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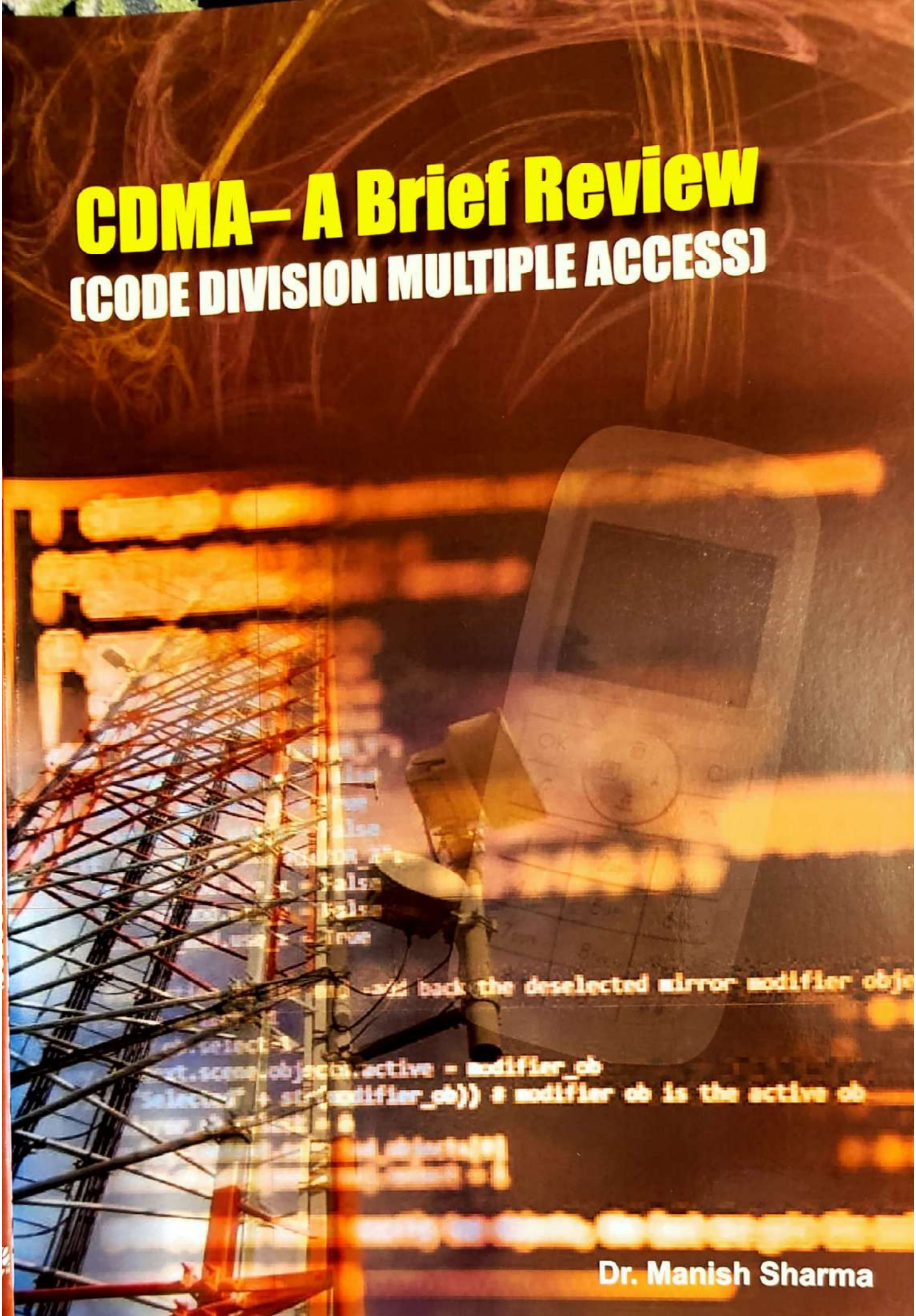
(CODE DIVISION MULTIPLE ACCESS)



Dr. Manish Sharma

About the Book

The book entitled **"CDMA-A Brief Review"** is comprehensively written to meet the curriculum requirements of Code Division Multiple Access for Undergraduate and Postgraduate Engineering students, especially in **Computer Science, Electronics and Communication Engineering.** Note that this book is a text cum reference book that also covers various topics of Communication Engineering under various universities. The following are the main features-

- The book contains 5 chapters covering the history, and working of CDMA in 3-G, the difference between WLAN and CDMA2000 cellular network,4-G,5-G, and 6-G Comparisons, their sources, effects, and applications.
- Each chapter provides the reader with a solid foundation on the topic and often resources for deeper investigation with its simple and lucid language.
- Attempts have been made to discuss the relevant topics (both theoretical and practical) with simple diagrams.
- The subject matter is discussed in very simple and precise language mentioning the need and aim of the study, performance analysis, conclusion, and futuristic applications to get a sense of satisfaction and involvement in Engineering and Sciences.
- An immense time has been devoted to designing the important questions and answers in the glossary section.

About the Author

Dr. Manish Sharma Ph.D. M.Tech, M.Sc. is presently working as A.P. Physics, Government P.G. College Nagrota Bagwan Himachal Pradesh India, earlier served in Sri Sai Instiutes Pathankot Punjab India as HOD Applied Sciences has several publications in his credit in the journals of national and international repute. Exposure in Electronics, Doping, and Routing Protocols. He has got the Young Investigator Award in 2013 by Interscience Research Network Bhubaneshwar, India, and also received "Pratiba Samman Prashasti Patra" in M.Sc. Physics(Electronics). He has been teaching since 2004. In 2019, his book "Evaluation of Various routing protocols in VANET" by Lambert Academic Publishers, Germany is an appreciated work.

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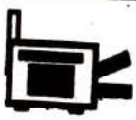

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This book covers key areas of Chemical Science. The contributions by the authors include plasma-assisted molecular beam epitaxy, anisotropic strain, structural-parametric model, electroelastic actuator, piezoactuator, deformation, matrix transfer function, phenolic compounds, chemotaxonomic implications, crystal structure, hydrogen bonding, liquid chromatography, mucolytic agent, serratiopeptidase, pharmaceutical dosage, corrosion rate, weight loss, corrosion combating efficacy, surface coverage, chemical compound, perfumery phenols, oxidation, inorganic and organic oxidants, kinetics, hypohalite ions, reaction mechanism, thermodynamic activation parameters, cathode surface, electrochemical reduction, and surface morphology. This book contains various materials suitable for students, researchers and academicians in the field of Chemical Science.

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Abstract

In DMS materials, magnetic ions replace a very small portion of the host semiconductor cation. We selected the transparent ZnO, which has a bandgap of 3.3 eV at ambient temperature, as the semiconducting host. Studies on 3d transition metal-doped ZnO showed that the magnetic moments were quite tiny. We looked into ZnO thin films doped with rare earth (RE) metal ions in light of more recent Gd in GaN studies that showed large magnetic moments. The 3d electrons in transition metals are exterior and delocalized, resulting in strong direct exchange interactions and high Curie temperatures, but the orbital momentum is often zero, resulting in small total magnetic moments per atom. The 4f electrons are localised in RE metals, and exchange interactions are indirect, via 5d or 6s conduction electrons, but the elevated orbital momentum leads to high total magnetic moments per atom, such as 3.27μB for Nd. Nd has a Curie point of 19 K. The findings of our investigation into Nd-doped ZnO films are presented in this work. In order to learn more about the electrical characteristics of films, hall measurements are used. Here, we made and examined ZnO films doped with various Nd concentrations. On a-plane Al2O3 or SiO2 substrates, the films are grown. Hall investigations of electrical properties revealed the presence of a degenerate, highly conducting, film–substrate interface layer for the films grown on $Al2O_3$; such an effect can be avoided, for example, by using SiO_2 substrates. No anomalous Hall effect was seen in the magnetotransport experiments, but there was a strong negative magneto resistance ratio, which can be explained by the system's paramagnetic reaction to the applied magnetic field. We want to keep using surface-sensitive methods to examine the magnetic characteristics of ZnO:RE thin films.

Keywords: Rare earth; thin films; hall measurements; spinotronics

Education: Key to Unlock Sustainable Development Goals

Dr. Sheetal Zalte & Dr. Smita Gupta

Education: Key to Unlock Sustainable Development Goals

Proceedings of the two-day international webinar
(Peer reviewed publication)

Edited by

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Associate Professor
Smt. Kapila Khandvala College of Education

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2

Climate Change and incidences of Tropical Cyclones in Coastal areas of India

Nikesh Sharma
Assistant Professor of Geography,
Government College Nagrota Bagwan (H.P.)

Abstract

The northern Indian Ocean consists by two seas namely the Bay of Bengal in the east side and the Arabian Sea located to the west side. The tropical cyclone activity in the Bay of Bengal is generally higher than that of the Arabian Sea. But new research has been conducted recently showed a drastic shift in this trend of cyclone incidences. In Indian Ocean five Cyclones forms annually in the Bay of Bengal and only one Cyclone develops in the Arabian Sea. But now a days risk scenario is drastically changing, about two years back in May 2020 cyclone Amphan gathered energy from anomalously high sea surface temperatures in the Bay of Bengal, intensified and turned into a catastrophic cyclone within a one day. After a span of one week, Nisarga cyclone was formed over the Arabian Sea and struck into western coast of India. The western part of the tropical Indian Ocean has been warming for about a century, at a rate of very high that is faster than any other region of tropical oceans of the World. Tropical Cyclones draw their power from warm waters, which is why they form over warm pool regions where temperatures are more 28 degrees celsius. Tauktae clearly demonstrates the relationship between global warming and cycones origin. The Indian east coast and the coasts of Bangladesh, Myanmar and Sri Lanka are more vulnerable to the incidence of tropical cyclones of the Bay of Bengal. The tropical cyclones wreak heavy loss of life and property in Bay of Bengal region every year. The Global climate changes resulting from different type of anthropogenic activities are likely to noticeable itself in the weather and climate of the Bay of Bengal region also.

Key words: *Climate, Tropical Cyclone, incidences, Global Warming*

Introduction

Tropical cyclone is basically a large type of weather system that has meticulous type of characteristics. The tropical Cyclones of the World are formed around a well-built centre of low atmospheric pressure, and causes winds to rotate inwards in a clockwise direction in Tropical Ocean of the World. This formation gives them the manifestation of a twisting snake, which is where the name comes from the particular areas of the World. In the Earth surface, cyclones are the most distressing natural forces to the life of human beings. We experience Tropical Cyclones every year in tropical Oceanic areas of the World. The Tropical Cyclones are not something unique to our planet but we have also spotted Cyclones in Mars and Neptune Planet also.

The origin of Tropical Cyclones is not well understood. These Cyclones are, however, quite different from that of the Temperate Cyclones. The air of the tropics is essentially homogenous, with no fronts. In addition, the warm air and warm sea ensure an abundant supply of water vapour into the atmosphere, and thus the necessary latent heat to fuel these types of Tropical Cyclones. The Tropical cyclones originate within a warm, humid air mass between 8˚ and 25˚ N and South in both the hemispheres of our planet. Tropical Cyclones usually develop from a small tropical depression. The Coriolis Effect also helps in the origin of Tropical Cyclones. The trade wind belt is typically a relatively shallow layer of warm, moist air above which is a deep layer of warmer, dry subsiding air. This forms the trade wind inversion- characteristic that limits the vertical development of clouds. The inversion is sometimes interupted by low-pressure trough, which allows thunderstorms development behind the wave. Increased convection and the normal pattern of high altitude winds causes the trough to deepen on an isolated low pressure system are formed. If the pressure continues to fall, winds pick up the pace and a tropical storm is born. In this process, the role of Coriolis Effect is quite significant (Majid, H.).

The northern Indian Ocean consists by two seas namely the Bay of Bengal in the east side and the Arabian Sea located to the west side. The tropical cyclone activity in the Bay of Bengal is generally higher than that of the Arabian Sea. But new research has been conducted recently related to Tropical Cyclones activities showed an extreme shift in this trend of cyclone

incidences. In Indian Ocean on an average five Cyclones forms annually in the Bay of Bengal and only one Cyclone develops in the Arabian Sea. But now a days risk scenario is considerably changing, about two years back in May 2020 cyclone Amphan gathered energy from anomalously high sea surface temperatures in the Bay of Bengal, intensified and turned into a catastrophic cyclone within a one day. After a span of one week, Nisarga cyclone was formed over the Arabian Sea and struck into western coast of India. The western part of the tropical Indian Ocean has been warming for about a century, at a rate of very high that is faster than any other region of tropical oceans of the World. Tropical Cyclones draw their power from warm waters, which is why they form over warm pool regions where temperatures are more 28 degrees celsius. Tauktae clearly demonstrates the relationship between global warming and cycones origin. The Indian east coast and the coasts of Bangladesh, Myanmar and Sri Lanka are more vulnerable to the incidence of tropical cyclones of the Bay of Bengal. The tropical cyclones wreak heavy loss of life and property in Bay of Bengal region every year. The Global climate changes resulting from different type of anthropogenic activities are likely to noticeable itself in the weather and climate of the Bay of Bengal region also.

To make things slightly more perplexing, there are also different types of cyclones in different parts of the World. As well as tropical cyclones, there are also extratropical cyclones and tornadoes are found in our Planet. Extratropical type of cyclones is emerges when there are temperature contrasts and are low-pressure systems, and rotate in the opposite way to tropical cyclones. Tornadoes are columns of air that rotate rapidly downward from a thunderstorm. You will often see that cyclones and other big storms are named differently in different part of the World. This helps us to keep track of them, both in the media and from a scientific point of view. Usually, the first storm of the year is named beginning with A, the next one B, and so on. If a tropical Cyclone is particularly dangerous in nature, the name would not be reused in future event of Cyclone.

Main Objectives of the Study:

1. To analyse history of Cyclones in India.
2. To identify main causes of Cyclones in Indian Ocean.

3. To study how to prepare for Tropical Cyclone in coastal areas of Northern Indian Ocean.
4. To study future of extreme of Tropical Cyclones in Coastal areas of Indian Ocean.

Research Methods and Techniques: The present study is Quantitative in nature and the different information and data are collected from different sources like literature related to climate change and incidences of Cyclones in India and online sources etc.

Study Area: In this research paper, main focus on climate and incidences of Tropical Cyclones in coastal areas of India.

Analysis of the Study:

The Tropical Cyclone along with very strong winds, cyclones bring heavy rain, storm surges (coastal floods), and tornadoes. This combination of extreme weather can bring destruction to coastal areas. According to some suggested estimates that near about 10,000 people are killed every year as a result of these tropical storms. Densely populated Coastal areas are predominantly at big risk from these types of tropical cyclones. Mostly these types of tropical cyclone generated strong winds can damage buildings and infrastructure, while heavy rain and storm surges can escort to flooding in coastal areas of northern Indian Ocean. Heavy rain leads to other risks likes landslides, mudslides and coastal areas erosion. It is not just an event itself that leads to different types of damage but the after-effects of cyclones can cause extensive pandemonium as people try and reconstruct their lives in cyclone affected areas. The Standing water due to cyclonic rainfall generated floods can lead to different types of diseases, electrical and water services can badly interrupted and the costal areas can coiled out of control. These tropical cyclonic storms have impacted humans as well as animals throughout history. Tropical Cyclones are the most deadly natural disasters we experience, and there is evidence to suggest they are getting stronger and lasting longer.

India has a long and tragic history about tropical cyclones with the origin of human life in our planet earth. The Indian subcontinent is mostly worst affected regions of the world by tropical cyclones storms. It is particularly more vulnerable due to its 7516 kilometers coastline, where a large number of the Indian population lives. The tropical cyclones are generally tended

to form in the North Indian Ocean between April and November each year. The tropical cyclones primary peak in November month whiles a secondary peak in month of May. The tropical cyclonic storms can affect the entire coast of Indian Ocean but the east coast is more prone as compared to the west coast of Indian Ocean. There have been some catastrophic cyclones have occured that have hit the country over the year. Some of the most notable cyclones in Indian Ocean throughout recent history:

1. The 1970 Bhola cyclone

The Bhola cyclone is one of the most deadly natural disasters that have ever recorded in Indian Ocean. The Bhola tropical Cyclonic storm that formed over the Bay of Bengal in November 11, 1970. This Bhola storm made landfall on the east coast of Pakistan (now Bangladesh) before continuing on to West Bengal. The Bhola Cyclonic storm on its peak, the cyclone generated winds are up to 115 mph devastating the coastal regions where it encountered. According to some estimates that between 300,000 and 500,000 people were killed during the disaster, making it the deadliest tropical cyclone on its historical record. It remains the deadliest tropical Cyclone ever recorded one of the most deadly natural disaster of Indian Ocean.Near about 2/3 of the Coastal regions fishing industry was destroyed and due to this regions 80 percent of the protein comes from fisheries.

2. The 1991 Bangladesh cyclone

The 1991 Bangladesh cyclone was another deadly cyclone that was originated and formed in Bay of Bengal of Indian Ocean. The tropical storm was firstly hit near the Chittagong region, one of the most populated areas of the Bangladesh. The cyclonic weather system was originated in the Bay of Bengal and it began moving northward and reached Bangladesh. By April 24, 1991 the storm was designated Tropical Storm 02B, and by April 28 it was a tropical cyclone. One day later the tropical storm hit south of Chittagong, with winds of up to 150 miles (240 km) per hour. The cyclone caused a deadly storm surge that was 20 feet high. The tropical cyclonic storm hit near the Chittagong region of Bangladesh's most populated area. About 140,000 people were killed by this tropical cyclonic storm, and as many as one crore people lost their homes, and overall property damage was in the billions of dollars. The storm surge washed away entire villages and swamped farms, destroying crops and spreading fears of widespread

hunger as well as economic woe. In the fallout of this tropical cyclonic storm, some of the World countries carried out one of the largest military relief efforts on historical record, and called it Operation Sea Angel. Since the 1991 storm, the Bangladesh government has built thousands of elevated shelters in the coastal areas believed to be most vulnerable to cyclones. In addition the government has started a reforestation of mangrove trees program designed to alleviate future flooding.

3. The 1999 Odisha cyclone

This tropical storm was the most powerful tropical cyclone ever recorded in the Bay of Bengal in North Indian Ocean. This tropical cyclone was one of the most destructive in this region. This cyclone organized into a tropical depression in the Andaman Sea on 25 October, though its origins could be traced back to an area of convection in Sulu Sea four days prior. The disturbance gradually strengthened the tropical cyclonic storm when it took a west-northwesterly path, and reaching cyclonic storm strength on the next day. The speed of winds was recorded of up to 160 mph at the peak of this tropical cyclonic storm. The air pressure was also recorded very low during this cyclone. This tropical storm maintained this intensity as it made landfall on Odisha on 29 October 1999. This Odisha cyclonic storm was hit the state of Odisha in India and also felt the impact in Thailand, Myanmar, and Bangladesh. Nearly 10,000 people were died, and it caused around $4.44 billion worth of damage due to this Odisha cyclone. The cyclone steadily weakened due to persistent land interaction and dry air, remaining quasi-stationary for two days before slowly drifting offshore as a much weaker system; the storm dissipated on 4 November over the Bay of Bengal.

4. Cyclone Amphan

The Amphan cyclonic storm is one of the most terrible to hit the region since 2007, and called the first 'super' tropical storm since the 1999 Odisha cyclone (mentioned above). The first tropical cyclone of the 2020 north Indian Ocean cyclone season, Amphan originated from a low-pressure area persisting a couple hundred miles (300 km) east of Colombo, Sri Lanka, on 13 May 2020. The Super Cyclonic Storm Amphan was a powerful and catastrophic tropical cyclone that caused widespread damage in eastern India, specifically in West Bengal and Odisha, and in Bangladesh, in May

2020. At least 72 people were killed in West Bengal and a further 12 in Bangladesh. The Amphan cyclonic storm reached coastal land on May 20 near the city of Kolkata, leaving 1.4 crore people without power and chaos in its wake. It is estimated that cyclone Amphan caused over $13 billion of damage, as winds reached up to 160 mph.

5. Cyclone Nisarga

The tropical Nisarga cyclonic storm was formed over the Arabian Sea at the beginning of June 2020. This cyclone began to gather strength; experts feared that the storm could strike the city of Mumbai, typically; tropical cyclones form less frequently over the Arabian Sea and usually head west towards Oman. During the onset of this cyclone Nisarga, Mumbai was the city in India that was worst hit by the covid-19. In early month of June, 2020, there were over 40,000 confirmed cases of covid-19. Mumbai is one of the most populous cities in the country, and home to more than 2 crore people. Thank God, the eye of the tropical storm narrowly missed the Mumbai city. Cyclone Nisarga cyclone was a near miss for Mumbai city, a city that is very vulnerable to natural disasters like cyclone. The Nisarga further intensified to a severe cyclonic storm and turned to the northeast, ultimately making landfall approximately 95 km (60 miles) south of Mumbai. The Nisarga tropical cyclone was rapidly weakened once inland and dissipated on 4 June, 2020. Nisarga was the second cyclone to strike the Indian subcontinent within two weeks time, after Cyclone Amphan, the first super cyclonic storm to have formed in the Bay of Bengal in the 21st century, devastated the state of West Bengal in May 2020.

Main causes of Tropical Cyclones:

1. Climate connection: Climate change amplifies the tropical cyclonic storms that typically form in the northern Indian Ocean. The rapidly increasing sea surface temperatures of Oceanic areas can make tropical cyclones more powerful. The Warmer oceans mean there is a heavy rainfall during tropical storms occurence. The sea levels are increasing rapidly due to the global warming make for higher cyclonic storm surges, which reaches larger inland areas. The increasing surface temperatures also lead to cyclones forming much faster, as was the case with Nisarga and Amphan in Indian Ocean. "This year both Arabian Sea as well as Bay of Bengal was about one degree warmer than normal (in early May) and

hence the conditions were favorable to increasing the strength of the cyclones. Although this is a global phenomenon, it is especially true for the Indian Ocean, which is the warmest of all five oceans, partly because the African-Asian landmass obstructs the entry of cold water from the Arctic. The north Indian Ocean, which comprises the Arabian Sea and the Bay of Bengal, generates 7% of the world's cyclones. "However, their impact is comparatively high and devastating, especially when they strike the East Indian and Bangladesh coasts bordering North Bay of Bengal due to high population density clustered around low-lying areas along these coastlines. About 33 percent of the global population lives around the Indian Ocean, many in low-lying coastal areas, small islands, developing states and least developed countries that are particularly vulnerable to climate impacts. Till recently, the Arabian Sea was spared severe cyclones but that no longer seems to be the case.

2. Heat and violence

The proportions of strongest tropical cyclonic storms are increasing about 8% a decade, latest research shows. The higher rainfall possibility during these storms has also increased rapidly. Our planet Earth's atmosphere heats up rapidly due to carbon emissions and it can hold more moisture, which often results in extreme rainfall that multiplies the chances of flooding due to cyclone storm. The links between climate change, cyclones and heavy rainfall have now been firmly established through attribution science, which look at particular examples of extreme weather events. Rising sea levels due to global warming also lead to increased storm surges that can inundate coastal areas. Global sea levels have risen by about 23 cm compared with pre-industrial times and are rising by 3.3 mm every year, according to NASA. This has grievous implications for South Asia, which has a large number of cities on the coast or close to it.

3. No warning

Like Nisarga and Amphan tropical cyclonic storms, a growing proportion of tropical cyclones develop quickly due to factors that are linked to climate change. The warm water of the Indian Ocean is one of the main factor are responsible for driving this rapid intensification. This makes it difficult to provide early warnings of cyclones. The number of tropical storms that intensify very rapidly just before landfall could increase substantially by the

end of this century and leading to higher rates of injuries as well as deaths, the recent research shows. "Our research shows that high ocean temperatures are conducive for rapid intensification of cyclones in the north Indian Ocean. These high temperatures can supercharge a cyclone since tropical cyclones primarily draw their energy from evaporation at the ocean surface."

4. Threat to coastal cities

South Asia has a large number of cities that has located along the coast of Indian Ocean. They house millions and have massive unplanned growth, with the poor constantly shifted to low-lying areas, making them particularly vulnerable to severe storms and flooding. Natural storm breakers such as mangroves have been cut down in recent years. The vanishing mangroves around Mumbai are a case in point. The damage from Cyclone Amphan would have been much greater if the mangroves of the Sundarbans forest had not blunted the storm's fury somewhat, experts said. The damage cyclones cause is made worse by inadequate drainage systems and loss of ponds that used to hold water, encroachment over existing drainage systems and reduction in coastal mangroves.

How to prepare for a tropical cyclone: The cyclones, hurricanes and typhoons are all being yearly occurrences in different parts of tropical regions of the World; we have got pretty good at preparing for them. From individual to global efforts, by studying and predicting cyclones, we are able to save millions of lives if we are able to do individual as well as global efforts and studying and predicting tropical cyclones. Some of the main points, who are responsible for preparation of tropical cyclones, are following:

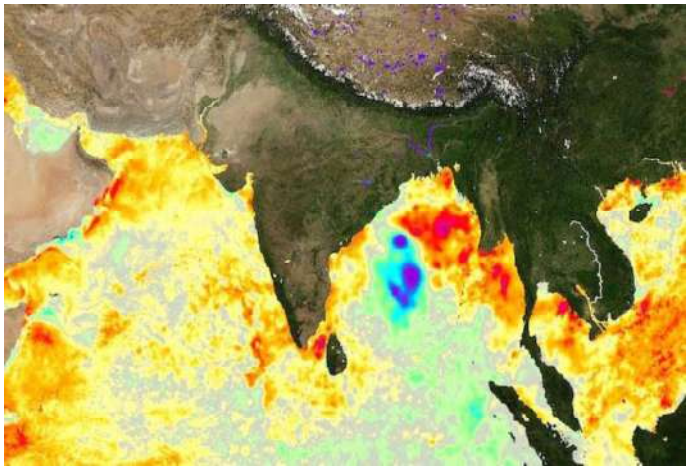
1. Infrastructure: One of the most crucial elements to preparing for cyclones in India and other countries is to have systems in place to deal with them. Now a day governments are prepared emergency shelters, different type of evacuation plans are made, and emergency response systems are developed in coastal areas of Indian Ocean.

2. Data related to tropical Cyclones: We are getting far better at understanding and predicting weather patterns across the globe. It is possible to detect and track cyclones by using satellite images, computer models, and other weather instruments. There are so many different types'

ways that data can be used to help plan for extreme events and protect people during them.

3. Risk reduction from Tropical Cyclones: The forces of nature are mostly beyond our control. We can predict the path of a cyclone may take, it is impossible to know exactly. We also can not stop tropical cyclonic storms as they evolution across sea and land. We can plan for ways to reduce the risk of tropical cyclone as they pose. In India, there are so many government-led projects to manage tropical cyclone storms risks. It hopes to reduce the impact of cyclones in a few ways. This includes improving early warning systems, helping communities to counter, and humanizing shelter and evacuation methods.

4. How to recover from a cyclone: Even with all the preparation that goes into reducing risk and predicting storm paths, cyclones can be incredibly destructive. The tropical cyclones affect individuals, communities, and entire regions, which is impacted by tropical cyclones. The high winds and flooding can damage and destroy property and roads, while livelihoods can be ruined. However, people and communities are often resilient. With the right support, people can rebuild their lives and support each other during such type of disasters. This course on community preparedness, recovery, and resilience explores, fostering positive developments is crucial. It also looks at disaster management and sustainable development. Accountability is also another crucial part of disaster management in coastal areas of Indian Ocean. On a local and as well as on global scale, it's essential for reducing the effects of events such as cyclones. As for cyclones in India, work is already on the go to pick up the pieces of Cyclone Amphan and Cyclone Nisarga.



A satellite image showing temperature anomalies in north Indian Ocean on May 19, a day before Cyclone Amphan made landfall in eastern India. There was a variation of more than 2C on May 19 in the Bay of Bengal (Image by PODAAC/NASA)

5. Disaster Preparedness, Mangroves, and Free-Flowing Rivers

On the basis of past cyclone tracks, Koll listed the Indian states and territories that may be most affected by increased activity: Lakshadweep, Gujarat, Maharashtra, Karnataka, and Kerala. Lakshadweep, composed entirely of tiny islands hundreds of kilometers off the coast of Kerala, is particularly vulnerable to cyclonic disaster. The archipelago's very survival has come under serious questioning given the threats posed by cyclonic activity, sea level rise, and coastal erosion. Experts said one manner in which states could prepare for the onslaught by cyclone is by conserving mangrove ecosystems. Such techniques also have benefits for climate adaptation and risk reduction. Detailing the benefits mangroves offer, Koll said they reduce the impact of winds and flooding during cyclones.

The future of extreme weather

The current examples of cyclones in India show just how catastrophic extreme weather can be. However, like many emergencies and disasters, as we investigate these events, there are trends that we can spot during occurrence of these disasters. This helps us to make better preparedness for when the worst disaster does happen. In Mumbai, during cyclonic storm

over 100,000 people, including coronavirus patients, were evacuated to safety places. But the science of climate change is clear human activity is increasing the risk of some types of extreme weather. According to some experts, 'As the climate continues to warm, it is expected that extreme tropical cyclone precipitation events and resulting inland flooding will become yet more frequent in near future.' Even if climate change doesn't directly result in more cyclones in India or elsewhere, it can intensify their effects. There is a mounting body of evidence linking several factors to this:

1. **Warmer sea temperatures:** When it comes to hurricanes (tropical storms similar to cyclones), warmer temperatures in the sea could be significant. It could increase the speed of the winds by up to 10% and mean they have 10-15% more precipitation. Both of these factors could cause more flooding and widespread damage during these cyclonic events.
2. **Rise in sea level:** Sea levels are expected to rise by 1-4 feet due to global warming. As a result, storm surges caused by cyclones and hurricanes could be even more damaging.
3. **Different areas:** As temperatures shift across the globe, so could the patterns of tropical storms. This could mean that areas that don't usually experience cyclones, such as Mumbai, could be more at risk in future due to climate change. Many of these places currently won't have the infrastructure to protect against these storms.

These tropical storms are just one of the implications of global warming. Therefore, it's more important than ever that we understand the causes of climate change and how we can slow it. It's clear that we're nearly at a tipping point when it comes to the natural systems of the environment, and we must act quickly to avoid disaster.

Conclusion: The Tropical Cyclone along with very strong winds, cyclones bring heavy rain, storm surges (coastal floods), and tornadoes. This combination of extreme weather can bring destruction to coastal areas. This combination of extreme weather can bring destruction to coastal areas. According to some suggested estimates that near about 10,000 people are killed every year as a result of these tropical storms. Densely populated Coastal areas are predominantly at big risk from these types of tropical cyclones. Mostly these types of tropical cyclone generated strong

winds can damage buildings and infrastructure, while heavy rain and storm surges can escort to flooding in coastal areas of northern Indian Ocean. Heavy rain leads to other risks likes landslides, mudslides and coastal areas erosion. It is not just an event itself that leads to different types of damage but the after-effects of cyclones can cause extensive pandemonium as people try and reconstruct their lives in cyclone affected areas. The Standing water due to cyclonic rainfall generated floods can lead to different types of diseases, electrical and water services can badly interrupted and the costal areas can coiled out of control. These tropical cyclonic storms have impacted humans as well as animals throughout history. Tropical Cyclones are the most deadly natural disasters we experience, and there is evidence to suggest they are getting stronger and lasting longer.

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Climate change amplifies the tropical cyclonic storms that typically form in the northern Indian Ocean. The increasing sea surface temperatures can make tropical cyclones more powerful. Warmer oceans mean there is heavy rainfall during tropical storms. The sea levels are increasing due to global warming make for higher storm surges, which reach larger inland areas. About 33 percent of the global population lives around the Indian Ocean and are vulnerable to climate impacts. The possibility of higher rainfall during these storms has also increased. South Asia has a large number of cities along the coast. The damage from Cyclone Amphan

would have been much greater if the mangroves of the Sundarbans forest had not blunted the storm's fury somewhat, experts said. We are getting far better at understanding and predicting weather patterns across the globe by using satellite images, computer models, and other weather instruments, it's possible to detect and track cyclones. Therefore, it's more important than ever that we understand the causes of climate change and how we can slow it. It's clear that we're nearly at a tipping point when it comes to the natural systems of the environment, and we must act quickly to avoid disaster.

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CHAPTER -25

STABILITY ANALYSIS FOR THERMOHALINE CONVECTION IN A COUPLE-STRESS FLUID

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INTRODUCTION

The stability of a layer of steady, viscous, incompressible thermohaline couple-stress liquid is investigated. The linear and nonlinear thresholds at the onset of convection are found to be same. The couple stresses and solute gradient both have the stabilizing impact on the system. Among the models proposed for the distinct behavior of non-Newtonian fluids, the one proposed by Stokes (1966) on couple stresses in fluids has relevance in theory of lubrication, synovial fluid present in synovial joints, liquid crystals, animal blood. Global nonlinear results are obtained in Sunil et al. (2011) for a layer of couple stress liquid. The corresponding problem in porous media is analysed by Choudhary and Sunil (2019).

MATERIALS AND METHODS

A horizontal layer of couple stress fluid with fixed viscosity heated and soluted from below for a free free conducting boundary system is considered. The temperature and concentration at lower and upper surfaces are fixed with gravitational force acting vertically downward. The governing equations for analysing onset in a thermohaline couple-stress liquid are (by using the Boussinesq approximation, Chandrasekhar (1961)):

$$\nabla \cdot \vec{q}_s = 0, \tag{1}$$

$$\rho_r \left(\frac{\partial}{\partial t} + \vec{q}_s \cdot \nabla \right) \vec{q}_s = -\nabla p_1 + \rho_r \left[1 - \alpha \left(T - T_{av} \right) + \alpha' \left(C - C_{av} \right) \right] \vec{g} + \left(\mu - \mu' \nabla^2 \right) \nabla^2 \vec{q}_s, \tag{2}$$

$$\frac{\partial T}{\partial t} + \vec{q}_s \cdot \nabla T = \kappa \nabla^2 T, \tag{3}$$

$$\frac{\partial C}{\partial t} + \vec{q}_s \cdot \nabla C = \kappa' \nabla^2 C. \tag{4}$$

Here, ρ_r is the reference fluid density, $\vec{q}_s$ is the fluid velocity, $\vec{g}$ is gravity, t denotes time, p_1 is the fluid pressure, μ is the viscosity, μ' is the visco-elasticity coefficient, κ is the thermal diffusivity, κ' is the solute diffusivity, α and α' are thermal and solute expansion coefficients.

To the above set of equations, we apply perturbations, normal mode techniques for linear analysis and then the energy method for nonlinear analysis. The critical values of Rayleigh number for both the cases (linear as well as non linear) are calculated and found to coincide.

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OUTCOMES

The values of the wave number (x_c) and thermal Rayleigh number (R_c) turned out to be dependent on couple stress parameter (F_1) and solute gradient (S_1). Figure 1 shows the behaviour of critical values of thermal Rayleigh number with varying solute gradient for considered values of couple stress parameter.

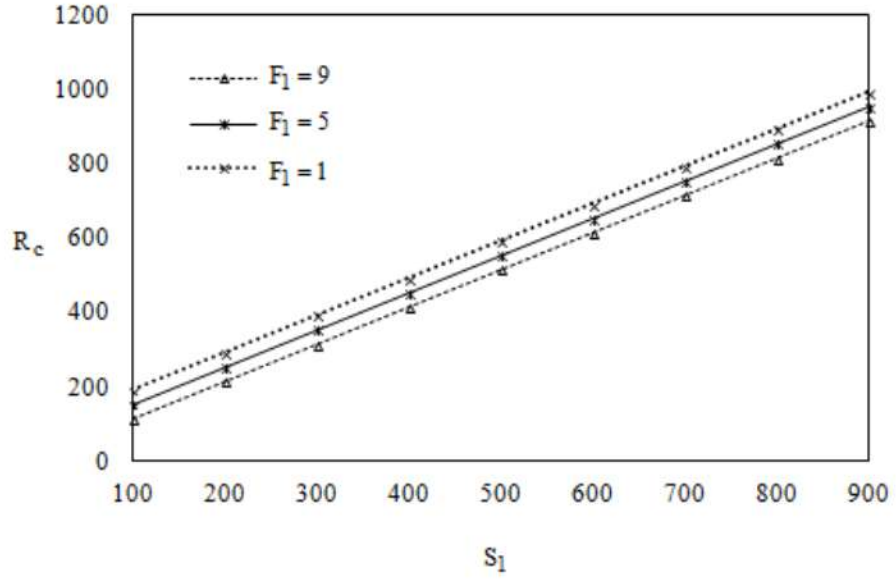

Figure 1: The variation in Rayleigh number R_c versus solute parameter S_1.

From this figure, the stabilizing nature of couple stresses as well as solute gradient is observed.

CONCLUSIONS

The critical values of Rayleigh numbers obtained using linearised theory and by energy technique of nonlinear theory are same. The coincidence of the two theories allows linear theory to capture the whole physics of the model. The onset of convection is advanced due to presence of solute. The critical Rayleigh number values for couple stress parameter shows stabilizing nature of the parameter.

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