

## Indian Monsoon Climate and Malaria: Medical Meteorology

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### Abstract

India has among the highest rates of malaria mortality, inoculation and infection, human and socio-economic-administrative costs. India is a subcontinent having monsoon climate (most variable). Meteorology being all about atmospheric processes and dynamics envelopes much of the ecology and environment. This communication presents Indian sub-continental atypical monsoon meteorology, east coast's geography, geomorphology of eosin plateaus (plateau environment in particular), orography (delta type sea with parabolic shore line) as having a nexus with the ever present human health hazard of malaria infection. There is not much scope for inter-disciplinary studies. Ongoing decadal works have been cited to indicate the historical etiology of the term 'Medical Meteorology' in clinical-cum- met domains. The finding is that due to such all-pervading meteorology the nature of the nexus is planetary in scale and all enveloping. Malaria is part of ecology. It is aided and abetted by Mother Nature. Malaria is here to stay.

**Keywords:** Medical meteorology; Malaria; Koraput; Odisha; Bay of Bengal; Multi-discipline; Malaria is ecological; Malaria is Here-to-Stay

### Introduction

In 1853, British clinician H. E. Hoskins used the term "Medical Meteorology" in the British Medical Journal (not produced), which apparently was also in vogue across the channel, is indicated in the British Journal of History of Sciences [1]. Unaware of such pre-use we in 2006 had also used this term as our caption in our nascent communication to the Vayu Mandal [2] to discuss the effect of severe cyclonic storms on pregnancy and primegravedei, in particular. And we generated few more of 'India specific medical meteorology' papers [3,4] as run up to this communication. Herein we discuss for the first time the effect of coastal meteorology and associated geomorphology cum orography of the eastern shore board of India on vector bionomics and ceaseless survival. For the instant case our in-space hypothetical view point is approximately at 91°E/20°N; mid Bay of Bengal (BoB). Also a clinical perspective is taken, which thus far has been entirely wanted. Medicine and Meteorology is a compatible couple. Malaria is part of ecology. It is here to stay. Objectively perused will generate critical technology, social good apart generating gainful employment in the enabled sector(s). It is a matter of informed policy.

### Issues

India historically has a malaria eradication program [5-8]. The crux issues translated as a question pair are (i) why has malaria survived the best of eradication programs (ii) why do it re-manifests (even after seeming eradication)? Vis-à-vis such pair, which among the following naturals viz., geomorphology; geology; geography; orography; demography; meteorology; entomology; phytology be the dominant cause? And, which among these will emerge as the binder factor in spite of modern science based inputs and efforts?

Meteorological processes are 24 x 7 phenomenon's which also range between micro to planetary in scale. The considered view is that

obstinate manifestation of malaria requires a gamut of factors with meteorology as the common binder. At end, malaria seems to be part of ecology. Ecology and meteorology go hand-in-hand. As on date, even very little idea exists about the cross-continent transmission of malaria that is (being) aided and abetted by meteorological processes and phenomena; about the role of meteorology in the mechanics that is involved in survival; hibernation and in re-manifestation of malaria. Meteorology is physical. Malaria is biological. Any bio-aspect that is met-supported is here to stay. Historically, malaria control programs have failed. And, the altruistic Indian Govt's sub-continent wide centurion efforts have thus far not taken on board excerpts from the Earth Sciences domain. It is an uncharted area. From drug discovery to clinical services need to know more about the weather-pathology couple (at present this domain is completely void). There are no alternatives.

### Study Model

Clinical conditions of the patient at presentation; observations; pathology, pharmacology and therapeutics, real time issues, health service operation ground realities and, immunology vis-à-vis various departments of the Earth sciences has thus far not been incorporated in any study model in the caption domain. Study period ranged from 2000 -to-2010 in a plateau that is drug resistant, endemic year round with mutant strains [9]. Co-relationing with other plateaus of the BoB rim and their hinterlands has also been attempted for the first time. It is multi-disciplinary and multi-lateral in scope. Such type of study was due. It is unique and policy indicating.

### The Matter

Globally, malaria is endemic all over the tropo-equatorial domains limited to 2000 meters from the mean sea level (MSL). The geography and the census of the Koraput district, (eastern shore board of India) is a plateau of the order 750-1000 mts above the MSL, with a geographical area of 100,000 Km<sup>2</sup> and a census of 1million; 65-70% of which are non-migrating, native tribal of ethnic stock. The

epidemiology status of this region is well known being variously documented [10]. In 1989 Rajagopalan et al. [11] have indicated that even pediatric stage malaria to be high in Koraput. Infestation in all age groups is round the year. The present study commenced in Koraput from 06-1998 (spanned to other plateaus). The natives have a frugal body cover cum bare feet life style. This is because of the (i) agro – flora couple (ii) geomorphology (iii) meteorology which includes the land-atmosphere and the sea-land couples. Which in turn because a robust transmission mechanism aided and abetted by another unique couple involving (iva) the asymptomatic gametocyte carriers who all also exhibit high drug resistance (iv-b) vector bionomics and (iv-c) aerodynamics (v) poly infestation and/or poly infections along-with malaria – which results in drug wasting and (possible) cross protection due the variations between the family/genus of the parasite types.

## Geography and Malaria Incidence

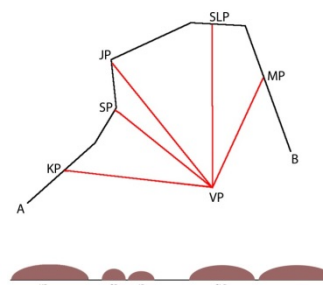
Accounting from the Koraput cum Kandhamal (kp); Similipal (slp); Jharkhand (jp); Shillong (slp) and Mezo-Manipur (mp) are 5 plateaus that encircle the warm apex region of the triangular BoB (Figure 1), with lush-green inter-plains in-between. Geologically the slp and the mp are of Eocene period. The rest are of the Gondwana. Excepting the slp the other plateaus are oblique to the lines of the sea-atmosphere forcing (slp is also >3000 mts above MSL). Figure 2 gives the schematic frontal elevation from hypothetical view position (vp) located in the mid BoB, when A-B is drawn straight. Locus vp and the forcing are meteorologically significant. Line C-D represents the shore line. Thus the plateaus have variable cross section, extents of coastal land as apron and flat inter regions, which are historically over populous; lush green; low lying, with land sea breeze (excellent buffer cum hibernating domain). The BoB also experiences a phenomena of unstable sea surface temperature (SST) conditions. This further abrupt alters the entomology environ. Line A-B hypothetically also marks the vector-parasite conducive year round land↔sea breeze region and also demarcates the lush coastal region that is low lying, cramped with natural stagnant water bodies and is intently malaria prone. Diurnally, the tropical foliage loaded plateau synclines experience a salubrious up-draft in the fore-noon hours and a cool-moist down draft, post noon. Annual atmospheric moisture remains consistently high with gain in astronomical gravity during full moon phases, which in turn imparts buoyancy to the vectors. Due size-mass barrier, gravity plays not on the hemoprotozoa (is weightless when inside the anopheline's gut). Whereas, selenic phase astronomical gravity imparts greater buoyancy and assists the vectors to communicate large distances and remain ever in circulation. Between these lush green, tropical coastal plateaus and the populous, moist plains around, the infested vectors fly in-and-out, year round. Such geography is unique. Such inter-plateau migration is also unique. Thus it is noted that the malaria season peaks in the Arakans and in the MP in Sep. It is thence intently rainy, wet and awash in the regions of KP through to SLP (and low malaria incidence). As the monsoon withdraws from the Arakans (slp-mp) between 15th Sep - 10th Oct., malaria resurgence peaks in the JP, and then oscillates between SLP to KP.

Across the BoB in the Hakha 22.5N / 94.6E cum Mandalay 22 N/96 E (200-300 kms E-W axis down south upto Rangoon/Yangon 17°N/ 96°E; 600 kms meridionally) of Myanmar, warm-moist met conditions peaks around Apr., whereas, such axial region remains intently malarial year round in-spite of having an annual mini-max temp range of 40°C -26°C (the 2nd widest swing after SLP). Data is deficient for this geo-domain. What enables the survival in-spite of such wide met

swing? Tides are meteorological phenomena. They are warm; moist; and because cyclic isothermal conditions. One of the reason may be the deep inland ingress of the diurnal tide (5-6mt amplitude; 150 km of turbid region) from Marataban gulf; alike Bangladesh. Our understanding of the cross (i) geo-political boundary (ii) meteorological inter member interactions\ nexus, on ground effects, are rudimentary. Hence, vector control efforts have all come naught. Public money in large tranches have gone waste?



**Figure 1:** The eastern shore board of the Indian peninsula showing 5 major plateaus that encircle the warm apex region of the Bay of Bengal, that also experiences year round forcings of the sea-atmosphere couple. Choice domain for vectors bionomics.



**Figure 2:** Imaginary line A-to-B runs through the 5 plateaus. Line C-D is the shore line. INDEX : Figure-2. ACD are points on the 16 °N lat. Kp=Koraput Kandhamal; Sp=Similipal; Jp=Jharkhand; Slp=Sikkim-Shillong; Mp=Mizoram-Manipur plateaus. Vp = view point approx at 91 °E/20 °N. The 5 radians marks the lines of forcings of the sea-atmosphere couple.

## Select Bionomics Aspects

Malaria is transmitted by the female mosquito – anopheline. Being poikilotherms (cannot self-adjust body temp i.e., cold blooded) they are dependent on the homeo blood meal as because humans are homeotherms (temp adjusting i.e., warm blooded). Among the flies, the anopheline is small compared even to the Tiger species that abound in the gardens, homes and hearths of the Asia-Pacific rim. The anopheline is estimated to have a flight speed of the order 20-30 cm/s with an average air displacement of 203 cm/s. They have 2 wings which they flap between 500-1000 times/sec interpreted as frequency in Hertz (Hz) that also is associated with a drone of the order 20-60 decibels (supporting information). Head wind above 30 cm/sec is deleterious to

the flea's flight (hiding is observed). Dry and desiccated conditions require higher Hz (due to inadequate displacement). In other words, atmospheric column density is a requisite. In ideal conditions such flea can fly up to 2 kms, non-stop. Higher Hz is also associated with more landings (rest). It may be correlated as energy depletion → fatigue → hunger and thirst (syndrome). This means, the meteorological conditions (moist-warm) of the atmospheric column assists buoyancy, which in turn requires the flea to bat its wings less, loose less energy (warm conditions further assists), and be air borne for longer. The diurnal syncline and anti-syncline breeze assists. Thus, vector the carried pathogenic load afar (wider transmission). And, the BoB rim region provides year long ideal met-conditions. Vectors are here to stay.

## Planetary Meteorological Aspects

Drug resistant strains differ between Asia and Africa. On the other hand, robust atmospheric tele-connection pathways exist between

Africa and Asia, due to the geostrophic rotation of the Earth; its inclination and baroclinic conditions (planetary scale). (Figure 3a and 3b) show such a connection between the equatorial Africa and the north Indian subcontinent ranging overland and over the sea, (which is also marked by various ailments – allergens, virus and vectors). One part of the feeder extends into (toxic) Western Europe. The mixed stream flow spans the entire tropo-equatorial and temperate belts meridionally and descends into the Indian peninsula. To minimize the effect of such (mixed) down-draft, the natives on the ground wear turbans as headgear, day long (supporting information). And Indo-African human-labour exchange has also come into motion since c. 1850. Casual survey indicates that the entire lot of the upper echelons of health service administrations are quite oblivious of the nexus as have been discussed in this transaction.

Station	Temp Range in0C			RF Range in mm			RH Range in%			W S /Kmph			C Mx
	Mx	Min	Mnt	Mx	Min		Mx	Min	Mnt	Mx	Min		
Koraput (KP)	37.7↔ 6.4		5 - 1	402↔ 2.5		7 - 2	87 ↔ 40		Koraput (KP)	37.7↔ 6.4	5 - 1	402↔ 2.5	7 - 2
Simlipal (SP)	IMD has no station on the Simlipal Massif (Biosphere Region; Stn necessary) 2												
Ranchi (JP)	41.7↔ 5.8		5 - 1	307 ↔ 3		8 -12	86 ↔ 36		Ranchi (JP)	41.7↔ 5.8		5 - 1	307 ↔ 3
Shillong (SLP)	26.8↔ 2.5		8 - 2	490 ↔ 8		6 - 1	91 ↔ 50		Shillong (SLP)	26.8↔ 2.5		8 - 2	490 ↔ 8
Imphal (MP)	33 ↔ 0.3		5 - 1	284 ↔1.4		6 -12	83 ↔ 51		Imphal (MP)	33 ↔ 0.3		5 - 1	284 ↔1.4
Aizawl (MP)	29.8 ↔ 8		5 - 1	477 ↔ 6		6 - 1	88 ↔ 51		Aizawl (MP)	29.8 ↔ 8		5 - 1	477 ↔ 6
Myanmar - Tenasrim plateau same as MP (Lush Green and moist)													
Hakka (Tenasrim)	26 ↔ 3		11- 4	Data not available									7
Mandalay (do)	25 ↔ 3		10- 4	- Same -									8
Semi dry and Dry Central India													
Raipur (CG)	45 ↔ 9		5 - 1	381 ↔ 4		7 -12	87 ↔ 23		Raipur (CG)	45 ↔ 9		5 - 1	381 ↔ 4
Jaipur (Raj)	44 ↔ 3		5 - 1	231 ↔ 3		8-11/12	82 ↔ 16		Jaipur (Raj)	44 ↔ 3		5 - 1	231 ↔ 3

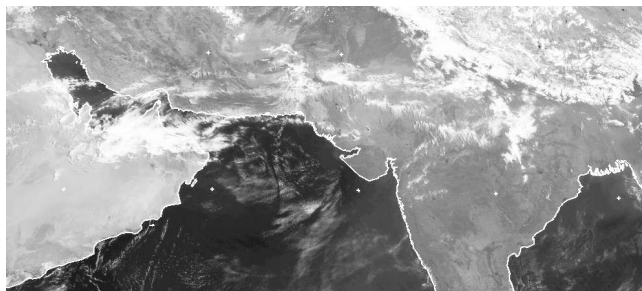
**Table 1:** Met and Geo- spatial conditions. Index: rf: Rain fall; rh: Relative humidity; ws: Wind speed; kmph: Kilometers per hour; ms: Maximum; mn: Minimum; mnt: Month; c: station identification number for clinicians for malaria related data input.

Drug resistant strains also differ within Asia. And, historically (since c.3rd B.C), there has been an extended connection between India-Sri Lanka - Malayadesa (Malaysia) and - Balidesa (Indonesia); Kambodha (Indo-China) i.e., the whole of Asia in human and animal exchange programs (Historical Fact). Figures 4a and 4b show a similar year long atmospheric vectoring connection between Sino Indo China regions towards the Deccan –cum- the intensely malaria prone eastern coastal regions of the Indian peninsula. There is suggestive tele-connection with low outgoing long wave radiation OLR (time and place). The

swerve is due to Coriolis. This apart, the north Indian plains and the Himalayas are year round effluxed by atmospheric stream flows from central Europe (data not shown), due to gravity exerted by the Tibet-Himalaya geomorph. Annually the whole of the Indian sub-continent's atmosphere (meteorology) experiences extra mural injections from 3 directions i.e., it is not unidirectional as is the case with most other nations ((Figures 3 and 4), curtsey Dundee Sat. Centre, Dundee Uni. Ori. Source, eumetsat VISSR (IODC) 057.0E Quicklooks, with thanks).

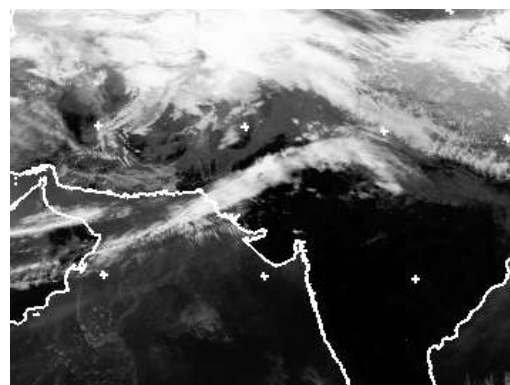
Thus, our understanding in the caption domain is rudimentary and hence our caption is justified.

Data for Table 1 has been procured from the India Meteorology Department [12]. A quick glance assessment indicates that neither latitude nor longitude matters. Possibly, met and geo-spatial conditions jointly matter. Among the sampled stations, KP (C-1) which is acknowledged as the drug resistant malaria hub of India has the widest annual range (swing) in Temp; RF; RH and even in WS. Yet malaria incidence – in such geo domain - is a year round phenomena.



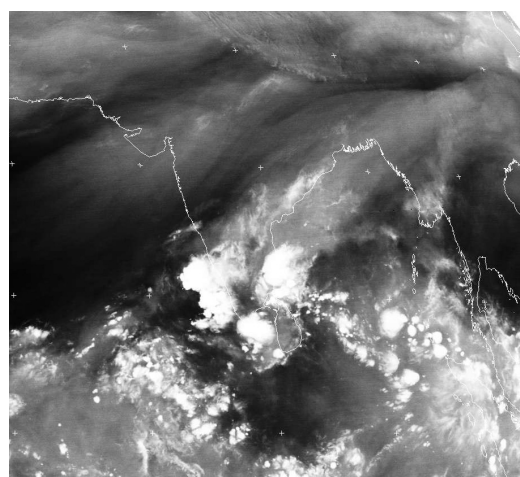
**Figure 3a:** Planetary scale, moisture in stream flow mode across Arabia-Iran-Baluchistan-Pakistan-Hindustan; 12-4-2011, 006-UTC; IR 5.7 – 7.1  $\mu\text{m}$ , geostationary; curtsey – Dundee University satellite service.

Geomorphologically it is a plateau, topographically full of hills and dales. Vis-à-vis this, we note that at Imphal and Aizawl RF peaks in the month of June while RH peaks in Dec. and Oct., respectively (6 months apart, NE monsoon), which is also associated with high WS (cold land breeze). Whereas, malaria incidence is reported to be high almost all over the Tenasrim plateau/ range during June-Aug (moist sea breeze period). In Raipur (Chattisgarh) RF; RH and WS have near common calendar period range with malariasis peaking also during such period. Therefore, it is quite clear that meteorology and infectious diseases and malaria in particular have a nexus. However, as to how meteorology and other geo-spatial conditions interact to maintain and down-regulate/up-regulate malariasis (and other pathological infections) is virtually nascent to us. The role of RH (with and without high WS) in aiding and abetting vector's aerodynamics posits as an eminent couple. RH in turn seems to have umbilicals with tide! And effect of warm tide during winter period has never been factored in (pre to this communication). Information about inter domain migration of vector, the pathogenic protozoa and specially our idea about the effect cum role of WS with modesty is to be accepted as 'nil'. The Table is quite talkative, and it is used for malaria purposes for the first time. A long march waits. It is high time to call in resource personals from all related faculties (neighboring nations in particular).



**Figure 3b:** Planetary scale, moisture in stream flow mode from tropical Africa via across Arabia-Arabian sea - to India; 12-2-2009, 006-UTC; IR 5.7 – 7.1  $\mu\text{m}$ , geostationary; curtsey – Dundee University satellite service.

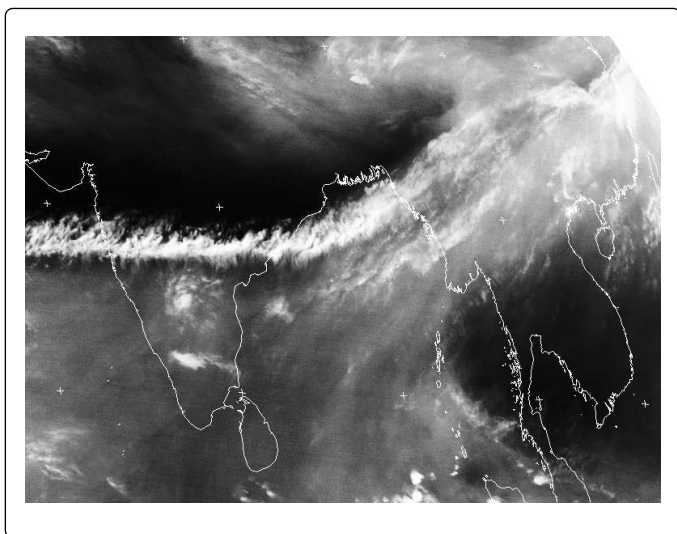
Our decade long study cum field observations has also indicated the following co-relatable observations.



**Figure 4a:** Planetary scale, moisture in stream flow mode from Industrial belt China across populous cum agro-met rich Indian peninsula. Other branches from Tibet across Pakistan and Iran-Baluchistan; 29-10-2009, 00-UTC; IR 5.7 – 7.1  $\mu\text{m}$ , geostationary; curtsey – Dundee University satellite service.

In Figure series 3 and 4 we note meteorological processes that are India oriented synoptic and planetary in scale (with and without meso events). Synoptic and meso scale events are associated up-drafts; down-drafts and gravity waves. During episodes of such type wave phenomena they vector around and down load bio-active substances if any carried. Such phenomenon are so large in scale and so intensive (on ground) that India administrations do not have any wherewithal in place to fend, far apart combat with. Pharmaco-Clinical sciences are of pico and micro scale (less than miniature). Met science is that of large scale. Therefore, there is an un-putdownable case to take earth science resource personnel onboard National and Community Health programs. There are no alternatives.





## Regional and Local Meteorological Aspects

(i) In Asian-monsoon studies OLR is a parameter of consideration. Vis-à-vis vectors it is noted that OLR hours (dusk) are associated with humming, swarming and mating. Low OLR, with blood meals (night-dawn). Low soil moisture and or at surface adiabatic conditions are associated with low (and even nil) flea count, in spite of moderate OLR. This is due to inadequate air displacement cum buoyancy failure cum heightened evapotranspiration from the body of the flea via osmosis. In other words, do OLR coupled with ideal flight (meteorological) conditions excites and exuberates the vectors? Long waves assists air borne periods and in-flight activities, including mating? These issues needs to be resolved.

(ii) Soon after a system pass (meteorological), a window of high pressure is noted on the ground. This is primarily due to 'gravity waves' i.e., free falling air due to break/staid hydro-dynamic conditions on the ground. Gravity wave periods are also noted as near breezeless, cool, calm and comfortable. Yet, during such periods the malaria vector and all forms of fleas are noted to be conspicuous by absence (butterflies included). Same happens when a thunder storm (meso event) approaches and thereafter. Possibly, the vectors cannot withstand dynamic down-thrust (which is not normal in nature). It is a case of flight failure due to abnormal condition of the atmospheric column. Thence, the vectors hide beneath the thick-large leafs and in fine crevasse.

## Neighbor Nation Aspect

This study also covers Bangladesh and Myanmar. Sri Lanka has not been covered, yet from caption context have similar ground and environment conditions, so also is the picture relating to malaria in that nation. Bangladesh and eastern half of West Bengal are densely riparian and the topography is loaded with stagnant and tide effected water bodies. Yet, malaria incidence is less than that of KP and SP. During the India plan period's c.1960-2000 KP has witnessed the making and completion of 2 large reservoirs atop KP. Epidemiology status has remained unchanged. And whereas in actual numbers incidence has come down in the Kp. Myanmar (Tenasrim regions), during the period c.1930-25 was considered at par with KP. Such status has remained. Data about surface breeze (even at 900-1000 hpa level) are available with respective national met organization. Bangladesh

and Myanmar are year round breezier than KP or SP or even the Coramandel coast. However, role of surface breeze in malariasis as yet remains to be factored in South Asia malaria control programs. Thus there is a lack of appreciation and application. Meteorological fronts and or the vectors brook no political or cultural frontiers; hence, in this treatise the term Indian sub-continent has been used for such reasons. Interestingly, met-fronts are atypical, with variability cum severity being the order, and are associated with near complete absence of vectors and viruses during event moments, with or without outbreaks in post event periods. Political fronts are marked as diminutive pillars and lean posts on the ground (even trees and vines are taller and wider). They do not act as screens. Therefore, vis-à-vis sub-continental scale, our knowledge is scant. Hence multi-lateral initiatives are warranted.

## About the Caption

Meteorology and/or malariology are malapropos as caption terms. Because, meteorology is the science of weather and climate. Weather is the daily\short period conditions of the climate. Climate is the average of the long period of the weather conditions. Hence, we have elected to use the term 'climate' in our caption.

Maladies wax and wane due to climatic variability i.e., weather. Health administrators have small idea about the planetary forces that because all this. Malaria is complicated. It is a malady. Malaria's vector resurgence can happen if conducive weather conditions remain in situ for around 6 hrs, only. However, malaria manifestation in anthropomorphism involving sizeable census requires at least a week long of ideal weather window and even more. Maladies get down-turned due stable weather conditions e.g., cold/hot arid regions; strong surface breeze (prairies type). And, monsoon is the emperor of variability. Malaria manifests due to weather conditions and becomes endemic due to vector-parasite conducive climate (alike monsoon). Hence, most of the Indian-sub continent experiences malaria with the monsoon, and wanes with its withdrawal. Only select geographies (Figures 1 and 2) remain year round malaria endemic.

Virus outbreak takes only 2 hrs and or a non-monsoon shower (meso event) or during high evapotranspiration from the soil with bright sunlight and nil-to-low surface breeze. It then can spread to become pandemic (seasonal flu; conjunctivitis; upper respiratory infections; chicken pox; etc) adversely effecting very large census and yet self-limit within 7days (die out). Even, bird flu; swain flu; dengue; measles are all self-limiting viruses that wane and die out within a range of 3-15days post clinical manifestation. These are not killers. They are man day loss causer. Post the completion of the life cycle of the virus the weather may become conducive, inclement, murky or clear; virus however will not be able to resurge. Virus life cycle is time bound. Short gestation resurgence is not the order and whereas, malaria remains in situ and well sustains weather variability). Sunshine and dry conditions up-regulate viremia, while heavy rains kills and clears (distinct from malarias is). Vis-à-vis malaria, heavy rains, long duration drizzle, cyclone/tornados can kill and clear the vectors but not the malaria parasite. A bout of RF in the plains with acyclic fair-pleasant weather is a malefic combination from human health perspective. And whereas, snow in the plains or in the hills that are associated also with acyclic RF kills and clears viruses. Acyclic rain assists malaria.

Therefore, resource personnel from respective health science collegiums can combine with meteorologists and other earth sciences

alias 'medical meteorology'. The term 'medical' also connotes 'clinical/health/malaria/infectious diseases (virus), etc. Meteorology remains as the overarching common-binder. The term 'medical meteorology' has a history of pre use of a century order and also rhymes well. By adopting it we do not have any revisionist theory.

## Discussion and Conclusion

The Indian sub-continental geography, geomorphology, orography has determined her meteorology, which all jointly in turn have provided ideal conditions for hemoprotozoa and their vectors. India is a very ancient civilization. So also is malaria in India. Malaria manifestation in general has a nexus with the climate, while, its subsidence, re-emergence and virulence is weather dependent. Such phenomena are boundary less, overarching and cannot be interdicted. Changing the climate is not permissible. The present global trend of global climate warming portends a domain expansion. Even the year 2015 phenomenon of El-Nino has triggered a rise in malaria incidence in the SP (Figure 2). In other words, malaria is here to stay. El-Nino is likely to persist during 2016, and the seas around the Indian subcontinent shall have a warm sea surface temperature anomaly. Fumigation and toxification of the ecology has thus far failed and will not yield results. New drugs have to be sourced [13-19]. Our understanding about medical meteorology is scant for this over populous, malaria endemic sub-continent wide monsoon region. It is also an emerging market. Medical-Met computer aided models can predict incidence, belt shift so as to pan out the commercial opportunities and the required logistics, in real time.

The day may not be far, whence new strains will emerge having the worst of the Afro-Asian characteristics as mixed features. Thus enlarged challenges are on the horizon. Malaria is here to stay and also act as a propeller of advanced research; man-hour engagement; with ever heightening public funding. New drugs are needed [20]. Above all malaria is a malady of the homes all over the BoB rim. Malaria has to be fought at home alias 'fight malaria at home' [21,22]. In the national malaria eradication programs meteorologists and earth scientists are currently not adopted. There is an acute need. Met resource personnel, field cum lab assets and hard earned enviable data-base are ready available. In some cases epidemiological data are also available. Only marriage of minds and material is wanting. Multi-lateral interdisciplinary work posits as profitable involving various streams of health care sciences and geo-spatial sciences.

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