Software Requirements Specification

for

WAVED

Version 3.0

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1. Document History

Name	Date	Reason	Version
Kristian Calhoun, Sean Bluestein, Hannah Pinkos, Steve Nguyen, Keith Horrocks	January 7, 2014	Initial Draft	1.0
Kristian Calhoun, Sean Bluestein, Hannah Pinkos, Steve Nguyen, Keith Horrocks	February 4, 2014	Updated requirements to match new paper prototype	2.0
Kristian Calhoun, Sean Bluestein, Hannah Pinkos, Steve Nguyen, Keith Horrocks	April 29, 2014	Combined UI and functional requirements, corrected grammar	3.0

2. Introduction

2.1 Purpose

This document provides the requirement specifications for Web App for Visualizing Environmental Data (WAVED). It specifies user interface attributes, functional and nonfunctional requirements, and long-term ideas for the evolution of the system.

2.2 Overview

Climate Central performs scientific research to collect multi-coordinate data on climate change. The company creates interactive maps and other graphics to present this data on their website for public consumption. For example, one such demonstration colors each state in the United States based on its recorded change in temperature. Clicking on a state displays a line graph showing the temperature data for that particular state. Currently, Climate Central develops each interactive visualization from scratch. This process is time and labor intensive and does not provide any mechanism for reusing common elements across visualizations.

WAVED is a web-based development environment that enables users of all technical skill levels to create interactive visualizations via a graphical user interface. Users upload data and decide how to visualize it on a map or graph. In addition to maps and graphs, users add other widgets, such as buttons or text blocks, to trigger user-defined events that manipulate how the data is displayed. As a user builds a project, he or she interacts with the visualization via a live preview. Once finished, projects are exported as a collection of web-embeddable HTML, JavaScript and CSS files.

2.3 Scope

This document describes the software requirements for the WAVED application. The initial release is tailored specifically to Climate Central’s immediate requirements. Developers are expected to use this document as a guide for creating the system and testers are to use it as a basis for validating the release of the product. These requirements are also intended for end-users interested in the application’s functionality and future evolution.

2.4 Definitions

Action - A process that changes the properties of a widget or data set via an event

Binding Data - Making an explicit association between a data set and a widget

Component - A widget or the workspace

Data Set - A data source or data subset

Data Source - A collection of data, such as the contents of a CSV or JSON file

Data Subset - The resulting portion of a data source meeting some specified criteria

Event - A user interaction (click, hover, etc.) that triggers an action

Glyph - A marker indicated by some shape or icon

Project - The context in which a user works to create a single visualization using the WAVED application

Property - Defines a value used for a widget attribute, such as width, height, color, name, etc.

Target - Part of a widget or data set affected by an action

Widget - A top level component that has properties and bound data

Workspace - The interactive area of the WAVED user interface that displays the visualization as it is assembled from widgets

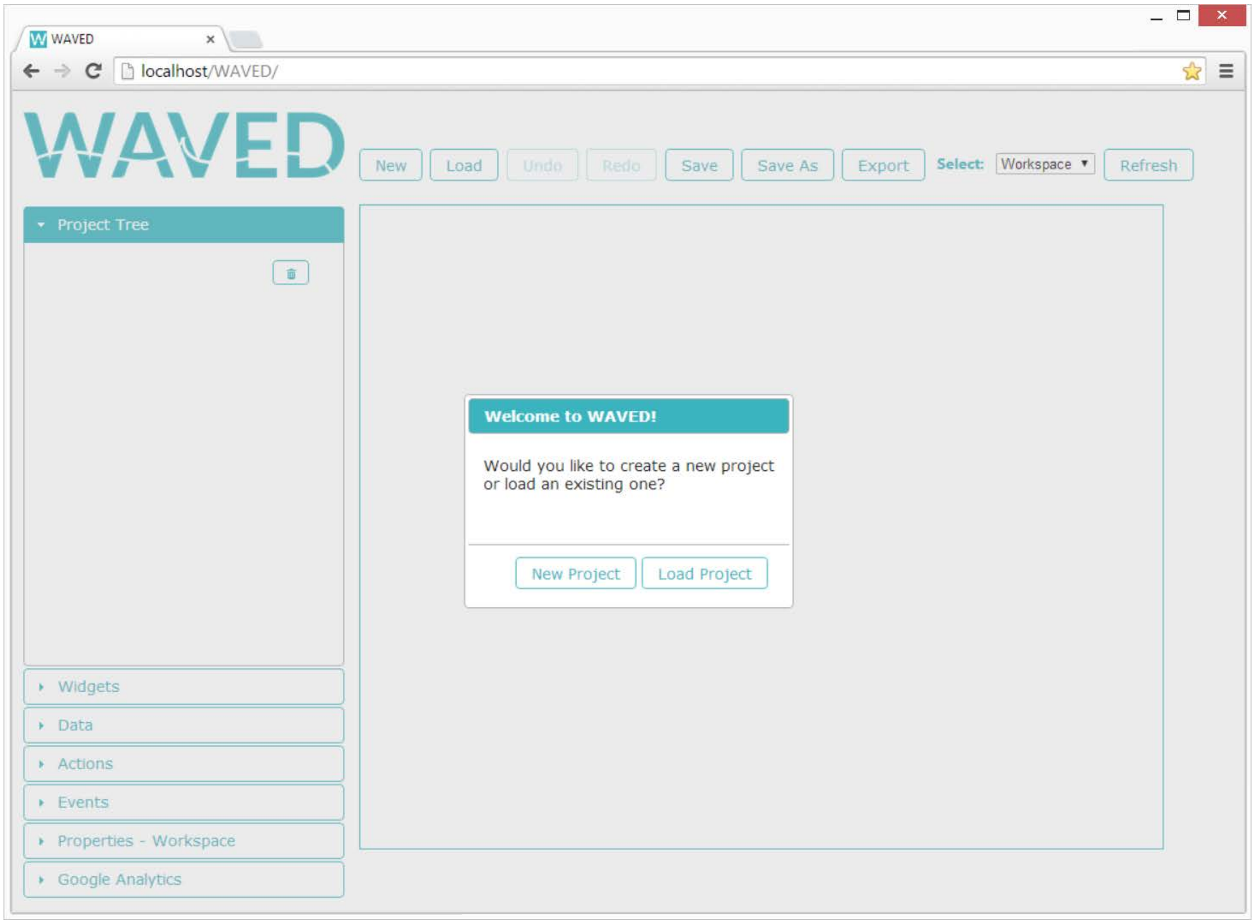
2.5 Requirements Apportioning

Priority Level	**Description**
1	Priority 1 items have the highest level of importance and are necessary for the usability of the product. The items labeled Priority 1 are completed and verified prior to the release of the application.
2	Priority 2 items are not crucial to the usability of the application, but would enhance the user experience and are expected to be implemented in the next release of the application. Priority 2 items not completed prior to release do not inhibit functionality of the release version of the application.
3	Priority 3 items are not crucial to the usability of the application and are not within the current scope of the system. These items are expected to change with future development.

3. User Interface and Functional Requirements

3.1 Welcome Screen

WAVED is a graphical, interactive, integrated development environment. The development environment runs within a web browser, using a keyboard and pointing device for input. Upon navigating to the web address of the WAVED application, users are presented with a welcome dialog with two options: Create a New Project or Load a Project (Figure 1). If the user selects to create a new project, they are prompted to enter a name for the project and are presented with a blank project (Figure 3). If the user selects to load an existing project, he or she is presented with a list of previously saved project names from which to pick. All possible methods for creating a project within WAVED are shown in the activity diagram in Figure 3.



Welcome to WAVED!

Would you like to create a new project or load an existing one?

Figure 1. The welcome splash screen

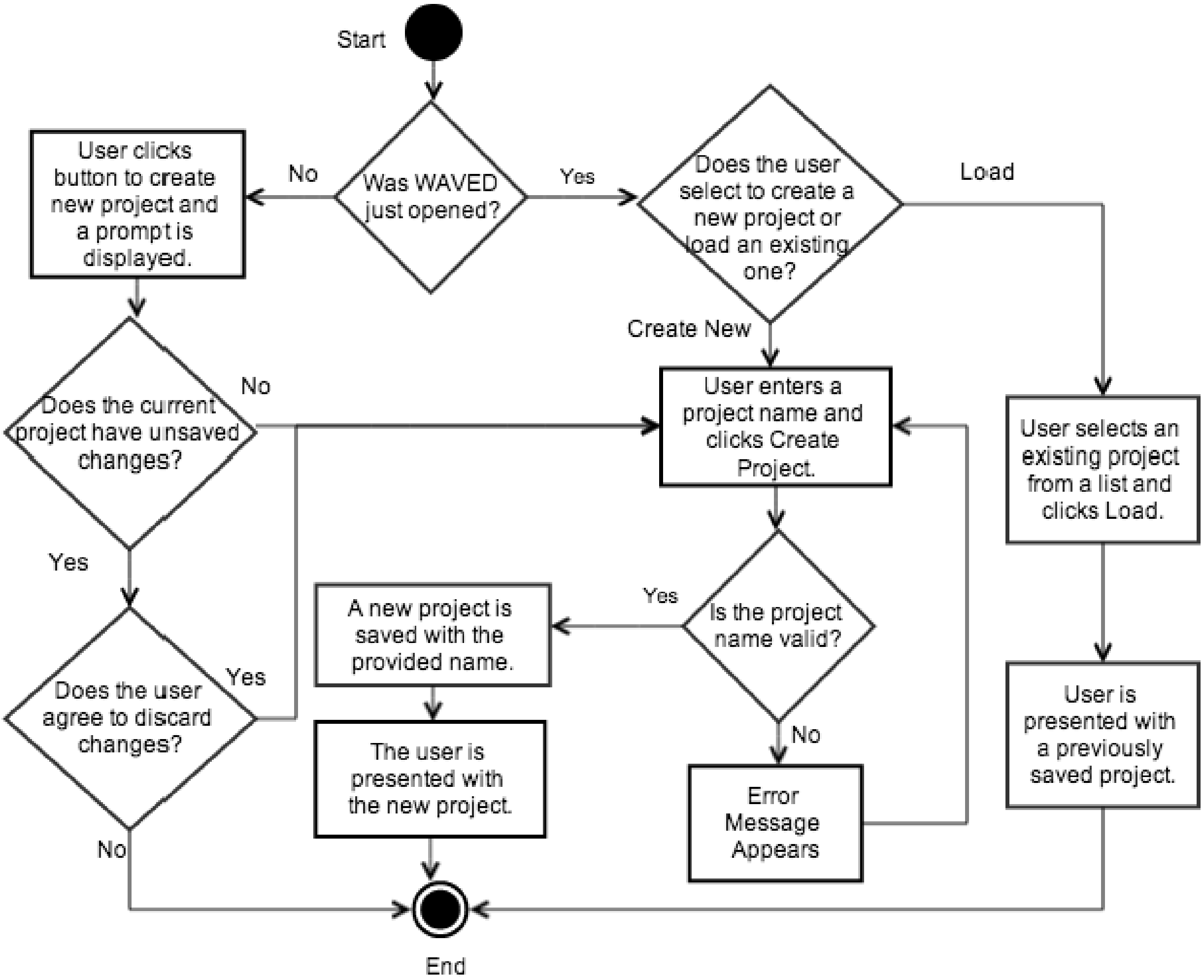

Start
Was WAVED just opened?
No
Yes
User clicks button to create new project and a prompt is displayed.
Does the user select to create a new project or load an existing one?
Load
Create New
Does the current project have unsaved changes?
No
Yes
User enters a project name and clicks Create Project.
User selects an existing project from a list and clicks Load.
Is the project name valid?
Yes
No
A new project is saved with the provided name.
The user is presented with the new project.
Does the user agree to discard changes?
Yes
No
Error Message Appears
User is presented with a previously saved project.
End

Figure 2. An activity diagram for creating a new WAVED project

R3.1 Welcome Screen Requirements

R3.1.1 Upon launching the application, the user must choose one of the following options:

R3.1.1.1 Create a new project **Priority 1**

R3.1.1.2 Load an existing project **Priority 1**

R3.1.2 Creating a Project

R3.1.2.1 The application provides the option to create a new project when launched. **Priority 1**

R3.1.2.2 The main interface presents an option to create a new project. **Priority 1**

R3.1.2.3 When a user selects to create a new project and the current project contains unsaved changes, the application prompts the user whether any unsaved changes should be abandoned. **Priority 1**

R3.1.3 The user is prompted to name a project upon creation. **Priority 1**

R3.1.3.1 Every project must have a unique name. **Priority 1**

R3.1.3.2 A valid project name contains 1 to 50 characters. **Priority 1**

R3.1.3.3 A valid project name only includes alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

R3.1.4 Loading a Project

R3.1.4.1 The main interface provides a way to load a previously saved project. **Priority 1**

R3.1.4.2 When the option to load a project is selected, a list of previously saved projects is displayed. **Priority 1**

R3.1.2.3 When loaded, the project state and workspace view match the most recently saved version of the project. **Priority 1**

R3.1.2.4 When a user selects to load a project and the current project contains unsaved changes, the application prompts the user whether any unsaved changes should be abandoned. **Priority 1**

3.2 Main Interface

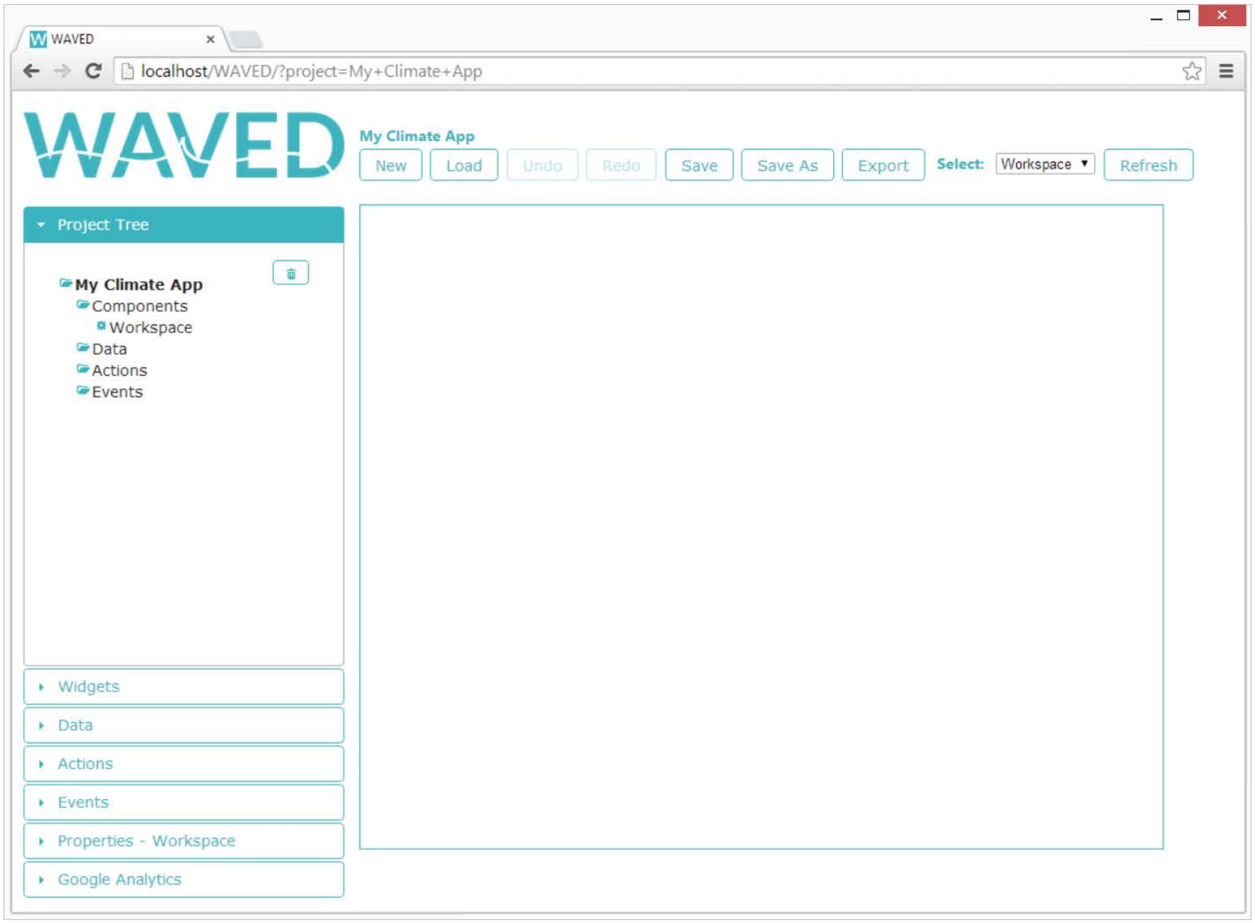


Figure 3. The WAVED interface after creating a new project

The main interface has of a series of collapsible panels on the left hand side, including the Project Tree Panel, Widgets Panel, Data Panel, Actions Panel, Events Panel, Properties Panel, and Google Analytics Panel. A menu at the top of the application displays buttons providing the functionality to create a new project, load an existing project, undo and redo changes, save, save as, export the project, and refresh the workspace. A combobox in the menu allows the user to choose which of the widgets added to the project is currently selected. Below the menu and to right of the collapsible panels is the workspace area.

R3.2 Main Interface Requirements

R3.2.1 The application automatically updates the workspace every time the user makes a change to the project. **Priority 1**

R3.2.2 The application provides a mechanism for restoring the workspace to a state where no user events were fired. **Priority 1**

R3.2.3 The workspace emulates the functionality of the exported project. **Priority 1**

3.3 Data Panel

The user opens the Data Panel to view a list of data sources added to the project (Figure 4). The user clicks on the add button in the source files section of the Data Panel to open a dialog and import local data files into the currently opened WAVED project (Figure 5). To remove a data source from the project, the user selects a data source from the source files list and clicks the delete button.

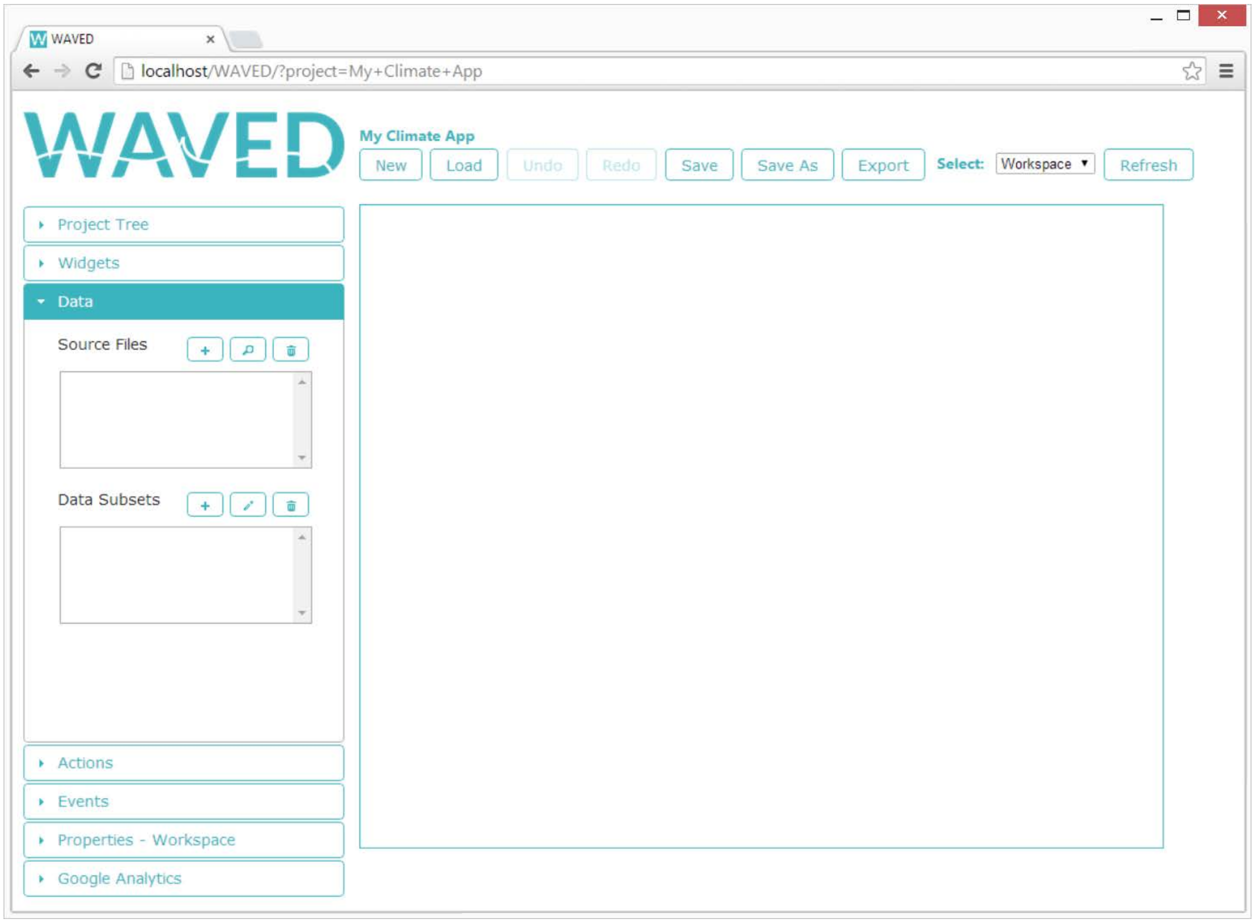
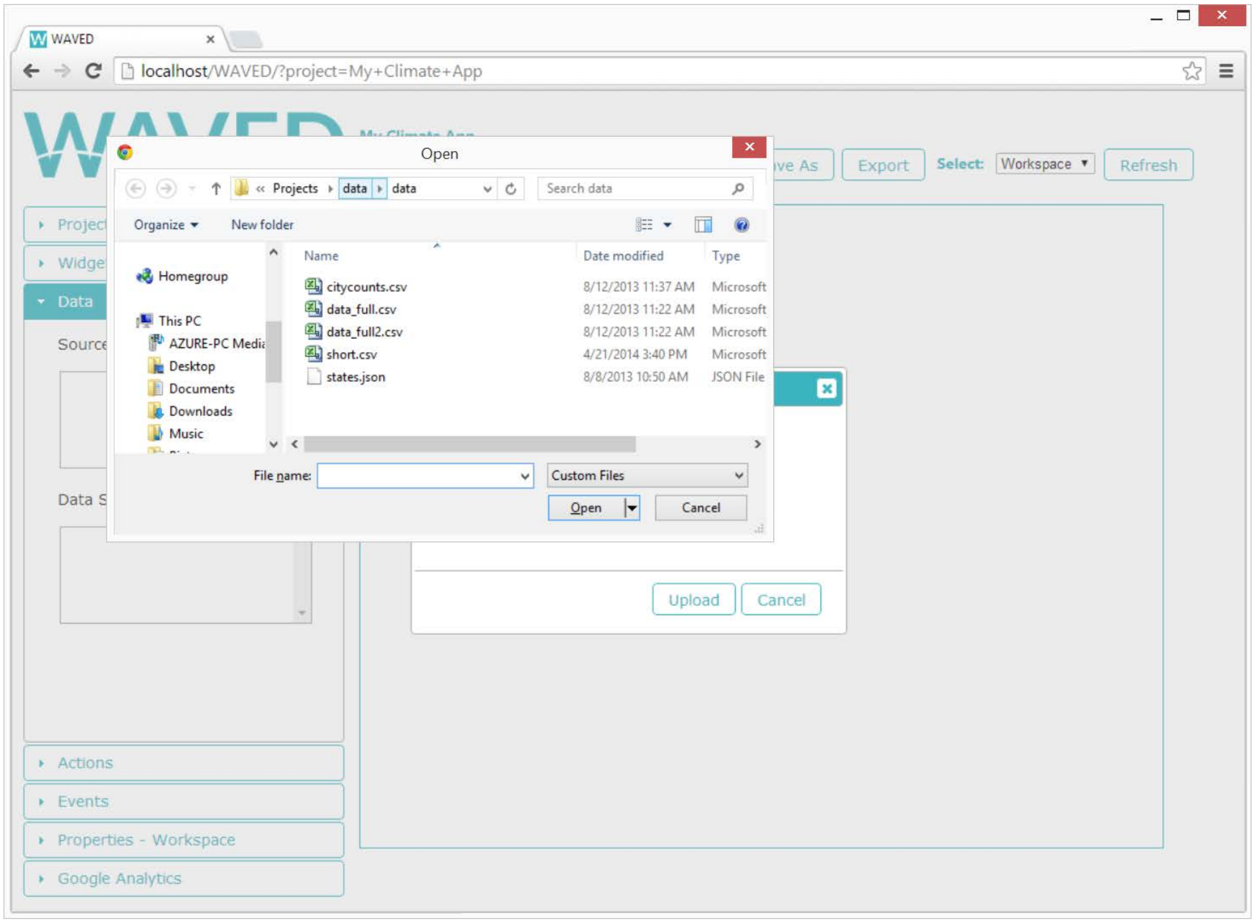


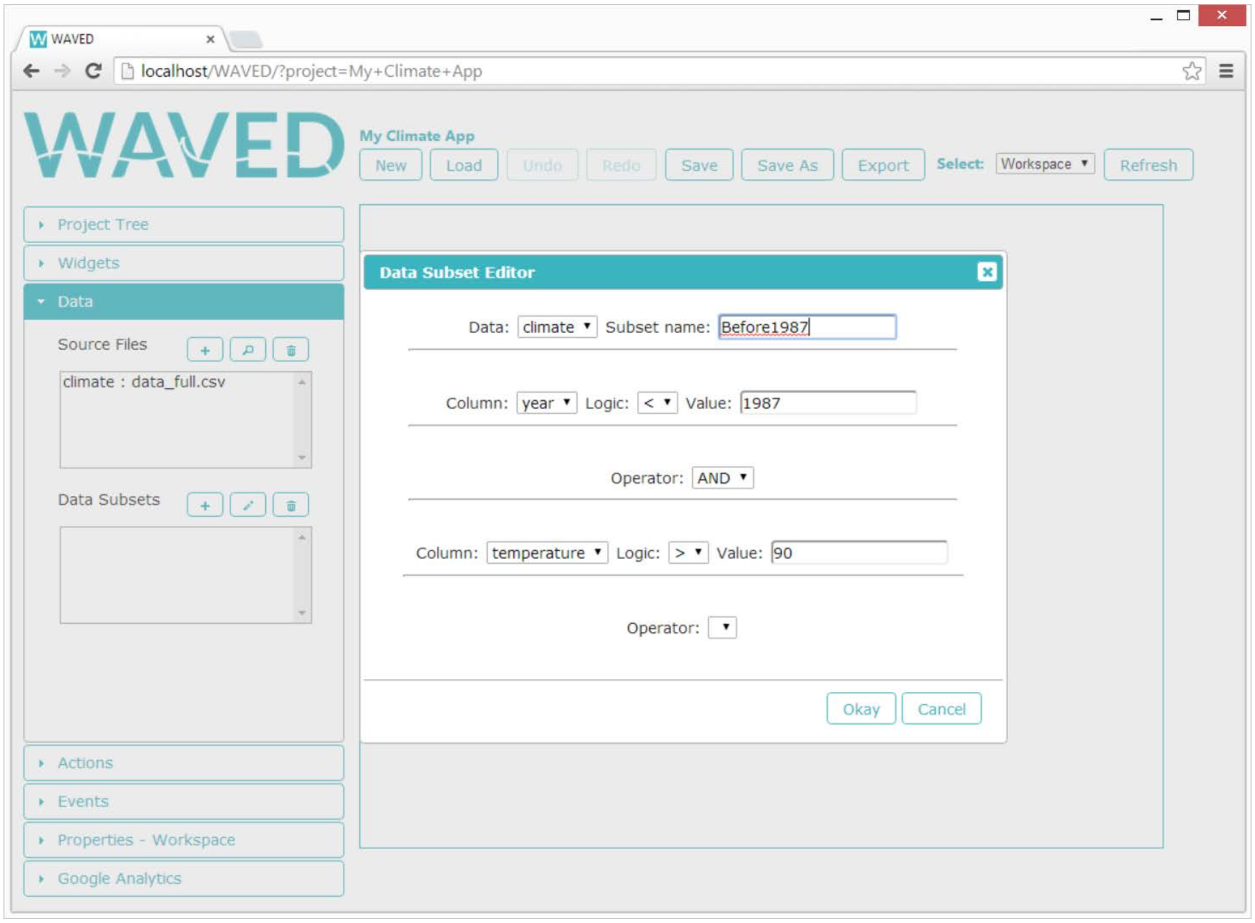
Figure 4. The Data Panel



Name	Date modified	Type
citycounts.csv	8/12/2013 11:37 AM	Microsoft
data_full.csv	8/12/2013 11:22 AM	Microsoft
data_full2.csv	8/12/2013 11:22 AM	Microsoft
short.csv	4/21/2014 3:40 PM	Microsoft
states.json	8/8/2013 10:50 AM	JSON File

Figure 5. A dialog for importing local data files into the current project

After a data source is added to a project, it is possible to preview the data fields and entries in the data and to create data subsets containing only parts of the original data matching some specified criteria. Clicking the add button in the data subsets section of the Data Panel opens a dialog for creating a new data subset. The data subset creation dialog provides fields for the user to choose a data source file, enter a name for the new data subset, and construct a query statement by selecting options from the provided combo boxes (Figure 6). Once a data subset is created, its name appears in the Data Subsets list of the Data Panel and it is available for binding to widgets just like any other data source.



localhost/WAVED/?project=My+Climate+App

Select: Workspace

climate : data_full.csv

Data: climate Subset name: Before1987

Column: year Logic: < Value: 1987

Operator: AND

Column: temperature Logic: > Value: 90

Operator:

Figure 6. Data Subset Creation Dialog

R3.3 Data Requirements

R3.3.1 Valid Data File Formats

R3.3.1.1 The application accepts data files of the following formats:

R3.3.1.1.1 A comma separated value (CSV) file. **Priority 1**

R3.3.1.1.2 An XML file **Priority 2**

R3.3.1.1.3 A JavaScript Object Notation (JSON) file. **Priority 2**

R3.3.2 Uploading a Data Source

R3.3.2.1 The user is able to select a local data file to upload and use in a project. **Priority 1**

R3.3.2.2 The user cannot upload a local data file that is not of a valid file format. **Priority 1**

R3.3.2.3 Each data source uploaded to a project has a unique name with the following characteristics:

R3.3.2.3.1 Name consists of between 1 and 50 characters. **Priority 1**

R3.3.2.3.2 Name is composed of only alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

R3.3.3 Viewing a Data Set

R3.3.3.1 The application provides a preview of data sets added to the current project. **Priority 1**

R3.3.3.2 Previews of data sets added to the current project display the first ten data entries. **Priority 1**

R3.3.4 Creating a Data Subset

R3.3.4.1 Each data subset added to a project has a unique name with the following characteristics:

R3.3.4.1.1 Name consists of between 1 and 50 characters. **Priority 1**

R3.3.4.1.2 Name is composed of only alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

R3.3.4.2 The user must specify the name of the data source from which the subset is created. **Priority 1**

R3.3.4.3 When creating a data subset, the user must specify one or more conditional statements, each consisting of one of each of the following:

R3.3.4.3.1 A data field contained in the data source specified by R3.3.4.2. **Priority 1**

R3.3.4.3.2 One of the following comparison operators:

R3.3.4.3.2.1 Less Than (<) **Priority 1**

R3.3.4.3.2.2 Less Than or Equal To (≤). **Priority 1**

R3.3.4.3.2.3 Equal To (=) **Priority 1**

R3.3.4.3.2.4 Not Equal To (≠) **Priority 1**

R3.3.4.3.2.5 Greater Than (>) **Priority 1**

R3.3.4.3.2.6 Greater Than or Equal To (≥) **Priority 1**

R3.3.4.3.3 A user-supplied value. **Priority 1**

R3.3.4.4 Conditional statements are combined using one of the following logical operators:

R3.3.4.4.1 AND **Priority 1**

R3.3.4.4.2 OR **Priority 1**

R3.3.4.5 The precedence of AND is greater than OR. **Priority 1**

R3.3.5 Removing a Data Set

R3.3.5.1 The application allows data sets to be deleted from a project. **Priority 1**

R3.3.5.2 If the user attempts to delete a data source and data subsets created from the data source exist, the user is asked to confirm deletion of the data source. **Priority 1**

R3.3.5.3 When a data source is deleted, all subsets created from that data source are also deleted. **Priority 1**

R3.3.5.4 When a user removes a data source from a project, the corresponding data file is deleted from the application server. **Priority 1**

R3.3.5.5 The user cannot remove a data set that is bound to widget. **Priority 1**

R3.3.5.6 If the user attempts to delete a data set bound to a widget, the user is instructed to unbind the data set before it is deleted. **Priority 1**

3.4 Widgets Panel

Opening the Widgets Panel provides the user with a selection of available widgets to add to the project (Figure 7). Selecting a widget from this panel adds it to the project's workspace and automatically opens the Properties Panel, which is populated with properties associated with the added widget (Figure 8). The added widget is selectable from the Project Tree Panel and the widget selection combobox in the menu.

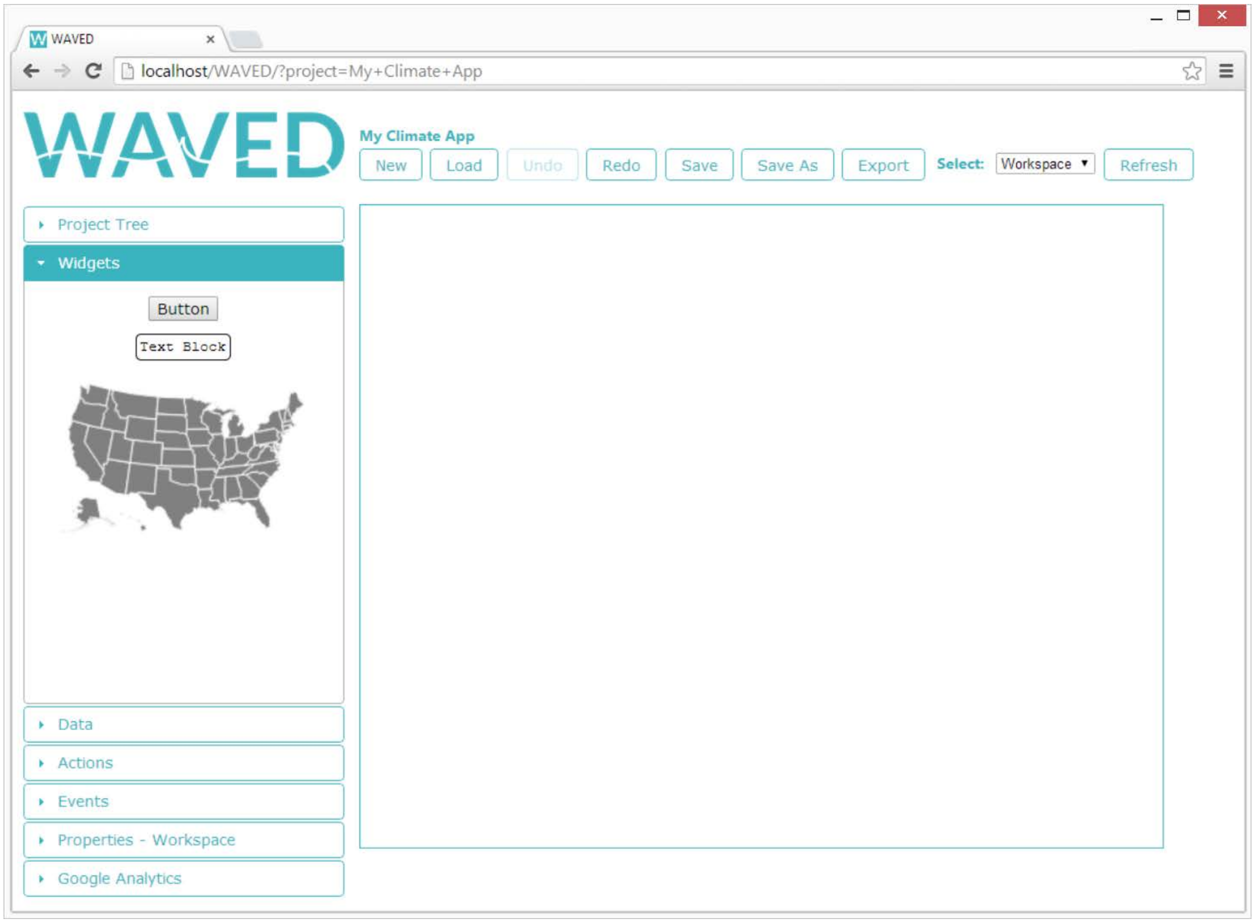


Figure 7. Widgets Panel

R3.4 Widget Panel Requirements

R3.4.1 Any widget is available to add to the project from the Widgets Panel. **Priority 1**

R3.4.2 The following widgets are available:

R3.4.2.1 U.S. Map **Priority 1**

R3.4.2.1.1 Displays all 50 United States. **Priority 1**

R3.4.2.2 Line Graph **Priority 1**

R3.4.2.2.1 Displays circles for data points. **Priority 1**

R3.4.2.2.2 Displays lines that connect the data points. **Priority 1**

R3.4.2.2.3 Optionally display a line of best fit. **Priority 2**

R3.4.2.3 Button **Priority 1**

R3.4.2.3.1 A clickable button. **Priority 1**

R3.4.2.4 Text Block **Priority 1**

- **R3.4.2.4.1** A rectangular area containing text. **Priority 1**

R3.4.2.5 Slider **Priority 3**

- **R3.4.2.5.1** A draggable selector to choose between a range of values **Priority 3**

R3.4.2.6 Combobox **Priority 2**

- **R3.4.2.6.1** A dropdown menu with one or more options. **Priority 2**

R3.4.2.7 Radio Button Set **Priority 2**

- **R3.4.2.7.1** A set of one or more radio buttons. **Priority 2**
- **R3.4.2.7.2** Each radio button has an associated label. **Priority 2**

R3.4.2.8 Checkbox Set **Priority 2**

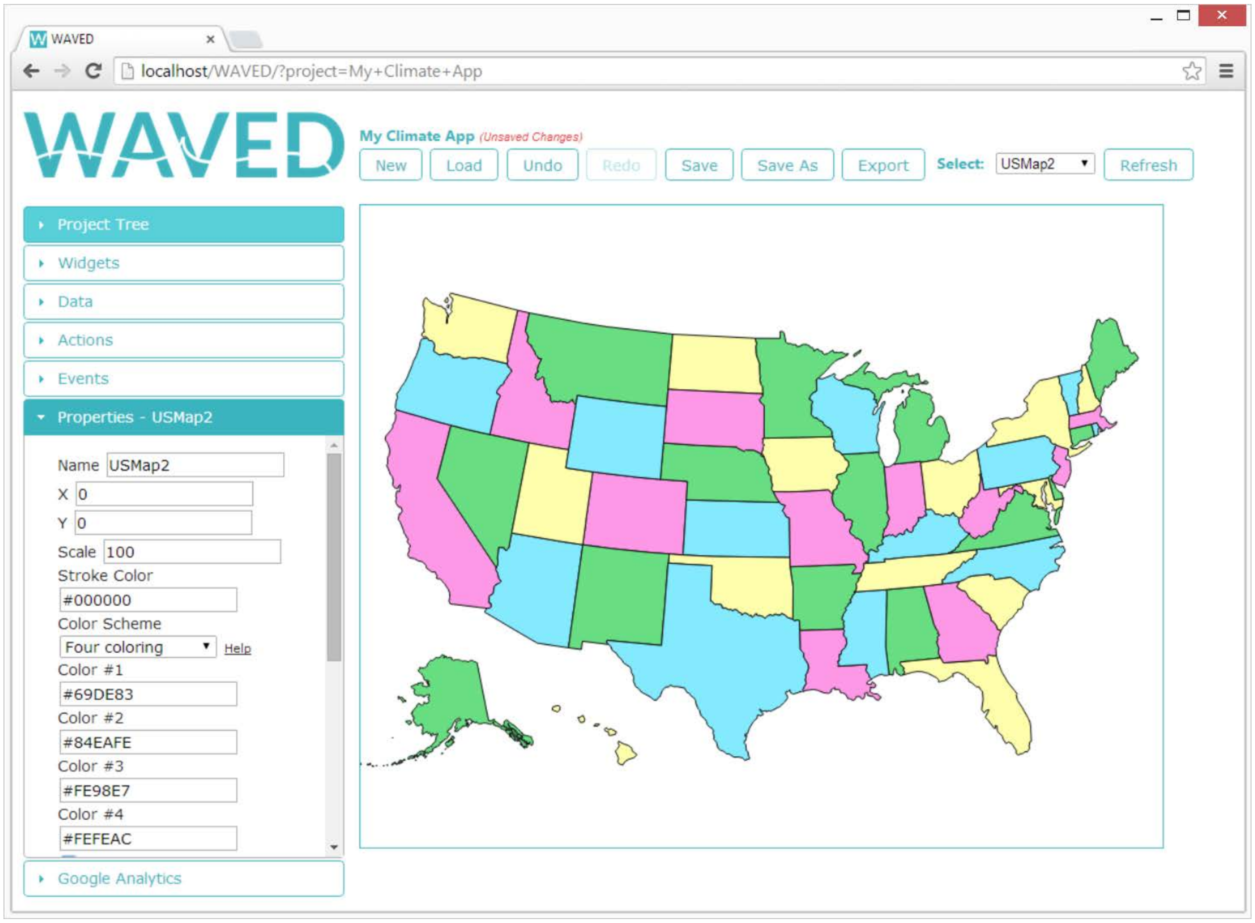
- **R3.4.2.8.1** A set of one or more checkboxes. **Priority 2**
- **R3.4.2.8.2** Each checkbox has an associated label. **Priority 2**

R3.4.2.9 Tooltip **Priority 1**

- **R3.4.2.9.1** A bubble with a pointer containing text. **Priority 1**

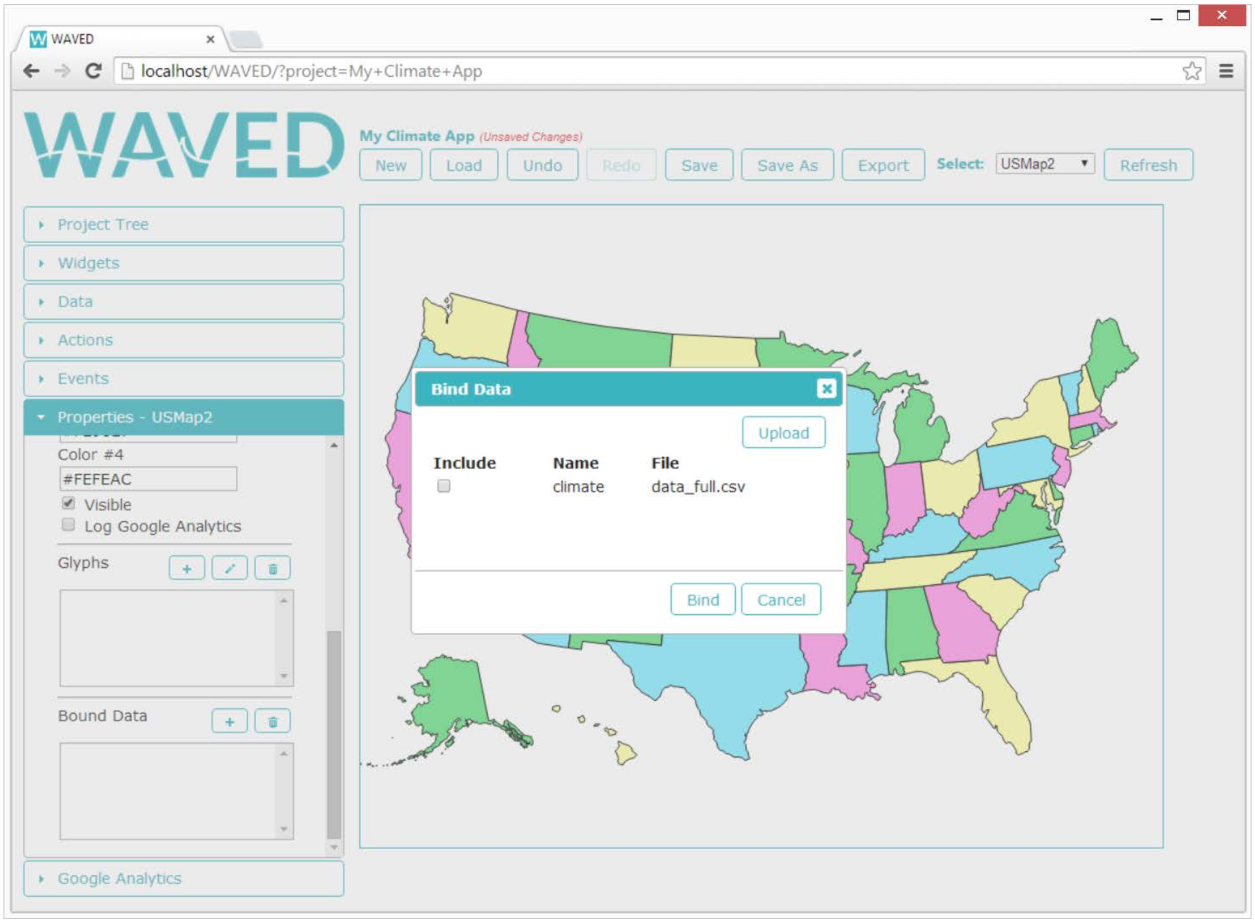
3.5 Properties Panel

The Properties Panel contains specific input fields for changing properties and binding data sets to the currently selected widget (Figure 8). Other widget specific features, such as the ability to add glyphs to a map, are also available in the Properties Panel. To bind data to a widget, the user clicks the add button in the Data Sources section of the Properties Panel to display a dialog containing a list of the available data sources (Figure 9).



Name USMap2
X 0
Y 0
Scale 100
Stroke Color
#000000
Color Scheme
Four coloring
Color #1
#69DE83
Color #2
#84EAFE
Color #3
#FE98E7
Color #4
#FEFEAC

Figure 8. A widget's Properties Panel



Select: USMap2

Color #4

#FEFEAC

☑ Visible

☐ Log Google Analytics

Include	Name	File
☐	climate	data_full.csv

Figure 9. A dialog for binding data to a widget

R3.5 Properties Panel Requirements

R3.5.1 Modifying Properties

R3.5.1.1 All defined properties of a widget or the workspace are available for edit from the Properties Panel. **Priority 1**

R3.5.1.2 The user cannot modify the properties of a component if the component is not currently selected. **Priority 1**

R3.5.2 Workspace Properties

R3.5.2.1 Height **Priority 1**

R3.5.2.1.1 A non-negative integer representing workspace height in pixels. **Priority 1**

R3.5.2.1.2 The default height value is 600 pixels. **Priority 1**

R3.5.2.2 Width **Priority 1**

R3.5.2.2.1 A non-negative integer representing the workspace width in pixels. **Priority 1**

R3.5.2.2.2 The default width value is 750 pixels. **Priority 1**

R3.5.2.3 Background Color **Priority 2**

R3.5.2.3.1 A legal CSS color value. **Priority 2**

R3.5.2.3.2 The default color is white. **Priority 2**

R3.5.3 Properties Required by All Widgets

R3.5.3.1.1 Name **Priority 1**

R3.5.3.1.1.1 Contains between 1 and 50 characters. **Priority 1**

R3.5.3.1.1.2 Unique to each widget. **Priority 1**

R3.5.3.1.1.3 Consists of only alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

R3.5.3.1.1.4 A default name is provided when the widget is added. **Priority 1**

R3.5.3.1.2 Visibility **Priority 1**

R3.5.3.1.2.1 If set to true, the widget is visible (otherwise the widget is hidden). **Priority 1**

R3.5.3.1.2.2 The default value is true. **Priority 1**

R3.5.3.1.3 Log Google Analytics. **Priority 1**

R3.5.3.1.3.1 If set to true, Google Analytics are logged for the widget when clicked on in a hosted exported application. **Priority 1**

R3.5.3.1.3.2 The default value is false. **Priority 1**

R3.5.3.1.4 Horizontal Offset **Priority 1**

R3.5.3.1.4.1 A number between 0 and 100 representing the horizontal location as a percentage of the workspace width. **Priority 1**

R3.5.3.1.4.2 Measured from the left edge of the workspace. **Priority 1**

R3.5.3.1.4.3 The default value is zero. **Priority 1**

R3.5.3.1.5 Vertical Offset **Priority 1**

R3.5.3.1.5.1 A number between 0 and 100 representing the vertical location as a percentage of the workspace height. **Priority 1**

R3.5.3.1.5.2 Measured from the top edge of the workspace. **Priority 1**

R3.5.3.1.5.3 The default value is zero. **Priority 1**

R3.5.3.1.6 Height **Priority 1**

R3.5.3.1.6.1 A number between 0 and 100 representing a percentage of the workspace height. **Priority 1**

R3.5.3.1.7 Width **Priority 1**

R3.5.3.1.7.1 A valid width value is a number between 0 and 100 representing a percentage of the workspace width. **Priority 1**

R3.5.3.1.8 Z-Index **Priority 1**

R3.5.3.1.8.1 A valid z-index value is an integer representing the ordering in which widgets appear on top of each other. **Priority 1**

R3.5.4 U.S. Map Properties

R3.5.4.1 Coloring **Priority 1**

R3.5.4.1.1 The individual states on the U.S. map are colored according to one of the following schemes:

R3.5.4.1.1.1 All states are colored using the same color. **Priority 1**

R3.5.4.1.1.2 The states are colored using four distinguishable colors such that no two adjacent states are the same color. **Priority 1**

R3.5.4.1.1.3 The intensity of the hue for each state varies based on a number valued property in a per-state data file. **Priority 2**

R3.5.4.1.2 The default coloring is grey for all states. **Priority 1**

R3.5.4.2 Glyphs **Priority 1**

R3.5.4.2.1 Name **Priority 1**

R3.5.4.2.1.1 Contains between 1 and 50 characters. **Priority 1**

R3.5.4.2.1.2 Unique to each glyph. **Priority 1**

R3.5.4.2.1.3 Consists of only alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

R3.5.4.2.1.4 A default name is provided when the glyph is added. **Priority 1**

R3.5.4.2.2 Visibility **Priority 1**

R3.5.4.1.2.1 If set to true, the glyph is visible (otherwise the glyph is hidden). **Priority 1**

R3.5.4.1.2.2 The default value is true. **Priority 1**

R3.5.4.2.3 Log Google Analytics. **Priority 1**

R3.5.4.1.3.1 If set to true, Google Analytics are logged for the glyph. **Priority 1**

R3.5.4.1.3.2 The default value is false. **Priority 1**

R3.5.4.2.4 Data **Priority 1**

R3.5.4.2.4.1 A data set bound to the parent widget. **Priority 1**

R3.5.4.2.5 Color **Priority 1**

R3.5.4.2.5.1 A legal CSS color value. **Priority 1**

R3.5.4.2.5.2 The default value is red. **Priority 1**

R3.5.4.2.6 Shape **Priority 1**

R3.5.4.2.6.1 The following options are available:

R3.5.4.2.6.1.1 Circle **Priority 1**

R3.5.4.2.6.1.2 Square **Priority 2**

R3.5.4.2.6.1.3 Triangle **Priority 2**

R3.5.4.2.6.2 The default is circle. **Priority 1**

R3.5.4.2.7 Size

R3.5.4.2.7.1 The dimension of each glyph is one of the following:

R3.5.4.2.7.1.1 A constant size, measured in pixels. **Priority 1**

R3.5.4.2.7.1.2 Scaled according to a numeric data field the user chooses from the selected data file. **Priority 1**

R3.5.4.2.8 Latitude

R3.5.4.2.8.1 A field in one of the data files bound to the parent U.S. Map widget. **Priority 1**

R3.5.4.2.8.2 The values are numbers between -180 and 180. **Priority 1**

R3.5.4.2.9 Longitude

R3.5.4.2.9.1 A field in one of the data files bound to the parent U.S. Map widget. **Priority 1**

R3.5.4.2.9.2 The values are numbers between -90 and 90. **Priority 1**

R3.5.5 Line Graph Properties

R3.5.5.1 Title **Priority 1**

R3.5.5.1.1 Contains between 0 and 50 characters. **Priority 1**

R3.5.5.2 X-Axis Label **Priority 1**

R3.5.5.2.1 Contains between 0 and 50 characters. **Priority 1**

R3.5.5.3 Y-Axis Label **Priority 1**

R3.5.5.3.1 Contains between 0 and 50 characters. **Priority 1**

R3.5.5.4 Graph Data **Priority 1**

R3.5.5.4.1 A bound data set to use for the x and y axis data. **Priority 1**

R3.5.5.5 X-Axis Data Field **Priority 1**

R3.5.5.5.1 A numeric field from a data set bound to the line graph widget. **Priority 1**

R3.5.5.6 Y-Axis Data Field **Priority 1**

R3.5.5.6.1 A numeric field from a data set bound to the line graph widget. **Priority 1**

R3.5.6 Button Properties

R3.5.6.1 Label **Priority 1**

R3.5.6.1.1 A valid label has between 0 and 50 characters. **Priority 1**

R3.5.6.2 Text Color **Priority 2**

R3.5.6.2.1 A valid color value is a legal CSS color value. **Priority 2**

R3.5.6.3 Background Color **Priority 2**

R3.5.6.3.1 A valid color value is a legal CSS color value. **Priority 2**

R3.5.7 Slider Properties

R3.5.7.1 Minimum Value **Priority 3**

R3.5.7.1.1 A number representing the lower bound of the slider. **Priority 3**

R3.5.7.1.2 The minimum value is less than the maximum value. **Priority 3**

R3.5.7.1.3 The default value is 0. **Priority 3**

R3.5.7.2 Maximum Value **Priority 3**

R3.5.7.2.1 A number representing the upper bound of the slider. **Priority 3**

R3.5.7.2.2 The maximum value is greater than the minimum value. **Priority 3**

R3.5.7.2.3 The default value is 100. **Priority 3**

R3.5.7.3 Current Value **Priority 3**

R3.5.7.3.1 A number representing the current position of the slider's pointer. **Priority 3**

R3.5.7.3.2 The current value of the pointer is between the minimum and maximum values inclusively. **Priority 3**

R3.5.7.3.3 The default for the current value is the minimum value. **Priority 3**

R3.5.7.4 Increment **Priority 3**

R3.5.7.4.1 A number that determines the amount by which the slider increments. **Priority 3**

R3.5.8 Text Block Properties

R3.5.8.1 Text Content **Priority 1**

R3.5.8.1.1 Contains between 0 and 500 characters. **Priority 1**

R3.5.8.2 Text Color **Priority 2**

R3.5.8.2.1 A legal CSS color value. **Priority 2**

R3.5.8.2.2 The default is black. **Priority 2**

R3.5.8.3 Background Color **Priority 2**

R3.5.8.3.1 A legal CSS color value. **Priority 2**

R3.5.8.3.2 The default is white. **Priority 2**

R3.5.8.4 Border Color **Priority 2**

R3.5.8.4.1 A legal CSS color value. **Priority 2**

R3.5.8.4.2 The default is black. **Priority 2**

R3.5.8.5 Border Thickness **Priority 2**

R3.5.8.5.1 A nonnegative integer representing the width of the border in pixels. **Priority 2**

R3.5.8.5.2 The default is 1 pixel. **Priority 2**

R3.5.8.6 Border Radius **Priority 2**

R3.5.8.6.1 A nonnegative integer in pixels determining the roundness of corners. **Priority 2**

R3.5.8.6.2 The default is 5 pixels. **Priority 2**

R3.5.9 Combobox Properties

R3.5.9.1 Options **Priority 2**

R3.5.9.1.1 The combobox must contain one or more options. **Priority 2**

R3.5.9.1.2 A valid option has a label and a value. **Priority 2**

R3.5.9.1.3 A valid label has text between 1 and 50 characters. **Priority 2**

R3.5.9.1.4 A valid value has between 1 and 50 characters. **Priority 2**

R3.5.9.2 Selected Option **Priority 2**

R3.5.9.2.1 The option currently selected from the list of available options **Priority 2**

R3.5.10 Radio Button Set Properties

R3.5.10.1 Labels **Priority 2**

R3.5.10.1.1 Contains between 1 and 50 characters. **Priority 2**

R3.5.10.2 Orientation **Priority 3**

R3.5.10.2.1 The radio button set is oriented vertically or horizontally. **Priority 3**

R3.5.10.2.2 The default orientation is vertical. **Priority 3**

R3.5.10.3 Selected Button **Priority 2**

R3.5.10.3.1 The currently selected button. **Priority 2**

R3.5.11 Checkbox Set Properties

R3.5.11.1 Labels **Priority 2**

R3.5.11.1.1 Contains between 1 and 50 characters. **Priority 2**

R3.5.11.2 Orientation **Priority 3**

R3.5.11.2.1 The checkbox set is oriented vertically or horizontally. **Priority 3**

R3.5.11.2.2 The default orientation is vertical. **Priority 3**

R3.5.11.3 Checked Boxes **Priority 2**

R3.5.11.3.1 The set of boxes that are currently checked. **Priority 2**

R3.5.12 Tooltip Properties

R3.5.12.1 Text Content **Priority 1**

R3.5.12.1.1 Contains between 0 and 500 characters. **Priority 1**

R3.5.13 Binding Data to Widgets

R3.5.13.1 A data set is bound to a widget before that widget accesses the data. **Priority 1**

R3.5.14 Unbinding Data from Widgets

R3.5.14.1 A bound data set is removed from a widget. **Priority 1**

R3.5.14.2 A bound data set is removed from a widget if it is not used by the widget. **Priority 1**

3.6 Actions Panel

The user can add, edit and remove actions from the Actions Panel (Figure 10). The workflow for creating a property type action is illustrated in Figure 11. Clicking the add button in the Actions Panel displays the Action Editor dialog. The Action Editor dialog contains options for selecting the affected widget and new values for properties of the chosen widget (Figure 12). If the “apply by default” option is selected in the Action Editor dialog, the workspace updates to reflect the effect of the action immediately. Once an action is created, it is displayed in the Actions Panel and is available for use by events. Selecting an action from the Actions Panel and clicking the delete button removes the action from the project.

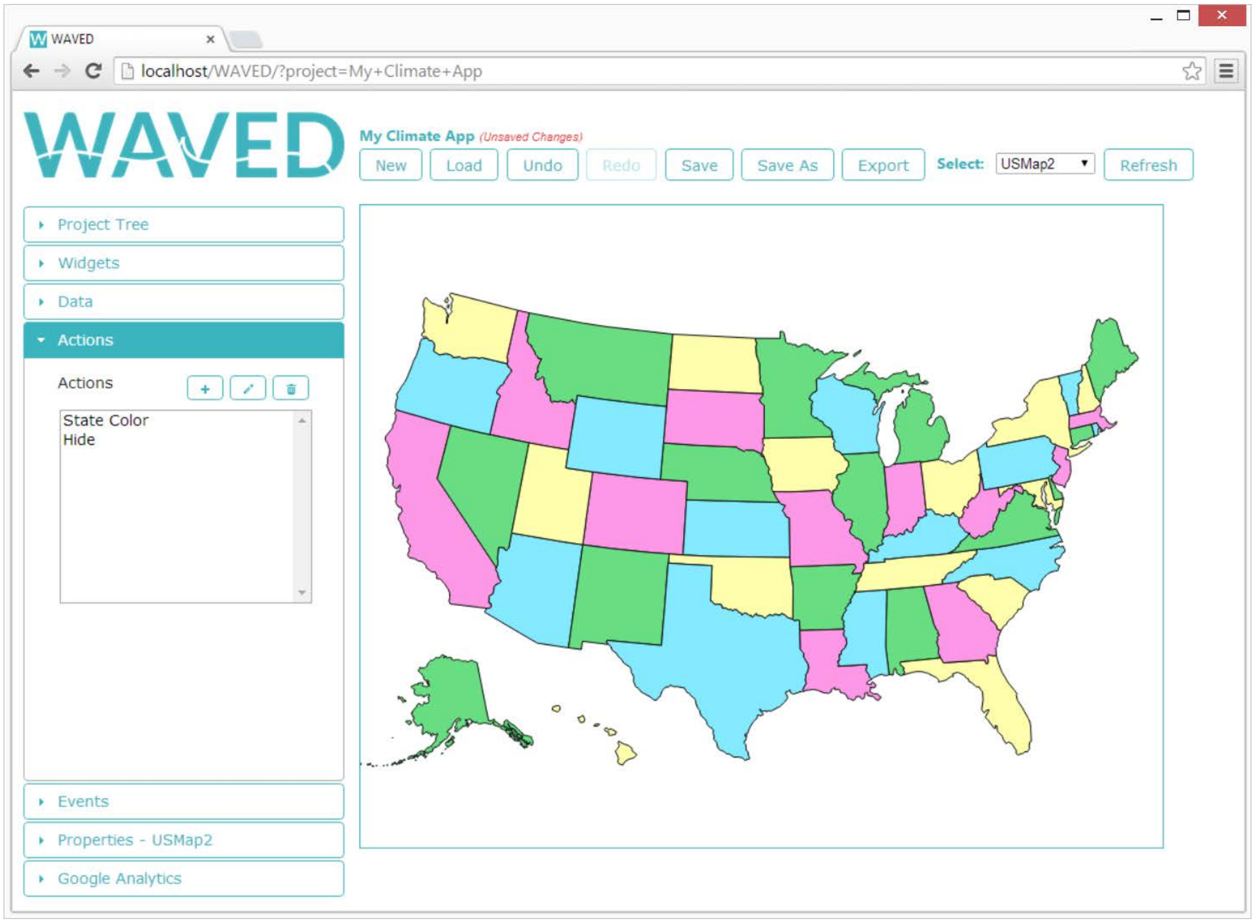


Figure 10. Actions Panel

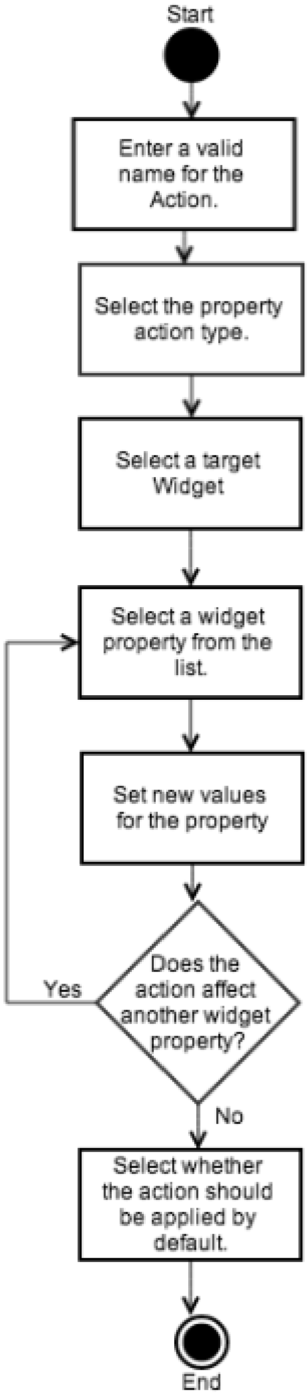
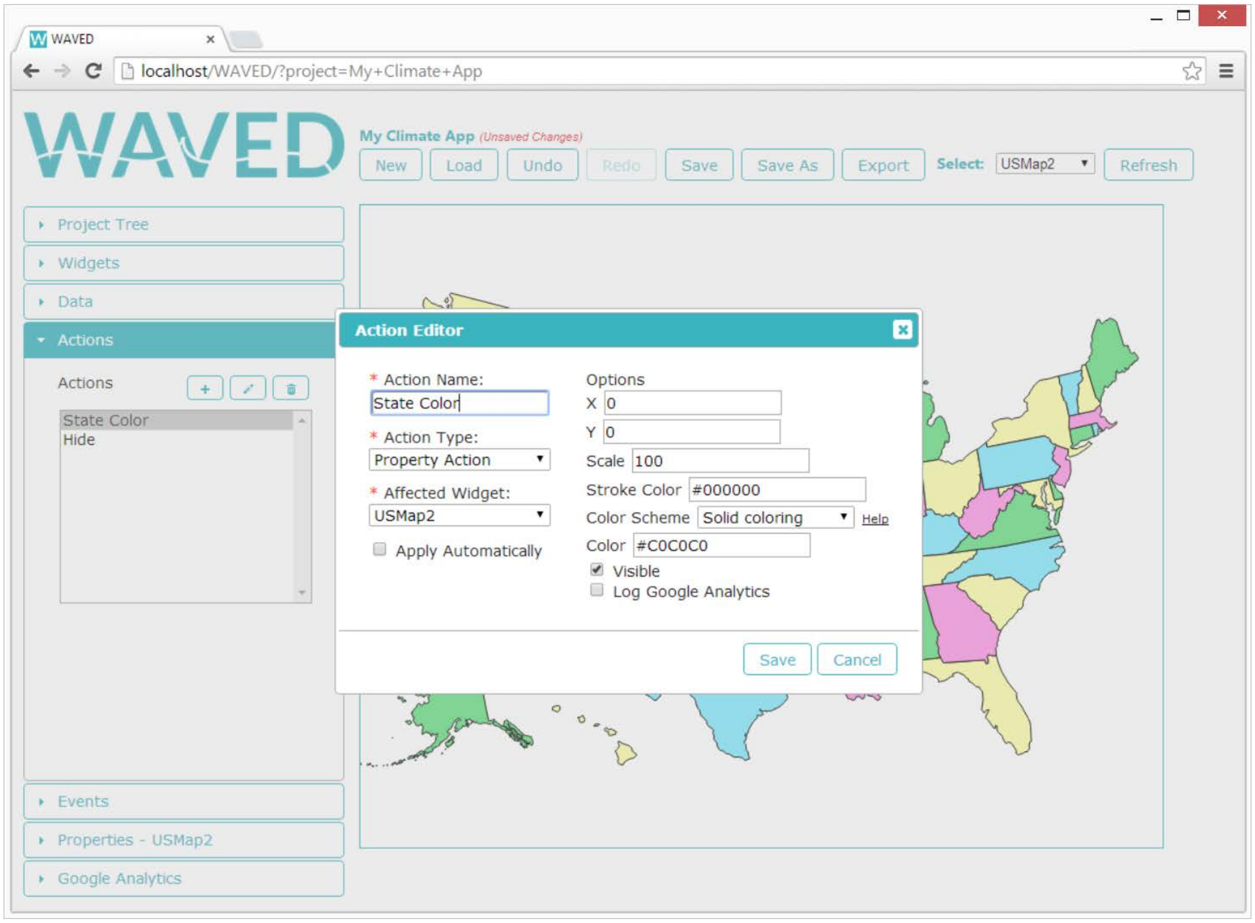

Start
Enter a valid name for the Action.
Select the property action type.
Select a target Widget
Select a widget property from the list.
Set new values for the property
Does the action affect another widget property?
Yes
No
Select whether the action should be applied by default.
End

Figure 11. Activity diagram for creating a property action



* Action Name: State Color

* Action Type: Property Action

* Affected Widget: USMap2

□ Apply Automatically

Options

X 0

Y 0

Scale 100

Stroke Color #000000

Color Scheme Solid coloring

Color #C0C0C0

☑ Visible

□ Log Google Analytics

Figure 12. Action Editor dialog

R3.6 Action Panel Requirements

R3.6.1 Creating an Action

R3.6.1.1 To create an action, the user must supply the following information:

R3.6.1.1.1 A unique name containing between 1 and 50 characters consisting of alphanumeric, space, hyphen and underscore characters. **Priority 1**

R3.6.1.1.2 A valid action type, as specified in R3.6.2. **Priority 1**

R3.6.1.1.3 The widget affected when the action is fired. **Priority 1**

R3.6.1.1.4 A data set if option R3.6.2.1.2 is selected for R.3.6.1.1.2. **Priority 1**

R3.6.1.1.5 The new value of the properties or data subset query. **Priority 1**

R3.6.1.1.6 Whether to apply the action immediately or in response to an event. **Priority 1**

R3.6.2 Action Types

R3.6.2.1 A valid action type is one of the following:

R3.6.2.1.1 Modify property values of the selected widget. **Priority 1**

R3.6.2.1.2 Modify the query of a data subset. **Priority 1**

R3.6.3 Modifying an Action

R3.6.3.1 Actions added to a project are editable. **Priority 1**

R3.6.4 Removing an Action

R3.6.4.1 Actions are removable from a project. **Priority 1**

R3.6.4.2 If the user attempts to remove an action used by an event, the user is alerted that the action cannot be removed until it is no longer used by any events. **Priority 1**

R3.6.5 Action Property Values

R3.6.5.1 Values specified for properties within an action must meet one of the following criteria:

- **R3.6.5.1.1** A valid value for the property as specified by each component in R3.5 **Priority 1**
- **R3.6.5.1.2** A string of the form {{template}} where template is one of the following:
  - **R3.6.5.1.2.1** x **Priority 1**
    - **R3.6.5.1.2.1.1** The x-coordinate of the event that fired the action. **Priority 1**
  - **R3.6.5.1.2.2** y **Priority 1**
    - **R3.6.5.1.2.2.1** The y-coordinate of the event that fired the action. **Priority 1**
  - **R3.6.5.1.2.3** dataset.field **Priority 1**
    - **R3.6.5.1.2.3.1** dataset is the name of a Data Set or Data Subset added to the current project. **Priority 1**
    - **R3.6.5.1.2.3.2** field is the name of a field in the qualified dataset. **Priority 1**

3.7 Events Panel

Opening the Events Panel (Figure 13) and clicking the add button opens the event editor dialog (Figure 14). From here, the user follows the workflow described in Figure 15 to create an event. After an event is added to the project, the user interacts with the workspace to trigger the event and fire the associated action. An exported visualization behaves in exactly the same way as the interactive preview in the workspace. Within WAVED, as opposed to an exported application, users click the refresh button located at the top right side of the window to reset the workspace to the initial state of the visualization (before any user events were fired or actions applied).

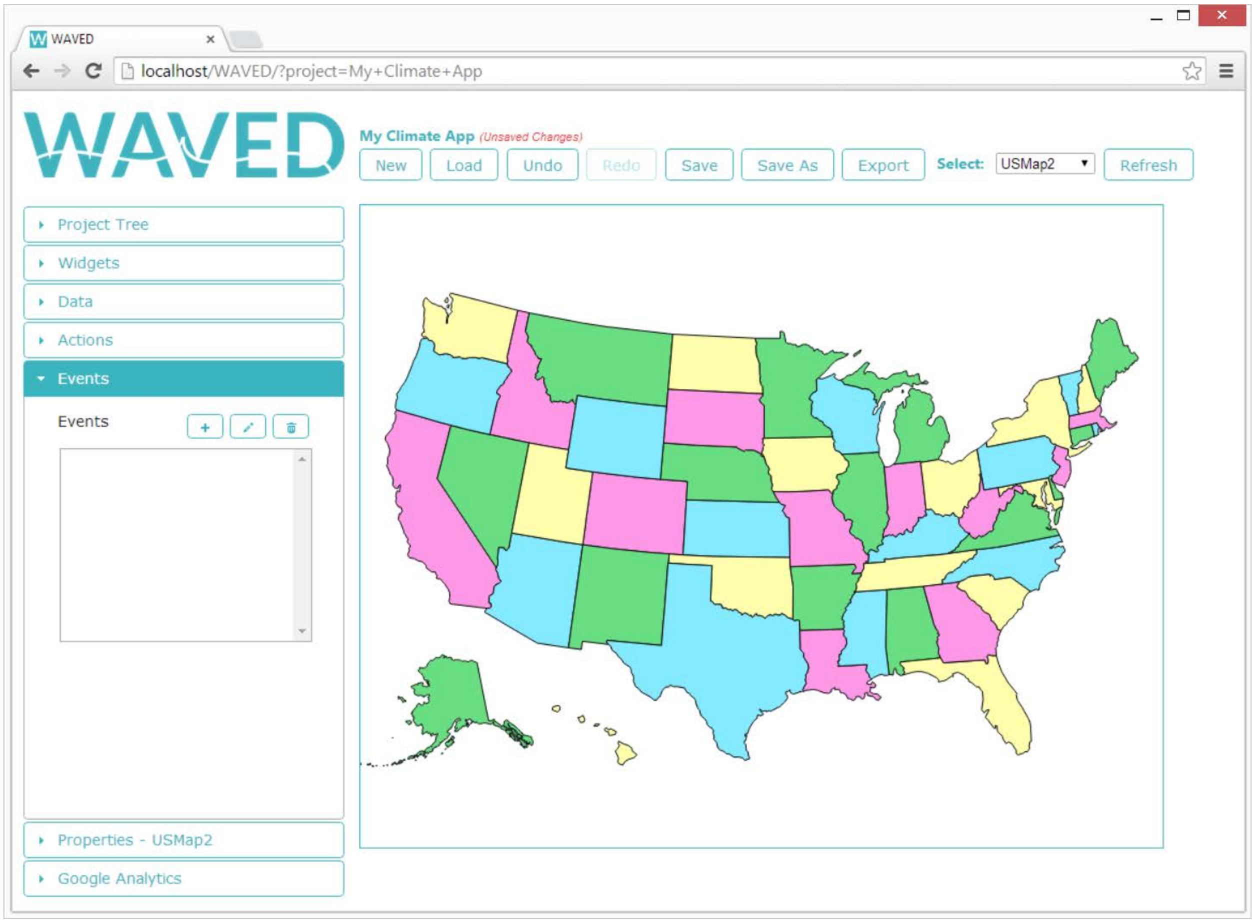
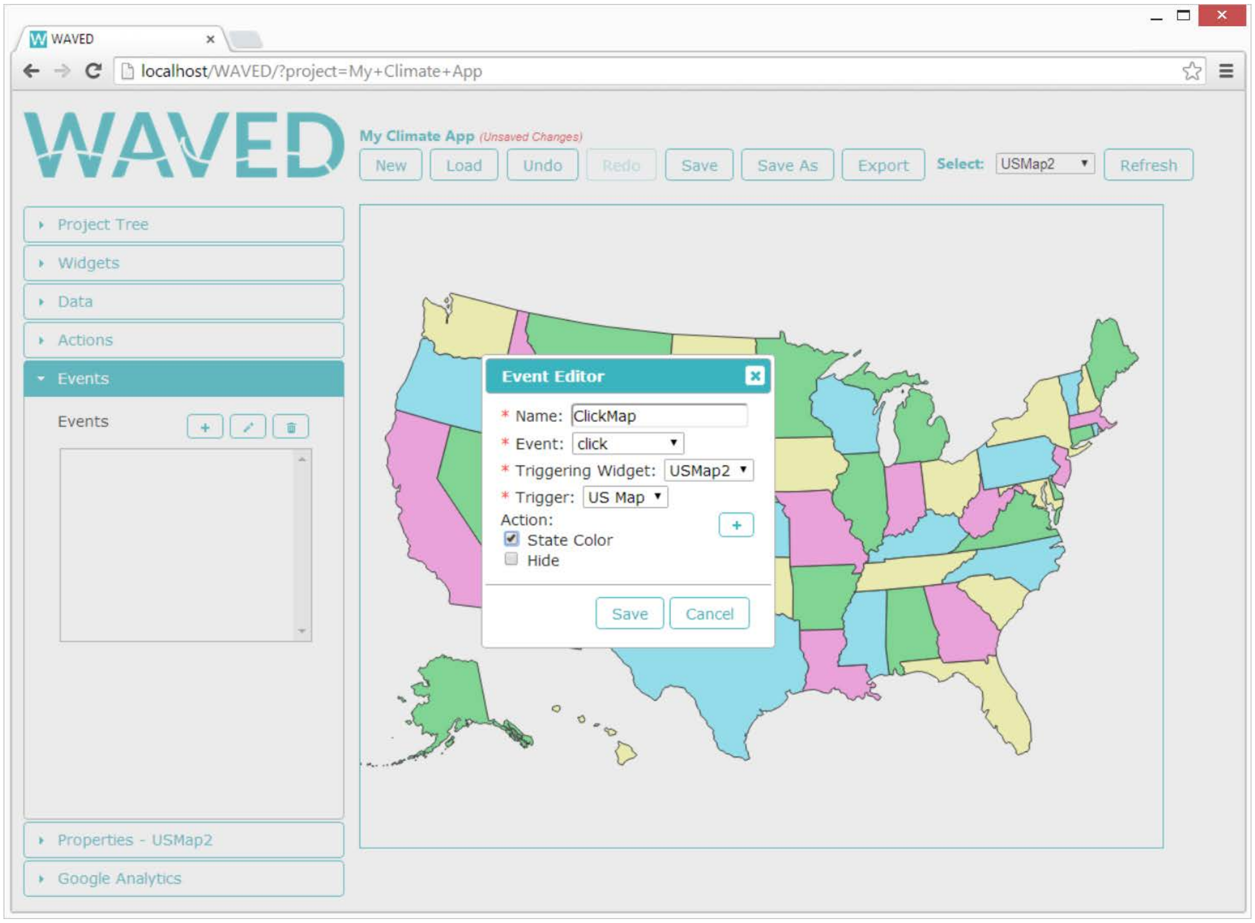


Figure 13. Events Panel



localhost/WAVED/?project=My+Climate+App

My Climate App *(Unsaved Changes)*

Select: USMap2

* Name: ClickMap

* Event: click

* Triggering Widget: USMap2

* Trigger: US Map

Action:

☑ State Color

□ Hide

Figure 14. Event Editor Dialog

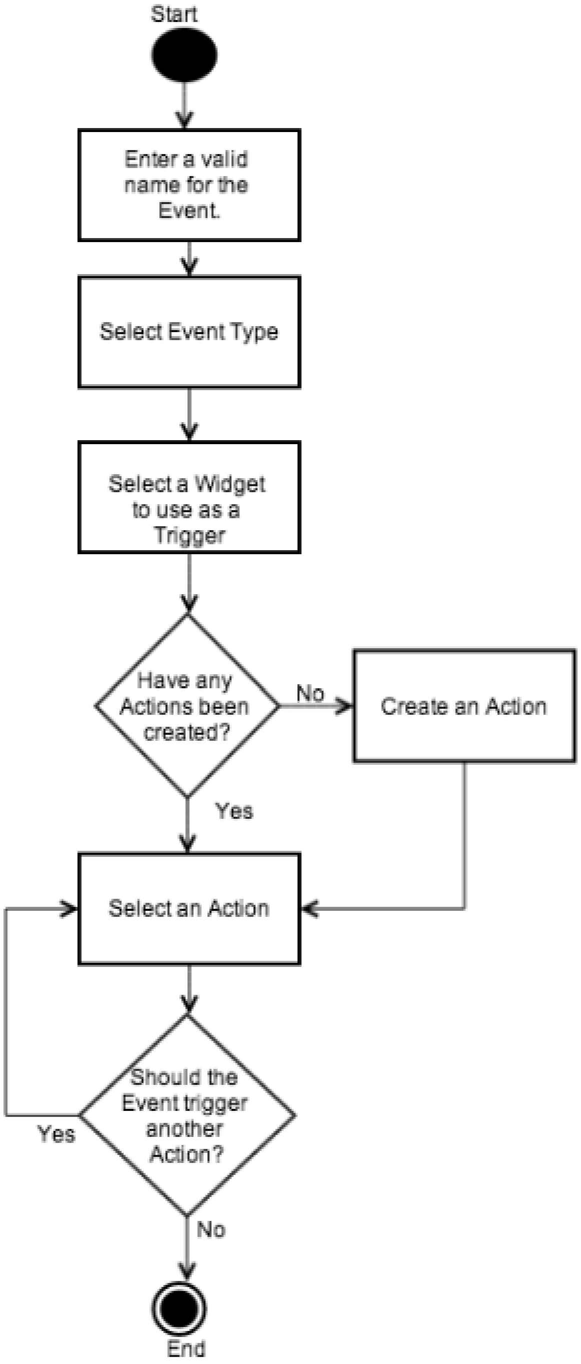

Start
Enter a valid name for the Event.
Select Event Type
Select a Widget to use as a Trigger
Have any Actions been created?
No
Create an Action
Yes
Select an Action
Should the Event trigger another Action?
Yes
No
End

Figure 15. Activity diagram for creating an event

R3.7 Events Panel Requirements

R3.7.1 Event Types

R3.7.1.1 A valid event type is one of the following:

R3.7.1.1.1 A click event, which fires an action when a user clicks on a widget. **Priority 1**

R3.7.1.1.2 A hover event, which fires an action when a user moves the mouse onto a widget. **Priority 1**

R3.7.1.1.3 A move event, which fires an action when a user moves the mouse while within the boundaries of a widget. **Priority 1**

R3.7.2 Creating an Event

R3.7.2.1 To create an event, the user must supply the following information:

R3.7.2.1.1 One of the event types specified in R3.7.1.1. **Priority 1**

R3.7.2.1.2 The name of a target widget. **Priority 1**

R3.7.2.1.3 One or more actions to occur when the event is triggered. **Priority 1**

R3.7.3 Modifying an Event

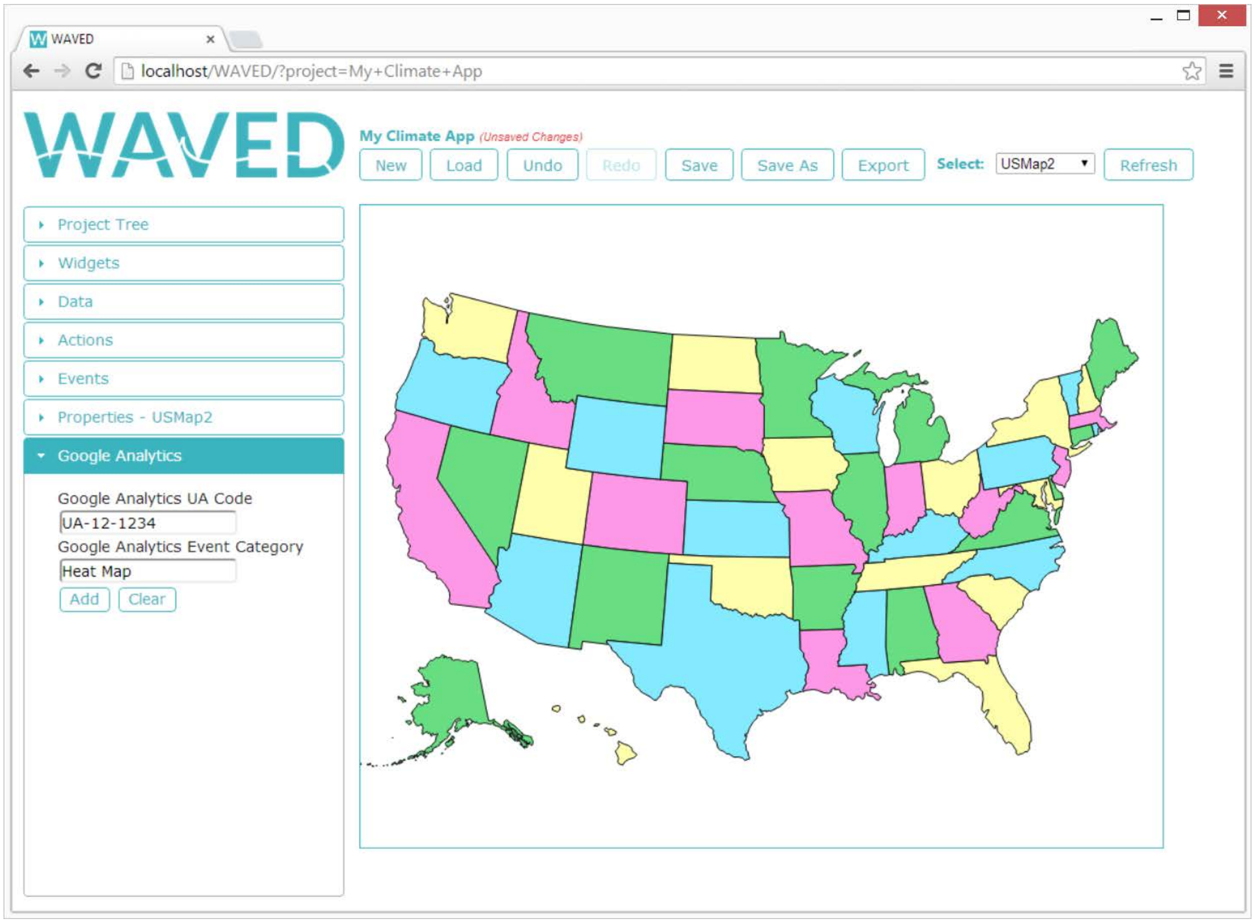
R3.7.3.1 Existing events are editable. **Priority 1**

R3.7.4 Removing an Event

R3.7.4.1 The user is able to remove events. **Priority 1**

3.8 Google Analytics Panel

Opening the Google Analytics Panel displays input fields to add a Google Analytics UA code and an event category used for grouping all logged events within Google Analytics (Figure 16). To have an individual widget log Google Analytics click events, the user checks the “Log Google Analytics” checkbox in the widget’s Properties Panel (Figure 17).

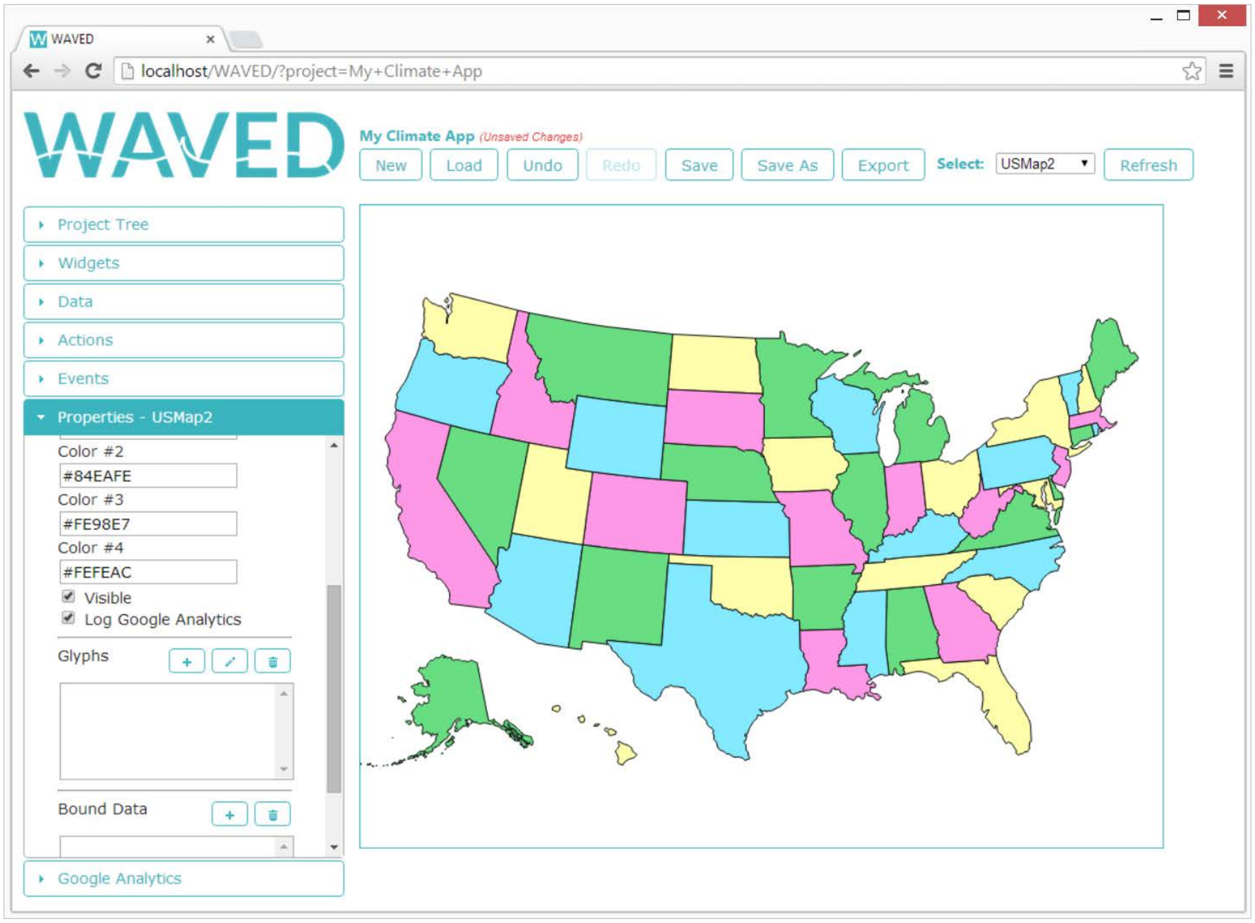


Select: USMap2

Google Analytics UA Code: UA-12-1234

Google Analytics Event Category: Heat Map

Figure 16. Google Analytics Panel



localhost/WAVED/?project=My+Climate+App

My Climate App *(Unsaved Changes)*

Select: USMap2

Properties - USMap2

Color #2 #84EAFE

Color #3 #FE98E7

Color #4 #FEFEAC

☑ Visible

☑ Log Google Analytics

Figure 17. A checked Log Google Analytics checkbox in a widget's Properties Panel

R3.8 Google Analytics Requirements

R3.8.1 A Google Analytics account may be associated with a project. **Priority 1**

R3.8.2 The user must supply a Google Universal Analytics (UA) tracking code and an event category when associating Google Analytics with the project. **Priority 1**

R3.8.3 A Google UA tracking code consists of alphanumeric characters and hyphens. **Priority 1**

R3.8.4 A Google UA tracking code is of the form "UA-####-##". **Priority 1**

R3.8.5 An event category is composed of only alphanumeric, hyphen (-), underscore (_) and space characters. **Priority 1**

3.9 Project Tree Panel

The Project Tree Panel displays all of the widgets, data, actions, and events added to the current project in a hierarchical fashion (Figure 18). Selecting an item from the tree and clicking the delete button located in the top right of the Project Tree Panel deletes the item from the project. Selecting the project folder from the Project Tree Panel and clicking the delete button displays a dialog asking the user to confirm deletion of the project. After a project is deleted, the user is shown the welcome screen pictured in Figure 1. Additionally, if the user opens the Properties Panel after selecting a widget from the project tree, the Properties Panel is populated with the properties for the selected widget. This behavior is the same as what happens when a widget is selected using the combobox found in the main menu.

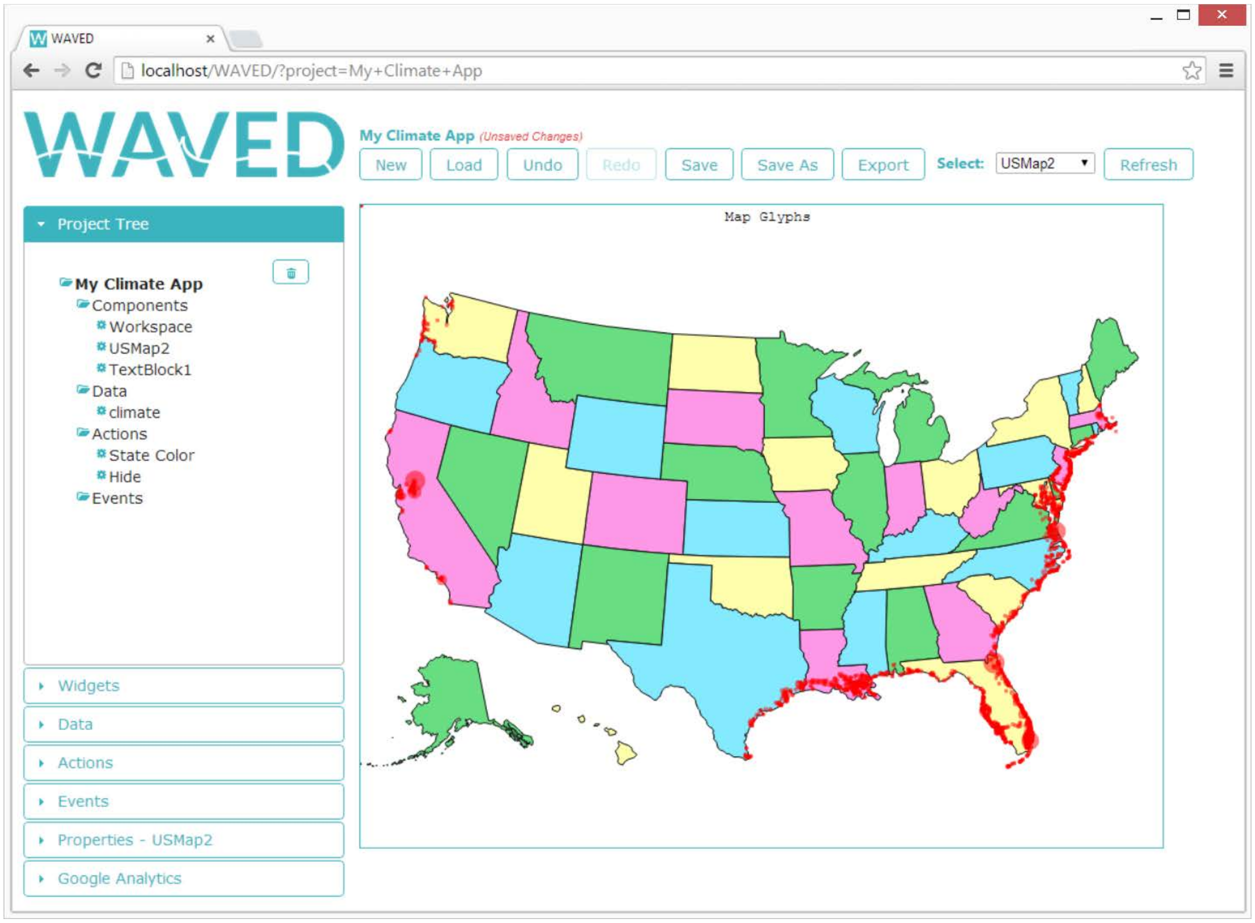


Figure 18. Project Tree Panel

R3.9 Project Tree Requirements

R3.9.1 Listing Components

R3.9.1.1 All components, datasets, actions, and events in the project are displayed in a hierarchical format. **Priority 1**

R3.9.1.2 All components, datasets, actions, events, and the project itself are selectable from the project tree. **Priority 1**

R3.9.1.3 The currently selected item in the project tree, including the project itself, is deletable. **Priority 1**

R3.9.2 Deleting a Widget

R3.9.2.1 The user deletes a widget added to the project. **Priority 1**

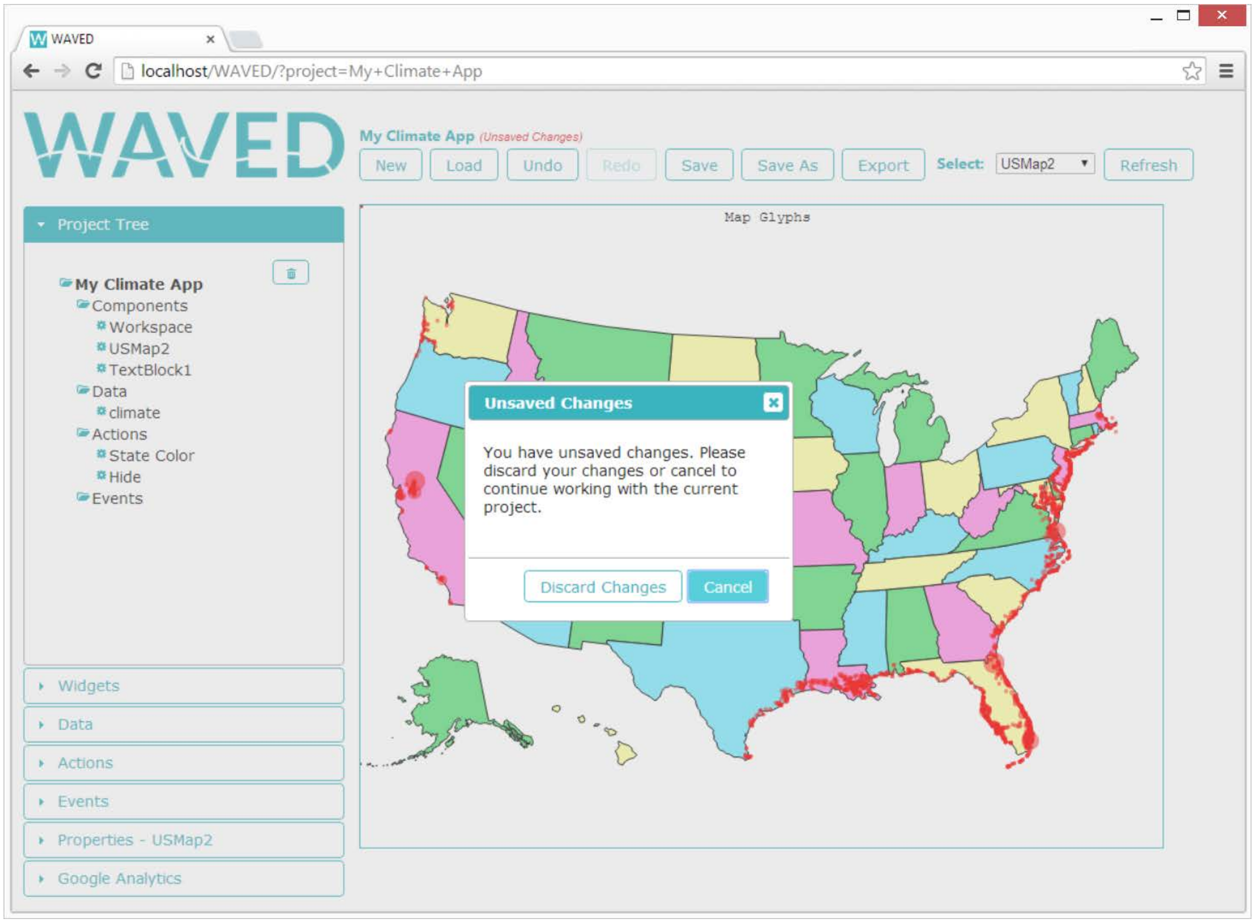
R3.9.2.2 A widget is deleted only if it is selected. **Priority 1**

R3.9.2.3 A widget is not deleted if any events require the widget. **Priority 1**

R3.9.2.4 A widget is not deleted if any actions target the widget. **Priority 1**

3.10 Main Menu

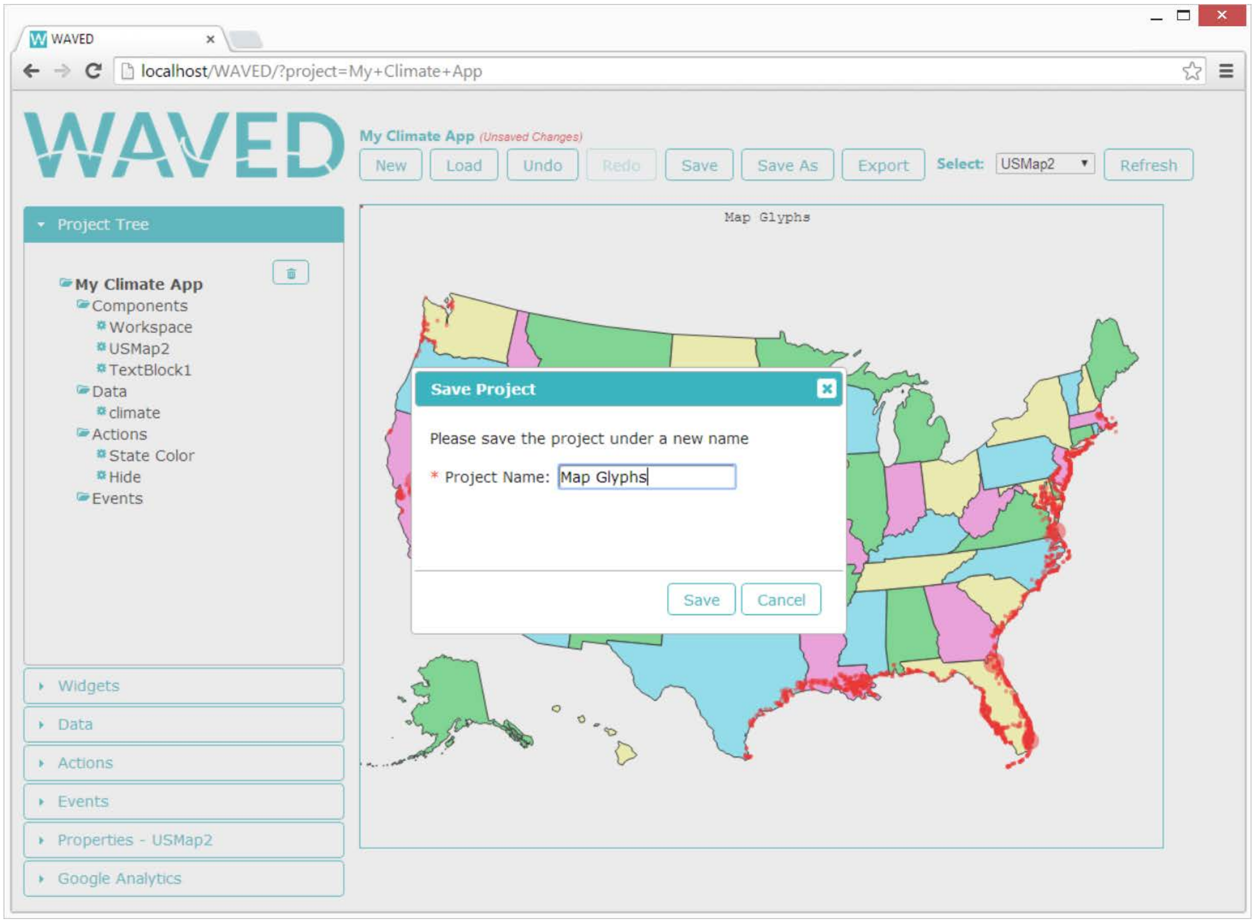
The main menu bar located at the top of the screen contains New, Undo, Redo, Save, Save As, Load, and Export buttons. There are two ways to create a new project, as shown in the activity diagram (Figure 2). The user is able to create a new project at any time by clicking the New button in the main menu. If there are any unsaved changes in the project when the New Project button is clicked, the user is prompted to either discard the unsaved changes or cancel the action (Figure 19). Clicking yes prompts the user to enter a valid name for the new project and then opens up a blank new project (Figure 3).



You have unsaved changes. Please discard your changes or cancel to continue working with the current project.

Figure 19. Dialog for discarding unsaved changes

Clicking the Save button saves the current state of the project under the name given to the project upon creation. The Save As button saves a copy of the project under a different project name. Clicking the Save As button opens a dialog prompting the user for a new project name (Figure 20). This workflow is described in Figure 21.



Save Project

Please save the project under a new name

* Project Name: Map Glyphs

Figure 20. Save As Dialog

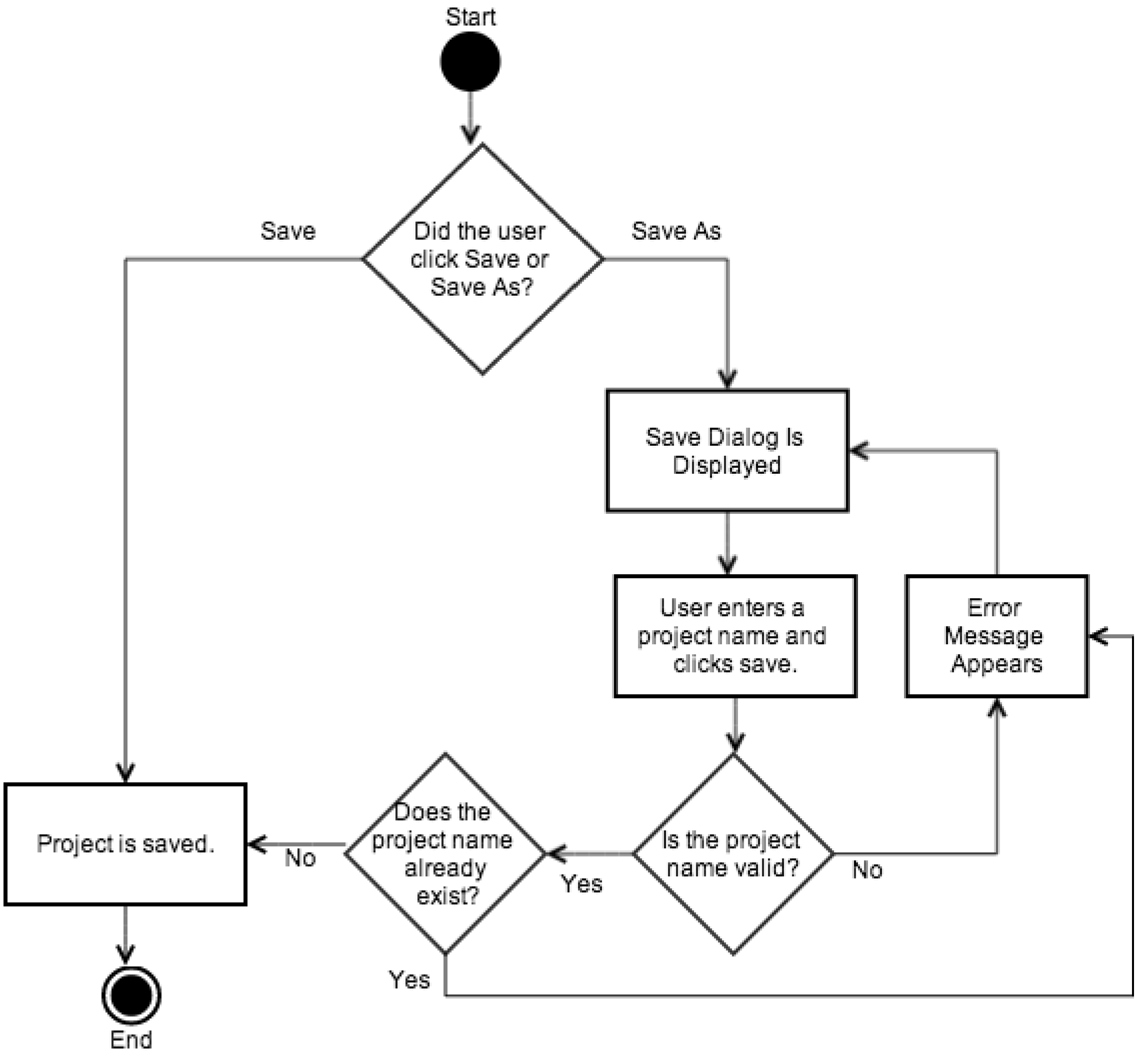
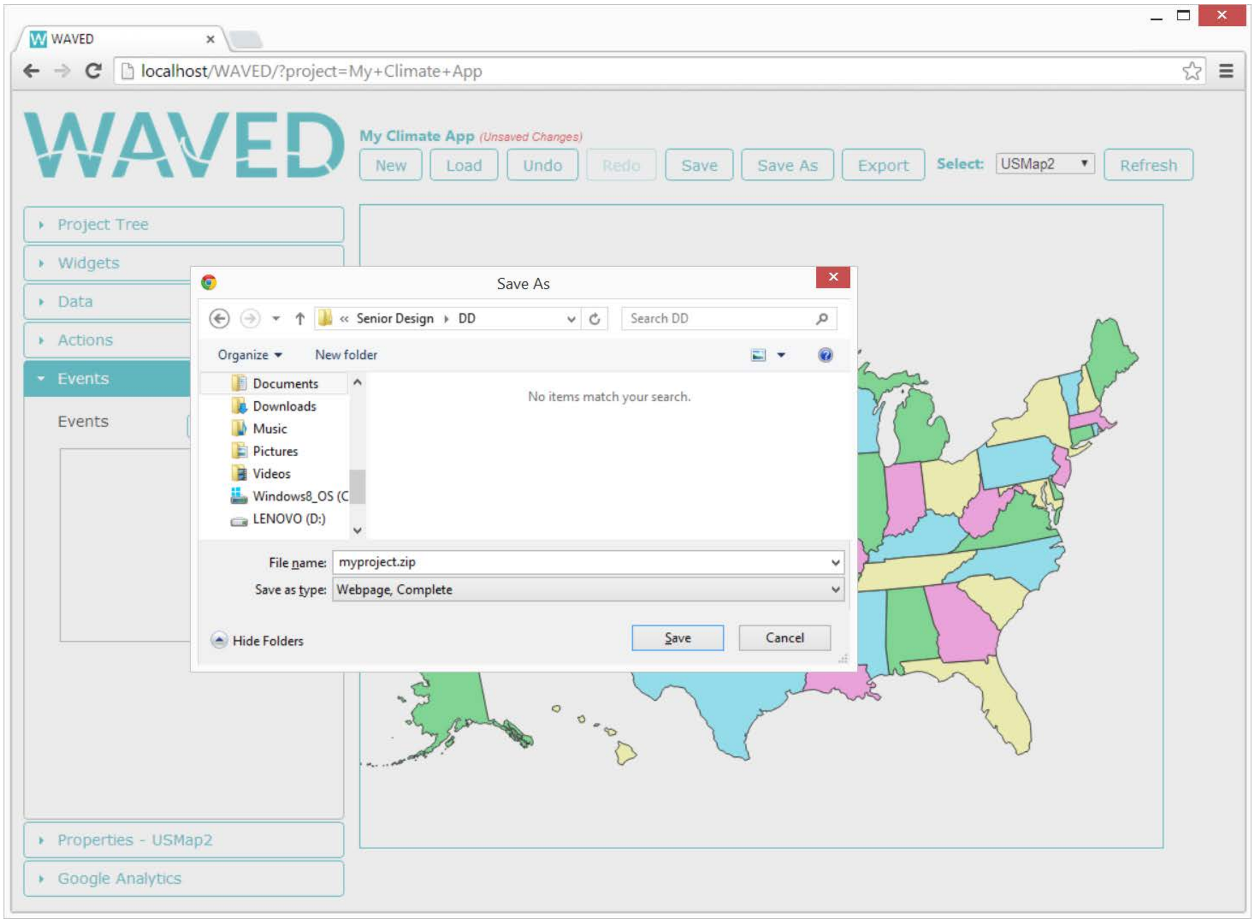

Start
Did the user click Save or Save As?
Save
Save As
Save Dialog Is Displayed
User enters a project name and clicks save.
Error Message Appears
Is the project name valid?
No
Yes
Does the project name already exist?
No
Yes
Project is saved.
End

Figure 21. An activity diagram for saving a project

Clicking the Export button displays a dialog for the user to name the exported project file. A file browser then appears for the user to designate the location to save the file if the user's web browser doesn't have a default download location (Figure 22).



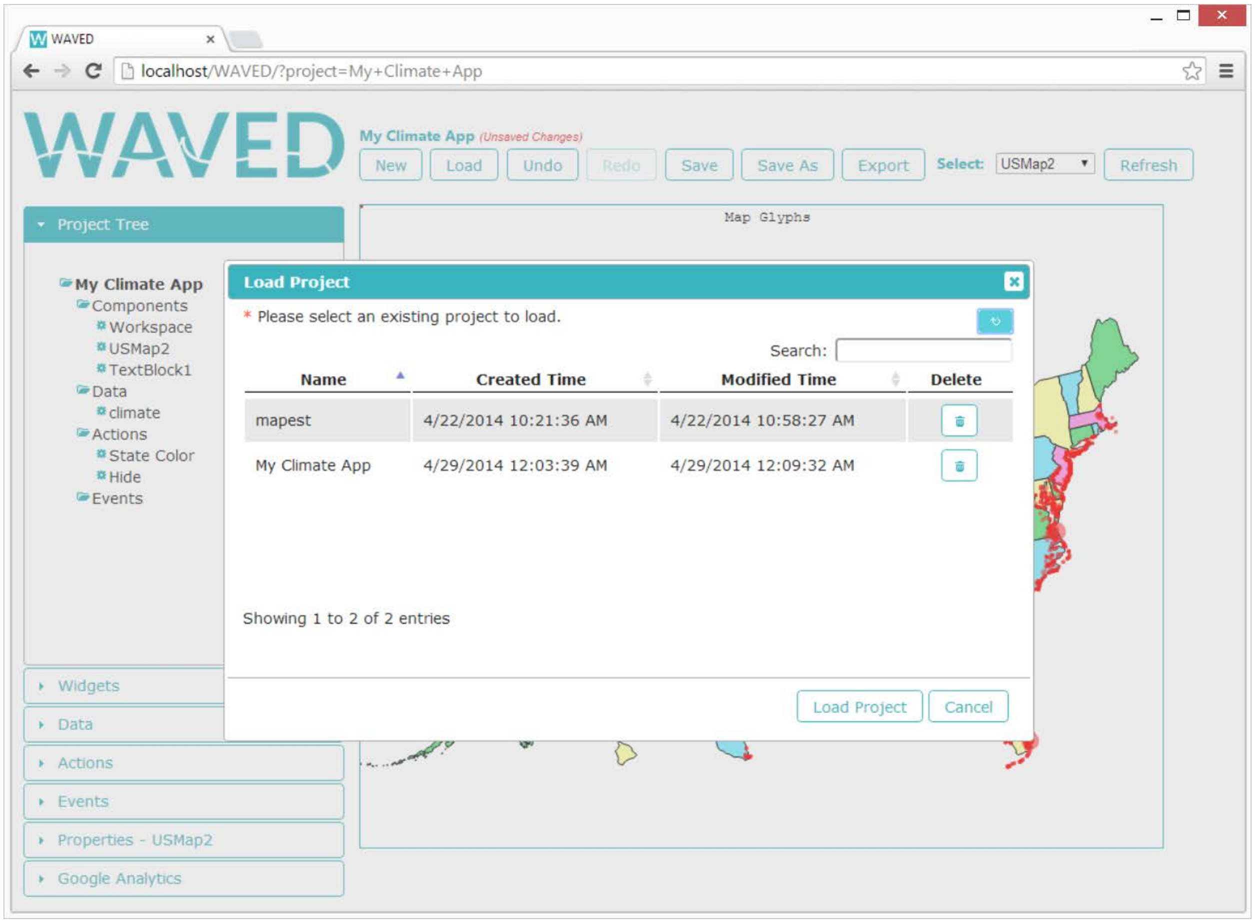
No items match your search.

File name: myproject.zip

Save as type: Webpage, Complete

Figure 22. Export Dialog

Clicking the Load button displays a dialog listing all existing projects available to the user (Figure 23). The user loads a project by selecting one from the list and clicking the load button. Once loaded, the workspace and side panels populate with the project's widget, data, action, event, and Google Analytics information. Clicking the trashcan icon next to a project listed in the load dialog prompts the user to confirm deletion of the project.



Load Project

* Please select an existing project to load.

Search:

Name	Created Time	Modified Time	Delete
mapest	4/22/2014 10:21:36 AM	4/22/2014 10:58:27 AM	🗑
My Climate App	4/29/2014 12:03:39 AM	4/29/2014 12:09:32 AM	🗑

Showing 1 to 2 of 2 entries

Figure 23. Load Project Dialog

R3.10 Main Menu Requirements

R3.10.1 Saving a Project

R3.10.1.1 The main menu provides a way to save the state of the current project. **Priority 1**

R3.10.1.2 The main menu provides an option to save a copy of the current project under a different name. **Priority 1**

R3.10.1.3 Saving a previously saved project under the same name does not require any prompts. **Priority 1**

R3.10.1.4 Once a project is saved, the application automatically saves the project every five minutes. **Priority 3**

R3.10.2 Deleting a Project

R3.10.2.1 Projects are deletable without being open. **Priority 1**

R3.10.2.2 The currently opened project is deletable. **Priority 1**

R3.10.2.3 The application prompts the user to confirm the deletion of a project before it is permanently deleted. **Priority 1**

R3.10.2.4 Once a project is deleted, the project no longer appears in the list of saved projects and cannot be loaded. **Priority 1**

R3.10.2.5 Once deleted, all files associated with the project are removed from the application server. **Priority 1**

R3.10.3 Export Visualization

R3.10.3.1 Exported File

R3.10.3.1.1 The current visualization is exported as a zip file. **Priority 1**

R3.10.3.1.2 The zip file contains the following files:

R3.10.3.1.2.1 An HTML file (.html) **Priority 1**

R3.10.3.1.2.2 A JavaScript file (.js) **Priority 1**

R3.10.3.1.2.3 A CSS file (.css) **Priority 1**

R3.10.3.1.2.4 A folder containing all data files bound to widgets **Priority 1**

R3.10.4 Project Revision History

R3.10.4.1 Undo

R3.10.4.1.1 Client-side changes made to the current project are revertible. **Priority 1**

R3.10.4.1.2 The undo functionality is disabled when no changes were made. **Priority 1**

R3.10.4.2 Redo

R3.10.4.2.1 Reverted changes are restorable. **Priority 1**

R3.10.4.2.2 When the user makes a change after reverting a change, the reverted change cannot be restored. **Priority 1**

R3.10.4.2.3 The redo functionality is disabled when no changes were reverted. **Priority 1**

R3.11 User Accounts Requirements

R3.11.1 Creating User Accounts

R3.11.1.1 When creating a user account, the following information is supplied:

R3.11.1.1.1 E-mail Address **Priority 3**

R3.11.1.1.1.1 Contains between 0 and 254 characters. **Priority 3**

R3.11.1.1.1.2 Is of the format `address@domain.extension` where address, domain and extension are not blank. **Priority 3**

R3.11.1.1.2 Password **Priority 3**

R3.11.1.1.2.1 Contains between 6 and 30 characters. **Priority 3**

R3.11.1.1.2.2 Includes at least one uppercase letter, one lowercase letter and one number. **Priority 3**

R3.11.1.1.3 First Name **Priority 3**

R3.11.1.1.3.1 Contains between 1 and 50 characters. **Priority 3**

R3.11.1.1.3.2 Includes alphabetic, hyphen (-) or space characters. **Priority 3**

R3.11.1.1.4 Last Name **Priority 3**

R3.11.1.1.4.1 Contains between 1 and 50 characters. **Priority 3**

R3.11.1.1.4.2 Include alphabetic, hyphen (-) or space characters. **Priority 3**

R3.11.1.1.5 Role **Priority 3**

R3.11.1.5.1 A user account must have one of the following roles:

R3.11.1.5.1.1 User **Priority 3**

R3.11.1.5.1.2 Administrator **Priority 3**

R3.11.1.2 Only a user with the Administrator role (R3.11.1.5.1.2) creates new user accounts. **Priority 3**

R3.11.1.3 There is at least one user account with the Administrator role. **Priority 3**

R3.11.2 Modifying User Accounts

R3.11.2.1 A user with the administrator role modifies user accounts. **Priority 3**

R3.11.2.2 The modified user account must continue to meet the details specified in R3.11.1.1. **Priority 3**

R3.11.3 Deleting User Accounts

R3.11.3.1 A user with the administrator role deletes user accounts. **Priority 3**

R3.11.3.2 Once a user account is deleted, that user cannot log into the application. **Priority 3**

R3.11.4 User Account Authentication

R3.11.4.1 A user cannot access the contents of the application if he or she is not authenticated. **Priority 3**

R3.11.4.2 The user is authenticated if he or she supplies a valid email address and password that match an existing user account. **Priority 3**

4. Nonfunctional Requirements

4.1 Human Factors

4.1.1 Types of Users

4.1.1.1 Users with little to no programming experience who do not desire to directly modify the underlying code of an exported visualization created in WAVED.

4.1.1.2 Users that have the capability to directly modify the underlying code of an exported visualization created in WAVED.

4.2 Documentation

4.2.1 Interactive Visualization Documentation

4.2.1.1 Documentation is provided on the use of the WAVED application to create interactive visualizations.

4.2.2 Application Architecture Documentation

4.2.2.1 Documentation is provided on the architecture of the system in order to specify how the functional requirements are implemented.

4.2.2.2 Documentation is provided on how to modify the WAVED system to add or remove features.

4.3 Hardware

4.3.1 The client must have a computer with the following hardware:

4.3.1.1 A keyboard

4.3.1.2 A pointing device

4.3.1.3 A monitor

4.3.2 The client's computer must have a network connection.

4.3.3 The server hardware must have a network connection.

4.4 Software

4.4.1 The WAVED application must function properly in the following Internet browsers:

4.4.1.1 Google Chrome version 31 or higher

4.4.1.2 Mozilla Firefox version 26 or higher

4.4.2 The server must support database software.

4.4.2.1 The database software must support multiple, concurrent connections.

4.4.3 The server must support web application hosting.

4.4.3.1 The hosting software must support multiple, concurrent connections.

4.5 Performance

4.5.1 Response Time

4.5.1.1 User interaction with the system that does not require the loading of data or off-client communication is under 0.5 seconds.

4.5.1.2 The system response for an export request is under 0.5 seconds. The actual download time of the visualization may vary depending on Internet connection speeds.

4.5.1.3 The system response time is less than 1 second when loading and saving data.

4.6 Error Handling and Reliability

4.6.1 System Downtime

4.6.1.1 The acceptable downtime for the application varies on a case-by-case basis, provided the end users are notified in advance by a system administrator.

4.6.1.2 The database server is not down during times WAVED is available to users.

4.6.1.3 The database is not down during times when WAVED is available to users.

4.6.2 Input Errors

4.6.2.1 When an input error occurs, the system must display an error message to the user.

4.6.2.2 The user must acknowledge the error message in 4.5.2.1 before continuing to use the application.

4.7 Security

4.7.1 Access to the WAVED application is restricted to users on the network where WAVED is hosted.

4.7.2 Database access is restricted to a system administrator and any other personnel the administrator authorizes.

4.8 Usability of Exported Code

4.8.1 The exported visualization has the same functionality as what is shown in the workspace.

4.8.2 The exported visualization is embeddable in a web page.

4.8.3 Readability of Exported Code

4.8.3.1 All exported code must comply with the following conventions:

4.8.3.1.1 Indentation and white space are used to indicate code hierarchy.

4.8.3.1.2 Each line contains a single statement.

4.8.3.1.3 Variable names are related to the context of the code.

4.8.3.1.4 Code comments separate code for each widget.

6. System Evolution

To narrow the scope of initial development, the current requirements are based on two expectations. The first expectation is that only a few widgets are needed to support Climate Central's immediate use cases. The second expectation is that WAVED is not public facing, but rather a tool used on an internal network, so an open permissions model suffices. As the system evolves, changes to WAVED adds functionality beyond these assumptions.

6.1 New Widgets

Future modifications to the system include expanding the set of available widgets by implementing new plugins. New widgets may include:

- Vector maps of geographic areas other than the United States
- Widgets using third party mapping APIs such as Google Maps, Leaflet, Cesium, etc.
- Different types of graphs (e.g. bar graph, pie chart, etc.)

6.2 User Permissions

Some future modifications to WAVED require expanding the user permissions model. Rather than using an open permissions model, users will be required to register and log in to WAVED with individual user accounts. Restrictions will be placed on the projects users are allowed to load and modify. Only users who are the owner, or who are given explicit permission from the owner, will be able to load and make changes to a given project within the WAVED development environment. Expanding the user system will also allow WAVED to associate uploaded data files with individual users such that users uses the same data files across multiple projects without having to re-upload them. Finally, stricter user permissions means that WAVED can evolve to allow users to permanently delete projects they previously created and saved to the server.