

## CURRICULUM VITAE

- I (a) Name: Emmanuel Fartiyahcha Nymphas  
(b) Date of birth: 13 September, 1965  
(c) Department: Physics  
(d) Faculty: Science
- II (a) First Academic Appointment: Assistant lecturer, (30 June, 2000)  
(b) Present Post (with date): Senior Lecturer, (1 October, 2010)  
(c) Date of Last Promotion: 1 October, 2010  
(d) Date last considered (in cases where promotion was not through): Not Applicable
- III University Education (with dates):  
(a) University of Maiduguri, Maiduguri 1984 – 1988  
(b) University of Ibadan, Ibadan 1992 – 1995  
(c) University of Ibadan, Ibadan 1996 - 2001
- IV Academic Qualifications (with dates and granting bodies):  
(a) B.Sc (Physics), University of Maiduguri 1988  
(b) M.Sc (Physics), University of Ibadan 1995  
(c) PhD (Physics), University of Ibadan 2001
- V Professional Qualifications and Diplomas (with dates): Nil
- VI Scholarships, Fellowships and Prizes (with dates) in respect of undergraduate and postgraduate work only:  
(a) Adamawa State Scholarship award 1984-1988  
(b) Senate Research Grant by the University of Ibadan 2006  
(c) Post Doctoral Fellowship, University of Fort Hare, South Africa 2007-2008
- VII Honours, Distinctions and Membership of Learned Societies:  
Member, Nigerian Institute of Physics  
(a) Member, Science Teachers Association of Nigeria  
(b) Member, Nigeria Meteorological Society
- VIII Details of Teaching/Working Experience:  
(a) Working Experience  
(i) Assistant lecturer University of Agriculture Abeokuta, Nigeria 1998-2000  
(ii) Assistant lecturer University of Ibadan, Ibadan, Nigeria 2000- 2003  
(iv) Lecturer II University of Ibadan, Ibadan, Nigeria 2003-2006

(v) Lecturer I	University of Ibadan, Ibadan, Nigeria	2006-2010
(vi) Senior Lecturer	University of Ibadan, Ibadan, Nigeria	2010-date

Teaching Experience:

Undergraduate

- (i) PHY 103: Introductory Heat and Thermodynamics (2016-2019) (taught with another lecturer)
- (ii) PHY 113: Basic principle of Physics IV (2011-2015) (taught with another lecturer)
- (iii) PHY 115: Basic principles of Physics II (2014-2016) (taught with another lecturer)
- (iv) PHY 118: Experimental Physics I (2015-date)(taught with thirteen other lecturers)
- (v) PHY 201: Classical Physics I (2005-2006)(taught alone)
- (vi) PHY 271: Physics for Biology I (2000-2003) (taught alone)
- (vii) PHY 272: Physics for Biology II (2009-2012)(taught alone)
- (viii) PHY 298: Experimental Physics I (2005-2010)(taught with two other lecturers)
- (ix) PHY299: Experimental Physics II (2005-2010) (taught with two other lecturers)
- (x) PHY 311: Mathematical Methods I (2015-date)(taught alone)
- (xi) PHY 312: Mathematical Methods II (2000-2003)(taught alone)
- (xii) PHY 309: Acoustics (2009-2015)(taught alone)
- (xiii) PHY 398: Experimental Physics I (2014-2015)(taught with another lecturer)
- (xiv) PHY 399: Experimental Physics II (2014-2015)(taught with another lecturer)
- (xv) PHY 405: Principles of Quantum Physics(2005-2006)(taught alone)
- (xvi) PHY 406: Classical Mechanics IV(2008-2009)(taught alone)
- (xvii) PHY 407: Solid State Physics II (2021-date) (taught with another lecturer)
- (xviii) PHY 483: Physical Principles of Meteorology (2009-2018) (taught alone)
- (xix) PHY 485: Atmospheric Electricity (2002-2005, 2018-date) (taught alone)
- (xx) PHY 499: Undergraduate Project (2001- date)(taught alone)

Courses taught at Federal University of Agriculture, Abeokuta

- (i) PHS 352: Quantum Physics (1999-2000)(taught alone)
- (ii) PHS 451: Nuclear Physics (1999-2000)(taught alone)
- (iii) PHS 364: Energy and Environment(1999-2000)(taught alone)

Courses taught at University of Fort Hare, South Africa

- (i) Advance Electromagnetism (2007-2008)(taught alone)
- (ii) Electricity and Magnetism (2007-2008)(taught alone)
- (iii) Mechanics of Particles (2007-2008)(taught alone)
- (iv) Mathematical Methods and Statistical Mechanics (2007-2008)(taught alone)

## Postgraduate Courses

- (i) PHY 737: Physical Meteorology I(2003-2005; 2016-date)(taught alone)
- (ii) PHY 741: Physical Meteorology II (2003-2005)(taught alone)
- (iii) PHY 735: Electrical processes in the Fair Weather Atmosphere (2005-2006)  
(taught alone)
- (iv) PHY 736: Atmospheric Electricity in Disturbed Weather (2012-2013)(taught alone)
- (v) PHY 704: Basic Fluid Dynamics (2010-2012, 2015-date)(taught alone)
- (vi) PHY 701: Electromagnetic Theory (2021-date)(taught with another lecturer)
- (vii) PHY 745: Radioactivity in the Atmosphere (2008-2009)(taught alone)
- (viii) PHY 761:Laboratory and Field Experiments in Meteorology (2016-date) (taught with three other Lecturers)

## (b) Research Supervision

### Completed:

- B. Sc – 25
- M. Sc - 22
- PhD – 1

### Ongoing:

- B. Sc – 3
- M. Sc – 7
- PhD - 5

## (c) Administrative Responsibilities:

- (i) Postgraduate coordinator 2002 – 2007, 2018-2020
- (ii) Member, Faculty of Science Board of Studies 2004 – 2007
- (iii) Member Finance Committee of Zoological Garden 2011 – 2012
- (iv) Faculty Representative, Farm Management Board 2019 – date
- (v) Congregation representative in senate, 2005 – 2006, 2019-2020
- (vi) Faculty Appointment and Promotion Panel 2017-2018

## (d) Community Service

- (i) National Institute of Physics (NIP) Local organizing committee (LOC) member and Chairman Technical Session 2012
- (ii) PhD Post-Field Examination, Pan African University 2019

## IX Research

### (a) Completed:

- (i) Investigation of the behaviour of lightning rods under tropical thunderclouds and the utilization of lightning signatures in Agriculture for Nigeria.

- (ii) Quantification of the parameters of surface energy balance equation for tropical environments.
- (iii) Study of the perturbation of surface energy fluxes and meteorological parameters under different conditions.
- (iv) Study of the variability of E and F region of the ionosphere in the tropical region
- (v) Determination of rain attenuation of radio wave propagation in a tropical area (Nigeria)
- (vi) Characterization of the rainfall structure and worst hours for Nigeria
- (b) In progress:

**(i) Investigation of lightning intensity in Nigeria:**

Cloud-to-ground lightning discharges are the most harmful to humans, infrastructures and installations. They bring down very high currents ( $\approx 200\text{A}$ ) and high electric fields and these can cause damage to structures, installations and electronic equipment at the point of strike. In siting government infrastructures such as airports, oil depots and relocation of displaced communities by natural disasters, knowledge of the frequency of occurrence ground lightning discharges in the intended location is key. Data collection on ground lightning discharges have started since 2019. Preliminary results revealed where the likely hotspots are. Thus the study intends to produce lightning density map for Nigeria. It is expected that by 2025, adequate ground data would have been collected for the production of Nigeria lightning map.

**(ii) Study of surface energy fluxes:** The aim of the study is to investigate the surface energy fluxes for this tropical area. Information obtained from the study will give insight into the mechanism of development of the atmospheric boundary layer of the region. This will in turn pave way for understanding the land-atmosphere dynamics, energy exchange processes and the complex weather system of the West African sub-region. The study started in 2004 and currently analysis of experimental data collected is ongoing and is expected to be concluded in 2023.

**(iii) Rain attenuation of radio signals:** Attenuation of radio signals by rain in Nigeria is very complex as it varies from one geographical location to the other. The study intends to characterize rain attenuation of radio signals for each geographical location and also determine the respective worst hours. This information is critical for the design of radio equipment operating at the 5G and higher wavebands. An attempt will be made to develop a rain attenuation model for the country that will help radio engineers and equipment designers to design radio equipment that will be most suitable for the country. The rainfall data required for the study is being collected by TRODAN across the country since 2007. The analysis is ongoing and is expected to be concluded in 2024.

**Project, Dissertation and Thesis;**

- (i) **Nymphas E. F.** (1995). Very low frequency atmospheric from distant sources. MSc Project, University of Ibadan. 78 pp.
- (ii) **Nymphas E. F.** (2001). Investigation of compound discharger configurations as lightning protectors. PhD Thesis, University of Ibadan. 131 pp.

## X Publications

(a) Books already published: Nil

(b) Chapters in Books already published:

1. Ibe, O. and **Nymphas, E. F.** (2009). Temperature variations and their effects on rainfall in Nigeria. In Ibrahim D.; Adnan M.; Arif H. and Hikmet. T. K. (Eds). Global Warming, Green Energy and Technology. New York: Springer Sciences +Business Media, LLC2010: 565-578. ISBN: 978-1-4419-1016-5, (United States of America). (Contribution: 60%)
2. **Nymphas, E. F.** (2013). Transformer and Transmission of Power. In Farai I. P. and Oni, O. M. (Eds.). Fundamentals of Electricity and Magnetism. Ibadan, Ibadan University Press: 205-222. ISBN: 978-978-8456-09-4. (Nigeria), (Contribution: 100%)

(c) Articles that have already appeared in Refereed Conference Proceedings

3. Oladosu, O.R., Ayoola, M.A. and **Nymphas, E.F.** (2004). Soil Thermal Properties at Nimex-1 site. Proceedings of the workshop on the Nigerian Micrometeorological Experiment (NIMEX-1). In Jegede, O. O., Okogbue, E. C. and Balogun, E. E. (Eds.): 44-46. (Nigeria) (Contribution: 20%). (Published in July 15, 2004).
4. **Nymphas, E.F.**, Adeniyi, M.O., Sunmonu, L.A., Jegede, O.O. and Ogolo, E.O. (2004). The Surface Energy Budget during NIMEX-1. Proceedings of the workshop on the Nigerian Micrometeorological Experiment (NIMEX-1), July 15, 2004. In Jegede, O. O., Okogbue, E. C. and Balogun, E. E. (Eds.):50-53. (Nigeria), (Contribution: 35%). (Published in July 15, 2004).
5. Ibe, O. and **Nymphas, E. F.** (2020). Determination of Rainfall Attenuation at Millimeter Wave Band for the Design of 5G and Higher Bandwidth Radio Equipment for Terrestrial Paths in the Tropical Region. International Conference on Research in Science and Technology (ICEST-20, 9-10 July, 2020), (Ghana): 48-65. (Publisher: IIERD Explore). In Sahajeev S. S., Chris R., Muhammad F. Razia P. (Eds). (Contribution: 60%)

(d) Patents and Copyrights: Nil

(e) Articles that have already appeared in learned journals

6. Oladiran, E. O. and **Nymphas, E. F.** (2001). A review of bulk layer Pollution transfer over Nigeria during the Harmattan season, Journal of Science Research, Vol.7, No. 1: 1- 4, (Nigeria). (Contribution: 80%)
7. **Nymphas, E.F.** and Oladiran, E.O. (2001). The design, construction and behaviour of a modified Franklin rod and its effectiveness in Lightning protection. Journal of Science Research, Vol. 7, No.2: 45-51, (Nigeria). (Contribution: 80%).
8. **Nymphas, E. F.**, Adeniyi, M. O., Ogolo, E. O. and Oladiran, E. O. (2004). Lightning signature as an index for the determination of the beginning of the planting season in Nigeria”, African journal

- of Science and Technology (Science and Engineering Series) Vol. 5, No. 2: 18-33. (Kenya). (Contribution: 20%)
9. Jegede, O.O., Mauder, M., Okogbue, E.C., Foken,T., Balogun, E.E., Adedokun, J.A., Oladiran, E.O., Omotosho, J.A., Balogun, A.A., Oladosu, O.R., Sunmonu, L.A., Ayoola, M.A., Aregbesola, T.O., Ogolo, E.O., **Nymphas, E.F.**, Adeniyi, M. O. Olatona, G.I., Ladipo, K.O., Ohamobi, S.I., Gbobaniyi, E.O., and G.O. Akinlade (2004). The Nigerian Micrometeorological Experiment(NIMEX-1):An Overview. *Ife Journal of Science*, Vol. 6, No. 2: 191-202, (Nigeria). (Contribution: 10%)
  10. Oladiran, E.O., **Nymphas, E.F.**, Akpan, U.E., and Israelsson, S. (2006).The Characteristics of Positive Ground Discharges of Tropical Thunderstorms at Ibadan, Nigeria. *African Journal of Science and Technology (Science and Engineering Series)* Vol.7. No. 2: 95-98, (Kenya). (Contribution: 50%)
  11. **Nymphas, E. F.**, Adeniyi, M. O., Ayoola, M. A. and Oladiran, E. O. (2009). Micrometeorological measurements in Nigeria during the total solar eclipse of 29 March, 2006. *Journal of Atmospheric Solar-Terrestrial Physics*, Vol.71: 1245-1253. (Austria). (Contribution: 50%)
  12. Ogolo, E. O., Falodun, S. E., Oluyamo, S. S. and **Nymphas, E. F. (2009)**. Analysis of data on net longwave, shortwave and global radiation during the transition period in a tropical station in Southwestern Nigeria. *Indian Journal of Radio and Space Physics*, Vol. 38: 347-352, (India). (Contribution: 40%)
  13. Adeniyi, M. O., Ogunsola, O. E., **Nymphas, E. F.** and Oladiran, E. O. (2009). Food security measures during uncertain climatic conditions in Nigeria. *African Journal of food, Agricultural Nutrition and development*, (Kenya). Vol. 9. No.2: 652-677. (30%)
  14. **Nymphas, E. F.**, Adeniyi, M. O., and Oladiran, E. O. (2010). Behaviour of multiple lightning dischargers under a tropical thundercloud. *Journal of Applied Science and Technology (JAST)*, Vol. 15. No. 1 & 2: 77-84, (Ghana). (Contribution: 60%)
  - \*15. **Nymphas, E. F.** and Oladiran, E. O. (2011). On the Environmental Effects on a Point Discharger. *Journal of Science Research*, Vol. 10. No. 1: 90-96. (Nigeria). (Contribution: 80%)
  - \*16. Adeniyi, M. O. and **Nymphas, E. F.** (2011). Estimation of bare soil surface temperature from air temperature and soil depth temperature in a tropical station. *International journal of Natural and Applied Sciences*, Vol.7. No. 4: 429-437, (Nigeria). (Contribution: 20%)
  - \*17. **Nymphas, E. F.**, Otunla, T. A., Adeniyi, M. O. and Oladiran, E. O. (2012). Impact of the total solar eclipse of 29 March 2006 on the surface energy fluxes at Ibadan, Nigeria. *Journal of Atmospheric Solar-Terrestrial Physics*, Vol. 80: 28-36, (Netherlands). (Contribution: 60%)

- \*18. Adeniyi, M. O.; **Nymphas, E. F.** and Oladiran, E. O. (2012). Characteristics of total solar radiation in urban tropical environment. *International Journal of the Physical Sciences*, Vol.7, No. 30: 5154-5161, (Nigeria). (Contribution: 20%)
- \*19. Adeniyi, M. O., Oshunsanya, S. O., and **Nymphas, E. F.** (2012). Validation of analytical algorithms for the estimation of soil thermal properties using de Vries model. *American Journal of Scientific Research*. Vol.3. No. 2: 103-114, (United states of America). Contribution: 20% (Currently Vol.8. No. 3, 2017)
- \*20. Salami, O. R. and **Nymphas, E. F.** (2012). Variability of the Critical Frequency of the F2 Layer, foF2 in West Africa using Ionosonde Stations at Ouagadougou and Dakar. *Research Journal of Applied Sciences*, Vol.7. No. 9 & 12: 474-480, (Pakistan). (Contribution: 80%)
- \*21. Adeniyi, M. O. and **Nymphas, E. F.** (2013). Estimation of surface energy fluxes from bare ground in a tropical station using priestleytaylor method. *Journal of Science and Technology*, Vol. 33, No. 1: 41-54, (Ghana). (Contribution: 20%)
- \*22. **Nymphas, E. F.** and Adeyemi, T. A. (2014). Variability of sporadic-e (Es) layer at two Equatorial stations: Fortaleza (3°S, 38°W) and Ilorin (8.5°N, 4.5°E). *Journal of Science and Technology*, Vol. 34, No. 3: 35-46, (Ghana). (Contribution: 80%)
- \*23. Rauff, K. O. and **Nymphas, E. F.** (2016). A Statistical Approach to Estimate Wind Speed Distribution in Ibadan, Nigeria. *Physical Science International Journal*, Vol.11. No.2:1-14, (India). (Contribution: 60%)
- \*24. Otunla T. A., Ukaegbu S. C. and **Nymphas, E. F.** (2018). Design and Construction of a low cost air temperature and pressure data-logging equipment using Raspberry Pi. *Journal of Nigerian Association Mathematical Physics*, Vol. 44: 421-424, (Nigeria). (Contribution: 40%)
- \*25. Ibe, O. and **Nymphas, E. F.** (2019). Characteristics of worst hour rainfall rate for radio wave propagation modeling in Nigeria. *Meteorology and Atmospheric Physics*, Vol. 131. No.2: 251-261, (Austria). (Contribution: 70%)
- \*26. Aluko T. O.; **Nymphas E.F.**; Bolaji O. A. and Odubanjo O. F. (2019). Meteorological Comfort Indices to Assess Extreme Warmness in Southwest Nigeria. *European Journal of Engineering Research and Science*, Vol. 4. No. 2: 50-53. (United Kingdom). (Contribution: 30%)
- \*27. Adeniyi M. O.; **Nymphas E. F.** and Oladiran E. O. (2019). Simulating the influence of Greenhouse Gases on the Climate of West Africa. *Pollution*, Vol.5. No.2: 301-312, (Iran). (Contribution: 30%)
- \*28. Nwaokoro E, and **Nymphas, E. F.** (2019). Temperature Variations and Soil Thermal properties at the Nigeria Mesoscale Experiment site, Ibadan, Nigeria. *International Research Journal of Pure and Applied Physics*, Vol. 6, No. 2: 34-43, (United Kingdom). (Contribution: 70%)

- \*29. **Nymphas, E. F.** and Udomboso, C. G. (2020). An Artificial Neural Network Estimation of global solar radiation at Ibadan, Nigeria using meteorological data. Transactions of the Nigerian Association of Mathematical Physics, Vol. 12: 179-186, (Nigeria). (Contribution: 50%)
- \*30. Nwakoro, E. and **Nymphas, E. F.** (2021). Comparison analysis of different models used to determine soil thermal conductivity and diffusivity at NIMEX site, Ibadan. International Research journal of Pure and Applied Physics, Vol. 8. No.1: 1-13, (United Kingdom). (Contribution: 70%)
- \*31. Ibe, O. and **Nymphas, E. F.** (2021). Characterization of tropical rainfall structure for some selected locations in Nigeria. Journal of the Nigerian Association of Mathematical Physics, Vol.59.: 43-156, (Nigeria). (Contribution: 70%). (Published in (March,2021)
- \*32. Ibe. O. and **Nymphas, E. F.** (2021). Worst Month Rain Rate Characterization for Line-of-sight link performance in tropical locations. Journal of Computing and Informatics, Vol. 2. No.1: 79-88, (Nigeria). (Contribution: 70%): (Published in May, 2021).

(f) Books, Chapters in Books and Articles already accepted for publications: Nil

(g) Technical Reports and Monographs: Nil

\* Publications which have appeared in journals since the last promotion

XI Major Conferences and Workshops Attended in the last five years with Papers Read (in the last 5 years):

1. Ibe, O. and **Nymphas, E. F.** (2020). International Conference on Researches in Science and Technology (ICRST-20), 9-10 July, 2020, (Accra, Ghana). Paper read: Determination of rainfall attenuation at millimeter wave band for the design of 5G and higher bandwidth radio equipment for terrestrial paths in the tropical region.
2. Ibe, O. and **Nymphas, E. F.** (2021). The 7th URSI-NG Conference, 2021, International Union of Radio Science- Nigeria Conference, July 2021. (Nigeria). Paper read: Attenuation of Millimeter Wave Radio Signal at Worst Hour Rainfall Rate in a Tropical Region.

Dr Emmanuel F. NYMPHAS      Signature:.....      Date



XII Ten Best Publications that Reflect the Totality of my Contributions to Scholarship

1. **Nymphas, E.F.** and Oladiran, E.O. (2001). The design, construction and behaviour of a modified Franklin rod and its effectiveness in Lightning protection. *Journal of Science\_Research*, Vol. 7, No.2, pp45-51
2. **Nymphas, E. F.** and Oladiran, E. O. (2001). On the protection of structures by a modified Franklin rod, *Journal of Science Research*, Vol. 7, No. 2, pp27-31
3. **Nymphas, E. F.**, Adeniyi, M. O. Ayoola, M. A. and Oladiran, E. O. (2009). Micrometeorological measurements in Nigeria during the total solar eclipse of 29 March, 2006. *Journal of Atmospheric Solar-Terrestrial Physics*, Vol.71: 1245-1253.
4. **Nymphas, E. F.**, Adeniyi, M. O., and Oladiran, E. O. (2010). Behaviour of multiple lightning dischargers under a tropical thundercloud. *Journal of Applied Science and Technology (JAST)*, 15(1 & 2): 77-84.
5. **Nymphas, E. F.**, Otunla, T. A., Adeniyi, M. O. and Oladiran, E. O. (2012). Impact of the total solar eclipse of 29 March 2006 on the surface energy fluxes at Ibadan, Nigeria. *Journal of Atmospheric Solar-Terrestrial Physics*, Vol. 80: 28-36
6. **Nymphas, E. F.** and Adeyemi, T. A. (2014). Variability of sporadic-e (Es) layer at two Equatorial stations: Fortaleza (3°S, 38°W) and Ilorin (8.5°N, 4.5°E). *Journal of Science and Technology*, Vol. 34, No. 3: 35-46
7. Ibe, O. and **Nymphas, E. F.** (2019). Characteristics of worst hour rainfall rate for radio wave propagation modeling in Nigeria. *Meteorology and Atmospheric Physics*, Vol. 131(2): 251-261
8. Adeniyi M. O.; **Nymphas E. F.** and Oladiran E. O. (2019). Simulating the influence of Greenhouse Gases on the Climate of West Africa. *Pollution*, Vol.5(2): 301-312
9. Nwakoro, E. and **Nymphas, E. F.** (2021). Comparison analysis of different models used to determine soil thermal conductivity and diffusivity at NIMEX site, Ibadan. *International journal of Pure and Applied Physics*, vol. 8(1): 1-13
10. Ibe, O. and **Nymphas, E. F.** (2021). Characterization of tropical rainfall structure for some selected locations in Nigeria. *Journal of the Nigerian Association of Mathematical Physics*, Vol.59: 143-156

## Research Focus

My area of research in Physics is Atmospheric Physics with particular interest in Atmospheric Electricity, Micrometeorology and Radio communication. These areas of study deals with the electrical processes in the atmosphere, meteorological processes at micro scale level and how radio signals are affected by meteorological parameters especially rain and also the coupling processes between the lower and upper atmosphere.

In Atmospheric Electricity, I designed a modified traditional Franklin rod used in lightning protection for structures and installations. The modified Franklin rod is about two and half times more effective than the traditional Franklin rod. I also characterized the ground lightning discharges and used the lightning signatures to determine the beginning of planting season in Nigeria.

In Micrometeorology, I have determined the magnitude of the terms in surface energy balance equation (for the tropics; wet and dry), the surface energy budget and the soil thermal properties. The variation of the radiation fluxes during the transition period (harmattan to wet season) have also been analysed for the region. For the first time in Nigeria, I have recorded the perturbation of meteorological parameters (e.g Net radiation, global radiation, heat fluxes, temperature, etc) during the sudden cut-off of terrestrial solar radiation by the total solar eclipse of 2006. I have also determined and documented the impacts of this sudden cut-off of terrestrial solar radiation on surface energy fluxes.

In Radio communication, I have characterized the rainfall structure in Nigeria and the worst hour rainfall rate which are critical for radio wave propagation, and determined the rainfall attenuation at millimeter waveband for the design of 5G and higher bandwidth radio equipment for terrestrial paths in this tropical area. This was necessary because rain attenuation has been a major issue for engineers and equipment designers for the tropics as required by the International Telecommunication Union-Radio (ITU-R) model for predicting rain attenuation in the tropics.

My further research work include investigation of lightning density of Nigeria with the view to produce a lightning map for the country; investigate the physical processes that contribute to the variability of the earth's atmospheric layers, their dynamics and energy budgets, and the coupling mechanisms during Sudden Stratospheric Warmings (SSWs). Information gained from the coupling between the earth's atmospheric layers during SSWs will open the door for improved tropospheric and surface weather forecasting and understanding of the sources of adverse effects on satellite navigation systems (GPS) and Radio communications.

Dr Emmanuel F. Nymphas Signature:..... Date: