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Adopting A new algorithm In GIS and Remote Sensing which Enables Forecasting Techniques to Avoid the Disasters Due to Climatic Change Phenomenon

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ABSTRACT

The climate change and influence WPI and GDP are chain phenomenon. Uneven monsoons, cloud bursting, floods, landslides, droughts are very common disasters. The escalating energy demand leads to utilize even substandard- coal which increases the emissions. The cement, steel plants also increase the emission. These emissions are widespread and it negatively influenced the monsoon rain fall pattern. The WPI, GDP. INDOEX study cautioned that the carbon particulates and their size have some negative or positive impact upon CCN by altering the size of the droplets which indirectly influences it to condense at new destinations not at its original geographical area. Due to this, Excess saturated clouds with accumulated water droplets suddenly condense or burst as an unexpected event over the Western Ghats or in Himalayan region. Further the monsoon winds also aggravate this, and these soils are vulnerable to landslides. CALIPSO satellite datasets on ACPI enabled to find probability rates, volumes with respect to droplet size in an area. A new algorithm is to be adopted with simulation studies on these clouds from the space borne Lidar data and image and processing it with graphics soft ware in order to understand the vertical distribution of aerosols, clouds, cloud bursting events in advance which avert human and economical loses. A model with an algorithm is designed and tested to warn about particulates with reference to cloud condensations.

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INTRODUCTION

The Global warming and climate change are becoming a determining factor in national security policies of independent states and UNFCCC has been working to arrive a global deal over climate by 2015. The developing economics may lose up to 1.7% of its Gross Domestic Product (GDP) if the annual mean temperature rises by 1 degree Celsius**.** Climate change is a result of a chain of events that begin due to events during the some neglected implementation of economical developmental programmes. As on date, the chain reactions may be easy to see in hindsight, but its prediction is difficult. As per the growing complexity of the regions and their economical developments, anything released into the environment can interact with another and will increase the risk of disasters. The agencies implementing these developmental projects will have to study the simulations based interpretations by using remote sensing and GIS technical tools. Proactive thinking of risk is extremely useful for preparedness and importance is to be given in forecasting and the mitigation of unforeseen phenomenon by enabling scientific research efforts rather than implementing the relief measures during these present climate change calamities.

Indian Climate Change Scenario:

The Indian Economy is based upon agricultural production. The climate change phenomenon is slowly showing its impact on agricultural productivity of apple , cotton, sugar cane, and vegetable, essential grain producing farmers in the north, central and the delta farmers all over the country. The unfavourable and unpredictable South West & North East monsoons have already damaged several parts of our country which are under floods and droughts and transformed the fertile agricultural lands into dry lands. But fortunately, the efficient management of agricultural sector by the officials have enabled in avoiding major food grain rice and wheat production losses by adopting new technologies. This catastrophic phenomenon influenced a lot of negative impacts, cloud bursting, floods, and erosion of fertile lands, massive

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landslides, and delay in monsoon rains causing shortage of water resources. The infrastructures created by the government by investing several million dollars are destroyed, fertile land erosion in agrarian areas, will take long periods to reclaim. The production losses of vegetables and fruits will escalate and their costs and Indian food security has become questionable. The uncertainties of monsoon rains compel the agricultural labour force to find alternative jobs in urban areas. Some of the latest studies revealed that the extinction of insects and land worms due to climate change affects the yields of cultivation because of the result of failed pollination. Thus due to the reduced vegetable cultivation which result s in their demand and the price rise of essential agricultural commodities thus increases the inflation. The compounded annual growth rate (CAGR) indicates a 21.26% rise and in the last five years the WPI of the agricultural commodities has increased by 5 per cent. Fortunately the per capita income has increased to Rs. 33,540 during 2009-10 against Rs. 25,956 in 2005-06, this benefit is not tasted because of the continuous increase in inflation and explosion of population from1.08 to 1.15 billion which results in the CAGR to increase to 5.26% (Table -1).The allocation of funds for human health care in combating the water borne epidemics namely diarrhea and malaria during the freak weather conditions on a emergency plans will indirectly influence the poverty alleviation programmes. The anticipated global temperature increase will be from 0.3 to 4.8°C due to the related melting of ice in the Polar Regions and in the high altitude glaciers .The increase in sea volume has lead to a sea level rise of 82 cms (or) 32 inches. The recent findings on coastline ground water samples indicate about the sea water intrusions up (Mohesen *et.al*., 1999) to 15KM and have cautioned about the submerging of the islands in Sunder bans and Nicobar Islands (Syed Shabudeen.P.S., 2011). This freak weather patterns impacts the people living in the coastline delta by unprecedented land erosions which leads to the disappearance of the fishing hamlets and cause considerable damages towards their Economics. There are reports of bigger challenges faced by the tourism industries, generally the higher altitude destinations which are attracting tourists due to the cooler temperature, but the recurrence of landslides and cloud bursting creates a lot of miseries. Similarly, the beach tourism is also losing its fancy due to the rise in the sea water levels and the following land erosions results in damage to the infrastructures of this industry.

Growing Demand on Electricity which results in Hazardous Emissions:

More and more efforts were taken to raise GDP to $5 trillions by the year 2025; in this effort supply of uninterrupted power to all becomes mandatory. The Indian electric power sector is 30% short of the demand. As on date, it has only managed with the support of thermal electricity. The data shows that, 400 million ton of coal is mined by Indian coal fields, 187 million tons are imported per annum, with this 587 million coal stock, 80% is utilized in order to generate 65.89 BU per day with an 8.91% growth rate. The demand for electricity during 2015 will escalate to a sharp rise of 80, 00,000KWh.The Indian power production statistics states that, during 2013, 23,000 to 27,000KWh was produced with emission of 10 to14tons of ash, which accounts for 650 to 850 tons of coal with retrospective emission of 250 to 350 tons per day, during this period 6, 50,000 units of electricity was generated. Recently, the concept of co-generation of electricity by sugar plants are catching up and by burning bagase in thermal power plants it produced 5000MW during the year 2013, which accounts for a burning of 100 to 2000 tons of bagase per day with an emission load of 10 to 80 tons, and generates 20,000 - 8, 00,000 Units per day (Megha R.Malali *et al.*, 2014). The power generation details are furnished in Table-2.

Due to the inferior quality of Indian coal ,ash content was as high as 35-50%.The estimates reveals that, 500MW power plant will emit 100 tons of SO_2. 20tons of NO_2, and 6tons of Ash per day and withdraws 8 tons of Oxygen for every 3 tons of coal burnt. This phenomenon proves that the prevalence of particulate matter in the Indian atmosphere is up by a higher range of 30-35µg/M (Courtesy to Hsu *et al*, the Atlantic). This necessitates India to reduce the chances of these radiation imbalances, prevention of emissions are needed, for which technological up gradation is required and it should be addressed with proper up gradation of thermal power plants. This will reduce or cut the emissions rates up to 15%

Influence of Black Carbon particles on Cloud condensation:

The Indian Ocean Experiments (INDOEX) revealed that the enhancement of boundary layer heating can significantly influence regional hydrological cycles and climate, it has suggested in its findings that the presence of soot carbon in the atmosphere over the northern Indian Ocean hinders its natural heating processes by 15%. The studies indicate that the aerosols affect the clouds during its precipitation process, key components of the climate system and make adverse effects upon the hydrological cycle. The recent report indicates that the climate change is probably being the indirect effect of aerosols on clouds. (National Research Council NRC 2005) They are referred as the “first indirect effect” or “Toomey effect” on cloud droplet size and reflectance for a constant liquid water path (Twomey S .,1967) and the “second indirect effect” is called the “cloud extent and life time effect”(Ackerman et.al.,2000 and Albrecht .,1989). As per these effects, the increased concentrations of aerosols suppress the warm-rain processes by

reducing particle sizes and results in creation of narrow droplet spectrum which inhibits collision and coalescence process (Squires *et al.*, 1961, Warner., 1968, Rosenfeld., 1999). and affect the precipitation process with less or nil rain falls and the second type of aerosol indirect effect (Albrecht., 1989) is more complex in nature with mixed-phase convective clouds with more rain falls or even cloud bursting.

The latest improvements in instrumentations enable the measure of the aerosol cloud precipitation interactions (ACPI) details and droplet size by Advanced Very High Resolution Radiometer (AVHRR). The estimations on the cloud top temperature and its effective droplet size could be measured with these instruments. This will create a knowledge on the suppressions at coalescence, precipitation process with respect to the smoke or aerosols(Rosenfeld *et al*., 1998) or desert dusts from the Thar desert (Rosenfeld *et al*.,2001). A careful attempt is to be made to design a research model which will give precautionary details to reduce the level of black carbon in the atmosphere either as dispersed or transported load, on a specified region of study for different seasons(Rosenfeld .,2000 and Rosenfeld *et al*., 2000). In this effort the captured Light Detection and Ranging LIDAR satellite images are to be processed by the image processing methods and color modulated profiles for Total attenuated back scatter (TAB) are to be assigned and the 2D simulations based on EASI modeling on aerosols and cloud loads are to be carried out with suitable algorithms. The necessary alarms could be raised to control the mitigations in order to get good widespread monsoons.

MATERIALS AND METHODS

The real world around us is sensed and the captured data from the satellites are processed with clever algorithms for data fusion, feature extraction, and integration with intelligence. These advanced technologies are utilized with the geographical data and information, and empowering to use on location specific data information. Thus the raw data is rapidly transformed into an actionable information and delivery. This includes web-based geo-processing, integrated vector and raster based spatial modeling, change detection, data revision-workflows based on the fusion of imagery, point cloud with GIS data. All these processes digitally describe and reveal the real problem to be faced by the world. The GIS based raster tools measure the problem accurately. The real time updates, will enable us to find new road maps in confronting these disasters. The GIS data with remote sensing and photogrammetric images will be helpful to process automated geo-processing, spatial data infrastructure, work flow optimization and web editing and web mapping. Thus the mitigation of black carbon particles in atmosphere can be done by enforcing strict emission controls at the sources.

2.1 Image exploitation: The cloud dynamic images are to be obtained, visualized, manipulated, analyzed and the intelligence is extracted from the satellite and airborne imagery, terrain, and point data for image processing, photogrammetric and/ or LiDAR workflows.
2.2 Powerful GIS Data production and Analysis: To generate and update vector layers, and perform the dynamic spatial analysis with automated reporting.
2.3 Rapid Publishing: To create and publish the data products and spatial models, which can be accessed and executed in 2D and 3D images.
2.4 Robust Data Management and Delivery: The management of massive amounts of geospatial data including discovery, describing, cataloging, analyzing and delivering for immediate actions.
*2.5 Dynamic Geoprocessing: I*n executing the robust and complex (on-the fly) geoprocessing data (such as change detection, site analysis, or elevation change) through web processing service (WPS) up to implementation levels.

RESULTS AND DISCUSSIONS

The cloud and soot material dynamics study with the help of GIS methodology:

The assessment of the impact of human activities on the environment requires a lot of qualitative and quantitative information on the spatial distribution of the soot material and dynamics of clouds. In this area GIS is emerging as a powerful tool to handle voluminous data (both spatial and non-spatial) and helps to integrate various types of information obtained spatially .As stated above, to study the data and make the characterization studies which will enable in the understanding of the clouds and soot materials over the space (Van Verhoeye *et al*., 1999). At a given frequent cloud cover, regular updating of land-cover maps of the tropical areas using optical satellite dataset obtained as multi-temporal data . A processing chain consists of calibration, reassembling, filtering, segmentation, principal component transformation and supervised classification of multi-temporal radar images can be designed.

Proposed Research work under review:

The advanced computer graphics and image processing gives benefits in remote sensing research. The Light Detection and Ranging (LIDAR) is a remote sensing system used to collect atmospheric data by using optical remote sensing technology and enables to study the atmospheric particulates (aerosol) and gas pollutants(Grany.,1987). This technique depends on backscattering light of palertics. Lidar produces a electro-magnetic radiation and computes the backward radiation scattered.

The Lidar equation is as follows, (Dakin *et.al*.,2006)

$$P_r(r) = \frac{C_N E_0 \exp\{-2\int_h^z \sigma(r')dr'\}\beta(r)}{r^2} + P_{bg}$$

Where
r = distance between scattered location and lidar (m)
h = lidar height
$P_r(r)$ = power signal that returned of distance z (m)
$\sigma(r')$=atmosphere extinction coefficient (m^{-1})
$\beta(r)$ = atmospheric back scatter coefficient (m^{-1} sr^{-1})
Pbg = back ground light power
$C_N E_0$ = System constant

The objective of this research is to utilize the developed algorithm in EASI Modeling and perform 2D simulations on satellite TAB images over some specified region of India. The comparison of 2D simulation images with TAB data enables to obtain an analysis on aerosols and cloud density trends. By using image processing software and computer graphics software,like , PCI Geomatica 10.1 and SCION image ® the digital numbers of the TAB images can be obtained for the aerosols and the clouds. The 2D simulations can be performed by using the available algorithms in EASI modeling. SCION image ® is used to obtain measurement and plot profiles of aerosols and clouds from the 2D simulation images. These steps evaluate aerosols and clouds density trend vertically in the atmosphere.

A fast simple automatic cloud detection algorithm is to be selected from the existing algorithms for our problem to be probed. The algorithms and measurements of Advanced Very High Resolution Radiometer (AVHRR) and Spinning Enhanced Visible and Infrared Imager (SEVIRI) can be incorporated into this process and is applied to resolve a real-time operational processing in particulate emission mitigations, which in turn will not influence the rain fall patterns and is most crucial to Indian agricultural sector which is totally based upon the monsoon rains. It is to be testified with the developed algorithm for the other regions of South East Asian country with some natural emissions could be prompted to be attempted from among the published research work referred in literature could be used. This dynamic threshold cloud-making (DTCM) algorithm, could be attempted with the available satellite images (Alias *et al*., 2009) over Indian context and during validation a effective model with more effective control mechanisms could be attempted to proposed based upon Image processing soft wares.

Utilize an Algorithm, EASI model, SCION image processing to Indian conditions:

In this proposed area of research studies based on utilizing the image processing techniques and resolving the impacts on cloud condensations due to this emitted particulate matter pollution, with the help of the CALIPSO data and the images which are to be downloaded from the free web portal of NASA and it is principally accepted to adopted the algorithm developed by Alias et.al., and with reference to Indian regional conditions it is anticipated to develop a new algorithms with improved versions. As per the existing details available from the web portal, the images showed the color-modulated profiles of Total Attenuated Backscatter (TAB) of the regions that has been measured by the CALIPSO. The color coding scheme applied in CALIPSO has the TAB image in which red represents strong returns from clouds and from surface. Yellows and greens represent weak cloud and strong aerosol scattering, blues represent weak aerosol and molecular scattering (Winker ,, 2007). The drawback of the CALIPSO TAB images was that the distribution of aerosols and clouds are not differentiated clearly. Research has already been done to distinguish between the aerosols and clouds using the 2D simulations by EASI modeling. As per the proven model, the digital number (DN) of aerosols and clouds has been determined by using PCI Geomatica 10.1(Table 3 and 4). By utilizing the DN values in the developed two algorithms using EASI modeling in PCI Geomatica 10.1 two raster layers for aerosols and clouds are to be created with respect to the area to be selected for our research studies. These CALIPSOTAB images are to be simulated by using EASI modeling and trials are to be carried out with the applications of this algorithm on aerosols and clouds which are to be distinguished properly and the resulting simulation of images can be viewed in pseudo color.

Algorithm for aerosols:

if (%1=255 AND %2=255 AND %3=0) or (%1=255 and %2=212 and %3=0) or (%1=255 AND %2=127 AND %3=0) or (%1=255 AND %2=170 AND %3=0) then %5=0 else%5=1
endif

Algorithm for clouds:

if (%1=255 AND %2= 255 AND %3=255) or (%1=253 AND %2=253 AND %3=253) or (%1=180 AND %2= 180AND %3=180) or (%1=225 AND %2=225 AND %3=225) or (%1=245 AND %2= 245 AND %3=245) or (%1=240AND %2=240 AND %3=240) or (%1=155 AND %2= 155 AND %3=155) or (%1=235 AND %2= 235 AND %3=235)

or (%1=249 AND %2= 249 AND %3=249) or (%1=100 AND %2= 100 AND %3=100) or (%1=70 AND %2= 70AND %3=70) or (%1=130 AND %2= 130 AND %3=130) or (%1=200 AND %2=200 AND %3=200) or (%1=242 AND %2=242 AND %3=242) then %4=0 else%4=1
endif

while %1 is a red layer, %2 is a green layer, % 3 is a blue layer and %4 and %5 are new added layers.

After the simulations using EASI modeling, the aerosols and clouds profiles will be successfully

separated and viewed as different images and the TAB data from the ground up to 20 km altitude is plotted. These data are being plotted with reference to multiple 1km range because we could observe that most of the aerosols and clouds are located in this range. Above this height, no clouds are observed and the numbers of aerosols are decreasing. The 2D simulations of aerosols and clouds are further analyzed using SCION Image®. The objective of this analysis is to see the density trend of aerosols and clouds across the study area. The x-axis represents the length of the study area on the 2D simulation image and the y-axis represents the density in the pixel values unit at the study area.

Conclusions:

The proposed simulation algorithm can be applied exclusively to the TAB images from space borne satellite, CALIPSO. If it is to be applied to other backscatter image, such as ground-based LIDAR, then it should be necessary to change the numbers in the brackets of this algorithm to the RGB values of aerosols and clouds in the images that could have been used. This algorithm is tested for its reliability in discerning clouds from aerosols by Malaysian model because it follows the essential characteristic of clouds which have higher backscatter values than aerosols. The further analysis using SCION Image ® proves the consistency of the proposed algorithm.

This new method of analysis using new algorithms with image processing and computer graphics software will provide an option to analyze the atmospheric backscatter data with the image captured by the space borne sensors to create an alarm over the load of aerosols and their impacts over monsoon rain falls, cloud bursting, droughts etc.This will enable us to understand our climate science in order to manage the economy of the country.

Table 1: Price Index: Source Ministry of Commerce and Industry: Government of India.

YEAR	Wpi	Potato	Onion	Tomoto	Brinjal	Okra Ladyfinger	Peas
JAN 2006	109.4	126.2	113.4	90.7	95	135.8	87.4
JAN 2007	112.3	85.1	174.8	140.3	119.4	128.9	68.2
JAN 2008	117.7	131.5	120.5	84.6	117.1	148	94.7
JAN 2009	124.2	92.7	252.8	117.2	148	159.8	109.2
JAN 2010	134.8	149.3	270.4	150	141.5	181	107
CURRENT	142.3	189.1	366.8	139.1	240	192.8	139.4
CAGR(IN%)	5.4	8.42	26.46	8.93	20.36	7.26	9.79

Table 2: Power Generation in India.

Installed capacity in MW	As on Nov30'2007	As on Nov 30'2010	Gross Generation 2004-05	
Coal	73492.38	89778.38	Hydro	84497 GWh
Diesel	1201.75	1199.75	Nuclear	16638 GWh
Gas	14581.71	17624.85	Thermal and Wind	486031 GWh
Total	89275.84	108602.98	No. Villages electrified	498286
Wind and Renewable Energy	10175.03	16786.98	Length of Transmission & Distristribution lines	6497727 Circuit km.
Nuclear	4120.00	4560.00	Per Capita consumption	606.2 kWh
Hydro	34680.76	37367.40	Loss-- Transmission, Distribution, Transformation and Unaccounted energy	32.15%
Grant total	138251.63	167317.36	Update: Gross generation in the country increased from 704.469 billion units in 2007-08 to 723.794 billion units in 2008-09. Generation was 662.5 billion units in 2006-07 and 617.5 billion units in the previous year.	

Table 3: The digital number for aerosols. The classification is based on the digital number (DN) of the weak backscatter colour.

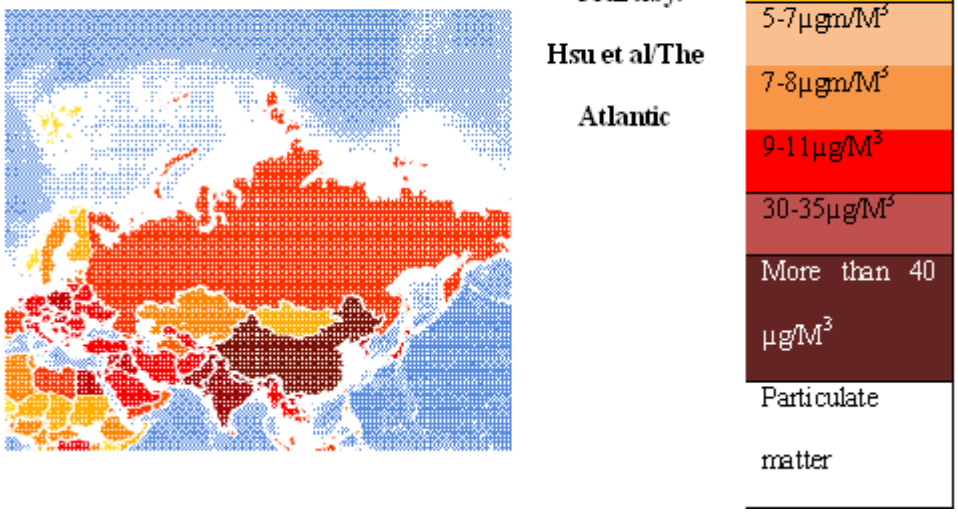
Red	Green	Blue
255	255	0
255	212	0
255	127	0
255	170	0

Table 4: The DN for clouds. The classification is based on the digital number (DN) of the strong backscatter color.

Red	Green	Blue
255	255	255
253	253	253
249	249	249
245	245	245
242	242	242
240	240	240
235	235	235
225	225	225
200	200	200
180	180	180

155	155	155
130	130	130
100	100	100
70	70	70

Fig:1 Particulate Pollution level all over world



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