CS 553 Scientific Visualization

Paper Analysis

Which Visualizations Work, for What Purpose, for Whom? Evaluating Visualizations of Terrestrial and Aquatic Systems

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06/09/2015

1. Overview and Short Summary

In the paper *Which Visualizations Work, for What Purpose, for Whom? Evaluating Visualizations of Terrestrial and Aquatic Systems* (Cushing J B, Hayduk E, Walley J, et al), the authors mainly talk about the project called Visualizations of Terrestrial and Aquatic Systems being applied in different specific scientific fields. The authors use VISTAS to develop visualizations to help ecologists or cross discipline scientists and what is more, it can also appraisal the visualizations and software. According to a plenty of surveys and interviews of ecologists, the authors make a novel development that VISTAS can integrate complex data from scattered resources and use mixed methods to make better visualizations on specific fields.

The paper's title "*Which Visualizations Work, for What Purpose, for Whom? Evaluating Visualizations of Terrestrial and Aquatic Systems*" means that for specific individuals and for some unique purposes, the relevant visualizations should adapt the requirements. And it shows that the paper would discuss about VISTAS project.

2. Introduction of The Authors

Judith Bayard Cushing. Ph.D., the Professor of Computer Science at the Evergreen State College. One of Her research interests is Ecology and Canopy Science. And now she is teaching Environmental Change and Health.

Evan Hayduk. Graduate Research Assistant, MES Program from the Evergreen State College.

Jerilyn Walley. Master in Environmental Studies Program, The Evergreen State College. Her research interest is environmental service.

Kirsten Winters. Ph.D., Environmental Service, Human Dimensions, Oregon State University. Her research topic is Development of tools for visualization and visual analytics of aquatic and terrestrial data. She is teaching Global Environmental Policy in Oregon State University now.

Denise Lach. Ph.D., the Professor in Sociology Program. Director of School of Public

Policy, Oregon State University. One of her research interests is Environmental Natural Resource Sociology.

Michael Bailey. Ph.D., the Professor in Computer Science at Oregon State University. His research fields include scientific visualization, high performance computer graphics, solid freeform fabrication, geometric modeling, and computer aided design and analysis.

Christoph Thomas. Ph.D., the Associate Professor in Atmospheric Sciences and the Adjunct Associate Professor in Forest Ecosystems & Society at Oregon State University. His mainly research fields are Biomicrometeorology, Climate change science and Instrumentation.

Susan G. Stafford. Ph.D., the Professor in Department of Forest Resources at University of Minnesota. Her Areas of Expertise are Environmental science, policy and management; applied statistics; environmental leadership; research information and data management; frameworks for interdisciplinary research and education.

3. Detailed Summary of This Paper

First of all, it is necessary to explain more about VISTAS. As shown on the VISTAS official website(http://blogs.evergreen.edu/vistas/)[2], it says, "VISTAS, funded by the National Science Foundation (BIO/DBI 1062572) and joint among scientists at The Evergreen State College, Oregon State University, and elsewhere, develops visual analytics software to enable scientists to better understand and communicate about large and complex environmental problems that span spatial and temporal scales." It is necessary for us to know that VISTAS would help scientists get a better understanding of the relationships among ecological processes at the same and different scales, develop new testable hypotheses, and explain research results.

Second, the authors mention the research model the "*H.J Andrews Long Term Ecological Research*"(LTER). This research is introduced detailed on its website (http://andrewsforest.oregonstate.edu) and its goal is that to give support to researchers

on forests, streams and watershed and to foster strong collaboration among ecosystem science, education, natural resource management, and the humanities[1]. The model is really fit VISTAS because it contains really large amounts of data including spatial data and temporal data, and complex ecological processes.

In the paper, the authors firstly evaluate the current situation on visualizations. Within the increasing amount of data, one hand the researchers can explore deeper on their fields; but on the other hand, the complicated data lead researchers make right estimates harder and harder. The current visualization tools are not fully exploited by ecologists since there is almost no tools used by ecologists being satisfied with the functional requirements. Even worse, there is almost no visualization tool designed for environmental processes or handle complex topography with a different complicated data. So the authors make a conclusion that the current visualization tools are hard to use and cannot offer required service for scientists on ecosystem filed.

The authors think that it is necessary to show ecologists how to use visualizations first, and develop visualization tools can offer different functionalities to relevant scientists on different fields. Within this goal, they believe that their research is not only focus on ecology but also can be well applied in other scientific fields, even interdisciplinary.
In the paper, the authors have done a really huge amount of surveys. First they did an investment to get to know what software that the LTER scientists use for visualization and the answer is there's no single software can let LTER scientists to easily see their visualized data on one canvas. This result just proves their assumption that there were almost no tools can accomplish what their partners want.

Then the authors surveyed about 25,000 visualizations in 1,142 articles from 8 ecology journals that published from July to December, 2011. This survey is useful in two aspects: 1) finding out which types of visualizations that ecologists more likely to use and 2) get to know more specific kinds of visualizations that their partners want to see. The authors found out and develop a profile of Visualization of Interest(VOI), which

means it can represent what the ecologists want to see: three-dimension, showing spatial and temporal data, project natural phenomena, color mapping, extruded volume data representing, comparison between each model, comparison between each physical realities, and simulations.

The conclusion of this sufficient survey is that hydrologists and ecosystem scientists are more likely to use visualizations than other ecologists. Within refining the data, the authors try to find out that by changes in media presentation, if it can make any difference in visualizations use. The conclusion is that for people in some specific disciplines of ecology, such as hydrology, ecology teachers and some ecologists who using sensing devices as LiDAR, are more likely to use Visualization of Interest.
What is more, the authors also did a informal survey to some visualization software, such as McIDAS and IDV, and the result of this survey shows that the expectant or real input and output data format can not match up with the complex visualization implement.

Then according to the interviews with the mainly partners, it shows that by the use of and need for visualization tools, VISTAS is highly expected by integrating data from scattered resources so that the results of different projects can be shown on the same canvas.

4. My Personal Comments for This Paper

I have really learned a lot after reading and analyzing this paper, and there are considerable things that I didn't know before.

According to this paper, I start to know that the transform from data to visualization is really difficult. And it is my first to know, for some specific fields, such as ecology, the data is not only spatial, but also temporal, that means the data can be 4-D, and it's really hard to handle this kind of data.

The idea of VISTAS is rally novel and practically significant. As authors introduce,

VISTAS can merging diverse data of scattered resources, it can help scientists and researchers get an integrated visualization from superfluous data. Since there's not a really good visualization tool for scientists to accomplish this, I think VISTAS is kind of revolution on scientific visualization field.

As a beginner of scientific visualization, I know there are amounts of knowledge for me to learn, such as I start to know why people need to use visualization tools when I read the paper. This is because people can more likely to learn and report things by graphs which is more directly.

What is more, VISTAS is based on user-driven, and it mixes different research areas' theories, not only computer science, or ecology, or environmental service, but also sociology. The interviews with each team members last as long as the project's development. With such communicating mode, the VISTAS can be well applied across different scientific fields. And I think people from different researching fields can achieve a huge success.

To be critical, I still feel uncertain for some points that stated in the paper.

The authors state that when they introduced VISTAS to ecologists, they highly expected this new projects. I don't think this is a really good instance since by only three cases (shown as Figure 1, 2, and 3 in the paper), scientists can not make a fixed judgment to a really new stuff. And as we know, there are considerable kinds of data, and three small cases cannot mean everything.

If I was one of these researchers, I think there are still many things to optimize VISTAS. As we know VISTAS is really needed a closed communication between end-users and developers of VISTAS, but with the development of this new and booming project, there should be more and more demands, and what the authors say that "… includes semi-structured interviews with all team members (users and developers)…" does not make much sense, since you can hardly let your team members face multiple different tasks at the same time. If it happened, it would lower the efficiency of the team. What

I want to do is to optimize the structure of the project and make the interface of VISTAS more uniform and convenient for user to operate.

5. References

[1] HJ Andrews Experiment Forest. Website: http://andrewsforest.oregonstate.edu/lter/index.cfm?topnav=180

[2] The VISTAS Project. Website: http://blogs.evergreen.edu/vistas/