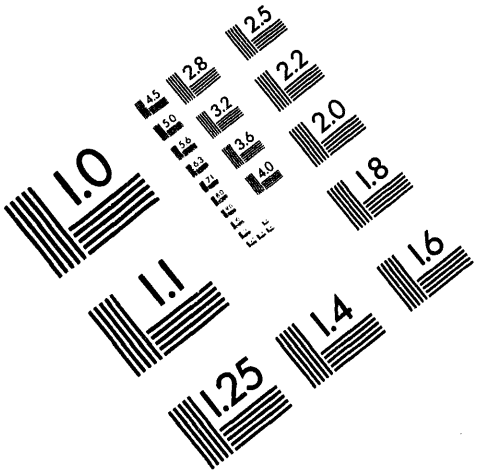
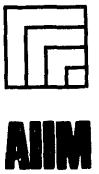




AIIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910

301/587-8202

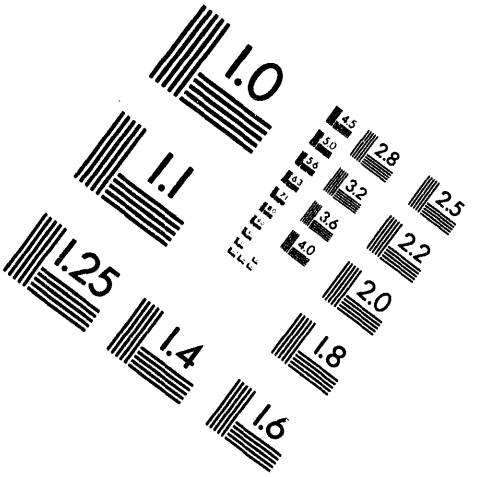
Centimeter

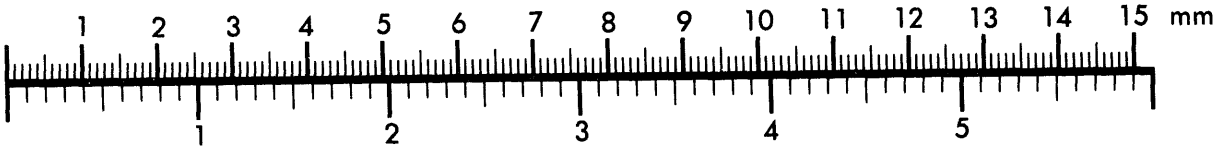
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

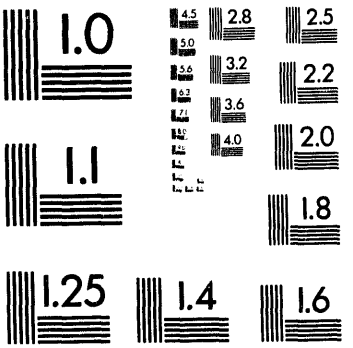
1 2 3 4 5

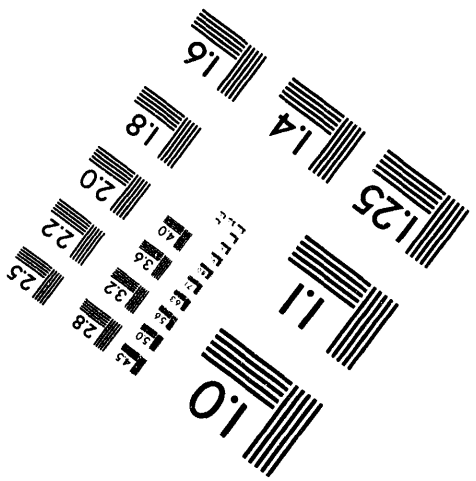
Inches

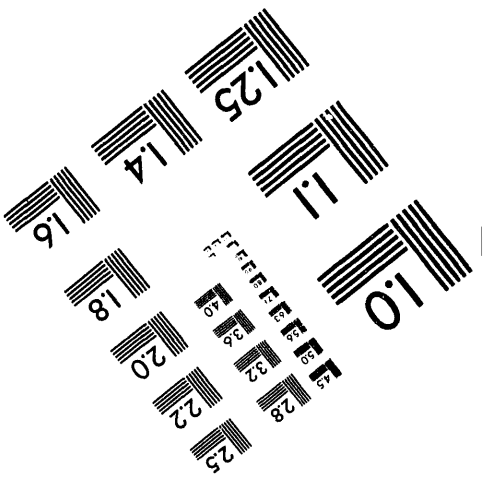
MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.











1 of 1

2

Conf-941193--1

UCRL-JC-114511
PREPRINT

Monsoons: AMIP Simulations of the 1987 and 1988 Drought and Flood Regimes

K.R. Sperber
T.N. Palmer

This paper was prepared for submittal to the
18th Climate Diagnostics Workshop
Boulder, CO
November 1-5, 1993

October 1993

Lawrence Livermore National Laboratory

This is a preprint of a paper intended for publication in a journal or proceedings. Since changes may be made before publication, this preprint is made available with the understanding that it will not be cited or reproduced without the permission of the author.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

Monsoons: AMIP Simulations of the 1987 and 1988 Drought and Flood Regimes

K. R. Sperber[1] and T. N. Palmer[2]

[1]Program for Climate Model Diagnosis and Intercomparison
Lawrence Livermore National Laboratory
P. O. Box 808, L-264
Livermore, CA 94551

[2]European Centre for Medium-Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX
United Kingdom

The simulation of monsoons, in particular the Indian summer monsoon, has proven to be a critical test of a general circulation models ability to simulate tropical climate and variability (Simulation of Monsoon Variability, WCRP-68, 1992). In an effort to better understand the necessary conditions for the simulation of a phenomenologically correct Indian Monsoon, we present analyses of simulations associated with the Atmospheric Model Intercomparison Project, a coordinated effort to simulate the 1979-88 decade using standardized boundary conditions with approximately 30 atmospheric general circulation models. Diagnostics, such as those performed under the auspices of the Monsoon Numerical Experimentation Group have been evaluated to address questions regarding the predictability of monsoon extremes. Particular attention has been devoted to the 1987 and 1988 Indian monsoon drought and flood regimes associated with El Nino and La Nina conditions in the Pacific.

Examination of the observed 1988-1987 differences of JJA averaged precipitation and low-level flow at 850 hPa indicate that there were several features that contributed to the enhanced precipitation over the Indian subcontinent, the Arabian Sea and the tropical Indian Ocean (Figs.1a and 1c). The enhancement of the Somali jet in conjunction with the presence of equatorial easterlies were associated with convergence and enhanced precipitation over the southern portion of the subcontinent and over the ocean, while over the northwestern portion of the subcontinent stronger westerly flow and suppressed dry-air advection contributed to the increased precipitation. Additionally, southeasterly anomalies over the Bay of Bengal strongly suggest that interannual changes in the behavior of the monsoon trough affected the distribution of precipitation over the northeastern portion of the subcontinent. Table 1 subjectively indicates the ability of the presently available AMIP models to simulate these low-level flow patterns deemed influential to the increase of precipitation in 1988 relative to 1987. In general the models exhibited subsets of the features deemed important with the most significant shortcoming being that all of the models were unable to capture the spatial structure of the precipitation enhancement that occurred

over the ocean. In the low-level flow this is exhibited by the pronounced inability of the models to simulate the easterly anomalies over the Indian Ocean. Most models were able to simulate an enhanced Somali jet to some degree but clearly such an increase in the low-level flow did not guarantee production of enhanced precipitation over the subcontinent or the ocean through enhanced surface evaporation. To varying extents southeasterly anomalies over the Bay of Bengal and the continent were simulated. Those models that have been successful in qualitatively simulating enhanced precipitation exhibit difficulty in simulating the spatial characteristics of the signal with fidelity. As an example, the 1988-1987 JJA differences of precipitation and 850hPa winds from the ECMWF AMIP simulation are given in Figs. 1b and 1d. The enhanced precipitation over the Indian subcontinent in this simulation arises as a consequence of southeasterly anomalies over the Bay of Bengal that extend over the Indian subcontinent. These anomalies are indicative of monsoon trough displacements and suppressed dry-air advection in 1988 relative to 1987.

In a effort to ascertain the robustness of the ECMWF models response to the prescribed sea-surface temperatures, three additional AMIP sensitivity simulations have been examined. These 10-year runs only differed in the prescription of the initial conditions. Examination of an All-India rainfall index (land points only, not shown) from these runs indicated that in each case the Indian subcontinent was wetter during the summer of 1988 than 1987, and that the low-level flow anomalies were qualitatively similar. With respect to each year, the rainfall departures were of similar magnitude during 1987 while those during 1988 exhibited a larger spread indicating that this models response to the El Nino conditions of 1987 was more coherent than its response to the La Nina conditions of 1988.

Examination of the 10-year JJA precipitation and low-level flow climatologies from the ensemble of AMIP integrations generally indicates that a weak Somali jet is associated with an underestimate of precipitation over India. Hence, while it is necessary to simulate the large-scale flow in order to obtain a good monsoon precipitation distribution, there are regional scale phenomena, such as the behavior of the trough in the Bay of Bengal and the dry-air advection from the northwest, that play important roles as mechanisms in moderating monsoon precipitation on seasonal and interannual time scales.

Acknowledgment. This work was performed under the auspices of the Department of Energy Environmental Sciences Division at the Lawrence Livermore National Laboratory under contract W-7405-ENG-48.

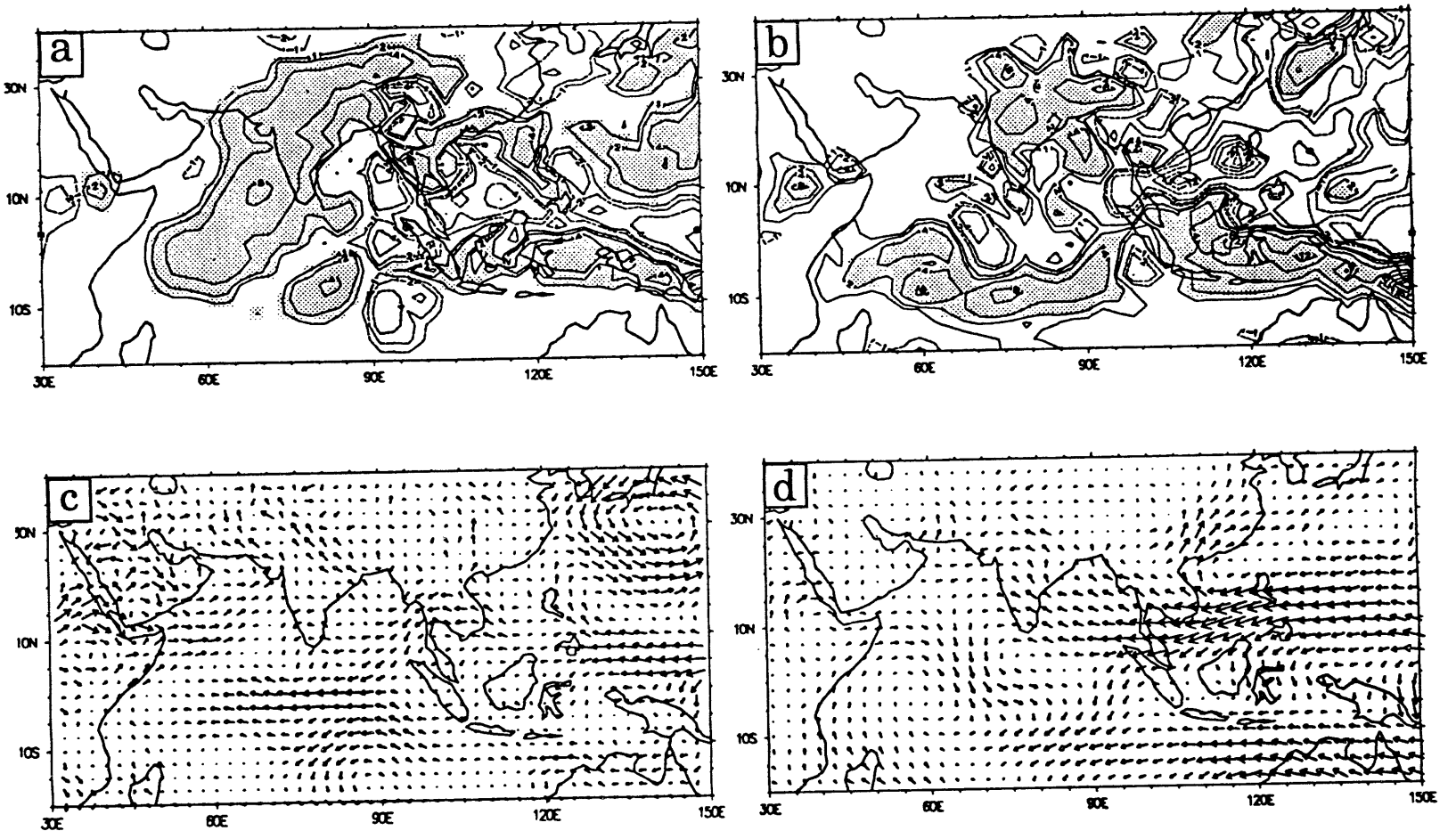


Figure 1. 1988-1987 differences of June/July/August averaged precipitation (mm/day) a) GPCP satellite derived precipitation, b) ECMWF AMIP simulation; and 850hPa winds c)ECMWF initializations d) ECMWF AMIP simulation. Precipitation anomalies ≥ 1 mm/day are shaded. Positive (negative) contours are solid (dashed). Contours are given for anomalies ±1, 2, 4, 8, 12... mm/day.

Table 1: The ability of the available AMIP models to qualitatively simulate the enhanced precipitation and 850hPa flow anomalies during JJA 1988 relative to 1987 is indicated. (+) indicates some ability to simulate the observed characteristics; (-) indicates that the simulated anomalies are in oppostion to those observed, and lack of a symbol indicates that a model failed to simulate a given feature.

Model	Increased Indian Subcontinent Precipitation	Enhanced Somali Jet	Equatorial Easterlies	Bay of Bengal South-easterlies	Suppressed Dry-Air Advection
Observations	+	+	+	+	+
1	+	+			+
2	-	-	-	+	
3	-	+		+	
4	+		-	-	
ECMWF	+			+	+
6	-	+		-	+
7	+	+		+	+
8	+	+		-	+
9		+		-	-
10	+	+	-	+	
11		+			+
12	-	-		-	+
13	+	+		-	+

DATE
FILMED
10/5/94

END