The Citizens and Remote Sensing Observational Network (CARSON) Guide:

Merging NASA Remote Sensing Data with Local Environmental Awareness

James Acker
NASA Goddard Earth Sciences Data and Information Services Center/ Wyle IS LLC, NASA GSFC, Greenbelt, MD
Holli Riebeek
Terra Outreach and NASA Earth Observatory/ SSAI Inc., NASA GSFC, Greenbelt, MD
Tamara Shapiro Ledley
TERC Inc., Cambridge, MA
David Herring
NOAA Climate Program Office, Silver Spring, MD
Steven Lloyd
NASA Goddard Earth Sciences Data and Information Services Center/ Wyle IS LLC, NASA GSFC, Greenbelt, MD

AGU 2008 Fall Meeting, December 15-19, 2008

Abstract

"Citizen science" generally refers to observational research and data collection conducted by non-professionals, commonly as volunteers. In the environmental science field, citizen scientists may be involved with local and regional issues such as bird and wildlife populations, weather, urban sprawl, natural hazards, wetlands, lakes and rivers, estuaries, and a spectrum of public health concerns. Some citizen scientists may be primarily motivated by the intellectual challenge of scientific observations. Citizen scientists may now examine and utilize remote-sensing data related to their particular topics of interest with the easy-to-use NASA Web-based tools Giovanni and NEO, which allow exploration and investigation of a wide variety of Earth remote-sensing data sets. The CARSON (Citizens And Remote Sensing Observational Network) Guide will be an online resource consisting of chapters each demonstrating how to utilize Giovanni and NEO to access and analyze specific remote-sensing data. Integrated in each chapter will be descriptions of methods that citizen scientists can employ to collect, monitor, analyze, and share data related to the chapter topic which pertain to environmental and ecological conditions in their local region.

A workshop held in August 2008 initiated the development of prototype chapters on water quality, air quality, and precipitation. These will be the initial chapters in the first release of the CARSON Guide, which will be used in a pilot project at the Maryland Science Center in spring 2009. The goal of the CARSON Guide is to augment and enhance citizen scientist environmental research with NASA satellite data by creating a participatory network consisting of motivated individuals, environmental groups and organizations, and science-focused institutions such as museums and nature centers. Members of the network could potentially interact with government programs, academic research projects, and not-for-profit organizations focused on environmental issues.

NEO NASA Earth Observations
http://neo.sci.gsfc.nasa.gov
Web Design by Kevin Ward

Giovanni The Bridge Between Data and Science
Goddard Earth Sciences Data and Information Services Center (GES DISC) Interactive Online Visualization ANd aNalysis Infrastructure
http://giovanni.gsfc.nasa.gov

Introduction

"Citizen science" – the involvement of non-scientists in scientific research – is becoming an increasingly popular tool both for scientific research and public education and outreach. Formal citizen science programs, which organize large groups of people to collect or analyze data for a pre-defined purpose, have grown throughout the past century.

The citizen science program has proven to be an effective outreach tool. Evaluations of existing citizen science programs have found that they improve scientific literacy — both knowledge of facts and understanding of the scientific process (Brossard et al. 2005, Thompson et al. 2007, Trumbell et al. 2000) — and increase an individual's awareness of and connection to the local environment, which can influence conservation decisions (Evans et al., 2005).

Evidence suggests that many Americans may not understand the relationship between local environmental issues like air or water quality and climate. In a 2007 survey of the public attitude towards science and technology, the National Science Foundation found that 43 percent of Americans expressed a strong concern for the environment, up from 35 percent in 2005. Though global warming was an issue of concern, it only ranked 8th among ten environmental issues. Incorporating global satellite observations into citizen science projects may improve an individual's perception of the connections between environmental issues of local concern with global environmental issues like climate change and biodiversity.

The CARSON Guide Workshop

On August 12-13, 2008, a workshop was held at NASA Goddard Space Flight Center to lay the foundation for a program in amateur satellite-based Earth observation, titled "The Citizens And Remote Sensing Observational Network (CARSON) Guide." The CARSON Guide has two objectives: to engage people in observations of their local environment and to help people connect their local observations to global systems using satellite data.

AIR QUALITY
WATER QUALITY
PRECIPITATION

The 2008 summer workshop focused on air quality, water quality, and precipitation. Each team identified local environmental measurements relevant to the satellite data set(s) appropriate for their topic. In two cases, precipitation and water quality, the teams found an existing citizen science project that had developed procedures for taking the ground-based measurements. The teams then outlined a procedure for comparing the measurements to the satellite data.

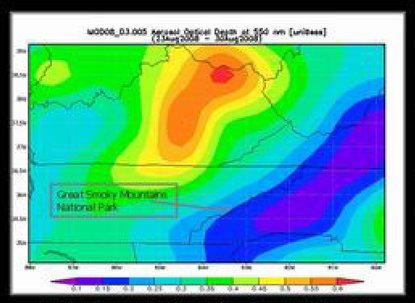
AIR QUALITY ACTIVITY

The air quality team developed an activity in which participants select a normally visible landmark and photograph it at the same time daily. The citizen scientist will note weather conditions, sky color, and the Environmental Protection Agency (EPA) air quality index for the time. Over time, participants will come to recognize what poor air quality typically looks like. The collected photos will serve as an archive of air quality to track trends over time.

Example: Views from Look Rock Tower, Great Smoky Mountains National Park


Clear conditions

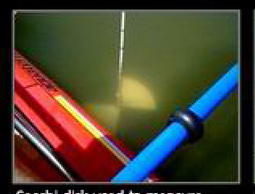

Hazy conditions



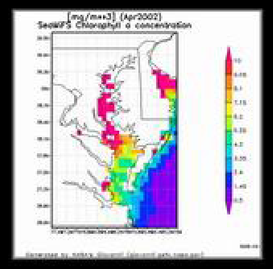
MODIS Aerosol Optical Depth, August 23-30, 2008

Those who want to do a quantitative analysis may compare MODIS aerosol optical depth values, available through the Giovanni or NASA Earth Observations (NEO) web sites, to numerical air quality values over time.

WATER QUALITY ACTIVITY


Secchi disk used to measure Secchi depth, to assess turbidity


Prepared sampling vials can be used to measure dissolved oxygen concentrations



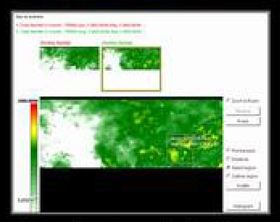
SeaWiFS chlorophyll concentration in the Chesapeake Bay, April 2002. While remotely-sensed chlorophyll concentrations are less accurate in shallow estuaries and near the coast, they can still be used to assess trends and events. Other remotely-sensed data products can also be investigated.

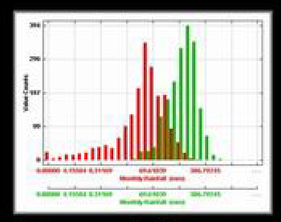
Citizen scientists will connect their measurements of local water conditions (streams, lakes, and rivers) to large-scale global patterns by monitoring ocean chlorophyll concentrations in waters closest to their watershed. Those monitoring water quality in the Washington, D.C. region, for example, would track chlorophyll concentrations in the Atlantic Ocean near the mouth of the Chesapeake Bay.

Local sampling campaigns combined with remote-sensing data can increase the awareness of citizens interested in environmental issues, by giving their local observations regional and global context. The importance of stormwater runoff, buffer zones, and streamwater quality is linked to estuarine and ocean water quality by means of simple and visually comprehensible analyses of remote-sensing data.

PRECIPITATION ACTIVITY


Professional-quality rain gauge shown at left. Rain gauges can also be set up with other weather station apparatus to monitor temperature, humidity, and wind speed.




The NEO histogram applet (right) was used to demonstrate the difference in total monthly precipitation over the U.S. Southeast and adjacent Atlantic Ocean (area in square box) in April (red) and August (green) 2002. This analysis shows the contribution of convective summer thunderstorms to the hydrology of this region. Remote-sensing data can also show regional rainfall accumulations, which may be quite different than the amount of precipitation collected in a rain gauge at a single location.

The precipitation team encouraged citizen scientists to join an existing rain gauge network (such as the Community Collaborative Rain, Hail, & Snow (CoCoRaHS) Network) and collect rainfall measurements near their home. Citizens can compare their measurements to other local measurements to track regional variability and/or to historical records, available through the local weather office.

Rainfall data from the Tropical Rainfall Measuring Mission extends to 45° north and south latitude. Data from the Global Precipitation Climatology Project can also be accessed.

Next Phase

The activities outlined during the workshop will be developed into three chapters for the CARSON Guide in late 2008 and early 2009. The activities will be evaluated through a partnership with the Maryland Science Center (Baltimore, MD) beginning in April 2009. The science center will sponsor an Earth observation club for citizen scientists. Based on the response from participants in the club, the chapters will be revised before being released through the NASA Museum Alliance. Further development of the CARSON Guide will include information on how to share observations and data through observer networks; subsequent versions of the CARSON Guide may include a data-sharing system for participants.

REFERENCES

Brossard, D., Lewenstein, B., and Bonney, R. (2005, July 15). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, 27(9), 1099-1121.

Evans, C., Abrams, E., Reitsma, R., Roux, K., Salmonsen, L., and Marra, P.P. (2005). The neighborhood nestwatch program: participant outcomes of a citizen-science ecological research project. *Conservation Biology*, 19(3), 589-594.

Thompson, S., and Bonney, R. (2007). Evaluating the impact of participation in an online citizen science project: a mixed methods approach. *Museums and the Web 2007*. http://www.archimuse.com/mw2007/papers/Thompson/Thompson.html

Trumbull, D.J., Bonney R., Bascom, D., and Cabral, A. (1999). Thinking scientifically during participation in a citizen science project. *Science Education*, 84(2), 265-75.