Introduction to Scientific Visualization

Scientific Visualization

Professor Eric Shaffer

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A Visualization Lexicon

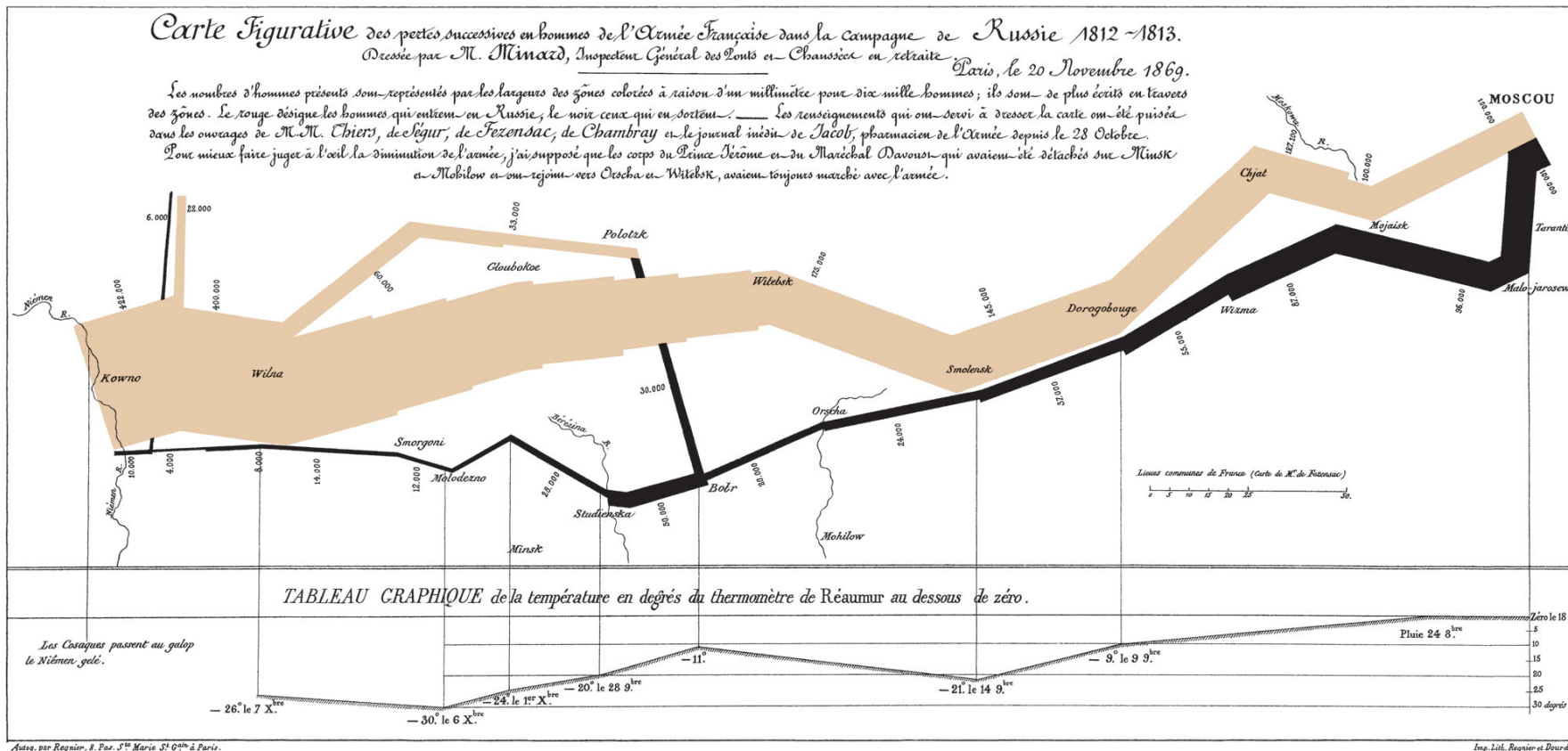Many different activities use the terms "visual" or "visualization"

- Data Visualization

- Information Visualization

- Visual Analytics

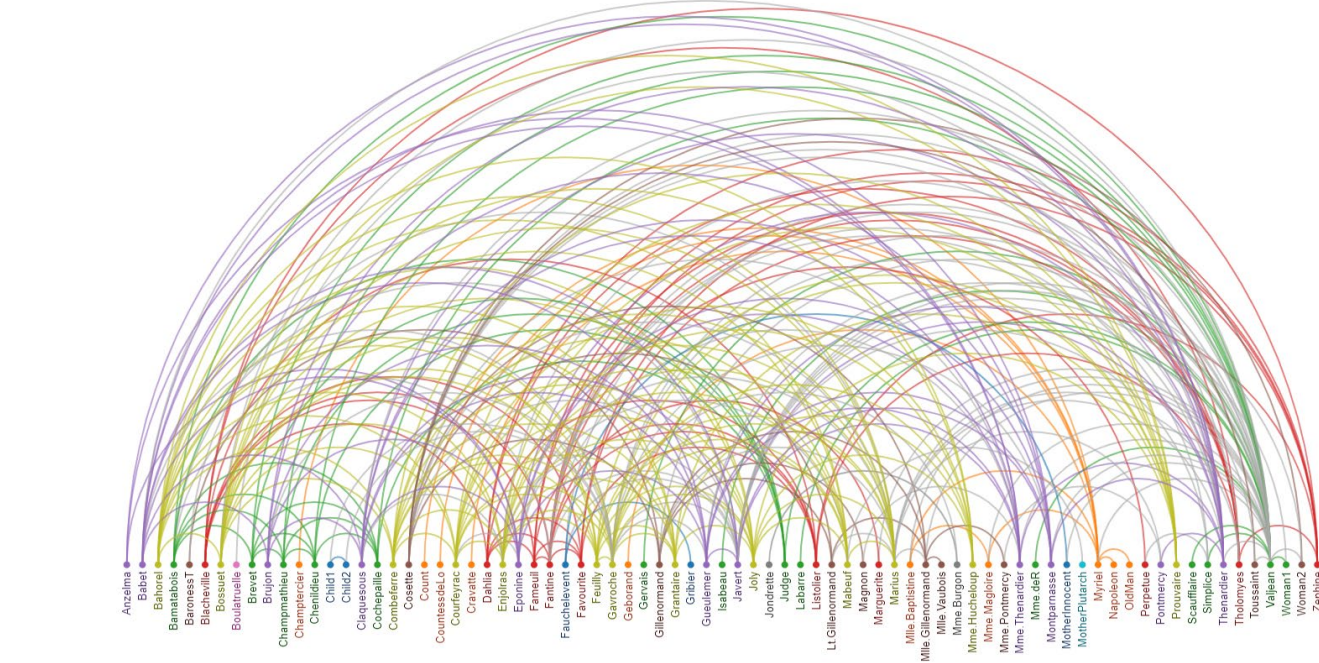- Scientific Visualization

What are the differences?

Data Visualization

Data visualization refers to the techniques used to communicate data or information by encoding it as visual objects

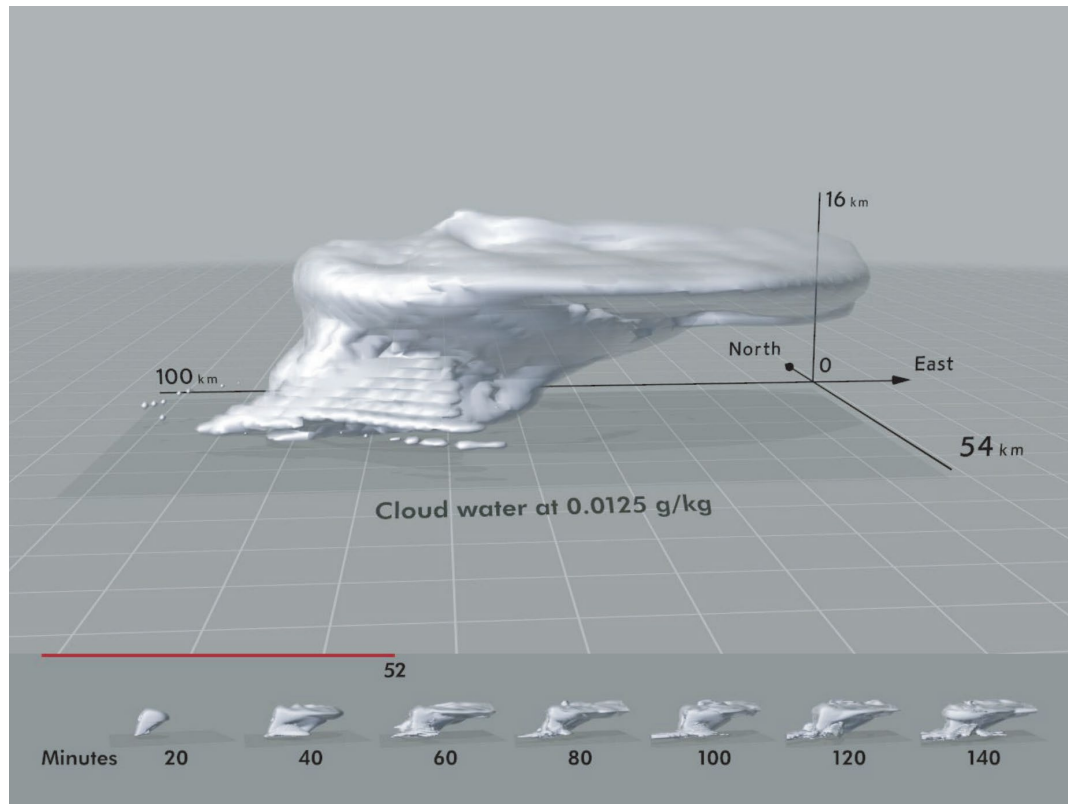- https://en.wikipedia.org/wiki/Data_visualization

Charles Joseph Minard's 1869 diagram of Napoleonic France's invasion of Russia

Information Visualization

Information visualization is a process of transforming data and information that are not inherently spatial into a visual form, allowing the user to observe and understand the information.

- Nahum Gershon and Steve Eick, procceedings of the first IEEE Symposium on Information Visualization

Scientific Visualization

…scientific visualization, which frequently focuses on spatial data generated by scientific processes..

- Nahum Gershon and Steve Eick, procceedings of the first IEEE Symposium on Information Visualization

Scientific Visualization versus Information Visualization

"the subfield names grew out of an accident of history and have some unfortunate connotations when juxtaposed: information visualization isn't unscientific, and scientific visualization isn't uninformative."
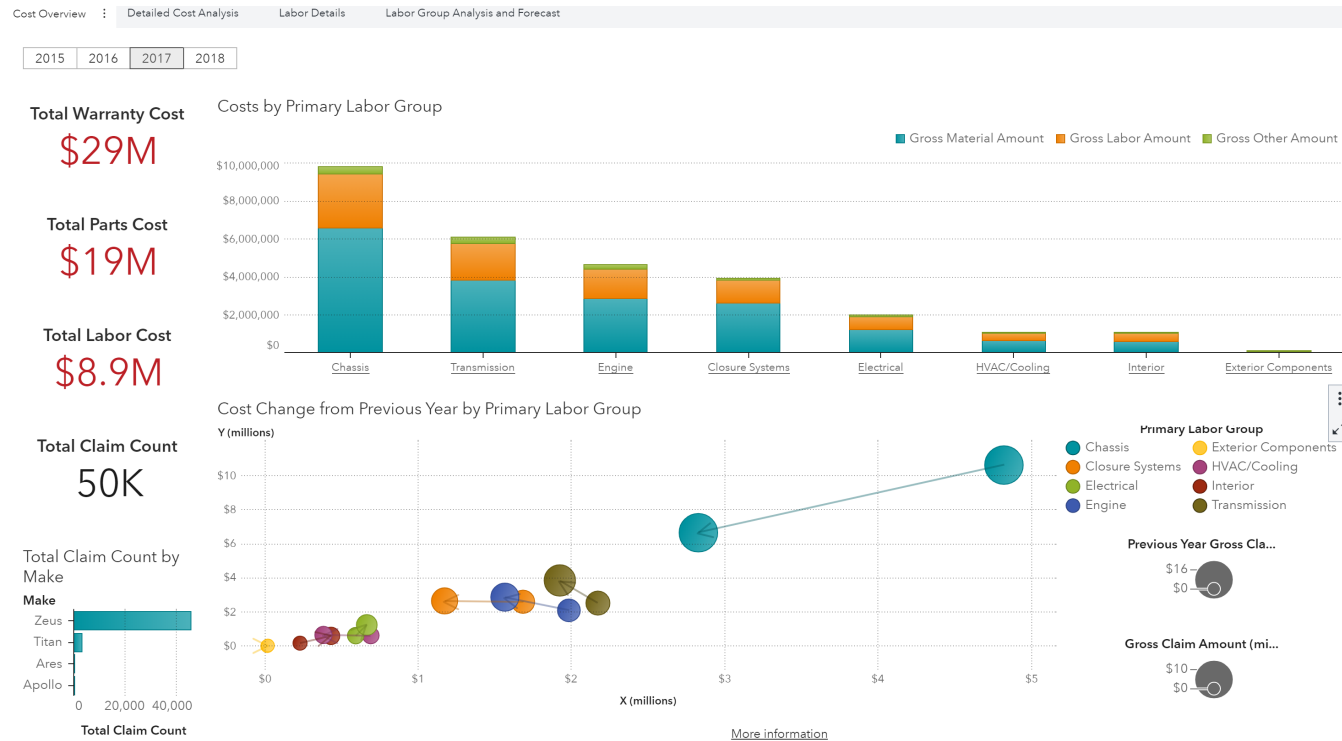
- Professor Tamara Munzner

- Fields are more similar than different

- Sci Vis typically uses data from a physical or metric space

- Info Vis typically uses more abstract data with no natural location

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Visual Analytics

"the science of analytical reasoning facilitated by interactive visual interfaces."
James J. Thomas and Kristin A. Cook (Ed.) (2005). Illuminating the Path: The R&D Agenda for Visual Analytics National

- Visual Analytics focuses on how to create computational tools for data analysis that use visualization.
- Often the tools include other capabilities such as data mining to assist the analyst.

A Sampling of Topics
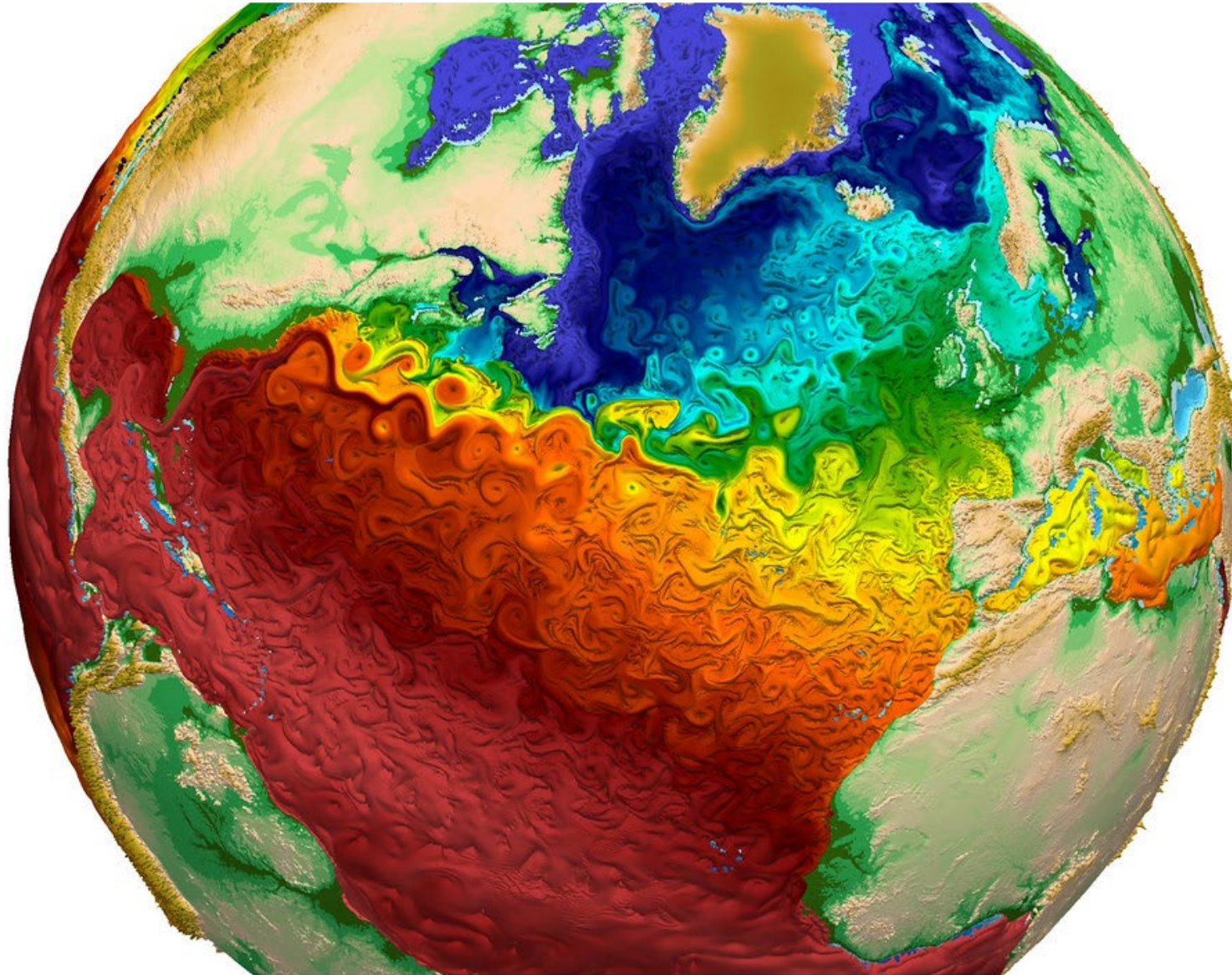
Terrain Visualization

Volume Visualization

Isosurfaces

Flow Visualization

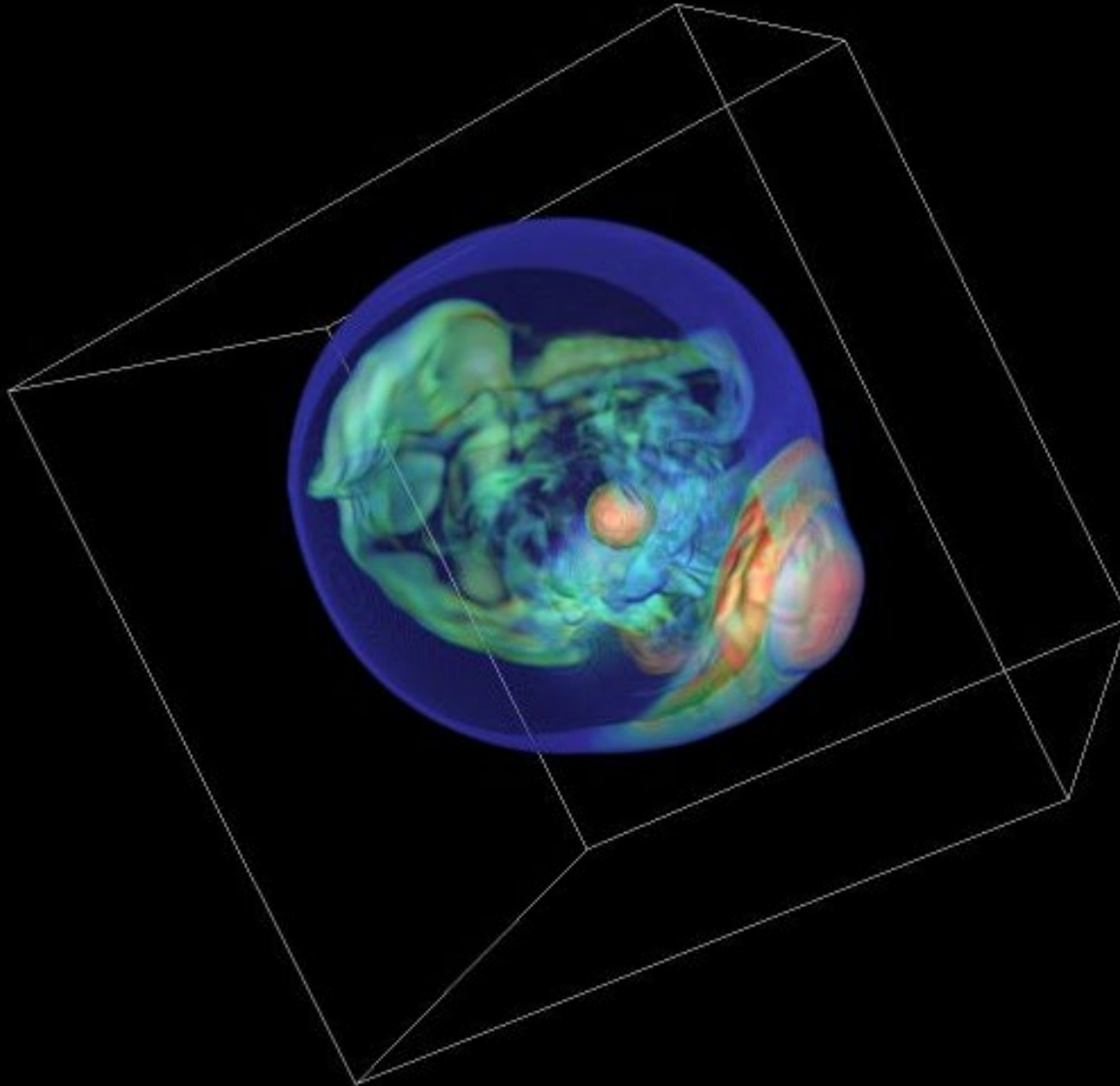Tensor Field Visualization

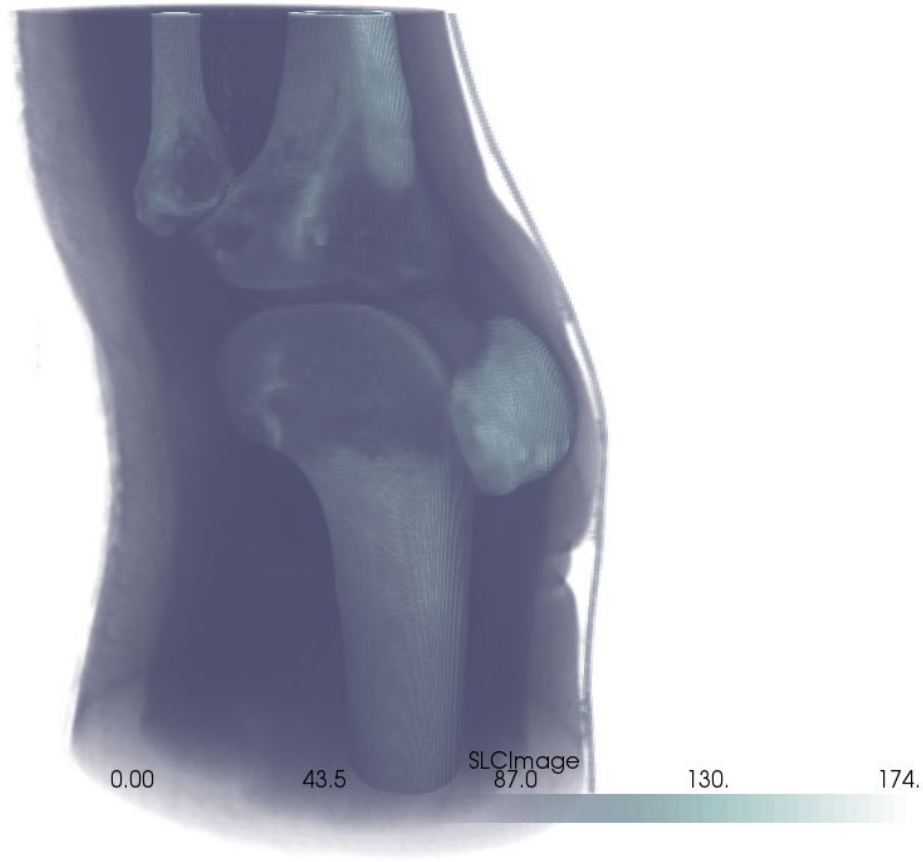Bioinformatics Visualization

Terrain Visualization

Visualization of global surface water temperature from Los Alamos National Laboratory

Volume Visualization

Simulation of a supernova
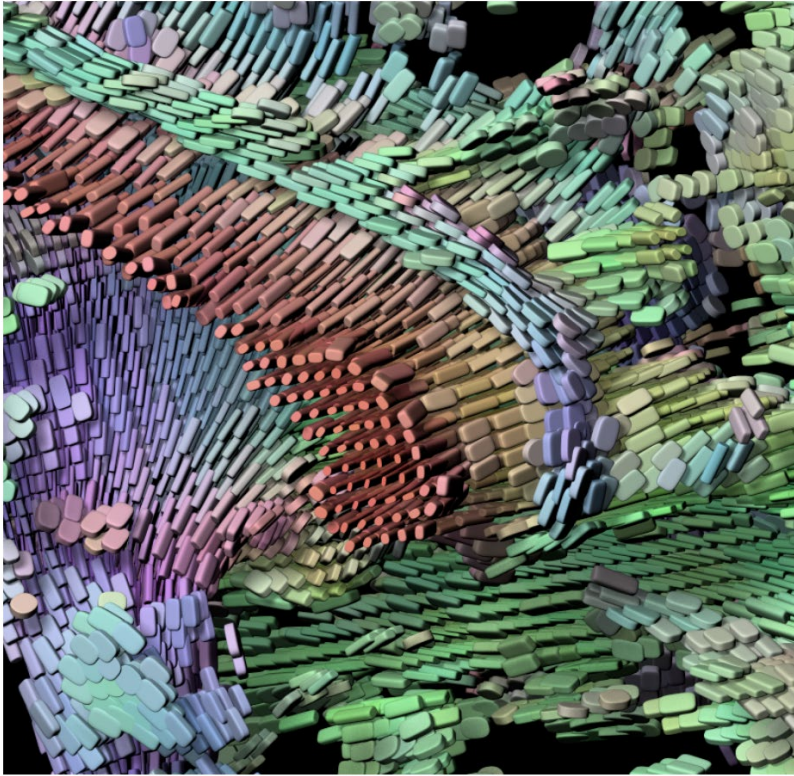
Isosurfaces

MRI data of a human knee
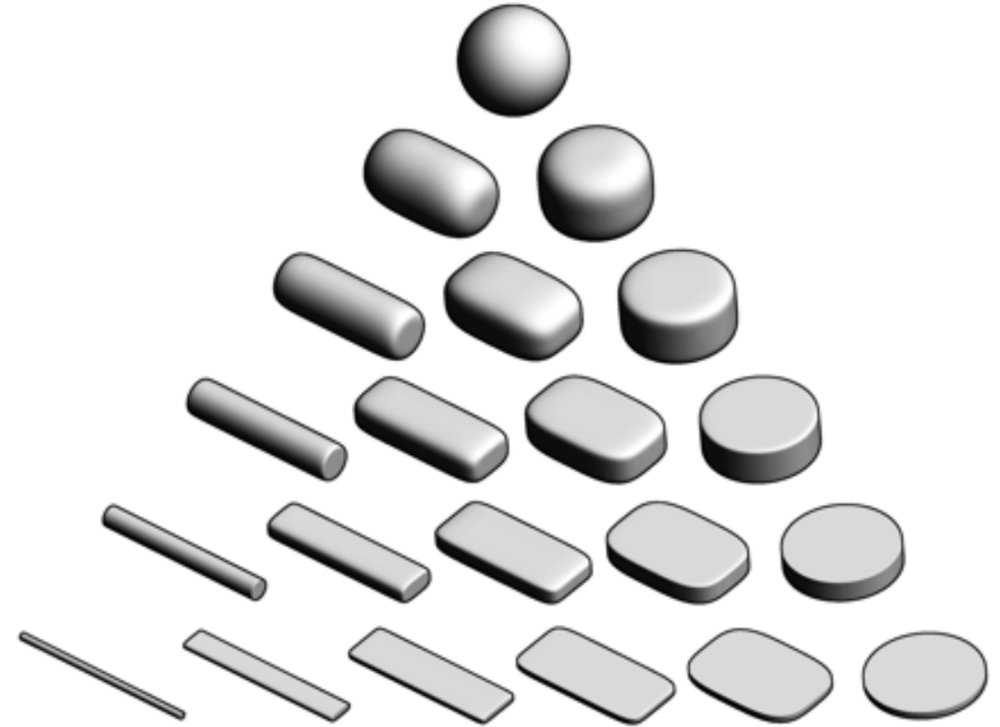
Flow Visualization

NASA Mars lander visualization from 2019.

Domain consists of 6-billion cells making it the world's largest interactive fluid visualization at the time.
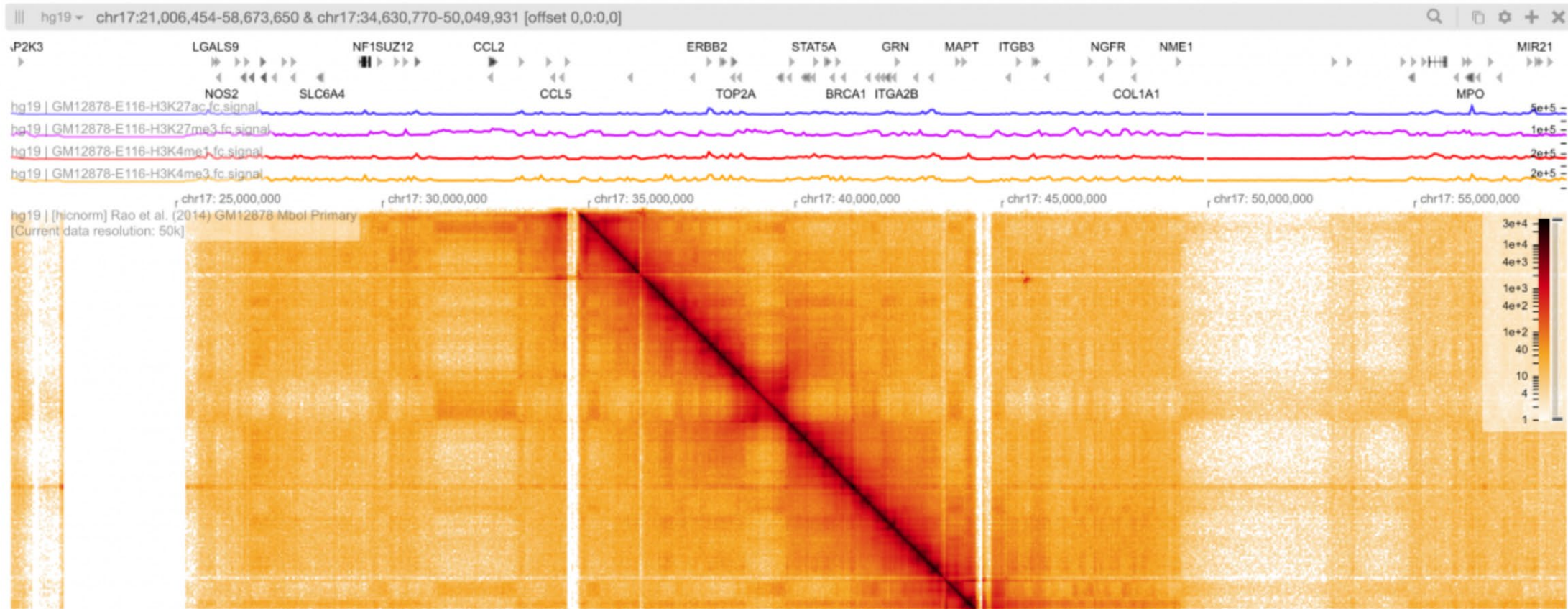
Tensor Field Visualization

Tensor field generated from Diffusion-Tensor MRI

Tensor glyphs

Bioinformatics Visualization

HiGlass is a web-based tool for visually exploring and comparing 2D genomic contact matrices