



**Indian Meteorological Society, Chennai Chapter
Newsletter**

**Vol.19, Issue No.2, Dec 2019 and
Vol.20, Issue No.1, May 2020**

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From the Chairman's Desk.....

Dear members of IMS Chennai Chapter and readers of BREEZE,

The current issue of BREEZE is a combined one of December 2019 & May 2020 (Vol. 19, Issue 2 & Vol 20, Issue 1) with usual technical notes from members. In addition, it contains tributes to (late) Shri. S. Raghavan, the *Bheesma-pitaamaah* of IMSCC. I am personally missing him as I was fortunate, while on tours, to stay with him in a single room on twin-sharing basis (he normally does not permit or allow twin-sharing in view of his food habits and other routine activities which may be considered fuzzy by others) during which period I learnt many things from our discussions varied from personal and official life, technical, scientific besides moral and ethics. As a recapitulation of his thousands of email correspondences like, “*This may interest you. I thought this phenomenon was already known, though detailed studies may not have been available..*”, “*...I am writing this only for your eyes. Please ensure that it does not go to any one else....*”, “*...That is what I meant when I said that the reins should be in your hands*”,....., I will be missing him.

We will be missing *his physical presence* in all our future activities. Nonetheless, his interactions with us and his concepts on meteorology and allied sciences (including humanities and social sciences) as summed up by him in his own presentation (TROPMET-2016, Bhubaneswar) are reproduced hereunder for pondering over and move in that direction the way that would be possible by members.

- *No amount of improvement in the accuracy of Meteorological Information will be of benefit to society unless the socio economic issues are tackled.*
- *Therefore objective inter disciplinary studies on the relationship between Meteorology and the Social Sciences is necessary.*
- *It is also necessary to interact with administrators, politicians, media and the public to make them appreciate the issues involved*
- *It will be of great national benefit if such inter disciplinary research is taken up.*

The Indian Meteorological Society can take the lead.

In regard to chapter activity, aftermath of the release of previous issue of Breeze, we conducted a half-a-day seminar on “**Review of Monsoons – 2019**” on 10th February 2020 with Dr. K. Satyagopal, IAS (retd.) as the Chief Guest. Over 30 college students from Women’s Christian College, Loyola College and few research scholars from SRM University also attended the seminar as part of our outreach initiatives to popularise meteorology.

Members may continue to browse the web link <http://www.imdchennai.gov.in/IMSWEB/imsimd/ims.htm> for updates on the activities of the Chapter.

I take this opportunity to thank all the members for their help, support, contribution and coordination in IMSCC activities as the current term of our local council comes to an end by May 2020. We will be announcing the date and time for the Annual General Body meeting to elect the new council members for the term 2020-2022 immediately after return of normalcy from the ongoing pandemic COVID-19 epoch. I wish members and their family a safe living.

I wish the future committee to take IMSCC activities to a new height.

With best regards & Bye

R. Suresh, Chairman, IMS Chennai Chapter, Chennai

Dated: 2 May 2020

Life Membership details of IMS Chennai Chapter (as on 01.04.2020): 152

The members list is available in http://www.imdchennai.gov.in/IMSWEB/imsimd/ims_imd.html

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Chennai Region – Rainfall Climatology and Recent Rainfall Trends

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1. Introduction

Chennai Metropolis located in the north eastern parts of the State of Tamil Nadu has a population of nearly 70 lakhs with a population density of 26553 people living in each sq. km area and is considered as a water deficient city. The surrounding districts of Chennai City such as Tiruvallur and Kanchipuram are also thickly populated. In the recent years 2016 and 2018 the city received deficient rainfall and experienced severe water scarcity. This has drawn focus to the water availability, water sources and water distribution in the ever expanding city. The rainfall realised by the city and neighbourhood in the past and in the recent years is another parameter which has received considerable attention. In this brief note, the rainfall climatology of Chennai City and the surrounding districts is presented. The rainfall during recent years and recent rainfall trends have also been analysed and discussed.

2. Geography

Fig.1 depicts the geographical location of the Chennai district and also the two co-located districts of Kanchipuram and Tiruvallur. Chennai City is positioned at (80.3°E, 13.1°N) along the Bay of Bengal coast. Fig.2 depicts the locations of four major reservoirs viz. Chembarambakkam, Cholavaram, Poondi and Puzhal which are located in the above two districts and which supply water to the Chennai City. Four major rivers viz. Adayar, Cooum, Kosathalaiyar and Araniar flowing by and large east to west, crisscross across the region and which empty into the Bay of Bengal are also shown in Fig.2.

3. Normal rainfall data of the 3 districts

In Table 1 is presented the normal rainfall data for the 4 seasons, viz. Winter (Jan-Feb, JF), Summer (Mar-Apr-May, MAM), Monsoon (Jun-Jul-Aug-Sep, JJAS) and Post Monsoon or North East monsoon (Oct-Nov-Dec, OND) of 11 rain gauge stations all located in Chennai, Tiruvallur and Kanchipuram districts. This normal data is taken from India Meteorological Department (IMD) records and is based on the 50 year period 1951-2000. The normal rainfall for the 3 districts are given in Table 1b. The inferences which could be drawn from Tables 1a and 1b are:

The annual rainfall of the stations vary between 89 cm at R.K.Pet in Tiruvallur district to 140 cm in Nungambakkam Chennai district. The North East monsoon is the rainiest (40-86 cm) though the SW monsoon season of JJAS also important (41-56 cm). In some interior stations the SW monsoon rainfall is slightly higher than the NE monsoon rainfall. When we consider district rainfall, Chennai district is the rainiest receiving 132 cm annual, 44 and 79 cm in JJAS and OND respectively The figures for Kanchipuram district are: 123, 44 and 69 and those for Tiruvallur are 114, 45 and 69. By and large NE monsoon rainfall decreases from coast to inland, i.e. from east to west. SW monsoon rainfall is slightly higher in the interior stations compared to coastal stations.

4. Rainfall of Nungambakkam (NBK) and Meenambakkam (MBK) observatories

The geographical locations of these two observatories maintained by IMD is presented in Fig.2. NBK observatory functioned as early as from 1796 but monthly rainfall data is available from 1901 only. MBK observatory functioned from 1943. For both NBK and MBK daily rainfall data has been available from 1.1.1969 for every day. In Table 2 is presented the rainfall data of these two stations including normal rainfall, coefficient of variation, range and number of rainy days. Accordingly the annual normal rainfall for NBK is 140 cm and that for MBK is 144 cm. The figures for JJAS are 46 and 48 cm and for OND are 84 and 85 cm respectively. The number of rainy days is nearly 26 for both JJAS and OND, 59 for the entire year for both the stations. The CV is 37, 42 and 27% for JJAS, OND and Annual rainfall respectively for NBK. For MBK similar figures are 29, 38 and 23%. Thus the rainfall of MBK shows less inter annual variation compared to the rainfall of NBK.

Table 3 presents the mean rainfall figures of both NBK and MBK for the 25 year periods of 1969-83 and 1984-2018 for JJAS, OND and Annual. The difference (former-latter) of these two means and its statistical significance is also indicated in each case. As shown the differences are all positive reaching nearly 10 cm for NBK Annual and 4 cm for MBK Annual. Though these are not statistically significant it is obvious that despite large inter annual variation the rainfall of Chennai city observatories has shown some increase which is welcome for a water stressed city such as Chennai.

5. Breaching of rainfall records in the recent past

In recent years there have been several instances when previously set climatological extremes on Chennai rainfall have been breached. Some of these are enumerated below:

For NBK: For JJAS 712.5 mm rainfall was recorded in the year 1961, which was breached in 1996 when 1178.3 mm was received.

For OND 1417.4 mm was realised which was breached in 1997 receiving 1570.7 mm which was again breached in 2005 receiving 2105.7 mm

For Annual rainfall, the year 1903 received 1946.2 mm rainfall which was breached in 1996 receiving 2438.6 mm and again in 2005 receiving 2562.8 mm

For MBK: For OND the year 1946 received 1546.8 mm which was exceeded in 2005 receiving 1859.9 mm and again in 2015 receiving 1879.1 mm

For Annual, the year 1977 received 1798.1 mm breached in 1985 (221.4 mm), 2005 (2394.8 mm) and again in 2015 (2453.6 mm).

In the 50 year period of 1969-2018 NBK and MBK received less than 100cm annual rainfall in 7 and 3 years respectively.

It is thus evident that rainfall of Chennai city has not only maintained its stationarity characteristic albeit with a slight increase with several rainfall records breached in recent years. Averments such as Chennai rainfall has decreased, heavy rainfall no longer occurs are unfounded though it must be said that there is very wide inter annual variation.

6. Rainfall during 2015-18

Now coming to the performance of monsoons in the year 2018 and a few preceding years, it is well known that 2018 received poor NE monsoon rainfall and Chennai city suffered severe water scarcity. In Table 4 we present the rainfall figures of Chennai, Tiruvallur and Kanchipuram districts for the years 2015,16,17 and 18 for JJAS,OND and annual, both as actual rainfall and as percentage departure from normal (PDN). In Table 5 similar figures for NBK and MBK rain gauge stations are presented.

As seen 2015 has been a prodigious rainfall year, 2016 poor NE monsoon year reflecting in annual figures also, 2017 good NE monsoon and near normal annual rainfall, 2018 a bad year in all the three periods, viz SW,NE and Annual. However despite the poor monsoons in terms of PDN figures the absolute rainfall figures for Chennai, Kanchi and Tiruvallur districts are 75, 83 and 75 cm respectively for 2018.

The annual rainfall realised within Chennai city at NBK and MBK was 149 and 160 cm respectively in 2017 and 83 and 102 cm respectively in 2018. In 2018 NBK and MBK received near normal rainfall of nearly 44 cm in JJAS preceding the NE monsoon.

7. Importance of Evaporation

Yet another factor that has to be taken into consideration while we analyse the water availability in a particular region in relation to the rainfall realised in that region is the quantum of evaporation. A percentage of rainfall falling into the surface would be evaporated back to the atmosphere. For Chennai and surroundings the Potential Evaporation or PE which

is the amount of evaporation when water is always available for evaporation, is close to 200cm thus exceeding the annual rainfall. However the actual evaporation for the entire region would be much less as water may not be available in every part of the region throughout the year. However the high PE values do indicate the potential for water stress in the region.

8. Discussions and conclusions

Chennai city has been known as a water starved city not just now but even in the 1960's. In the city substantial population still depends upon open wells and bore wells for their water needs. Piped water supplied by the Corporation is available only to a limited extent. As such the rainfall realised within the city limits is as important as the rainfall realised in the catchment areas of the dams and reservoirs which feed water to the city. Frequently the public and sometimes even the media do not correctly differentiate between scarcity of water and deficiency of rainfall and the rainfall is described as deficient even if normal rainfall is realised.

The technique of Rain water harvesting (RWH) which has been adopted in recent decades has definitely improved the situation in several building complexes. Recycling of waste water is another technique which could be implemented and the water thus recycled could be used for flushing of toilets. This could generate up to 25 litres of water out of the 100 litres which could be the optimal amount of water requirement per person per day for Chennai city. Both RWH and recycling will need some investment and planning before a housing complex is built.

It is also known that the several streams which take rain water to the reservoirs are beset by heavy encroachments which prevent the free flow of rainwater. This issue could be addressed but will need political will coupled with administrative action. Deepening of reservoirs and removing silt accumulation will be able to reduce the evaporation of water from reservoirs to some extent. The annual rainfall realised in Chennai city even in a deficient year is still higher than the annual normal rainfall of a few other metros such as Delhi, Bangalore and Hyderabad. Whether it is possible to plan for normal availability of water even if the rainfall is slightly deficient is a challenge which could be addressed. In all such planning the unstable nature of NE monsoon and its rainfall and the wide inter annual variation of both NE monsoon and annual rainfall should be taken into account. ■

Table 1a

Normal seasonal and annual rainfall (in mm) of a few stations of Chennai and surrounding districts (1951-2000)

Station	District	JF	MAM	JJAS	OND	Annual
Nungambakkam	Chennai	38.4	65.0	442.6	856.7	1402.7
Meenambakkam	Kanchipuram	42.1	68.6	487.8	777.7	1376.2
Chengalpattu	Kanchipuram	28.7	58.3	461.7	622.7	1171.4
Sriperumbudur	Kanchipuram	24.5	71.1	459.7	637.1	1192.4
Kanchipuram	Kanchipuram	22.1	80.8	558.4	531.9	1193.2
Tiruttani	Tiruvallur	29.2	79.4	461.9	441.8	1012.3
R.K.Pet	Tiruvallur	12.5	76.5	406.9	397.9	893.8
Poondi	Tiruvallur	39.6	67.0	538.6	591.5	1236.7
Red Hills	Tiruvallur	39.0	62.7	404.8	750.5	1257.0
Ponneri	Tiruvallur	39.0	55.2	427.5	757.1	1278.8
Arakkonam	Vellore	23.9	79.9	504.8	509.5	1118.1

Table1b

Normal seasonal and annual rainfall (in mm) of Chennai and surrounding districts (1951-2000)

District	JF	MAM	JJAS	OND	Annual
Chennai	36.7	58.5	439.1	789.9	1324.2
Kanchipuram	29.1	66.0	490.8	641.8	1227.7
Tiruvallur	31.5	67.2	451.6	589.3	1139.6

Table 2

Normal seasonal and annual rainfall (in mm) of Nungambakkam and Meenambakkam Observatories of Chennai City (1969-2018)

Station		JF	MAM	JJAS	OND	Annual
Nungambakkam	Mean mm	33.9	58.0	461.8	840.0	1393.6
	CV %	208.1	144.2	37.0	41.6	27.2
	Range mm	0-398.7	0-423.7	197.2-1178.3	311.5-2105.7	738.1-2562.8
	NRD	1.6	2.7	26.2	27.3	57.8
Meenambakkam	Mean mm	36.1	71.5	484.4	850.0	1442.1
	CV%	175.1	118.5	28.6	38.2	23.0
	Range mm	0-322.6	0-363.1	176.0-772.4	350.3-1879.1	873.1-2453.6
	NRD	1.9	3.0	27.6	27.3	59.7

Table 3a
Rainfall statistics and short term trend of rainfall of Chennai
Nungambakkam and Meenambakkam observatories 1969-2018

Station	Season	Mean (mm)	SD (mm)	CV (%)	CC	<i>t</i>	<i>n</i>
Nungambakkam	JJAS	461.8	170.7	37.0	0.19	1.37	50
	OND	840.0	349.4	41.6	-0.02	-0.13	50
	Annual	1393.6	378.5	27.2	0.09	0.63	50
Meenambakkam	JJAS	484.4	138.4	28.6	0.05	0.38	50
	OND	850.0	324.7	38.2	-0.00	-0.02	50
	Annual	1442.1	331.4	23.0	0.07	0.50	50

Table 3b
Difference between means of 1969-83 & 1984-2018

Station	Season	Mean 1969-83 mm	Mean 1984-2018 mm	Difference mm	<i>t</i>	<i>n1,n2</i>
Nungambakkam	JJAS	431.1	492.6	61.5	1.30	25, 25
	OND	829.3	850.7	21.4	0.22	25, 25
	Annual	1343.8	1443.4	99.5	0.94	25, 25
Meenambakkam	JJAS	478.8	490.0	11.1	0.28	25, 25
	OND	849.9	850.1	0.2	0.00	25, 25
	Annual	1420.2	1463.9	43.7	0.47	25, 25

n1, n2 - No. of observations during 1969-83 and 1984-2018 respectively

Table 4
Rainfall (mm) during 2015-19

Year	District	JJAS A	JJAS P	OND A	OND PDN	Ann A	ANN PDN
2015	Chennai	370.0	-16	1614.5	104	2057.6	55
2015	Kanchi	345.0	-30	1815.1	183	2256.6	84
2015	Tiruvallur	455.1	1	1469.9	149	2019.2	77
2016	Chennai	495.8	13	342.1	-57	1036.6	-22
2016	Kanchi	484.2	-1	334.8	-48	992.5	-19
2016	Tiruvallur	406.8	-10	247.8	-58	814.3	-29
2017	Chennai	449.8	2	937.8	19	1393.8	5
2017	Kanchi	493.9	1	672.5	5	1197.2	-2
2017	Tiruvallur	503.3	11	677.9	15	1203.1	6
2018	Chennai	395.3	-10	353.6	-55	754.9	-43
2018	Kanchi	397.0	-19	417.1	-41	833.0	-32
2018	Tiruvallur	364.3	-20	343.2	-42	733.4	-35

JJAS : June July August September OND : October November December

A : Actual, N : Normal, PDN : Percentage Departure from Normal

Table 5
Rainfall (mm) in Nungambakkam and Meenambakkam during 2015-18

Year	Nungambakkam			Meenambakkam		
	JJAS	OND	Annual	JJAS	OND	Annual
2015	407.7	1663.9	2094.6	427.9	1879.1	2453.6
2016	526.3	324.6	1060.7	522.5	459.1	1228.8
2017	508.7	978.5	1494.8	638.2	960.6	1609.5
2018	432.3	388.7	826.8	441.1	563.9	1018.2



Fig.1. Geographical locations of Chennai, Kanchipuram and Tiruvallur Districts

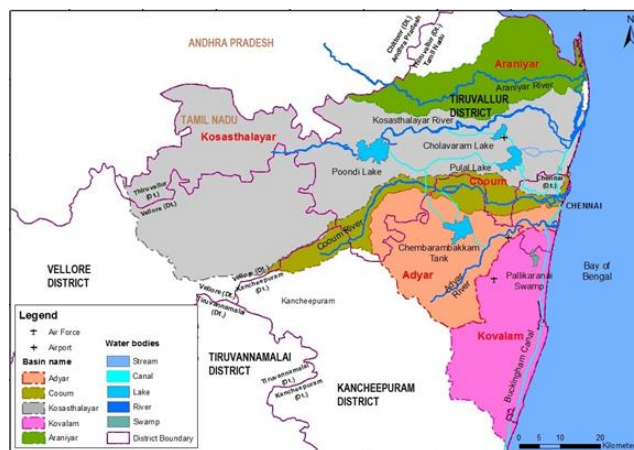


Fig.2. Geography of Chennai City and Surroundings

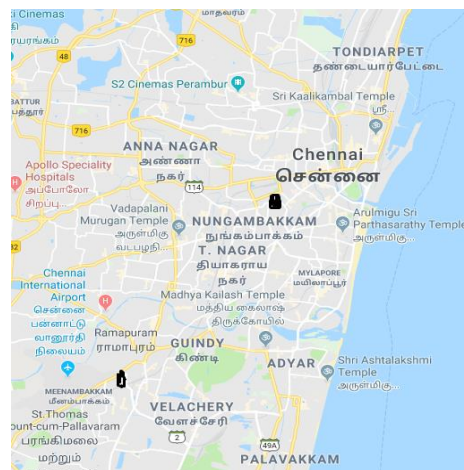


Fig.3. Location of Nungambakkam and Meenambakkam

Monitoring Landslides from Satellites

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With the advent of satellite era, study of large scale features of different atmospheric and meteorological processes has been advanced to a great extent. Due to the coarse resolution data sets provided by satellites, monitoring the hazardous events had not been possible in the earlier days. With the rapid improvement in satellite retrieving algorithms and technological changes in the sensors, satellites are thus able to give high resolution data sets. These features can be taken as an advantage to study the natural hazards such as floods, landslides and local heavy rainfall events. Different studies have already emerged in reporting the structure and spatio-temporal extent of heavy rain events across the globe. Also utilisation of satellite retrieved rainfall data is being used for many flood forecasting systems. However, the fine resolution satellite rainfall data can also be attempted to study the rainfall induced landslide occurrences in the terrain areas where conventional measurements of rainfall are a difficult task. The advances in monitoring the rainfall induced landslides take part in mapping the landslide prone zones, estimating the rainfall thresholds for landslide occurrences. But the advantage of satellite capability in providing the near real time data for monitoring the landslides over Indian region has not been fully explored yet.

Global landslide catalog reports that during 2007 to 2015, more than 100 landslides occurred over the WG region of India and most of them are rainfall induced which caused the damage to human accessories and resulted in severe mortality rates. For example, *Malin* landslide (Maharashtra, Pune) which occurred on 30th July 2014 caused the huge loss of property and killed more than 200 people (Savade et al, 2017). This shows that an immediate attention to be paid in studying the rainfall induced landslides in order to assess and monitor them, which helps in framing the predicting systems to minimize the human and property loss. Ground based measurements over complex topographic regions are very sparse and may involve many corrections in the data related to orographic effects, quality control etc.

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So, in these conditions, satellite rainfall data can be taken as a substitute for the ground measurements. The lacuna for considering the satellite rainfall data sets for the aforementioned hazards is the spatio-temporal resolution and accuracy in estimating the rainfall.

In light of above, Thakur et al 2019 attempted a study to monitor the rainfall induced landslides over Western Ghats (WG) by using the satellite rainfall measurements. Satellite based rainfall data from TRMM and GPM have been used in the study. It may be noted that the rainfall data obtained from these satellites have been subjected to different statistical tests and processes. Good agreement between the ground gauge measurements across the globe has been reported in literature. Further, a few studies recommended the correction factors for the accurate estimation of satellite rainfall data using the ground data (Thakur et al. 2019). In this article, we present our study in understanding the rainfall conditions obtained from the satellites (TRMM & GPM), ground measurements (IMD) and WRF rainfall simulations for the three landslide events occurred on 30th July, 2014 (event 1), 3rd September 2009 (event 2) and 12th August 2008 (event 3). The locations of the landslides occurred in the Western Ghats region can be seen in Fig.(1).

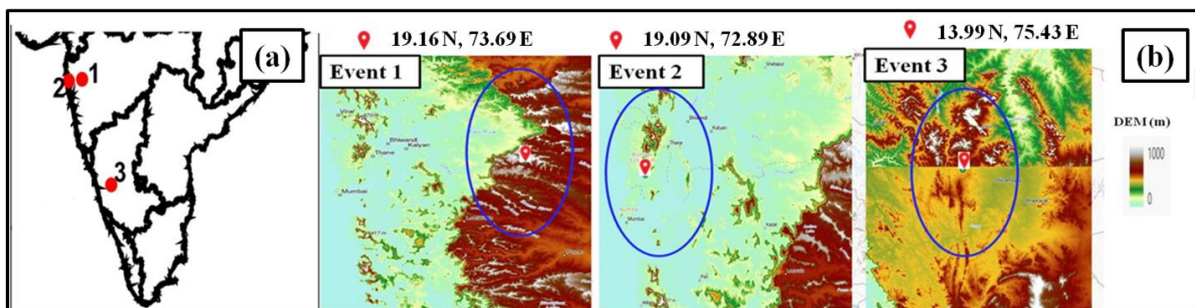


Fig. 1.(a) Location map of three landslide events (1,2 and 3) and (b) Elevation map of the landslides site and nearby surrounding area

Based on the coverage of the rainfall data, we have used IMERG data for the event 1 and TRMM data for the remaining events. The time series of rainfall during these landslide occurrences show higher magnitudes with different intensity rates. The accumulated rainfall for the five days over the three locations show a gradual increase and peak activity during the time of landslide occurrence. The accumulated rainfall conditions are one of the major criteria in mapping the landslide prone areas and also in estimating the rainfall threshold for their occurrence. The advantage of using IMERG is its high resolution on space and time scale. IMERG provides data at 30 min time interval and $0.1^{\circ} \times 0.1^{\circ}$ spatial grid resolution. While the earlier data sets (TRMM) provide data with a resolution of 3hour interval, IMERG final and IMERG early (Near Real Time - NRT) with 30 minutes interval could show a gradual increase of rainfall attaining the peak activity at the time of *Malin* landslide (occurred

during the morning hours of 30 July 2014). The comparison of NRT and final version of IMERG go both hand in hand in depicting the rainfall pattern at 30min time interval, thus IMERG early run shows its ability in capturing the *Malin* landslide (Fig.2).

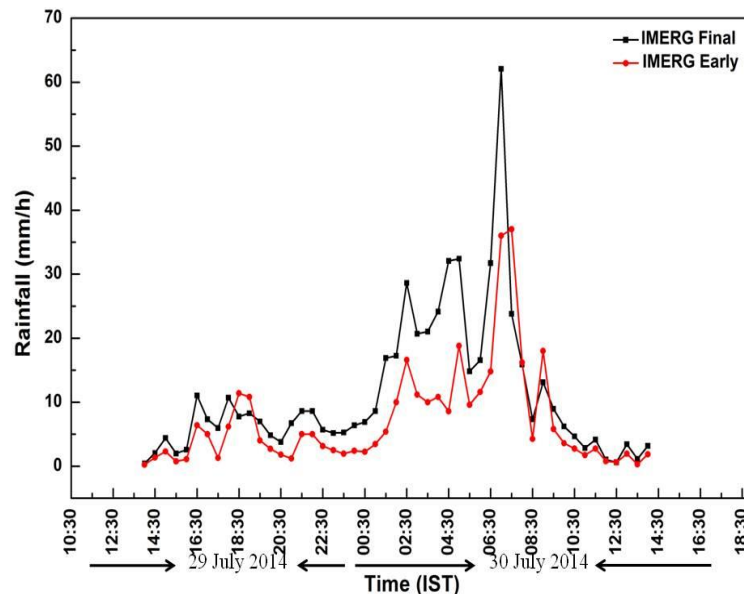


Fig. 2. Half-hourly IMERG Final and Early rain rate before and after Malin landslide occurrence* (*Communicated for publication in Advances in Space Research)

The actual rainfall which is collected from the IMD shows good agreement with the rainfall that estimated from the IMERG final. We also verified these rainfall magnitudes with the WRF model simulations over the respective locations. Model outputs with 9km x9km obtained by applying the suitable physics schemes of WRF show a similar rainfall pattern during the landslide occurrences. Hence using the satellite data of high resolution with a supplement of model derived rainfall patterns, *Malin* landslide has been captured and well reported in our study. However, the present resolution of the satellite rainfall data sets (30 minutes & $0.1^{\circ} \times 0.1^{\circ}$) is still a challenge in accurately locating the rainfall induced landslides. Finally, we conclude that satellite observations need to be improved further in providing the measurements at micro scale to effectively monitor the landslide hazards.

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South West Monsoon - 2019

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During mid-May 2019, development of southerly to southwesterly flow over southern parts of north Indian Ocean (NIO), strengthening and deepening of cross-equatorial flow over the Andaman Sea were observed. Cloudiness, rain and associated cyclonic circulation at mid-tropospheric levels led to the arrival of southwest monsoon (SWM) over south Andaman Sea, some parts of South Bay of Bengal and Nicobar Islands on 18th May. By 30th May, SWM flow covered SW, SE and Central BoB and remaining Andaman Islands.

Over Kerala, out of 14 stations considered for SWM onset, 71%, 57% and 50% stations had reported rainfall of more than 2.5 mm on 6th, 7th and 8th June. *Thus the southwest monsoon commenced over Kerala on 08th June with a delay of 7 days from normal.* Followed by onset, further advance was sluggish due to the formation of a depression over east central Arabian Sea which became a Very Severe Cyclonic Storm 'VAYU' (10-17 June). The Somali Low Level Jet (LLJ) at 850 hPa in the region (50°E - 70°E, 5°S - 20°N) strengthened and peaked in mid-June which accounted for the genesis of 'VAYU' and intensification in to a VSCS. Further advance of monsoon took place after the dissipation of 'VAYU'. By 20th June SWM covered entire Peninsular India.

During the SWM period, the off-shore trough along the west coast remained inactive most of the days in the month of June and Sep and active for more than two weeks continuously in the month of July & August. It is not common that the off-shore trough remains active for such a long period during August. There were 14 monsoon low pressure systems formed in the North Indian Ocean, of which two becomes VSCS, one in June and September. Though the frequency of cyclonic storms is not common in these season, past 30 years of data shows there had been 3 more such years when cyclonic storms were reported i.e. in 1996 (2 CS), 2007 (2) and 2015 (2). The deep depression which formed in August caused fairly widespread to widespread rainfall along Kerala, Coastal & Interior Karnataka, Konkan & Goa and over Ghat sections of Tamil Nadu with very heavy rainfall by strengthening of the monsoon current. Based on past 143 years of data, it has been found that Kerala witnessed second highest rainfall in the month of August with 950.5 mm.

⁺ Area Cyclone Warning Centre, Regional Meteorological Centre, Chennai

The ever recorded maximum was 1132.9 mm in the year 1931. Similarly two stations in Avalanche of Nilgiris district of Tamil Nadu reported 228 cm and 300 cm rainfall between 3rd to 11th August. Overall, the entire southern peninsular India received 840.9 mm rainfall which is 15.8 % more than the seasonal normal of 726.2 mm.

Due to the prevalence of an active ITCZ, across central India, north Indian Ocean, and non-formation of anti-cyclonic circulation in lower tropospheric levels over Rajasthan in 1st September, the withdrawal of southwest monsoon was delayed till 9th October the most delayed since 1961. In 1961 it was 01st October followed by 30th September in 2007. Between 13th and 15th October, SWM withdrew from entire north Bay of Bengal, central Bay of Bengal, entire Odisha, Chhattisgarh, some parts of Coastal Andhra Pradesh, Telangana, North Interior Karnataka, entire north Arabian Sea and some parts of central Arabian Sea.

Thus in a rapid phase, the Southwest Monsoon withdrew from the entire country, giving way to simultaneous commencement of northeast monsoon rains on 16th October, 2019.

Melody of South West Monsoon – 2019

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The contents of this article are purely my imagination as a weather outlook when South West monsoon 2019 was drawing to a close. I have put the melody of South West monsoon-2019 which is on the verge of a grand swansong.

The annual South West Monsoon musical melody is on the verge of a grand swansong after enthralling the audience spread far and across the country. The Jugalbandhi of Monsoon trough, off shore troughs and monsoon lows, over the last few months have not just alleviated the monsoon/weather watchers mood, it has also ensured the much needed flow in all the major rivers, streams, canals, water bodies and the like. The ever so classical monsoon rendition was such that it has left a lasting impression on the mind, body and soul and wouldn't be a forgotten musical note for sure.

The “Synoptic” musical wave is on a roll with all requisite key notes playing in tandem and as follows as per the official agency India Meteorological Department's observations. “The cyclonic circulation over Interior Karnataka & adjoining areas of Rayalaseema and Telangana extending up to 5.8 km above mean sea level tilting southwestwards with height persists. The trough in easterlies extending up to 5.8 km above mean sea level from the above cyclonic circulation to Jharkhand across Telangana, south Chhattisgarh and interior Odisha persists. The cyclonic circulation extending upto 0.9 km above mean sea level over north Konkan & adjoining Madhya Maharashtra persists”.

The aforementioned synoptic symphony is likely to ensure an acoustic rainfall spread across the following regions of the country. Heavy to very heavy rainfall, very likely at isolated places over Bihar and heavy rainfall at isolated places over Himachal Pradesh, Uttarakhand, East Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand, Gangetic West Bengal, Odisha, Gujarat region, Madhya Maharashtra, Konkan & Goa, north Coastal Andhra Pradesh, Karnataka, Kerala & Mahe and Lakshadweep.

With regards to TN, the Thunderstorm fusion notes is very likely to be of varying intensity with a higher degree of concentration over interiors in the noon/evening session. The musical caravan is expected to move towards north coastal regions and offer a plethora of entertainment all on its own. Let the monsoon ring in the melody.

Psychological Heat Wave?

S. Raghavan

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Editor's Note : Shri. S. Raghavan had mailed this article on 9 April 2019 for inclusion in Breeze. Due to delay in publishing the Newsletter Breeze, Shri. Raghavan had expressed in his email dated 29 July 2019 that ".....my article may be treated as withdrawn as it has lost its topical relevance because of the efflux of time". Shri. S. Raghavan passed away on 6 February 2020. Considering the sad truth that this was his last article for Breeze, it was decided to include it in this issue.

1. March Temperatures in Kerala

In the month of March 2019, there were several reports about above-normal maximum temperatures in Kerala. Some sections of the media called it a Heat Wave. Three deaths due to "sunstroke" were reported. The Chief Minister was said to have advised people about what to do such as avoiding going out between 11 a.m. and 3 p.m.

The India Meteorological Department (IMD) had forecast temperatures 2 to 3 C above normal in several districts of Kerala and interior Tamil Nadu on some days, but *not* a heat wave. Temperatures were actually 2 to 3 degrees above normal on several days. But this did not meet IMD criteria of a heat wave. In Kerala, Palakkad recorded a maximum temperature of 40.2 degrees on two occasions. This was 2.4 degrees above normal and was the highest in the State. It may be noted that Palakkad is slightly in the interior, situated at the gap in the Western Ghats.

According to old IMD records the highest maximum recorded in Palakkad in March was 41.4 C on 28 March 1959. More recent figures are not readily available on the IMD website. So the temperature of 40.2 C was well within the range of inter-annual variations and cannot be regarded as unprecedented or as caused by Climate Change.

According to the study of trends in temperatures by Rathore et al (2013), mean maximum temperatures in March in Kerala (based on data of 7 stations) showed a trend of +0.01 C per year for the period 1951-2010. The same trend is shown in the mean minimum temperature and in the daily range of temperature. These authors consider these trends significant. With this trend March mean maximum temperatures should be about 0.6 c higher now than in 1951.

2. Statistics and realities

But these statistics do not tell the whole story. Monitoring and prediction of the temperatures and their publication in the media is for the benefit of the public so that they are aware of how it will affect them and to adjust their activities accordingly. The effect on humans depends also on other meteorological parameters besides temperature. In addition, the way they perceive this information and act on it depends on several sociological and psychological factors.

Considering Meteorological factors first, the effect of high air temperature depends among others on humidity. In northwest India for instance, where the humidity in summer is very low, a desert cooler which works by evaporation of water is very effective but it is not so in more humid Tamil Nadu or Kerala. Clothing to be worn is also different in the two areas. Dr J.B.S. Haldane the British Scientist who settled down in Odisha was attending office bare-chested as he considered that that was the best attire for that climate. But that is not valid for a dry desert climate, where a bare bodied person would rapidly lose moisture by evaporation. Hence a loose white garment is usually recommended.

When a person goes outdoors in an urban area the absorption by the body, of reflected solar radiation from buildings adds to the intake by the body of direct solar radiation and adds to the heat stress. Depending on the shape of structures they may concentrate radiation in some directions. In a rural area with farmland or wooded surroundings this component of reflected radiation is very small.

The heat island effect in cities and the changes in wind circulation due to buildings also affect the local temperature in the immediate surroundings of the person.

In the case of a fully clothed sedentary person indoors, comfort zones are defined but these vary with several factors including the acclimatisation of the person. The Glossary of the American Meteorological Society says:

“As represented on comfort charts of the American Society of Heating and Air Conditioning Engineers, comfort zones are areas bounded by curves of effective temperature and relative humidity. The limiting conditions vary somewhat according to season and to the native climate of the person or group. In the United States the comfort zone with normal ventilation lies between air temperatures of about 17° and 24°C (63° and 75°F) at a relative humidity of 70%, and 19°C (67°F) at a relative humidity of 30%, giving an effective temperature within a few degrees of 19°C (67°F). The limits, however, vary with the season, being higher in summer than in winter. In the United Kingdom, the comfort zone is centered on an effective

temperature of about 16°C (60°F). In the Tropics the comfort zone lies between the same limits of relative humidity, but at air temperatures around 26°C (78°F)".

In addition, age, state of health and metabolism determine how a person is affected. We come across many people saying that this year is hotter than the last. The temperature statistics do not confirm this. As one ages one is less able to withstand heat or cold. Many in the public equate this with climate change. An increase in temperature by 0.6 C as revealed by Rathore et al (2013) may be important in other ways but should not make a serious difference to the comfort level of an individual. Also, as mentioned acclimatisation matters. Refugees from the Northwest Frontier Province (now in Pakistan) who settled in Delhi felt that the Delhi winter was not cold enough to be enjoyable (personal communications)! Hence we who live in a tropical country cannot simply go by standards of temperate countries.

3. Psychology

The feeling that the weather is hotter, itself creates psychological stress among people. This is aggravated by the practice of some electronic media to start reporting temperatures in degrees Fahrenheit in summer just to be able to say that the temperature has crossed the magic figure of 100 degrees.

An assurance that the weather is not really warmer to any appreciable extent, will relieve people of this stress.

The advice not to go out between 11 and 15 hrs is not uniformly suitable for all. Some have a need to work outdoors. This author has worked outdoors in over 40 C temperatures in Delhi, Rajasthan, Gujarat and Tamil Nadu, and was none the worse for that. But that cannot probably be done at an advanced age. Some decades ago farm workers used to start work at sunrise and work till sunset with a long break during the hottest hours of the day. There was much wisdom in this. Because of various social circumstances they now start work late and their hot hour break is curtailed. There used to be free supply of buttermilk to wayfarers but this has dwindled now.

So an adjustment of our lifestyle will go a long way in relieving stress. All concerned organisations may do well to create awareness and relieve the anxiety of people.

A Tribute to (late) Shri. S. Raghavan (1932-2020)

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This is my personal tribute to late Shri S Raghavan, who passed away on 6.2.2020, based on my long years of association with him.

1. I joined IMD at Pune in Oct 1980 first as a trainee and then in Oct 1981 as Met-2. Very soon I came across Mr SR's name and came to know that he was the head of Cyclone Warning Radar at (then) Madras. I started reading several of his papers published in Mausam. Everybody who was associated with him described him as a Radar Meteorologist extremely proficient in his field, a no-nonsense officer and a strict disciplinarian. I also came to know that he did work in Pune itself in the Agromet division in the late 1960's and up to the early 1970's.

2. In connection with a research study on tropical cyclones, Dr. A.A.Ramasastri, DDGM(WF) under whom I worked at Pune in early 1980's advised me to go to Madras on tour and spend 2-3 days at the CDR. He described Shri SR as a person '*who lives with the Radar*'. On 31.10.1984 around 1000 hrs I reported at the chambers of late Dr.N.S. Baskara Rao then Regional Director RMC Madras. There I met Shri SR also and got introduced to both. I briefed about the purpose of my visit and after some time proceeded to CDR. Shri SR had already reached CDR by then and he met me in his room along with late Shri.S.Rengarajan. Briefly he explained me about the functioning of the CDR. Then came the news that PM had been assassinated. Despite the city having come to a standstill, I somehow learnt about the DVIP facility which had been installed at CDR in the time available to me within the next 2-3 days.

3. The next occasion I had good interaction with him was in a WMO Storm Surge Workshop held at Calcutta in Dec 1987 in which myself and Shri SR (as a resource person) attended. All delegates stayed in the same CSIR Guest House and I learnt a lot from him about Cyclone Tracking, Forecasting etc in the various interactions I had with him. In the workshop his presentation on BoB cyclones contained two important theories. One is that for west moving SCS in lower latitudes the belt of strong winds is located in the left forward sector (SE) of the SCS and not in the right forward (NW) sector as widely believed. Another is that by tuning the CDR suitably it is possible to determine approximately the Radius of Maximum winds of the SCS from the radar imagery. The RMW is a crucial parameter in storm surge computations. That he could manipulate an analogue CDR to get an estimate of RMW earned

the appreciation of all including from Dr. Jelesnianski who introduced the SLOSH model of storm surge in the USA and was a very renowned SS expert.

4. During our Calcutta stay some of us took to Tram travel and also the Metro tube train travel both at that time existed only in Calcutta but each belonging to different time periods, the former bit primitive and the latter ultra modern. Shri SR used to show lot of enthusiasm for these outdoor activities and would join us after putting a leather type jacket over his shirt.

5. In the 1987 ACR meeting held at Pune Shri SR and Dr Sen Sharma contributed substantially to the proceedings by their incisive and fluent presentations. Shri SR got approved a proposal that in the event of occurrence of cyclones when Officers and Staff are held up within CWC/ACWC for some times days together, IMD should meet their food expenditure. I don't know whether this approval became office order and was implemented.

6. Shri SR was DDGM (SI) at Pune during 1986-88 and returned to RMC Madras again in 1989. While at Pune he started a Humour Club which was reported in the Pune edition of IE. Some of us working in Pune did wonder how a person such as Shri SR who appeared very serious and so business-like could be a Humour Club founder.

7. I did meet Shri SR at RMC Madras in 1990 once when he was DDGM. In Dec 1991 I came to Madras on transfer and found that Shri SR was a frequent visitor to RMC Madras even after his retirement. He used to come to RMC during the afternoon hours in his 2w riding all the way from his residence at Thiruvanmiyur nearly 12 km away from the office. He used to sit for a long time in the Library occasionally coming into my room to say hello to me and to (late) Dr T.R.Sivaramakrishnan, both of us shared the same room.

8. If I remember right, I took over from Dr. TRS the Secretaryship of IMS Madras Chapter which led me to a fruitful period of interaction with Shri SR. I used to take lot of his advice about how to enhance the activities of IMS Madras Chapter and he was ever ready to help. Once, he delivered a nice talk on the topic '*Humour in Meteorology*' and I found that within Shri SR, normally identified with the personality of seriousness and strictness, a humourist was hiding somewhere.

9. In 1999, IMS Chennai Chapter held the Tropmet-99 seminar of IMS at Chennai. I was the Secretary of Chennai Chapter then and with support from Dr. R R Kelkar, then DGM and IMS President we decided to hold the meet within RMC Chennai campus by upgrading the limited facilities available at the RMC. Shri SR played a stellar role in several types of scientific work associated with the seminar. He drafted the pamphlet content, attended all the LOC meetings, suggested the idea of Floor Managers to manage the sessions, was

considerably involved in finalising the scientific programme and chaired a session during the seminar. He was ever available for providing any advice.

10. After Tropmet-99 was very successfully completed Shri SR took over as the Chairman of IMS CC. Another one day workshop was held during this time.

11. In the late 1900 and early 2000's he started writing a book on Radar Meteorology. On several days I saw him sitting in the library for hours together taking extensive notes. Internet in India was in its nascent stage and one has to depend upon printed copies of journals and new text books to update one's knowledge. When he completed the book, it was difficult for him to get a suitable publisher. By the time a Holland based reputed publisher (Springer Netherlands) agreed to publish the book, Shri SR felt that the book needed further updating and again started working on it. Eventually the book was published in 2003 as a Library Edition and though expensive in India to buy, it was a very well written book on Radar Meteorology. (Current price US \$280)

12. Though Shri SR worked throughout his latter part of his service in the analogue radar, he was very fluent in the DWR technique and technology as well. He was in several committees constituted by IMD and DST when DWRs were being procured for IMD. Not only in DWR he was expert in several other fields of meteorological instrumentation such as Wind Profilers, MST radar, Sodar etc. Obviously he acquired this knowledge by continuous updates thru books, journals and later on thru Internet.

13. When I became DDGM RMC Chennai in Dec 2008, I had close coordination with Shri SR and worked with him during the holding of several seminars/meets/workshops organised by IMS/RMC Chennai. In Oct 2009 there was a 2 day Agromet seminar, he was in the Scientific Advisory committee providing us with useful ideas. When a 2 day seminar on DWR named Draws-2010 was held at Chennai (NIOT was the venue) in Mar 2010 organised by IMD Shri SR played a pivotal role in identifying and finalising the several scientific aspects of the seminar. A booklet prepared by him titled '*History of Radar Meteorology in India*' was released by Secretary MoES during the IF. Shri SR was also felicitated by IMD for the service he rendered to Radar Meteorology in India during the above function.

14. In 2011 IMSCC conducted a seminar exclusively on Indian North East monsoon named as Inemrec-2011. Again Shri SR was very much there in all the committees helping us to plan the seminar. In two other major events, viz. i. Brain Storming meet on establishing National Centre for Atmospheric Technology and ii. ROCOIS-BS meet on Tropical cyclones

– both organised by IMD at Chennai with national participation, Shri SR again played important role.

15. When I was asked by DGM to write a Met Monograph on Cyclone Climatology I prepared the draft (nearly 200p with several tables and figures) and requested Shri SR whether he can go through the draft. He readily agreed and went thru the material line by line so meticulously in his characteristic style making track changes in the soft copy of the doc itself. Obviously an involving, demanding and may be thankless task but he did it nevertheless to enable me to improve the content.

16. When I guided B Amudha (now Dr. B Amudha) for PhD, we used the digital DWR data on rainfall extensively. We felt that the output of the old analogue CDR which functioned at Madras up to 2002 which Shri SR headed for more than 15 years could not and would not have generated any digital output; and that in most of the rainfall related studies based on analogue CDR photographic images, the quantum of rainfall figures were all bit crude estimates. But then I read a paper by him and his co-workers entitled '*A radar reflectivity-rainfall rate relationship for the southwest monsoon season for the Madras area*' published in Mausam 1987 and found that he made good the output from DVIP attached with the analogue CDR and wondered as to how he was way ahead of the times.

17. Shri SR was present invariably in all the IMS talks and WMO day meets held at RMC Chennai and he attended even some of the in house colloquium talks. He was also present in the Viva Voce exams of my PhD students, held at RMC Chennai. His mere presence in such meets would improve the academic atmosphere and the seriousness of the meet. He used to listen to all the talks very attentively and would come out with relevant and probing questions towards the end.

18. When I retired in March 2014 Shri SR was kind enough to attend my retirement party and also delivered a brief address. On his invitation I joined VMC – Veteran Meteorological Club- immediately, which he founded before 25+ years. That he had a vision to found such a club and nurture it for more than 25 years is testimony to his commitment and sincerity. The quarterly get together meets organised and the magazine Vayu published every quarter have been his other initiatives.

19. After I moved into my Greenways Road Extension residence and Shri SR's residence at Mandaveli was just 1.5 km away, I had been to his house on several occasions. He has visited my house at least on 4 occasions generally when there are some meetings connected with VMC.

20. Though Shri SR hailed from a conservative family, he apparently lost his faith in religion and its various associated manifestations. How and when he developed this trait I am not aware. But credit goes to him that he stood steadfast in his belief (or disbelief) and that he did not flinch from this till the end.

21. When he passed away, Shri SR was 87 years+ 2 months. Though Shri SR may not have believed in GOD, let us thank the almighty GOD for Shri SR's life which was a complete life and was a life well lived.

22. I conclude my tribute by reproducing the immortal lines of Kavignar Vaali in the 1965 Tamil movie Panam Padaithavan which was composed by MSV-TR duo sung by that great singer TMS and lip synched in the movie by MGR: 'Irunthaalum Marainthaalum per solla vendum, ivar pola yaar enru oor solla vendum' இருந்தாலும் மறைந்தாலும் பேர் சொல்ல வேண்டும், இவர் போல யாரென்று ஊர் சொல்ல வேண்டும். (Rough English translation: *Whether a person is alive or no more, his/her name should remain well known, people should say of that person whether there is anybody like him/her*). Generally these lines perfectly suited MGR himself as he is still remembered decades after his death. Shri SR also will be remembered in the Indian and International Meteorological community in a similar fashion.

25. I am also enclosing a photograph taken during the visit of IMS Chennai Chapter members to Kavalur Astro Observatory some time during the 1990's. ■



A Humble Tribute to (late) Shri. S. Raghavan

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Shri. Raghavan was a living testimony of how fine and perfect a person could be. What stood him apart was his strong convictions, courage and characteristic approach which was ever disciplined and systematic. These qualities are sadly very difficult to find these days.

He will always be remembered as a no nonsense man: a man of high integrity, intelligence, shrewdness, sharp wit, great administrative skills, leadership qualities and more than all, a great human being with utmost empathy for others.

I have in-numerous pleasant memories of working under him both in cyclone and in aviation forecasting. He was my mentor both officially and post retirement. What struck me most was his meticulous approach. It will be humanly impossible to recall all the good interactions I had and the knowledge gained though I would certainly relish with nostalgia the routine discussions and exchange of information we had during actual cyclone days when I was in ACWC/CWRC while he was CDR in-charge.

The one other striking aspect which I ever admire with awe was his systematic approach of going through the journals and periodicals of Library at RMC Chennai or from anywhere and bring to the notice of relevant articles to his colleagues and subordinates, keeping in mind their interest, earlier research and operational obligations. Even while he was DDGM(I) in Pune he used to send updated articles to me on low level wind shears, microbursts etc. to mention a few. Thus he believed in nurturing and kindling the scientific temperament amongst the colleagues and subordinates.

He had a wide knowledge not only on the subject of Meteorology but also on varied topics like religion, music, literature, movies etc. Great aficionado of watching movies and a voracious reader. Endowed with a good sense of humour and a gentle demeanour, Shri. Raghavan was a good friend and lovable in the social circles too. Enjoyed his Humour Club activities immensely.

The very formation of the Veteran Meteorological Club(VMC Club) is only because of his initiative and effort. Veteran Meteorologists Club was founded by him in 1993 where retired colleagues could keep in touch regularly. Started off with regular meets, then in pace with technological advancements, bloomed to its present glory to establish an active Email

and WhatsApp groups. He ever aspired to maintain its standard and decorum taking care not to indulge in controversies and other unpalatable exchanges among the members.

In spite of his open rational views, he was well versed in ancient Indian literature and scriptures and could effortlessly quote from Bhagavad Gita, Thirukkural and Sangam (Tamil) literature.

The character of the life he lived might be summed up in a few words: he was sincere, he was earnest, he was loyal.

Very devastating that a colossus has fallen indeed. The grief and sorrow of the entire meteorological fraternity will be unfathomable.

May his soul rest in peace.



கண்ணீர் அஞ்சலி ...Tearful Tribute to Late Shri. S. Raghavan



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Amongst the Chennai based- or for this purpose jurisdiction of Regional Meteorological Centre (RMC), Chennai based- my senior or contemporary Meteorologists, I had limited period of association with late Shri Raghavan - who is not physically present with us from 6th February 2020 -, as (i) my interactions started only from 1994 and (ii) I did not work under him in his official capacity in India Meteorological Department (IMD). When I was undergoing one year training as Meteorologist Grade II (Weather Forecasting) at IMD, Pune during September 1989-1990, Shri S. Raghavan (hereafter SR) was working as Dy. Director General of Meteorology (Surface Instruments) at Pune and was transferred during November 1989 to Chennai and retired from Government service on 30th November 1990. Neither I had seen him nor had any interaction with him at Pune albeit my fellow trainees who were earlier working in IMD spoke about him with great regards and high respects. Nonetheless, on my transfer from Aerodrome Meteorological Office (AMO), Santacruz, Mumbai to Chennai during late 1993, I had substantial interactions / discussions with him from 1994 on officio-personal, scientific and above all matters of common interests including religion and ethics. In addition, when I worked with him in many committees and in various capacities in Indian Meteorological Society (IMS) Chennai chapter (IMSCC) including as Secretary of IMSCC when SR was the Chairman, I admired his way of working, straightforward comments (including cutthroat) as well as compliments besides his meticulous attention to even minute details. On the day of his demise on 6.2.2020, I was far away from Chennai on a pilgrimage but could recapitulate his feeble voice on a telephonic conversation with me nearly a month back on some ecological issues and expressing his sinking health condition. I am sharing my interactions with him, as one of his deemed family members since SR used to say I was like his son on a few counts to his wife and mother-in-law, through this tribute.

Scientific & Technical :

1. Many of the readers of this tribute are well aware of scientific and technical knowledge of SR and I will not delve much on known things but for stating the following few. He had been adjudged as Radar Meteorologist of India by international forums. His dedication in the field

of Radar Meteorology, systematic maintenance of Radar to effectively use it well beyond thrice the normal life span of Radar are well established to Meteorologist community in India and abroad. SR had the wisdom of preserving analogue Radar data and products (though mostly in photography, microfilm format which were only available those days) for future reference, record, analysis and research.

2. In addition to Radar, he had a thorough knowledge of other surface and upper air meteorological instrumentation. His interest went to stellar and astronomical observations also as he himself participated in many of the eclipse scientific campaigns. SR was second to none in updating his instrumentation knowledge on any field be it that of Aviation Meteorology, Satellite Meteorology, Boundary Layer Meteorology, Agrometeorology. He was instrumental in conducting a heat island study experiment in Chennai.

3. When Satellite based direct readout ground station for receiving and processing NOAA polar orbiters was getting installed in RMC Chennai during 1994-1995, I had seen him visiting and guiding with his own style. I was posted as Meteorologist grade II in that unit on its commissioning and started working in that field with high zeal and enthusiasm by developing software for archival of digital image data and products and processed sounder (TOVS) products. Delighted to see the real time and archived 1.1 km resolution processed VIS and IR imageries, many of the TOVS products from NOAA-12 and 14 satellites and semi-automatic mode of building up TOVS climatology data in data cartridges (DAT/DLT), he through (late) Shri G.S. Ganesan, the then Head of RMC Chennai, asked me to give a colloquium talk on that facility during which period I was promoted as Meteorologist Grade I and transferred & posted to Civil Aviation Training College (CATC), Bamrauli. On listening my colloquium talk during 1996, SR praised and appreciated the efforts taken by me and commented if he were Head of RMC, Chennai he would saw to it that I did not go out of that Satellite Met. unit, Chennai in view of my ongoing initiatives in Satellite Meteorology and that spoke about his erstwhile official determination, audacity and authority in administration while in service.

4. After completing little more than one year period at CATC Bamrauli as teaching faculty of aviation meteorology, I got my transfer back to Chennai during late 1997 and started working in the same Satellite Meteorology unit. SR used to interact with me, whenever he visited my unit or while he visited RMC library, by giving reference to latest international papers on Satellite Meteorology especially on sounders. In fact, the celebrated book on Satellite

Meteorology by Kidder and vonder Harr (1995) was ushered to me only by him as he was knowing about that book by subscribing to American Met. Society journal(s) - courtesy his son Shri Manmatha. He had all praise when I was diagnostically working with TOVS data during 2000-2001 to understand the plausible reason for the peculiar looping and southward travel of Mahabalipuram cyclone (28 November-7 December, 1996) by consulting a paper by Simpson (1954, *On the structure of tropical cyclone as studied by aircraft reconnaissance, Proc. of the UNESCO Symp. of Typhoons, Tokyo, 129-150*). As SR liked my inquisitiveness and more specifically consulting that particular literature, subsequently he gave me a good account of reconnaissance flights and dropsondes which were, till that time, unknown to me. My TOVS work when published in *Mausam* (2002, *Mausam*, 53, 2, 215-224) ultimately was adjudged as the best paper for the 22nd Biennial Mausam Award for the term 2002-2003. SR considered that as an award to RMC, Chennai as it was the first Mausam award won by a Scientist from RMC, Chennai to which he had a bonding.

5. I functioned as Secretary, IMSCC when SR was the Chairman during 1999-2001. During this tenure, IMSCC conducted a number of symposiums including TROPMET-99, seminars on popularisation of Meteorology and allied sciences including educating School Teachers teaching Physics and Geography on latest in Meteorology, Climatology, quiz program for students etc. SR had openly appreciated the pace with which I was drafting and disseminating the minutes of our council meetings within a day or two in those days whence usage of email was not that popular. As a token of my memory on TROPMET-99, I am pasting below a photo from my album of a technical session which was chaired by SR and myself as the *floor Manager*, the concept he ushered for the first time I suppose in the history of TROPMET series, *as this was the first photo I had with him*.



Love for Environmental Science & a Naturalist :

6. SR had a passion for watching and admiring nature. He along with naturalists and ornithologists used to go to *Pazhaverkadu* (a place near Pulicat lake – close to Shriharikota) for bird watching. He had a good understanding of land use and concern for its deterioration due to human activities. Whenever opportunity arose, he used to raise his concern vociferously on the deteriorating environment due to wrong land use. SR loved visiting historical places and monuments besides going for a merry-go-round with his family to enjoy the nature's beauty. Until 2013, he used to send new year greetings mostly on 31st or 30th December by way of photos taken by him to his mailing list. I am placing below some of his new year greetings which speak about his love for nature and passion for photography. From 2014, he dispensed this sort of attachments but send normal greeting phrases through email on 31st December.

<p><i>Best wishes for a HAPPY NEW YEAR</i> 2007</p>	<p><i>Best wishes for a HAPPY NEW YEAR</i> 2012 <i>and a Great Environment</i></p>
 <p>Rajiv Gandhi National Park, Nagerhole, Karnataka, India, which we visited last week (Mother and Baby crossing the road near our jeep)</p>	  <p>Birds at the Adyar Estuary, Chennai. The river is highly polluted by wastes and is also encroached upon by builders and others. There may be no birds in the future- Photo by SR</p> <p>Pileus Cloud at Elliotts Beach, Chennai on a July evening. In the foreground is the KAJ Schmidt monument which is ill-preserved. ((Photo bySR)</p>
<p>From R. Lakshmi and S. Raghavan</p> <p>11/16, Bayline Apts., 15, Cross St., Radhakrishnan Nagar, Chennai-600041, India</p>	<p>From R. Lakshmi and S. Raghavan</p> <p>G 1, PRATHYEKA APTS., 12, 1 ST TRUST LINK ST., MANDAVELI, CHENNAI- 600028., INDIA</p>

7. When I was carrying out clear air radar returns and Radar ornithology related studies during 2004-2005 and published a paper in *Mausam* (2005, **56**, 2, 447-464), SR was the first person to laud that work and said 'had I been in your place, I would have made three papers out of the material pumped in that paper'. I still recollect his words which were encouraging me as a budding Radar Meteorologist. After that paper publication, whenever a paper on birds / insects (Radar ornithology / entomology) is read or encountered by SR, he invariably passes those paper / cuttings / reference to me. It appeared that SR had cultivated interest on this subject to his grand-daughter also as can be seen from his mail to me enclosing a cutting from *Science* he had received from his grand-daughter.

On Thu, Jan 12, 2017 at 11:25 AM, S. Raghavan <raglaksh@gmail.com> wrote:
12 January 2017

Dear Dr. Suresh,

The attached article on Insect travel tracked by radar (obtained by me from my grand-daughter) may interest as you had made radar observations of birds/insects some years ago. I thought the Science article would be a detailed paper but it only gives some generalities which are mostly known.

Raghavan ... Radar ornithology Anusha 120117.pdf

Best wishes for a HAPPY NEW YEAR
2013



← Raghavan's father's farm at Samalpatti, Tamil Nadu, where he spent his younger days

→ Birds and Squirrels at Lodhi Garden, New Delhi

← Lake near Naini Tal, Uttarakhand,

→ Temple architecture Hampi, Karnataka

Some Memories

From R. Lakshmi and S. Raghavan

G 1, PRATHYEKA APTS., 12, 1ST TRUST LINK ST., MANDAIVELI,
CHENNAI- 600028., INDIA

Humour, Jovial and Sarcastic :

8. SR was known for his seriousness and as a tough task master while he was in service when dealing with non-performers. He was also known for giving lift and encouragements to those whom he considered deserving. I was told that there could be hardly a few who did not receive any memo for their lapse or inefficiency or imprecision, if any, while working under him especially on Radar operation and servicing. Yet, he was having a taste of humour. SR delivered a talk on 'Humour in Meteorology' under the aegis of RMC Chennai and IMSCC. He told me many wits and jokes of day-to-life in lighter vein and even mono acted a particular situation of day-to-day life by speaking English with typical accent and style of people from Tamil Nadu, Kerala, Andhra Pradesh, Uttar Pradesh and West Bengal when we

went for a morning walk while on tour to National Atmospheric Research Laboratory, Tirupati. His vocabulary, usage and observation of phonetics had a deep bearing in me.

9. While I was on tour to Indian Institute of Tropical Meteorology, Pune during 28-30 March 2019, I noticed a paper cut on 'splendid birds' at Pulicat lake near Shriharikota which I forwarded by email on 28.3.2019 to SR and some other Radar Scientists to whom it would be of interest on radar point of view. When one in that mailing list responded by email to the extent that he also had observed similar movements of birds and through Radar signatures some years earlier, SR quipped immediately by a reply email on 2.4.2019 with his own style, "*Your experience in respect of Bird movement is interesting. But why do you have to send the message on 1 April?.. Raghavan*". Of course, that witticism was taken sportively by all concerned.

10. SR used to stress the matters of importance in his own witty style, at times. Here is an example from his presentation. *Forecast QUALITY is the degree of correspondence between the forecast and the weather experienced. The economic VALUE of meteorological information is defined as the saving or benefit the user gets from applying the information (data or forecasts). Information can be accurate but (at times) useless. A balloonist has a problem with his balloon and comes down in a field. (No GPS at that time). He does not know where he is. He asks a passerby, "Where am I"?. The latter replies "You are in a balloon". 100% correct answer but of no use. Example of October weather in Delhi.*

Economics and Meteorology :

11. SR often advocated Environmental Economics and Ecological Economics should be of interest to Meteorologists dealing with the Environment. SR stated '*Physics can be applied to Economics but one has to be cautious since the latter deals with human behaviour and not natural laws!!*'. His idea on economics vis-à-vis meteorology are reproduced from one of his presentations. *Economists and Meteorologists are the only people who try regularly to predict the future (apart from Astrologers). But though the USA has most of the Nobel Laureates in Economics, they failed to predict the recession in 2008. After the event they wrote a lot about it. Meteorologists have done better apparently because Economics is based on human behaviour while Meteorology is based on Physics. Meteorological prediction however has limitations.*

12. SR considered unwise land use, such as destruction of vegetation (coastal wetlands, forests), indiscriminate construction, blocking natural water flow, excessive depletion of ground water, destruction of water storages and occupation of vulnerable areas, as economic activities. According to him, *in India the 2013 Uttarakhand flood, the 2005 floods in Mumbai and Tamil Nadu and the landslide near Pune in July 2014 and even the floods in Chennai in December 2015 following heavy rain showed the impact was largely human made or aggravated by human actions.* He always opined that *droughts were also often human made.*

Religion, knowledge on Veda, Sastras and Tamil literature :

13. SR was widely known as an atheist and did not believe in religious rituals. Yet, he had very good Sanskrit knowledge and knew *Sastras, Smritis and Puranams.* He was a theist in his early days and changed 180 degrees due to circumstance as he told me once. He often talked about *Ithihas and epics* based *Matsya Nyaya* (i.e the law of fishes.... bigger one swallowing/devouring smaller ones). Although he considered and openly admitted on many forums / occasions that Mathematics was above his head, he used to quote a couplet from a 9th century great Scholar Mahavira लौकिके वैदिकेवापि तथा सामाईकेपी यह व्यापारस्तत्र सर्वत्र संख्यानमुपयुज्यते which were uttered in the context that *calculations were of use in day to day as well as vedic / religious life.*

14. He was often in search of Manusmriti from which IMD quoted आदित्याज्जायते वृष्टिः as its motto in its emblem. Only on seeing the full Manusmriti 3/76 verse, he got convinced about the sequence from rain to plant and animal life. The same is reproduced below:

अग्नौ प्रास्ताहुतः सम्यगादित्यं उपतषिठते । आदित्याज्जायते वृष्टिर्वृष्टेरन्नं ततः प्रजाः which means the offerings given through fire reaches the Sun God and is getting converted into Rain and from Rain, food grains (*annam*) and from food grains, life (plant and animal, more specifically human life) are produced. I had a series of correspondence during 16-18 January 2012 on this subject.

15. During our personal conversations, SR quoted few verses of *Bhagavad Gita*, especially from *Karma Yoga* as it talks about ‘devotion to duty’ and to that extent only he liked *Bhagavad Gita*. During 2002-2010, I visited his house periodically for some discussions, to assist him in preparing power point presentations on a few cases and for copying American Met. Society journal papers. I used to discuss with his mother-in-law on pious and religious

matters. During such conversations, he used to have a patience listening but never countered even when he considered they were not to his taste. Such was his magnanimity.

16. SR wanted to revisit the available Tamil glossary on meteorological terms of RMC Chennai for unambiguous and proper reporting of weather by print and electronic media. A committee was constituted by IMSCC collaborating with RMC Chennai during 2006. Media were unable to distinguish between drizzle, rain and shower but reported all these three phenomena as *Mazhai* (மழை) which is the correct usage only for rain. Though we had *Thooral* (தூறல்) as Tamil word for drizzle, there was no word available for shower in that glossary of RMC Chennai till that time. I suggested *sara mazhai* (சரமழை) from the 4th song in *Thiruppavai* of the Tamil poet *Aandaal* (8th century**) and explained the stages of Rain and thunderstorm mechanism as spelt by that poet and compared with 16th song of *Thiruvempavai* by another poet *Manickavasagar* (6th or 7th century**) who mentioned even the precise levels of byproducts of thunderstorm including formation of rainbow in its wake which are in conformity with modern days' scientific observational truths. [** exact period of those poets still not yet converged, but definitely more than 1000 years from now has been accepted without any dispute by historians]. Even though, those songs were in praise of *Lord Krishna and Goddess Parvathy* respectively with poetic metaphor, SR appreciated the impeccable observation capacity of nature by those Tamil scholars and many other poets. After finalising all Tamil glossary terms that would be of day-to-day relevance for reporting weather by media, IMSCC released that Glossary of meteorological terms in Tamil in 2006. As a sequel, we had individual discussions on some occasions about ancestral Tamil poets (from centuries to millennium old) indicating Pascal's law, Newton's law, vorticity, tsunami etc.

Data source / Knowledge bank :

17. In regard to Science, SR had a passion and interacted with all young and old regardless of their position and status (beginner or emeritus) with a view to update his knowledge and share as well. He collected copies (hard/soft) of almost all papers that he considered fit from respective authors and also from various sources for updating his knowledge and shared those papers to others whom he considered fit to kindle interest or ponder over that subject. His points of contacts were international and I am afraid I may leave many by naming only a few I am aware of and hence not mentioning any name here.

18. When I was doing some research on turbulence and boundary layer dynamics by consulting legendary books authored by Tatarski, Panofsky, Stull etc. during late 1990s, SR wished me good luck by saying that abstract mathematics was well above his head. Subsequently, when I was working on turbulence and eddy dissipation rate (EDR) as applicable on aviation parlance using Radar data and published a paper in Mausam (2009, Mausam, 60, 3, p 325 - 342), SR congratulated that first of its kind work in India and used a few slides in his presentations with acknowledgements. His noting on one of his latest mail to me assumes significance in this connection. Excerpts are copy pasted below:

24.8.2017

Turbulence mysteries

The attached article from the Nature 24 August 2017 may perhaps interest you or some of your colleagues. If not please trash it. I am not sending it to all my contacts.

[http://www.nature.com/news/mysteries-of-turbulence-unravelling-1.22474?WT.ec_id=NATURE-](http://www.nature.com/news/mysteries-of-turbulence-unravelling-1.22474?WT.ec_id=NATURE-20170824&spMailingID=54768018&spUserID=MjA1NzU3OTY2MgS2&spJobID=1224039369&spReportId=MTIyNDAzOTM2OQS2)

[20170824&spMailingID=54768018&spUserID=MjA1NzU3OTY2MgS2&spJobID=1224039369&spReportId=MTIyNDAzOTM2OQS2](http://www.nature.com/news/mysteries-of-turbulence-unravelling-1.22474?WT.ec_id=NATURE-20170824&spMailingID=54768018&spUserID=MjA1NzU3OTY2MgS2&spJobID=1224039369&spReportId=MTIyNDAzOTM2OQS2)

Turbulence is a daunting subject.....

Turbulence is important in many fields not just meteorology. In aviation ICAO goes by the Eddy Dissipation Rate in assessing turbulence.....

I never learnt anything of this topic in college or in IMD. But, I found the need to understand it in connection with my book on Radar Meteorology and my work with MST Radar. I tried to read Tatarski (1961, 1971) but the maths was well above my head. I consulted some other books too but I had to end up with the satisfaction that greater minds than mine found it difficult to tackle.....

But what seems to be new in the present paper is (1) the suggestion that even in the absence of viscosity, dissipation occurs and (2) the promise of a way to a model of turbulence that is simpler to use than the Navier–Stokes equations.

Perhaps somebody in India is working on these ideas.

Raghavan

Last phase 2019-2020 :

19. As Chairman, IMSCC, I could fulfil his desire by conducting a Brain Storming Meet on Chennai Water Management on 3.8.2019. We had many email correspondences and three local meetings with constructive discussions to conduct this Meet. It was a seminar with rich technical contents and no extravaganza, attended by 61 persons comprising invited speakers, Academicians, Govt. officials, Research scholars, media and a few members of IMSCC. On a single day, as many as 14 Resource persons of eminence from Central & State Government, Academic and Research institutions delivered invited talks based on which the draft summary was drafted and read out by me at the end of the day which was ultimately vetted by SR through a series of correspondences. The finalised crisp recommendations were submitted to

the Government of Tamil Nadu on 10.8.2019 after detailed deliberations. A word of acknowledgement in his own style from SR is copy pasted below :

4 August 2019

Dear Dr Suresh,

The Brainstorming meeting yesterday provided a great opportunity to meet and interact with many friends and a few new faces. I write this to thank you and the organising team which carried out everything in an excellent manner..... I admire your energy in doing things so quickly.....

Raghavan

I place on record my deep sense of appreciation and thankfulness to the fact that despite his deteriorating health since early 2019, SR involved himself in conducting this meet successfully.

20. Immediately after submitting the recommendations to Govt. of Tamil Nadu, I received a SOS call on 16th August for conducting a 5 days webinar programme on Satellite Meteorology during 19-23 August 2019. I was not knowing that SR had registered himself long back as a participant for that lecture programme which was to be originally delivered by an Emeritus Scientist. His reaction to that programme by way of email is copy pasted below:

25 August 2019

Dear Dr Suresh,

I listened to your webinar on all days except the 22nd. I am surprised that you could put in so much innovation in it at such short notice.

I could not keep pace with the rate at which information was received and I have many doubts. But in my present state of health I do not feel like seeing the video or delving into it any further.

Congratulations on the good job done.

Raghavan

Such was his passion for understanding developments in any branch of Meteorology and sense of appreciation.

21. I am missing him in the rest of my life. As a memory of my association with him, I am placing below a photo taken on 3.8.2019 when I was giving memento, as Chairman, IMSCC, for his talk in the brain storming meet on Chennai water management. This was the last photo I had with him which completes the cycle of my first photo with him taken during TROPMET-99 which is placed at the beginning of this tribute.



22. SR had been a guiding force for many and more specifically for Chennai based meteorologists. I am sure that whomsoever associated with him ever remember him for his systematic life, scientific and technical works, and humanitarian approach (and tough also). Let us salute that noble soul.

Book Review - சங்க கால வானிலை

N. Selvam

e-mail : nselvam_kavi@yahoo.com

Name of the book :
Weather in Sangam Period
Written in :
Tamil language
Author :
Dr. K.V. Balasubramanian
Meteorologist 'B'
RMC Chennai
No. of pages : 270
Cost of the book : Rs. 300/-
Publishers : Mukkadai,
No.11, 33rd Street
Balaji Nagar Extention 3
Puzuthivakkam,
Chennai-600091.
Mobile-9444365642



This is a book describing the meteorological information in Sangam period of Tamil Nadu. There are a number of books written in English on Meteorology both by Indian and foreign authors. Dr. K.V. Balasubramanian (hereafter KVB) has indicated them in the **Bibliography** portion of this book. The books by Indian authors will be having a chapter informing the knowledge of Meteorology in Vedas, Smruthis, Kavya, Purana and Ithihasa. KVB has discussed about these in Chapter 1. He has actually mentioned the works of Greek scholars (Thales of Miletus, Anaximander, Anaxagoras, Empedocles, Aristotle, Theophrastus, Archimedes, Lucius Seneca of Rome) and also the contributions of Indian scholars (Vedas, Manu Smruthi, Panini, Kaudilya, Kalidasa, Varahamihira). However no such information from Tamil is included in these books. To remove such lacunae, KVB has done a research in Tamil bringing out the Meteorological information available in the oldest books of Tamil, Sangam Literature, thus adding one more feather to this Classical Language, Tamil.

In the chapter **Information about Wind in Sangam Literature** of this book, KVB has described how one can arrive at Beaufort Scale from the information available in Sangam literature. The officials who work in National Weather Services still use similar terms to

describe the possible damages due to a cyclone. (Kacha houses will be damaged, branches of trees will be broken etc.). Beaufort Scale evolved during the period from 1703 to 1838. Rear Admiral Sir Francis Beaufort (1774 –1857) by his analysis of the data collected by ships formulated this. But the beginning of the Beaufort Scale can be attributed to Daniel Defoe (He is the author of the famous book Robinson Crusoe). In 1704, after he had witnessed the Great Storm of 1703, Daniel Defoe suggested a scale of winds comprising 11 points and using words normally used in the English language. Beaufort Scale has evolved out of the study of various data collected in the 17, 18 and 19th centuries.

The next chapter in the book is on **Rain**. Rain in India, especially in the regions of Sangam Era (Tamil Nadu, portions of Andhra Pradesh, Karnataka and Kerala) occurs due to various reasons. Convection rain in summer and due to the moist winds from sea in monsoon seasons to mention a few. Clouds are formed due to evaporation of sea water and they travel to the land area and give rain. This concept is very neatly explained in many songs of **ettuthogai** ("eight anthologies") and the **pattuppāṭṭu** ("ten idylls"). This has been brought out by the author very nicely. In one of the songs of Paripaadal, a poet Maiyodak Kovanaar has described this fantastically. The song goes like this :

The clouds absorbed fully the waters
of the huge, dark ocean. Unable to bear the
weight they carried, they roar thunder in
anger, and their stomachs break open like
tanks whose shores have broken.

Like the very long rows of warriors of the
Pāndiyan army, whose victorious drums roar
when they conquer desired lands,
the Vaiyai river with abundant water meanders
night and day not considering the difficulties
of flowing, starting from rains that fall and feed
the flourishing waterfalls on the mountains
from which water flows down swelling many
large streams that merge with it.

The rushing river brings prosperity to the land and
makes the country flourish beautifully.

One however has to read this poem in its Tamil version to absorb the beauty which the poet wants to share. In this poem an incidence of heavy rainfall is described. It is mentioned that it rained as if a tank bund has breached and water is gushing through it. Also it looks like that the stomach of the sky has torn off and water is pouring through that hole. What a description! It reminds me of the rainfall that has occurred during the deluge of Chennai in December, 2015.

In this chapter there is one another interesting portion. It is a portion titled **Thunder and Snakes**. It is generally believed that snakes have no ears and they cannot hear. In Sangam Literature, there are many poems which mention that on hearing thunder, snakes fear. KVB has read some latest foreign research papers and has corresponded with the authors of those research papers through email and sought for more clarification from them. He has finally shown how the poets of Sangam era were correct in telling that snakes has listening capacity by observing the vibrations of the floor of cave and holes in the mountain when thunder occur. He is to be appreciated for this separately.

The next chapters on **Clouds** and **Climate** have been written after a very thorough research. I would like to request KVB to write a separate book on Climate and Sangam Literature by doing extensive research on that chapter alone.

KVB has brought out his Ph.D thesis in the form of this book. I am happy that the thesis has not remained as thesis only. This book should be translated into English so that the name and fame of Tamilians will spread throughout the country as well as the world.

It is an interesting book and all those who love Tamil language should read at least once.

Seminar on Monsoons -2019 : Photographs

The annually held seminar was conducted on 10 February 2020 under the joint auspices of IMS Chennai Chapter and Regional Meteorological Centre, Chennai.



Dr. S. Balachandran and Dr. R. Suresh felicitating Dr. K. Satyagopal, Govt. of Tamil Nadu



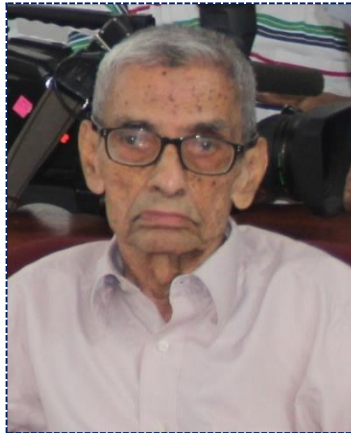
Talks



Audience and media coverage



Obituary - Shri. S. Raghavan



Date of birth : 28.11.1932 Date of demise : 06.02.2020
Life Member No.387, IMS Chennai Chapter, RMC Chennai

Shri. S. Raghavan renowned radar meteorologist, passed away on 6th Feb 2020 in Chennai around 0210 hours IST. Shri. Raghavan served in IMD in various capacities in Delhi, Pune and Chennai and retired in 1990 as Deputy Director General of Meteorology, RMC Chennai. He is the author of the book on "Radar Meteorology". He was a meticulous man of principles. We will miss him in the front row of all IMS meetings in Chennai. We, on behalf of all members of IMS, Chennai Chapter paid homage to his departed soul. As wished by Shri. Raghavan, his family members handed over his mortal body to a hospital for medical research.

In Dec 2016, Shri. Raghavan received the Life Time Achievement Award given by IMS-National, New Delhi. IMD in its Foundation Day celebrations on 15 Jan 2020 honoured him with Life Time Achievement Award. He was instrumental in organising the Brainstorming Meet on Chennai Water Management under the joint auspices of IMS, Chennai Chapter and RMC Chennai on 3 Aug 2019. He enthusiastically gave away certificates to student participants on 3 Aug 2019.

Subsequently, when Dr. M. Mohapatra, Director General of Meteorology, IMD had expressed interest in meeting veteran IMD-ians during his visit to Chennai on 22 Aug 2019, Shri. Raghavan visited RMC Chennai along with many other veterans. For the 4th National Conference on India Radar Meteorology on IIT Madras, Chennai during 5-7 Feb 2020, Shri. Raghavan had recorded an audio message for the participants and had passed it on to Dr. Balaji Narasimhan, Convener as he could not physically attend due to his frail health. Such was his passion for Atmospheric Science, in general and radar meteorology, in particular.

Bio data of S. RAGHAVAN

Former **Deputy Director General of Meteorology**, India Meteorological Department
Retired as **Head of the Southern Region** of the Department.

Work: Operations and Research in Meteorology in the Fields of:

Tropical Cyclone tracking, prediction, warning and interaction with disaster management Community.

Techno-Economic analysis of Meteorological Services.

Meteorological Instruments and Observations,

Radar Meteorology, Radar Study of Tropical Cyclones Radar-Satellite estimation of precipitation, Radio wave Propagation.

Publications:

Book on “**RADAR METEOROLOGY**” published by Kluwer Academic Publishers (now merged with Springer of Germany) of the Netherlands, **2003**, ISBN1-4020-1604-2

Contributed Chapter in a two-volume book on “**STORMS**” published by Routledge Press, UK., **2000**, ISBN 0-415-21288-3, 0-415-21287-1

Contributed Chapter in book “**The Economics of India’s Space Programme**”, published by Oxford University Press, New Delhi, **2007**, ISBN 019568345-5.

About **70** research papers in Indian and foreign Journals.

Present and recent activities:

Consultant to various organisations, notably the **Indian Space Research Organisation, India Meteorological Department, Ministry of Earth Sciences, Madras School of Economics, Centre for Airborne Systems (DRDO)** etc.

Chairman or Member of various committees of these organisations.

Associated with Universities and **IITs** as guest lecturer, examiner or Faculty member.

Lectured and participated in several conferences in India and abroad.

Program Committee Member, “First Asian Conference on Radar in Meteorology and Hydrology (ARAD-2007)”, **China**

Principal Investigator of a Research Project at the National MST Radar Facility (Now , National Atmospheric Research Laboratory), Gadanki, near Tirupati (Andhra Pradesh)..

Membership of Scientific Bodies

Fellow of the Indian Meteorological Society. Past Member of its National Council and Past Chairman of its Chennai Chapter.

Emeritus Member of the American Meteorological Society

Fellow of the Institution of Electronic and Telecommunication Engineers.

Life-Member of the Association of Hydrologists of India.

Life-Member, Astronautical Society of India

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Honour Plaque to Shri. S. Raghavan IMD Foundation Day celebrations – 15 January 2020

Shri **SOUNDARARAJAN RAGHAVAN**, son of a farmer, was born in Coimbatore, Tamil Nadu in 1932. He took a First class B.Sc. Honours degree from Madras University in 1952 in Physics with specialisation in “Wireless” and taught in a College for about a year. He joined the India Meteorological Department (IMD) in 1953 and worked in the offices of the Department at Pune, New Delhi and Chennai for over 37 years in various capacities from Professional Assistant to Deputy Director-General of Meteorology. He retired from the Department in 1990 as Head of the Southern Region of IMD.

Besides advanced training in Meteorology in the IMD, he had specialised training in the United States Weather Bureau and Japan Meteorological Agency.

In the IMD, Shri Raghavan has been involved in operations, research and personnel training in the fields of Instruments and Observations, Radar Meteorology, Agricultural Meteorology and Tropical Cyclone Warning and Disaster Management. He was the Principal Delegate of India to the tenth session of the Commission of Instruments and Methods of Observation (CIMO) of the World Meteorological Organisation (WMO) and was on the Advisory Working Group of CIMO.

He has conducted research mainly in the fields of Radar Meteorology, Upper air observations and Tropical Cyclones and their Impact and has to his credit about 70 scientific papers published in Indian and foreign journals and presented in Conferences in India or abroad. Some of this research has found operational application in the IMD.

He has authored a book on “*Radar Meteorology*” published in Europe in 2003. He has written chapters in a book on “Storms” published in the UK and a book on “The Economics of India’s Space Programme” published by Oxford University Press in India.

Shri Raghavan has been a Consultant or Resource Person or Lecturer or Chairman/Member of Committees on various subjects to the WMO, Asian Disaster Preparedness Center, Bangkok, IMD, Ministry of Earth Sciences, several units of the Indian Space Research Organisation, Madras School of Economics, Ministry of Defence, Council of Scientific and Industrial Research (CSIR), Indian Institutes of Technology (IIT), Madras and Kharagpur, Indian Institute of Tropical Meteorology (IITM) and various Universities. He was a Member of the Faculty of Marine Sciences at Cochin University of Science and Technology.

He was a Program Committee Member and Invited Delegate to the “First Asian Conference on Radar in Meteorology and Hydrology (ARAD-2007)”, in China in 2007. He was also Principal Investigator of a Department of Science and Technology Project on Study of Precipitating Weather Systems at the National Atmospheric Research Laboratory.

Shri Raghavan is a Member of the Indian Meteorological Society since 1957 and was elected Fellow of the Society in 2000. He is also an Emeritus Member of the American Meteorological Society, a Fellow of the Institution of Electronics and Telecommunication Engineers and Life-Member of the Association of Hydrologists of India and of the Indian Astronautical Society.

Photos Collage

From archives and personal memories - Shri. Raghavan – A legendary scientist







Collage by : Shri. J.S.Jayasenana, S.A., RMC Chennai

In the Winds of Time

INDIAN METEOROLOGICAL SOCIETY ~ CHENNAI CHAPTER				
Tenure of the Local Council	Chairman	Secretary	Joint-Secretary	Treasurer
<i>S/Shri</i>				
1997-1999	Julius Joseph	Y.E.A. Raj	R. Suresh	P.C.S. Rao
1999-2001	S. Raghavan	Dr. R. Suresh	P.C.S. Rao	E.R. Sukumar
2001-2003	A.K. Bhatnagar	S.K. Subramanian	P.V. Revikumar	E.R. Sukumar
2003-2005	S. Sridharan	P.V. Revikumar	S.R. Ramanan	E. Kulandaivelu
2005-2007	S. Sridharan	P.V. Revikumar (up to 6 July 2006) R. Nallaswamy (from 7 July 2006)	R. Nallaswamy (up to 6 July 2006)	E.R. Sukumar
2007-2009	R.V. Sharma (up to 02.12.2008) Dr. Y.E.A. Raj (from 03.12.2008)	R. Nallaswamy	Dr. S. Balachandran	Dr. K.V. Balasubramanian
2009-2011	Dr. Y.E.A. Raj	Dr. R. Asokan (up to 30.06.2010) Dr. S. Balachandran (from 01.07.2010)	Dr. B. Amudha	Dr. K.V. Balasubramanian
2011-2014	Dr. R. Suresh	Dr. B. Geetha	Dr. S.R. Ramanan	N. Selvam
2014-2016	Dr. N. Jayanthi	Dr. S.R. Ramanan	Dr. K.V. Balasubramanian	N. Selvam (up to 18.06.2014) N. Ramamurthy (from 19.06.2014)
2016-2018	S.B. Thampi	Dr. K.V. Balasubramanian	Dr. B. Geetha	N. Selvam
2018-2020	Dr. R. Suresh	Dr. B. Amudha	A. Roiden	N. Selvam