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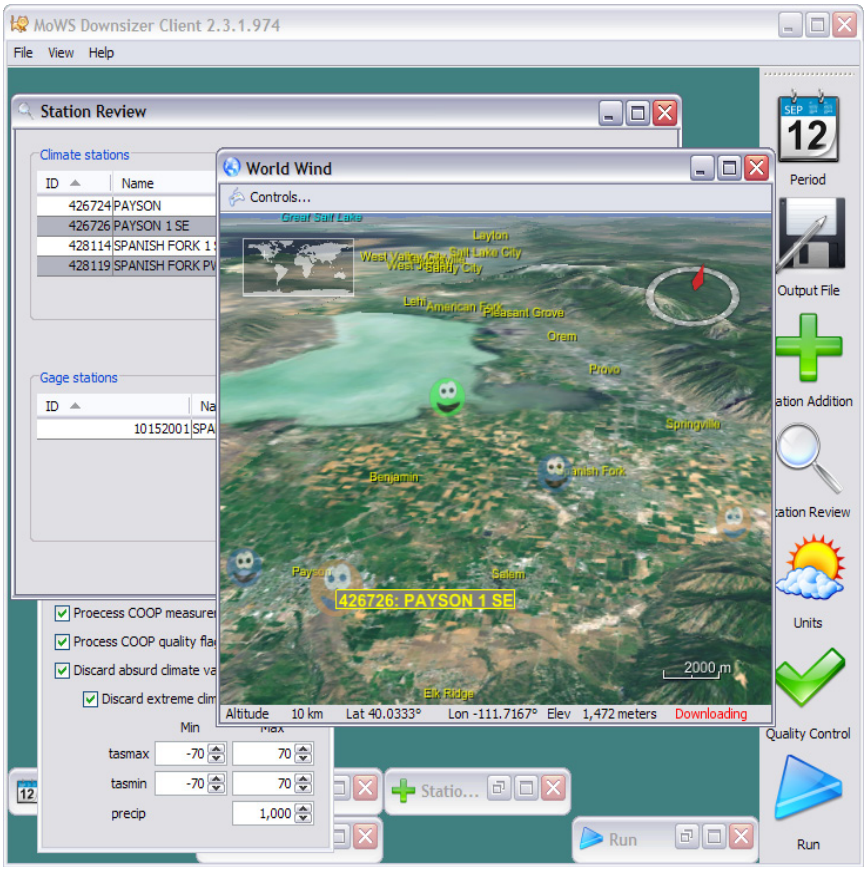
Downsizer—A Graphical User Interface-Based Application for Browsing, Acquiring, and Formatting Time-Series Data for Hydrologic Modeling

By Christian Ward-Garrison, Steven L. Markstrom, and Lauren E. Hay



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Downsizer—A Graphical User Interface-Based Application for Browsing, Acquiring, and Formatting Time-Series Data for Hydrologic Modeling

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Abstract

The U.S. Geological Survey *Downsizer* is a computer application that selects, downloads, verifies, and formats station-based time-series data for environmental-resource models, particularly the *Precipitation-Runoff Modeling System*. *Downsizer* implements the client-server software architecture. The client presents a map-based, graphical user interface that is intuitive to modelers; the server provides streamflow and climate time-series data from over 40,000 measurement stations across the United States. This report is the *Downsizer* user's manual and provides (1) an overview of the software design, (2) installation instructions, (3) a description of the graphical user interface, (4) a description of selected output files, and (5) troubleshooting information.

Introduction

Many environmental-simulation models are not capable of using the best and latest data sources, which are available on the internet in near real-time. This is a particular problem for the U.S. Geological Survey (USGS), with scientists developing and applying hydrologic-simulation models that are used to support decision making and further the understanding of the natural world. Techniques that reduce errors, misinterpretation, misuse, and duplication of effort in preparation of data for simulation models are a high priority for USGS (U.S. Geological Survey, 2007).

The USGS *Downsizer* is a computer application that selects, downloads, verifies, and formats station-based time-series data for environmental-resource models, particularly the *Precipitation-Runoff Modeling System* (PRMS) (Leavesley and others, 1983) and the *Coupled Ground-Water and Surface-Water Flow Model* (Markstrom and others, 2008). In addition, *Downsizer* produces time-series data, which are directly compatible with modeling support tools such as *Luca* (Hay and Umemoto, 2006), a tool used for model calibration, and the *Object User Interface* (Markstrom and Koczot, 2008), a generic map-based modeling interface.

Initial testing and prototyping done during the development of *Downsizer* indicate that this tool is very effective for building input data sets for environmental-simulation models. Specifically, time-series data sets can be built in a fraction of the time that is required to do this job manually. In addition, *Downsizer*-built data files are much more consistent, contain fewer data transcription errors, and are formatted specifically for the intended simulation model.

Software Design

Downsizer implements the client-server software architecture (fig. 1). Both the client and server are written in the Java programming language (*http://java.sun.com, accessed May, 2009*). The *Downsizer* client presents a map-based, graphical user interface that is intuitive to modelers. The client sends requests for data to the *Downsizer* server. The server provides access to daily streamflow data values from the U.S. Geological Survey National Water Information System (USGS NWIS, 1998), and daily minimum and maximum temperature and precipitation data values from the National Oceanic and Atmospheric Administration Cooperative Observer Program (NOAA COOP, *http://www.nws.noaa.gov/om/coop*, accessed May, 2009) and the U.S. Department of Agriculture, Natural Resources Conversation Service, National Water and Climate Center, Snow Survey and Water Supply Forecasting Program (NRCS SNOTEL, *http://www.wcc.nrcs.usda.gov/snow*, accessed May, 2009).

The client collects information from the user about the characteristics of the model input files that it will generate (fig. 1). This process is described in detail in the “Description of the Graphical User Interface” section of this report. The client then sends the server a Remote Method Invocation-based request for the data the user has specified. The server *Dispatcher* creates a *Worker* for the client that accepts this request and determines what data it needs to read from the *Data Acquisition Portal*. The *Data Acquisition Portal* retrieves data from the *External Data* sources using specific interfaces. The retrieval is guided by the *Worker*, which ensures that only the appropriate data sources are accessed and that only data within the user-specified time interval are read. The retrieved data are then passed on to the *Quality Controller* and the *Formatter*. The *Quality Controller* identifies “bad” values and fills missing values, if necessary. The *Formatter* prepares the data in precisely the format required by the model (for example, PRMS) and sends it on to the user.

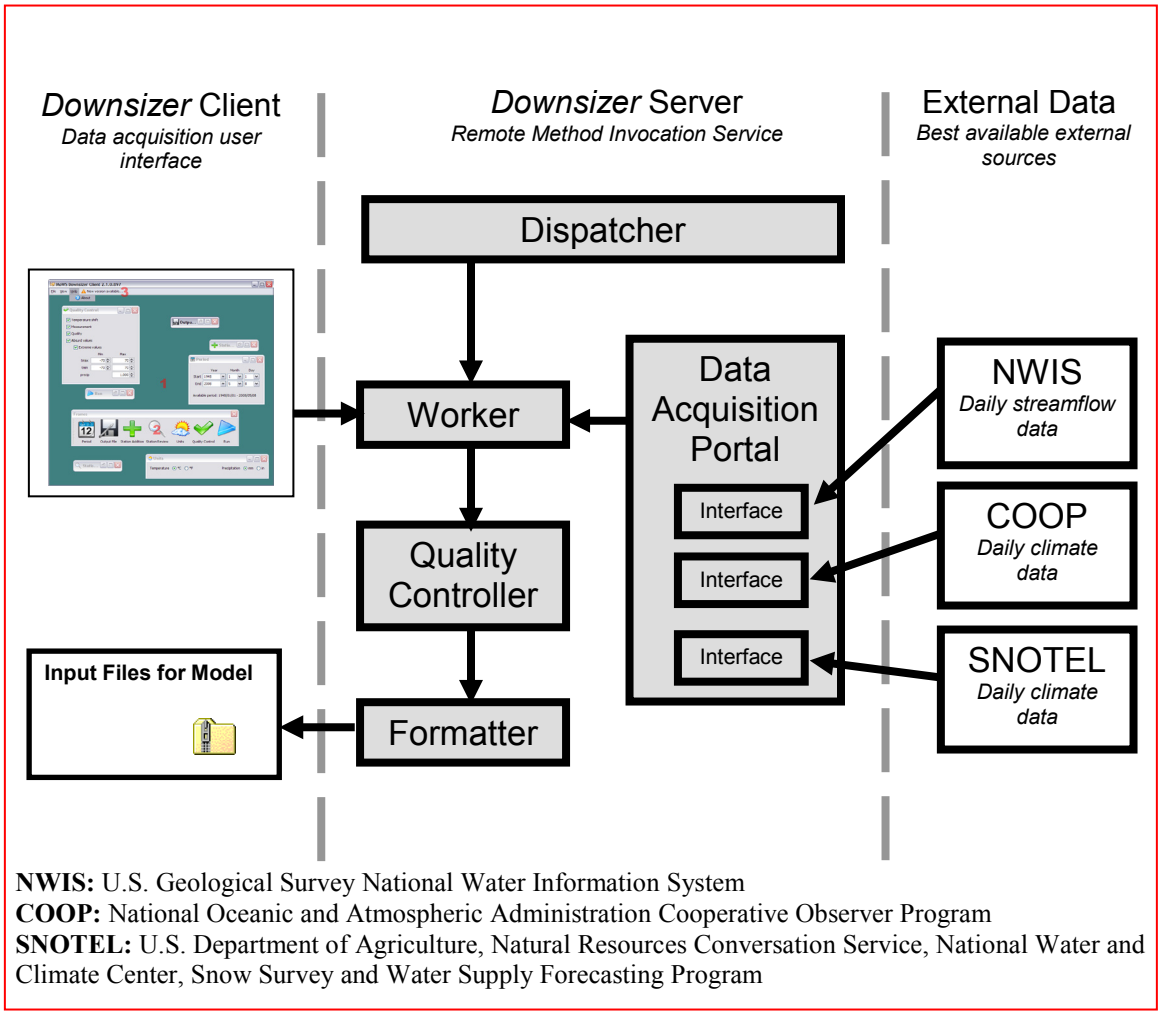

Figure 1. Conceptual diagram showing the relations between the *Downsizer* client, server, and external data sources.

Purpose and Scope

This report describes the *Downsizer* client version 2.3.0 and serves as the user's manual. The report first describes how to install the client, including hardware and software requirements. An overview of the various graphical frames is presented in the section "Description of Graphical User Interface". The unique output files produced by *Downsizer* are described in the section "Output Files". The final section, "Troubleshooting", shows users how to handle problems that may occur. Details of the *Downsizer* server software are not included as they are beyond the scope of this report.

Installation Instructions

The latest version of the *Downsizer* client is available from the USGS *Downsizer* web page (*http://water.usgs.gov/lookup/get?crresearch/downsizer*, accessed May, 2009) and is distributed as a zip file. About 10 megabytes of disk space are required for installation. This installation includes libraries, documentation, and startup scripts.

Hardware Requirements

Minimum hardware requirements include a 1.5 gigahertz Intel Pentium 4 processor (or equivalent), 512 megabytes random access memory, a 3D hardware accelerator, a display capable of 1024x768 resolution and 16-bit color depth, and 1 gigabyte of hard disk space. However, hardware requirements depend on the size of the data sets being retrieved.

Software Requirements

The *Downsizer* client is developed for 32- and 64-bit Windows, Linux, and Mac operating systems. Running the client on other operating systems can require platform-dependent modifications. Operating systems that the client has been tested on include Windows XP, Linux 2.6, and Mac OS X.

The client also requires that version 1.6 or later of the Java Runtime Environment be installed. Java is usually installed as a shared-system resource, which may require system administrator privileges. Check with your system administrator before attempting to install Java. Java is freely available from the Sun Microsystems web page (*http://java.sun.com/javase/downloads/index.jsp, accessed May, 2009*).

Downsizer Execution

Two startup scripts are included in the *Downsizer* distribution: *client.bat* and *client.sh*. Windows users can start *Downsizer* by either double-clicking the *client.bat* batch file in Explorer or by executing the command `client.bat` from a command prompt within the installation directory. Linux and Mac users can start *Downsizer* by executing the command `./client.sh` from a Unix shell within the installation directory. All users should avoid editing the *client.properties* file, as it contains important runtime arguments to the client.

Description of Graphical User Interface

The *Downsizer Client* frame is the parent container from which all *Downsizer* functionality is accessible (fig. 2). A frame is a graphical user interface (GUI) window with a title, a border, and three buttons at the upper-right that are used to minimize, restore, and close the frame. This frame contains (1) the desktop area, (2) the toolbar, and (3) the menu bar. These parts are described below.

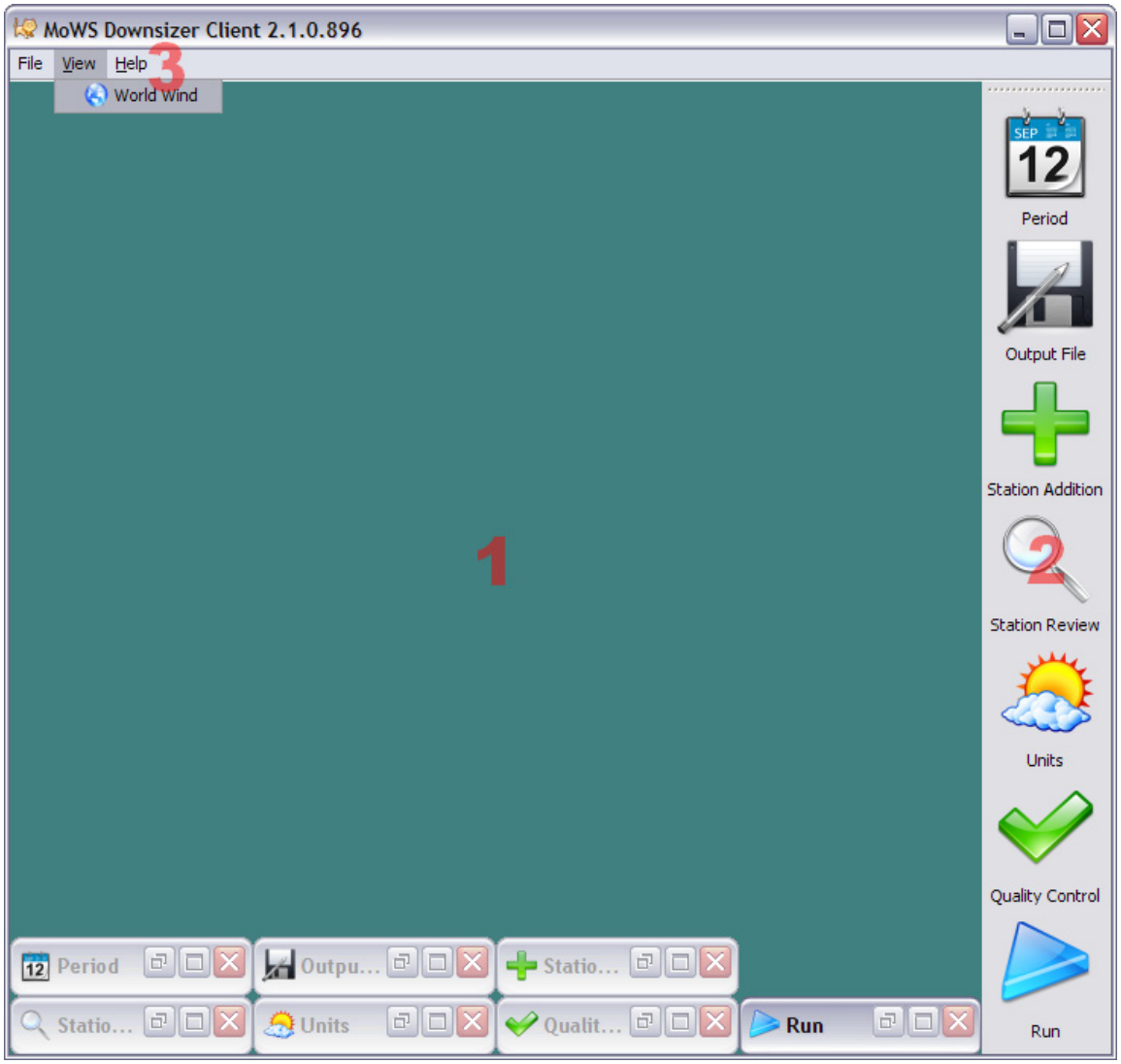

Figure 2. Screen image of the *Downsizer Client* frame upon startup showing (1) the desktop area, (2) the toolbar, and (3) the menu bar.

The desktop area is where the user can open the child frames and interact with GUI elements that control *Downsizer*. Upon startup, all child frames are minimized at the bottom of the desktop area (fig. 2). Any of these frames can be made visible by clicking on the *Restore* (left) or *Maximize* (middle) buttons on their icons. The frames can be closed by clicking on the *Close* (right) button. No information that was entered into a frame is lost when the frame is closed.

The toolbar provides an alternative way to work with the child frames (fig. 2). Each button on the toolbar corresponds to a frame and clicking one of the buttons will change the visual state of its associated frame. Clicking on a toolbar button associated with a closed or minimized frame will restore the frame and designate it to receive input from the user, making it the “selected” frame. If the frame is restored but not selected, clicking on the toolbar button will select it. Finally, if the frame is selected, clicking on the toolbar button will minimize it.

The menu bar has three top-level menus, each containing one menu item (fig. 2). The *File-Exit* option causes *Downsizer* to exit. This option is identical to clicking the red *X* button at the upper-right of the *Downsizer Client* frame. The *View-World Wind* option selects the *World Wind* frame (described in the “World Wind Frame” section), restoring or reopening it if necessary. Finally, the *Help-About* option displays a dialog that provides information about the *Downsizer* application and its developers.

The appearance of the *Downsizer Client* frame will change as the user begins to work with it. For example, figure 3 shows the *Downsizer* desktop area with (1) open child frames which can be moved and resized in any configuration, (2) the toolbar undocked and reoriented (horizontal instead of vertical), and (3) the menu bar containing a notice indicating that a new version of the client is available. Clicking on the notice will display a dialog giving information about how to upgrade to a new version. This notice will not appear if the user is running the latest version.

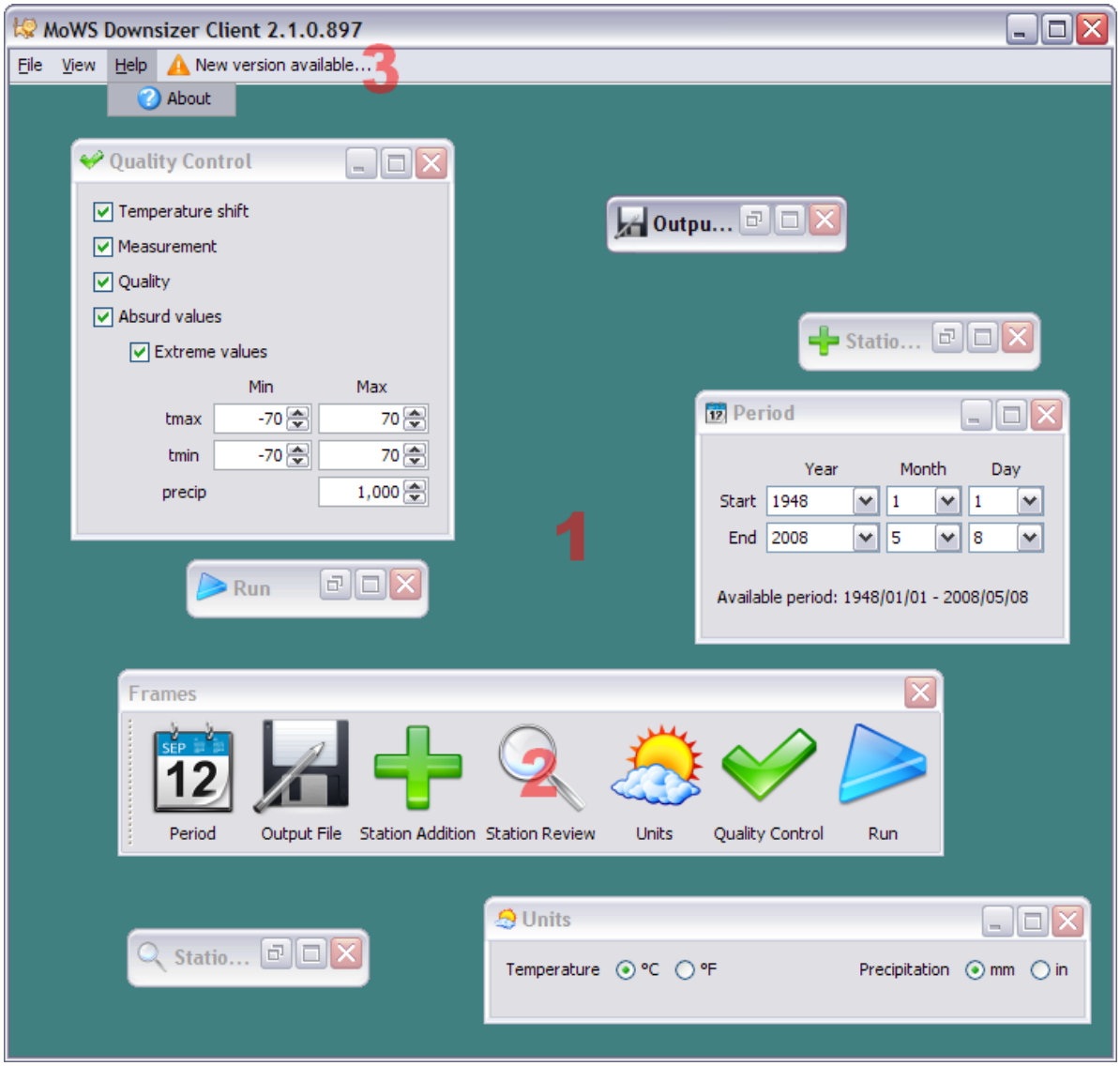

Figure 3. Screen image of the *Downsizer Client* frame after the user has (1) moved and restored child frames and (2) undocked and reoriented the toolbar. The menu bar (3) indicates that a new version of the client is available.

Period Frame

The *Period* frame allows the user to select the interval of time for the data to be retrieved (fig. 4). This time interval is known as the Period of Record (POR). The top row of combo boxes is used to select the start date (inclusive) of the desired POR. In figure 4, the start date for the example query is September 28, 1993. The bottom row of combo boxes is used to select the end date (inclusive) of the desired POR. The end date must be later than the start date. In figure 4, the

end date for the example query is April 10, 2000. The label at the bottom indicates the overall period for which data are available on the server. In figure 4, no data before 1948/01/01 or after 2008/05/08 are available. Any attempts to set the start or end dates outside of that period will fail.

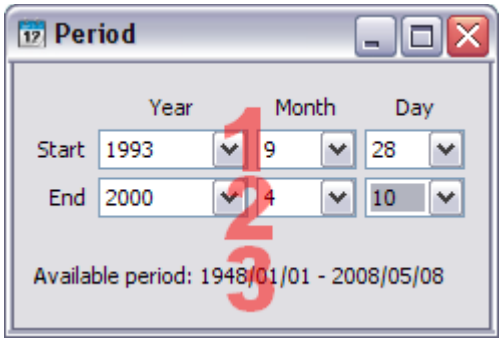

Figure 4. Screen image of the *Period* frame that allows the user to (1) select the Period of Record (POR) start date, (2) select the POR end date, and (3) view the overall period for which data are available.

Output File Frame

The *Output File* frame allows the user to select the (1) format, (2) path, and (3) description of the file in which the data will be written (fig. 5). The *File Format* combo box contains the three available output formats (1) PRMS-MMS (Leavesley and others, 1996), (2) NetCDF (*http://www.unidata.ucar.edu/software/netcdf/, accessed May, 2009*), and (3) XYZ, described in

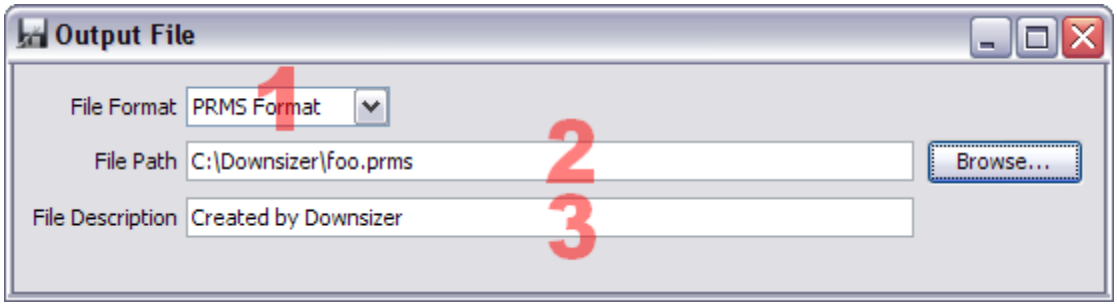

Figure 5. Screen image of the *Output File* frame which allows the user to select the (1) format, (2) path, and (3) description of the file in which the data will be written.

the “XYZ File Format” section. The *File Path* text field determines where the data file will be written. The path can be absolute, as shown in figure 5, or relative to the working directory, which is most likely the directory in which *Downsizer* resides. Clicking on the *Browse* button will pop up a dialog that allows the user to navigate the file system graphically and then select the desired file from a list. Finally, the *File Description* text field allows the user to specify a description that is written to the header of PRMS-MMS format output files. This field only applies to PRMS-MMS files and is disabled for all other formats.

Station Addition Frame

The *Station Addition* frame allows the user to build a set of climate and stream-gage stations from which to pull data by using one of three options: (1) specifying stations that lie within a geographical boundary, (2) reading a list of stations from a file, and (3) typing station identifiers (IDs) directly (fig. 6). When a station is added, detailed

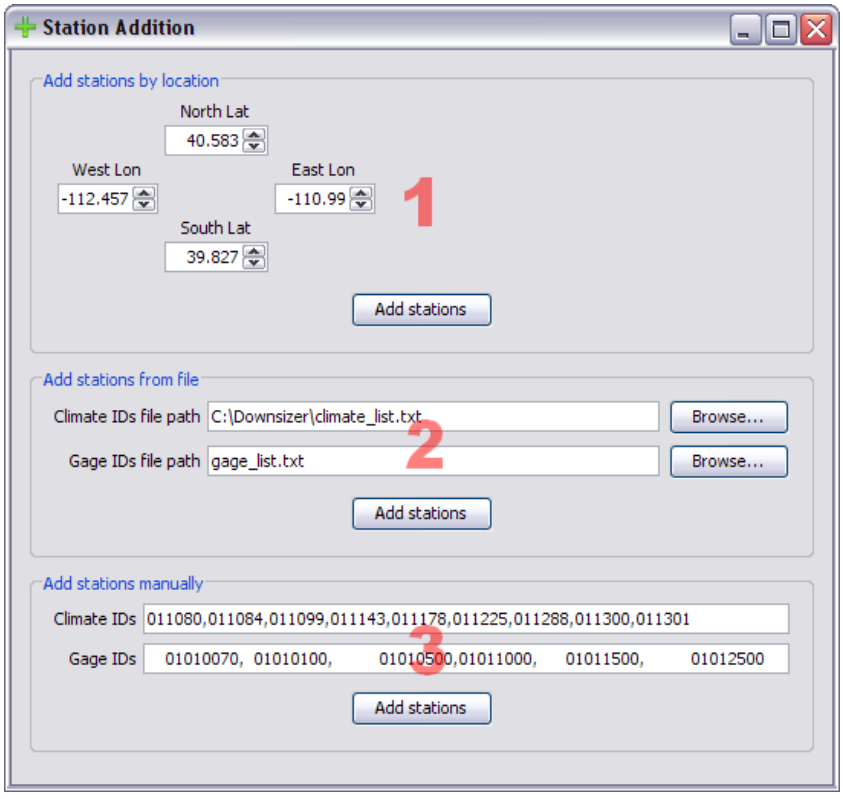

Figure 6. Screen image of the *Station Addition* frame which allows the user to build a set of climate and stream-gage stations from which to pull data by using one of three options: (1) specifying stations that lie within a geographical boundary, (2) reading a list of stations from a file, and (3) typing station identifiers (IDs) manually.

information about it can be viewed in the *Station Review* frame (described in the next section). The station's location also can be viewed graphically in the *World Wind* frame (described in the "World Wind Frame" section).

In the *Add stations by location* option (1), the spinners describe a latitude-longitude rectangle on the surface of the Earth (fig. 6). The coordinates specified in the spinners are as follows:

- The coordinate in the top spinner is the northernmost latitude of the selection rectangle.
- The bottom coordinate is the southernmost latitude of the selection rectangle.
- The left coordinate is the westernmost longitude of the selection rectangle.
- The right coordinate is the easternmost longitude of the selection rectangle.

Each spinner can be incremented or decremented by one degree by clicking on the arrow buttons. Latitude-longitude values can also be specified by typing new values into the corresponding text boxes and then hitting the *Enter* key. The *Add Stations* button adds any stations that lie within the rectangle specified by the coordinate spinners to the *Station Review* frame (described in the next section). The top coordinate must be greater than the bottom coordinate and the right coordinate must be greater than the left coordinate, or else an error dialog will be displayed.

In the *Add stations from file* option *(2),* the *Climate IDs file path* and *Gage IDs file path* text fields display the paths of files that contain climate and gage IDs (fig. 6). The paths can be absolute or relative to the working directory, which is most likely the directory in which *Downsizer* resides. Clicking either of the *Browse* buttons will pop up a dialog that allows the user to navigate the file system graphically and then select the desired file from a list. Each file must contain exactly one station ID per line. The *Add Stations* button adds any stations specified in the selected files to the *Station Review* frame (described in the next section).

In the *Add stations manually* option *(3),* the *Climate IDs* and *Gage IDs* text fields display comma-separated lists of climate and gage IDs (fig. 6). White space between IDs is permitted, as shown in the *Gage IDs* text field. The *Add Stations* button adds any stations specified in the text fields to the *Station Review* frame (described in the next section). Any item in either list that is not a valid station ID will be reported.

Station Review Frame

The *Station Review* frame shows the complete set of climate and stream-gage stations from which data will be retrieved (fig. 7). With this frame, the user can (1) select climate stations,

(2) remove selected climate stations, (3) remove all climate stations, (4) select stream-gage stations, (5) remove selected stream-gage stations, and (6) remove all stream-gage stations. In addition, the contents of the *Climate stations* and *Gage stations* tables are plotted as points on the map in the *World Wind* frame (described in the "World Wind Frame" section). The contents of the *Station Review* frame and *World Wind* frame are always synchronized.

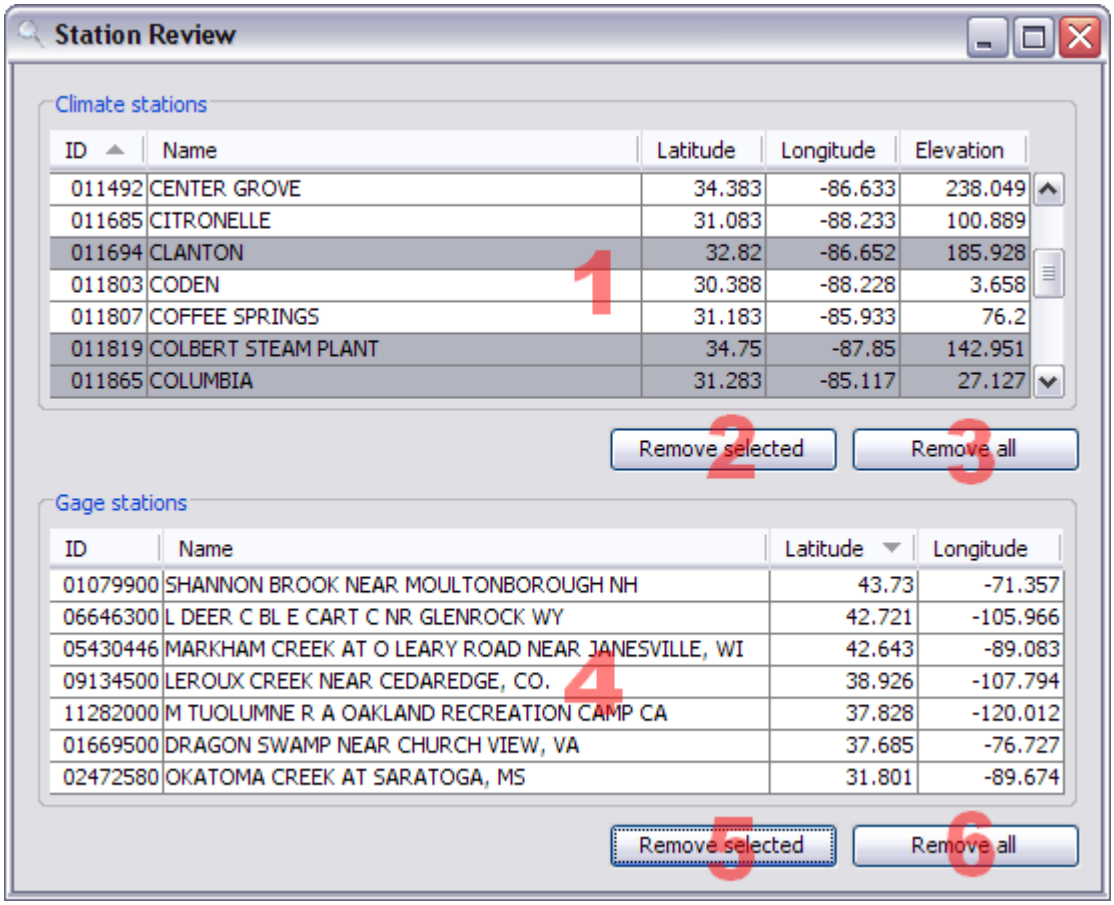

Figure 7. Screen image of the *Station Review* frame that allows the user to (1) select climate stations, (2) remove selected climate stations, (3) remove all climate stations, (4) select stream-gage stations, (5) remove selected stream-gage stations, and (6) remove all stream-gage stations.

The *Climate stations* table lists IDs and other information of climate stations from which the *Downsizer* client will retrieve data (fig. 7). This table can be customized in several ways:

- Click a column header to sort the stations by the values in the column; one click will sort in ascending order and two clicks will sort in descending order.
- Click and drag on the bar between two columns to adjust the widths of the columns.
- Click and drag the header of a column to change the location of the column in the table.

Double-clicking on a row in the *Climate stations* table will center the view of the map in the *World Wind* frame (described in the "World Wind Frame" section) on the corresponding station. A single station can be selected in the *Climate stations* table by clicking on its corresponding row. Multiple stations can be selected by holding down the *Ctrl*- or *Shift*-key while clicking. The *Remove selected* button directly below the *Climate stations* table will remove any selected stations from the table. Likewise, the *Remove all* button directly below the *Climate stations* table will remove all stations from the table.

The *Gage stations* table lists IDs and other information of stream-gage stations from which the *Downsizer* client will retrieve data (fig. 7). Options for editing this table using its associated buttons are the same as the options for the *Climate stations* table.

Units Frame

The *Units* frame specifies the temperature and precipitation units of the data in the output file (fig. 8). With this frame, the user can select (1) a temperature unit of either degrees Celsius or degrees Fahrenheit, and (2) a precipitation depth unit of either millimeters or inches.

Figure 8. Screen image of the *Units* frame that allows the user to specify (1) the temperature unit and (2) the precipitation unit of the retrieved data.

Quality Control Frame

The *Quality Control* frame allows the user to specify quality control checks and adjustments that *Downsizer* will perform on retrieved climate data (fig. 9). These operations include (1) shifting daily temperatures, (2) processing measurement flags, (3) processing quality flags, (4) discarding absurd values, and (5) discarding extreme values. Extreme value ranges can be specified for (6) maximum daily temperature, (7) minimum daily temperature, and (8) daily precipitation. The *Shift SNOTEL temperatures* check box instructs *Downsizer* to shift measured NRCS SNOTEL maximum and minimum daily temperature data back one day. The *Process COOP measurement flags* check box instructs *Downsizer* to apply the rules in table 1 to values measured at NOAA COOP stations. The *Process COOP quality flags* check box instructs *Downsizer* to apply the rules

in table 2 to values measured at NOAA COOP stations. The *Discard absurd climate values* check box instructs *Downsizer* to apply the rules in table 3 to determine if values measured at NRCS SNOTEL or NOAA COOP stations are unrealistic. The *Discard extreme climate values* check box instructs *Downsizer* to discard climate values that fall outside the ranges set forth in the 5 text boxes at the bottom of *Quality Control* frame. After the quality control process has run, *Downsizer* produces a quality assurance report that describes the quality of retrieved data. This report is described in the "Quality Assurance Report" section.

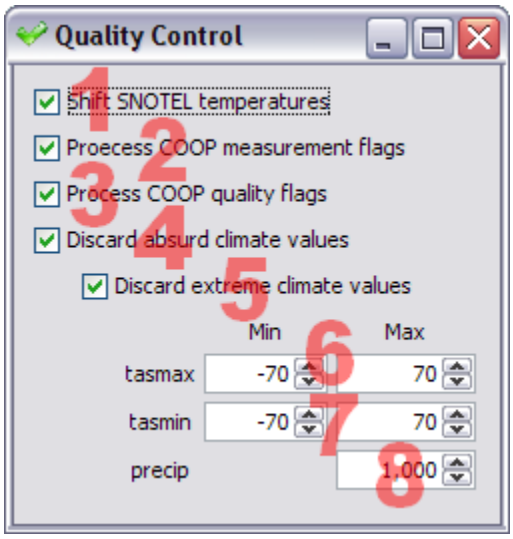

Figure 9. Screen image of the *Quality Control* frame that allows the user to check and adjust retrieved data by (1) shifting daily temperatures, (2) processing measurement flags, (3) processing quality flags, (4) discarding absurd values, and (5) discarding extreme values. Extreme value ranges can be specified for (6) maximum daily temperature, (7) minimum daily temperature, and (8) daily precipitation

Table 1. Measurement flags used by *Downsizer* for data collected by the National Oceanic and Atmospheric Administration Cooperative Observer Program.

Measurement flag	Definition	Downsizer action
A	Accumulated amount since last measurement.	Disaggregate based on nearest stations
B	Accumulated amount includes estimated values (since last measurement).	Disaggregate based on nearest stations
E	Estimated (see Table "2" for estimating method).	
J	Value has been manually validated.	
M	For fixed length records only. Flag1 is "M" if the data value is missing. In this case, the sign of the meteorological value is assigned "-" and the value of the meteorological element is assigned "99999".	
S	Included in a subsequent value. (data value = "00000" OR "99999").	Use with “A” and “B”
T	Trace (data value = 00000 for a trace).	Set = 0.0001
(	Expert system edited value, not validated.	
)	Expert system approved edited value.	

Table 2. Quality flags used by *Downsizer* for data collected by the National Oceanic and Atmospheric Administration Cooperative Observer Program.
[TMAX: Daily maximum temperature; TMIN: Daily minimum temperature; TOBS: Temperature at observation time]

Quality flag	Definition	Downsizer action
0	Valid data element	
1	Valid data element from unknown source	
2	Invalid data element (subsequent value replaces original value)	
3	Invalid data element (no replacement value follows)	
4	Validity unknown (not checked)	Set to missing
5	Original non-numeric data value has been replaced by its deciphered numeric value	
A	Substituted TOBS for TMAX or TMIN	Set to missing
B	Time shifted value	Set to missing
C	Precipitation estimated from snowfall	Set to missing
D	Transposed digits	Set to missing
E	Changed units	Set to missing
F	Adjusted TMAX or TMIN by a multiple of ±10 degrees	Set to missing
G	Changed algebraic sign	Set to missing
H	Moved decimal point	Set to missing
I	Rescaling other than F, G, or H	Set to missing
J	Subjectively derived value	
K	Extracted from an accumulated value	
L	Switched TMAX and (or) TMIN	
M	Switched TOBS with TMAX or TMIN	Set to missing
N	Substitution of “3 nearest station mean”	
O	Switched snow and precipitation data value	Set to missing
P	Added snowfall to snow depth	Set to missing
Q	Switched snowfall and snow depth	Set to missing
R	Precipitation not reported; estimated as “0”	Set to missing
S	Manually edited value	
T	Failed internal consistency check	Set to missing
U	Failed areal consistency check	Set to missing

Table 3. Rules and actions used by *Downsizer* for absurd climate values.
[TMAX: Daily maximum temperature; TMIN: Daily minimum temperature; n: Current time step]

Absurd value	Action
Precipitation is negative	Set to missing
TMAX(n) < TMIN(n)	Set both to missing
TMAX(n) < TMIN(n-1)	Set both to missing
TMIN(n) > TMAX(n-1)	Set both to missing
TMAX(n) < TMIN(n+1)	Set both to missing
Temperature records have same value for more than 4 consecutive days	Set all to missing
TMAX is missing	Set TMIN to missing
TMIN is missing	Set TMAX to missing

Run Frame

The *Run* frame initiates data retrieval and shows the progress of this process (fig. 10). With this frame, the user can (1) view the status of the data retrieval, (2) view the overall progress, (3) run the retrieval, and (4) cancel the retrieval.

The text area in the *Run* frame shows messages describing the status of the data retrieval (fig. 10). The messages displayed are a subset of the messages that will appear in the log file. The progress bar below the text area shows a graphical representation of the retrieval progress. The percentage shown by the progress bar is only an estimate and it may, for example, take much longer for the first half of the bar to fill up than the second half.

Clicking the *Run* button in the *Run* frame initiates a process that collects all the information specified in the *Period, Output, Station Addition, Station Review, Units,* and *Quality Control* frames (fig. 10). This information is transmitted to the *Downsizer* server, which ultimately executes the data retrieval. Finally, the results—an output file, a quality assurance report (described in the "Quality Assurance Report" section), and a log file (*downsizer.log)*—are transmitted from the server back to the client.

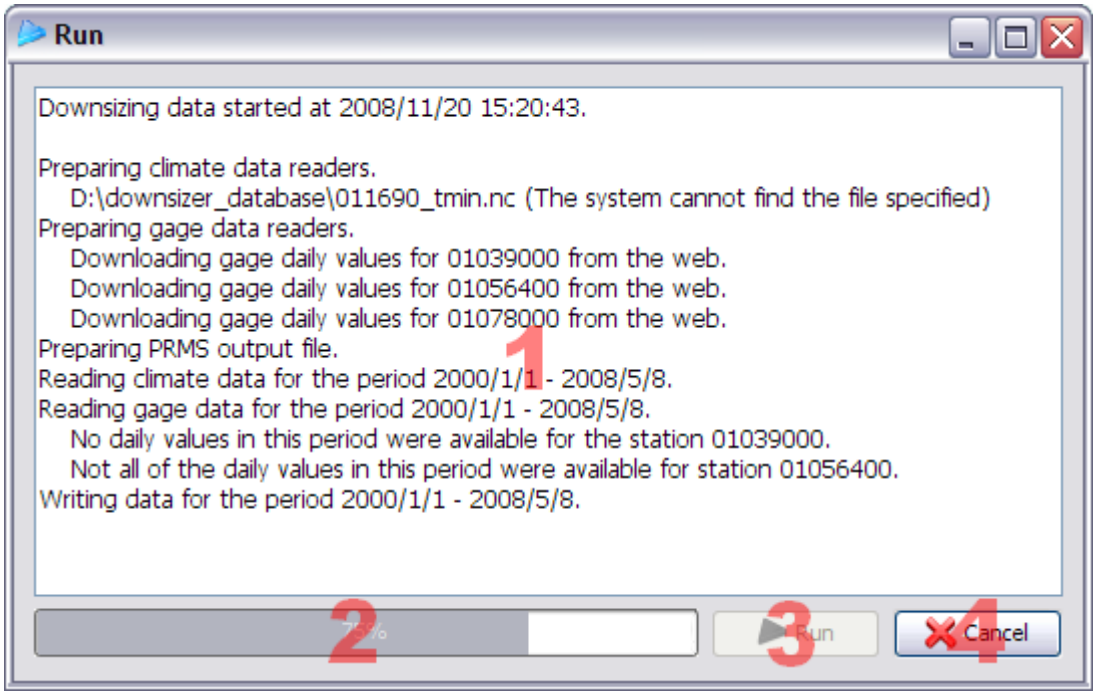

Figure 10. Screen image of the *Run* frame that allows the user to (1) view the status of the data retrieval, (2) view the overall progress, (3) run the retrieval, and (4) cancel the retrieval.

There are two conditions that must be met before the retrieval process can be initiated. If either is not met, an error dialog will be displayed and the corresponding frame will pop up. These conditions are:

- The tables in *Station Review* frame must contain at least one climate or one stream-gage station.
- A valid file must be specified in the *Output File* frame.

Also, if the total number of climate and stream-gage stations is more than 100, a popup dialog will warn about the massive size of the output file and the lengthy processing time that will be required. This dialog is only a warning, and the user may still proceed with the large job.

Clicking the *Cancel* button in the *Run* frame cancels any *Downsizer* client or server operation that is currently in progress (fig. 10). There may be a small delay between when the user clicks the button and when the job is actually cancelled, depending on the status of the server.

World Wind Frame

The *World Wind* (*http://worldwind.arc.nasa.gov/java/index.html, accessed May, 2009*) frame gives the user a geographic view of the locations of climate and stream-gage stations listed

in the tables of the *Station Review* frame (figs. 7, 11). The *World Wind* frame allows the user to (1) view an animated globe for visualization of information on the surface of the Earth, (2) reference the view by world map, (3) reference the view by compass, (4) reference the view by map scale, and (5) reference the view by geographic coordinates. The frame shows a view of the globe that is taken from the perspective of a camera hovering high above the Earth. The camera can be panned, zoomed, rotated, and tilted in any direction relative to the planet. Left-clicking a point on the globe will cause the camera to reposition directly overhead of that point.

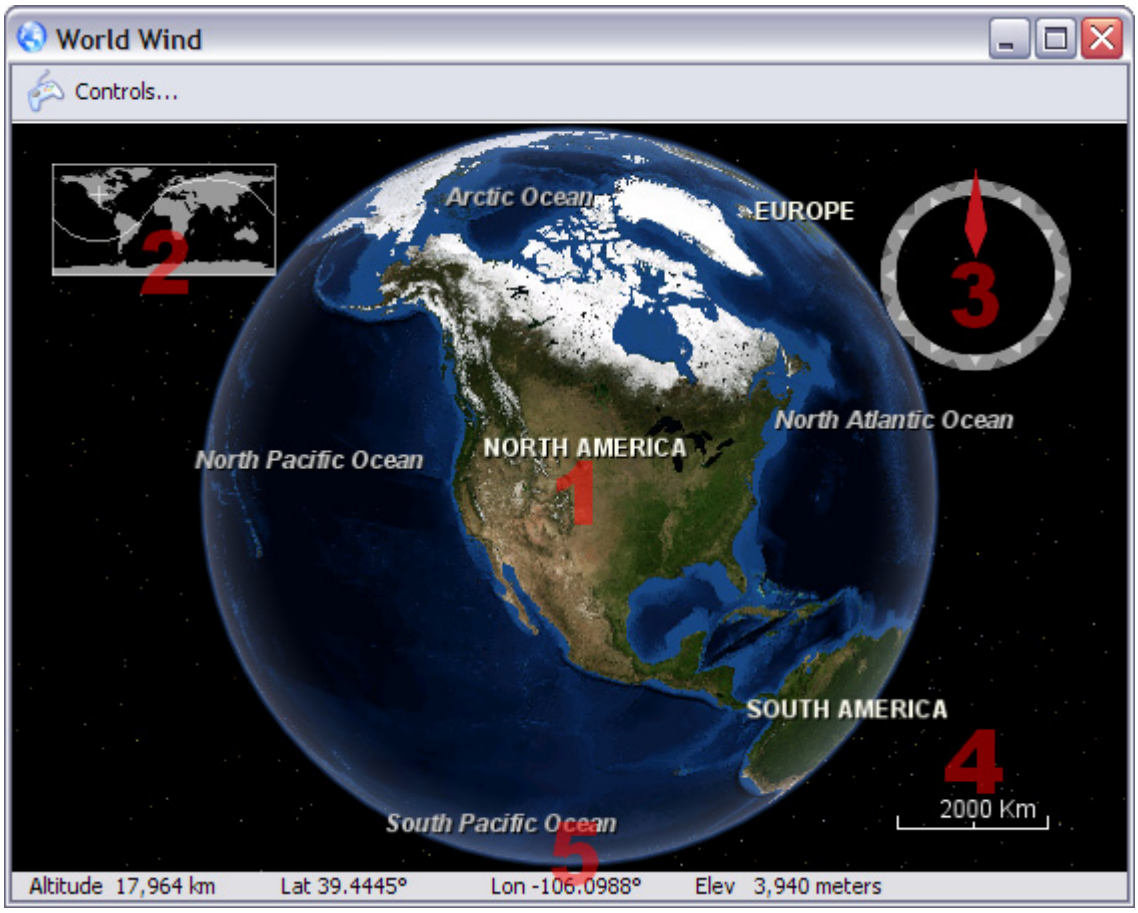

Figure 11. Screen image of the *World Wind* frame which allows the user to (1) view an animated globe for visualization of information on the surface of the Earth, (2) reference the view by world map, (3) reference the view by compass, (4) reference the view by map scale, and (5) reference the view by geographic coordinates.

The cross hairs on the world map indicate the location of the floating camera on the globe—in this case Colorado, USA (fig. 11). The cross hairs also lie within a subsection of the world map bounded by a wavy line at the bottom and the map's edges at the left, top, and right.

This subsection corresponds to the region of the globe currently viewable by the camera, which includes all of North America plus small parts of South America, Europe, and Russia. The viewable subsection will change size and shape as the camera is moved.

The compass indicates the direction north, with the red arrow, regardless of the position and direction of the camera (fig. 11). The compass also tracks camera tilt. When the camera is perpendicular to the globe surface, the compass will appear circular. As the camera is tilted, the compass will begin to look oval. The greater the angle between the camera's line of sight and the surface normal of the globe, the broader the oval becomes.

The scale bar can be used to measure distances on the globe (fig. 11). As the camera's distance from the globe is increased or decreased, the scale bar adjusts accordingly.

The status bar displays five pieces of information (fig. 11). From left to right, they are:

- *Altitude*: The distance above the globe surface where the camera is located.
- *Lat*: The latitude of the location on the globe indicated by the mouse arrow. The mouse arrow is not visible in figure 11, but it is positioned near Colorado, USA.
- *Lon*: The longitude of the location on the globe indicated by the mouse arrow.
- Elev: The elevation of the location on the globe indicated by the mouse arrow.
- *Heartbeat* (not visible): This area displays messages concerning the status of the globe view in the *World Wind* frame. There is not always a message to display, as in figure 11.

An example of repositioning the camera is shown in figure 12. In this case, the camera overlooks a mountain in the Colorado Rockies. The camera is at almost the same latitude and longitude as in figure 11, but it is at an altitude of 4 km instead of about 18,000 km. In this example, the compass indicates that the camera is facing east and has been tilted significantly from the surface normal of the globe. The length of the scale bar has also been updated from 2000 km to 100 m. Additionally, figure 12 shows the *Heartbeat* area on the status bar displaying the message "Downloading". This indicates that the *World Wind* frame is retrieving satellite imagery from internet map servers at the National Aeronautics and Space Administration. If the internet map servers are unavailable, the *Heartbeat* area will display the message "No Network".

Figure 12. Screen image showing the *World Wind* globe with the camera repositioned to an altitude of 4 km.

The *Downsizer* client uses the globe in the *World Wind* frame to show the positions of climate and stream-gage locations (fig. 13). In this example, the camera is looking straight down at Utah Lake, USA from 100 km above the Earth. The smiley-face icons (hereafter referred to as "spots") represent climate or stream-gage stations, either selected or unselected. Specifically:

- A *blue spot* indicates an unselected climate station.
- An *orange spot* indicates a selected climate station.
- A *green spot* indicates an unselected stream-gage station.
- A *magenta spot* indicates a selected stream-gage station.

The name of a station (shown in yellow text in fig. 13) is displayed in a tooltip when the mouse pointer (not visible in fig. 13) is positioned over its corresponding spot. The spot will visually enlarge on the globe view.

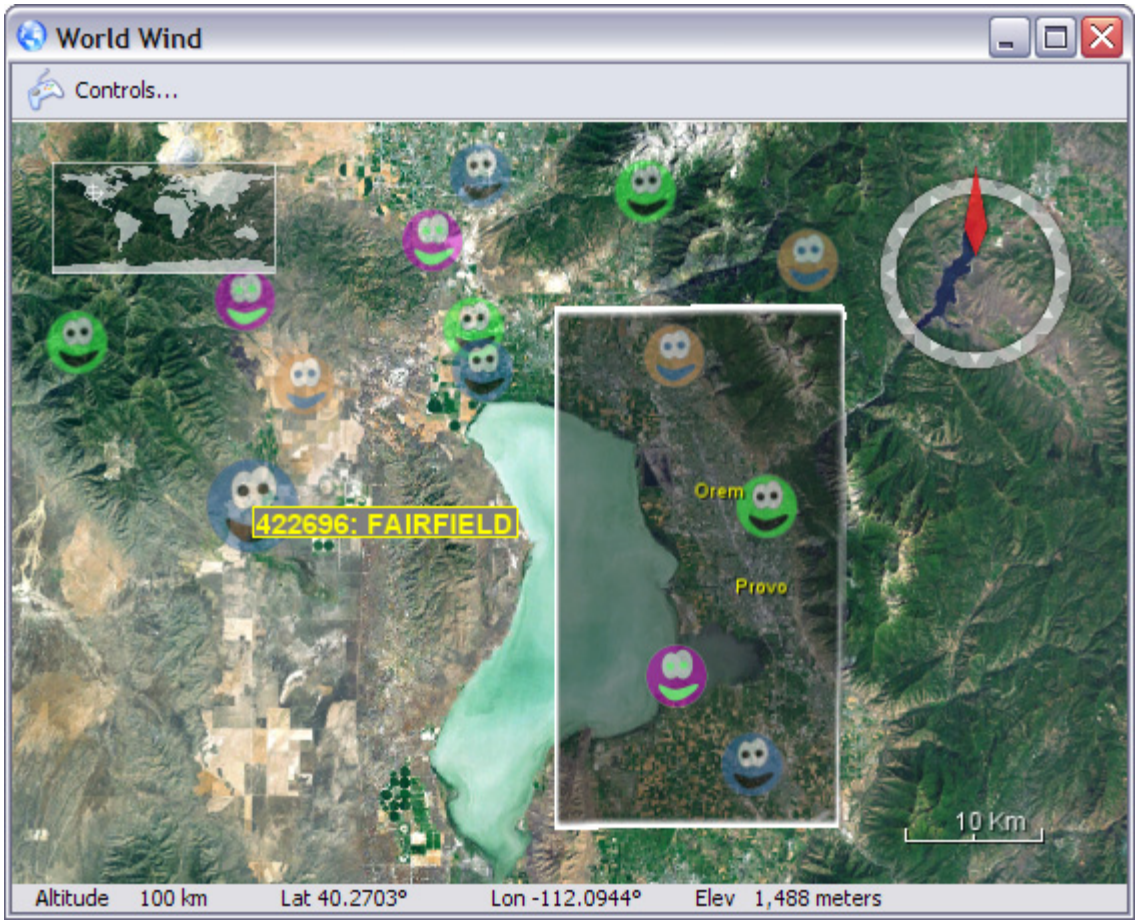

Figure 13. Screen image showing the *World Wind* globe with the positions of climate and stream-gage locations represented as smiley-face icons.

Figure 13 also shows a selection rectangle. This is the graphical representation of the geographic boundary that the four spinners in *Station Addition* frame denote. Changes made to the selection rectangle in *World Wind* frame are reflected in *Station Addition* frame, and vice versa. Clicking the *Controls* button displays a popup window containing the mouse and keystroke input controls for the *World Wind* frame (table 4).

Table 4. Description of the mouse and keystroke input controls for the *World Wind* frame.

Action	Mouse and (or) keystroke
Globe controls	
Pan	Left click + drag (all directions)
Zoom	Scroll the mouse wheel or hold it down and drag the mouse
Tilt	Right click + drag (forward and backward)
Rotate	Right click + drag (left and right)
Stop all camera movement	Spacebar
Reset heading	N
Reset heading and tilt	R
World map controls	
Fly to location	Left click the location
Selection rectangle controls	
Delete selection rectangle	Right click
Toggle selection of enclosed spots	Left click
Spot controls	
Display tool tip	Hover arrow over spot
Toggle selection	Left click
Station review controls	
Fly to station	Double-click on a row in Station Review frame tables

Output Files

Downsizer produces two unique output files that have not been previously documented. These are the XYZ file and the quality assurance report. The formats of these files are described below.

XYZ File Format

The XYZ file format is a plain-text format for station-based time-series model data (fig. 14). Fields must be separated by at least one space. Additional spaces between fields are permitted, as shown in figure 14, where extra white space has been used to make the file more readable.

```
// Created by Downsizer                                        C1: First comment line
// on 2009/05/29 13:23:08                                      C2: Second comment line
Number of stations: 2                                          M1: Number of stations
Variable: tasmin                                               M2: Variable of file's data
Unit: Fahrenheit                                               M3: Unit of file's data
ID:                  503163                  51k14s            M4: Station IDs
Network:             COOP                    SNOTEL            M5: Station networks
Name:                "FT RICHARDSON W.T.P." "MCNEIL CANYON"    M6: Station names
Latitude(degree_N):  61.2275                 59.75             M7: Station latitudes
Longitude(degree_E): -149.6503               -151.2667         M8: Station longitudes
Elevation(meter):    149.352                 402.336           M9: Station elevations
2000 1 1             -6                      -4                D1: First data line
2000 1 2             -6                      12.2
2000 1 3             -8                      8.6
2000 1 4             -999                    -5.8
2000 1 5             4                       14
2000 1 6             -2                      17.6
2000 1 7             8                       -0.4
2000 1 8             8                       -2.2
2000 1 9             5                       -7.6
2000 1 10            5                       -4
2000 1 11            -8                      -7.6
2000 1 12            -9                      -11.2
   Date              Station 1               Station 2         D1 to EOF: Data lines
YYYY MM DD           Daily Data              Daily Data
```

Figure 14. The XYZ file format.

An XYZ file begins with zero or more comment lines, which may contain useful information for human readers, but are ignored by computer programs. Each comment line starts with the delimiter string "//". Comment lines may only appear at the top of a file.

Following the comments, there are 9 metadata lines (M1-M9) that describe the stations within an XYZ file:

- Line 1 specifies the number of stations for which the file contains data.

- Line 2 specifies the climate or weather variable of the file's data. For XYZ files generated by *Downsizer*, the variable will be "tasmin" (minimum temperature), "tasmax" (maximum temperature), "precip" (precipitation rate), or "discharge" (streamflow rate).
- Line 3 specifies the unit in which the data are represented as a UDUNITS unit string (*http://www.unidata.ucar.edu/software/udunits/udunits-2/udunits2lib.html#Syntax, accessed May, 2009*). Tasmin and tasmax units will be in either degrees Celsius ("Celsius") or degrees Fahrenheit ("Fahrenheit"). Precip units will be in either millimeters per day ("mm per day") or inches per day ("in per day"). The discharge unit will be cubic feet per second ("ft3 per sec").
- Line 4 specifies the IDs of the stations.
- Line 5 specifies the networks that the stations belong to. For *Downsizer*, the possible networks are "COOP", "SNOTEL", and "NWIS".
- Line 6 specifies the names of the stations. Each name is surrounded by double quotation marks, which permit names with embedded spaces (for example, "GREERS FERRY DAM").
- Line 7 specifies the latitudes of the stations in the UDUNITS unit given in parentheses. For *Downsizer*, the unit will be decimal degrees north of the equator ("degree_N").
- Line 8 specifies the longitudes of the stations in the UDUNITS unit given in parentheses. For *Downsizer*, the unit will be decimal degrees east of the prime meridian ("degree_E").
- Line 9 specifies the elevations of the stations in the UDUNITS unit given in parentheses. For stations that have elevation data (typically COOP and SNOTEL), *Downsizer* will use meters as the unit ("meter"). For stations that don't have elevation data (typically NWIS), the specification will be "1" (unitless) and the values in each column will be "-999" (missing).

Beginning after the 9th metadata line and continuing to the end of file are the data lines. The first 3 columns of each data line are the year, month, and day of that line's records. Following the 3 date columns are each station's scalar value for that date. A value of "-999" indicates that the station does not have a record for that date.

Quality Assurance Report

The quality assurance report is a plain-text file that describes the quality of retrieved data (fig. 15). The file is composed of one or more tables of station metadata. The first four to six columns of each table describe the stations themselves, including ID, name, data type (if

applicable), latitude, longitude, and elevation (if applicable). The next two columns give the number of missing values out of the total number of values requested. Subsequent columns give the number of values that are associated with various quality control flags. Definitions of the flags are given beneath the tables.

```
//////////////////////////////////////////
  SUMMARY FOR GAGE DAILY VALUES
//////////////////////////////////////////

ID        Name              Latitude  Longitude  [Missing / Total]  Ice  e     P    A
15239070  BRADLEY HOMER     59.801    -150.885    13111   / 22554   0    1937  312  9285
15254000  CRESCENT LANDING  60.496    -149.679    16267   / 22554   0    0     0    6287
15238795  SELDOVIA NR       59.387    -151.677    22006   / 22554   0    0     0    548
15266500  BEAVER KENAI      60.563    -151.12     18536   / 22554   0    0     0    4018
15237020  MAIN BAY PORT     60.518    -148.094    21093   / 22554   0    0     0    1461

----- Gage Data Flag Description -----
Ice     Ice affected
e       Value has been estimated.
P       Provisional data subject to revision.
A       Approved for publication -- Processing and review completed.
```

Figure 15. The quality assurance report.

At least one and up to three tables of station metadata will appear in the report, depending on the types of stations added to *Station Addition* frame and the type of file selected in *Output File* frame.

- The table "SUMMARY FOR CLIMATE DATA" will appear if at least one climate station was added.
- The table "SUMMARY FOR GAGE DAILY VALUES" will appear if at least one stream-gage station was added.
- The table "SUMMARY FOR GAGE MEASUREMENTS" will appear if at least one stream-gage station was added **and** the XYZ file format was selected.

Troubleshooting

Several common problems have been encountered during testing and prototyping of *Downsizer*. These problems, along with their remedies, are described below.

The GUI does not start and an error is written to the console instead: This most likely means that Java version 1.6 or later is not installed. To find out, open a command prompt and execute the command: `java -version`. The first line of the response should be in the format:

`java version "1.X.0_YY"`. If X is less than 6, then an old version of Java is installed and must be upgraded. If the command is not recognized, Java is not installed on the system at all. In either case, see the section "Software Requirements" for instructions on how to install Java.

If neither of the two cases above applies, you may have encountered a bug in *Downsizer*. Please email all error information written to the console to mowshelp@usgs.gov.

The GUI starts but immediately shows an error dialog with the text "A communication error occurred while trying to connect to the server": First, confirm that the computer is connected to the internet. If it is, the problem is likely that the *Downsizer* server isn't running. If this is the case, please send an email to mowshelp@usgs.gov indicating that the server needs to be started.

The GUI starts but immediately shows an error dialog with the text "The client you are using is incompatible with the server running on lobo.cr.usgs.gov": Upgrade to the latest version of the *Downsizer* client (*http://water.usgs.gov/lookup/get?crresearch/downsizer*, accessed May, 2009).

Most (or all) of the values in the model input file that the server returned are "-999": A value of "-999" indicates a missing value. The value may be marked as missing because it fell outside of the quality control boundaries. Open up *Quality Control* frame and ensure that the data constraints aren't too tight.

Another reason that a data value may appear as "-999" is that it doesn't exist. Not all of the stations have data for the entire *Available period* displayed in *Period* frame, so missing values may be common. Therefore, adjust the period selected in *Period* frame to find out if the station has data for other dates. Some stations have no data for the entire *Available period*. These stations should be avoided.

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