

Every dry season

**Dams year after year
Dotted the subcontinent
Countlessly increased**

**On inter(intra) faults
Water moments changed so fast
They quaked mother earth**

**Dams controlled earthquakes!
Till at last great ones occurred
So shallow off land**

**Boomeranged back west
Fast accurate tsunamis!
Creating chaos!**

**Men part of nature
Destroying nature for self
Themselves sure destroyed!**

**They are the culprits
They should relearn harmony
Specialists modern**

**Reforest the earth!
Reverdure your call before
More great boomerangs!**

**Demolish excess!
Life way born out of nature
Womb of mother earth!**

**Is forever safe
Healthy wholesome longlasting
You part of nature!
R. Ashok Kumar**

Earthquakes caused by dams

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The paper examines the consequences of harnessing rainfall behind some 4500 dams in India. Changes of geological magnitude are occurring in an instant, rivaling the effects of 'tectonic plate forces'. The article provides epidemiological evidence including correlation with stress relief in rocks to show that the force and moment waves, because of dams on the Indian subcontinent are a cause of the waves of worldwide earthquakes. Dry season earthquake parameters in percent are a faithful reproduction of those for the monsoon. A significant race is on between the two seasons to record the biggest earthquake ever. The paper expects earthquakes of magnitude 8 MM or greater in the coming monsoons following the displacements caused by the 9.4 MM great Andaman earthquake. The article shows that the pendulum of the earthquake wave has synchronized with the pendulum of the wave of applied rate of change of water moment-a state of chaos.

Key words: hydro- cycle, India, dams, force surges, moment-surges,waves of earthquakes, causality, displacements, prediction, chaos.

INTRODUCTION

The earthquake at Bhuj on 26th January 2001 was preceded and followed by a number of earthquakes worldwide. The pattern depicted by this phenomenon raised a question whether the archimedian lever effect caused by the oscillating weight of waters behind large dams on the Indian subcontinent caused earthquakes worldwide. The earthquakes were so far thought to be caused by

some dams only locally by the pore pressure effect. However, the dynamics of the earth appeared to be affected by the rapidly rising concentration of waters behind dams during the gigantic transfer of rain-waters from the oceans to the Indian subcontinent by the South-West monsoon and by the withdrawal of the waters during the dry season thereafter. Hence the following hypothesis was formulated and investigated.

THE HYPOTHESIS

In this article a hypothesis is proposed that the weight of waters behind dams on the Indian subcontinent exerts rapidly changing moments on faults, which display stick-slip behavior. This results in earthquakes worldwide with a regularity typical of the South-West monsoon on the Indian subcontinent, followed by water withdrawal during the dry season. The hypothesis is tested by a statistical analysis of earthquake data and its correlation with water moments caused by dams. Dams other than the Indian are excluded from the study. The reasons are as follows. Assuming that the study shows a statistically significant result that the dams in India are causing worldwide earthquakes, there are two possibilities for the result for a study with the other dams excluding 1) the Indian dams and 2) other dams in areas having similar hydrological cycle: Either the result is significant, in which case the others act similar to the Indian, or the result is not significant, in which case the other dams do not cause worldwide earthquakes.

THE WATER MOMENT AND ITS RATE OF CHANGE

The 124 year rainfall data (1871-1994)(Columbia University Website) for each month from June to September, was used to compute the mean rainfall and the running mean rainfall for each of these months for India and expressed in percent of the running mean rainfall total for June to September. The monthly rainfall is taken as a measure of the change in the water moment during the month. The weight of water acting at the center of gravity of all the water masses behind the reservoirs exerts moments in all directions about the center of gravity. This moment becomes effective whenever a fulcrum is offered at the faults (stick-slip phenomenon). The dry season period from October to June witnesses water withdrawal from the reservoirs and is assumed to be a linear draw down from 100 percent

storage at the begin of October to zero percent storage by the end of May. It is not the water moment, but its rapid rate of change that is being studied here for its effects. Today simultaneously, behind dams in India part of the Indian subcontinent more than 300 billion cubic meters (BCM) of water are collected each year during the monsoon. The dam storages rise from zero at the commencement of the monsoon to more than 300-400 BCM in just 4 months. This is withdrawn in 8 months of the dry season from October to May. Thus at the center of gravity (23,78.75) of these water masses, a gigantic surge wave of the rapidly changing vertical load rises from zero to 300-400 billion tons in 4 months of monsoon and slumps to zero by end May. This is a force application at the center of gravity of the water masses whose wave rises at the rate of about 326 million newtons per second during the monsoon. This is a giant wave of changing load at the rate of 33000 tons per second or equivalent to a rapidly rising water column head of 33 kilometers per square meter every second at the center of gravity for 4 months of the monsoon: a pressure wave of 325 million pascals per second! During the dry season from October to May, this reduces progressively to zero by release of a wave of force at half this rate! This caused a total rate of change of water moment on the Sagaing fault during the 2000-2001 hydrological year of the order of $1183 \cdot 10^{19.05}$ Nm/year (Table 7). This corresponds to a surge wave of bending moment at the Sagaing fault, changing at the rate of 420 million megawatts (MW) of power during the whole year! Note that during four months of the monsoon, one half of the total annual change of water moment of $1183 \cdot 10^{19.05}$ Nm was applied on the Sagaing fault, which is a rate of change of applied bending moment of 630 million megawatts power. During the dry season of eight months, the remaining half of the change in bending moment was released at half this rate or 315 million MW. During the same year the total seismic moment released during 1-9.9 MM (moment magnitude) earthquakes in the region, -90 to 90 degrees latitude and 78.75 to 180 degrees longitude, was $987 \cdot 10^{19.05}$ Nm. This is an average seismic moment release at 351 million MW of power! So we are dealing with geological time scale and type variations in an instant (every second of every year). Such gigantic waves of repeated alternating rate of change of moment applications throughout the year, every year, on faults, and their consequences, form the subject matter of this article. With deep continental roots and cratons welded to the underlying mantle (Pratt 2000), it is possible indeed that

the force and moment surge waves travel throughout the earth and when they meet faults, the stresses build up causing them to snap releasing earthquakes.

THE SCIENCE OF THE INVESTIGATIONS

The method used has followed those of science: The principle of the canon of agreement: same antecedents: the worldwide earthquakes following from dams which harness the common factor: the rains; conditions of difference: dams and no dams: effects and no effects; independent laws: a number of favourable instances from the worldwide earthquake data base confirm truth of the hypothesis linking cause to effect and effect to cause. The plausibility: for instance same ratio seismic moment to change of water moment as the stress relief ratio in rocks; dry season and monsoon outcomes of earthquake patterns are reproductions of one another and related rigidly to reservoir content changes.

A STUDY OF THE USGS DATABASE ON WORLDWIDE EARTHQUAKES (USGS WEBSITE) IN THE RANGE 1-9.9 MM BRINGS OUT THE FOLLOWING FINDINGS:

DAM ERA

Highly significant correlation of percentage values of earthquake parameters with percentage change of water moment.

The monsoon and dry season earthquake parameters latitude, longitude, depth, seismic moment and the number of earthquakes summed up each for each month, cumulatively for each year, and expressed in percent of the wet and dry season sums respectively, display statistically highly to extremely significant linear regression, when correlated with the corresponding monthly percent change of water moment (Table 1). When negative sign is attached to the dry season values, the correlations become statistically extremely significant (Table 1M).

Table 1M: The earthquake parameters correlate in linear regression statistically highly significantly with the monthly change of water moment(WM') for magnitude range 1 to 9.9 MM for the period June 1973 to May 2001.							
Here Las1-9.9 means latitude sum for earthquakes in the range 1-9.9 MM; similarly Los: Longitude sum; Des:Depth sum;SM: Seismic Moment sum;Q: Sum of the number of earthquakes. The wet season values(June to September) are expressed as a percentage of the wet season total and the dry season values(October to May) as a percentage of the dry season sum. After the percentages are computed, the dry -season values are multiplied by -1.							
		<----- Jun73-May01 ----->					Jan2001-Dec 2004
	WM'	Las1-9.9	Los1-9.9	Des1-9.9	SM1-9.9	Q1-9.9	Focal mechanisms
Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent 5-9.9
Jun	19.1811	25.429866	29.04957	24.43837732	31.24518485	24.91237667	25.5
Jul	32.1871	26.663602	24.84778	25.33602064	25.93952971	26.41970056	23.5
Aug	28.5735	24.430441	27.22736	26.23776999	22.08132873	24.93364939	26.5
Sep	20.0583	23.476092	18.87528	23.98783204	20.73395671	23.73427338	24.5
Oct	-12.5	-12.128623	-7.9821	-12.62959856	-18.20354683	-12.26549755	-14.76453
Nov	-12.5	-11.297503	-14.3336	-12.4261381	-19.6325319	-12.15140216	-12.72804
Dec	-12.5	-12.683896	-16.4371	-12.34564564	-9.355577905	-12.21937388	-13.61901
Jan	-12.5	-12.633541	-10.0788	-12.3739602	-10.34433649	-12.55874699	-14.76453
Feb	-12.5	-11.086804	-16.9764	-11.08654746	-8.322015891	-11.4352715	-11.7098
Mar	-12.5	-13.231575	-12.8724	-12.72345952	-10.54506611	-12.93162045	-9.843021
Apr	-12.5	-12.968149	-13.2095	-13.04194836	-10.10049529	-12.85442399	-11.03097
May	-12.5	-13.96991	-8.11007	-13.37270215	-13.49642958	-13.58366348	-11.54009
r with %WM'		0.9863574	0.96916	0.987185719	0.954851914	0.987564195	0.978933017
df		10	10	10	10	10	10
t		18.947711	12.43653	19.56286737	10.16387738	19.86405005	15.1612934
p		3.638E-09	2.09E-07	2.66332E-09	1.36925E-06	2.29402E-09	3.15466E-08
tails		2	2	2	2	2	2
1-r^2		0.0270991	0.060729	0.025464357	0.088257823	0.024716961	0.041690149

The linear regressions for each year correlate with the yearly cumulative reservoir capacities in a logarithmic regression.

The trajectory of the Linear Regression correlation r (%WM', %y, an earthquake parameter) of the cumulative monthly sums of the earthquake parameters with the annual cumulative reservoir capacity (June 1973-May 1974, June 1973-May 1975, ... June 1973-May 2001) for the various earthquake parameters is shown in Figure 1: This regression is logarithmic and is statistically extremely significant (Table 2). The reservoir capacity (and water storage) is given in million hectares created irrigation potential equivalent (Mha CIPE). The reservoir capacity in billion cubic meters (BCM) is got by multiplying the reservoir capacity expressed in million hectares created irrigation potential equivalent (Mha CIPE) by the factor (water application at canal head in meters/efficiency of water storage).

The F-Ratio Test on the Earthquake Parameters and the Rate of Change of Water Moment

The F-Ratio Test for the variables %WM' and the earthquake parameters of Table 1 shows that they all come from the same parent population (Table 3). The F-Ratio Test provides further evidence that the rate of change of water moment and hence the dam storage variations govern the earthquakes persistently. Here sdp is the standard deviation of the population, $p(F)$ is the probability of the F-Ratio being exceeded by chance and df is the number of degrees of freedom. The F-Ratio probability shows that the percentage rate of change of water moment and the various earthquake parameters in percentage are statistically not significantly different.

Percent Focal Mechanisms per month correlate with Percent Rate of Change of Water Moment: January 2001 to December 2004

This connection of earthquake parameters to rate of change of water moment was tested by correlating available data on beachball representations (focal mechanisms) with the monthly rates of change of water moment (Table 1). Those, which exhibited tension at the top end of the beachball representation, were counted for each month for each hydrological year. The mean count for each

month was expressed as a percentage of sum of such means for the two seasons respectively. When the percent mean counts were correlated with the percent rates of change of mean water moment in linear regression, it was found that the foci exhibit a statistically extremely significant correlation: $r=0.839, p=0.000638$. Further, the chi-square distribution is 7.38 with $p=0.77$, degrees of freedom 11, showing that the differences between the two quantities are due to chance. Thus the stresses in the rocks appear to be controlled by the rate of change of water moment.

PREDAM ERA AND TRANSITION TO THE DAM ERA

A similar study for the predam era –2150 to 1850 and transition to the dam era till 1951 shows no such statistically significant correlation (Focal mechanism data was not studied as data was not available for this period). See Table 4. The data for significant worldwide earthquakes (5.5-9.9 MM) of the USGS data base from 2150 BC to 2001 AD was used. It was assumed that the monsoon rain magnitudes expressed in percent of the total for the monsoon remain invariant statistically whatever era is being considered in the period being studied. The monthly change of water moment is still given by the monthly rainfall, but the effect is governed by the rainfall that is harnessed by collecting the waters behind dams as surface water storage.

THE RELATION OF SEISMIC MOMENT TO WATER MOMENT

DAM ERA

Four statistically extremely significant results were deduced on the basis of scaling procedures developed below.

First Result

For the 1973-2001 database when the annual rate of change of water moment is compared with the annual seismic moment sum for all earthquakes in the 5.5 –9.9 MM and in the range 1-9.9 MM, it is found that the annual cumulative mean of the ratio of the seismic moment sum to the corresponding change of water moment to be statistically the same as the stress relief ratio for rocks, that is, stress relieved from rocks during earthquakes as a percentage of the stress built up in the rock prior to earthquakes(19.743%)(Turcotte and Schubert, 2002) (Table 5, Figures 2,3,4 and Table 7, Figure 5). This connects the stress build up in the rocks at the faults to the waves of force on account of the dams.

Second Result

The ratio of the yearly seismic moment sums on either side of the center of gravity of the water masses converges to the corresponding ratio of the initiating water moment arms (Figures 4, 6, Table 7). This identifies and quantifies the effect of the water moment waves.

Third Result

For the earthquake range 1-9.9 MM, it is found that the mean latitude per quake and 90- mean longitude per quake for the period June 1973 to May 2001 are not significantly different from the location of the center of gravity of the water masses (23,78.75)(Figure 7). This confirms the relation of the worldwide earthquakes to the cause- the giant force waves at the center of gravity. The longitude of the mean hypocenter has to be different from that of the center of gravity, to produce the wave of water moment changes to cause the wave of earthquakes (Table 8). In Table 8, the computations use the straight line connecting the center of gravity to the mean annual hypocenter for the water moment arm and arrive at the same result as the computation method of Table 7(which is as described under scaling procedure below). The latter uses the initiating water moment arms, which for 1-9.9 MM quakes are the lines connecting the center of gravity to the Sagaing fault on the right and to the Murray Ridge on the left of the center of gravity. The extremely close correlation(Table 1) with percent change of water moment, shown by both the student's t test and the chi square distribution, of the latitude sum,

the depth sum and the sum of earthquakes within the hydrological year spanning the period June 1973 to May 2001 also significantly show the dams as a cause of the worldwide earthquakes.

Fourth Result. The worldwide earthquake pattern for the Indian dry season is a reproduction of that for the Indian monsoon and vice versa.

During the monsoon reservoir build up the force at the center of gravity of the water masses exerts moment at faults resulting in stress build up leading to earthquakes by the stick-slip phenomenon. During dry season water release from the dams causes forces to act at the faults in the opposite direction to that during the monsoon causing earthquakes. And consequent displacements occur in a direction opposite to that in the monsoon. This is the hypothesis in case the dams do cause worldwide earthquakes. Partitioning the data into monsoon and dry season sets and analysis shows that the displacements for the two periods are a mirror reflection of one another and cancel out leaving a comparatively small but significant net displacement per earthquake. Adding the data for the monsoon and the dry seasons separately for each year cumulatively filters out transients and brings out the persistent cause and the hypothesis is proved right : Referring to Table 9, the monthly displacements are related logarithmically to the mean reservoir content buildup and discharge (buildup: $r = -0.964$, $p = 0.036$; discharge: $r = 0.9305$, $p = 0.0007967$). The other earthquake parameters in this table have similar statistically extremely significant logarithmic relations with the mean reservoir content (Figure 8). The correlations between displacements and the other earthquake parameters of Table 9 are linear and statistically extremely significant. The correlations between the annual mean cumulative reservoir capacity and the annual values of earthquake parameters are also statistically extremely significant as Table 10 shows which is derived from Tables 11a and 11b. Figure 9 shows the chi-square analysis for displacements, which confirms the mirror reflection. The rapid build up behind dams cause one set of injuries to the living earth by earthquakes whose displacements are sought to be negated by another set of earthquakes during the dry season of water use, causing another set of injuries. For a particular season, beginning from a particular hydrological year, as shown in Table 11, the cumulative displacement from all the earthquakes is computed as the cumulative seismic moment sum till a particular year per mean applied force at the center of gravity of the dams till that year. This is then

divided by the cumulative number of quakes to arrive at the displacement per quake. The mean applied force in newtons is computed from the mean cumulative reservoir capacity till that year. The net displacement in a year is taken as the sum of the positive displacement per quake in the monsoon and the negative displacement per quake in the dry season. As an example, the net displacement till May 2001 from June 1973 was 0.7 m/Q for the year of the Bhuj 8.0 MM quake on 26th January 2001, while it was -24.4 m/Q till 9th May 2005, in the year of the great earthquake of 9.4 MM in the Andaman Basin on 26th December 2004. In Figure 9, the great Andaman quake was taken as of 9.0 MM. If it is considered a 9.4 MM quake, we neglect this huge value, and consider for the chi-square sum, values till 2003, to see the persistent dam effect. Because of the persistent surges of bending moment and force applied on faults, the great Andaman quake may well have been triggered by the dams in India. On the basis of the mirror reflection hypothesis growing out of this evidence, a series of strong to huge earthquakes should occur in the coming monsoon(s) as a reaction to the huge negative displacement deficit for the dry season ending 31 May 2005. The surge of release of water from all dams in the dry season reproduce effectively the earthquake pattern of the monsoon, when the reservoirs contents rapidly build up synchronously and vice versa.

Study of peak magnitudes for reflection of wet season performance in dry season and vice versa.

Table 12 reveals this reflection of one season's performance in the other by means of the dry season- monsoon season race to register the maximum unprecedented earthquake, driven rigidly by the waves of reservoir content changes: The 1974 and 1975 dry seasons register 8.1 MM and 8.2 MM maximum magnitude earthquakes. The wet season of 1976 replies with 8.0 MM quake. The 1976 dry season registers an 8.1 MM quake. The 1977 and 1978 monsoons record 8 MM each. The monsoons of 1979, 1980 and 1985 record 8.1, 8 and 8.1 MM quakes respectively. The 1986 and 1988 dry seasons reply with a record 8.3 MM quake and an 8.2 MM quake. The 1993 and 1994 monsoons register unprecedented wet season highs of 8.2 MM each. 1994 dry season replies with 8.3 MM. The 1995 monsoon registers 8 MM for the maximum magnitude quake for that year. The dry season of 1995 registers 8.2 while that of 1997 and 1998 register 8.3 each. The 2000 monsoon then

replies with an all time high of 8.3 but the dry season of 2000 answers with 8.2. The monsoon of 2001 soars to a record unprecedented 8.4 MM maximum magnitude quake. The 2001 dry season replies with 8.0 but that of 2002 has an unprecedented record of 8.5! The 2003 monsoon registers 8.3. Then the 2004 dry season replied with an all time high of 9.4 MM. And already North Chile recorded in the monsoon season, on 13th June 2005, a major quake of 7.9 MM. The correlation between the cumulative reservoir capacity and the moment magnitudes in Table 12 is high($r=0.5452, p=0.0048, \text{degrees of freedom } 23$), pointing to the fact that the regression of the race is statistically very significant.

THE DAMS CONTROL WHEN EARTHQUAKES OCCUR

The dams determine the timing of the earthquakes rigidly as shown in Figure 11 for the period June 1973 to May 2005. The mean duration of the peak magnitude earthquake for each month correlates statistically extremely significantly with the corresponding monthly mean change of water moment, with all values expressed as percentages of the respective seasonal totals :Linear regression: $r=0.9, p=6.24E-05; X^2=7.34; p=0.77$. The yearly running mean of the mean of each of the seasonal durations separately also exhibit statistically extremely significant correlations with the relentlessly increasing cumulative dam storage capacities(logarithmic correlation)(Figure 12)($r(\text{wet})=-0.9286; p=1.87E-14$ (June 1973 to May 2005); $r(\text{dry})=-0.9322; p=1.56E-12$ (June 1978- May 2005).

PREDAM ERA AND THE TRANSITION TO THE DAM ERA

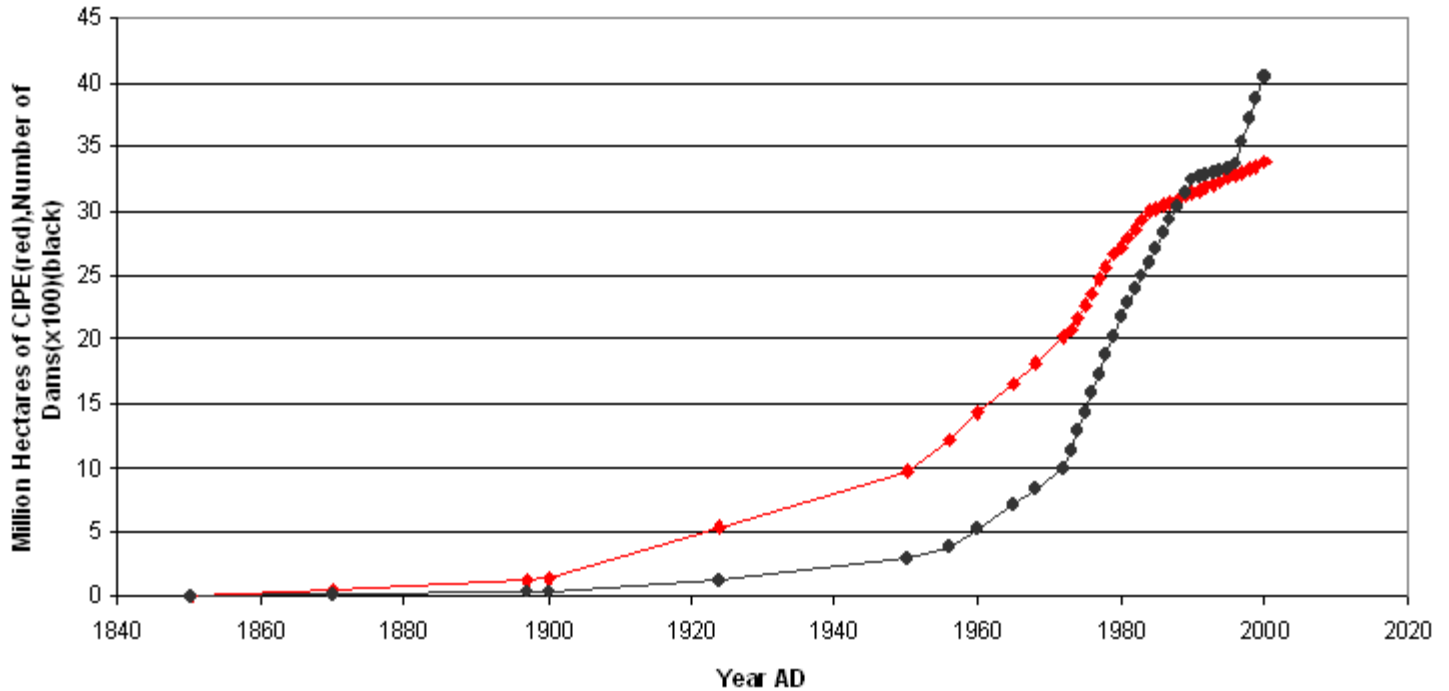
For the predam era and the transition to the dam era no such laws were found (Table 13). Further as we pass from the predam era to the dam era, the number of major and great earthquakes in the longitude band $0-180^0$ more than doubles *statistically extremely significantly* compared to that in the longitude band 0 to -180^0 (Table SDMGQ). A more detailed evaluation confirms the significant doubling of the relative risk(Table MGOPNL). Together with the fact that the Indian dams are situated in the $0-180^0$ longitude band and the other results deduced in this paper, this doubling of

the relative risk is indeed caused by the Indian dams. For evidence on the exponential rise of the number of Indian dams in the 20th century see Figure 0.

Table SDMGQ:Major and great earthquakes in the predam and dam eras: Proportion of quakes in the 0-180 longitude band compared to the total. Statistically			
extremely significant difference of proportions of dam era and predam era.			
Predam Era: 2150 BC to 1850 AD			
Number of	Quakes in 0-180 longitude band	x1	86
Total number of quakes		n1	177
Proportion of quakes in 0-180 longitude band to total, x1/n1			0.485875706
Dam Era: 1850 AD to 2006 AD			
Number of	Quakes in 0-180 longitude band	x2	887
Total number of quakes		n2	1361
Proportion of quakes in 0-180 longitude to total, x2/n2			0.651726672
Probability of quakes in 0-180 longitude band in predam and dam era.			
	p	(x1+x2)/(n1+n2)	0.632639792
Probability of quakes in 0 to -180 longitude band in predam and dam era.			
	q	1-p	0.367360208
Variance for binomial p-dist.			
	pq		0.232406686
	pq/n1		0.001313032
	pq/n2		0.000170762
Standard error of difference	sed	(pq/n1+pq/n2)^.5	0.038520045
Difference mod(x1/n1-x2/n2)		w	0.165850965
		w/sed	4.305575639
Result	Extremely	significant.	

Table MGQPNL: Relative risk of major and great quakes in positive and negative longitudes: -2150 BC 2005 AD. The Relative Risk more than doubles on the average during the dam era compared to the predam era.								
The relative risk is Statistically significant at the 95% Level of Confidence								
S.No	Predam Era	Number of quakes .		Ratio	Dam Era	Number of quakes.		Ratio
		0 to 180 Longitude	0 to -180 Longitude			Positive Longitude	Negative Longitude	
		pos	neg	pos/neg		pos	neg	pos/neg
1	-2150-1550	33	2	16.5				
2	1550-1600	0	14	0	1850-1900	47	33	1.424242
3	1600-1650	9	12	0.75	1900-1950	279	153	1.823529
4	1650-1700	6	16	0.375	1950-1973	133	67	1.985075
5	1700-1750	11	7	1.5714	1973-1994	95	53	1.792453
6	1750-1800	12	11	1.0909	1973-2006	333	168	1.982143
7	1800-1850	15	29	0.5172	1850-2006	887	474	1.871308
8	1550-1850	53	89	0.5955	sdp			0.206535
9	-2150- 1850	86	91	0.9451				
	sdp 2-9			0.4792				
	n 2-9			8	n			6
	95%CI			0.3727	95%CI			0.185499
	Mean 2-9			0.7306	Mean 2-7			1.813125
	Lopre			0.3579	Lo dam			1.627626
	Hipre			1.1033	Hidam			1.998624
Relative Risk								
Mean	Dam/Predam	2.4815		Overall Dam Era/	1850-2006			
95% limits of confidence	Lodam/Hipredam	1.4752		Overall Predam Era	/-2150-1850	1.980105		
	Hidam/Lopredam	5.5837						
Statistically significant at the 95% Level of Confidence								
Source for raw data on earthquakes: USGS Data Base					See reference cited.			
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Figure 0:Reservoir Capacity Build up in India in million hectares of Created Irrigation Potential Equivalent,MHa CIPE:1850-2000 AD

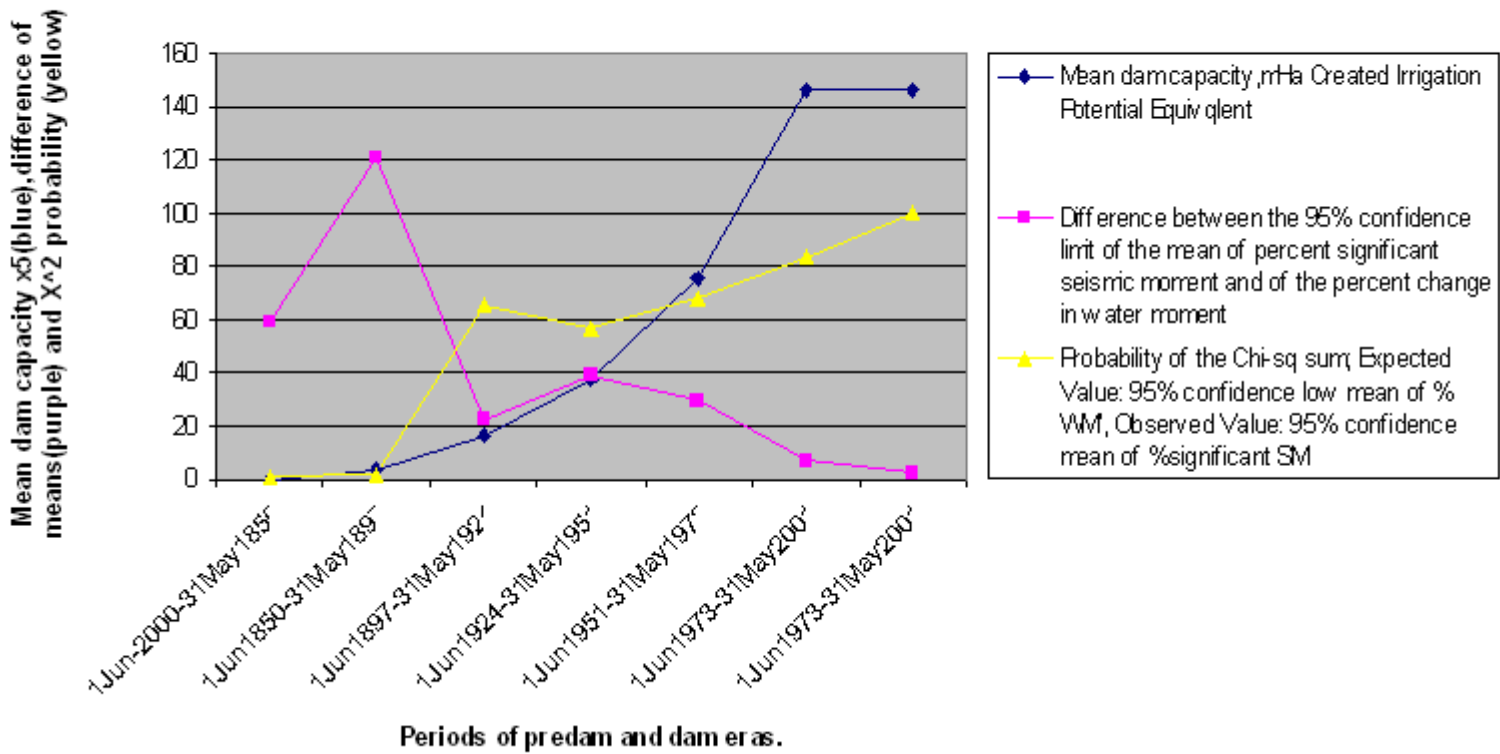


WATER MOMENT CONTROLS SEISMIC MOMENT IN DAM ERA

The 95 percent confidence limits of the percent significant seismic moments (observed values) converge to the corresponding limits of the percent change in water moment (expected values) in the dam era. But they diverge away from the expected values in the predam era (Table 4a and Figure PDDE). The chi-squared distribution probability for the chi-squared sum for the pre-dam era and the dam era shows extremely significant difference in the two means for the predam era and no significant difference in the two means during the dam era. In Figure PDDE, the last point on the chi-squared probability curve is shown as 100% and is the upper limit of the expectation. When we consider the negative signs for the values of the water moments in the dry season and the corresponding percent seismic moment

values negative, the chi-square probabilities for the dam era become 96.5% percent while those for

Figure PDDE: Predam and dam eras: Convergence of percent significant seismic moment to percent change in water moment in dam era and divergence away from it in the palio era.



the predam era become 0.1 percent. The conclusion therefore remains the same, that, together with the other results of this article, this evidence shows that the persistent surge waves of earthquakes worldwide during every hydrological cycle are being persistently caused by Indian dams. The detailed analysis of the predam era and the dam era is contained in Table CSMWM (ignoring dry season negative signs) and Tables PDERA and DERA (with negative signs for the dry season values considered).

Table 4a	95% confidence limits of the % Significant Seismic Moments converge to the corresponding values of percent change in Water Moment in the dam era.							
		PRE-DAM ERA	Transition to	Effective	Dam Era	<-----	DAM-ERA	----->>
Period		2150BC- 1850AD	1850-1897	1897-1924	1924- 1951	1951- 1973	1973-2001	1973-2001
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Mean Reservoir Capacity	mHa CIPE	0.0000001	0.653508532	3.343	7.5395	15.2	29.2937	29.2937
	Percent change:							
	Water Moment	%SignificantSM	%SignificantSM	%SignificantSM	%SignificantSM	%SignificantSM	%SignificantSM	%SM
	%WVM'	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	1-9.9MW
mean	16.66666667	16.66666667	16.66666667	16.66666667	16.66666667	16.66666667	16.66666667	16.666667
sdp	7.002401363	16.36299173	26.03366513	10.50903594	13.21020967	11.71973997	8.068079616	7.4411066
95%CI	4.447122143	10.39189545	16.53359793	6.6741342	8.389609921	7.443034532	5.123918732	4.7257374
Lomean	12.21954452	6.27477122	0.133068737	9.992532467	8.277056746	9.223632135	11.54274793	11.940929
Himean	21.11378881	27.05856211	33.2002646	23.34080087	25.05627659	24.1097012	21.7905854	21.392404
Himean-Himean%WVM'		5.944773304	12.08647579	2.227012057	3.942487777	2.995912388	0.676796589	0.2786153
E:HimeanWVM'%	$\chi^2=(O-E)^2/E$	1.673803312	6.918838596	0.234897808	0.736163936	0.42510092	0.021694525	0.0036766
O:Himean	df	6	5	4	3	2	1	0
	χ^2 Sum	10.01417567	8.340372361	1.421533765	1.186635957	0.450472021	0.025371102	0.0036766
	p(χ^2)	0.124056319	0.138447909	0.840443842	0.756211317	0.798327783	0.873445845	
	χ^2 Sum[2 to 3]	8.592641908	6.918838596					
	df[2 and 3]	1						
	p(χ^2)[2 to 3]	0.00337524						
E:LomeanWVM'%	$X^2=(O1-E1)^2/E1$	2.892115133	11.95485615	0.40587296	1.271995846	0.734519279	0.037485327	0.0063526
O:Lomean	X^2 Sum	17.30319734	14.41108221	2.45622606	2.0503531	0.778357254	0.043837975	0.0063526
	p(X^2)	0.008231221	0.013198606	0.652490979	0.562021778	0.677613219	0.83415535	
	X^2Sum[2 to 3]	14.84697128	11.95485615					
	df[2 and 3]	1						
	p(X^2)[2 to 3]	0.000116595						

Table CSMWM: 95% confidence limits of percent seismic moment means converge to those of the percent change in water moment in the dam era while those in the predam era diverge.						
Note:	For dry season, absolute values for the means are used with signs ignored.					
% Change in Water Moment	% SigniSM	% SigniSM	% SigniSM	% SigniSM	% SigniSM	% SigniSM
	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM
	Predam Era					
% WM	2000BC-1000 AD	1000 AD-1850 AD	1850 AD-1870 AD	1870 AD-1897 AD	1000 AD-1870 AD	1850 AD-1897 AD
95% Confidence limits for the mean						
Expected, E, E1	O	O	O	O	O	O
12.21954452	-0.809212517	5.871405	-2.0568859	7.385890163	1.9976128	0.133068737
21.11378881	34.14254585	27.461928	35.390219	25.94744317	31.33572	33.2002646
E	12.21954452	12.219545	12.219545	12.21954452	12.219545	12.21954452
E1	21.11378881	21.113789	21.113789	21.11378881	21.113789	21.11378881
(O-E)^2/E	13.89155788	3.2979032	16.679547	1.912036445	Chi-squared Test for higher confidence	
X^2 Sum	35.78104451	21.889487	18.591583		limit.	
df	3	2	1		Extremely significant.	
p[X^2]	8.33061E-08	1.765E-05	1.619E-05			
(O-E1)^2/E1	8.039699154	1.908652	9.6532398	1.106585592	Chi-squared Test for lower confidence	
X^2(O,E1)					limit.	
Sum	20.70817656	12.668477	10.759825			
df	3	2	1			
p[X^2(O,E1)]	0.000121037	0.0017745	0.0010373		Extremely significant.	
% Change in Water Moment	% SigniSM	% SigniSM	% SigniSM	% SigniSM	SM	% SigniSM
	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	1-9.9MM	5.5-9.9MM
	Dam Era					
% WM	AD					
	1897-1924	1924-51	1951-73	1973-01	1973-01	1870-01
95% Confidence limits for the mean						
E	O1	O1	O1	O1	O1	O1
12.21954452	9.992532466	8.2770567	9.2236321	11.54274793	11.940929	11.08583003
21.11378881	23.34080087	25.056277	24.109701	21.7905854	21.392404	22.24750331
E	12.21954452	12.219545	12.219545	12.21954452	12.219545	12.21954452
E1	21.11378881	21.113789	21.113789	21.11378881	21.113789	21.11378881
	1897-1924	1924-1951	1951-1973	1973-2001	1973-2001	Chi-squared Test for lower limit.
(O1-E)^2/E	0.40587296	1.2719958	0.7345193	0.037485327	0.0063526	
X1^2 Sum	2.45622606	2.0503531	0.7783573	0.043837975		
df	4	3	2	1		Statistically Means same.
p[X1^2]	0.652490979	0.5620218	0.6776132	0.834155351		
(O1-E1)^2/E1	0.234897808	0.7361639	0.4251009	0.021694525	0.0036766	Chi-squared Test for upper limit.
X1^2(O1,E1)Sum	1.421533765	1.186636	0.450472	0.025371102		
df	4	3	2	1		
p[X1^2]	0.840443842	0.7562113	0.7983278	0.873445845		Means same.

Table PDERA:		95% confidence limits of percent seismic moment means					
		converge to those of percent change in water moment in the dam era while they diverge away from them in the predam era.					
		Chi-squared sum for dam era:	0.580646777 ; p=		0.9651898		
		Chi-squared sum for predam era:	16.12977698 ; p=		0.001066583		
Note:		Dry season values are taken as negative.					
		<-----		Predam Era	----->		
		Percent	% Signi	% Signi	% Signi	% Signi	% Signi
		change in	SM	SM	SM	SM	SM
Month		water moment	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM
		% WM	-2150-1000	1000-1850	1850-1870	1870-1897	-2150-1870
Jun		19.18114803	4.0080679	15.207812	0.100516068	6.8431195	4.183317331
Jul		32.18708941	44.238805	36.120537	0.059192278	47.49577	12.17922048
Aug		28.57345556	50.57093	10.154274	99.74096005	32.30385	73.7587025
Sep		20.058307	1.1821978	38.517377	0.099331599	13.357261	9.878759686
Oct		-12.5	-0.1112129	-5.7880489	-1.77707175	-13.621154	-5.695391244
Nov		-12.5	-83.70043	-47.570128	-1.40713204	-1.1464574	-46.93857785
Dec		-12.5	-0.1570925	-2.7230561	-21.0971951	-0.1164066	-3.025066639
Jan		-12.5	-0.8833958	-0.8060146	-29.3355668	-3.0469034	-1.292353788
Feb		-12.5	-9.9118636	-7.7844326	-6.22882955	-14.907779	-7.767050279
Mar		-12.5	-0.1570925	-31.900757	-0.15771312	-28.268894	-31.22396015
Apr		-12.5	0	-1.2941993	-39.9557199	-9.8558626	-1.947260555
May		-12.5	-5.0789124	-2.1333633	-0.0407717	-29.036543	-2.110339497
mean		0	3.33E-10	-1.67E-10	-4.17E-10	-9.17E-10	-4.17E-10
sd		18.76336665	32.561267	24.330366	34.23763495	22.728456	28.59397034
95% CI		11.91633826	20.679182	15.451857	21.74381853	14.434508	18.15961012
		E	11.916338	11.916338	11.91633826	11.916338	11.91633826
X^2		(O-E)^2/E	6.4438783	1.0489712	8.104785744	0.5321418	3.271008476
X^2 Sum			16.129777	9.6858987	8.636927502		
df			3	2	1		
p[X^2Sum]			0.0010666	0.0078838	0.003294165		
r(%WM',y)			0.62785	0.7501529	0.581015024	0.874204	0.682504944
df			10	10	10	10	10
t			2.5508782	3.5873575	2.257460391	5.6933902	2.952970739
p			0.0288205	0.0049508	0.047573237	0.0002001	0.014460972
sd of %WM'			18.763367	18.763367	18.76336665	18.763367	18.76336665
F-Ratio			3.0114876	1.6814182	3.329553398	1.4672981	2.322348513
df			11	11	11	11	11
p(F-Ratio)			0.0404268	0.2010642	0.028929011	0.2677202	0.089001629

Table :DERA		95% confidence limits of percent seismic moment means					
		converge to those of percent change in water moment in the dam era					
		while they diverge away from them in the predam era.					
		Chi-squared sum for dam era:	0.580646777		; p=	0.9651898	
		Chi-squared sum for predam era:	16.12977698		; p=	0.001066583	
Note:	Dry season values are taken as negative.						
			Dam Era				
			←-----		-----→		
			%SigniSM	%SigniSM	%SigniSM	%SigniSM	SM
Month			5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	5.5-9.9MM	1-9.9MM
		%WM'	1897-1924	1924-1951	1951-1973	1973-2001	1973-2001
Jun		19.18114803	38.155221	39.153139	20.87185331	33.754051	31.24456372
Jul		32.18708941	11.582048	10.970867	37.02791101	25.229741	25.93976428
Aug		28.57345556	28.773062	44.499176	29.51518699	21.651809	22.08152837
Sep		20.058307	21.48967	5.3768178	12.58504869	19.3644	20.73414364
Oct		-12.5	-6.6705938	-6.7717006	-5.6933467	-18.865398	-18.20033833
Nov		-12.5	-16.721393	-17.496561	-28.7131261	-21.305558	-19.62905937
Dec		-12.5	-14.400419	-18.301748	-8.96932045	-8.6072169	-9.353921131
Jan		-12.5	-27.806947	-7.7622989	-6.62978594	-9.1599412	-10.35380797
Feb		-12.5	-6.5777774	-7.6174052	-6.50772488	-7.8896712	-8.329705482
Mar		-12.5	-3.8743962	-24.832413	-28.9847824	-10.353278	-10.53750693
Apr		-12.5	-15.037639	-5.4128228	-2.82958252	-9.8138915	-10.10059408
May		-12.5	-8.9108345	-11.80505	-11.672331	-14.005045	-13.49506672
mean		0	1.33E-09	6.67E-10	6.67E-10	7.50E-10	-2.50E-10
sd		18.76336665	20.333965	21.852687	20.98529504	19.186563	18.9314651
95%CI		11.91633826	12.913802	13.87832	13.32745232	12.185104	12.02309512
		E	11.916338	11.916338	11.91633826	11.916338	11.91633826
X^2		(O-E)^2/E	0.0834933	0.3230333	0.167101909	0.0060619	0.00095642
X^2	Sum		0.5806468	0.4971535	0.174120188	0.0070183	
df			4	3	2	1	
p[X^2Sum]			0.9651898	0.9195163	0.916622011	0.9332352	
r(%WM',y)			0.8596515	0.8277593	0.909184321	0.9385229	0.954873111
df			10	10	10	10	10
t			5.3211156	4.6652691	6.904744136	8.597116	10.16643478
p			0.0003372	0.0008872	4.17E-05	6.23E-06	1.37E-06
sd of %WM'			18.763367	18.763367	18.76336665	18.763367	18.76336665
F-Ratio			1.1744178	1.3564012	1.250859782	1.0456175	1.01799799
df			11	11	11	11	11
p(F-Ratio)			0.3972424	0.310922	0.358495313	0.4711774	0.488465441

THE SCALING PROCEDURE

THE NATURE OF THE INITIATING WATER MOMENTS : ON WHAT FAULTS ARE THE WATER MOMENTS INITIALLY EXERTED? THE SIGNIFICANCE OF THE MEAN VALUE OF THE EARTHQUAKE PARAMETER.

On account of the control exerted by the rate of change of water moment on the earthquake parameters, the mean hypocenter for a quake in any year as given by the latitude per quake, the longitude per quake and the depth per quake (determined as the sum of the values of the parameter under consideration divided by the number of earthquakes during the period) is used to derive values for the initiating or earthquake triggering water moment arms. On a two dimensional fractured surface map of the world (Cartographic Division, National Geographic Society, 1995) (Figure 2), the mean location for a quake in any given year is plotted and joined by a straight line to the center of gravity (CG) (23,78.75), of the water masses behind dams in India (See Appendix A for the derivation of the location of the center of gravity). This line is then extended upwards to meet the Himalayan Frontal Thrust (HFT) fault line in the north. In the south the line crosses the Owen Fractured Zone (OFZ) or the Carlsberg Ridge (CR) or the Mid- Indian Ridge (MIR). The two water-moment arms are then 1) CG-HFT and 2) CG-OFZ or CG-CR or CG-MIR. The total water moment arm for computation of the total rate of change of water moment is then HFT-OFZ or HFT -CR or HFT-MIR. These statements hold good for earthquakes in the range 5.5-9.9 MM during the period June 1973-May 2001. It is noteworthy that for this period of the study, the limits as shown in Figure 2 for these lines are a narrow band and they all intersect the Himalayan Frontal Thrust north of the center of gravity, CG and either of the three faults as mentioned above, south of it.

The initiating water moments from the scaling procedure.

Table 5 displays the data for earthquakes in the range 5.5 to 9.9 MM for the years 1973-74 to 2000-01. It shows how the water moments are computed which are acting on the faults which exhibit

a stick-slip behaviour resulting in earthquakes due to these water moments. This should be referred to in connection with Figure 2, which illustrates the situation created by the water moments and their changes due to the monsoon and the dry season. During the monsoon the reservoirs fill up increasing the bending stresses on the stick-slip faults resulting in earthquakes when the faults snap. During the dry season when water is being withdrawn for use, these moments are released resulting in stress relief and again consequent earthquake occurrence. A similar situation exists for the earthquakes in the range 1-9.9 MM resulting in ratios statistically indistinguishable to those for 5.5-9.9 MM quakes (Figure 3).

Computation of the rate of change of water moment for any year for worldwide earthquakes.

Let us first take the earthquakes in the range 5.5 to 9.9 MM. Let us take the year 1973 (See Table 5). Corresponding to the location, [(mean latitude, Las/Q , mean longitude, Los/Q)]=(4.27108, 60.7636), a line is drawn on a two dimensional fractured surface map, connecting this mean epicenter to the center of gravity, CG, of the water masses (23,78.75). This straight line passes through a point say MIR, on the Mid Indian Ridge below the centre of gravity, CG and meets the Himalayan Frontal Thrust fault, at say HFT, north of the CG. On the map (scale 1 inch=758 miles at the equator), these arms of the water moment CG-MIR and CG-HFT measure 6.7 cm and 2.1 cm respectively. The total of the two water moment arms (CG-MIR+CG-HFT) is 8.8 cm (called the total water moment arm and denoted by WMAT). The water moment arm above CG (above 23° N latitude), CG-HFT, is called WMA>23, for the arm meeting the Himalayan Frontal Thrust. This is entered in the column captioned WMA>23 and the value for the year 1973 is 2.1. The next column is the worldwide sum of the seismic moments in the range 5.5 to 9.9 MM for each year; for 1973, the value is $223.1 \times 10^{19.05}$ N-m. For all earthquakes worldwide occurring in latitudes >23° N latitude, the seismic moments in the range 5.5 to 9.9 MM are summed up and entered in the column marked SM>23. The value for 1973 is $90.6 \times 10^{19.05}$ N-m. The total rate of change of water moment for any year in Newton-meters is given by twice the product of the weight of water masses behind dams (in newtons) and the sum of the water moment arms north and south of the centre of gravity (CG) of the water masses in meters. This is because at the end of the monsoon the rate of change of water moment as measured by the total rainfall is a maximum equal to the total reservoir capacity in India. During the dry season, October to

May, this water is withdrawn for use, till the reservoirs are empty by the end of May. So the total rate of change of water moment during the dry season, October to June, is measured by the total water storage available at the end of the monsoon. This is also the total reservoir capacity because of the shortage of water on the Indian subcontinent. For comparing the effect of water storage capacities from year to year, however, the effective water moment arm from the centre of gravity of the water masses to the concerned fault must be factored in. The total rate of change of water moment in newton-meters/year for worldwide earthquakes for latitudes greater than lat, $WM'>lat$, and corresponding water moment arm, $WMA>lat$, for any year, is given by

$$WM'>lat = 2 * RC (Mha CIPE^*) [10^{10} m^2] * (Water\ application\ at\ canal\ head, 0.8m / Storage\ efficiency, 0.8)(m) [m^3] [10^3 kg] * 9.81 (msec^{-2}) [N] * WMA>lat (cm) / 2.54 (in) * 758 (miles) * 1.58 (km) * [10^3 m] N-m/year \quad (1)$$

$$= 9251.0617328 * 10^{16} * RC * WMA>lat \ N-m/year \quad (2)$$

$$= (9251.0617328 * 10^{16} / 10^{19.05}) * RC * WMA>lat * 10^{19.05} \ N-m/year \quad (3)$$

$$= 8.245017448 * RC * WMA>lat * 10^{19.05} \ N-m/year \quad (4)$$

Thus, for worldwide earthquakes for all latitudes and longitudes, if the total rate of change of water moment for any year is denoted by $WM'T$ and total water moment arm is $WMAT$, then

$$WM'T = 8.245017448 * RC * WMAT * 10^{19.05} \ N-m/year \quad (5)$$

And for worldwide earthquakes for latitudes >23 degrees,

$$WM'>23 = 8.245017448 * RC * WMA>23 * 10^{19.05} \ N-m/year \quad (6)$$

For the year 1973, RC is 20.7 Mha, WMAT=8.8 cm and WMA>23 is 2.1 cm; WM'T, from Equation (5) works out to $1502 * 10^{19.05}$ N-m and WM'>23, from Equation (6), becomes $358.41 * 10^{19.05}$ N-m.

An assumption is made for the reservoir efficiency of 0.8 and for the water application at canal head of 0.8m, for the purposes of this study. Still with Table 5, for 1973, ratio SMT/WM'T*100= $223.1/1502 * 100 = 14.853\%$. And SM>23/WM'>23*100= $90.6/358.41 * 100 = 25.291\%$. The various ratios of the seismic moment to rate of change of water moment are entered in Table 5 as T%, meaning SMT/WM'T%; >23% meaning the ratio SM>23/WM'>23%; the cumulative mean of the ratio SMT/WM'T% is CM T%; the cumulative mean of SM>23/WM'>23% is entered in the column CM>23%. The moment magnitude range of the earthquakes for which these ratio values are entered are indicated in the respective columns as either just 5.5-9.9 or just 1-9.9. The captions O1, O2 for the cumulative ratios indicate that those ratios are used as observed values in computing the chi-squared sums; similarly the caption E indicates that the ratio is the expected value in determining the chi-square values.

ANALYSIS OF CORRELATION OF EARTHQUAKES IN THE RANGE 1-9.9 MM WITH RATE OF CHANGE OF WATER MOMENT

The water moment arms for each year hit the Sagaing fault to the right of the center of gravity (23,78.75) and pass through the Murray Ridge to the left. The water moment arms, like for the 5.5-9.9 MM earthquakes, form a narrow cone on either side of the center of gravity. There is a clockwise shift in the cone by about 30 degrees from 5.5-9.9 MM epicenter line to the 1-9.9 MM epicenter line connecting the center of gravity (Figure 2, Table 7, Figure 5).

DANCE OF THE EARTHQUAKES IN SYNCHRONISM WITH THE HYDROLOGICAL CYCLE BECOMES TIGHTER WITH MORE DAMS COMMISSIONED ON THE INDIAN SUBCONTINENT: CHAOS.

With each annual hydrological cycle, the annual feature of the earth's response to the oscillatory rate of change of water moment is cyclically repeated. See the hold on the earthquake parameters

exercised by the rapidly increasing storages in the monsoon behind Indian dams and the occurrence of the earthquakes during the dry season when the water moments applied on the faults are released as the waters are drained from the dams (Figures 10-10b). The control becomes stronger as more and more dams are commissioned on the subcontinent of India as revealed by the closer correlation displayed by the earthquake parameters (Figure 1). Table 2 shows the logarithmic regression between the storages and the correlation between the percent seismic moment and percent change in water moment is $r=0.710$, 26 degrees of freedom with probability of the two-tailed t-distribution $2.2868E-05$ (June 1973- May 2001). The hypocenter and the number of quakes also show this attribute. That the control by the dams is plausible is also seen by the specific nature of the correlations connecting to the ground realities. The latitude mean for the earthquakes is that of the center of gravity, the location of which is on the earth's surface. Thus the power of the waves of bending stresses exerted by the dams is maximum at or near the earth's surface. Hence the 1-9.9 MM, June 1973 to May 2001 earthquakes have a mean depth of 6.57 km! (Tables 11a and b). The longitude can be all round the center of gravity because the moments are exerted all round. But see result 3: the longitude is shown to be constrained to a mean of 90 – the longitude of the center of gravity. This is for the range of reservoir capacities built so far! The nature of the earth is not, however, under the type of rigid control seen statistically, regarding the number of quakes, the latitude and the depth. The earth appears to finally decide on the timing of an earthquake, the longitude and the amount of seismic moment released during an earthquake (Table 12). Even here the control by the dams is indisputably statistically significant. Together with the quantification of the control of worldwide earthquakes with dam storages developed here, this brings out a characteristic feature of the observed phenomenon: Chaos. There is a disturbance pendulum which we recognize here as the rate of change of water moment. And there is a response pendulum -the worldwide earthquakes- characterized by their parameters as discussed above. The response pendulum, year after year, as the dams on the subcontinent increase, merges with the disturbing pendulum. The similarity to the synchronization of feedback responses described in Sarasola et al (2003) is striking (both created by man). The statistical results presented here have established by Student's t tests, the F-ratio test and Chi square analyses that the synchronization is effectively complete. A giant experiment in chaos has been unwittingly let loose on the earth by the dams by their gigantic waves of force and bending moment changes on faults every year.

CONCLUSIONS.

This paper furnishes statistically highly significant whole earth epidemiological evidence that dams in India are also causing worldwide earthquakes in the range 1-9.9 MM. The rates of change of water moment exerted on faults by the water masses behind dams cause shallow earthquakes to occur on account of the well-known stick-slip phenomenon. The ratio of the arms of the water moment on either side of the center of gravity of the water masses controls the ratio of the corresponding seismic moments in a persistent manner recurring with each hydrological cycle: the monsoons and the dry season of water withdrawal: the cumulative mean of the ratio of the annual sum of the seismic moments north of the center of gravity for 5.5-9.9 MM (east of the center of gravity for 1-9.9 MM) to the total annual sum converges to the mean of the corresponding ratio of the leverage arms of water moment. The monthly rates of change of water moment as measured by the monthly all India rainfall govern the number, location, depth and seismic moment magnitude and timing of the earthquakes occurring worldwide by causing the monthly sums of these parameters to be statistically highly significantly proportional to the corresponding rates of change of water moment (when expressed as percentages of the wet and dry season sums of the respective variables). This robust control of the earthquake parameters allows us the use of a scaling procedure for measuring the total annual rate of change of water moment as a function of the dam storage and the water moment arms. It turns out that the cumulative mean of the ratio of the annual seismic moment sum to the annual rate of change of total water moment converges to the stress relief ratio in rocks persistently with extreme statistical significance. The variations of the cumulative annual sums of the earthquake parameters are practically completely explained by the variations of the corresponding annual cumulative sums of the rapidly changing dam storages. The paper tests these results against the earthquake data for the pre-dam era and the transition to the era when dams exert significant control over earthquakes. There is no significant statistical correlation between water moment changes (monthly rainfall during monsoon and the rate of release of water moment during the dry season) and earthquake parameters in the pre-dam era or the incipient dam era contrasting with the results for the dam era (all values expressed in

percentages of the respective seasonal totals). The control over earthquakes by dams each hydrological year becomes stronger as more dams are commissioned in India with consequent increase in the effect of the monthly rains and the total monsoon rains in the same fixed time span (in 4 months of monsoon and 8 months of dry season) manifesting as increasing stress changes in rocks. Dry season earthquake parameters do not differ statistically significantly from the monsoon parameters. The displacements at the faults caused by the dams during the dry season are opposite in direction to those caused by the dams in the monsoon so that the net displacement is a comparatively smaller quantity, though substantial in absolute terms. There is a race between the dry season and the monsoon to establish ever-higher records of peak magnitude earthquakes, with the monsoon always lagging behind, time-wise as well as magnitude-wise. Because of the sudden huge gap of a net negative displacement caused by the great Andaman Basin earthquake of 9.4 MM on 26th December 2004, the coming months would see the reflection of this in the form of a series of strong and huge earthquakes in the monsoon(s) throughout the world. This is a giant global experiment set off by the dams resulting in a chaotic system, whereby the pendulum of the earthquakes synchronizes with the pendulum of the rate of change of water moment. This calls for a fresh approach to the harnessing of rainfall and for a reappraisal of dams.

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APPENDIX A

CENTRE OF GRAVITY OF STORED WATER BEHIND DAMS

A map of India was taken on a suitable scale, in this case it was 1 inch = 116 miles (National Geographic Society, 1997). The distances of the water bodies from Bhuj were measured and inserted into the equations :

$$X = \text{Sum}(S_i * X_i) / \text{Sum } S_i \quad (1)$$

$$Y = \text{Sum } (S_i * Y_i) / \text{Sum } S_i \quad (2)$$

Where

S_i = Storage of dams in state i , assumed to be located at the center of the state ;

X_i, Y_i are the x and y coordinates of the water bodies of state i from the origin taken to be Bhuj arbitrarily, and

X and Y are the coordinates of the centre of gravity of stored water behind all the dams in all the states.

Thus the center of gravity, CG , has latitude and longitude as given by:

$$\text{Latitude of CG} = \text{Latitude of Bhuj} + Y \quad (3)$$

$$\text{Longitude of CG} = \text{Longitude of Bhuj} + X \quad (4)$$

Referring to Table 58(Tata services Ltd., Department of Economics and Statistics, 1999) for the year 1998-99, we read off the total irrigation potential (IP) created up to 1993-94 for Major and Medium dams for the various states(a measure of the dam storages) and enter them into equations 1 and 2 above. We also enter into them the x and y coordinates from the origin- Bhuj, for the water bodies for each state as read off from the map :

We tabulate in the form of a table for convenience (Table A)

Thus the x and y values in equations 1 and 2 above are

$$x=12.5 \text{ and } y= -0.6$$

Thus from equations (3) and (4), with appropriate readings from the map referred to above, the Latitude of CG becomes

$$\text{Latitude of Bhuj} + 'y' = 23$$

And the longitude of CG becomes

$$\text{Longitude of Bhuj} + 'x' = 78.75$$

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TABLES AND FIGURES

Table A: To Determine the Coordinates of the Centre of Gravity of Water Masses behind Dams in India						
S.No.	State	Irrigation Potential (IP), mHa	Distance x from Bhuj in centimetres	(IP)I *(Xi) mHa-cm	Distance y from Bhuj in cm	(IP)I * (Yi) mHa-cm
1	Andhra Pradesh	3.1	12.5	38.75	-9	-27.9
2	Assam	0.2	30.5	6.1	5	1
3	Bihar	2.8	23	64.4	0	0
4	Gujarat	1.4	2	2.8	-2	-2.8
5	Haryana	2.1	9	18.9	10	21
6	Jammu, Kr	0.2	9	1.8	17	3.4
7	Karnataka	1.5	6.5	9.75	-12	-18
8	Kerala	0.6	10	6	-23	-13.8
9	Madhya Ph	2.1	6	12.6	-2.5	-5.25
10	Maharashtra	2.2	6	13.2	-8.5	-18.7
11	Orissa	1.5	22	33	-6	-9
12	Punjab	2.4	9	21.6	13	31.2
13	Rajasthan	2.1	8	16.8	3	6.3
14	Tamilnadu	1.5	12	18	-19	-28.5
15	Uttar Prad	7	15	105	6	42
16	West Beng	1.3	25	32.5	0	0
17	Sum1-16	32.1		401.2		-19.05
18	Center of gravity			12.49844		-0.593457944
				say 12.5		say -0.6

Table 1: The earthquake parameters correlate in linear regression statistically highly significantly with the monthly rate of change of water moment(WM').Note that the probabilities for longitude and seismic moment are two to three orders of magnitude order lower. Here Las1-9.9 means latitude sum for earthquakes in the range 1-9.9 MW; Los: Longitude sum; Des: Depth sum; SM: Seismic Moment sum, Q : Sum of Number of earthquakes. In this table the wet season values (June to September) are expressed as a percentage of the wet season sum and the dry season values(October to May) as a percentage of the dry season sum(June 1973 to May 2001).

		<----- Jun73-May01 ----->					Jan2001-Dec 2004
	WM'	Las1-9.9	Los1-9.9	Des1-9.9	SM1-9.9	Q1-9.9	Focal mechanisms
Month	Percent	Percent	Percent	Percent	Percent	Percent	Percent 5-9.9
6	19.18114803	25.42986617	29.04957	24.4383773	31.2451848	24.91238	25.5
7	32.18708941	26.66360151	24.84778	25.3360206	25.9395297	26.4197	23.5
8	28.57345556	24.43044066	27.22736	26.23777	22.0813287	24.93365	26.5
9	20.058307	23.47609165	18.87528	23.987832	20.7339567	23.73427	24.5
10	12.5	12.12862259	7.982095	12.6295986	18.2035468	12.2655	14.76453
11	12.5	11.29750294	14.33362	12.4261381	19.6325319	12.1514	12.72804
12	12.5	12.68389596	16.43708	12.3456456	9.3555779	12.21937	13.61901
1	12.5	12.63354116	10.07876	12.3739602	10.3443365	12.55875	14.76453
2	12.5	11.08680391	16.97644	11.0865475	8.32201589	11.43527	11.7098
3	12.5	13.2315746	12.87241	12.7234595	10.5450661	12.93162	9.843021
4	12.5	12.96814854	13.20952	13.0419484	10.1004953	12.85442	11.03097
5	12.5	13.96991029	8.11007	13.3727022	13.4964296	13.58366	11.54009
r with %WM'		0.897472613	0.782377	0.90414428	0.69383108	0.907159	0.839442961
df		10	10	10	10	10	10
t		6.434480691	3.972493	6.6923524	3.04675937	6.817415	4.884648921
p		7.49472E-05	0.002633	5.4158E-05	0.01231965	4.64E-05	0.000637527
tails		2	2	2	2	2	2

Table 2: The correlation coefficients of linear regression of the monthly cumulative sums of each earthquake parameter in the range 1-9.9 MM for each year during the period June 1973 to May 2001 displays a logarithmic relation with the annual cumulative reservoir storages of dams(Cum RC) in India. This points towards the fact that the rate of change of water moment as measured by the monthly rainfall on India seen above to be persistently governing worldwide earthquakes is caused by the dam storages. The logarithmic relation is given by $y=b +m* \ln$ Cum RC, where CumRC is the annual cumulative sum of the total of the reservoir storage capacities in India in Mha CIPE,m is the slope and b the intercept. Mha CIPE stands for million hectares of created irrigation potential equivalent(Figure 1).

	Las1-9.9	Los1-9.9	Des1-9.9	SM1-9.9	Q1-9.9
	Percent	Percent	Percent	Percent	Percent
LR,r(LnCumRC,y)	0.94959924	0.960344824	0.85283204	0.710343174	0.942532012
t	15.44670374	17.56295943	8.3277086	5.146018842	14.38419938
p	1.2943E-14	6.09219E-16	8.2644E-09	2.2868E-05	6.84506E-14
m	0.155835925	0.292475168	0.05846966	0.128203311	0.045944284
b	-0.12572784	-1.123686124	0.51765386	-0.00537991	0.606779505

Table 3: The F-Ratio Test for the earthquake period June 1973 to May 2001 for the variables of Table 1 shows that they all come from the same parent population.

F-Ratio Test		<-----Jun73-May01----->					Jan2001-Dec 2004
	'WM'	Las1-9.9	Los1-9.9	Des1-9.9	SM1-9.9	Q1-9.9	Focal mechanisms
	Percent	Percent	Percent	Percent	Percent	Percent	Percent 5-9.9
sdp	6.704288885	5.977829952	6.835269	5.93688393	7.12527795	5.938399	4.751519608
F		1.257819507	1.039455	1.27565912	1.12953107	1.274579	1.419626721
pF		0.355151071	0.474991	0.34671547	0.42175943	0.347221	0.272681978
df	11	11	11	11	11	11	11

Table 4 There is no statistically significant correlation between the percent change of water moment and percent significant seismic moment for significant earthquakes of 5.5-9.9 MW for the Pre-Dam Era.									
The percent change of water moment exerts significant control over the earthquakes in the dam era 1951 and beyond.									
		PRE-DAM ERA		Transition to	Effective	Dam Era	<-----	DAM-ERA	----->>
		5.5-9.9 MW		5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	5.5-9.9 MW	1-9.9MW
		%SignificantSM		%SignificantSM	%SignificantSM	%SignificantSM	%SignificantSM	%SignificantSM	%SM
Month	%WVM'	2150BC-1850AD	1850-1897	1897-1924	1924-1951	1951-1973	1973-2001	1973-2001	1973-2001
1 Jun	19.18115	12.82911503	0.462971363	38.15522086	39.15313935	20.87185331	33.75405051	31.2445637	
2 Jul	32.18709	37.84476361	2.609192233	11.58204751	10.97086717	37.02791101	25.22974085	25.9397643	
3 Aug	28.57346	18.73830645	96.11581177	28.77306185	44.49917571	29.51518699	21.65180873	22.0815284	
4 Sep	20.05831	30.58781491	0.812024639	21.48966979	5.376817778	12.58504869	19.36439992	20.7341436	
5 Oct	12.5	5.76329752	9.150805849	6.67059375	6.771700615	5.693346701	18.86539812	18.2003383	
6 Nov	12.5	47.7276587	1.244844619	16.72139337	17.4965605	28.71312609	21.30555751	19.6290594	
7 Dec	12.5	2.711868358	8.035249714	14.40041866	18.30174808	8.96932045	8.607216924	9.35392113	
8 Jan	12.5	0.806352035	12.96911401	27.80694675	7.762298905	6.629785936	9.159941212	10.353808	
9 Feb	12.5	7.79370835	11.63205653	6.577777401	7.617405162	6.507724876	7.889671167	8.32970548	
10 Mar	12.5	31.76235247	17.65880489	3.87439616	24.83241348	28.98478242	10.35327841	10.5375069	
11 Apr	12.5	1.288556507	21.21654378	15.03763942	5.412822788	2.829582519	9.813891458	10.1005941	
12 May	12.5	2.146206057	18.09258061	8.910834483	11.80505047	11.672331	14.0050452	13.4950667	
r	(%WVM',y)	0.420360106	0.385072433	0.339124442	0.393238715	0.669767715	0.616720358	0.69393353	
p[r]		0.173636053	0.216427836	0.28087183	0.206008219	0.017183906	0.032682671	0.01230142	

Table 5: Dynamics of Worldwide Earthquakes initiated by Dams in India(5.5-9.9 MVV:June1973-May2001)															
Year	RC	Cum RC	Las/Q	Los/Q	T	>23	SMT	>23 SM	WMT	WM>23	T,%	>23,%	CMT%	CM>23%	CMT%
5.5-9.9	Mha,CIPE	Mha,CIPE	5.5-9.9	5.5-9.9	WMA	WMA	5.5-9.9MW	5.5-9.9MW	8.2450174	8.24501745	SM/WM'	SM/WM'	SM/WM'	SM/WM'	SM/WM'
MM			deg	deg	cm	cm	v*10E19.05	v*10E19.05	*RC*WMA	*RC*	5.5-9.9	5.5-9.9	5.5-9.9	5.5-9.9	1-9.9
Jun73							N-m	N-m		WMA>23			=O1	=O2	=E
to									v*10E19.05	v*10E19.05					
May01									N-m	N-m		Mean	20.20952	21.311	21.796
1973	20.7	20.7	4.27108	60.7636	8.8	2.1	223.08215	90.646	1501.9124	358.410908	14.853207	50.58217	14.85321	25.2911	16.011
1974	21.635	42.335	5.91225	34.6673	7.7	2.45	391.81859	225.56	1373.5333	437.033334	28.526326	103.2232	21.68977	38.4514	21.61
1975	22.612	64.946	2.56412	42.128	8.6	2.3	598.08476	38.95	1603.3525	428.803569	37.302138	18.16683	26.89389	28.662	28.172
1976	23.633	88.579	1.49028	54.5326	8.8	2.05	493.61126	146.7	1714.7196	399.45172	28.786705	73.45068	27.36709	30.6779	28.827
1977	24.7	113.279	0.57267	42.0118	8.4	2.1	280.05053	73.01	1710.6762	427.669055	16.37075	34.14322	25.16783	27.9566	26.507
1978	25.638	138.917	2.96519	43.6474	8.5	2.2	437.36905	144.4	1796.7789	465.048666	24.34184	62.10103	25.03016	28.4723	26.593
1979	26.595	165.512	2.99133	39.9532	8.1	2.3	382.78478	52.18	1776.1375	504.33535	21.551528	20.69258	24.53321	25.8828	26.292
1980	27.248	192.759	0.71	53.616	8.8	2	321.41414	69.04	1977.0101	449.320471	16.257587	30.73085	23.49876	24.5682	25.275
1981	27.911	220.671	0.55948	43.7622	8.5	2.1	210.30721	49.34	1956.0768	483.266032	10.75148	20.41939	22.0824	22.9728	23.757
1982	28.591	249.261	0.06491	24.5477	8	2.5	271.85867	76.18	1885.8664	589.333235	14.415585	25.85295	21.31571	21.9681	22.918
1983	29.287	278.548	2.48568	36.8905	8.1	2.3	184.77265	52.24	1955.9218	555.3852	9.4468323	18.81217	20.23673	20.8261	21.779
1984	30	308.548	-0.91211	28.3372	8.2	2.35	166.79644	16.38	2028.2743	581.27373	8.2235641	5.635899	19.23563	19.3255	20.716
1985	30.226	338.774	3.47925	26.1107	8.5	2.65	390.76154	103.98	2118.3181	660.416828	18.446782	31.4892	19.17495	19.05	20.76
1986	30.454	369.229	-1.04604	18.2341	7.9	2.35	447.46245	70.27	1983.6407	590.070339	22.557636	23.8175	19.41657	18.5399	20.972
1987	30.684	397.913	0.45058	24.9997	7.9	2.6	214.87811	75.7	1998.6219	657.7743	10.751314	23.01701	18.83888	18.0712	20.365
1988	30.915	430.83	1.1417	40.737	8.5	2.2	305.7766	26.03	2166.6051	560.768372	14.113167	9.28369	18.54353	17.2318	20.141
1989	31.149	461.978	4.43582	49.4022	8.7	2.2	159.78778	39.33	2234.3692	565.012907	7.1513598	13.92181	17.8734	16.6277	19.491
1990	31.384	493.362	3.08612	38.2778	8.2	2.4	192.63849	71.28	2121.8453	621.027906	9.0788184	22.95549	17.38481	16.3415	19.017
1991	31.621	524.983	8.43722	48.4235	8.1	2.3	142.4336	46.95	2111.7971	599.646102	6.7446628	15.65924	16.8248	15.8936	18.445
1992	31.86	556.843	0.81596	25.2275	7.6	2.45	225.2181	92.56	1996.4155	643.581327	11.281123	28.76404	16.54762	15.818	18.14
1993	32.1	588.943	1.88985	32.5836	8.1	2.35	420.29082	74.88	2143.787	621.962891	19.605064	24.07861	16.69321	15.638	18.381
1994	32.332	621.275	3.13337	61.8991	8.9	2	967.54601	404.11	2372.5433	533.155808	40.780963	151.5917	17.78811	18.3725	19.773
1995	32.565	653.84	2.67107	41.5142	8.35	2.2	795.88584	113.87	2241.9666	590.697785	35.499451	38.5544	18.55817	18.4118	20.565
1996	32.8	686.64	6.43584	36.842	7.8	2.55	462.95621	163.41	2109.4053	689.613259	21.947239	47.39178	18.69938	18.632	20.615
1997	33.037	719.676	0.21631	26.784	8	2.25	695.79388	150.29	2179.1251	612.878943	31.929965	49.04394	19.2286	18.8676	21.119
1998	33.275	752.971	-0.22112	37.614	8.7	2.2	413.07432	27.66	2386.8707	603.576502	17.306104	9.165367	19.15466	18.3182	21.066
1999	33.515	786.467	1.94442	27.6904	7.6	2.05	351.20118	52.65	2100.1214	566.480108	16.722899	18.58847	19.0646	17.9839	20.921
2000	33.757	820.224	1.83012	55.9014	8.5	1.9	1183.7862	76.2	2365.78	528.821403	50.037882	28.8188	20.17078	17.8563	22.046

Table 6		Worldwide earthquakes 5.5 to 9.9 MM: June 1973 to May 2001: The annual cumulative mean of the ratio of seismic moments (SM>23/SMT) % converges to the corresponding ratio of the water moment arms (VMA>23/VMAT) %															
Year	RC	Cum RC	Las/Q	Los/Q	T	>23	SMT	>23 SM	Mean	Mean	Fig. 4						
5.5-9.9 MWV	Mha, CIPE	Mha, CIPE	5.5-9.9 deg	5.5-9.9 deg	cm	cm	5.5-9.9MWV $\sqrt{10E19.05}$	5.5-9.9MWV $\sqrt{10E19.05}$	(VMA>23/ (SM>23/ (VMA>23/ (SM>23/	(VMA>23/ (SM>23/ (VMA>23/ (SM>23/	(O-E)^2/E	X^2	df	%p[X^2]			
Jun73 to May01							N-m	N-m	=E	=O							
1973	20.7	20.7	4.27108	60.7636	8.8	2.1	223.08215	90.646	23.863636	40.633461	23.863636	40.63346	11.78475	37.0931	27	9.3343317	
1974	21.635	42.335	5.91225	34.6673	7.7	2.45	391.81859	225.56	31.818182	57.5674571	27.840909	49.10046	16.23397	25.3083	26	50.158107	
1975	22.612	64.946	2.56412	42.128	8.6	2.3	598.08476	38.95	26.744186	6.51245488	27.475335	34.90446	2.008779	9.07435	25	99.849522	
1976	23.633	88.579	1.49028	54.5326	8.8	2.05	493.61126	146.7	23.295455	29.7197434	26.430365	33.60828	1.949366	7.06557	24	99.96862	
1977	24.7	113.279	0.57267	42.0118	8.4	2.1	280.05053	73.01	25	26.0702955	26.144292	32.10068	1.35703	5.11621	23	99.996522	
1978	25.638	138.917	2.96519	43.6474	8.5	2.2	437.36905	144.4	25.882353	33.0155963	26.100635	32.25317	1.450296	3.75918	22	99.999532	
1979	26.595	165.512	2.99133	39.9532	8.1	2.3	382.78478	52.18	28.395062	13.6316808	26.42841	29.59296	0.378923	2.30888	21	99.99987	
1980	27.248	192.759	0.71	53.616	8.8	2	321.41414	69.04	22.727273	21.4800755	25.965768	28.57885	0.262968	1.92996	20	99.99992	
1981	27.911	220.671	0.55948	43.7622	8.5	2.1	210.30721	49.34	24.705882	23.4609169	25.825781	28.01019	0.184762	1.66699	19	99.99993	
1982	28.591	249.261	0.06491	24.5477	8	2.5	271.85867	76.18	31.25	28.0219134	26.368203	28.01136	0.102395	1.48223	18	99.99999	
1983	29.287	278.548	2.48568	36.8905	8.1	2.3	184.77265	52.24	28.395062	28.2725824	26.552463	28.03511	0.082788	1.37983	17	99.99981	
1984	30	308.548	-0.91211	28.3372	8.2	2.35	166.79644	16.38	28.658537	9.82035373	26.727969	26.51721	0.001662	1.29704	16	99.99995	
1985	30.226	338.774	3.47925	26.1107	8.5	2.65	390.76154	103.98	31.176471	26.6095791	27.070161	26.52432	0.011006	1.29538	15	99.999845	
1986	30.454	369.229	-1.04604	18.2341	7.9	2.35	447.46245	70.27	29.746835	15.7041111	27.261352	25.75144	0.083628	1.28437	14	99.999489	
1987	30.684	397.913	0.45058	24.9997	7.9	2.6	214.87811	75.7	32.911392	35.2292744	27.638022	26.3833	0.056962	1.20075	13	99.998845	
1988	30.915	430.83	1.1417	40.737	8.5	2.2	305.7766	26.03	25.882353	8.51275085	27.528292	25.26639	0.185852	1.14378	12	99.997016	
1989	31.149	461.978	4.43582	49.4022	8.7	2.2	159.78778	39.33	25.287356	24.613897	27.396473	25.22801	0.171637	0.95793	11	99.995951	
1990	31.384	493.362	3.06612	38.2778	8.2	2.4	192.63849	71.28	29.268293	37.0019518	27.500463	25.88212	0.095236	0.78629	10	99.994351	
1991	31.621	524.983	8.43722	48.4235	8.1	2.3	142.4336	46.95	28.395062	32.9627289	27.547547	26.25478	0.060668	0.69106	9	99.987918	
1992	31.86	556.843	0.81596	25.2275	7.6	2.45	225.2181	92.56	32.236842	41.0979408	27.782012	26.99694	0.022185	0.63039	8	99.967998	
1993	32.1	588.943	1.88985	32.5836	8.1	2.35	420.29082	74.88	29.012346	17.8162351	27.840599	26.55976	0.058926	0.60821	7	99.894598	
1994	32.332	621.275	3.13337	61.8991	8.9	2	967.54601	404.11	22.47191	41.766489	27.596568	27.25098	0.004328	0.54928	6	99.718612	
1995	32.565	653.84	2.67107	41.5142	8.35	2.2	795.88584	113.87	26.347305	14.3073284	27.542252	26.68821	0.026483	0.54495	5	99.038476	
1996	32.8	686.64	6.43584	36.842	7.8	2.55	462.95621	163.41	32.892308	35.2970745	27.756837	27.04691	0.018157	0.51847	4	97.167829	
1997	33.037	719.676	0.21631	26.784	8	2.25	695.79388	150.29	28.125	21.5997875	27.771564	26.82903	0.031989	0.50031	3	91.882297	
1998	33.275	752.971	-0.22112	37.614	8.7	2.2	413.07432	27.66	25.287356	6.69613152	27.676018	26.05469	0.094982	0.46832	2	79.123408	
1999	33.515	786.467	1.94442	27.6904	7.6	2.05	351.20118	52.65	26.973684	14.9914075	27.650005	25.64493	0.1454	0.37334	1	54.118874	
2000	33.757	820.224	1.83012	55.9014	8.5	1.9	1183.7862	76.2	22.352941	6.43697322	27.460824	24.95894	0.227941		0		

Table 7 : Worldwide Earthquakes 1-9.9 MM : June 1973 to May 2001.																
Convergence of Seismic Moment to Rate of Change of Water Moment Ratios CM(SM/WM%78.75-180 Lo) and CM(SM/WM%T).															Fig. 5	
Sg'gFit : Sagaing fault																
Year	RC	Cum RC	1-9.9 Las/Q	1-9.9 Los/Q	WMA T cm	WMA CG- Sg'gFit cm	WMT <----- V^10E19.05 N-m	WM' CG-Sg'gFit	SM	SM78.75 to 180 Lo	SM/WM% >78.75Lo	SM/WM% T	E: CM(SM/WM%	O: (CM SM/WM%	X^2	% p[X^2]
1973	20.7	20.7	13.51975	25.09059	8.5	4.5	1450.7	768.0233753	232.276	154.9177	20.170962	16.01117	16.011166	20.170962	13.0987	98.86
1974	21.64	42.335	15.909	8.962967	8	4.3	1427	767.0380957	400.756	78.833	10.277586	28.08285	21.610377	15.224274	12.0179	99.107
1975	22.61	64.946	18.13651	20.12573	7.9	4.2	1472.8	783.032605	608.22	188.8723	24.120618	41.29552	28.172092	18.189722	10.1308	99.629
1976	23.63	88.579	14.55155	23.9768	8.4	4.4	1636.8	857.3597883	504.016	424.5975	49.523841	30.79316	28.82736	26.023252	6.59365	99.983
1977	24.7	113.279	15.24443	14.41119	8.1	4.35	1649.6	885.8858997	291.129	197.2369	22.264368	17.64865	26.591619	25.271475	6.32089	99.977
1978	25.64	138.917	20.30073	18.11783	7.5	4.2	1585.4	887.8201808	445.617	133.5189	15.038958	28.10767	26.844293	23.566055	6.25535	99.959
1979	26.6	165.512	19.73825	-0.15235	7.5	4.35	1644.6	953.8516398	391.96	145.5763	15.261944	23.83355	26.414187	22.379754	5.85501	99.953
1980	27.25	192.759	17.82875	12.17098	7.85	4.25	1763.6	954.8060005	330.378	250.1896	26.203187	18.73333	25.45408	22.857683	5.2388	99.96
1981	27.91	220.671	15.80564	22.38664	8.2	4.4	1887	1012.557401	219.07	50.6976	5.0068865	11.60919	23.915759	20.874261	4.97396	99.945
1982	28.59	249.261	18.82904	12.79488	7.7	4.2	1815.1	990.0798342	282.555	185.3152	18.717198	15.56652	23.080835	20.658555	4.58716	99.937
1983	29.29	278.548	19.84274	18.82847	7.65	4.3	1847.3	1038.328852	195.768	83.1752	8.0104872	10.59777	21.946011	19.50873	4.33295	99.912
1984	30	308.548	16.89818	14.54217	8	4.3	1978.8	1063.607251	178.562	62.1847	5.8465848	9.02375	20.869156	18.370218	4.06227	99.879
1985	30.23	338.774	21.18443	14.60083	7.5	4.15	1869.1	1034.237674	403.142	107.8048	10.4236	21.56872	20.922969	17.75894	3.76304	99.842
1986	30.45	369.229	17.94154	3.94768	7.7	4.2	1933.4	1054.593798	458.822	128.1354	12.150214	23.73106	21.123547	17.358317	3.28456	99.845
1987	30.68	397.913	20.1235	10.19614	7.5	4.15	1897.4	1049.908979	225.178	120.4376	11.471242	11.86755	20.50648	16.965845	2.61342	99.901
1988	30.92	430.83	23.31206	18.11514	7.2	4.05	1835.2	1032.323593	316.532	268.1648	25.976816	17.24743	20.302789	17.529031	2.00209	99.94
1989	31.15	461.978	24.52496	18.63424	7	4	1797.8	1027.296194	170.46	110.7875	10.784378	9.481728	19.666256	17.132286	1.62314	99.944
1990	31.38	493.362	25.0929	16.35161	7	4	1811.3	1035.04651	204.185	107.0423	10.341786	11.27264	19.199945	16.755036	1.29665	99.944
1991	31.62	524.983	23.97914	6.530416	7	4	1825	1042.862787	152.769	100.6847	9.654645	8.370842	18.629992	16.381332	0.98531	99.947
1992	31.86	556.843	21.96223	-3.69438	7.25	4	1904.5	1050.745024	236.76	104.8986	9.9832593	12.43175	18.32008	16.061428	0.7139	99.949
1993	32.1	588.943	25.94145	-0.01682	7	4	1852.7	1058.66024	429.974	342.1599	32.320086	23.20851	18.552862	16.83565	0.43543	99.965
1994	32.33	621.275	22.84814	13.98992	7.15	3.95	1906	1052.982721	979.918	605.8346	57.535094	51.4114	20.046432	18.685625	0.27649	99.96
1995	32.57	653.84	19.10354	21.86019	7.75	4.15	2080.9	1114.270822	805.772	502.0536	45.056694	38.72292	20.858453	19.832193	0.18412	99.928
1996	32.8	686.64	16.83351	16.12553	8.05	4.25	2177	1149.355432	473.673	224.71	19.550958	21.75792	20.895931	19.820475	0.13362	99.787
1997	33.04	719.676	18.5539	8.361654	7.8	4.25	2124.6	1157.660226	705.455	544.6691	47.049133	33.20341	21.38823	20.909621	0.07827	99.431
1998	33.28	752.971	17.3129	5.198964	7.8	4.15	2140	1138.564766	422.406	380.9255	33.456639	19.73902	21.324799	21.392199	0.06756	96.678
1999	33.52	786.467	19.51357	2.625578	7.6	4	2100.1	1105.327039	360.691	211.606	19.144198	17.17476	21.171093	21.308939	0.06735	79.524
2000	33.76	820.224	16.46943	20.90288	8.1	4.25	2254.4	1182.889979	1195.8	986.6696	83.411781	53.04175	22.309331	23.526898	0.06645	

Table 8		Worldwide Earthquakes 1-9.9 MW June 1973 to May 2001						As reservoir capacity builds up on the subcontinent, the worldwide Ratio of Seismic Moment to Rate of Change of Water Moment becomes identical to the stress relieved ratio in rocks. The surge of stress build up in rocks is the result of a surge wave of force and of bending moment caused by the rapid build up of water masses behind dams in the monsoon and their surge wave of release during the dry season. The result is a surge of earthquakes as an annual feature. See Figure 5						
		WMA stands for the distance to the annual mean cumulative coordinates of the hypocenter from the centre of gravity of the water masses.						WVM'		Stress		Chi-squared		
								=8.245*		Relief		Values		
								Mean CRC		Ratio				
								*WMA		SM		CSM		
								v ⁴ 10 ¹⁹ 9.05		v ⁴ 10 ¹⁹ 9.0		v ⁴ 10 ¹⁹ 9.05%CSM/		
								Nm		Nm		WVM'		
								in		X ²		%p(X ²)		
S.No	Year	RC	Cum RC	Cum RC	JMLas.	JMLos/Q	WMA	v ⁴ 10 ¹⁹ 9.05	v ⁴ 10 ¹⁹ 9.0	v ⁴ 10 ¹⁹ 9.05%CSM/	rocks	X ²	%p(X ²)	
		<-----	mHa CIPE	----->	1-9.9	1-9.9	cm	Nm	Nm	Nm	%			
1	1973	20.7	20.7	10.35	13.52	25.09059	12.85	1096.564388	232.276	232.2757	21.182132	19.743	19.610339	84.670397
2	1974	21.635	42.335	31.5175	14.74	16.83091	14.4	3742.00974	400.756	633.0313	16.916881	19.743	19.505436	81.43959
3	1975	22.612	64.946	42.66033	15.94	17.99577	14.2	4994.629166	608.22	1241.251	24.851719	19.743	19.10089	79.225757
4	1976	23.633	88.579	54.14	15.6	19.48723	14	6249.3802	504.016	1745.267	27.927039	19.743	17.778953	81.359788
5	1977	24.7	113.279	65.9678	15.52	18.40415	14.2	7723.444056	291.129	2036.396	26.366419	19.743	14.386434	91.52688
6	1978	25.638	138.917	78.126	16.26	18.36011	14.1	9082.499067	445.617	2482.013	27.32742	19.743	12.164397	95.389039
7	1979	26.595	165.512	90.60971	16.89	14.98656	14.7	10982.03329	391.96	2873.972	26.169767	19.743	9.2507854	98.709963
8	1980	27.248	192.759	103.3784	17.02	14.58618	14.7	12529.61412	330.378	3204.35	25.574214	19.743	7.1587361	99.613108
9	1981	27.911	220.671	116.4109	16.87	15.57542	14.6	14013.19357	219.07	3423.42	24.429979	19.743	5.4364521	99.896035
10	1982	28.591	249.261	129.6959	17.12	15.21795	14.6	15612.40335	282.555	3705.975	23.73738	19.743	4.3237655	99.958515
11	1983	29.287	278.548	143.2279	17.43	15.63138	14.6	17241.34601	195.768	3901.744	22.630157	19.743	3.5156275	99.978662
12	1984	30	308.548	157.0046	17.37	15.50488	14.6	18899.74073	178.562	4080.306	21.589217	19.743	3.0934183	99.979194
13	1985	30.226	338.774	170.9868	17.84	15.39327	14.7	20723.86223	403.142	4483.448	21.634229	19.743	2.9207739	99.965949
14	1986	30.454	369.229	185.147	17.85	14.21189	14.75	22516.42097	458.822	4942.269	21.949623	19.743	2.7396085	99.945178
15	1987	30.684	397.913	199.3314	18.06	13.83675	14.85	24405.78779	225.178	5167.447	21.173041	19.743	2.4929801	99.923162
16	1988	30.915	430.83	213.8001	18.55	14.22875	14.7	25912.88828	316.532	5483.979	21.163135	19.743	2.3893983	99.85326
17	1989	31.149	461.978	228.3988	19.1	14.64056	14.75	27776.43027	170.46	5654.439	20.356968	19.743	2.2872465	99.720535
18	1990	31.384	493.362	243.1189	19.67	14.80336	14.65	29366.15496	204.185	5858.624	19.950259	19.743	2.2681533	99.384116
19	1991	31.621	524.983	257.9539	20.08	14.02492	14.65	31158.05748	152.769	6011.393	19.29322	19.743	2.2659776	98.65298
20	1992	31.86	556.843	272.8984	20.27	12.20896	15.1	33975.70813	236.76	6248.152	18.390057	19.743	2.2557308	97.21509
21	1993	32.1	588.943	287.9481	20.86	10.94759	15	35611.98068	429.974	6678.126	18.75247	19.743	2.1630167	95.026928
22	1994	32.332	621.275	303.0993	21.04	11.22547	15	37485.80818	979.918	7658.044	20.429181	19.743	2.1133206	90.898692
23	1995	32.565	653.84	318.3489	20.86	12.20738	14.9	39109.32314	805.772	8463.816	21.641428	19.743	2.0894719	83.663155
24	1996	32.8	686.64	333.6944	20.57	12.48955	14.75	40581.8243	473.673	8937.489	22.023379	19.743	1.9069247	75.28728
25	1997	33.037	719.676	349.1336	20.42	12.19001	15.1	43466.96361	705.455	9642.944	22.184536	19.743	1.6435337	64.955963
26	1998	33.275	752.971	364.6658	20.2	11.68566	15	45100.04852	422.406	10065.35	22.317825	19.743	1.3415988	51.129968
27	1999	33.515	786.467	380.2881	20.16	11.13558	15.1	47345.67969	360.691	10426.04	22.021103	19.743	1.0057975	31.591203
28	2000	33.757	820.224	396.0001	19.91	11.79704	15.1	49301.81534	1195.8	11621.84	23.572844	19.743	0.7429321	

Table 9 : Dry Season Water withdrawal causes earthquakes whose parameters are a mirror reflection of those for the monsoon.									
		1-9.9MM, June 1973 to May 2001							
Month	Mean Inflow to Reservoir	Jun73-May01 Monthly build-up	Mean Monthly build-up	Force on fault =F	1-9.9 Displacement SM/Q/F	1-9.9 Des/Q/F km/Q/N*	1-9.9 Las/Q/F Degrees/Q/N*	1-9.9 Los/Q/F Degrees/Q/N*	1-9.9 Q/F Q/N*
	% Rain/100*	Mean Cum RC 1973-01	/discharge /discharge			10 ^{-19.05}	10 ^{-19.05}	10 ^{-19.05}	10 ^{-19.05}
Monsoon	Mha CIPE	Mha CIPE	Mha CIPE	√19.05N	m	√1E2	√1E2	√1E2	√1E6
		X			Y1	Y2	Y3	Y4	Y5
June	75.95734622	75.95734622	37.97867311	0.000332054	147.1720328	195.327928	597.7025561	399.0085482	74.06324138
July	127.4608741	203.4182203	139.6877832	0.001221314	31.32369027	51.91573586	160.6676647	87.49812773	21.35486382
Aug	113.150884	316.5691043	259.9936623	0.002273169	15.18006856	30.6073153	83.8066881	54.58261191	10.82805436
Sep	79.43089571	396	356.2845521	0.003115057	10.92713714	21.45186192	61.73747323	29.00801129	7.521531674
Dry season									
Oct	49.5	49.5	24.75	0.000216393	-258.90944	-311.9283519	-919.9048131	-361.0476001	-116.7456511
Nov	49.5	99	74.25	0.00064918	-93.9519293	-103.2616359	-288.3044812	-218.1428069	-38.55322216
Dec	49.5	148.5	123.75	0.001081967	-26.71337137	-61.21323386	-193.1302454	-149.2582597	-23.2613272
Jan	49.5	198	173.25	0.001514754	-20.52746537	-42.63976847	-133.6895088	-63.60564206	-17.07669463
Feb	49.5	247.5	222.75	0.001947541	-14.10641288	-32.63306044	-100.2152827	-91.51460622	-12.09370893
Mar	49.5	297	272.25	0.002380328	-12.93244716	-27.09630377	-86.53314222	-50.2050097	-11.18963204
Apr	49.5	346.5	321.75	0.002813115	-10.54444528	-23.6426949	-72.19358068	-43.8554832	-9.411629221
May	49.5	396	371.25	0.003245902	-11.55547387	-19.88206426	-63.7825713	-22.08254665	-8.619482577
Regression					(Ln X, Y1)	(Ln X, Y2)	(Ln X, Y3)	(Ln X, Y4)	(Ln X, Y5)
Wet	Season			Wet	Wet	Wet	Wet	Wet	Wet
r	Correlation Coefficient			-0.963990513	-0.969819964	-0.9722031	-0.964856872	-0.977170535	
df	Degrees of freedom			2	2	2	2	2	
t	Student's t			5.126365831	5.625135328	5.872161548	5.192687928	6.504522591	
p	Probability of distribution	2 tailed		0.036009487	0.030180036	0.0277969	0.035143128	0.022829465	
Dry	Season			Dry	Dry	Dry	Dry	Dry	Dry
r	Correlation Coefficient			0.930482575	0.937119914	0.933447085	0.986044672	0.934821611	
df	Degrees of freedom			6	6	6	6	6	
t	Student's t			6.22162868	6.577123173	6.374052568	14.50800482	6.448104873	
p	Probability of distribution	2 tailed		0.000796706	0.000592611	0.00070066	6.72362E-06	0.000658833	
Regression					(Y1,Y2)	(Y1,Y3)	(Y1,Y3)	(Y1,Y4)	
Wet	Season			Wet	Wet	Wet	Wet	Wet	
r	Correlation Coefficient				0.999673313	0.999450671	0.999399232	0.998465975	
df	Degrees of freedom				2	2	2	2	
t	Student's t				55.31302778	42.64861324	40.78032902	25.50255199	
p	Probability of distribution	2 tailed			0.000326687	0.000549329	0.000600768	0.001534025	
Dry	Season				Dry	Dry	Dry	Dry	
r	Correlation Coefficient				0.994837062	0.991871284	0.944362559	0.994628658	
df	Degrees of freedom				6	6	6	6	
t	Student's t				24.01183926	19.09366638	7.033025404	23.5377086	
p	Probability of distribution	2 tailed			3.42726E-07	1.33461E-06	0.000412801	3.85867E-07	
Note:	Cum RC: Cumulative Reservoir Capacity			Las: Latitude sum; Los: Longitude sum; Des: Depth sum; Q: Quake sum					
Mean Cum RC for the period June 1973 to May 2001 is 396 Mha created irrigation potential equivalent(Mha CIPE)									
SM: Seismic moment sum: √ 10 ^{-19.05} Nm;									
Percent Rain is the long term mean for the month as % of Mean Monsoon rain.									

Table 10 1-9.9 MM Earthquakes, June 1973 to May 2005 : Correlation of wet and dry season earthquake parameters with mean cumulative reservoir capacity are statistically extremely significant.						
For each parameter, the wet and dry season values correlate statistically extremely significantly.						
These are for annual parameters.			Tables 11a and 11b.			
	r	p	df	t		
	inmrcr,a	-0.96542667	4.53971E-19	30	20.28627458	
	inmrcr,b	0.934728908	5.09623E-15	30	14.40707444	
	inmrcr,a+b	0.566868738	0.00071778	30	3.768823266	
	a,b	-0.930943257	1.15719E-14	30	13.96366615	
	mrcr,1-9.9csmw	0.984020169	4.82045E-24	30	30.2695172	
	mrcr,1-9.9csmd	0.805165703	2.75119E-08	30	7.436261493	
1-9.9	csmw,csmd	0.958817902	5.98936E-18	30	18.49036636	
	mrcr,1-9.9clasw	0.977248122	9.23199E-22	30	25.23633387	
	mrcr,1-9.9clasd	0.980668253	8.26576E-23	30	27.44262771	
1-9.9	clasw,clasd	0.999564571	2.54461E-47	30	183.4472294	
	mrcr,1-9.9closw	0.993880271	2.8756E-30	30	49.28095021	
	mrcr,1-9.9closd	0.985228208	1.49441E-24	30	31.51197772	
1-9.9	closw,closd	0.9825382	1.80545E-23	30	28.92376267	
1-9.9	mrcr,cdepsw	0.80428882	2.92442E-08	30	7.413304052	
1-9.9	mrcr,cdepsd	0.810964894	1.82409E-08	30	7.591381036	
1-9.9	cdepsw,cdepsd	0.999770409	1.22709E-51	30	256.5803352	
1-9.9	mrcr,cqsw	0.978331225	4.47373E-22	30	25.88092898	
1-9.9	mrcr,cqsd	0.978096429	5.25052E-22	30	25.73718859	
1-9.9	cqsw,cqsd	0.999921287	1.30532E-58	30	436.511485	
Legend: mrcr: mean cumulative reservoir capacity; csm: cumulative seismic moment; csmw means csm for wet season; csmd for dry season; clas: cumulative latitude sum; clos cumulative longitude sum; cdes: cumulative depth sum; cqs: cumulative quake sum; w for wet and d for dry season as for csm						
a: displacement , wet season b: displacement , dry season				inmrcr: log to base e of mrcr.		

Table 11a Worldwide earthquakes 1-9.9 MM: June 1973 to May 2005(till 9th May):									
Dryseason values are statistically the same as monsoon values except for seismic moment, applied force and displacement									
which are mirror reflections of monsoon values. Values are percentages of quantities indicated in bold.									
JS refers to June to September monsoon period. OM refers to dry season . This part of the table is for monsoon.									
Values are percentages of absolute quantities indicated in bold									
	Reservoir	Cumulative Reservoir	Capacity	Mean Water Force	1-9.9 JS	1-9.9 JS	1-9.9 JS	1-9.9 JS Cumulative	1-9.9 JS Cumulative
June y to	RC	Cum RC	Mean Cum RC	F	Cumulative Latitude sum	Cumulative Longitudesum	Cumulative Depth sum	Seismic moment Sum:	JS Cumulative quakesum
					CLasJS	CLosJS	CDesJS	CSMJS	CQJS
					%2004 value:	%2004 value:	%2004 value:	%2004 value:	%2004 value:
May y+1	Mha CIPE	Mha CIPE	Mha CIPE	v ^{19.05} N	2527981.85	1092491.46	2382952	4565.774907	132237
1973	20.7	20.7	20.7	9.0492E-05	1.01644282	4.505308444	0.78507666	1.727312235	1.206923932
1974	21.635	42.335	31.5175	0.00013778	1.977059289	5.542338976	1.42614287	3.095484687	2.459220944
1975	22.612	64.946	42.66033333	0.00018649	3.250103239	10.63642822	2.20917585	6.022795165	3.747816421
1976	23.633	88.579	54.14	0.00023668	4.264779828	15.67366394	2.85168564	10.88677622	5.062123309
1977	24.7	113.279	65.9678	0.00028838	4.930655258	17.69400742	3.49940746	13.87177876	6.247116919
1978	25.638	138.917	78.126	0.00034153	6.217054921	19.75227523	4.21907785	18.89559851	7.488070661
1979	26.595	165.512	90.60971429	0.00039611	7.427681492	22.68545056	4.84539344	24.04727522	8.90068589
1980	27.248	192.759	103.378375	0.00045193	8.921470302	22.68031825	5.52739208	28.19170767	10.48496261
1981	27.911	220.671	116.4108889	0.0005089	10.08530698	26.49767075	6.1208115	30.37998607	12.02008515
1982	28.591	249.261	129.6959	0.00056698	11.46584063	29.45604627	6.83370458	31.85378431	13.52117789
1983	29.287	278.548	143.2279091	0.00062613	13.18745979	34.25939549	7.63759404	32.69526021	15.29224045
1984	30	308.548	157.0045833	0.00068636	14.84588151	38.78218783	8.37827619	33.16171313	17.10338256
1985	30.226	338.774	170.9868462	0.00074748	16.72655403	45.21594979	9.23331649	38.07478581	19.32817593
1986	30.454	369.229	185.147	0.00080939	19.28162024	42.02478892	10.1408505	38.93298788	21.75336706
1987	30.684	397.913	199.3314	0.00087139	21.33661561	46.99580077	10.9702755	40.31153651	23.89951375
1988	30.915	430.83	213.8000625	0.00093465	23.83101999	51.50774726	11.8632058	41.30128628	26.19009808
1989	31.149	461.978	228.3987647	0.00099846	26.96308718	56.58832976	12.6310517	41.64435166	28.68410505
1990	31.384	493.362	243.1189444	0.00106282	30.1861562	64.66569816	13.6608794	44.13713125	31.54563398
1991	31.621	524.983	257.9538947	0.00112767	34.06503215	68.65609824	14.7036617	44.84441811	34.54101348
1992	31.86	556.843	272.89835	0.001193	39.24453018	63.34473223	16.0273644	46.75573415	38.67979461
1993	32.1	588.943	287.9480952	0.00125879	46.06360603	65.99559048	17.4444764	53.43474618	43.6572215
1994	32.332	621.275	303.0993182	0.00132502	51.19124886	68.6010946	18.962392	60.10223143	47.97673873
1995	32.565	653.84	318.348913	0.00139169	55.14013283	74.12119267	20.5162294	64.83450378	52.39078321
1996	32.8	686.64	333.694375	0.00145877	59.25950892	83.15941252	22.0036996	69.6383792	56.60821102
1997	33.037	719.676	349.13364	0.00152627	62.15803171	86.21162586	23.0969319	70.463	60.12689338
1998	33.275	752.971	364.6658462	0.00159417	65.86389455	87.71785731	24.3746244	71.39981254	64.93795231
1999	33.515	786.467	380.2881111	0.00166246	70.49529173	87.47249979	25.703002	74.27685745	69.49870309
2000	33.757	820.224	396.0001071	0.00173115	75.92545295	102.6702708	27.3903125	84.24574942	74.65232877
2001	34.0007474	853.981	411.7925517	0.00180019	80.75620875	100.4708732	41.9393257	94.22044981	79.82561613
2002	34.2462548	887.738	427.6574	0.00186954	87.14928432	101.9052451	59.8354898	97.54827093	85.92224566
2003	34.4935349	921.495	443.5876452	0.00193918	93.90126594	101.8763753	78.1915036	98.83697805	93.50862467
2004	34.7426006	955.252	459.5771563	0.00200908	100	100	100	100	100

Table 11b: Worldwide earthquakes 1-9.9 MM: June 1973 to May 2005(till 9th May):								
Dryseason values are statistically the same as monsoon values except for seismic moment, applied force and displacement which are mirror reflections of monsoon values.								
Values are percentages of quantities indicated in bold.								
This part is for dry season but shows also calculations for both seasons.								
	1-9.9	1-9.9	1-9.9	1-9.9	1-9.9	1-9.9JS	1-9.9OM	1-9.9JS+OM
	OM	OM	OM	OM		% Cum ulative	% Cum ulative	% Net
	CLasOM	CLosOM	CDesOM	CSMOM	OM	Displacem ent:	Displacem ent:	Cum ulative
June y to					CQOM	% Cum SMJS	Cum SMOM	Displacem ent
						/CQJS/F	/CQOM/F	% JS 1973
	% 2004 value:	% 2004 value:	% 2004 value:	% 2003 value:	% 2004 value:	% 1973 value	-% 1973 value	Cum ulative
May y+1	5407262.87	2770238.53	4801222.6	8942.478687	274760	546.0634418	-588.0322668	Displacement
1973	0.644678294	2.279971537	0.65417296	-1.715525759	1.049279371	100	-100	-7.685704945
1974	1.57897539	3.392308965	1.25562393	-5.498458382	2.157883244	57.76419756	-102.3588681	-52.46167114
1975	2.667901182	5.031113332	2.0311389	-10.80532574	3.365118649	54.48474642	-95.29661502	-48.13608526
1976	3.463190426	7.128086548	2.67481037	-13.95811172	4.449701558	57.45498553	-73.3570354	-21.54005517
1977	4.598722237	9.001071832	3.49894004	-15.68962569	5.747197554	48.68553131	-52.39486104	-7.736244157
1978	5.638709775	11.04872005	3.99323289	-18.10775531	6.741155918	46.71695464	-43.53102492	-0.159736412
1979	7.384836277	9.857138187	4.74022179	-19.86057883	8.366574465	43.12677997	-33.16910069	7.408400067
1980	8.586304405	12.39068392	5.37070704	-21.43902643	9.701193769	37.61873533	-27.06539789	8.473170814
1981	9.762400547	15.64098598	6.09753857	-22.77152157	11.10423642	31.40261508	-22.30354938	7.384880703
1982	11.5008766	17.63625748	6.89599145	-25.17873874	12.8734168	26.27239448	-19.09317401	5.711775455
1983	13.22290995	20.42217787	7.81884181	-26.93830017	14.52722376	21.59063538	-16.39170565	3.9391116
1984	14.91701623	22.78663599	8.68500869	-28.69693068	16.53151842	17.86166799	-13.99827785	2.787523807
1985	17.7921744	25.30019211	9.64523703	-30.69662212	18.9485369	16.66338744	-11.99544713	3.746005631
1986	19.56198164	27.83180552	10.4579529	-35.38925766	21.03290144	13.98150628	-11.50587955	1.591318774
1987	21.92050486	29.15412919	11.4140594	-37.2034812	23.24610569	12.23894449	-10.16533958	1.292326898
1988	24.90606491	33.67201307	12.287414	-40.23778872	25.64856602	10.66836878	-9.290250526	0.664097011
1989	28.357412	38.9586683	13.2675165	-41.9688067	28.39277915	9.193914171	-8.193872517	0.370284788
1990	32.50792189	42.96907855	14.2167622	-42.97937879	31.4525404	8.323872817	-7.116227776	0.660712771
1991	36.59651819	44.53278938	15.2008157	-44.32660665	34.85478236	7.279652065	-6.242007094	0.557902723
1992	40.73493657	44.47352842	16.4407062	-45.99832664	38.74108313	6.406623561	-5.508503139	0.474753124
1993	46.24481221	43.41710784	17.7589537	-47.39643028	42.94402388	6.147985627	-4.852805941	0.92220734
1994	51.31139796	51.31003972	19.2814722	-54.95021207	47.29400204	5.977977954	-4.853360871	0.751602086
1995	56.41523361	64.65643448	20.8391858	-61.54466489	52.32930558	5.622472294	-4.67741932	0.585560326
1996	59.63660705	70.71648231	22.1831602	-64.38883012	56.31714951	5.332117776	-4.337956777	0.660758441
1997	64.4454748	74.93502085	23.7905903	-71.85661392	61.16174116	4.854897474	-4.260488999	0.266959862
1998	68.87572288	77.95332447	25.1793137	-76.10189038	65.85165235	4.360966862	-4.012341731	0.040248385
1999	72.93415532	79.68462773	26.6033822	-78.6664074	69.93339642	4.064840111	-3.745037618	0.031969952
2000	76.6801685	89.26054537	28.1217663	-86.94869914	74.96287669	4.121817223	-3.708393216	0.128407845
2001	80.51803444	87.73771441	43.9870795	-89.7307238	80.25877129	4.145756611	-3.437434361	0.444131187
2002	88.11118184	82.53172589	61.5550839	-98.34852823	86.71458728	3.839700589	-3.357715916	0.223920535
2003	95.73554522	85.64577939	80.4674334	-100	93.82442859	3.446416353	-3.042067645	0.170544365
2004	100	100	100	-256.5169684	100	3.147175499	-7.066785381	-4.462742155

Table 12 : The race of the seasons to register peak quakes				worldwide . The dry season-monsoon game.						
Cum RC: Cumulative Reservoir Capacity.				Mha: Million hectares created irrigation potential equivalent.						
	Hydrological	Season	Moment	Seismic	Date	Hypocentre				
CumRC	Year y:	d: dry	Magnitude	Moment SM		Latitude	Longitude	Depth		
MHaCIPE	Jun y-May y+1	m: wet	MM	v*10 ¹⁹ .05	Month	Day	degrees	degrees	km	
1	42.335	1974	d	8.1	141.253754	May	26	36	-17.65	33
2	64.946	1975	d	8.2	199.526231	Jan	14	-28.43	-177.66	33
3	88.579	1976	m	8	100	Jul	27	39.57	117.98	23
4	88.579	1976	d	8.1	141.253754	April	21	-9.97	160.73	33
5	113.279	1977	m	8	100	Aug	19	-11.09	118.46	33
6	138.917	1978	m	8	100	Jul	24	22.1	121.4	18
7	165.512	1979	m	8.1	141.253754	Sept	12	-1.7	135.9	5
8	192.759	1980	m	8	100	Jul	17	-12.52	165.92	33
9	338.774	1985	m	8.1	141.253754	Sept	19	18.19	-102.53	27
10	369.229	1986	d	8.3	281.838293	Oct	20	-28.12	-176.37	29
11	430.83	1988	d	8.2	199.526231	May	23	-52.34	160.57	10
12	588.943	1993	m	8.2	199.526231	Aug	8	12.98	144.8	59
13	621.275	1994	m	8.2	199.526231	Jun	9	-13.84	-67.55	631
14	621.275	1994	d	8.3	281.838293	Oct	4	43.77	147.32	14
15	653.84	1995	m	8	100	Jul	30	-23.34	-70.29	45
16	653.84	1995	d	8.2	199.526231	Feb	17	-0.89	136.95	33
17	719.676	1997	d	8.3	281.838293	Mar	25	-62.88	149.53	10
18	752.971	1998	d	8.3	281.838293	Nov	29	-2.07	124.89	33
19	820.224	2000	m	8.3	281.838293	Jun	4	-4.72	102.09	33
20	820.224	2000	d	8.2	199.526231	Nov	16	-3.98	152.17	33
21	853.981	2001	m	8.4	398.107171	Jun	23	-16.26	-73.64	33
22	853.981	2001	d	8	100	Nov	14	35.95	90.54	10
23	887.738	2002	d	8.5	562.341325	Nov	3	63.52	-147.44	4
24	921.495	2003	m	8.3	281.838293	Sept	25	41.81	143.91	27
25	955.252	2004	d	9.4	12589.2541	Dec	26	3.3	95.98	30
		r	0.54519816	0.61057272	Wet Mean		4.265	61.37083	HFT	
		df	23	22	Dry Mean		-0.47231	53.81231	HFT	
		t	3.11899805	3.61614125						
		p	0.00482522	0.00153074						

S No	1		2		3		4		5		6		7		8	
	Pre-Dam Era		Dam Era													
Period	June-May	-2000-1000	1000-1870	1870-1897	1897-1924	1924-1951	1951-1978	1951-2003	1978-2003							
WMAT		10.35	8.2	7	7.7	8	8	9	8.9							
WMA>23		2.35	4.6	3.2	4	4	4	5	4.154							
WMA/WMAT%=E		22.705314	56.097561	45.714286	51.948052	50	50	55.5555556	46.674157							
SMT		2237.8	110247.82	3527.8	39629.8	21724.5	12631.5	23472.4451	10841.045							
SM>23 called SM		2237.8	8913.42	2253	19419.7	8430.2	7749.5	12385.7325	4646.03							
SM/SMT%=O		100	8.08489456	63.864165	49.002771	38.805036	61.350592	52.7671169	42.855924							
SM/SMT%-WMA/WMAT%		77.294686	-48.012666	18.149879	-2.945281	-11.19496	11.350592	6.09295957	-12.69963							
(SM/SMT)/(WMA/WMAT)		4.40425532	0.14412203	1.3970286	0.9433033	0.7761007	1.2270118	1.13054247	0.7714066							
SM/WMA		952.255319	1937.7	704.0625	4854.925	2107.55	1937.375	2981.64	929.206							
SMT/WMAT		216.21256	13444.8561	503.97143	5146.7273	2715.5625	1578.9375	2637.35338	1204.5606							
WM>23		5.8127E-11	210.848017	663.5722	2976.8141	6713.6374	15733.571	47103.6198	25637.69							
WMT		2.5601E-10	375.859509	1451.5642	5730.3671	13427.275	31467.142	84786.5156	54929.09							
>23SM/WMA' % =O1		3.8498E+15	4227.41466	339.52598	652.36523	125.5683	49.254552	26.2946512	18.121875							
SMT/WMA' T % =E1		8.7411E+14	29332.1886	243.03438	691.57524	161.79381	40.141872	27.6841723	19.736437							
(O-E)^2/E		263.130846	41.0929833	7.206021	0.1669876	2.5065445	2.5767187	0.13995702	0.3123551							
X^2=Sum[(O-E)^2/E]		317.132413	54.0015672	12.908584	5.7025629	5.5355752	3.0290308	0.45231208	0.3123551							
df		7	6	5	4	3	2	1	0							
p(X^2)		1.3225E-64	7.3718E-10	0.0242507	0.2224895	0.1365262	0.2199147	0.50123903								
%p(X^2)		1.3225E-62	7.3718E-08	2.4250663	22.248947	13.652623	21.991473	50.1239025								
(O1-E1)^2/E1		1.013E+16	21486.6229	38.309925	2.2230768	8.1108678	2.0686862	0.0697427	0.1320811							
X^2(1)=Sum[(O1-E1)^2/E1]		1.013E+16	21537.5372	50.91438	12.604455	10.381378	2.2705101	0.20182384	0.1320811							
p(X^2)(1)		0	0	9.005E-10	0.0133793	0.0155876	0.3213402	0.65325271								

Figure 1: Control of the Correlation Coefficients of the Earthquake Parameters by Storage Behind Dams in India:1-9.9 MM; June 1973 to May 2001.

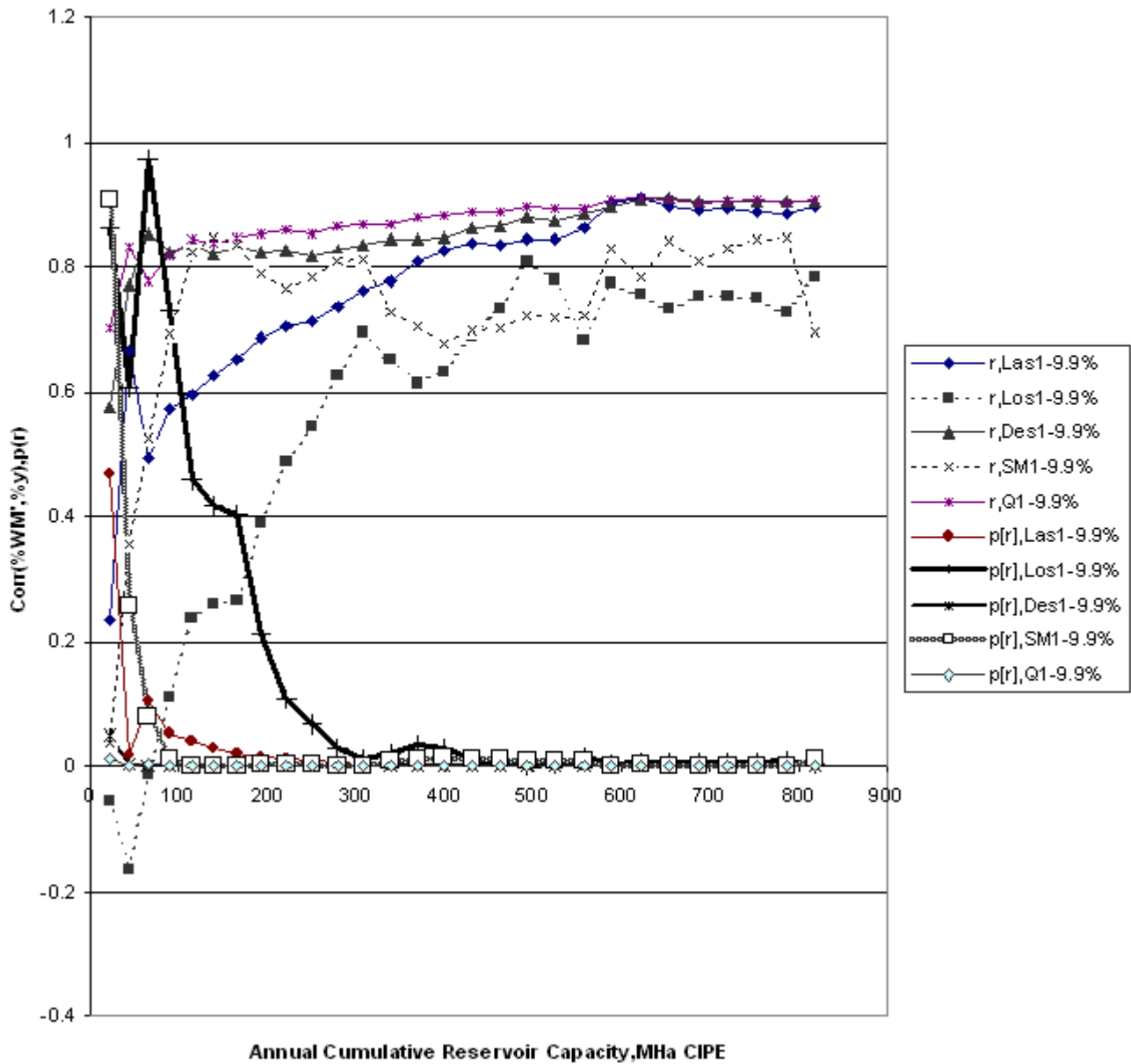


Figure 2: The Initiating water moments. Scale: 1 inch = 758 miles.

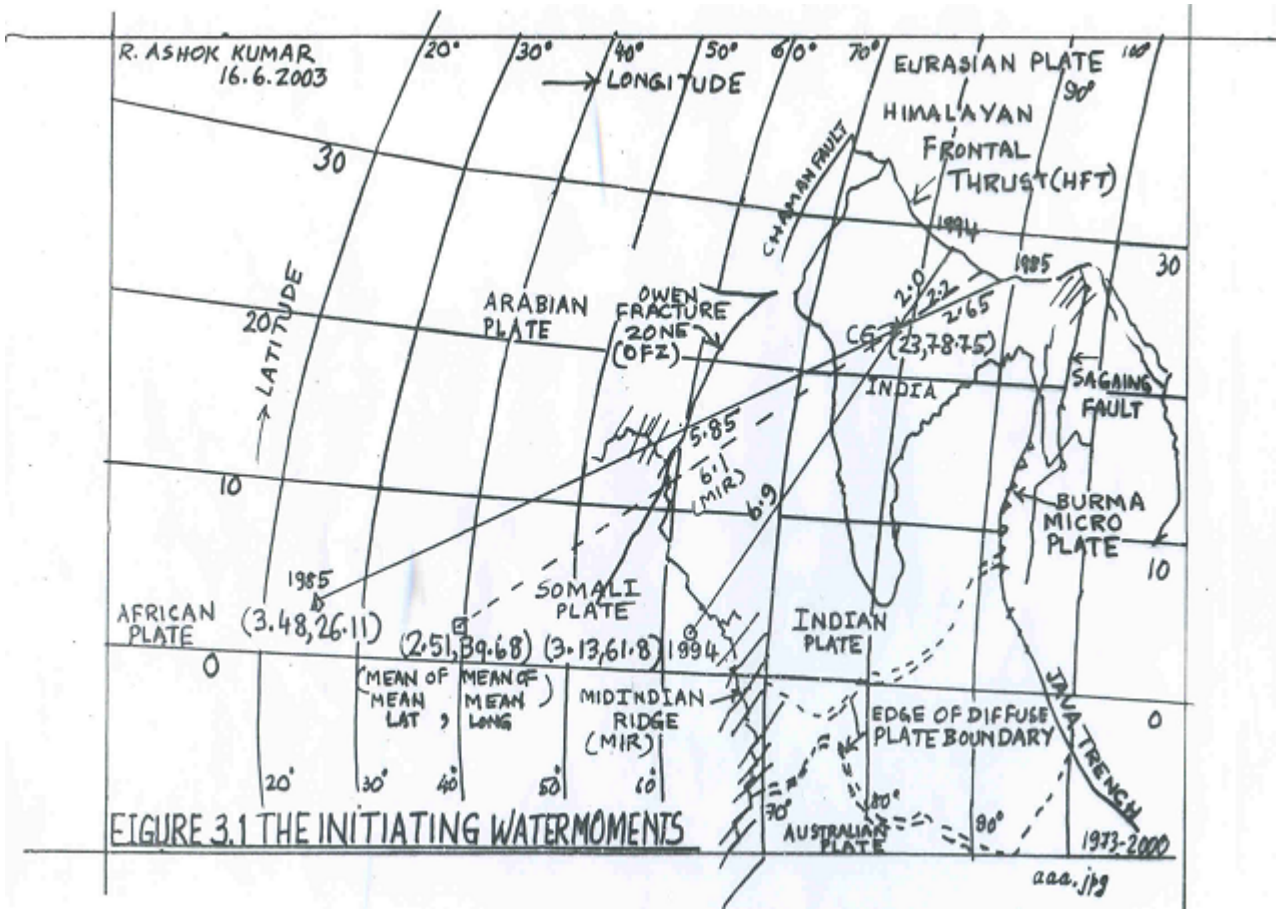


Figure 3: Cumulative Means of %SM/MM' for 5.5-9.9 MM, >23 SM/MM 5.5-9.9MM and %SM/MM' 1-9.9MM are statistically extremely significantly equivalent as determined by Chi-square sums and their probabilities (1973-2001)

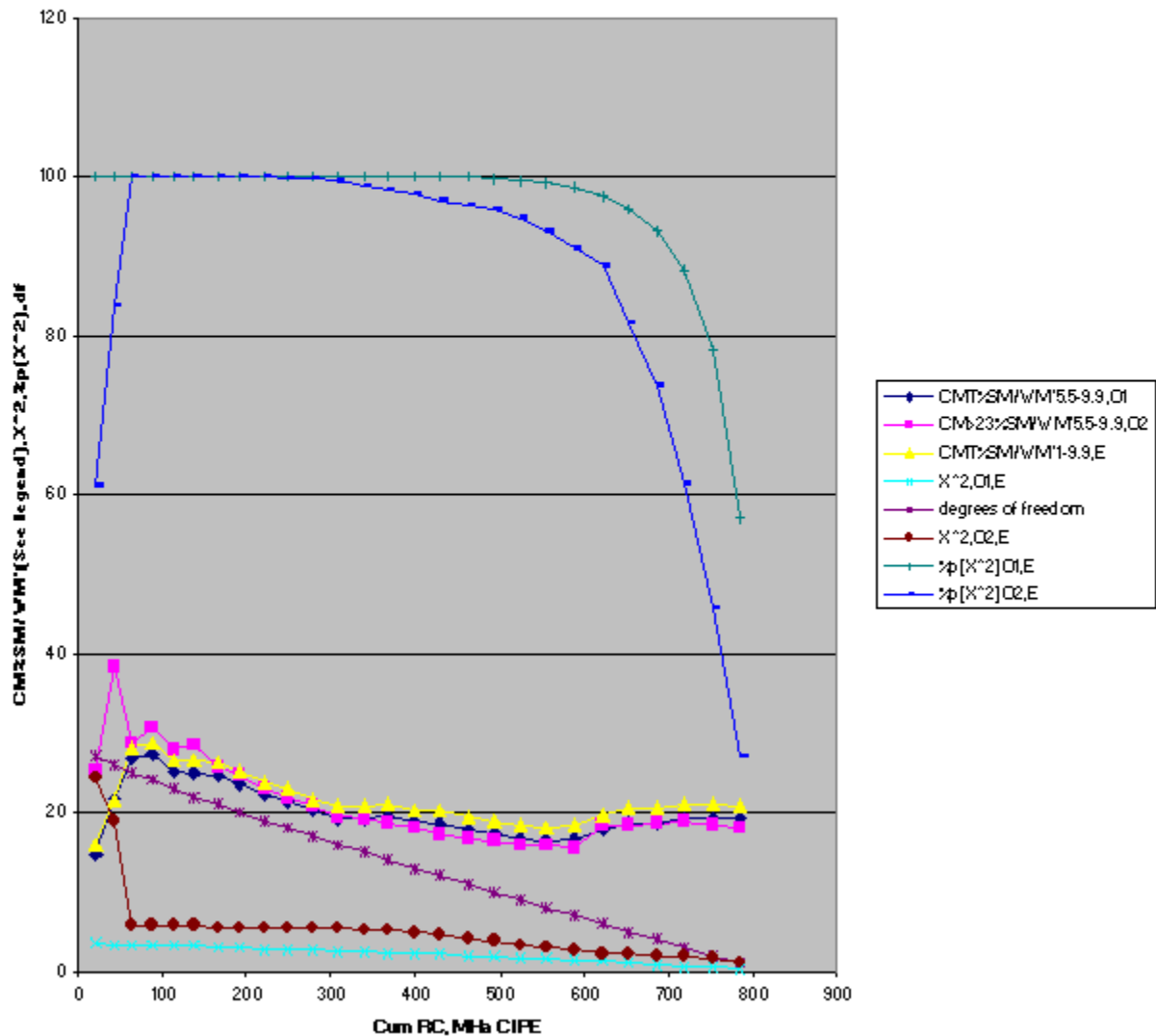


Fig.4 Control of Seismic Moment by Water Moment: Seismic Moment Ratio $SM > 23 / SMT$ converges to Ratio of Water Moment Arms $WMA > 23 / WMAT$. The Ratio of Seismic Moment to Rate of Change of Water Moment $SM / \dot{W}M' \%$ & $SMT / \dot{W}M'T \%$ converge to the Stress Relief Ratio

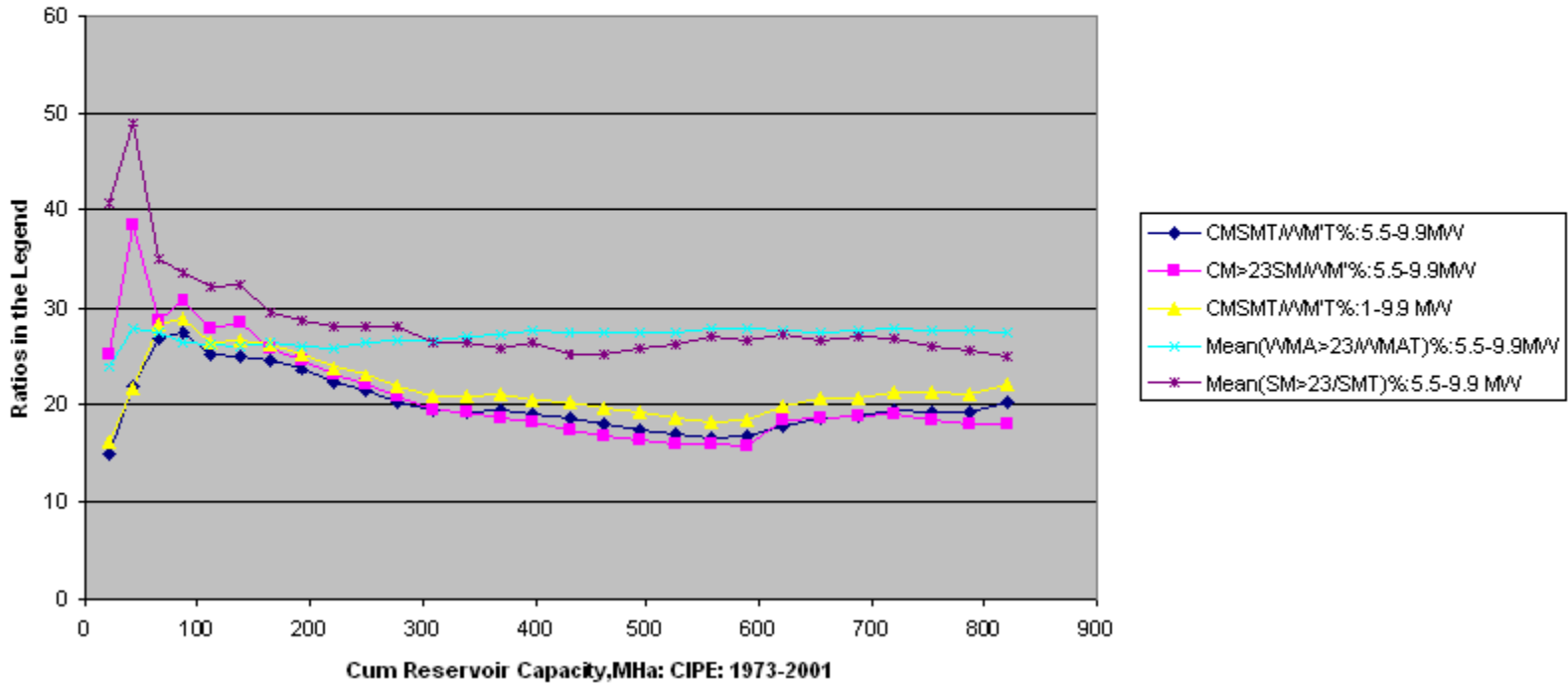


Figure 5: The Ratio of the Seismic Moment to the Rate of Change of Water Moment Worldwide and for -90 to 90 Latitude, 78.75-180 Longitude converge as shown by the Chi squared Distribution: 1-9.9MM: 1973-2001

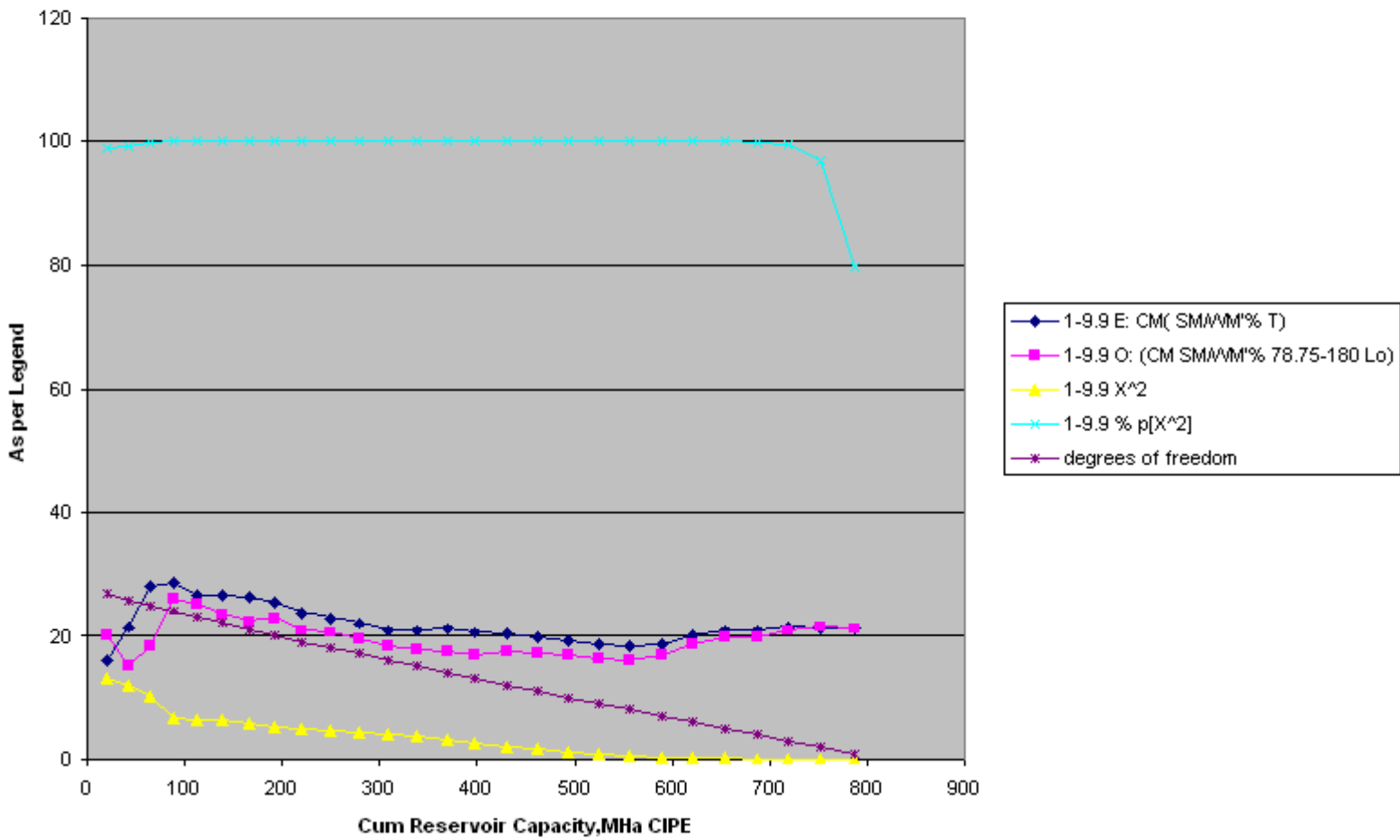


Figure 6: The Water Moment Arm 78.75 to 180 Longitude controls the Seismic Moment of Earthquakes in the zone -90 to 90 Latitude, 78.75-180 Longitude; Range 1-9.9 MW, 1973-2001

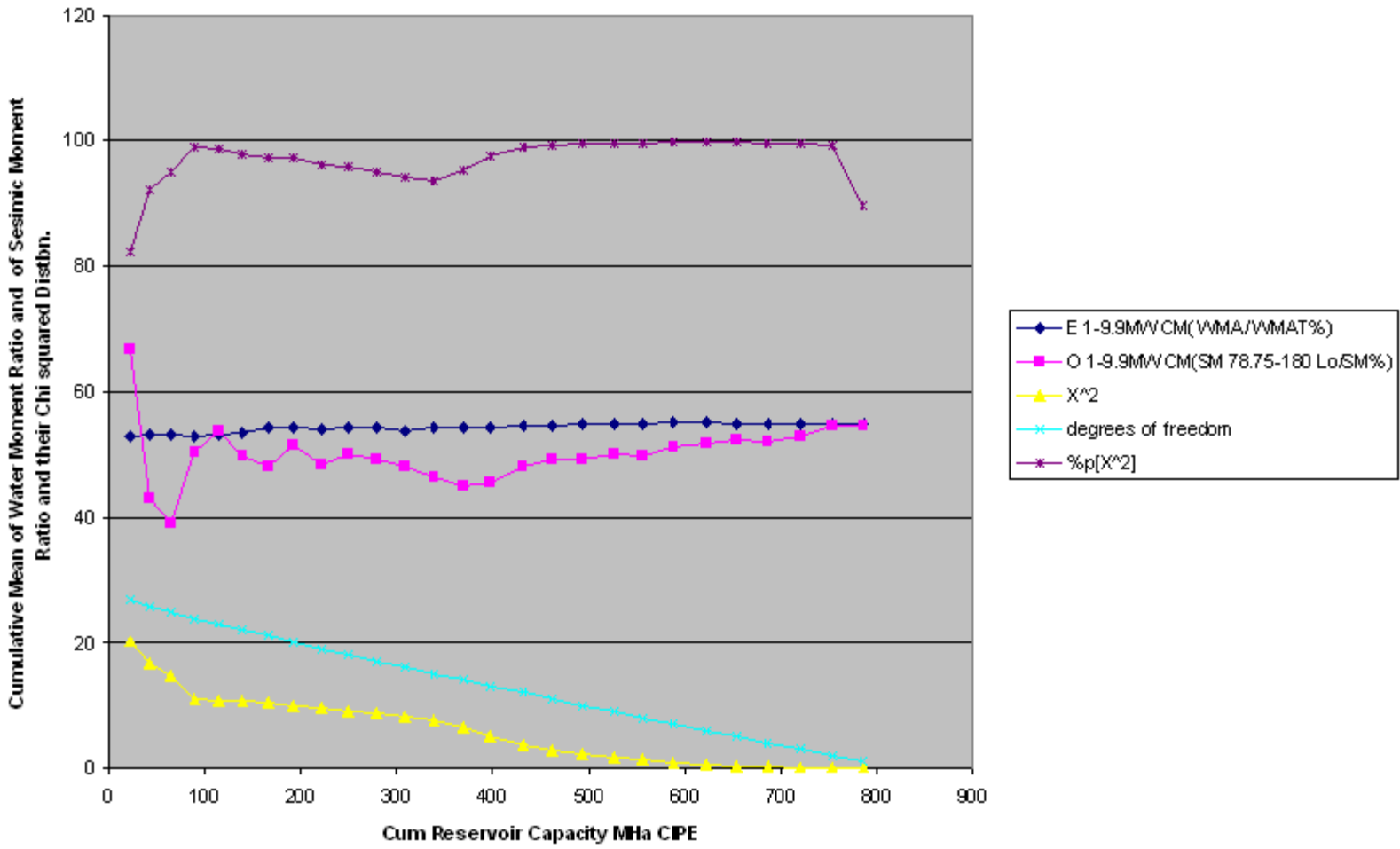


Figure 7: For quakes 1-9.9 MW the latitude per quake and (90 deg- the longitude per quake) converge to the latitude and longitude of the (1994) center of gravity of the surface water masses on the India part of the Indian plate (1973-2001)

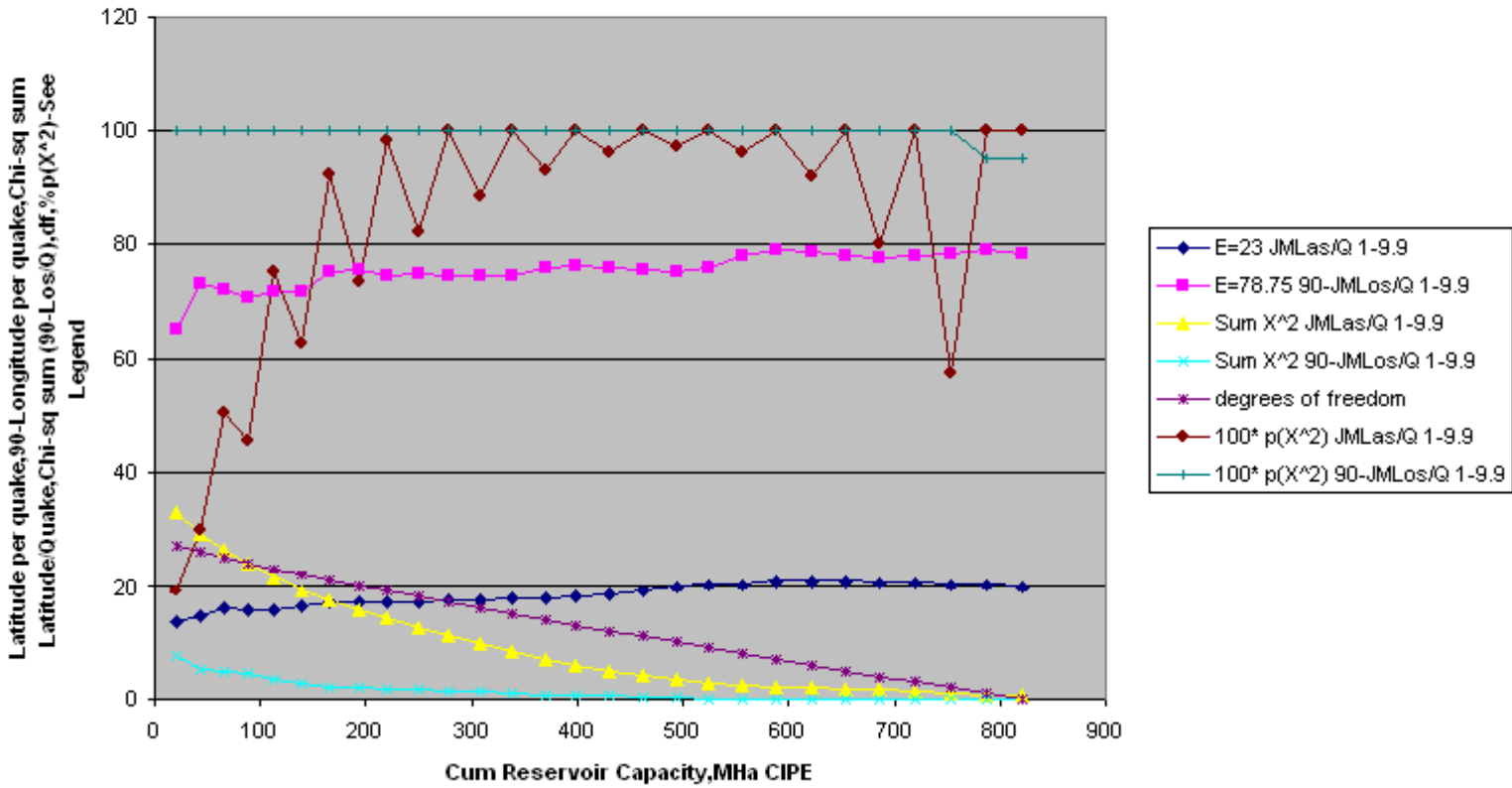


Figure 8: June 1973 to May 2001: Worldwide Earthquakes caused by dams: Monsoon and dry season patterns are mirror reflections of each other: 1-9.9MM (Table 9). The 4 points of upper graph refer to Monsoon June to September; Lower 8: October to May.

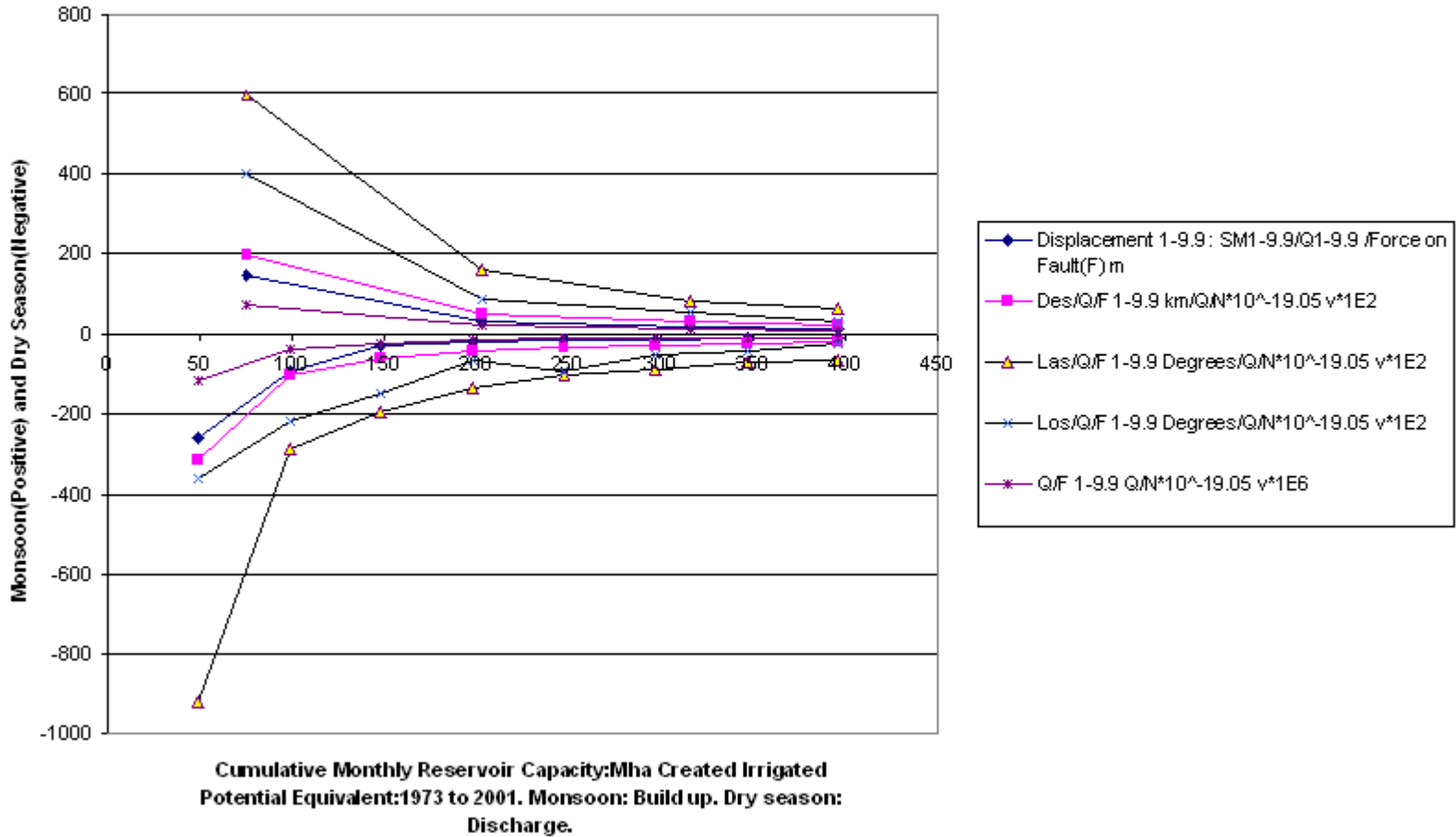


Figure 9: Worldwide earthquakes caused by Indian dams:1-9.9 MM: June 1973 to May 2005: Chi-square test shows that there is no statistical difference in the absolute values of monsoon and dry season displacements(Table 11b).

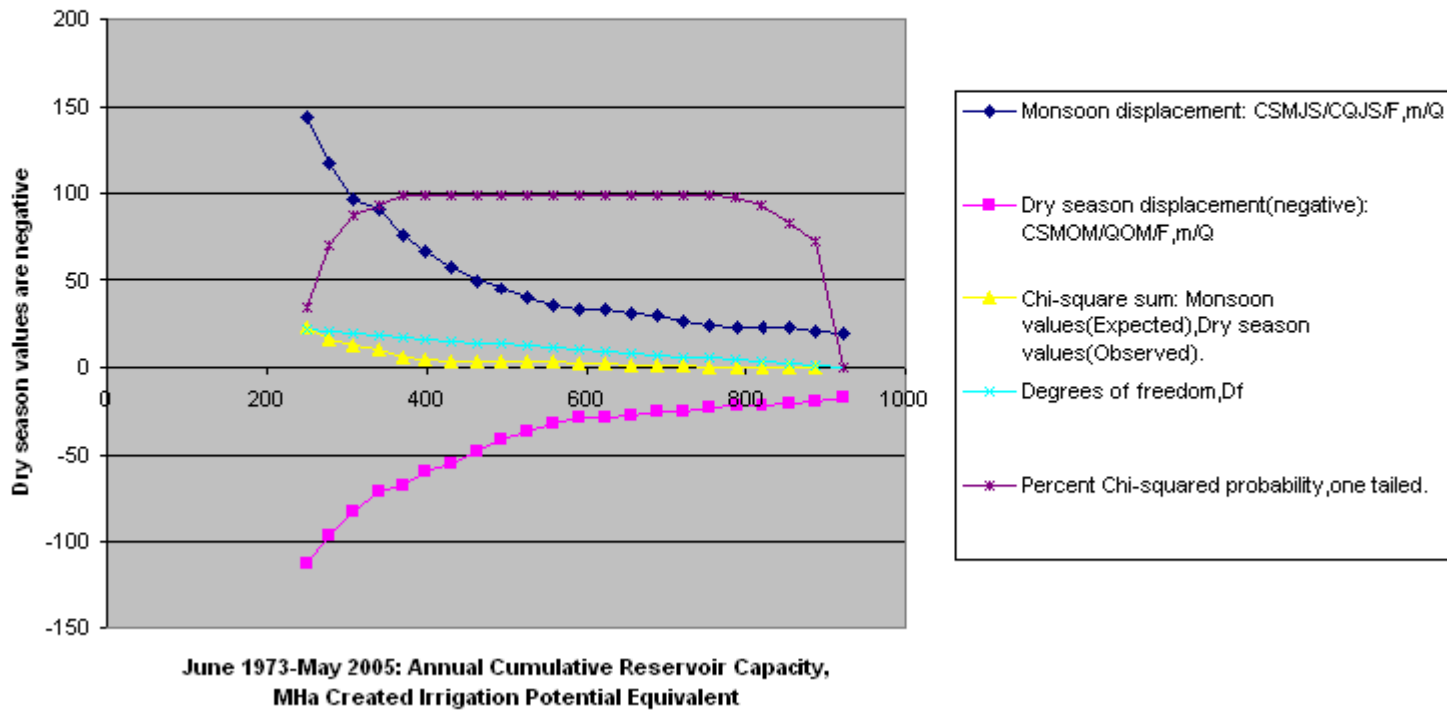


Figure 10: The Cumulative SM% is controlled by the %WM¹ repeatedly during successive hydrological cycles: 1-9.9 MW: See Figure 1 and Table 2.

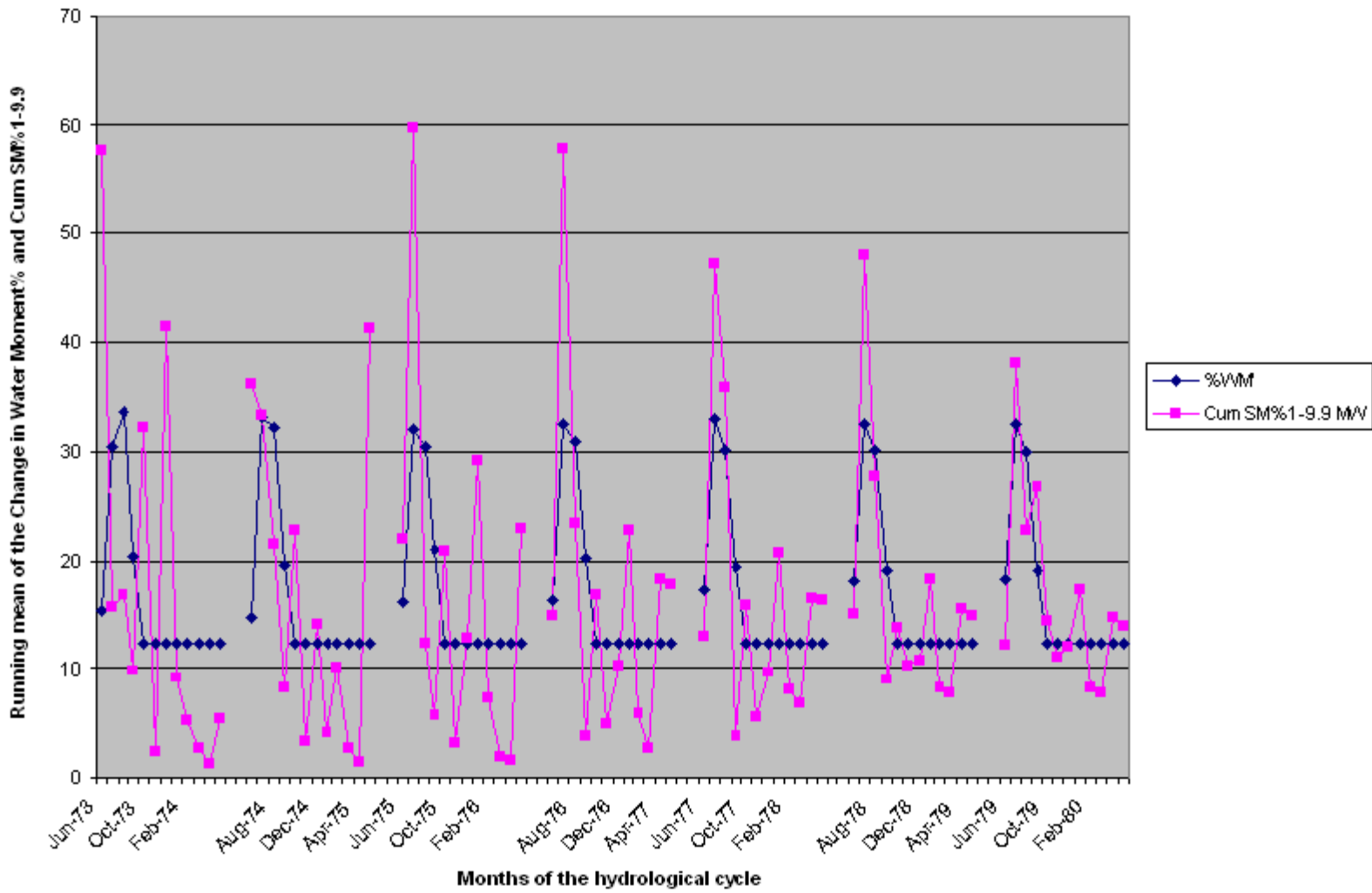


Figure 10a: The correlation of the Cum SM% with Mean VMM% becomes more and more statistically significant as more and more dams are commissioned in India: See Figure 1 and Table 2.

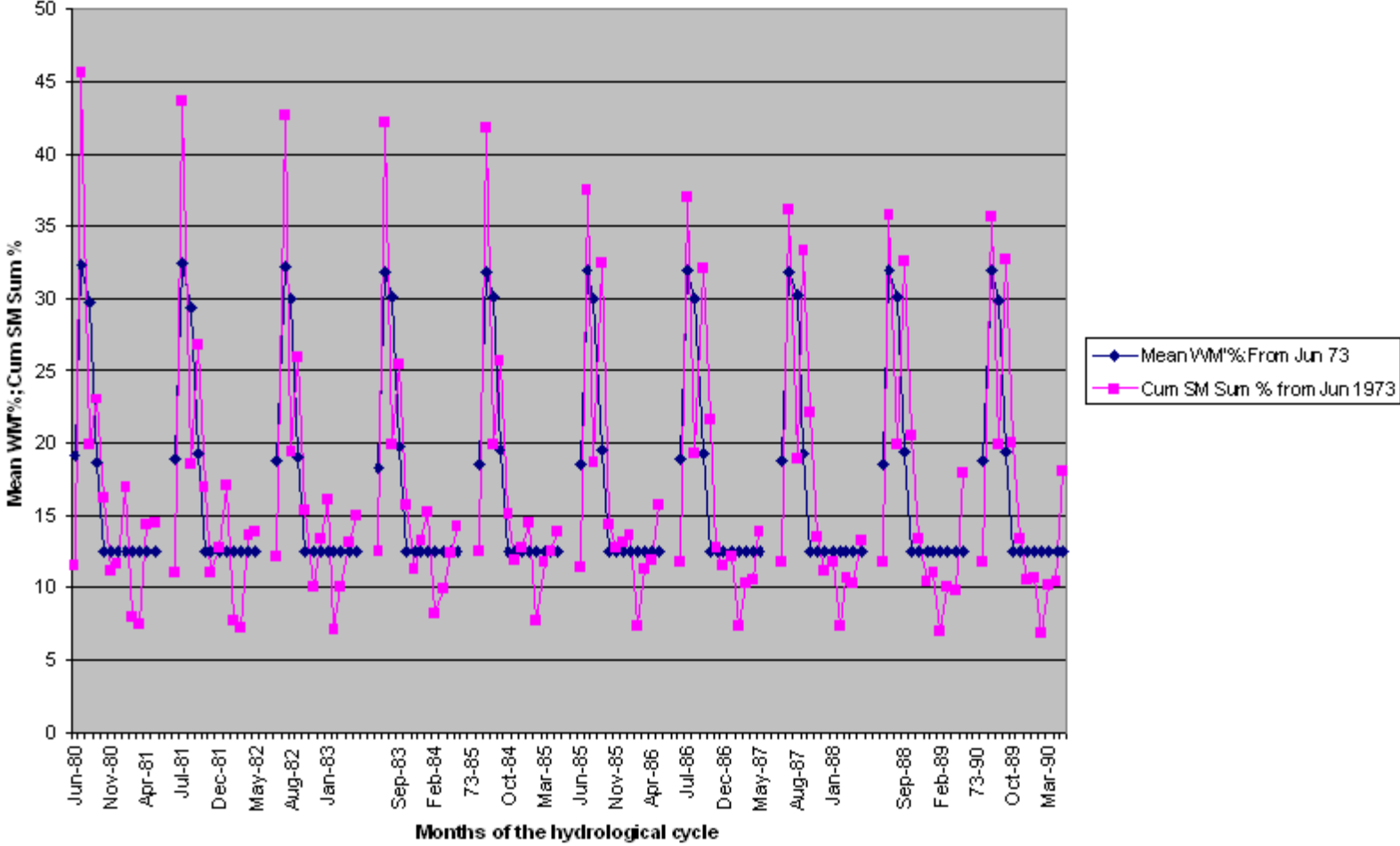


Figure 10b: Control of Cum SM Sum % of worldwide earthquakes by Mean WM'% gets stiffer with increasing number of dams commissioned in India:1973-2001: 1-9.9 MW. See Figure 1 and Table 2.

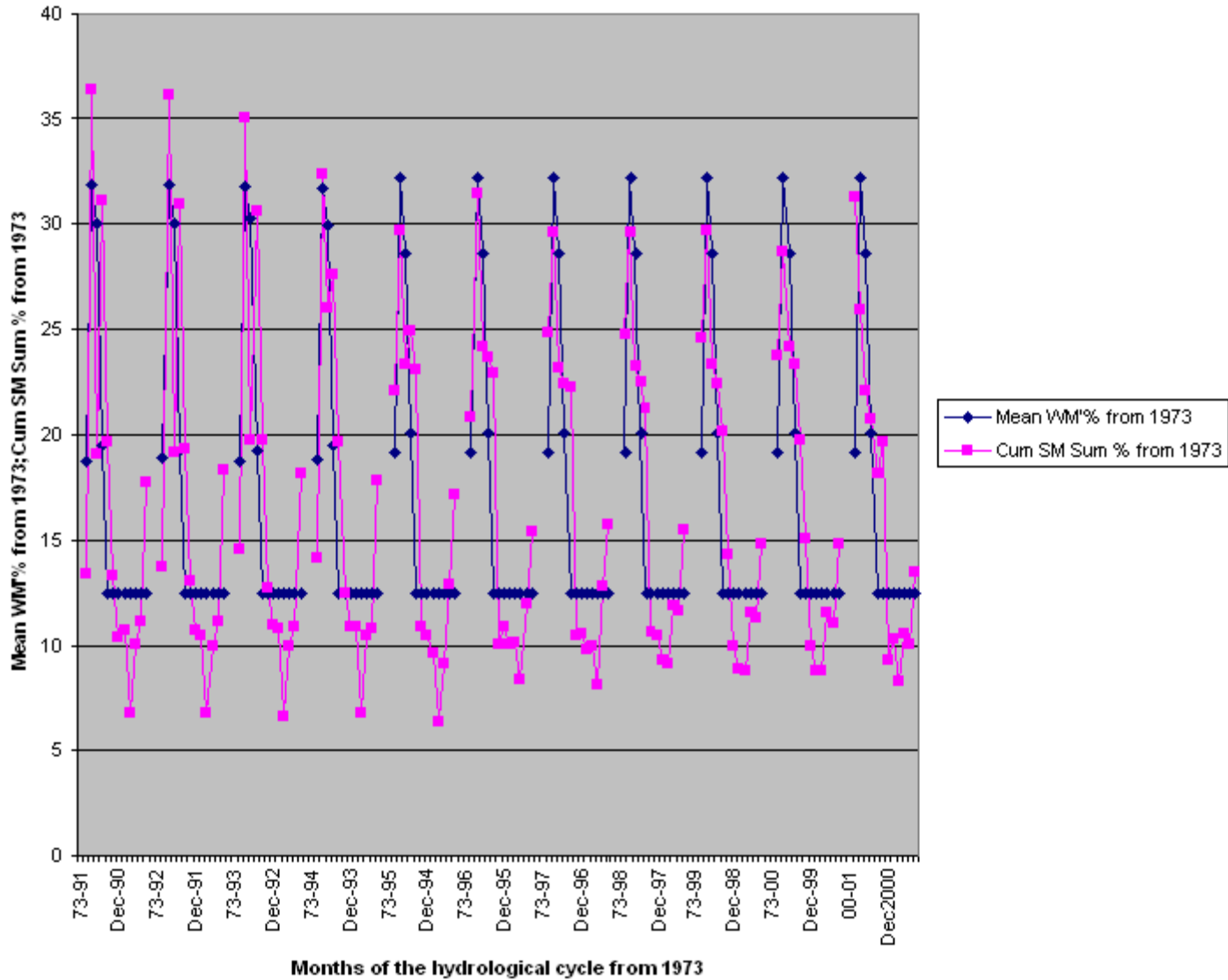


Figure 11(Table 14): Mean Duration Between Monthly Peak Magnitudes of Worldwide Earthquakes: June 1973 to May 2005. Extreme statistical significance of linear regression with change of water moment: $r=0.9$; $p=6.24E-05$. Chi-dist: $\text{Sum } X^2=7.34$; $p=0.77$.

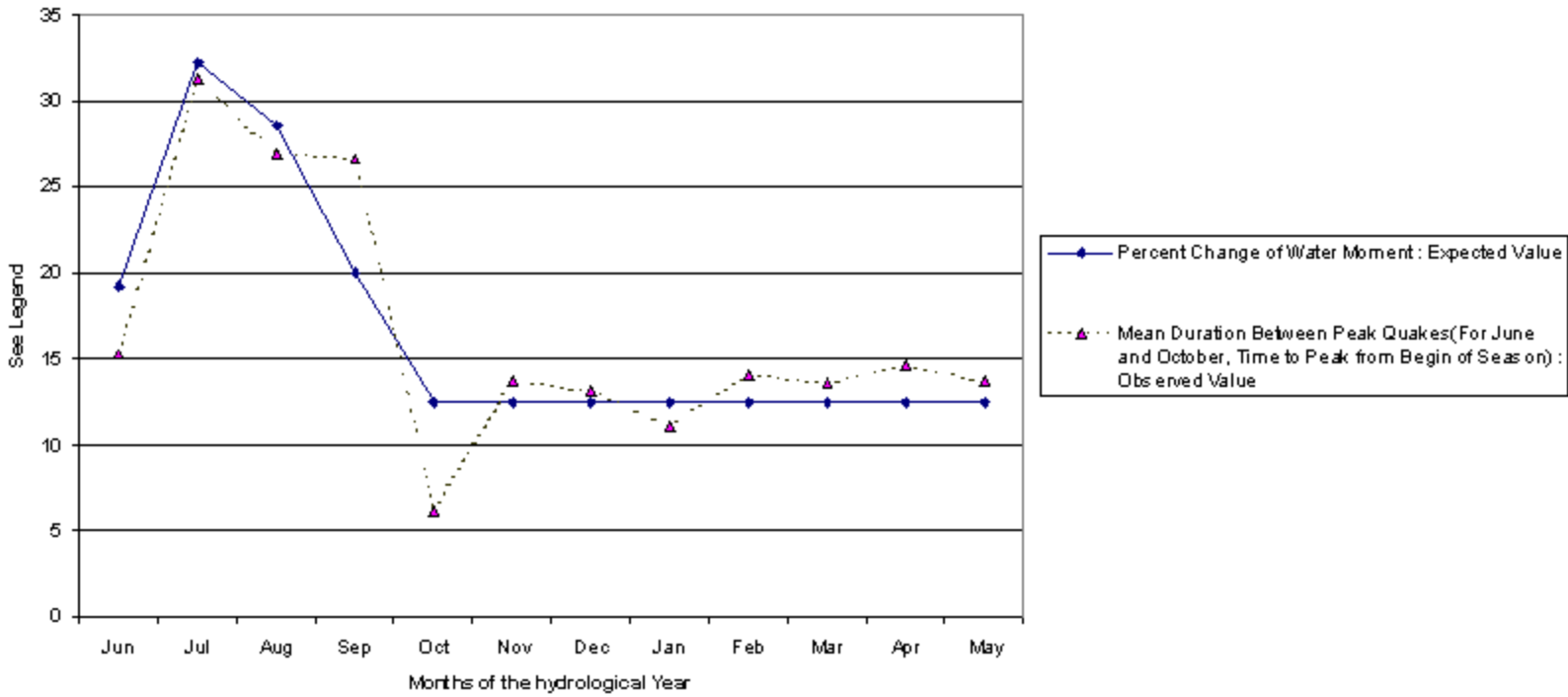
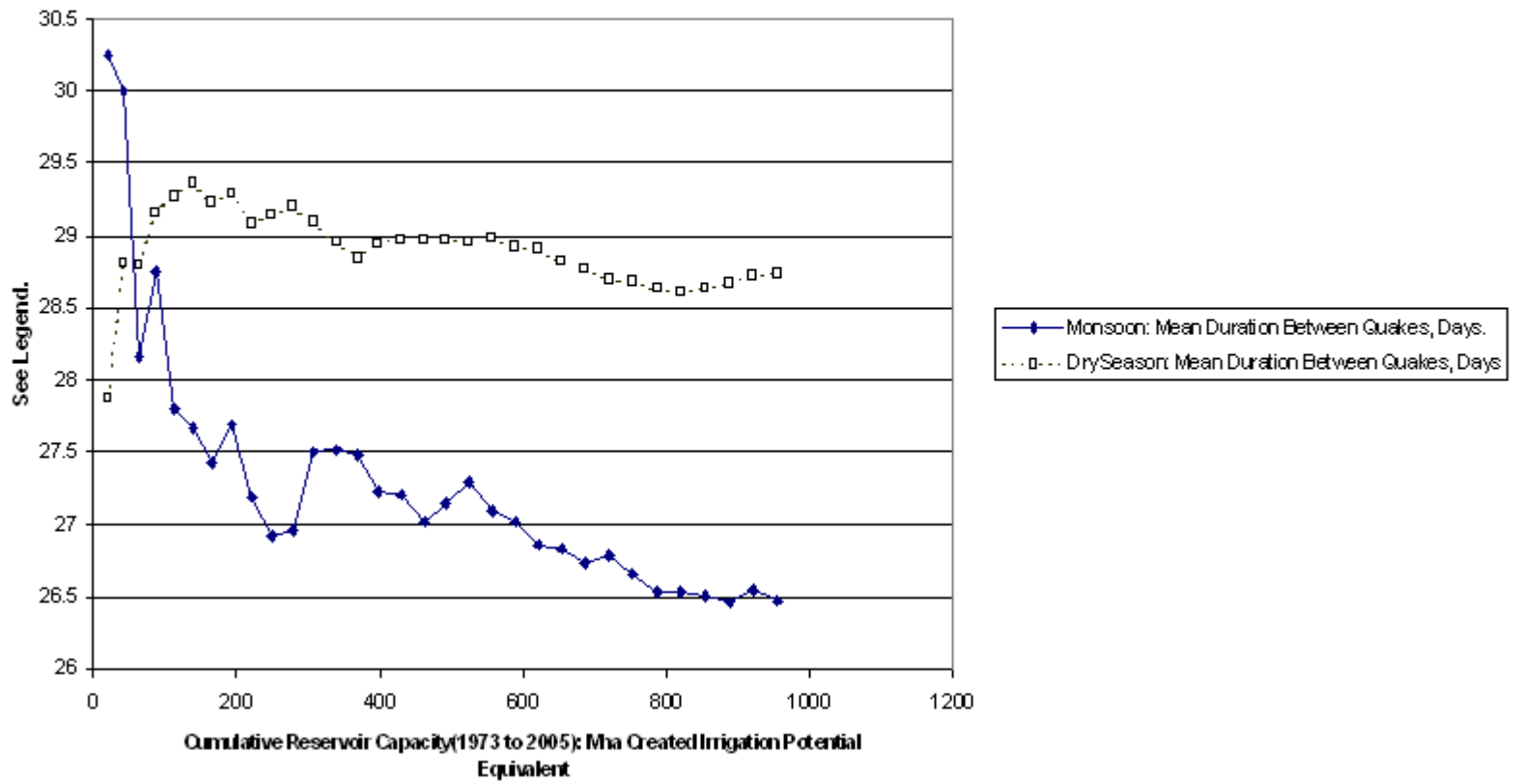


Figure 12: As the reservoir capacity increases, the mean duration between monthly peak magnitude quakes decreases logarithmically extremely significantly (for dry season from 1978): $r(\text{wet}) = -0.93$, $p(\text{wet}) = 1.87\text{E-}14$; $r(\text{dry}) = -0.93$, $p(\text{dry}) = 1.57\text{E-}12$.



Epilogue

Homeland Refugees

To Reverdure

Homeland refugees
Whose land is their homeland
Created by selfish concentration
Of rainwater by dams
On the subcontinent Indian
Worldwide seismic moments shallow
By destroyers of forests follow
Driven by magnificent monsoons every year
Damned by Hydroelectricks!
Natural intrinsic control lost
Of equitable water distribution
Replaced single mindedly by surface reservoirs
Relentlessly silted up by the rushing rains
Lake after lake becoming a barren landscape
Welcome homeland refugees to hell
By hydroterrorists, rainwater robbers:
The stupidest peasant or tribal
Is more competent, yes Wendell Berry
Than the most intelligent in a society
Of inhuman specialists!

Ramaswami Ashok Kumar

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