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A report on the workshop on MONTBLEX research results

The decade of 1980s has witnessed major advances in Atmospheric Science Programmes in the country. The development of sophisticated instruments like spectrophotometers, fast response electronic sensors, remote sensing devices, viz. sodar, MST radar, lidar, etc., have led to a rapid progress in some areas.

The dynamical and thermodynamical effects in the boundary layer are of primary importance in monsoon dynamics studies. The Department of Science & Technology launched the Monsoon Trough Boundary Layer Experiment (MONTBLEX) Programme in 1987–88 to investigate these effects. The summer monsoon trough is located in the northern plains of India with its axis parallel to Himalayan foothills. Western end of the trough extends over West Rajasthan, where dry convection with shallow clouds is seen; whereas the eastern end is over north Bay of Bengal, with organized moist convection prevailing. Little information is available on the activity of the boundary layer processes associated with deep moist, unsaturated and near dry processes occurring within the trough region. Under the MONTBLEX programme, micro-meteorological observation facilities established at Jodhpur, Delhi, Varanasi and Kharagpur in the trough region have provided fine structure data on the monsoon boundary layer.

To provide a scientific forum and to promote research, a workshop on MONTBLEX results was sponsored by the Department of Science & Technology at the Indian Institute of Tropical Meteorology (IITM), Pune during 26–27 March 1993. The studies presented interesting results on turbulence structure, surface fluxes and modelling studies of atmospheric boundary layer (ABL) using MONTBLEX data A total of 36 papers were presented at the meeting The active participation from atmospheric scientists all over the country indicated that the boundary layer research has caught the interest of increasing number of scientists. Salient aspects of these presentations are summarized in the following paragraphs.

In the inaugural address R. Narasimha (then Director, National Aeronautical Laboratory, Bangalore) stated that the challenge before scientific community is to identify those areas where analysis of the results of MONTBLEX '90, could have impact on weather forecasting.

In the first session on 'Turbulence structure of the ABL' R. Narasimha summarized some of the interesting results of the turbulent structure in the ABL over monsoon trough region. An analysis of MONTBLEX data brings out that turbulent bursts are the characteristic signature of atmospheric events. A presentation by S. Rudra Kumar (IISc, Bangalore) brought out the results for various stability conditions. G. K. Sen and D. K. Sinha (Calcutta University) described their studies aimed at diagnosis of the effect of some physical processes on atmosphere. Probable time varying flux profiles constructed from the initialized data were presented. M. Chatterjee from the same university talked about the relevance of transient turbulence theory and boundary layer (BL) structure.

A. Chanda, J. Das and P. Bedajna presented some results of BL studies conducted using the sodars at Banaras and Calcutta during MONTBLEX. The temperature field, as measured in the lower region of BL from sod analysed to identify atmospheri A. M. Selvam and V. V. Sapre Pune) discussed fractals appr interpret time series of MON data. The resolution-dependent v of observed parameters can be m and can be used to predict bo layer fluxes for different time from the fixed time scale obser Finally, M. Radhamani and Selvam (IITM, Pune) present spectral analysis of fluxes co using MONTBLEX '89 Pilot ment data Their important find predictability of total pattern c tuations can be used for modelli flows in the monsoon region.

In the second session on 'Bo layer characteristics'. Y. Rama summarized physical mechanism boundary layer processes govern life cycle of the rain pr mesoscale flow in the monsoon A new methodology was sugges modification or validation of the methods of evaluating surface fl the monsoon region.

S. B. Debaje, S. Sivaramakrishn K. G. Vernekar discussed the from the tethered balloon and based instruments at Kharagpur wind and temperature profiles. T neutral stability conditions wer during the period 18–24 June 19 computations for roughness leng reported S. S. Parasnis, M. K. K and V. A. Kunchur, (IITM, Pu scribed the parametric model a to study convective scale dow during passage of a disturbanc data included aerological sound few stations, i.e. Calcutta, baneswar, New Delhi and

during 18–21 August In this interesting study a characteristic mixing layer in the lower troposphere ahead of disturbance was reported.

R S. Singh. Y. S Ramakrishna. A S. Rao. A Prabhu and S. Vasudev in a joint paper (CAZRI, Jodhpur and IISc, Bangalore) discussed the dust particle analysis recorded at Jodhpur. Seasonal variations of particle size and density and the influence of boundary layer parameters on them were reported over the arid region. P. Seetaramayya, S. B. Debaje, S. G. Nagar and S. Saxena presented a study of convective processes over Bay of Bengal during MONTBLEX '90, where convective processes are expected to release large amounts of sensible and latent heat from the air–sea interface. Results were presented on observations conducted during 18–20 August 1990. A study of formation of monsoon depression and consequent SST variation using surface meteorological data suggested that unlike cyclonic situations, the SST variability was not seen to be critical during a monsoon depression. Plausible feedback processes that could occur at the air–sea interface were described.

D. V. Viswanatham and A. N V. Satyanarayana (BHU, Varanasi) presented about the surface layer structure at Banaras during pre-monsoon and monsoon periods, as revealed by the slow response surface layer data of MONTBLEX. Computation of parameters u_*, θ_*, Monin Obukov length, sensible heat and momentum fluxes using gradient transfer method were reported. In the last presentation of this session V. S. N. Murthy, D. P. Rao and Y. V. B. Sarma (NIO. Goa) described the stability characteristics of marine BL characteristics in the upper 100 m ocean layer during 18–31 August and 9–19 September 1990.

In the third session on Surface fluxes in the ABL over land/ocean, A. Prabhu presented results on turbulent structure of the surface layer In a paper with K. G. Rao and R Narasimha he discussed results of flux computations using fast response data on the observed structure of the surface layer at Jodhpur and Kharagpur during 'active' (2–10 August 1990) and 'break' (26 July–1 August 1990) monsoon phases. G. Raj Kumar, R. S Saraswant and B. Chakravorthy described thermodynamic aspects of disturbed boundary layer in the event of a depression in the vicinity of the observation platform. Results showed that entrainment from the top of PBL due to various cloud processes seem to be important in monsoon weather conditions.

It was gratifying to see that surface layer data over land and oceans were analysed by various groups for different epochs. However, it was felt that further efforts are needed and overlaps are to be avoided. Reena Pradhan and U. K. De (Jadavpur University) reported the sensible heat flux computations over deep moist region using multilayer tower data collected at Kharagpur during stable and unstable situations. S. Sivaramakrishnan, M. N. Patil and K. G. Vernekar described variation of surface fluxes of heat, moisture and momentum over the ocean. In the diurnal variation study, night time flux values were seen to be higher compared to day time values. Also, during a depression the momentum fluxes became smaller. Mixed layer heights in the marine BL and its diurnal variations are correlated to cloud amounts in another paper by S. S. Parasnis, S. B. Morwal and M. K. Kulkarni.

Malti Goel and Y. Ramanathan presented a comparative study of surface fluxes computations made by different groups using methods available in the literature, i.e. bulk aerodynamic, profile and eddy correlation methods. The study made for Jodhpur and Kharagpur during the active monsoon period of 1–12 July 1990 concluded that the bulk method results are realistic to those of profile method. Another interesting observation made was that during noon hours when the ground-air temperature was high over Jodhpur, and turbulent eddies were generated by free convection, surface fluxes by profile method (using slow response data), and eddy correlation method (using fast response data) were in good agreement. The reasons for discrepancies during other hours were discussed.

In the fourth session on 'Modelling studies in the ABL', U. C. Mohanty (NCMRWF) proposed a higher value of drag coefficients for the monsoon region. T. Venugopal, Parashuram, P. Parihar and U. C. Mohanty (IIT, Delhi) presented the simulated structure of ABL by one-dimensional TKE closure model with vertical resolution of 40 levels during monsoon depression (15–25 August 1990). K. V. J. Potty, U. C. Mohanty, K. J Ramesh and B Nandi discussed the results from a high resolution primitive equation and three-dimensional model having 16 layers in the vertical which was integrated up to 48 h using FGGE MONEX 79 data. A direct method approach for estimating surface fluxes using two level data from the cubic surface layer equations was proposed by S. Sinha. Results were found to be in agreement with MONTBLEX '90 observed tower data over Kharagpur.

J. S. Pillai, S. Saxena and K. G. Vernekar (IITM, Pune) presented the techniques of evaluating surface fluxes using the simulated values of surface temperature from the soil temperatures measured at 0 1, 0.2 and 0 3 m depths, taking few interesting case studies from Kharagpur, Jodhpur and Varanasi. S. B. Morwal, K. G Vernekar, S. S. Aralikatti and S. S. Parasnis discussed various surface forcings during 'active' and 'break' conditions on monsoon at Kharagpur. Using wind observations they showed that forces in the surface layer were different during the two conditions, but balanced up to the BL: the height of which was different in the two cases.

In the fifth session on 'Structure of the ABL', D. K. Sinha delivered a talk on 'Boundary layer structure from selected data. a diagnostic critique'. This was followed by results on sodar studies of ABL structure. In a joint paper, B. S. Gera, S. P. Singal and Y. S. Ramakrishna (NPL, New Delhi and CAZRI Jodhpur) described the utility of sodar observations to atmospheric turbulence studies from the observations made at Jodhpur. Doppler sodar observations around Kharagpur revealed vertical structure of BL over moist convective region. R. Pradhan, B Roy, U. K. De and D. K. Rakshit (Jadavpur University) described the importance of sodar observations in the mixed layer observations and variation of its thickness under disturbed and undisturbed conditions, stability parameters and the development of annual and cirrus clouds. L. K. Sadani and B. S. Murthy (IITM, Pune) suggested a method of estimation of nocturnal temperature profiles using sodar inversion heights.

A. Chanda, A. K. De, S. K. Tripathi and J. Das (ISI, Calcutta) described a digitization scheme for sodar measured echograms suggesting it for estimating vertical velocity field of updraft. B. Roy, U. K. De and D. K. Rakshit analysed Doppler sodar data for computing mixed layer temperature structure parameter using Wyngaard's similarity method and compared it with the computations from Tatarskie turbulent mixing method over the height

range between 60 m and the elevated layer base height. Wyngaard's approach for estimation of temperature structure and stability characteristic in the ABL using Doppler sodar measured winds and temperature is found to be better in the absence of surface layer and radiosonde measurements. D. K. Paul, S. P. Ghaneskar, B. S. Murthy and K G Vernekar highlighted the sodar observed variations in the vertical wind profile over Kharagpur during passage of synoptic scale disturbances.

In the concluding session P. R. Pisharoty offered his illuminating thoughts about the computation of surface fluxes in the monsoon region and recalled earlier predicaments. The meeting concluded that MONTBLEX '90 has provided valuable and good quality data for atmospheric boundary layer research in the monsoon region. Several new groups have started work on boundary layer studies, with younger scientists coming forward to present the results. D. R. Sikka suggested that the boundary layer research community, which has been generated through MONTBLEX, should make sustained efforts in future too. These efforts should culminate in understanding the unresolved problems of monsoon dynamics

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SCIENTIFIC CORRESPONDENCE

Biological control programmes in India – A review in retrospect

Professor H. S. Smith coined the term 'Biological Control' in 1919 in reference to the control or regulation of pest populations by natural enemies. Biological control has been in practice since 1200 AD and has provided environmental safety and stability, in addition to profits, to its practitioners. The well-documented introduction of the vedalia lady beetle from Australia to California gave an impetus to biological control. California, Hawaii and Australia were well-benefited from biological control programmes until the advent of World War II. The discovery of chlorinated hydrocarbons during World War II, along with cyclodienes, organophosphates, carbamates, synthetic pyrethrins and others, has subsequently led to the increased use of pesticides and the reduction in utilization of biological control programmes throughout the world. The publication of 'Silent Spring' by Rachel Carson in the early 1960s created a public awareness of the environmental damage that synthetic pesticides can cause. A search for alternative methods to synthetic chemicals led to the re-emergence of biological control. Biological control was rediscovered, not just begun as an 'environmentally safe alternative to the chemical means of control'[1].

Various biological control projects that have been carried out, the benefits derived from them, and problems encountered in different parts of the world have been reviewed and documented[2, 3]. Criticism of this programme has been based on fewer facts and some misinformation. Introduction of the vedalia beetle has not only been a huge success but also, thus far, shown no adverse effects. However, a person could conduct a witchhunt to find a minor adverse effect just to discredit this project. In fact, in 1989, the US celebrated by having centenary seminars and workshops to commemorate the introduction of vedalia beetle.

Some authors who wish to discredit biological control repeatedly cite *Teleonemia scrupulosa* Stål introduction to Uganda and India as misjudgements. In Uganda this insect caused annual defoliation of lantana and when there was no foliage it moved on to sesame[4]. On sesame, only the first generation developed and not the succeeding ones[5]. Also, it happened to be one of the most preferred cultivars planted at the Research Station when the observations were made[6]. Greathead[6] stated that he has been misquoted (pers. comm.) by some authors to support their views and it is time to put an end to this controversy. In 1943, a laboratory culture of *T. scrupulosa* in Dehra Dun, India, was destroyed as it was found to feed on the leaves of teak[7]. However, the culture escaped from the laboratory and spread throughout India[8]. Ironically, a school teacher was even given an award by the late Prime Minister Indira Gandhi for aiding the spread of this natural enemy and controlling lantana bushes. *T. scrupulosa* has never been reported to feed on teak in the field and also it has not been reported as a pest of sesame since 1967 (ref. 5). Now, it is widely used as an effective natural enemy of lantana throughout the world.

The project for introduction of the Mexican beetle, *Zygogramma bicolorata* Pallister, to India was halted after host-specificity testing in the laboratories of Australia and India and field releasing in some parts of India, because the beetle has been observed to feed on sunflower in the field[9, 10]. Time will tell whether the scientists who conducted host-specificity tests failed to detect the beetle feeding on sunflower or if this project will become another wasted controversy and resource, like the introduction of *T. scrupulosa*.

The project to replace *Parthenium* with another exotic, invasive, alien weed, *Cassia uniflora* Mill., lacks merit as the superior allelopathic property of one weed is utilized to replace the other[11]. It may lead to the replacement of one devil with another or may end up aiding the spread of a highly allelopathic exotic weed. Since *Cassia* spp are serious weeds in the tropical regions, some research has already been conducted to explore the possibility of