Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: H

Environment & Earth Science

COVID-19 Pandemic

Step towards Spiritualistic World

Highlights

Estimation of Hurricane Intensity

ATMS-Derived Temperature Anomaly

Discovering Thoughts, Inventing Future

VOLUME 20 ISSUE 4 ISSUE 1.0

© 2001-2020 by Global Journal of Science Frontier Research, USA

Global Journal of Science Frontier Research: H
Enviornment & Earth Science

Global Journal of Science Frontier Research: H
Enviornment & Earth Science
Volume 20 Issue 4 (Ver. 1.0)

Open Association of Research Society

© Global Journal of Science Frontier Research. 2020.

All rights reserved.

This is a special issue published in version 1.0 of "Global Journal of Science Frontier Research." By Global Journals Inc.

All articles are open access articles distributed under "Global Journal of Science Frontier Research"

Reading License, which permits restricted use. Entire contents are copyright by of "Global Journal of Science Frontier Research" unless otherwise noted on specific articles.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without written permission.

The opinions and statements made in this book are those of the authors concerned. Ultraculture has not verified and neither confirms nor denies any of the foregoing and no warranty or fitness is implied.

Engage with the contents herein at your own risk.

The use of this journal, and the terms and conditions for our providing information, is governed by our Disclaimer, Terms and Conditions and Privacy Policy given on our website http://globaljournals.us/terms-and-condition/menu-id-1463/

By referring / using / reading / any type of association / referencing this journal, this signifies and you acknowledge that you have read them and that you accept and will be bound by the terms thereof.

All information, journals, this journal, activities undertaken, materials, services and our website, terms and conditions, privacy policy, and this journal is subject to change anytime without any prior notice.

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*
Sponsors: Open Association of Research Society
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Editorial Board

Global Journal of Science Frontier Research

Dr. John Korstad

Ph.D., M.S. at Michigan University, Professor of Biology, Department of Biology Oral Roberts University, United States

Dr. Alicia Esther Ares

Ph.D. in Science and Technology, University of General San Martin, Argentina State University of Misiones, United States

Dr. Sahraoui Chaieb

Ph.D. Physics and Chemical Physics, M.S. Theoretical Physics, B.S. Physics, cole Normale Suprieure, Paris, Associate Professor, Bioscience, King Abdullah University of Science and Technology United States

Tuncel M. Yegulalp

Professor of Mining, Emeritus, Earth & Environmental Engineering, Henry Krumb School of Mines, Columbia University Director, New York Mining and Mineral, Resources Research Institute, United States

Andreas Maletzky

Zoologist University of Salzburg, Department of Ecology and Evolution Hellbrunnerstraße Salzburg Austria, Universitat Salzburg, Austria

Dr. Gerard G. Dumancas

Postdoctoral Research Fellow, Arthritis and Clinical Immunology Research Program, Oklahoma Medical Research Foundation Oklahoma City, OK United States

Dr. Mazeyar Parvinzadeh Gashti

Ph.D., M.Sc., B.Sc. Science and Research Branch of Islamic Azad University, Tehran, Iran Department of Chemistry & Biochemistry, University of Bern, Bern, Switzerland

Dr. Indranil Sen Gupta

Ph.D., Mathematics, Texas A & M University, Department of Mathematics, North Dakota State University, North Dakota, United States

Dr. Richard B Coffin

Ph.D., in Chemical Oceanography, Department of Physical and Environmental, Texas A&M University United States

Dr. A. Heidari

Ph.D., D.Sc, Faculty of Chemistry, California South University (CSU), United States

Dr. Xianghong Qi

University of Tennessee, Oak Ridge National Laboratory, Center for Molecular Biophysics, Oak Ridge National Laboratory, Knoxville, TN 37922, United States

Dr. Vladimir Burtman

Research Scientist, The University of Utah, Geophysics Frederick Albert Sutton Building 115 S 1460 E Room 383, Salt Lake City, UT 84112, United States

Dr. Shyny Koshy

Ph.D. in Cell and Molecular Biology, Kent State University, United States

Dr. Gayle Calverley

Ph.D. in Applied Physics, University of Loughborough, United Kingdom

Dr. Bingyun Li

Ph.D. Fellow, IAES, Guest Researcher, NIOSH, CDC, Morgantown, WV Institute of Nano and Biotechnologies West Virginia University, United States

Dr. Baziotis Ioannis

Ph.D. in Petrology-Geochemistry-Mineralogy Lipson, Athens, Greece

Dr. Matheos Santamouris

Prof. Department of Physics, Ph.D., on Energy Physics, Physics Department, University of Patras, Greece

Dr. Vyacheslav Abramov

Ph.D in Mathematics, BA, M.Sc, Monash University, Australia

Dr. Fedor F. Mende

Ph.D. in Applied Physics, B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine

Dr. Moustafa Mohamed Saleh Abbassy

Ph.D., B.Sc, M.Sc in Pesticides Chemistry, Department of Environmental Studies, Institute of Graduate Studies & Research (IGSR), Alexandria University, Egypt

Dr. Yaping Ren

School of Statistics and Mathematics, Yunnan University of Finance and Economics, Kunming 650221, China

Dr. Yilun Shang

Ph.d in Applied Mathematics, Shanghai Jiao Tong University, China

Dr. T. David A. Forbes

Associate Professor and Range Nutritionist Ph.D. Edinburgh University - Animal Nutrition, M.S. Aberdeen University - Animal Nutrition B.A. University of Dublin-Zoology

Dr. Bing-Fang Hwang

Department of Occupational, Safety and Health, College of Public Health, China Medical University, Taiwan Ph.D., in Environmental and Occupational Epidemiology, Department of Epidemiology, Johns Hopkins University, USA Taiwan

Dr. Moaed Almeselmani

Ph.D in Plant Physiology, Molecular Biology, Biotechnology and Biochemistry, M. Sc. in Plant Physiology, Damascus University, Syria

Dr. Giuseppe A Provenzano

Irrigation and Water Management, Soil Science, Water Science Hydraulic Engineering , Dept. of Agricultural and Forest Sciences Universita di Palermo, Italy

Dr. Eman M. Gouda

Biochemistry Department, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt

Dr. Claudio Cuevas

Department of Mathematics, Universidade Federal de Pernambuco, Recife PE, Brazil

Dr. Arshak Poghossian

Ph.D. Solid-State Physics, Leningrad Electrotechnical Institute, Russia Institute of Nano and Biotechnologies Aachen University of Applied Sciences, Germany

Dr. Qiang Wu

Ph.D. University of Technology, Sydney, Department of Mathematics, Physics and Electrical Engineering, Northumbria University

Dr. Lev V. Eppelbaum

Ph.D. Institute of Geophysics, Georgian Academy of Sciences, Tbilisi Assistant Professor Dept Geophys & Planetary Science, Tel Aviv University Israel

Prof. Jordi Sort

ICREA Researcher Professor, Faculty, School or Institute of Sciences, Ph.D., in Materials Science Autonomous, University of Barcelona Spain

Dr. Eugene A. Permyakov

Institute for Biological Instrumentation Russian Academy of Sciences, Director Pushchino State Institute of Natural Science, Department of Biomedical Engineering, Ph.D., in Biophysics Moscow Institute of Physics and Technology, Russia

Prof. Dr. Zhang Lifei

Dean, School of Earth and Space Sciences, Ph.D., Peking University, Beijing, China

Dr. Hai-Linh Tran

Ph.D. in Biological Engineering, Department of Biological Engineering, College of Engineering, Inha University, Incheon, Korea

Dr. Yap Yee Jiun

B.Sc.(Manchester), Ph.D.(Brunel), M.Inst.P.(UK) Institute of Mathematical Sciences, University of Malaya, Kuala Lumpur, Malaysia

Dr. Shengbing Deng

Departamento de Ingeniera Matemtica, Universidad de Chile. Facultad de Ciencias Fsicas y Matemticas. Blanco Encalada 2120, Piso 4., Chile

Dr. Linda Gao

Ph.D. in Analytical Chemistry, Texas Tech University, Lubbock, Associate Professor of Chemistry, University of Mary Hardin-Baylor, United States

Angelo Basile

Professor, Institute of Membrane Technology (ITM) Italian National Research Council (CNR) Italy

Dr. Bingsuo Zou

Ph.D. in Photochemistry and Photophysics of Condensed Matter, Department of Chemistry, Jilin University, Director of Micro- and Nano- technology Center, China

Dr. Bondage Devanand Dhondiram

Ph.D. No. 8, Alley 2, Lane 9, Hongdao station, Xizhi district, New Taipei city 221, Taiwan (ROC)

Dr. Latifa Oubedda

National School of Applied Sciences, University Ibn Zohr, Agadir, Morocco, Lotissement Elkhier N66, Bettana Sal Marocco

Dr. Lucian Baia

Ph.D. Julius-Maximilians, Associate professor, Department of Condensed Matter Physics and Advanced Technologies, Department of Condensed Matter Physics and Advanced Technologies, University Wrzburg, Germany

Dr. Maria Gullo

Ph.D., Food Science and Technology Department of Agricultural and Food Sciences, University of Modena and Reggio Emilia, Italy

Dr. Fabiana Barbi

B.Sc., M.Sc., Ph.D., Environment, and Society, State University of Campinas, Brazil Center for Environmental Studies and Research, State University of Campinas, Brazil

Dr. Yiping Li

Ph.D. in Molecular Genetics, Shanghai Institute of Biochemistry, The Academy of Sciences of China Senior Vice Director, UAB Center for Metabolic Bone Disease

Nora Fung-yee TAM

DPhil University of York, UK, Department of Biology and Chemistry, MPhil (Chinese University of Hong Kong)

Dr. Sarad Kumar Mishra

Ph.D in Biotechnology, M.Sc in Biotechnology, B.Sc in Botany, Zoology and Chemistry, Gorakhpur University, India

Dr. Ferit Gurbuz

Ph.D., M.SC, B.S. in Mathematics, Faculty of Education, Department of Mathematics Education, Hakkari 30000, Turkey

Prof. Ulrich A. Glasmacher

Institute of Earth Sciences, Director of the Steinbeis Transfer Center, TERRA-Explore, University Heidelberg, Germany

Prof. Philippe Dubois

Ph.D. in Sciences, Scientific director of NCC-L, Luxembourg, Full professor, University of Mons UMONS Belgium

Dr. Rafael Gutirrez Aguilar

Ph.D., M.Sc., B.Sc., Psychology (Physiological), National Autonomous, University of Mexico

Ashish Kumar Singh

Applied Science, Bharati Vidyapeeth's College of Engineering, New Delhi, India

Dr. Maria Kuman

Ph.D, Holistic Research Institute, Department of Physics and Space, United States

Contents of the Issue

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Contents of the Issue

1. Ecological Consciousness and Self-Realization-an Identification: A Step towards Spiritualistic World. *1-4*
2. Estimation of Hurricane Intensity from ATMS-Derived Temperature Anomaly using Machine Learning. *5-15*
3. Age and Gender as Determinants of Adult Coping with COVID-19 Pandemic. *17-28*
4. Application of Lineament Analysis in Geohazard Studies in Mukuru Area Boki Lga Cross River State Nigeria. *29-44*
5. Micropaleontological Analysis of Rocks of Mbakwah and Environs, Gboko, Southeast Nigeria. *45-58*

v. Fellows
vi. Auxiliary Memberships
vii. Preferred Author Guidelines
viii. Index

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Ecological Consciousness and Self-Realizationan Identification: A Step towards Spiritualistic World

By Dr. Mayuri Barman
Pandu College

Abstract- The most dangerous tendency of the present human generation is to enjoy every aspect of life selfishly which leads to serious threat to an environment. From the very beginning man was never a solitary creature in the planet where the relationship between humans and nature is one of the most fundamental issues we face and must deal with today. A universal holistic approach is needed, which may develop ecological consciousness among us. Many religions, scriptures can help to build a model of ecological consciousness. The importance of ancient Indian religious practices shows that human beings are an integral part of nature, and should, therefore, naturally understand the framework of life. At present human society is misled by the false attraction of the materialistic life, so to realize his true 'self ,' one has to get out of this false notion that human society is the only proprietor of the world. The 'Bhagavad-Gita' nicely describes detachment from materials activities to the transcendental activities with realizing our true 'self.' Warwick Fox and Arne Naess's 'Self Realization' shows how a person who Is self-realized and well-identified with the non-human world, will behave in harmony with nature, acting from inclination rather than duty.

Keywords: environmental crisis, holistic, ecological consciousness, scriptures, self- realization.

GJSFR-H Classification: FOR Code: 060299

Strictly as per the compliance and regulations of:

© 2020. Dr. Mayuri Barman. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Ecological Consciousness and Self-Realization- an Identification: A Step towards Spiritualistic World

Dr. Mayuri Barman

Abstract- The most dangerous tendency of the present human generation is to enjoy every aspect of life selfishly which leads to serious threat to an environment. From the very beginning man was never a solitary creature in the planet where the relationship between humans and nature is one of the most fundamental issues we face and must deal with today. A universal holistic approach is needed, which may develop ecological consciousness among us. Many religions, scriptures can help to build a model of ecological consciousness. The importance of ancient Indian religious practices shows that human beings are an integral part of nature, and should, therefore, naturally understand the framework of life. At present human society is misled by the false attraction of the materialistic life, so to realize his true 'self ,' one has to get out of this false notion that human society is the only proprietor of the world. The '*Bhagavad-Gita'* nicely describes detachment from materials activities to the transcendental activities with realizing our true 'self.' Warwick Fox and Arne Naess's 'Self Realization' shows how a person who Is self-realized and well-identified with the non-human world, will behave in harmony with nature, acting from inclination rather than duty.

Keywords: environmental crisis, holistic, ecological consciousness, scriptures, self- realization.

I. Introduction

The current capitalist economy is ego-centric. Everyone is structured to satisfy the needs of an individual. What needed is a deeper shift in consciousness so that we begin to care and not only for ourselves but for the entire ecosystem. Therefore, the economic imperatives of our time are need of an evolution of our ecological consciousness and self-realization. Arne Naess, founding father of environmental movement, developed his own ecological philosophy, which he called "*Ecosophy*." "By an ecosophy, I mean a philosophy of ecological harmony or equilibrium."(Naess, 1986).

II. Problem

The environment is an integrated system in which all its elements act and react in such a way that a balance is always maintained. The strains of the ecological crises are so apparent that the task of preserving the environment is a must.

Author: Asstt. Prof. (Senior Grade), Dept. of Philosophy, Pandu College, Guwahati-781012, Assam. e-mail: mayuree.bn@gmail.com

III. Objectives

In this paper, '*Self-realization'* and '*Ecological Consciousness'* can develop to safeguard against cruelty to all creatures. 'Self-realization' denotes the realization of the organic wholeness as well as some sort of 'rectification' of ourselves. Ecological consciousness for the betterment of society is needed that can create ecological balance. A universal holistic approach which draws from religious or cultural values and beliefs may develop ecological consciousness among us. There are many religions, scriptures, prove to be helpful in building a model of ecological consciousness.

IV. Result and Discussion

a) *Ecological Consciousness in the Vedic period and Bhagavad-Gita*

Starting from the Vedas, all the way to the present, respect for all is a capsule in the context of "*Vasudhaiv Kutumbakam*", that is the whole world is one family. The four Vedas are full of Hymns, which explicitly advocate the supremacy of different natural power. The ancient religious practices show that human beings are connected with nature and every individual self merged with other self.

In the *Atharva Vedas* (Prithvi Sukta, Slok No. 12), the Vedic seer solemnly declares the enduring filial allegiance of humankind to Mother Earth. Here, Nature has been described as 'O Mother Earth.' The Vedic Hymn to the Earth, the Prithvi Sukta in Atharva Veda, is one of the oldest evocative environmental invocations. "The Earth is not for human beings alone, but also all other bipeds and insects and other creatures." (Atharva Veda 12.115). The Vedic man was nature cantered for him nature and its phenomena were part of eternal divine design. (The Hymns of Atharva Veda, 2009).

The entire earth is continual by a harmonious cosmic principle, the operation of immutable laws. The laws of unity in nature are known as '*Rta'* or cosmic order in the Vedic system. It is the self-regulative law of harmony. It is uncongenial power, the underlying regulator of all life on earth at the natural and human level.

At present human society is being misled by leaders who are blind, for they do not know the aim and

© 2020 Global Journals

objective of human life, which is "*Self-Realization*". According to Vedic civilization, the perfection of life is to realize one's relationship with the Supreme Personality of Godhead. (The Science of Self-Realization, Swami Prabhupada, 1968).

V. Bhagavad- Gita

In the "*Bhagavad-Gita*, which is accepted by all authorities in transcendental science as the basis of all Vedic knowledge, we understand that not only human beings but all living entities are parts and parcels of God. So, now the question arises- *Why are human beings given or better chance to lead a comfortable life by the Laws of Nature*? The answer describes as we are given this human form, not just to lead a comfortable life, but to attain the highest perfection of life. The 'Bhagavad Gita' very vividly describes how a spirit soul, by the laws of nature, takes his birth and gets a suitable body, and sense organs for enjoying matter in the material world. The human body is an excellent vehicle by which we can reach eternal life. In our present material consciousness, we are attached to the sensual material conception of life, but his conception can be removed at once by realizing our true self. By realizing our true self, we can give equal rights to every species of this ecosystem to live freely in this biosphere. (The Science of Self-Realization, Swami Prabhupada, 1968).

The *fifteen chapters* of the Bhagavad-Gita (15.3.4) very nicely describe detachment from material activities to the transcendental activities with realizing our true *self*:

"na rupam asyeha tathopalabhyate
nanto no cadir na ca sampratistha
asvattham enam su-virudha mulam
asanga-sastrena drdhana chittva"

"The real form of this Banyan tree cannot be perceived in this world. No one can understand where it ends, where it begins, or where its foundation is. But with determination, one must cut down this strongly rooted tree with the weapon of detachment." By searching in this way, one understands the false reflection of reality, and by knowledge, one can cut off. The connection and detached automatically from this material extension and realize the true self. As long as a human being is in this dark material world, he is in conditional life, but as soon as he reaches the spiritual sky by cutting through the false, perverted tree of this material world, he becomes liberated. So, to realize his true self, one has to get out of this false notion that human society is the only proprietor of this world. These faulty associations bind one to this material world. (The Science of Self-Realization, Swami Prabhupada 1968).

Thus, in the Bhagavad Gita Chapter-15 *Text-5* describes:-

"Nirmana moha jita sanga dosa
Adhyatma-nitya vinivrtta kamah
Dvandvair vimuktah sukla duhkha samjnair
gacchantry amudhah padam avyayam tat."

"Those who are free from false prestige, illusion and false association, who understand the eternal, who are done with material lust, who are freed from the dualities of happiness and distress, know how to surrender unto the supreme person." (Bhagavad-Gita,15.6)

Keeping this perspective in mind, we find that Vedic worship is nothing but environmental worship where ecological consciousness developed by showing gratitude towards them. Thus, acceptance of sentimental relations between man and environment is a hallmark of the Vedic concept. Feeling of love and attachment towards the environment, expression of belief, gratitude, and sacrifice in special circumstances for environmental conservation and true sentiments which will help us to grow our 'Ecological Consciousness.' Many concepts of Aryan lifestyle and philosophy, despite being old, are still relevant and useful today. The most famous sayings like *'Ekom Sad Vipra Bahudha Vadanti,' 'Isha Vasyamidam Sarvam,' 'Vasudhaiva Kutumbakam,' 'Sarve Bhavantu Sukhina,'* have reflected in the ideas like unity in diversity, live and let live, simple living and high thinking. Thus, human thought towards environment has been inspired by these Vedic principles, which are refined as well as broad in meaning.

VI. Spiritualistic Aspect: Arne Naess's Holistic Approach

In modern times, humanity gets embedded in materialistic ambitions selfish motives and become insensitive towards ecological surroundings. Arne Naess arises to find out a solution to our current disconnectedness with nature with his concept of ecological self. His view on ecological self is the light of the process of identification and the idea of self-realization, to understand the asymmetrical relationship among human beings and nature. His new scientific, philosophical – religious approach claims for a new treatment for the Earth and develops a process to show the meaning and truth in our lives. Arne Naess's theory of 'Deep-Ecology' is a holistic approach to facing environmental problems that bring together thinking, feeling, spirituality, and action. This approach makes everyone connected where we can move from seeing ourselves as part of the earth, along with other living beings. It points towards the development of spirituality, a higher consciousness that would recognize and integrated spiritual values towards nature.

Now, the question arises – *what will be the 'way of thinking'*? Thinking built on the spiritual aspect, which

© 2020 Global Journals

implements that we see ourselves involved, can give our lives aspirations beyond material success. If we see ourselves involved, then a deep ecological approach to spirituality might emphasize our relationship with this larger whole. This life-saving spirituality enables one to face and handle environmental problems. Thus, deep ecology plays a vital role in society from anthropocentric ethic to eco-centric view, which rejects human as the center of the society. Now, the second question comes to our mind – *How the real ecological consciousness includes*?

Naess in reply to this question as he tends to focus on this connection between humans and nature as a way to justify the development of ecological consciousness. Thus, the real ecological consciousness includes both anthropocentric and ecocentric components. Regarding the phenomenon of life, three basic ideas on Deep ecology are ----

1. *Firstly*, Deep ecology not only asks deeper questions about our relationship with the world around us but also look for the solutions to what is causing the problems around us.
2. *Secondly*, the attempt to replace Anthropocentric forms of thinking, valuing, and acting with eco-centric forms of thinking, valuing, and acting.
3. *Thirdly*, cultivating a particular kind of approach to our relationship with the world around us that Arne Naess refers to as "Self-Realization."

VII. Arne Naess & Warwick fox View

a) The concept of 'Self-Realization:- An identification

'*Self*' is the outcome of an identification process in which the individual grows to identify with others. Traditionally, the self develops through 3 stages—from ego to social life, comprising the ego and from there to metaphysical self comprising the social self. With the growing maturity and identification with others, the self is widened and deepened. (Arne Naess, 1989).

Both the selves with a capital 'S' with a meaning to the India atman and small 's' meaning individual self are distinguished by Naess. Self is spelled with a capital 'S' to indicate that it is an enlarged sense of self, not a narrow sense of self. The term 'self-realization' also carries an exclamation mark to mean "do it" – that is, "realize a larger sense of self." The question, therefore, arises in our mind – "how are we to realize as wide and deep a sense of self as possible"? For Naess, the answer is through the process of coming to a full sense of commonality with the world around us. Thus Naess says, "Every living being is connected intimately and from this intimacy follows the capacity of identification and as its natural consequence, the practice of non-violence."(*Deep Ecology and Virtue Ethics, Issues 26, Warwick Fox*.).Thus, the personal attempt to cultivate wider and deeper sense of identification with the world around us must certainly approach to virtue ethics.

So, when Arne Naess objects to ethics saying "Just as we do not need morals to make us breathe……. so if your 'self' in the wide sense embraces another being you need no moral exhortation' to show care ….. You care for yourself without feeling any moral pressure to do it." (*Deep Ecology and Virtue Ethics, Issues 26, Warwick Fox.).*

On the other hand, a person who is self-realized and well-identified with the nonhuman world will perform from inclination rather than duty as Immanual Kant gave a pair of concepts – Moral act and beautiful act. Moral acts are always motivated by moral laws, and it becomes our moral duty to perform it whether we like it or not. Sometimes it goes against our inclination, but we are bound to do it by our respect for moral law. If we do something only because of moral law, then the outcome our satisfaction decreases. And if we do what is right with our inclination, then it turns into a beautiful act. So, Arne Naess says that people should take environmental affairs as a '*beautiful act'* rather than the *'moral act.'*

Warwick Fox explains very distinctly about a person who realized his self. A '*Self-Realized'* individual would not experience confusion over what is his or her own body or person and what is a sparrow, tree, or stone.

"What is being emphasized is the tremendously common experience that through the process of identification my sense of self can expand to include the tree even though I and the tree remain physically separate." (W.Fox. 1990a, p.81).

Therefore Fox's analysis of identification of the self is deeper and wider. "How does one realize, in this worldly sense, as expansive a sense of self as possible? Fox's simple answer is through the process of "identification." (Fox. 1990b, p. 249).

By identification, Fox means the experience of commonality between my self and the world. An ecologically sound life would be one that sustains the widest and deepest possible identification." (Fox 1990 b, p. 249).

VIII. Conclusion

The appearance of ecological consciousness and self- realization is a turning point in today's society from the anthropocentric mechanism to eco-centric holism. The presence of ecological crisis requires a big change in our form of life. Exploring our ecological self, our life can be enhanced through increased self-realization, and this can be realized by replacing anthropocentric thinking to eco-centric forms of thinking. By diminishing of 'G' from 'ego,' throw away egoism to receive altruism, the self should reach 'c' that is 'eco.' This ecological self feels a strong bond with the natural setting around her. Naess expresses the feelings of ecological self as " My relation to this place is part of myself. If this place is destroyed, something in me is

© 2020 Global Journals

destroyed" (Naess 1986, 231). Therefore, the self has a major role in the identification and, finally the realization of our relationship with nature.

Naess wrote, "Moral actions are motivated by acceptance of moral law, and manifest themselves clearly when acting against inclination" (Naess 1989, 85).

Thus, if we act rightly towards the environment by inclination and say we do not need to follow moral law as "Morality is too narrow, too patronizing and too open" (Naess, 1993, 71).

References Références Referencias

1. Arthava Veda.
2. Bhagavad- Gita.
3. Fox, Warwick. "Towards a Transpersonal Ecology", Sunny Press, *London & Shambala, 1990.*
4. Mathew, Freye. "Value in Nature and Meaning in Life". *Newyork, Oxford University,* 1995.
5. Naess, Arne. "The Shallow and the Deep Long Range Ecology Movement." *Cambridge University Press, 1973.*
6. Naess, Arne. "The Deep Ecology Movement: Some Philosophical Aspects, Philosophical Inquiry". *Shambhala, Boston & London, 1986.*
7. Naess, Arne. "Self- Realization: An Ecological Approach to Being in the world". *The Trumpeter: Journal of Ecosophy, 1987.*
8. Naess, Arne. "Ecology, Community and Lifestyle". *Cambridge University Press, UK, 1989.*
9. S.Subbarao, "Ethics of Ecology and Environment", Rajat Publication, New Delhi, 2001.
10. Session, George.Deep Ecology for the 21st Century, Shambala Publication, Boston and London, 1995.

© 2020 Global Journals

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Estimation of Hurricane Intensity from ATMS-Derived Temperature Anomaly using Machine Learning

By Lin Lin
ESSIC/University of Maryland

Abstract- The warm-core structure is one of the basic characteristics that vary during the different stages of tropical cyclones (TCs). The warm core structure of the TCs during 2016-2019 over the Atlantic Ocean was derived based on the observations of the ATMS onboard S-NPP. From linear regression, the mean prediction error (MPE) is 39.04 mph for V_{max} and 14.47 hPa for P_{min}. The root-mean-square error (RMSE) is 42.70 mph for the maximum sustained wind (V_{max}) and 77.69 hPa for the minimum sea-level pressure (P_{min}). Several machine learning (ML) techniques are used to develop the Atlantic TC intensity (V_{max} and P_{min}) estimation models. The support vector machine (SVM) model has the best performance with the MPE of 14.62 mph for V_{max} an 7.66 hPa for P_{min}, and the RMSE of 19.91 mph for V_{max} and 10.58 hPa for P_{min}. Adding latitude and day of year (DOY) can further improve the estimation of V_{max} by decreasing MPE to 13.01 mph and RME to 17.33 mph using SVM. Best estimation of P_{min} occurs when adding the day of year to the training process, as the MPE is 7.23 hPa and RMS is 9.88 hPa. Other TC information, such as longitude and local time, does not help to improve the performance of the hurricane intensity estimation models significantly.

Keywords: *ATMS, warm core, atlantic hurricane intensity, machine learning.*

GJSFR-H Classification: *FOR Code: 059999p*

Strictly as per the compliance and regulations of:

© 2020. Lin Lin. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Estimation of Hurricane Intensity from ATMS-Derived Temperature Anomaly using Machine Learning

Lin Lin

Abstract- The warm-core structure is one of the basic characteristics that vary during the different stages of tropical cyclones (TCs). The warm core structure of the TCs during 2016-2019 over the Atlantic Ocean was derived based on the observations of the ATMS onboard S-NPP. From linear regression, the mean prediction error (MPE) is 39.04 mph for V_{max} and 14.47 hPa for P_{min}. The root-mean-square error (RMSE) is 42.70 mph for the maximum sustained wind (V_{max}) and 77.69 hPa for the minimum sea-level pressure (P_{min}). Several machine learning (ML) techniques are used to develop the Atlantic TC intensity (V_{max} and P_{min}) estimation models. The support vector machine (SVM) model has the best performance with the MPE of 14.62 mph for V_{max} an 7.66 hPa for P_{min}, and the RMSE of 19.91 mph for V_{max} and 10.58 hPa for P_{min}. Adding latitude and day of year (DOY) can further improve the estimation of V_{max} by decreasing MPE to 13.01 mph and RME to 17.33 mph using SVM. Best estimation of P_{min} occurs when adding the day of year to the training process, as the MPE is 7.23 hPa and RMS is 9.88 hPa. Other TC information, such as longitude and local time, does not help to improve the performance of the hurricane intensity estimation models significantly.

Key Points

- ATMS-derived maximum temperature anomalies in hurricanes are highly correlated with the hurricane intensities over the Atlantic Ocean.
- Compared with linear regression, machine learning can estimate hurricane intensity more accurately.

Keywords: ATMS, warm core, atlantic hurricane intensity, machine learning.

I. Introduction

The intensity of a tropical cyclone (TC) is defined as the maximum 1-minute surface wind near the center of the TC. Accurate estimation of it is necessary for early warning/management of disasters. Moreover, accurate estimation of TC intensity can benefit better initialization of the hurricane forecasting models, which can help to improve the hurricane forecasting.

Most of TC's life is spent over open oceans. A major problem with TC intensity estimation and prediction is the lack of in-situ observations because there are very few surface observations on small islands and from buoys. Although supplementary data can be obtained from reconnaissance, i.e., research aircraft with radar, radiosondes, and other instruments, such missions are costly and limited to the Atlantic Ocean and the eastern North Pacific Ocean. Satellite remote sensing observations cannot directly measure surface winds, they can provide high temporal resolution data from over the globe (e.g., clouds, water vapor, and precipitation) from combined Polar and Geostationary platforms to help estimate the TC intensity.

Microwave instruments have a long history of describing TCs because of their advantages, namely, that microwave radiation can penetrate clouds and that microwave radiation is sensitive to a variety of atmospheric parameters, including temperature, moisture, cloud liquid water, and cloud ice water. Since the 1960s and 1970s, a warm temperature anomaly has been observed in the hurricane atmosphere from microwave sounders, such as the Microwave Sounding Unit (MSU), the Advanced Microwave Sounding (AMSU), and the Advanced Technology Microwave Sounder (ATMS) (Kidder et al., 1978, 1980; Velden and Smith, 1983; Velden, 1989; Velden et al., 1991; Kidder et al., 2000; Zhu and Weng, 2013; Lin and Weng, 2018), and also from aircraft field campaigns and Global Positioning System dropsonde observations (La Seur and Hawkins, 1963; Hawkins and Rubsam, 1968; Hawkins and Imbembo, 1976; Halverson et al., 2006; Dolling and Barnes, 2014; Stern and Zhang, 2016; Brown et al., 2017). Two methods are usually used to retrieve the thermal structure of TCs from satellite microwave sounding data, i.e., statistical algorithms (Goldberg, 1999; Kidder et al., 2000; Zhu et al., 2002; Zhu and Weng, 2013; Tian and Zou, 2016; Lin and Weng, 2018), and one-dimensional variation algorithms (1DVAR) (Han and Weng, 2018; Hu and Weng, 2019).

A typical hurricane is accompanied by a warm core anomaly that can cause the brightness temperature (T_b) of the sounding channel at high altitude to increase by a few degrees. Moreover, characteristics of the warm core are closely related to changes of TC intensity (Wang et al., 2010; Dolling and Barnes, 2012; Zhang and Chen, 2012; Galarneau et al. 2013; Zhu and Weng, 2013; Lin and Weng, 2018; Wang and Jiang, 2019). Zhu and Weng (2013) developed a regression

Author: ESSIC/University of Maryland, College Park, MD.
e-mail: linlin@umd.edu

© 2020 Global Journals

algorithm to retrieve atmospheric temperature using the Suomi-National Polar-orbiting Partnership (S-NPP) ATMS data. After studying ten Atlantic TCs in 2012, they concluded that the warm-core strength usually increases with TC intensity. The correlation coefficients between the maximum warm core (WC_{max}) and the maximum sustained wind (V_{max}) and the minimum sea level pressure (P_{min}) were 0.78 and -0.83, respectively. Lin and Weng (2018) used an improved temperature retrieval algorithm developed by Tian and Zou (2016) and studied the three major hurricanes (Harvey, Irma, and Maria) over the Atlantic Ocean in 2017, obtaining a correlation coefficient of 0.67 between WC_{max} and V_{max}. However, the sample sizes of these two studies are very small, and the linear relationship between WC_{max} and TC intensity is not statistically significant.

In this study, examined were TCs on the Atlantic Ocean from 2016 to 2019 using S-NPP ATMS data, and used were traditional linear regression and several machine learning (ML) schemes to analyze the relationship between WC_{max} and TC intensity (V_{max} and P_{min}). Also evaluated was the impact of introducing additional TC information into the ML schemes, i.e., latitude, longitude, local time, and day of the year (DOY), on the TC intensity estimation. This paper is organized as follows. Section 2 introduces the S-NPP ATMS data, the TC best track data, and the ATMS overpass selection. Section 3 briefly describes the ATMS atmospheric temperature retrieval algorithm and several ML techniques used in this study. Section 4 compares the performance of linear regression and ML models in the hurricane intensity (V_{max} and P_{min}) estimation. Section 5 provides a summary and conclusions.

II. Methodology

a) Warm-core retrieval algorithm for ATMS

There are several steps to obtain atmospheric temperature from a microwave sounder. First, the satellite observations (T_b) need to be corrected for antenna side lobes and limb adjustments. Then, using collocated reanalysis/radiosonde/dropsonde data, a linear regression is performed to obtain the relationship between the corrected satellite T_b and the atmospheric temperature from the surface to the Stratosphere. Goldberg (1999), Zhu and Weng (2013), Tian and Zou (2016), Zhang et al. (2017), and Lin and Weng (2018) provide more details about AMSU-A and ATMS temperature retrievals.

In this study, the atmospheric temperature is retrieved following Tian and Zou (2016). The temperature (T) at pressure level (p), with the sensor zenith angle (θ) can be obtained from a linear combination of ATMS T_b on the detection channel (v_i) as follows:

$$T(p,\theta) = C_0(p,\theta) + \sum_{i=i_{1,p}}^{i_{n,p}} C_i(p,\theta) T_b(v_i,\theta) \qquad (1)$$

where $i_{1,p},\ldots,i_{n,p}$ are a subset of ATMS channels 5–15 that are significantly correlated with the temperature at the pressure level p, and C_0 and C_i are the regression coefficients. In this algorithm, only ATMS channels 5–15 are selected because these channels are not affected by surface emissions and precipitation. The regression coefficients in Eq. (1) were generated for clear sky and cloudy condition separately. Pixels under clear-sky condition are defined when the cloud liquid water path (CLWP) retrieved from ATMS 23.8 GHz and 31.2 GHz channels is less than 0.015 kg/m^2 following Weng et al. (2003).

The temperature anomaly near the TC is defined as the difference between the temperatures obtained from Eq. (1) and the ambient reference temperature. Options of the reference sounding include the mean tropical sounding (La Seur and Hawkins, 1963; Hawkins and Rubsam, 1968; Hawkins and Imbembo, 1976), the domain-averaged sounding excludingthe TC (Zhu and Weng, 2013; Lin and Weng, 2018), and the average sounding in a ring space within a certain distance from the center of the TC (Knaff et al., 2004; Halverson et al. 2006). Recent research (Durden, 2013; Stern and Zhang, 2016; Munsell et al., 2018) suggests using an average of at least several hundred kilometers away from the TC center. In this study, the temperature anomaly is defined as the temperature retrieved from the ATMS minus its average temperature in the 20° latitude/longitude box but outside the cloudy area where CLWP > 0.015 kg/m^2. The strength of the warm core is defined as the highest temperature anomaly within 20 km from the TC center.

b) Machine Learning Techniques

Over the past three decades, ML, a fusion of principles from statistics and computer science, has grown tremendously and can be used in many applications. As computer power increases, ML can be used to build effective prediction models. Among the popular ML prediction models are the decision tree methods, including random forests (RFs), and the kernel methods, including support vector machines (SVM). One of the major advantages of these ML techniques is that they do not rely on the explicit assumptions required by traditional statistical models. In this study, used to develop the hurricane intensity estimation model are SVM, the multi-layer perceptron (MLP), the decision tree (DT), the Adaptive Boosting (Ada Boost), Ada Boost with DT (ADT), and the RF techniques.

The SVM is one of the most popular ML methods, successfully applied to classification, regression, and other learning tasks. In the present

© 2020 Global Journals

study, the radial basis function kernel was selected. This study also used the MLP, which is a feed-forward network consisting of an input layer, multiple hidden layers, and an output layer. A three-hidden-layer configuration was chosen because both the uncertainty and computing time are relatively low. The weights of the MLP were optimized by the Limited-memory Broyden–Fletcher–Goldfarb–Shanno solver, and the transfer (activation) function of the neurons was the hyperbolic tangent sigmoid function. DT is an analysis method that evaluates the risk of a project and determines its feasibility by constructing a decision tree based on the known probability of occurrence of various situations. It represents a mapping relationship between object attributes and object values. In this study, the number of estimators is set to 1, and the maximum depth is set to 3. AdaBoost is used in combination with DT to improve the performance by feeding into the tree growth algorithm to obtain future tree tendencies in the training sample collected at each stage of DT. The number of estimators is 300, and the maximum depth is 3. RF is a holistic learning method for classification, regression, and other tasks. It operates a tree by constructing a large number of decision trees during training and using these classes as the mean prediction (regression). In this study, the maximum depth is 3 in RF.

c) Performance Evaluation Metrics for linear regression and ML models

The model performance is then quantitatively evaluated using two statistical indicators, i.e., the mean prediction error (MPE) and the root-mean-square error (RMSE) between model estimation and the best track data. The indicators are calculated as follows:

$$\mathrm{MPE} = \frac{1}{n}\sum_{i=1}^{n}\left|y^{best-track}(i) - y^{model}(i)\right|, \qquad (3)$$

and

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y^{best-track}(i) - y^{model}(i)\right)^2}, \qquad (4)$$

where n is the total number of samples (=144), y is V_{max} or P_{min}, $y^{best\text{-}track}$ is the best track data, and y^{model} is the model prediction from linearregression and the ML schemes described in section 2.2.

III. Description of ATMS and Hurricane Data

a) Characteristics of ATMS Data

The ATMS is a cross-track microwave radiometer with 22 channels that can measure microwave radiances from 23.8 to 183.3 GHz. The ATMS inherits most of the sounding channels of previous instruments AMSU-A and the Microwave Humidity Sounder (MHS), which were carried by the previously launched NOAA polar-orbiting satellite. The ATMS was first deployed on the S-NPP satellite and then on the NOAA-20 satellite. S-NPP, as a pathfinder for the Joint Polar Satellite System operational satellite series in the United States, was successfully launched into a circular, near-polar, afternoon-configured orbit on 28 October 2011 (Weng et al., 2012). On 18 November 2017, the NOAA-20 satellite was also successfully launched into a sun-synchronous orbit similar to the S-NPP orbit. So far, the ATMS onboard S-NPP is still performing well.

The ATMS can provide detailed atmospheric temperature information from the surface to about 1 hPa (~45 km) and tropospheric water vapor information from the surface to about 200 hPa (~10 km) under both clear and cloudy conditions, except for heavy precipitation conditions. Compared with the AMSU-A and MHS, the ATMS can provide more detailed information on warm cores with a higher spatial resolution and a wider scan swath.

b) TC Best Track Data and Selection of ATMS Overpasses

Based on best track data from the National Hurricane Center, the intensity and location of storm centers were obtained for Atlantic TCs during 2016–2019. The TC intensity includes the 1-minute V_{max} and P_{min} at the center of the storm. All of them are linearly interpolated to match the observation time of the ATMS.

The ATMS has a band width of 1,429 km, and it is not possible for it to observe all TCs. Selected here are ATMS overpasses that can capture the TC center, resulting in a total of 721 ATMS TC overpasses in 66 TCs during 2016-2019. Among them, 577 overpasses occurred between 2016 and 2018, and 144 overpasses occurred in 2019. Overpasses were dived into seven TC intensity categories: tropical depression (TD), tropical storm (TS), category 1 (H1), category 2 (H2), category 3 (H3), category 4 (H4), and category 5 (H5) according to the Saffir-Simpson hurricane wind scale. Table 1 shows the number of ATMS overpasses for each intensity category and different latitudes over the Atlantic Ocean in 2016-2018 and 2019, respectively. Generally, as the TC intensity increases, the number of overpasses decreases, which is consistent with the statistics in the best track data. Figure 1 shows the geographic distribution of TC centers covered by the 721 selected ATMS overpasses during 2016–2018 and 2019. The strongest TCs (H4 and H5) mostly occurred between 10° and 30° latitudes.

© 2020 Global Journals

Table 1: The number of TCs with S-NPP ATMS overpasses during 2016-2018 and 2019 individually.

	2016-2018							2019						
50-60N	TD	TS	H1	H2	H3	H4	H5	TD	TS	H1	H2	H3	H4	H5
40-50N	1	14	3	1	–	–	–	–	1	–	–	–	–	–
30-40N	26	96	46	14	5	1	–	–	4	3	1	–	–	–
20-30N	26	78	35	11	15	12	3	10	17	5	6	4	–	–
10-20N	39	90	19	8	12	10	7	8	33	2	4	5	4	2
0-10N	–	5	–	–	–	–	–	6	18	6	2	1	2	–

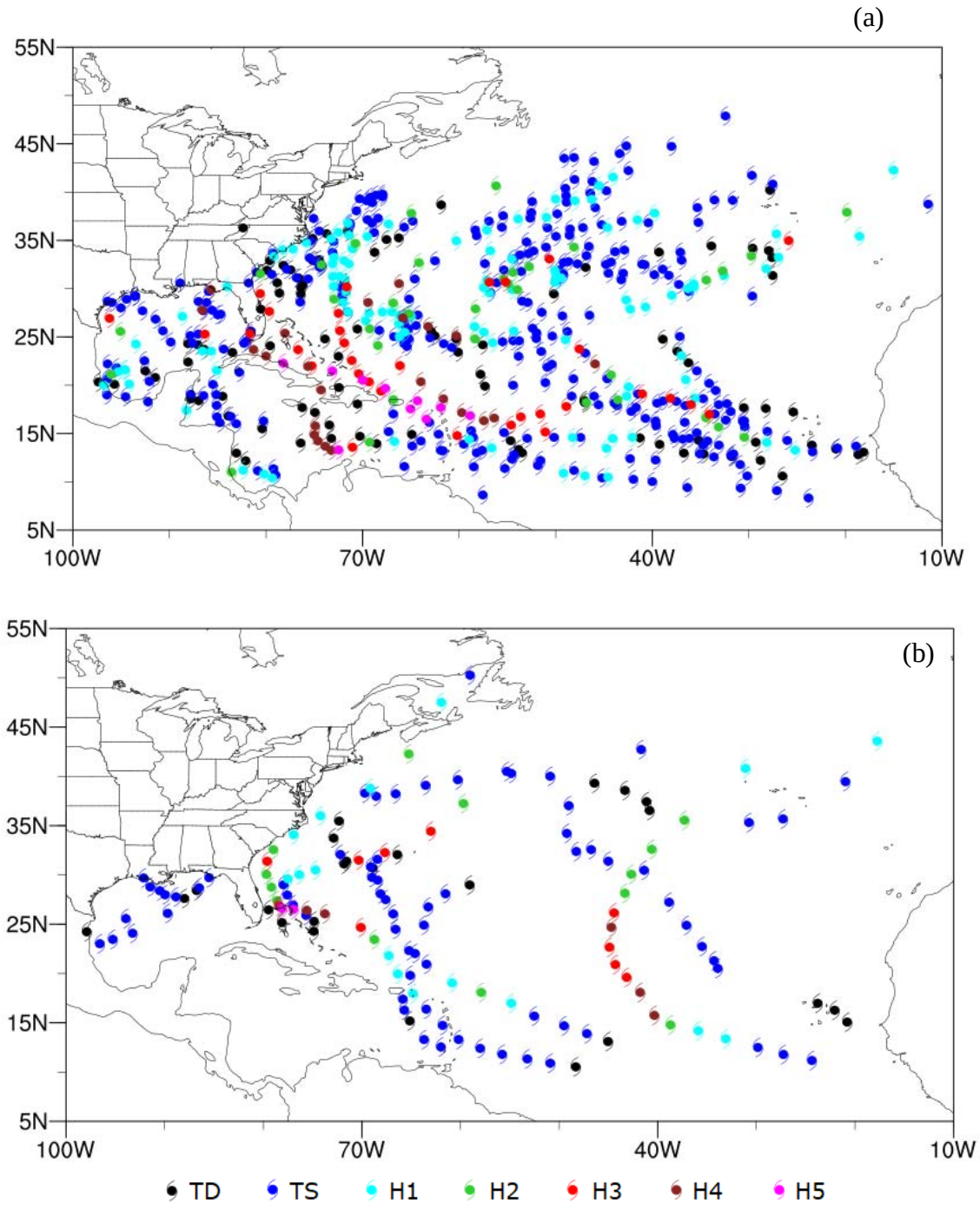


Figure 1: The geographic distribution of the tropical cyclone (TC) center covered by (a) the 577 cases during 2016-2018 and (b) 144 cases in 2019 over the Atlantic Ocean. Colors represent different TC intensities.

© 2020 Global Journals

IV. Discussion

Previous studies show that the warm-core strength is better correlated with P_{min} than with V_{max} (Zhang & Chen, 2012; Zhu & Weng, 2013; Kieu et al., 2016; Gaona et al., 2017). Figure 2 shows the relationships between the TC intensity (V_{max} and P_{min}) and WC_{max} within 20 km of the storm centers for the 577 cases during 2016–2018. Considering the full TC intensity range, WC_{max} is well correlated with V_{max}, with a correlation coefficient of 0.786. The correlation with P_{min} is higher, with a correlation coefficient of -0.841. Using these correlation coefficients, estimated are V_{max} and P_{min} for the 144 TC cases in 2019. The MPE and RMSE for V_{max} are 39.04 and 42.70 mph, respectively, and the MPE and RMSE for P_{min} are 14.47 and 77.69 hPa, respectively.

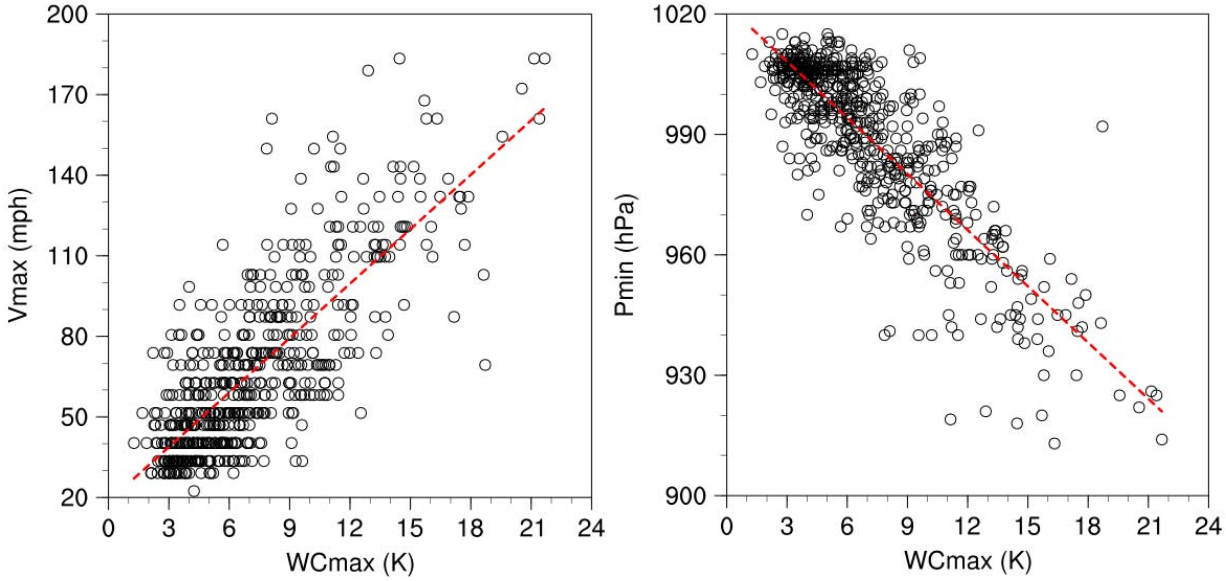


Figure 2: Scatterplots of WC_{max} versus V_{max} (left panel) and P_{min} (right panel) for the 577 TC cases during 2016-2018 shown in Fig. 1a. The linear regression fitting is indicated by the red dashed line. The Pearson correlation coefficients are 0.786 and -0.841, respectively.

The five ML models described in Section 2.2 (SVM, DT, AdaBoost, ADT, and RF) were constructed using only WC_{max} as the input. The 577 TC cases during 2016–2018 (Fig. 1a) were used in the training process, and the 144 TC cases in 2019 were used for validation. Table 2 lists the MPE and RMSE for each ML model. Compared to linear regression, the ML models all show better performances, shown by the decrease in MPE by ~60% for V_{max} and by ~50% for P_{min}. The RMSE also decreased by ~50% for V_{max} and by ~85% for P_{min}. The best performance occurred with the SVM model, where the MPE and RMSE for V_{max} are 14.62 and 19.91 mph, respectively, and the MPE and RMSE for P_{min} are 7.66 and 10.58 hPa, respectively.

Table 2: Estimates of V_{max} and P_{min} based on linear regression and SVM, DT, AdaBoost, ADT, and RF when the maximum warm-core strength is the only input to ML training.

ML Scheme	V_{max} (mph)		P_{min} (hPa)	
	MPE	RMSE	MPE	RMSE
Linear Regression	39.04	42.70	14.47	77.69
SVM	14.62	19.91	7.66	10.58
DT	15.00	20.61	8.12	10.85
Ada	15.89	20.79	9.62	12.09
ADT	16.49	21.27	8.94	11.24
RF	14.78	19.88	7.73	10.43

With the selection of those five ML schemes, experiments evaluating the ML model performance with seven different combinations of TC information were conducted (Table 3). The choices of TC information include: WCmax, Latitude (Lat), Longitude (Lon), day of year (DOY), and local time (LT). An average MPE of around 15.38 mph could be achieved if adding the information of latitude in ML training process (Exp. A). Among the five ML schemes, SVM produces the minimum MPE of 13.40 mph, with a minimum RMSE of 18.37 mph. The variation is within 4.2 mph for the MPE and within 3.39 mph for the RMSE. An average MPE of around 15.79 mph can be reached if adding the information of DOY in the ML training process (Exp. B). Again, SVM produces the minimum MPE of 14.19 mph, with a minimum RMSE of 19.92 mph. The variation is

© 2020 Global Journals

within 3.17 mph for the MPE and within 2.54 mph for the RMSE. With both Lat and DOY added into the training process, only the SVM performs better with the MPE decreased to 13.01 mph, and the RMSE decreased to 17.33 mph. Other ML schemes have larger MPEs and RMSEs. Since LT is derived from longitude through the relation LT=UTC+Lon/15, only adding LT or Lon is considered in Exp. D-G. Adding longitude (LT or Lon) information does not markedly improve the model performances, noting that the SVM still performs the best.

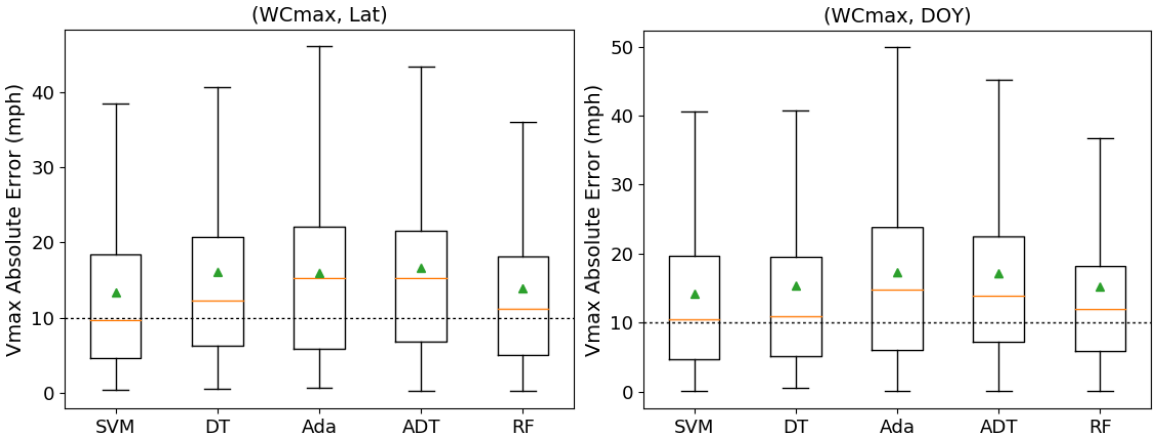
Table 3: Inputs to ML models

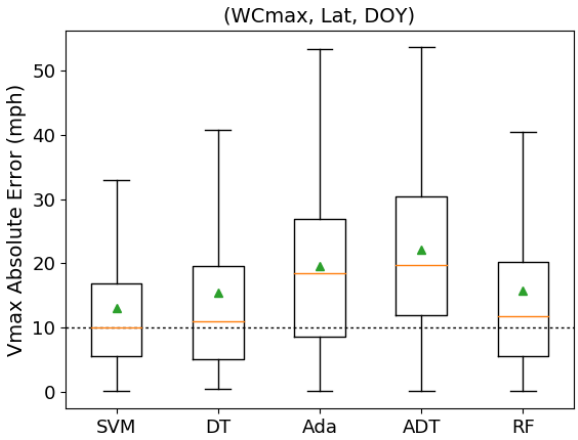
EXP	Inputs				
	WC_{max}	Lat	DOY	Lon	LT
A	✓	✓			
B	✓		✓		
C	✓	✓	✓		
D	✓	✓		✓	
E	✓	✓			✓
F	✓	✓	✓	✓	
G	✓	✓	✓		✓

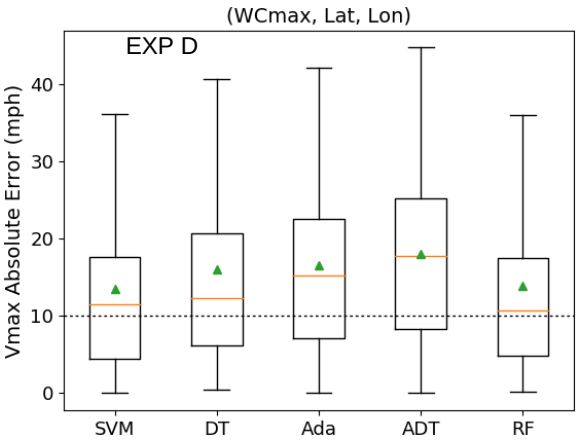
For P_{min} (figures omitted), an average MPE of around 8.83 hPa can be achieved if adding the information of latitude in the ML training process (Exp. A). Among the five ML schemes, RF produces the minimum MPE of 7.75 hPa, with a minimum RMSE of 10.62 hPa. The variation is within 2.77 hPa for the MPE and within 2.24 hPa for the RMSE. An average MPE of around 8.85 hPa can be reached if adding the information of DOY in the ML training process (Exp. B). Again, the SVM produces the minimum MPE of 7.23 hPa, with a minimum RMSE of 9.88 hPa. The variation is within 3.80 hPa for the MPE and within 3.29 hPa for the RMSE. Adding both Lat and DOY into the training does not improve the performances. As with V_{max}, adding longitude (LT or Lon) information does not markedly improve the model performances, noting that the SVM still performs the best when adding latitude and DOY into the training process.

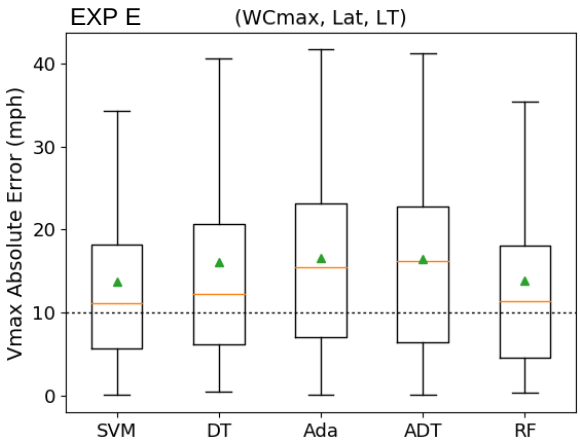
Since SVM and RF are the top two accurate models for all 7 different combinations of training variables (Fig. 3), The performance with different combinations of training variables for V_{max} and P_{min} are further examined (Fig.4). In general, all combination produces similar results, with small variations. The best estimation for V_{max} using SVM occurs when WC_{max}, Lat and DOY are used in training, while as for P_{min} occurs when WC_{max} and DOY are used in training. The best estimation of both V_{max} and P_{min} using RF occurs when WC_{max}, Lat and Lon are used in training. It's concluded that adding more TC information won't necessarily improve the estimation accuracy. The green box in Fig. 4 indicates the optimal combination option for SVM and RF. The performance of the optimal choice relative to the best track intensities is shown in Fig. 5, by stratifying the validation dataset of various intensities. Both models tend to have over-forecasts (MPE for V_{max} is positive, and MPE for P_{min} is negative) for tropical depressions and tropical storms, and under-forecasts (MPE for V_{max} is negative, and MPE for P_{min} is positive) for hurricanes. The mean V_{max} MPE for TD and TS is 10.77 mph for SVM, and 7.08 for RF, for Hurricane is -4.72 mph for SVM and -7.96 mph. The mean P_{min} MPE for TD and TS is -3.47 hPa for SVM, and -4.80 hPa for RF, for Hurricane is 4.79 hPa for SVM and 3.98 hPa. The smaller sample size of hurricane cases may contribute to the larger variation in underestimation situation for hurricanes. A future modification to address this issue will be to randomly drop out the samples with tropical storm intensities in the training data for reducing the overall sampling bias.

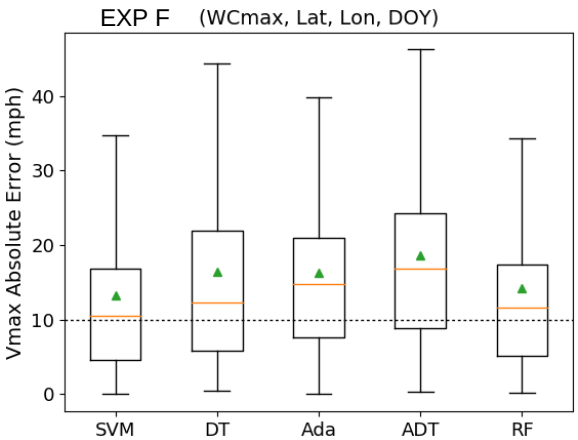
© 2020 Global Journals











© 2020 Global Journals

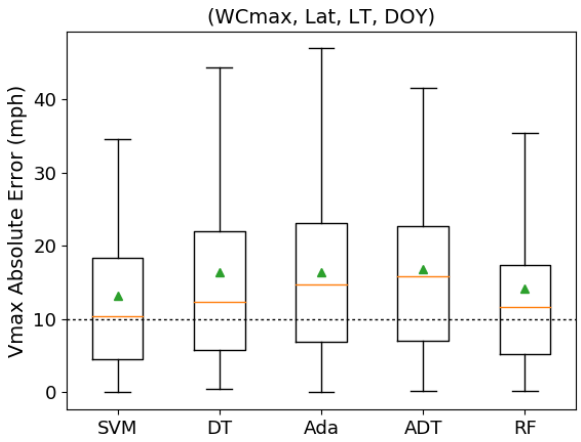


Figure 3: Boxplots of the absolute V_{max} errors relative to the best track intensity for SVM, DT, Ada, ADT, and RF scheme in a comparison with n=144 samples from the TC cases in 2019. On each box, the median (orange line), 25th percentile, and 75 percentile are indicated; the whiskers extend to the 5th and 95th percentiles; the green triangle indicates the mean MPE. The TC information used in the training of ML schemes is listed on top of each panel.

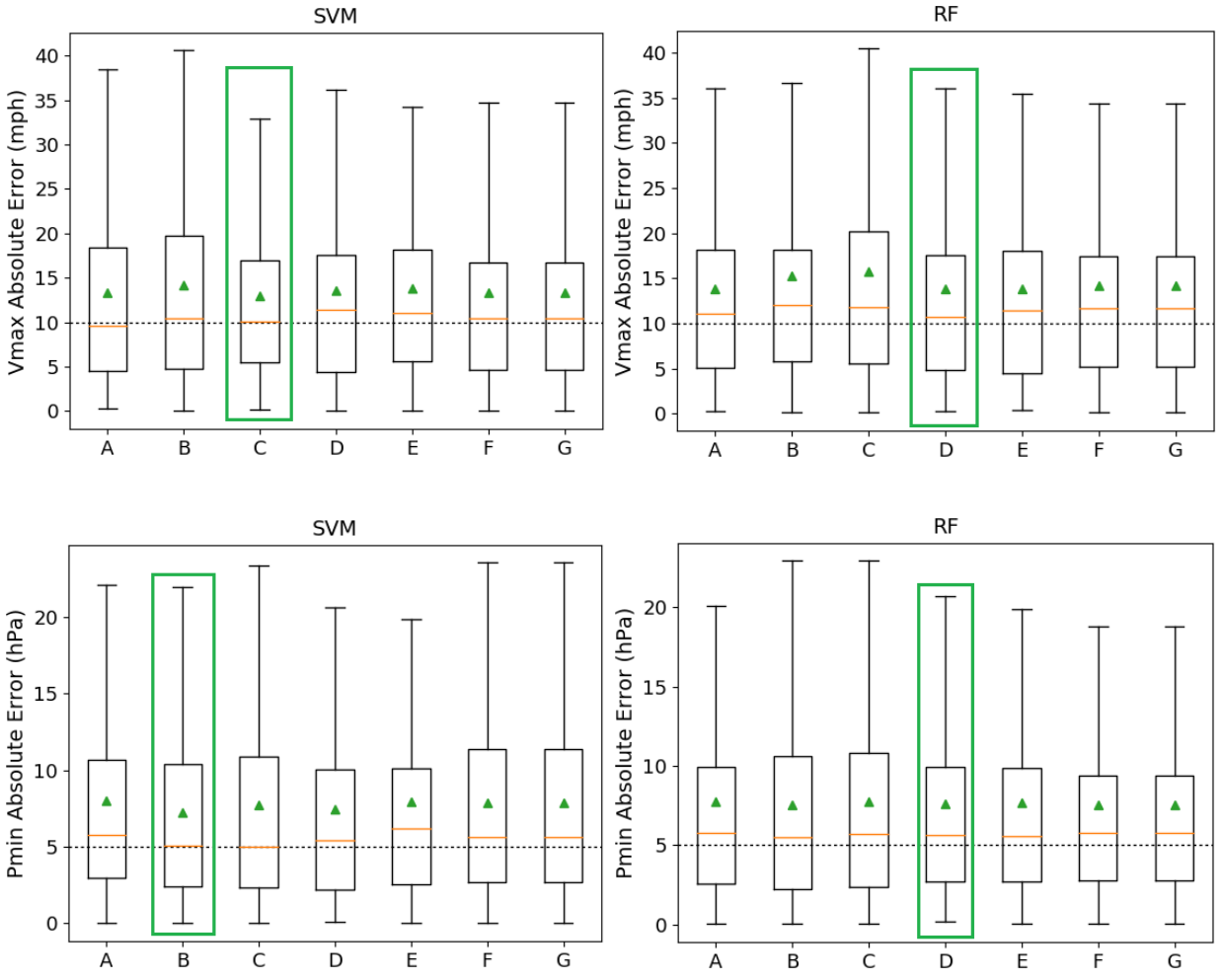


Figure 4: Boxplots of (a-b): the absolute V_{max} errors and (c-d): the absolute P_{min} errors relative to the best track intensity for SVM (left panels) and Random Forest model (right panels).

© 2020 Global Journals

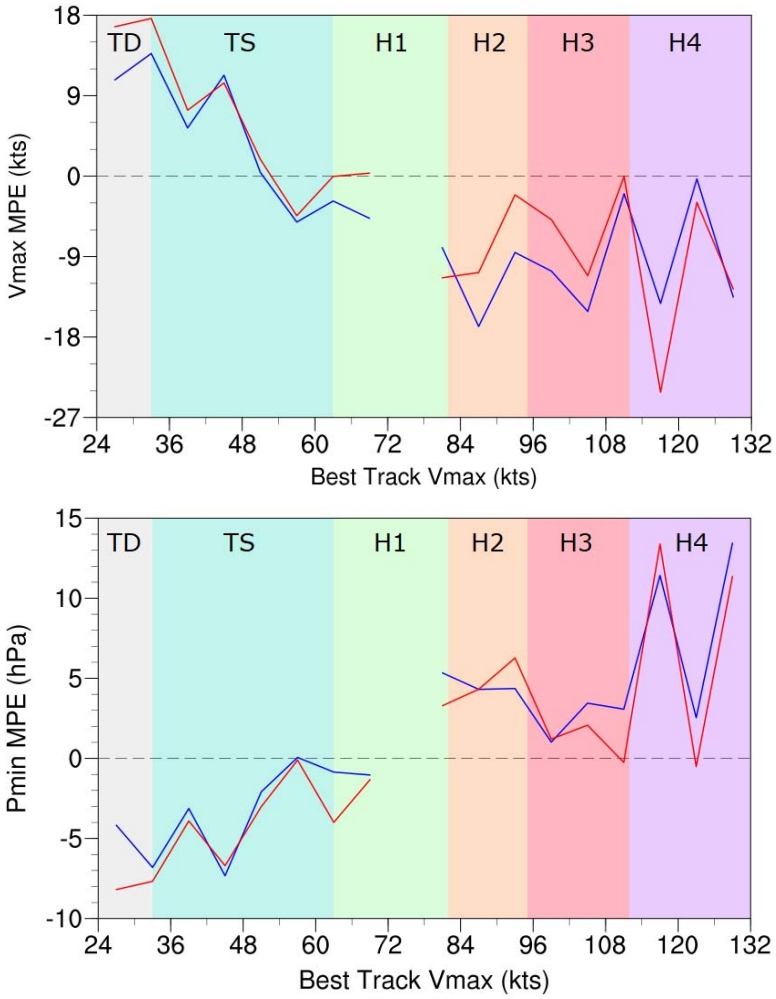


Figure 5: MPE of V_{max} (upper) and P_{min} (lower) according to best track V_{max} from SVM (blue) and RF models (red). The combinations of TC information used in this figure are corresponding to the green box in Fig. 4.

V. Summary and Conclusions

The warm-core structure is an important parameter for monitoring the TC intensity, studying TC inner-core dynamics, and establishing the initial vortices for TC simulation and prediction. Traditionally, WC_{max} is considered to be directly related to the intensity of a TC. From the 577 Atlantic TCs observed by the S-NPP ATMS during the period 2016–2018, the correlation coefficients between WC_{max} and the V_{max} and P_{min} of TCs are 0.786 and -0.841, respectively. The MPE and RMSE for V_{max} are 39.04 and 42.70 mph, respectively, and the MPE and RMSE for P_{min} are 14.47 and 77.69 hPa, respectively. ML estimation results indicate that the overall MPE for V_{max} is 15.36 mph, with more than a 60% decrease, and for P_{min} is 8.41 hPa, with more than a 50% decrease.

The present study also developed several ML models using different combinations of TC information (including latitude, longitude, DOY, and LT) as inputs to the training process for hurricane intensity estimation. The best estimation of V_{max} from the SVM model occurs when the training process uses WC_{max}, Lat, and DOY. The MPE and RMSE are 13.01 mph and 17.33 mph, respectively. The best estimation of P_{min} from the SVM model occurs when the training process uses WC_{max} and DOY. The MPE and RMSE are 7.23 hPa and 9.88 hPa, respectively.

The results from this study show that ML algorithms can capture the complex relationship between TC information and hurricane intensity, thereby avoiding complex intermediate processing. This can feasibly simplify and improve hurricane intensity estimation. Future studies will modify the retrieval of atmospheric temperature from the ATMS by considering scattering effects using ML methods and will extend the present study to the Pacific Ocean to develop an accurate estimation of typhoon intensity using the maximum warm-core intensity (WC_{warm}) and other TC information.

Acknowledgments

This work was supported by NOAA grant NA19NES4320002 (Cooperative Institute for Satellite

© 2020 Global Journals

Earth System Studies-CISESS) at the Earth System Science Interdisciplinary Center (ESSIC), University of Maryland (UMD).The data sets used in this paper are freely available online. S-NPP ATMS TDR data can be obtained from NOAA/CLASS (https://www.bou.class.noaa.gov/saa/products/search?sub_id=0&datatype_family=ATMS_TDR&submit.x=35&submit.y=11), and the hurricane best track information from the National Hurricane Center (https://www.nhc.noaa.gov/data/hurdat/hurdat2-1851-2018-120319.txt).

References Références Referencias

1. Brown, S., B. Lambrigtsen, B. Lim, & T. Gaier (2017), Demonstrating the impact of rapid repeat passive microwave observations from the global hawk: Implications for future SmallSat or GEO missions. *Proceedings of 2017 IEEE International Geoscience and Remote Sensing Symposium, Fort Worth, TX, USA*, 5938–5941. doi: 10.1109/IGARSS.2017.8128361
2. Dolling, K. & G. M. Barnes (2012), Warm-core formation in Tropical Storm Humberto (2001). *Monthly Weather Review*, 140, 1177–1190. doi:10.1175/MWR-D-11-00183.1
3. ——, & G. M. Barnes (2014), The evolution of Hurricane Humberto (2001). *Journal of Atmospheric Sciences*, 71, 1276–1291. doi: 10.1175/ JAS-D-13-0164.1
4. Durden, S. L., 2013: Observed tropical cyclone eye thermal anomaly prdiles extending above 300hPa. *Monthly Weather Review*, 141, 4256–4268, doi:10.1175/MWR-D-13-00021.1.
5. Galarneau, T. J., Jr., C. A. Davis, & M. A. Shapiro (2013), Intensification of Hurricane Sandy (2012) through extratropical warm core seclusion. *Monthly Weather Review*, 141, 4296–4321. doi:10.1175/MWR-D-13-00181.1
6. Gaona,M.F. R., A. Overeem, A. M. Brasjen, J. F. Meirink, H. Leijnse,&R. Uijlenhoet (2017), Evaluation of rainfall products derived from satellites and microwave links for the Netherlands. *IEEE Transanctionon Geoscience and Remote Sensing*, 55, 6849–6859. doi:10.1109/TGRS.2017.2735439
7. Goldberg, M.D. (1999), Generation of retrieval products from AMSU-A: Methodology and validation. *10 th Int. ATOVS Study Conference,* Boulder, CO, 219-229.
8. Han, Y., & F. Weng (2018), Remote sensing of tropical cyclone thermal structure from satellite microwave sounding instruments: Impacts of optimal channel selection on retrievals. *Journal of Meteorological Research*, 32(5), 804–818. doi: 10.1007/s13351-018-8005-x
9. Halverson, J. B., J. Simpson, G. Heymsfield, H. Pierce, T. Hock, & L. Ritchie (2006), Warm core structure of Hurricane Erin diagnosed from high altitude dropsondes during CAMEX-4. *Journal of Atmospheric Sciences*, 63, 309–324. doi:10.1175/JAS3596.1
10. Hawkins, H. F., & D. A. Rubsam (1968), Hurricane Hilda, 1964. Part II: Structure and budgets of the hurricane core on 1 October 1964. *Monthly Weather Review*, 96, 617–636. doi:10.1175/ 1520-0493(1968)096,0617:HH.2.0.CO;2
11. & S. M. Imbembo (1976), The structure of a small, intense Hurricane-Inez 1966. *Monthly Weather Review*, 104, 418–442. doi:10.1175/1520-0493(1976)104,0418:TSOASI.2.0.CO;2
12. Hu, H., F. Weng, Y. Han, & Y. Duan (2019), Remote sensing of tropical cyclone thermal structure from satellite microwave sounding instruments: impacts of background profiles on retrievals. *Journal of Meteorological Research*, 33(1), 89–103. doi:10.1007/s13351-019-8094-1
13. Kidder, S. Q., W. M. Gray, & T. H. Vonder Haar (1978), Estimating tropical cyclone central pressure and outer winds from satellite microwave data. *Monthly Weather Review*, 106, 1458–1464. doi:10.1175/1520-0493(1978)106<1458:ETCCPA>2.0.CO;2
14. ——, ——, & —— (1980), Tropical cyclone outer surface winds derived from satellite microwave data. *Monthly Weather Review*, 108, 144–152. doi:10.1175/1520-0493(1980)108 <0144:TCOSWD>2.0.CO;2
15. ——, M. D. Goldberg, R. M. Zehr, M. DeMaria, J. F. W. Purdom, C. S. Velden, N. C. Grody, & S. J. Kusselson (2000), Satellite analysis of tropical cyclones using the Advanced Microwave Sounding Unit (AMSU). *Bulletin of American Meteorological Society*, 81, 1241–1260. doi:10.1175/1520-0477(2000)081<1241:SAOTCU>2.3.CO;2
16. Kieu, C., V. Tallapragada, D.-L. Zhang, & Z. Moon(2016), On the development of double warm cores in intense tropical cyclones. *Journal of Atmospheric Sciences*, 73, 4487–4506, doi:10.1175/JAS-D-16-0015.1.
17. Knaff, J. A., S. A. Seseske, M. DeMaria, & J. L. Demuth (2004), On the fluences of vertical wind shear on symmetric tropical cyclone structure derived from AMSU. *Monthly Weather Review*, 132, 2503–2510. doi:10.1175/1520-0493(2004)132,2503:OTIOVW.2.0.CO;2
18. La Seur, N. E., & H. F. Hawkins (1963), An analysis of Hurricane Cleo (1958) based on data from research reconnaissance aircraft. *Monthly Weather Review*, 91, 694–709. doi:10.1175/1520-0493(1963)091,0694:AAOHCB.2.3.CO;2
19. Lin, L, & F. Weng (2018), Estimation of hurricane maximum wind speed using temperature anomaly derived from advanced technology microwave sounder. *IEEE Geoscience and Remote Sensing*

© 2020 Global Journals

Letters, 15(5), 639–643. doi:10.1109/LGRS.2018.2807763.
20. Munsell, E. B., F. Zhang, S. A. Braun, J. A. Sippel, & A. C. Didlake (2018), The inner-core temperature structure of Hurricane Edouard (2014): Observations and ensemble variability. *Monthly Weather Review*, 146, 135–155. doi:10.1175/ MWR-D-17-0095.1.
21. Stern, D. P., & F. Zhang (2016), The warm-core structure of Hurricane Earl (2010). *Journal of Atmospheric Sciences*, 73, 3305–3328. doi:10.1175/JAS-D-15-0328.1.
22. Tian, X., & X. Zou (2016), ATMS- and AMSU-A-derived hurricane warm core structuresusing a modified retrieval algorithm. *Journal of Geophysical Research: Atmosphere*, 121, 12630–12646. doi:10.1002/2016JD025042.
23. Velden, C. S., & W. L. Smith (1983), Monitoring tropical cyclone evolution with NOAA satellite microwave observations. *Journal of Climate and Applied Meteor*ology, 22, 714–724. doi:1520-0450(1983)022<0714:MTCEWN>2.0.CO;2.
24. ——, (1989), Observational analyses of North Atlantic tropical cyclones from NOAA polar-orbiting satellite microwave data. *Journal of Applied Meteorology*, 28, 59–70. doi:10.1175/1520-0450(1989)028<0059:OAONAT>2.0.CO;2.
25. ——, B. M. Goodman, & R. T. Merrill (1991), Western North Pacific tropical cyclone intensity estimation from NOAA polar-orbiting satellite microwave data. *Monthly Weather Review*, 119, 159–168. doi:10.1175/1520-0493(1991)119<0159:WNPTCI>2.0.CO;2.
26. Wang, X., & H. Jiang (2019). A 13-Year Global Climatology of Tropical Cyclone Warm-Core Structures from AIRS Data. *Monthly Weather Review*, 147(3), 773–790. doi:10.1175/MWR-D-18-0276.1.
27. Wang, Z., M. T. Montgomery, & T. J. Dunkerton (2010), Genesis of preHurricane Felix (2007). Part II: Warm core formation, precipitation evolution, and predictability. *Journal of Atmospheric Sciences*, 67, 1730–1744. doi:10.1175/2010JAS3435.1.
28. Weng, F., L. Zhao, R. Ferraro, G. Poe, X. Li, & N. Grody (2003), Advanced microwave sounding unit cloud and precipitation algorithms. *Radio Science*, 38(4), 8086-8096. doi:10.1029/2002RS002679.
29. ——, X. Zou, X. Wang, S. Yang, & M. Goldberg (2012), Introduction to Suomi NPP ATMS for NWP and tropical cyclone applications. Journal of Geophysical Research, 117(D19112), 1–14. doi:10.1029/2012JD018144.
30. Zhang, D.-L., & H. Chen (2012), Importance of the upper-level warm core in the rapid intensification of a tropical cyclone. Geophysical Research Letter, 39(L02806), 1–6. doi:10.1029/2011GL050578.
31. Zhang, K., L. Zhou, M. Goldberg, X. Liu, W. Wolf, C. Tian, & Q. Liu (2017), A methodology to adjust ATMS observations for limb effect and its applications. *Journal of Geophysical Research: Atmosphere*, 122 (21), 11,347–11,356. doi:10.1002/2017JD026820.
32. Zhu, T., D.-L. Zhang, & F. Weng (2002), Impact of the Advanced Microwave Sounding Unit measurements on hurricane prediction. *Monthly Weather Review*, 130, 2416–2432. doi:10.1175/1520-0493(2002)130<2416:IOTAMS>2.0.CO;2.
33. ——, & F. Weng (2013), Hurricane Sandy warm-core structure observed from Advanced Technology Microwave Sounder. *Geophysical Research Letter*, 40, 3325–3330. doi:10.1002/grl.50626.

© 2020 Global Journals

This page is intentionally left blank

© 2020 Global Journals

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Age and Gender as Determinants of Adult Coping with COVID-19 Pandemic

By Eshel, Y., Kimhi, S., Marciano, H. & Adini, B.
University of Haifa

Abstract- *Objective:* The roles of age and gender in coping with the threats of COVID-19 pandemic are studied. It is hypothesized that coping supporting characteristics, such as a sense of wellbeing and resilience, will be strengthened with age, while coping suppressing factors, such as psychological symptoms of anxiety and a sense of danger, will be weakened with age, and affected by gender of adults.

Method: 1346 Israelis have responded to an internet questionnaire pertaining to these issues.

Keywords: *coping, national resilience, community resilience, individual resilience, sense of danger, distress symptoms, wellbeing.*

GJSFR-H Classification: *FOR Code: 070199*

Strictly as per the compliance and regulations of:

© 2020. Eshel, Y., Kimhi, S., Marciano, H. & Adini, B. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Age and Gender as Determinants of Adult Coping with COVID-19 Pandemic

Eshel, Y. [α], Kimhi, S. [σ], Marciano, H. [ρ] & Adini, B. [ω]

Abstract- Objective: The roles of age and gender in coping with the threats of COVID-19 pandemic are studied. It is hypothesized that coping supporting characteristics, such as a sense of wellbeing and resilience, will be strengthened with age, while coping suppressing factors, such as psychological symptoms of anxiety and a sense of danger, will be weakened with age, and affected by gender of adults.

Method: 1346 Israelis have responded to an internet questionnaire pertaining to these issues.

Results: Results have generally supported the research hypotheses. Higher age groups have scored significantly lower than younger groups on levels of distress symptoms and perceived danger; and have scored higher than younger groups on wellbeing, individual resilience and community resilience. Men cope better than women with the threats of COVID-19 pandemic.

Discussion: These findings support the socio-emotional theory which posits that older people are motivated to regulate their emotions in order to maintain high levels of wellbeing.

Keywords: coping, national resilience, community resilience, individual resilience, sense of danger, distress symptoms, wellbeing.

I. Introduction

Coping abilities pertain to people's capacity to adjust to adversities and to resume functionality as they have done before the challenge has occurred (Bonanno, 2005). Researchers emphasize the major contribution of personality attributes, such as ego resilience or positive self-concept for maintaining positive outcomes in face of various sources of stress (Luthar & Brown, 2007; Masten, 2001). Additional research examining the role of demographic variables in strengthening coping abilities has found that family income, political attitudes, level of religiosity and gender contribute to enhancing public resilience (Marciano, Kimhi, & Eshel, 2019).

Author α: Yohanan Eshel, Professor Emeritus, Department of Psychology, University of Haifa, Israel. e-mail: yeshel@psy.haifa.ac.il
Author σ: Professor. Stress and Resilience Research Center, Tel-Hai College, Israel. e-mail: shaulkim@telhai.ac.il
Author ρ: PhD., Stress and Resilience Research Center, Tel-Hai College, and the Ergonomic Human Factors Unit, University of Haifa, Israel. e-mail: Hmarcia1@univ.haifa.ac.il
Author ω: Ph.D., Head of the Department of the Emergency Management and Disaster Management. School of Public Health, Sackler Faculty of Medicine, Tel Aviv University.
e-mail: Adini@tauex.tau.ac.il

Age as a determinant of coping and resilience has been studied in the past mainly as a characteristic of children and adolescents (Garmezy, 1987; Masten & Coatsworth, 1998), and more recently as a beneficial characteristic of older people (Ong, Bergeman, & Boker, 2009). The association of age with coping has been studied more rarely. Available studies suggest that people's resilience grow with age, and increases their ability to cope with adverse experiences (Marciano et al., 2019; Laird et al., 2018). A number of reasons may support the contention that age of adults will positively correlate with coping with adversities and threats of disasters, i.e., with a higher level of resilience. Older adults are more likely to have a higher emotional maturity compared with younger individuals. Most probably their vaster experiences have taught many of them that they are capable of coping with difficulties and risky situations, increased their personal and social capitals, and enhanced their belief that they are able to survive the next adversity as well (Li, & Mutchler, 2019). Over time they have had a chance to develop higher emotional maturity and a realization that most adversities will end eventually. Consequently, their life experience has helped them develop a substantial degree of psychological fortitude. Furthermore, greater maturity is associated with acceptance of their social position, making peace with their life course, and with a sense of wellbeing (Charles, 2010). A study of coping with type 2 diabetes mellitus (Hara, Hisatomi, Ito, Nakao, Tsuboi, & Ishihara, 2014) has indicated similarly that coping with this chronic illness has enhanced with age. The role of age as a predictor of coping with adversity has been studied in the present research in the context of the COVID-19 pandemic.

a) Gender and coping

The role of gender in successful coping with hardship has been discussed by several researchers. A large scale study has found that men have coped significantly better than women following the September 11th terror attack, in terms of posttraumatic stress symptoms (Bonanno, Galea, Bucciarelli, & Vlahov, 2006). Another large scale research has shown that women have displayed a higher level of somatic symptoms and psychological distress compared to men (Matud, 2004). Similar findings have demonstrated, that a non-clinical sample of women under stress, expressed significantly more subclinical depressive and anxiety

© 2020 Global Journals

symptoms than men (Kelly, Tyrka, & Carpenter, 2008). Another research on coping strategies throughout life-span has found that women more often use emotional coping and social support seeking coping strategies, whereas men cope more often by problem solving strategies (Meléndez, Mayordomo, Sancho, & Tomás, 2013). Thus it appears that overall, previous studies on the variance between men and women submit that men tend to demonstrate less stress symptoms, and appear more resilient in comparison to women.

The COVID-19 pandemic is an emerging infectious disease caused by the most recently discovered coronavirus. Since no vaccines have been found to date, the length of the pandemic and its final global impacts are as yet unknown. The COVID-19 pandemic is more dangerous for older rather than younger individuals, while its' perceived threats concern people of all ages. Two emotional responses constitute indicators of the level of the psychological stress caused by this pandemic. First, the strength of anxiety and depression symptoms and second, the sense of danger of this endemic and its potential hazardous health, social and economic consequences. A recent review of COVID-19 studies (Rajkumar, 2020, in press) concludes that anxiety and depression are indeed the commonest individual mental health symptoms of this virulent disease. Furthermore, similar to the Ebola outbreak (Pier, 2019, in press), a high sense of danger, which accompanies COVID-19, is further enhanced by media reports and internet communication, causing havoc, raising the alarm, and spreading panic.

b) Distress symptoms

Highly threatening and painful events, such as the COVID-19 pandemic, undermine people's basic sense of security and increase psychopathological distress symptoms of anxiety. These symptoms which include depression, anxiety, and grief, cause continuous emotional and behavioral problems (Hadi, Llabre, & Spitzer, 2006; Soffer-Dudek, 2016). Distress symptoms that are associated with COVID-19 constitute one indicator of the negative emotional effect of this pandemic in the current study.

c) Sense of danger

Disastrous events are likely to enhance a continuous sense of danger that strongly and negatively influences the reaction to these adversities (Scott, Poulin & Cohen Silver, 2012). A high sense of danger is positively correlated with distress symptoms (Braun-Lewensohn & Al-Sayed, 2018), and negatively correlated with individual resilience (Kimhi & Eshel, 2016). The extent to which the COVID-19 pandemic is perceived as dangerous, constitutes a second measure for the distress caused by it, in the current study.

d) Psychological resilience

Many studies that focus on the function of resilience as a predictor of mental health indicators, support the contention that resilience is negatively correlated with anxiety and depression symptom levels (e.g., Goldstein, Faulkner, & Wekerle, 2013; Satici, 2016; Poole, Dobson, & Pusch 2017; Shapero et al., 2019). The following three main modes of resilience have been studied more extensively: individual, community and national resilience.

e) Individual resilience

The American Psychological Association defines individual resilience as a process of bouncing back from difficult experiences and adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress (APA.org, 2014), whereas Masten (2015) defines it as "the potential of manifested capacity of a dynamic system to adapt successfully to disturbances that threaten the function, survival, or development of the system", (P. 187). Research shows that individual resilience is negatively associated with depression, apathy, and anxiety, and positively associated with quality of life (Laird et al., 2018). Under threats of terror resilience has been positively correlated with a sense of coherence and self-efficacy, and negatively correlated with a sense of danger and exposure to terror acts (Kimhi, Eshel, Leykin & Lahad, 2017). Another recent meta-analysis of 55 studies involving a total of 15,003 sick patients (Färber & Rosendahl, 2018) reports a strong association between individual resilience, as a resource for successful coping, and mental health among the somatically ill. Hjemdal, Vogel, Solem, Hagen and Stiles (2011) report, by the same token, that higher resilience scores have predicted lower scores of depression, anxiety, stress and obsessive–compulsive symptoms after controlling for age and gender.

f) Community resilience

Community resilience reflects the interaction between individuals and their community, and refers to the members' belief that their community will provide for their needs in difficult times (Bonanno, Romero, & Klein, 2015). Carri (2013) defines community resilience as the community's "capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change" (p. 10). Research shows that community resilience has negatively correlated with decreased miscommunication and positively correlated with increased local effectiveness, resources and social support (Patel, Rogers, Amlôt, & Rubin, 2017), as well as with sense of coherence, self-efficacy and social support (Kimhi et al., 2017). Several studies indicate that age of adults is positively correlated with measures of public resilience (Eshel, Marciano, & Kimhi, 2019; Marciano et al., 2019; Cohen, et al., 2016).

© 2020 Global Journals

g) National resilience

National resilience is defined as "the nation's ability to cope successfully with its adversities (whether terrorism, corruption or poverty), while keeping its social fabric intact" (Canetti, Waismel-Manor, Cohen & Rapaport, 2014, p. 10). Ben-Dor, Pedahzur, Canetti-Nisim, & Zaidise (2002) have claimed that this mode of addressing issues of societal sustainability and strength includes three factors: a. trust in the integrity of the government, the parliament and other national institutions; b. belief in social solidarity; and c. patriotism. Research has shown that the level of national resilience is associated with psychological as well as demographic variables. This resilience has positively correlated with a sense of coherence and community resilience, and has negatively correlated with a sense of danger and level of anxiety symptoms. Simultaneously, it has been found that national resilience is positively correlated with religious devotion and right-wing political attitudes (Kimhi & Eshel, 2019). National resilience is most probably the least researched aspect of the resilience domain, and the development of national resilience theories has not gone much beyond attempts to determine what factors constitute the basis of this resilience (e.g. Ben-Dor et al., 2002; Marciano et al., 2019).

h) Wellbeing

Psychological wellbeing is defined as the subjective experience of positive feelings or cognitive appraisals including lower activation affects such as being calm or satisfied, as well as higher activation affects such as being excited or thrilled (Hernandez et al., 2018). DuBois, Lopez, Beale, Healy, Boehm, & Huffman (2015) have found that psychological wellbeing is related to improved prognosis and slower disease progression in patients with chronic cardiovascular disease.

The current study examines the associations of age and gender with coping suppressing and supporting factors. In face of this unfamiliar COVID-19 threat the present study examines whether the pattern of associations, that have been found in other contexts would also emerge in the present circumstances. Namely, do these indicators of coping increase or decrease with age, and how do they manifest with respect to gender.

In light of previous findings the following hypotheses have been examined: 1. Age of the participants will negatively correlate with levels of distress symptoms and a sense of danger, and will positively correlate with individual, community and national resilience, as well as sense of wellbeing. Older adults will cope better than younger ones with the psychological adversities of the COVID-19 pandemic, and will score higher than them on coping supporting factors. 2. Men will cope better than women with the COVID-19 threat in terms of the investigated variables.

II. Method

a) Sample

The present study combined two samples: (a) an internet sample of 605 Jews derived at random from the Israeli population. This sample included similar numbers of males and females (299 females), who agreed to participate in this research (for the reliability and validity of an on-line questionnaire, see Vallejo et al., 2007). (b) A second internet sample of 741 respondents (535 females and 206 males). A snowball sampling was employed in which participants were invited to participate in an online survey and were later asked to invite other potential participants by forwarding the study online link. The similarity of these two samples was assessed by examining the impact of each of them on level of distress symptoms, using group analysis (Amos 2011). This analysis revealed no significant differences between these samples. Tel Aviv University Ethics Committee approved this study (No. 0001150-1, April 1st, 2020). All data were gathered anonymously, following an approval of the IRB of the Tel Aviv University (for the reliability and validity of the on-line questionnaire, see Vallejo, Jordán, Díaz, Comeche, & Ortega, 2007). All participants signed an informed consent before filling out the questionnaires. The demographic characteristics of the investigated sample are presented in Table 1. These participants tend to be non-religious or traditional, with a wide range of family incomes, and center to right political attitudes. Most of them are married and have children. Their responses to our questions indicate the behavioral responses of these healthy participants to the COVID-19 pandemic: a. the vast majority of them (89.8%) have reported a failure to stay in isolation as requested by the Ministry of Health; b. most of them (75.7%) have claimed that their family members failed to stay in such isolation; and, c. 62.0% of them have not believed that a member of their community has been infected by the Coronavirus. An empirical study which concentrates on the "ugly side" of the Israeli character claims that Israelis tend to describe their fellow Israelis, in this context, by two major characteristics: proneness to violation of social norms, and a know all presumptuousness. The misbehaving of the present sample, as far as keeping the COVID-19 pandemic precaution rules is concerned, seems to show that this sample represents, most likely, the general Israeli public.

© 2020 Global Journals

Table 1: Distribution of demographic attributes of the present sample

Variable	rating scale	Number of Respondents	Percent	Mean (S.D.)
Age groups	1. 18-30	449	33.4	
	2. 31-40	253	18.3	
	3. 41-50	210	15.6	2.26
	4. 51-60	207	15.4	(1.56)
	5. 61-70	160	11.9	
	6. 71+	58	4.3	
Gender	1. Males	512	38.0	
	2. Female	834	62.0	
Level of religiosity	1. Non religious	798	59.3	
	2. Traditional	305	22.7	1.63
	3. Religious	186	13.8	(.87)
	4. Very religious	57	4.2	
Family income compared to national average	1. Much lower	258	19.2	
	2. Lower	289	21.5	
	3. Average	344	25.6	2.82
	4. Higher	352	26.2	(1.23)
	5. Much higher	103	7.7	
Political attitude	1. Extreme left	57	4.2	
	2. Left	284	21.1	
	3. Center	452	33.6	3.20
	4. Right	435	32.3	(1.01)
	5. Extreme right	118	8.8	
Education	1. Elementary	5	. 4	
	2. High school	230	17.1	
	3. High school+	179	28.2	3.59
	4. Bachelor degree	430	31.9	(1.03)
	5. Master degree+	302	22.4	
Familial status	1. Single	383	28.5	
	2. Married	728	54.1	
	3. Divorced	98	7.3	
	4. Widow	15	1.1	
	5. Partnerhood	122	9.1	
Number of children	1. No children	533	39.6	
	2. One child	113	8.4	
	3. 2-3 children	511	38.0	1.76
	4. 4-5 children	139	10.3	(1.84)
	5. 6+ children	59	3.7	
Stayed in isolation	1. Yes	137	10.2	
	2. No	1209	89.8	
Family in isolation	1. Yes	327	24.3	
	2. No	1019	75.7	
Sick person in home place	1. Yes	512	38.0	
	2. Doesn't know	457	34.0	
	3. No	377	28.0	

III. Instruments

a) Individual resilience

Individual resilience was measured by the 10-item Connor-Davidson scale (CD-RISC 10) (Campbell-Sills & Stein, 2007) portraying individual feelings of ability and power in the face of difficulties. This scale was rated by a 5-point response scale ranging from 1=not true at all, to 5=generally true. Significant correlations were found between this scale and emotional intelligence, life satisfaction, self-esteem, and positive affect; and a negative significant correlation was found with negative affect (Alarcón, Cerezo, Hevilla, & Blanca, 2020). Cronbach's alpha reliability of this scale in the present sample was α=.85.

b) Community resilience

Community resilience was assessed by a short version of 10 items of the CCRAM scale (CCRAM10; Leykin, Lahad, Cohen, Goldberg, & Aharonson-Daniel, 2013). For this study, we changed the scale each time the word 'security crisis' emerged for the 'COVID-19 crisis'. This tool covered five main issues: social trust, social support, leadership, emergency preparedness and attachment to place (e.g., ''I trust the decision-makers in my community''). Items of this scale were

© 2020 Global Journals

rated by a 5-point scale ranging from 1 (does not agree at all) to 5 (totally agree). The Cronbach alpha reliability of this scale in the present sample was α=.93.

c) National resilience

A short version of the National Resilience Scale was employed (Kimhi & Eshel, 2019). This 12-item tool pertained to trust in national leadership, patriotism, and trust in major national institutions. (e.g., "I love Israel and am proud of it"). The 6-point response scale ranged from 1 (very strongly disagree) to 6 (very strongly agree). Cronbach's alpha reliabilities in the present sample was α=.92.

d) Sense of danger

A seven-item Sense of Danger Scale, based on Solomon and Prager (1992) scale, referred to as a lingering sense of danger in the context of security threats, was employed. In the current study we modified the threat from security to the COVID-19 pandemic threat (e.g., "To what extent are you worried about the increase of the COVID-19 global crisis?"). In addition, we included the item "To what extent are you worried that we will not be able to overcome the COVID-19 crisis before many citizens in our country will die from this disease"? Responses were rated by a Likert-like scale ranging from 1 (not at all) to 5 (very much). The Cronbach alpha reliability of this scale in the present sample was α=.82.

e) Distress symptoms

The level of individual distress symptoms, in the context of the COVID-19 pandemic, was determined by nine items concerning anxiety and depression out of the Brief Symptom Inventory (BSI, Derogatis & Savitz, 2000). This inventory was scored by a Likert scale ranging from 1 (not suffering at all) to 5 (suffering very much). (e.g., "How much do you suffer from feelings of a sudden fear with no reason?"). Due to ethical considerations, we did not include the item concerning suicidal thoughts. Cronbach's alpha for this sample was α=.86.

IV. Results

Three items have determined the association of the participants with the COVID-19 pandemic. The vast majority of them (89.8%) have failed to stay in isolation as requested by the Ministry of Health; most of them (75.7%) have claimed that their family members failed to stay in isolation; and only 38.0% of them have believed that a member of their living place have been infected by the Coronavirus. It appears that this sample which has employed characteristic Israeli responses to potential adversity represents the general Israeli public.

Table 2 presenting the Pearson correlations between the investigated variables shows that, as hypothesized, higher age is negatively and significantly correlated with level of distress symptoms and extent of perceived danger, and positively correlated with wellbeing, individual and community resilience. Being a woman compared to being a man is positively correlated with levels of distress and sense of danger, and negatively correlated with individual and national resilience. Individual, community and national resilience, as well as wellbeing are positively correlated with each other. Distress level is positively correlated with sense of danger, and negatively correlated with wellbeing, and each of the resilience scores, whereas sense of danger is negatively correlated with these positive indices of coping accept for national resilience.

Table 2: Pearson Correlations between the investigated variables

	Gender	Distress	Danger	Wellbeing	Individual resilience	Community resilience	National resilience
Age	-.151	-.248**	-.227**	.199**	.072**	.079**	.015
Gender	1	.130**	.192**	.019	-.088**	.051	-.065*
Distress level		1	.454**	-.544**	-.398**	-.176**	-149**
Sense of danger			1	-.255**	-.220**	-.117**	.006
Well-being				1	.415**	.318**	.253**
Individual resilience					1	.256**	.156**
Community resil.						1	.378**
National resilience							1

The age variable has further been divided into groups (18-30, n=449; 31-40, n=253; 41-50, n=210; 51-60, n=207; 61-70, n=160; 71 and on, n=58). The association of age groups and gender (women, n=829; men n=508) with the investigated coping criteria during the COVID-19 pandemic have further been studied by MANOVAs, examining whether the investigated psychological characteristics consistently and significantly associated with age groups and gender. Table 3 presenting these results indicates the following: significant effects have been found for mean distress scores [$F(1334, 5)=10.908$. $p<.000$, $\eta p^2=.040$], mean sense of danger [$F(1334, 5)=8.574$, $p<.000$, $\eta p^2=.031$], and mean wellbeing scores [$F(1334, 5)=10.291$, $p<.000$, $\eta p^2=.037$]. Lower, but significant age group effects have been found as well for community resilience [$F(1334, 5)=2.464$, $p<.031$, $\eta p^2=.009$] and national resilience [$F(1334, 5)=2.359$, $p<.038$, $\eta p^2=.009$]. No

© 2020 Global Journals

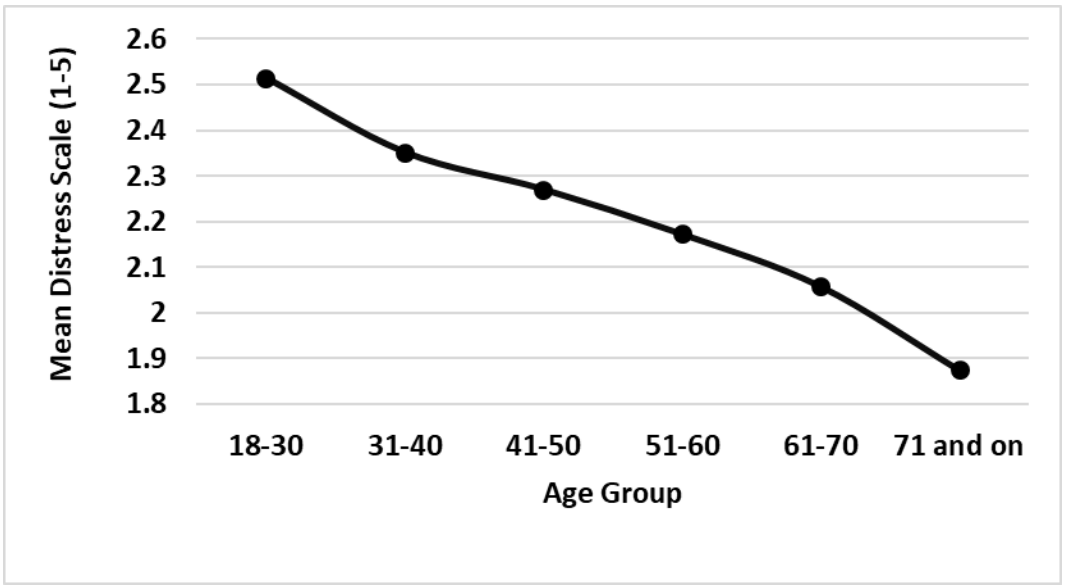
significant age group effect has been found for individual resilience score. These age groups main effects were further analyzed with least significant differences (LSD) post hoc analysis. Figures 1, 2, 3 and 4 show the associations of these four variables with age group, an asterisk represents significant difference between two adjacent age groups, though more significant differences have been found between non adjacent groups. A further examination of these results shows that mean distress symptoms scores have consistently decreased with age group. The decreasing slope of sense of danger with age group, seems to stop between the 41-50 and 51-60 age groups before resuming its decline in the higher age groups. Similarly, the increase of wellbeing scores with age group is slowed between age groups 31-40 and 51-60 but continues in the higher age groups, and the increase of the community resilience scores with age group is interrupted by a substantial decline at the age group of 51-60, and resumes its incline in the higher age groups.

Table 3 which pertains as well to the effects of gender on the investigated variables shows the following: men have scored significantly lower than women on distress symptoms (M=2.179, s.d.=.736 and M=2.387. s.d.=.791 respectively), sense of danger (M=2.625, s.d.=.696 and M=2.912, s.d.=.720 respectively), wellbeing (M=4.126, s.d.=.841 and M=4.158, s.d.=.796 respectively) as well as community resilience (M=3.366, s.d.=.842 and M=3.453, s.d.=.815 respectively). Men have scored higher than women on individual resilience (M=3.662, s.d.=.621 and M=3.550, s.d.=.609 respectively) and national resilience (M=3.986, s.d.=.996 and M=3.855,s.d.=.975 respectively). Table 3 indicates that all these differences are significant,($p<0.05$), apart from the difference of the community resilience ($p=0.56$).

Table 3: MANOVAs for the Effects of Age Groups and Gender on Indicators of Coping Tests of Between Subjects

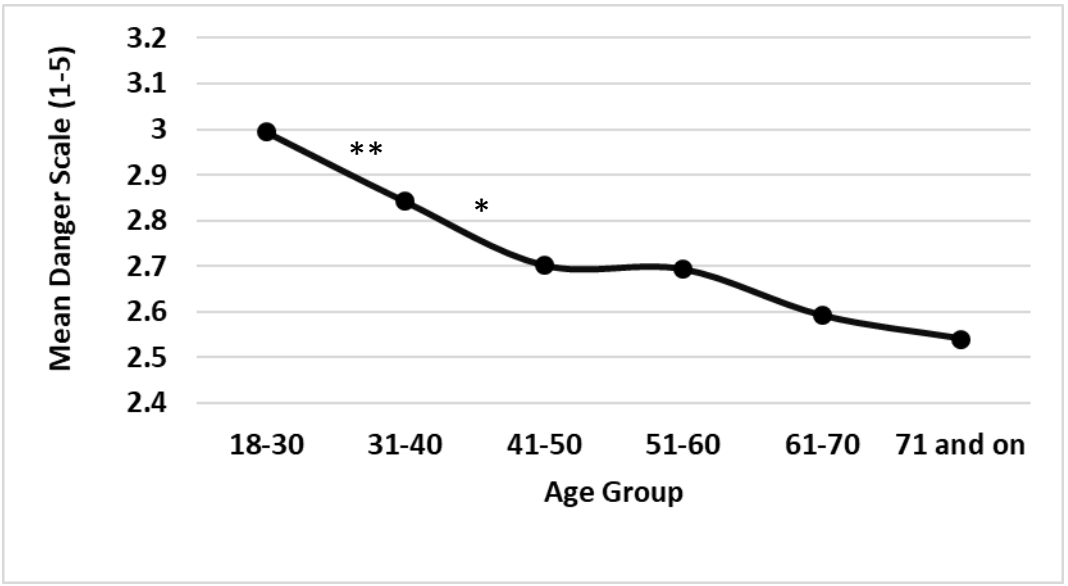
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
age_groups	Distress	30.838	5	6.168	10.908	.000	.040
	Sense of danger	20.896	5	4.179	8.574	.000	.031
	Wellbeing	32.250	5	6.450	10.291	.000	.037
	Individual resil.	1.059	5	.212	.561	.730	.002
	Community resil.	8.291	5	1.658	2.464	.031	.009
	National resil.	11.345	5	2.269	2.359	.038	.009
gender	Distress	2.694	1	2.694	4.764	.029	.004
	Sense of danger	9.136	1	9.136	18.744	.000	.014
	Wellbeing	4.116	1	4.116	6.568	.010	.005
	Individual resil.	2.640	1	2.640	6.992	.008	.005
	Community resil.	2.466	1	2.466	3.664	.056	.003
	National resil.	5.783	1	5.783	6.013	.014	.005
age_groups by gender	Distress	4.968	5	.994	1.757	.119	.007
	Sense of danger	3.164	5	.633	1.298	.262	.005
	Wellbeing	7.064	5	1.413	2.254	.047	.008
	Individual resil.	2.960	5	.592	1.568	.166	.006
	Community resil.	3.928	5	.786	1.167	.323	.004
	National resil.	4.552	5	.910	.947	.450	.004

© 2020 Global Journals



***p<.01; significant differences between two adjacent age groups.*

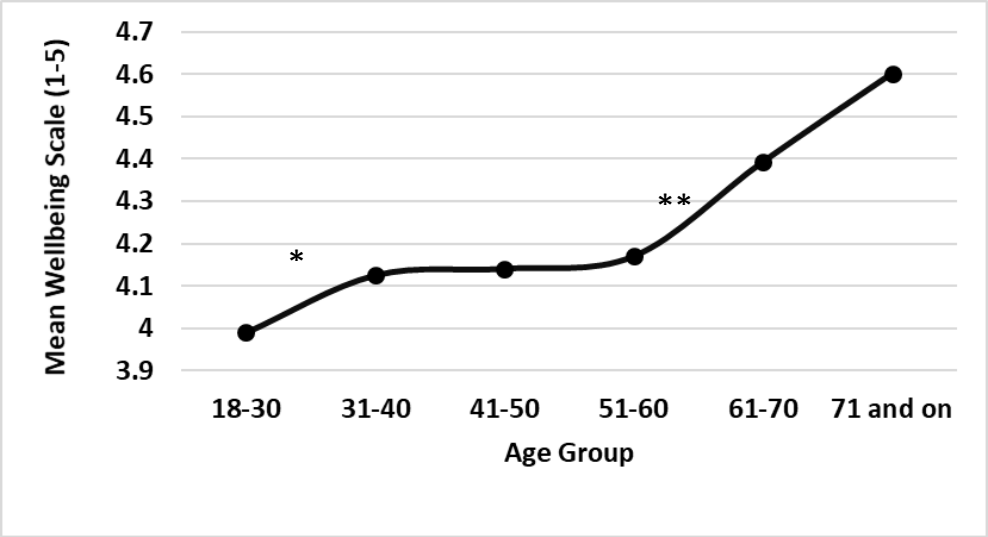
Figure 1: Mean distress symptoms scores by age group



**p<.05; **p<0.01; significant differences between two adjacent age groups.*

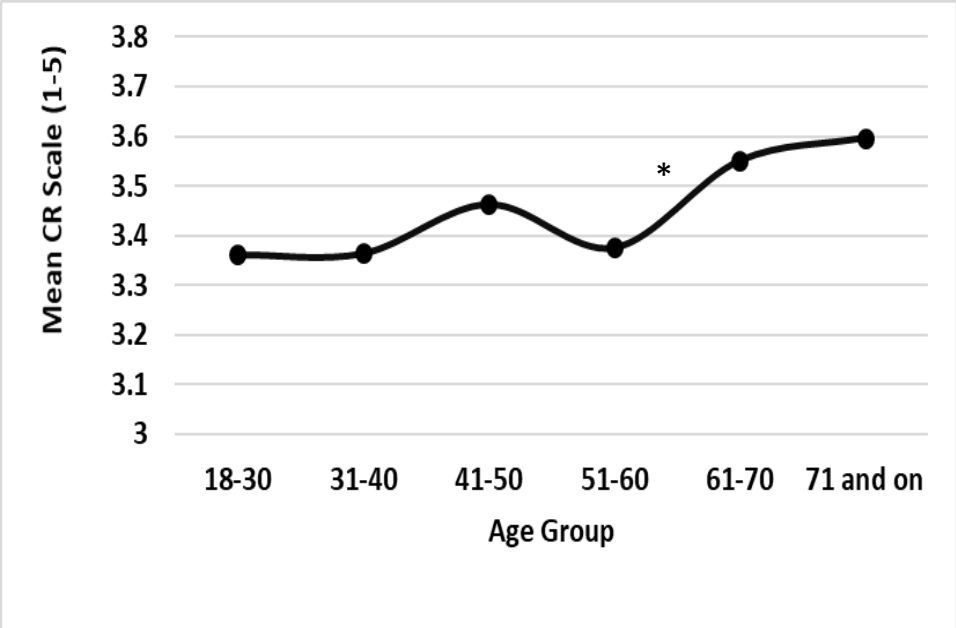
Figure 2: Mean sense of danger scores by age group

© 2020 Global Journals



**p<.05; **p<0.01; significant differences between two adjacent age groups.*

Figure 3: Mean wellbeing scores by age group



**p<.05; significant differences between two adjacent age groups.*

Figure 4: Mean community resilience scores by age group

Finally, the only significant interaction between age group and gender for the wellbeing scores has been significant [$F(1334, 5)=2.554$, $p<0.05$, $\eta p^2=.008$]. Figure 5 indicates that wellbeing scores have steadily increased with age group although none of the differences between men and women have been significant. A nearly significant simple comparison of the two genders at the "70 and on" age group showing higher wellbeing scores of women ($p=0.084$).

© 2020 Global Journals

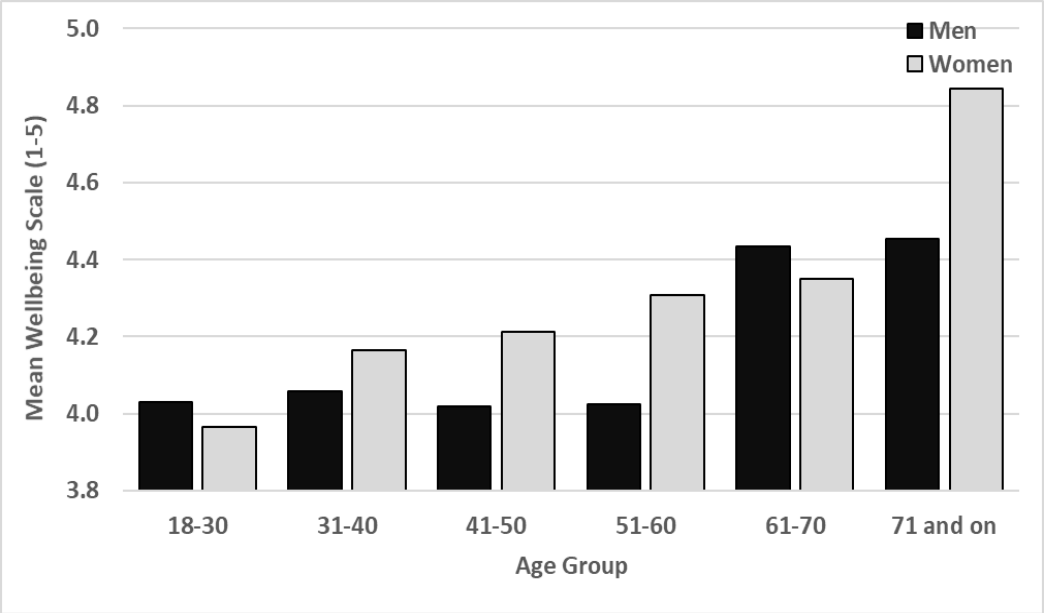


Figure 5: Mean wellbeing scores by age and gender

V. Discussion

In order to examine the question what makes older people cope better than younger ones with the disastrous threats of the COVID-19 pandemic, we have defined coping in terms of lower levels of distress symptoms and sense of danger, and higher levels of wellbeing and resilience. Studies have found that older adults, who have experienced countless positive and negative experiences, have learned what they are capable of surviving, what they need to do to feel content, and the actions necessary to avoid high levels of distress in their daily lives. Their life experience has made them realize that they are capable of coping with most current adversities, much the same as they have overcome previous ones (Rothermund & Brandstadter, 2003; Blanchard-Fields, 2007; Li & Mutchler, 2019). It has further been shown that people with a more limited life expectancy strive to adopt emotion regulation strategies, to a greater extent than younger adults (Carstensen, Fung, & Charles, 2003).

The findings of the current study support the socio-emotional theory which posits that the realization that time is limited is accompanied by a more present-focused awareness. Older adults therefore focus on their present lives. A desire to maintain emotional well-being motivates them to regulate their emotions to maintain high levels of wellbeing (Carstensen et al., 1999; Charles, 2010; Wang, Di, Ye, & Wei. 2020). The higher resilience of older individuals is not limited solely to coping with challenging conditions, it is most probably characteristic of older age groups in general. Two previous studies have reported that a higher age was associated with higher levels of community and national resilience in relatively peaceful times (Kimhi, Goroshit, & Eshel, 2013; Marciano et al., 2019). It should also be emphasized that the higher vulnerability of the elderly population to the COVID-19 threat has not been manifested in their ratings of distress or perceived danger. Similar results have been reported by Limcaoco, Mateos, Fernandez, and Roncero, 2020). It may be surmised that getting older does increase the psychological resilience of people.

In line with previous studies the present results indicate that men cope better than women with adversity in terms of lower sense of danger and distress symptoms, and higher individual and national resilience. Yet women have shown higher wellbeing and higher community resilience. There are no established data pertaining to possible reasons for this finding. A recent study posits that structural physical differences between men and women are correlated with characteristic brain regions, known to be involved in the prefrontal-limbic system, which is considered critical in stress regulation (e.g., Li, et al., 2015). Other researchers claim that these results are consistent with the notion that men and women are socialized to cope with stress in different ways. Ptacek, Smith, and Dodge, (1994) as well as Meléndez et al. (2013) have claimed that women tend to seek more often social support and use emotion-focused coping to a greater extent than men, whereas men tend to use relatively more problem-focused coping than women. This perspective on life-span coping is supported by the present finding of higher community resilience score of women.

It should though also be considered that gender differences may impact the tendency to report concerns, distress or decreased levels of resilience when responding to questions that pertain to elements that

© 2020 Global Journals

may be perceived as presenting weaknesses. As has previously been found that men consider it vital to appear 'strong' and are more reluctant than women to show weaknesses (Samulowitz, Gremyr & Hensing, 2018), they may also find it harder to admit to not being highly coping with the COVID-19 threat as compared to women.

It is quite possible that the inconsistent inclines and declines of mean responses over age portray midlife crisis. Results from a number of large surveys have revealed that the lowest points of life satisfaction in the life cycle were among those aged 40 to 60 (Ulloa, Møller, & Sousa-Poza, 2013; Lachman, Teshale, & Agrigoroaei, 2015). However, chronological age may not be the best anchor for identifying what is midlife, which may be affected as well by roles, timing of life events, and life experience (Lachman, 2004). Furthermore, where midlife stands depends on the dimension that is supposed to be affected by it (Staudinger, Bluck, & Herzberg, 2003).

References Références Referencias

1. Alarcón, R., Cerezo, M. V., Hevilla, S., & Blanca, M. J. (2020). Psychometric properties of the Connor-Davidson Resilience Scale in women with breast cancer. *International Journal of Clinical and Health Psychology, 20,* (1), 81-89.
2. APA.org (2014) The road to resilience. (http://www.apa.org/helpcenter/road-resilience.aspx).
3. Arbuckle JL. *Amos 20 User's Guide*. Chicago, IL: SPSS Inc; 2011.
4. Ben-Dor, G., Pedahzur, A., Canetti, D., & Zaidise, E. (2002). The role of public opinion in Israel's national security. *American Jewish Congress: Congress Monthly, 69.*
5. Blanchard-Fields, F. (2007). Everyday problem solving and emotion: An adult developmental perspective. *Current Directions in Psychological Science, 16*(1), 26-31.
6. Bonanno, G. A., (2005). Resilience in the face of potential trauma. *Current Directions in Psychological Science, 14*, 135–138.
7. Bonanno, G. A., Galea, S., Bucciarelli, A., & Vlahov, D. (2006). Psychological Resilience after disaster: New York City in the aftermath of the September 11th terrorist attack. *Psychological Science, 17* (3), 181-186.
8. Bonanno, G. A., Romero, S. S., & Klein, S. I. (2015). The temporal elements of psychological resilience: An integrative framework for the study of individuals, families, and communities. *Psychological Inquiry, 26*(2), 139–169.
9. Braun-Lewensohn, O., & Al-Sayed, K. (2018). Syrian Adolescent Refugees: How Do They Cope During Their Stay in Refugee Camps? *Frontiers in Psychology, 20*, 9, 1258. doi: 10.3389/fpsyg.2018.01258.
10. Campbell-Sills, L., & Stein, M. B. (2007). Psychometric analysis and refinement of the Connor–Davidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. *Journal of Traumatic Stress, 20,* 6, 1019–1028.
11. Canetti, D., Waismel-Manor, I., Cohen, N., & Rapaport, C. (2014). What Does National Resilience Mean in a Democracy? Evidence from the United States and Israel. *Armed Forces & Society 40*(3)
12. Carstensen, L. L., Fung, H. H., & Charles, S. T. (2003). Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation and Emotion, 27*(2), 103–123.
13. Charles, S. T. (2010). Strength and vulnerability Integration: A model of emotional well-being across adulthood. *Psychological Bulletin, 136* (6), 1068–1091.
14. Cohen, O., Geva, D., Lahad, M., Bolotin, A., Leykin, D., Goldberg, A., et al. (2016). Community resilience throughout the lifespan – The potential contribution of healthy elders. *PLoS ONE 11*(2): e0148125. doi:10.1371/
15. Derogatis, L. R., & Savitz, K. L. (2000). The SCL-90-R and Brief Symptom Inventory (BSI) in primary care. In: M. E. Maruish (Ed.), *Handbook of psychological assessment in primary care settings* (pp. 297-334). Mahwah, NJ: Lawrence Erlbaum Associates.
16. DuBois, C. M., Lopez, O. V., Beale, E. E., Healy, B. C., Boehm, J. K., Huffman, J. C. (2015). Relationships between positive psychological constructs and health outcomes in patients with cardiovascular disease: A systematic review. *International Journal of Cardiology, 195*, 265–280.
17. Eshel, Y., Marciano, H., & Kimhi, S. (2919). Predictors of national and community resilience of Israeli border inhabitants threatened by war and terror. *Community Mental Health Journal, Journal of Community Psychology, 47*(8), 1952-1960.
18. Färber, F., & Rosendahl, J. (2018). The association between resilience and mental health in the somatically ill - a systematic review and meta-analysis. *Deutsches Ärzteblatt International, 115*, 621–627.
19. Garmezy N. (1987). Stress, competence, and development: Continuities in the study of schizophrenic adults, children vulnerable to psychopathology, and the search for stress-resistant children. *American Journal of Orthopsychiatry, 987*, (57), 159–174.
20. Goldstein, A. L., Faulkner, B., & Wekerle, C. (2013). The relationship among internal resilience, smoking, alcohol use, and depression symptoms in emerging adults transitioning out of child welfare. *Child Abuse & Neglect,* 37, 22–32.

© 2020 Global Journals

21. Hadi, F., Llabre, M. M., & Spitzer, S. (2006). Gulf War-related trauma and psychological distress of Kuwaiti children and their mothers. *Journal of Traumatic Stress*, *19*, 653–662.
22. Hara, Y., Hisatomi, M., Ito, H., Nakao, M., Tsuboi, K., & Ishihara, Y. (2014). Effects of gender, age, family support, and treatment on perceived stress and coping of patients with type 2 diabetes mellitus. *BioPsychoSocial Medicine, 8*(16), 1-11.
23. Hernandez. R., Bassett, S. M., Seth W. Boughton, S. W., Schuette, S. A., Shiu, E. W., & Judith T. Moskowitz, J. T. (2018). Psychological Well-Being and Physical Health: Associations, Mechanisms, and Future Directions. Emotion Review, 10 (1), 18-29.
24. Hjemdal, O., Vogel, P. A., Solem, S., Hagen, K., & Stiles, T. C. (2011). The relationship between resilience and levels of anxiety, depression, and obsessive– ompulsive symptoms in adolescents. *Clinical Psychology and Psychotherapy, 18*, 314–321.
25. Kelly, M. M., Tyrka, A. T., & Carpenter, L. L. (2008). Sex differences in the use of coping strategies: Predictors of anxiety and depressive symptoms. *Depression and Anxiety, 25*(10), 839-848.
26. Kimhi, S. & Eshel, Y. (2016). Demographic characteristics and sense of danger predicting a new measure of individual resilience following a war. *Journal of Community Medical Health Education, 6*(5), 472-480.
27. Kimhi, S., Eshel, Y. (2019). Measuring national resilience: A new short version of the scale (NR-13). *Journal of Community Psychology, 47*(3), 517-528.
28. Kimhi, S., Eshel, Y., Leykin, D., & Lahad, M. (2017), Individual, community, and national resilience in peace time and in the face of terror: A longitudinal study, *Journal of Loss and Trauma, 22*, 8, 698-713.
29. Kimhi, S., Goroshit, M., & Eshel, Y. (2013). Demographic variables as antecede of Israeli community and national resilience. *Journal of Community Psychology, 41*(5), 631-643.
30. Lachman, M. E. (2004). Development in midlife. *Annual Review of Psychology, 55*, 305–331.
31. Lachman, M. E., Teshale, S., & Agrigoroaei, S. (2015). Midlife as a pivotal period in the life course: Balancing growth and decline at the crossroads of youth and old age. *International Journal of Behavioral Development*, *39*(1), 20–31.
32. Laird, K. T., Lavretsky, H., Paholpak, P., Vlasova. R. M., Roman, M., St Cyr, N., & Siddarth, P. (2018). Clinical correlates of resilience factors in geriatric depression. *International Psychogeriatrics, 31*(2), 193-202.
33. Leykin, D., Lahad, M., Cohen, O., Goldberg, A., & Aharonson-Daniel, L. (2013). Conjoint Community Resiliency Assessment Measure-28/10 Items (CCRAM28 & CCRAM10): A self-report tool for assessing community resilience. *American Journal of Community Psychology, 52*, 313-323.
34. Li, H., *et al* (2015). Neuroanatomical differences between men and women in help- seeking coping strategy. *Scientific Reports, 4,* 5700.
35. Li, Y., & Mutchler, J. E. (2019). Do consequences of hardship narrow in later life? The impact of hardship on self-rated health among older adults. *Annals of epidemiology, 1*(37), 4-9.
36. Limcaoco, R. S., Mateos, E. M., Fernandez, J. M., & Roncero, C. (2020). Anxiety, worry and perceived stress in the world due to the COVID-19 pandemic. Preliminary results. *medRxiv*.
37. Luthar, S. S., Brown, P. J. (2007). Maximizing resilience through diverse levels of inquiry: Prevailing paradigms, possibilities, and priorities for the future. *Development and Psychopathology, 19*, 931–955.
38. MacLeod, S., Musich, S., Hawkins, K., Alsgaard, K., & Wicker, E. R. (2016). The impact of resilience among older adults. *Geriatric Nursing, 37*(4), 266-272.
39. Marciano, H., Kimhi, S., & Eshel, Y. (2019). Predictors of individual, community and national resiliencies of Israeli Jews and Arabs. *International Journal of Psychology*, DOI: 10.1002/ijop.12636
40. Masten, A. S. (2001). Ordinary magic: Resilience processes in development. *American Psychologist, 56*, 227–238.
41. Masten, A. S. (2015). Pathways to integrated resilience science. *Psychological Inquiry, 26*(2), 187-196.
42. Masten, A. S., & Coatsworth, J. (1998). The development of competence in favorable and unfavorable environments: Lessons from research on successful children. *American Psychologist, 53*, 205–220.
43. Matud, M. P. (2004). Gender differences in stress and coping styles. *Personality and Individual Differences, 37*(7), 1401-1415.
44. Meléndez, J. C., Mayordomo, T., Sancho, P., & Tomás, J. M. (2013). Coping strategies: Gender differences and development throughout life span. *The Spanish Journal of Psychology, 15*(3), 1089-1098.
45. Ong, A. D., Bergeman, C. S., & Boker, S. M. (2009). Resilience comes of age: Defining features in later adulthood. *Journal of Personality, 77*(6), 1777-1804.
46. Pier, E. (2019 in press). Media framing and the threat of global pandemics: The Ebola crisis in UK media and policy response. *Sociological Research Online, 24*(1) 73–92.
47. Poole, J. C., Dobson, K. S., & Pusch, D. (2017). Childhood adversity and adult depression: The protective role of psychological resilience. *Child Abuse & Neglect, 64,* 89–100.

© 2020 Global Journals

48. Ptacek, J. T., Smith, R. E., & Dodge, K. L. (1994). Gender Differences in Coping with Stress: When Stressor and Appraisals Do Not Differ. *Personality and Social Psychology Bulletin, 20*(4), 421-430.
49. Rajkumar, R. R. (2020). COVID-19 and mental health: A review of the existing literature. *Asian Journal of Psychiatry* (in press). doi: 10.1016/j/ajp. 2020. 102066
50. Samulowitz A, Gremyr I, Eriksson E, Hensing G. (2018). "Brave men" and "emotional women": A theory-guided literature review on gender bias in health care and gendered norms towards patients with chronic pain. *Pain Research and Management.*
51. Satici, S. A. (2016). Psychological vulnerability, resilience, and subjective well-being: the mediating role of hope. *Personal and Individual Differences,* 102, 68–73.
52. Scott, S. B., Poulin, M. J., & Cohen-Silver, R. (2012). A lifespan perspective on terrorism: Age differences in trajectories of response to 9/11. *Developmental Psychology, 49*(5), 986–998.
53. Sela-sheffy, R. (2004). 'What makes one an Israeli?' Negotiating identities in everyday representations of 'Israeliness'. *Nations and Nationalism 10* (4), 2004, 479–497.
54. Shapero, B. G., Farabaugh, A., Terechina, O., DeCross, S., Cheung, J. C., Fava, M., et al. (2019). Understanding the effects of emotional reactivity on depression and suicidal thoughts and behaviors: moderating effects of childhood adversity and resilience. *Journal of Affective Disorders, 245*, 419–427.
55. Soffer-Dudek, N. (2016). Sleep-related experiences longitudinally predict elevation in psychopathological distress in young adult Israelis exposed to terrorism. *Personality and Individual Differences*, *100*, 131–139.
56. Solomon, Z., & Prager, E. (1992). Elderly Israeli holocaust survivors during the Persian Gulf War: A study of psychological distress. *The American Journal of Psychiatry, 149*, 1707–1710.
57. Staudinger, U. M., Bluck, S., & Herzberg, P. Y. (2003). Looking back and looking ahead: Adult age differences in consistency of diachronous ratings of subjective wellbeing. *Psychology and Aging, 18*, 13–24.
58. Ulloa, B. F. L., Møller, V., Sousa-Poza, A. (2013). How does subjective well-being evolve with age? A literature review. *Journal of Population Aging, 6*, 227–246.
59. Vallejo, M. A., Jordán, C. M., Díaz, M. I., Comeche, M. I., & Ortega, J. (2007). Psychological assessment via the internet: a reliability and validity study of online (vs. paper-and-pencil) versions of the General Health Questionnaire-28 (GHQ-28) and the Symptoms Check-List-90-Revised (SCL-90-R). *Journal of medical Internet research*, *9*(1), e2.
60. Wang, Y., Di, Y., Ye, J., & Wei, W. (2020). Study on the public psychological states and its related factors during the outbreak of coronavirus disease 2019 (COVID-19) in some regions of China. *Psychology, Health & Medicine, 31*, 1-0.

© 2020 Global Journals

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Application of Lineament Analysis in Geohazard Studies in Mukuru Area Boki Lga Cross River State Nigeria

By Egesi, N. & Agbebia, M. A.
University of Port Harcourt

Abstract- The study area Mukuru is in the eastern part of Boki LGA in Cross River State. It is a high grade granulites terrain, others rock types identified are charnockitic, migmatitic and less of granitic and doleritic rocks. The extracted lineaments from the satellite imagery are in a zone of charnockitic rocks belt highlands and migmatites lowlands. They appear as lines or edges and the colour differences help to identify them on straight rock boundaries, valleys and drainage channels. The total number of 265 altitudes of planar and linear features were mapped. The accuracy of the lineaments depends on ground-truth of the results of lineament survey. The charnockites have caves which can accommodate ten to two hundred people. Rockfalls or rockslides geohazards mapping and analysis can provide valuable information to ease the catastrophic loss, reduce loss of lives and properties, and also provide guidelines for a sustainable planning and development. All the areas surrounded by highlands are potential geohazard zone, this has been recorded at Bumaji, Ofambe and Buanchor, they needs monitoring and evaluation.

Keywords: *rockfalls, lineaments mapping, geohazards prevention, mukuru-boki area, nigeria.*

GJSFR-H Classification: *FOR Code: 040399*

Strictly as per the compliance and regulations of:

© 2020. Egesi, N. & Agbebia, M. A. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Application of Lineament Analysis in Geohazard Studies in Mukuru Area Boki Lga Cross River State Nigeria

Egesi, N. [α] & Agbebia, M. A. [σ]

Abstract- The study area Mukuru is in the eastern part of Boki LGA in Cross River State. It is a high grade granulites terrain, others rock types identified are charnockitic, migmatitic and less of granitic and doleritic rocks. The extracted lineaments from the satellite imagery are in a zone of charnockitic rocks belt highlands and migmatites lowlands. They appear as lines or edges and the colour differences help to identify them on straight rock boundaries, valleys and drainage channels. The total number of 265 altitudes of planar and linear features were mapped. The accuracy of the lineaments depends on ground-truth of the results of lineament survey. The charnockites have caves which can accommodate ten to two hundred people. Rockfalls or rockslides geohazards mapping and analysis can provide valuable information to ease the catastrophic loss, reduce loss of lives and properties, and also provide guidelines for a sustainable planning and development. All the areas surrounded by highlands are potential geohazard zone, this has been recorded at Bumaji, Ofambe and Buanchor, they needs monitoring and evaluation.

Keywords: rockfalls, lineaments mapping, geohazards prevention, mukuru-boki area, nigeria.

I. Introduction

The petrology and structural features of Uwet area parts of Oban massif and southern Obudu has been studied by Ekwueme, (1987, 1990). He observed orientations of planar, linear and small-scale geological structures. These features are consistent with the isotopic data results, indicate that the area was subjected to poly-phase deformation, poly-metamorphism and magmatism during the Precambrian period. Ukaegbu, (2003) identified pressure-temperature distribution and linear structures as the centre of the geotectonic features of southern Obalinku area. Boki area, which is in the south of Obudu and Obalinku Local Government Areas, contains sheets 304 Bansara and 305 Mukuru and has received attention recently, Egesi and Ukaegbu (2010, 2013), Egesi, (2015), which identified the rock types in the area, while Agbebia and Egesi (2019), carried preliminary lineament survey Figs.1 and 2. This paper is an attempt to use lineament analysis to investigate the geology of the area particularly hazardous zones that may put the lives and properties of the inhabitants at great risks if unchecked and control measures put in place.

Author: Department of Geology, Faculty of Science, University of Port Harcourt. e-mail: ndukauba.egesi@uniport.edu.ng

II. Geological Setting

Edet *et al.,* (1994) observed that lineament density are high in areas of outcropping bedrock, overburden and thin cover in parts of Oban and Obudu areas. The Nigerian Geological Survey Agency NGSA (2010) described the study area as granulites terrain using aeromagnetic survey data only. We carried out detailed field investigations, ground-truth, lineament analysis and confirmed the presence of granulites at Kanyang, Wula, Afi River area between Katabang and Kanyang, Bamba and Abuogbagante; other rock types identified are migmatites, eclogites, schists, amphibolites, granites and dolerites Egesi, (2015). Field observations show fracturing increases from Bansara in the west to Mukuru in the east as shown in the terrain Fig.2. It has been observed that the eastern Nigeria terrain is overlain by high grade, migmatitic, metasediments intruded by several voluminous proterozoic, plutonic, hyperbyssal and volcanic suites. In comparison to western Nigeria or western Cameroon, field observations made by Fèrrè *et al.* (1995) indicate no basement-cover relationship within these rock units. Most rock types they identified are coarse grained and include banded migmatites, paragneiss, anatectic granite, granitic gneiss, kinzigites, charnockites, diorites, amphibolites, quartzites and calc-silicate rocks. The calc-silicate forms boudins within the gneisses and migmatites. In addition, lenses of almost pure sillimanite and garnet occur conformably with the layering of the migmatites. These features are also present in Bansara and Mukuru Boki area.

In comparison with Ekwueme (1990), there is indication that metamorphism reached grades higher than upper amphibolites facie, like the granulites facie at Kanyang and Wula, with the formation of abundant metatexites and diatexites (Fèrrè *et al.* 1995). All the metamorphic rocks identified are coarse grained gneisses or anatexites (grain size commonly, 0.5 – 1cm). The observation of orthopyroxene and mesoperthite, in leptynites and its associated leucosomes, are typical minerals of the granulites facie, which is a characteristic of deep-seated regional metamorphism, suggesting peak temperatures well above 650^{o} C for granulites formation (Fèrrè *et al.* 1996). Figures 1 and 2 are the satellite terrain map of Boki

© 2020 Global Journals

showing the Mukuru area and the topographical map with Cameroon boundary in the east.

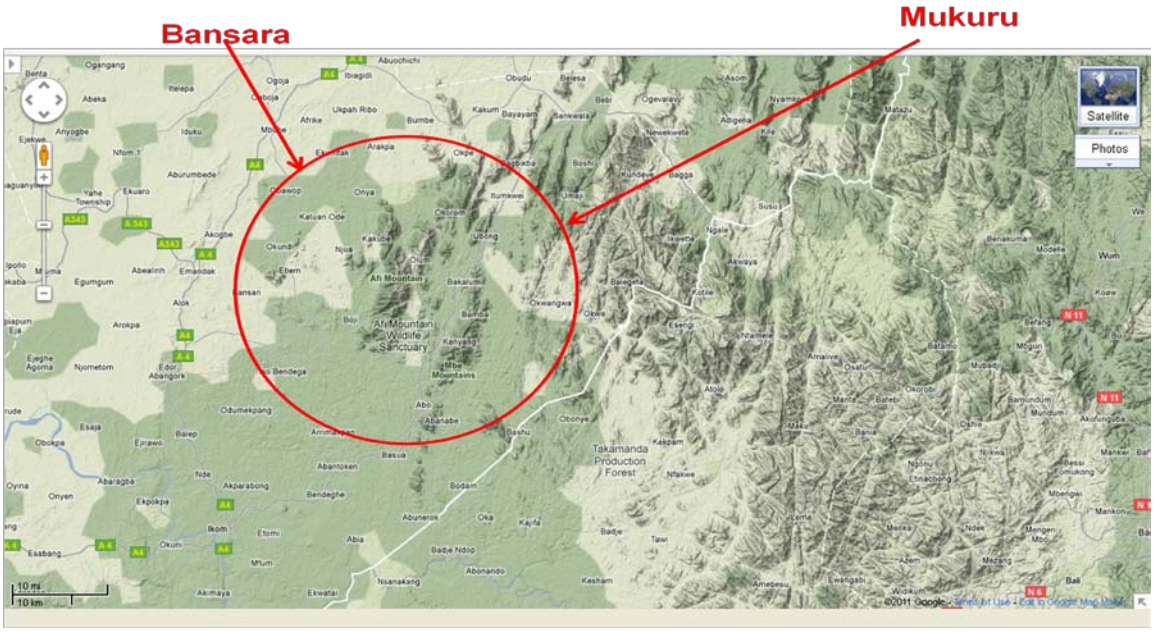


Figure 1: Satellite terrain map showing fractures in Boki, increasing towards the east in the Bamenda massif of Cameroon area (Source: Google Earth 2020)

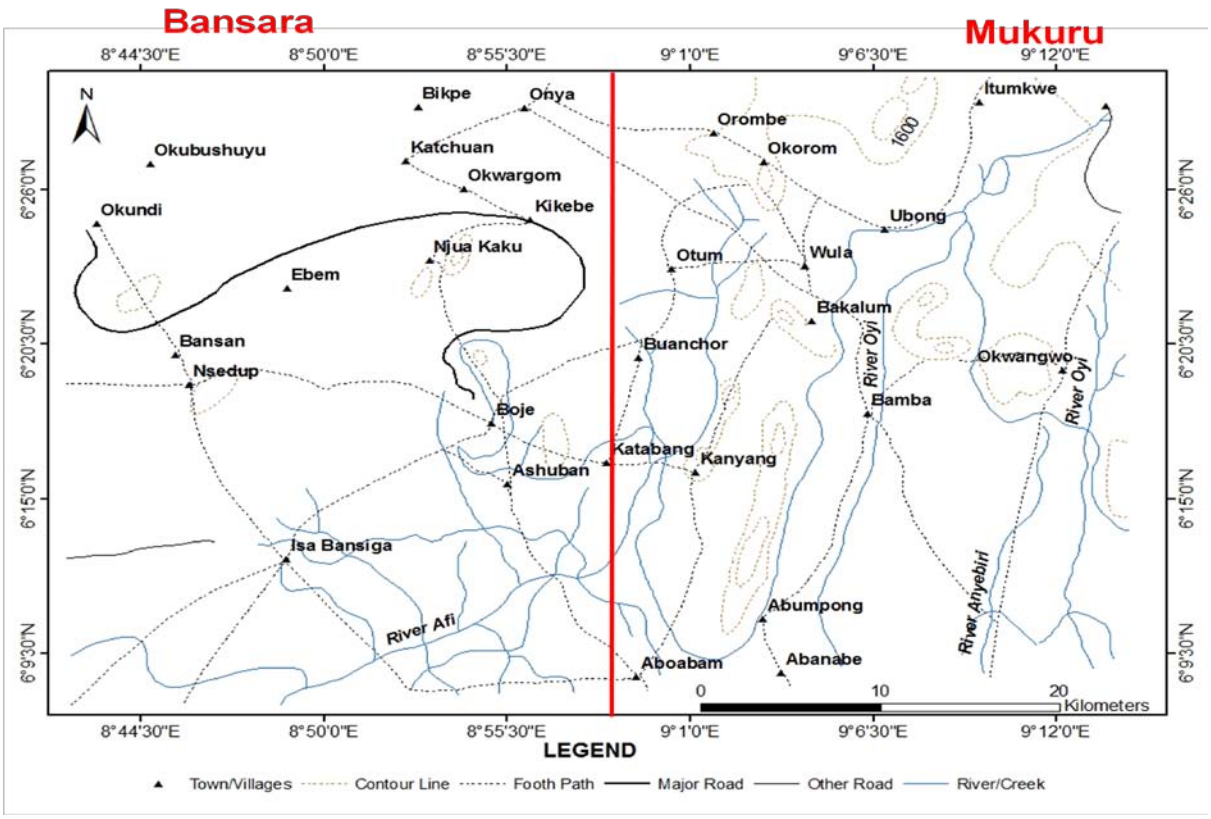


Figure 2: Location map of parts of the study area

Rockfalls or rockslides can occur when a stable slope becomes unstable due a discontinuity. There are a number of factors which can lead to this situation. They can be group into Natural factors and Human activities. Using a sketch for a channel morphology of fluvial systems Ibisate *et al.*(2011), showed the main

© 2020 Global Journals

factors that determines the effectiveness of the resultant features human activities and natural factors can produce (Figure 3). It should be noted that human activity is the main driver for such a geohazard occurrence. Plate 1 is part of massive charnockitic rocks in Buanchor area before the rockfalls and rockslides which occurred in the area due to human activities at the foot of the highlands after a heavy rainfall and storm.

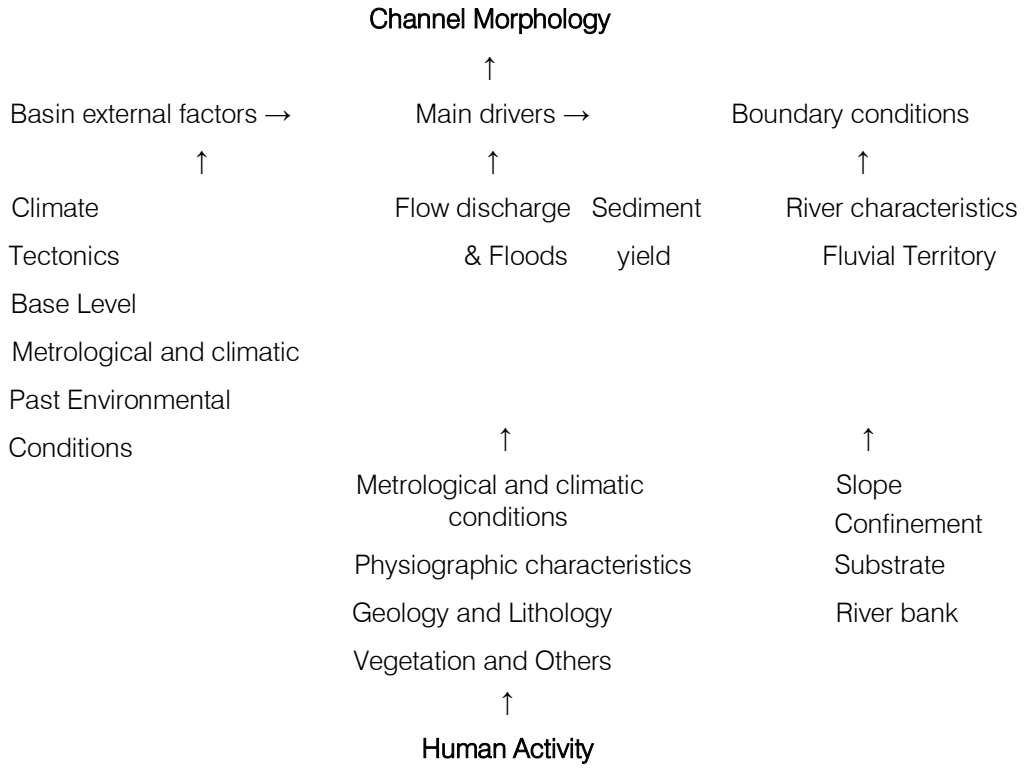


Figure 3: A sketch showing the main factors that determine channel morphology (Ibisate *et al*. 2011)

Plate 1: Field photograph of massive charnockitic rocks at Buanchor hills before the rockfalls and rockslides

Mouri *et al.* (2011), carried out a study in the mountainous granitoids terrain in Japan, they found that extreme events such as large storms and floods due to heavy precipitation can trigger off rockfalls, rockslides,

© 2020 Global Journals

landslides and mudslides, that can carry large volumes of rock materials for fluvial relocation. Thus, the geology of a locality, can fundamentally influence the hydrology and the morphology that can be transformed. Umeuduji, (2019), using an illustration on Man, Rivers and Morphological transformation and safety, observed that an increasing order of magnitude can occur beyond the annual mean rainfall floods, the 5-year floods with a 20% chance, 50-year floods with a 2% chance and 100-year floods with 1% chance of occurring which may pose threat to safety of lives and properties. The plate 2, below is a lake on top of biotite granite rock which if it is large enough, under large storms favourable conditions can release the water and other rock materials contained after a heavy rainfall to the lowlands where communities are residing. The effect which may be hazardous, will be similar to the collapse or failure of a water dam. There is need for a controlled release of the water in the pond to safeguard inhabitants living at the lowlands.

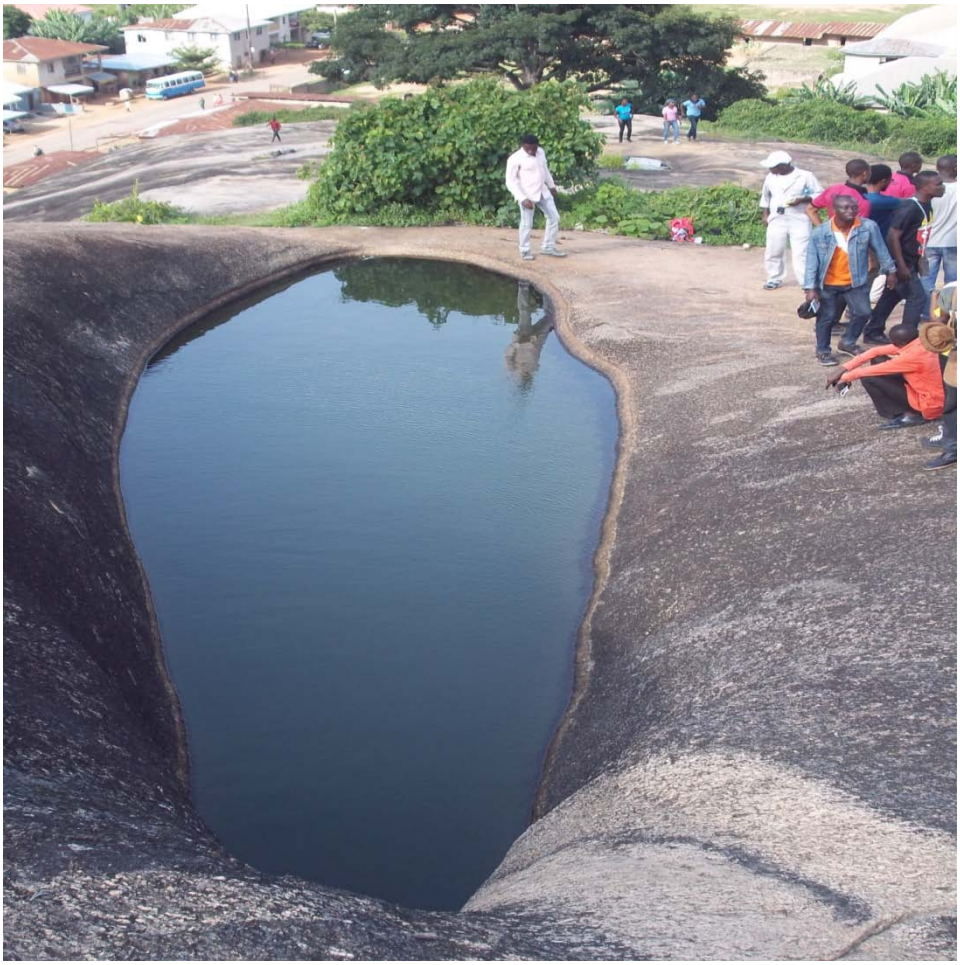


Plate 2: Field photograph showing a 3m deep lake on top of biotite granite a potential geohazard feature

III. Materials and Methods

The Buanchor highlands are part of the source of Afi River which is a tributary to the Cross River. The methods used includes data sourcing, imagery and software. Field investigations, structural features modelling and analysis, ground-truth and lineament and structural interpretation. The materials acquired are Shuttle Radar Topographic Mission (SRTM) 30 x 30m, LandSat 8 Pixel size: 1 – 7.9: 30m and Nigerian shape files 2019. The PCI GEOMATICA 19 was used for lineament mapping, ARCGIS 10.5 for Cartography and spatial analysis while Grapher 12 and Rockworks 19 were used for altitude analysis. A total number of 265 altitudes were measured in Mukuru sheet 305. As result of the colour differences lineaments appear as lines or edges on the images. Their identification is by observing straight rock boundaries, valleys, tone variations and vegetation cover alignments.

© 2020 Global Journals

Table 1: List of data and method of acquisition

S/N	Data	Method of Acquisition	COST(NGN)
1	LandSat-ETM 2019, Path 187, Row 056	Purchase through Agents	-
2	SRTM (Shuttle Radar Topographic Mission), Path 187, Row,056	Purchase through Agents	-
3	Nigerian Shape Files Nigeria Sat-X	Given at ASTAL Uyo	-
4	PCI Geomatica 19	Purchase Online	350,000
5	Arc GIS 10.5	Purchase Online	75,000
6	Rockworks 19	Purchase Online	50,000
7	Stereonet 9	Purchase Online	15,000
8	GeoRose 0.4.1	Purchase Online	10,000

Table 2: Parameters of structures measured at Owambe/Otanchi/Bibo area.

S/N	Strike	DIP	DIP Direction	S/N	Strike	DIP	DIP Direction
1	324	53	58	43	324	53	58
2	154	53	65	44	154	53	65
3	354	44	76	45	354	44	76
4	355	32	54	46	355	32	54
5	312	23	88	47	312	23	88
6	143	34	86	48	143	34	86
7	336	42	37	49	336	42	37
8	314	43	44	50	314	43	44
9	305	65	61	51	305	65	61
10	322	32	82	52	322	32	82
11	318	31	88	53	318	31	88
12	341	21	60	54	341	21	60
13	342	43	42	55	342	43	42
14	312	36	34	56	312	36	34
15	336	42	37	57	336	42	37
16	324	53	58	58	324	53	58
17	154	53	65	59	154	53	65
18	354	44	76	60	354	44	76
19	355	32	54	61	355	32	54
20	312	23	88	62	312	23	88
21	143	34	86	63	143	34	86
22	336	42	37	64	336	42	37
23	314	43	44	65	314	43	44
24	305	65	61	66	305	65	61
25	322	32	82	67	322	32	82
26	318	31	88	68	318	31	88
27	341	21	60	69	341	21	60
28	342	43	42	70	321	34	77
29	312	36	34	71	340	40	82
30	336	42	37				
31	324	53	58	S/N	TREND	PLUNGE	
32	154	53	65				
33	354	44	76				
34	355	32	54	1	294	30	
35	312	23	88	2	287	76	
36	143	34	86	3	277	67	
37	336	42	37	4	310	77	
38	314	43	44	5	284	30	
39	305	65	61	6	290	76	
40	322	32	82	7	294	30	
41	318	31	88	8	287	76	
42	341	21	60	9	277	67	

© 2020 Global Journals

IV. Results and Discussion

The results are presented as stereonet, rose and rosette plots, tables, maps and ground-truth field photographs. Remote sensing and GIS can be employed for rockfalls and rockslides geohazard analysis and assessment. They are done before the event and after the event. These helps to unveil the topography or how the landscape have changed with time, what triggered the rockfalls and also predict future events. The lineaments indicates a major NW/SE to minor N-S with altitude in NE-SW in Figs.4 and 8 Owambe and Kanyang areas, while Figs.5, 6, and 7, is similar except that the altitudes are in NW/SE direction in Bumaji, Ubong/Olum/Buanchor axis and Bamba areas. Seventy four (74) altitudes of planar and ten (10) of linear features were measured in Owambe/Otanchi/ Bibo, forty six (46) of planar and nine (9) of linear in Bumaji, sixty (60) of planar and sixteen (16) of linear in Ubong/Olum/Buanchor, eighteen (18) of planar and six (6) of linear in Bemi, fourteen (14) of planar and four (4) of linear in Bamba, and four (4) altitudes of planar and four (4) of linear features in Kanyang area.

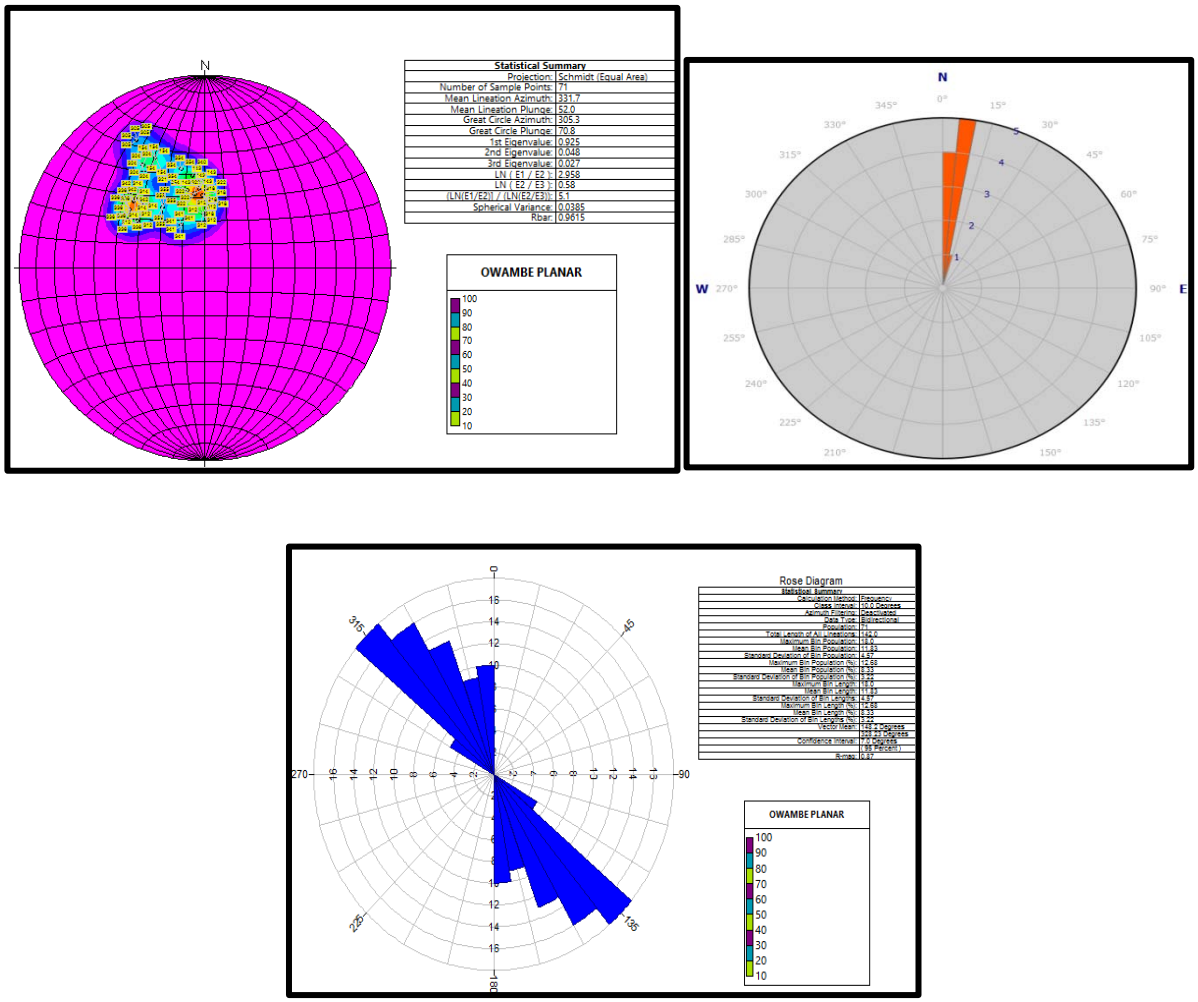
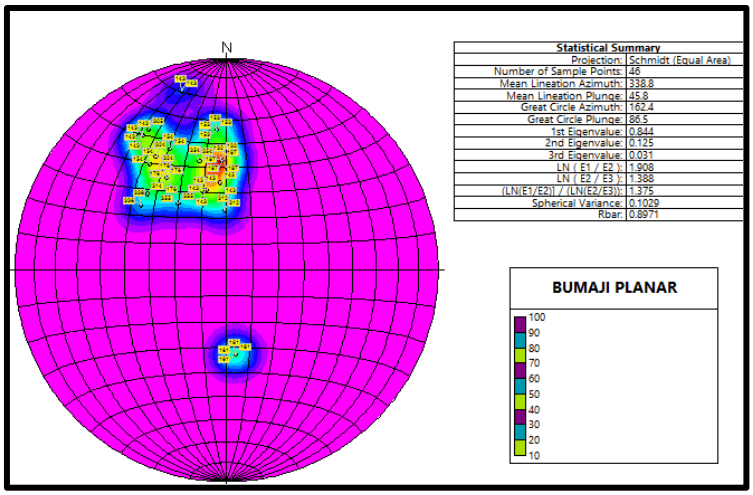
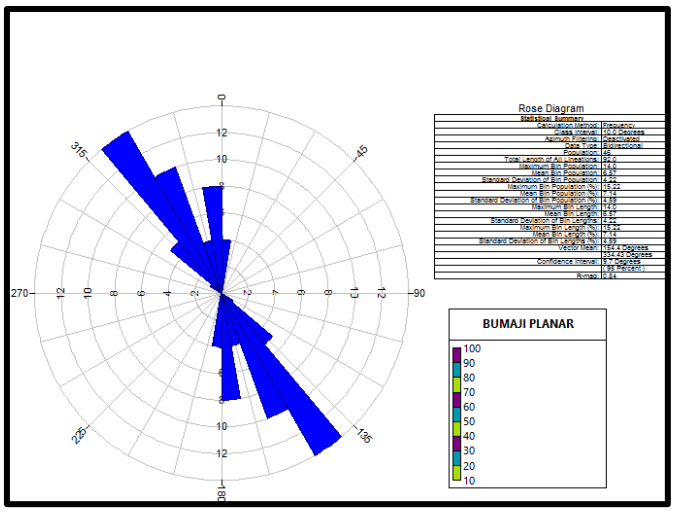


Figure 4: A- Planar Stereonet plot, B- Planar Rose Plot and C- Linear Rosette Plot of the altitudes of Owambe/Otanchi/ Bibo Striking NW/SE to N-S and Trending NE/SW

© 2020 Global Journals





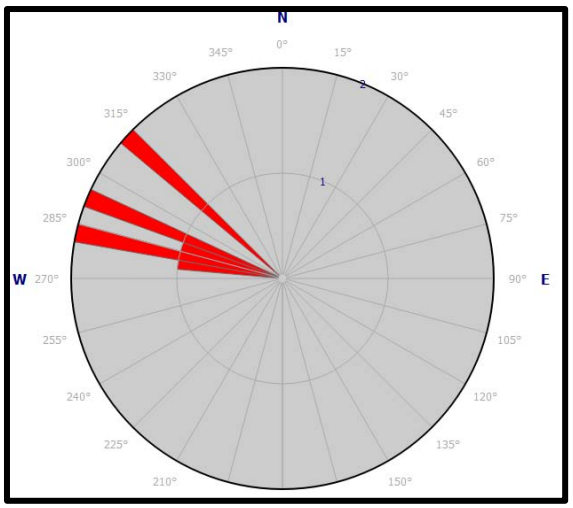


Figure 5: A- Planar Stereonet plot, B- Planar Rose Plot and C- Linear Rosette Plot of the altitudes of Bumaji Striking NW/SE to N-S and Trending NW/SE.

© 2020 Global Journals

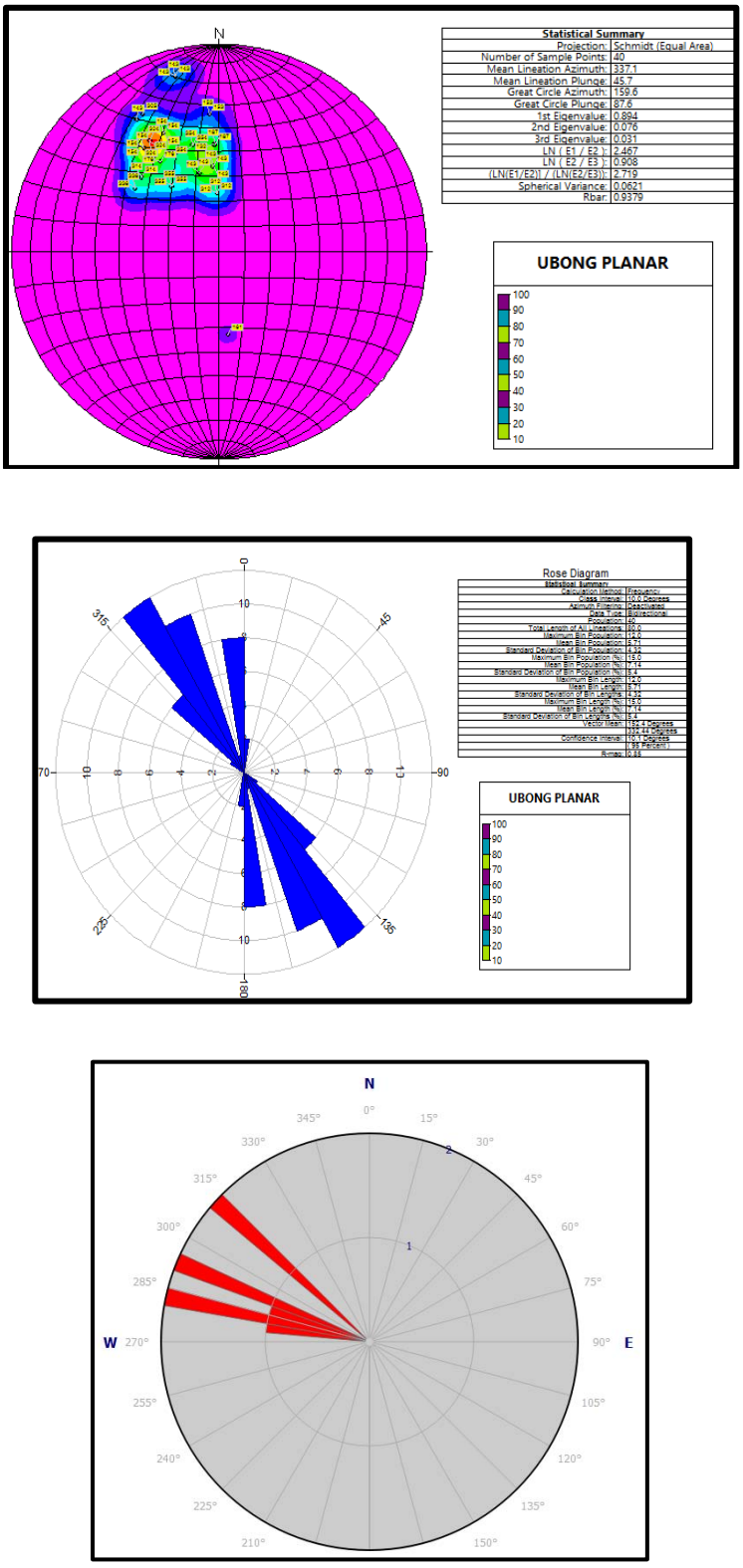
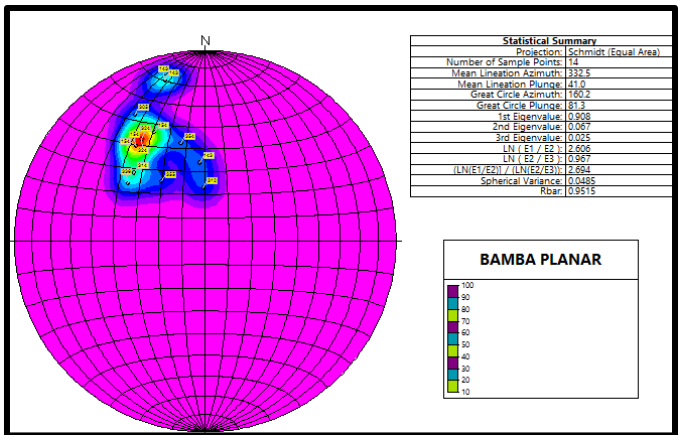
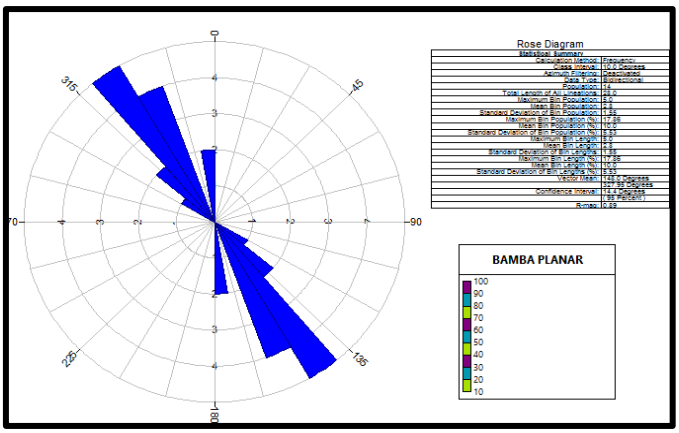


Figure 6: A- Planar Stereonet plot, B- Planar Rose Plot and C- Linear Rosette Plot of the altitudes of Ubong/Olum/Buanchor area Striking NW/SE to N-S and Trending NW/SE

© 2020 Global Journals





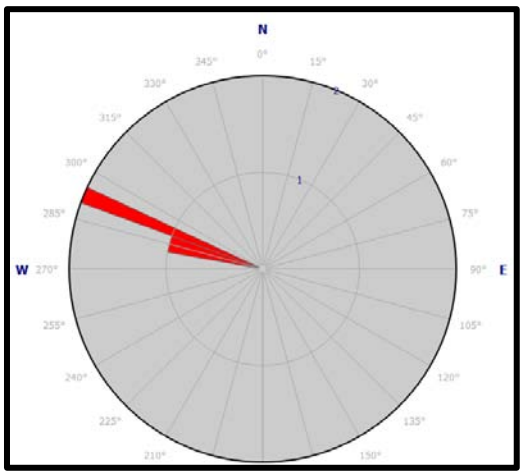


Figure7: A- Planar Stereonet plot, B- Planar Rose Plot and C- Linear Rosette Plot of the attitudes of Bamba area Striking NW/SE to N-S and Trending NW/SE

Table 3: Altitude of structures measured at Kanyang area.

S/N	Strike	DIP	DIP Direction	S/N	Trend	Plunge
1	154	52	54	1	274	38
2	143	76	76	2	280	78
3	324	53	58	3	294	30
4	154	53	65	4	277	70

© 2020 Global Journals

The Digital Elevation Model (DEM) is use Remote Sensing for the determination of characteristics of an area such as highlands and lowlands, slope and intersection density maps (Figs 9-11), while the groudtruth field photographs after the geohazard event is on plate 3, compared with plate 1 before the event (Okeke *et al.* 2019). The slope values range between 0 - 2.8m and 61.224 – 89.725m also displaying aspect of high intensity.

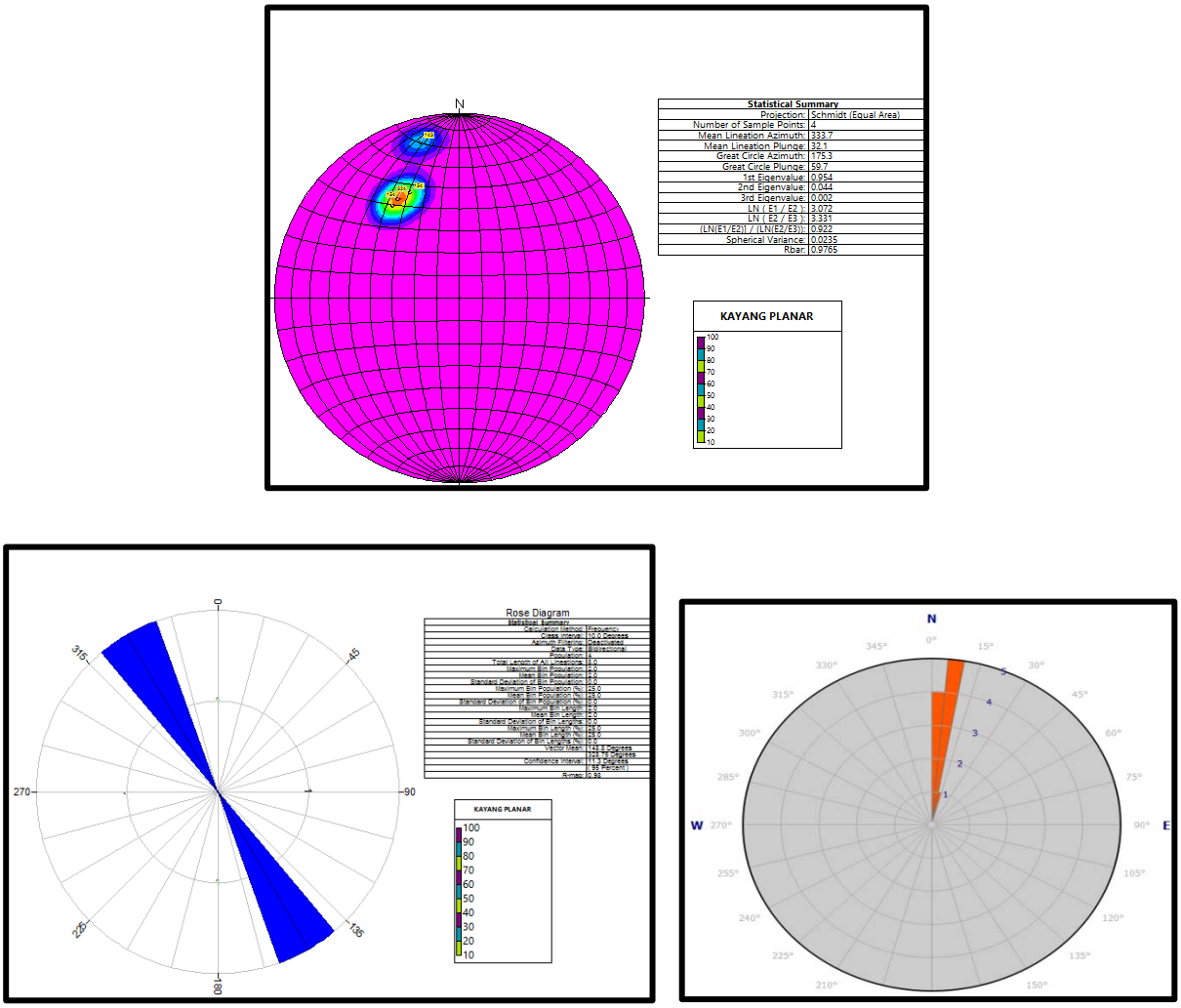


Figure 8: A- Planar Stereonet plot, B- Planar Rose Plot and C- Linear Rosette Plot of the altitudes of Kanyang area Striking NW/SE snd Trending NW/SE.

© 2020 Global Journals

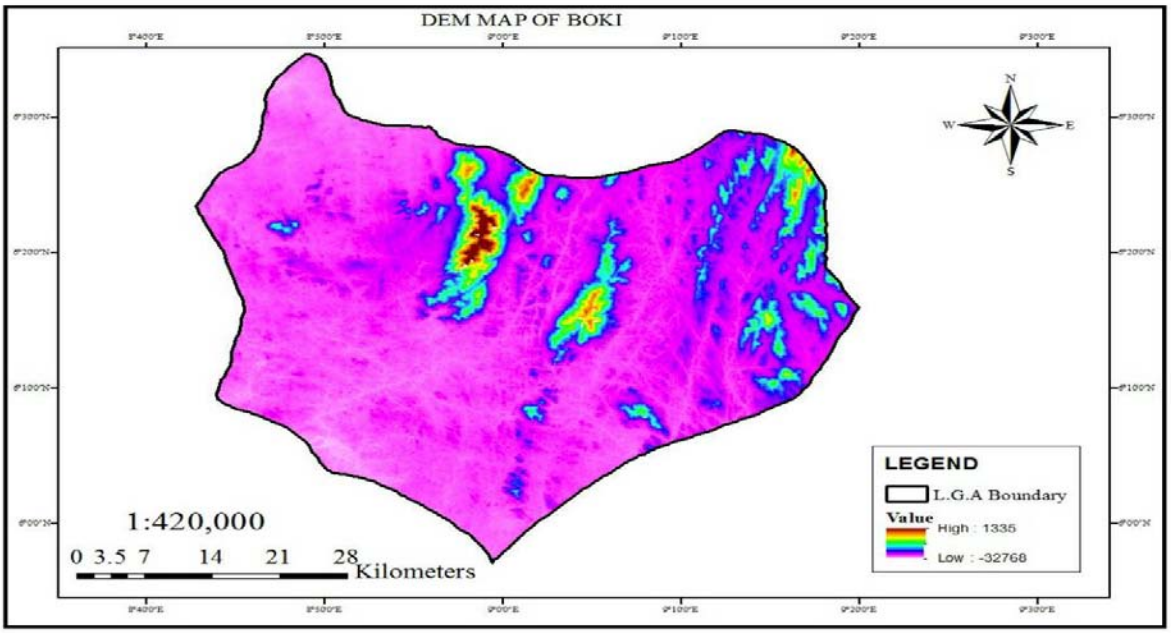


Figure 9: Digital Elevation Model map of Boki, the study area

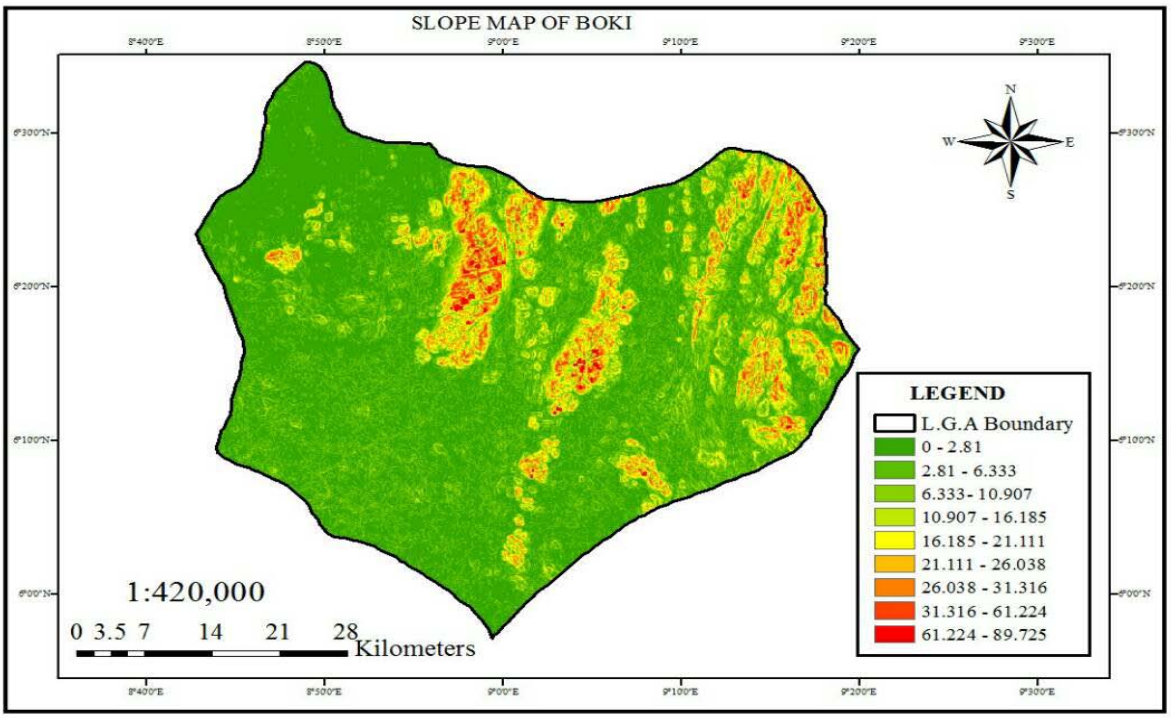


Figure 10: Slope Model of map Boki, the study area

© 2020 Global Journals

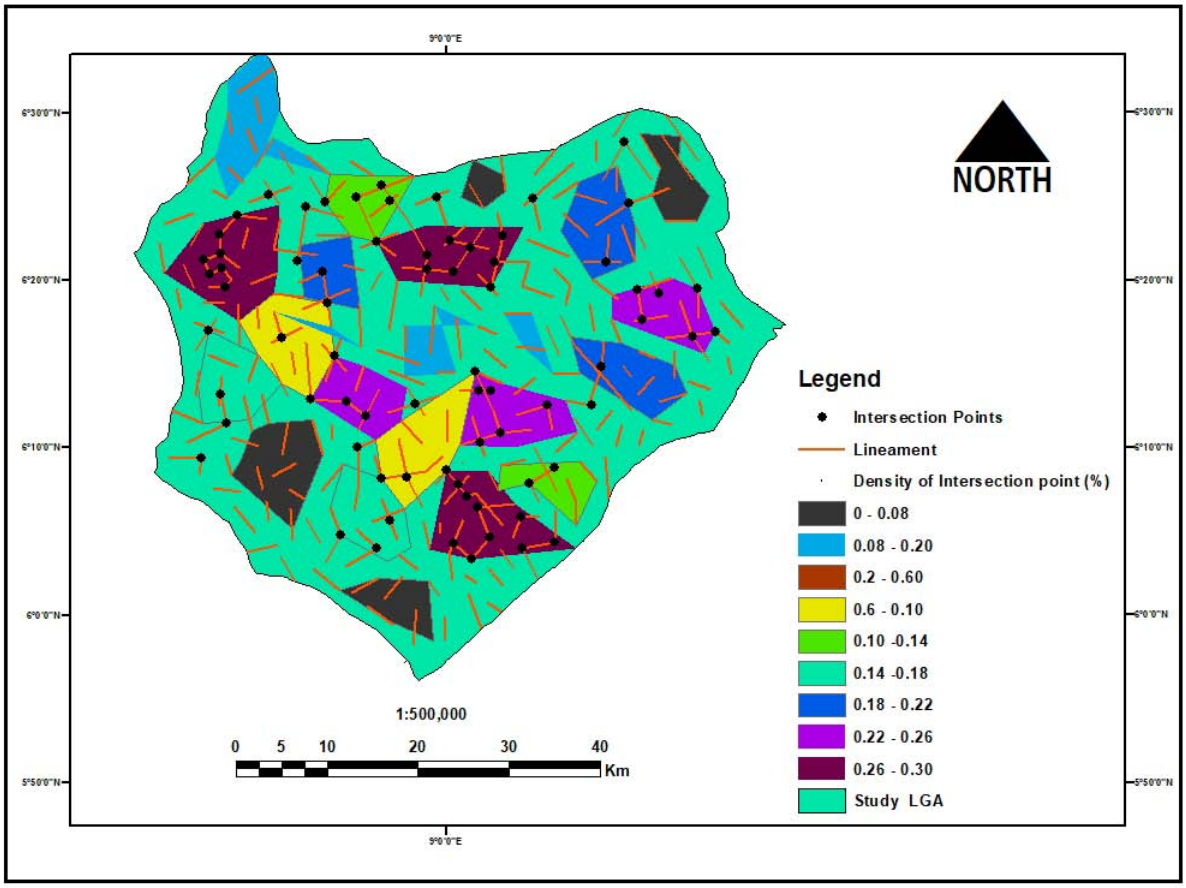


Figure 11: Lineament intersection density map with a search radius of 8 km

Plate 3a: Field photograph near the foot of Buanchor hills after the rockfalls and rockslides

© 2020 Global Journals

Plate 3b: Field photograph showing geosciences students accessing the foot of the highlands flow route of the rockslides about 2km.

Plate 4, is a damaged six class room block of Community Secondary School Buanchor which is about 1km from the foot of the highlands after the rockfalls and rockslides in the area, while plate 5 is the Walkaway part which are usually connected to trees, was also damaged as the trees were equally affected at about 2km from the highlands. The farmlands were also washed off and filled with sands and gravels (plate 6). The methods of controls on any identified slope prone to rockfalls and rockslides or have been affected by such geohazards are protected with rock netting as shown on plate 7.

Plate 4: Field photograph showing what is left of the damaged six classroom block at Community Secondary School Buanchor after the rockslides.

© 2020 Global Journals

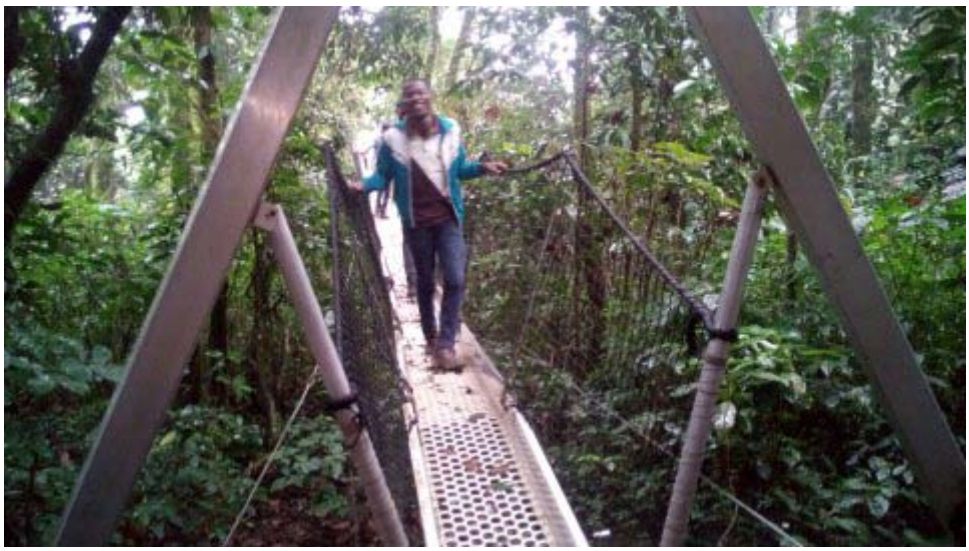


Plate 5: Walkway part before the rockfalls and rockslides at Buanchor

Plate 6: Field photograph of the damage to farmlands and a 400m Walkway at Buanchor

© 2020 Global Journals

Plate 7: Rock netting a method for protecting critical infrastructure like road and human settlements near Obudu Plateau cattle ranch gate

Rockfalls and rockslides are geohazards features, their mapping and analysis can provide valuable information to mitigate or prevent the catastrophic loss and provide guidelines for a sustainable planning and development (Agbebia and Egesi, 2019). In the Northwestern part of Cameroon, the Lake Nyos which is part of the Cameroon Volcanic Line (CVL), about 190 km from Buanchor-Boki area has been identified as active and violent Ebeniro (2012). The lake is located at a height of about 1.34km above mean sea level. It has previously, released large volumes of carbon dioxide CO_2 and other gases into the atmosphere and has capacity to do more. In 1986, the lake activity led to the release of poisonous gases which killed over 1,000 people, about 2000 livestock and numerous wild animals which were uncountable. The Lake Nyos Dam contains CO_2-rich water at this height and has been eroding at a fast rate with more than 600m of its area already eroded off. Presently, less than 35m of the dam is left and evidence of its weakness can be observe as water spews out from different points around the dam that is not the spillway created at the lowest part of the dam.

If the dam collapses or fails it will release several tons of CO_2-rich water from its high elevation through the northeast to the southeast parts of Nigeria in areas like Kumbi, Mbum and Katsina Ala Rivers drainage system and contributes to issues of Climate Change in the region. The resultant effect may cause flooding in all the drainage channels particularly low-lying areas and towns in Cameroon as well as densely populated areas like Katsina Ala and Adikpo in Benue State, Ogoja, Obudu and Boki towns in Cross River State which are about 155km, 150km, 160km and 165km away from Lake Nyos respectively (Ebeniro, 2012). To determine the lithology of the area, geo-electric study of the structure and its Geological implications of lake Nyos indicated a shallow basement at 113m depth, saturated pyroclastic rocks and weathered basement at 110m, with probably 10m thick agglomerate occurring at about 6m depth from the surface. This result is an indication that there is a need to either strengthen the dam at its lowest point to protect it from failure or alternatively to carry out a controlled release of the lake waters to reduce its level and potential strength (Okwueze *et al*., 1995). In Mineral Exploration surveys, lineament density and intersections are pointers to possible mineralization and mostly target for search for minerals (Ashano and Olasehinde, 2010).

Available data indicates Nigeria may not be on any location considered to be at danger of any powerful earthquake (Ebeniro, 2012). However, it can never be ruled out that a much smaller earthquake can cause a lot of damage to the national psyche, as we are close to the Cameroon Volcanic Line (CVL) which is known to be active both onshore and offshore. It is in our interest to identify lineaments and lakes that are hazardous on top of highlands and appropriately advise the government of today at Federal, State, Local and initiate the processes of taking safety first. We should learn from the experiences of other countries rather others using our own experiences to solve their problems, as I witnessed in Cape Town South Africa, during America Association of Petroleum Explorationists AAPG Cape Town 2018 conference, where Nigeria was given as a bad example of oil wealth management and no country wants to copy that type of example.

V. Conclusion

The use of lineaments in geohazard surveys is important and requires ground-truth to ensure accuracy. A personal communication on the reasons for the rockfalls and rockslides from Peter Jekings the Director of the Wildlife Santuary and Walkaway at Buanchor area, Boki Cross River State indicated that one of the major causes or main drivers of the disaster is human farming activities at the base of the hills which exposes the rocks to massive erosion, by the citizens who are primarily farmers. There is need to identify lakes or ponds, establish protected areas and buffer zones in the area and other highlands within the residential areas in

© 2020 Global Journals

Boki, Obalinku and Obudu Local Government Areas. These highlands particularly those with altitude ranges from about 1,050m to 1,650m. This will help reduce the damage that may be cause by such potential geohazards occurrence, will pose threat to human lives and properties and also caves which are wildlife closet during adverse weather conditions.

References Références Referencias

1. Agbebia, M. A. and N. Egesi. 2019. Lineament Analysis and Inference of Geological Structures in Bansara-Boki, Southeastern Nigeria. Pacific Journal of Science and Technology. 20(2): 372-386.
2. Ashano, E.C. Olasehinde, A. 2010. An integrated study of the economic mineral potential of the Ropp complex, North Central Nigeria, Global Jour. of Geological Sciences 8(1): 1-15.
3. Ebeniro, J. O. 2012. "Geophysics, a panacea for National Wealth and Safety". An Inaugural Lecture, Inaugural Lecture Series No.84 p. 33 -47.
4. Edet, A. E., Teme, S. S., Okereke, C. S., Esu, E. O., 1994. Lineament analysis for groundwater exploration in Precambrian Oban Massif and Obudu Plateau, SE Nigeria. Journal of Mining Geology Vol. 30, No.1, pp. 87 – 95.
5. Egesi, N. and Ukaegbu, V. U., 2010. Petrologic and Structural Characteristics of the Basement Units of Bansara Area, southeastern Nigeria. Pacific journal of science and technology (PJST) 11(1):510 – 525. http://www.akamaiuniversity.us/PJST11_1_510.pdf
6. Egesi, N. and Ukaegbu, V. U., 2013. Dimension Stone Exploration and Development in Boki Area SE Nigeria. J. Appl. Sci Environ. Manage. Vol. 17 (3) 343-354.
7. Egesi, N. 2015. Petrology, Structural Geology and Geochemistry of parts of Bansara (Sheet 304) and Mukuru (Sheet 305) SE Nigeria. Unpubd PhD Thesis Univ. of Port Harcourt. p. 256.
8. Ekwueme, B. N. 1987. Structural orientations and Precambrian deformational episodes of Uwet Area, Oban massif, SE Nigeria. Precambrian Res., 34; 269-289.
9. Ekwueme, B. N. 1990. Petrology of Southern Obudu Plateau, Bamenda massif, SE Nigeria. In: G. Rocci and M. Deschamps (Editors), Recent Data in African Earth Sciences. CIFEG (Paris) Occas. Publ. 22. Pp. 155-158.
10. Fèrrè, E., Gleizes, G. and Bouchez, J. 1995. Internal fabric and strike-slip emplacement of the Pan-African granite of Soli Hills, Northern Nigeria. Tectonics, 14: 1205-1219.
11. Fèrrè, E., Deleris, J., Bouchez, J. I., Lar, A. U., Peucat, J. J. 1996. The Pan-African, reactivation of Eburnian and Archaen proinces in Nigeria: structural and isotopic data. Jour. Geol. Soc. London. p.153.
12. Google Earth 2020. Satellite terrain map showing fractures in Bansara and Mukuru area.
13. Ibisate, A., Ollero, A. and Diaz, E. (2011): Influence of catchment processes on fluvial morphology and river habitats. Limnetica. Vol. 30, No.2 pp.169-182.
14. Mouri, G., Shiiba, M., Hori, T. and Oki, T. (2011): Modelling reservoir sedimentation associated With an extreme flood and sediment flux in a mountainous granitoid catchment, Japan. Gemorphology. Vol. 125, Issue 2, pp. 263-270.
15. Nigerian Geological Survey Agency (NGSA). 2010. Nigerian Mining and Geosciences Society (NMGS) Abstract of Conference proceedings.
16. Okeke, C. J., Ukaegbu, V. U., Egesi, N. 2019. Remote sensing signature of geological structures inferred on Landsat imagery of Afikpo area Southeastern Nigeria. Jour. of Geology and Mining Research, Vol. 11(1) pp.1-13.
17. Okwueze, E. E. J. O. Ebeniro and M. Mbogning, 1995. The Geo-electric structure of Lake Nyos dam, Cameroon and its Geologic Implications, Nigerian Journal of Mining and Geology, Vol.30, No.1 p. 1-5.
18. Umeuduji, J. E. 2019. Man, Rivers and Morphological Transformation: Are we safe? An Inaugural Lecture, Inaugural Lecture Series No.155 p. 7 -21.
19. Ukaegbu, V. U. 2003. The Petrology and Geochemistry of Parts of Southern Obudu Plateau, Bamenda massif, Southeastern Nigeria, Unpub. PhD Thesis, University of Port Harcourt Nigeria.

© 2020 Global Journals

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Micropaleontological Analysis of Rocks of Mbakwah and Environs, Gboko, Southeast Nigeria

By Ozioko Obinna Hyginus, Onwuka Solomon Obialo
& Ezugwu Chimankpam Kenneth
University of Nigeria

Abstract- Micropaleontological analyses of rock samples from outcrops and hand-dug wells in Gboko and its environs were carried out to better understand the geology of the area, properly delineate the various lithologies and infer the ages of the rocks. Detailed geologic mapping, micropaleontologic and petrographic methods were applied. Micropaleontological analysis involved washing and viewing of shale samples under microscope for the identification of the microfossils. The area is underlain by black shale inter-bedded with calcareous sandstone and carbonaceous limestone beds. Results of micropaleontological analysis yielded foraminifers and ostracods ranging from Cenomanian to Coniacian. Ovocytherideasymmetrica and Ovocytheridea-reniformisranges from Cenomenian to Coniacian, while Ovocytheri-deaashakaensis and Clithocytheridea-senegaliare indices of Turonian age. Foraminiferal analysis reveals the occurrence of benthic and planktonic index forms including Ammo-baculitesjessensis, Ammobaculitesbenuensis, Whiteinell-abaltica and Heterohelixreussi. The dominant arenaceous benthic foraminifers and the smooth ostracods suggests a shallow marginal marine brackish water environment.

GJSFR-H Classification: *FOR Code: 059999*

MICROPALEONTOLOGICALANALYSISOFROCKSOFMBAKWAHANDENVIRONSGBOKOSOUTHEASTNIGERIA

Strictly as per the compliance and regulations of:

© 2020. Ozioko Obinna Hyginus, Onwuka Solomon Obialo & Ezugwu Chimankpam Kenneth. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Micropaleontological Analysis of Rocks of Mbakwah and Environs, Gboko, Southeast Nigeria

Ozioko Obinna Hyginus [α], Onwuka Solomon Obialo [σ] & Ezugwu Chimankpam Kenneth [ρ]

Abstract- Micropaleontological analyses of rock samples from outcrops and hand-dug wells in Gboko and its environs were carried out to better understand the geology of the area, properly delineate the various lithologies and infer the ages of the rocks. Detailed geologic mapping, micropaleontologic and petrographic methods were applied. Micropaleontological analysis involved washing and viewing of shale samples under microscope for the identification of the microfossils. The area is underlain by black shale inter-bedded with calcareous sandstone and carbonaceous limestone beds. Results of micropaleontological analysis yielded foraminifers and ostracods ranging from Cenomanian to Coniacian. *Ovocytherideasymmetrica* and *Ovocytheridea-reniformis*ranges from *Cenomenian* to Coniacian, while *Ovocytheri-deaashakaensis and Clithocytheridea-senegali*are indices of Turonian age. Foraminiferal analysis reveals the occurrence of benthic and planktonic index forms including *Ammo-baculitesjessensis, Ammobaculitesbenuensis, Whiteinell-abaltica* and *Heterohelixreussi.* The dominant arenaceous benthic foraminifers and the smooth ostracods suggests a shallow marginal marine brackish water environment. From the Shanon-Weiner Information functionfor the foraminifer's species, H(s) value of 1.93163 was gotten and the Equitability of the specimen was calculated to be 0.69. This value implies that the species are not evenly distributed. Results of micropaleotological analysis revealed the presence of index species of foraminifers and ostracods, these showed the rocks are of Turonian age, and belong to the Ezeaku Formation.

I. Introduction

The Benue trough is an elongate intracratonic basin of over 1,000 km long and up to 3000 km at its widest parts. Popoff *et al.* (1991), noted that the Benue Trough is a continental scale intra-plate tectonic mega structure initiated from the Late Jurassic to Early Cretaceous Period which is a part of the mid-African rift system, related to the opening of the Central and South Atlantic Oceans. The major geological study covering the Gboko area still remains the work of Shell-BP geologists. The main stratigraphical units in Southern Benue Trough have been established by the Shell D' Arcy geologists. Many other works (Reyment (1965), Petters (1982), Petters and Ekweozor (1982), Adekeye and Akande (2000; 2002) and Adekeye (2003) have published findings from their work in the southern parts of the Benue Trough. Reyment (1965) described the general geology and stratigraphy of Southeastern Nigeria (southern Benue Trough) in which the study area falls. He attempted a biostratigraphic correlation of the formations of the Southeastern Nigeria sedimentary basin, based on index fossils such as ammonites, foraminifera and pelecypods. Fayose and De Klasz (1976), working on the carbonate/shale sequence of the Eze-Aku Shales, exposed at the Nkalagu limestone quarry in Lower Benue Trough, found abundant species of Heterohelix and Hedbergella suborder and some ostracods such as Brachycythere, Ovocytheridea and Paracypris which gave a Lower Turonian age. Petters (1980) also, used Hedbergellaplanispira; Heterohelixmoremani; Guembelitriaharrisi and Prae-bulimina fang assemblages found in the Nkalagu Formation to assign a Turonian age to the Eze-Aku Shales. This agrees with the Early Turonian ammonite age given by Offodile and Reyment (1976).

a) Regional Stratigraphic Setting

Sensustric to, the lithic fill of the Benue Trough spans from the Lower Cretaceous to the Santonian, (Nwajide, 2013). Reyment (1965) undertook the first detailed study of the stratigraphy of the southern Nigerian sedimentary basins, and he proposed many of the lithostratigraphic units in the region. The lithostratigraphic and biostratigraphic divisions of the Abakaliki region proposed by Reyment (1965) have been revised largely as a result of the detailed research carried out in recent times by researchers, institutions and the oil companies. In his work, Ojoh (1992) gave a more detailed division of the Albian to Santonian sediments.

b) Asu River Group (Albian)

The Asu River Group was deposited in the earliest stages of the basin's formation. Outcropping sediments are found at Ogoja-Abakaliki-Lokpauku, Uturu and Okigwe and turns to Amuri, Nkalagu forming a closure.

Outcrops of the Asu River Group (Abakaliki Formation) are also found in the Mamfe Embayment and the Calabar Flank. According to Reyment (1965), the Asu River Group is associated with marine transgression. The sediments at Ogoja and Abakaliki are arkosic and non-fossiliferous fanglomerates. Ojoh

Author α σ ρ: University of Nigeria, Nsukka.
e-mail: obinnaorogeny@gmail.com

© 2020 Global Journals

(1992) has divided the Group into three formations (Ekebeligwe, Ngbo, and Ibri and Agila Sandstones) ranging from Middle Albian to the Lower Cenomanian. The Ekebeligwe Formation (mid-Albian) was interpreted as deep marine from the presence of mega slumps and turbidites and from the foraminifera and ammonite assemblages found in the formation (Ojoh, 1992), while the Ngbo Formation (Upper Albian) contains more sands than the former and changes from shelf to nearshore environment (regression?)

c) Eze-Aku Group (Cenomanian-Turonian)

Cenomanian sediments within the Abakaliki basin were assigned to the Odukpani Formation consisting of sandstones, shales and limestones of shallow marine shelf environment (Reyment, 1965, Kogbe, 1989). Although some authors think that the Cenomanian is absent in Abakaliki Basin, Nwachukwu (1972) attributes the absence of the Cenomanian to a possibly slight folding phase within this area. Ojoh (1992) established the presence of the Cenomanian in the Abakaliki Basin using pollen and spores. He placed the upper formations (Ibir and Agila Sandstones) in the Lower Cenomanian while the marine shales outcropping at Ezillo originally classified as part of the Eze-Aku Shales was dated upper Cenomanian. The upper members of the Eze-Aku Group are Turonian (Reyment, 1965, Kogbe, 1989). A widespread transgression that occurred during this period deposited black shales with limestone and calcareous sandstones. This was the first transcontinental connection of the Tethys Ocean (present day Mediterranean Sea) with the Atlantic. The Makurdi Sandstones (Nwajide, 1982), Agala Sandstones (Murat, 1972), Konshisha Section, Amaseri Sandstones (Kogbe, 1989) and the Agu-Ojo Sandstones (Ojoh, 1992), are storm deposits laid by a short localised regression that occurred during mid-Turonian period. Renewed transgression laid some limestone deposits on the platforms areas (Nkalagu Limestone). Others include bluish grey shales with limestones and calcareous sandstones. Since there was no break in deposition, some authors classify these later deposits that continued into Coniacian as belonging to the Awgu Group. However, the presence of ammonites in some of these Awgu Group (Coniacian-Santonian)

As mentioned earlier, the Awgu Group is similar to the Ezeaku Group. The shales are believed to be of marine origin considering the limestones contained in some locations. Sediments in the Abakaliki Basin were folded into an anticlinorium during the Santonian deformation thereby causing subsidence in the platforms. Also, there was emplacement of intrusions in some localities, especially in the core of the anticlinorium, by magmatic activity that accompanied this event. Although most authors are of the opinion that there was no deposition during the Santonian, Ojoh (1992) noted that sandstones in Ugep contains fossil assemblages dated Santonian to Lower Campanian. This indicates that, contrary to widely held opinions (Reyment, 1965; Kogbe, 1989), deposition probably occurred during the Santonian in some areas within this basin. The Coniacian stage records the beginning of the regression that culminated in the uplift that ended the first tectonic phase. At the end of the Santonian, deposition in the Abakaliki-Benue Trough ended while deltaic complexes were developed on the Anambra Platform axis units places them in the Turonian Eze-Aku Group.

© 2020 Global Journals

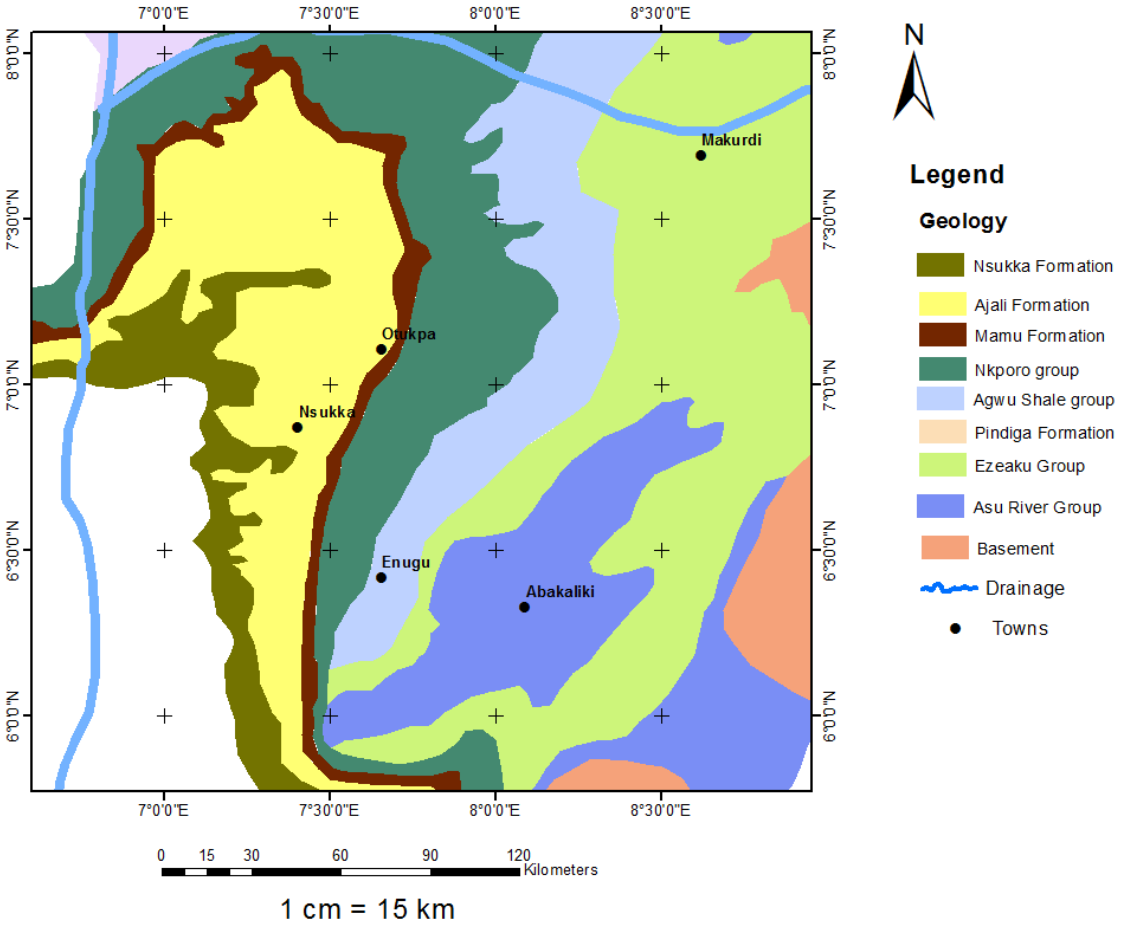


Fig. 1: Regional stratigraphic map of Southeastern Nigeria (after Nwajide, 1990)

© 2020 Global Journals

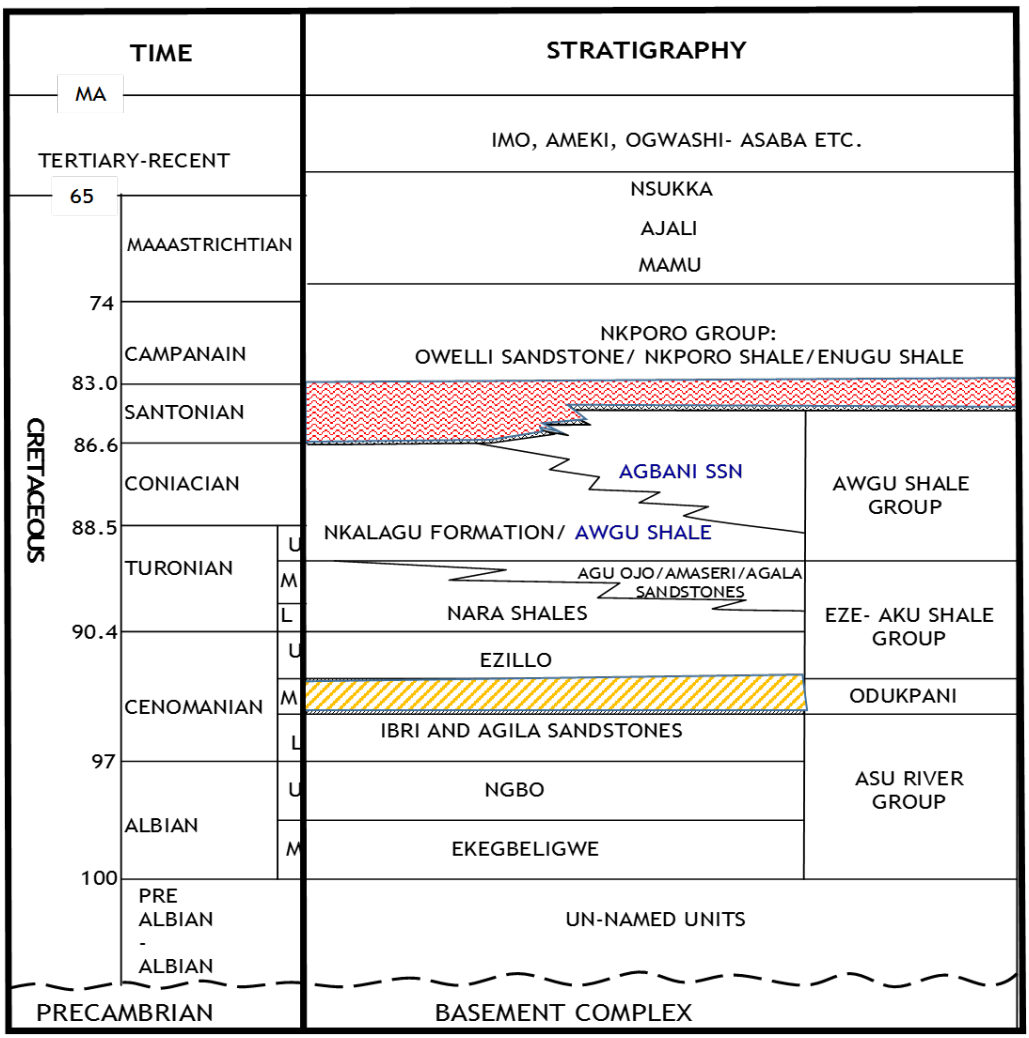


Fig. 2: Summarized stratigraphy of the Benue Trough and Anambra Basin (after Reyment, 1965 and Ojoh, 1992)

II. Materials and Methods

Preliminary reconnaissance studies were carried out in March 2014 and involved visiting the area, getting acquainted with the local traditional rulers and arrangement for accommodation were made. Detailed field work started in November and lasted till December 2014, spanning a total of 21 days. It involved the detailed mapping and description of lithologic units within the area. Instruments used for the field work were the Global Positioning System (GPS), geologic hammer, compass, topographic map, sample bags, hydrochloric acid, digital camera, masking tape, field notebook, and sediment-size description guide. The GPS was used to get the coordinates and elevation of the various locations, and thus locate the outcrop on the map. The compass was used to measure the attitude of the beds and other structures while the sediment-size description guide was used to determine the grain sizes of the sediments.

III. Sampling

Samples were collected with the aid of the geologic hammer, labeled and put into the sample bag. Lithological characteristics of outcrops were described megascopically in the field and recorded in the field notebook. Representative shale samples were collected from hand dug wells and outcrops for micro paleontological analysis. The following procedure and precautions were taken during sample preparation for paleontological analysis. 50grams of each shale sample was measured using a weighing balance, each sample was soaked in beaker containing kerosene and allowed to stand for 24 hours. The dissolved samples was washed in a 63 microns sieve mesh, and shale filtrates were allowed to dry for a day. Dried samples were poured into fossil trays for fossil identification under the paleontological microscope. Fossils were picked using picking brush based on its diagnostic forms and placed in a fossil box for more detailed description. Precautions including rewashing of the sieve mesh after sieving a particular sample, cleaning up the fossil plate and

© 2020 Global Journals

picking brush after each use were taken to avoid contamination of samples.

IV. Measurement of Diversity

This is a statistical attempt to quantify the relationship between the number of individuals and the number of species in an assemblage of fossil or recent organisms. Shannon – Wiener information function H(S) (Shannon *et al*. 1949);this is represented by the formular;

$$H(s) = -\Sigma Pi \ln Pi \quad (1)$$

Where pi is the proportion of individuals found in ith species.

a) Equitability (E)

The equitability 'E' is a parameter related to the information function H (s). It measures the evenness with which species are distributed in a population.

$$\text{Equiitability 'E'} = (e^{H(s)})/ S \quad (2)$$

H(s) – information function

S - Number of species.

V. Results and Discussion

a) Field description

From the results of field studies, the area is chiefly underlain by dark grey to light grey shale mapped in two outcropping sections and in over 40 hand dug wells studied within the area.

At location 3-Mbakwagh, the exposure is about 10m thick and over 150m in lateral extent (fig. 5a). The outcrop is made up of alternation of highly indurated sandstone, limestone and shale. The sandstone in the location is fine, micaceous and highly indurated with wave parallel ripple laminations observed between the contacts of adjacent sandstone beds. The sand beds are calcareous especially close to contacts with the limestone beds. On the other hand, the limestone beds are highly indurated and carbonaceous. The shale is the dominant lithology, it is highly indurated at the base of the exposure but becomes more fissile at the top. The second exposure of the shale unit is along Uerku River at Anhur (fig. 5b). The exposure is about 3m in thickness and about 30m in lateral extent. Here there is about 1m thick shale with a trend of 50NE-230SW.

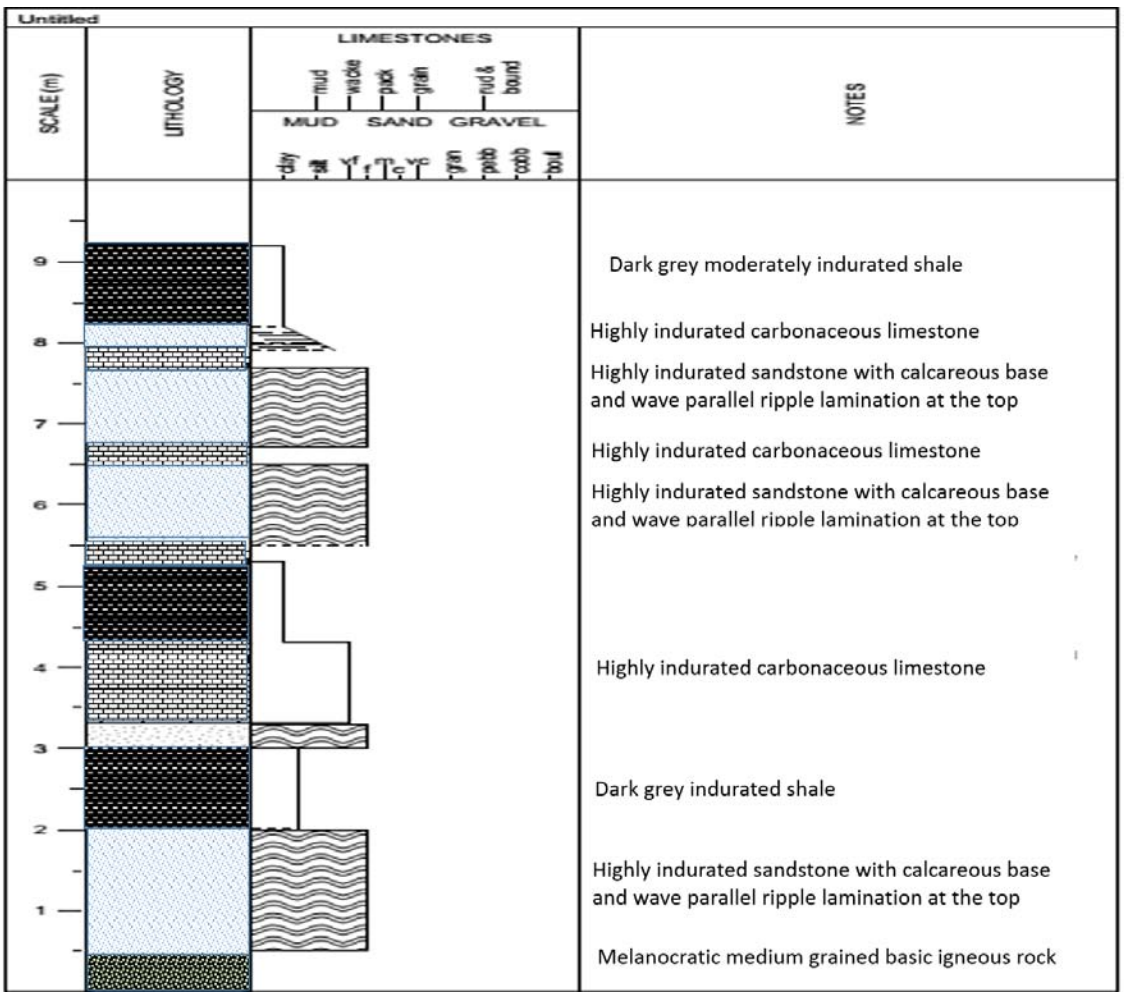


Fig.3: The lithologic log of the outcrop at location 3, (OOH/3/MBAKWAGH)

© 2020 Global Journals

The grey shale unit was also observed in hand dug wells within the study area (fig 5c & d). Over 40 hand dug wells was studied during this field work, all scattered within the map area. The dominant lithology in these hand dug wells is shale but fine micaceous sandstone, limestone and intrusions where also observed in some of the wells. The wells range from a depth of 3m to over 7m with laterite covering between 2-3m of the total depth of the wells.

VI. Hand Dug Well Correlation

From the hand dug wells mapped, certain correlations can be made. Some of the hand dug wells with similar lithologic units encountered were mapped close to one another and hence could be easily correlated.

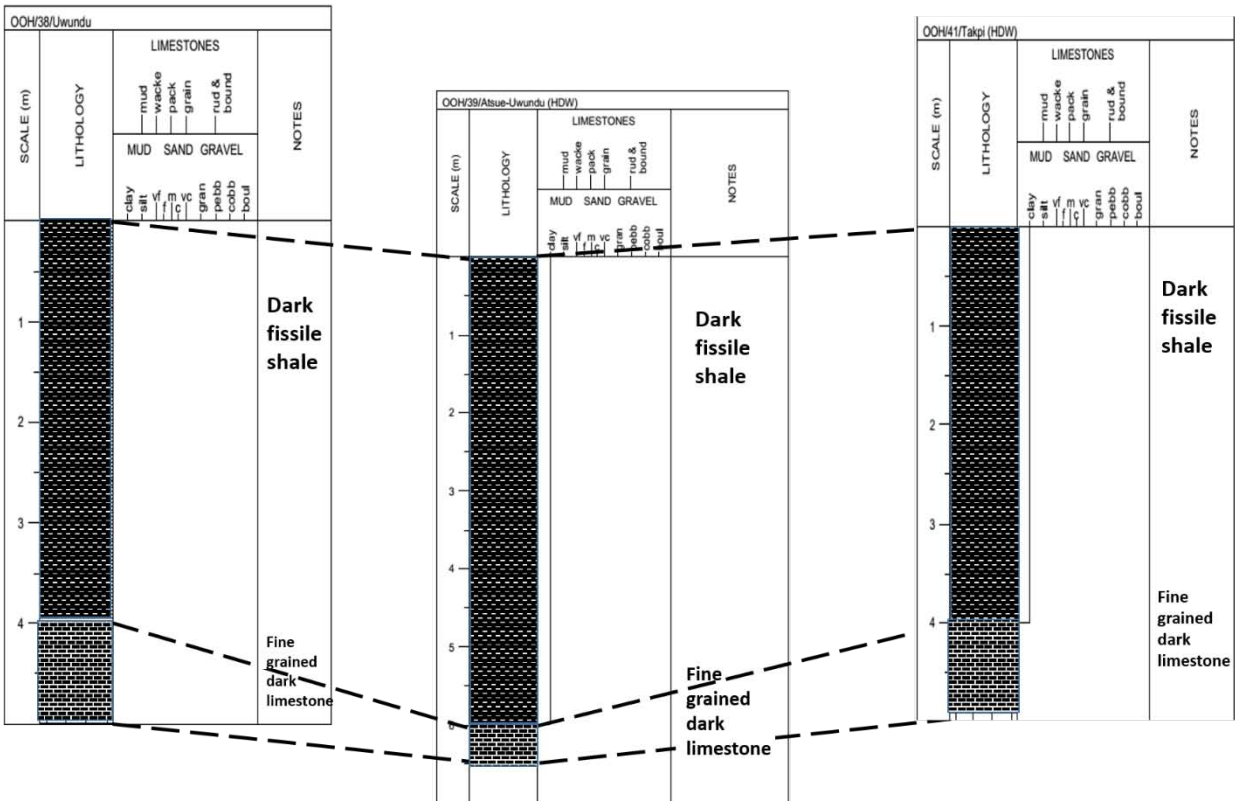


Fig. 4: Correlation of hand-dug wells from location 38-Uwundu, 39-Uwundu and 41-Takpi respectively, showing similarities in their lithologic makeup

© 2020 Global Journals

Fig. 5: A &B shows outcrops along dry river banks. C: a shallow hand-dug well. D: Hand-dug well cuttings. (Scale: Geologic hammer).

© 2020 Global Journals

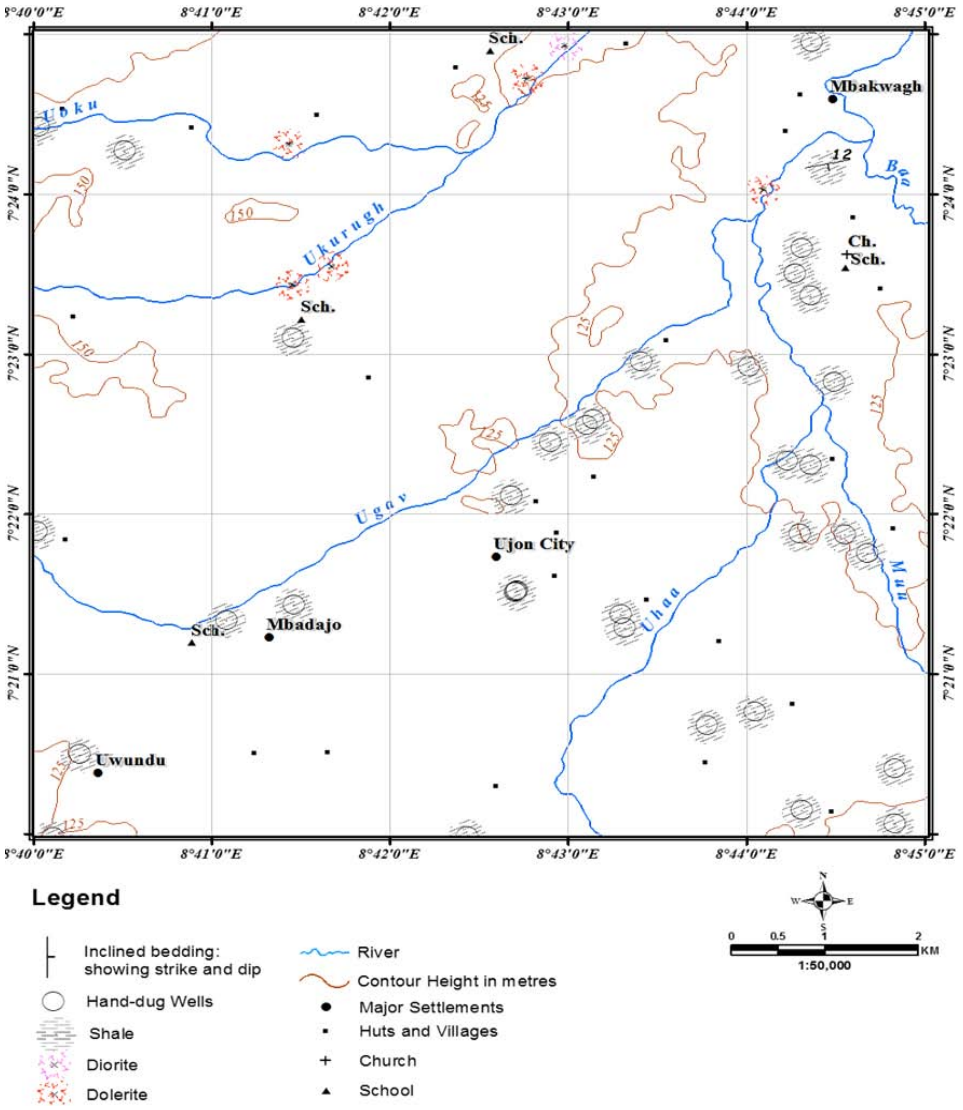


Fig. 6: Outcrop map of the study area

© 2020 Global Journals

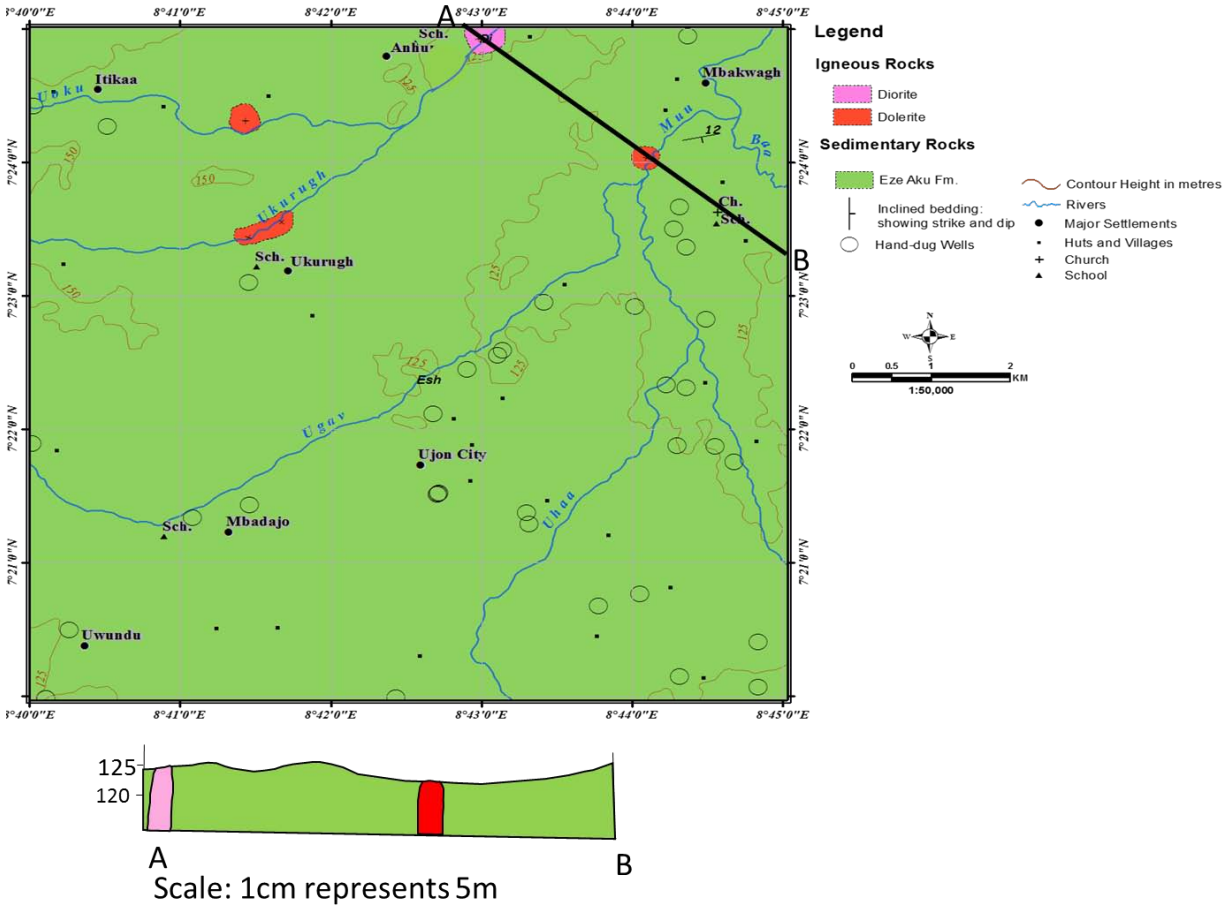


Fig. 7: Geologic map and cross section.

VII. Micropaleontology

A total of ten shale samples were analyzed, out of which four of the samples were fossiliferous. Samples from OH/14 and OH/35 were rich in planktonic foraminifers', OH/18 yielded dominantly benthic species while the fourth (OH/12) yielded exclusively ostracods. Four ostracod species recovered (Table 1) include; *Ovocytherideasymmetrica* (Reyment 1960), *Ovocytherideareniformis*(Bold 1964), *Clithrocytherideasenegali Apostolescu*and *Ovocytheridea Ashakaensis* (Okosun 1992). Benthic species (Table 2) include; *Ammobaculitesbenuensis* (Peters 1982), *Ammobiculitesbauchensis* (Peters 1982), *Ammotium Bornum* (Peters 1982). The planktonic species (Table 3) include; *Whiteinellabaltica* (Douglas and Rankin, 1969), *Heterohelixreussi* (Cushman, 1938), *Heterohelixmoremani* (Cushman1938), *Hedbergella cf. delrioensis* (Carsey, 1926). 1982), *Ammobiculitescoprolithiformis* (Schwager 1868), Ammobaculitesamabensis (Peters 1982).

© 2020 Global Journals

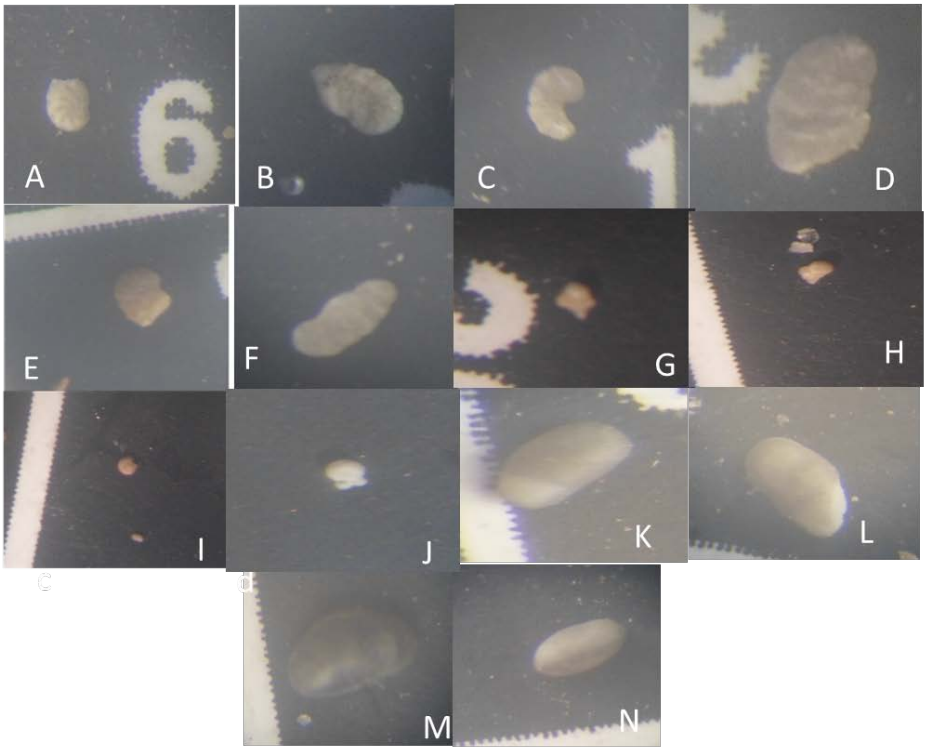


Fig. 8: A: Ammobacullites. Jensiensis, B: Ammobaculitesbenuensis C: Ammotiumcfnwalium D: Ammotium Nkalagum E: Ammobiculitesbauchensis:F: Ammobiculitescoprolithiformis G: Heterohelixmoremani I: Whiteinellabaltica H: Heterohelixreussil: J: Hedbergella cf. delrioensis K: Clithrocytherideasenegali Apostolescu L: Ovocytheridea. Ashankaensis M: Ovocytheriddeareniformis N: Ovocytherideasymmetrica

Table 1: Result of micropaleontological analysis of ostracods

S/N	Location	Species Count	Scientific Name
1	OH/12 from black shale sample at location 12.	4	Ovocytherideasymmetrica (Reyment 1960)
2	OH/12 from black shale sample at location 12	7	*Ovocytheridеareniformis* (Bold 1964)
3	OH/12 from black shale sample at location 12	3	*ClithrocytherideasenegaliApostolescu*
4	OH/12 from black shale sample at location 12	1	*OvocytherideaAshakaensis* (Okosun 1992)

Table 2: Result of micropaleontological analysis of benthic foraminifera

S/N	Location	Species Count	Scientific Name
1	OOH/18 from black shale sample at location 18	18	*Ammobaculitesbenuensis*(Peters 1982)
2	OOH/18 from black shale sample at location 18	12	*Ammobiculitesbauchensis* (Peters 1982)
3	OOH/18 from black shale sample at location 18	7	AmmotiumBornum(Peters 1982)
4	OOH/18 from black shale sample at location 18	15	*Ammobiculitescoprolithiformis* (Schwager 1868)
5	OOH/18 from black shale sample at location 18	8	Ammobaculitesamabensis(Peters 1982)

© 2020 Global Journals

Table 3: Result of micropaleontological analysis of planktonic foraminifera

S/N	Location	Species Count	Scientific Name
1	OH/14 from dark grey shale sample at location 14	2	Whiteinellabaltica (Douglas and Rankin 1969)
2	OH/14 from dark grey shale sample at location 14	3	Heterohelixreussi (Cushman 1938)
3	OH/14 from dark grey shale sample at location 14	1	*Heterohelixmoremani (Cushman1938)*
4	OH/35 from dark grey shale sample at location 35	3	*Hedbergella cf. delrioensis (Carcey)*

VIII. Depositional Environment

The study area is predominantly underlain by shale. The shale is dark grey, fissile and calcareous at contacts with limestone. The shale is interbeded with carbonaceous limestone and fine, micaceous sandstone beds as exposed along Baa River.

The depositional environment of the sedimentary rock in the study area is inferred based on the rock type (dark grey shale) and presence of ostracods and foraminifera recovered from the shale samples. The alternation of shale and limestone and sandstone beds can be associated with sea level fluctuation due to intermittent sea level fluctuation (Opeloye, 2009). The predominance of sandstone units, calcareous sandstone, massive beddings and cross-stratification suggest deposition in a shallow marine environment during transgressive/regressive phases in Turonian times (Ukaegbu et al., 2009).

The presence of dark grey shale indicates deposition under low energy in a reducing environment (absence of oxygen) condition which prevents complete decomposition of fossils (Oertli, 1971).

The dominant arenaceous benthic foraminifers and the smooth ostracods suggest a mainly shallow marginal marine brackish water environment with an increase in water depth represented by horizons with planktonic foraminifers (Saka, 2012). The abundance of the different forms of Ammobaculites are related to their successful exploitation of the environment as detritivores. Species of Ammotium are also typical of brackish habitats below 10m depth (Murray, 1991).

The dark colour of some of the ostracod carapace is indicative of some degree of pyratization. Pyrite is an early diagenetic mineral that forms when the overlying sediments is being deposited. The pyritization of the ostracods probably took place shortly after death when individuals were buried a few millimeters of centimeters below the surface, where reducing conditions prevented the complete decomposition of the organic matter (Oertli, 1971). Due to the high amount of pyrite formed, it probably replaced the calcite that originally formed the test, which gave some of the tests their black coloration.

Foraminiferal analysis reveals the occurrence of benthic and planktonic index forms. These forms are Ammobaculitesjessensis, Ammobaculitesbenuensis, Whiteinellabaltica and Heterohelixreussi. The above fossil assemblage points to a Turonian age for the study area. Similar assemblage was also used to assign a Turonian-coniacian age to the New Netim Formation, Calabar Flank, Nigeria (Bassey et al, 2012). This is also in line with the assertions of both Petters (1982) and Gebhardt (1997) on the ages of other marine formations in the Northern Benue Trough. The age range of the ostracods is Cenomanian to Coniacian (Fig.9) *Ovocytherideasymmetrica and Ovocytheridearenii-formis ranges from Cenomenian to Coniacian. Ovocytherideaashakaensis and Clithocytherideasenegali are indices of Turonian age.* (Saka, 2012).

© 2020 Global Journals

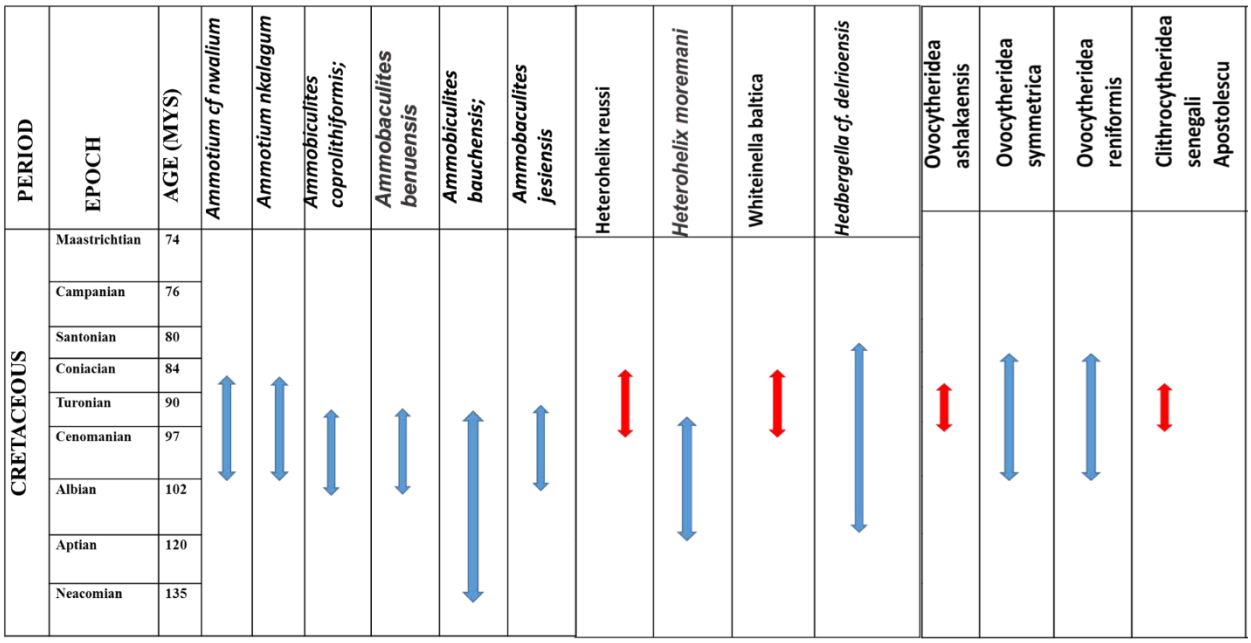


Fig. 9: Biostratigraphic range chart of the study area

IX. Measurement of Diversity

This is a statistical attempt to quantify the relationship between the number of individuals and the number of species in an assemblage of fossil or recent organisms. The results of Shannon-Wienner information function H(S) is presented in table 4.Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon index increases as both the richness and the evenness of the community increases. From the Shanon-Weiner Information function for the foraminifer's species, H(s) value of 1.93163 was gotten and the Equitability of the specimen was calculated to be 0.69. This value implies that the species are not evenly distributed (Magurran, 2004). This is evident in the greater abundance of benthics than the planktonics. This also agrees with the earlier assertion that the environment of deposition of the shale is typical shallow marine environment.

Table 4: Calculated H(S) for foraminifera assemblage from location 18-Mbakwagh

s/n	Species	frequency	Pi	lnpi	Pi lnPi
1	*Ammotiumcfnwalium*	12	0.139535	-1.96944	-0.27481
2	*Ammotiumnkalagum*	14	0.162791	-1.81529	-0.29551
3	*Ammobaculitescoprolithiformis*	8	0.093023	-2.37491	-0.22092
4	*Ammabaculitesbenuensis*	22	0.255814	-1.3633	-0.34875
5	*Ammobaculitesbauchiensis*	18	0.209302	-1.56398	-0.32734
6	*Ammobaculitesjesiensis*	6	0.069767	-2.66259	-0.18576
7	*Heterohelixreussi*	2	0.023256	-3.7612	-0.08747
8	*Heterohelixmoremani*	1	0.011628	-4.45435	-0.05179
9	*Whiteinellabaltica*	2	0.023256	-3.7612	-0.08747
10	*Hedbergelacfdelrioensis*	1	0.011628	-4.45435	-0.05179
	Total	86		Σ	-1.93163

X. Conclusion

The area is underlain by predominantly shale with sandstone and limestone interbeds, The shale unit is generally black to dark grey, fissile and moderately indurated. Based on field and laboratory analysis, the rock belongs to the Turonian Ezeaku Formation. The foraminifera and ostracod species recovered from the shale were used to decipher the environment of deposition and age of the formation. Ostracod specmies including *Ovocytherideasymmetrica* and *Ovocytheri-deareniformis*ranges from *Cenomenian* to Coniacian. *Ovocytherideaashakaensis* and *Clithocy-therideasenegali*are of Turonian age. Foraminiferal species includes benthic and planktonic index forms. These forms are *Ammobaculitesjessensis, Ammoba-culitesbenuensis, Whiteinellabaltica* and *Hetero-helixreussi*. The above fossil assemblage indicates a Turonian age for the study area. The abundance of are naceousbenthics as well as smooth ostracods in the

© 2020 Global Journals

shale indicates a dominantly brackish shoreline environment.

References Références Referencias

1. Adekeye, O. A. and Akande, S. O., 2000.Albian (Asu River Group) sediments exposed at Yandev, Middle Benue Trough Palaeoenvironments and Hydrocarbon Potential Evaluation. 36th Annual Conference, Nigerian Mining and Geosciences Society,Enugu. Book of Abstracts, 21pages.
2. Adekeye, O. A., 2003. Qualitative Analyses and Paleoecological Interpretation of Foraminifera Fauna from the AlbianAsu River Group exposed around Yandev Nigeria. Journal of Mining and Geology, volume 39, number 2, pages 103 -108.
3. Bassey E .D, Nse U. E., 2012.Age and Paleoecology of the New Netim Formation Calabar Flank, South Eastern Nigeria.International Journal of Engineering & Technology, volume 12, pages1-19.
4. Carsey, D. O., 1926. Foraminifera of the Cretaceous of central Texas. Texas, University Bulletin, number 2612, pages 1-56.
5. Cushman, J.A., 1938. The future of paleontology. Geology society of America bulletin. Volume 49, pages 359-366.
6. Douglas, R. G., and Rankin, C., 1969. Cretaceous planktonic foraminifera from Bornholm and their zoogeographic significance: Lethaia, volume 2, pages 185-217
7. Fayose E.A and De Klasz, I. (1976). Microfossils of the Ezeaku Formation (Turonian) at Nkalagu quarry Eastern Nigeria. Npgeria Journal. M. Geol. 13:51-61.
8. Gebhardt, H., 1997. Cenomanian to Turonian foraminifera from Ashaka (NE Nigeria): quantitative analysis and palaeoenvironmental interpretation. *Cretaceous Research* volume18, pages 17–36.
9. Kogbe, C.A., 1989. Paleogeographic history of Nigeria from Albian times. *In* Kogbe, C.A. (*ed*.), Geology of Nigeria. Elizabethan Publishers, Lagos, pages 257-275.
10. Murat, R.C., 1972. Stratigraphy and Paleo-Geography of the Cretaceous and Lower Tertiary in Southern Nigeria. African Geology, Ibadan University Press, pages 251-276.
11. Murray, J. W., 1991. Ecology and paleoecology of benthic foraminifera: Longman Science and Technology. New York. 397pages.
12. Nwachukwu, S.O., 1972. The Tectonic Evolution of the Southern Portion of the Benue trough. Geological Magazine, volume 109, pages 411-419.
13. Nwajide C. s., 2013. Geology of Nigeria's sedimentary basins. CSS publishers limited, Lagos. Pages 565.
14. Nwajide, C.S., 1982. Geology of the Makurdi Formation. Unpublished PhD Thesis, University of Nigeria, 310 pages.
15. Nwajide, C.S., 1990.Cretaceous Sedimentation and Geography of the Central Benue Trough. *In:*Ofoegbu, C.O. (*ed)*. The Benue Trough Structure and Earth Evolution Series. Germany, pages 77-91.
16. Obiora S.C. and Umeji A.C., 2004. Petrographic evidence for regional burial metamorphism of the sedimentary rocks in the Lower Benue rift. Journal of African Earth Sciences.volume38, pages 269–277.
17. Obiora, S.C. and Charan, N. S., 2011. Tectonomagmatic Origin of Some Volcanic and Sub-Volcanic Rocks from the Lower Benue Rift, Nigeria. Chin.J.Geochem, volume 30, pages 507–522.
18. Oertli, H.J., 1971. The aspect of Ostracods Faunas: A possible new tool in petroleum sedimentology. *Centre for Research Bullettin*. volume5, pages 137-151.
19. Offodile, M. E. &Reyment, R. A. 1976. Stratigraphy of the Keana-Awe area of the middle Benue region of Nigeria. Bulletin of the Geological Institutions of the University of Uppsala, New Series 7, 37–66.
20. Ojoh, K.A., 1992. Southern part of the Benue Trough (Nigeria) Cretaceous Stratigraphy, Basin Analysis, Palaeo-oceanography and Geodynamic Evolution in the Equatorial domain of the South Atlantic. NAPE Bulletin, volume 2.
21. Okosun, E.A., 1992. Cretaceous Ostracods Biostratigraphy from Chad Basin in Nigeria, *Journal of African. Earth Science*. volume14, pages 327-339.
22. Peters, S. W., 1982. Central West African Cretaceous Tertiary benthic foraminifera and stratigraphy. *Palaeontographica. Volume* 179, pages1 -104.
23. Peters, S.W and Ekweozor, C.M., 1982. Petroleum Geology of Benue Trough and Southeastern Chad Basin. AAPG Bulletin, Volume 66, Number 8, pages 1141-1149.
24. Peters, S.W., 1978. Stratigraphic Evolution of the Benue Trough and its Implications for the Upper Cretaceous Paleogeography of West Africa. *Journal of Geology*, volume. 86, pages 311-322.
25. Peters, S.W., 1980. Biostratigraphy of Upper Cretaceous Foraminifera of the Benue Trough, Nigeria. Journal. Forams, Research. Volume 10, pages 191 – 204.
26. Popoff, M., 1991. The Mesozoic to Early Cenozoic Magmatism of the Benue Trough (Nigeria); Geochemical Evidence for the involvement of the St Helena Plume. Journal of petrology, Volume 37, pages1341-1358.
27. Reyment, R. A., 1960. Studies on Nigerian upper cretaceous and lower Tertiary ostracods. Actauniversitatis Stockhomeienses, Stockhomes. Contributions in Geology volume 7, pages 1-239.

© 2020 Global Journals

28. Reyment, R.A., 1965. Aspects of the Geology of Nigeria. University of Ibadan press, 145pages.
29. Saka A. O., 2012. Microfossils and Paleo-environment of the Numanha Shale of the Upper Benue Trough, Northeastern Nigeria. Journal of Mining and Geology, Volume 48, pages 167–175.
30. Schwager, C., 1868.Fosile Foraminifera von karNikobar, Reise der Oestereischan Fregatte Novara um Erde. Palaeontologische Mittheilung, volume 2, pages 187-268.
31. Shell BP 1957. Geological maps, 1:250,000 Sheets; (63); Enugu Makurdi (64); Ankpa (72); Ogoja (73); Umuahia (79); Oban Hills (80). Calabar (85). *GeologicalSurvey of Nigeria.*
32. Umeji, O.P., 1985. Subtidal Shelf Sediments: An Example from the Turonian Eze-aku Formation in Nkalagu Area, Southeastern Nigeria. Nig. Journal of Mining and Geology vol. 22, Nos.1&2, Pages 119-123.
33. Van den Bold, W. A., 1964. Ostracodenaus der Oberkreide von Abu Rawash, Agypten. Palaeonto-graphica A 123, 111–136.
34. Whiteman, A., 1982. Nigeria: its petroleum geology, resources and potential. Graham & Trotman Limited., volume 1, pages 114-131.
35. Ukaegbu V.U &Akpabio I.O. 2009. Geology and Stratigraphy of Middle Cretaceous Sequences Northeast of Afikpo Basin, Lower Benue Trough, Nigeria.The Pacific Journal of Science and Technology10(1):518-527.
36. Shannon, C.E. & Weaver, W., 1949.The mathematical theory of communication. The University.
37. Magurran, A.E. 2004. Meausuring Biological Diversity. Blackwell.

© 2020 Global Journals

Global Journals Guidelines Handbook 2020

www.GlobalJournals.org

Memberships

Fellows/Associates of Science Frontier Research Council

FSFRC/ASFRC Memberships

Introduction

FSFRC/ASFRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSFRC/ASFRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSFRC

Fellow of Science Frontier Research Council

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefit

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FSFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FSFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSFRC or William Walldroff, M.S., FSFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FSFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

© Copyright by Global Journals | Guidelines Handbook

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example,
john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows and associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career | Credibility | Exclusive | Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A ASFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The “ASFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ASFRC or William Walldroff, M.S., ASFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Associate members of ASFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All associates get a dedicated page on the website with their biography.

Career | Credibility | Reputation

© Copyright by Global Journals | Guidelines Handbook

Future Work

Get discounts on the future publications

Associates receive discounts on the future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Associates get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example,
john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to almost all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

© Copyright by Global Journals | Guidelines Handbook

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

© Copyright by Global Journals | Guidelines Handbook

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

Allegiance · 3
Amphibolites · 42
Anthropocentric · 6, 7
Assemblage · 63, 70, 71, 72

C

Catastrophic · 42, 57
Collapses · 57
Culitesbenuensis · 72

D

Defluoridation · 21
Delineate · 59

E

Evocative · 3

F

Flocculation · 23, 27

M

Materialistic · 2, 4

O

Ostracod · 67, 70, 71

S

Spiritualistic · 1, 2, 4, 6

U

Unveil · 48

V

Virulent · 31

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896

© Global Journals