Gulf war and the Indian monsoon

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Studies dismiss alarmist predictions.

Following the Gulf war and the large-scale burning of oil wells in Kuwait, several scientists had predicted that the onset and character of the monsoons could be affected, ranging from delayed onset and decreased rainfall to disastrous failure of the monsoon itself and possible famine and starvation death of millions of Asian peoples

The India Meteorological Department (IMD) had, on the other hand, issued public statements as early as January 1991 to the effect that oil fires in the Gulf region would not have any perceptible effect on Indian weather and the monsoon (see Box 1).

Almost all investigations on the problem have formulated the sequence of events in the following chain: Millions of tons of smoke particles and possible dust particles injected into the atmosphere over Kuwait region → their spread vertically and horizontally → estimation of smoke concentration at various distances → reduction in the intensity of incoming solar radiation, reduction of surface temperature, and decrease in temperature gradients → their effect on winds → impact on the general circulation of the atmosphere, particularly the Asian monsoon system. All atmospheric effects were quantified using available physical and climatological data.

An article in *New Scientist*[1], quoting Richard Turco of the University of California and John Cox, vice-president of the Campaign for Nuclear Disarmament, stated that the Gulf oil fires burning for over a month could release enough smoke to disrupt the energy balance of the atmosphere and spread the smoke cloud, and concluded that even a partial failure of the monsoons could cause the death of more persons than the combined populations of Iraq, Kuwait and Saudi Arabia. Their prediction was based on the premise that the monsoon winds are caused by the rising hot summer air from the Asian mainland sucking in cooler ocean air. Once there was a pall of smoke over the Indian subcontinent and South Asia, the temperature gradient would decrease substantially and the monsoon would be shut down, bringing drought and famine to hundreds of millions of people. In the same article the author quotes Richard Scorer of University College, London, who doubted peoples' ability to influence climate.

The alarmist predictions regarding the effects of the Gulf war were naturally challenged by Indian scientists, who have long experience in studying the monsoon and have successfully predicted the behaviour of the monsoon rains for three successive years, including the 1990 monsoon. They pointed out that, since the activity of the Indian monsoon is dependent on as many as 16 parameters, no single parameter, such as wind pattern, has exclusive importance. The monsoon is a very extensive, almost global phenomenon and is too complex and too powerful to be affected by a single feature and by local events such as the burning of oil wells in the Gulf area (see Box 2). The Arabian region does not play any significant part in the dynamics of the Indian monsoon. Assuming that 10 million barrels of oil are burnt daily in an area of about 1000 square kilometres, the Indian studies predicted that, while there would be considerable local effects within 500–1000 square kilometres, any effect on the Indian summer monsoon beyond its natural variability was unlikely and no perceptible global changes were to be expected.

Two recent computer studies of climatic response to environmental effects of burning oil wells in Kuwait confirm that the burning of oil will not lead to any statistically significant changes in the Indian monsoon (see Box 3). The first article[2], by Browning *et al*

Box 1

A Statements of Vasant Gowariker, presently adviser to the prime minister on science and technology (January and February 1991)

(1) We must remember that the southwest monsoon is a massive macro-phenomenon, whereas the Gulf spill and fires are extremely local It is therefore unlikely that they will have any impact on our monsoon this year

(2) The monsoon is a very complex phenomenon depending on many parameters. Our calculations definitely show that the Gulf fires (which may affect one or two of these) will not affect our monsoons this year

B Statement of S M Kulshrestha, Director-General, IMD (January and February 1991)

Whatever be the nature of the monsoon of 1991 our results show that the southwest monsoon this year will not be affected by the oil fires of the Gulf

C. IMD statement (19 January 1991)

(1) Most of the perceptible weather-related effects would be confined to a local area of about 500-km radius around Kuwait

(2) Most parts of India would be totally free from the products injected into the atmosphere over the Gulf area However the air mass at higher altitudes of the troposphere over the Gulf region would be moving in rarefied form across the extreme north of the country

(3) There will be no effect of the Gulf events on the day-to-day weather over Indian territory.

Box 2

*A. From 'Environmental impacts of the Persian Gulf oil spill and oil-fire smoke', U. R. Rao et al., Current Science, 1991, **60**, 486–492*

Using satellite imagery from INSAT-1B, NOAA-11 and IRS-1A ... only local areas will suffer environmental hazards Smoke-induced cooling of key thermal subsystems of the monsoon over the Indian subcontinent is estimated to be about 1 K, which may result in a slight delay in the onset of monsoon in 1991, as well as some weakening of it.

*B. From 'Gulf oil spill and the monsoon', U. R. Rao, Nature, 1991, **351**, 704*

The monsoon is governed by several global factors, some of which may compensate for the adverse effects of the oil smoke; the continuous injection of smoke itself will adversely perturb the onset and the performance of the southwest monsoon in 1991 and possibly in 1992 unless compensated for by other factors.

of the UK Meteorological Office (MO), deals with the main environmental effects arising from the burning oil wells in Kuwait. Three models, viz. MO mesoscale weather-prediction model, a trajectory model as a basis for general-circulation-model integrations, and the MO long-range dispersion model, were used to study the effect of smoke plumes on the Asian summer monsoon. The authors conclude that the smoke plume is very unlikely to reach the stratosphere and the bulk of the smoke will remain in the lowest few kilometres of the troposphere, before being deposited on the ground within a week or so of its emission. Beneath the plume there is severe reduction in daylight and a daytime-temperature drop of $\sim 10^{\circ}C$ within ~ 200 km of the source. Episodic events of acid rain and photochemical smog will occur within ~ 1000 to 2000 km of Kuwait. At longer range, a net heating of the troposphere-surface system will occur, resulting in a slight enhancement of the Asian monsoon activity and an enhancement of precipitation in most places. However, the predicted changes in precipitation over Southeast Asia exceed twice the standard deviation of interannual variations over only 10% of the total area and are all increases—an interesting conclusion!

In the investigation reported by S. Bakan *et al.*[3] of the Max-Planck-Institut für Meteorologie, Hamburg, Germany, the approach was different. They performed a series of numerical experiments using a coupled atmosphere–ocean general circulation model with an interactive soot-transport model and an extended radiation scheme to investigate the response of the global climate system to smoke generated by burning oil wells. They found that soot from oil burning is injected into only the lowest 2 km of the atmosphere and that the bulk of it can be washed out and removed by dry deposition or rain within a few thousand kilometres from the source. Over the Tibetan plateau they observed an anomalous heating during May. In the distribution of precipitation, there was no indication of any weakening of the monsoon. On a global scale, anomaly fields could not be distinguished from natural model variability.

The actual weather in India during the past five months has been normal and IMD's predictions have been amply verified. The southwest monsoon arrived on time (one day late in Kerala, two days ahead in Bombay, and five days ahead in East Uttar Pradesh) and has been vigorous thus far[4]. The rainfall has been normal or above normal: about 12% above normal for the first month of the monsoon, and above normal in the normally deficient areas in the area covered so far by the monsoon.

Box 3

*A. Results of model studies made by the UK Meteorological Office, Bracknell; from 'Environmental effect from burning oil wells in Kuwait', K. A. Browning et al., Nature, 1991, **351**, 363–367*

(1) Most of the smoke from the oil fires in Kuwait will remain in the lowest few kilometres of the troposphere.

(2) Beneath the plume there is a severe reduction in daylight and a lowering of the daytime temperature (nearly 10°C). But changes in the Asian summer monsoon are unlikely to exceed the natural variability.

(3) Stratosphere ozone concentrations are also unlikely to be affected.

*B Results of numerical experiments undertaken at the Max-Plank-Institut fur Meteorologie, Hamburg, Germany; from 'Climate response to smoke from the burning oil wells in Kuwait', S. Bakan et al., Nature, 1991, **351**, 367–371*

(1) The results show a decrease in surface air temperature of nearly 4°C in the Gulf region. Outside this region the changes are small and statistically insignificant No weakening of the Indian summer monsoon is expected

(2) Worst-case-scenario studies show no indication of weakening of the Indian summer monsoon.

(3) There is even a region of enhanced rainfall during the onset phase of the monsoon. This enhanced-rainfall region shifts further north during the following two months.

1. Pierce, Fred, *New Scientist*, 12 January 1991, p. 30–31.
2. Browning, K. A. *et al.*, *Nature*, 1991, **351**, 363–367.
3. Bakan, S. *et al.*, *Nature*, 1991, **351**, 367–371.
4. India Meteorological Department, personal communication, 28 June 1991.

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