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NEWS

New Assessment Focuses on Ecosystems, Human Well-Being, and the Climate System

Five volumes of working group assessment reports, which were published which were published on 19 January by the Millennium Ecosystem Assessment (MA) [*Millennium Ecosystem Assessment,* 2006], synthesize scientific data on the consequences of ecosystem change for human well-being as well as options for responding to those changes.

The MA is an international work program modeled after the Intergovernmental Panel on Climate Change. It was launched by U.N. Secretary-General Kofi Annan in June 2001 and completed in March 2005. More than 1300 authors from 95 countries have participated in preparation of the peer reviewed assessment.

The reports cover conditions and trends, scenarios, responses, and sub-global assessments of ecosystem services for human well-being (i.e., the benefits people obtain from ecosystems). These benefits include provisioning services, such as food and timber, and regulating services, such as flood control and nutrient cycling. Among regulating services, the assessment considers climate regulation, which is based on the ability of ecosystems to influence local, regional, and global climate through different biophysical and biogeochemical mechanisms, and which therefore affect human well-being [*House et al.,* 2006]. Some aspects of the assessment are important for the geophysical community.

The assessment's conceptual framework rests on several pillars: (1) the analysis of drivers of ecosystem changes, with a focus on human actions; (2) the identification and evaluation of ecosystem services that affect human well-being; and (3) the assessment of trade-offs between different services when promoting one service reduces the supply of another service [*Millennium Ecosystem Assessment,* 2003].

Using this methodological basis, the MA addresses the following key questions: (1) How have changes in ecosystem services affected human well-being in the past? (2) How will ecosystem changes affect people in future decades? (3) What response options might be adopted at local, national, or global scales to improve ecosystem management and thereby contribute to human well-being and the alleviation of poverty?

The assessment applies an integrated systems approach to evaluate trade-offs between different ecosystem services incurred as a result of alternative strategies and courses of action, and the impact of these trade-offs on enhancing human well-being.

The MA also examines the unintentional trade-offs that society makes to satisfy growing demands for food, water, timber, and other goods. One example of these unintentional trade-offs is that gains in food production and water use over the last decades have been made at the expense of other ecosystem services.

Clearing a forest for cropland enhances the ability to obtain food (provisioning ecosystem service), but it decreases carbon sequestration, flood mitigation, and biodiversity services (regulating ecosystem services) provided by that forest. Likewise, rice paddies provide food, but they release methane to the atmosphere. Many of the trade-offs occur over long distances (e.g., climate teleconnections, or interactions between remote regions) or over long time periods (e.g., the buildup of greenhouse gases in the atmosphere). The reports challenge scientists to identify and quantify these trade-offs to provide a sound basis for decision-making.

The assessment's concept broadens the conventional geophysical view of the biosphere's role in the climate system as a modifier of water, heat, air momentum, gases, and aerosol fluxes. Although this view has led to significant progress in understanding biophysical and biogeochemical mechanisms responsible for climate-ecosystem feedbacks, it is not exactly focused on benefits people obtain from ecosystems, i.e., ecosystem services.

A challenge is to define and evaluate services that ecosystems provide to humans, particularly with respect to climate regulation. For example, ecosystems cool the climate system by serving as a sink for greenhouse gases, such as carbon dioxide (carbon sequestration, or a cooling service), but they are also a source of some other greenhouse gases, such as methane. By transpiring water during the day, plants contribute to enhanced air humidity near the ground that may protect it from the night frost (a warming service). By pumping water from the soil to the atmosphere, terrestrial plants contribute substantially to water maintenance within the atmosphere and formation of clouds and precipitation, especially within continental interiors (a water recycling service).

Also, ecosystems affect atmospheric chemistry by contributing to the cycle of the hydroxyl radical, which plays a role as atmospheric detergent (atmospheric cleansing service) by, for example, reducing the concentration of the greenhouse gas methane in the atmosphere.

Previously, ecosystem services were considered mainly in relation to food production, and the emphasis was placed on maximizing human benefits of this one service. More recently, biodiversity and the recreational/aesthetic importance of ecosystems have become more prevalent. The assessment systematically considers all benefits humans receive from ecosystems, and it begins to evaluate trade-offs among these services.

References

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Task Force Examines U.S. Hurricane Research Agenda

While U.S. federal, state, and local governments continue to debate what should be done, following the devastating 2005 hurricane season, to rebuild the Gulf Coast and to prevent future disasters, a task force of the U.S. National Science Board (NSB) has begun an effort to construct a national agenda for federally-sponsored hurricane research.

At a 24 January meeting at the U.S. National Science Foundation (NSF) headquarters in Arlington, Va., task force members and government representatives examined current hurricane-related research conducted and supported by several federal agencies, identified gaps in understanding and future priorities, and discussed how these agencies can better coordinate their activities.

NSB member and task force co-chair Kelvin Droegemeier, associate vice president for research at the University of Oklahoma, Norman, said creation of the task force had been motivated by the NSB's desire to ensure that important research questions are not obscured by other federal activities following the 2005 hurricanes.

Shyam Sunder, deputy director of the building and fire research laboratory at the National Institute of Standards and Technology, agreed that a large, national vision was needed to drive the government's hurricane research agenda.

In presentations given to the task force, speakers from several federal agencies identified better modeling of hurricanes and their impacts on various levels—such as ecosystems, neighborhoods, and buildings—as a critical need. For example, Robert Atlas, of the U.S. National Oceanic and Atmospheric Administration, said that global climate models with one-kilometer resolution will be achievable within a few years, but that the development of complex models of the structure of hurricanes will require multi-agency cooperation.

Moving these models and other resources from the research to operational stage is another key issue. Edward Laatsch, of the U.S. Federal Emergency Management Agency, said that timeliness is an important concern for FEMA because information from models needs to be available for decision makers within 90 minutes, a time frame often not achievable with models used in research. For example, during Hurricane Katrina, it took 24 hours to provide decision makers with information from a model for five-meter-resolution flooding in New Orleans, La., Laatsch noted.

Hurricane science might also benefit from better coordination and collaboration among various sciences, several speakers and task force members agreed. David Lightfoot, assistant director for social, behavioral, and economic sciences at NSF, noted that there is a growing appreciation of the role of social and behavioral sciences in this area. He said that NSF awarded several small exploratory grants following Hurricane Katrina that crosscut social and behavioral sciences, engineering, and/or geological sciences.

Meeting participants recognized that the eventual federal hurricane research agenda may depend on events, such as the actions of the U.S. Congress, that are beyond their control. Atlas said, "resource issues always enter into what we are able to do and how quickly."

The task force plans two additional meetings—7 February at NCAR in Boulder, Colo., and 18 April in Pensacola, Fla.—prior to submitting its report to the NSB in May or June.

—SARAH ZIELINSKI, Staff Writer

Correction

In the news article "NASA Terminates Two Earth Observation Missions" in the 24 January 2006 issue of *Eos* (*Eos (87)*4, 2006), a remark by Richard Anthes, president of the University Corporation for Atmospheric Research, Boulder, Colo., was misinterpreted. It should have read, "Anthes said the termination of Hydros and the delay in the release of the next ESSP announcement 'means that [Hydros] is indefinitely delayed at best and, at worst, it is dead.'"