Reflecting on IMD's forecast model

Vasant Gowariker

The choicest jokes on weather stem mostly from the West. Here is one. 'The trouble with weather forecasting is that it's right too often for us to ignore and wrong too often for us to rely on it!', said Patrick Young!

One notable exception is the India Meteorological Department (IMD) model[1,2]. Its forecast has been hitting the bull's eye since 1988, excepting this year when for the first time, the IMD forecast of normal monsoon is under a cloud.

The monsoon model, which owes its existence to scientists from IMD and Indian Institute of Tropical Meteorology, has made an original and noteworthy contribution to the understanding of the monsoon, its laws, relationships and underlying processes.

Some years ago, an international group working on the Indian monsoon sent their forecast to the Prime Minister for three years in succession – 1986, 1987 and 1988. According to them, the 1986 monsoon was supposed to be 'normal'; it was not. The 1987 rains were to be on the lower side of 'normal'; they were not, they were amongst the *worst* in the century! The 1988 monsoon was to be *average*; it was not. For the first time in its century-old history, IMD disagreed, *publicly*! Its recently operationalized model had indicated that 1988 was not to be an *average* but an *excellent* monsoon year. And, it was one of the best monsoons of the century!

IMD has, since then, been issuing operational forecasts based on its model which utilizes 16 global and regional parameters, having influence on the monsoon process in a power regression mode. These were arrived at after screening out a large number of antecedent signals. Out of the 16 parameters, 6, 5, 3 and 2 relate to the forcings arising from temperature, pressure, wind and snow cover respectively (see refs 1 and 2). Unlike all other approaches, the IMD model gives quantitative forecast. It has shown that each of the 16 forcings makes numerically different contribution to the total rainfall. For all the 14 years in a row, the model has not gone qualitatively wrong even once! Quantitatively too, the forecast has stayed in most years within a reasonable error margin (see Table 1).

The Indian monsoon rains have some positive features. Unlike African rains, they never fail totally. That is a big big plus, endowed by nature to this country! In the past 123 years (1878–2001), for instance, the rainfall has always been over 72% of the normal. Indeed, barring six years (1899, 1918, 1951, 1972, 1979 and 1987) or so from the past 123 years, the country always had more than 80% rains (the percentage being of the long period average value of the rains). In fact, the average rainfall of the 13 years from 1958 to 1970 is a hefty 100%. This falsifies the environmentalists' contention that it was global warming that gave India normal rainfall from 1988 to 2001 consecutively. Similarly, the average rainfall in all the 14 years from 1931 to 1945 was also normal, despite there being no global warming!

Is there any *natural* climate change or *cyclic* change in the weather systems? One simple parameter can tell you yes or no: the number of deficient monsoon years in the decades starting from 1901 to 1910 and 1991 to 2000 which are 3, 2, 1, 0, 0, 1, 3, 3, 3, 0 respectively. There is clearly no *cyclic* change of any sort nor is there any indication of a climate change in this insofar as India is concerned.

Has this year any parallel in the past? Yes, there is some. In 1992, for instance, the trend of deficiency till the end of July was similar to this year's, but it was much less severe (–12% as against –30% this year). However, the second half of 1992 made up for the deficiency of the first half, and the 1992 season ended with a normal rainfall of 93%, compared to the predicted 92%. Something similar seems to have happened in the current season: the deficiency prevailing at the end of July 2002 declined by about 25% within a month. For instance, Maharashtra, which the state government first declared (and later rescinded) as total drought area in July has received normal rainfall in all its four sub-divisions up to 4 September 2002. For the country as a whole, the 30% deficiency in rainfall that

Table 1. Southwest monsoon rainfall: IMD forecast and actual rainfall

Year	IMD forecast	Actual rainfall
1988	Excellent rains*	Excellent rains
1989	Normal (102%)	Normal (101%)
1990	Normal (101%)	Normal (106%)
1991	Normal (94%)	Normal (91%)
1992	Normal (92%)	Normal (93%)
1993	Normal (103%)	Normal (100%)
1994	Normal (92%)	Normal (110%)
1995	Normal (97%)	Normal (100%)
1996	Normal (96%)	Normal (103%)
1997	Normal (92%)	Normal (102%)
1998	Normal (99%)	Normal (105%)
1999	Normal (108%)	Normal (96%)
2000	Normal (99%)	Normal (92%)
2001	Normal (98%)	Normal (91%)

*There was no *quantitative* prediction in 1988.

Table 2. 'Century's Worst Monsoon Years' category

Year	IMD forecast (percentage of normal)	Actual rainfall (percentage of normal)
1965	82	82
1966	90	87
1972	76	76
1979	82	81
1982	91	86
1987	79	81

Table 3. Century's Best Monsoon Years' category

Year	IMD forecast (percentage of normal)	Actual rainfall (percentage of normal)
1959	117	114
1961	120	122
1964	111	110
1970	110	112
1975	118	115
1983	113	113

prevailed as on 31 July 2002 has come down to 17% by 11 September 2002.

There is some unjustified criticism that the IMD model is untested for extreme drought conditions. The validity of the model was checked with data (refs 1 and 2) of 30 years (prior to 1988) which included six years each of the 'Century's Worst Monsoon Years' category and of the 'Century's Best Monsoon Years' category. This can be seen from Tables 2 and 3.

Table 4. Comparison of actual rainfall of 44 years with computed values from IMD model

Year	Rainfall as percentage of normal	
	Actual	Computed from IMD model
1958	Normal (110%)	Normal (110%)
1959	Excess (114%)	Excess (117%)
1960	Normal (101%)	Normal (104%)
1961	Excess (122%)	Excess (120%)
1962	Normal (97%)	Normal (97%)
1963	Normal (98%)	Normal (97%)
1964	Normal (110%)	Normal (111%)
1965	Deficient (82%)	Deficient (82%)
1966	Deficient (87%)	Deficient (90%)
1967	Normal (100%)	Normal (102%)
1968	Deficient (90%)	Deficient (85%)
1969	Normal (100%)	Normal (98%)
1970	Excess (112%)	Normal (110%)
1971	Normal (104%)	Normal (99%)
1972	Deficient (76%)	Deficient (76%)
1973	Normal (108%)	Normal (108%)
1974	Deficient (88%)	Deficient (91%)
1975	Excess (115%)	Excess (113%)
1976	Normal (102%)	Normal (102%)
1977	Normal (104%)	Normal (102%)
1978	Normal (109%)	Normal (107%)
1979	Deficient (81%)	Deficient (82%)
1980	Normal (104%)	Normal (108%)
1981	Normal (100%)	Normal (104%)
1982	Deficient (85%)	Normal (91%)
1983	Excess (113%)	Excess (113%)
1984	Normal (96%)	Normal (100%)
1985	Normal (93%)	Normal (99%)
1986	Deficient (87%)	Deficient (88%)
1987	Deficient (81%)	Deficient (79%)
1988	Excess (119%)	Excess (113%)
1989	Normal (101%)	Normal (101%)
1990	Normal (106%)	Normal (102%)
1991	Normal (94%)	Normal (91%)
1992	Normal (92%)	Normal (93%)
1993	Normal (103%)	Normal (100%)
1994	Normal (92%)	Normal (110%)
1995	Normal (97%)	Normal (100%)
1996	Normal (96%)	Normal (103%)
1997	Normal (92%)	Normal (102%)
1998	Normal (99%)	Normal (105%)
1999	Normal (108%)	Normal (96%)
2000	Normal (99%)	Normal (92%)
2001	Normal (98%)	Normal (91%)

What is the long-range forecast for? Some critics question the utility of the prediction of the June to September total rainfall. What the vast country needs, they plead, is a region-wise and time-wise forecast. Agreed. But, it is a dream no country in the world has so far come anywhere near to fulfilling! The global climatic forcings are far too complex for that, at the moment! However, in practice, the IMD forecast model carries not a fundamental, but a derived answer to meet the need. For instance, if the forecast is say for more than 100% rains, it generally entails that roughly 90% or more of India's land mass gets *normal* rains at *normal* times. That means the forecast of more than 100% rains is virtually a forecast for at least 90% of India receiving normal rains evenly distributed, both region-wise and time-wise. That is a vital and practical information for everybody. Similarly, a forecast of 90 to 100% rains generally means that at least three-fourths of India's land mass will get normal rains evenly distributed region-wise and time-wise.

The IMD model is sometimes criticized as 'it uses too many parameters'. Does it? It is true that Blanford[3] used just one parameter (of Himalayan snow cover) for his forecasts from 1882 to 1885, but it is also true that Walker had identified some 200 parameters that he thought influenced the Indian monsoon. So, it seems no number is sacrosanct; the accuracy is. The proof of the pudding is, after all, in the eating! The performance should settle this 'the means and the end' issue, really!

How does the IMD model fare in this *performance test*? While its first *prospective* forecast came out in 1988, in reality the efficacy of the model now stands validated by its almost flawless performance for 44 years (see Table 4). No forecast model developed for the prediction of the Indian monsoon at any time, at any place, and by anybody else has come anywhere near the accuracy of the IMD model!

The model appears to have the potential for wider application. Ray Garnett of Canadian Wheat Board, Winnipeg, Canada says, 'The Long-Range Weather and Crop Forecasting Group formed in Canada in 1993, is working towards forecasting the Canadian spring wheat and possibly the USA corn crop a season or quarter in advance, modelling the success that has been achieved in India in

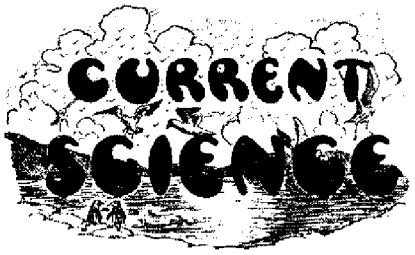
forecasting the monsoon in recent years (Gowariker *et al.*, 1989; Thapliyal and Kulshrestha, 1992). The approach used in India relies heavily on teleconnections that have been established through the use of statistical analysis and that have a dynamical and thermodynamical basis. It is felt that a similar seasonal forecasting technique should be developed for the Canadian prairies and possibly the USA corn belt'[4].

All the successes notwithstanding, this year's aberration is thought provoking. Finally, there are three observations. Three years ago, IMD replaced 3 of the original 16 parameters (having apparently turned insensitive as predictors) by 3 other parameters, and based on this gave the last 3 years' forecasts. Secondly, one hopes that IMD has now reached a level of professionalism by which any member of the forecast team, given the model, can give the same forecast. Finally, no model seems visible anywhere on the scientific horizon better than the IMD model.

1. Gowariker, V., Thapliyal, V., Sarkar, R. P., Mandal, G. S. and Sikka, D. R., *Mausam*, 1989, **40**, 115–122.
2. Gowariker, V., Thapliyal, V., Kulshrestha, S. M., Mandal, G. S., Sen Roy, N. and Sikka, D. R., *ibid*, 1991, **42**, 125–130.
3. Blanford, H. F., *Proc. R. Soc., London*, 1834, **37**, 3–22.
4. Ray Garnett, R., http.//www.esig.ucar.edu/elnino/garnett.html.

Vasant Gowariker is at 'Fetilizer Dictionary', No. 2 Mukta Apartments, 93/A2-3, Shivaji Nagar, Off Senapati Bapat Road, Pune 411 016, India
e-mail: fdp@pn2.vsnl.net.in

FROM THE ARCHIVES



Vol. IX] FEBRUARY 1940 [NO. 2

A great educational institution

During the first fortnight of this month the Madras Presidency College celebrated its Centenary with great social pomp and academic pageantry. The old students, who had assembled on this historic occasion to testify their affection and loyalty to their College, were legitimately in a holiday mood, and the present students, temporarily relieved of their anxious thoughts about books, studies and examinations, must have naturally made the most ardent contributions to the gaiety of the varied festivities, which, judged by the press reports, were ingeniously conceived and delightfully enjoyed.

This great Institution, during the long period of its existence, has been a fertile cradle in producing distinguished young men, who in later life have achieved remarkable success in the different spheres of public activities in which they were engaged. On this memorable occasion which, in certain respects, marks the turning-point in the career of the College, it must have been a matter of pride and pleasure to the staff and students to recall to their memory the names of those eminent men who are no longer with us, and who have left indelible impressions of their genius on whatever work it was their lot to perform.

The Presidency College at one time enjoyed the reputation of being an aristocratic institution, receiving within its portals princes and patricians, which used to provoke the retort that it fell to the lot of other colleges to produce princes and patricians among their scholars. Whether it really possessed this dubious reputation or not, the staff relied, almost to the point of religious fervour, on the theory that impersonal teaching of prescribed text-books formed the backbone of sound Indianism, with the result that the students imbibed all their lessons and even the superiority complex of their professors. However, within the last three decades, a great change has overtaken the College which, having shed its aristocratic clothes, has assumed the humbler garments of democracy and even the graceful short-skirts of feminism. This alteration in the spirit and the complexion of the College has followed in the wake of the progressive Indianisation of its staff – a body of eminent scholars and scientists, who worthily uphold the high formal academic standards for which it was always distinguished. It seems to us that the traditions of any educational institution are built up by the co-operative effort of the members of the staff and the students, and this body of traditions is enriched by the achievements of the latter when they enter life. From the standpoint of output of scientific investigations, none of the South Indian Colleges were distinguished till 1900 except, perhaps, in one department of study in the Presidency college, where the researches of Sir Alfred Bourne led to his election into the Royal Society. It is a sad reflection on the scientific teaching of our colleges, that after decades of toil and travail, we could produce a single Sir Venkataraman. The most baneful influence that pervaded the academic atmosphere of the higher educational institutions of South India in the last century was the competitive spirit, which manifested in the form of a rivalry for annexing prizes at the public examinations. If the energy of students had not been expended in memorising text-books and in leaping over the murderously high hurdles academically named public examinations, but had been conserved and directed towards developing independent thinking, promoting the spirit of independent enquiry and fostering small pieces of independent work in the laboratories, the Madras colleges should have produced more scientists, more scholars, more statesmen and more jurists, whose collective accomplishments would be the true and lasting foundation of their traditions. The tradition of an institution as an asylum of higher teaching of text-books is one thing; the tradition of an institution as a dynamic centre for extending and conquering the untrodden fields of knowledge is a totally different thing.