

Web Resources on Environmental Quality

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As instructors, it's useful for our students to see the interactions between biological, chemical, physical, and human systems. Earth scientists, particularly practitioners of earth system science, share this appreciation of system interactions, whether studying water/air pollution, soil degradation, climate modification, or land-use change. This review highlights exemplary resources useful when discussing issues relating to environmental quality. Recommended sites are organized by "Atmosphere," "Hydrosphere," "Geosphere," and "Biosphere" headings. The "Biocomplexity from Space" section features resources dedicated to satellite imagery of resource extraction, pollution, and land-use change, themes that often surface in instruction and research. It should be noted that some data archived for water and air quality are "provisional" in nature and might change after undergoing later review. In addition, successful data retrieval at several sites will mean learning on-line GIS or GIS-like interfaces.

The recommended sites below are practical, are well organized, have authentic content, and have few, if any, grammatical errors. While the sites chosen are certainly excellent, the list is by no means exhaustive; many worthy resources do not appear because of space limitations. The sites reviewed are archived at "Resources For Earth Science And Geography Instruction" (<http://webs.cmich.edu/resgi>) and were featured on the weekly "Earth Science Sites of the Week Listserv." To suggest useful sites for listing in future installments or to be added to the listserv please contact Mark.Francek@cmich.edu.

Atmosphere			
Site Name	Author	URL	Description
National Atmospheric Deposition Program	University of Illinois	http://nadp.sws.uiuc.edu/	Download tabular or graphical data on precipitation chemistry from over 250 U.S. sites. Daily, weekly, seasonal, and yearly data are available for hydrogen (acidity as pH), sulfate, nitrate, ammonium, chloride, and base cations (such as calcium, magnesium, potassium and sodium). In addition, data are available for mercury deposition which is monitored at over 90 sites. A five to six month time lag exists between the times samples are collected and when data are available on-line.
Airnow	EPA	http://www.epa.gov/airnow/where/	Find current and forecast conditions for ozone and particle pollution (less than 2.5 microns). Animation maps, showing pollution trends for 24 hours, are useful for linking pollution levels with periods of sunshine, passage of weather fronts, and industrial/motor vehicle activity. Pollution condition severity is gauged by six color-coded categories, ranging from good (green) to hazardous (brown). Web cams at select locations provide a real time visual for observing air quality. There are also many useful air quality resources designed for health providers, students, and teachers.
EPA Global Warming	EPA	http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html	This comprehensive site focuses on the nature of enhanced global warming, the knowledge base regarding this phenomenon, greenhouse gas emission levels, temperature trends, implications of unabated warming, and remediation efforts. To make the impact of global warming more tangible to students, there are interactive greenhouse gas emission calculators that estimate one's greenhouse gas emissions based on heating, transportation, and recycling choices. For a K-12 audience, there is a "Global Warming For Kids" section with appropriate content (often enlivened with animations) games, puzzles, and word searches.
Carbon Dioxide Information Analysis Center (CDIAC)	Oak Ridge National Laboratory	http://cdiac.esd.ornl.gov/index.html	The CDIAC delves into global warming issues with more depth than the EPA site above. Sections are devoted to how oceans and vegetation act as carbon sinks, the quantification of carbon dioxide and other greenhouse gas emissions, and the vulnerability of coastal areas to rising sea level. The "Frequently Asked Global Change Questions" section is especially useful. Find answers to questions relating to the atmospheric lifetime of carbon dioxide and methane, the effectiveness of carbon sequestration in trees, and greenhouse gas atmospheric residency times.
Paleo-climatology	NOAA	http://www.ngdc.noaa.gov/paleo/paleo.html	The stated mission of the website is to "provide the paleoclimatic data and information needed to understand and model interannual to centennial scale environmental variability." There are numerous links to research programs, paleoclimatic data, research article summaries, and an outreach section designed to introduce the field of paleoclimatology to middle and high school students. There is also an excellent climate timeline section relating paleoclimate to human history.
Total Ozone Mapping Spectrometer (TOMS)	NASA	http://toms.gsfc.nasa.gov/	TOMS measures stratospheric ozone levels and it is also capable of measuring aerosols (dust, smoke, and ash). Data can also be explored through animations, tables, and maps. Beginning Jan. 1, 2006, the Ozone Monitoring Instrument (OMI) site will begin archiving all future data and images, see http://toms.gsfc.nasa.gov/omi/omi_data_access.html for the most current ozone trends. Several lesson plans using the data are also available under the "teachers" section.
NOAA El Nino	NOAA	http://www.elnino.noaa.gov/	This site gauges the climate impact of El Nino/La Nina on the U.S and the rest of the world, on marine life, and on its connection to natural hazards. Animations and 3-D graphics are available for many of these topics. Age appropriate content is found at the "El Nino For Kids" section.

Hydrosphere			
Site Name	Author	URL	Description
Locate Your Watershed	EPA	http://www.epa.gov/surf	View boundaries for all U.S. watersheds identifying the extent of impaired rivers stream flow characteristics, and the progress of remedial efforts to restore area wetlands and improve river health. For the location of specific point sources of pollution within the watershed access the Enviromapper site (http://www.epa.gov/enviro/html/em/).
National Water Quality Assessment Program (NAWQA)	USGS	http://water.usgs.gov/nawqa/index.html	The NAWQA site provides a more detailed assessment of water chemistry, hydrology, land use, stream habitat, and aquatic life than the "Locate Your Watershed" resource. More than 50 watersheds are analyzed. Each report considers local geology, geomorphology, vegetation, land use, and climate to help develop sound watershed management policies. Resources are available in the form of raw data, reports, journal articles, and fact sheets.
The Great Lakes: An Environmental Atlas and Resource Book	EPA	http://www.epa.gov/glnpo/atlas/index.html	This richly illustrated and concisely written on-line atlas, in its 3rd edition and last last updated in 2003, has chapters devoted to the natural and cultural history of the Great Lakes, current problems and sources of exploitation, plus management policies. The comprehensive approach to understanding the Great Lakes lends credibility to the systems approach advocated by the earth systems approach.
Water Resources of the United States	USGA	http://water.usgs.gov/	This is the premier gateway on water resources and water quality issues. Peruse by state real time stream flow data, historical stream flow records, ground water depths, water use rates, and water quality. Publications and reports accompany each of these topics. The multidisciplinary nature of water related research is reflected in reports relating to assessment and restoration efforts for Chesapeake Bay, South Florida, the Mojave Desert, and the Platte River.
Geosphere			
Site Name	Author	URL	Description
Soil Characterization Database	Natural Resources Conservation Service	http://ssldata.nrcs.usda.gov/default.htm	Download soil related data like phosphorus and carbonate content, pH, and mineralogy for U.S. soil pedons. Presented in much more detail than information in soil survey manuals, this data can be downloaded in comma delimited files and used in spreadsheets. The similar "Soil Geochemistry Spatial Database" (http://soils.usda.gov/survey/geochemistry/gen_description.html) accesses the same data but uses an ArcIMS GIS map format to lend a spatial perspective on soil properties.
National Resource Inventory	Natural Resources Conservation Service	http://www.nrcs.usda.gov/technical/land/nri01/	Find national-level estimates for land use, soil erosion, and urbanization displayed in chart and tabular format for 1982-2001. Lands included in the analysis are privately owned lands, tribal lands, and lands controlled by state and local governments. A bulleted "Key Findings" section accompanies each of the categories and provides a useful synopsis of trends. One example: "Between 1982 and 2001, about 34 million acres - an area the size of Illinois - were converted to developed uses."
State of the Land	Natural Resources Conservation Service	http://www.nrcs.usda.gov/technical/land/	Maps, tables, graphs, and related publications are available for the extent of farmland, forests, land-use, soil erosion, water quality, wetlands, and urbanization. Although the most recent data are from 1997, this is still an all-inclusive resource relating to U.S. land stewardship, especially if used in conjunction with the most recent National Resource Inventory, completed in 2001.
Park Geology	National Park Service	http://www2.nature.nps.Gov/geology/usgsnps/project/home.html	This site focuses on the geological setting of our nation's national parks. The "Park Geology Tour" focuses on the general geological features of each national park. In addition, there are informational pages on mineral management, soils, and the restoration of disturbed lands in the national parks.

Biosphere			
Site Name	Author	URL	Description
A Climate Change Atlas For 80 Forest Tree Species Of The Eastern United States.	U.S. Forest Service	http://www.fs.fed.us/ne/delaware/atlas/index.html	This site models the range shifts and change in abundance of 80 tree species in the Eastern U.S. if climate changes as a result of an increase carbon dioxide levels. The resulting distribution maps are based on scenarios generated from five climate change models involving modifications in temperature, precipitation and potential evapotranspiration. Regardless of whether one accepts the presented climate change scenarios, the site is still a useful resource for showing current tree distributions and how climate, elevation, and soil type influence the spatial patterns of different tree species.
Plants Database	USDA	http://plants.usda.gov/	Discover a "one stop" resource on U.S. grasses, shrubs, and trees including those plants important as buffers, as windbreaks, in stabilizing soil, and in providing wildlife habitat. Plant fact sheets feature an image of the plant in question and information on the plant's range, uses, and management. There are also descriptions of threatened and endangered species, wetland species, and noxious and invasive species. A number of interesting automated tools are also available for calculating levels of crop nutrient extraction, estimating soil erosion, and determining site suitability before introducing a plant species.
Invasive Species	USDA and UGGS	http://www.invasive-speciesinfo.gov/	The site serves as a clearinghouse for providing timely and relevant information regarding invasive species, defined as "1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Obtain profiles, fact sheets (which include information on species identification, life cycle, and control strategies) and databases for a number of species, even microbes like the West Nile Virus and Whirling Disease. A clickable map of the U.S. provides easy access to lists of invasive species impacting individual states.
Coral Reef Information System	NOAA	http://www.coris.noaa.gov/	Find a searchable warehouse of information including the results of aerial coral reef monitoring, bleaching reports, paleoclimatological studies, reef biology, deep water corals, and hazards facing corals. A glossary of over 500 related terms is included. Numerous NOAA sponsored publications are provided like "Status of Coral Reefs of the World" and "State of U.S. Coral Reefs."
Environment From Space			
Site Name	Author	URL	Description
Earth Observatory Data and Imagery	NASA	http://earthobservatory.nasa.gov/Observatory/	Experience a highly interactive site that allows global scale manipulation of parameters relating to the atmosphere, oceans, land, biosphere, and radiation budget. Over 25 parameters are available, including cloud cover, sea surface height, land cover classification, chlorophyll content, out going heat radiation, and much more. Build animations for different time periods (there is selective parameter coverage for 1978-2003). For example, compare land cover with fires in order to discuss spatial and temporal trends. Click on the "Features" section and read related archived NASA news stories like "NASA Satellites Watch World's Cities Grow" and "Scientists "Reconstruct" Earth's Climate Over Past Millennia." A site glossary mode allows quick access to the meaning of unfamiliar concepts.
Earthshots: Satellite Imagery of Environmental Change	USGS	http://edcwww.cr.usgs.gov/earthshots/slow/tableofcontents	Although the site has not been updated in over three years, it is still a standout for displaying detailed imagery (often time sequenced and zoom able) of global environmental change. The articles and accompanying images are more in-depth than the OSEI or Visible Earth sites described below because Earthshots includes references, locator maps, and questions for class discussion (with answers). Around five images with articles are available for each of these topics: disasters, geology, forests, water, and wildlife.
Operation Significant Event Imagery (OSEI)	NOAA	http://www.osei.noaa.gov/index.html	Find high resolution imagery focusing on hazard related themes like dust storms, fires, floods, severe weather, and volcanoes. A current events section has imagery from Iraq and recent volcanic eruptions. Short narratives accompany each image. Weekly updates of the latest imagery can be sent directly to your e-mail account.
NASA Visible Earth	NASA	http://visibleearth.nasa.gov/view_set.php?categoryID=561	A searchable index of images, animations, and data visualizations relating to the earth sciences with over 6000 records available. Under the "Environmental Impacts" section check for biomass burning (325 images), contaminants (2 images), deforestation (94 images), desertification (2 images), fossil fuel burning (7 images), eutrophication (7 images), industrial emissions (10 images), oil spills (3 images), urbanization (23 images) and much more. These images are searchable by keyword, title, or location