

# DR. MUHSIN M

SPACE PHYSICS LABORATORY  
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## CURRICULUM VITAE

### AREAS OF SPECIFIC RESEARCH INTEREST:

**Atmospheric Sciences:** *Stratosphere-Troposphere Exchange (STE), Dynamics of Tropical Tropopause Layer (TTL), Upper Troposphere and Lower Stratosphere (UTLS) processes, Deep convection, Cirrus, Turbulence and Remote sensing.*

### PROFESSIONAL EXPERIENCE

Mar 2017 – Present :	Research Associate, Space Physics Laboratory, VSSC, Trivandrum, India
Nov 2012 – Dec 2015	Senior Research Fellow, Space Physics Laboratory, VSSC, Trivandrum, India
Dec 2010 – Oct 2012	Junior Research Fellow, ISRO HQ, Bangalore, India
Sep 2008 – Oct 2010	Teaching Assistant, Gadha College, Kozhikode, India

### ACADEMIC QUALIFICATIONS:

<b>Aug 2017</b>	<b>Ph.D (Atmospheric Science)</b> - Thesis Submitted to <i>Cochin University of Science and Technology, Cochin, India</i> Thesis title: ' <b>Characterization of Thermal and Turbulent Structure in the Tropical Troposphere – Lower Stratosphere and Effect of Convective Clouds</b> '
<b>2006-2008</b>	<b>M.Sc (Physics)</b> <i>University of Kannur, Kannur, India</i>
<b>2003-2006</b>	<b>B.Sc (Physics)</b> <i>University of Calicut, Calicut, India</i>

### AWARDS & ACHIEVEMENTS:

1. **Research Fellowship** from **Indian Space Research Organization**, Dec 2010-Dec 2015.
2. **Qualified National Eligibility Test (NET)** in the subject of **Earth, Atmospheric, Ocean and Planetary sciences** conducted by Council of Science and Industrial Research – University Grants Commission (**CSIR-UGC**) on June 2015.

### PROFESSIONAL MEMBERSHIPS:

1. *Life member of Indian Science Congress Association (ISCA).*
2. *Student member of American Geophysical Union (AGU).*

## PROFICIENCY IN COMPUTERS:

Operating Systems	:	WINDOWS and LINUX
Programming Languages	:	FORTRAN
Analytical Softwares	:	MATLAB, ORIGIN and GRADS

## MAJOR SCIENTIFIC OUTCOME:

- ✓ A new method is devised to define Tropical Tropopause Layer (TTL) based on static stability criteria using radiosonde and COSMIC-radio occultation (RO) observations.
- ✓ Developed a methodology to calculate turbulent parameters from radiosonde data using Thorpe method by considering the effect of measurement noise and atmospheric moisture.
- ✓ Formulated an algorithm to segregate the radiosonde profiles during different convective cloud conditions.

## EXPERIMENTAL AND PROGRAMMING SKILLS:

- ✓ Expertised in *design and execution of field experiments* (especially balloon borne experiments) to study the TTL dynamics and UTLS processes.
- ✓ Expertised in *pre-flight preparations and launching of Cryogenic Frost point Hygrometer (CFH) and Electrochemical Concentration Cell (ECC) ozonesonde*.
- ✓ Hands on experience in setting up of ground stations, pre-flight preparation and launching of different make of Radiosondes (Dr. Pisharoty sonde, iMet, meisei, Graw).
- ✓ Experience in *handling large volume of satellite data* (eg. KALPANA-1, COSMIC, CloudSat, CALIPSO, AURA, Megha-Tropiques, etc).
- ✓ Experience in setting up and maintenance of network of meteorological towers.
- ✓ Basic understanding in WRF simulation and data assimilation.

## PARTICIPATION IN EXPERIMENTAL CAMPAIGNS:

Science Programs	Location and Period	Major Responsibilities
Integrated Campaign for Aerosols gases and Radiation Budget (ICARB-2018) - Ship cruise	Arabian Sea and Indian Ocean January-February 2018	<ul style="list-style-type: none"><li>➤ <i>Design and execution of campaigns.</i></li><li>➤ Setting up of experimental systems.</li><li>➤ Pre-flight preparation and launch of Radiosondes, Ozonesondes and CFHs.</li><li>➤ Data analysis, interpretation and publication of results</li></ul>
GPS Aided Radiosonde Network Experiment for Tropospheric and stratospheric Studies (GARNETS)	Trivandrum, Cochin, Coimbatore, Hyderabad and Kolkata August 2013 - present	<ul style="list-style-type: none"><li>➤ <i>Design and execution of campaigns.</i></li><li>➤ Setting up of experimental systems.</li><li>➤ Pre-flight preparation and launch of Radiosondes, Ozonesondes and CFHs.</li><li>➤ Data analysis, interpretation and publication of results</li></ul>
Tropical Tropopause Dynamics (TTD) Experiment	Trivandrum, Gadanki (Dec 2010 – Mar 2014)	<ul style="list-style-type: none"><li>➤ <i>Setting up of ground stations.</i></li><li>➤ Pre-flight preparation and launch of Radiosondes and Ozonesondes.</li><li>➤ Data analysis, interpretation and publication of results</li></ul>

Prediction of Regional Weather using Observational Meso-Network and Atmospheric Modelling (PRWONAM)	About 25 field stations over Indian Peninsula	<ul style="list-style-type: none"> <li>➤ <i>Setting up and maintenance of network of meteorological towers of different heights.</i></li> <li>➤ <i>Launching of Radiosonde during rocket launch campaign for data assimilation.</i></li> <li>➤ <i>Data analysis.</i></li> </ul>
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## SUMMARY OF THE PHD THESIS

### “Characterization of Thermal and Turbulent Structure in the Tropical Troposphere – Lower Stratosphere and Effect of Convective Clouds”

The prime objective of this doctoral work is to investigate the short-term variability of temperature and turbulence in the Troposphere and Lower Stratosphere (TLS) with emphasis on variability of the Tropical Tropopause Layer (TTL). The effect of convection on the thermal structure of TLS and TTL is also investigated. Major data set used for the study is the radiosonde data over Trivandrum (8.5°N, 76.9°E) and Gadanki (13.5°N, 79.2°E) obtained as a part of Tropical Tropopause Dynamics (TTD) Experiment campaign from Dec 2010 to Mar 2014. Radiosonde data from a few WMO stations and data sets from different satellite like COSMIC-RO, AURA-MLS, KALPANA-1, CALIPSO, etc are also used in this study. The major outcomes of the thesis are,

- ✓ A new method is devised to define TTL based on static stability criteria. TTL is extending from the level of minimum stability (LMinS) to the level of maximum of stability (LMaxS) and comprises of three sub-layers. Ozone and water vapor mixing ratios show a discernible change in their gradients across these sub- layers. Occurrences of small-scale turbulence and cirrus are maximum in the bottom layer (BL) and decrease in the middle layer (ML) and upper layer (UL) of TTL (*JGR, 2017*).
- ✓ Analysis between different TTL parameters show that adiabatic processes in the TTL-base exhibit a transition to diabatic process towards the upper limit of the TTL (*JGR, 2017*).
- ✓ Diurnal variability of temperature at free troposphere is around  $\pm 0.5\text{K}$ , where as that of lower stratosphere (LS) is around  $\pm 2\text{K}$ . LS shows clear diurnal pattern whereas the TTL shows the semi diurnal variations. The diurnal amplitude of the TTL thickness is relatively high at Trivandrum ( $\sim 1.3\text{ km}$ ) compared to that at Gadanki ( $\sim 0.9\text{ km}$ ) (*JGR, 2017*).
- ✓ Observation on the effect of convective clouds, with varying cloud top altitude, on the thermal structure of the TLS and at the TTL revealed, with respect to the clear-sky temperature, a free tropospheric warming ( $\sim 2$  to  $4\text{ K}$ ) due to latent heat, an anomalous cooling ( $\sim -2$  to  $-4\text{ K}$ ) in the ML of the TTL due to adiabatic lifting and a warming ( $\sim 3$  to  $6\text{ K}$ ) in the UL due to subsidence (*JASTP, 2018*).
- ✓ The effect of deep convection is observed at the level of TTL-top, with a descend of  $\sim 0.5\text{ km}$  and an ascend of TTL-base by  $\sim 1.5\text{ km}$ , leading to thinning of TTL up to  $2\text{ km}$  in its thickness (*JASTP, 2018*).
- ✓ Altitude structure of turbulence in the TLS using Thorpe method (considering the effect of measurement noise and atmospheric moisture) are examined using high resolution radiosonde observations at different time scales such as annual, seasonal, monthly, day-to-day and diurnal. It is observed that the altitude region of  $10\text{--}15\text{ km}$  is highly turbulent with its occurrence comparable to that in the Atmospheric Boundary Layer. But the in-between altitude is relatively less turbulent (*JASTP, 2015*).
- ✓ Generation mechanism of turbulence is examined using stability parameters. Below  $15\text{ km}$  while the turbulence is mainly governed by the static instability at Gadanki, wind-shear driven (dynamic) instability also contribute for the generation of turbulence at Trivandrum. At both these stations, the generation of turbulence above  $15\text{ km}$  is dominated by dynamic instability (*JASTP, 2015*).
- ✓ This study shows that, both the atmospheric stability and turbulence depict a pronounced diurnal variation in the lower troposphere with almost insignificant variation in the altitude region above  $15\text{ km}$  (*AR, 2016*).

(Thesis advisor: S V Sunilkumar)

## LIST OF PUBLICATIONS:

1. **Muhsin M.**, S. V. Sunilkumar, M. Venkat Ratnam, K. Parameswaran, B. V. Krishna Murthy, and M. Emmanuel (2018), Effect of Convection on the Thermal structure of the Troposphere and Lower Stratosphere including the Tropical Tropopause Layer in the South Asian Monsoon Region, *J.Atmos.Sol.-Terr. Phys.*, 169, 52-65, doi: <https://doi.org/10.1016/j.jastp.2018.01.016>
2. Sunilkumar, S. V., **M. Muhsin**, M. Venkat Ratnam, K. Parameswaran, B. V. Krishna Murthy, and M. Emmanuel (2017), Boundaries of tropical tropopause layer (TTL): A new perspective based on thermal and stability profiles, *J. Geophys. Res. Atmos.*, 122, doi:10.1002/2016JD025217.
3. **Muhsin, M.**, S.V. Sunilkumar, M. Venkat Ratnam, B. V. Krishna Murthy and K. Parameswaran (2017), Seasonal and diurnal variations of Tropical Tropopause Layer (TTL) over the Indian Peninsula, *J. Geophys. Res. Atmos.*, 122, doi:10.1002/2017JD027056.
4. **Muhsin, M.**, S.V. Sunilkumar, M. Venkat Ratnam, K. Parameswara, Geetha Ramkumar, and K. Rajeev (2016), Diurnal variation of stability and turbulent parameters in the troposphere and lower stratosphere derived from simultaneous radiosonde observations at two tropical stations, in the Indian Peninsula, *Atmos. Res.* 180, 12-23.
5. Sunilkumar, S.V., **M. Muhsin**, Maria Emmanuel, Geetha Ramkumar, K. Rajeev, and S. Sijkumar (2016), Balloon-borne cryogenic frost-point hygrometer observations of water vapour in the tropical upper troposphere and lower stratosphere over India: First results, *J.Atmos.Sol.-Terr.Phys.* 140, 86–93.
6. Sunilkumar, S.V., **M. Muhsin**, K. Parameswaran, M. Venkat Ratnam, Geetha Ramkumar, K. Rajeev, B. V. Krishna Murthy, K.V. Sambhu Nambodiri, K.V. Subrahmanyam, K. Kishore Kumar, and S. S. Das (2015), Characteristics of turbulence in the troposphere and lower stratosphere over the Indian Peninsula, *J.Atmos.Sol.-Terr. Phys.*, 133, 36–53.
7. Ratnam, M.V., S.V. Sunilkumar, K. Parameswaran, B.V. KrishnaMurthy, G. Ramkumar, K. Rajeev, G. Basha, S. R. Babu, **M. Muhsin**, M. K. Mishra., A. H. Kumar, S. T. A. Raj, and M. Pramitha (2014), Tropical tropopause dynamics (TTD) campaigns over Indian region: an overview, *J.Atmos.Sol.-Terr.Phys.* 122, 229–239.
8. Maria Emmanuel, S.V. Sunilkumar, M. Venkat Ratnam, **M. Muhsin**, K. Parameswaran and B. V. Krishna Murthy (2018), Diurnal variation of the tropospheric water vapour over a coastal and an inland station in southern Indian Peninsula, *J.Atmos.Sol.-Terr. Phys.*, (Under review)
9. Maria Emmanuel, S.V. Sunilkumar, **M. Muhsin**, B. Suneel Kumar, N. Nagendra, P.R. Satheesh Chandran, Geetha Ramkumar and K. Rajeev (2018), Inter-comparison of Cryogenic Frost-point Hygrometer observations with SAPHIR, MLS, COSMIC, radiosonde and reanalysis datasets over Indian Peninsula, *Atmos. Meas. Tech.*, (Under review)

## CONFERENCES/SYMPOSIA:

1. **Muhsin M** and Kusuma G Rao, *Characterisation of Monsoon Cloud System of Indian Summer Monsoon using spaceborne Cloud Profiling Radar on CloudSat. Poster* at 17<sup>th</sup> National Space Science Symposium (NSSS-2012) at SV University, Thirupathi on February 2012.
2. **Muhsin M** and N Narendra Reddy, *Characterisation of Monsoon Cloud System of Indian Summer Monsoon using spaceborne Cloud Profiling Radar on CloudSat. Poster* at 13<sup>th</sup> International Workshop on Technical and Scientific Aspects of MST Radar (MST-13), Kuhlungsborn, Germany, March 2012.
3. S. V. Sunilkumar, K. Parameswaran, K Rajeev, Geetha Ramkumar, Manoj Kumar Mishra, **Muhsin, M**, Asha Babu, S. Meenu, *Spatial heterogeneities in the tropospheric turbulence, dynamical features of tropical tropopause and cirrus clouds over the Indian Region*, National workshop of CAWSES-India program, 29 April-02 May 2013, NARL, Tirupati/Gadanki.

4. **Muhsin M**, S V Sunilkumar, M Venkat Ratnam, K Parameswaran, B V Krishna Murthy, Geetha Ramkumar and K Rajeev. 2015. *Radiosonde Observations of Turbulence in the Troposphere and Lower Stratosphere over Indian Monsoon Region*. 102<sup>nd</sup> Indian Science Congress at Mumbai University, Mumbai during 3-7 January 2015.
5. **Muhsin M**, S V Sunilkumar, M Venkat Ratnam, K Parameswaran, B V Krishna Murthy, Geetha Ramkumar and K Rajeev. 2015. *Altitude structure of turbulence from stability parameters in the troposphere and lower stratosphere from radiosonde observations*. 27<sup>th</sup> Kerala Science Congress at Alappuzha during 27-30 January 2015.
6. **Muhsin M**, S V Sunilkumar, M Venkat Ratnam. 2015. *Altitude structure of Tropical Tropospheric Turbulence and stability parameters from radiosonde observations*. 52<sup>nd</sup> Indian Geophysical Union (IGU) convention at NCAOR, Goa during 3-5 November 2015.
7. Anurose T J, Bala Subrahmanyam D and **Muhsin M**. 2015. *High resolution convection-permitting and resolving NWP model simulations for a convective event over the India region*. 52<sup>nd</sup> IGU convention at NCAOR, Goa during 3-5 November 2015.
8. **Muhsin M**, S V Sunilkumar, M Venkat Ratnam, K Parameswaran, B V Krishna Murthy, Geetha Ramkumar and K Rajeev. 2015. *Characteristics of turbulence in the troposphere and lower stratosphere from radiosonde observations at tropical stations, Trivandrum and Gadanki*. National Space Science Symposium (NSSS)-2016 at VSSC, Trivandrum during 9-12 Feb 2016.
9. Sunilkumar S V, **M Muhsin**, Maria Emmanuel and Geetha Ramkumar. 2015. *Accurate balloon-borne measurements of water vapour in the tropical upper troposphere and lower stratosphere over India*. National Space Science Symposium (NSSS)-2016 at VSSC, Trivandrum during 9-12 Feb 2016.
10. Maria Emmanuel, S V Sunilkumar, M Venkat Ratnam and **M Muhsin**. 2015. *A study on the diurnal variation of atmospheric water vapour over Trivandrum and Gadanki*. National Space Science Symposium (NSSS)-2016 at VSSC, Trivandrum during 9-12 Feb 2016.
11. **Muhsin M**, S V Sunilkumar, M Venkat Ratnam, K Parameswaran, B V Krishna Murthy. 2017. *Diurnal variation of turbulence in troposphere and lower stratosphere using balloon-borne radiosonde observations over two tropical stations*. Joint SPARC Dynamics & Observations Workshop, Kyoto University, Japan during 9-14 October 2017

#### RESEARCH SUPERVISION:

Co-supervised dissertation works of five MSc (Physics) students.

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**REFERENCE:**

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