

VISITING PROFESSOR REPORT

Institute for Space–Earth Environmental Research (ISEE)

Nagoya University, Japan

Visiting Faculty	Prof. Devanaboyina Venkata Ratnam
Home Institution	Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation (KLEF Deemed to be University), Vaddeswaram, Guntur, India
Host Institution	Institute for Space–Earth Environmental Research (ISEE), Nagoya University, Japan
Host Division	Division for Ionospheric and Magnetospheric Research, ISEE
Position Held	Designated Professor
Host Professor	Prof. Yuichi Otsuka, ISEE, Nagoya University
Period of Visit	April 2, 2026 – July 31, 2026
Report Prepared By	Devanaboyina Venkata Ratnam (ratnam2002v@gmail.com)

1. Purpose and Overview of the Visit

This report summarizes the academic and research activities carried out during my tenure as Designated Professor / Visiting Professor at the Institute for Space–Earth Environmental Research (ISEE), Nagoya University, Japan, from April 2 to July 31, 2026. The visit was hosted by the Division for Ionospheric and Magnetospheric Research with the of Prof. Yuichi Otsuka, ISEE, Nagoya University, Japan.

The primary objectives of the visit were to: (i) undertake collaborative research on GNSS ionospheric error modelling and space-weather risk assessment using long-term GEONET and global GNSS TEC datasets; (ii) co-author and finalize joint research manuscripts with ISEE faculty; (iii) present research findings at international conferences; (iv) participate in ISEE's academic and workshop activities, including the SuperDARN Workshop 2026; and (v) develop a follow-on India–Japan student exchange proposal under the JST Sakura Science / LOTUS Programme.

2. Host Institution and Academic Setting

ISEE, Nagoya University, is a leading Japanese research institute conducting inter-university collaborative research on the space–earth environmental system, including ionospheric and magnetospheric physics, atmospheric science, and geospace observation networks such as GEONET (Japan's nationwide network of over 4,400–7,000 GNSS receivers) and SuperDARN. During the visiting period I was based in the Division for Ionospheric and Magnetospheric Research and worked closely with Prof. Yuichi Otsuka's research group.

I regularly participated in the Otsuka group's weekly research seminars (Research Building I, 8F Meeting Room), presenting my ongoing work to the group (e.g., the group meeting of June 29, 2026) and engaging with group members and international visiting researchers.



With Prof. Yuichi Otsuka, ISEE, Nagoya University

3. Research Activities and Collaborative Work

3.1 Extreme TEC Prediction using Extreme Value Theory (JpGU-AGU 2026)

Collaborative research was carried out with Prof. Yuichi Otsuka (ISEE, Nagoya University), Dr. Suneetha Emmela (KLEF), Dr. Atsuki Shinbori (ISEE), and Dr. Michi Nishioka and Dr. Septi Perwitasari (NICT, Japan) on “Machine Learning–Aided Extreme Total Electron Content Prediction Using Extreme Value Theory: Insights from Long-Term GNSS Data.”

The study applied Generalized Extreme Value (GEV), Generalized Pareto Distribution (GPD) and machine-learning-aided GPD methods (LightGBM, XGBoost, Gradient Boosting Regression) to 1997–2021 GNSS TEC data over India, Japan (low and mid latitudes) and globally, using 2D VTEC maps ($0.15^\circ \times 0.15^\circ$ resolution) derived from over 7,000 GNSS receivers operated by GEONET, Japan. Recommended moderate/severe TEC thresholds relevant to ICAO aviation safety limits were derived for each region, and LightGBM was found to give the best TEC prediction performance across solar cycles 23 and 24.

This work was presented as an oral presentation at the JpGU-AGU Joint Meeting 2026 (session P-EM16, Coupling Processes in the Atmosphere–Ionosphere System), held May 24–29, 2026 at Makuhari Messe, Chiba, Japan (presented May 25, 2026). Certificates of Attendance and Presentation were issued by the Japan Geoscience Union. In connection with this work, I was also invited to deliver a related invited talk in Tokyo, Japan, on the JpGU research theme.

3.2 CCIR Colloquium Seminar, ISEE, Nagoya University

On May 21, 2026, I delivered an invited seminar at the CCIR Colloquium, ISEE, Nagoya University, titled “Large-Scale Traveling Ionospheric Disturbances and GPS Positioning Impact During the May 2024 Super Geomagnetic Storm over the Indian Region.” The talk presented an analysis of Traveling Ionospheric Disturbances (TIDs) using VTEC/ Δ TEC keograms and ROTI maps, GPS SPP/PPP positioning errors, Large-Scale TID–GNSS wave velocities (approximately 595–778 m/s), and LSTID detection using ESA Swarm in-situ electron density and TEC data, focused on the Indian region during the May 2024 super geomagnetic storm.



PRESTIGIOUS INDO–JAPANESE COLLABORATIVE RESEARCH GRANT

UNDER THE CIRCULATION OF TALENTED YOUTHS IN SCIENCE (LOTUS) PROGRAMME

INTERNATIONAL JOINT RESEARCH PROJECT

PROJECT TITLE

“Quantifying the Impact of Medium-Scale Traveling Ionospheric Disturbances on GNSS Real-Time Kinematic Positioning and Development of a Physics-Informed Transformer Model for Network RTK Virtual Reference Station Corrections”

Approved Funding: ₹3.29 Million (approx. ₹19–20 Lakh)



Prof. D. Venkata Ratnam
Principal Investigator –
Indian Side

Dept. of ECE, KLEF Deemed to
be University, Guntur, India



Prof. Yuichi Otsuka
Principal Investigator –
Japan Side

ISEE, Nagoya University, Japan



**Ms. Siri Chandana
Vutukuru**
Fellowship Awardee

M.Tech Embedded Systems
Regd. ID 2501230002
Dept. of ECE, KLEF Deemed to
be University, Guntur, India

Ms. Siri Chandana Vutukuru will undertake a **fully funded research visit of up to one year** to the Institute for Space–Earth Environmental Research (ISEE), Nagoya University, Japan, supported by the JST LOTUS Programme. Her work will focus on **AI-driven modelling for GNSS and satellite navigation systems**, including high-precision positioning techniques.

WITH SINCERE THANKS TO

KLEF Deemed to be University • Nagoya University • LOTUS Programme • JST

KLEF–Nagoya University JST LOTUS Programme collaboration poster

3.6 JSPS–DST India–Japan Bilateral Joint Research Proposal

Building on the collaboration developed during this visit, a joint proposal was submitted (August 31, 2026) to the Japan Society for the Promotion of Science (JSPS) Bilateral Joint Research Program with India's Department of Science and Technology (DST), titled “AI-Based Forecasting of Ionospheric Irregularities Using Long-Term Global GNSS Data and Assessment of Their Impact on RTK Performance over Japan and India.”

Prof. Yuichi Otsuka (ISEE, Nagoya University) is the Japan-side Principal Investigator and I am the India-side Principal Investigator. The proposed project period is June 1, 2027 – March 31, 2029 (1 year 10 months), with an annual JSPS grant request of ₹1,000,000 (₹2,000,000 total) covering researcher exchange, travel and related expenses and Indian side proposed grant is 20 lakhs INR. The Japan-side team includes Dr. Atsuki Shinbori, Fu Junxian, K. Adhiguna, Omori Ryosuke, Miyabara Kazuki and Suzuki Kosei (ISEE, Nagoya University); the India-side team includes Dr. K. Venkatesh (Physical Research Laboratory), T. Venkateswara Rao (TIFR), Dr. Nishanth Kumar and Prof. E. Suneetha (KLEF), Ms. Siri Chandana (KLEF, M.Tech) and S. Vinod Kumar (KLEF).

The proposal explicitly cites this 2026 four-month visiting professorship at ISEE as the basis on which the research plan was conceived and jointly developed with Prof. Otsuka, extending the prior India–Japan collaboration (2017 and 2022 visits, five joint peer-reviewed publications) from forecasting ionospheric disturbances themselves to predicting their impact on GNSS RTK positioning performance, comparing Japan's mid-latitude and India's equatorial/low-latitude ionospheric environments.

4. Conferences and Workshops Attended

4.1 JpGU-AGU Joint Meeting 2026

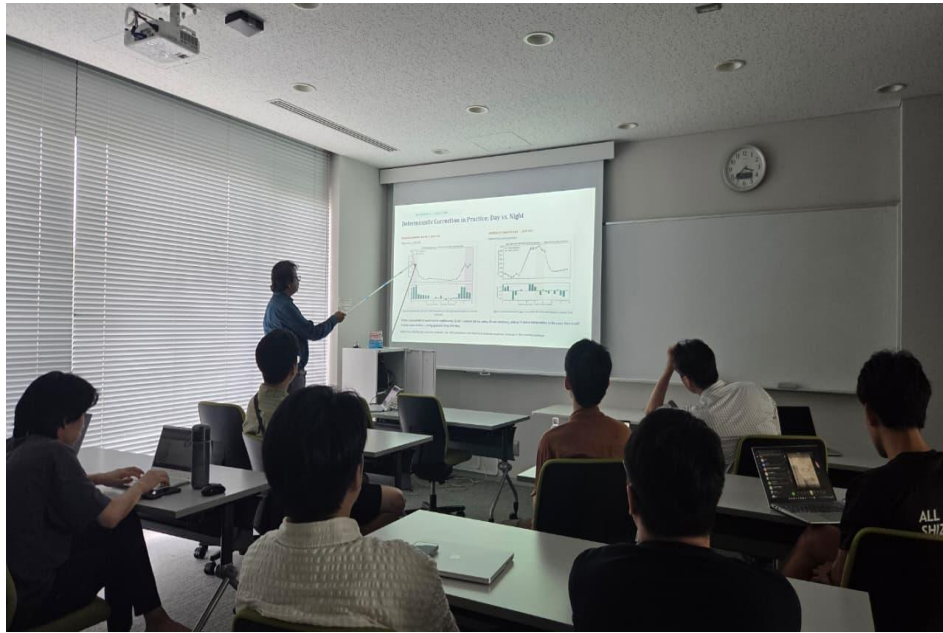
- Period: May 24–29, 2026 (Hybrid); On-site venue: Makuhari Messe, Chiba, Japan
- Co-hosted by the Japan Geoscience Union (JpGU) and American Geophysical Union (AGU)
- Delivered an oral presentation (PEM16-30) and received Certificates of Attendance and Presentation

4.2 SuperDARN Workshop 2026

- Period: June 7–12, 2026, Higashiyama Campus, Nagoya University, Japan
- Hosted by ISEE, Nagoya University and the National Institute of Polar Research, with support from the University of Electro-Communications, i-SPES (Kyushu University) and Kyushu Institute of Technology
- 72 participants from 8 countries (44 overseas) attended; the workshop covered SuperDARN HF radar science, technical/operational updates and future plans, and included a half-day excursion to Gujo-Hachiman
- Participated as a listed participant (KLEF Deemed to be University) alongside international SuperDARN collaborators



SuperDARN Workshop 2026 group photo, Nagoya University



Seminar presentation at ISEE, Nagoya University

5. Key Outcomes

- Two joint research manuscripts prepared with Prof. Yuichi Otsuka (ISEE); the MSTID/Network RTK manuscript has been submitted to the journal Satellite Navigation (Impact Factor ~ 12 , Q1), and the QZSS CLAS ionospheric disturbance warning index manuscript is being finalized for submission.
- One international conference oral presentation delivered at the JpGU-AGU Joint Meeting 2026 on ML-aided extreme TEC prediction, resulting from India–Japan–NICT co-authorship, along with a related invited talk in Tokyo, Japan.
- An invited seminar delivered at the CCIR Colloquium, ISEE, Nagoya University (May 21, 2026) on Large-Scale TID impacts on GPS positioning during the May 2024 super geomagnetic storm.
- Participation in the SuperDARN Workshop 2026 at Nagoya University, strengthening ties with the international SuperDARN and geospace research community.
- A JST Sakura Science LOTUS Programme proposal, co-developed with Prof. Otsuka during the visit, was formally selected for funding (¥3.29 million, FY2026–FY2027), enabling an approximately 8-month research exchange for a KLEF postgraduate student at ISEE — a direct, tangible follow-on of this visiting professorship.
- Establishment of an ongoing India–Japan collaborative research pipeline in GNSS/ionospheric science between KLEF Deemed to be University and ISEE, Nagoya University, with continuing joint supervision of student research.
- A follow-on JSPS–DST India–Japan Bilateral Joint Research proposal (2027–2029) co-developed with Prof. Otsuka and submitted in August 2026, extending the collaboration to AI-based forecasting of ionospheric irregularities and their impact on GNSS RTK performance over Japan and India.

6. Acknowledgements

I gratefully acknowledge Prof. Yuichi Otsuka and the Division for Ionospheric and Magnetospheric Research, ISEE, Nagoya University, for hosting this visit, for the collaborative research support, and for facilitating my participation in institute seminars and workshops. I also thank Dr. Kazuo Shiokawa, Director, ISEE, for institutional support, and the JST Sakura Science Program office for reviewing and approving the LOTUS Programme proposal that will extend this collaboration.

I would like to place on record my special and sincere gratitude to the President, Er. Koneru Satyanarayana, for his unconditional support that made this visiting professorship possible, and to the Vice Presidents, Er. Koneru Raja Hareen and Ms. Koneru Nikhila, for their continued encouragement. I also thank the Pro-Chancellor, Dr. K. S. Jagannatha Rao; the Vice Chancellor, Dr. G. Pardha Saradhi Varma; the Pro Vice Chancellors, Dr. K. Rajasekhara Rao and Dr. N. Venkatram; the Registrar, Dr. K. I. Pavan Kumar; and the Head of the Department of Electronics and Communication Engineering, Dr. Govardhini, for their institutional support and encouragement throughout this visiting professorship.