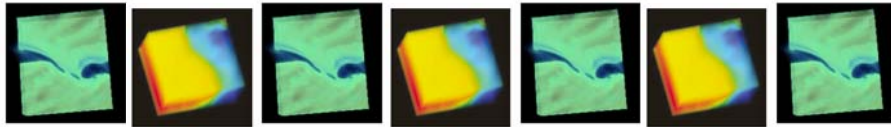


Scientific Visualization for Ocean Data

Yeon Gyoung Gwack
University of California, Santa Cruz
March 5, 2007



Procedure

- Overview
 - What is scientific visualization?
- Data types
- Current visualization methods

What is visualization?

- Scientific visualization (SciVis)
- Compress a lot of data into one picture
- Correlations between different quantities both in space and time
- Interactive display and analysis of data

Data types

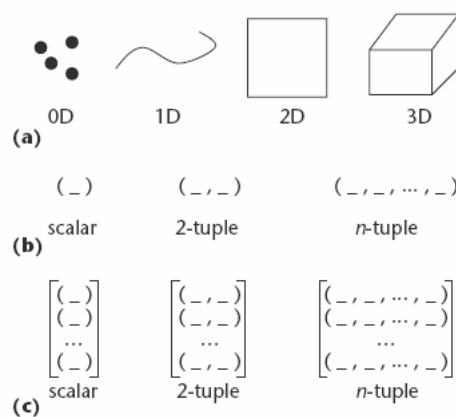


Illustration and comparison between (a) multidimensional, (b) multivariate (at each location), and (c) multivalued (at each location) data

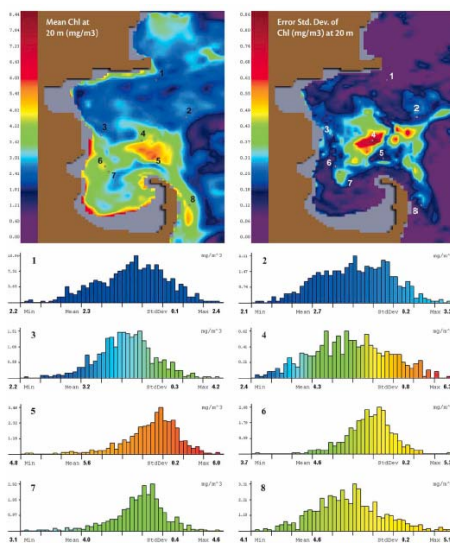
Alison Love, David Kao and Alex Pang.

Visualizing Spatial Multivalued Data, IEEE Computer Graphics and Applications, May/June 2005.

Current Visualization Methods

- Pseudocolor and Histogram
- Volume Rendering
- 3D surface Contour (Isosurface)
- Glyphs
- Line Integral Convolution
- Streamlines

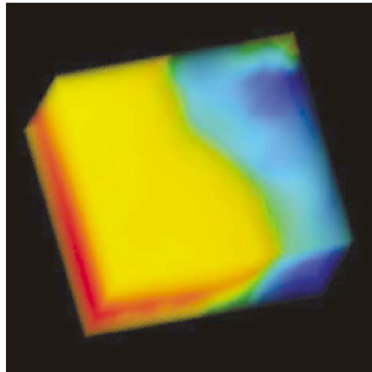
Pseudocolor and Histogram



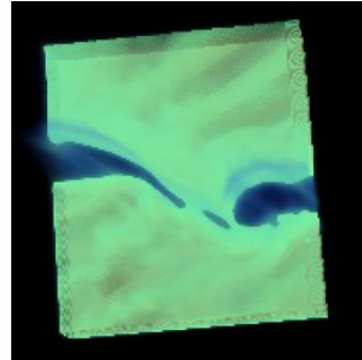
Chlorophyll mean and uncertainty of the Massachusetts Bay data set

Lermusiaux P.F.J., C.-S. Chiu, G.G. Gawarkiewicz, P. Abbot, A.R. Robinson, R.N. Miller, P.J. Haley, W.G. Leslie, S.J. Majumdar, A. Pang and F. Lekien, 2006. Quantifying Uncertainties in Ocean Predictions. *Oceanography, Special issue on "Advances in Computational Oceanography"*, T. Paluszkiwicz and S. Harper, Eds., Vol. 19, 1, 92-105.

Direct Volume Rendering



(a) Mean salinity



(b) Standard deviation

The data is based on the Middle Atlantic Bight shelfbreak, off the east coast of the United States.

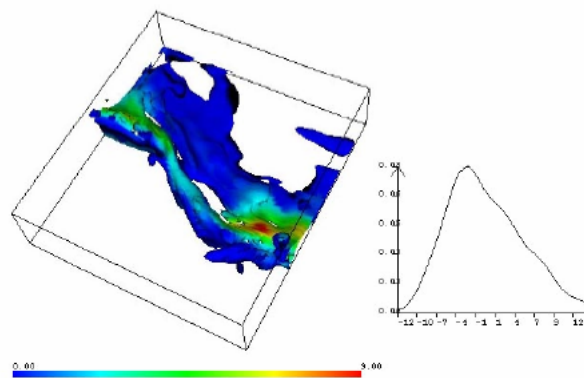
(a) Suzanna Djurcilov, Kwansik Kim, Pierre Lermusiaux, Alex Pang.

Visualizing Scalar Volumetric Data with Uncertainty in Computers and Graphics, vol 26, 2002, pp. 239–248.

(b) Alison Luo, David Kao, and Alex Pang.

Visualizing Spatial Distribution Data Sets IEEE Visualization Symposium, Grenoble, France, May 2003

Isosurface



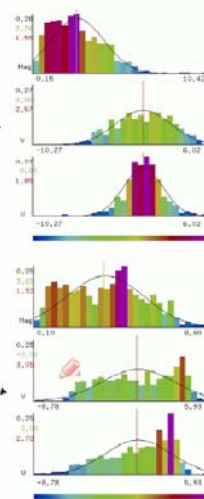
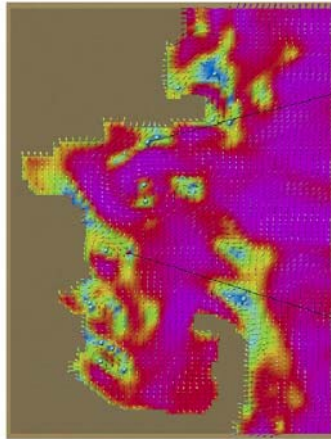
An isosurface using a reference distribution within the mixing region

The data is based on the Middle Atlantic Bight shelfbreak, off the east coast of the United States.

Alison Luo, David Kao, and Alex Pang.

Visualizing Spatial Distribution Data Sets IEEE Visualization Symposium, Grenoble, France, May 2003

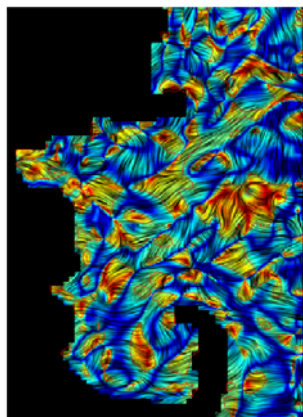
Glyphs



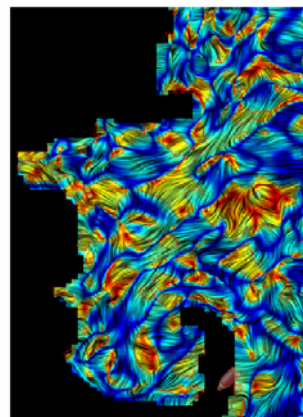
Lermusiaux P.F.J.,
Uncertainty Estimation and Prediction for Interdisciplinary Ocean Dynamics. J. Computational Physics, Special issue on "Uncertainty Quantification", J. Glimm and G. Karniadakis, Eds., 2006. .

(a, left) Mean horizontal velocity magnitude(color mapping) and directions(arrows).
 (b, right) Local PDF's of surface velocity of the Massachusetts Bay data set

Line Integral Convolution



(a) Massachusetts Bay Major

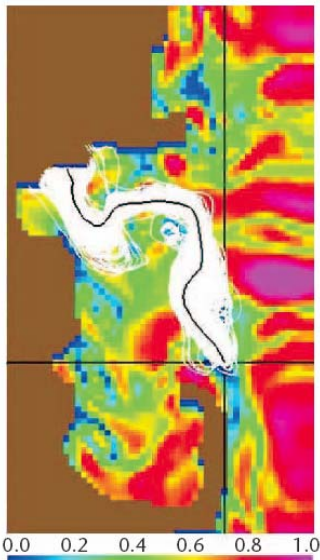


(b) Massachusetts Bay Minor

Two sets of LIC images showing the composite eigenvectors of the Massachusetts Bay data set

Xiaoqiang Zheng Alex Pang
2D Asymmetric Tensor Analysis, to appear in IEEE Vis 2005

Streamlines



Conventional spaghetti plot from a seed point

Alison Love, David Kao and Alex Pang,
Visualizing Spatial Multivalued Data
IEEE Computer Graphics and Applications, May/June 2005.

References

- Alison Luo, David Kao, and Alex Pang, *Visualizing Spatial Distribution Data Sets* IEEE Visualization Symposium, Grenoble, France, May 2003
- Alison Love, David Kao and Alex Pang, *Visualizing Spatial Multivalued Data*, IEEE Computer Graphics and Applications, May/June 2005.
- Lermusiaux P.F.J., C.-S. Chiu, G.G. Gawarkiewicz, P. Abbot, A.R. Robinson, R.N. Miller, P.J. Haley, W.G. Leslie, S.J. Majumdar, A. Pang and F. Lekien, 2006. *Quantifying Uncertainties in Ocean Predictions. Oceanography*, Special issue on "Advances in Computational Oceanography", T. Paluszkiwicz and S. Harper, Eds., Vol. 19, 1, 92-105.
- Suzanna Djurcilov, Kwansik Kim, Pierre Lermusiaux, Alex Pang. *Visualizing Scalar Volumetric Data with Uncertainty* in Computers and Graphics, vol 26, 2002, pp. 239-248.
- Xiaoqiang Zheng Alex Pang, *2D Asymmetric Tensor Analysis*, to appear in IEEE Vis 2005