J3.1 CONNECTING STUDENTS TO SCIENCE THROUGH THE INTERACTIVE USE OF NASA EARTH SCIENCE CLIMATE DATA

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1. INTRODUCTION

Children in grades K-12 represent a very technologically savvy group of individuals. For these students, reading material in a book is not always enough to capture their interest. Students today crave interactive, hands-on approaches to teaching material, especially when instruction focuses upon science. Administrators, from the Department of Education to local school boards, all recognize the need for technology infused content. To help meet this need, the "Mentoring and inquiry using NASA Data on Atmospheric and Earth science for Teachers and Amateurs" (MY NASA DATA; Chambers et al., 2008) project was established to systematically support educational activities at all levels of formal and informal education through the use of web-based educational tools and teacher development.

2. DESCRIPTION

At the core of MY NASA DATA is the reduction of NASA's large Earth science data holdings to *microsets*. These microsets are small enough to be easily portable and useable by students, teachers and citizen scientists. The microsets are taken primarily from data housed at NASA's Distributed Active Archive Centers (DAAC's) e.g. Atmospheric Science Data Center (ASDC) at NASA Langley Research Center and Physical Oceanography DAAC at NASA's Jet Propulsion Laboratory. To increase the usability of the data, the microsets are part of an integrated website (http://mynasadata.larc.nasa.gov), which allows users to browse through data information pages, a science glossary, suggested computer tools and lesson plans for use with different microsets. A key component of MY NASA DATA is the Live Access Server (LAS) tool that allows users to explore the data, create custom microsets and visualize the data. Through the LAS and website users can access data covering a broad array of weather and climate topic areas such as: radiation budget, clouds, leaf area index, precipitation, aerosols, sea surface temperature, sea surface height and tropospheric chemistry (e.g. ozone and nitrous oxide). More than 140 parameters are now available. The LAS is scalable to meet different needs. There are currently three separate instances of the LAS available on the website to better meet the needs of beginners through advanced users. Through the LAS, users can choose from a variety of parameters obtained from many satellite missions, such as the Clouds and the Earth's Radiant Energy System (CERES), the Multi-Angle Spectro Radiometer (MISR), and the International Satellite Cloud Climatology Project (ISCCP), just to name a few. Additionally, users can download custom microsets in formats usable in spreadsheet programs (e.g., Microsoft Excel) and GIS software (e.g., ESRI's Arc View).

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3. SCAFFOLDING FOR DATA USE

Aside from the size and format of the data files, a major hurdle in using authentic data is the data documentation (or lack thereof). Many people outside of a specific discipline have difficulty understanding the jargon-heavy language of a particular science area. MY NASA DATA seeks to ease those difficulties by providing teacher- and student-friendly data documentation. The science glossary provides pictures and background information on most of the parameters and other key concepts on the MY NASA DATA website. Additionally, MY NASA DATA supports a FAQ page where users can ask questions and get responses from top scientists in their field, which further connects users to those actually doing Earth science research.

MY NASA DATA also supports formal education initiatives by offering complete and peer-reviewed lesson and unit plans on the website. New last fall is a search tool that allows educators to pinpoint lessons tied to specific national (or Virginia State) education standards within the growing MY NASA DATA collection. The lesson plans cover a broad variety of topics such as radiation, ozone, clouds, aerosols, and sea surface temperature. Lessons contained on the website are from MY NASA DATA team members and most importantly, more

than 40 lessons from teachers who have used MY NASA DATA in their classrooms.

To further strides in informal education, MY NASA DATA also has on its website a webpage devoted strictly to science project ideas. This page serves as a guide to amateur scientists – broadly defined to include both K-12 students doing a science fair project all the way to retired people who practice science as a hobby - who want to explore various topics, e.g., precipitation and clouds in atmospheric science. About a dozen project starter ideas are currently posted. The common theme among these projects is exploration of some Earth system aspect that can be measured locally; and then compared with the historical record from available satellite data.

4. CASE STUDY: Hurricanes as Heat Engines

To illustrate the MY NASA DATA model, consider the team-developed lesson plan on "Hurricanes as Heat Engines". This lesson follows the outline used for all the lessons on the MY NASA DATA website:
1) Purpose: what is the point of the lesson
2) Grade level: a suggested range (4-12 here)
3) Estimated time for completing activity
4) Learning outcomes: what will students achieve
5) National standards: identifies Geography, Math, and Science education standards that the lesson addresses
6) Virginia Standards of Learning: Because the project team is based in Virginia, these are also included. For lessons developed by teachers in other states, the related state standards are usually given in the Teacher Notes.
7) Prerequisite: What students should be familiar with before they begin this lesson.
8) Tools: What is needed to do the lesson
9) Vocabulary: specialized terms used in the lesson. These are linked to the MY NASA DATA science glossary where at a minimum students can find a student-friendly definition. Many entries also include an illustration and a link for further information.
10) Lesson links: For technical reasons, all other URL links in the lesson are collected under this heading. In many cases, as here, the lesson links include links to sample graphs or data files that are produced in the lesson, so that teachers know

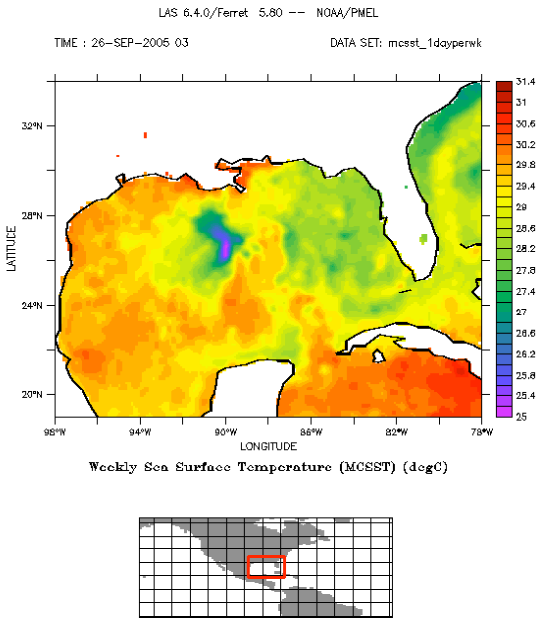

Figure 1. Sample map for the hurricane lesson

what to look for, or can adapt the lesson for use when a computer lab is not available. See Figures 1 and 2.
11) Background: a short introduction to the topic at hand. This is not meant to replace a textbook, but merely to ensure that all students have a basic grounding in the topic.
12) Procedure: Step-by-step instructions on how to create the specific data microsets used in the lesson. Once students are comfortable with this procedure, they can easily begin to explore the data in the LAS for further scientific inquiry.
13) Questions: some suggested questions that a teacher might pose to assess whether the students understood the lesson.
14) Extensions: Ideas for ways that students might want to further explore the topic.
15) Teacher Notes (optional). Additional hints for implementing the lesson in the classroom.

The point of this lesson is to enable students to explore authentic Earth system science data, and to see for themselves some of the interconnections that exist in common phenomena like hurricanes, which leave an interesting and not often discussed signature of their passage on the ocean. Once they take the first step, our hope is that many will follow their curiosity to explore other aspects of the Earth system using data microsets available within the LAS.

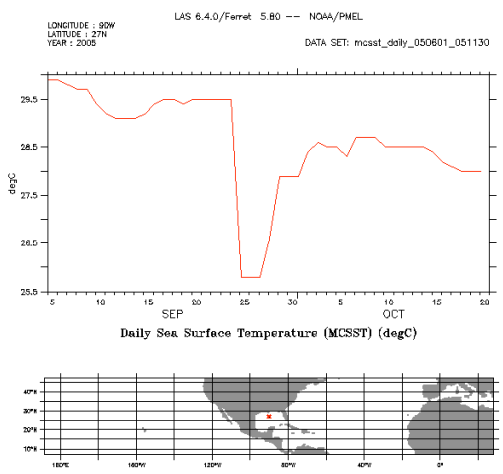

Figure 2. Sample line graph from hurricane lesson showing the cooling of surface waters in the Gulf of Mexico following the passage of Hurricane Rita.

5. PROFESSIONAL DEVELOPMENT

The MY NASA DATA project conducts mini-workshops and brief presentations at various conferences throughout the year to reach different user communities. Presentations at national and regional conferences, such as the National Science Teachers Association and National Council of Teachers of Mathematics, allow us to share the project more widely with teachers around the country. Targeted workshops are also held with local science and math teachers, who provide invaluable feedback to the project team.

In addition, MY NASA DATA summer teacher workshops held in 2004, 2005, and 2007 have drawn about 20 educators each from around the country (and the world! A participant in 2007 came from Guam. In 2005 a teacher came from Canada.) to the NASA Langley Research Center for an intensely interactive, multi-day experience. Typically the workshop begins on the weekend with an informal activity that takes advantage of local venues, such as Colonial Williamsburg, or the 400th anniversary of the English Colony at Jamestowne. This allows the teachers and the team to get acquainted while experiencing a fun activity. During the week, teachers meet scientists, familiarize themselves with the website, learn techniques for working with the data, and build personal networks with teachers who share the same interests. They also spend time developing lesson plans for using data in the classroom. The final workshop in the series is planned for June 22-27, 2008. Application information is posted on the website, with applications due on April 9, 2008.

Other workshops have taken advantage of NASA's Digital Learning Network (DLN) to enable the team to connect by videoconference with a remotely located group of interested educators. A MY NASA DATA module is also offered through the DLN.

6. COMMUNITY

Alumni from the teacher workshops, and other interested people who sign up on the website, become part of a distributed MY NASA DATA community. The team writes and sends a monthly E-note to update these groups on recent developments in the project, as well as upcoming opportunities. The E-notes are also archived on the website. In addition, a number of workshop alumni have served as ambassadors for the project, presenting at regional conferences on behalf of the team. This provides an opportunity for teacher-to-teacher interaction, familiarizes more educators with the project, and results in excellent feedback.

7. IMPACT

As a web-based project, the impact of MY NASA DATA can be gauged only through anecdotal feedback or through web-based metrics. We have been tracking the number of distinct users each month since the website was launched in January 2004. Figure 3 shows a very satisfying growth in this metric, suggesting that the project is meeting the needs of its audience. In late 2007 we exceeded 10,000 distinct users in a month.

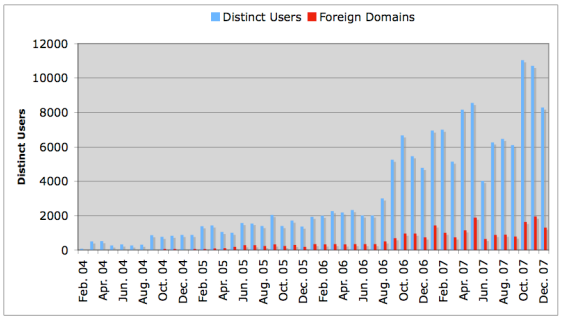

Figure 3. Number of distinct users of the MY NASA DATA website each month since January 2004.

8. CONCLUSION

MY NASA DATA is a web-based source of NASA satellite-derived data and instructional guidance for education and the general public. The data on the Web site are actually microsets of larger data sets available from NASA Earth-observing satellites. The MY NASA DATA project welcomes relevant contributions of corresponding lesson plans, data sets, computer tools and project ideas to share with others - especially successful uses of the MY NASA DATA resources in the classroom. The project supports various science education tools such as science fair project ideas, an interactive Earth science glossary and the LAS that allows for interactive data visualization. The FAQ section and mentor network provide resources to further understanding on Earth system science related topics. Please contact the MY NASA DATA (mynasadata@lists.nasa.gov) team for further information, or to provide feedback. With the implementation of the science portion of NCLB, MY NASA DATA is poised to assist educators with authentic science and the scalable support necessary to achieve great success with the bright minds of tomorrow.

9. REFERENCES

Chambers, L. H., E. J. Alston, D. D. Diones, S. W. Moore, P. C. Oots, C. S. Phelps, Forrest M. Mims, III, The MY NASA DATA Project, 2008: *Bull. Amer. Meteor. Soc.*, in press.