VISUALIZATION FOR UNDERSTANDING REGRESSION MODELS

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8 September, 2020

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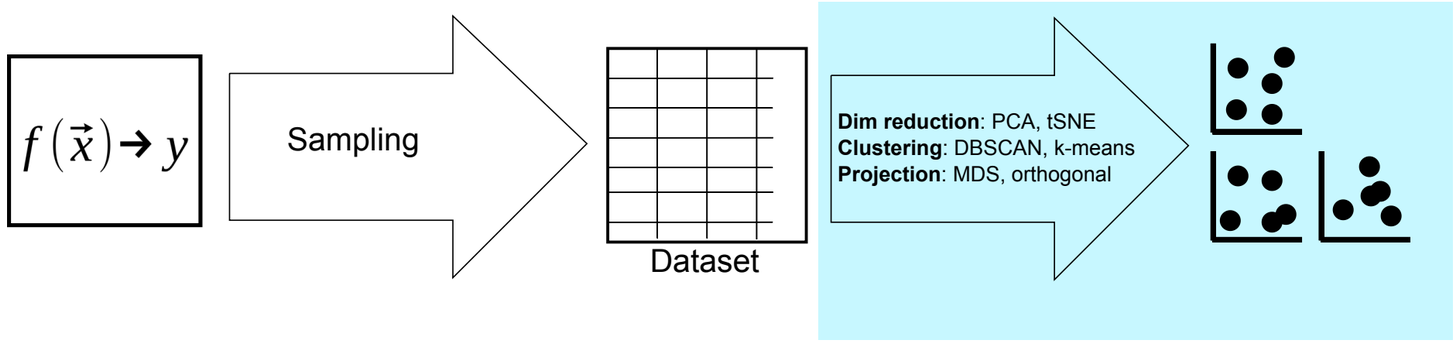
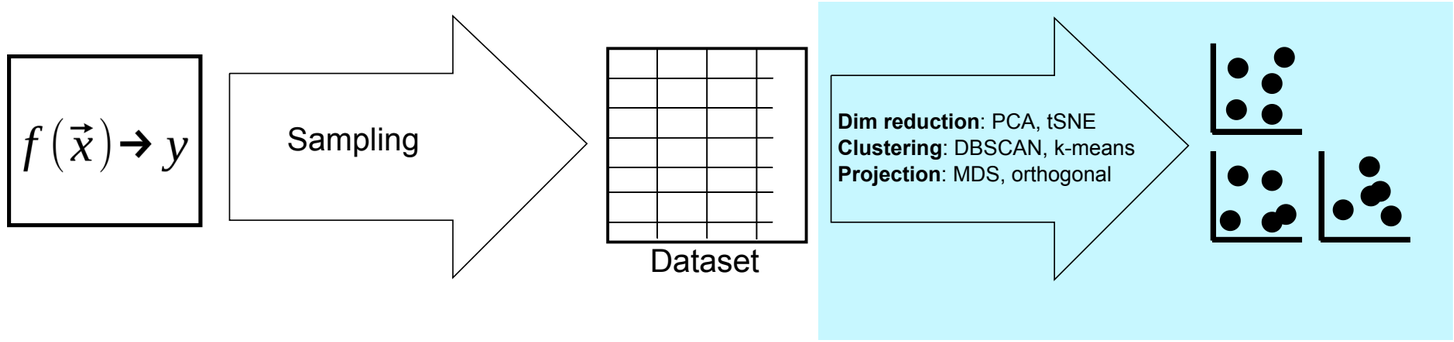
VISUALIZATION PIPELINES

Discrete

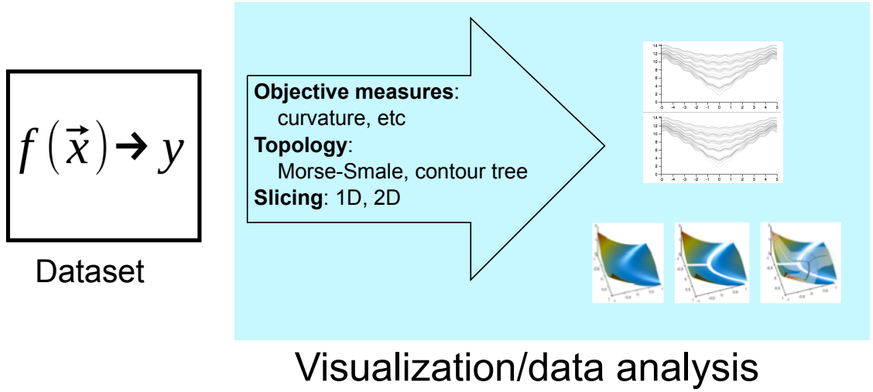


VISUALIZATION PIPELINES

Discrete



Continuous



AGENDA

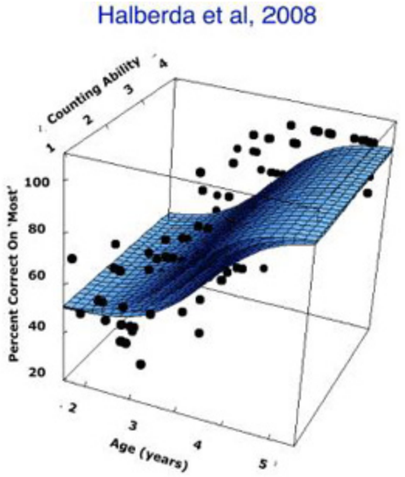
Benefits of treating a regression model itself as the “dataset” for visual data analysis

- What are regression algorithms?
- Overview of slicing
- Advantages of regression model as dataset

WHAT ARE REGRESSION MODELS?

"predict the value of one or more *continuous* target variables given the value of a D-dimensional vector of input variables" (Bishop 2006)

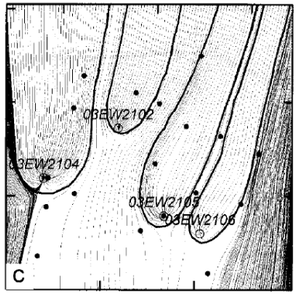
- Important bits:
  - Take a number of factors as input (often continuous)
  - Output is a scalar
  - Inputs are often meaningful
  - Conceptually a multi-dimensional surface (manifold)



key issue: how do we understand this multi-dimensional surface?

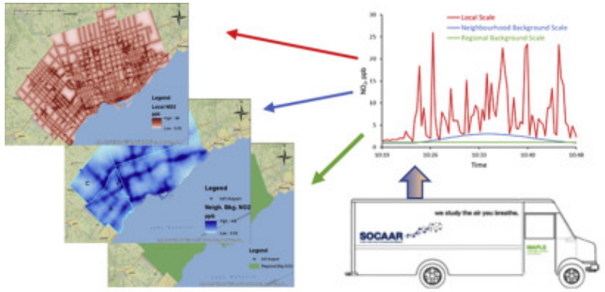
APPLICATION AREAS

Geostatistics



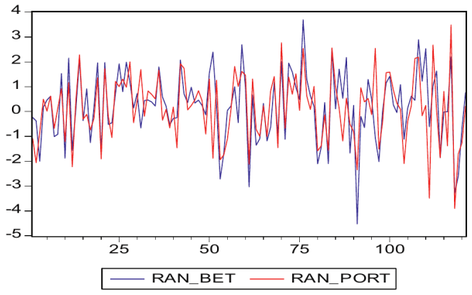
(Tonkin and Larson 2002)

Urban studies



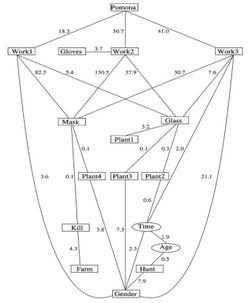
(Shairsingh et al. 2019)

Finance



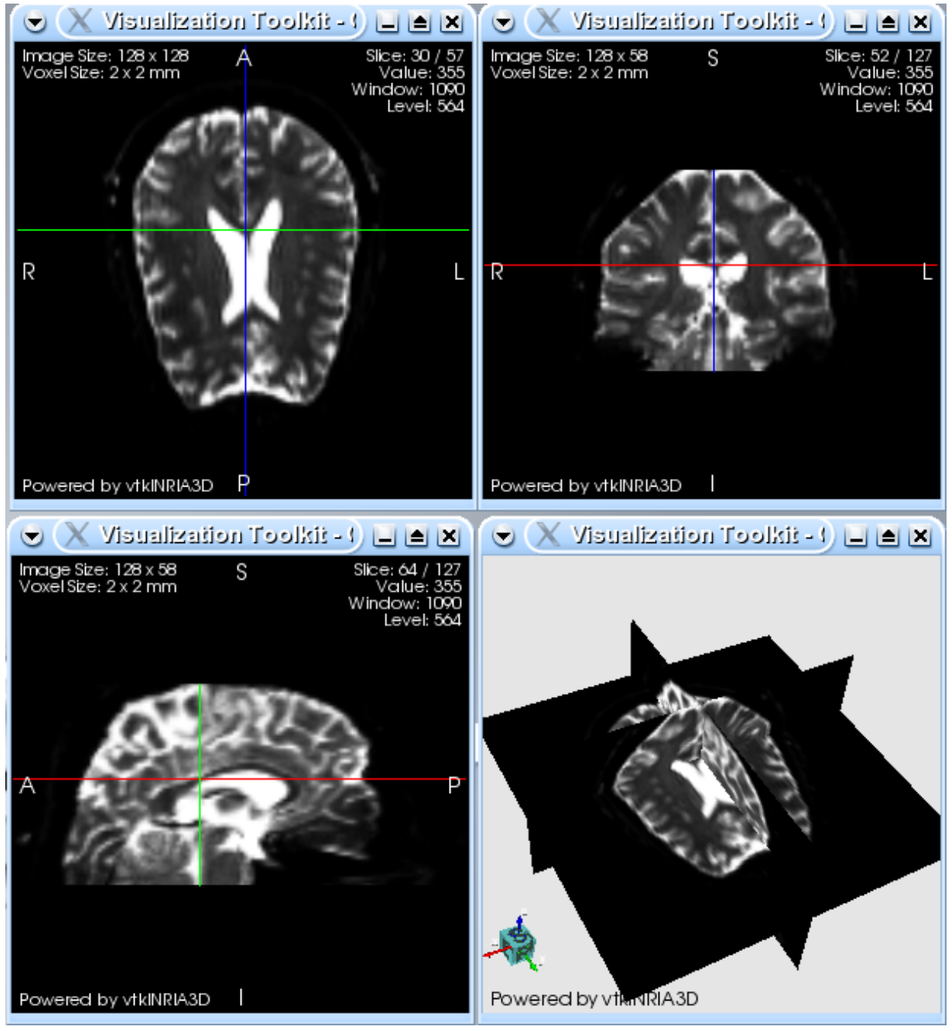
(Anghelache and Anghel 2014)

Epidemiology



(Pittavino et al. 2017)

SLICING



- **Pros**
  - Reduces dimensionality
  - Easy to understand metaphor
- **Cons**
  - Focus point selection important

MULTI-D SLICING

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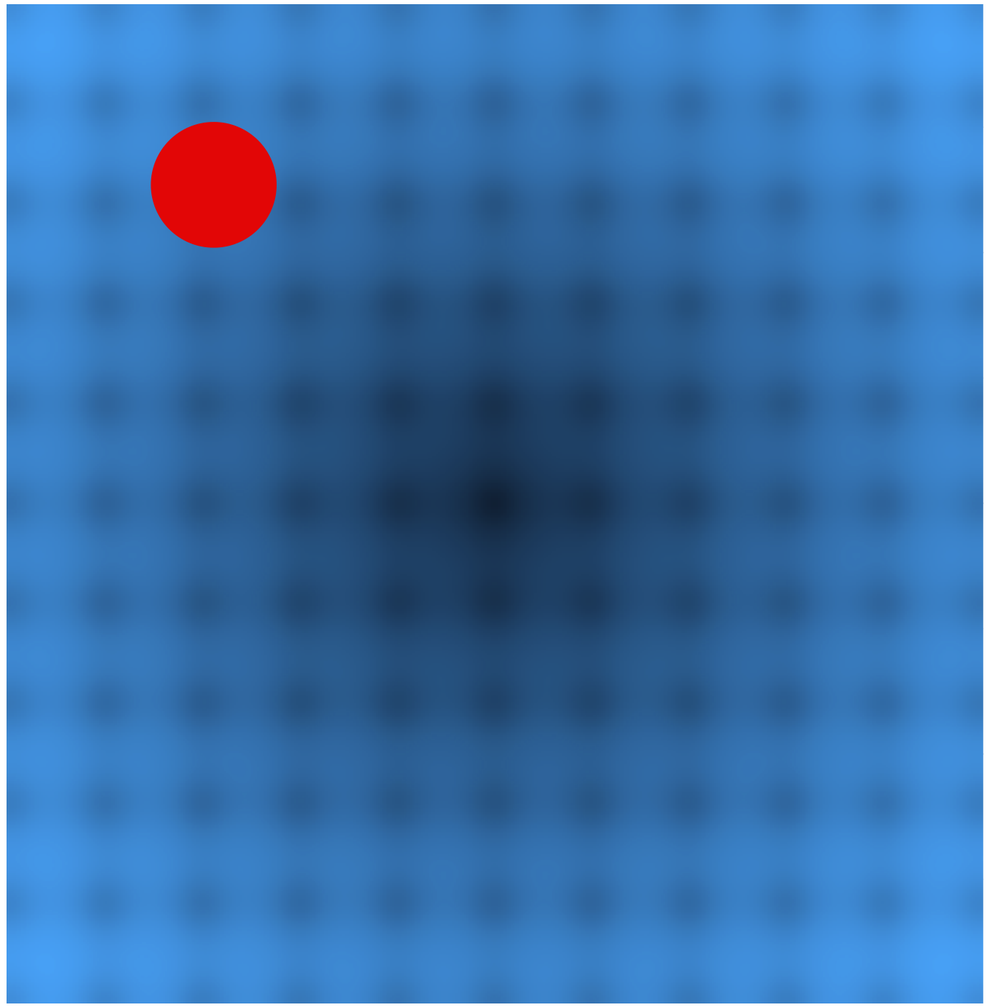

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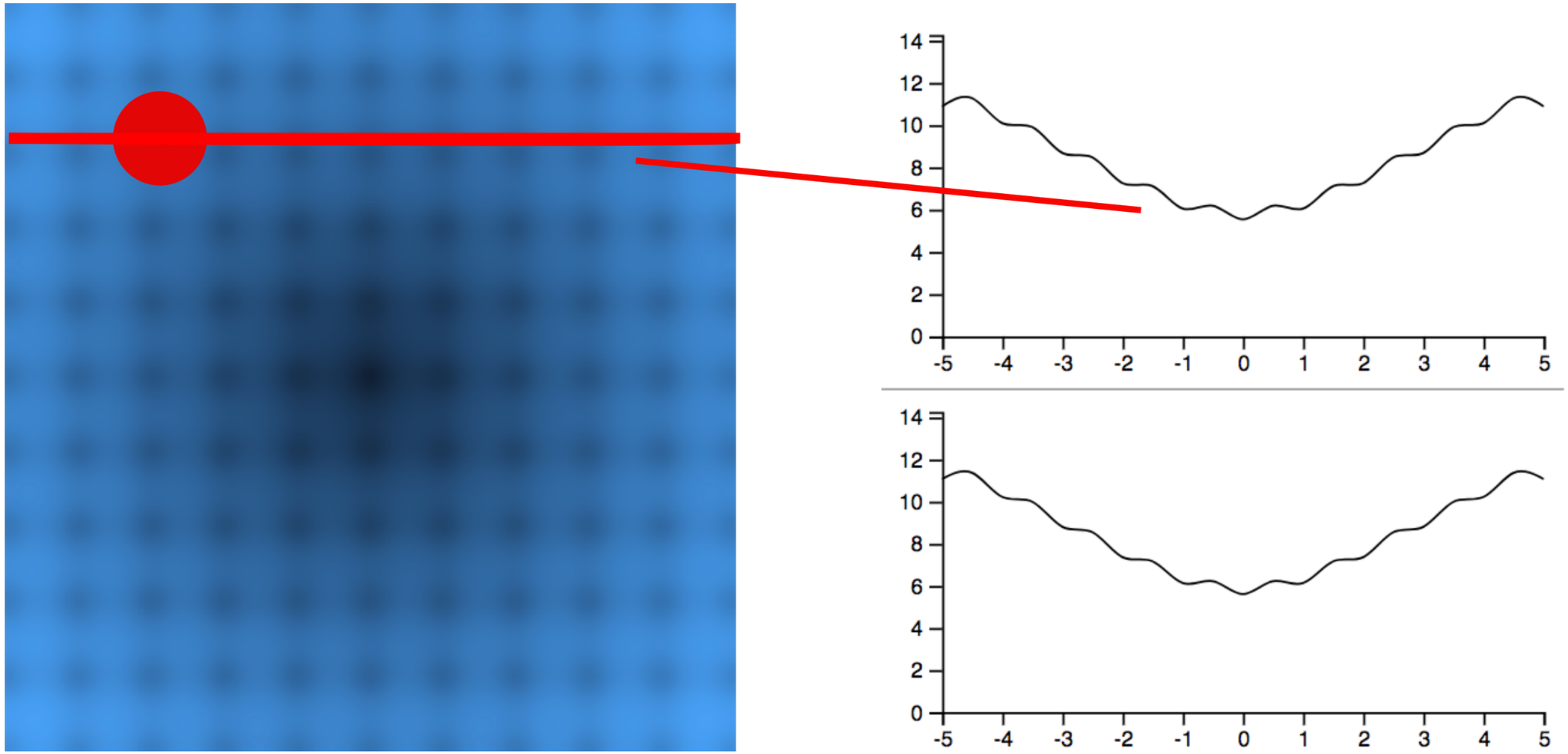

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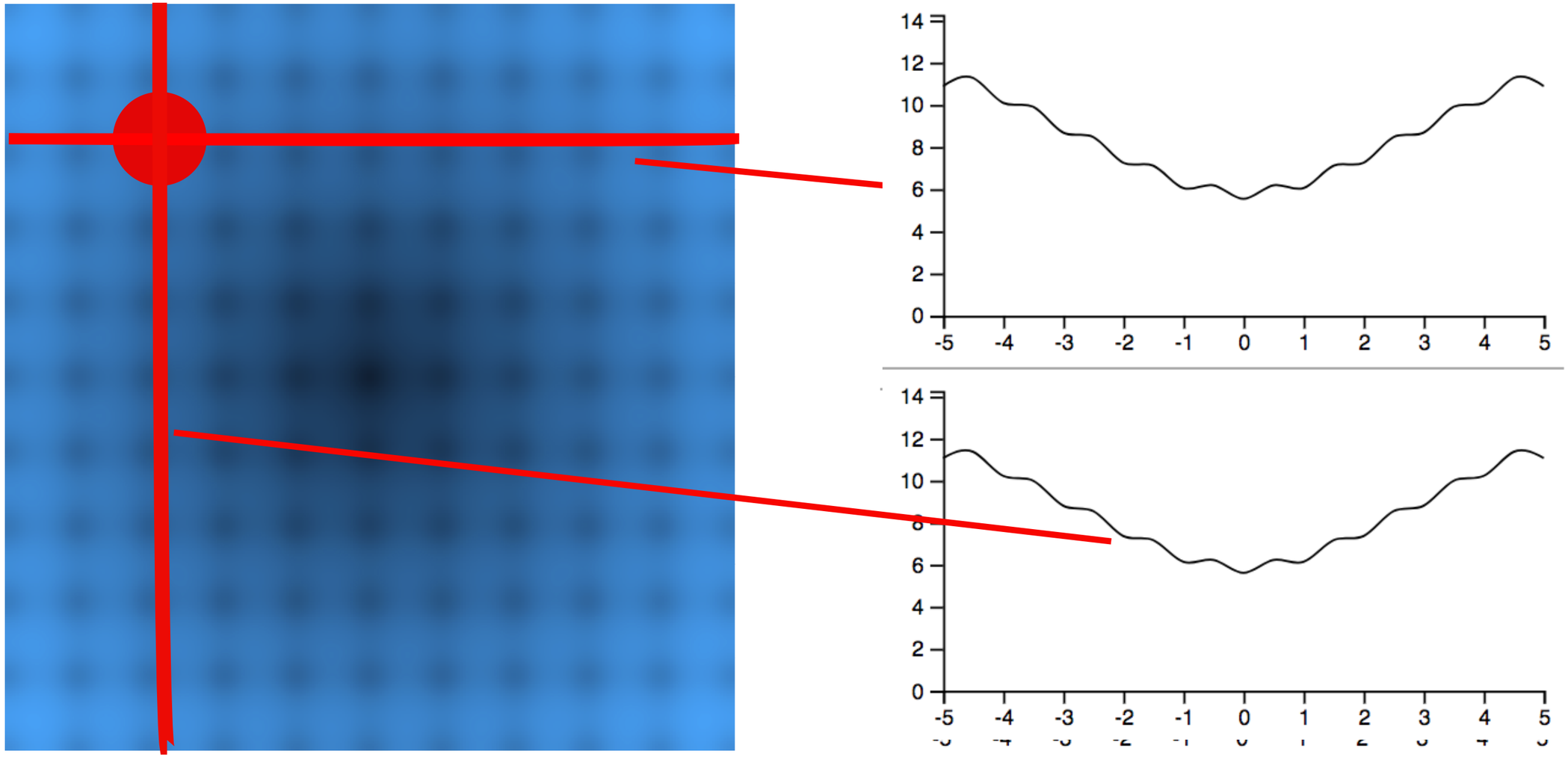
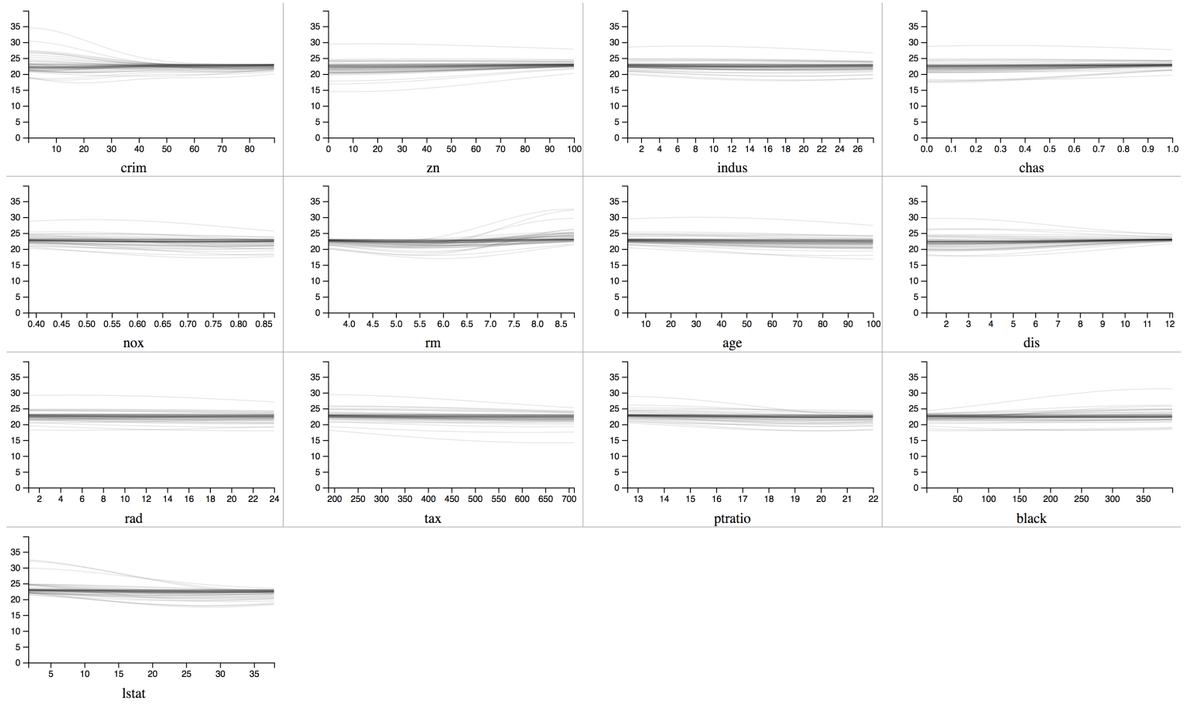


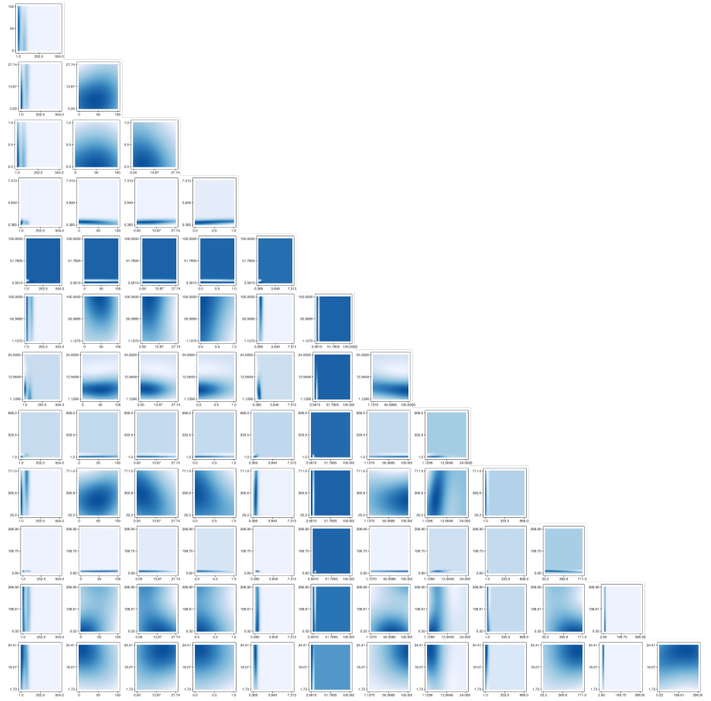
SLICING

1D



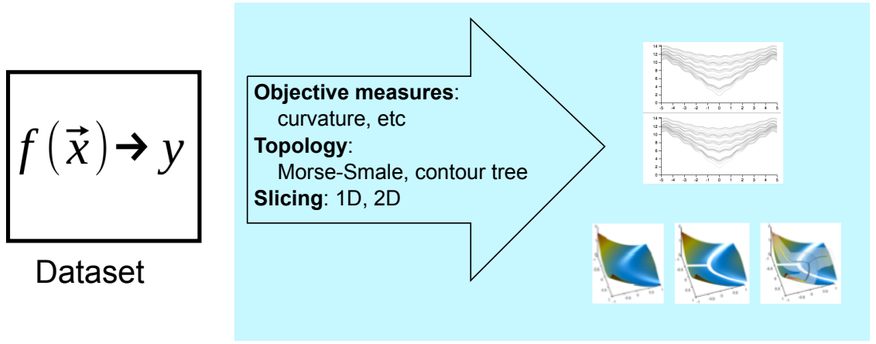
Sliceplorer (Torsney-Weir, Sedlmair, and Möller 2017)

2D



Hyperslice (Wijk and Liere 1993)

BENEFITS OF PIPELINE

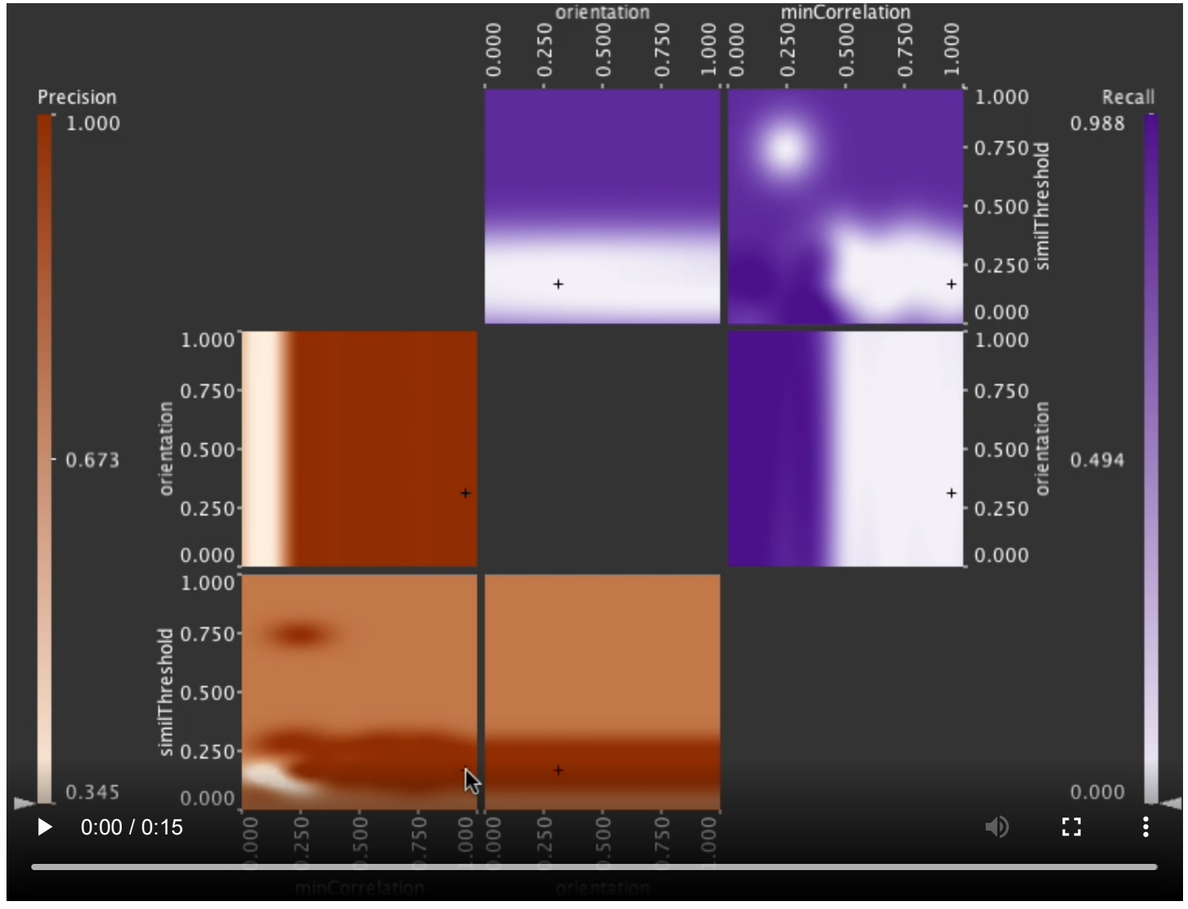


- Fast rendering
- Focus point selection

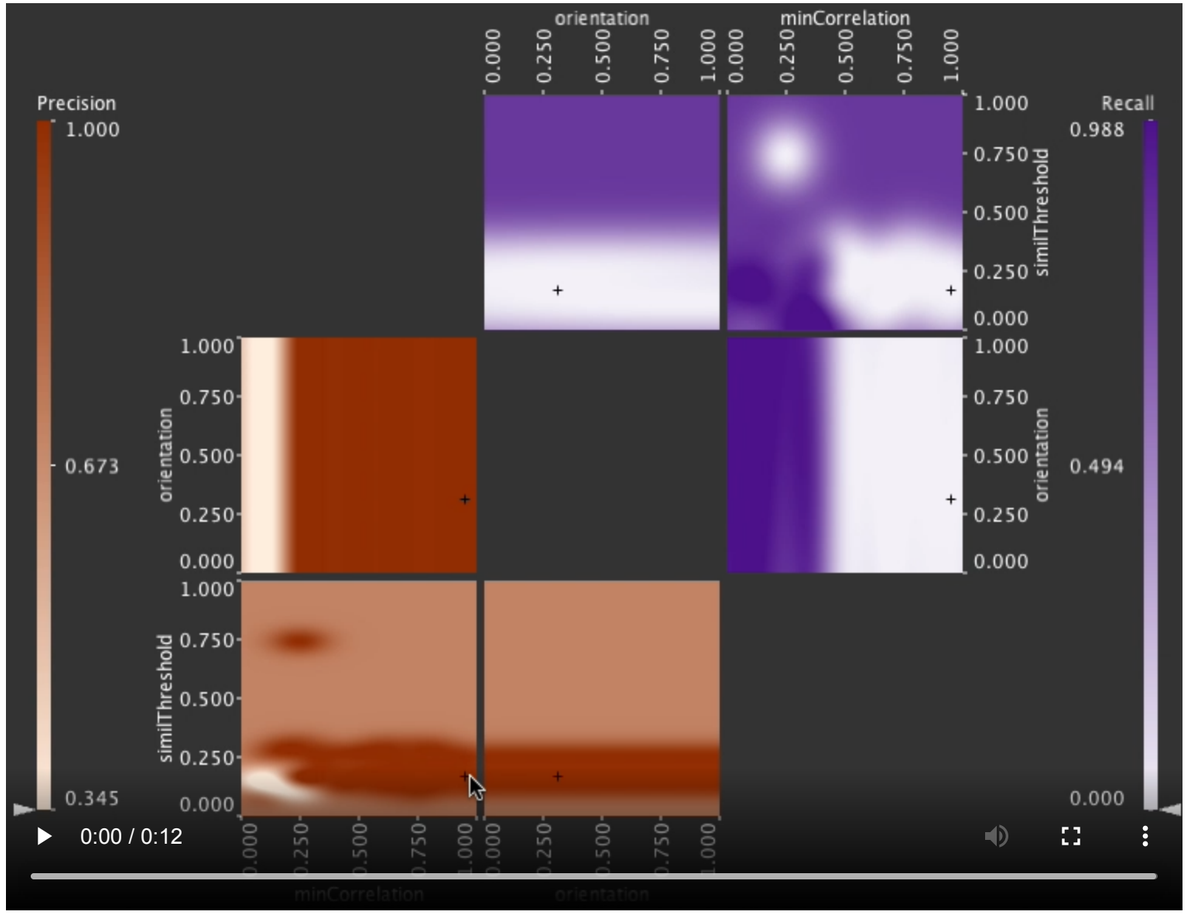
FAST RENDERING

Because we know the details of the model, the visualization system can execute the regression model at any point

3 fps

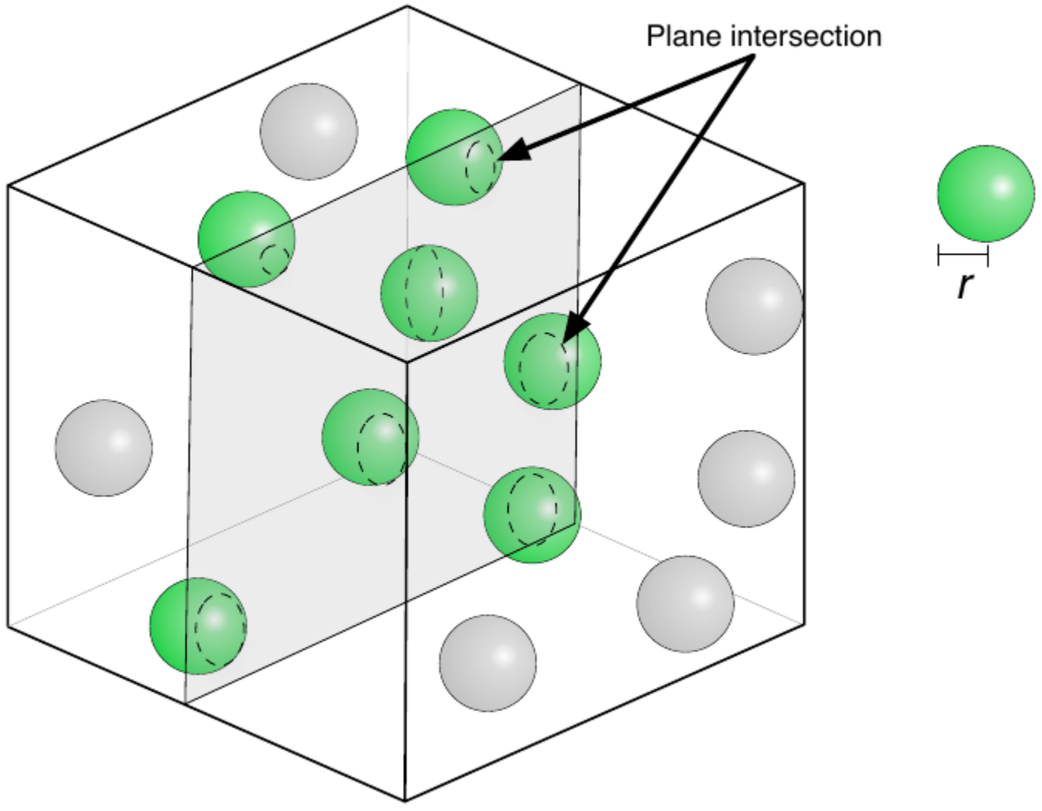


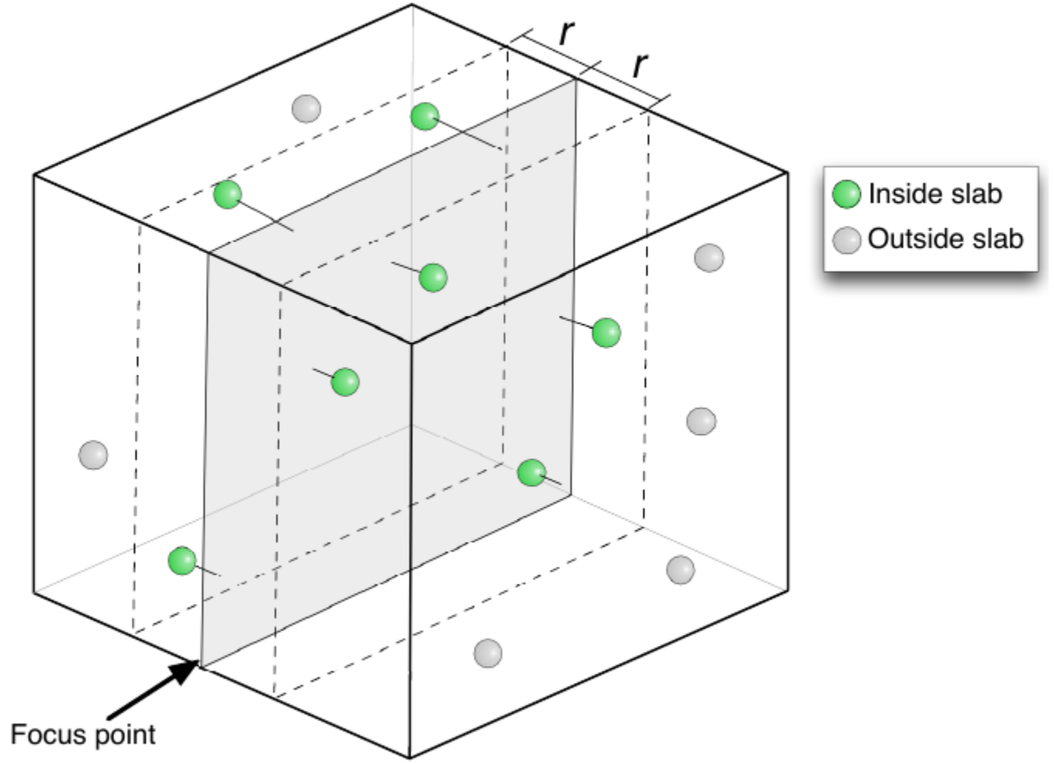
30 fps



FAST RENDERING

Knowing we were using Gaussian process models, we could analyze the geometry of the scene to figure out how to make it run faster





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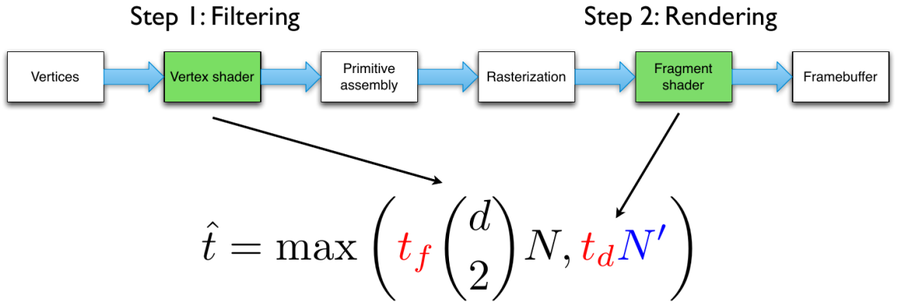
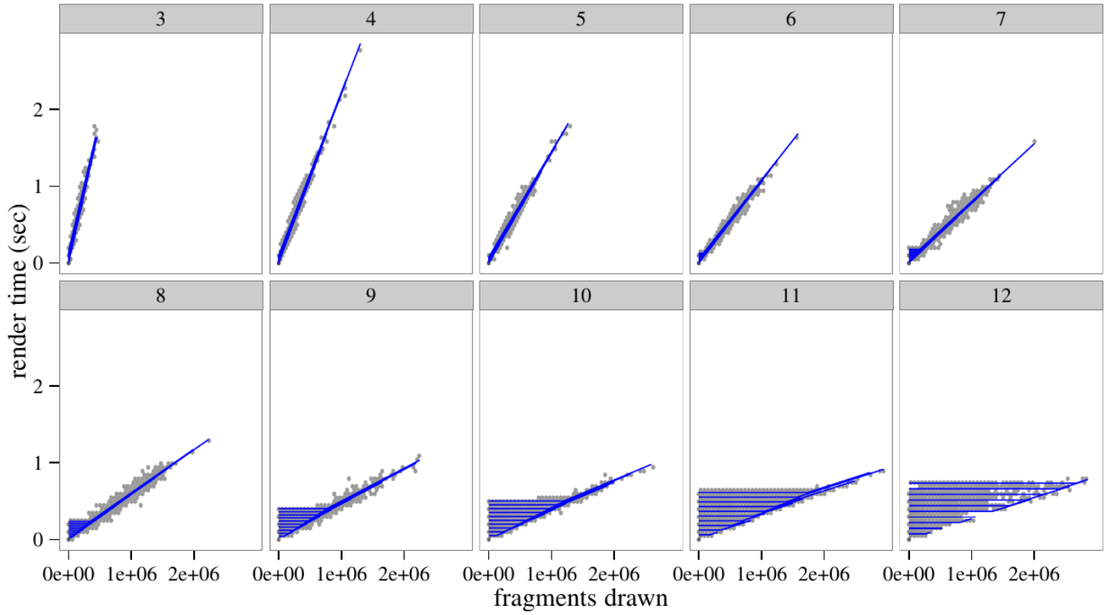
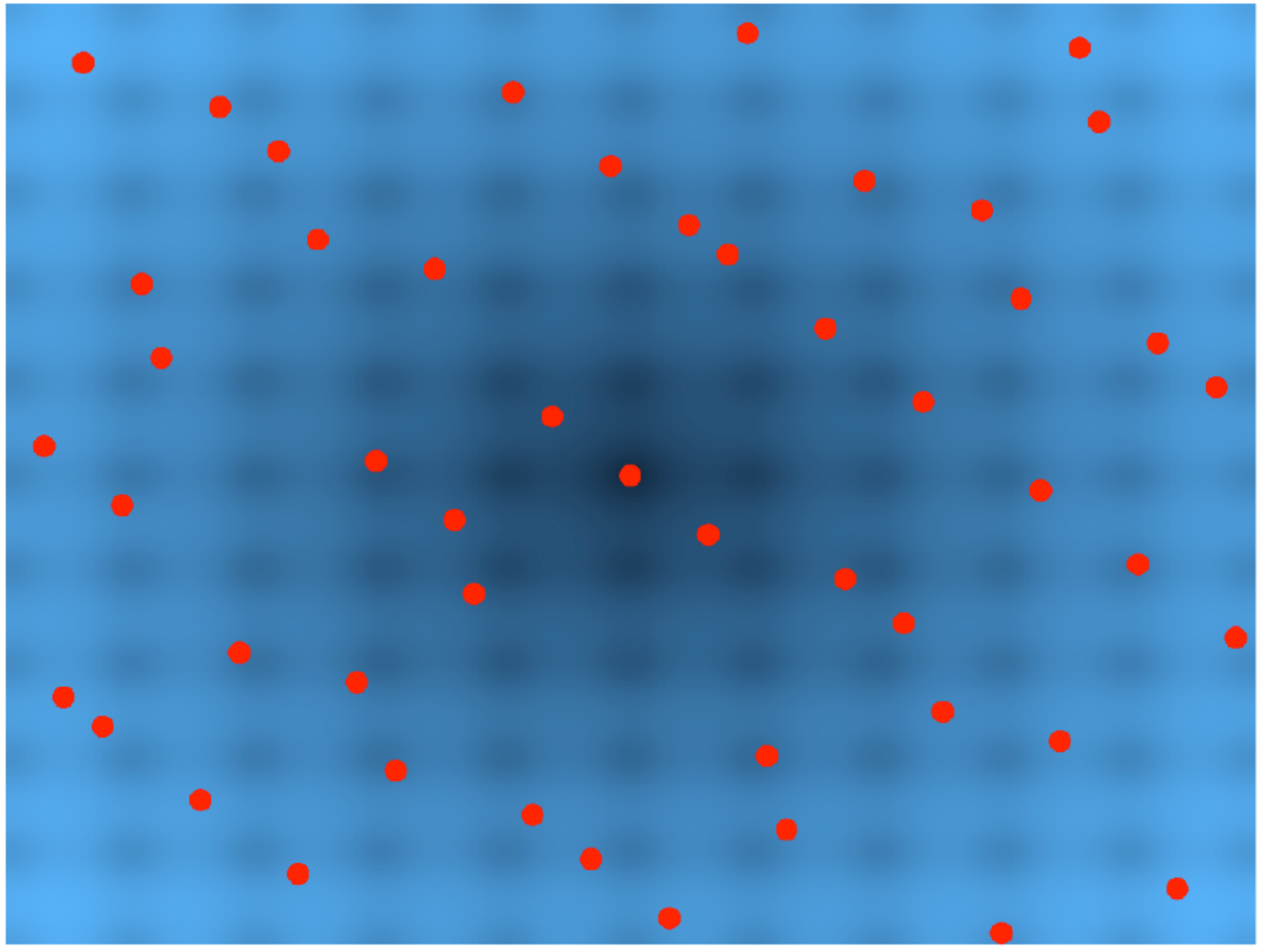
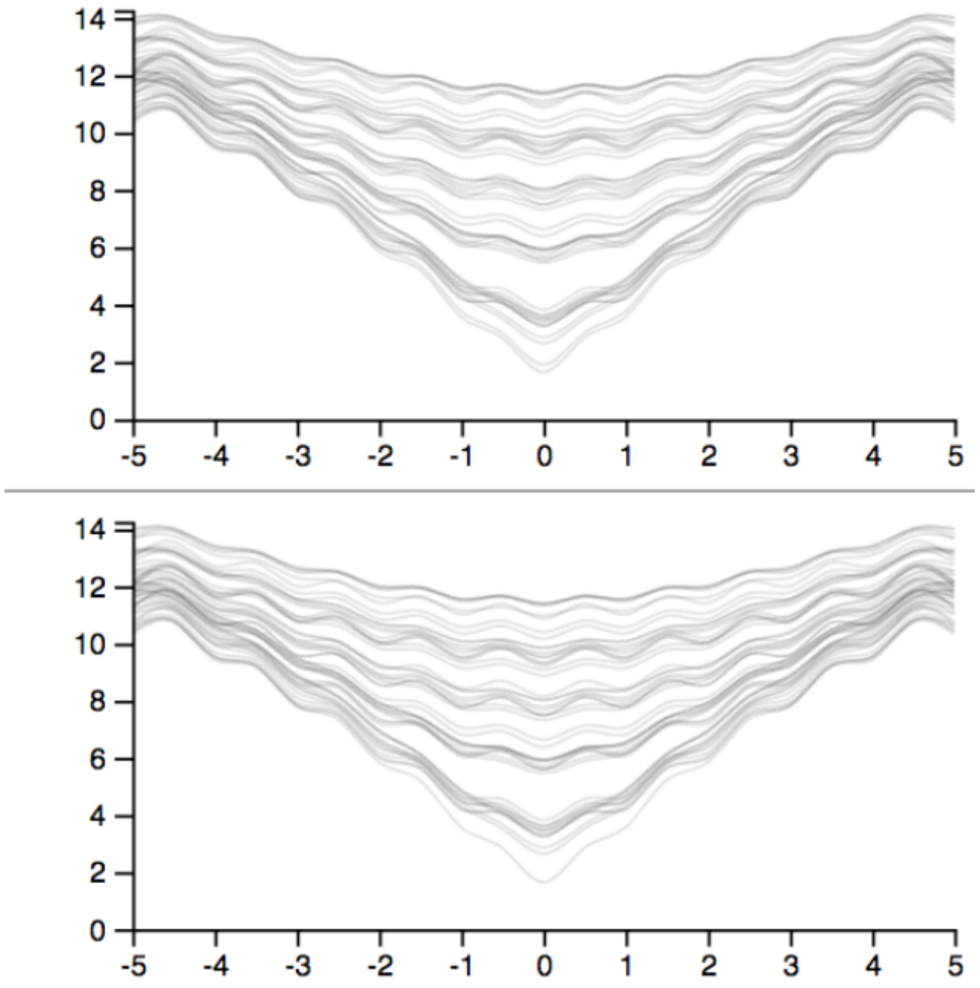




(Torsney-Weir et al. 2017)

FOCUS POINT SELECTION





Focus point sampling using space-filling design (Torsney-Weir, Sedlmair, and Möller 2017)

CONCLUSION

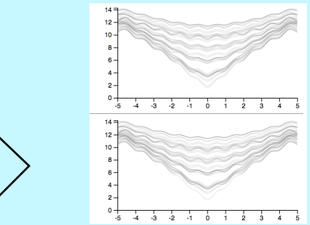
Treating the regression model itself as the datatype allows us to analyze the model more efficiently.

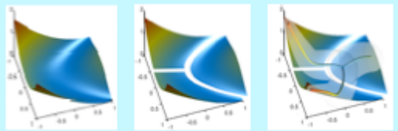
- Slice-based visualization
- Efficient rendering
- Control of sampling

$$f(\vec{x}) \rightarrow y$$

Dataset

Objective measures:
curvature, etc
Topology:
Morse-Smale, contour tree
Slicing: 1D, 2D





Visualization/data analysis

THANKS!

Questions?

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