

**RIMS:**

# **Rapid Integrated Mapping and Analysis System**

*(Online GIS tools for data visualization, analysis, manipulation, and education)*

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*Water Systems Analysis Group,*

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<http://earthatlas.sr.unh.edu/maps>

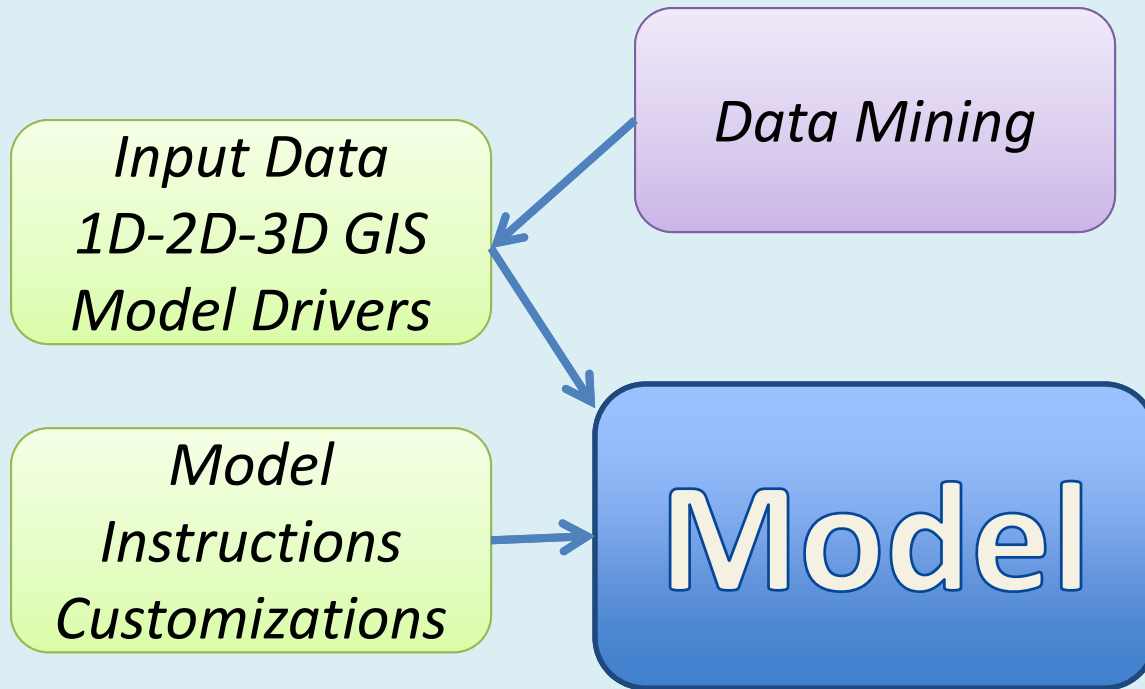
<http://neespi.sr.unh.edu/maps>

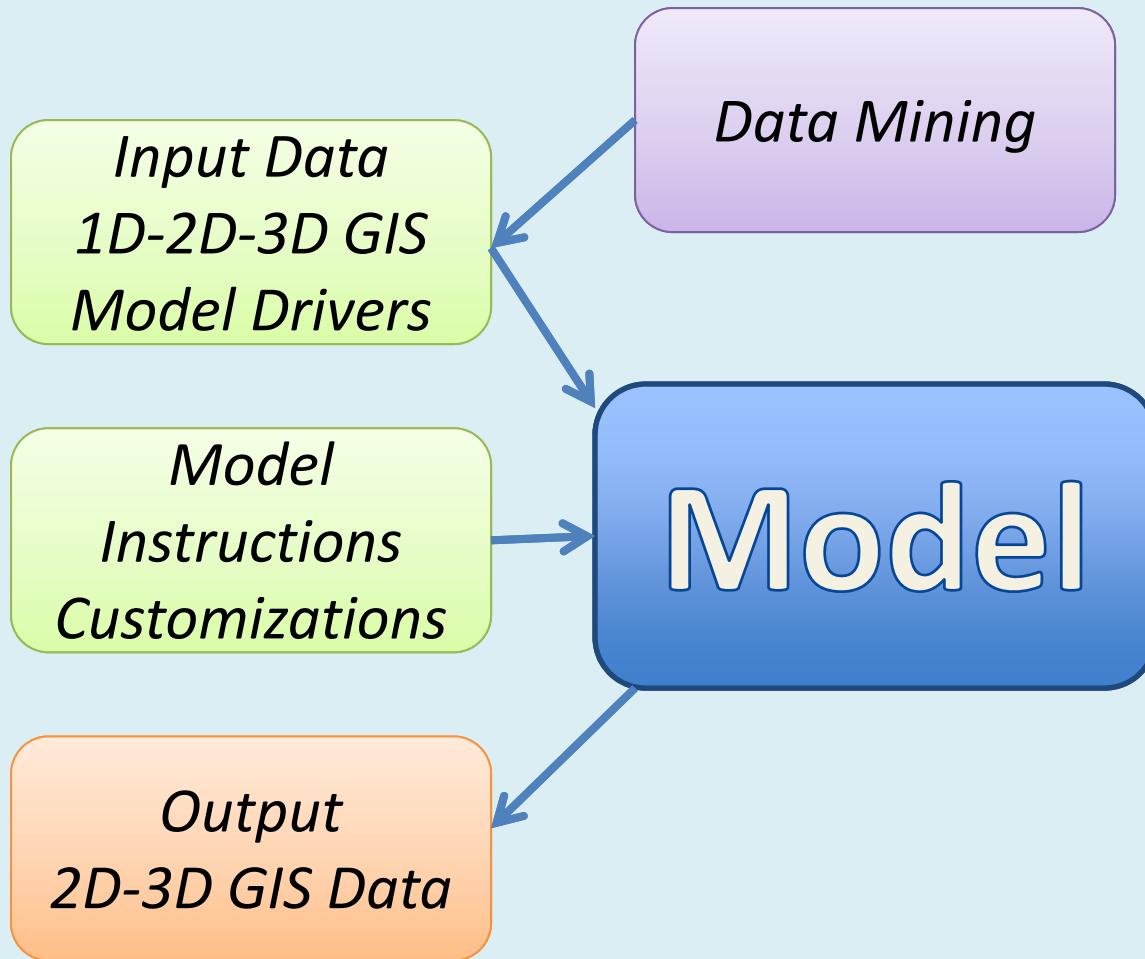
<http://nh-rims.sr.unh.edu/maps>

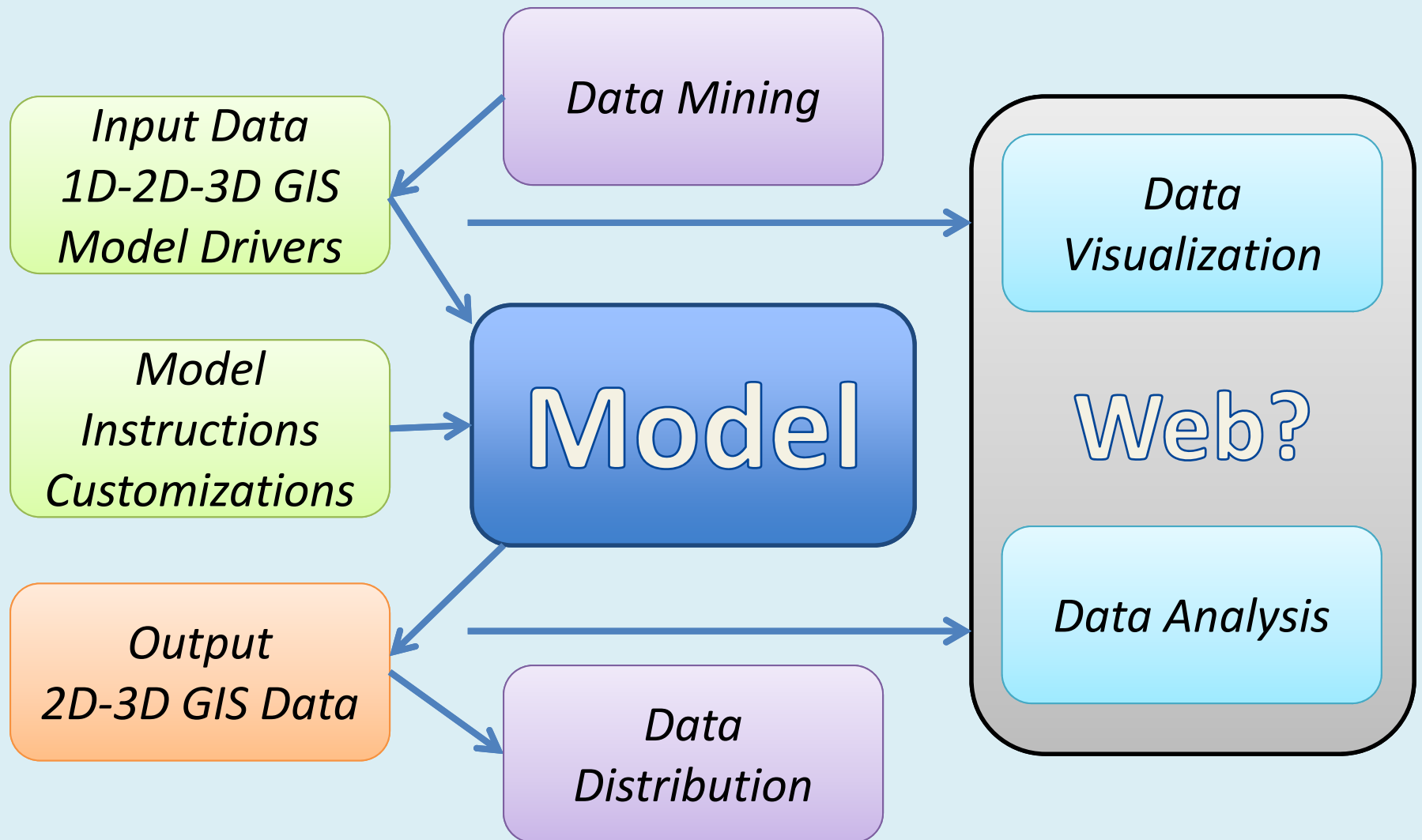
<http://www.riverthreat.net/maps>

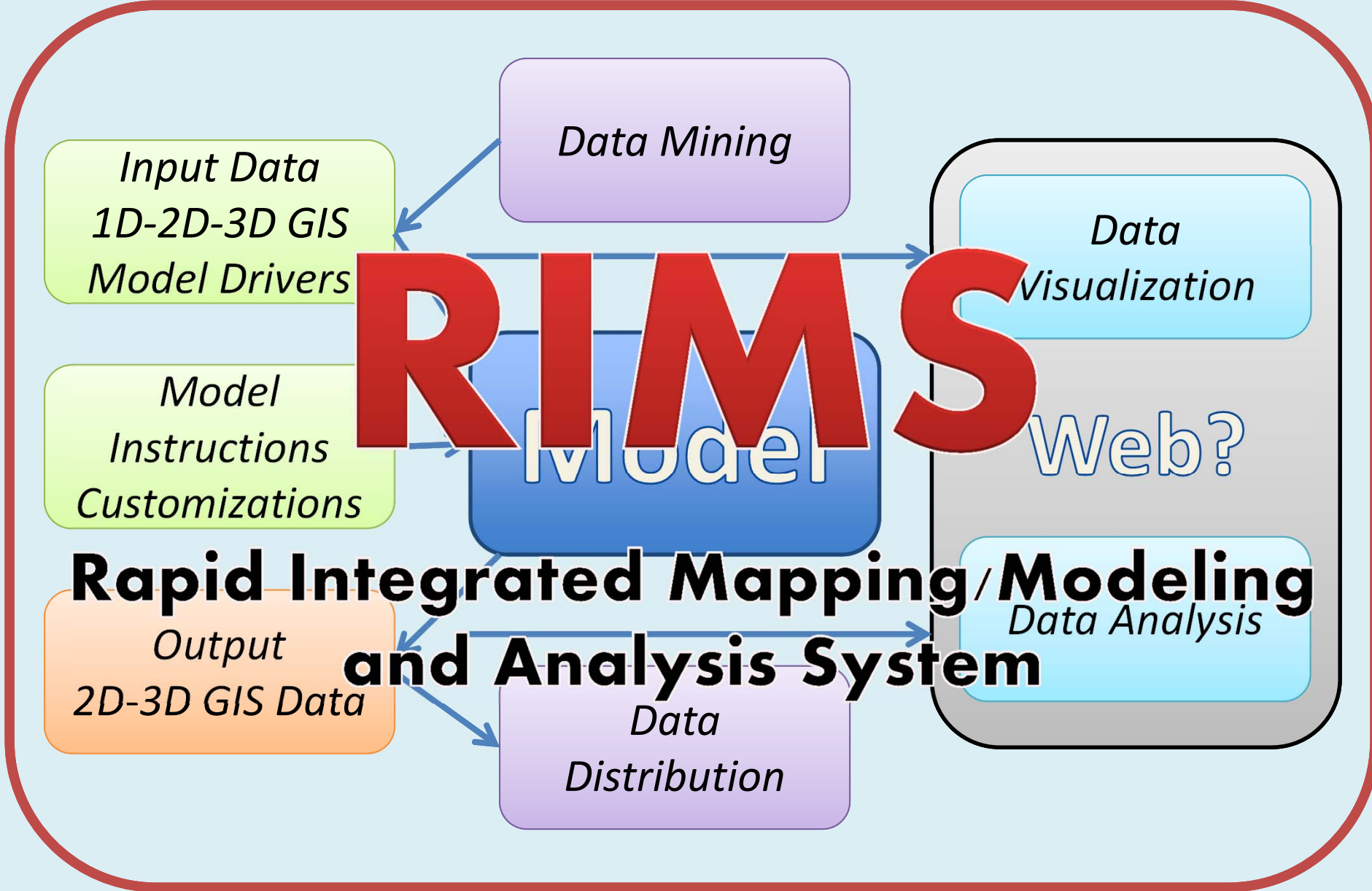
<http://riceghg.sr.unh.edu/maps>

Model







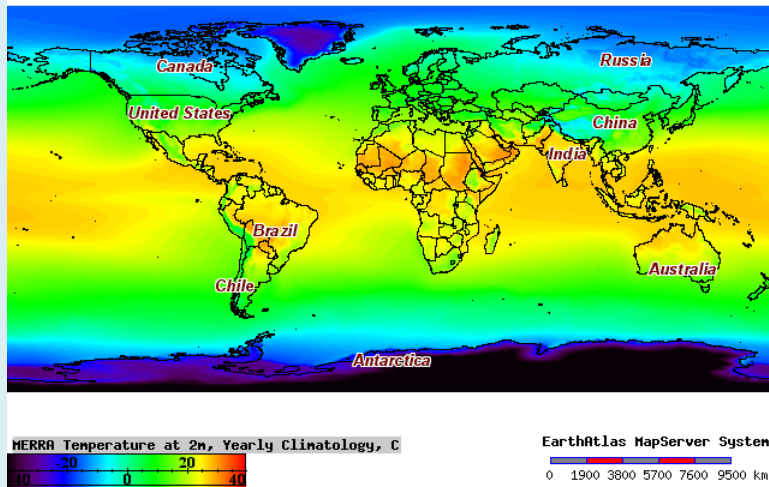


## Core Functions of the RIMS

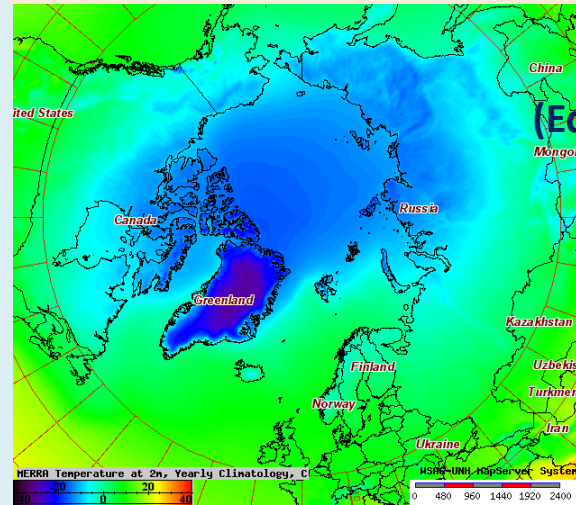
Data management	Data acquisition, aggregation, production	Data visualization, exploration	Data manipulation
<b>Offline Access- Command line, GUI Interfaces</b>		<b>Online Access- Web Client Interface to Web Services</b>	
<ul style="list-style-type: none"> <li>• Create <b>abstraction data access</b> by Data ID that allows on-the-fly spatial re-projection, re-gridding, sub-setting, etc.</li> <li>• Distributed LAN storage and onsite and offsite backup</li> <li>• Data distribution and sharing (FTP)</li> </ul>	<ol style="list-style-type: none"> <li>1. Data mining-               <ul style="list-style-type: none"> <li>• On demand</li> <li>• Scheduled or automated</li> </ul> </li> <li>2. Data aggregation-               <ul style="list-style-type: none"> <li>• Temporal</li> <li>• Spatial</li> <li>• Downscaling</li> </ul> </li> <li>3. Modeling-               <ul style="list-style-type: none"> <li>• Manual</li> <li>• Batch runs</li> <li>• Scheduled runs</li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• Mapping</li> <li>• Graphing</li> <li>• Animations</li> <li>• Queries</li> <li>• Data access</li> <li>• Station/Point data access</li> <li>• Data masking</li> <li>• Etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Web GIS</li> <li>• Advanced data queries</li> <li>• Data manipulation</li> <li>• Data calculations</li> <li>• Data integration</li> <li>• Time series integration</li> </ul>

# Illustration of a Dataset Abstraction with Web Map Services (WMS)

[earthatlas.sr.unh.edu/maps](http://earthatlas.sr.unh.edu/maps)



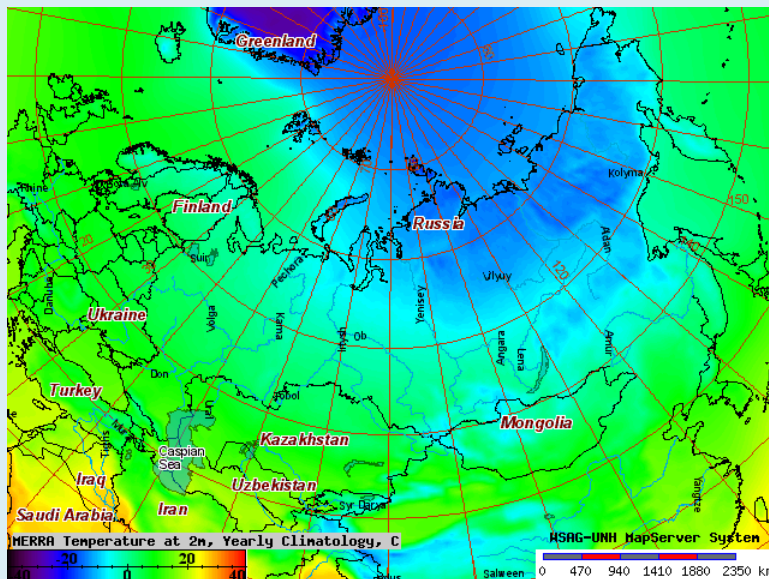
[nh-rims.sr.unh.edu/maps](http://nh-rims.sr.unh.edu/maps)



**EASE projection  
(Equal Area Scalable Earth)  
Polar view**

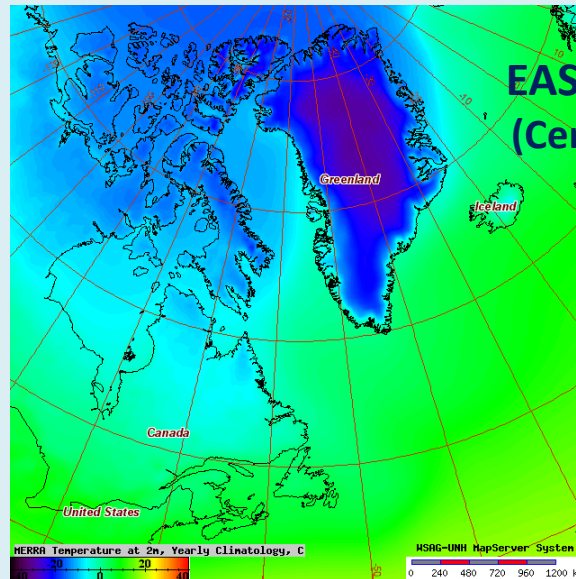
In fixed projection like this zooming to Alaska will result in showing it upside down (North down and South up).

[neespi.sr.unh.edu/maps](http://neespi.sr.unh.edu/maps)



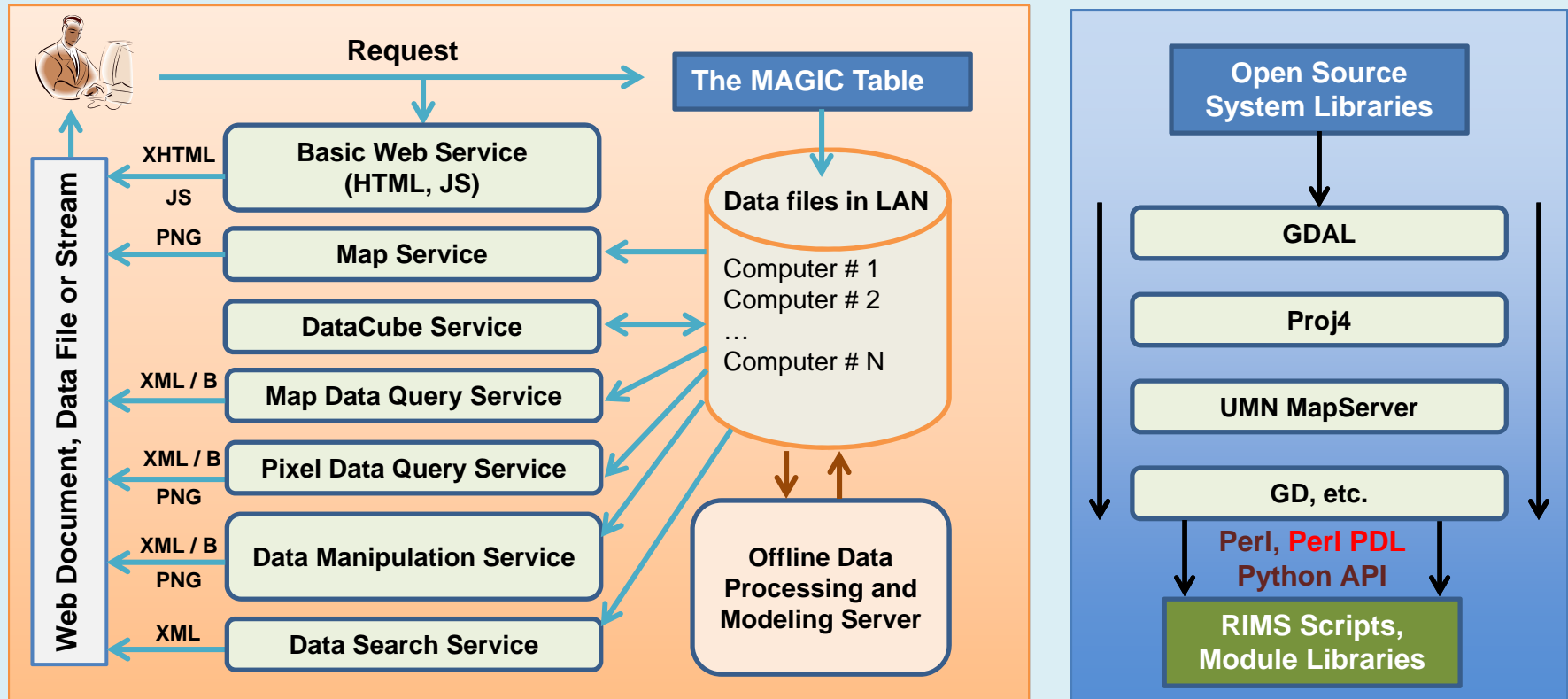
**EASE adaptive projection  
(Central Meridian to North)**

In adaptive projection like this zooming or panning to any geographical area will automatically rotate map view so that North always positioned upward.





# Conceptual software design for the RIMS



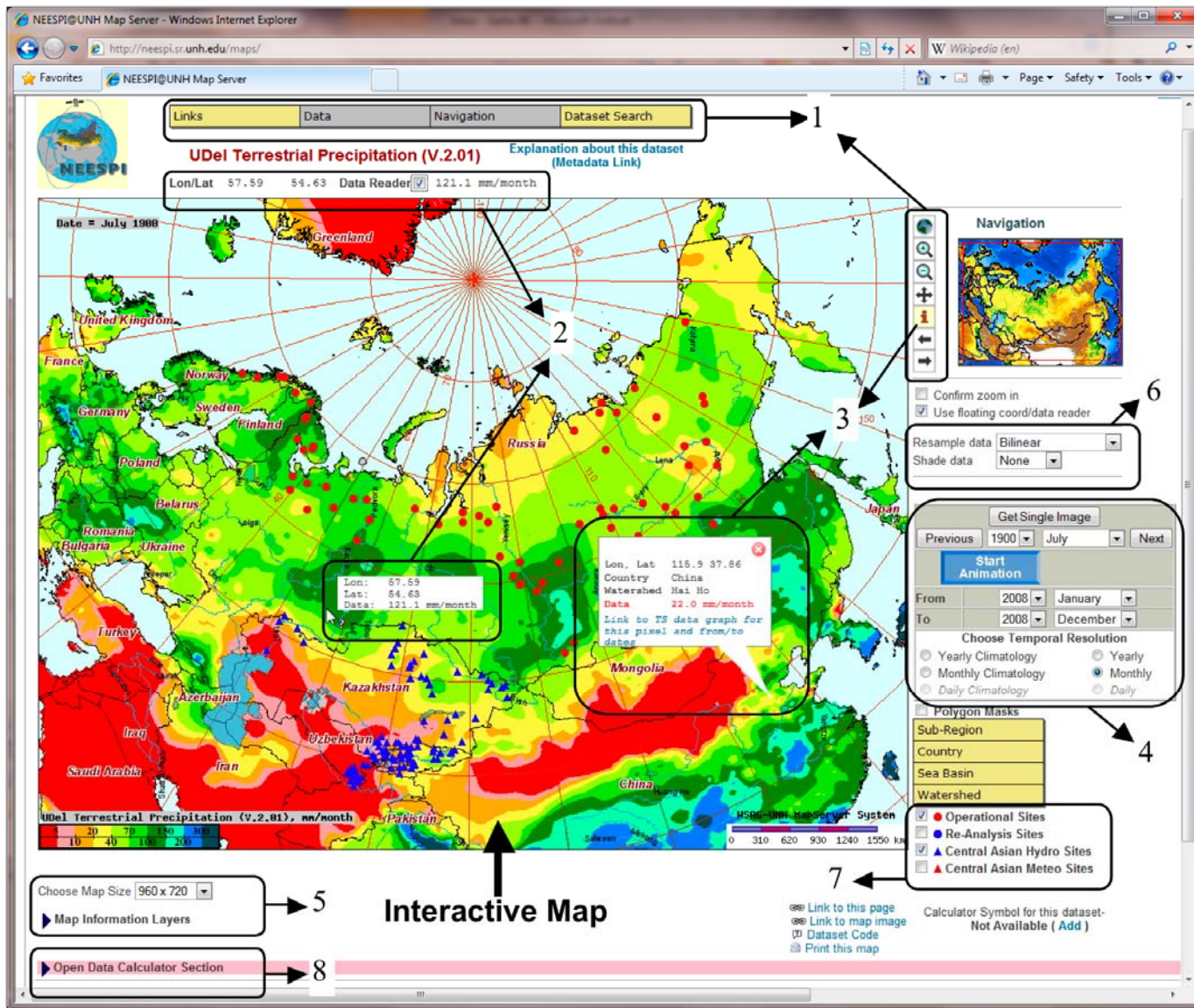
*A Web user generates a sequence of requests to the RIMS system which are evaluated, processed and assembled to a document, graphics or data file utilizing a number of stand-alone services that use the same pool of raw data which, in turn, has all its metadata summarized in the Manipulation and Geographic Inquiry Control (MAGIC) Table. New data becomes immediately available to a user as soon as its metadata is added.*

## Conceptual structure of the Manipulation and Geographic Inquiry Control (MAGIC) Table

Block (Size)	Fields & Headers	Function
ID (4)	Data ID, DataCube ID, Project ID, Data Group ID	Unique IDs to identify data
Time Series (3)	TS type, steps, lists, Start/End dates	Time Series (TS) descriptors
Legend & Color Palette (3)	Legend, Palette	Value/Color lookup table and Legend bar image. Static or dynamic. Data attribute table locator.
Web Labels and Links (5)	Data name, Graph label, Units	Web names, labels, data units, data credit links
Unit conversion (2)	Scale, Offset	Unit conversion on-the-fly
GIS Projection (1)	Projection	EPSG or full proj+ projection definition for the source data
MapServer & GDAL options (12)	Sampling, Scaling, Central Meridian, Rounding, etc.	Map and data processing specific instructions
Data Locator (3)	File Path, Variable Name, Number of bands	Description of file organization to locate TS band within a file and within LAN file system.
Spatial Aggregation (3)	Aggregation path, Mask translation keys, Attributes	Information about spatial aggregation by given masks. Supports any number of masks per dataset
Site Specs (N)	Calculator symbols, others	Customization of a web site specific features

## Summary of RIMS data holdings

Earth System Science Data Category	Key Sources	Examples of Major Parameters	Current Dataset Count	
			Source	Source + DataCube
Hydrology	UNH, CCNY	Discharge, runoff, river networks, irrigation, dams	200	250
Past and Present Climate	NASA, NOAA, UDel, Princeton U.	Temperature, precipitation, evapotranspiration (ET), heat radiation, pressure, wind	70	210
	NCEP, MERRA		62	160
Future Climate and Hydrology	IPCC, UNH	Temperature, precipitation, ET, snow, runoff, discharge	680	4100
Remote Sensing	MODIS, UNH, UOklahoma	Vegetation indices, soil moisture, clouds	48	60
Physical Geography	NASA, USGS, UNH	Elevation, bathymetry, Blue Marble, Lon/Lat	28	22
Oceanography	NOAA, NCOF	SST, sea ice	3	4
Land Cover	UM, NASA, USGS	Land cover, vegetation, permafrost, freeze/thaw	60	80
Sociology and Economics	CIESIN, World Bank, US CIA, UNH	Population, GDP, industry, mortality/birth/malnutrition rates	30	60
Agriculture	UWisc, Various	Crop land, crops, fertilizer loads, greenhouse emissions	160	200
Polygon Masks	UNH	Watershed, sea/ocean catchments, continents, countries, administrative units	18	18
Station Data	UNH, AGS	Hydrology, climate, public health	8	8
<b>Total</b>			~1400	~5100



## Web Client application for the RIMS system

1) data search/selection, spatial navigation, metadata link, etc.;

2) coordinate and map data value reader;

3) pixel query tool (i-tool) gets coordinates, country, watershed, and map data value;

4) time series navigation tool;

5) map size and base layer choices;

6) data interpolation and shading tools;


7) point/station data list with clickable symbols that open station pages in a separate browser window;

8) fold-out section to run the Data Calculator application to perform mathematical and logical functions over gridded or vector datasets;

Earth System Atlas Map Server - Windows Internet Explorer

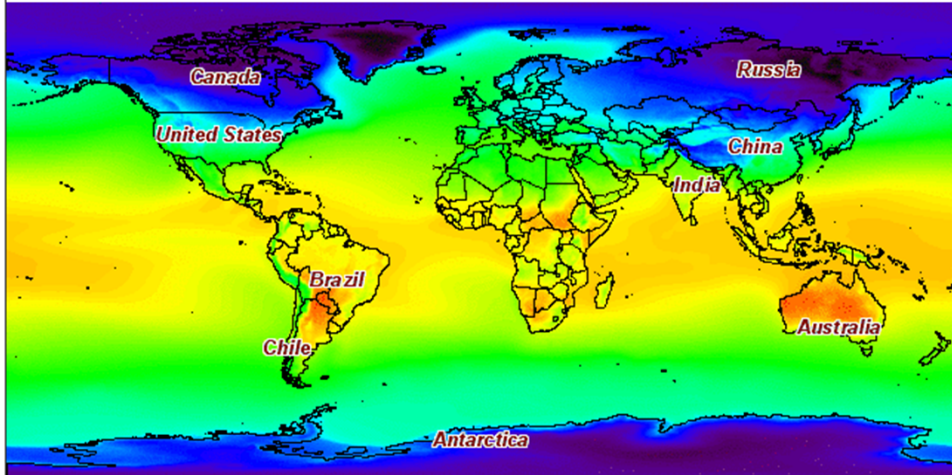
http://earthatlas.sr.unh.edu/maps/ W shiba inu


[Data](#)
[Navigation](#)
[Dataset Search](#)
[Data Manipulation](#)



**MERRA Temperature at 2m, Monthly Climatology**
[Explanation about this dataset \(Metadata Link\)](#)

Lon/Lat      Data Reader  Check to Load


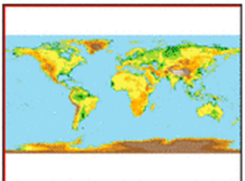
Date = January



**MERRA Temperature at 2m, Monthly Climatology, C**  


**EarthAtlas MapServer System**  


**Navigation**

Confirm zoom in  
 Use floating coord/data reader

Resample data:   
 Shade data:

From:   
 To:

**Choose Temporal Resolution**  
 Yearly Climatology     Yearly  
 Monthly Climatology     Monthly  
 Daily Climatology     Daily

Choose Map Size:

[Link to this page](#)  
[Link to map image](#)  
[Dataset Code](#)  
[Print this map](#)

Calculator Symbol for this dataset - **Not Available (Add)**

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Done      Internet | Protected Mode: On      100%

# Point/Station data linked to RIMS system


Stream Discharge Station Data - Windows Internet Explorer

http://rims.unh.edu/data/station/station.cgi?station=6342

Google Search Bookmarks Check AutoFill More alex.p... Convert Select

Favorites Stream Discharge Station Data Page Safety Tools

**Station Information**

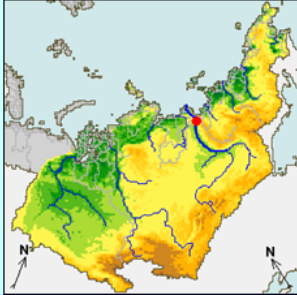


**Stream Discharge Station Data**

Station Name:  
**LENA AT KUSUR**

Station Code: 3821	R-ArcticNet ID: 6342	ArcticRIMS ID: 3
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Source: ROSHYDROMET, Russia	Latitude: 70.68	Longitude: 127.39	Continent: Asia
Drainage area: 2430000 km <sup>2</sup>	Contributing area: 2430000 km <sup>2</sup>	Interstation area: 6342 km <sup>2</sup>	Next Upstream Station: <a href="#">6147</a> <a href="#">6236</a> <a href="#">6266</a>
<b>Operational Site</b>			Next Downstream Station(s): <a href="#">6344</a>

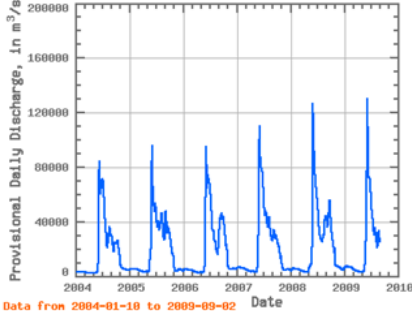


**Monthly Climatology and other Graphs**

Beginning Date:		Ending Date:	
<b>Discharge Climatology</b>			
1936		2000	
<b>Archival Monthly Discharge</b>			
1936	January	2000	December
<b>Archival Daily Discharge</b>			
1978	January	1	1999
		December	31
<b>Provisional Monthly Discharge</b>			
2000	January	2009	August
<b>Provisional Daily Discharge</b>			
2004	January	10	2009
		September	2
<b>Provisional Monthly Stage</b>			
2000	January	2009	August
<b>Provisional Daily Stage</b>			
2000	January	10	2009
		September	2

Discharge Graph Units -  m<sup>3</sup>/s  km<sup>3</sup>  mm

Data Type	Daily	Monthly
Archival Discharge, m <sup>3</sup> /s	<a href="#">Range from 1978-01-01 to 1999-12-31</a>	<a href="#">Range from 1936-01 to 2000-12</a>
Archival Stage, m	N/A	N/A
Provisional Discharge, m <sup>3</sup> /s	<a href="#">Range from 2000-01-10 to 2009-09-02</a>	<a href="#">Range from 2000-01 to 2009-08</a>
Provisional Stage, m	<a href="#">Range from 2000-01-10 to 2009-09-02</a>	<a href="#">Range from 2000-01 to 2009-08</a>



Data from 2004-01-10 to 2009-09-02

**Available Data Downloads**

Data Type	Daily	Monthly
Archival Discharge, m <sup>3</sup> /s	<a href="#">Range from 1978-01-01 to 1999-12-31</a>	<a href="#">Range from 1936-01 to 2000-12</a>
Archival Stage, m	N/A	N/A
Provisional Discharge, m <sup>3</sup> /s	<a href="#">Range from 2000-01-10 to 2009-09-02</a>	<a href="#">Range from 2000-01 to 2009-08</a>
Provisional Stage, m	<a href="#">Range from 2000-01-10 to 2009-09-02</a>	<a href="#">Range from 2000-01 to 2009-08</a>

**Station Lists Sorted by**

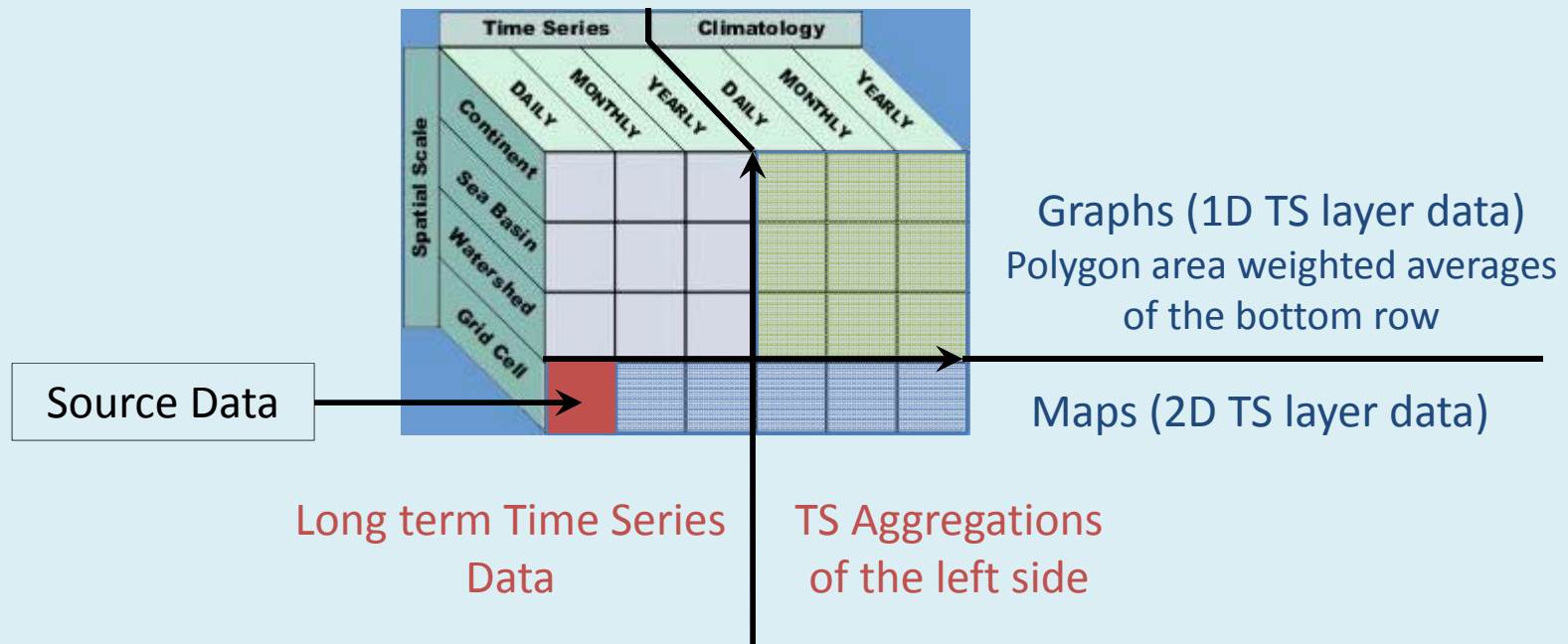
<a href="#">R-Arctic Net ID</a>	<a href="#">Arctic RIMS ID</a>	<a href="#">Station Code</a>	<a href="#">Station Name</a>	<a href="#">Continent</a>	<a href="#">Drainage Area</a>	<a href="#">Annual Discharge</a>
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Done Internet | Protected Mode: On 75%

# Illustration of DataCube Data Aggregation Concept Used in RIMS

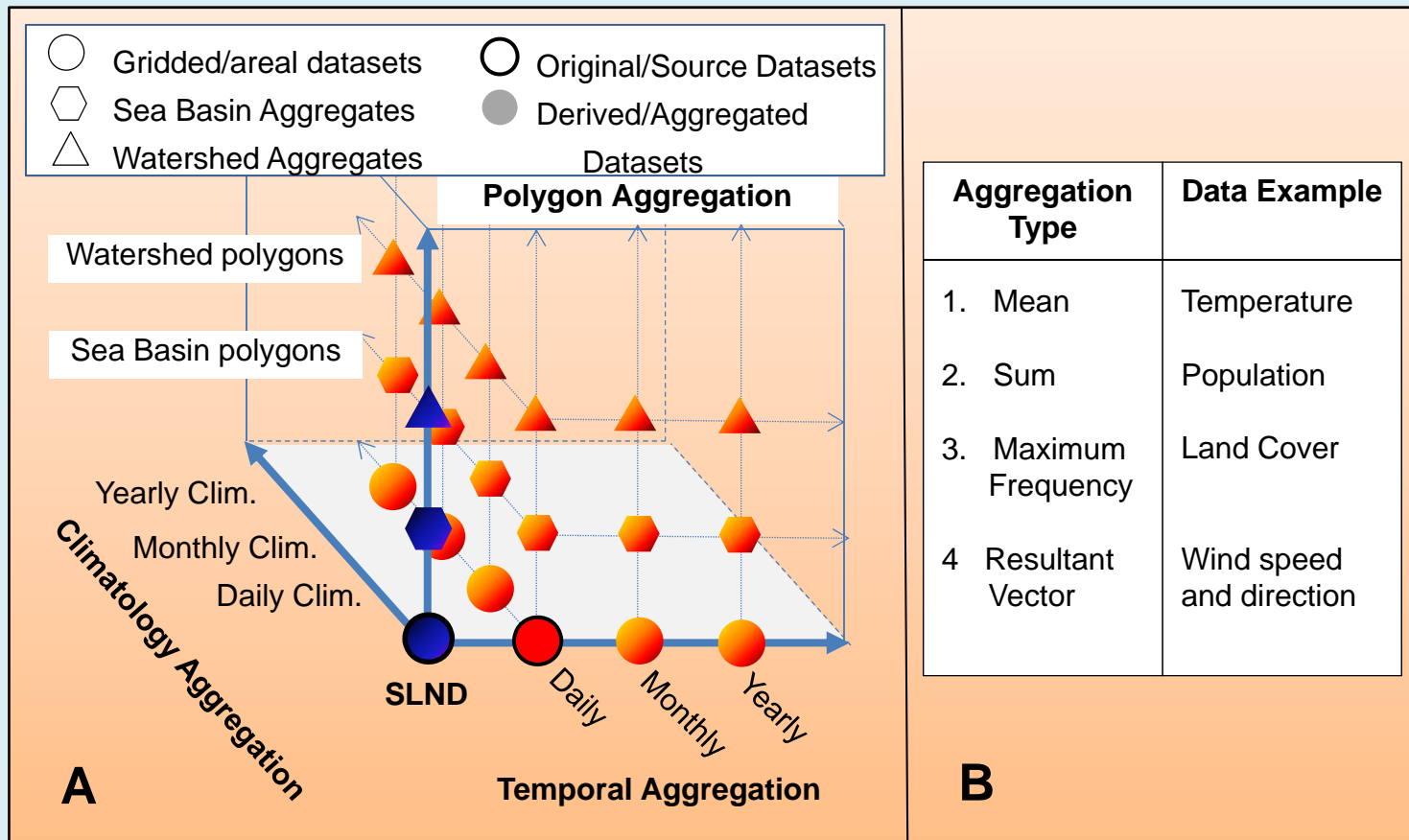


# Illustration of DataCube Data Aggregation Concept Used in RIMS





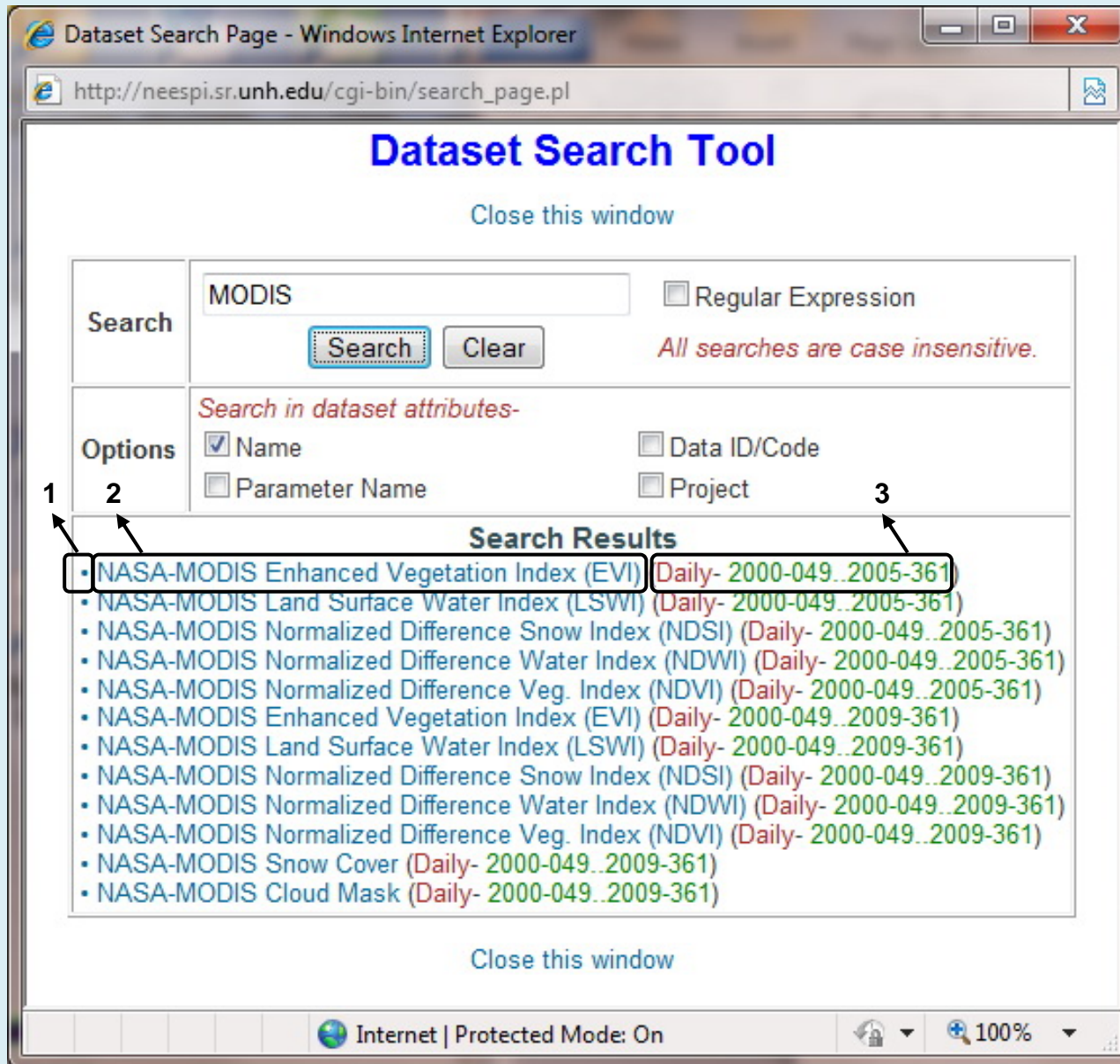
# DataCube aggregation scheme used in RIMS



(A) Original Daily dataset (e.g. NCEP daily temperature at 2 m) can be aggregated along the temporal scale to monthly and yearly derivative datasets, and along the climatology scale to daily, monthly and yearly climatology (long-term averages) derivative sub-datasets. In turn, each of these can be aggregated by any number of polygon sets (on the polygon aggregation scale) to polygon averages or cumulatives (e.g. average temperature per country). Single layer non-dated datasets (e.g. elevation) can be aggregated only along the polygon aggregation scale (e.g. average elevation of a watershed).

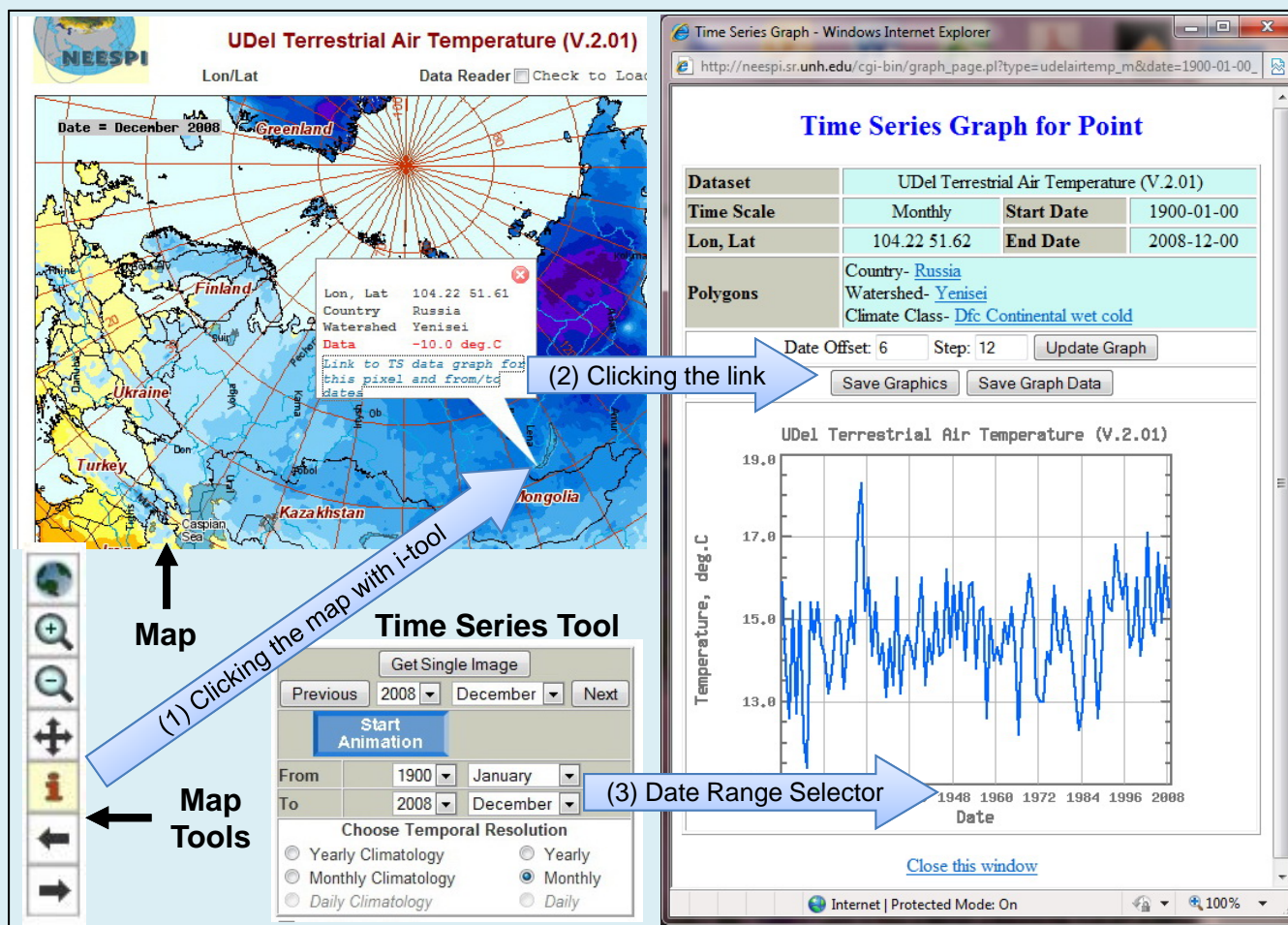
(B) Aggregation method can be one of the following types- (1) average, e.g. temperature; (2) cumulative, e.g. population; (3) max frequency, e.g. land cover; (4) vector average, e.g. wind

# Web based Dataset Search Tool that uses DSS service



- (1) Link to full metadata information.
- (2) Link to the dataset visualization and manipulation in the parent Map page.
- (3) Time series metadata information.

# Components of RIMS Web client application that utilize Pixel Data Query Service



*In this example a time series graph for city of Irkutsk for summer month of July is displayed over a date range from 1900 to 2008. (1) Clicking the map with i-tool selected on the map toolbox brings a pixel information call-out box where basic data for the pixel is displayed such as coordinates, country, watershed, data value along with a link to time series data.*

*(2) Clicking the link brings a pop-up window for pixel time series data display where a user can choose options of a) data selector with date offset and step, b) saving graph with full information, c) saving graph data in a spreadsheet compatible format for analysis outside of the system, d) switch to polygon data and graphs where the selected pixel is present (in this example it is a country polygon for Russia, watershed polygon for Yenisei, and climate type polygon for Dfc class). (3) The date range for the graph is taken off the Time Series Tool on the map page (Figure 2), and a user can set a Date offset and Step in a Web form above the graph to plot any specific month or day of the year over a given range of years.*

NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Wångström

Close Data Calculator Section

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other **User Defined**

Symbol	Dataset	Units	Symbol	Dataset	Units	Symbol	Dataset	Units
temp	Princeton Air Temperature at 2m	C*						
UDeI_T_mc	UDeI Terrestrial Air Temperature (V.2.01)	deg.C*						

\*Time Series datasets- See instructions.

Pixel Equation	max(UDeI_T_mc{0000-01-00..0000-12-00})-min(UDeI_T	Operators/Functions	Map Options	<input checked="" type="checkbox"/> Ignore Illegal Math
Area Integral	∫ d A (km <sup>2</sup> )	StatFunctions	Data Options	<input type="checkbox"/> High resolution interpolation
Area Average	<input type="checkbox"/> Area Weighted Mean = Area Integral (above) / Area	Examples	Color Options	<input type="checkbox"/> Get Results as Data
Instructions	Do Calculations Reset	TS-Range, [j] = YYYY-MM-DD ... YYYY-MM-DD		

Calculation Results for Selected Area

Equation used - Calculated in 0 min 29 sec  
 $\max(\text{UDeI\_T\_mc}\{0000-01-00, .0000-12-00\}) - \min(\text{UDeI\_T\_mc}\{0000-01-00, .0000-12-00\})$

Frequency Histogram for the Calculated Data

Pixel Average = 32,237

LEGEND

©2008 University of New Hampshire  
 Programming by Alex Prusavich

Home | WSAG | CSRC | EOS | UNH |

NEESPI Contacts +1 603.862.0850 (voice) + +1 603.862.0587 (fax) + Richard.Lammers@unh.edu + Alex.Shiklomanov@unh.edu + neespi.sr.unh.edu

## “Data Calculator” Web application that uses RIMS Data Manipulation Service.

Example:  
 Temperature difference between the warmest and coldest month of the year is calculated for the NEESPI project.

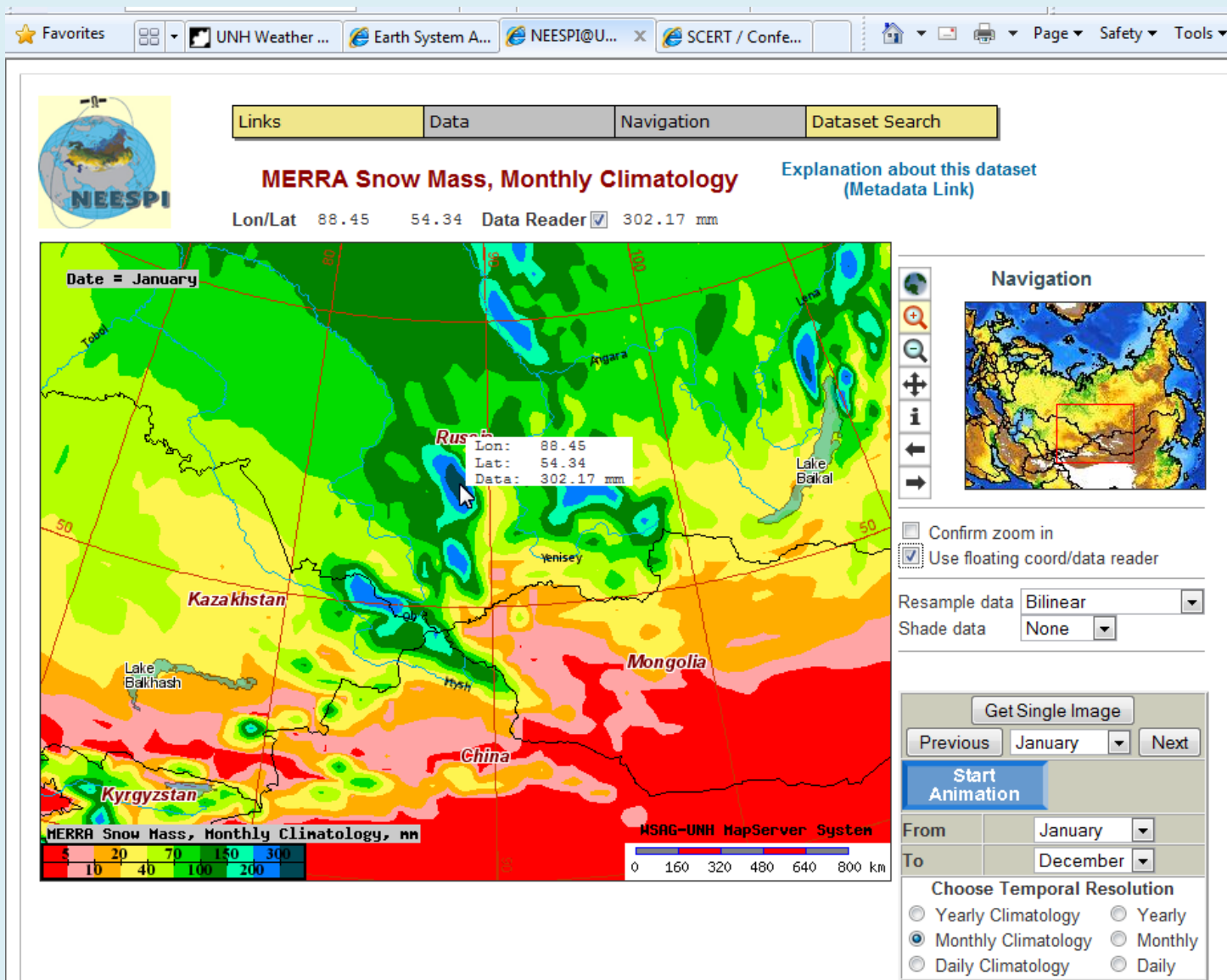
The equation is entered in the “Pixel Equation” input form and the results are displayed as a map and frequency histogram at the bottom of the Web page.

# **Summary for the RIMS (Regional Integrated Mapping and Analysis System) system design and applications**

- 1) The system is primarily used for data management, mining, aggregation, manipulation, automated or batch model runs.**
- 2) Web visualization (maps, graphs, GIS calculator) is a secondary, but important side of the RIMS system. Web client API is scalable and customizable for a specific projects.**
- 3) RIMS is designed for use in science applications. For example, NEESPI RIMS is a set of Web based and online research and data analysis tools that can be used for rapid analysis of various natural phenomena and events.**
- 4) System is build on Open Source system libraries (e.g. GDAL, Proj4, UNM MapServer, GD) interfaced with Perl, Perl PDL, Python APIs.**
- 5) RIMS can be ported or can be used for hosting data.**
- 6) The system can be customized for education and other applications.**

# Demo # 1:

## Reading map data values, class names on mouse over



# Demo # 1:

## Reading map data values, class names on mouse over

★ Favorites UNH Weather ... Earth System A... NEESPI@U... x SCERT / Confe... Page Safety Tools

NEESPI

Links Data Navigation Dataset Search

**Land Cover** [Explanation about this dataset \(Metadata Link\)](#)

Lon/Lat 82.52 68.84 Data Reader  Open Shrubland (9)

Finland Russia Kazakhstan Uzbekistan Tajikistan Mongolia China

Land Cover

0 320 640 960 1280 1600 km

HSAG-UNH MapServer System

Navigation

Confirm zoom in  
 Use floating coord/data reader

Polygon Masks

- Sub-Region
- Country
- Sea Basin
- Watershed

● Operational Sites  
 ● Re-Analysis Sites  
 ▲ Central Asian Hydro Sites  
 ▲ Central Asian Meteo Sites

Choose Map Size 640 x 480

# Demo # 2: Controls of interpolation method

Links Data Navigation Dataset Search

### MERRA Total Surface Precipitation, Monthly Climatology

Lon/Lat Data Reader  Check to Load

Explanation about this dataset (Metadata Link)

Date = July

Navigation

Confirm zoom in  Use floating coord/data reader

Resample data: Nearest Neighbour  
Shade data: None, Bilinear, Cubic, Cubic Spline  
Get: Nearest Neighbour

Previous July Next

Start Animation

From: January To: December

Choose Temporal Resolution  
 Yearly Climatology  Yearly  
 Monthly Climatology  Monthly  
 Daily Climatology  Daily

MERRA Total Surface Precipitation, Monthly Climatology, mm/no

MSAG-UNH MapServer System

0 280 560 840 1120 1400 km

NB



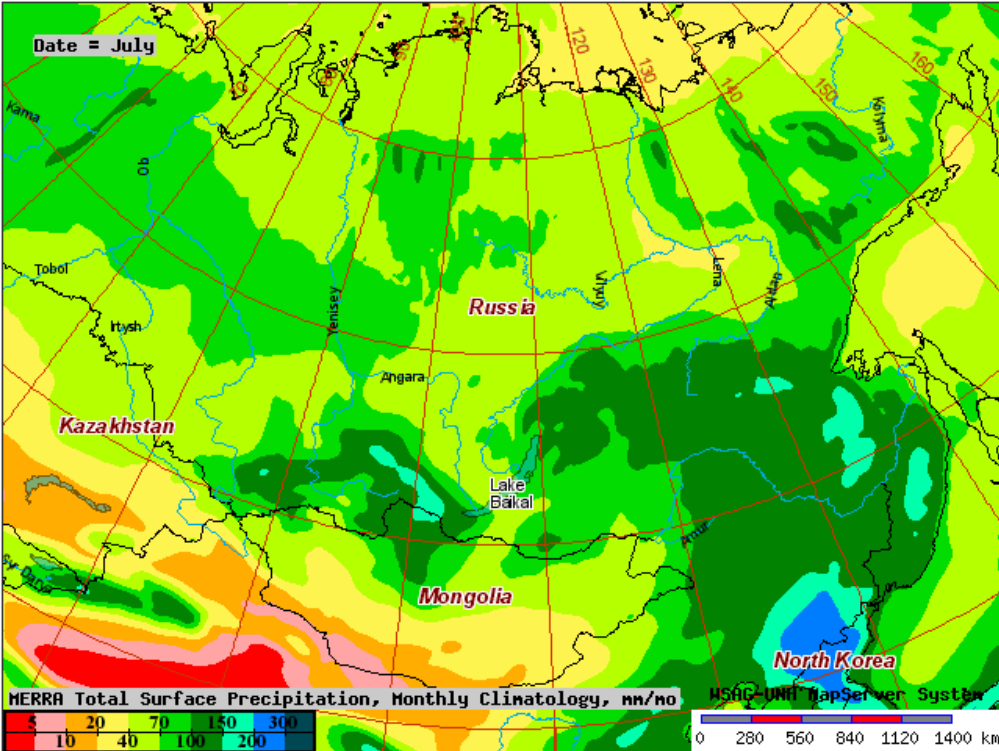
# Demo # 2: Controls of interpolation method

UNH Weather ... Earth System A... NEESPI@U... SCERT / Confe...

Links Data Navigation Dataset Search

### MERRA Total Surface Precipitation, Monthly Climatology

Lon/Lat Data Reader  Check to Load [Explanation about this dataset \(Metadata Link\)](#)



Date = July

Navigation

Confirm zoom in  
 Use floating coord/data reader

Resample data: Cubic Spline  
Shade data: None, Bilinear, Cubic, **Cubic Spline**, Get Nearest Neighbor

From: January To: December

Choose Temporal Resolution:  
 Yearly Climatology  Yearly  
 Monthly Climatology  Monthly  
 Daily Climatology  Daily

MERRA Total Surface Precipitation, Monthly Climatology, mm/no

MSAG-UNH MapServer System

→ NB

# Demo # 3: Controls of temporal resolutions

Links Data Navigation Dataset Search

MERRA Temperature at 2m, Yearly Climatology Explanation about this dataset (Metadata Link)

Lon/Lat Data Reader  Check to Load

Navigation

Confirm zoom in   
Use floating coord/data reader

Resample data Bilinear  
Shade data None

Choose Temporal Resolution

- Yearly Climatology
- Monthly Climatology
- Daily Climatology
- Yearly
- Monthly
- Daily

Polygon Masks

- Sub-Region
- Country
- Sea Basin
- Watershed

Operational Sites

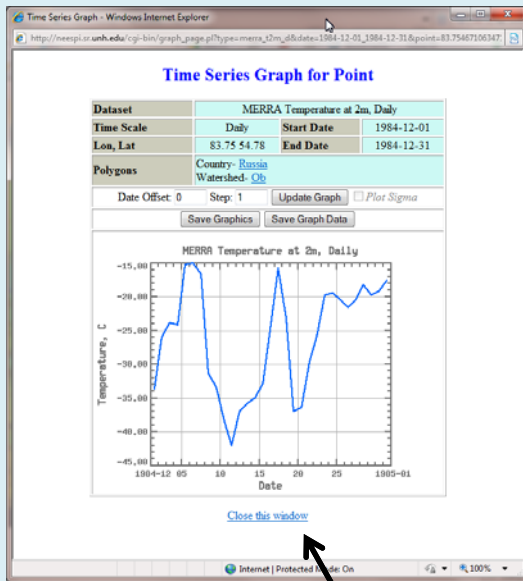
MERRA Temperature at 2m, Yearly Climatology, C

MSAG-UNH MapServer System

0 470 940 1410 1880 2350 km

NB

# Demo # 3: Controls of temporal resolutions



Earth System At... NEESPI@UN... SCERT / Confer...

Data Navigation Dataset Search

**MERRA Temperature at 2m, Daily** [Explanation about this dataset \(Metadata Link\)](#)

Data Reader  Check to Load

**Navigation**

Confirm zoom in  
 Use floating coord/data reader

Resample data: Bilinear  
Shade data: None

Get Single Image

Previous 1984 December 22

Start Animation

From 1984 December 1 To 1984 December 31

Choose Temporal Resolution

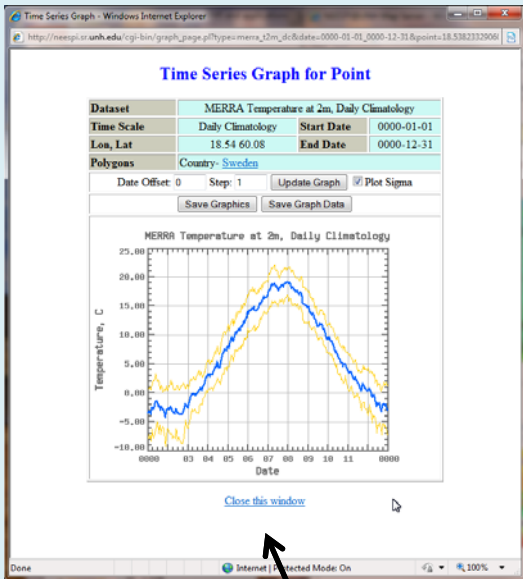
Yearly Climatology       Yearly  
 Monthly Climatology       Monthly  
 Daily Climatology       Daily

MSAG-UNH MapServer System

Lon, Lat 83.75 54.77  
Country Russia  
Watershed Ob  
Data -25.93 C  
[Link to TS data graph for this pixel and from/to dates](#)

→ NB

# Demo # 3: Controls of temporal resolutions



MERRA Temperature at 2m, Daily Climatology

Explanation about this dataset (Metadata Link)

Lat Data Reader  Check to Load

Navigation

Confirm zoom in   
Use floating coord/data reader

Resample data Bilinear  
Shade data None

Get Single Image  
Previous July 8 Next  
Start Animation

From January 1  
To December 31

Choose Temporal Resolution

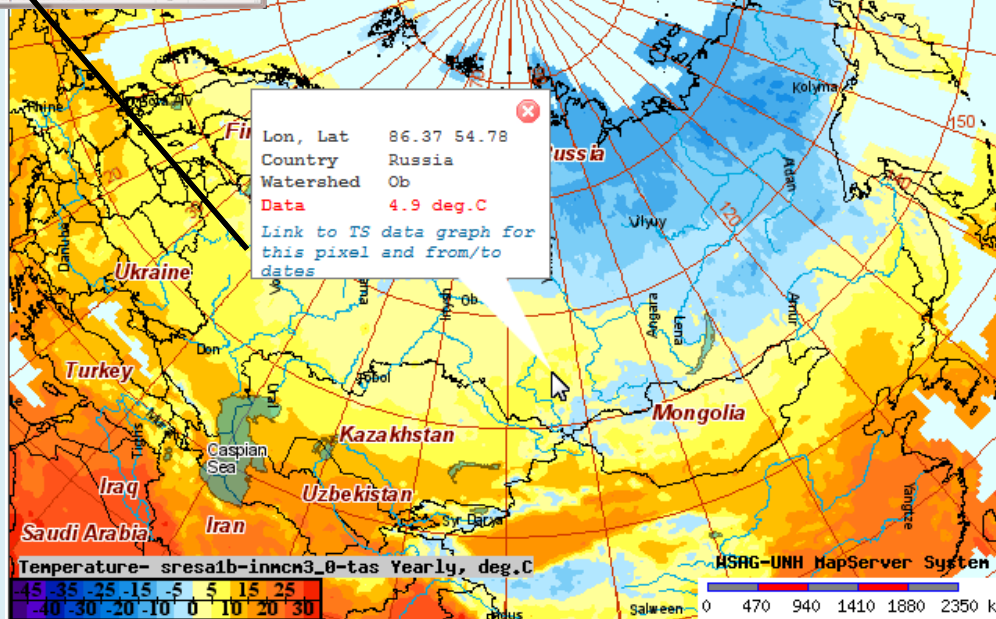
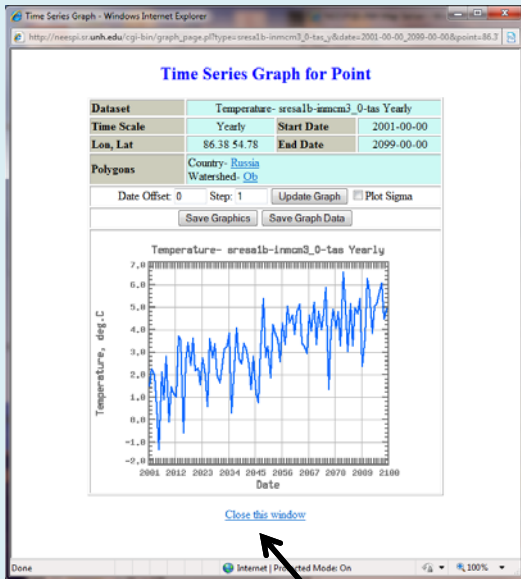
- Yearly Climatology
- Monthly Climatology
- Daily Climatology
- Yearly
- Monthly
- Daily

MERRA Temperature at 2m, Daily Climatology, C

MSAG-UNH MapServer System

→ NB

# Demo # 3: Controls of temporal resolutions



Weather S... Earth System At... NEESPI@UN... x SCERT / Confer...

Navigation Dataset Search

Temperature- sresa1b-inmcm3\_0-tas Yearly Explanation about this dataset (Metadata Link)

/Lat 86.37 54.78 Data Reader  Check to Load

Navigation

Confirm zoom in

Use floating coord/data reader

Resample data Bilinear

Shade data None

Get Single Image

Previous 2099 Next

Start Animation

From 2001

To 2099

Choose Temporal Resolution

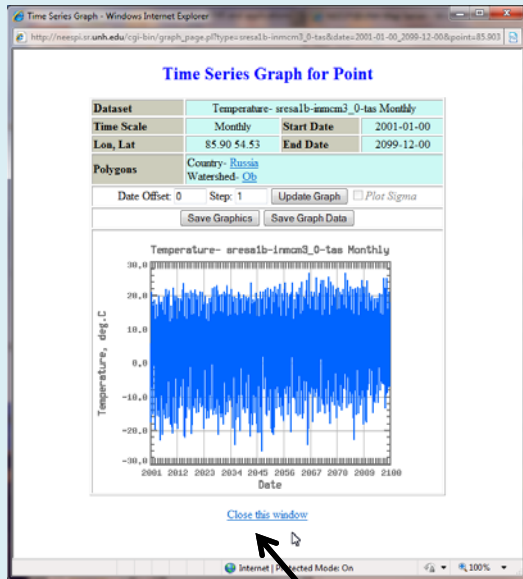
Yearly Climatology  Yearly

Monthly Climatology  Monthly

Daily Climatology  Daily

NB

# Demo # 3: Controls of temporal resolutions



Weather S... Earth System At... NEESPI@UN... SCERT / Confer...

ks Data Navigation Dataset Search

## Temperature- sresa1b-inmcm3\_0-tas Monthly

Explanation about this dataset (Metadata Link)

/Lat Data Reader  Check to Load

Navigation

Confirm zoom in

Use floating coord/data reader

Resample data: Bilinear

Shade data: None

Get Single Image

Previous 2099 November Next

Start Animation

From 2001 January To 2099 December

Choose Temporal Resolution

Yearly Climatology  
 Monthly Climatology  
 Daily Climatology

Yearly  
 Monthly  
 Daily

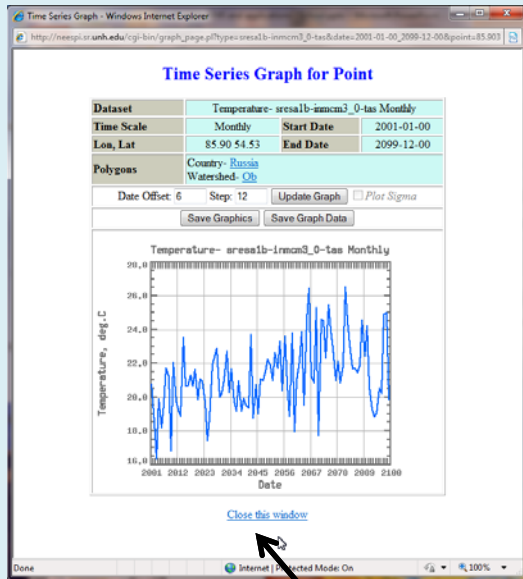
Temperature- sresa1b-inmcm3\_0-tas Monthly, deg.C

MSRG-UNH MapServer System

0 470 940 1410 1880 2350 km

NB

# Demo # 3: Controls of temporal resolutions



Weather S... Earth System At... NEESPI@UN... SCERT / Confer...

ks Data Navigation Dataset Search

### Temperature- sresa1b-inmcm3\_0-tas Monthly

Explanation about this dataset (Metadata Link)

/Lat Data Reader  Check to Load

Navigation

Confirm zoom in  
 Use floating coord/data reader

Resample data: Bilinear  
Shade data: None

Get Single Image

Previous 2099 November Next

**Start Animation**

From: 2001 January To: 2099 December

Choose Temporal Resolution

- Yearly Climatology
- Monthly Climatology
- Daily Climatology
- Yearly
- Monthly
- Daily

Temperature- sresa1b-inmcm3\_0-tas Monthly, deg.C

MSRG-UNH MapServer System

Salween 0 470 940 1410 1880 2350 km

Lon, Lat: 85.9 54.53  
Country: Russia  
Watershed: Ob  
Data: -2.2 deg. C

Link to TS data graph for this pixel and from/to dates

NB

# Demo # 4: The Data Calculator

Calculation of temperature difference between MERRA and NCEP climate models

Equation:  
 $T2mNcepYC - T2mMerraYC$

NB

NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Macro Calculator for Selected Area

Land Characteristics
  Ocean
  Climate
  Hydrology-1
  Hydrology-2
  Other
  User Defined

Symbol	Dataset	Units	Symbol	Dataset	Units	Symbol	Dataset	Units
T2mMerraYC	MERRA Temperature at 2m, Yearly Climatology	C						
T2mNcepYC	NCEP Air Temperature at 2m	C						

\*Time Series datasets- See instructions.

Pixel Equation:  Operators/Functions:

Area Integral:  d A (km<sup>2</sup>) Stat Functions:

Area Average:  Area Weighted Mean = Area Integral (above) / Area Examples:

Instructions:

Map Options:  Set range: Min= Max=

Data Options:  Color Options:   Use Log Scale

TS-Range, {} = YYYY-MM-DD ... YYYY-MM-DD

Calculation Results for Selected Area

Equation used -  $T2mNcepYC - T2mMerraYC$  Calculated in 0 min 13 sec

Frequency Histogram for the Calculated Data

Pixel Average = -1.4928

MSR@-UNH MapServer System

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Done Internet | Protected Mode: On 100%



# Demo # 4: The Data Calculator

Calculation of temperature difference between summer and winter

Equation:

$$\max(T2mMerraMC\{0000-01-00..0000-12-00\}) - \min(T2mMerraMC\{0000-01-00..0000-12-00\})$$

NB

NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other **User Defined**

Symbol	Dataset	Units	Symbol
T2mMerraYC	MERRA Temperature at 2m, Yearly Climatology	C	Roff_A1B_MC
T2mNcepYC	NCEP Air Temperature at 2m	C	T2mMerraMC
T2mNcepM	NCEP Air Temperature at 2m	C*	
T2mNcepMC	NCEP Air Temperature at 2m	C*	

\*Time Series datasets- See instructions.

Pixel Equation:  $\max(T2mMerraMC\{0000-01-00..0000-12-00\}) - \min(T2mMerraMC\{0000-01-00..0000-12-00\})$

Area Integral:  d A (km<sup>2</sup>)

Area Average:  Area Weighted Mean = Area Integral (above) / Area

Do Calculations Reset

Calculation Results for Selected Area

Equation used -  $\max(T2mMerraMC\{0000-01-00..0000-12-00\}) - \min(T2mMerraMC\{0000-01-00..0000-12-00\})$

Frequency Histogram for the Calculated Data

Pixel Average = 27.263

LEGEND

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# Demo # 4: The Data Calculator

Calculation of temperature anomaly for May 2011

Equation:  

$$T2mNcepM\{2011-05-00\} - T2mNcepMC\{0000-05-00\}$$

NB

Close Data Calculator Section

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other

Symbol	Dataset	Units	Symbol	Dataset	Units	Symbol	Dataset	Units
T2mMerraYC	MERRA Temperature at 2m, Yearly Climatology	C						
T2mNcepYC	NCEP Air Temperature at 2m	C						
T2mNcepM	NCEP Air Temperature at 2m	C*						
T2mNcepMC	NCEP Air Temperature at 2m	C*						

\*Time Series datasets - See instructions.

Pixel Equation: T2mNcepM{2011-05-00} - T2mNcepMC{0000-05-00}

Area Integral: [ ] d A (km<sup>2</sup>)

Area Average:  Area Weighted Mean = Area Integral (above) / Area

Instructions: [ Do Calculations ] [ Reset ]

Map Options:  Ignore irregular boundaries,  High resolution interpolation,  Get Results as Data

Color Options: [ ]

Equation used - Calculated in 0 min 11 sec  
 $T2mNcepM\{2011-05-00\} - T2mNcepMC\{0000-05-00\}$

Frequency Histogram for the Calculated Data

Pixel Average = 1.5695

Frequency, %

Calculated Data

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MSAG-UNH MapServer System

Scale: 0 470 940 1410 1880 2350 km

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NB

# Demo # 4: The Data Calculator

Calculation/Integration for total population of Russia in 2015

Equation (Area Integral):  
Pop15 if Country==187

NB

Macro Calculator for Selected Area

Symbol	Dataset	Units	Symbol	Dataset	Units
Country	Country ID		Cell_30m	30min Cell Area	km2
RiverB	Watershed ID		Lon	Longitude	Deg.
Cont	Continent ID		Lat	Latitude	Deg.

Pixel Equation: Area Integral | Pop15 if Country==187 | d A (km<sup>2</sup>)

Map Options:  Use Log Scale

Calculation Results for Selected Area

Equation used - Pop15 if Country==187

Equation for Area Integral - Pop15 if Country==187

Frequency Histogram for the Calculated Data

Pixel Average = 8,1251  
Area Integral = 136,562,258

LEGEND

NB

NB

# Demo # 4: The Data Calculator

Calculation of month of maximum runoff as a snowmelt propagation front

Equation:  

$$(\max(\text{Roff\_A1B\_MC}\{0000-01-00..0000-12-00\}))\{1\}+0.5$$

NB



NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other User Defined

Symbol	Dataset	Units	Symbol	Dataset	Units
T2mMerraYC	MERRA Temperature at 2m, Yearly Climat				
T2mNcepYC	NCEP Air Temperature at 2m				
T2mNcepM	NCEP Air Temperature at 2m				
T2mNcepMC	NCEP Air Temperature at 2m				

Time Series datasets- See instructions.

Pixel Equation:  $(\max(\text{Roff\_A1B\_MC}\{0000-01-00..0000-12-00\}))\{1\}+0.5$

Area Integral:  $\int dA \text{ (km}^2\text{)}$

Area Average:  Area Weighted Mean = Area Integral (above) / Area

Do Calculations Reset

TS-Range, {} = YYYY-MM-DD ... YYYY-MM-DD

Calculation Results for Selected Area

Equation used - Calculated in 0 min 33 sec  
 $(\max(\text{Roff\_A1B\_MC}\{0000-01-00..0000-12-00\}))\{1\}+0.5$

Frequency Histogram for the Calculated Data

Pixel Average = 5.1831

Frequency, %

Calculated Data

LEGEND

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# Demo # 4: The Data Calculator

Calculation/Integration of Arctic sea ice area (daily) for 2010

Equation (Area Integral):  
 $Sealce\{\}/100*1e-6 \mid 2010-01-01 .. 2010-12-31$

NB

The screenshot shows the ArcticRIMS v.2 Map Server interface. At the top, the browser address bar shows <http://nh-rims.sr.unh.edu/maps/>. The main interface is titled "Macro Calculator for Selected Area" and includes a table of datasets:

Symbol	Dataset	Units
SeaST	Sea Surface Temperature	C*
Sealce	Sea Ice Percent	%*

Below the table, the "Pixel Equation" section is highlighted with a box and an arrow pointing to the text "NB". The equation entered is  $Sealce\{\}/100*1e-6$  with units  $d A (km^2)$ . The "Area Integral" option is selected. The "Do Calculations" button is visible.

The "Calculation Results for Selected Area" section displays a map of the Arctic region with a color-coded overlay representing sea ice area. The map includes labels for Mexico, Canada, United States, Greenland, Russia, Mongolia, China, Kazakhstan, Pakistan, Turkmenistan, and Iran. A scale bar at the bottom indicates distances up to 3250 km.

On the right side, a "Time Series Graph for Area Aggregation" window is open, showing a line graph of the calculated data for 2010. The graph shows a seasonal cycle with a peak in April and a minimum in October. The x-axis is labeled "Date" and ranges from 2010 to 2011. The y-axis is labeled "Frequency, %" and ranges from 0 to 16. A legend below the graph shows a color scale from blue to red.

# Demo # 4: The Data Calculator

Calculation of number of days with Temperature above 25 C in July 2010

Equation:  

$$\text{sum}(\text{map}(\$_{>25}, \text{T2mMerraD}\{2010-07-01..2010-07-31\}))$$

NB

NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Close Data Calculator Section

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other  User Defined

Symbol	Dataset	Units	Symbol	Dataset	Units	Symbol Dataset Units
T2mMerraYC	MERRA Temperature at 2m, Yearly Climate					
T2mNcepYC	NCEP Air Temperature at 2m					
T2mNcepM	NCEP Air Temperature at 2m					
T2mNcepMC	NCEP Air Temperature at 2m					

\*Time Series datasets- See instructions.

Pixel Equation:  $\text{sum}(\text{map}(\$_{>25}, \text{T2mMerraD}\{2010-07-01..2010-07-31\}))$

Area Integral:  d A (km<sup>2</sup>)

Area Average:  Area Weighted Mean = Area Integral (above) / Area

Do Calculations Reset

Map Options: Min= 1, Max= 31, Use Log Scale

Stat Functions:

Examples:

TS-Range, {} = YYYY-MM-DC ... YYYY-MM-DC

Calculation Results for Selected Area

Equation used -  $\text{sum}(\text{map}(\$_{>25}, \text{T2mMerraD}\{2010-07-01..2010-07-31\}))$  Calculated in 1 min 17 sec

Frequency Histogram for the Calculated Data

Pixel Average = 8.5649

LEGEND

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Internet | Protected Mode: On

# Demo # 4: The Data Calculator

Calculation of number of days with Temperature above average in July 2010

Equation:  

$$\text{sum}(\text{map}((\$\_T2mMerraMC\{0000-07-00\}) > 0, T2mMerraD\{2010-07-01..2010-07-31\}))$$

NB

NEESPI@UNH Map Server - Windows Internet Explorer

http://neespi.sr.unh.edu/maps/

Close Data Calculator Section

Macro Calculator for Selected Area

Land Characteristics Ocean Climate Hydrology-1 Hydrology-2 Other User Defined

Symbol	Dataset	Units	Symbol	Dataset	Units
T2mMerraYC	MERRA Temperature at 2m, Yearly Climatology	C	Roff_A1B_MC	Distu	
T2mNcepYC	NCEP Air Temperature at 2m	C	T2mMerraMC	MEF	
T2mNcepM	NCEP Air Temperature at 2m	C*	T2mMerraD	MEF	
T2mNcepMC	NCEP Air Temperature at 2m	C*			

\*Time Series datasets- See instructions.

Pixel Equation:  $\text{sum}(\text{map}((\$\_T2mMerraMC\{0000-07-00\}) > 0, T2mMerr$

Area Integral:  $d A \text{ (km}^2\text{)}$

Area Average:  Area Weighted Mean = Area Integral (above) / Area

Instructions: Do Calculations Reset

Examples: TS-Range, {} = YYYY-MM-DC ... YYYY-MM-DC

Use Log Scale

Calculation Results for Selected Area

Equation used - Calculated in 1 min 22 sec

$\text{sum}(\text{map}((\$\_T2mMerraMC\{0000-07-00\}) > 0, T2mMerraD\{2010-07-01..2010-07-31\}))$

Frequency Histogram for the Calculated Data

Pixel Average = 19.429

Frequency

Calculated Data

LEGEND

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Internet | Protected Mode: On

# Demo # 5: The Data Masking by a Polygon

Links Data Navigation Dataset Search

**Mixed Forest** Explanation about this dataset (Metadata Link)

Lon/Lat Data Reader  Check to Load

Navigation

Confirm zoom in  
 Use floating coord/data reader

Resample data Bilinear  
Shade data None

Polygon Masks

- Sub-Region
- Country
- Sea Basin
- Watershed

Operational Sites  
 Re-Analysis Sites  
 Central Asian Hydro Sites  
 Central Asian Meteo Sites

Mixed Forest, fraction

0.0 0.2 0.4 0.6 0.8  
0.1 0.3 0.5 0.7 0.9

MSRG-UNH\_MapServer System

0 190 380 570 760 950 km

**NB**



# Thank You!

## Acknowledgements-

This ongoing project has been indirectly supported by a number of NSF, NASA, NH-IRC, etc.

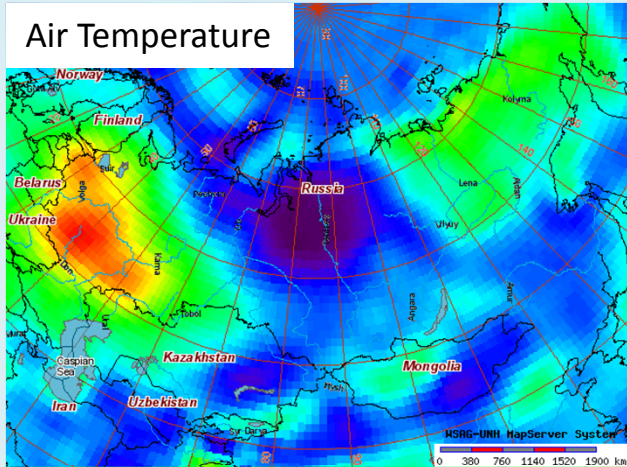


# Analysis of 2010 extreme summer in Russia

*Example of RIMS Application to a Regional Research*

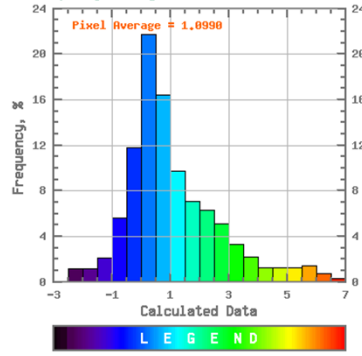


### Air Temperature

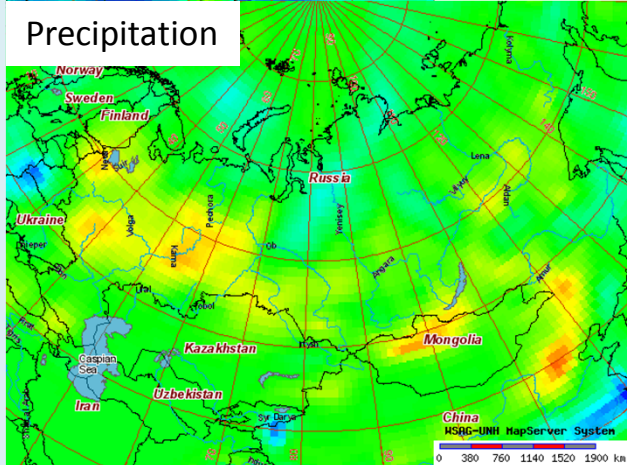


Equation used -   
 $\text{average(NCEP\_T\_MT[2010-07-00, \dots, 2010-08-00])} - \text{average(NCEP\_T\_HC[0000-07-00, \dots, 0000-08-00])}$   
 Calculated in 0 min 14 sec

Frequency Histogram for the Calculated Data

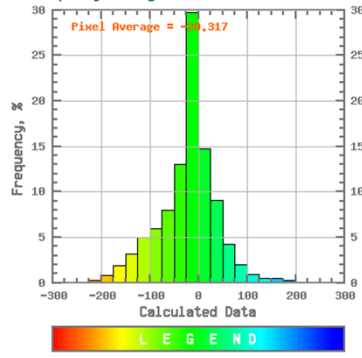


### Precipitation

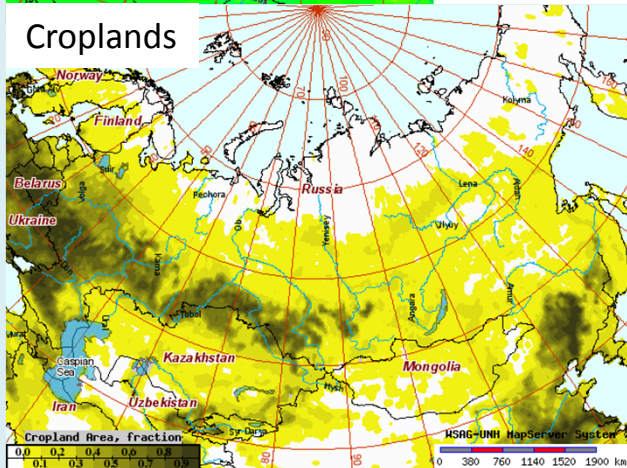


Equation used -   
 $\text{sum(NCEP\_P\_M[2010-07-00, \dots, 2010-08-00])} - \text{sum(NCEP\_P\_HC[0000-07-00, \dots, 0000-08-00])}$   
 Calculated in 0 min 13 sec

Frequency Histogram for the Calculated Data



### Croplands



Cropland Area, fraction  
 0.0 0.2 0.4 0.6 0.8  
 0.1 0.3 0.5 0.7 0.9  
 HSRG-UHH MapServer System

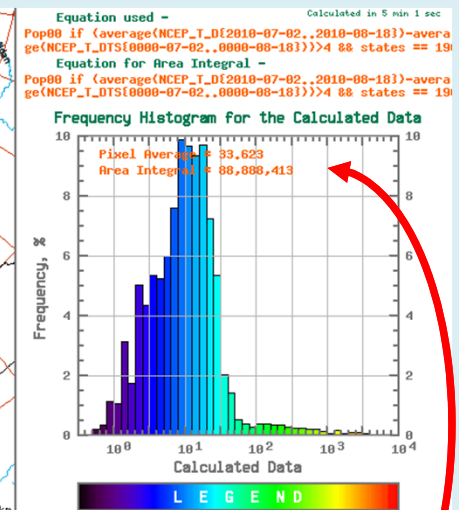
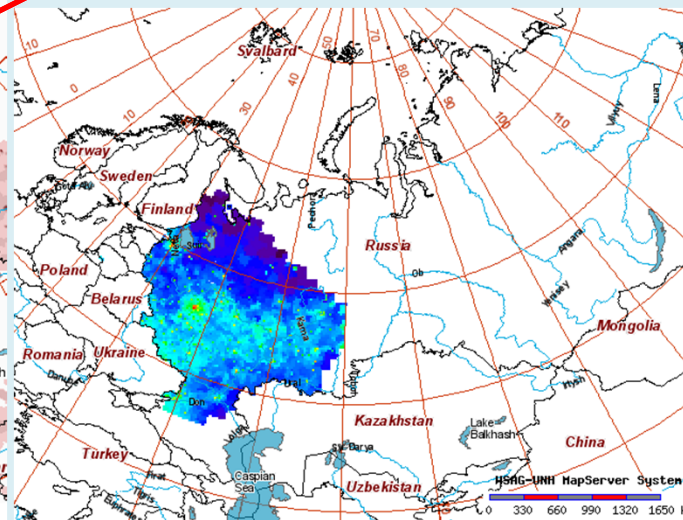
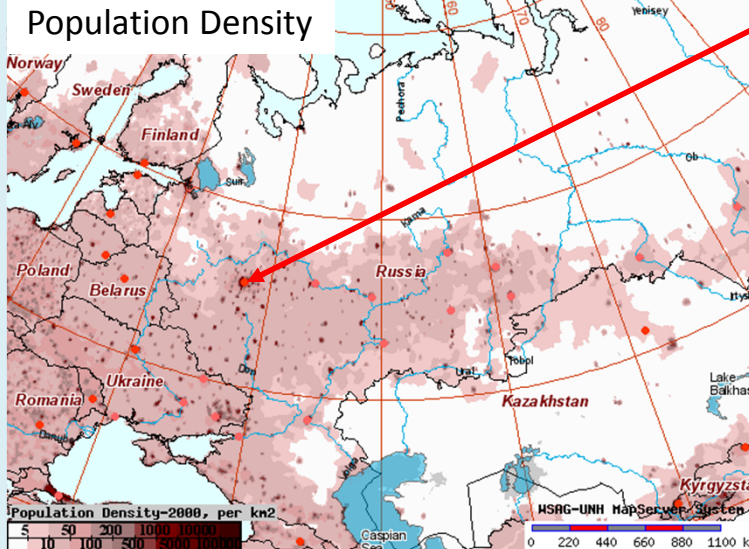
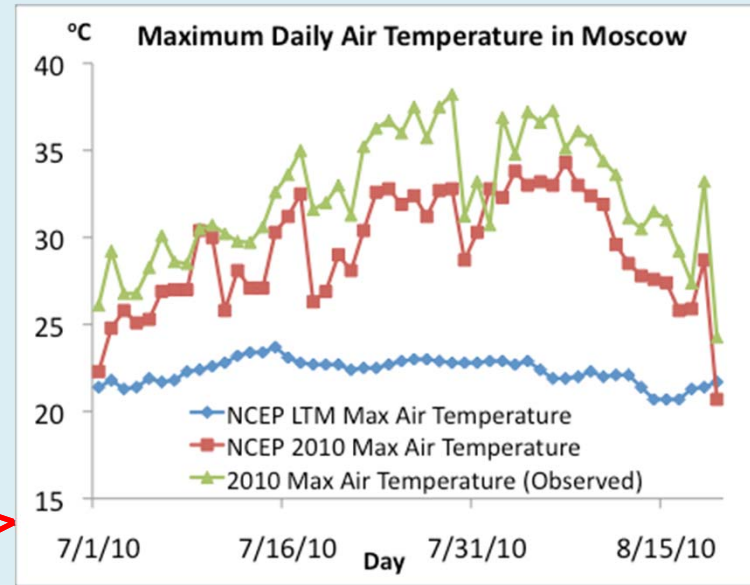
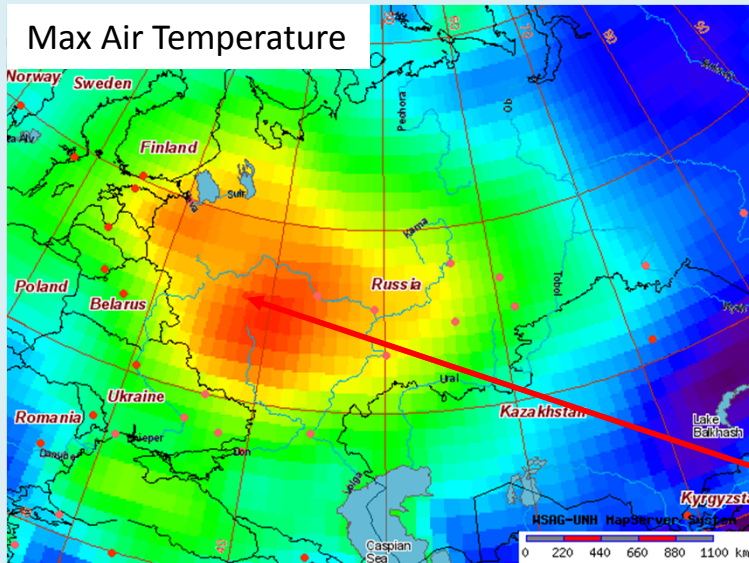
Deviation of mean July-August air temperature in 2010 from LTM over 1948-2010 (NCEP data)

Deviation of sum of precipitation over July-August 2010 from LTM over 1948-2010 (NCEP data)

Distribution of cropland area

# Analysis of air temperature and population in summer 2010

Deviation of daily max air temperature over July2-Aug18, 2010 from LTM

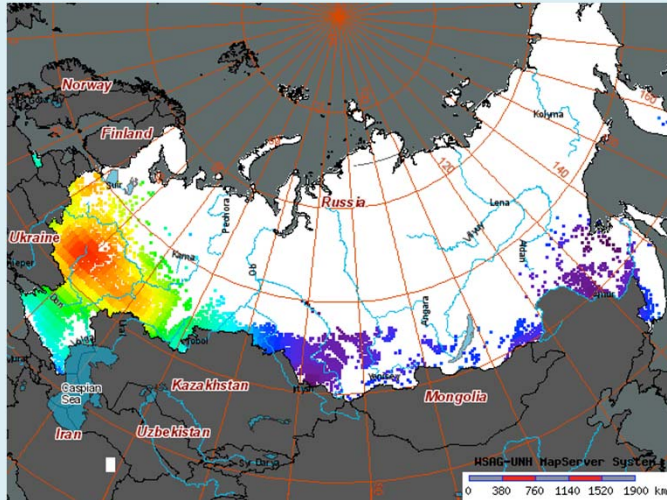


Distribution of population density

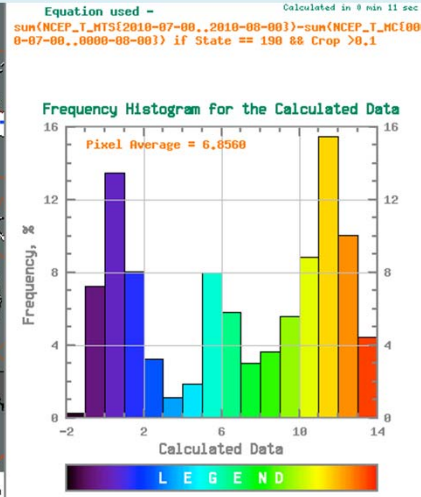
Calculation of area and population in Russia where mean daily air temperature over the period 07-02-2010 to 08-18-2010 was 4°C higher than LTM. This heat effected about 90 million people or ~ 60% of total Russian population

# Anomalies of air temperature and precipitations in summer 2010 from long-term mean over 1985-2010 for Russian cropland area (cropland >10% per grid cell)

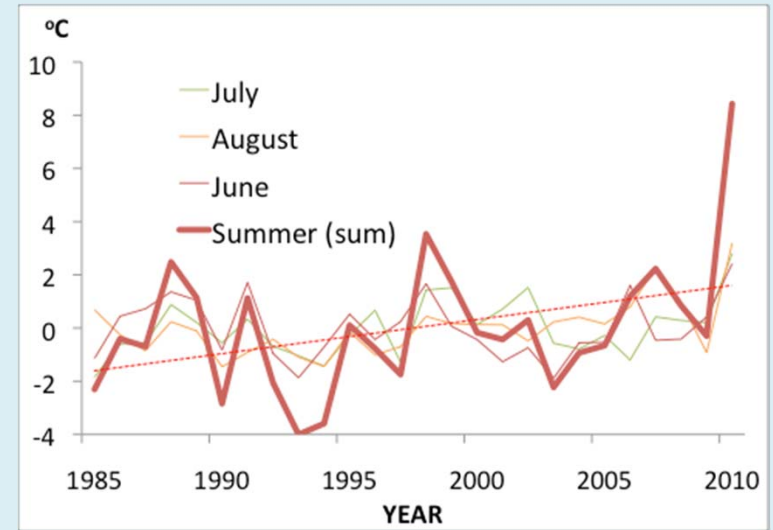
Anomalies of summer 2010 from LTM



## Air Temperature

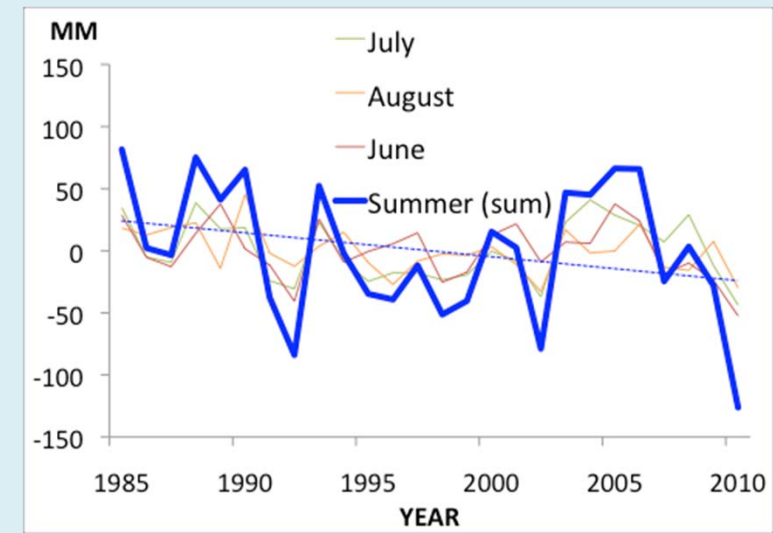
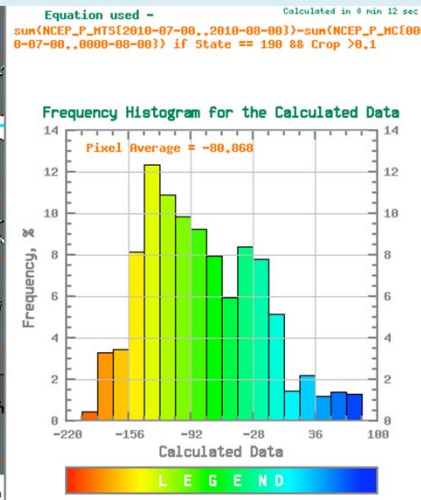
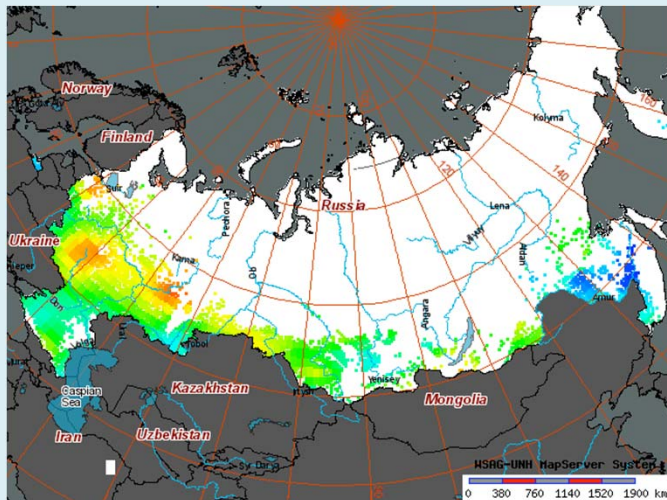


Anomalies of over 1985-2010



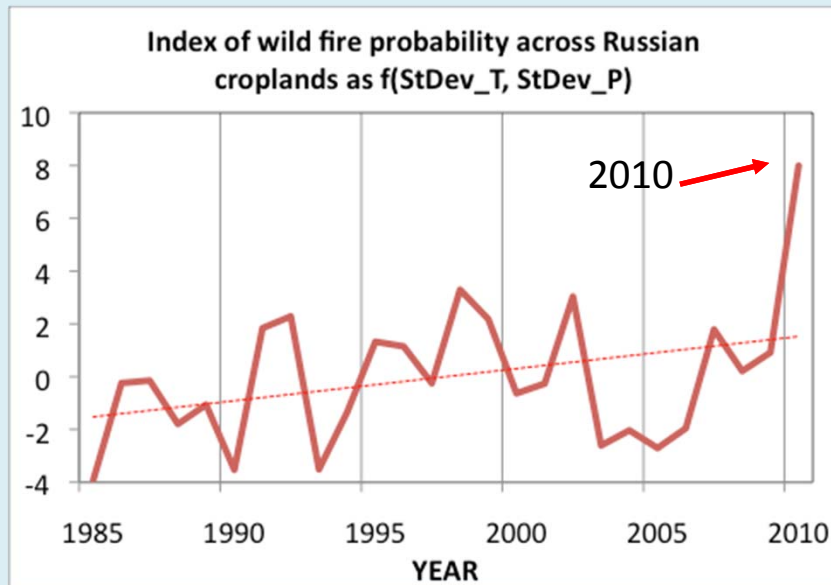
## Precipitation

Anomalies of summer 2010 from LTM

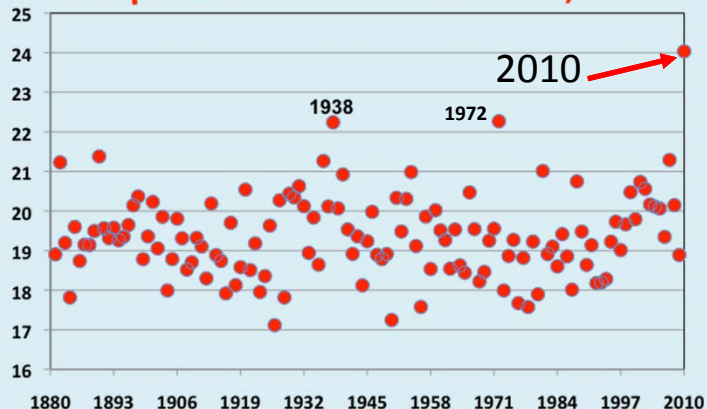


2010 wheat yield in Russia was ~40% less than in 2008, 2009

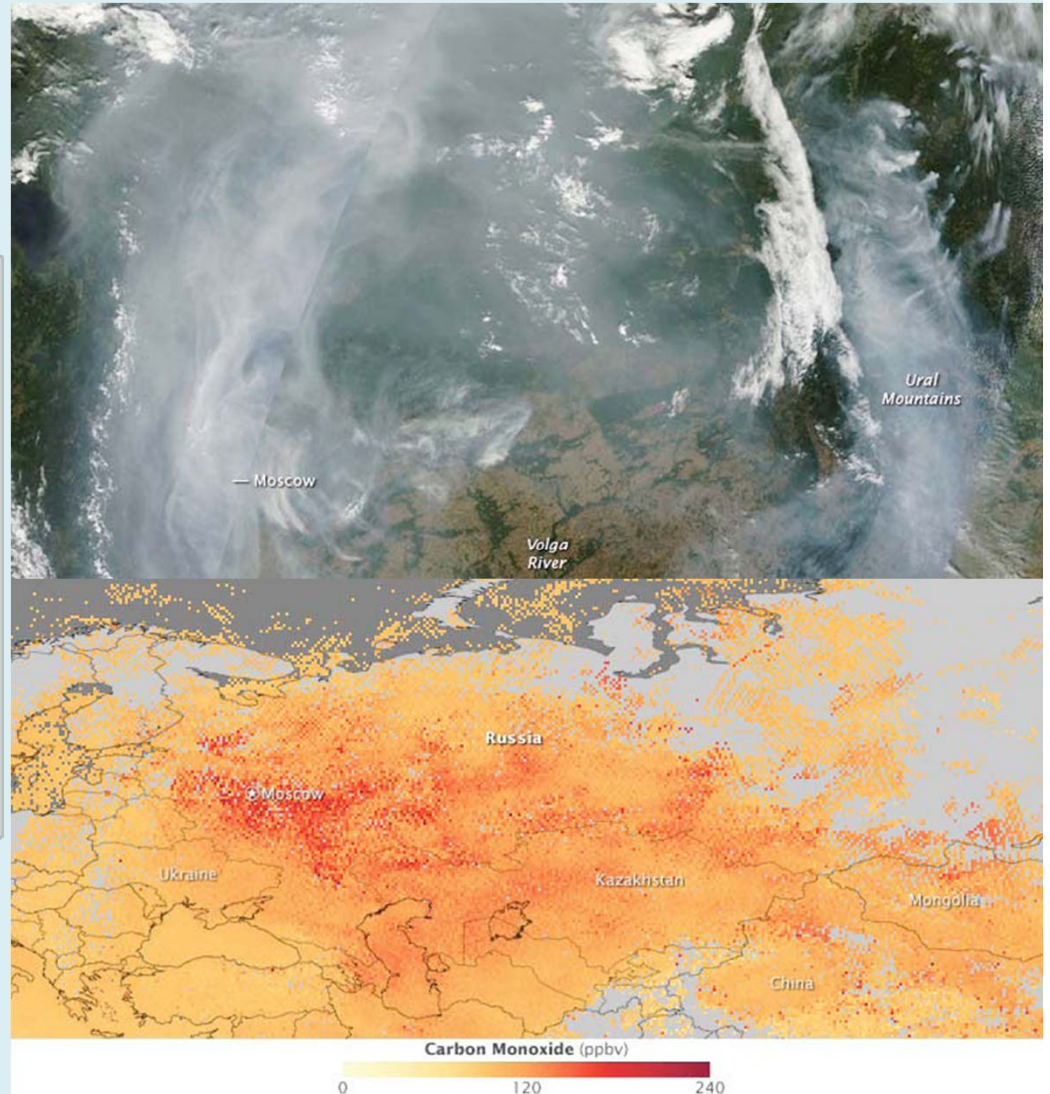
Using air temperature and precipitation data in NEESPI RIMS we evaluated index of wild fire probability for summer months from 1985 to 2010



**July-August surface air temperatures, over European Russia south of 60°N, °C**



Anomalies from the mean for the 1961-1990 period were used for area-averaging with the following restoration of actual values; GHCN-v2 data (NCDC 2010)



Carbon monoxide concentrations in the atmosphere between 2 and 8 km above Russia as recorded from 1 to 8 August 2010 by NASA (MOPITT). Ground concentrations of this dangerous gas are reported to be much higher, causing people to report headaches, dizziness, and other more serious conditions.