



Design

CMSC 436/636
Data Visualization

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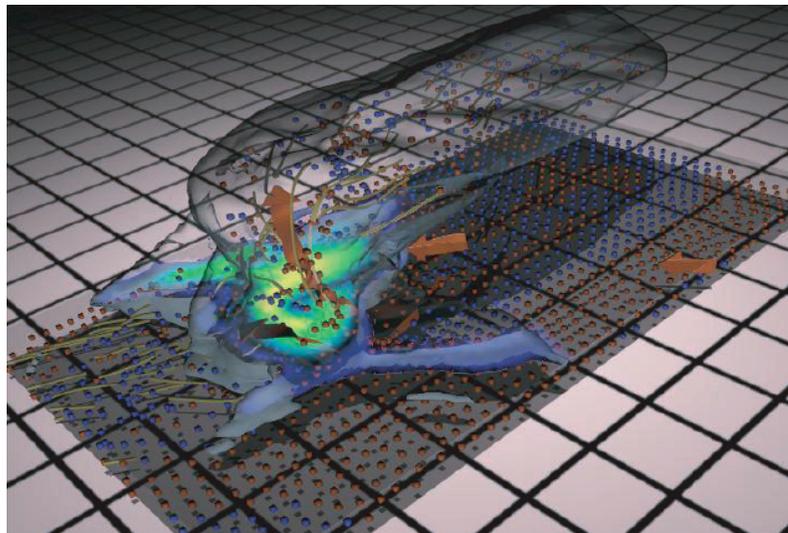


Announcements

After the Storm

- Pauline Baker and Colleen Bushnell, IEEE Computer Graphics and Applications, vol. 15, no. 3, 1995, pp. 12-15.
- Original visualization produced at NCSA and widely distributed
- Current article grew out of visit to NSCA by Edward Tufte

Original Visualization

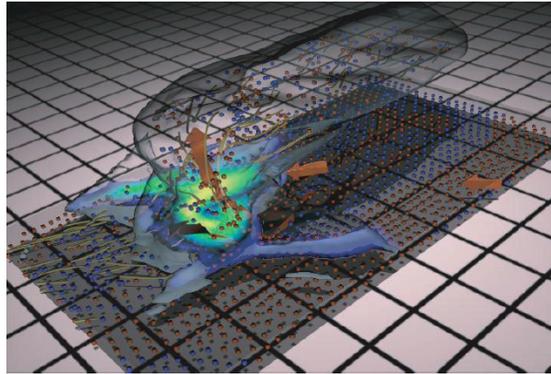


Baker and
Bushnell,
'95

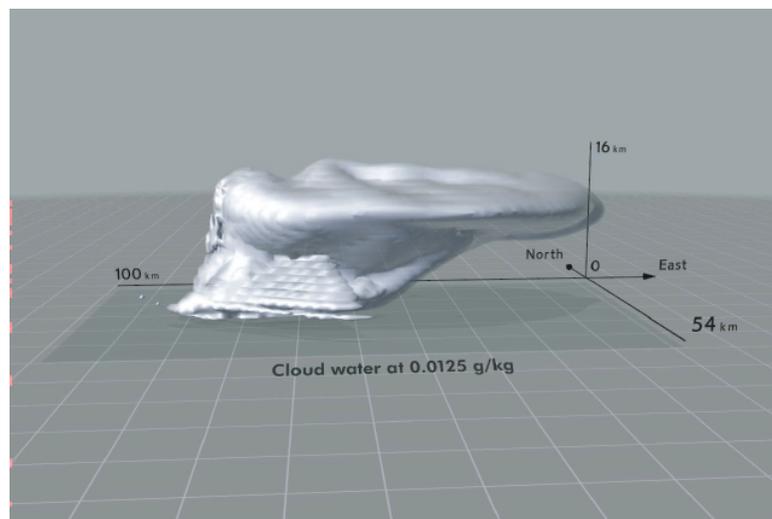
Original Visualization

- Visual features
 - Grid marks space
 - Shadow shows overall shape and height
 - Box shows computational domain
 - Particles show movement
 - Scale given by narration

Baker and Bushnell, '95



Revisited Visualization

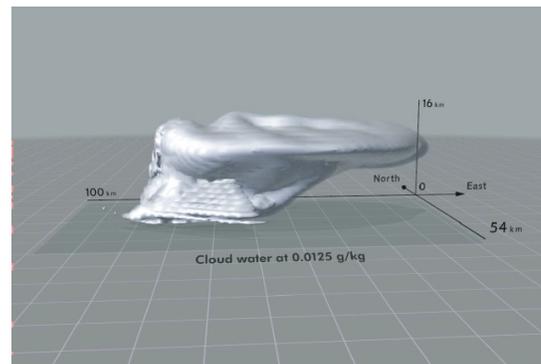


Baker and
Bushnell,
'95

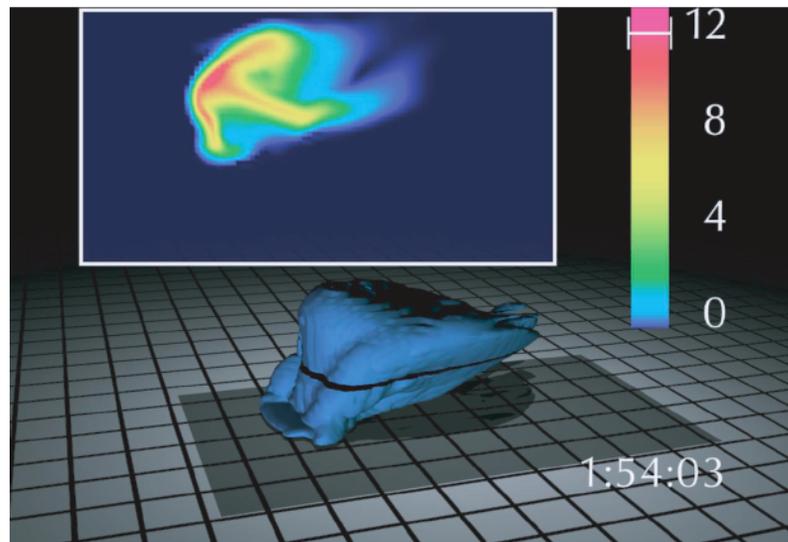
Revisited Visualization

- Revised features
 - Grid and box de-emphasized
 - Axes and labels in visual
- Design basis
 - Just-noticeable difference (7% apart, 2% adjacent)
 - Simultaneous contrast

Baker and Bushnell, '95



Original Visualization

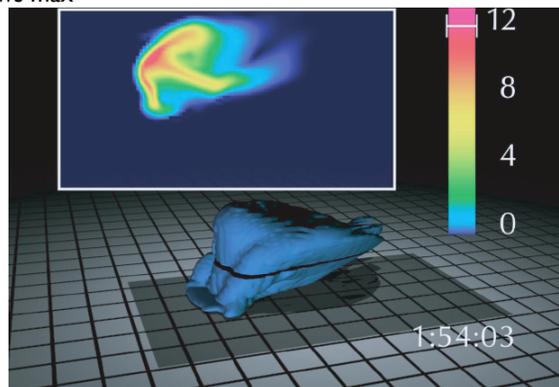


Baker and
Bushnell,
'95

Original Visualization

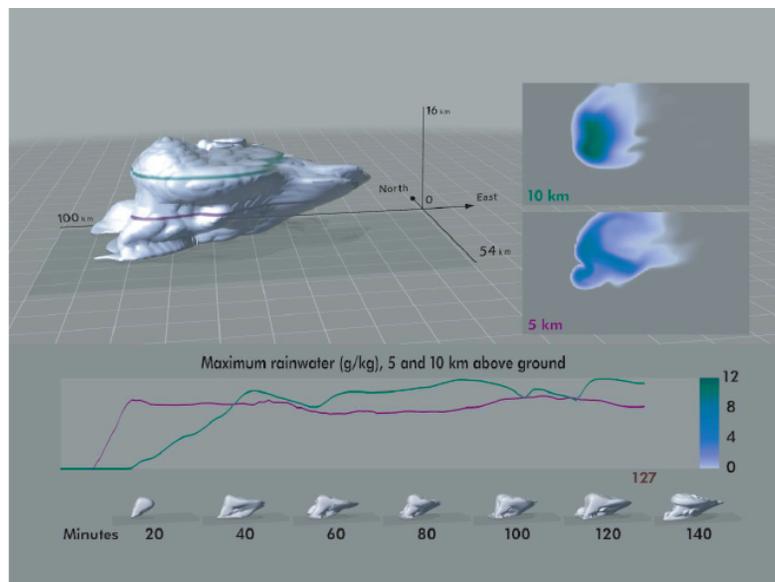
- Visual features

- Interior slice extracted
- Stripe shows position
- Color bar shows mapping
- White marker shows max



Baker and Bushnell, '95

Revisited Visualization

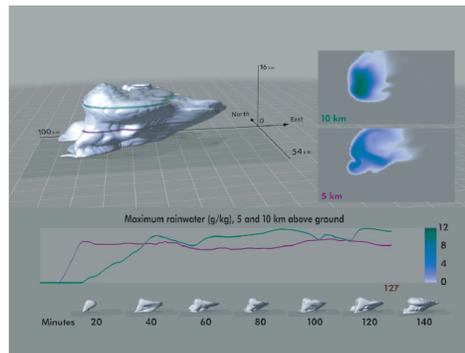


Baker and
Bushnell,
'95

Revisited Visualization

- Visual features
 - Two slices extracted
 - Stripe shows positions
 - Continuous-hue color scale
 - Color bar shows mapping
 - Graph shows max
 - Attribute labeled
 - Mini clouds show temporal context

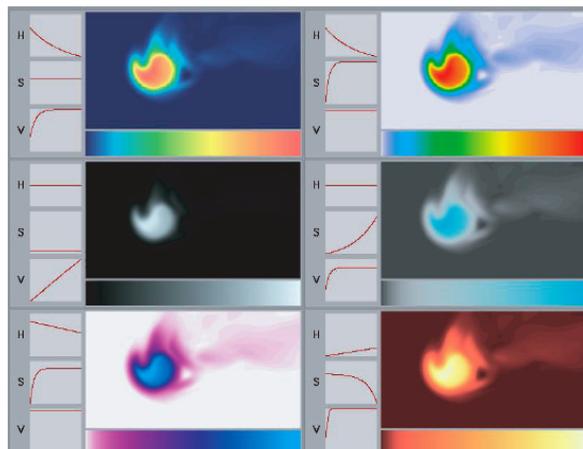
Baker and Bushnell, '95



Color Choices

- Natural colors for observable phenomena
- Lightness scale for shape info

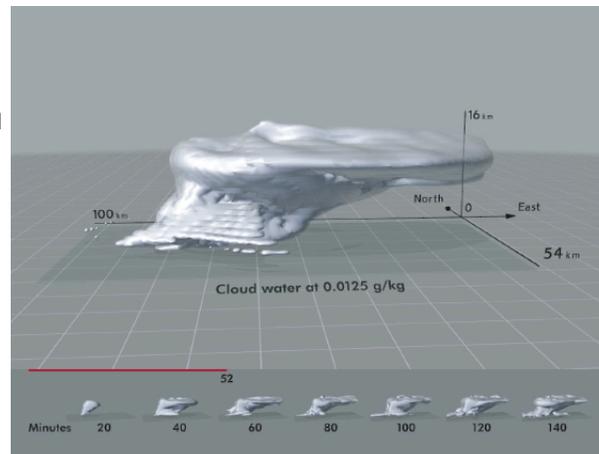
Baker and Bushnell, '95



Animation

- Motivation
 - Reduce distraction motion
- Changes
 - White slider replaced by graph
 - Clock replaced with timeline
 - Grid lines de-emphasized to reduce crawl

Baker and Bushnell,
'95

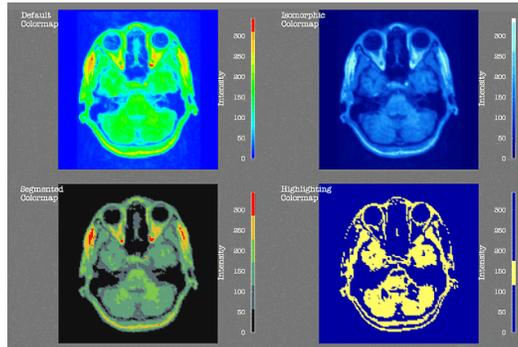


How Not to Lie

- Bernice Rogowitz and Lloyd Treinish, *Computers and Physics*, vol. 10, no 3, May/June 1996, pp. 263-273.
- Representation influences interpretation
- In tradition of:
 - How to Lie with Statistics [Huff54]
 - How to Lie with Visualization sessions
 - (How to Lie with Maps [Monmonier96])

Colormap Choices

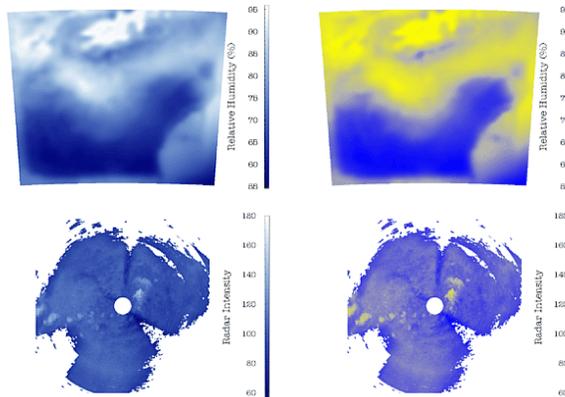
- Four scales
 - False contours in rainbow scale
 - Isomorphic with even perceptual steps
 - Segemented to delineate regions
 - Highlighting to draw attention
- Colormap selection
 - Data type
 - Data frequency
 - Visualization task
 - Other design choices



Rogowitz and Treinish, '96.

Spatial Frequency

- Guidelines
 - Luminance for high spatial frequency info
 - Saturation/hue for low spatial frequency info
- Examples
 - Low (top)
 - High (bottom)

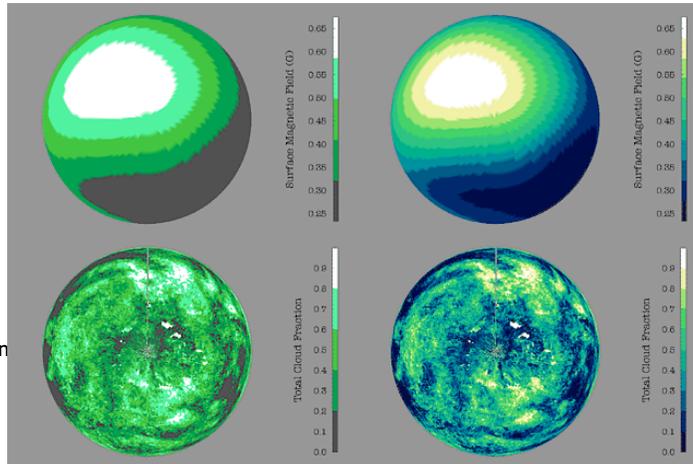


Rogowitz and Treinish,

Segmentation Tasks

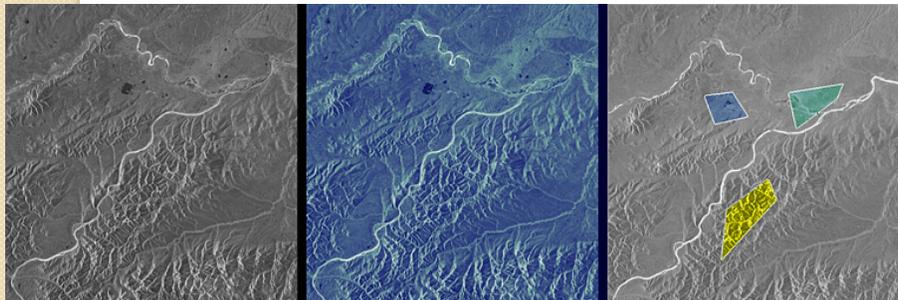
- Colormaps with explicit steps visually segment data
- Ideal number segments related to spatial frequency characteristics (more for lower)

Rogowitz and



Highlighting Tasks

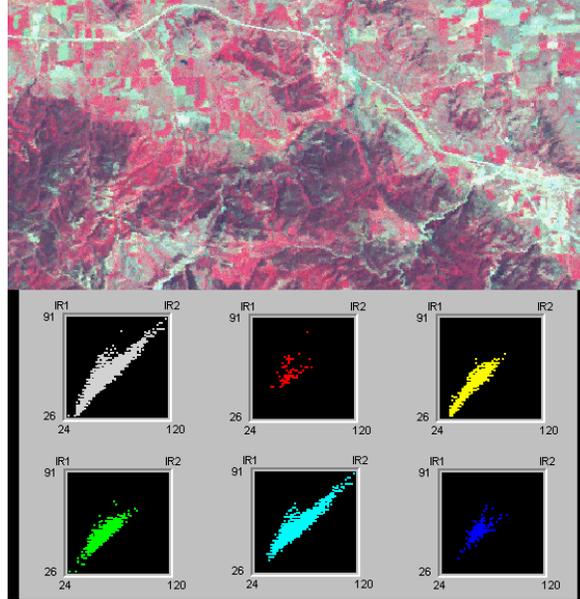
- Can highlight particular ranges of data values
- Example colormap
 - Increasing luminance
 - Differentiated hue



- Rogowitz and Treinish, '96.

Complementary Techniques

- Multiple views of data to show different aspects



Rogowitz and Treinish,
'96.

13 Ways to Say Nothing with Scientific Visualization

Al Globus and E. Raible, NASA '92

1. Never include a color legend
2. Avoid annotation
3. Never mention error characteristics
4. When in doubt, smooth
5. Avoid providing performance data
6. Quietly use stop-frame video techniques
7. Never learn anything about the data or scientific domain
8. Never compare your results with other visualization techniques
9. Avoid visualization systems
10. Never cite references for your data
11. Claim generality, but use a single data set
12. Use viewing angle to hide blemishes
13. This is easily extended to 3D



A Knowledge Task-based Framework for Design and Evaluation of Information Visualizations

- Robert Amar and John Stasko, Proceedings of Information Visualization '04, pp. 143-149.
- Limitations of current vis systems
 - Simple operations
 - Predetermined representations
 - Importance of uncertainty
- Emphasis on higher-level understanding



Analytic Gaps

- Goal: promote generation of higher-level knowledge about a domain that results in justifiable actions.
- Rationale gap
 - Perceiving relationship vs understanding strength, likelihood, and usefulness of that relationship
- Worldview gap
 - What is shown vs what needs to be shown for decision-making
- Key tasks
 - Complex decision-making, especially under uncertainty
 - Learning a domain

Rationale-based Tasks

- **Expose uncertainty:**
 - Show uncertainty in data measures and aggregations and possible effect of uncertainty on outcomes
- **Concretize relationships:**
 - Clearly present relationship and ideally concrete outcomes
- **Formulate cause and effect:**
 - Clarify possible sources of causation

Worldview-based Tasks

- **Determination of domain parameters:**
 - Creating, acquiring, and transferring knowledge or metadata about important domain parameters (attributes) within a dataset
- **Multivariate explanation:**
 - Provide support for discovery of relationships among many variables and with varying correlative models and constraints
- **Confirm hypotheses:**
 - Support formulation and verification of hypotheses



Using Tasks

- **Design**
 - Generate new subtasks for a visualization to support or perform
 - Identify possible shortcomings in representation or data
 - Discover possible relationships to highlight or use as the basis for a visualization
- **Evaluation**
 - How relationships and outcomes are shown
 - How confident users is about outcomes relative to uncertainty