an NSF-sponsored research network for
Sustainable Climate
Risk Management

PENNSTATE

Visualizing Data with OpenMORDM

This work was supported by the National Science Foundation through the Network for Sustainable Climate Risk Management (SCRiM) under NSF cooperative agreement GEO-1240507.

What is OpenMORDM?

- A **free** and **open source** visualization framework written in R
- Supports 3D and 2D visualization of datasets
- Analytics: sensitivity analysis, PRIM, CART, etc.
- Accessible via your web browser!

Demo

- Open your web browser to:

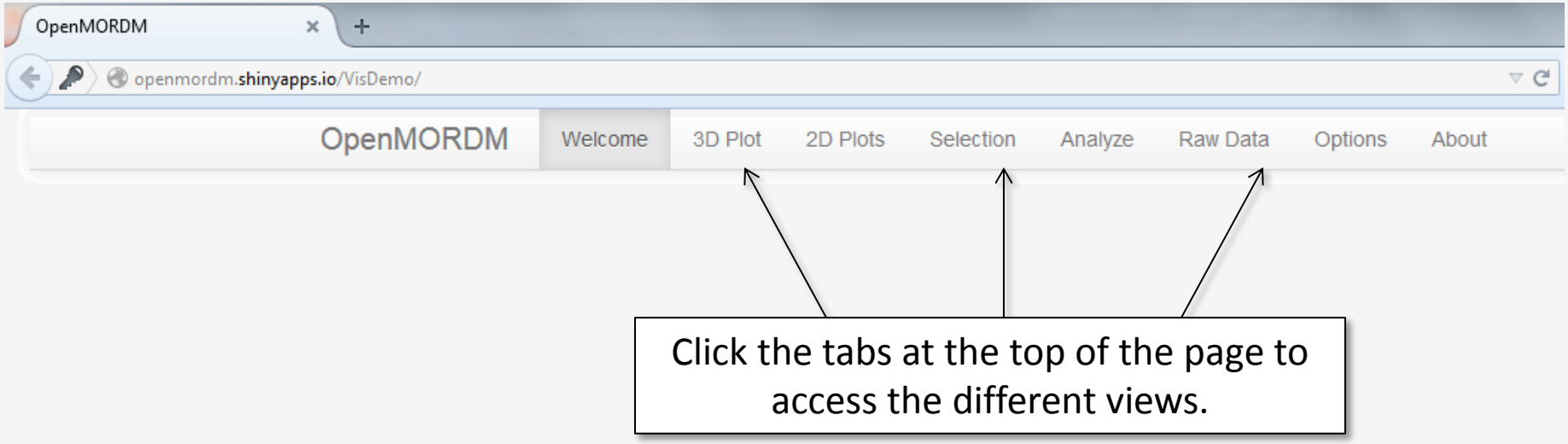
  http://openmordm.shinyapps.io/VisDemo/

- Login with the username / password provided by SCRiM

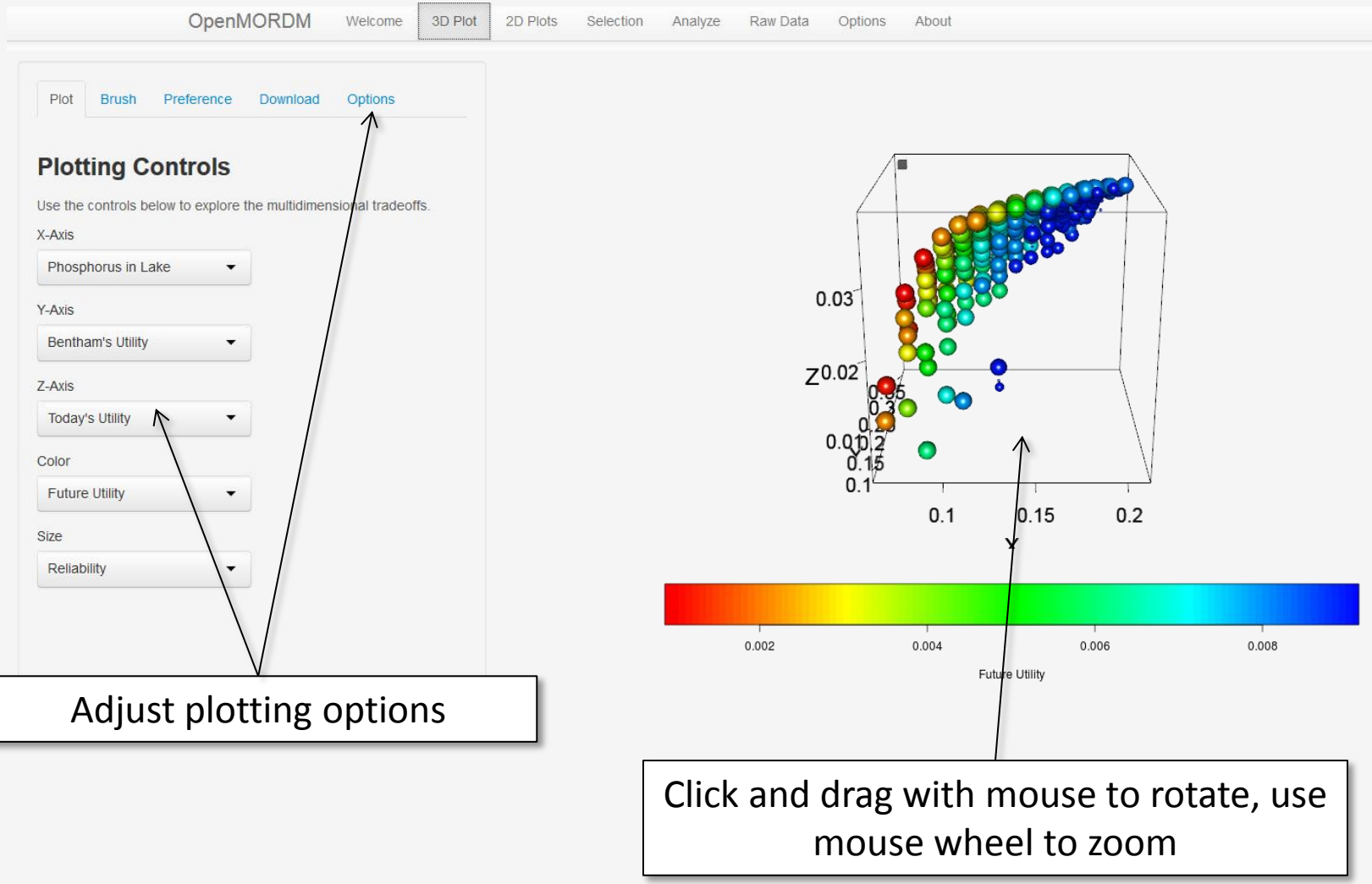
- Best to use latest version of Firefox or Chrome

This is a beta version. If the application stops responding, refresh the page in your browser.

Navigation


OpenMORDM
openmordm.shinyapps.io/VisDemo/
OpenMORDM
Welcome
3D Plot
2D Plots
Selection
Analyze
Raw Data
Options
About
Click the tabs at the top of the page to access the different views.

3D View


OpenMORDM
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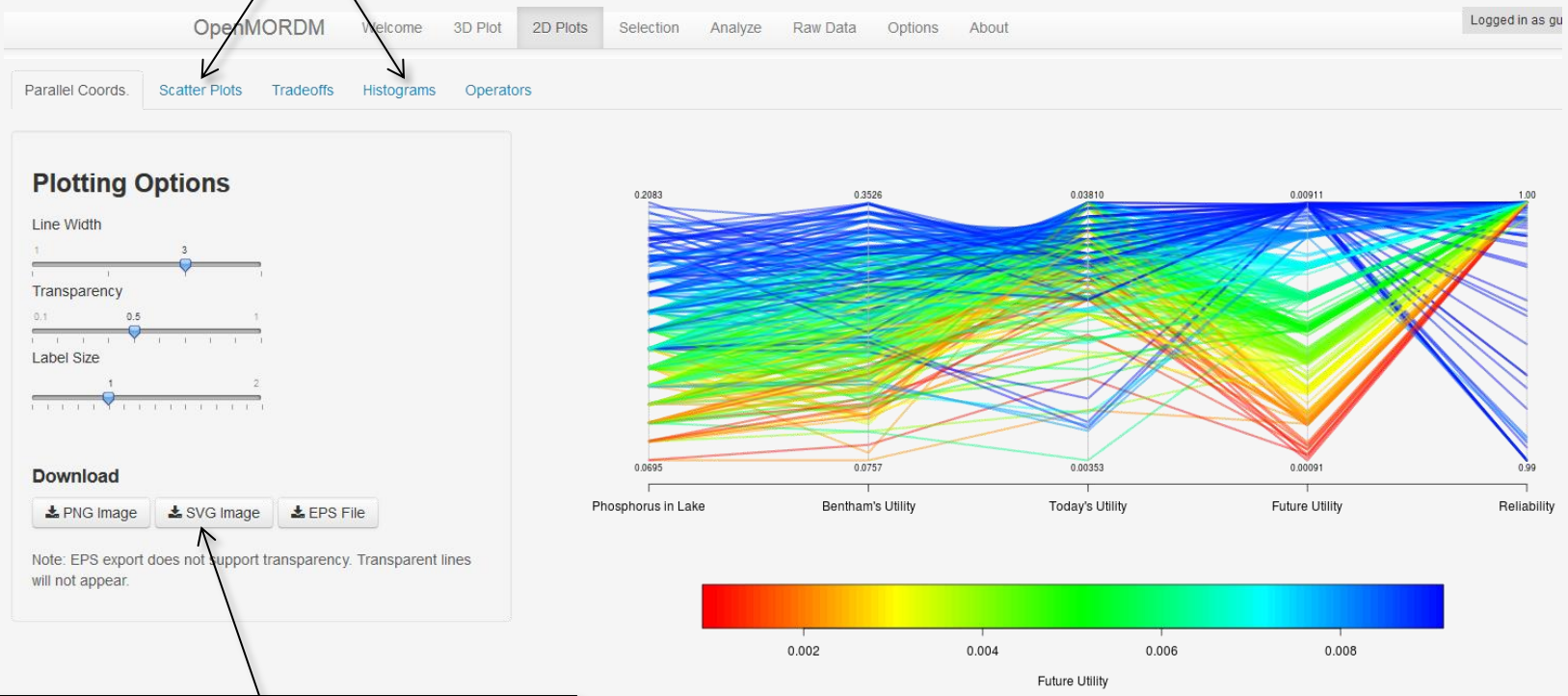
Options
Plotting Controls
Use the controls below to explore the multidimensional tradeoffs.
X-Axis
Phosphorus in Lake
Y-Axis
Bentham's Utility
Z-Axis
Today's Utility
Color
Future Utility
Size
Reliability
Adjust plotting options
0.03
Z 0.02
0.1
0.15
0.2
Y
0.002
0.004
0.006
0.008
Future Utility
Click and drag with mouse to rotate, use mouse wheel to zoom

2D Views

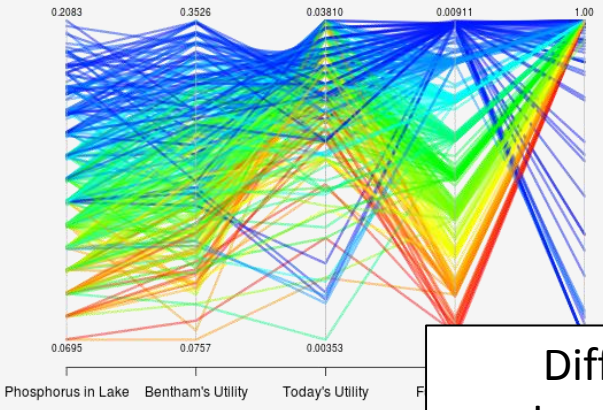
Click tabs to access all 2D views



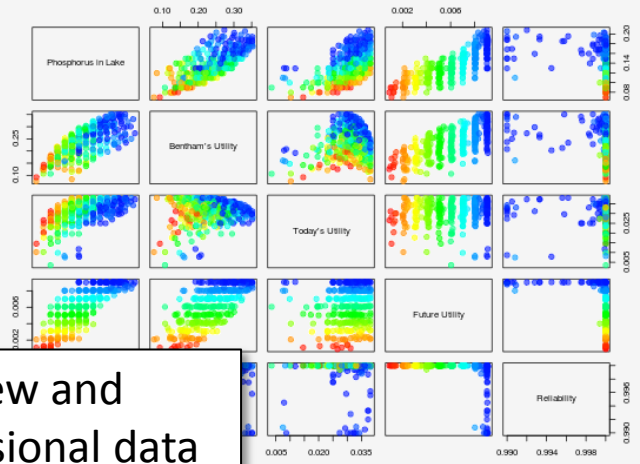
Download high-def image

2D Views (Continued)

Parallel Coordinates

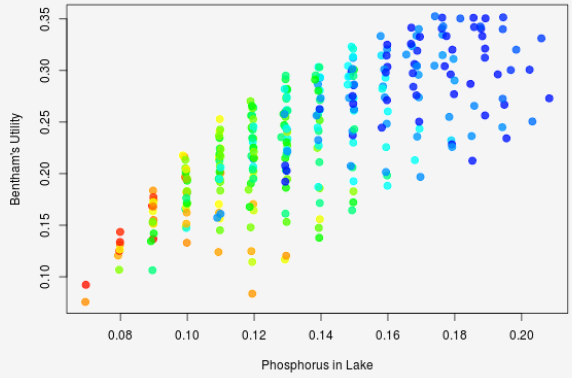


Scatter (Multiattribute) Plot

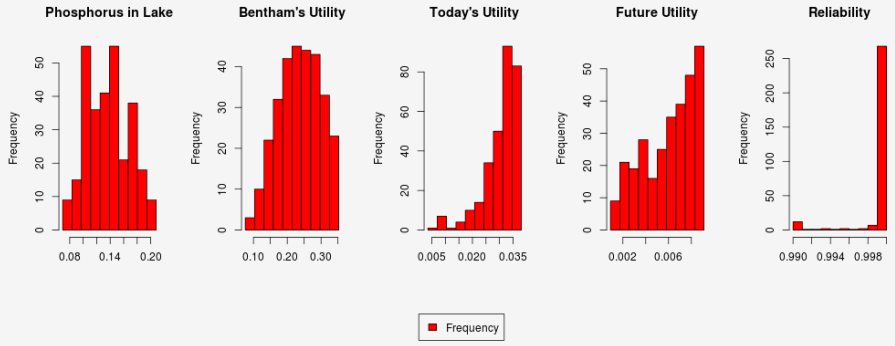


Different ways to view and understand high-dimensional data

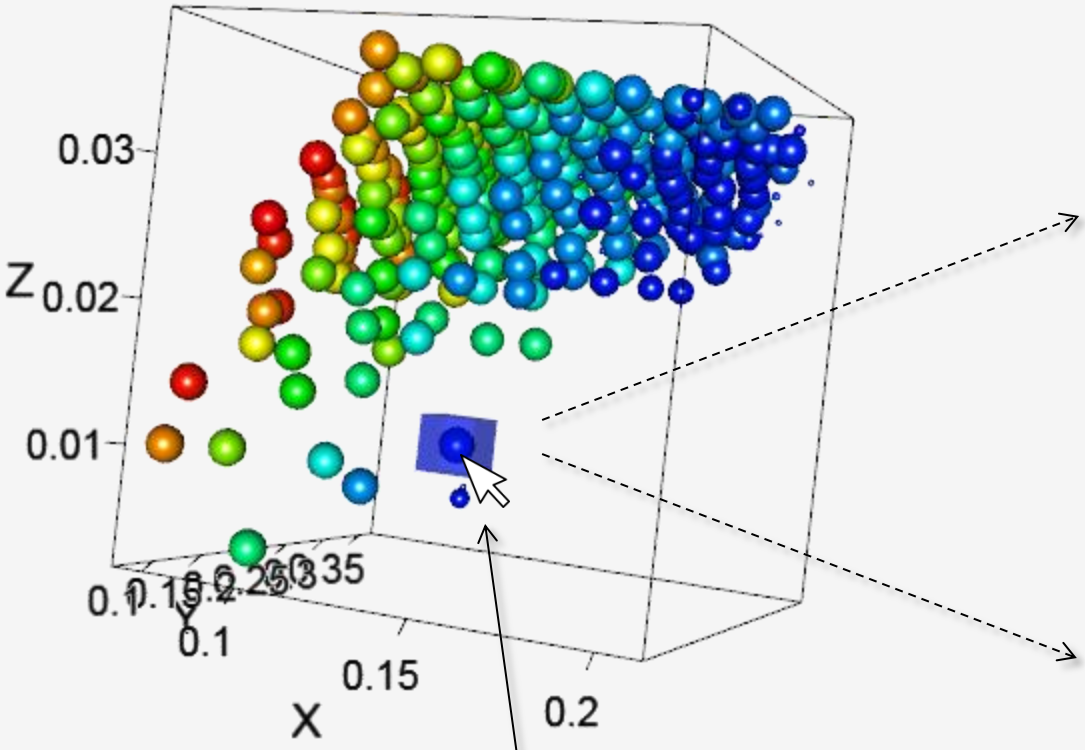
Tradeoff Between Two Objectives

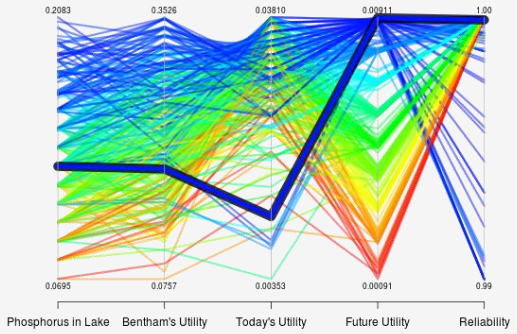


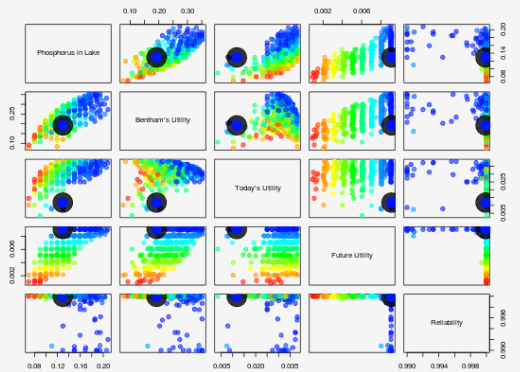
Histogram



Selecting Points







Click a point in the 3D view to highlight the point in all plots

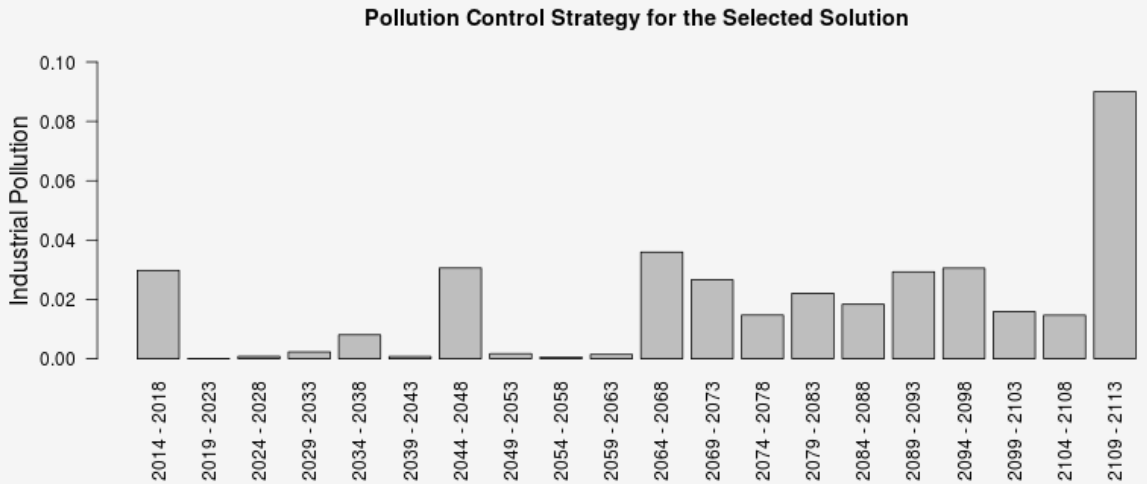
Viewing Details

OpenMORDM | Welcome | 3D Plot | 2D Plots | Selection | Analyze | Raw Data | Options | About | Logged in as

You can provide a custom Shiny interface that will display details for the currently selected point. In this example, the figure to the right shows the pollution control strategy for the lake problem.

Download

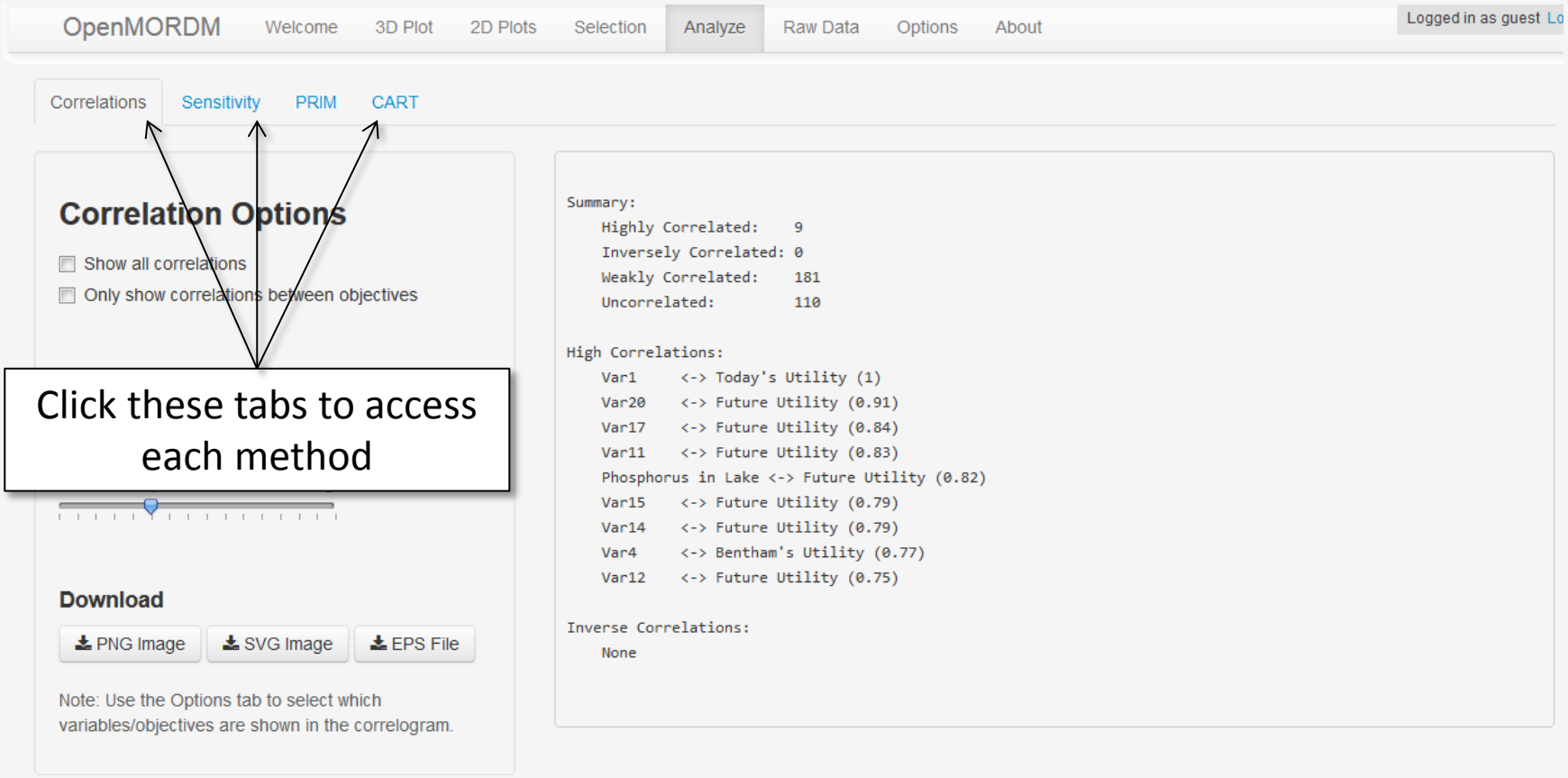
PNG Image | SVG Image | EPS File



When a point is selected, switch to the Selection tab to view details of that point. In this example, we are looking at the pollution control strategy for the lake problem.

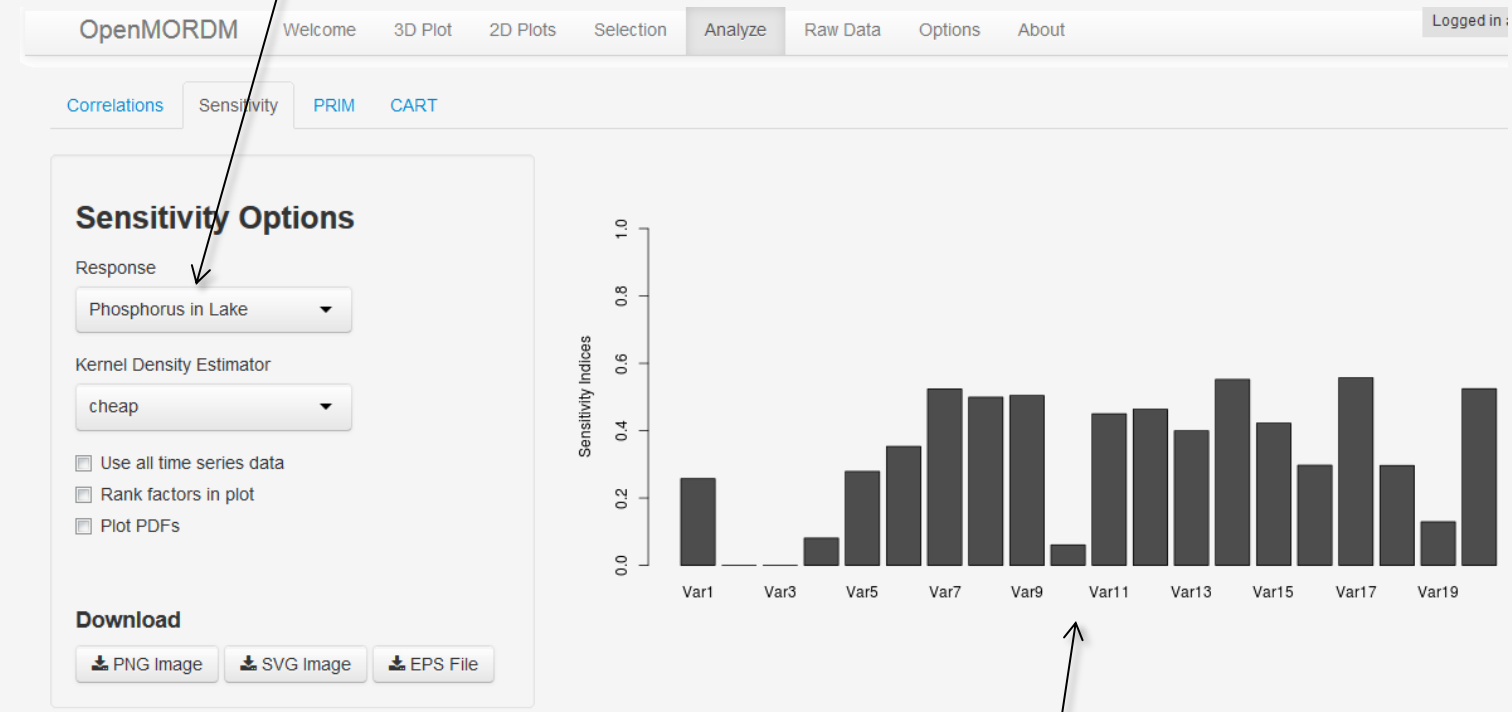
Analysis

The Analyze tab provides a number of routines to analyze multivariate data



Sensitivity Analysis

Select the response (the objective) of interest…



…to view the sensitivity of that response to each input variable

Plischke, Borgonovo, and Smith (2013). "Global sensitivity measures from given data", European Journal of Operational Research 226(3):536-550.

PRIM

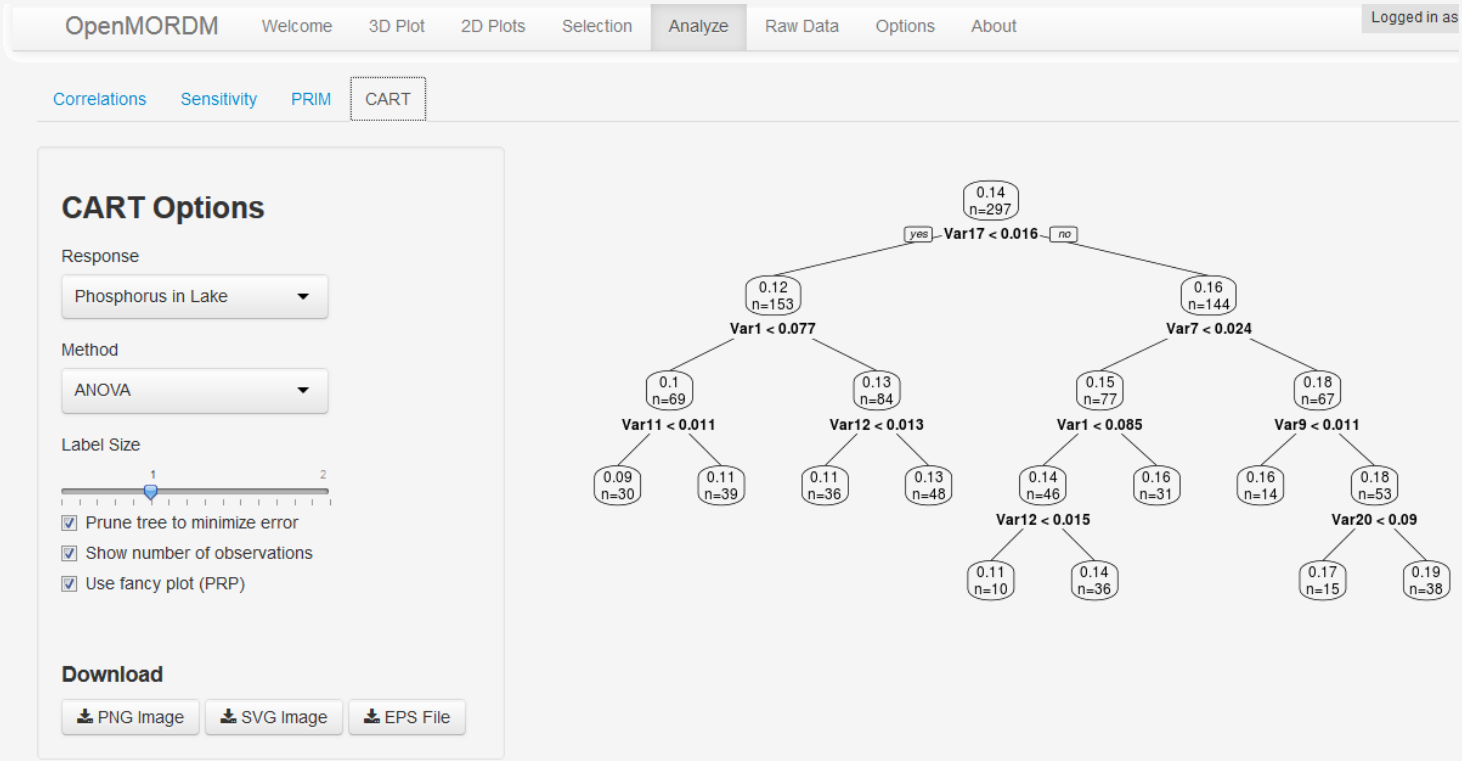
Use the Patient Rule Induction Method (PRIM) to discover the ranges of inputs that cause a response to be less than or greater than a given threshold.

Inputs contained within these red boxes have a high likelihood of satisfying our conditions.

Friedman, J.H. and Fisher, N.I. (1999). "Bump-hunting for high dimensional data", Statistics and Computing, 9, 123–143.

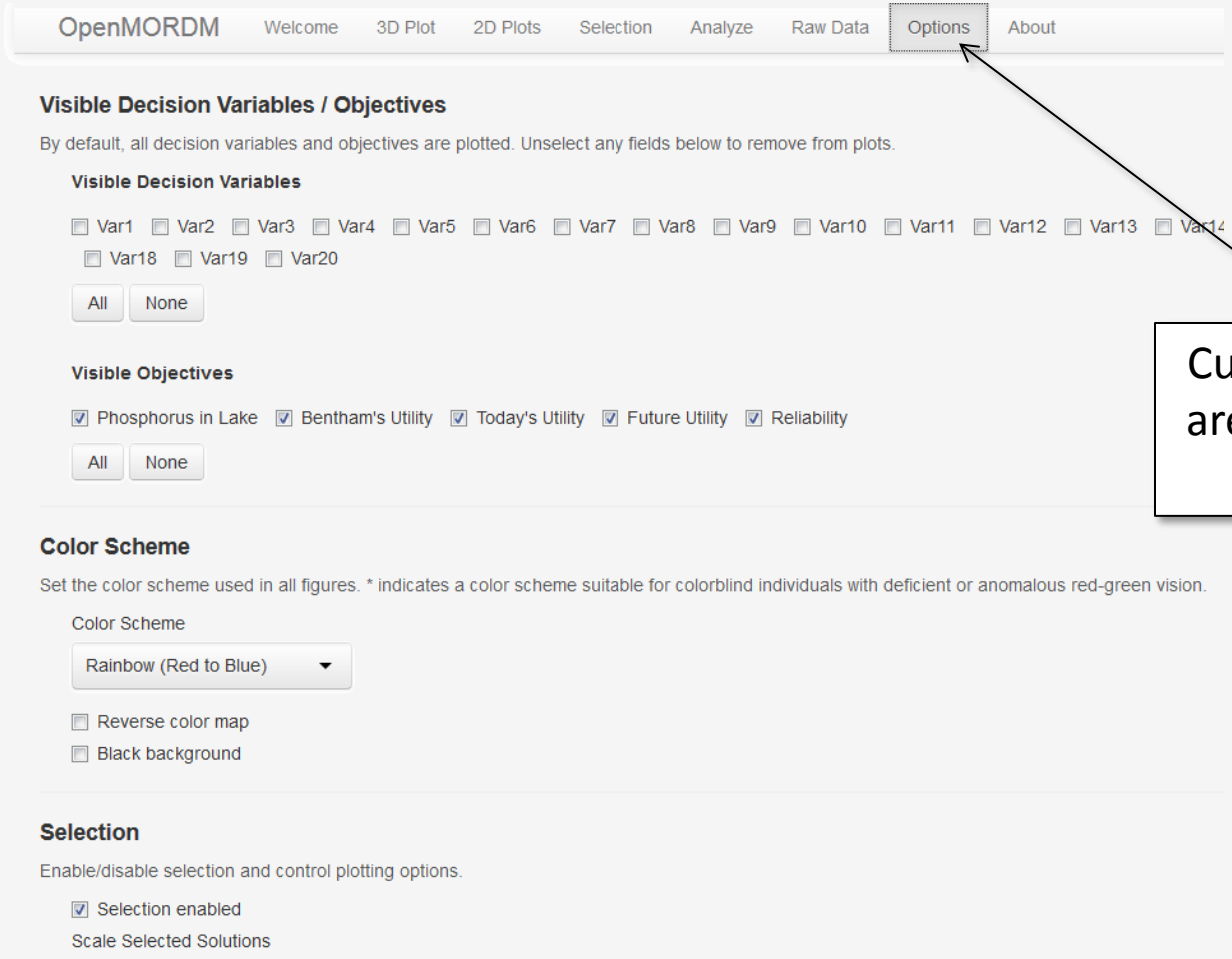
CART

Similar in use to PRIM, Classification and Regression Trees (CART) determine how to partition the data into similar subsets, identifying the key input variables.



Breiman, Leo; Friedman, J. H.; Olshen, R. A.; Stone, C. J. (1984). *Classification and regression trees*. Monterey, CA: Wadsworth & Brooks/Cole Advanced Books & Software. ISBN 978-0-412-04841-8.

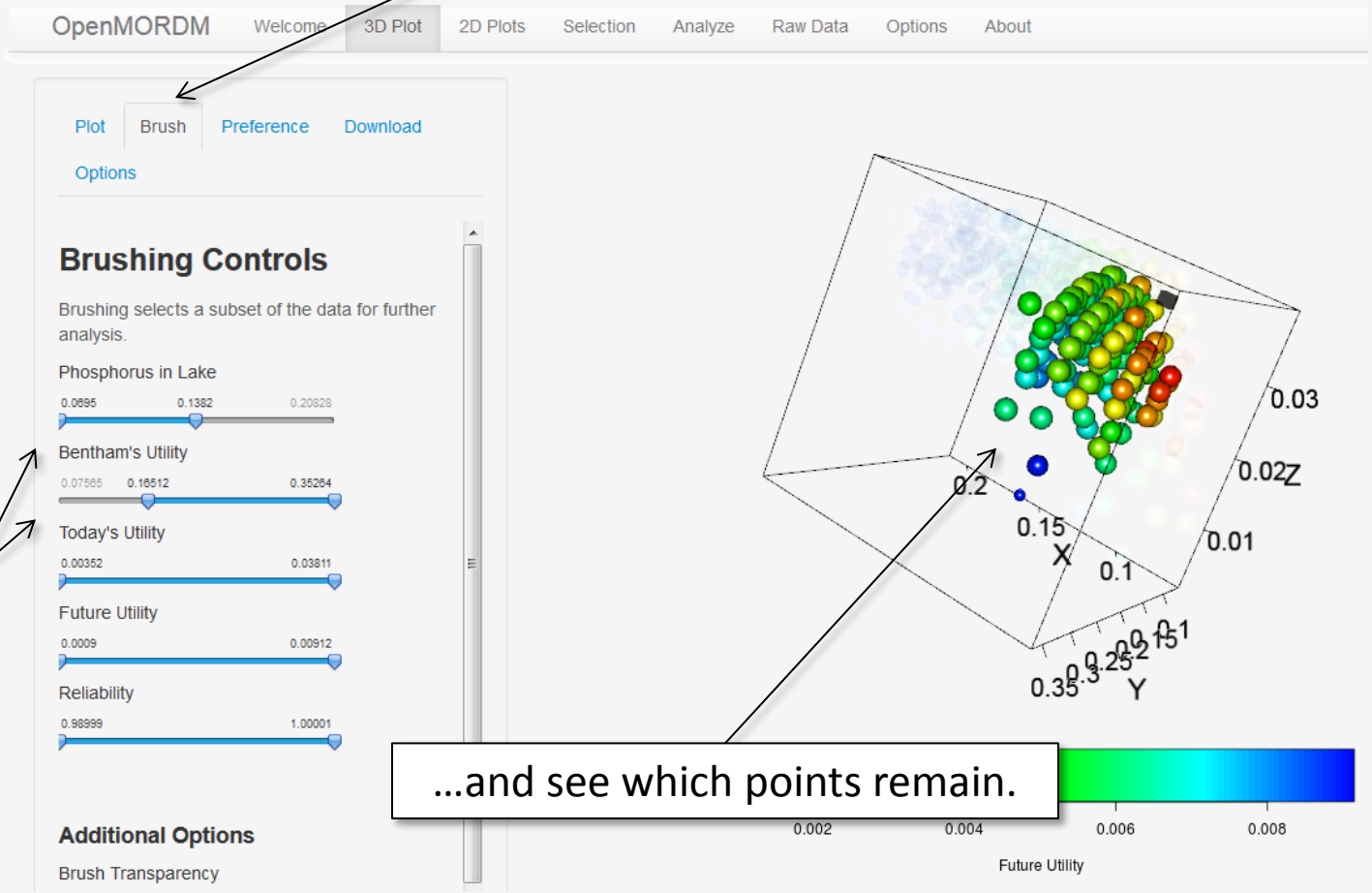
Customization



Customize the tool (which fields are plotted, color schemes, etc.) using the Options tab

Advanced: Brushing

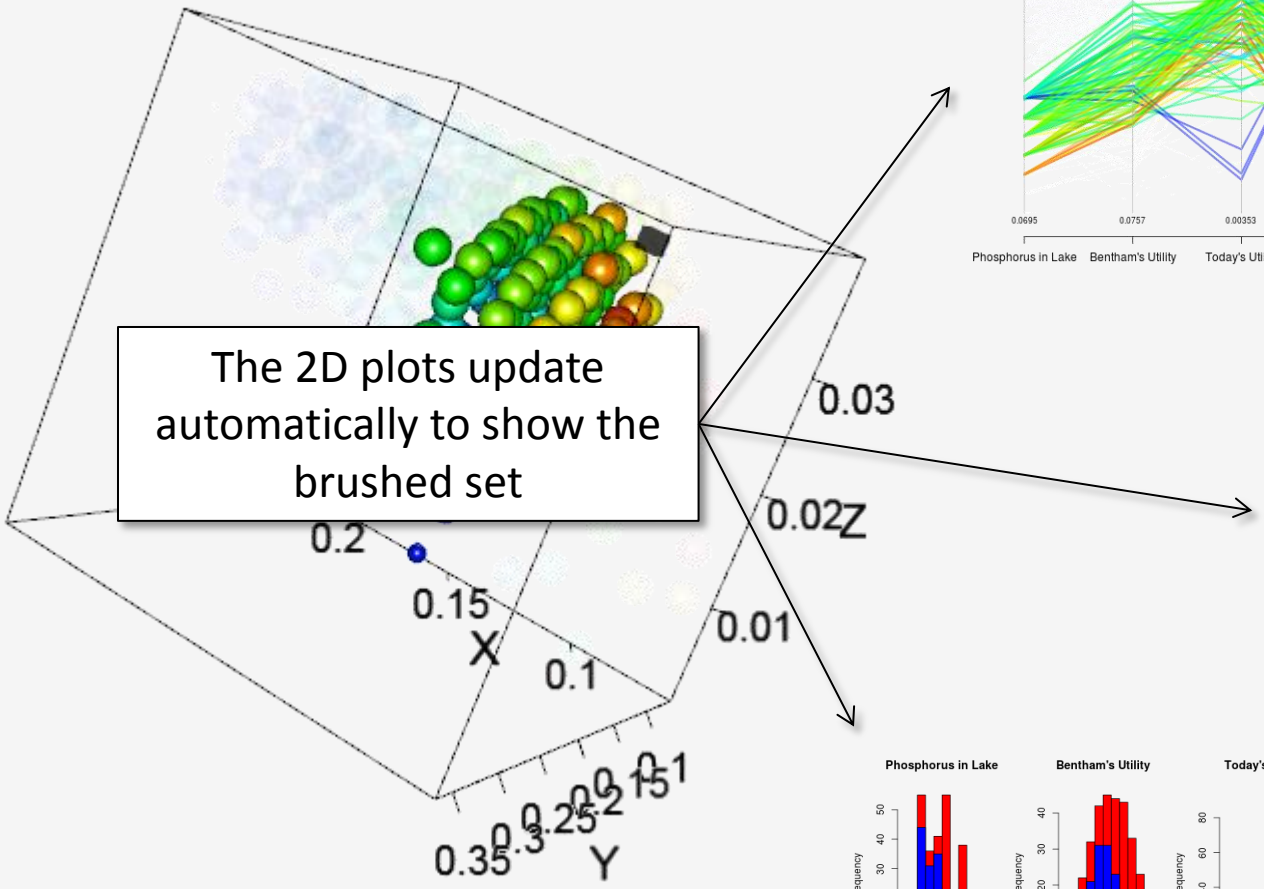
Brushing lets you identify a subset of the data for analysis.



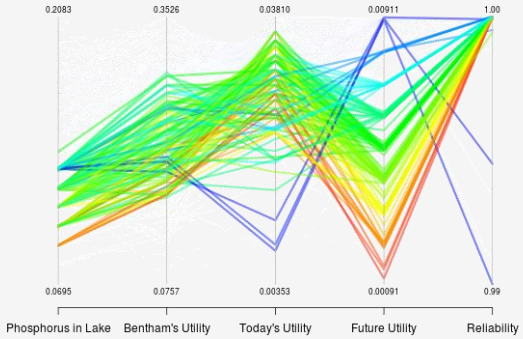
Use these sliders to specify the lower/upper bounds…

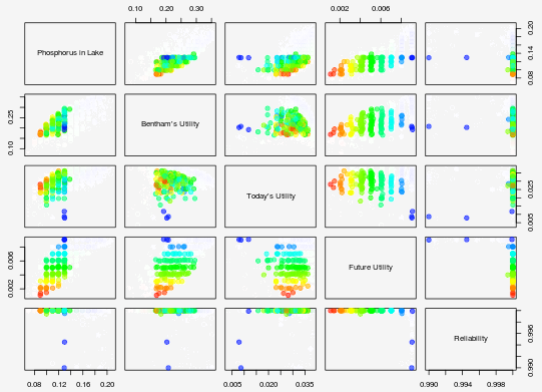
…and see which points remain.

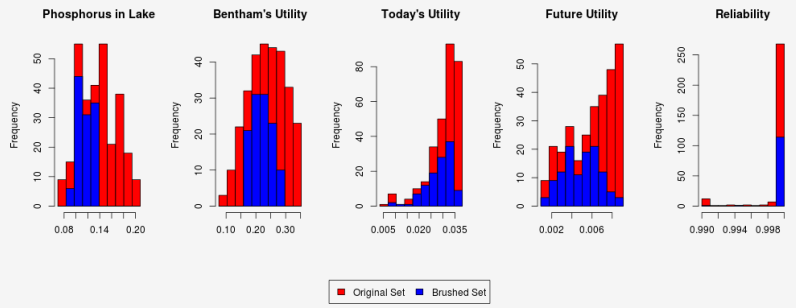
Advanced: Brushing



The 2D plots update automatically to show the brushed set

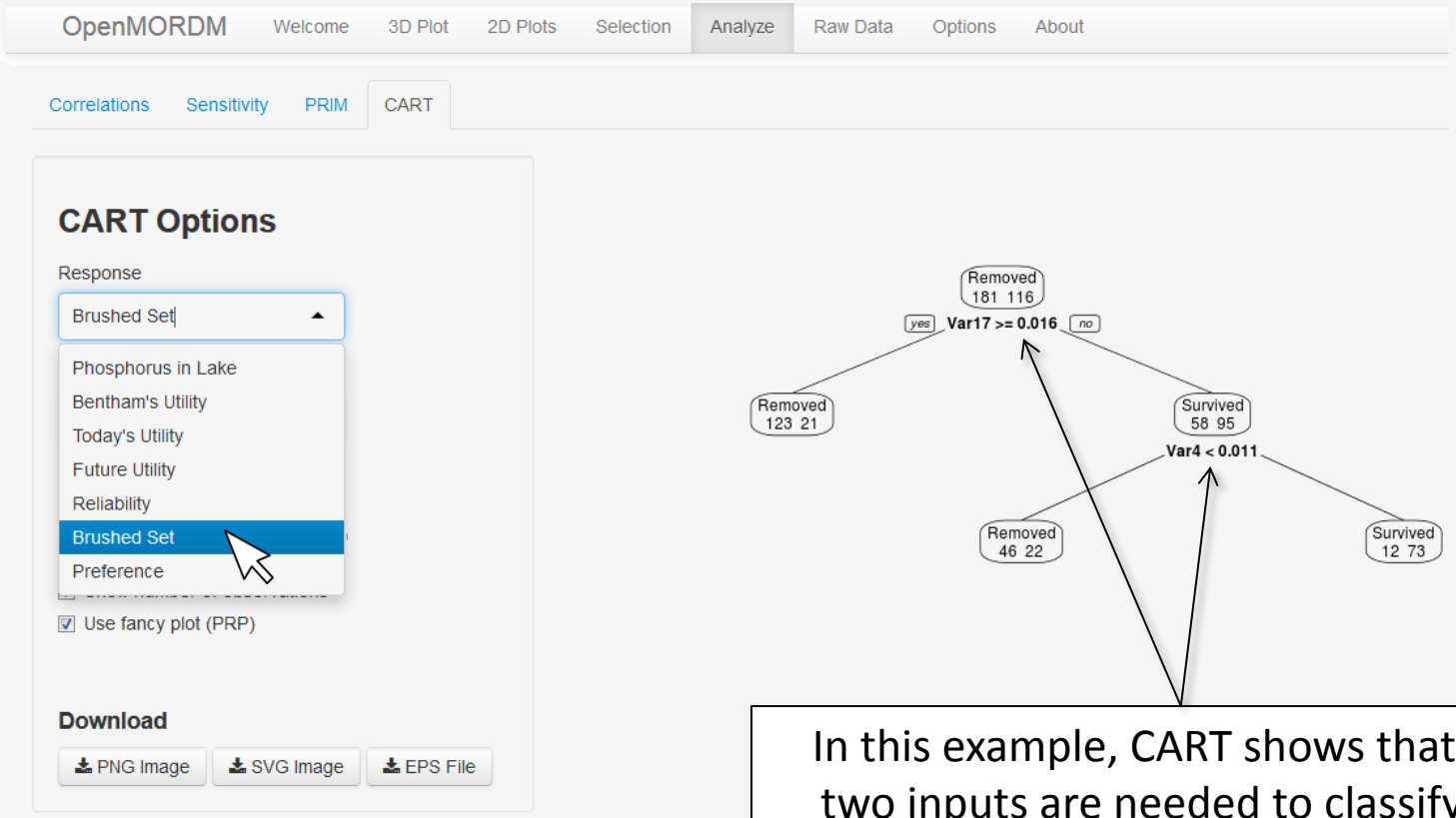






Advanced: Brushing

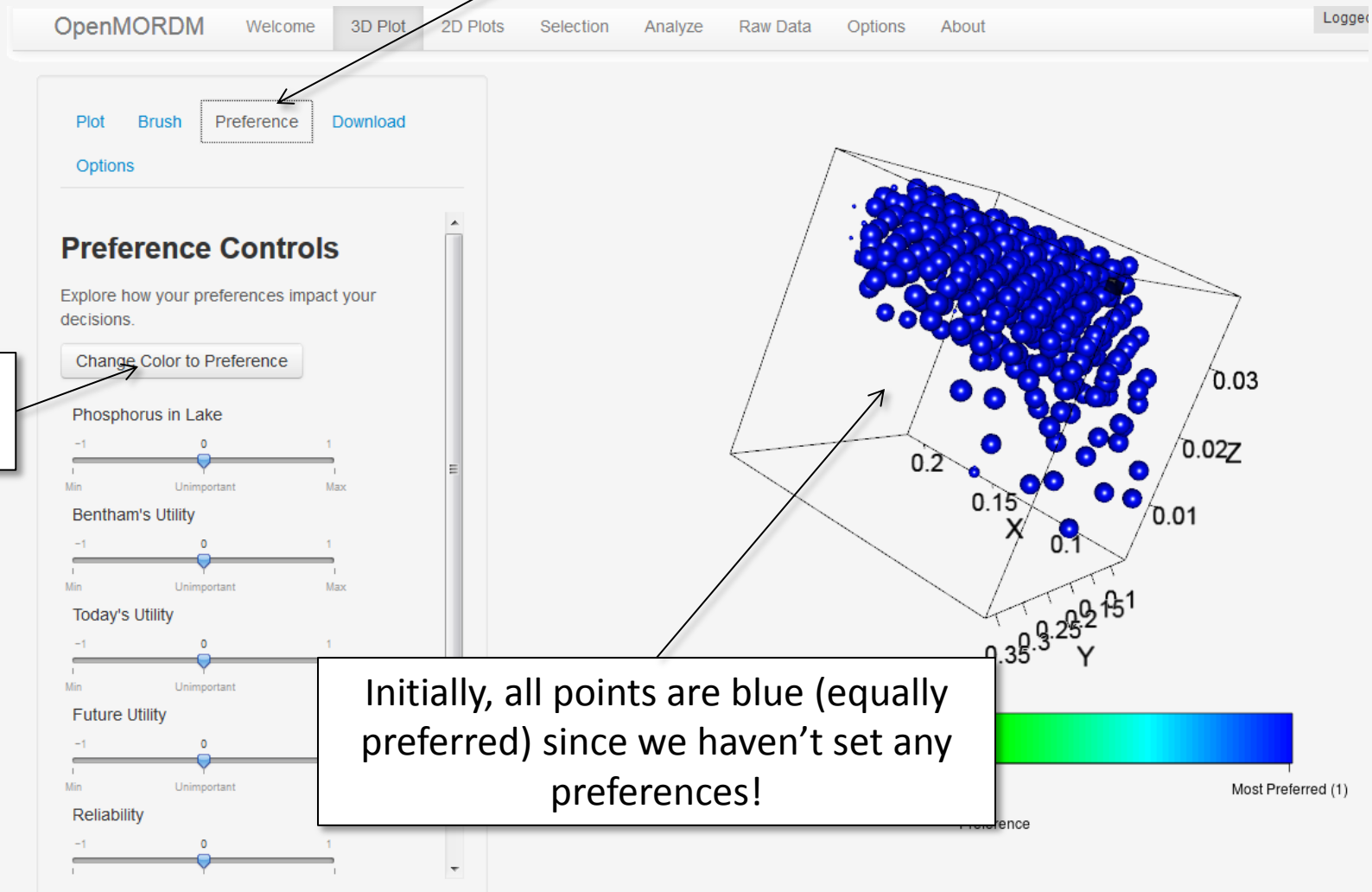
Additionally, the analysis methods include a “Brushed Set” response to analyze the difference between the solutions in the brushed set and those removed.



In this example, CART shows that only two inputs are needed to classify our brushed set!

Advanced: Preferences

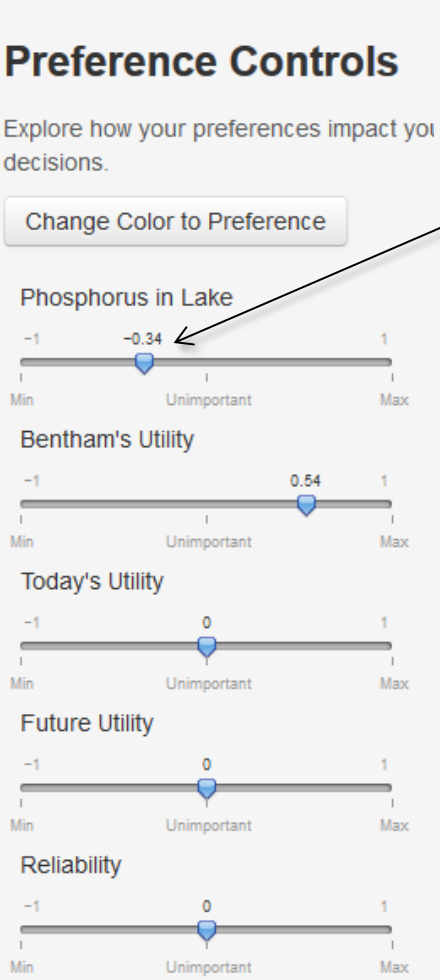
Specify preferences to color points by their relative importance



Click to color by preference

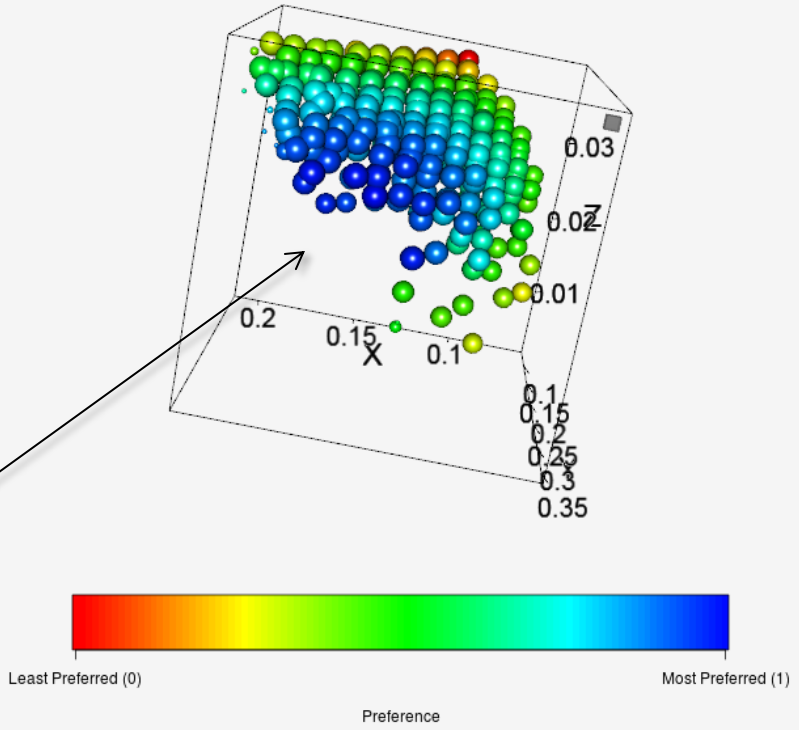
Initially, all points are blue (equally preferred) since we haven't set any preferences!

Advanced: Preferences

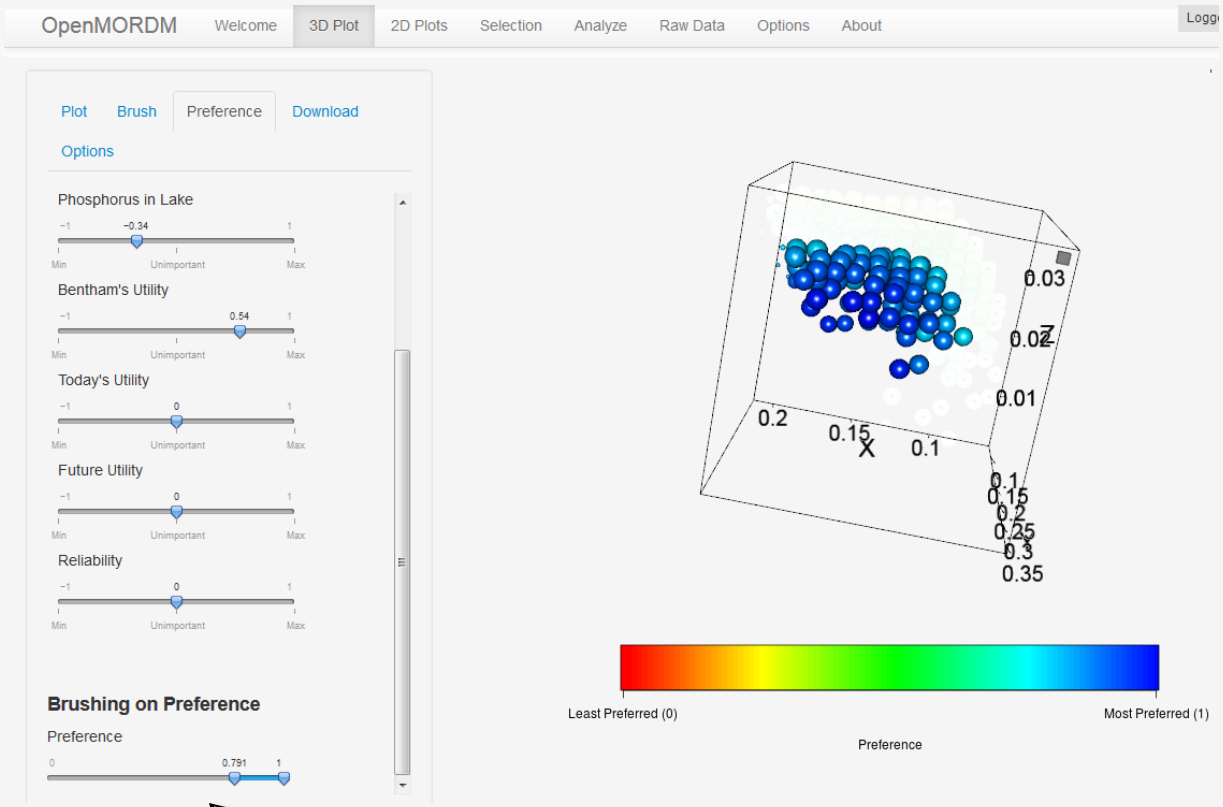


Adjust these sliders to set your preferences. Slide left to minimize, right to maximize. The further to the left/right increases the importance of that objective.

Your preferred points (blue is most preferred).



Advanced: Preferences



Finally, you can brush on your preferences and run the analyses on your brushed set.

Conclusion

- OpenMORDM aims to be a free and accessible visualization toolkit

- Please send comments and suggestions to:

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Dr. David Hadka (OpenMORDM developer) – dmh309@psu.edu

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