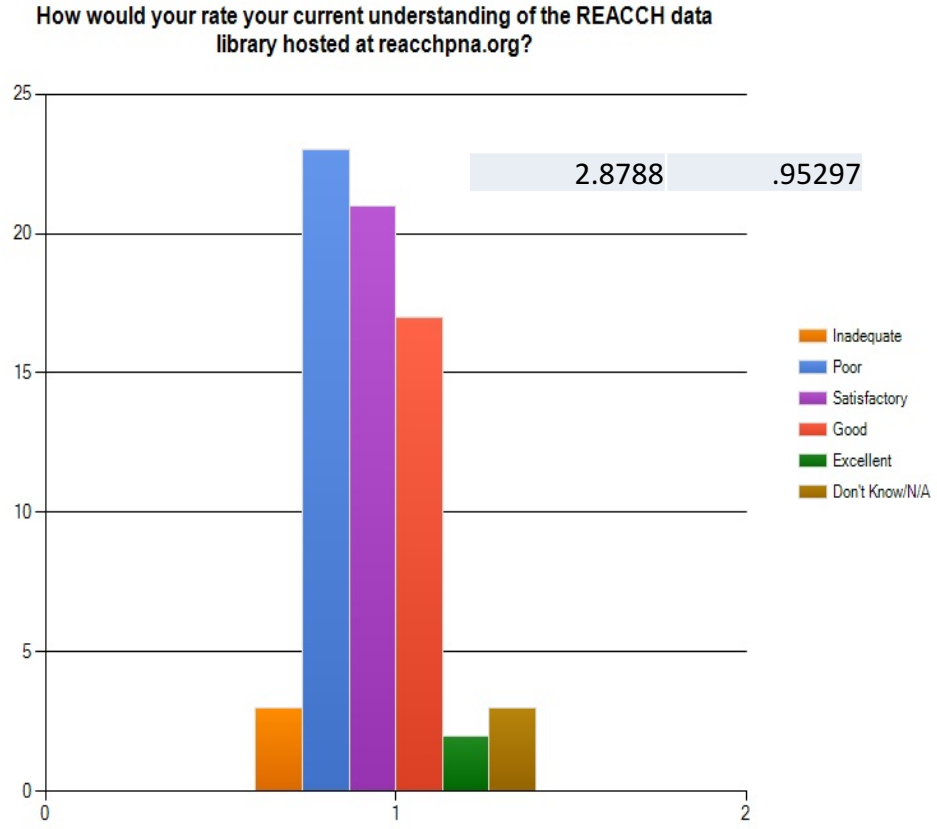
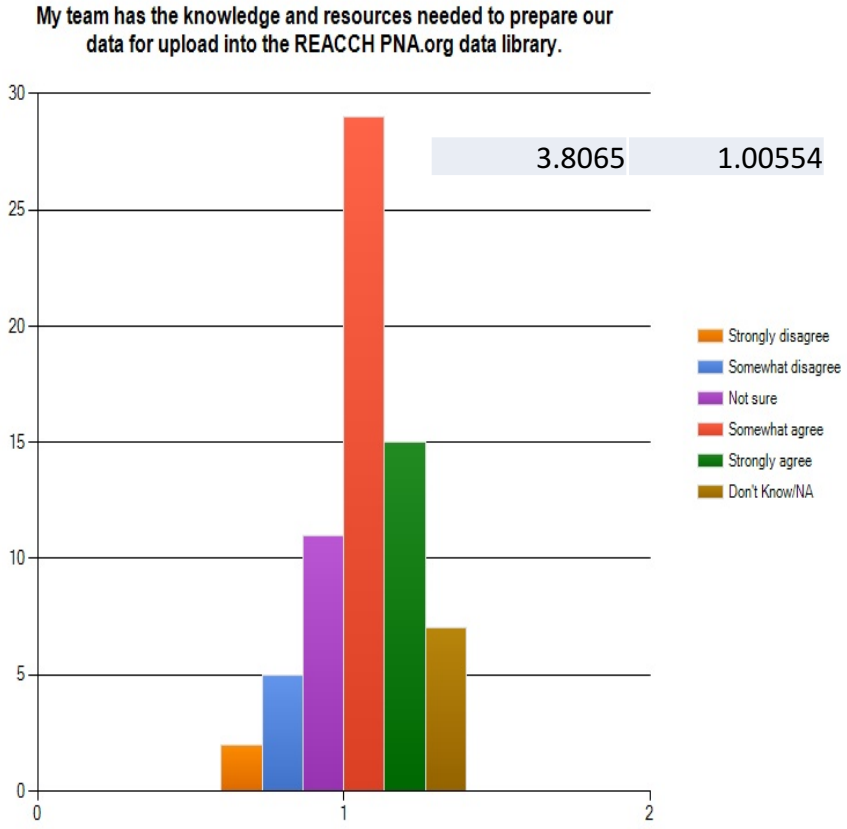
Data Management Metrics





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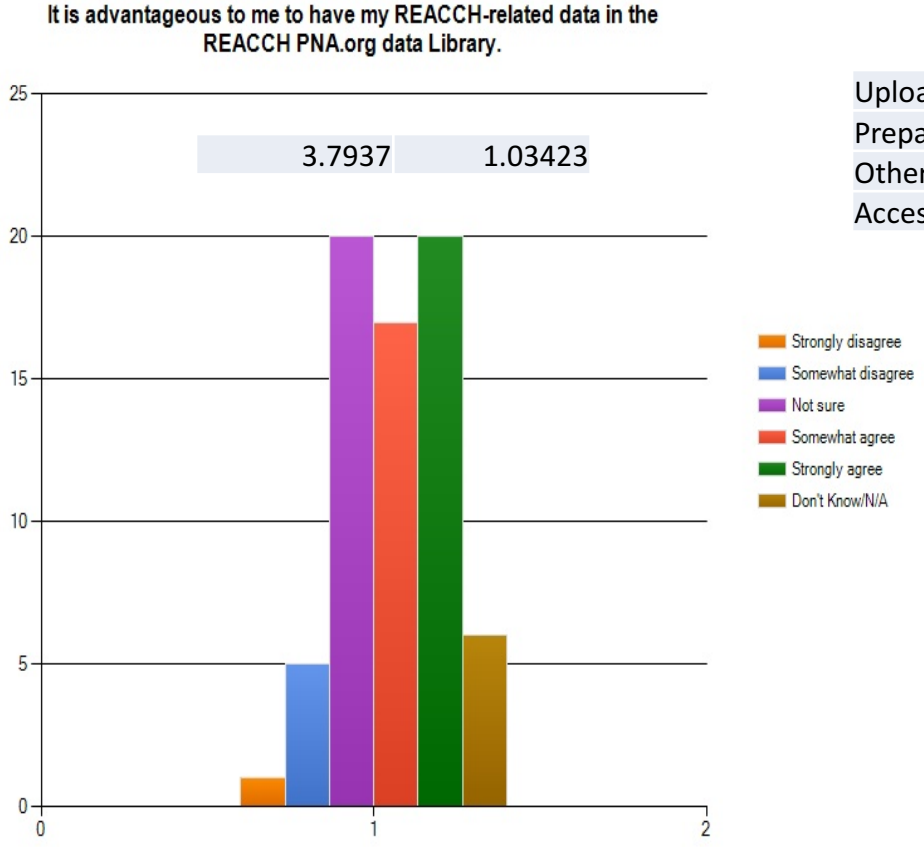
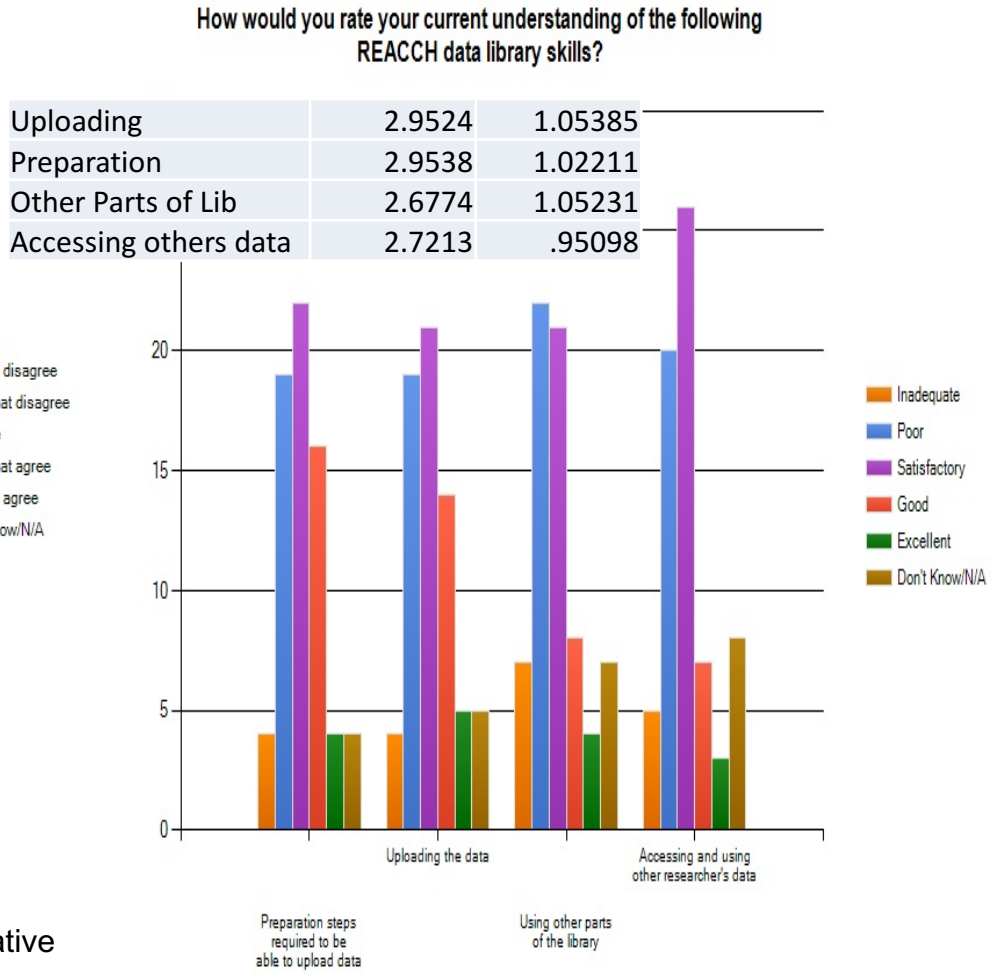
Data Management Metrics





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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

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Questions?