with microbarometers in order to clean routinely the signal from the atmospheric pressure effect.

URL: http://geoscope.ipgp.jussieu.fr

U22B MCC: 2002-2004 Tuesday 1340h

Estimating the Consequences of Severe Geophysical Events I

Presiding: **A Nur,** Stanford University; **R L Wesson,** U.S. Geological Survey

U22B-01 1340h

Oil & War: Revisiting M. King Hubbert's predictions.

Amos M Nur (650 723 0839; amos.nur@stanford.edu)

Oil is, unlike almost any other natural resource on earth, not only finite but also irreversibly consumed. At the same time worldwide data shows that at least at present and for the foreseeable future oil consumption rate is directly proportional to the national standard of living. In 1956 and again in 1962, M. King Hubbert predicted, using a simple model based on the logistic equation, that oil production in the lower 48 United States will follow a bell shaped curve with a production peak around the year 1971 and a production level of 3 billion barrels per year, followed by a rapid decline. While his model approach was ridiculed at the time production data to date reveals a remarkable agreement with this prediction: US oil production did peak in 1971 at a level of 3.2.10 barrels a day and has been declining ever since. M. King Hubbert similarly estimated also the future of oil production worldwide - predicting peak production sometime between 1995-2010 (now!) at a level of 25 to 35 billion barrels per year. Current worldwide production is 27 billion barrels per year. Thus because about half of the oil in earth has already been discovered, the world is destined to face more and bigger conflicts over the control of global supplies. Although many economists and political scientists tend to dismiss the significance of Hubbert's thinking about the finiteness of recoverable oil as well as the consequent implications, it appears that without careful management these conflicts could turn into wars much bigger than in Kuwait in 1991 or in Iraq in 2003. It is therefore imperative for us as earth scientist to try to educate the public and our leaders about the basic geological reality of finite fossil energy resources, and the serious consequences of this fact.

U22B-02 1405h INVITED

Large Earthquakes in Developing Countries: Estimating and Reducing their Consequences

Brian E. Tucker (tucker@geohaz.org)

GeoHazards International, 200 Town and Country Village, Palo Alto, CA 94301, United States

Recent efforts to reduce the risk of earthquakes in developing countries have been diverse, earnest, and inadequate. The earthquake risk in developing countries is large and growing rapidly. It is largely ignored. Unless something is done - quickly - to reduce it, both developing and developed countries will suffer human and economic losses far greater than have been experienced in the past. GeoHazards International (GHI) is a nonprofit organization that has attempted to reduce the death and suffering caused by earthquakes in the world's most vulnerable communities, through preparedness, mitigation and prevention. Its approach has included raising awareness, strengthening local institutions and launching mitigation activities, particularly for schools. GHI and its partners around the world have achieved some success: thousands of school children are safer, hundreds of cities are aware of their risk, tens of cities have been assessed and advised, and some local organizations have been strengthened. But there is disturbing evidence that what is being done is insufficient. The problem outpaces the cure. A new program is now being considered that would attempt to improve earthquake-resistant construction of schools, internationally, by publicizing well-managed programs around the world that design, construct and maintain earthquake-resistant schools. While focused on schools, this program might have broader applications in the future.

U22B-03 1430h INVITED

Consequences of Predicted or Actual Asteroid Impacts

Clark R. Chapman (303-546-9670; cchapman@boulder.swri.edu)

Southwest Research Inst., Suite 400, 1050 Walnut St., Boulder, CO 80302, United States

Earth impact by an asteroid could have enormous physical and environmental consequences. Impactors larger than 2 km diameter could be so destructive as to threaten civilization. Since such events greatly exceed any other natural or man-made catastrophe, much extrapolation is necessary just to understand environmental implications (e.g. sudden global cooling, tsunami magnitude, toxic effects). Responses of vital elements of the ecosystem (e.g. agriculture) and of human society to such an impact are conjectural. For instance, response to the Blackout of 2003 was restrained, but response to 9/11 terrorism was arguably exaggerated and dysfunctional; would society be fragile or robust in the face of global catastrophe? Even small impacts, or predictions of impacts (accurate or faulty), could generate disproportionate responses, especially if news media reports are hyped or inaccurate or if responsible entities (e.g. military organizations in regions of conflict) are inadequately aware of the phenomenology of small impacts. Asteroid impact is the one geophysical hazard of high potential consequence with which we, fortunately, have essentially no historical experience. It is thus important that decision makers familiarize themselves with the hazard and that society (perhaps using a formal procedure, like a National Academy of Sciences study) evaluate the priority of addressing the hazard by (a) further telescopic searches for dangerous but still-undiscovered asteroids and (b) development of mitigation strategies (including deflection of an oncoming asteroid and on- Earth civil defense). I exemplify these issues by discussing several representative cases that span the range of parameters. Many of the specific physical consequences of impact involve effects like those of other geophysical disasters (flood, fire, earthquake, etc.), but the psychological and sociological aspects of predicted and actual impacts are distinctive. Standard economic cost/benefit analyses may not apply due to the exceptional rarity of major impacts.

U22B-04 1455h

Hurricanes: The Consequences of the Energy Equivalent of a 10-megaton Nuclear Bomb Exploding Every 20 Minutes

Edward N. Rappaport (305-229-4412; Edward.N.Rappaport@noaa.gov)

National Hurricane Center, 11691 SW 17th St., Miami, FL 33165-2149, United States

Through the ages tropical cyclones have killed and maimed millions of people, devastated economies, and profoundly altered physical and political landscapes. Both the nature of the threat and the human response have evolved. The largest losses of life have shifted with the population, from on the sea during the era of global exploration, to the coastline and, now, increasingly to inland areas. At the same time, the primary threat has changed from winds and waves to storm surge and freshwater floods. An international and multidisciplinary collaboration over the past half century has focused on identifying and minimizing tropical cyclone risks through advancing operational hurricane forecasting, improving communications systems, and heightening public awareness. In the United States, meteorologists and emergency managers work together closely to reduce the frequency of the most catastrophic outcomes. This paper reviews the most significant historical impacts, the contemporary challenges, and highlights of the most successful current mitigation strategies of the U.S. hurricane warning program.

U22B-05 1520h

Volcanic Catastrophes

John C Eichelberger (1-907-474-5530; eich@gi.alaska.edu)

Alaska Volcano Observatory, Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775, United States

The big news from 20th century geophysics may not be plate tectonics but rather the surprise return of catastrophism, following its apparent 19th century defeat to uniformitarianism. Divine miracles and plagues had yielded to the logic of integrating observations of everyday change over time. Yet the brilliant interpretation of the Cretaceous-Tertiary Boundary iridium anomaly introduced an empirically based catastrophism. Undoubtedly, decades of contemplating our own nuclear self-destruction played a role in this. Concepts of nuclear winter, volcanic winter, and meteor impact winter are closely allied. And once the veil of threat of all-out nuclear exchange began to lift, we could begin to imagine slower routes to destruction as "global change". As a way to end our world, fire is a good one. Three-dimensional magma chambers do not have as severe a magnitude limitation as essentially two-dimensional faults. Thus, while we have experienced earthquakes that are as big as they get, we have not experienced volcanic eruptions nearly as great as those preserved in the geologic record. The range extends to events almost three orders of magnitude greater than any eruptions of the 20th century. Such a calamity now would at the very least bring society to a temporary halt globally, and cause death and destruction on a continental scale. At maximum, there is the possibility of hindering photosynthesis and threatening life more generally. It has even been speculated that the relative genetic homogeneity of humankind derives from an evolutionary "bottleneck" from near-extinction in a volcanic cataclysm. This is somewhat more palatable to contemplate than a return to a form of Original Sin, in which we arrived at homogeneity by a sort of "ethnic cleansing". Lacking a written record of truly great eruptions, our sense of human impact must necessarily be aided by archeological and anthropological investigations. For example, there is much to be learned about the influence of volcanism on humankind in the North Pacific, where Holocene time saw many caldera-forming eruptions in an area of comparatively intense human activity.

U22C MCC: 2002-2004 Tuesday 1600h

Estimating the Consequences of Severe Geophysical Events II

Presiding: **A Nur,** Stanford University; **R L Wesson,** U.S. Geological Survey

U22C-01 1600h

"Dangerous" Climate Change

Michael D Mastrandrea (mikemas@stanford.edu)

Stanford Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA 94305, United States

Current climate change mitigation policy decisions must be made despite layers of uncertainty. Modeling of future climate, projections for future economic growth and greenhouse gas emissions, and characterizations of the interactions and feedbacks within the coupled social-natural system all contain uncertain components. Researchers communicating with policymakers have learned that, instead of presenting "best guesses" or other point estimates, uncertainty assignments require such techniques as probability distributions of outcomes and quantitatively defined descriptions of subjective confidence. We present a quantification of "dangerous" climate change, a term important in policy discussions. Article 2 of the United Nations Framework Convention on Climate Change expresses the opinion of the signing Parties that steps be taken to "prevent dangerous anthropogenic interference with the climate system," but the Convention did not specify what constitutes the value judgment of being "dangerous." We present one possible definition. A threshold for "dangerous" climate change is a clear tool for evaluating the need for and impact of proposed climate policy. Monte Carlo analyses with a simple integrated assessment model demonstrate that endogenously calculated climate policy controls appreciably reduce the probability of "dangerous" climate change. Under mid-range assumptions, climate policy reduces the probability of "dangerous" climate change by 30-50%.

URL: http://www.stanford.edu/~shs

U22C-02 1615h

A "CLIPER" Risk Model for Insured Losses From US Hurricane Landfalls and the Need for an Open-Source Risk Model

Richard J Murnane (1-443-622-6484; rmurnane@bbsr.edu)

Risk Prediction Initiative, Bermuda Biological Station for Research, Inc. PO Box 405, Garrett Park, MD 20896, United States

To plan for the consequences of hurricanes, earthquakes, and other natural hazards the public and private sectors use a variety of risk models. Model output is tailored for specific users and includes a range of parameters including: damage to structures, insured losses, and estimates of shelter requirements to care for people displaced by the catastrophe. Extensive efforts are made to tune risk models to past events. However, model "forecasts" of losses are rarely verified through a comparison with new events. Instead, new events generally are used to further tune a new version of the model. In addition, there has been no public attempt to determine which model has the most predictive skill, in part because there is no agreed upon reference forecast, and in part because most risk models are proprietary. Here I describe a simple risk model that can be used to provide deterministic and probabilistic exceedance probabilities for insured losses caused by hurricanes striking the US coastline. I propose that loss