

## J 3.2 BRIDGING THE GAP BETWEEN EARTH SCIENCE AND STUDENTS: AN INTEGRATED APPROACH USING NASA EARTH SCIENCE CLIMATE DATA

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### 1. INTRODUCTION

Under the auspices of the Department of Education's *No Child Left Behind* (NCLB) Act, beginning in 2007 students will be tested in the science area. There are many techniques that educators can employ to teach students science. The use of authentic materials or in this case authentic data can be an engaging alternative to more traditional methods. An Earth science classroom is a great place for the integration of authentic data and science concepts.

The National Aeronautics and Space Administration (NASA) has a wealth of high quality Earth science data available to the general public. For instance, the Atmospheric Science Data Center (ASDC) at NASA's Langley Research Center houses over 800 Earth science 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 factors that influence global climate; however, a major hurdle in using authentic data is the size of the data and data documentation.

To facilitate the use of these data sets for educational purposes, 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 through the project's Web page. MY NASA DATA seeks to ease the difficulty in understanding the jargon-heavy language of Earth science. This manuscript will show how MY NASA DATA provides resources for NCLB implementation in the science area through an overview of the Web site, the different microsets available, the lesson plans and computer tools, and an overview of educational support mechanisms.

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### 2. THE MY NASA DATA WEBSITE

The MY NASA DATA website serves as the gateway into all the resources that the project offers. The project's URL is <http://mynasadata.larc.nasa.gov> (see Figure 1). The site contains lesson plans, computer tools, data documentation, FAQs, links to related science information resources and an Earth science glossary. The MY NASA DATA website consists of two main sections. One section caters to K-12 educators and students, while the other section is geared towards amateur or citizen scientists.

The MY NASA DATA website's layout provides a broad overview of the project's major attractions. For instance, a student who wants to further understand a vocabulary word he/she saw in class can use the interactive Earth science glossary. The glossary covers a wide spectrum of words frequently encountered in Earth science and words from all MY NASA DATA lesson plans. Many terms in the glossary have graphics associated with them, as well as hyperlinks that allow for further exploration and understanding of the term (see Figure 2).



Fig. 1 MY NASA DATA Website



Fig. 2 MY NASA DATA Glossary

Additional resources readily available from the MY NASA DATA website include links to the available microsets and support features. From there visitors can access FAQ pages, submit questions to the MY NASA DATA team, ask for expert advice from MY NASA DATA mentors or become a mentor themselves. There is also a link that allows visitors to know when MY NASA DATA team members will be giving presentations at various conferences across the nation. Last but not least, there is a link that allows teachers to request that their classrooms have an interactive real-time lesson with the MY NASA DATA team through NASA's Digital Learning Network.

The amateur scientist website is a place where thought-provoking research areas are presented along with ideas for how MY NASA DATA resources can assist those interested in these areas. This website also includes an area dedicated to science fair project ideas. These ideas provide teachers, students and amateur scientists the background information necessary for further research. The topics are presented to encourage an inquiry based approach. Additionally, the projects are sorted into expertise areas that allow everyone from the beginner to the more advanced to explore these areas and the resources available through MY NASA DATA (see Figure 3).



Fig. 3 MY NASA DATA Science Project Page

### 3. AVAILABLE DATA

Both static and custom microsets are available for analysis and can be downloaded from the MY NASA DATA website. 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. Examples of single parameters include science quantities such as temperature, cloud cover, net radiation and ozone concentrations. A majority of these static microsets come from the Clouds and the Earth's Radiant Energy System (CERES) project, along with microsets from the Stratospheric Aerosol 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. The LAS is a user interface created by the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory (( NOAA/PMEL) for data visualization and analysis (see Figure 4).

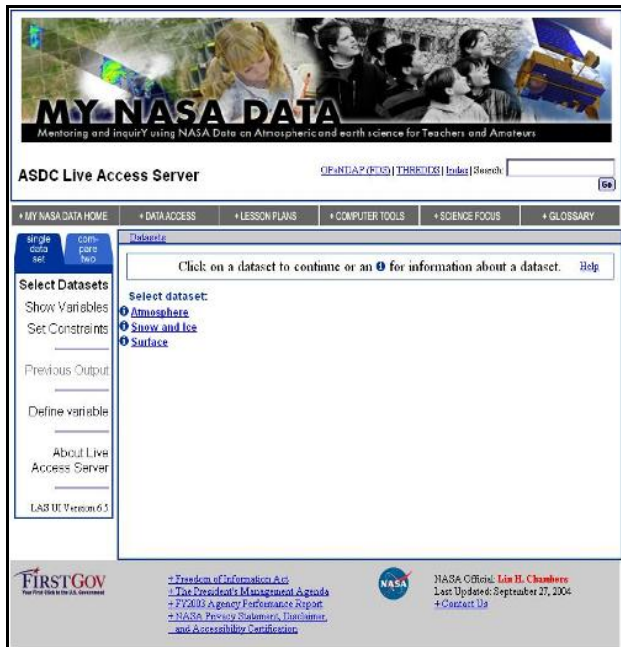


Fig. 4 MY NASA DATA Live Access Server

The LAS allows users to create in real-time custom plots or text output of a selected parameter for any region or time period covered by the selected dataset. In response to user feedback, the MY NASA DATA team created an LAS Introduction page that allows users to gain some background on LAS features, parameter naming conventions, hyperlinks to background information on the data sources, and information on the time periods associated with the datasets (see Figure 5). The customized 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 within the LAS interface.

The MY NASA DATA LAS implementation is the first educational application of a Live Access Server. It currently supports over 150 parameters for making microsets and analysis plots. The parameter selection within the interface is governed by NASA's Global Change Master Directory (GCMD; <http://gcmd.nasa.gov>) data categories. 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 (MISR) instrument, and the Tropospheric Ozone Residual (TOR) data set.

The MY NASA DATA project has developed partnerships with other NASA centers and governmental agencies. These partnerships allow MY NASA DATA to provide other datasets of interest such as sea surface temperature (SST) and precipitation data. SST data has received attention in the news because of its relation to El Niño/ La Niña events and to the development and strengthening of hurricanes. Due to the high visibility and demand for this type of data, the

MY NASA DATA team created a lesson plan to specifically look at the relation of sea surface temperature and hurricanes (see Figures 6 & 7). It is the scalability of the LAS that allows teachers to choose the type and amount of real data to bring into their classrooms.

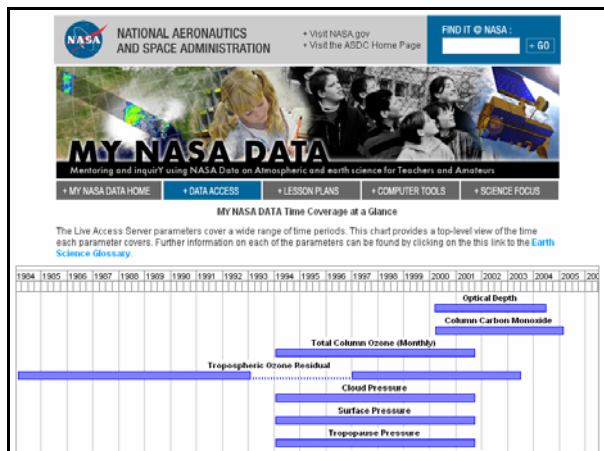


Fig. 5 MY NASA DATA Time Coverage at a Glance Page

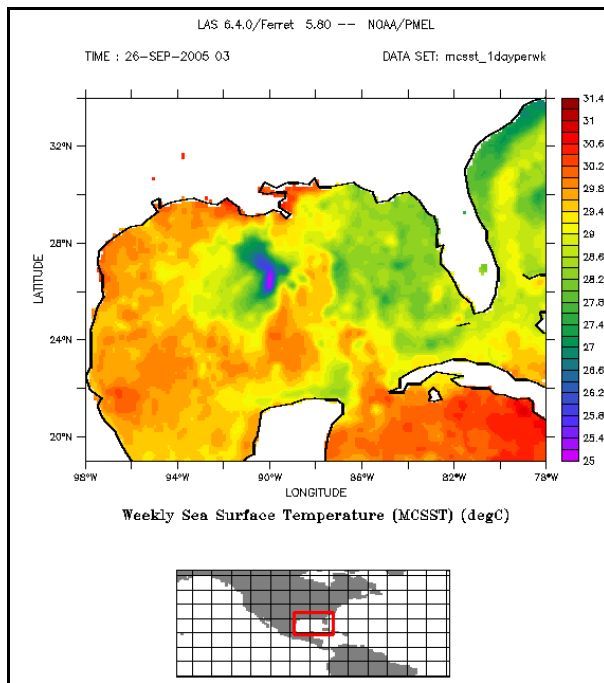


Fig. 6 Example of LAS map, Sea Surface Temperature on September 26, 2005 showing Hurricane Rita

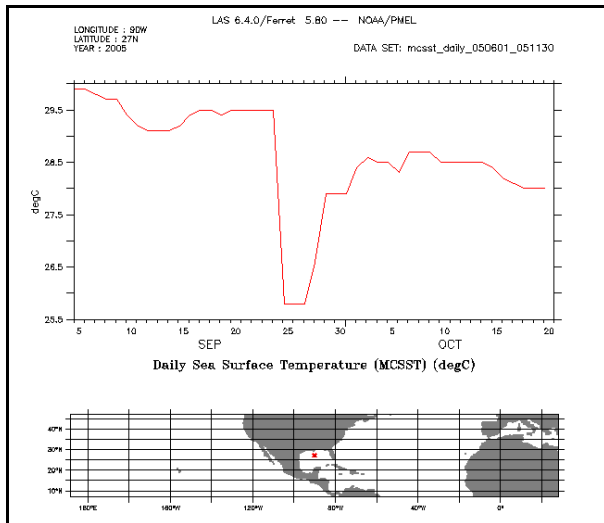


Fig. 7 Example of LAS line plot, Sea Surface Temperature vs. Time (Time Series) associated with Hurricane Rita

#### 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 in the national education standards for science, math and computer technology, materials are developed with the objective of incorporating authentic data into the classroom, where made up or insignificant data is often used for analysis and teaching. By addressing national standards, these ready-to-use lessons allow teachers to save time in their lesson planning processes without sacrificing quality. The lesson plans consist of learning objectives, and 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. Additionally, some lessons have procedures that are in slide show formats that provide visual and textual instructions. 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. Also of interest are the user contributed lessons. These lessons were contributed to MY NASA DATA from teachers from across the country, Canada and Puerto Rico. Those teachers participated in a week long intensive workshop held at NASA Langley; where the teachers were allowed time to develop lessons that were directly applicable to each of their own classrooms. Each teacher was able to tailor their lesson to meet national and state specific education standards. Teacher-contributed lessons cover a variety of topics such as air quality, ocean circulation, snow/ice cover, and soil temperature to name a few.

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 age-appropriate at the teacher's discretion.

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. All of the lessons contained on the MY NASA DATA website are reviewed by the MY NASA DATA team. The approved contributed lesson plans and tools are made available on the MY NASA DATA Web site. Additionally, to ensure that all of the lesson plans meet high standards and are consistent with NASA's guidelines all lesson plans are reviewed by NASA's Earth Science Education Product Review (see Figure 8). This process allows for independent peer review of NASA's educational products and provides feedback from scientists and educators. This feedback enables MY NASA DATA to stay current with new pedagogies and foci in the science education sphere. The implementation of NCLB is sure to impact how science products are judged and applied, and through this review the project can continue to provide relevant and useful materials to educators striving to meet these new goals.

Example lesson plans using the MY NASA DATA microsets from the Data Access page are listed below. All lessons have been reviewed by the MY NASA DATA team (MND Team). Lessons passing additional NASA Earth Science Education Product Review are indicated by "ESE".

ID	MY NASA DATA Lesson Plans	Grade Level	Reviewed By
H	Hurricanes As Heat Engines	3, and 4 - 12	MND Team
A	Circle the Earth! Explore Surface Types on a Journey around the Earth (Also featured on DLN)	4-12	ESE
B	Seasons and Cloud Cover, Are They Related? (Also featured on DLN)	4-12	ESE
F	A Comparison of Cloud Cover over Africa (Also featured on DLN)	9-12	ESE
C	Storm Clouds: Fly over a Late Winter Storm onboard a NASA Earth Observing Satellite	9-12	ESE
D	Earth's Energy Budget: Seasonal Cycles in Net Radiation (Also featured on DLN)	9-12	ESE
G	Validation of Stratospheric Ozone	9-12	ESE

ID	User-Contributed Lesson Plans	Grade Level	Reviewed By
3	Comparison of Snow Cover on Different Continents	4-8	ESE
7	Graphing S'COOL Data: Temperature, Pressure and Humidity (Word File)	4-8	ESE
23	Coral Bleaching in the Caribbean	5-12	MND Team
4	Snow Cover by Latitude	6-8	ESE
9	Trouble in the Troposphere - A Lesson on Tropospheric Ozone	6-8	ESE
13	Does Humidity Affect Cloud Formation?	6-8	ESE
5	Aruba Cloud Cover Measured by Satellite	6-9	ESE
22	Sea Surface Temperature Trends of the Gulf Stream	6-12	MND Team
18	Does cloud type affect rainfall?	7-9	MND Team
8	Cloud Patterns in Toronto, Ontario, Canada (Word File)	7-10	ESE
2	State of the Atmosphere: Interpreting Weather Observations (Word File)	7-12	ESE
15	Creating and Analyzing Graphs of Tropospheric Ozone	7-12	ESE
16	How Much Water is Available in the Atmosphere for Precipitation?	7-12	MND Team
17	Analysis of Atmospheric Conditions for a High Mountain Retreat	7-12	MND Team
19	A Comparison of Land and Water Temperature	7-12	MND Team
20	Using radiosonde data from a weather balloon launch	7-12	MND Team
6	Using MY NASA DATA to Determine Volcanic Activity	8-12	ESE
1	Using Imported Data in Excel: Plot Atmospheric Temperature (Word File)	9-12	ESE
10	Linkages between Surface Temperature and Tropospheric Ozone	9-12	ESE

Fig. 8 MY NASA DATA Lesson Plans Page

## 5. EDUCATIONAL SUPPORT MECHANISMS

MY NASA DATA provides a wealth of user support activities to encourage the use of all related MY NASA DATA products. The MY NASA DATA Summer Teacher Workshop is a major activity of the project. Participants are chosen from across the country and come to NASA Langley Research Center in Hampton, VA for a week during their summer vacations. To gain relevant math and science content, participants explore topics in atmospheric science, use of weather measurements and hands-on classroom activities. Participants benefit from the expertise of nationally recognized atmospheric science researchers. Each day, the participants contribute feedback and suggestions about the workshop and instructional materials. The feedback provided allows the MY NASA DATA team to make improvements that will translate into making the next workshop even better for participants.

It is through this workshop that a majority of the user-contributed lessons originate. The lessons cover a broad cross section of science topics from across the nation. By creating the lessons the teachers make MY NASA DATA an interactive experience and take ownership of the project through their contributions. It is this ownership that has led to participants becoming MY NASA DATA ambassadors. These ambassadors spread the benefits of MY NASA DATA to other educators through presentations at schools, school boards and teacher conferences such as the National Science Teacher Association (NSTA).

In addition to summer teacher workshops, MY NASA DATA hosts smaller workshops. For instance, the MY NASA DATA team has held a number of short workshops in the local area for Virginia Beach City Schools. The MY NASA DATA team also presents mini-workshops at national and regional teacher conferences on how to use the MY NASA DATA Web site and how to access the microsets and lesson plans. To increase accessibility to those interested in MY NASA DATA there is a webpage dedicated to providing information on when and where the MY NASA DATA team will be next (see Figure 9).

Under NCLB, teacher development is a large part of educators maintaining their highly qualified status. MY NASA DATA seeks to help teachers achieve and maintain their status through various outreach activities that are available at different scales. MY NASA DATA offers products and support for educators looking for more simplistic, off-the-shelf approaches to scientific topics as well as those who are looking for an integrated approach using the newest technologies. The scalability of MY NASA DATA allows educators to choose the intensity of their individual development, from overviews to week long development workshops. MY NASA DATA offers something for all.

+ MY NASA DATA HOME						+ DATA ACCESS						+ LESSON PLANS						+ COMPUTER TOOLS						+ SCIENCE FOCUS					
																													
TEAM VISITS																													
Date	City	State	Country	Meeting																Who									
July 3-7, 2006	Boulder	CO	USA	Seventh International Conference on School and Popular Meteorological and Oceanographic Education																Dennis Diones									
July 17-21, 2006	Palisades	NY	USA	2006 Summer Federation of Earth Science Information Partner Conference																Dennis Diones									
September 18-19, 2006	Harrisonburg	VA	USA	Symposium on Earth Science Education in Virginia																Lin Chambers									
October 7, 2006	Virginia Beach	VA	USA	Tidewater Association of Science Educators (TASE) Fall Conference																Susan Moore									
October 11, 12, and 14 2006	Hampton	VA	USA	Virginia Air and Space Center Open House																Dennis Diones									
October 19-21, 2006	Omaha	NE	USA	NSTA Regional Conference																Kelen Panec, MND Ambassador									
October 23-27, 2006	Exeter		UK	CERES Science Team Meeting																Lin Chambers									
November 2-4, 2006	Baltimore	MD	USA	NSTA Baltimore Area Conference on Science Education																Dennis Diones									
November 16-18, 2006	Richmond	VA	USA	Virginia Association of Science Teachers																Susan Moore									
November 16-18, 2006	Toronto	ON	CAN	Ontario Science Teachers Association Conference (OAME)																Laurissa Werhun, MND Ambassador									
November 17-18, 2006	Boulder	CO	USA	Coalition for Earth Science Education Meeting																Lin Chambers									
December 7-9, 2006	Salt Lake City	UT	USA	NSTA Regional																Susan Moore									
December 11-15,	San																												

Fig. 9 MY NASA DATA Team Visits Page

## 6. 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 and other sources. 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 real-time data visualization. The FAQ section and mentor network provide resources to further understanding on MY NASA DATA and atmospheric science related topics. Please contact the MY NASA DATA ([mynasadata@larc.nasa.gov](mailto:mynasadata@larc.nasa.gov)) team for further information, assistance 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.