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Using Stella in Earth System Science Colloquium (11:015:401)

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## 1. Objectives

- o To introduce students to the concept of modeling in sufficient depth to use it for projects in other courses.
- o To promote interdisciplinary communication between students.
- o To demonstrate two specific models related to Earth System Science. A population model and a zero-dimension radiative model of the earth-atmosphere system.
- o To have some groups use Stella in their team projects for the course.

## 2. Setting Up

First, the software had to be installed on a central server system for the students. The contact for the server was Scott Livesey (livesey@gandalf.rutgers.edu). He needed the software for about a month to test for reliability before he could fully install it on the network. The classroom reservations have to be done through Mey Lein Ho (mho@jigsaw.rutgers.edu). Reservations have to be done several weeks in advance to compete against other Rutgers computer seminars also held in the teaching lab.

## 3. Preparation

Several documents had to be prepared for the students to look at and use in the lab sessions. A Stella basics document was put together telling students how to get around the Stella program and use most of its features. Another document took the students through a very simple population model which was to be used in the first lab session. The homework assignment expanded on this lab session. A third document explained the second lab session. In class lectures on background material were given prior to each of the lab sessions.

## 4. Laboratory Sessions

Topics of the labs were population and the greenhouse effect. The population model was used as a springboard to help students become familiar with Stella. A full 80 minute period was used to teach students how to use certain parts of Stella.

A homework assignment was given to the students to expand on the population model. The model covered in the lab session used birth rates and death rates to control how a population grows or shrinks. The assignment incorporated a resource that was renewable. The birth rate and death rates were controlled by the amount of the resource available. This model showed students the effects on a population and its available resources by using different formulas to compute birth rate and death rate. The TA had office hours after the lab session to help students with the homework assignment.

The second 80 minute session was devoted to modeling the earth-atmosphere system. The first part of the assignment was to model an earth without an atmosphere using a zero-dimensional point model using only radiation and albedo. The second part added the atmosphere as a layer that absorbed long-wave radiation and reflected short-wave radiation (Few). The last part was the same as the second except that carbon dioxide levels in the atmosphere were allowed to change. Students examined the temperature responses as they varied parameters such as albedo, absorption, and rate of increasing carbon dioxide. All work was done in class and no assignment was given.

## 5. Team Projects

Stella was used by the Sea Level Rise group in their final project. Their model assumed a beach profile of the coast and calculated the inland intrusion due to sea level rise. They calculated how much sand would be needed to maintain the present shoreline and then ran a separate— model to determine whether beach replenishment projects would continue to be economically feasible into the future. —

## 6. Conclusions

Students responded well to the material presented to them. The laboratory sessions were improved when background material was given in the lecture prior to the lab. The students should be able to complete, independently, homework assignments on Stella after the first two, in class, laboratory sessions. The TA should make office hours available to help students with the homework assignment.

Non-science students have a difficult time writing formulas for their models. A worksheet to transform written words to formulas and vice versa would be helpful not only for the students in working with Stella and also for those students who are unfamiliar with the formulas appearing in articles, papers and journals.

## Stella Basics

Stella is a software package for modeling dynamic systems. The following documentation gives an introduction to Stella. Words appearing in **BOLD** are objects on the Macintosh screen that can be selected or manipulated. Words UNDERLINED are actions, usually with the mouse or keyboard or items in pull down menus.

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### **I. Accessing Stella**

You must be a registered student at Rutgers University and have an e-mail account under one of the student machines. Get help from the aid station at Loree Room 009 to obtain a student account.

Find a working Macintosh (Mac) not in use. DO NOT INSERT YOUR DISK. Login using your assigned student login and password that you chose. If the Mac is already on, Restart it by holding the mouse button down over the word Special and drag down the list until Restart is highlighted and then let go of the mouse button.

When you see the start-up menu, click on Student Login and fill in the appropriate login ID and password. If you do not have an account, use the **Guest** login.

NOTE: If you get an error at this point, try logging in as **Guest** as the student machine may be down and unable to confirm your login ID and password.

After it finishes, find the **CLASS-S/W** (class software) folder icon. An icon is a small picture, with a name, depicting the purpose. In this case, a folder containing our application for our class. Move the mouse over to the folder icon and double-click. Double-clicking means rapidly pressing the mouse button twice over the object to open or activate it. After opening the **CLASS-S/W** folder, open the **Stella II** folder. Find **Stella II LAB/LAN 2.2.2** and run it by double-clicking on the icon.

You are now in **Stella**. Proceed following these instructions given to you in class. You may also find other instructional manuals available at the aid station desk at Loree. For more detailed instructions consult your TA.

At this point, insert your disk. Inserting your disk after **Stella** is running will reduce the steps needed to save your work.