Indian Academy of Sciences, Bengaluru
Indian National Science Academy, New Delhi
The National Academy of Sciences India, Prayagraj

SUMMER RESEARCH FELLOWSHIPS — 2025

Format for the four-week Report*,^,@

Name of the candidate	:	**Sudhan R**
Application Registration no.	:	**ENGS1672**
Date of joining	:	**07/04/2025**
Name of the guide	:	**Dr. Y. Bhavani Kumar**
Guide's institution	:	**National Atmospheric Research Laboratory, Tirupati**
Place of stay during the tenure of the fellowship	:	Hostel provided by _____ Guide Ranipet, Tamil Nadu Own arrangement Other (Specify) _____

Sudhan. R

Signature of the candidate

Signature of the guide

Date: **10/04/2025**

Date: _____

INSPIRE/KVPY FELLOWSHIP (please fill this box)#			
1.	I am currently a recipient of	INSPIRE FELLOWSHIP	□ Yes / ✓ No
		KVPY FELLOWSHIP	□ Yes / ✓ No
		If, YES, fill cols. 2, 3 & 4	
2.	**INSPIRE/KVPY** Fellowship is from _____[month]/_____[yr] to _____[month]/_____[yr]		
3.	I receive a monthly fellowship of Rs. _____from INSPIRE/KVPY towards my living expenses		
4.	I also receive towards contingencies a sum of Rs. _____per year		
	I affirm that the information given above is correct. Sudhan. R		
	Signature of the candidate		

IMPORTANT NOTES:

*** The four-week report could be between 300 and 350 words.**

^ This format should be the first page of the report and should be stapled with the main report.

 # Mandatory to fill this section, this should be filled and signed by you even if you are not an INSPIRE/KVPY Fellow. Otherwise release of fellowship amount will be withheld.

@ The hard copy of the duly signed report should reach the Academy office within 10 days of completing the first month fellowship. If delayed the fellowship amount will not be paid.

(For office use only; do not fill/tear)

Candidate's name:	Fellowship amount:
Student: Teacher:	Deduction:
Guide's name:	Amount to be paid:
KVPY Fellow: INSPIRE Fellow:	A/c holder's name:
PFMS Unique Code:	
Others	

Indian Academy of Sciences, Bengaluru
Indian National Science Academy, New Delhi
The National Academy of Sciences India, Pryagraj

SCIENCE ACADEMIES'

SUMMER RESEARCH FELLOWSHIP PROGRAMME

P. B. No. 8005, C. V. Raman Avenue, Sadashivanagar Psot, Bengaluru 560 080
Telephone: (080) 2266 1207, 2266 1202, 2266 1221, Fax: (080) 2361 6094
Email: sumfel@ias.ac.in Website: www.ias.ac.in

National Atmospheric Research Laboratory

Department of Space, Government of India, Gadanki,
Tirupati, Andhra Pradesh

Title	LiDAR-Based Observational Study of the Atmospheric Boundary Layer
Name	Mr. Sudhan R
Application Number	ENGS1672
Candidate's Institute	Sri Eshwar College of Engineering, Affiliated to Anna University
Name of the Guide	Dr. Y. Bhavani Kumar
Name of the Institute	National Atmospheric Research Laboratory (NARL)
Report	4 – Week Report

1. INTRODUCTION

The Atmospheric Boundary Layer (ABL) is the lowest part of the troposphere that is directly influenced by Earth's surface. It plays a crucial role in weather patterns, air quality, and environmental processes. Understanding ABL dynamics is essential for applications in meteorology, climate science, and renewable energy.

LiDAR (Light Detection and Ranging) is a remote sensing technique that uses laser pulses to probe the atmosphere and collect high-resolution vertical profiles of backscattered signals. These signals are influenced by aerosols and atmospheric particles, making LiDAR particularly useful in ABL studies.

2. OBJECTIVES OF THE STUDY

- To understand the principles of LiDAR backscatter technology and its application in atmospheric studies.
- To identify and analyze waveform structures in LiDAR data that represent features of the ABL.
- To detect the boundary layer height using suitable analytical techniques.
- To explore methods such as gradient method and wavelet transform for detecting ABL height.
- To propose a methodology for further analysis and visualization.

3. WORK COMPLETED DURING FIRST FOUR WEEKS

3.1 Literature Review

- Reviewed basic concepts of the Atmospheric Boundary Layer: diurnal cycle, turbulence, inversion layers.
- Studied LiDAR types, with a focus on elastic backscatter LiDAR used for ABL and aerosol detection.
- Collected references related to ABL height detection methods from LiDAR backscatter data.

3.2 Data Familiarization

- Gained access to LiDAR waveform data (backscatter intensity vs. altitude/time).
- Understood the structure of wave-like LiDAR signals and how they relate to aerosol concentration.
- Identified candidate features indicating the top of the boundary layer (e.g., sharp backscatter gradient).

3.3 Tools and Techniques Identified

- Proposed to use gradient-based detection method for determining ABL height.
- Investigated use of wavelet transforms as an advanced technique for layer boundary detection.
- Identified potential plotting and data analysis tools (e.g., Python with Matplotlib, Pandas, SciPy).

4. FUTURE WORK PLAN

- **Preprocessing** of LiDAR wave data for noise removal and signal enhancement.
- **Implementation** of boundary layer height detection algorithms.
- **Visualization** of ABL height over time to observe diurnal variation.
- **Validation** using literature or supporting weather data if available.
- **Exploration** of seasonal or event-based patterns if sufficient data is available.

5. CONCLUSION

The first month of the internship focused on gaining a strong foundational understanding of ABL concepts and LiDAR data analysis techniques. A clear direction has been set to process the available LiDAR backscatter waveforms to detect the height and evolution of the ABL. The next steps will involve algorithm development, analysis, and result interpretation.

6. REFERENCES

1. Sathe, A., Mann, J., Vasiljevic, N., & Lea, G. (2015). A review of turbulence measurements using ground-based Doppler LiDARs. *Atmospheric Measurement Techniques*, 8(11), 4699–4723.
2. Emeis, S. (2010). *Surface-based remote sensing of the atmospheric boundary layer*. Springer.
3. Hennemuth, B., & Lammert, A. (2006). Determination of the atmospheric boundary layer height from radiosonde and lidar backscatter. *Boundary-Layer Meteorology*, 120(1), 181–200.
4. Tucker, S. C., et al. (2009). Evaluation of boundary layer depth estimates from lidar, ceilometer, and radiosonde. *Journal of Atmospheric and Oceanic Technology*, 26(5), 791–807.
5. Boquet, M., et al. (2021). Automatic detection of the atmospheric boundary layer height using LIDAR: Review and evaluation. *Remote Sensing*, 13(3), 457.