## TOOLS FOR EXPLORING NASA EARTH OBSERIVNG SYSTEM CLIMATE DATA IN K-12 CLASSROOMS

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### 1. INTRODUCTION

The Atmospheric Science Data Center (ASDC) at NASA's Langley Research Center houses over 800 data sets related to Earth's radiation budget, clouds, aerosols and tropospheric chemistry. These data sets were produced to increase academic understanding of the natural and anthropogenic perturbations that influence global climate change. However, the large file size and format of these data sets means they are not readily usable by the general public or education community. To facilitate the use of these data the "Mentoring and inquirY using NASA Data on Atmospheric and earth science for Teachers and Amateurs" (MY NASA DATA) project has been established to systematically support educational activities at all levels of formal and informal education. The MY NASA DATA project accomplishes this by reducing these large data holdings to 'microsets' that are easily accessible and explored by K-12 educators and students though the project's Web page. This manuscript will provide an overview of the Web site, the different microsets available, the lesson plans and computer tools, the e-mentor network and highlight the successes from the second annual MY NASA DATA Summer Teacher Workshop held in July 2005.

#### 2. THE MY NASA DATA WEB SITE

The MY NASA DATA Web site serves as the gateway into all the resources that the project offers. The project's URL is http://mynasadata.larc.nasa.gov. The educational microsets are available on the MY NASA DATA Web Site, established in December 2003 The site contains lesson plans, (see Figure 1). computer tools, data documentation, FAQs, links to related science information resources and an earth science glossary. Currently, the MY NASA DATA Web site caters to K-12 educators, but a new area of the website is planned for 2006 to draw specialized interest from amateur scientists. More advanced project ideas and computer tools are being investigated for this area of the site. An additional area will provide thoughtprovoking and interesting science fair project ideas related to atmospheric science. The Web site also provides access to lesson plans and tools created and/or used by teachers or citizens.

An interactive feature on the Web site is the earth science glossary. The glossary contains vocabulary from the lessons on the Web site. Common science terminology is incorporated as well. Additionally, it contains descriptions for the different satellites, their instruments, and parameters. A majority of the definitions not only contain links to other Web sites for additional information; but also include a picture or diagram to further understanding of the term.

The MY NASA DATA project also reaches out to the citizen scientist community, both as data users and a source for project ideas. An online registration and submission form is now available and entries are highly encouraged. The FAQ page is an easily accessible knowledge repository where people can ask/read questions related to the site. The MY NASA DATA team analyzes all submissions for correctness and relevance before they are included in the public materials.



Fig. 1. The MY NASA DATA Web site

### 3. AVAILABLE MICROSETS

Both static and custom microsets are available for analysis and download from the MY NASA DATA Web site. The static microsets are in simple ASCII text format and serve to investigate a single parameter, event or region for a variety of educational topics. Parameters include science quantities such as temperature, cloud cover and ozone amount. A majority of these static microsets come from the Clouds and the Earth's Radiant Energy System (CERES)

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project, along with microsets from the Stratospheric Ozone and Gas Experiment III (SAGE III) project and radiosonde data. Corresponding lesson plans are also supplied to assist in teaching and are directly linked to national standards of learning. These lesson plans also engage students in the use of computers and the Internet to collect and compare informational resources.

A major attraction available on the MY NASA DATA Web site is the Live Access Server (LAS) which produces custom microsets. LAS is a user interface to created by NOAA/PMEL for data visualization and analysis (see Figure 2).



Fig. 2. The Live Access Server (LAS) User Interface

The MY NASA DATA LAS implementation is the first educational application of a Live Access Server. It currently supports 150 parameters for making microsets and plots. The parameter selection within the interface is governed by Global Change Master Directory (GCMD) data categories (see Figure 3). The majority of these parameters are provided by data holdings from ASDC's projects such as CERES, the International Satellite Cloud Climatology Project (ISCCP), the Surface Radiation Budget project (SRB) project, the Multi-angle Imaging Spectrometer instrument (MISR) instrument, and Tropospheric Ozone Residual (TOR) data set.



Fig. 3. LAS Parameter Selection Page

There is an on-going effort to bring newer and more varied data into the LAS. For instance, Sea Surface Temperature data are now available. This type of data has gained notoriety in the news because of its relation to El Niño/ La Niña events and to the development and strengthening of hurricanes.

LAS allows users to create custom plots or text output of a selected parameter for any region or time period covered by the selected dataset. The plots can be maps, line plots or Hovmoller diagrams (parameter for latitude or longitude versus time). Quick links to the user interface help, data documentation, and the MY NASA DATA earth science glossary are available from the LAS interface. Example plot output is provided in Figures 4, 5 and 6.



Fig. 4. Example of a LAS Hovmoller diagram, in this case, Sea Surface Temperature at a given longitude vs. time



Fig. 5. Example of a LAS line plot, in this case, Sea Surface Temperature vs. Time (Time Series)



Fig. 6. Example of a LAS map, Sea Surface Temperature for June 4, 2005

# 4. LESSON PLANS AND COMPUTER TOOLS

Lesson plans and computer tools, designed for the K-12 education community, are available on the MY NASA DATA Web site. Using the requirements stated by the national education standards for science, math and computer technology materials are developed with the objective of incorporating authentic data into the classroom where arbitrary data is often used for analysis and teaching. All developed lesson plans have a similar format. The lesson plans consist of learning objectives, a background section that often incorporates the reason for studying a particular data set and which project provided the data. Vocabulary for the lesson is linked to the earth science glossary. Questions and extension activities are included to test understanding of the subject matter and to challenge the student to access and analyze additional related data. Currently, there are seven lesson plans developed by the MY NASA DATA team. These lesson plans cover a broad

range of atmospheric science topics such as clouds, meteorology, and aerosols.

Additionally, to motivate student interest in data analysis as a learning tool, computer software applications used in authentic scientific analysis, such as Excel, IDL Virtual Machine, Texas Instruments Graphing Calculators, and ArcVoyager GIS are available for teachers to introduce and utilize within the curriculum. For some lessons, the computer tool is incorporated into the procedure of the main lesson. In other cases, the computer tool is suggested as a method of implementing the extension activity. There are mini-tutorials provided on how to use some of these tools. All lesson plans and tools aim to be ageappropriate at the teacher's discretion.

Again, educators and amateur scientists are encouraged to submit lesson plans and tools that have been demonstrated as successful methods of using MYNASA DATA microsets in the classroom. After review by the team, all approved contributed lesson plans and tools are made available on the MY NASA DATA Web site.

## 5. TEACHER WORKSHOPS

The second annual MY NASA DATA Teacher Workshop was held at NASA Langley Research Center on July 25-29, 2005. The workshop consisted of 20 participants from 15 states and Puerto Rico. Additionally, this year's class can boast having an international participant from Toronto, Ontario. The group consisted of middle school and high school math and science educators (see Figure 7). The objectives of the workshop focused on accessing microsets of atmospheric data, exploring model lessons using microsets, exploring data-collection methods used by scientists, and integrating examples of data collection and analysis into the curriculum. Each participant had an opportunity to access MY NASA DATA microsets, as well as to analyze realtime data using the computer tools available on the Web site. Each participant was tasked with creating a lesson utilizing the MY NASA DATA Web site and resources that was directly applicable to their classes in their home state.

To gain relevant math and science content, participants explored topics in atmospheric science, use of weather measurements and hands-on classroom activities. Participants benefited from the expertise of nationally recognized atmospheric researchers. Each day, the participants contributed feedback and suggestions about the workshop and instructional materials. Participant feedback and curricular contributions will be enlisted as further development of microsets continues. Already, participants have requested a MY NASA DATA presenter's packet to be created such that they may serve as "ambassadors" to present MY NASA DATA materials during local or regional in-service training, as well as presenting at regional and state conferences.

The participants presented their respective lesson plans before the entire group. The MY NASA DATA team requested that the participants review and revise their lesson plans, so that they can be published on the MY NASA DATA Web site. To date, there have been eight teacher contributed lesson plans added to the Web site, with more soon to come.

In addition, to the annual summer teacher workshop, MY NASA DATA hosts smaller workshops. For instance, the MY NASA DATA team has held two short workshops in the local area for Virginia Beach City Schools. The MY NASA DATA team also presents mini-workshops on how to use the MY NASA DATA Web site and how to access the microsets and lesson plans. In the coming year, MY NASA DATA will hold more of these smaller workshops at regional and national teacher conferences.

All workshop participants are encouraged to submit their lesson plans and tools to the MY NASA DATA Web site. By publishing participant developed tools and lesson plans, the MY NASA DATA project gains notoriety and an expanded user base. This process creates feelings of ownership within those who contribute, and they in turn become the best advocates and users of the MY NASA DATA project.



Fig. 7. Teacher workshop participants and MY NASA DATA staff for the second MY NASA DATA summer teacher workshop

## 6. E-MENTOR NETWORK

Sometimes teachers are required to educate their students in science without specific training in certain scientific concepts or educational materials, and often these teachers can spare little time to seek resources to improve their science teaching. Therefore, the MY NASA DATA project also focuses upon establishing a ementor network where scientists and educators can register to serve as a resource for questions regarding science education. Potential mentors are solicited through a variety of ways, including groups such as the Society for Amateur Scientists (SAS) and professional contacts. An online registration form is available on the MY NASA DATA Web site. Any visitor to the MY NASA DATA website can easily submit a question through a simple form on the site. This question is sent to the MY NASA DATA team and, if needed, forwarded to the mentor network. Registered mentors with relevant expertise respond with an answer. The team then integrates all answers into a single response which is sent to the questioner and also, if appropriate, posted on the Frequently Asked Questions (FAQ) page. This page then provides another mechanism to bridge the gap between the data and the targeted audiences. This allows questions to be answered directly by experts in Atmospheric Science as well as in pedagogy.

#### 7. CONCLUSION

Mentoring and inquirY using NASA Data on Atmospheric and earth science for Teachers and Amateurs (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 the Atmospheric Science Data Center at NASA Langley Research Center. The MY NASA DATA project welcomes relevant contributions of corresponding lesson plans, computer tools and project ideas to share with others - especially successful uses of the MY NASA DATA resources in the classroom. An e-mentor network is also included as a possible resource for teachers and citizen scientists for sharing knowledge and opportunities to incorporate real data into the classroom curriculum. The FAQ section and earth science glossary provide resources to further understanding on MY NASA DATA and atmospheric science related topics. Please contact the MY NASA DATA (mynasadata@larc.nasa.gov) team for further information, assistance or to provide feedback.

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