Using the NASA Giovanni DICCE Portal to Investigate Land-Ocean Linkages with Satellite and Model Data

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ABSTRACT

Data-enhanced Investigations for Climate Change Education (DICCE), a NASA climate change education project, employs the NASA Giovanni data system to enable teachers to create climate-related classroom projects using selected satellite and assimilated model data. The easy-to-use DICCE Giovanni portal (DICCE-G) provides data parameters relevant to oceanic, terrestrial, and atmospheric processes. Participants will explore land-ocean linkages using the available data in the DICCE-G portal, in particular focusing on temperature, ocean biology, and precipitation variability related to El Niño and La Niña events. The demonstration includes the enhanced information for educators developed for the DICCE-G portal. The prototype DICCE Learning Environment (DICCE-LE) for classroom project development will also be demonstrated.

Introduction

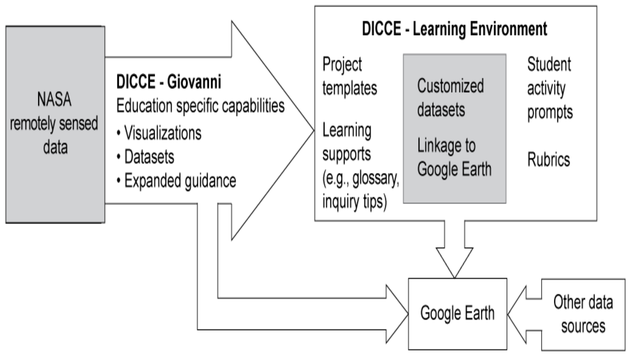
One of the major hallmarks of science instruction in the modern classroom is the increase of "hands-on" investigation and experimentation. While "hands-on" classroom activities can be implemented relatively easily in the traditional sciences such as chemistry, biology, and physics, such is not always the case for the earth sciences, particularly for climate and weather investigations with a regional and global perspective.

To address this difficulty, the usage of satellite data from Earth-observing instruments would be useful. Until recently, however, routine usage of such data has been hampered by the number of procedures required to acquire and prepare it for classroom instruction. The implementation of the NASA Giovanni data visualization and analysis system (http://giovanni.gsfc.nasa.gov), which provides rapid access and basic analytical functions for a wide variety of geophysical parameters, markedly reduces the effort required to introduce and utilize remotely-sensed data to investigate weather and climate phenomena and events.

Even though the NASA Giovanni system is easy to use, the system still features a very large population of geophysical parameters from many different Earth observation missions. These parameters frequently have unfamiliar scientific names, and for many of these parameters, documentation of their meaning and significance to meteorology and climate science was cursory.

For these reasons, the Data-enhanced Investigations for Climate Change Education (DICCE) project was proposed as a collaborative effort between the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC), SRI International Inc., and Education Development Center Inc. (EDC) to the NASA Climate Change Education program. DICCE was selected and is currently in the second year of a three-year project. Figure 1 displays the major elements of the DICCE project.

Figure 1. DICCE Classroom Project Development Process



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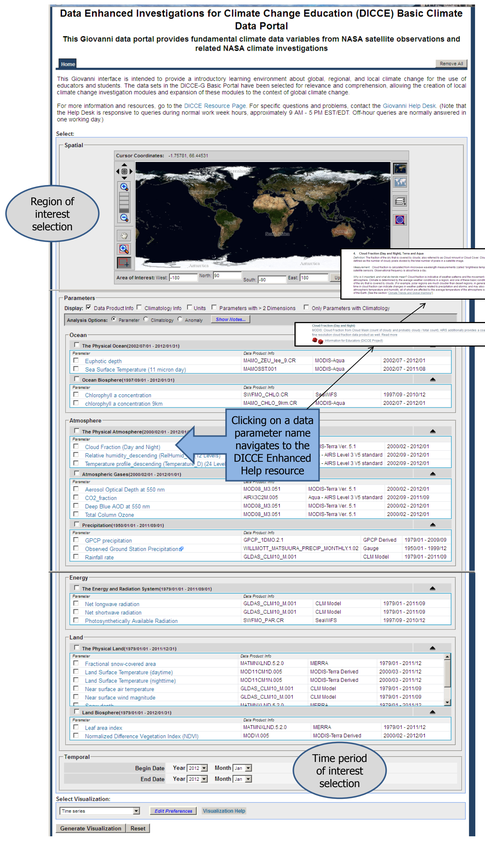
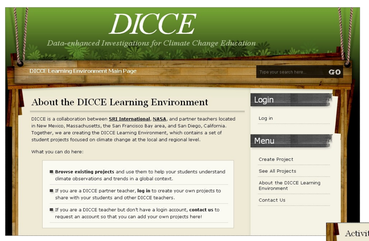
DICCE-Giovanni

The DICCE-Giovanni data portal provides a selection of climate-relevant data parameters cross-cutting the data available in the Giovanni system. This selection enables rapid creation of regional maps and time-series to demonstrate basic climate concepts and allow investigation of data trends. When fully realized, there will be four DICCE-Giovanni data portals: Basic, Intermediate, Full, and Daily (for data available at daily temporal resolution.) Data parameters in the Basic and Daily data portals are intended primarily for instruction at the secondary school level; the Intermediate and Full data portals, which will have a larger population of data parameters, are potentially suitable for undergraduate education and research. Resources include data parameter information, trend discussion, and video tutorials.

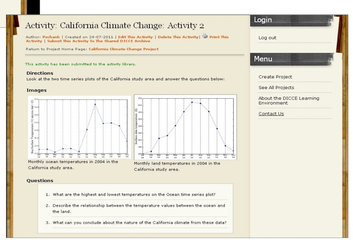


DICCE-Learning Environment



The DICCE Learning Environment (DICCE-LE) provides an online location for the creation and compilation of climate change education instructional projects. While it will initially be used by teachers, DICCE-LE can also be used for student projects. DICCE-LE provides structure for projects that integrate DICCE-Giovanni graphics, questions and responses, notes and comments, and it enables sharing of completed projects among teachers.

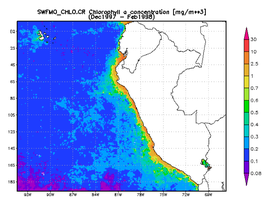
In the current phase of DICCE, teacher groups (in the locations shown above) have been introduced to DICCE-Giovanni and DICCE-LE, and have tried out many different functions in the two interfaces. Evaluation of the first phase of teacher interactions is continuing. The beta test version of the DICCE-Giovanni Basic portal is now available on the Giovanni home page.



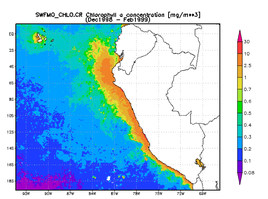
Investigating Land-Ocean Linkages with DICCE-Giovanni

Classic El Niño Patterns - Chlorophyll and Precipitation

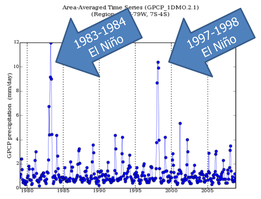
Classic signatures of an El Niño event can be demonstrated easily with DICCE-Giovanni. Although sea surface Temperature (SST) does not extend back to 1979, the Global Precipitation Climatology Project (GPCP) does. A time-series of precipitation for coastal Peru demonstrates peaks along the normally dry coast corresponding to the 1983-1984 El Niño and the 1997-1998 El Niño. Using chlorophyll concentrations from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS), a striking comparison can be made between the average chlorophyll concentrations from December 1997-February 1998 and the corresponding three-month period the following year.



SeaWiFS chlorophyll, Dec 1997 – Feb 1998



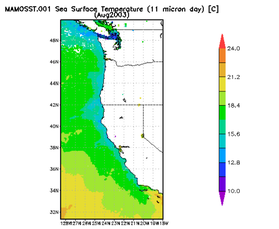
SeaWiFS chlorophyll, Dec 1998 – Feb 1999



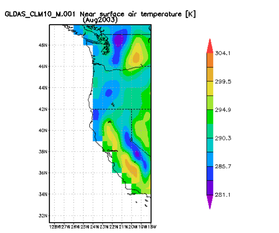
GPCP precipitation for coastal Peru 1999-2008

The Cool California Coast

Coastal upwelling is a dominant factor in the climate of California. Maps of sea surface temperature from the Moderate Resolution Imaging Spectroradiometer and near surface air temperature from the Global Land Data Assimilation System (GLDAS) model for August 2003 clearly show the cool upwelled waters along the coast, and the influence of these cool SSTs on coastal temperatures, contrasted with warmer temperatures inland.



MODIS-Aqua sea surface temperature, August 2003

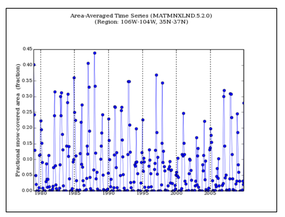


GLDAS near surface air temperature, August 2003

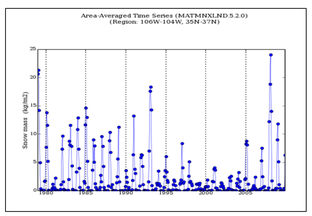
Do Lower Winter SSTs influence snow in New Mexico?

Snow pack conditions in the northern mountains of New Mexico are a continuing concern, due to the fact that much of the state depends on runoff from the snow pack to provide water for populated areas to the south for both agriculture and public use. Over the past few years, drought conditions have reduced the snow pack in these northern mountains. One contributing factor may be the decline in sea surface temperature observed in the Pacific Ocean off of southern California, Baja California, and the Gulf of California. Moisture from the ocean is transported inland via the monsoonal flow to provide both rain and snow in the state.

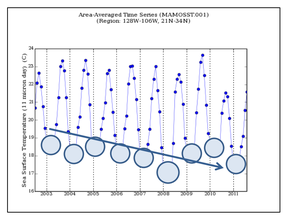
Fractional snow cover and snow mass data from the Modern Era Retrospective-analysis for Research and Applications (MERRA) project demonstrates the reduced snow pack in the mountains of New Mexico. MODIS-Aqua SST for the Pacific Ocean shows that winter SSTs have been decreasing over the past ten years.



MERRA fractional snow cover, 1979-2010 over northern New Mexico



MERRA snow mass, 1979-2010 over northern New Mexico



MODIS-Aqua SST, 2002-2011, Eastern Coastal Pacific Ocean