



Office of International Relations  
Indian Institute of Technology  
Kharagpur-721302

Student Undertaking to Apply for Foreign Internship

Section A: Applicant details (to be filled in by student)			
Name :	SAMRAT SANTRA		
Roll Number:	20EF92R02	Degree enrolled in:	PHD
Department/ School/ Centre:	Environmental Science and Engineering	Expected date of graduation:	24-12-2025
Proposed Foreign internship details (to be filled in by student)			
Host organization (university/ laboratory) with full address	LATMOS, Sorbonne Université Tower 46, Boite 102 4 place Jussieu 75252 Paris Cedex 05 France		
Name, title, contact of supervisor/mentor (if available)	Prof. Cathy Clerbaux, Directrice de Recherche classe exceptionnelle at CNRS LATMOS (Sorbonne Université – 4 Place Jussieu – 75005 Paris. Email: cathy.clerbaux@latmos.ipsl.fr Contact: +33 1 44 27 47 73		
Title of project/ Name of activity:	Impact of Traffic Emissions on Tropospheric Ozone Distribution and Variability across Europe and Asia (2012-2022): Insights from IASI Measurements		
Start date of internship:	06 March, 2024	End date of internship :	23 August, 2024
Source of funding & other support (self/ scholarship):	Agency	Amount awarded	Amount applied for
Undertaking by student:	<ul style="list-style-type: none"><li>My internship does not violate any academic schedule or policy of IIT Kharagpur. I take full responsibility for my conduct during my visit and agree to strictly follow all guidelines laid down by my host university and host country and I understand that I am answerable to the Associate Dean IR&amp;R and Dean SA in case of any misconduct that may harm the Institute's reputation.</li><li>Once I accept the offer of an internship, I shall not renege on my acceptance, nor accept any other offer for internship from CDC/ Dept/ Any other source.</li><li>I shall keep OIR &amp; CDC informed about internship offers I receive/accept/decline.</li><li>Failure to comply with the above may adversely affect my placement opportunities</li></ul>		
Post completion requirements (if any):			
I am using this form for (tick one):	An application made through OIR or FTP	Requesting NOC from Associate Dean, IR & Ranking	Other (specify):
Signature of student with date:	<i>Samrat Santra</i> 12.09.23		
Section B: Departmental Approval (to be filled in by Dept./School/ Centre)			
Faculty Advisor (signature with date):	<i>ORR</i> 12/09/2023		
Head of Dept/ School/ Centre (signature with seal and date):	<i>Seoel</i> 12/9/23 Chairperson School of Environmental Science and Engineering, Indian Institute of Technology, Kharagpur-721302		
Section C: Institute Approval			
Chairperson CDC (signature with seal and date):	NOT APPLICABLE		
Associate Dean AA & IR (signature with seal and date):	<i>Shakuntla</i> 12/9/2023 सह-संकायध्यक्ष (अंतर्राष्ट्रीय संबंध एवं श्रेणी) Associate Dean (International Relations) भा.प्रौ.सं. खड़गपुर/IIT Kharagpur		

Received  
19.09.23





08 September 2023

## Letter of agreement for the fellowship of Samrat Santra

I work at LATMOS (Sorbonne University) as a senior scientist and as a teacher. I am managing a team with young scientists, engineers and PhD students (13 people in 2013). The lab is located downtown Paris, inside Sorbonne University, an institution well known for high quality science.

My expertise is in satellite remote sensing. I am in charge (PI) of the coordination of the atmospheric chemistry studies using the IASI mission, an infrared remote sensing instrument flying onboard the Metop suite of satellites since 2006. The 3 IASI instruments have provided a tremendous dataset from which atmospheric concentrations for pollutants and climate gases can be retrieved. Each day 5 million of new data are available.

My team and I are the leading scientists for the exploitation of IASI satellite data using advanced methods (eg deep learning) to derive trace gas concentrations for atmospheric compounds, and studying trends. Hereafter I show some examples of recent results that we have obtained, with societal impacts. Ozone is a key molecule in the atmosphere as it is a pollutant near the ground and a protective shield upper in the atmosphere. The expertise of Samrat Santra for ground-based ozone would be a good fit for a team, and by analyzing global scale ozone data measured from satellite it would enlarge the scope of his PhD. As IASI is a long term mission, it would also be possible to start a long term collaboration.

By spending some time with us, I hope that the candidate would benefit from our expertise in satellite data. I would be very happy to welcome Samrat Santra in our team for a 6 months stay.

Yours sincerely,

Cathy Clerbaux ([cathy.clerbaux@latmos.ipsl.fr](mailto:cathy.clerbaux@latmos.ipsl.fr))

+33 1 44 27 47 73

Directrice de Recherche classe exceptionnelle at CNRS

LATMOS (Sorbonne Université – 4 Place Jussieu – 75005 Paris.



भारतीय प्रौद्योगिकी संस्थान खड़गपुर

खड़गपुर : ७२१ ३०२, भारत

Indian Institute of Technology Kharagpur  
Kharagpur - 721 302, India

**DEPARTMENT OF MINING ENGINEERING**

**Aditya Kumar Patra, Associate Professor**

PhD & DIC, MBA, M Tech, BE, Diploma  
FEMA, MMGI, MIE, MIPHE, MSGAT

Date: 11 September 2023

**Research Experience Letter**

I am writing this letter to provide my observation of Samrat Santra as a researcher for a duration of nearly 3 years. Samrat is carrying out research on ground-level ozone and particulate matter under my supervision. He joined my research group in January 2021 and has since exhibited remarkable dedication, aptitude, and enthusiasm through his work. In addition to research particularly related to his research area, he has carried out other studies which include Monitoring of Air Quality at Kusmunda Open-cast Mines in Mahanadi Coalfields Limited and Particle Size Distribution Analysis at Bolani Ores Mines. He consistently exhibited a deep understanding of the research area, developed innovative research ideas, and implemented them effectively. He has earned trustworthy operating skills in air quality monitoring instruments. He is actively engaged with fellow researchers and collaborated across disciplinary boundaries, fostering a dynamic research environment.

Therefore, he possesses a good research aptitude. I trust he will effectively utilise this experience in quick understanding of the topic which he intends to do research during his tenure at Sorbonne University's LATMOS lab as a part of the Raman-Charpak Fellowship.

(Aditya Patra)





भारतीय प्रौद्योगिकी संस्थान खड़गपुर  
खड़गपुर : ७२१ ३०२, भारत

Indian Institute of Technology Kharagpur  
Kharagpur - 721 302, India

**DEPARTMENT OF MINING ENGINEERING**

**Aditya Kumar Patra, Associate Professor**

PhD & DIC, MBA, M Tech, BE, Diploma  
FEMA, MMGI, MIE, MIPHE, MSGAT

Date: 11 September 2023

**Letter of Recommendation from the PhD supervisor**

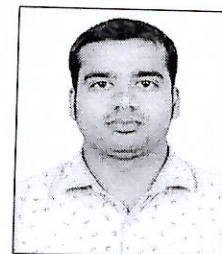
I am writing this letter for Samrat Santra, who joined the PhD program in January 2021 under my supervision at IIT Kharagpur. His research pertains to the understanding of ground level ozone emission in traffic environment. In addition, he is also looking at the particulate matter concentration in traffic area. Over the last two years, he has developed a good understanding of the subject and doing good advance in his research.

He possesses strong work ethics, which includes conducting rigorous experiments, meeting project deadlines, and pursuing innovative research. He possesses a global perspective and a keen interest in working with international collaborators. His proposed research project at Sorbonne University's LATMOS lab, focusing on Ground-level Ozone in a traffic environment and satellite data holds great potential for significant scientific contributions. I believe that this Fellowship will provide him with a unique opportunity to extend his expertise in the field of Ground-level ozone and satellite data analysis. He has the ability to handle complex data sets and derive meaningful inferences from it.

I am confident that Samrat will perfectly fit to the academic environment at Sorbonne University and bring a fresh perspective to the ongoing research efforts. I therefore strongly recommend his application for the Raman-Charpak Fellowship.

(Aditya Patra)

## FORMAT OF CV Indian & French PhD Students



- I. Name:** SAMRAT SANTRA
- II. Address for correspondence:** School of Environmental Science and Engineering, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal, India, 721232  
**E-Mail:** santra127samrat@kgpian.iitkgp.ac.in  
**Contact:** +91 8918246243
- III. Date of Birth:** 01-06-1995
- IV. Educational Qualifications (Give all national exam results from secondary school):**

SL. No	EXAMS PASSED / Previous Diploma	UNIVERSITY / INSTITUTION / BOARD	YEAR OF PASSING	MAIN DOMAIN	SUBJECT OF SPECIALISATION	DIV. / CLASS & % OF MARKS
1	Secondary	WBBSE	2011	-	-	-
2	Higher Secondary	WBCHSE	2013	Science	Pure Science	A+, 80%
3	Bachelor of Science	The University of Burdwan	2016	Science Honours	Environmental Science	B+, 69%
4.	Master of Science	Visva-Bharati (Central University)	2018	Environmental Science	Environmental Science	A+, 70%
						A++, 80%

**V. Details about ongoing PhD:**

PhD registered University:	Indian Institute of Technology Kharagpur
Name of institute/lab of PhD work	School of Environmental Science and Engineering/Air Quality Research Laboratory
Present Position: (only for Indian candidates)	Research Scholar (3 <sup>rd</sup> year)
Name of your PhD supervisor:	Prof. Aditya Kumar Patra
Title of PhD work:	Assessment of Ground-level Ozone in a Traffic Environment
PhD starting month and year	January, 2021
PhD ending (month/year) estimated	December, 2025

**VI. Gate Qualified (yes/no):** NO

**VII. NET Qualified (yes/no):** Yes, UGC-NET (June, 2020), LS

**VIII. Professional Training (if any):**

SL. No	Organization	Period		Details of Training/ Project undertaken
		From	To	
1	Jawaharlal Nehru Computer Literacy Drive	12-02-2020	10-07-2020	Certificate in Computer Application (Grade A, 97%)
2	WBUTTEPA	04-08-2019	26-06-2021	Bachelor of Education (BEd) (Grade A, 88%)

**IX. Two references**

- i. Prof. Aditya Kumar Patra, Department of Mining Engineering, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal, India, 721302  
Email: akpatra@mining.iitkgp.ac.in



Contact: +91 9475427366

- ii. Srinivasan Balachandran, Department of Environmental Studies, Institute of Science, Visva-Bharati, Santiniketan, West Bengal, India, 731235  
Email: s.balachandran@visva-bharati.ac.in  
Contact: +91 9002189061

**X. Any other information, if any, which you would like to mention in support of your suitability for the Raman-Charpak Fellowship.**

Other information: In my current PhD work, I can operate 15 Air Quality Monitoring instruments such as Grimm 11-D Aerosol Spectrometer, Particulate matter sensors such as OPC N2/N3, Personal Aerosol Monitor (SidePack AM520), Diesel Particulate Monitor (DPM 520i), Black Carbon Monitor (microAeth MA350), Single Gas Detector (GfG Micro IV), Portable Weather Station (Kestrel 5500), GPS Garmin, Multigas Monitor (GfG 999), Ultrafine Particle Counter (P-Trak 8525), Environmental Monitor (EVM 7), Indoor Air Quality Monitor (Direct Sense II Multisensing Probes), Cascade Monitor (8 stages), High Volume Sampler (Respirable Dust Sampler), and Serinus 10 Ozone Analyzer (Acoem) which are entirely used for primary data collection in field works. Therefore, my commitment to environmental research and air quality monitoring aligns with the global concerns of climate change and pollution, making me a candidate who can contribute meaningfully to the scientific objectives of the Raman-Charpak Fellowship.

Summary of Achievements: 1. University Topper (2<sup>nd</sup>), Bachelor of Science Honours, 2016  
2. Qualified UGC NET 2020 (LS) and WB SET 2021  
3. Institute Research Fellow 2021  
4. Chief Minister Scholarship 2012, 2014  
5. Merit-cum-Means Scholarship 2011, 2016

Research Interests: Ozone, Air Pollution, Air Quality and Climate Change

- XI. If previously travel to France (for Indian candidates)/any other country for research work/fellowship/any other work related to professional experience/ whether previously or presently involved/supported under any Programme/Project of CEFIPRA (mention details):** NO
- XII. List of Publications, if any, including Title, Authors, with impact factor:** NO
- XIII. List of Conference (Oral/Poster) Presentations, if any:**  
Poster presentation, "Integrated Waste Management from Variable Sectors of Visva-Bharati University" in the National Seminar on "Waste Management of Local Self Government (Municipalities and Panchayats)" at Visva-Bharati, Sriniketan during 16-17 March, 2018

**DECLARATION: -**

I certify that the foregoing information is correct and complete to the best of my knowledge and belief and nothing has been concealed / distorted. If at any time I am found to have concealed / distorted any material information, my appointment shall be liable to be summarily terminated without notice / compensation.

**Place:** IIT Kharagpur

**Date:** 10-09-2023



Signature of the candidate





## Format for Research Proposal

### For Indian and French PhD Students

<b>Name of the Candidate:</b>	SAMRAT SANTRA
<b>Title and Brief abstract of Research Plan/Proposal for the Raman-Charpak Fellowship (max 10 lines):</b>	<p><b>Title</b>          “Impact of Traffic Emissions on Tropospheric Ozone Distribution and Variability across Europe and Asia (2012-2022): Insights from IASI Measurements”</p> <p><b>Brief abstract</b>          This project focuses on tropospheric ozone (O<sub>3</sub>), an atmospheric pollutant. We will study its variability, formation, and distribution, in particular over Europe and Asia. The satellite data provided by the IASI/Metop instruments (provided by the host laboratory) will be analyzed, together with ground-based data (from my PhD work) to characterize its seasonal and interannual variability, the impact of meteorology on formation and dispersion, and to assess traffic-induced impacts. This research should contribute to unraveling the complex interplay of ozone, meteorology, and human activities, shedding light on environmental challenges and insights for sustainable air quality management.</p>
<b>Name of PhD registered University:</b>	Indian Institute of Technology Kharagpur
<b>Name of institute/lab of PhD work</b>	School of Environmental Science and Engineering/Air Quality Research Laboratory
<b>Present position of the candidate (only for Indian candidates):</b>	Research Scholar (3 <sup>rd</sup> year)
<b>Name and address of your PhD supervisor:</b>	Prof. Aditya Kumar Patra, Department of Mining Engineering, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal, India, 721302 Email: akpatra@mining.iitkgp.ac.in Contact: +91 9475427366
<b>Title of PhD work:</b>	“Assessment of Ground-level Ozone in a Traffic Environment”



in what we call the boundary layer, it lasts only 1 to 2 days, mostly disappearing through dry deposition. But when it's higher up in the free troposphere, it can hang around for several weeks. This longer duration lets ozone travel across continents and even between hemispheres (Monks et al., 2015).

The Infrared Atmospheric Sounding Interferometer (IASI) is a nadir-oriented spectrometer (Clerbaux et al., 2009; 2015) that has been operational aboard the Metop-A (October 2006), Metop-B (September 2012) and Metop-C (November 2018) satellites of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). The IASI instrument records atmospheric spectra from which ozone can be retrieved at any location 2 times per day. Road traffic is recognised as the main source of photochemical precursors ( $\text{NO}_x$  and VOCs). Motor vehicles are one of the major sources of  $\text{NO}_x$  ( $\text{NO} + \text{NO}_2$ ) emissions and hydrocarbons (Tilton, 1989). Chelani (2009) found that  $\text{O}_3$  persistence (how long it remains in air) and concentration changes more frequently at traffic sites due to traffic-induced variability of  $\text{NO}$  emission. Shen et al. (2010) observed that road side  $\text{O}_3$  concentration is closely associated with the overall traffic conditions and meteorological status.

To really understand this, we need data about ozone's various forms, its effects, and how it spreads over different times and places. One effective way to gather this crucial information is by using instruments in space for observations. By harnessing the extensive  $\text{O}_3$  dataset collected through continuous IASI observations, it will become possible to extract insights into the interannual variability and the impact of meteorology on formation and distribution of tropospheric ozone and explain long-term trends on traffic-induced impacts in particular over Europe and Asia.

### c) Objective(s) (max 1 page):

The research objectives arising from the aforementioned contextual investigation, focusing on both Europe and Asia, include the following: -

1. **Characterization of Tropospheric Ozone Variability:** The interannual variability of tropospheric ozone will be assessed by using the data from continuous observations of IASI to understand long-term trends and variations in ozone concentration over different atmospheric regions.
2. **Identification of the Meteorological Drivers of Ozone Formation and Dispersion:** The influence of meteorological conditions, such as temperature, humidity, wind speed, and solar radiation, on the formation and dispersion of ozone in the troposphere will be assessed by quantifying their impacts on ozone concentration levels.
3. **Assessment of the Impact of Traffic Emissions on Ozone Levels:** The role of road traffic as a major source of photochemical precursors ( $\text{NO}_x$  and VOCs) and its impact on altering ozone concentrations throughout the regions will be assessed by considering both chemical reactions and traffic-induced turbulence.
4. **Evaluation of the Temporal and Spatial Distribution of Ozone:** The temporal patterns and spatial distribution of ozone concentration will be evaluated to understand how ozone levels vary throughout the seasons and across different locations.



The expected results of this proposed research are outlined as,

- To reveal significant interannual variability in tropospheric ozone concentrations across different atmospheric regions in both Europe and Asia. Long-term trends and variations in ozone levels will be identified, helping to understand the factors influencing ozone dynamics over time.
- It is expected that specific meteorological conditions conducive to photochemical reactions will be linked to periods of elevated ozone levels.
- The assessment of traffic emissions influence on ozone concentrations is likely to highlight the role of road traffic as a significant source of ozone precursors (NO<sub>x</sub> and VOCs).
- The study may reveal that traffic-related emissions contribute substantially to the alteration of ozone levels.
- The temporal analysis is expected to demonstrate diurnal patterns of ozone concentration, with peaks during specific hours coinciding with traffic-intensive periods.
- The spatial distribution analysis may reveal strong correlations between high ozone concentrations and areas of heavy traffic, confirming the influence of traffic emissions.
- The research is likely to establish a strong positive correlation between high ozone concentrations and elevated levels of NO<sub>2</sub> and VOCs.
- The utilization of an atmospheric chemical transport model will provide valuable insights into ozone formation and dispersion, validating the model's ability to simulate ozone variations due to traffic emissions. The model's outputs are likely to align closely with observed satellite ozone concentrations.
- The statistical analysis is anticipated to quantify the relationships between traffic emissions, meteorological conditions, and ozone concentrations. Strong statistical correlations and trends may be identified, providing robust evidence of the link between traffic-related emissions and elevated ozone levels.

Overall, the research is expected to shed light on the complex interplay between traffic emissions, meteorological conditions, and ozone concentration levels in both Europe and Asia. The findings will contribute to a better understanding of the factors influencing tropospheric ozone variability and its implications for a sustainable air quality management and policy development.

**f) List all references for proposal formulation (if any):**

- Bower, F. A., & Ward, R. B. (1982). *Stratospheric Ozone and Man*. Vol. I, 216 pp. and Vol. II, 263, pp.
- Brunekreef, B., & Holgate, S. T. (2002). Air pollution and health. *The Lancet*, 360(9341), 1233–1242. [https://doi.org/10.1016/S0140-6736\(02\)11274-8](https://doi.org/10.1016/S0140-6736(02)11274-8)
- Chelani, A. B. (2009). Statistical persistence analysis of hourly ground level ozone concentrations in Delhi. *Atmospheric Research*, 92(2), 244–250. <https://doi.org/10.1016/j.atmosres.2008.12.001>
- Clerbaux, C., Boynard, A., Clarisse, L., George, M., Hadji-Lazaro, J., Herbin, H., Hurtmans, D., Pommier, M., Razavi, A., Turquety, S., Wespes, C., & Coheur, P. F. (2009). Monitoring of atmospheric composition using the thermal infrared IASI/MetOp sounder. *Atmospheric Chemistry and Physics*, 9(16), 6041–6054. <https://doi.org/10.5194/acp-9-6041-2009>
- Clerbaux, Cathy, Hadji-Lazaro, J., Turquety, S., George, M., Boynard, A., Pommier, M., Safieddine, S., Coheur, P.-F., Hurtmans, D., Clarisse, L., & Van Damme, M. (2015). Tracking pollutants from space: Eight years of IASI satellite observation. *Comptes Rendus Geoscience*, 347(3), 134–144. <https://doi.org/10.1016/j.crte.2015.06.001>
- Crutzen, P. J. (1979). The role of NO and NO<sub>2</sub> in the chemistry of the troposphere and stratosphere. *Annual Review of Earth and Planetary Sciences*, 7(1), 443–472. <https://doi.org/10.1146/annurev.ea.07.050179.002303>
- Crutzen, P. J. (1988). Tropospheric Ozone: An Overview. In I. S. A. Isaksen (Ed.), *Tropospheric Ozone* (pp. 3–32). Springer Netherlands. [https://doi.org/10.1007/978-94-009-2913-5\\_1](https://doi.org/10.1007/978-94-009-2913-5_1)