NEWS

Afghanistan Earthquake Hazards Mapped

PAGE 254

As part of efforts to build capacity within Afghanistan for studying, preparing for, and responding to earthquakes, the U.S. Geological Survey has released a map of potential earthquake hazards within the country.

Afghanistan is located in a tectonically active area near where the Indian and Eurasian plates collide, and earthquakes powerful enough to cause significant damage or fatalities occur every few years. However, decades of violence and strife have left the country with few scientists and limited resources to address geohazards. The U.S. Agency for International Development commissioned the USGS to assist in the nation's reconstruction efforts by assessing seismic hazards there.

In developing the hazards map, scientists compiled a catalog of historical earthquakes, mapped the country's geologic regions and fault systems, determined which faults are active, and evaluated how seismic energy would dissipate as it propagates from the source. Four faults were found to hold the greatest hazard.

The most notable of these faults is the Chaman Fault, which runs diagonally through the eastern part of the country and comes within miles of Kabul, the country's capital and largest city. It is a large strike-slip fault system similar in type to the San Andreas Fault in California. However, unlike the San Andreas, for which the hazards and risks are reasonably well understood and modeled, the extent of hazard and risk posed by the Chaman Fault is not yet well known because the geological characteristics have only been identified in general terms from remote sensing, said Harley Benz, scientist in charge at the USGS National Earthquake Information Center in Golden, Colo.

"What we have done is provided a first-order understanding of the hazards," Benz said. Afghan scientists and others can then combine this data with field studies and demographic data to evaluate the risk to important areas, such as Kabul or Kandahar, he added.

The USGS has begun building capacity so that Afghan scientists can take the next steps in geohazards research, including performing field studies. The USGS and British Geological Survey worked together to rebuild the Afghan Geological Survey's building in Kabul. In October 2006, the USGS, along with AGS and Kabul University, reconstituted the Kabul seismic station after two decades of being offline; data is now available in near real time. And the USGS has begun training AGS scientists who will serve as the core of a new geohazards team. Three scientists are currently in the United States being trained on instrumentation; three more will be trained later this summer in geology, active faults, and tectonics.

Ambassador of the Islamic Republic of Afghanistan H.E. Said Tayeb Jawad indicated at a 30 May briefing that the seismic hazard map will help in the design of new roads, much-needed dams and power plants, schools, factories, homes, and villages. In addition, he noted that the reconstituted seismic station will provide crucial information for the entire region.

The hazards map and additional information are available in the USGS Fact Sheet "Earthquakes Pose a Serious Hazard to Afghanistan," which can be found at http://pubs.usgs.gov/fs/2007/3027

—SARAH ZIELINSKI, Staff Writer

MEETINGS

Investigators Share Improved Understanding of the North American Carbon Cycle

U.S. North American Carbon Program Investigators Meeting, Colorado Springs, Colorado, 22–25 January 2007

PAGE 255

The U.S. North American Carbon Program (NACP) sponsored an "all-scientist" meeting to review progress in understanding the dynamics of the carbon cycle of North America and adjacent oceans, and to chart a course for improved integration across scientific disciplines, scales, and Earth system boundaries. The meeting participants also addressed the need for better decision support tools for managing the carbon cycle of North America, so that strong science can inform policy as interest in taking action increases across the nation.

Herein we report on themes to integrate the diversity of NACP science and fill significant gaps for understanding and managing the North American carbon cycle: integration among disciplines involving land, atmosphere, and ocean research; strengthening data management infrastructure to support modeling and analysis; identification of study regions that are critical for reducing uncertainties in the North American carbon balance; and integrating biophysical science with the human dimensions of carbon management and decision support.

NACP requires cross-disciplinary integration to evaluate the range of carbon sources and sinks contributing to the carbon balance of North America and adjacent oceans. For example, carbon dynamics in coastal margins are poorly understood, in part because few studies have spanned terrestrial, atmospheric, and ocean reservoirs and disciplinary boundaries. Improved integration would reduce gaps in knowledge of the carbon cycle and how it is changing, and improve attribution of changes to major driving factors such as climate variability, wildfires, insects, and land-use change.

Integrated long-term observation systems are the backbone of the NACP. Some critical observations are "contributed" to the NACP from well-established programs such as land inventories conducted by the U.S. Department of Agriculture. The AmeriFlux observation network can quantify the effects of climate variability on the carbon cycle at seasonal to interannual timescales. An open ocean observing system is being developed as part of the Global Earth Observation System of Systems (GEOSS). Remote sensing observations and analyses have proven critical to supporting biophysical modeling activities within NACP. The meeting participants noted that long-term continuity of these systems is essential.

Equally important is the need to support integrated modeling with robust data management. Large investments in individual projects were not matched by data system infrastructure to enable storage, search, and access of data.

Meeting participants identified a number of regions where intensive studies can fruitfully address NACP goals. In addition to the ongoing midcontinent intensive study, these regions include coastal margins, the interior West region of mixed grasslands and woodlands, and the boreal/Arctic region. Lack of systematic monitoring and comprehensive modeling across all of North America represents a critical shortcoming of carbon cycle science.

To achieve its objectives, the NACP must integrate human dimensions with the biologic, atmospheric, and oceanic sciences.

Social processes that drive land use and fossil fuel emissions should be quantitatively integrated into land use/cover and emissions modeling, to promote the emergence of the carbon/climate/human modeling needed to provide science and analytical tools for climate action programs at various levels of government. Decision support integrated with basic research would ensure that outcomes are as intended.

A companion meeting followed that involved the carbon programs of Canada, Mexico, and the United States, offering the intriguing possibility of better understanding and management of the carbon cycle by considering a broader array of data sources, models, and management opportunities in the context of diverse national goals, policies, and land-use histories within North America.

The full text of this meeting report can be found in the supplement to this *Eos* edition.

—Richard A. Birdsey, USDA Forest Service, Newtown Square, Pa.; E-mail: rbirdsey@fs.fed.us; Robert Cook, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.; Scott Denning, Department of Atmospheric Science, Colorado State University, Fort Collins; Peter Griffith, Science Systems and Applications, Inc., Carbon Cycle and Ecosystems Office, NASA Goddard Space Flight Center, Greenbelt, Md.; Beverly Law, College of Forestry, Oregon State University, Corvallis; Jeffrey Masek, NASA Goddard Space Flight Center, Greenbelt, Md.; Anna Michalak, Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor; Stephen Ogle and Dennis Ojima, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins; Yude Pan, USDA Forest Service, Newtown Square, Pa.; Christopher Sabine, NOAA Pacific Marine Environmental Laboratory, Seattle, Wash.; Edwin Sheffner, Earth Science Division, NASA Science Mission Directorate, Washington, D.C.; Eric Sundquist, U.S. Geological Survey, Woods Hole, Mass.

FORUM

Pattern Informatics and Cellular Seismology: A Comparison of Methods

PAGE 254

The recent article in *Eos* by *Kafka and Ebel* [2007] is a criticism of a NASA press release issued on 4 October 2004 describing an earthquake forecast (http://quakesim.jpl.nasa.gov/scorecard.html) based on a pattern informatics (PI) method [*Rundle et al.*, 2002]. This 2002 forecast was a map indicating the probable locations of earthquakes having magnitude $m \geq 5.0$ that would occur over the period of 1 January 2000 to 31 December 2009. *Kafka and Ebel* [2007] compare the *Rundle et al.* [2002] forecast to a retrospective analysis using a cellular seismology (CS) method. Here we analyze the performance of the *Rundle et al.* [2002] forecast using the first 15 of the $m \geq 5.0$ earthquakes that occurred in the area covered by the forecasts.

Twelve of these $m \geq 5.0$ earthquakes occurred after publication of the *Rundle et al.* [2002] forecast, but all 15 occurred prior to publication of the criticism by *Kafka and Ebel* [2007]. The observed success of the *Rundle et al.* [2002] method was substantially greater than could have been expected based on any previously published work, either in 2002 or on 4 October 2004, when the NASA press release appeared.

NASA issued the press release to document the greatly increased resolution and specificity in predictions of future earthquake locations that have become possible, particularly when compared with other then-current forecast products such as the National Seismic Hazard Map (http://earthquake.usgs.gov/research/hazmaps/products_data/images/nshm_us02.gif), which is a forecast of ground shaking over a 50-year period. Since the NASA press release was issued, there has been a significant expansion of interest [*Field*, 2007] in time-dependent forecasts of future earthquake locations of the type first published by *Rundle et al.* [2002].

The *Kafka and Ebel* [2007] article argues that a CS forecast method published by *Kafka* [2002] is superior to the PI method as published by *Rundle et al.* [2002], so the Rundle et al. results should have been anticipated and were not surprising. However, systematic examination reveals major differences between the method published by *Kafka* [2002] and the *Kafka and Ebel* [2007] implementation: *Kafka* [2002] did not decluster the small earthquake catalog, whereas *Kafka and Ebel* [2007] did. Also, *Kafka* [2002] used small earthquakes having $m \geq 3.0$ to define the forecast area, whereas *Kafka and Ebel* [2007] changed the magnitude of the declustered small earthquakes to $m \geq 4.2$ to optimize performance of the method. The method used by *Kafka and Ebel* [2007] is therefore not the same method described by *Kafka* [2002].

Most important, the *Kafka and Ebel* [2007] analysis was published after all of the 15 earthquakes $m \geq 5.0$ had occurred, thereby allowing the authors the opportunity to change their forecast model to produce optimal results, an

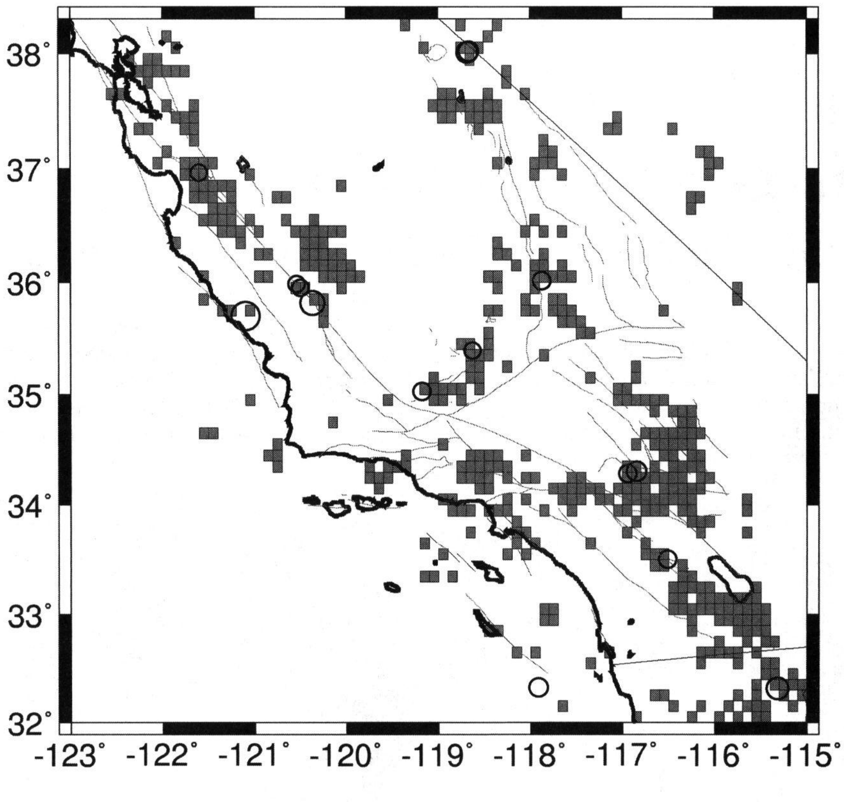

Fig. 1. Individual hot spot pixels and earthquakes corresponding to the original color-contoured map of Rundle et al. *[2002, Figure 4] for a hit rate of 14 out of 15, or 93%. Original map also reproduced as Figure 1 of* Holliday et al. *[2005] with corresponding pixel plots in Figure 4 there.* Kafka *[2002] normalizes forecast area to land (map) area, a practice that we follow here. The shading covers 476 (13.9%) of the 3427 total land pixels on the map and forecasts the locations of 14 of 15 large earthquakes. To be counted as a hit, the epicenter of the large earthquake must fall directly on a gray hot spot pixel. There is no margin of error allowed.*