Investigating Multivariate, Vector, and Topological Data Analysis Techniques for Mantle Flow Pattern Visualization

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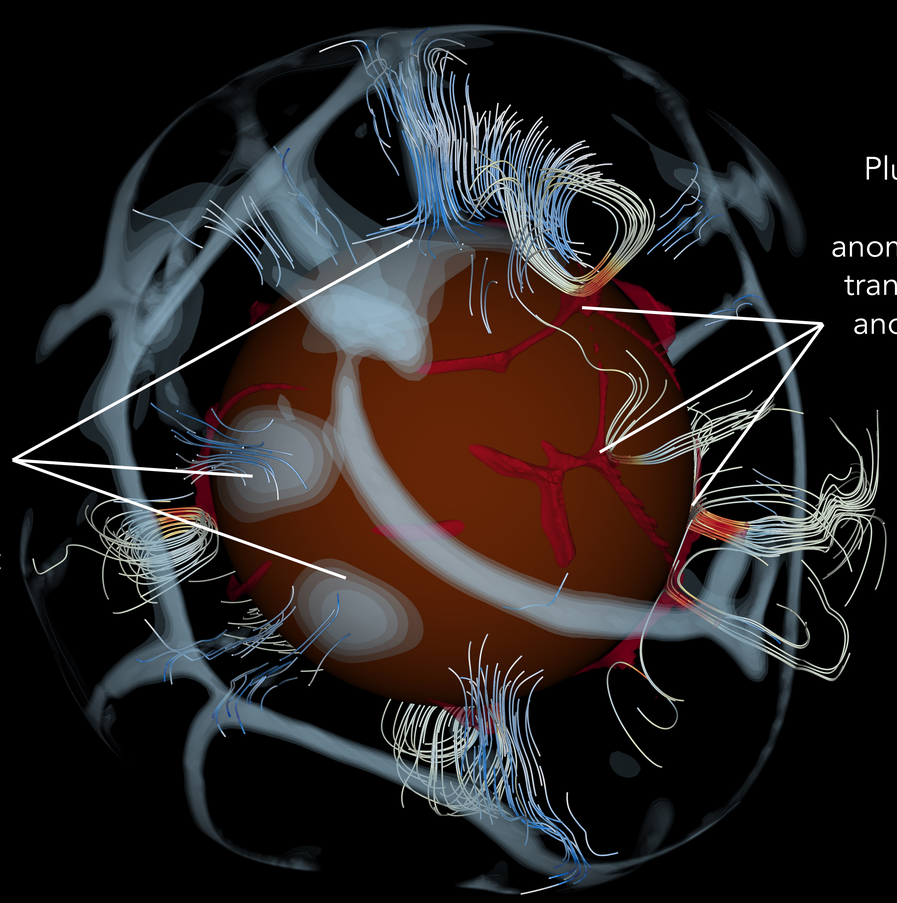


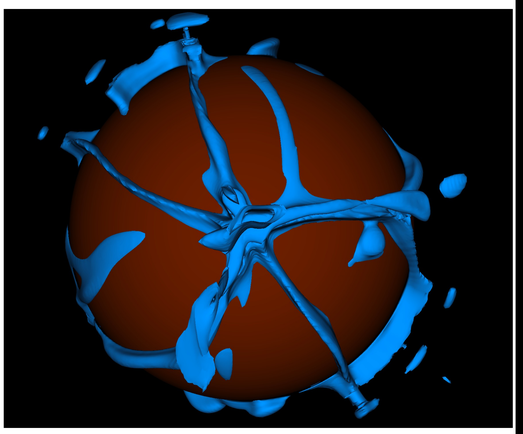
Injections of cold upper mantle material sweep around ridges of hot material at the core mantle boundary.

Plumes rise from regions of high temperature anomaly and negative spin transition-induced density anomaly shown using the feature level-set.

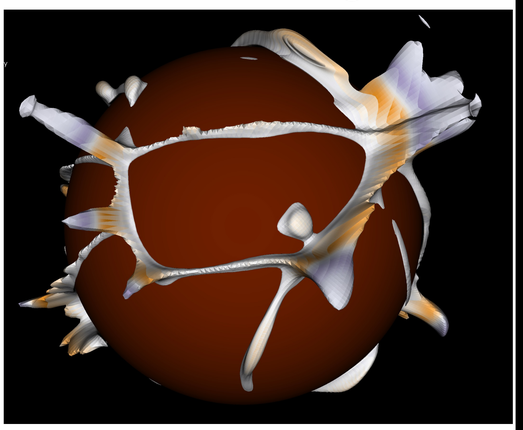
Locally colored isosurfaces, feature level-sets, attribute-filtered integral curves, and topological analysis may assist domain scientists to better understand the convection processes in the Earth's mantle.

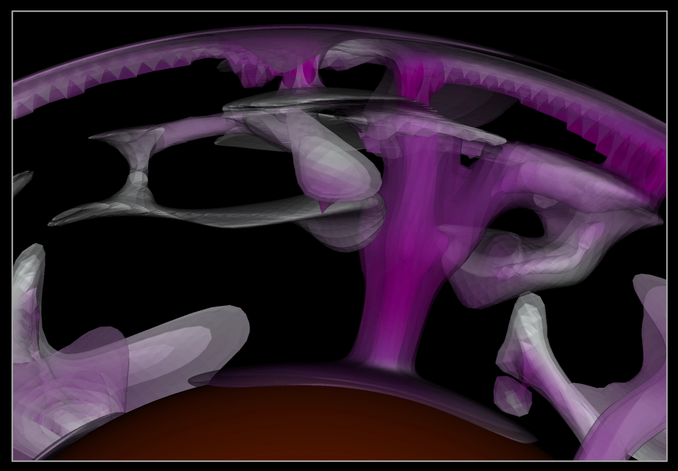
Isosurface-based Techniques

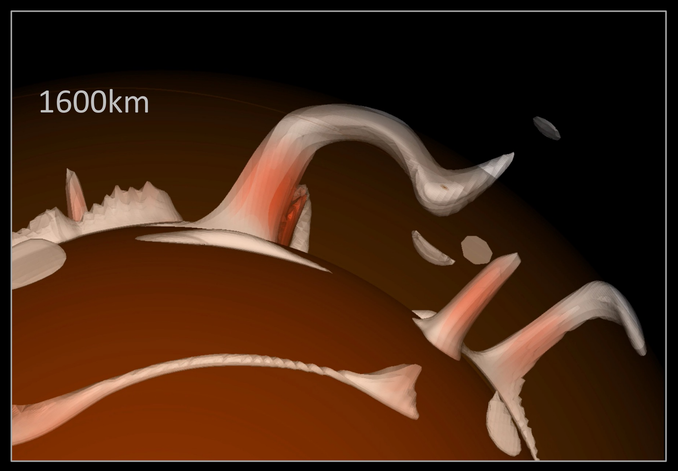
- Feature Level-Sets



- Local Coloring







To visualize mantle flow patterns, we first computed contours of low (left) and high (right) temperature anomaly, and then encoded the velocity magnitude using color. Here, white contours are regions of very low velocity magnitudes and help identify stagnated/diverted cold slabs and hot plumes at a depth of 1600km.

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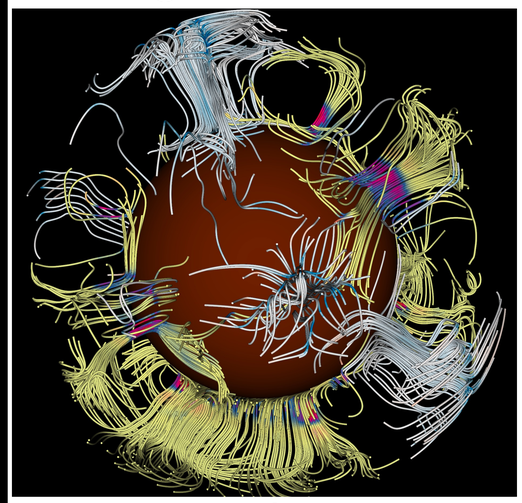
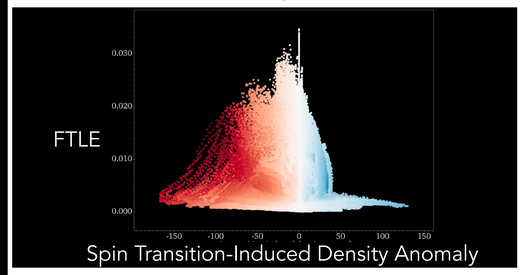
Flow Visualization Techniques

- Attribute-Filtered Integral Curves



- FTLE Analysis



Topological Data Analysis Techniques

- Topology Simplification