



SAS® GLOBAL FORUM 2016

IMAGINE. CREATE. INNOVATE.

Generating Color Scales in SAS®

256 Shades of RGB

#SASGF



11362 - Generating Color Scales in SAS®: 256 Shades of RGB

Jeff GRANT – Mahmoud MAMLOUK

Bank of Montreal, Business Initiatives, Toronto CA and Chicago IL

ABSTRACT

Color is an important aspect of data visualization and provides an analyst with another tool for identifying data trends. But is the default option the best for every case? Default color scales may be familiar to us; however, they can have inherent flaws that skew our perception of the data. The impact of data visualizations can be improved with a little thought toward choosing the correct colors.

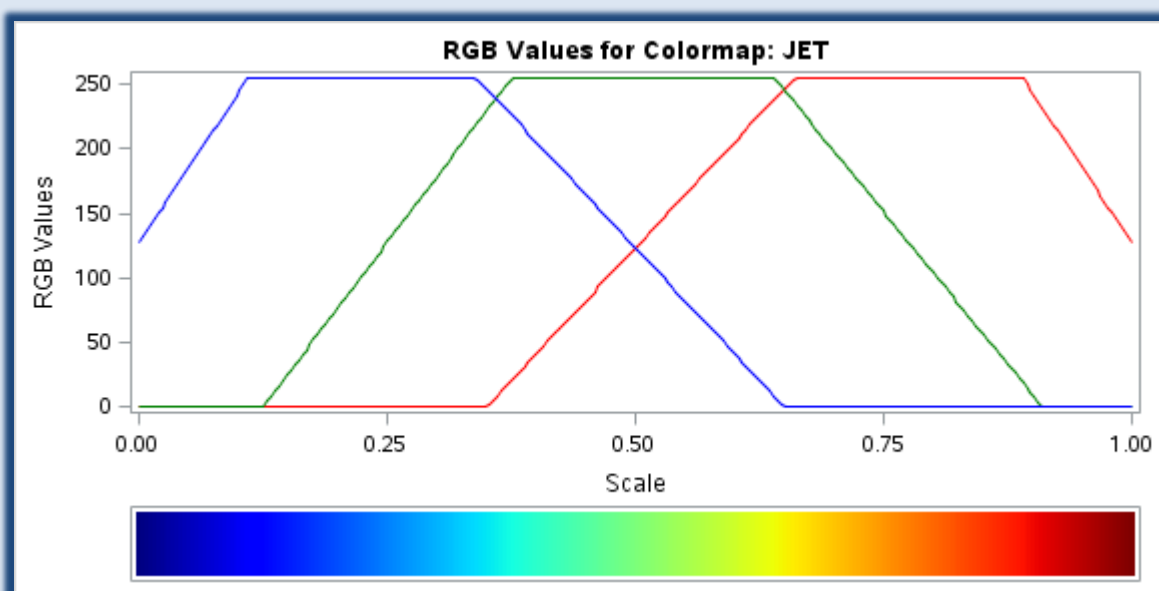
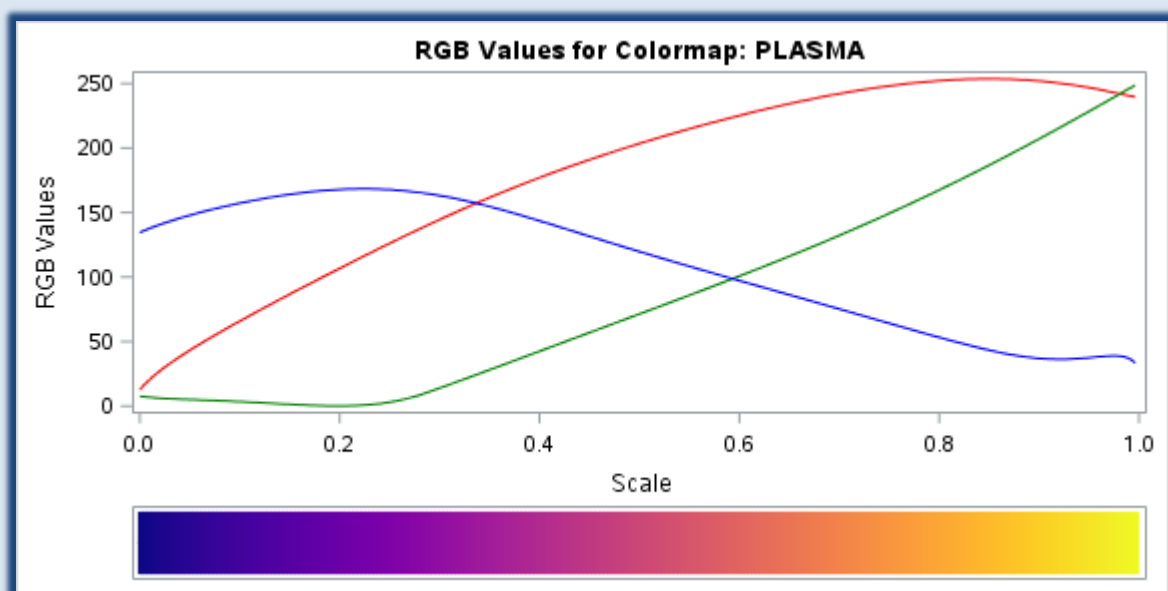
A simple technique is presented, detailing how you can use SAS® to generate a number of color scales and apply them to your data. Other techniques can be used to apply pre-defined color maps on your data in order to emphasize singularities or volumes.

Using just a few graphics procedures, you can transform almost any complex data into an easily digestible set of visuals. The techniques used in this discussion were developed and tested using SAS® Enterprise Guide® 5.1.

WHAT IS A COLORMAP?

A **Colormap** is defined as:

- a three column matrix specifying values for RGB components, *i.e.* the intensities of the red, green, and blue components of your screen.
- RGB triplets contain information in three 8-bit color channels with values of 0 to 255.
- Typically, these triplets are converted into a single hexadecimal number for a total of 256 color codes per colormap.



R(red), G(green), and B(blue) intensities for PLASMA and JET. The resulting colormap is defined by the combination of the three color channels.

METHOD – GENERAL

Consider your data

Categorical, continuous, or divergent?

Define your colormap

You can use any combination of linear or non-linear functions to define the R, G, and B curves. Combine the RGB triplet and convert to hexadecimal.

	color_index	R	G	B	HEX
1	1	0	0	127.5	CX00007F
2	2	0	0	132.04545455	CX000084
3	3	0	0	136.59090909	CX000088
4	4	0	0	141.13636364	CX00008D
5	5	0	0	145.68181818	CX000091

Scale your data

Use a `color_index` field to rank your data from its minimum (1) to its maximum (256). Join on the `color_index` field in your colormap.

Create a Template

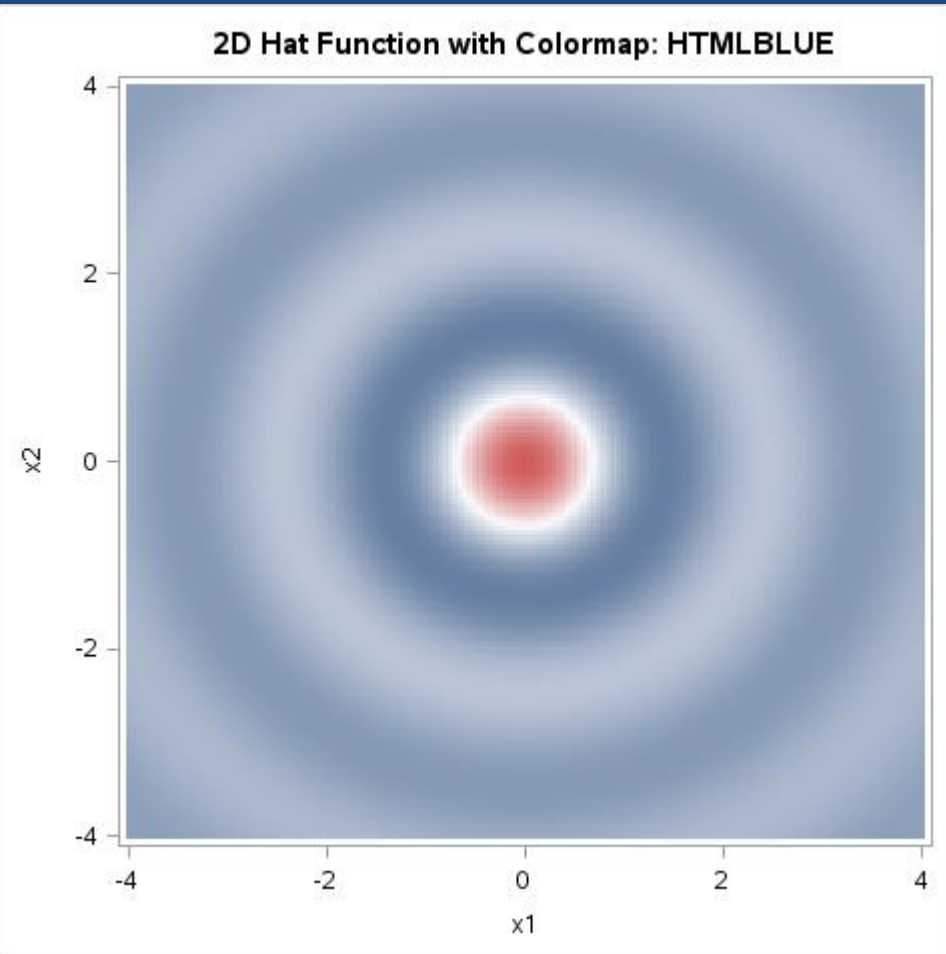
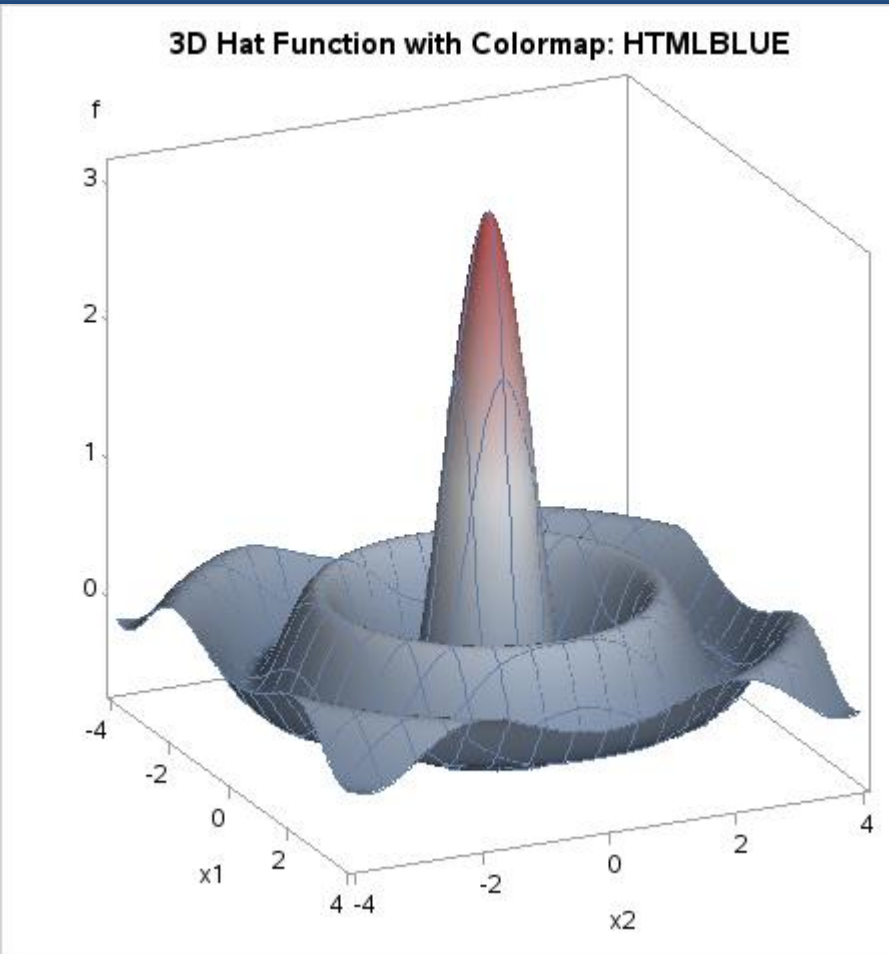
Use **PROC TEMPLATE** and the `COLORRESPONSE=` option to create a template for your colored data.

The `COLORRESPONSE=` option is keyed using a `RANGEATTRMAP` and a `RANGEATTRVAR` related to the `color_index` and `hex` variables.

Plot

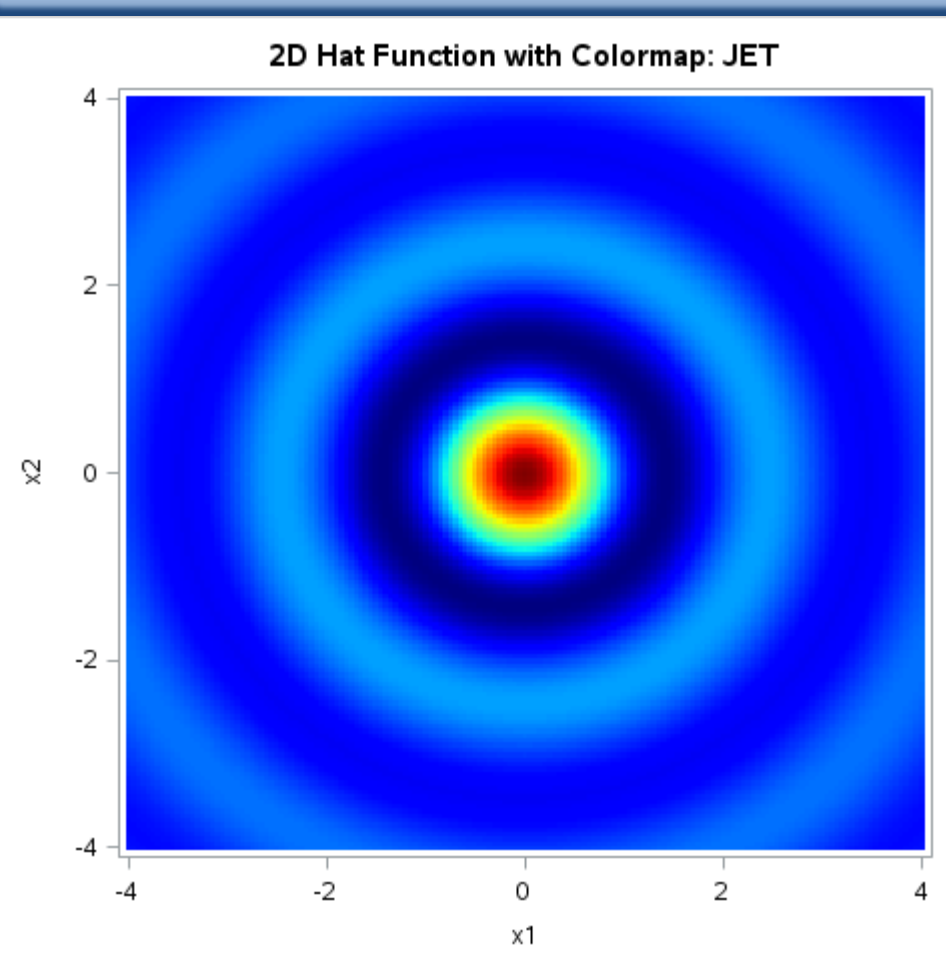
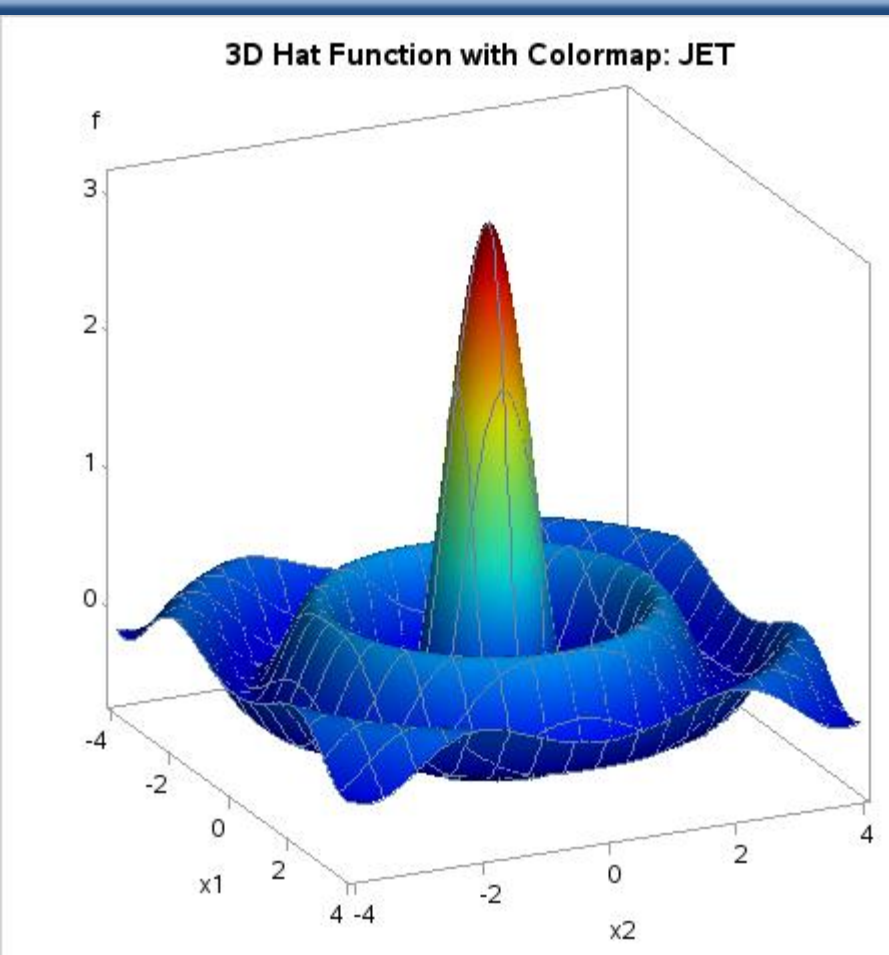
Reference your template and dataset in **PROC SGRENDER** to complete the visualization.

EXAMPLE – SURFACE PLOT



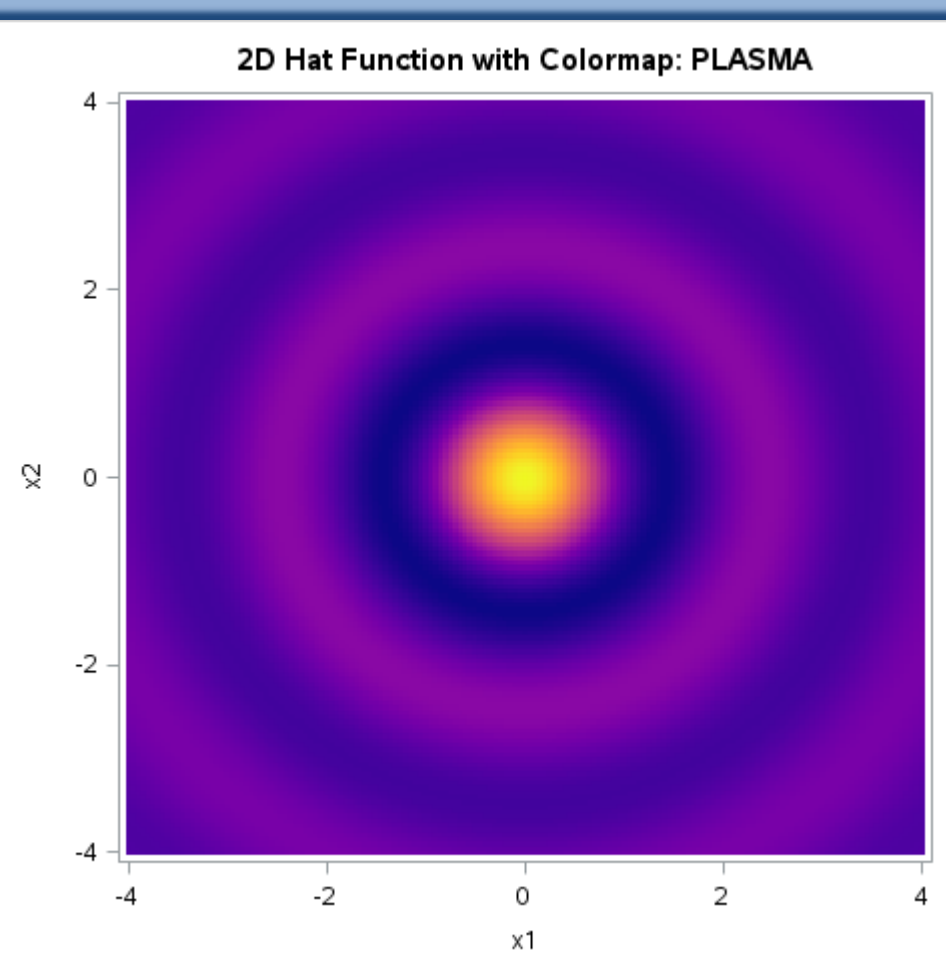
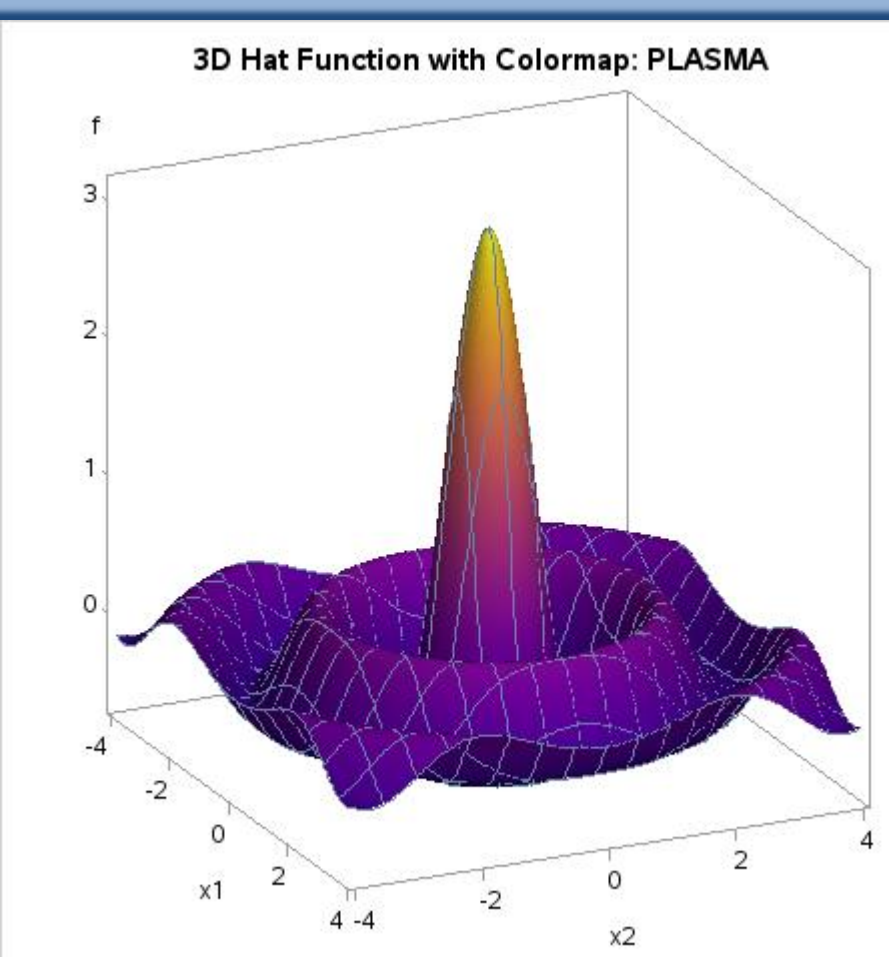
SAS Default Style HTMLBLUE:

Smooth transitions between colors. Center color of white implies a middle region of significance.



Common rainbow colormap JET:

Sharp transitions between colors, implying sharp gradients in data. Brightness scales from dark to light to dark.



Linear colormap PLASMA:

Smooth transitions between colors. Brightness scales dark to light. Highlights true trends in this continuous data.

11362 - Generating Color Scales in SAS®: 256 Shades of RGB

Jeff GRANT – Mahmoud MAMLOUK

Bank of Montreal, Business Initiatives, Toronto CA and Chicago IL

METHOD - 3D SCATTER

Define your colormap

You can use any combination of linear or non-linear functions to define the R, G, and B curves. Combine the RGB triplet and convert to hexadecimal.

Scale your data

Use a `color_index` field to rank your data from its minimum (1) to its maximum (256). Join on the `color_index` field in your colormap.

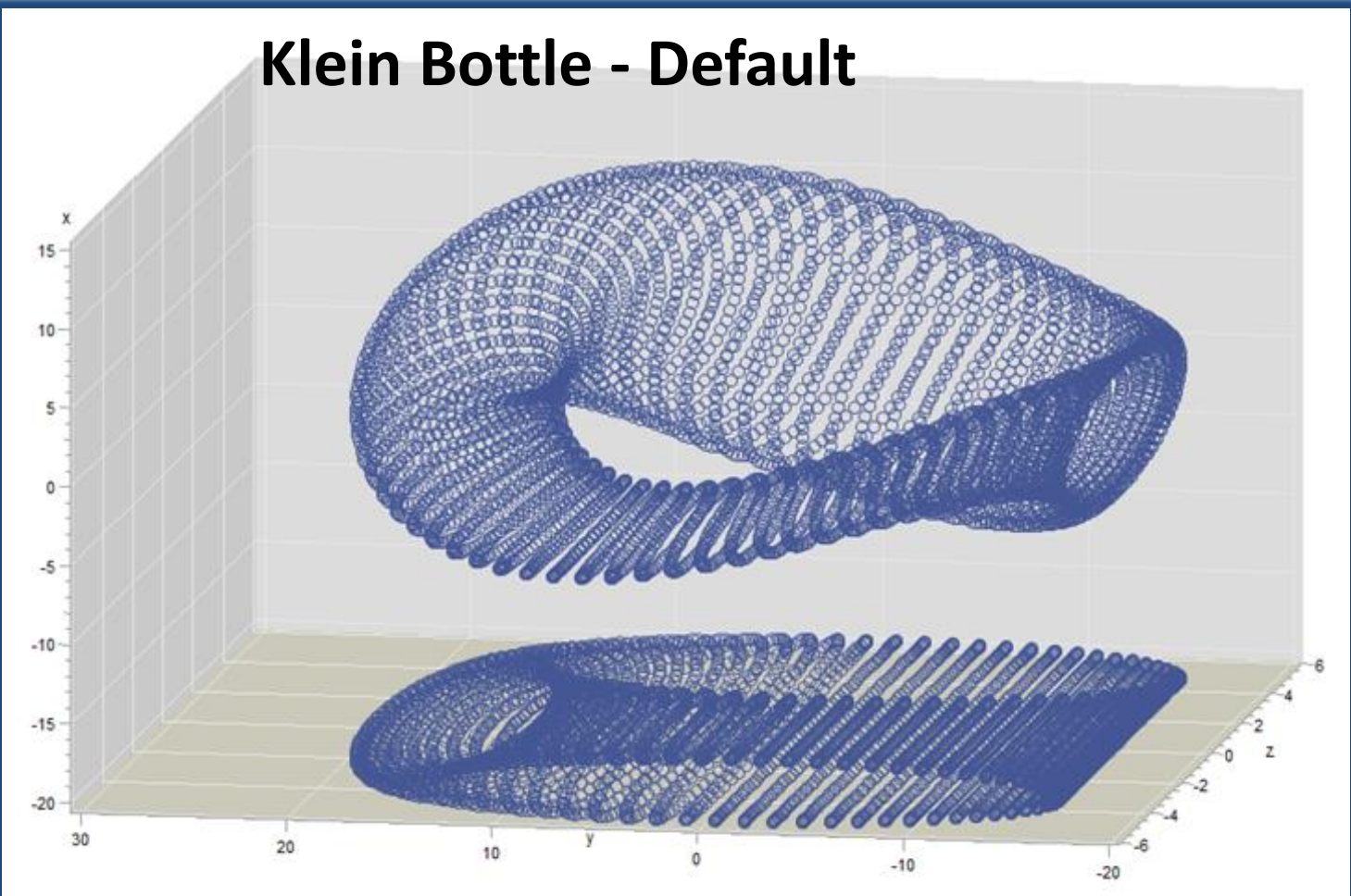
Plot

Reference your `color_index` in **PROC G3D** to complete the visualization.

KEY STATEMENTS

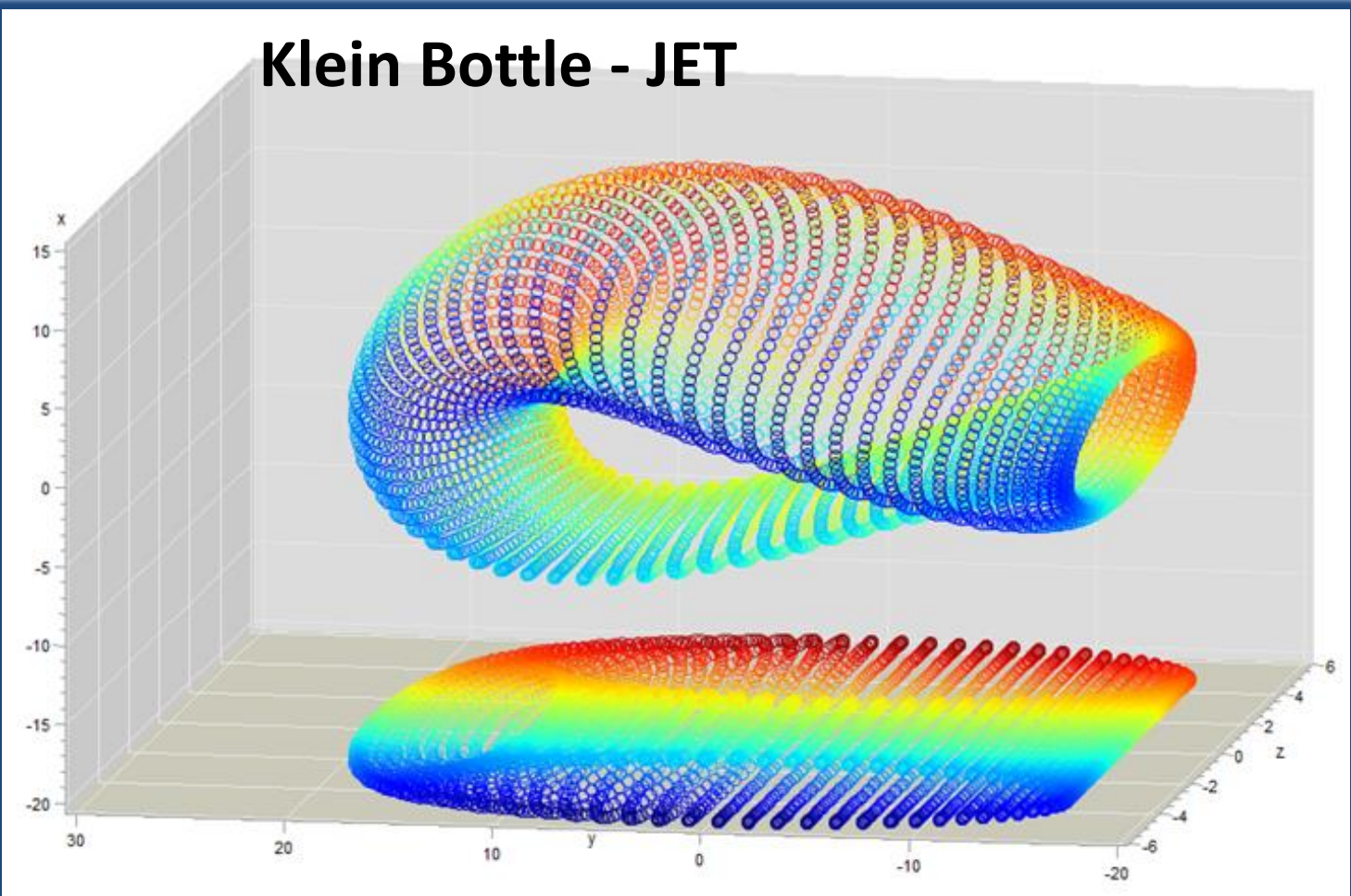
PROCEDURE	OPTION	PURPOSE
PROC TEMPLATE	RANGEATTRMAP, RANGEATTRVAR	Establish the color/data mapping
PROC TEMPLATE	(2D) HEATMAPPARM with COLORRESPONSE=	Select the previously established colormap
PROC SGRENDER	TEMPLATE=	Render the graphics with the defined template
PROC G3D	SCATTER w/ COLOR=	Establish the color/data mapping without assigning a template

EXAMPLE – SCATTER PLOT



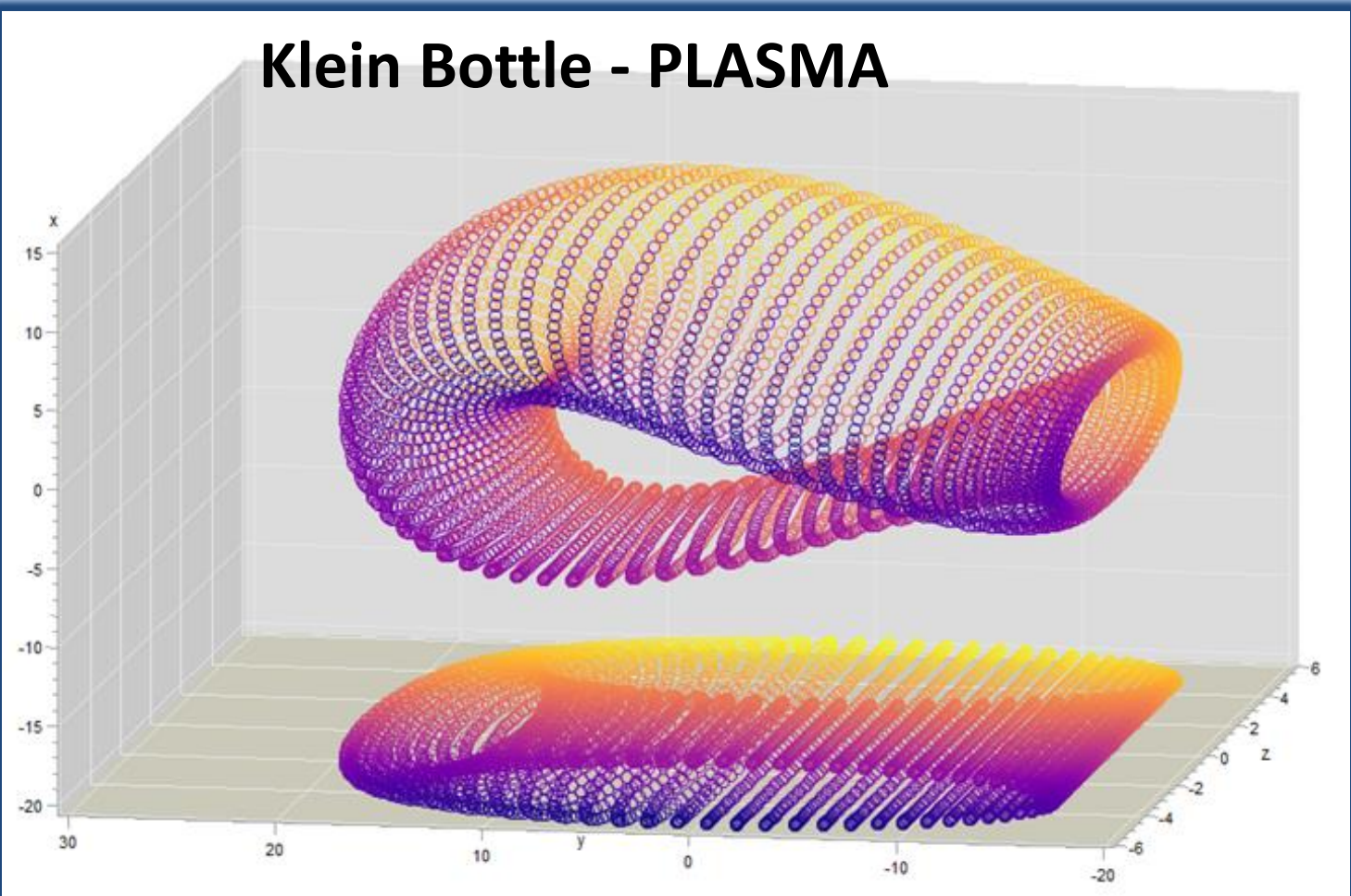
SAS Default Style HTMLBLUE:

All points given the same color. Hard to see if there are different levels – the plot doesn't suggest complex geometry.



JET Colormap:

Can distinguish what's in the different planes. Red is in the back, blue in the front and green/yellow highlights how the middle tube is inside the big tube.



PLASMA Colormap:

Similar to Jet, Plasma highlights the complex geometry of the Klein bottle and gives better perspective on the inner tube.

CONSIDERATIONS

Data:

Some data types are more conducive to certain colormaps – they can highlight significant features. E.g. water temperature with white as the freezing point

Colors:

Certain color combinations should be avoided for colorblindness. E.g. Deuteranomaly (Red/Green pairings)

Brightness:

Printers are usually grayscale and colors with similar brightness can be indistinguishable. Brightness should scale with the data.

CONCLUSIONS

- Colors are an important part of data visualization
 - The correct colormap can really help highlight the important features of your data
 - The wrong colormap can hinder understanding
- Using PROC TEMPLATE can add significant customization to your plots
- RANGEATTRMAP let you apply user-defined colormaps to your data
- PROC SGRENDER and ODS options provide options for final output and appearance
- PROC G3D has a built-in parameter (`color =`) when used with Scatter plot that accommodates a different color for each data point *without* the need to define a template

REFERENCES

- Nathaniel Smith, University of California, Berkeley, "A Better Default Colormap for Matplotlib", SciPy 2015 (<https://bids.github.io/colormap/>)
- Warren F. Kuhfeld, SAS Institute Inc, Cary NC "The Graph Template Language and the Statistical Graphics Procedures: An Example-Driven Introduction", SAS Global Forum 2010, 334-2010.
- Steve Eddins, MathWorks, "Rainbow Color Map Critiques" http://www.mathworks.com/tagteam/81137_92238v00_RainbowColorMap_57312.pdf
- Paul Bourke, Klein Bottle parametrization (<http://paulbourke.net/geometry/klein/>)



SAS[®] GLOBAL FORUM 2016

IMAGINE. CREATE. INNOVATE.

LAS VEGAS | APRIL 18-21

#SASGF