In this issue

Climate, monsoon, and India's water

Precipitation during the Indian summer monsoon is the main source of water for India. Of the 400×10^6 m^3 of water received annually from precipitation, the country uses approximately 60×10^6 m^3 for irrigation and about 15×10^6 m^3 to meet industrial and domestic needs. About 175×10^6 m^3 flow out to the sea, a large fraction of it to the Bay of Bengal. Without the monsoon, India would be a barren land. The country's dependence on this resource can be gauged from the fact that a deficit of a few per cent in monsoon precipitation can lead to major adverse impacts on the country's economy. While being so important for the sub-continent's availability of water, the Indian summer monsoon is also an important element of the global climate system. A complex series of interactions between the monsoon and the rest of the elements of the climate system determines availability of water in India. A microsymposium (5 lectures) on 'Climate, Monsoon, and India's Water' organized during the 66th Annual Meeting of the Indian Academy of Sciences, Goa, 24–26 November 2000, provided glimpses of the complex processes that go on in this system. Four articles based on the lectures form a special section in this issue. R. Ramesh (**page 1432**) discusses how the monsoon varied during the last 10,000 years. He finds that different techniques used in the reconstruction provide consistent results. However, records from different locations do not always mimic each other. Most likely this is an indication that the spatial variability that existed then is no different from what is observed today. Historically the monsoons have been a stable (but with considerable interannual variability) feature of the global climate. A concern today is that man-made influences might be disturbing this stability. A. Jayaraman (**page 1437**) writes about impact of man-made fine suspended particles in the atmosphere on precipitation. The particles occur in the cloud (sometimes called cloud of 'soot') that forms due to pollutants over Asia. The cloud then drifts to the N. Indian Ocean with monsoon circulation. The cloud of pollutants was observed during the recent Indian Ocean Experiment (INDOEX). Besides influencing precipitation, the cloud also has an impact on the radiation budget of both the local atmosphere and the ocean. M. M. Sarin (**page 1446**) discusses a possible impact of the monsoons on the global climate on geological timescales. Uplift of Himalaya has led to intensification of the Indian summer monsoon. It turns out that the weathering of continental rocks in Himalayan rivers fed by monsoon precipitation can remove atmospheric carbon dioxide. Sarin points out that present estimates suggest that the impact of this process on the global climate cannot be ignored. Studies such as these highlight the complexity associated with the Earth System. Predicting behaviour of such systems is risky business. Nonetheless, practical considerations today require that predictions be made. In fact, come May, India eagerly awaits the prediction from India Meteorological Department (IMD) about precipitation expected during June–September (and hence availability of water for the rest of the year). M. Rajeevan (**page 1451**) describes how IMD has been making these predictions since 1988. He goes on to discuss other techniques that have been in use worldwide to make seasonal predictions, and their success rates.

Satish R. Shetye

Himalayan deformation

The Himalayan mountain ranges have been a showcase of tectonics associated with contractile deformation, resulting in phenomenal stacking-up of crustal slices at the collisional meeting point of India and Asia. The evolution of this stupendous geologic monument dates back to the hoary geologic past. And ever since, the Himalaya is constantly forced up because of the underthrusting of the Indian subcontinent, and the processes are still continuing unabated. The strain that is built up during these processes is released by small-to-large earthquakes and occasionally by mega-earthquakes. It is believed that frontal segments of 200–300 km in length rupture during mega-earthquakes, allowing the Himalaya to slide several metres onto the Indian plains. K. S. Valdiya, who has a long experience with Himalayan geology, in his article (**page 1418**), based on the evaluation of the geomorphic signatures, suggests that all the boundary thrusts starting from the northern main central thrust to the southernmost frontal thrust in the central (Kumaun) Himalaya have been reactive during the late Quaternary time. He derives his evidence for this resurgence across major thrust zones from drainage anomalies, river incision and development of river terraces and ponding of streams, the elements that can be broadly categorized under tectonic geomorphology.

His evaluation has serious implications from the point of view of seismic hazard, primarily because these anomalies indicating resurgent activity are located in a Himalayan segment known in the scientific literature as 'central seismic gap'. The proponents of 'gap theory' argue that the central part has not been ruptured in a mega-earthquake for a while, compared to other parts of the Himalaya. The recent GPS measurements, apparently indicating slower slip rate in this region, support the premise that this region under the Himalaya is presently 'locked'. Considering accumulated slip deficit under this segment against a convergence rate of 584 mm/yr, this part of the Himalaya, defined as an earthquake gap may be ready to generate an *M*8 earthquake in future; the major seismic events in this region including that of 1803 and 1834, may not have helped to release the accumulated strain.

These premises must be studied further. For example, we need to understand more about the mechanics of how contraction rate within a fold–thrust–belt translates into rupturing of basal decollement resulting in mega-earthquakes or how the strain is being partitioned between different thrusts and transverse faults. Still, we do not have an idea about the rate of recurrence of mega-earthquakes in the central Himalaya. We also have to find out the relative role of climatic changes in the resurgence of tectonism in Quaternary time. Such information would have helped us to do a reality-check on the existing models of deformation in the Himalaya. The observations by Valdiya provide a springboard for further studies, particularly to constrain the long-term slip rates from the geomorphic surfaces identified by him. This is important because such data will be useful for comparing them with GPS measurements. As more and more geological, geodetic and seismological data become available, better-constrained models of Himalayan deformation can be generated.

C. P. Rajendran