Proposal Title: Statewide Integration of CI-Visualization for EPSCoR MILES

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Project Summary

The purpose of this project is to kick-start a highly innovative, creative and cross-institutional investigation into effective Visualization strategies for ecosystem services in Idaho. This endeavor will create a statewide visualization working group with participants from all three institutions and interested stakeholders and partners. Our emphasis is on developing intuitive 3D visual interfaces to enable researchers, stakeholders and the public to interactively view modeling products emerging from the MILES program. Integrating with data services already established at NKN, BSU and GIS TReC, the working group will research and select a cross-platform solution that can be implemented institutionally and statewide. New advances in software that leverages our Institutions' existing investment in hardware and software licenses is available for deployment. CityEngine is an example of a new 3D visualization package that could draw from our existing data services to publish 3D web scenes and web based maps. There is interest across the institutions to research and evaluate CityEngine, and other related visualization tools, to determine which tool will meet our needs and lead us to make an informed decision. With CI as the "glue" that brings the MILES project together, a statewide integration of visualization has the potential to leverage existing infrastructure to disseminate ecosystem service research from the three pilot sites.

Project Description

One of the key findings of the EPSCoR MILES Advisory Board from the statewide meeting in April 2014 was that visualization needs to be a priority in the operational and strategic plan of MILES in the short- and medium-term. Visualization, the Board said, should be part of the program at all phases, not just a product introduced at the end of the project to communicate and disseminate our results. This proposed iSEED application will bring together investigators from across campuses and disciplines to investigate the CityEngine and like platforms in order to foster rapid development of visualization tools for the MILES pilot sites.

What is visualization?

In the literature, visualization can refer to several distinct uses and forms of visual media. Visualization is, in general, a method of computing that enables scientists and citizens to directly observe and intuitively interact with simulations, computations, and data flows. By transforming data into visual symbols and structures, the method of visualization enables scientists and citizens to directly observe and intuitively interact with simulations, computations, and data flows (Card et al. 1999; Spence 2007). Visualization can be used in several ways: to manage data by reducing their complexity and transforming numbers into visual geometric forms, to communicate by using graphics to share information among the scientists in a project and with stakeholders and the public, and to generate insight by allowing interaction with models and providing immediate feedback (McCormick, DeFanti, and Brown 1987; Tufte 1997; Thomas and Cook 2005).

In this sense, "visualization" is a method rather than a specific object, though in recent years the term has come to refer also to specific tools, diagrams, maps, and products that enable visualization. The MILES program has already generated several such products (sometimes simply called "visualizations") including network maps, virtual worlds, and 3D representations of landscapes, all designed to help both analysts and stakeholders understand the complex data, models, relationships, and systems that are part of the overall project. As individual products, their creation and implementation demands technical skills (such as programming and data management), but as components of an overall methodological approach, these tools require careful design and attention to the cognitive constructs of their audience. This user-centered approach demands different tools (different data, modes of interaction, levels of detail, affordances, and user experiences) depending on the audience.

Visualization can also aid users in exploring the spatial attributes of MILES datsets. Our approach will take geographic data, and convert it into interactive and predictive three dimensional models that will enable spatial and temporal relationships to be viewed in innovative ways (MacEachern & Kraak, 1997; 2001; Kraak, 2003; Kinzel, 2009). Coupled with recent innovations in virtual environments, geo-based visualization can facilitate interaction and problem-solving scenarios thereby involving researchers and stakeholders in shared, inquiry- based discovery. Evaluating the visualization properties of CityEngine and its ability to process MILES datasets is a priority goal of this proposal. As the visualization working group embarks on establishing a common platform for visualization, we will examine potential products like CityEngine for their facility to cater to these various audiences and visualization applications, all of which are relevant and important to the goals of MILES. Our working group must be familiar with not only the data and models but also the needs and demands of the scientists, stakeholders, and/or general public for whom the tools are designed. This effort requires cooperation, conversation, and collaboration, all of which will be fostered through funding from this proposal.

How can visualization help MILES achieve its strategic goals?

Project coordination and sharing among scientists

Through visualization the working group will be able to unify effort around a software platform that will enhance the MILES effort in sharing data, characterization, modeling, understanding relationships, interpreting historical phenomena and events, steering models, and disseminating results. This will require research into and training with visual analytics products (introduced and demonstrated at conferences and workshops), the investment in hardware and technical facilitation (enabling seamless data sharing, model parameterization and execution, and insight communication among MILES researchers), and frequent collaborations and updates among the working group (best done at same-place working group retreats).

Stakeholder involvement

Stakeholder engagement in MILES' projects is key to the program's success. As members of the visualization working group, we seek to provide stakeholders with the information and tools that they need to not only understand the work that is being performed by MILES researchers but also, importantly, assist in that work through the active involvement in data sharing and analysis. To that end, we propose complementing our IT infrastructure at each institution with mobile devices for group citizen data collection in the field. For example, these devices will be piloted in Adventure Learning programs that are designed to enable stakeholders to draw polygons, lines, or points on maps on their devices (possibly using CityEngine) and annotate them with personal descriptions, stories, or photographs.

Communication to the general public

To the general public, the MILES program may appear to consist of three different regional projects that could appear disconnected. A demonstration of unity and cooperation among the three primary institutions in MILES would be communication efforts to the general public that have a similar look and feel across the institutions. Visualization in general, and the use of a common platform more specifically, offers the general public a common interface to interact with MILES without the sensation of exploring three different research projects. Training is simplified for the public outreach through deployment of the tools on the idahoecosystems.org website.

What are we going to do to achieve these goals?

A significant challenge facing visualization researchers is the assessment of the effectiveness of the tools that are produced. Our proposed implementation of a platform like CityEngine must include measurements to establish that it (or some other platform) is useful and helpful in achieving the goals of MILES project – that is, to characterize ES, to model and envision future scenarios, to communicate results, and to affect change in planning and policy – as well as the goals of visualization in general – that is, to manage data, to communicate, and to generate insight. These goals are, of course, not mutually exclusive.

Our working group will help establish these metrics relative to the MILES project, and develop a framework for collection of data that will allow a systematic assessment of visualization platforms. Fortunately, assessment of visualization is a core theme in visualization literature (Chen and Yu 2010;

Plaisant 2004), and workshops, conferences, and special journal issues are dedicated to this type of research. We seek to attend and participate in one such conference in November (BELIV 2014; see http://beliv.cs.univie.ac.at/).

Since the primary goals of any visualization method are the facility of data management and the generation of useful insights and hypothesis, one possible method for assessing tools that are developed is the deployment of an application that resembles a game. Such a web interface would allow users of the system to not only use the CityEngine application to explore MILES-related data but also upload their own data (photos, descriptions, locations, observations) and capture their insights (after using the application) about the pilot areas. "Players" would vie for points or badges according to the originality, accuracy, and value of their contributions. Their observations and insights would be open for community-based peer review – with experts and stakeholders "liking" (or disliking) the data sets, observations, insights, and hypotheses. This follows on existing research in other fields that has demonstrated that this combination of social media and so-called "gamification" of science can be a successful approach in insight generation and knowledge construction (McGonigal 2011; Khatib et al., 2012; Beier, Miller, and Wang 2013).

While establishing detailed methods like the example above for measuring the success of a platform will be part of the working group's mission, we can say here that a successful visualization platform will be flexible enough to be useful to scientists and stakeholders. A successful system must enable: (a) the upload of data by researchers collecting data in the field and gathering secondary data from various sources, but also enable the easy incorporation of crowd-sourced information from stakeholders and the public through a simple web interface, (b) the detailed analysis of shared information by connecting to (and steering of) models used by researchers, but also help stakeholders explore data sets and make connections and generating insights that might have otherwise be missed by researchers, and (c) the communication of insights and findings both among stakeholders and researchers in the program and between the program and the general public.

Anticipated Pubs:

Developing an Integrated Web Visualization Platform for Ecosystem Services in Idaho

Evaluation of a visualization environment with community-based peer review in a game interface

Work Plan Summary

- Initial (virtual) meeting to discuss and explore CityEngine, with a demo by ESRI representative
- Develop pilot project descriptions
- Larger (face-to-face) researcher and stakeholder meeting to discuss pilot-project descriptions and identify necessary data and data sharing
- Gather and prep pilot project data
- Third meeting (virtual) to develop base pilot project in CityEngine
    - training of students
    - hands-on draft pilot project visualization
- Refine pilot project and demonstration via webinar to MILES EPSCoR faculty (by end of Year 1)

Citations

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Budget

Description	Budget	
Salaries - Grad/Undergrad	$	18,000.00
Salaries - Graduate Student		
Salaries - Undergrad		
Fringe	$	3,000.00
Travel	$	17,800.00
Equipment	$	33,700.00
Student Tuition		
Other		
Indirect Costs	$	9,000.00
Subtotal	$	81,500.00

Budget justification

Salaries/Fringe Benefits

- Funds for an undergraduate student or part-time graduate student at each institution to help gather data, attend meetings, and assist with draft pilot project. ($6K salary + $1K fringe + $3K indirects = $10K * 3 institutions = $30,000)

Travel

- Travel funds are requested to bring together a large working group to build consensus around visualization needs and requirements, as well as, the evaluation of software platforms. We are anticipating travel funds of approximately $750/person to travel to a 2-day kick-off meeting within Idaho. An estimate of interest indicates that a minimum of 15 people would require travel funds ($800*15 = $12,000). Conference facilities with catered breakfast, lunch and coffee ($400/day = $800).
- Conference travel to visualization events to advance cutting edge knowledge and present MILES research. Events such as SIGSPATIAL (http://sigspatial2014.sigspatial.org/) or Visualization and Data Analysis (VDA - http://vda-conference.org/) are candidate conference events. Estimate conference travel costs are $5000.

Equipment

- Testing visualization platforms across mobile devices will be an important consideration for each institution. We are proposing 15 units @ $500 each ($7500) to be distributed for each campus. Additional usage will enhance visualization of datasets in the field as well as data collection.
- To share visualization methods, practices and innovations across campuses we will leverage existing IQ Stations located at each. In order to accommodate conferencing across the campuses with IQ Station platforms that are 3D ready and capable, upgrades will be required to enhance video and sound capabilities. (anticipated amount is $1500 * 3 = $4500)

- Oculus VR for each campus IQ Station ($350*6 = $2,100). Visualization googles for immersive experience.
- Leap motion controller for IQ Stations ($100*3 = $300)
- Workstations ($2000*2 = $4000) and server infrastructure (RAM/disk = $2300) devoted to CityEngine
- Production box for data rendering ($5,000)
- Misc equipment for running CityEngine on tile display ($3000)
- 3D software for data preparation ($5000)

Tuition/Fees

- Tuition fees are not requested for this proposal

Other

Timeline