Gridding & Mapping of Field Measured Brine Data Animation Java Applet

by John R. Victorine

Introduction

The Gridding and Mapping of Field Measured Brine Data Animation Web Application is an interactive process that assists the user in building simple color contour maps of Brine Data Well data and presenting the data as an animation at each Sampled Data Time slice. The "contour" map uses a "colorlith" presentation, i.e. mapping 3 brine data curves to 3 primary colors, Red, Green and Blue and mixing the colors to create a final color based on the magnitude of the selected brine data curves. The Gridding & Mapping module first appeared in PfEFFER Pro an Excel Spread Sheet Program developed by the Kansas Geological Survey, released 1998. It also appeared in GEMINI (**G**eo-**E**ngineering **M**odeling through **IN**ternet **I**nformatics) web application developed by Kansas Geological Survey 2000 – 2003 as part of Volumetrics Module. A stand-alone Gridding & Mapping Web App was one of the first web apps developed as part of the Gemini Tools in November of 2003. The 2003 version was designed for a user to enter any type of data for the group of wells, core data, tops thickness, etc. The data was saved as XML Extensible Markup Language Project Files. The program automatically accessed the saved data between dialogs. This new version focuses on the CO_2 Wells with Brine Data. The data is stored on the CO_2 ORACLE Database Tables at the Kansas Geological Survey (KGS). A series of ORACLE PL/SQL Stored Procedures were created to access this data. This version is very dependent on the KGS database.
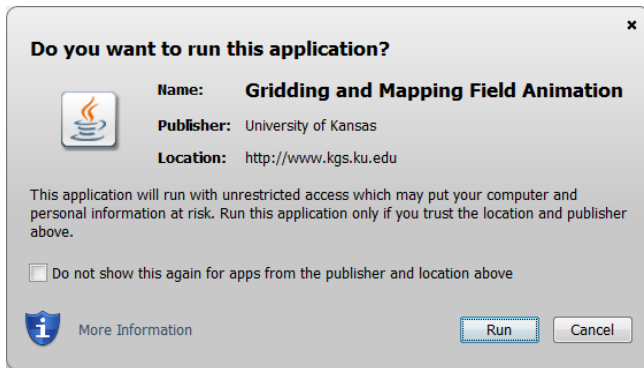
Peter L. Briggs[1] identified a method to assist geologist in well log interpretation by creating a color log presentation. His method provided a means to combine three different log curves from one well into one image track that varies along the depth by assigning each curve to a specific primary color of red, green and blue. His method assumed that the primary colors would appear to the human eye as orthogonal and miscible where the resulting color image would preserve all the information of the original log curves. The color image presentation of well log data reduced the number of displays competing for the interpreter's attentions by uniting the three log curves into one display and relieved the burden of mentally combining data from several separate displays. Overall the color log images presented log data to the user in a form that differs from the conventional log presentation and relied on the human perceptions and pattern recognition skills. The term Colorlith was first introduced by David Collins[2] in a USGS paper discusses the visualization of subsurface geology as achieved by COLORLITH, a software system… Many of the GEMINI Tools use a "Colorlith" plot track to illustrate the lithology at a glance. This

(1) Color display of well logs, Peter L. Briggs, Mathematical Geology, Volume 17, Number 4, May 1985.
(2) Color Images of Kansas Subsurface Geology from Well Logs, D. R. Collins and J. H. Doveton, Computer & Geosciences, Vol. 12, No. 4B, pp.519-526 1986

program extends this concept to the Gridding & Mapping web app with the brine data curves since there are a number of data types that are created for each water sample for each well. The idea of using the brine data magnitudes to create the color "contour" map would reflect the general chemistry of the brine data. The influence of the CO_2 injected into the Mississippian might alter the brine chemistry which could be mapped over time by the color changes on the Gridding and Mapping Web App.

To access Gridding and Mapping of Field Measured Brine Data Animation web site go to http://www.kgs.ku.edu/PRS/Ozark/Software/GRID_FIELD/index.html at the top of the web page there is a menu "Main Page|Applet|Help|Copyright & Disclaimer|". Select the "Applet" menu option a "Warning - Security" Dialog will appear *("Do you want to run this application?")*. The program has to be able to read and write to the user's PC and access the Kansas Geological Survey (KGS) Database and File Server, ORACLE requires this dialog. The program does not save your files to KGS, but allows you to access the KGS for well information. The program does not use Cookies or any hidden software. The blue shield on the warning dialog is a symbol that the Java web app is created by a trusted source, which is the University of Kansas. Select the "Run" Button, which will show the Brine Data "Enter" Panel illustrated below,
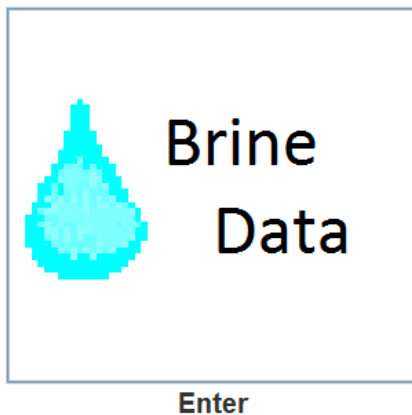
Select the Brine Data Icon button and the Brine Data Dialog will display with a list of the measured brine data of the monitoring wells in the Brine Data table.

Brine Data Dialog

This program is designed to create a gridding and mapping animation of the 15 monitoring wells in around the Wellington KGS 2-28 CO_2 Sequestration Well using a "colorlith" presentation of the brine data, i.e. 3 brine data curves mapped to 3 colors Red, Green and Blue respectively and mixes the color to reflect the general chemistry. The idea is that by picking and plotting the right three curves that may be especially sensitive to the brine chemistry and reflect the CO_2 interaction and see a change in the presentation on the map over time by the color changes.
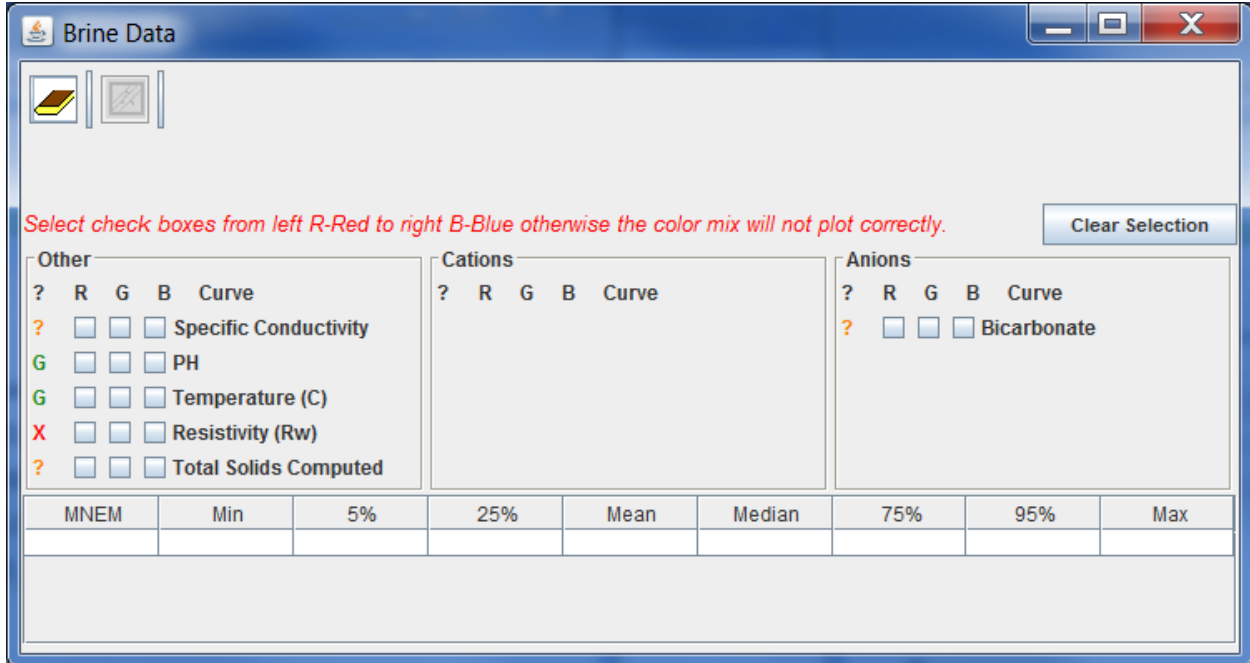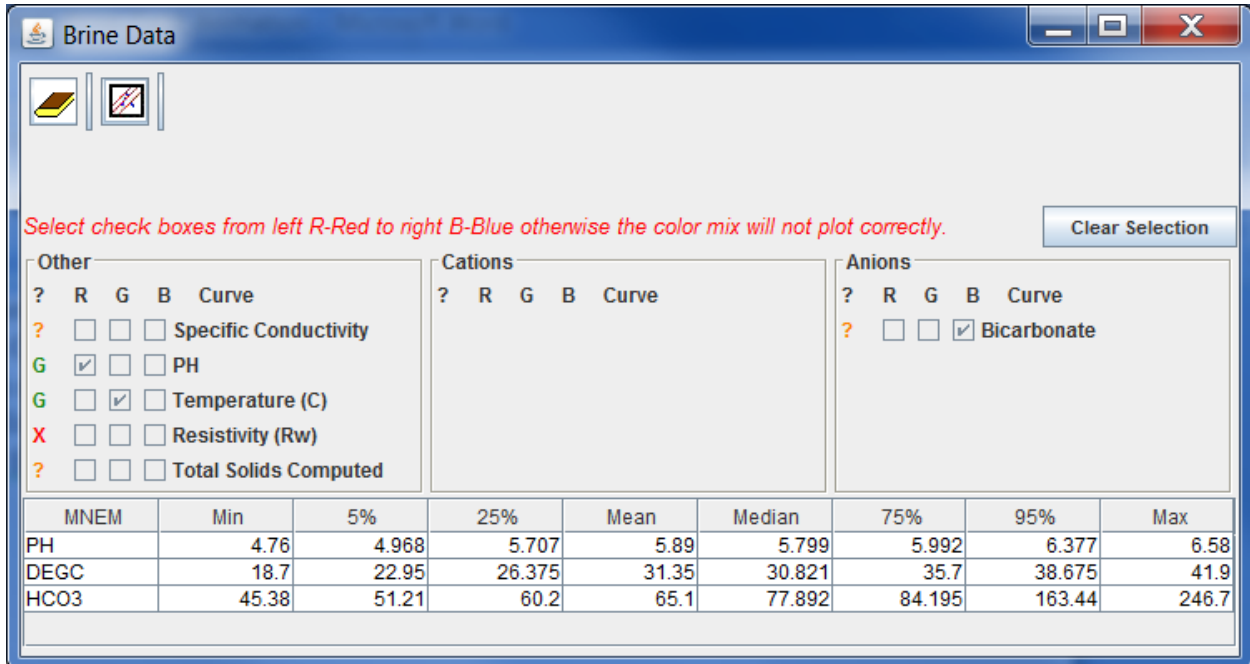

Close this dialog and all dialogs opened by this dialog.

Begin Animation of Brine Data.

The brine data for the 15 monitoring wells are automatically downloaded when the user starts the program and loaded into this dialog. The bottom panel is the basic control to select the 3 brine data curves to map to the 3 colors Red, Green and Blue respectively and automatically mixes the color to reflect the general chemistry. At the top of the panel is a "warning" to select the boxes from left R-Red to right B-Blue otherwise the color mix will not plot correctly. The "Clear Selection" button allows the user to clear the selection so they can select a different set of curves. The user will note next to each Curve row is a set of labels **X**, **?**, or a **G**, as indicators on the number of samples within each of the curves. If the curve you are selecting has data for all rows then you will see the Green **G** for good data curve, if you have 20% to 99% of the curve rows filled you will see an Orange **?** for questionable curve data, and if you have from 0 to 19% of the

curve rows filled you will see a Red **X** for bad curve "do not select". The bottom table shows the statistics of the data for the complete data set. The plot icon button will only enable when the user has selected the 3 curves for plotting.

The "Clear Selection" button resets the check boxes so the user can choose a different set of curves, the Statistics Table is also cleared.

The applet is automatically downloading the brine data for this animation from a ORACLE PL/SQL Stored Procedure,

http://chasm.kgs.ku.edu/ords/iqstrat.co2_gridding_pkg.getDateXML?sID=FIELD

This data set is all the data that is necessary to create an animation over time. Each data set will have a Group ID ("FIELD") and a Group Number starting at 0, 1, 2, … etc. Each number also represents a date the well was sampled, i.e. 0 is 20 January 2015, 1 is 27 January 2015, etc. The wells were automatically group to simplify the process. The color limits for each date is set at the beginning using the statistics table at the bottom of the Brine Data Frame and every time slice is set to those limits, i.e. 5% is the minimum value and 95% is the maximum value. The data over time is plotted to the same limits in the hope of observing brine chemistry changes over time with respect to the wells.

Map Brine Data Frame

The "Map Brine Data" Frame is basically the Gridding & Mapping Control Panel. The frame has 2 sections the upper or check boxes of possible brine data types that were analyzed for the well group. The check boxes are grouped in 3 separate panels, "Other Brine Data Types, Cations, and Anions. There are 3 check boxes for each brine data type, R-Red, G-Green and B-Blue. The user will note next to each Curve row is a set of labels **X**, **?**, or a **G**, as indicators on the number of samples within each of the curves. If the curve you are selecting has data for all rows then you will see the Green **G** for good data curve, if you have 20% to 99% of the curve rows filled you will see an Orange **?** for questionable curve data, and if you have from 0 to 19% of the curve rows filled you will see a Red **X** for bad curve "do not select". The program is designed to allow the user to select up to 3 brine data curves and to map each curve with a primary color to form a "Colorlith" of the brine data on the Gridding & Mapping Well Map Plot.

As the user selects each brine data curve for plotting the program computes a statistical analysis of the data, i.e. computing the Minimum, Maximum, Mean, Median, etc. of the brine data curve in the second section. The data is presented so the user knows the spread of the data. The program automatically selects the 5% and 95% for the minimum and maximum plot values and places them in the text fields at the bottom of the panel for the color selected. The user can change the values, which will change the color of the Gridding & Mapping Plot Area.

Example: PH, Temperature and Bicarbonate Anion Brine Data Well Map:

Starting with the upper panels this example will generate a Gridding & Mapping Brine Data Well Map for the PH, Temperature and Bicarbonate Anion.

Select the R (Red) Check box in the PH Curve Row. This action will perform a number of steps,

1. All other check boxes under the R (Red) column are disabled.
2. The PH data spread is computed and inserted in the statistics table.

Clear Selection

Other

?	R	G	B	Curve
?	☐	☐	☐	Specific Conductivity
G	☑	☐	☐	PH
G	☐	☐	☐	Temperature (C)
X	☐	☐	☐	Resistivity (Rw)
?	☐	☐	☐	Total Solids Computed

Cations

?	R	G	B	Curve

Anions

?	R	G	B	Curve
?	☐	☐	☐	Bicarbonate

MNEM	Min	5%	25%	Mean	Median	75%	95%	Max
PH	4.76	4.968	5.707	5.89	5.799	5.992	6.377	6.58
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0

The user can then select the G (Green) Check box in the Temperature Curve Row and then the B (Blue) Check box in the Bicarbonate Curve Row as illustrated below.

Clear Selection

Other

?	R	G	B	Curve
?	☐	☐	☐	Specific Conductivity
G	☑	☐	☐	PH
G	☐	☑	☐	Temperature (C)
X	☐	☐	☐	Resistivity (Rw)
?	☐	☐	☐	Total Solids Computed

Cations

?	R	G	B	Curve

Anions

?	R	G	B	Curve
?	☐	☐	☑	Bicarbonate

MNEM	Min	5%	25%	Mean	Median	75%	95%	Max
PH	4.76	4.968	5.707	5.89	5.799	5.992	6.377	6.58
DEGC	18.7	22.95	26.375	31.35	30.821	35.7	38.675	41.9
HCO3	45.38	51.21	60.2	65.1	77.892	84.195	163.44	246.7

The data has been entered and the user only needs to select the "Plot Map" button, which will display the Gridding & Mapping Brine Data Well Map. The user will also notice that the "Create Report" Button will then be enabled. The user can generate a Output Web Page for this data selection if they wish. The user can also modify the Colorlith minimum and maximum limits for each color, which will automatically be reflected in the plot.

The color map reflects the brine chemistry for the PH-Temperature and Bicarbonate Anion. The Colorlith Red-Green-Blue color mix is controlled by the minimum and maximum displayed in the lower panel of the "Map Brine Data" Frame. The Brine Data Well Map will have dark and light colors, dark being the maximum of the color mix or maximums of the PH-Temp-HCO3 data values and light the minimum of the color mix or minimums of the PH-Temp-HCO3 data. Each Red, Green and Blue Color goes from 0 – Maximum Brine Data Value to 255 – Minimum Brine Data Value. The value of the specific curve set the value of the color, i.e.

Color Value = 255 – [255 * (brine data value – Minimum) / (Maximum – Minimum)]

This is done for each curve for each cell and the cell is then painted to the color of the Red-Green-Blue color values. If all the colors are set to 0 then the grid cell is black and this indicates that the maximum value for all the selected curves was used. If all the colors are set to 255 then the grid cell is white and this indicates that the minimum value for all the selected curves was used. If the brine data was proportional between the wells, i.e. they brine data changes by a factor "A" then you would expect the color to be grays. The brine data is not necessarily proportional, in that the concentration of PH-Temperature-Bicarbonate is the same by only a factor of "A" for each well. This gives the color of the map. The Bicarbonate will be at a maximum for some wells and a minimum for others and the same for the PH and Temperature will vary across the well area.
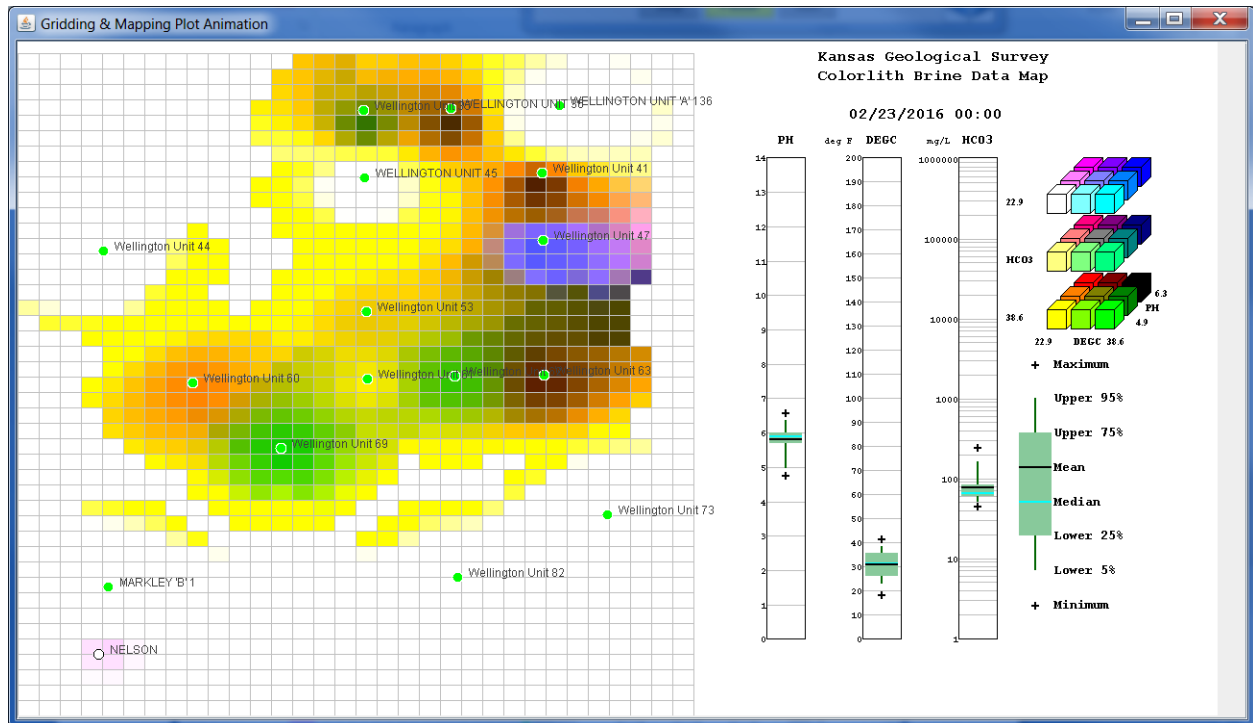
The plot icon button will only enable when the user has selected the 3 curves for plotting and will show the brine gridding & mapping map for the first sampled data. The Animation Control Dialog will appear at the top of the screen.

Animation Control Dialog

To start the animation select the "Run" Button, which will turn yellow and each Wellington field brine data sampled date will appear with the date & time appearing in the 4th title on each plot. Select the "Pause" Button, which will turn yellow and pause the animation at the event. Select the "Run" Button to resume the animation. Select the "Stop" Button, which will turn yellow and reset to the first sampled date.
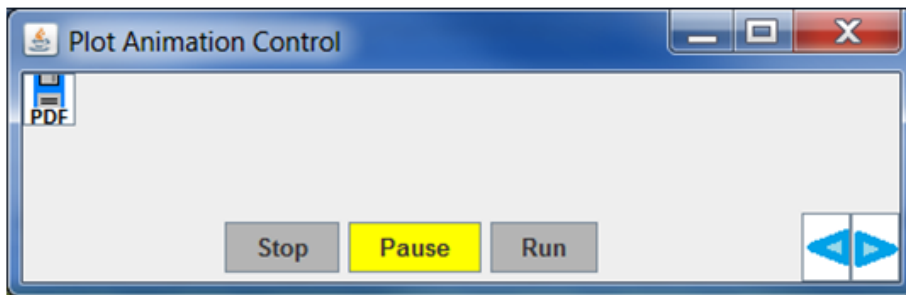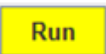

PDF – capture a specific time event and make PNG images with the capability of converting each image into a PDF document.

Stop animation – stop animation and reset to beginning event.
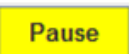
Pause animation – stop animation at event.

Run animation – steps through each event at 1 second intervals.

Previous – steps back one event.
Next – steps forward one event.