2009–2011 GEO Health Tasks

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Changes in the natural environment can compromise human health. Climate change and extreme weather events are associated with a wide range of health risks. Exposure to persistent organic pollutants, mercury, and other environmental contaminants have the potential to harm human health. Changes in biodiversity can affect the transmission of vector-borne diseases such as malaria, West Nile virus, and Lyme disease.

New scientific tools, both remote and in situ, are providing Earth observations that will sharpen our understanding of environmental sources of health hazards. As part of its vision for the Global Earth Observation System of Systems (GEOSS), the Group on Earth Observations (GEO) is wielding these tools to give the health community access to comprehensive, user-friendly environmental data. These data can reduce disease risks by supporting prevention, early warning, research, health care planning and delivery, and timely public alerts.

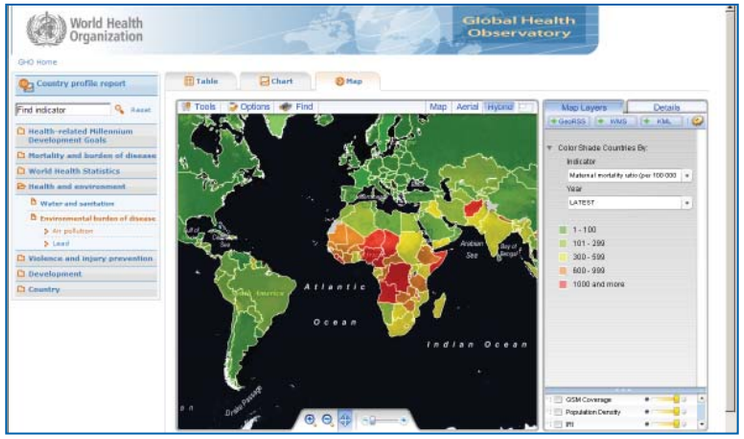
Prepared by the U.S. Environmental Protection Agency.

HE-09-01: Information Systems for Health

Goals:

- Improve in situ environmental and health data collection for the utilization and validation of remotely sensed data.
- Explore how GEOSS will support the collection and distribution of information and meet the diverse needs of the health community.
- Support further development of a global public health information network database to improve health decision-making at the international, regional, country, and district levels.
- Interface WHO's Global Health Observatory with other health and environmental systems and the GEO GEOSS Common Infrastructure (GCI).

To improve predictive and decision-support tools for human diseases with environmental drivers (e.g., malaria, meningitis, heat-related illness), more extensive, validated observation and epidemiological data are needed. The World Health Organization's Global Health Observatory is designed to help health practitioners, scientists, and others find models, risk factors, and research outputs for specific diseases. A "Health and Environment" module provides access to data from WHO and other organizations on diseases with environmental risk factors. The goal of this effort is to support the development, assessment, and validation of decision-support tools, working toward standardized assessment tools for the health community.



WHO's Global Health Observatory.

HE-09-02: Monitoring and Prediction Systems for Health

Goals:

- Support the development of operational health-related applications.
- Connect established and emerging cross-cutting Earth observation systems to health monitoring and prediction systems.

HE-09-02a. Monitoring and Prediction of Aerosol Impacts on Health and Environment

Airborne sand and dust present serious risks to human health in countries in and downwind of arid regions. Sand and dust aerosols can travel hundreds and even thousands of miles, carrying fine particles, spores, bacteria, viruses, and persistent organic pollutants. Health impacts can include respiratory and cardiovascular illness, eye infections, and in some regions, diseases such as meningitis and valley fever. An estimated 300,000 premature deaths worldwide may result from long-range transport of $PM_{2.5}$ in sand and dust aerosols.

The Sand and Dust Storm Warning Advisory and Alert System (SDS-WAS), a project of the World Meteorological Organization, has established an international partnership of research and operational experts and users to help countries forecast and predict sand and dust storms and deliver information to users. SDS-WAS provides a Web-based portal (www.wmo.int/sdswas) for user access to regional research and forecast activities and services, with a regional node for Asia and another for North Africa, Europe, and the Middle East.

The project aims to improve forecasting and observation technology through coordinated international research and assessment. It is seeking to integrate satellite

Saharan sand blew off the coasts of Mauritania and Senegal on June 22, 2009. Although this image shows dust immediately off the coast of West Africa, a layer of dust from storms such as this often travels virtually intact to the other side of the Atlantic. *NASA image by Jeff Schmaltz, MODIS Rapid Response Team, Goddard Space Flight Center. Caption by Michon Scott.*

and surface-based observations of aerosols, through a partnership of environmental agencies, meteorological services, satellite agencies, and others. A community of forecast centers is planned that could forecast sand and dust storms on a regional basis, cooperating to deliver standardized products useful to the health community and members of the public. Bringing together researchers and users for regular scientific exchange, demonstration, and training will be crucial for developing and implementing effective, realistic modeling and forecasting tools.

HE-09-02b. Air Quality Observations, Forecasting, and Public Information

Informing the public about air quality in near-real time, and forecasting air quality for the near future, can help people take action to avoid exposure and increase awareness of the health effects associated with air pollution. The AIRNow program (www.airnow.gov), run by the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and other agencies, provides local air quality conditions and forecasts, based on an index of five air pollutants. More than 300 cities are providing air quality forecasts, and more than 4,000 monitors are providing real-time data.

The U.S. AIRNow system has been redesigned to provide multiple language support and worldwide mapping capability, using open components that can be adopted by any state, country, or province. The new system—AIRNow International—is improving access to air quality information throughout the world through more advanced mapping and data distribution techniques. An AIRNow International pilot partnership between the U.S. EPA and Shanghai is currently under way.

Worldwide sharing of air quality observations and forecasts can help researchers better understand the transmission pathways of respiratory diseases, and can help decision-makers intervene to reduce air pollution-related disease. AIRNow International envisions using GEOSS models and observations (such as satellite air quality data) and in turn providing GEOSS with observations from ambient air monitors worldwide.

A pilot partnership between AIRNow-International and Shanghai's Environmental Monitoring Center will help Shanghai decision-makers understand, visualize, forecast, and report air quality conditions.

HE-09-02c. Global Monitoring Plan for Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants (POPs) (www.pops.int) is a global treaty to protect human health and the environment from highly dangerous, long-lasting chemicals by restricting and ultimately eliminating their production, use, trade, release and storage. In May 2009, the baseline levels of persistent organic pollutants in ambient air and human milk or blood were adopted by the Stockholm Convention.

A global monitoring plan is an important component of evaluating the treaty's effectiveness, by providing a harmonized organizational framework for the collection of comparable monitoring data from all regions. This monitoring will identify changes in levels over time and provide information on regional and global environmental transport.

To support this monitoring plan, researchers are investigating sampling and analytical methods for a group of chemicals newly listed by the Stockholm Convention: perfluorooctane sulfonic acid (PFOS) and its salts. This research includes an analytical methodology for PFOS in human breast milk, as well as a sampling and analysis method for air.

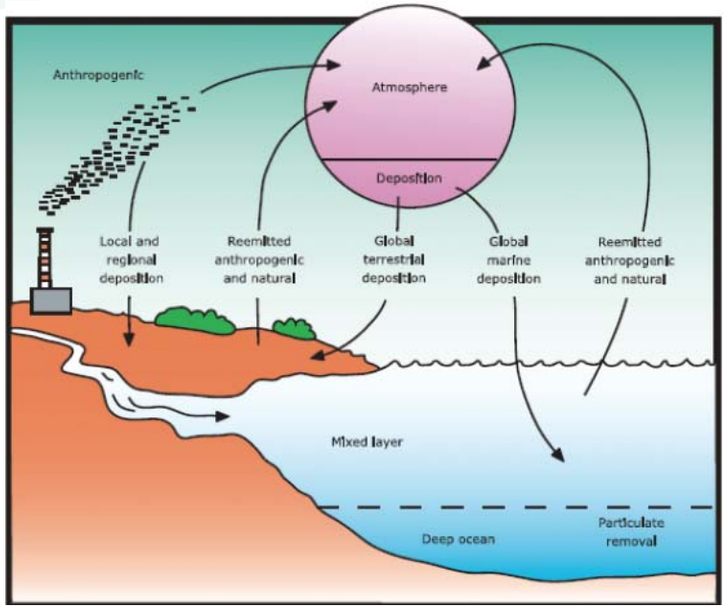
WHO photo (www.who.int/features/factfiles/breastfeeding/en/index.html).

HE-09-02d. Global Monitoring Plan for Atmospheric Mercury

To establish a forecasting and alert system for health problems related to mercury exposure, a coordinated monitoring network is needed to provide high-quality observations of mercury concentrations in air, atmospheric deposition, water, soil, sediments, vegetation, and biota.

Planning is under way to establish an international atmospheric mercury monitoring network, involving 25 to 40 mercury monitoring sites around the world. The project, anticipated to begin in late 2010, would establish an interoperable system to make the monitoring information available on the Internet to the international community. Data from the network will also be used to validate regional and global atmospheric mercury models, which are important for evaluating different policy options for reducing mercury pollution impacts on people and ecosystems.

Ongoing preparatory work includes conducting regional studies, developing bilateral agreements worldwide, training scientists and technicians, and setting up the monitoring network infrastructure.



The mercury cycle.

Goal:

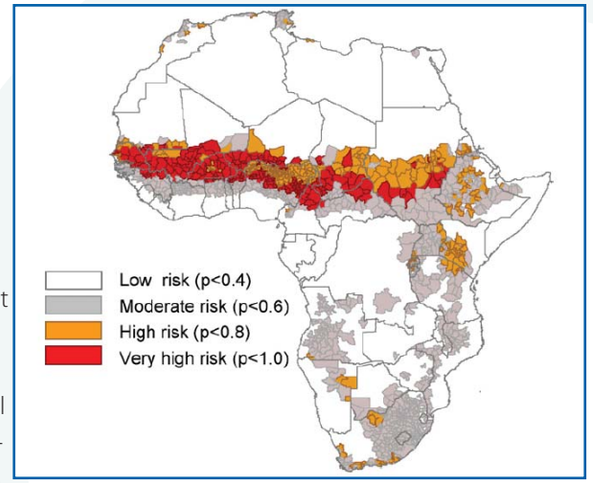
- Advance the application of observation, monitoring, and forecasting systems to health decision-making processes.

HE-09-03a. Meningitis Decision-Support Tool

Meningococcal meningitis is a disease that afflicts people throughout sub-Saharan Africa, with devastating health, social, and economic consequence. About 350 million people are at risk. The Meningitis Environmental Risk Information Technologies (MERIT) project has brought together people working on environmental, epidemiological, and clinical aspects of the disease. The project is developing a decision-support tool that will increase the effectiveness of prevention and control strategies. Better predictions will have an immediate impact, helping people take protective measures and get treatment earlier, and allowing a new vaccine being deployed over the next 10 years to be targeted to those most at risk.

Meningitis occurs in epidemic form during the dry, dusty winters in sub-Saharan Africa, nearly disappearing with the first rains. Thus, analyses and forecasts of weather, climate, and sand and dust storms are of particular interest for developing early warning and assessment systems for meningitis epidemics. However, the role of environmental factors in meningitis epidemic outbreaks is not well understood. MERIT researchers are pursuing several avenues to investigate dust as a risk factor—examining the role of abrasive dust in damaging mucosa and increasing invasiveness of the bacteria to the bloodstream, iron-rich dust in promoting bacterial growth, and movement of dust in transporting bacteria.

A modeling framework based on data from the January–April 2009 meningitis season will be tested during 2010, to see how well it predicts disease risk. Next steps, if sufficient resources are available, include integrating environmental information (e.g., space surveillance of dust) into the model, and creating a test bed to demonstrate the new decision-support tool.



The "meningitis belt" in Africa.

HE-09-03b. Implementation of a Malaria Early-Warning System

About half the world's population is at risk for malaria, a life-threatening but preventable disease caused by parasites transmitted through the bites of infected mosquitoes. Worldwide prevalence of the disease is about 250 to 350 million cases per year. Mortality due to malaria is estimated to be over 1 million deaths each year. The vast majority of deaths occur among young children in Africa, especially in remote rural areas with poor access to health services.

Certain environmental factors—rainfall, temperature, humidity, vegetation health, land cover type, and vector density—are known to strongly influence malaria transmission risk. Using satellite-derived observations of temperature, precipitation and moisture, vegetation health, and other factors, a number of organizations worldwide are developing algorithms that can quantify the conditions likely to lead to higher incidence of vector growth and malaria transmission.

Working together as part of the GEO task HE-09-03b, NOAA, the French Centre National d'Études Spatiales (CNES), and the GEO-Informatics and Space Technology Development Agency of Thailand (GISTDA) are coordinating their work in using satellite observations to predict malaria outbreaks and pinpoint areas of increased risk for disease transmission.

The project combines satellite-based observations of environmental risk factors with data from on-the-ground work of health practitioners to develop better predictions and risk maps for areas most affected by malaria. A current focus is coordinating observations and projects under way in different regions of the world to create a holistic project within GEO for malaria detection and monitoring.

The *Anopheles funestus* mosquito, which along with *Anopheles gambiae* is one of the two most important malaria vectors in Africa, where more than 80 percent of the world's malarial disease and deaths occurs. *CDC/James Gathany, Dr. Frank Collins, University of Notre Dame.*

HE-09-03c. Decision-Support Tools and Research on Ecosystems, Biodiversity, and Health

The links among changes in land use, biodiversity, and infectious diseases, such as Lyme disease, are complex. People acquire the Lyme disease bacteria though tick bites, and ticks acquire it by feeding on infected mammals such as mice and squirrels. Some "hosts" transmit the disease agent more efficiently than others. Changes in land use and the degree of forest connectivity can affect the relative populations of host species, thereby altering the rates of tick and human infection.

GEO and the U.S. EPA are integrating Earth observation data and field data into a Lyme disease model to map and predict risks to biodiversity and health. The project employs a multidisciplinary approach: Earth scientists use real-time observations to study animal and vector populations related to land cover features; epidemiologists contribute knowledge on disease life cycles and transmission; social scientists identify human behavior that affects biodiversity and human health; and economists place a monetary value on biodiversity as it relates to disease reduction.

The results will help environmental decision-makers and public health practitioners better understand the effectiveness of such measures as repellents, integrated pest management, land use practices, and disease treatment.

Inspecting a bird for infestation by black-legged ticks (part of a GEO/U.S. EPA investigation of biodiversity, habitat change, and the risk of Lyme disease).

NOTES: