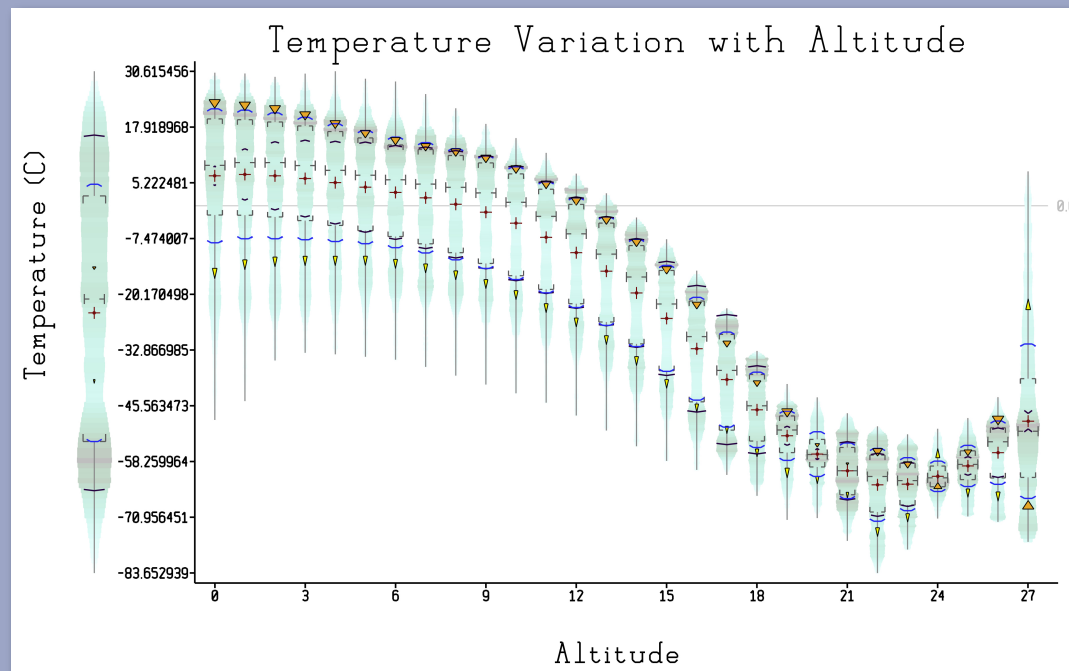


Visualization of statistical measures of uncertainty



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University of Utah
Oct. 31, 2007

What is uncertainty?

- standard deviation
- error
- confidence level
- can be produced in any stage of the visualization pipeline

Visualization needs Uncertainty Information

- Qualitative information is typically missing
- Often presented alongside as tables, charts
- Should be incorporated into visualizations to maintain fidelity to data
- Create better decision making tools
- Improve the usefulness of visualization

Problems with Many Existing Uncertainty Visualizations

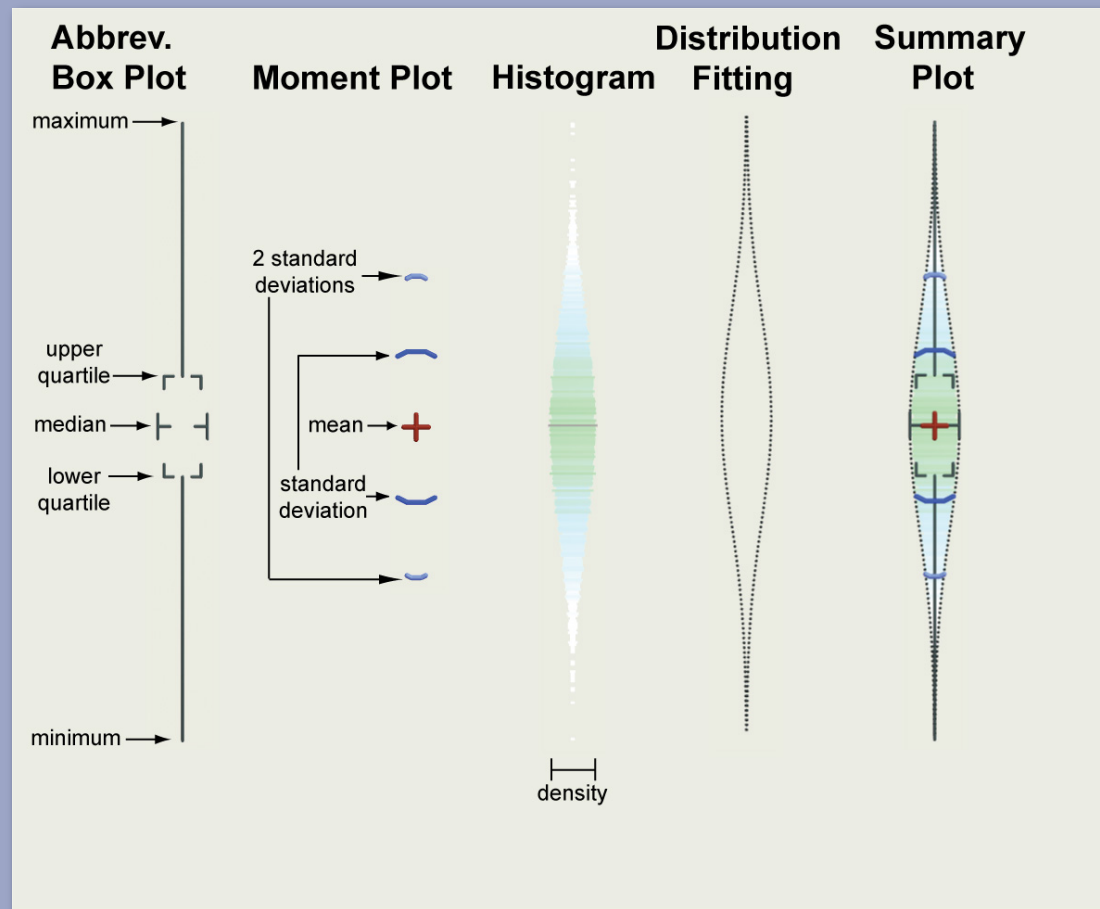
- Express syntax of uncertainty as “unknown” through blur, noise, distortion, transparency, etc.
- Can create distracting, unreadable visualizations
- Does not express the actual values of measures categorized as uncertainty

My Approach: Descriptive Statistics

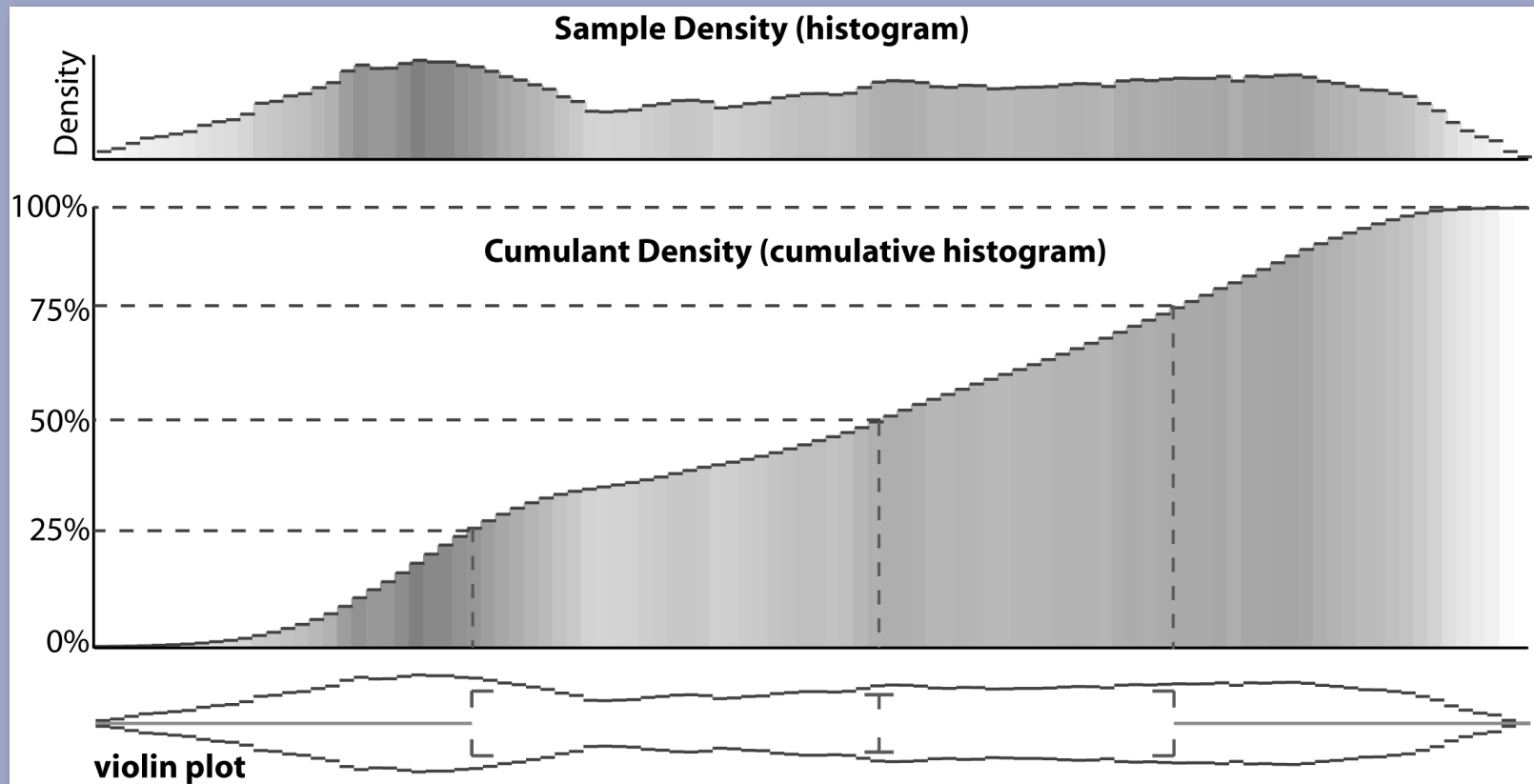
- Use statistics to describe the features and characteristics of the data set, including uncertainty
- Rather than rendering “uncertainty” render specific, meaningful, known values
- Look to existing techniques for displaying this information in 1D, translate to 2 & 3D

The Summary Plot

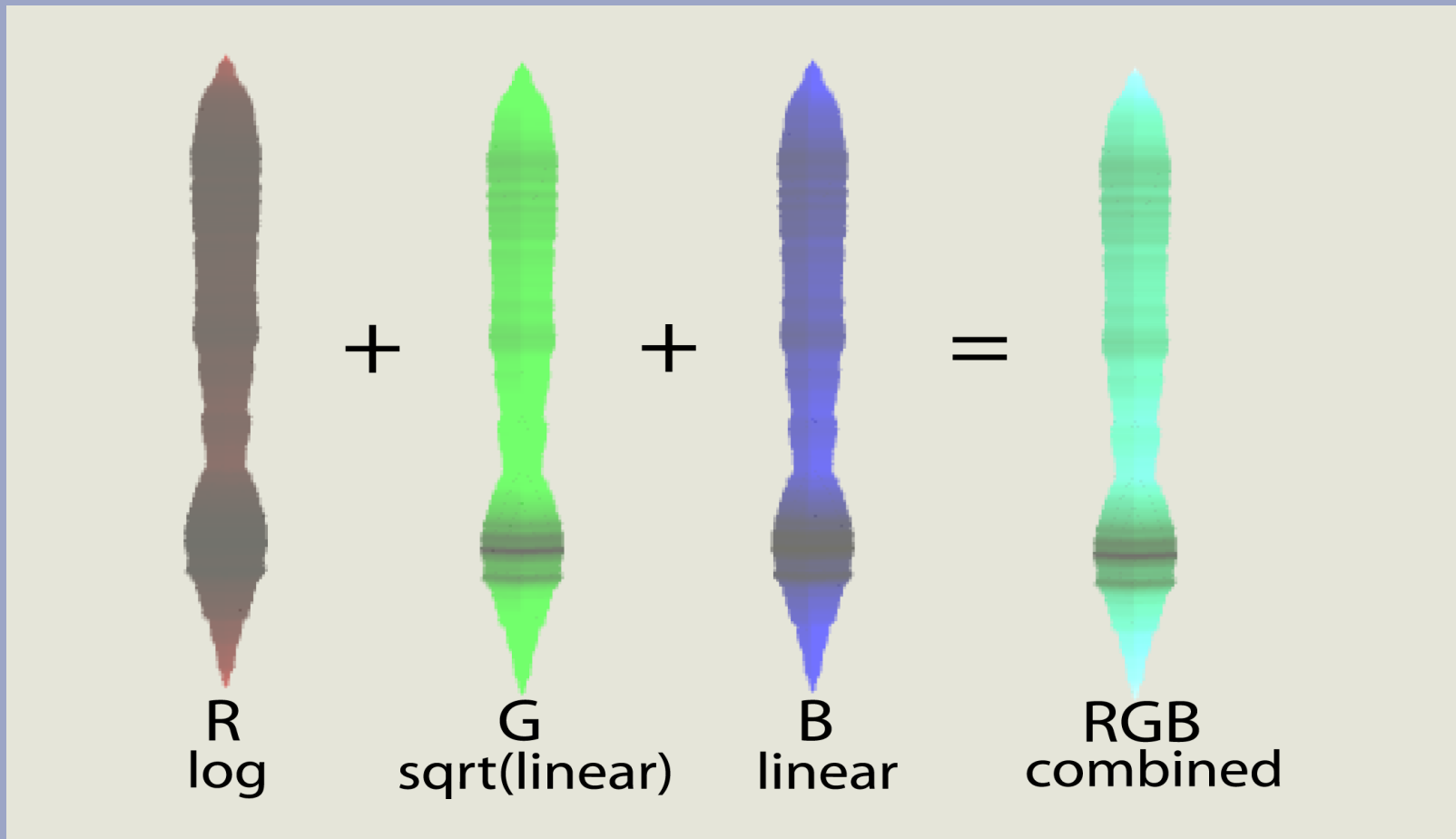
Combines multiple visual paradigms to describe the data



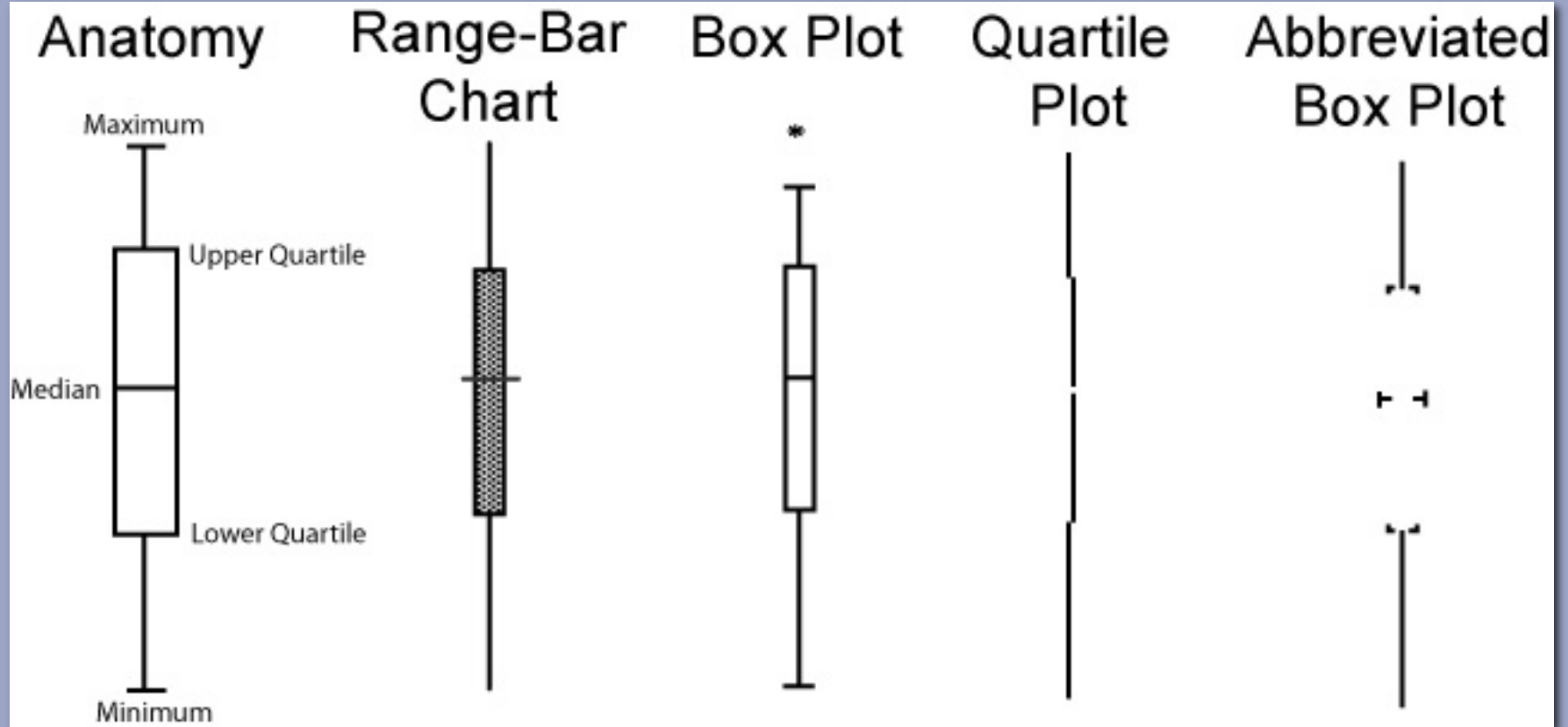
The Histogram



The Histogram

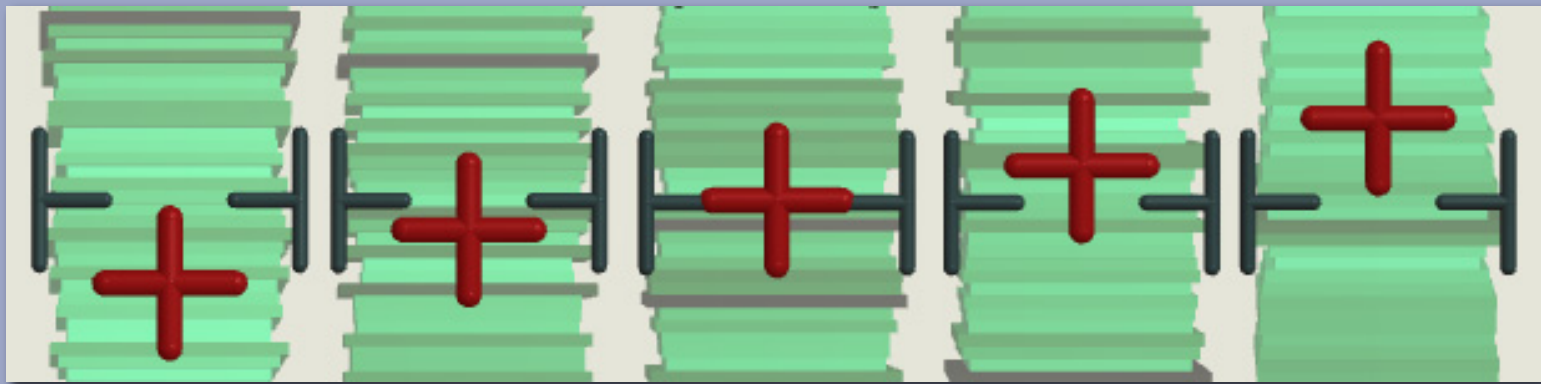


The Box Plot



Central Moments Plot

Create glyphs that describe the meaning of each moment

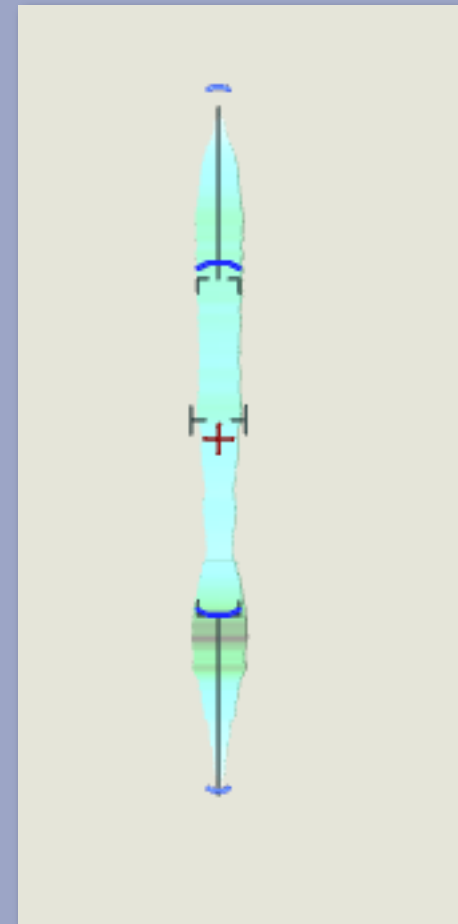


median = mean is a normal distribution

Central Moments Plot

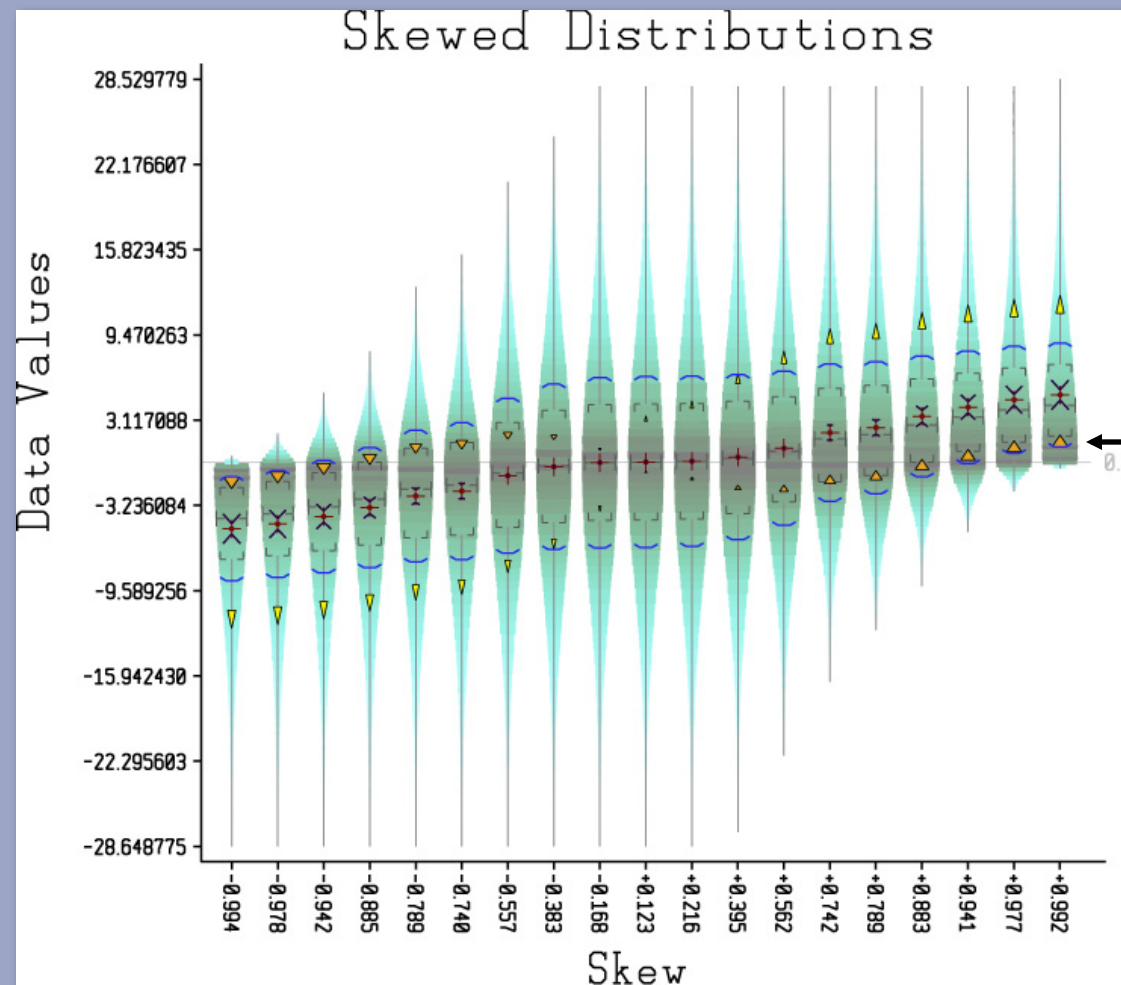
Create glyphs that describe the meaning of each moment

1st and 2nd
standard deviations



Central Moments Plot

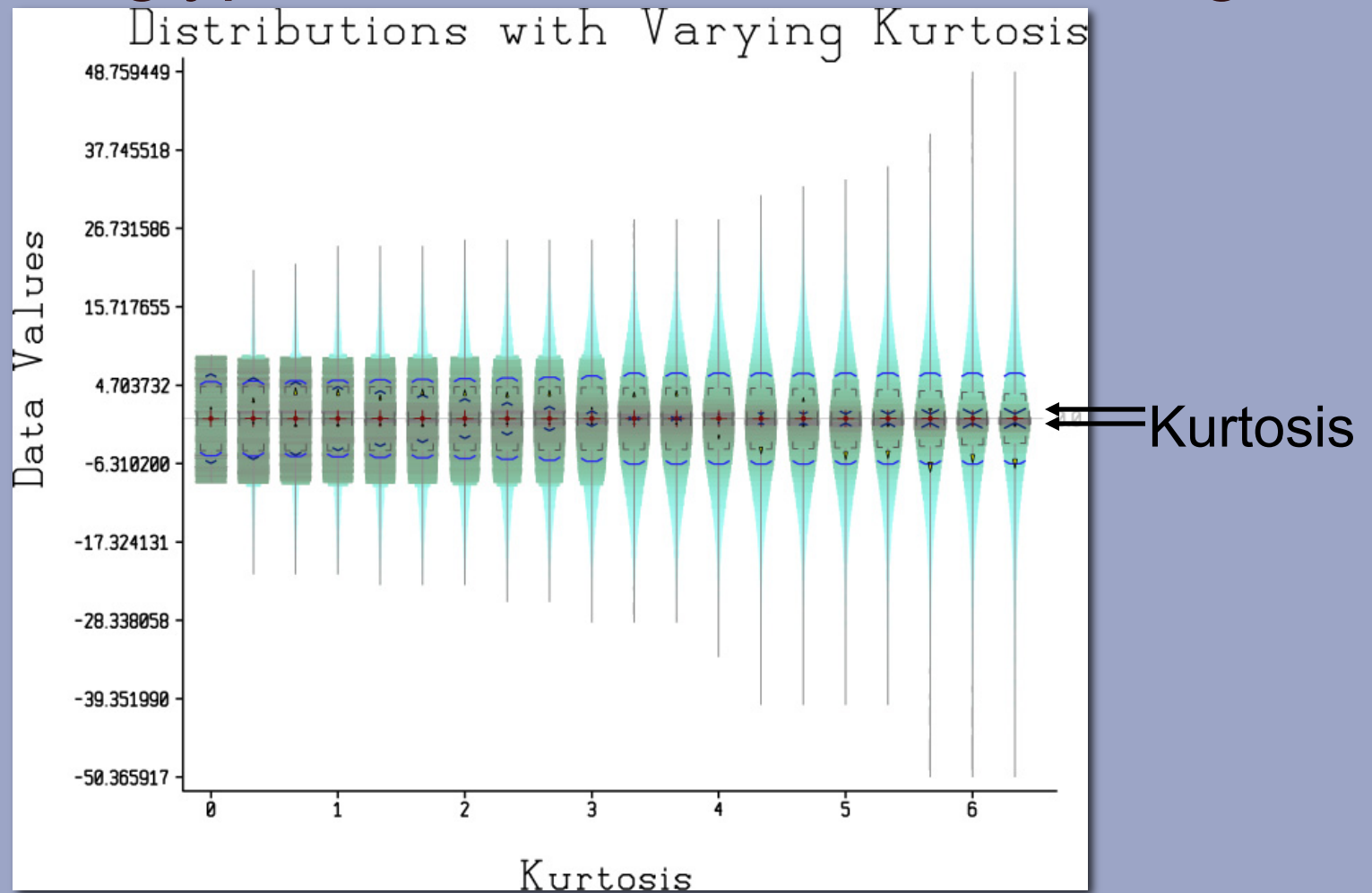
Create glyphs that describe the meaning



Skew

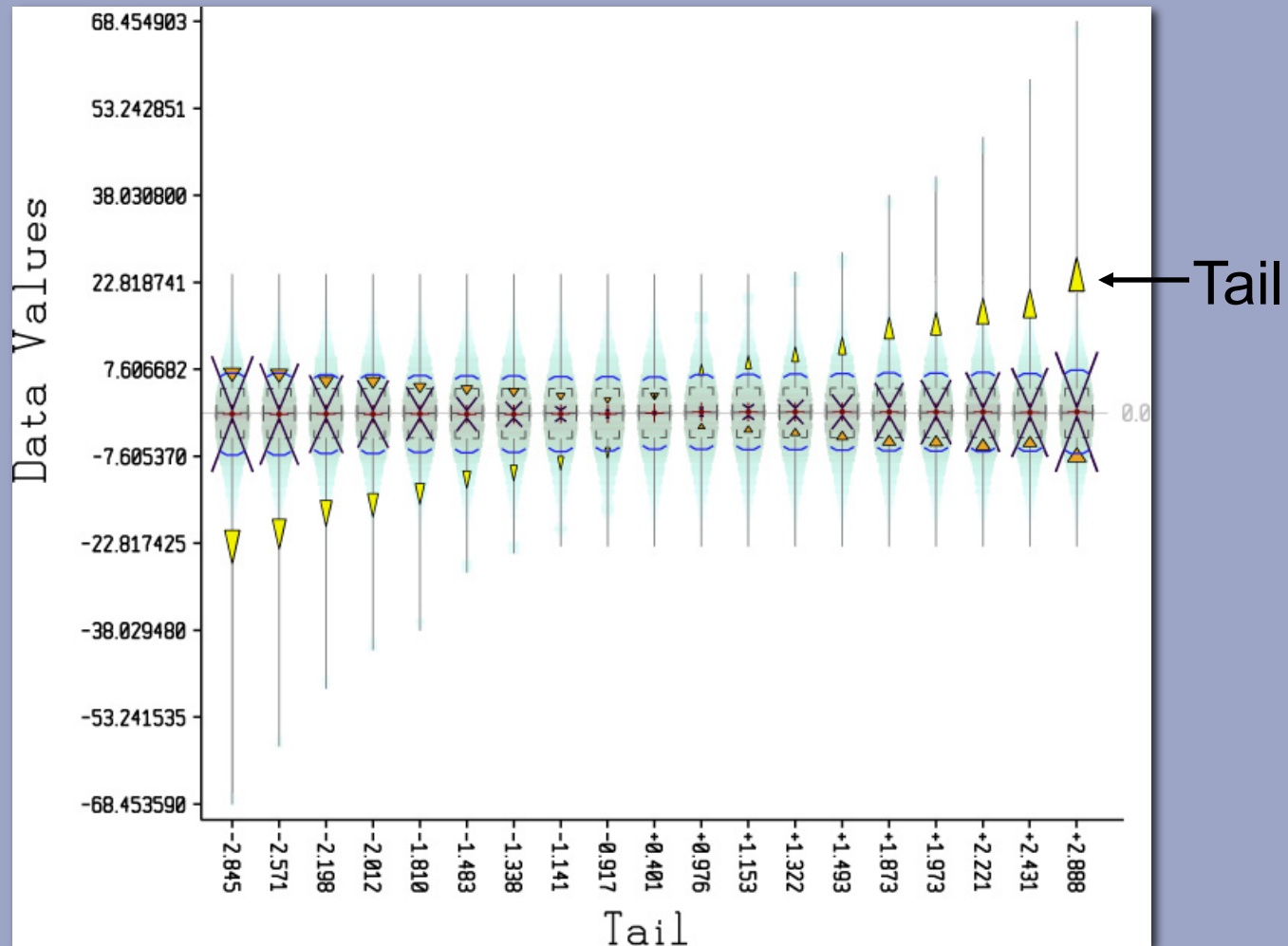
Central Moments Plot

Create glyphs that describe the meaning



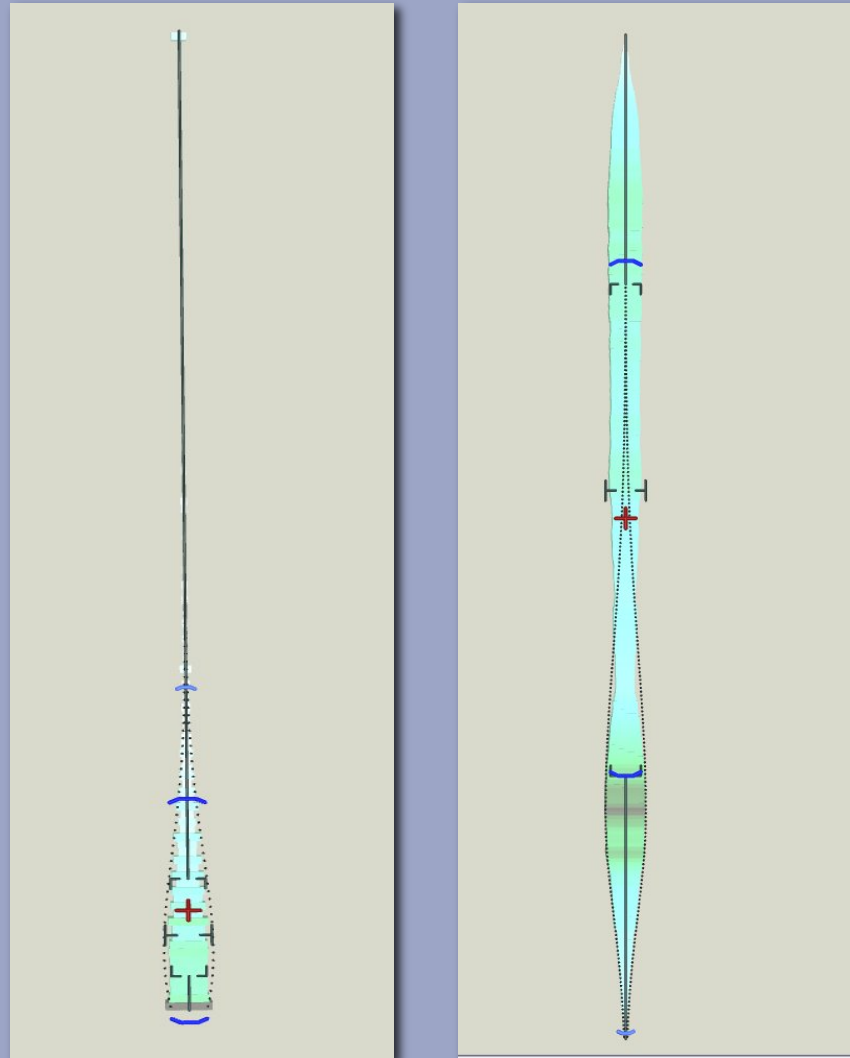
Central Moments Plot

Create glyphs that describe the meaning



Distribution Fitting

- Fit various distributions to the data
- Use the “violin plot” technique for displaying the fit alongside the data
- Through UI allow user to choose a specific distrib, or run through all for a “best fit”



User Interface

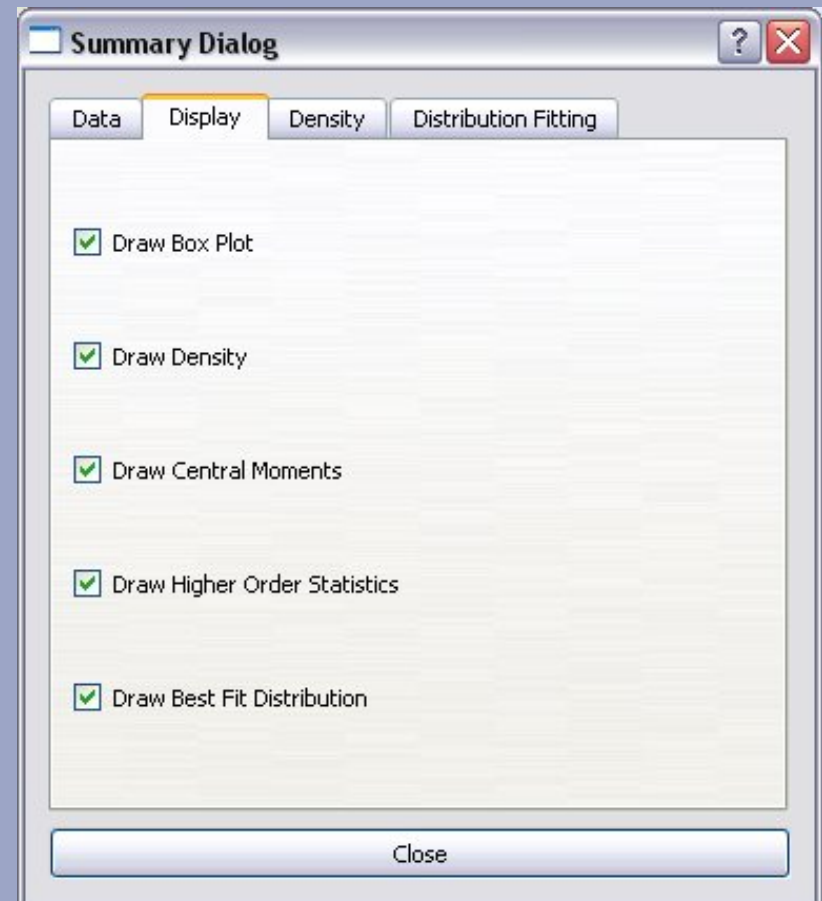
- Retrieve statistical values
- Reduce visual clutter
- Modify parameters
- Evaluate distributions

The image shows a software window titled "Summary Dialog" with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains several tabs: "Data" (selected), "Display", "Density", and "Distribution Fitting". Below the tabs, there are input fields for "Data File Name" (containing ".../data/weather/TT.nhdr") and "Number of Samples" (containing "1524096"). A section titled "5-Number Summary Statistics" contains five rows of data: Maximum (30.6155), Upper Quartile (2.23077), Median (-21.2582), Lower Quartile (-53.7056), and Minimum (-83.6529). Below this is a section titled "Central Moment Statistics" with two rows: Mean (-24.4183) and Standard Deviation (29.2872). At the bottom of the dialog is a "Close" button.

Statistic	Value
Data File Name	.../data/weather/TT.nhdr
Number of Samples	1524096
5-Number Summary Statistics	
Maximum	30.6155
Upper Quartile	2.23077
Median	-21.2582
Lower Quartile	-53.7056
Minimum	-83.6529
Central Moment Statistics	
Mean	-24.4183
Standard Deviation	29.2872

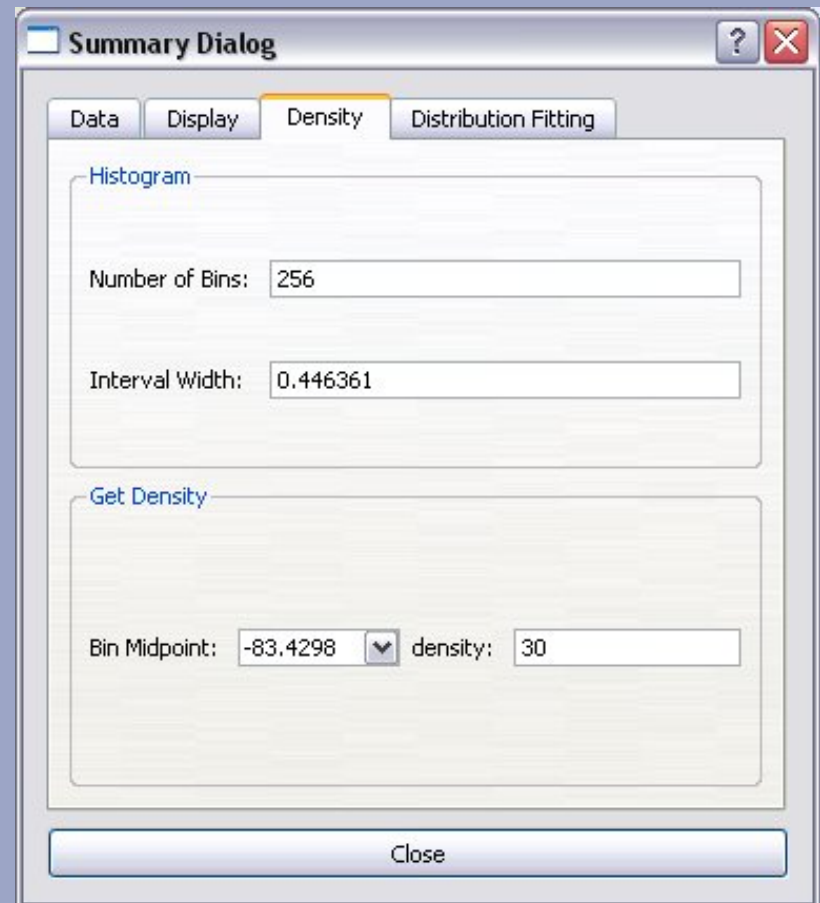
User Interface

- Retrieve statistical values
- Reduce visual clutter
- Modify parameters
- Evaluate distributions



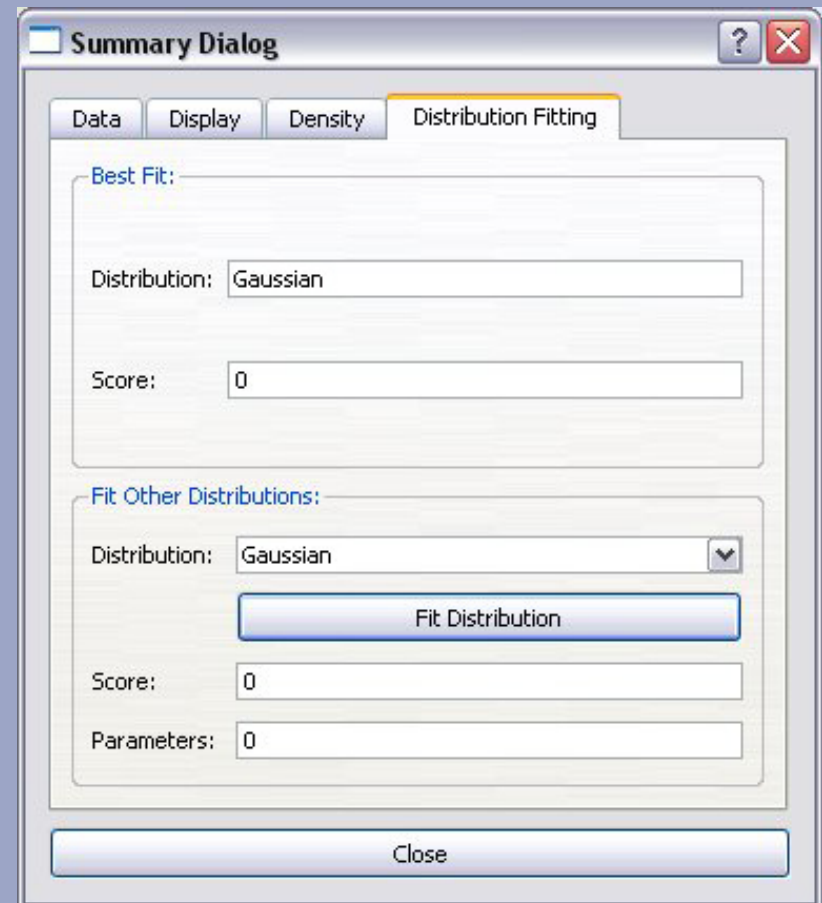
User Interface

- Retrieve statistical values
- Reduce visual clutter
- Modify parameters
- Evaluate distributions

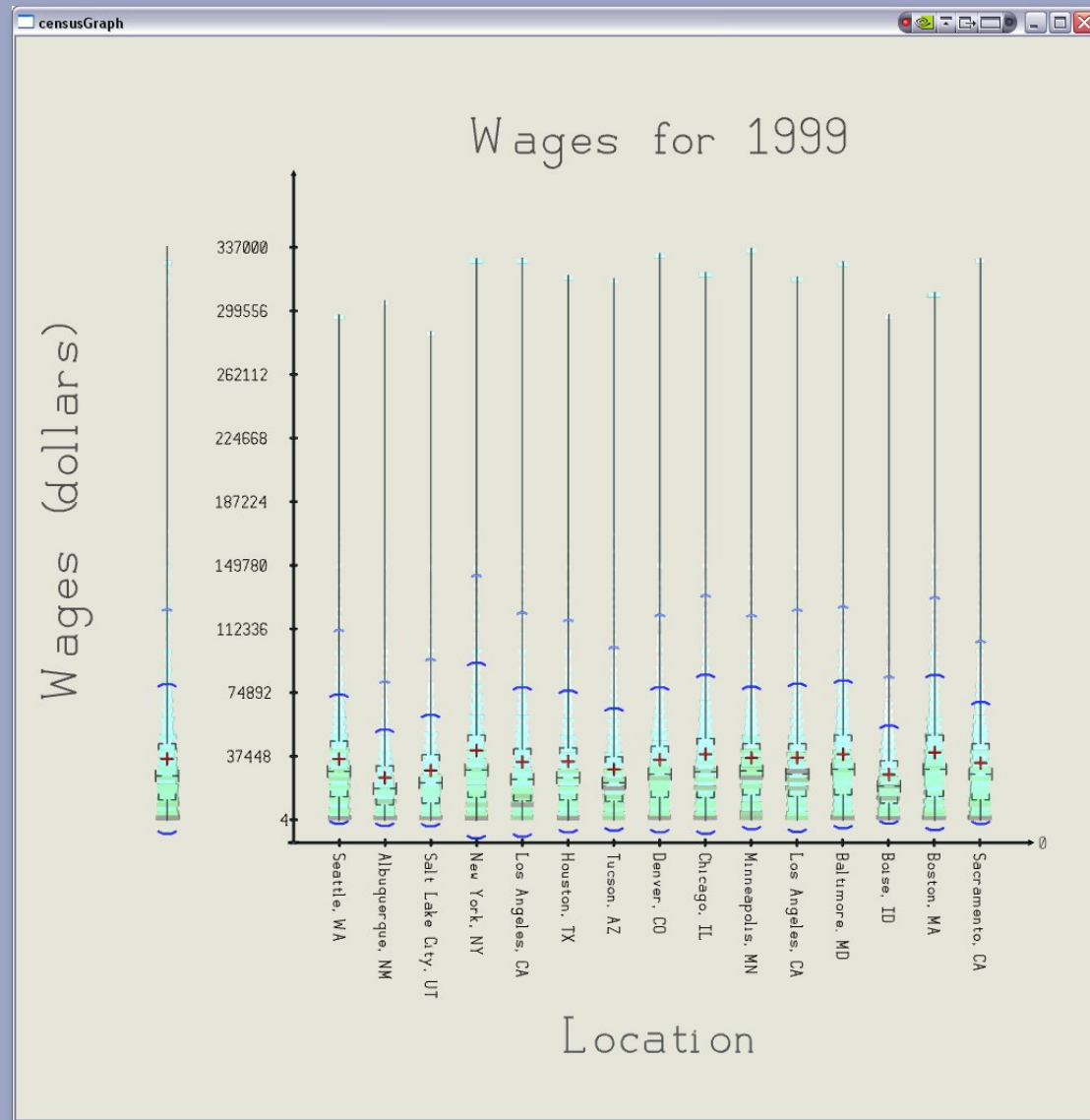


User Interface

- Retrieve statistical values
- Reduce visual clutter
- Modify parameters
- Evaluate distributions



1D Results



Move into Higher Dimensions

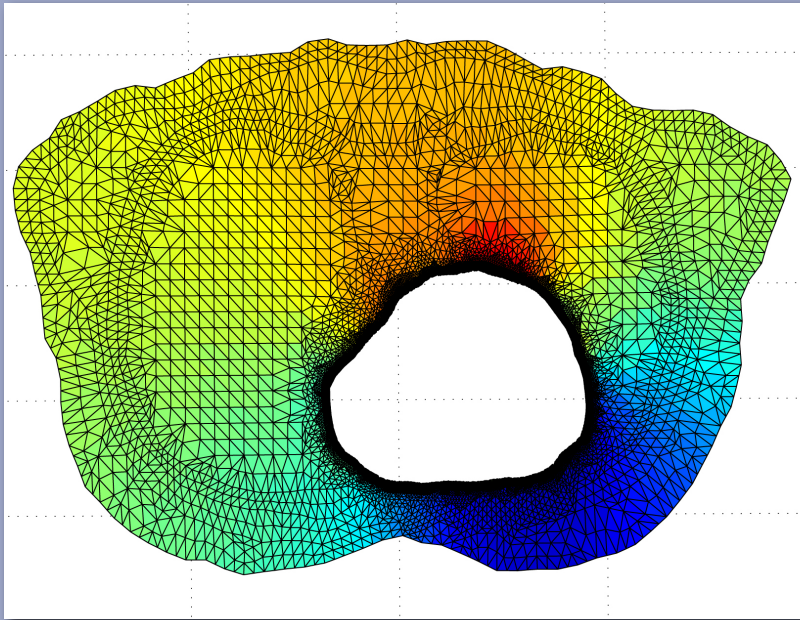
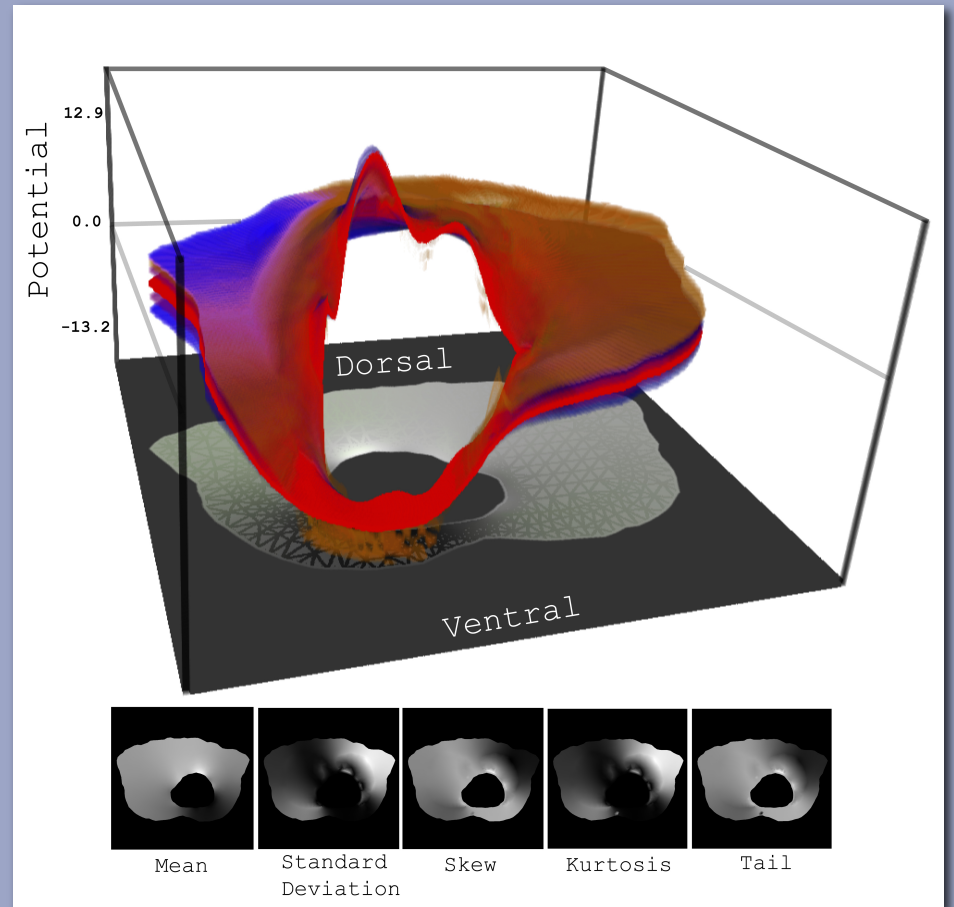


Image and data courtesy of
Sarah Geneser and Mike Kirby



Conclusion

- Rather than rendering “uncertainty”
render specific, meaningful,
known values
- Understand the various measures
that can describe uncertainty
- Design visualization techniques to
express these measures

Acknowledgements

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