Integrating a Community Model of the Chesapeake Bay into a Web 2.0 Based Framework using the Google Maps API, Django and AJAX

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The Chesapeake Bay is the largest estuary in the United States. Watershed is home to more than 16 million people. Provides food, habitat, jobs, and many other benefits. Ecosystem is especially fragile due to its long dendritic shoreline and high concentration of human activities.
Introduction

Many computer models and simulations exist with varying degrees of complexity.

The Phase 5 Watershed Model consists of three sub-models: hydrologic, non-point source, and river.
Introduction

The Phase 5 Model is very detailed and complex, both in its installation and use. Linux command line environment, requiring special training or experience to fully utilize. Text files specifying the details of the watershed environment are input into the system, which in turn generates text files detailing the changes in water quality over the extent of the bay.
Objectives

To enhance secondary and post-secondary science instruction relating to the Chesapeake Bay

National Science Education Standards: systems, models, and the abilities necessary to do scientific inquiry

Maryland Science Education Core Learning Goals: Goal 1 - Skills And Processes: The student will demonstrate ways of thinking and acting inherent in the practice of science.

NASA’s 2010 Science Plan recognizes Enhancing Environmental Stewardship and Educating the Next Generation as important goals that this project could contribute to
Objectives

To improve upon the first version of the Chesapeake Bay Community Model Visualization Tool by using a robust web framework and enhance its user interface by using AJAX technology

To complete the final requirements of a Master of Science degree at in the field of Natural Resources Science

To disseminate this work to a wider audience by including members of the agricultural extension community
A web-based interface to the Phase 5 Watershed Model was created, to facilitate its use in secondary and post-secondary classrooms.

Output is displayed using the Google Maps Application Programmer Interface (API).

Nitrogen, Phosphorus, and Suspended sediment are shown in kg/year/acre for each river segment in the watershed.
This tool is called the Chesapeake Bay Community Model Visualization Tool, or CMVT and is a functional first step.

Created using standard web technologies including html, JavaScript, and Python.
A lesson using the Phase 5 Model and data in a secondary science classroom was tested.

Students were given background information about nutrient pollution and computer modeling.

A 21 question survey was administered to students before and after the lesson to assess their attitudes and understanding of these issues.
Summary data are presented on the site as well, including graphs showing correlation between land use and nutrient pollution.

Controls for the display of summary data can be added as an enhancement to the current, giving the user more control over the analysis.
Results

Students used the CMVT to investigate nutrient pollution in the Chesapeake Bay.

Pre- and Post- survey responses were analyzed to determine the effectiveness of the CMVT and the use of authentic data.
Results

Students in Biology and Computer Science courses have used the site and participated in the survey so far.

Results have been positive, though the sample size so far is somewhat small (n < 20)
Sample of the six highest performing survey questions as well as the overall mean response

<table>
<thead>
<tr>
<th>Code</th>
<th>Question</th>
<th>%Difference Pre to Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Overall Mean</td>
<td>10.01</td>
</tr>
<tr>
<td>G</td>
<td>My activities have an impact on water quality in the Chesapeake Bay</td>
<td>24.47</td>
</tr>
<tr>
<td>E</td>
<td>I understand how scientific data is used to make decisions about the Chesapeake Bay</td>
<td>23.16</td>
</tr>
<tr>
<td>T</td>
<td>Nutrient pollution is a problem for the Chesapeake Bay that can be addressed by everyone</td>
<td>17.49</td>
</tr>
<tr>
<td>H</td>
<td>Computer models are useful scientific tools</td>
<td>14.81</td>
</tr>
<tr>
<td>R</td>
<td>The Chesapeake Bay watershed is a very complex system</td>
<td>13.88</td>
</tr>
<tr>
<td>N</td>
<td>Excess nutrients in the Chesapeake Bay can harm its water quality</td>
<td>13.49</td>
</tr>
</tbody>
</table>
Sample of the six highest performing survey questions as well as the overall mean response

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<tr>
<th>Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>Overall Mean</td>
<td>10.01</td>
</tr>
<tr>
<td>B</td>
<td>Nutrient pollution is a problem for the Chesapeake Bay</td>
<td>-0.1347</td>
</tr>
<tr>
<td>Q</td>
<td>Computer models can provide accurate descriptions of our world</td>
<td>1.7857</td>
</tr>
<tr>
<td>P</td>
<td>There are many uses for computer models</td>
<td>2.0592</td>
</tr>
<tr>
<td>C</td>
<td>Agricultural activities have a great impact on the Chesapeake Bay</td>
<td>4.6753</td>
</tr>
<tr>
<td>M</td>
<td>Human activities on the Chesapeake Bay can be controlled better so they are less harmful to the Bay</td>
<td>4.9689</td>
</tr>
<tr>
<td>K</td>
<td>Many diverse living things can be found in the Chesapeake Bay watershed</td>
<td>5.4054</td>
</tr>
</tbody>
</table>
Discussion and Conclusions

Future improvements include implementation of CMVT using Django framework and Ajax web technologies to enhance user interface.

The creation of additional useful scenarios.

The implementation of controls for data summary.

The addition of more publicly available data layers to the map to allow additional analysis.
Use of the software with additional secondary and post-secondary courses: Environmental Science, Marine and Estuarine Ecology

Use of the software with Agricultural Extension workers

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Questions?