

MEETINGS

Opening Doors for Geophysics in Soil Sciences

PAGE 243

Urban soils are subject to strong variations in environmental conditions such as water flow, solute transport, and heat budget. For soil scientists, the effects of the temporal and spatial dynamics of soil moisture distribution on the sorption and release of contaminants is crucial for understanding soil processes.

The INTERURBAN research project was formed in 2001 in Berlin, Germany, to study the dynamics of water and materials at urban locations while giving special consideration to spatial heterogeneity, organic soil substance, and soil-biological transformation processes. The project is the cooperative effort of six departments of the Technical University of Berlin and the Free University of Berlin; namely, the departments of soil sciences, water quality control, environmental chemistry, microbiology, soil zoology, and applied geophysics.

The project's objectives set the target for the underlying geophysics: to develop a non-invasive concept for mapping water distribution and important structural parameters at high resolution (to centimeter-scale).

In connection with the INTERURBAN project, a meeting was recently held in Berlin to discuss the prospects and future challenges of high-resolution geophysics in soil sciences. Three particular topics were discussed in a joint geophysics/soil physics workshop.

First, soil scientists discussed the heterogeneity of soil water content, which showed the importance of customizing rock physics for particular soil properties, such as organic matter and multiphase flows. An area with broad research possibilities lies in understanding the development of preferential flow paths; for example, those that result due to water-repellent areas in the soil. Participants pointed out that a vertical resolution in the range of a decimeter is necessary if soil physics questions are to be addressed.

Second, geophysical methods for determining soil water content were presented. Case histories and examples of standard methods, such as geoelectrics and ground-penetrating radar,

were presented. The focus of this portion of the workshop was on spatial and temporal variations of soil moisture.

New geophysical techniques in soil sciences were also discussed. The model calculations for particular applications of electromagnetics and nuclear magnetic resonance show the potential for high-resolution water mapping. Promising examples of spectral-induced polarization, surface nuclear magnetic resonance, and magneto-electrical resistivity imaging technique were presented. Nevertheless, these techniques still depend on the continued development of instrumentation.

In total, 66 researchers from 10 countries in Europe, Asia, and America presented 25 posters and 40 talks. Besides the projects of the INTERURBAN group, related work from all over the world helped fuel discussion of the prospects of geophysics in soils sciences; different groups of researchers specified their needs and possible contributions.

The meeting "Water and Organic Matter in Anthropogenic Soils: Dynamics and Processes" was held 2–4 April 2003, in Berlin, Germany.

For more information about the workshop and the INTERURBAN project, see www.interurban.de

—MARTIN MÜLLER, Technical University of Berlin, Germany

Earth Processes in Wake of Gujarat Earthquake Reviewed from Space

PAGE 244

Two years after a devastating earthquake in Gujarat, India, scientists from many disciplines met at an international workshop to share the latest knowledge about Earth system processes related to this natural disaster. The meeting particularly focused on the use of spaceborne technology to study the effects of lithosphere-atmosphere-ionosphere interaction prior to and following the earthquake. More than 80 of the participants were affiliated with research and academic institutions in India, and several scientists from the United States, Germany, Russia, and China also participated.

Soon after the earthquake on 26 January 2001, Indian scientists established a Global Positioning System (GPS) network to monitor crustal motion around the earthquake's epicenter in cooperation with scientists from Japan, Germany, and the United States. Observations made by routine GPS measurements in the past have shown that the Bhuj area has significantly shifted anti-clockwise. The leveling observations made by the Survey of India show that the Santal Pur Bhuj Block was uplifted up to 60 cm, while Bhuj, Bhachau, and Mundra subsided ~60 cm. The need to establish a dense network of level lines and gravity stations in Kachchh was stressed at the meeting.

The latest results related to the geology of the Indian-Eurasian collision in Pakistan were

reviewed at the meeting, and many basement faults were found to have developed within the Indian plate during collision. These faults are currently connected to a great deal of seismic activity in the eastern Indian plate and show right-lateral offset. Faults have also developed in the western part of north/south-oriented, left-lateral basement. The geophysical data show strike-slip movements near the Chaman faults, where the slip direction reverses. At 250 km east, the Kachchh rift experiences an extensional tectonic regime. The cause of uplift in Kachchh is due to the effect of Makaran subduction passing through Karachi in Pakistan.

New data were revealed at the meeting about the structure and tectonic framework of Kachchh. The region is now a thin-skinned thrust belt with regularly spaced asymmetrical buckle-to-recumbent folds and break-thrust folds. The present epicenter lies at the eastern extreme of the Kachchh mainland fault, and it appears that the eastern part of the Kachchh mainland is emerging progressively upward.

Based on the broadband seismic data, the depth of focus of the Gujarat earthquake was found to be at 22.6 km and the focal mechanism of strike-step nature. The deformation and large strain associated with the Gujarat earthquake are likely due to some anomalous local features responsible for stress in the Kachchh region. This event occurred along a hidden, south-dipping fault 25 km north of the

Kachchh Mainland Fault (KMF). The peak ground acceleration at Bhuj city was reported to be 0.38 g, and was estimated based on assessment of structural damage near the source region and the observed near-source ground motion data for the Gujarat earthquake.

Paleoseismic studies carried out after the earthquake revealed morphologic characteristics that suggest that deformation associated with the 1819 Bhuj earthquake corresponds to a broad zone. The Bhuj earthquake exposed many fossil features related to other earthquakes and the relation of the decollement zone with the rifting events in the Bhuj region. Several episodes of Earth movements along major east-west faults indicate that the initial phase of incision, which began around the early Holocene, are continued along the major rivers north of Bhuj. Aftershock data suggest that the east-west-trending fault was responsible for the main earthquake. The aftershock zone includes a 60-km x 40-km region between the Kachchh Mainland Fault (KMF) and the North Wagad Fault (NWF).

Tomography based on the inversion of 8374 P-waves and 7994 S-waves of 1404 aftershocks recorded by 25 temporary seismic stations established and observed by Indian, Japanese, and American scientists was presented at the meeting. First, a one-dimensional P- and S-wave velocity model was created, and then a three-dimensional tomographic inversion was conducted. A cross-validation technique for determining an optimum model has been applied. Results show that the aftershock distribution corresponds to the high-velocity anomalies. Low V_p/V_s anomalies are generally found at a depth of 10–35 km; i.e., the depth

range of the aftershock distribution. However, relatively high V_p/V_s and low V_s characterize the deeper region below the hypocenter of the main shock, at depths of 30 to 40 km. This anomaly may be due to a weak fractured and fluid-filled rock matrix, which might have helped trigger the Gujarat earthquake.

Details of many observed seismic events and other phenomena prior to the Gujarat earthquake were presented. Prior to the rupture, upwelling at the port of Kandla and excessive sedimentation were observed. Other precursors, based on newspaper reports, were an increase in the frequency of micro-earthquakes at Bhavnagar and Porbandar from September through December 2000, and hydrologic changes. For example, several wells in Gujarat and Rajasthan that had been dry for decades suddenly filled with water between December 2000 and January 2001.

Radon precursory signals were observed at 400 km from Chamoli (Uttar Pradesh province) and 1200 km from Bhuj (Gujarat province), where earthquakes occurred in 1997 and 2001, respectively. The radon anomaly was observed 2 days before the Chamoli main shock, and 4 days prior to the Gujarat earthquakes before the main event. Some data on the release of helium associated with the Gujarat earthquake were presented; these were collected by a survey of naturally dissolved helium in groundwater from localities characterized by high and low densities of collapsed buildings. A seismic zoning map of the Gujarat region based on estimated seismic hazard values suggested peak ground acceleration (PGA) values varying from 0.4 to 1.0 g for the Kachchh region.

A detailed hydrogeologic study of the Bhuj area revealed a sharp increase in water levels in all areas in Kachchh, except in Rapar, after the Gujarat earthquake. However, no rise in temperature or changes in groundwater quality were found prior, nor were any five significant changes of water level parameters after the main event of 26 January 2001.

Some papers presented at the meeting discussed changes in geomagnetic field behavior prior to the earthquake. In addition, a brief overview of the various geomagnetic field satellites, in orbit or proposed during the decade of geopotential research, was given. Geomagnetic data from a current magnetic satellite, which found a sizable, unexplained signal near a magnitude-8.4 earthquake, were shown. However, some caution was expressed, because it needs to be verified that the geomagnetic anomalies were due to ionospheric sources/magnetospheric disturbance.

Recent maps of aeromagnetic gravity satellite data and heat flow with good data coverage of the different geophysical parameters were presented. Ground magnetic, magnetovariational (MV), and long magnetotelluric (LMT) data and GPS over the Gujarat region were discussed. Thin sheet model (of conductance) based on the magnetic source (derived from magnetic data over Gujarat) reproduced the induction pattern shown by observed induction arrows, and was not based on surface geology. The LMT data reveal the presence of a conductor

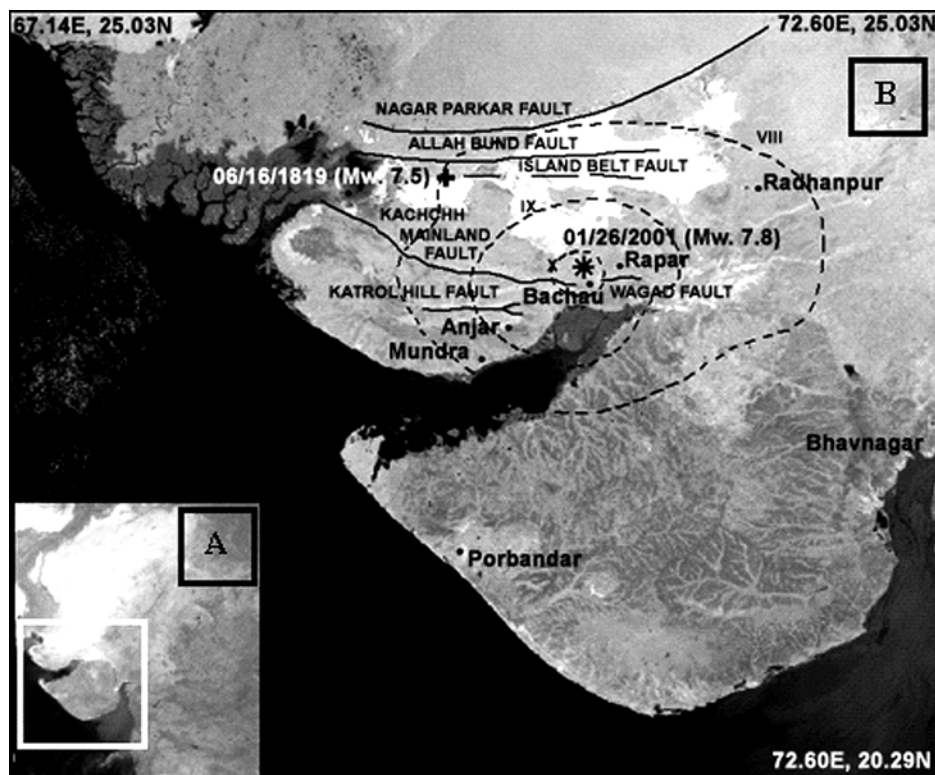


Fig. 1. (a) Thermal infrared band of IRS P4 OCM image highlights Gujarat Province. (b) IRS P4 OCM (band 8) image highlights the Gujarat region; dotted lines are isoseismals of the 26 January 2001 earthquake; solid lines show different faults; the bright area is the Rann of Kachchh.

at the depth range of 10–17 km, which may be attributed to the presence of fluid. The gravity and magnetic survey studies have delineated a hidden thrust fault striking northwest-southeast along the western margin of Wagao uplift near the epicentral region of Bhuj earthquake.

New and promising results based on laboratory experiments were presented to explain the “thermal anomalies” observed using satellite data before major earthquakes. These experiments revealed a correlation between the deformation of rocks under high levels of uni-axial stress and an increase in mid-infrared luminance surface temperature. Also reported were well-defined correlations of rises in land and sea surface temperature, chlorophyll content, and ionic potential of the ionosphere before and after the Gujarat and Iran (2002) earthquakes from the latest Terra/MODIS satellite data, with a combination of GPS total electron content. The results from the application of multi-sensor data may one day be used to develop early warning of intra-plate earthquakes on the basis of increases in soil moisture content, doubling of fish catches, and chlorophyll concentration and water vapor in the atmosphere—all of which were associated with the Gujarat earthquake. The importance of satellite images in estimating probabilistic hazard values, as well as the direction of maximum horizontal compressive stresses, was shown.

Liquefaction in the Bhuj and Bhachau areas using LISS-3 data was mapped in detail, after initial evaluation of liquefaction using IRS-1C WiFS data. An attempt was made to derive band ratio to map liquefaction using Indian remote sensing data.

A tutorial workshop presented the latest NASA Moderate Resolution Imaging Spectroradiometer (MODIS)/Terra and MODIS/Aqua satellite data. The main topics of this tutorial workshop were data products and parameter descriptions, data search and order, and data tools. Discussion involved how to use some of the data products for natural hazard studies.

Six papers dealing with ionospheric perturbations and monitoring of ionospheric signals were presented. Results show a strong correlation between the changes in ionosphere and earthquake events. Work suggests that the behaviors of aerosol and gravity waves change significantly prior to an earthquake and electric field measurement within the ionosphere over the seismically active areas. An ionospheric anomaly was observed during the Bhuj earthquake.

A study based on correlation of the occurrence of global earthquake and Earth-directed coronal mass ejection and change in magnetic field (K_p indices) and electron flux of the Earth-Sun environment was presented. An extensive and holistic discussion of the application of space technology to disaster management covered mitigation, preparedness, warnings, response, recovery, relief, education, and training.

Three topics were presented at the workshop panel discussions, including one about the present status of seismic hazard identifiers in India. During the discussion, several scientists pointed out the importance of seismic hazard estimation, including soil characteristics, liquefaction potential, and site response. Panel members recommended installing more strong motion accelerographs and seismograph stations

throughout India to obtain a better estimation of PGA value and attenuation relation; preparing a homogeneous and consistent catalogue of Indian earthquakes; and preparing seismic hazard maps incorporating soil characteristics, liquefaction potential, site response, and better attenuation relationships for corresponding regions.

A panel discussion on the future directions of geology, tectonics, and seismology in India was focused on monitoring seismicity and understanding the geologic context and tectonic history of major earthquakes in that country. Recommendations were made to stimulate comprehensive tectonic and structural model building and testing; initiate workshops on themes related to understanding intra-continental seismicity; establish a working group on intra-plate seismicity to assess the state of knowledge of the Indian shield and its intra-continental tectonic features in associated seismicity; and to conduct a comprehensive study of "associated events" during the earthquakes on the basis of thermal

anomalies associated with the Gujarat earthquake detected by infrared satellite data.

A panel discussion on natural and man-made hazards using space technology and international cooperation formulated different problems and themes related to natural hazards, and focused on India's cooperation with the international community toward disaster management. The panelists represented international agencies, and the following recommendations were made:

- Studies on earthquake "associated phenomena" and climate change need to be initiated at the international level.
- A more transparent system for exchange of satellite data needs to be created.
- Geomagnetic field satellites should be used to detect ionospheric current system fluctuations whose origin is not yet fully understood.
- Weather fluctuations associated with natural hazards need to be investigated.
- A joint Indo-U.S. satellite mission needs to be designed by the international community

in coordination with the current geomagnetic field satellite and those in the planning stages.

The workshop was supported by the ICSU Committee of Space Research and various agencies of the Indian government. Abstracts of the workshop are available online at <http://home.iitk.ac.in/~ramesh/>. Proceedings materials, which are currently being prepared, will include major publications. To reserve a copy, please send an e-mail message to Ramesh Singh (ramesh@iitk.ac.in).

The International Workshop on Earth System Processes Related to Gujarat Earthquake Using Space Technology was held 27–29 January 2003, at the Indian Institute of Technology in Kanpur.

—RAMESH P. SINGH, Indian Institute of Technology, Kanpur; and DIMITAR OUZOUNOV, Science Systems and Applications, Inc., Goddard Space Flight Center, Greenbelt, Md.

FORUM

Anonymous Reviews: Self-serving, Counterproductive, and Unacceptable

PAGE 249

Recently, I became involved in an incident in which a manuscript was rejected on the advice of two anonymous reviewers and an anonymous associate editor. This re-activated my long-standing disgust at the entire system of anonymous reviews and pushed me—finally—into doing something about it. A few weeks or months ago, I read a similar protest, somewhere—one much more persuasive than I am likely to write—but my high-mileage brain has misplaced its provenance. Consider this a "high-five" to that misplaced author.

The system of reviewing is supposed to filter out junk science and provide useful feedback to authors of non-junk science who have submitted work that can be improved. These are honest, commendable endeavors that can be accomplished quite comfortably out in the open. Concealment, on the other hand, permits

and invites all manner of dishonorable motives—not least of which is laziness—to creep in. Off-hand I can think of four reasons for remaining anonymous in a review, none valid.

1. You need to say something negative about a manuscript written by somebody in power over you. If you can't do so openly, you should of course refuse to do the review. Perhaps you should also look for another job. Early in my career I remained anonymous (the only time, I think) for this reason, and I have been ashamed of myself ever since.

2. You have just deep-sixed a paper by a bitter scientific rival and hope to get away with it. Again, obviously, you should have declined the review. A more courageous and useful alternative would be to do the review, suppressing your dislike of the conclusions, then argue politely for a different interpretation. But this is hard, and would take more time.

3. You have agreed to do a review, then find you have no time, or are uninterested in the topic. One way out is to do a slap-dash, superficial, inadequate job, then remain anonymous to protect your reputation. Far better to apologize to the editor and send it back.

4. A friend and/or respected colleague has submitted a paper that, in your judgment, is wrong and should be rejected. Clearly, if your

relationship with the author is such that a friendship would be ended by a negative review, you shouldn't be doing the review. However, having agreed to do it, the easy way out is to lambast the paper, then duck from sight. A far better course of action would be to return the paper to the editor unreviewed, then contact the author and explain your problems with his/her ideas.

The bottom line on reviewing in general is that we should all do it in such a way as to eliminate any incentive to stay anonymous. A good review is hard to do, and takes time. In particular, it takes great effort and ingenuity to write a negative review in such a way that the author is glad to get it. The problem with anonymous reviews is that they afford the opportunity to be rude, vindictive, and/or lazy—especially the latter. In my 40-odd years of writing papers for publication, I have received plenty of negative reviews, most of them ultimately useful. I don't like receiving negative reviews—who does?—but I can swallow my pride and work through a thoughtful negative review to the betterment of the paper. The only reviews I remember that left me permanently angry were anonymous.

There is far too much unpleasantness in the world already to needlessly introduce even a little bit more. Anonymous reviews are unnecessary, unacceptable, and should not be permitted.

—MYRL E. BECK, JR., Professor of Geology, Emeritus, Western Washington University, Bellingham