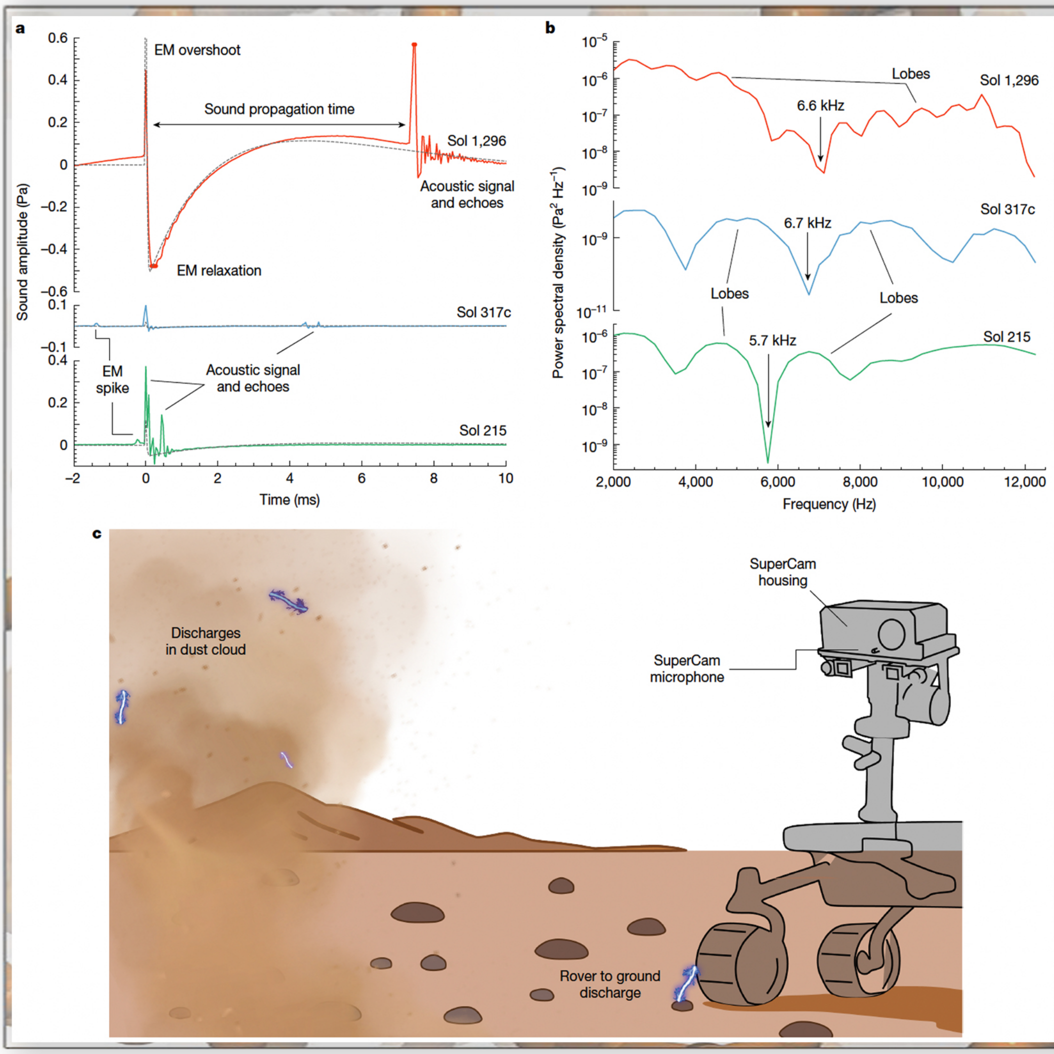
ATMOSPHERIC ELECTRICITY

NEWSLETTER

Vol.37 No.1 2026 May



Cover Story :

It reports in situ detections of triboelectric discharges, identified by their electrical and acoustic signatures captured by the Super-Cam microphone aboard the Perseverance rover11,12. Fifty-five events have been detected over two Martian years, usually associ-ated with dust devils and dust storm convective fronts. This in situ evidence may have implications for surface chemistry, habitability and human exploration.

More details refer to Chide, B., Lorenz, R.D., Montmessin, F. et al. Detection of triboelectric discharges during dust events on Mars. Nature 647, 865–869 (2025). https://doi.org/10.1038/s41586-025-09736-y

ICAE

IAMAS IUGG
https://www.iamas.org/icae/

*18*th International Conference on Atmospheric Electricity

Barcelona, July 13-17, 2026

https://icae2026.upc.edu

Dear Friends and Colleagues,

We are delighted to invite you the 18th International Conference on Atmospheric Electricity (ICAE 2026), which will be held in the colorful city of Barcelona, Spain. The International Conference on Atmospheric Electricity is the world's largest event dedicated to advancing the science of atmospheric electricity. ICAE 2026 provides an opportunity for researchers from all over the world to present the latest discoveries, exchange ideas, and the most important: learn, interact with your colleagues and make new friends.

This is the first time that ICAE 2026 lands in Spain. Our tradition in modern atmospheric electricity is dated at the beginning of XX century (1904) with measurements of atmospheric potential gradient, ions and air conductivity, and radio detection of lightning. After more than 100 years of tradition in atmospheric electricity, we are proud to host the ICAE 2026 in Spain.

The conference will be host at the Universitat Politecnica de Catalunya (Diagonal Campus) in Barcelona from July 13 to17, 2026.

Organized by:

International Commission of Atmospheric Electricity

Topics include:

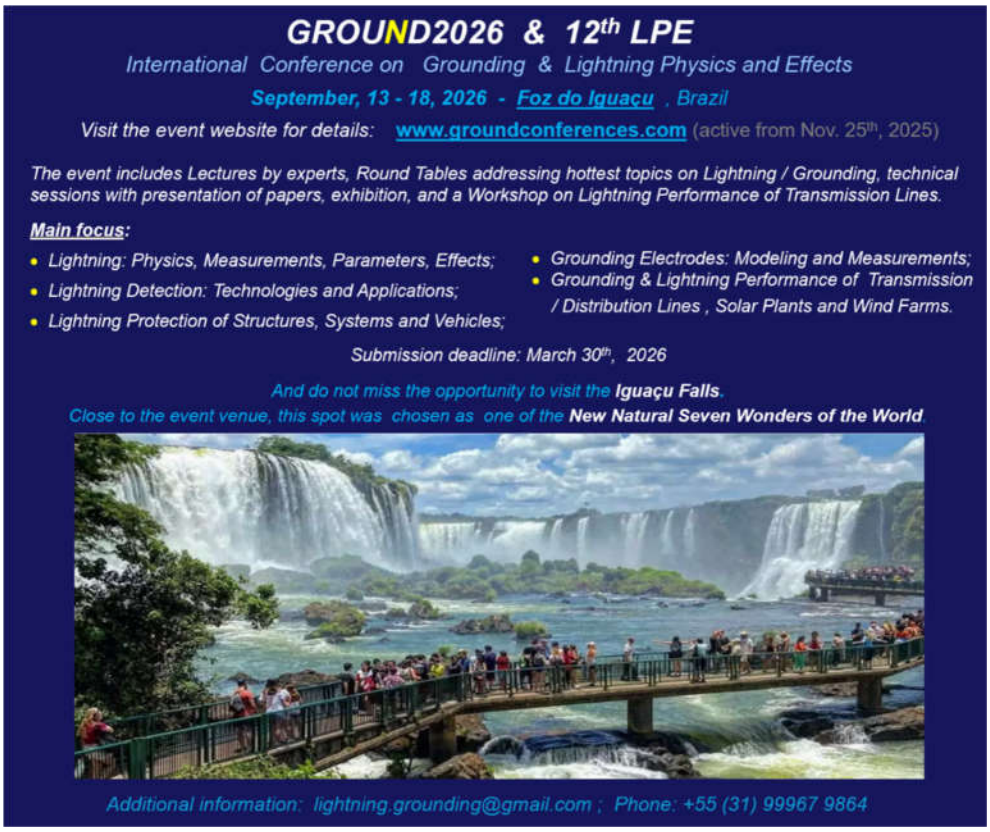
- Lightning Physics
- Lightning and Meteorology
- Meteorological Applications of Lightning Data
- Energetic Radiation from Lightning and Thunderstorms
- Thunderstorm Electrification and Microphysics
- Lightning Effects on the Middle and Upper Atmosphere

- Lightning Climatology and Chemical Effects
- Lightning and Thunderstorm Detection Technologies
- Space-based Lightning Detection
- Lightning Effects, Hazards and Mitigation
- Fair Weather and Atmospheric Ions
- Global Electric Circuit
- Planetary Lightning
- Ball lightning
- Climate Change and Atmospheric Electricity
- Artificial Intelligence (including Machine Learning) in Atmospheric Electricity
- Related Topics

Contact:

icae2026@event.upc.edu

*I*nternational Conference on Grounding & Lightning Physics and Effects



*D*octoral Positions

We are pleased to announce 2+1 doctoral positions at the Universitat Politècnica de Catalunya (UPC) as part of the European MSCA-DN GRAIL (Gamma Radiation from the Atmosphere for Investigation and Learning) project. In this action, 15 Doctoral Candidates will research high-energy phenomena emitted by thunderstorms, as well as their effects on nature and technology.

Two positions are available at the UPC and one position at DENA (industry):

Position 1: Doctoral Position at the UPC Lightning Research Group: Aircraft Interferometry
The main objective of this project is to investigate broadband (VHF and higher) radio emissions from lightning and other electrical breakdown processes in thunderstorms, with the ultimate goal of designing an unprecedented broadband digital interferometer (DINTF) for airborne applications. The candidate will participate in high-voltage laboratory experiments and field campaigns. The project will be done in close collaboration with Duke University including the ENLIGHTEN field campaign by deploying an interferometer onboard a stratospheric aircraft.

Download: Position brochure
Euraxess link: https://euraxess.ec.europa.eu/jobs/419204
Link to application form: https://forms.gle/A97adzK9r4aTRF2YA

Position 2: Doctoral Position at the UPC Lightning Research Group: Thunderstorm electrification and high energy radiation
The main objective of this project is to investigate how thunderstorm electrification influences the production of atmospheric high-energy emissions. The candidate will model lightning leaders depending on realistic thunderstorm charge environment derived from UPC's Lightning Mapping Arrays data including data obtained during the ENLIGHTEN aircraft campaign.
Download: Position brochure
Euraxess link: https://euraxess.ec.europa.eu/jobs/422015
Link to application form: https://forms.gle/xBV76bhre8dGGE2C6

Position 3: Doctoral Position at DENA: Research on high voltage laboratory radio and high energy emissions
The aim of this project is to investigate radio-frequency (RF) emissions associated with high-energy (HE) processes in electrical discharges, with a particular focus on atmospheric phenomena such as TGFs, FGFs, and GRGs. The research will be based on experimental studies of meter-scale high-voltage sparks using a dedicated setup capable of simultaneously measuring HE and RF emissions

across a broad electromagnetic spectrum. Atmospheric conditions will be reproduced by adjusting air density to simulate altitude-dependent effects. The goal is to identify RF signatures associated with high-energy emissions, analyze their temporal and spectral correlations, and evaluate their detectability. Special focus will be placed on advancing RF techniques through the design and development of a dedicated RF antenna to investigate emissions from high-energy atmospheric phenomena in future aerospace missions.

Euraxess link: https://euraxess.ec.europa.eu/jobs/421599

CMA Key Laboratory of Lightning, State Key Laboratory of Severe Weather Meteorological Science and Technology, Chinese Academy of Meteorological Sciences, Beijing, China

Reflectivity characteristics of isolated small-scale storms producing large-peak-current cloud-to-ground lightning in Guangzhou. This study analyzed radar and lightning data from 53 isolated storms (34 LCG-producing, 10 SCG-only, 9 non-CG). It reveals significant differences in updraft intensity between storms that produce LCG flashes and those that do not. Two parameters, the 40-dBZ echo top height (Top40) and the 40-dBZ echo area at 5 km altitude (Area40_5), effectively characterize updraft evolution related to LCG activity. Results show that storms exceeding thresholds (e.g., maximum Top40 >12 km or maximum Area40_5 >160 km²) exhibit markedly increased LCG frequency, with maximum production when both thresholds are exceeded. While overall updraft intensity (maximum Top40) affects total LCG production, storms with lower maximum Top40 but larger Area40_5 can also produce substantial LCGs, indicating sustained updrafts facilitate LCG production (Figure 1). For strong updraft storms (maximum Top40 >12 km), the first LCG typically occurs within 30 minutes when Top40 exceeds about 8 km during its increasing phase, and a positive correlation exists between maximum Top40 in that period and LCG counts. LCG flashes mainly occur during active updraft periods, as shown by the close correspondence between LCG frequency and Top40 evolution. Scans with LCG flashes show higher Top40 (9-11 km) and Area40_5 (50-100 km²) compared to SCG-only scans (8-9 km and 0-50 km²). The most intense LCG activity aligns with the growth phase of Area40_5, and after its peak, LCG activity declines rapidly. These findings confirm that Top40 and Area40_5 represent different aspects of intense updraft activity, and strong updrafts control LCG production. Frequent LCG lightning can serve as an indicator of vigorous updrafts and strong vertical development. However, due to the limited sample size, the specific numerical values may vary with more data and different storm populations, but the relative relationships are expected to remain stable. Also, these conclusions are derived from spatially limited storms, so generalizability requires further verification with more observations.

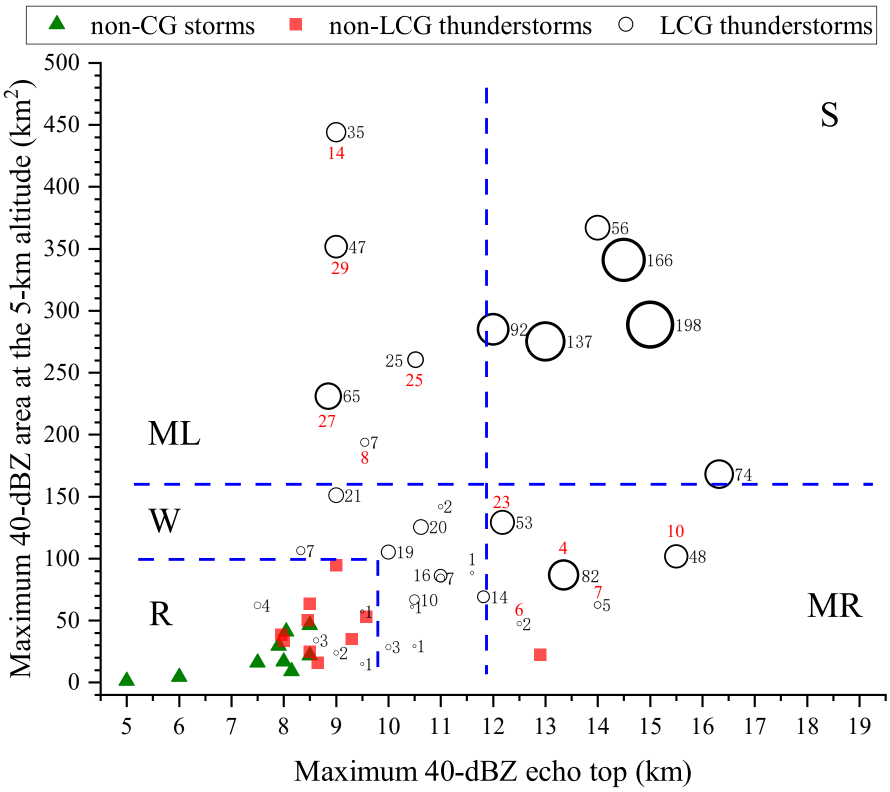


Figure 1. Relationship between the maximum 40-dBZ echo top height and 40-dBZ area at 5-km altitude for storms. Circles, red squares, and green triangles denote storms with LCG flashes, only SCG flashes, and no CG flashes, respectively. Circle sizes and adjacent black numbers indicate total LCG flashes per storm; red numbers in the ML/MR regions show sustained radar volume scans during storm maturity.

Characteristics of negative cloud-to-ground lightning flashes associated with their peak currents of first return strokes. This study investigates the characteristics of negative cloud-to-ground (CG) lightning flashes across varying peak current (PCs) ranges by combining 3D location data from 2597 negative CG flashes with radar observations. The flashes were classified into five PC bins: −25 kA < PC < 0 kA, −50 kA < PC < −25 kA, −75 kA < PC ≤ −50 kA, −100 kA < PC ≤ −75 kA, and PC ≤ −100 kA. Key parameters analyzed include initiation altitude, reflectivity at initiation points, vertical reflectivity cores, lightning extension spaces, horizontal distances between initiation and grounding points (HD), and time differences between the first-detected radiation source and the first return stroke (TD). Results reveal that while initiation environments were broadly similar across PC ranges, large-PC flashes tended to initiate at lower altitudes (1-3 km).

These flashes form first return strokes faster (the median TD for current bins below −75 kA is less than 44 ms, whereas for bins above −75 kA the median TD is greater than 57 ms) after shorter horizontal propagation (The median HD for current bins below −75 kA is around 1.0 km, while for bins above −75 kA the median HD exceeds 1.2 km) (Figure 2), with smaller pre-return-stroke extension areas. Despite this, large-PC flashes usually develop more extensive total channel areas. These findings underscore the distinct environmental conditions that facilitate the initiation and propagation of large-PC negative CG flashes during thunderstorms.

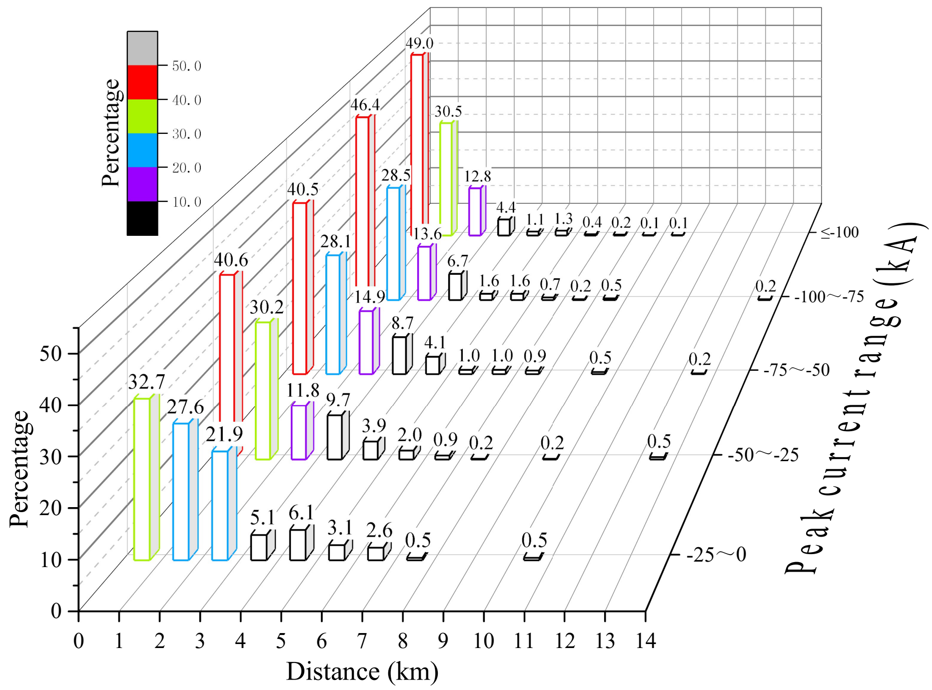


Figure 2. Distributions (%) of the horizontal distances between the initiation point and the first return stroke of negative CG flashes in different peak current bins.

HUN-REN Institute of Earth Physics and Space Science (HUN-REN EPSS), Hungary

Contributors: József Bór, Tamás Bozóki, Gabriella Sátori, Daniel Piri, András Barna Reichardt, Earle Williams

Observational results suggest that lightning discharges with continuing current may play a more important role in the generation of Schumann resonances (SRs) than previously thought. This highlights the need for accurate modeling of such sources. To address this, a modified analytical model of SRs was developed that incorporates continuing current excitation sources. Theoretical spectra calculated with this model were compared to spectra obtained using a full finite-difference time-domain (FDTD) numerical model. The results presented by Bozóki et al. (2025) show very good agreement between the two approaches, confirming that the analytical model is well suited to interpret ELF measurements for the purposes of studying global lightning activity or individual lightning discharges. For future SR studies, we propose using an exponentially decaying excitation source in the analytical model, as this may provide better agreement with observations than the traditionally used impulse-like excitation source.

Reports on ongoing investigations have been presented in the General Assembly of the European Geophysical Union in Vienna (3–8 May 2026). Bór and Yair (2026, EGU26) demonstrated that involving citizen observers in ground-based observation campaigns associated with space-borne observation missions can in fact help achieving mission goals. In the UHU experiment (https://uhu.epss.hu/en/), an associated ground campaign was organized to obtain optical records of a TLE simultaneously from the ground and from space. Among the experiences shared, it can be highlighted that organizing an extensive community of observers is challenging, and that efficient communication is of key importance from the point of view of achieving success. In the UHU experiment, all necessary conditions were met to fulfill the above-mentioned goal of the mission, and only the unfortunate selection of observation targets for the astronauts prohibited achieving it.

Steps are being made to benefit from the ELF-band monitoring site (JAR, https://jeli.sr.epss.hu/) that has been set up in September 2024 in Hungary. The site was established to have good quality magnetic field measurements in addition to the long-running electric field measurements in the geophysical observatory of EPSS (NCK, https://nckobs.hu/data/sr/). Reichardt et al.

(EGU26) suggests a metric to characterize the quality of ELF-band radio observations quantitatively from the point of view of their suitability for Schumann resonance research. Clear differences in the quality values appear between data recorded in winter and in summer. The quality indicator is supposed to be obtainable for any ELF band time series.

Variations of global lightning distribution are studied by changes of DFRs (daily frequency range) using the 1st and 2nd Schumann resonance modes of the vertical electric field component measured in the Széchenyi István Geophysical Observatory (NCK) at Nagycenk, Hungary, during three consecutive solar cycles.

Power distribution and transmission lines both in Hungary and Italy were used to measure the air-earth current of the global DC-circuit. Improvements from an initial short line measurements (40 m and 1.5 km) in Hungary have recently been achieved with a longer line (12.8 km) near Milan, Italy. A custom designed AC-filter and sensitive ammeter was developed and the collaboration with the Italian power company Terna S.p.A enabled the use of an out-of-service transmission line in relative isolation from energized lines. Further evaluation of global representativeness is under way.

INPE, National Institute for Space Research, Brazil

The lightning physics research group at the National Institute for Space Research (INPE), Brazil, led by Dr. Marcelo M. F. Saba, is dedicated to investigating the physical processes associated with lightning flashes through the integrated use of different sensors: high-speed cameras, Lightning Location Systems (LLS), electric field sensors, Lightning Mapping Arrays (LMA), among others.

The group is currently composed of two master’s students, two PhD students, two technical training fellows, two postdoctoral researchers, and one external collaborator. A summary of the main research activities developed by the group is presented below.

Pre-trained neural network. The group is implementing machine learning techniques based on pre-trained neural networks for lightning image analysis, with the participation of master’s student Hentony dos S. Barbosa. This research line follows recent advances in the field, including a study co-authored by Dr. Marcelo M. F. Saba in collaboration with researchers from South Africa, in which deep neural networks (Xception-BiLSTM) were used to estimate the peak current of return strokes from high-speed camera images (Essa et al., 2026).

Lightning flashes on wind turbines. The group investigates lightning interaction with wind turbines, with a focus on both upward and downward lightning flashes. In this context, a recently approved project in Brazil involves Dr. Tagianne P. da Silva, engineer José Claudio de O. e Silva (both technical training fellows), and M.Sc. João C. M. Alves (PhD student), who will participate in different stages of the project, from data acquisition campaigns to the analysis of lightning records obtained at wind farms in Croatia, South Dakota (USA), and Rio Grande do Sul (Brazil). Recent results obtained by the group using high-speed camera observations have allowed the characterization of the temporal evolution of upward lightning in wind turbines, including the identification of their different phases and comparisons with upward lightning observed in static structures such as telecommunication towers (da Silva et al., 2026).

High-speed camera lightning monitoring and positive cloud-to-ground lightning analyses. The group conducted lightning observations during the summer of 2025–2026 using instruments installed in Lorena (SP, Brazil). The monitoring was carried out by PhD student M.Sc. Diego R. R. da Silva, who also developed analyses of high-speed camera recordings of positive cloud-to-ground (+CG) lightning flashes. A recent result from this line of research revealed the existence of two propagation modes of positive leaders (with and without branching, see Figure 1), which differ mainly in leader propagation speed and peak current. Branched positive downward leaders tend to exhibit recoil leaders, lower speeds and smaller peak current values, while unbranched positive downward leaders are faster and associated with higher peak current values. In addition, a strong correlation has been observed between the final propagation speed of the positive leader and the peak current of the return stroke (Saba et al., 2026).

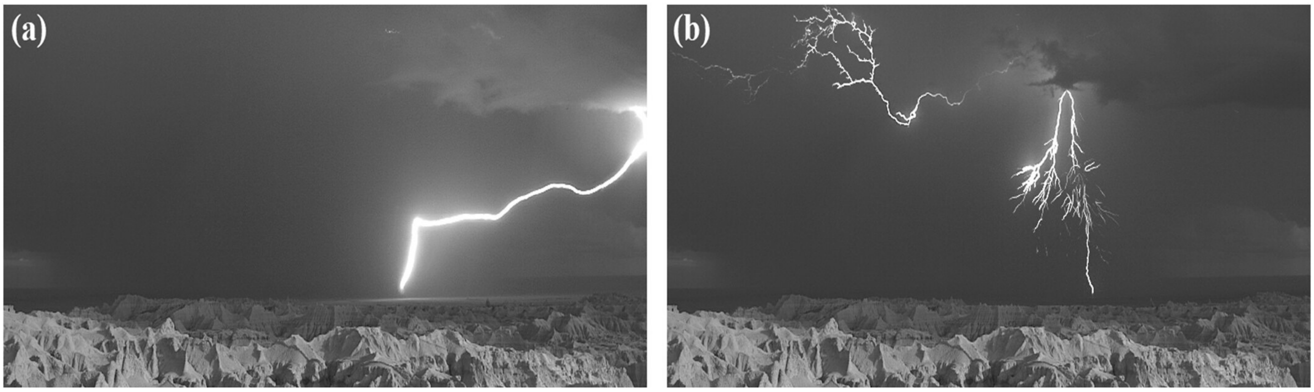


Figure 1. Time-integrated image of all video frames. Image (a) shows an unbranched positive downward leader. Image (b) shows a branched positive downward leader. From Saba et al. (2026).

Leader propagation. Another research line of the group is dedicated to investigating different processes involved in lightning, covering from the initial stages of formation to ground connection. In this context, Dr. Ivan T. Cruz will develop, in Brazil, a recently approved postdoctoral project focused on the investigation of positive and negative leaders in lightning flashes. This line of research also includes the participation of master's student Danilo Bueno.

Recent results from the group include the first observation and characterization of positive upward illumination (+UI) discharges, a rare phenomenon associated with competing branches of a single leader, in which a secondary branch connects to ground a few milliseconds after the main discharge, producing a short and partially illuminated channel. The study presents the first records of this phenomenon in positive cloud-to-ground lightning (Saraiva et al., 2026).

Relativistic runaway electron avalanche modeling. Understanding processes associated with Relativistic Runaway Electron Avalanches (RREA) is essential for advancing the knowledge of atmospheric electrical phenomena and high-energy emissions. In this context, Dr. Gabriel S. Diniz (postdoctoral researcher) uses Monte Carlo simulations with the GEANT4 code to investigate RREA development in simulated thunderstorm environments. This work is developed in collaboration with different institutions and uses the high-performance computing infrastructure of the Academic Center for Computing and Media Studies at Kyoto University.

Long continuing current. Dr. Paola B. Lauria (collaborating researcher) is currently analyzing hundreds of high-speed camera videos recorded in Lorena (SP, Brazil). This work aims to study long continuing currents produced by lightning flashes. For this purpose, she compares video information with electric field sensors data from the Fire Neural Network (FNN).

Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP, CAS), Beijing, China

HRUnet: A deep learning model designed for lightning forecasting at high spatial resolution. A novel deep learning architecture, High-Resolution U-Net (HRUnet), is developed to address the critical lack of precise lightning forecasting at a high spatial resolution of 1x1 km. Utilizing historical weather radar and lightning detection data from Binzhou, China, the researchers constructed a model that significantly improves upon traditional frameworks by integrating three key structural innovations. The study incorporates an InceptionRes-Convolutional Block Attention Module (IR-CBAM) to enhance spatial-temporal feature extraction, utilizes PixelShuffle modules instead of standard pooling to prevent information loss during resolution transitions, and introduces a specialized "focus loss" function to systematically mitigate the extreme class imbalance inherent in lightning probability datasets. This enhanced architecture allows the model to capture the complex dynamics of thunderstorm cells far more effectively than existing methods. Consequently, HRUnet demonstrates superior predictive capabilities regarding the initiation, development, and dissipation of lightning clusters, achieving a 10.86% absolute equitable threat score (ETS) improvement over the baseline and outperforming other state-of-the-art deep learning models. This advancement offers a highly accurate, computationally efficient tool that could significantly mitigate lightning-induced hazards across vulnerable infrastructure. (Figure 1, Wu et al., 2026)

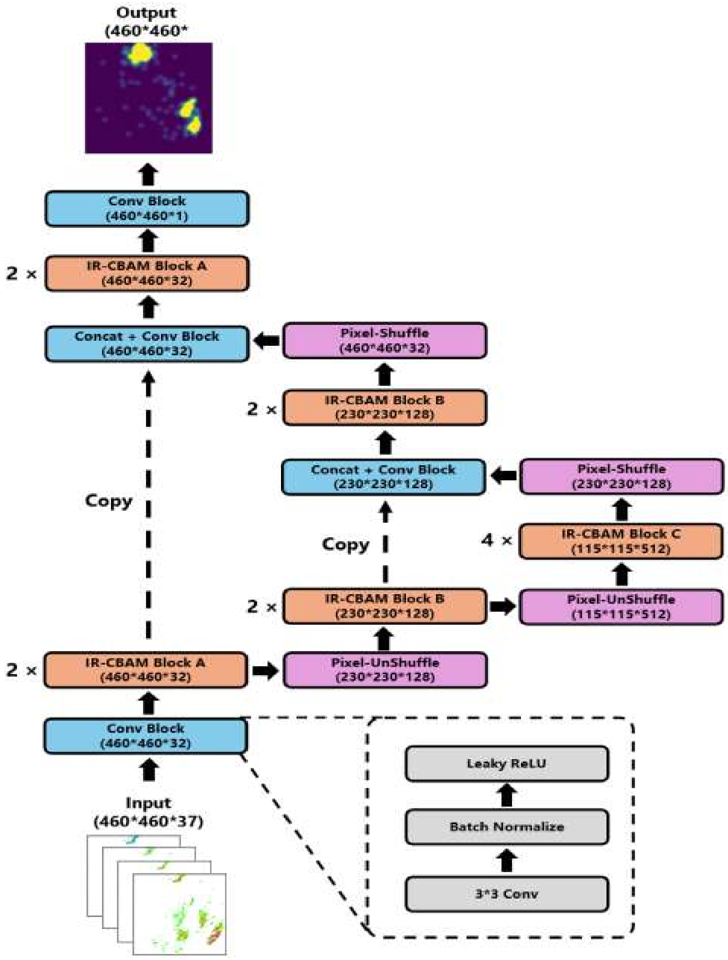


Figure 1. Scheme of HRUnet.

Future trend of lightning activity over the Tibetan Plateau under global warming. A comprehensive climatological study is conducted that links historical lightning activity trends over the highly sensitive Tibetan Plateau (TP) to future global warming projections. Using 18 years of continuous satellite data from the Optical Transient Detector (OTD) and Lightning Imaging Sensor (LIS) combined with CMIP6 climate model outputs, the authors analyzed historical flash densities and discovered a significant, consistent increase of 0.064 fl km^{-2} y^{-2} across the eastern TP. The study develops a robust regional proxy via multiple linear regression, revealing that large-scale atmospheric circulation—specifically driven by sea surface temperatures northwest of Australia—coupled with local surface temperatures, are the primary drivers of interannual lightning variability, explaining 67% of the variance. This challenges the traditional reliance solely on local thermodynamic factors for predicting regional lightning, underscoring the critical, newly identified role of remote oceanic thermal forcing. Furthermore, the study provides compelling projections indicating that lightning activity will surge by 32% under a low-emission scenario (SSP1-2.6) and by a drastic 60% under a moderate-emission scenario (SSP2-4.5) by the end of the century. (Huang et al., 2026)

Increased thunderstorm activities caused by warming and wetting over the Tibetan Plateau. A comprehensive observational study investigates the divergent trends of thunderstorm activities over the highly climate-sensitive TP using a newly generated, continuous thunderstorm dataset derived from World Wide Lightning Location Network (WWLLN) data between 2010 and 2024 via a density-based spatial clustering algorithm. The authors discover a significant long-term dichotomy: while thunderstorm frequency has substantially increased over the past two decades, the intensity of these storms—measured by their lightning production capacity—has concurrently decreased. Through composite analysis of thermodynamic environments, the study reveals that the surge in thunderstorm frequency is primarily driven by enhanced Convective Available Potential Energy (CAPE) resulting from increased near-surface specific and relative humidity across the entire plateau. Conversely, the weakened storm intensity is attributed to a reduction in ice-phase microphysical processes in favor of warm rain processes. This microphysical shift is triggered by distinct regional factors: wetter soil conditions in the western TP, which lower the lifting condensation level, and ambient warming in the eastern TP, which raises the freezing level. Both regional shifts effectively deepen the warm cloud layer and suppress the cloud electrification mechanisms required to generate lightning. These findings highlight the complex and sometimes opposing responses of severe convective weather to regional warming and wetting, providing critical insights into future global energy reallocation and the Asian water cycle. (Zhu et al., 2026a)

Thermal deformation correction for the FY-4A LMI. A targeted methodological study addresses a critical observational limitation in the Fengyun-4A (FY-4A) Lightning Mapping Imager (LMI): the daily periodic lightning positioning deviations induced by the thermal expansion and contraction of the payload under varying direct solar radiation. Because current operational correction algorithms rely on surface feature matching and perform poorly at night — when LMI's detection efficiency is paradoxically at its peak — researchers developed a novel correction method utilizing high-precision ground-based lightning location data from the WWLLN and the Beijing Broadband Lightning Network (BLNET) as reference standards. By extracting the coordinate differences between space-based observations and ground-based references, the study reveals that nighttime thermal deformation creates a distinct bimodal deviation pattern as the satellite transitions through the Earth's shadow. To rectify this, the authors applied a weighted multi-peak Gaussian curve fitting approach, adaptively adjusting the model based on data density and standard deviations to robustly capture the complex, lagged thermal displacement trends. This empirical correction framework successfully mitigates systematic biases without requiring redundant physical environment simulations, significantly enhancing the spatial reliability of LMI products by reducing nighttime positioning errors to an accuracy within ±1 pixel. (Zhang et al., 2026)

Evolutionary characteristics of charge structure in an atypical bottom-heavy thunderstorm over the central Tibetan Plateau. A comprehensive observational study reconstructs the lifecycle of a unique, bottom-heavy thunderstorm over the central TP that exclusively produced intra-cloud (IC) lightning. Utilizing high-precision very high frequency (VHF) lightning interferometers synchronized with C-band Doppler radar and multi-band electromagnetic field measurements, the researchers detailed the dynamic charge structure evolution within different convective regions of the storm. The analysis reveals the concurrent existence of a persistent inverted dipole and a tripolar charge structure characterized by an unusually large lower positive charge center (LPCC). During stages of weak convection, the storm maintained an inverted negative dipolar structure, but as updrafts intensified into the mature stage, an upper positive charge region formed—driven by ice crystals and snow aggregates—creating a complete tripolar structure. Notably, the robust LPCC, primarily composed of positively charged graupel particles, effectively suppressed all cloud-to-ground (CG) lightning. Consequently, lightning activity was restricted entirely to IC flashes, reaching a maximum rate of 4 fl/min, which predominantly initiated as negative IC flashes between the middle negative charge region and the LPCC. This study provides novel microphysical and electrical insights into the distinct, atypical charge configurations of high-altitude thunderstorms, significantly contrasting them with typical lower-elevation convective systems. (Figure 2, Liu et al., 2026)

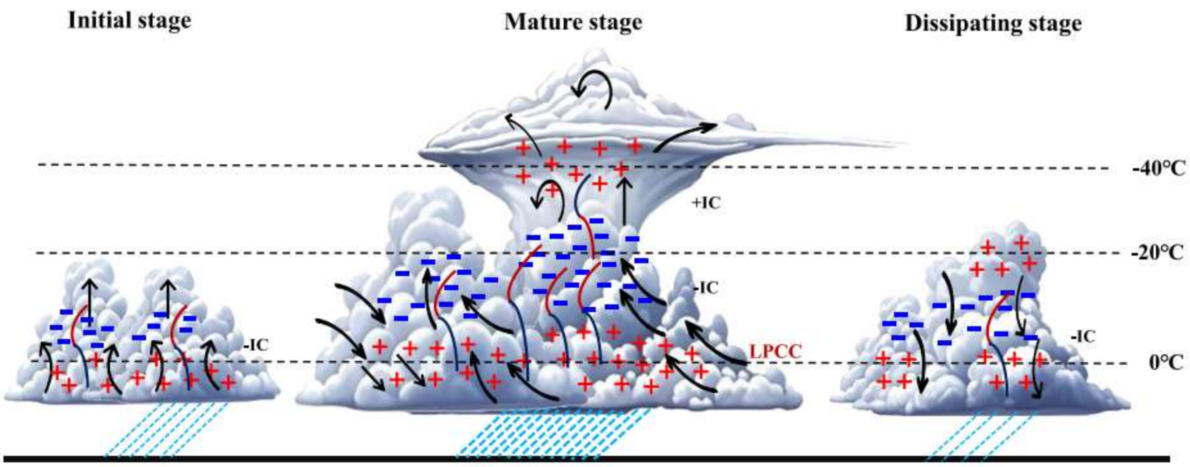


Figure 2. Schematic diagram of the evolution of the charge structure in a bottom-heavy thunderstorm over the central TP. Red "+" stands for the positive charge region, and blue "−" for the negative charge region. Dark red lines represent the positive lightning channels, and deep blue lines represent the negative lightning channels. Brighter blue lines stand for the rainfall. Black arrows stand for the airflow and black dashed lines stand for the environmental temperature.

Stratospheric intrusions over Hong Kong: Impact and seasonality based on long-term ozonesonde records. A comprehensive climatological study investigates the impact and seasonality of stratospheric intrusions (SI) on tropospheric ozone (O_3) levels in the Pearl River Delta (PRD) region of southern China, a megacity cluster uniquely situated far from typical stratosphere-to-troposphere transport (STT) hotspots. By integrating 24 years (2000–2024) of high-resolution ozonesonde records from Hong Kong with MERRA2-GMI chemical reanalysis data and HYSPLIT trajectory simulations, the researchers established a robust SI detection method to track both direct and indirect stratospheric injections. The study reveals that tropopause foldings—primarily triggered by cut-off lows (COL) and short-wave troughs—act as the main mechanism for injecting dry, O_3-rich stratospheric airmasses downward, while the topographic forcing of the TP significantly facilitates their downstream transport to the PRD. Climatological analysis spanning 2000 to 2019 demonstrates that SI events occur most frequently and penetrate deepest into the troposphere during winter (accounting for 85.9% of events alongside spring). This deeper winter penetration is anti-correlated with CAPE, as lower CAPE allows stratospheric filaments to descend with less convective erosion. Conversely, while summertime SI events are rarer and shallower due to high CAPE, they paradoxically induce the largest O_3 enhancements in the upper troposphere, frequently facilitated by typhoon activity. These findings provide critical quantitative constraints on natural stratospheric O_3 inputs, which is vital for formulating accurate anthropogenic emission control policies in highly polluted receptor regions. (Chen et al., 2026)

Israel Atmospheric Electricity Group

The *CRAIG* campaign (*Cosmic Radiation In Greenland*) was launched in April 2026 and was able to obtain new CR data in a region where no previous measurements were conducted. Yoav Yair (Reichman University) and Yuval Reuveni (Ariel University) initiated ground-based cosmic-ray measurements in Svalbard and Greenland, using a portable detector that was developed by Karen Aplin (U. Bristol; Aplin et al., 2026). The expedition was led by Gal Yoffe and Reut Soreq-Abramovitch from ArcTerra and consisted of 5-days in Svalbard (on snow bikes) and a 3-week west-east traverse of the southern Greenland icecap by foot. Data was transmitted via Starlink, and results will be published when analysis is complete.

While the Israeli Ez stations in the Negev desert and Mt. Hermon were recently rendered dysfunctional due to security considerations, a new project was launched in March 2026 to continue ground-based observations. "*SeaEz*" is a new shipborne campaign for measuring the fair-weather electric field on board a ship near the coastal region of Israel and the Mediterranean Sea. A CS110 detector was mounted on the mast of the MEDEX research ship, harbored in the Herzliya marina of central Israel. Roy Yaniv and Assaf Hochman from Hebrew University of Jerusalem and Yoav Yair from Reichman University will conduct short-term sailing expeditions in order to track the daily cycle of the electric field in the marine boundary layer, as well as the effects of transported air-pollution and Saharan dust.

Carynelisa Haspel and Assaf Hochman (Hebrew University of Jerusalem together with Yoav Yair (Reichman University) are working with student Jonathan Bar Zeev on simulations of sprite generation in Jupiter's atmosphere, using the 3D model developed by Haspel et al. (2022). Initial results suggest that for reasonable charge amounts and realistic lightning discharge current profile, potential sprite inception in the Jovian mesosphere can persist longer and cover a larger volume than on earth, suggesting that sprites there will have lateral and vertical dimensions significantly larger than on earth. Results were presented at the EGU General Assembly in Vienna, during session NH1.11.

Yoav Yair, Menahem Korzets and Karin Pitlik (Reichman University) continue the analysis of severe Mediterranean thunderstorms, as part of a project led by Colin Price (Tel-Aviv University). They we evaluate the skill of atmospheric predictors - meaning LPI, KI, CAPE, and precipitation – all computed from WRF ensemble simulations, in reproducing observed lightning activity. Ten case studies were selected, representing different synoptic conditions in winter. A comprehensive processing pipeline was developed to co-register model outputs and ground-based lightning detections from the ILDN and ENTLN networks onto a uniform 4 × 4 km grid and 3-hour temporal intervals. Spatially, all parameters were averaged per grid cell. Temporally, precipitation was summed, while other variables (LPI, KI, CAPE) were averaged over each period. All datasets were smoothed with a Gaussian kernel to reduce spatial noise and enable direct comparison across domains. The analyses indicate that thermodynamic indices and accumulated precipitation exhibit broad spatial footprints, significantly overestimating the areal extent of lightning activity. While LPI also displays a tendency towards broader coverage than observed, it demonstrates the highest degree of spatial localization among the examined parameters.

As part of the above project postdoc Vlad Landa, together with Colin Price (Tel Aviv University), has developed a new lightning nowcasting algorithm based on machine learning and AI. The algorithm uses only local lightning data to save time in the provision of the nowcasts. We are also working on a nowcasting scheme over Africa using the MTG lightning and cloud data.

Colin Price, together with Alex Golberg and undergraduate student Aviv Shay have been working on the mystery behind the large Sargassum (seaweed) blooms in the tropical Atlantic. Since 2011 there have been annual blooms of Sargassum. Others have claimed desert dust or upwelling along the Canary Islands coasts may supply the nutrients needed. However, none of these sources match the spatial distribution of the seaweed blooms. We propose that the thunderstorm activity over the Atlantic, and the NOx production by lightning, produce nitrates and nitrites in the rainwater, acting as a natural "fertilizer" for the Sargassum blooms.

Colin Price, together with graduate students Hadar Reshef, Noam Tishler, Shachar Shoval and Lidor Ivgi are analyzing the MTG-LI data over Africa to better understand the relationships between lightning and 1) African Easterly Waves; 2) biomass burning aerosols; 3) severe weather; and 4) the Hadley circulation.

Colin Price, together with Michal Gruntman and PhD student Muriel Said, is investigating the connection between the fair-weather DC electric field and plant physiology. We have purchased two field mills for monitoring the fair-weather field in the university's botanical garden, and we plan to also measure the electric fields near the leaves of plants. This is related to the Bristol study showing that plants and bees use the fair-weather field during pollination. We also plan to study the impact of the AC Schumann resonance fields on plants in laboratory settings.

Langmuir Laboratory for Atmospheric Research, New Mexico Tech, USA

The Langmuir Lab team's recent publications span topics from lightning initiation and channel physics to optical diagnostics and regional climatology.

In a late-2025 study published in Geophysical Research Letters, Bennecke et al. examined 14 high-power narrow bipolar events (NBEs) recorded in Florida, each followed by a puzzling oscillatory signal. Using empirical mode decomposition and broadband interferometry, they demonstrated that the oscillations are evidence of a standing electromagnetic wave resonating within the ion-filled plasma cavity left by the preceding streamer system. The cavity's fundamental mode wavelength equals twice the radiator length, and the residual conductivity of 0.01–0.1 mS/m points to an ion trail formed as electrons attach to oxygen molecules.

Also in late-2025, Pantuso et al. (Geophysical Research Letters) used self-consistent simulations of an unbranched positive leader to explore how channel cutoff and dart leaders naturally arise. The simulations show that positive leaders exist in an unstable equilibrium and spontaneously undergo cutoff, accumulating negative charge at the junction between decayed and active channel segments. A residual conductivity in the cutoff region converts the local electric field enhancement into a reionizing traveling wave—a dart leader—enabling the frail positive leader to continue propagating without any channel branching.

In early 2026, Stover and da Silva (Journal of Applied Meteorology and Climatology) analyzed 22 years of National Lightning Detection Network data to map seasonal and geographical lightning patterns across New Mexico. Lightning peaks in July and August afternoons in the eastern Great Plains region near the Texas border, while secondary hotspots occur in forested mountain ranges such as the Gila and Lincoln National Forests, which face the highest risk of lightning-ignited wildfires.

Wemhoner et al. (Scientific Reports, 2026) introduced SOPAPILLA, a near-infrared photometer array at Langmuir Lab designed to measure temperatures of lightning and its sub-processes. Across 23 return strokes, the average peak temperature was 34.8 kK, and peak temperature was found to have weak correlation with peak current (Figure 1). The instrument also resolved that dart leader channels are on average 3.5 kK cooler than the ensuing return stroke, and that a return stroke followed by continuing current can sustain temperatures around 20 kK for at least 10 ms.

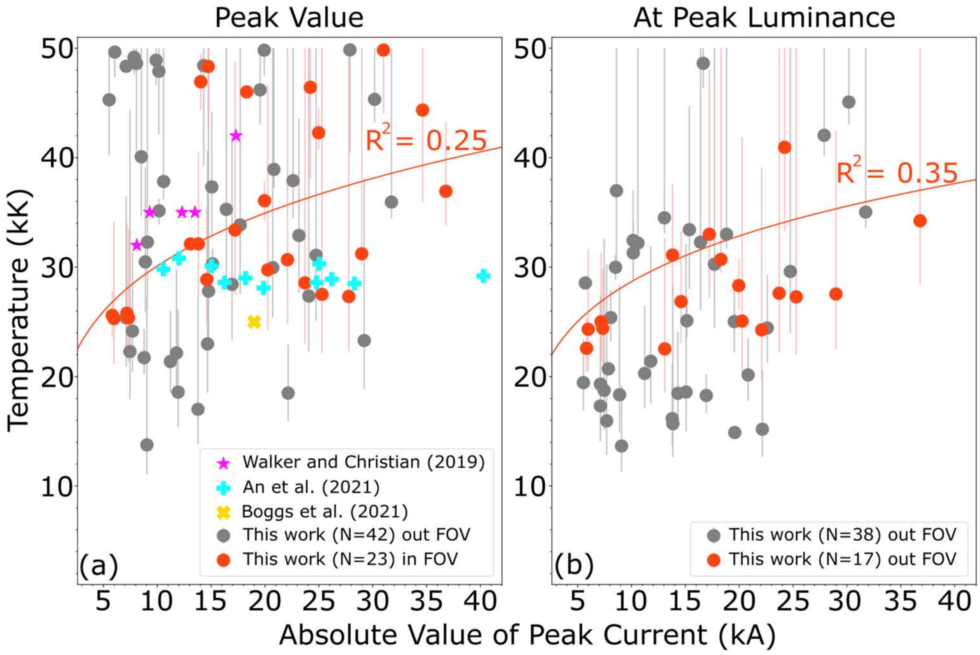


Figure 1. Large-scale study of the relationship between temperature and peak current as determined from a photometry-based technique. This is Figure 2 of Wemhoner et al. (Scientific Reports, 2026).

Most recently, Leal et al. (Geophysical Research Letters, 2026) combined simultaneous ultraviolet (337 nm), near-infrared (777 nm), and broadband radio observations of 11 cloud-to-ground lightning flashes. The 337 nm emission consistently peaked 38 μs before the 777 nm peak, with faster rise times and a stronger correlation with peak current ($R^2 = 0.62$ vs. 0.25). These results reveal that ultraviolet emissions reflect cold-streamer attachment processes while near-infrared emissions trace the hotter return-stroke channel, demonstrating that multiband optical observations offer powerful new tools for characterizing lightning. In addition, two students have received PhD degrees from New Mexico Tech in 2026: Dr. Luis Contreras-Vidal and Dr. Jacob Wemhoner.

LOFAR Lightning Group

We are continuing to improve our imaging pipeline to create more detailed images of lightning using the LOFAR radio telescope. Most recently we imaged an airplane flying out of Schipol airport (Scholten et al. 2025a). This airplane was apparently producing copious small sparks from its engines and below the tail (although not at wing or tail tips), which provided an excellent opportunity to both validate and refine our imaging process. Using this opportunity, we developed a new imaging technique that adaptively adjusts integration periods to center around peaks in the beamformed VHF spectrum; as opposed to taking consecutive integration periods which can cut VHF sources in-half. The result is that we were able to resolve VHF emission locations with significantly better than a meter precision. We could resolve the length of the jet engines using the sources detected near both the exhaust and intake, and deduce that the airplane was banking by 14 degrees.

We are now using our new imaging techniques to great effect. We have recently published a work investigating the starts of intracloud dart-leaders (sometimes referred to as recoil leaders) (Figure 1, Wu et al. 2026). We show that sometimes, just before a dart leader, there appear to be smaller dart leaders (100-500 m long) that propagate along nearby positive leader branches. We refer to these as "backwards darts" since they appear to propagate "backwards". That is, they are most likely negatively charged and propagate towards positive leader tips. Occasionally, these backward darts are followed by VHF sources that occur randomly along the backwards dart's length for roughly 500 µs duration. We interpret these results as strong evidence for accumulation of negative charge just before and at the location of the initiation of a dart leader.

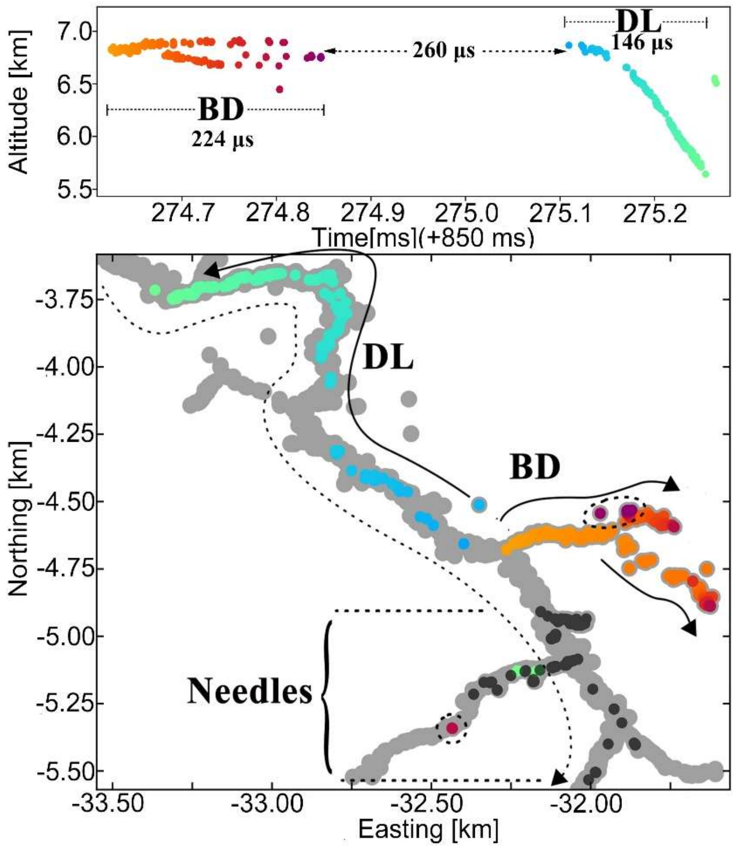


Figure 1. Backwards dart preceding a dart leader. The grey dots show radio source locations from all time, thus showing the location of a positive leader channel. The black dots show locations of needles,

which occurred before t=274.6 ms (outside the displayed timespan), and are closest to the tip of the positive leader (which is somewhere to the south-east). The root of the flash, and thus negative leader, is to the north-west and lower altitude. This figure shows a backwards dart (BD) and dart leader (DL) both colored by time. The backwards dart propagates away from the main channel, towards the tip of a positive leader branch. The dart leader starts 260 µs later, and propagates along the main channel towards the negative leader. Figure modified from Wu et al. (2026).

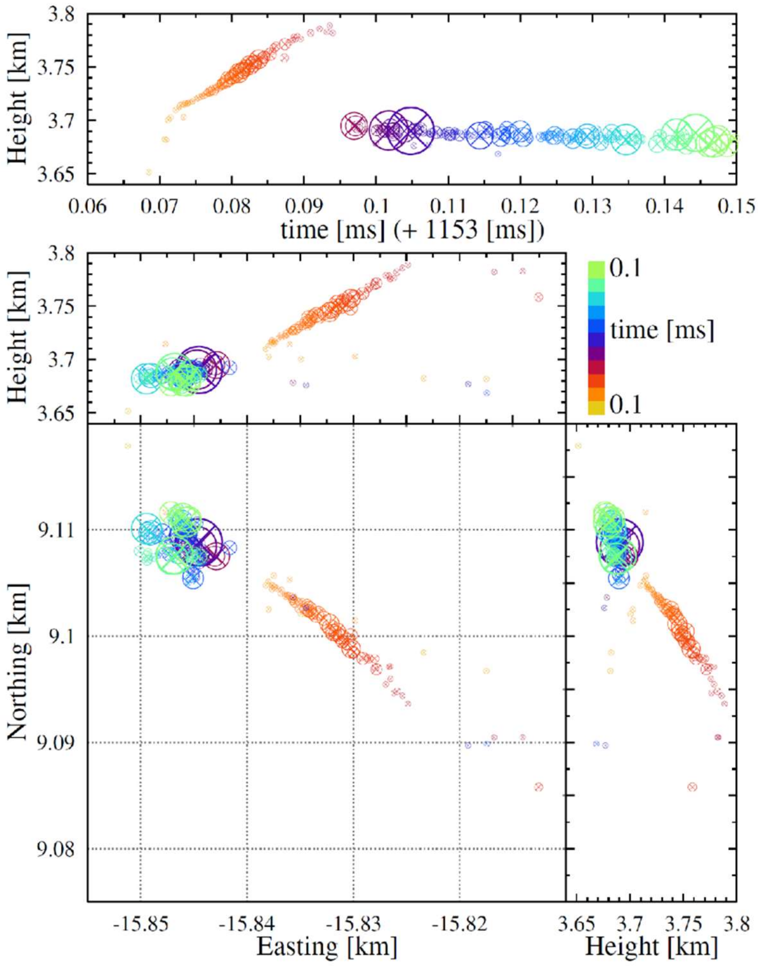


Figure 2. A positive initiating event (PIE) can be seen between t=0.07 ms and 0.09 ms. It propagates upwards and to the south-east over roughly 100 m. Its direction indicates it is positively charged. A negative leader initiates after the PIE at t=0.095 ms. The negative leader propagates downwards at initially lower speed. Figure borrowed from Scholten et al. (2025b).

We have also imaged the initiation of seven lightning flashes. This work is currently under review at JGR: Atmospheres (preprint available at Scholten et al. 2025b). These initiating events consist consists of a positively-charged discharge propagating at around 5×10^6 m/s, with lengths ranging from roughly 30 m up to 300 m (Figure 2). The results are consistent with and build on previous work in Sterpka et al. (2021). The paths of later dart leaders show that these positive initiating events (PIE) are not producing conducting channels. In this way, they have some similarities to fast breakdown (positively charged, around 100 m in length, and not strongly-conducting), however there are significant differences. Primarily, PIEs are significantly slower, and are less than a meter wide even after having propagated over 100 m. The lack of conductivity shows that the PIE has not established a leader channel, but the extremely narrow width makes it very difficult to interpret these PIEs as systems of streamers.

Finally, we have multiple works under final preparation to be submitted soon. This includes a Monte Carlo analysis of LOFAR polarization reconstruction accuracy, imaging of the corona at the front of negative leaders, and imaging of a volume of small sparks milliseconds before lightning initiation.

Massachusetts Institute of Technology

Contributor: Earle Williams

Air-earth current measurements to a transmission line. A long (12.8 km) decommissioned and unenergized power transmission line on the outskirts of Milan, Italy has been made available indefinitely for a trial measurement of the air-earth current of the DC global electrical circuit. This special opportunity is the product of a collaboration among MIT (Earle Williams), the Department of Electrical Engineering at Federico II in Naples (Amedeo Andreotti), TERNA (a large power company centered in Rome), and the Geodetic and Geophysical Institute in Sopron, Hungary (Daniel Piri and Jozsef Bor). Jumpers on one pylon of the transmission line have enabled the independent measurement of air-earth current to separate sub-segments of the line (8.0 km and 4.8 km, respectively) as a weak test of global representativeness. All three phase wires are used for current collection. The single overhead wire is retained for lightning protection. Remote access to the current readings has been established via a datalogger with rf link. Comparative current measurements are underway to evaluate global representativeness in fair weather conditions.

Mechanism for thunderstorm electrification. A new mechanism for charge separation in thunderstorms based on L-defects in ice and the diffusional transfer of protons (H+) from graupel in collisions with ice crystals by Kang, Jayaratne and Willams (JGR, 2023), earlier successful in explaining the findings of a novel laboratory experiment by Mason and Dash (2000) without riming, has now been extended to riming conditions typical of thunderstorms. The physical origins of the L-defects (microscopic deposition of water vapor) and protons (CO2 dissolution in ice) remain the same, but now the rimed ice is warmed by the latent heat of freezing which greatly increases its L-defect concentration. A theoretical model predicts that graupel will charge negatively in collisions with crystals at modest LWC, but positively at high LWC. The predictions are broadly consistent with laboratory charging patterns and with the existence of highly prevalent positive cloud dipoles and infrequent negative cloud dipoles in thunderstorms. The new findings will appear soon in JGR-Atmospheres (Kang, Williams and Jayaratne, 2026).

School of Earth and Space Sciences, University of Science and Technology of China (USTC), Hefei, China

Could narrow bipolar events serve as a distinct lightning proxy for revealing overshooting thunderclouds development? Narrow bipolar events (NBEs) are fast intracloud discharges frequently associated with the upper regions of intense thunderstorms, while overshooting thunderclouds (OT) represent deep convective updrafts that penetrate above the tropopause and influence stratosphere-troposphere exchange. However, how and under what conditions OT produces such discharges remains unclear. Using three years of ground-based lightning observations over South China together with simultaneous Himawari-8 cloud-top brightness temperature measurements, we developed a more accurate OT detection algorithm to first investigate the effects of OT morphology and phase on NBE genesis. The unprecedented data set of 6,646 OT cells and 117,518 NBEs were identified. Approximately 52% of OTs are associated with NBEs, and NBE occurrence increased strongly with OT vertical depth, exceeding 75% when OT depth was greater than 10 K, while showing little dependence on horizontal area. The polarity of NBE outbursts was closely linked to OT evolution: positive NBE outbursts preferentially occurred during the upwelling stage, whereas negative NBE outbursts were concentrated during the decaying stage. Our results suggest that ground-based radio observations of NBE occurrence and polarity can provide a distinct proxy for remotely diagnosing OT dynamics, offering an effective new approach for monitoring the coupling process from the thundercloud to the lower stratosphere. (Figure 1, Wu et al., 2026, Geophys. Res. Lett.)

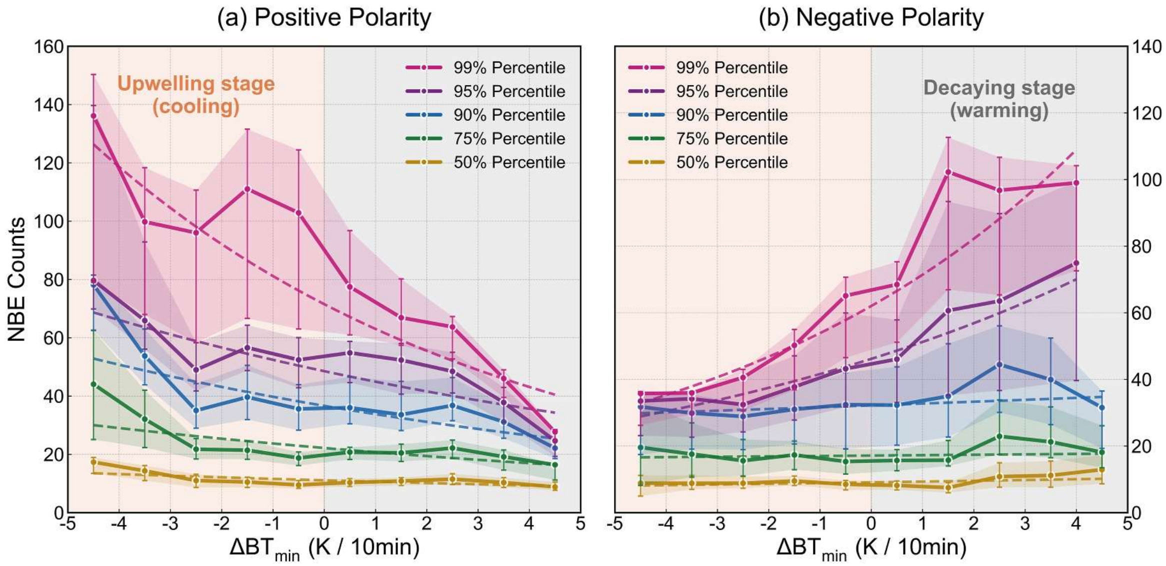


Figure 1. Variations in the distribution of narrow bipolar event (NBE) counts as a function of the change rate of minimum cloud top brightness temperature over time (ΔBT_{min}). The statistics are presented separately for (a) positive polarity and (b) negative polarity. The solid lines with markers depict the smoothed 99th, 95th, 90th, 75th, and 50th percentiles of NBE counts calculated within each ΔBT_{min} bin. The dashed lines represent the trend fits corresponding to each percentile. The shaded bands and vertical error bars jointly indicate the standard deviation from the percentiles. Background shading distinguishes the upwelling stage (orange, $\Delta BT_{min} < 0$) from the decaying stage (gray, $\Delta BT_{min} > 0$).

Development of the first-stroke leader in negative cloud-to-ground lightning during thunderstorm evolution. As the path pioneer of negative cloud-to-ground lightning, the initiation and development of the first stroke leader are influenced by the thunderstorm's charge structure. Although the horizontal development of the leader channel is widely recognized as an important factor contributing to its prolonged duration, it remains unclear at which stages of thunderstorm evolution, and in which spatial regions, conditions are favorable for such development. Using a broadband VLF/LF lightning observation array and weather radar measurements, the temporal and spatial evolution of first-stroke leaders in isolated thunderstorms is investigated. The results show that leaders in the incipient stage tend to exhibit longer durations and greater horizontal propagation distances, whereas leaders in the mature stage become substantially shorter and more compact. In addition, leader duration is strongly negatively correlated with return-stroke peak current and positively correlated with horizontal propagation distance. Radar analyses further indicate that long-duration leaders are primarily associated with strong convective cores, while short-duration leaders are more common near storm edges and weak-reflectivity regions. These observations suggest that the distribution of lower positive charge regions within thunderstorms plays a regulatory role in leader propagation paths and development times. This study provides new insights into the coupling between thunderstorm charge structures and lightning initiation processes, improving our understanding of how lightning development evolves throughout the thunderstorm life cycle. (Figure 2, Tian et al., 2026, JGR Atmospheres)

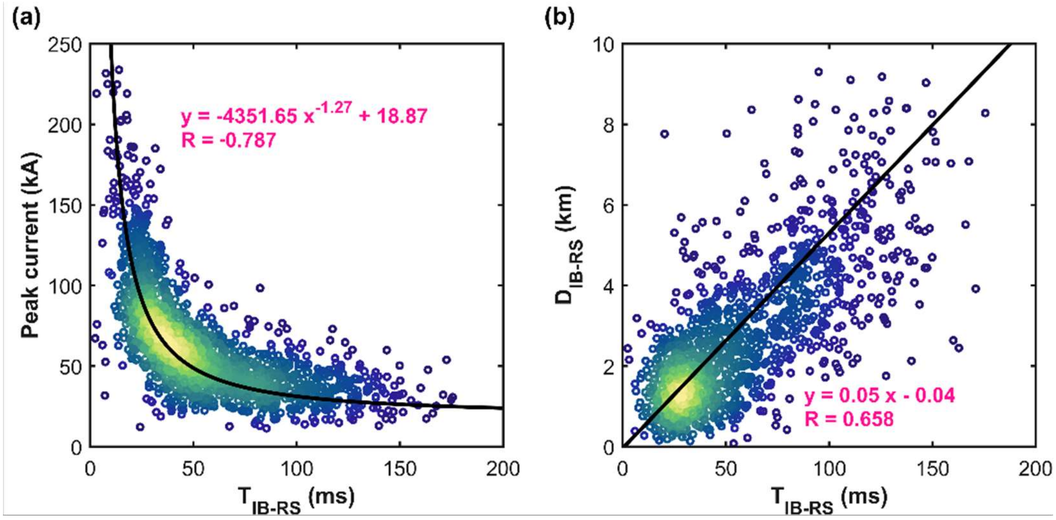


Figure 2. (a) Scatterplot of the peak current of the first RS versus leader duration. (b) Scatterplot of horizontal propagation distance versus leader duration. The color of the scatter points represents the point density. The black solid line indicates the fitted function. A negative power-law relationship was observed between the peak current of the first RS and leader duration, whereas a positive linear correlation existed between horizontal propagation distance and leader duration.

On the energy source of green emissions in ghosts. Ghosts represent a newly discovered and fascinating category of transient luminous events (TLEs) characterized by green emissions atop associated red sprites or gigantic jets. However, the mechanisms underlying their formation and the energy sources driving these emissions remain poorly understood. In this study, we analyzed six ground-based observations of ghost events captured by digital SLR cameras, including the first observation of a ghost following a gigantic jet. Our analysis revealed that ghosts predominantly occur within the diffusive upper region of TLEs, with the green emissions typically spanning altitudes from 87 to 98 km and decaying exponentially over durations of hundreds of milliseconds. Notably, the characteristics of ghosts suggest that their formation is largely governed by residual ionization left by sprite elements rather than direct energy injection from the gigantic jet itself. By calculating the ratio between blue and red optical emissions, we estimated the lowest reduced electric field (E-field) responsible for ghost generation to be approximately 108 Td. Furthermore, statistical analysis of associated lightning activity indicates that consecutive lightning strokes, regardless of their individual strengths, may play a significant role in accumulating the necessary E-field for ghost formation in the upper atmosphere. These findings advance our understanding of the complex mechanisms behind ghosts and highlight the critical role of ambient E-fields in upper-atmospheric phenomena. (Figure 3, X. Huang et al., 2026, Geophys. Res. Lett.)

Direct ionosonde evidence of F-layer disturbances driven by intense lightning activity at low latitudes. The Earth's ionosphere is influenced by both upstream space weather and lower atmospheric activity, yet observational evidence of strong tropospheric lightning directly affecting the upper ionospheric F-layer remains limited. In this study, we utilized high-resolution (5-min burst mode) observations from the DPS-4D ionosonde at Fuke Station in Hainan, China, combined with lightning detection data, to investigate F-layer responses to a severe thunderstorm. Our results reveal that variations in the F-layer electron density corresponded with time-resolved lightning occurrence, remarkably preceding the lightning peak by approximately 5 minutes. This temporal delay suggests that charge separation within thunderclouds establishes a quasi-electrostatic field that extends upward and modifies the F-layer even before the dielectric breakdown of lightning occurs. Following the peak lightning activity, small-scale spread-F structures emerged alongside sudden and significant enhancements in both horizontal and vertical plasma drift velocities. These features indicate that intense lightning can disturb ionospheric electric fields, drive pronounced $E \times B$ drifts, and subsequently trigger plasma irregularities through Rayleigh-Taylor instabilities. This study provides the first high-resolution direct ionosonde evidence of thunderstorm-induced F-layer disturbances at low latitudes, offering crucial new insights into the electrodynamic coupling between the troposphere and the ionosphere. (Figure 4, Z. Cheng et al., 2026, Geophys. Res. Lett.)

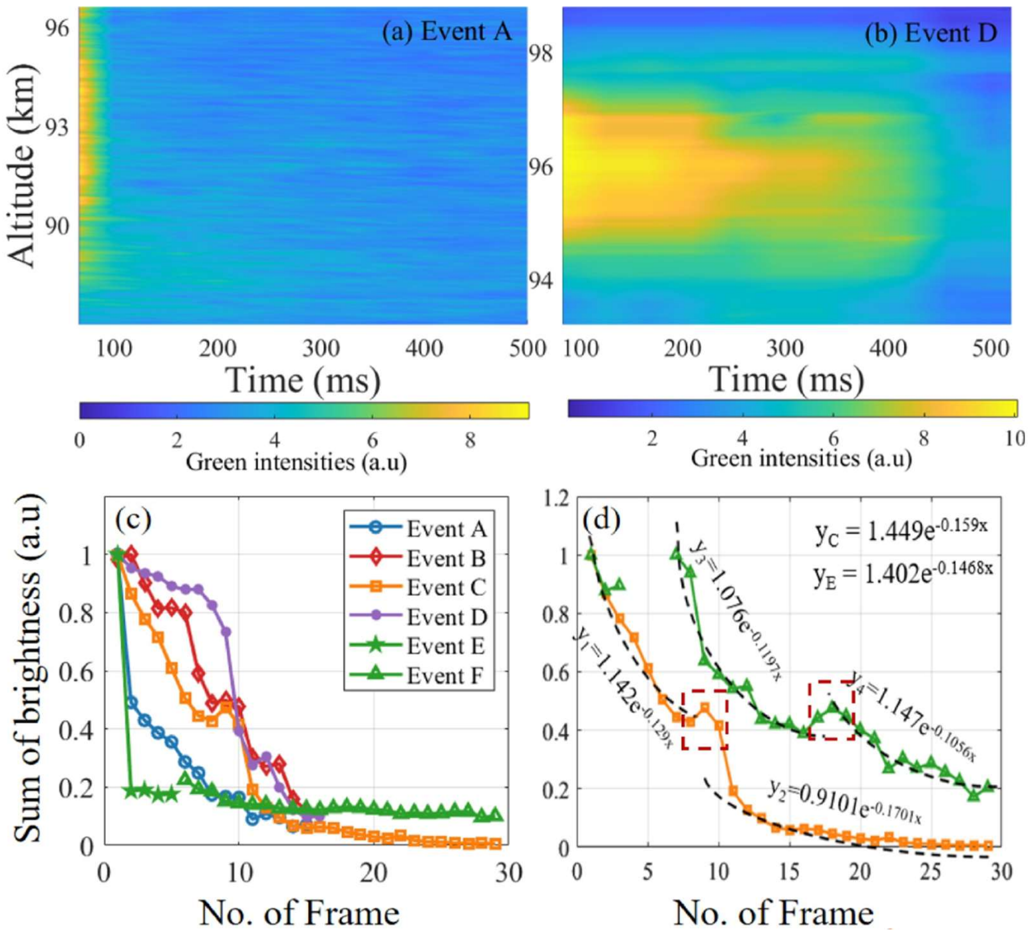


Figure 3. Temporal evolution of green emission intensity in representative ghost events. Panels (a) and (b) show the altitude–time distributions of green emissions for two typical cases, event A (following a gigantic jet) and event D (following a red sprite), respectively. Panel (c) presents the normalized brightness variations frame by frame for six observed events, demonstrating a consistent trend of exponential decay. Panel (d) shows the exponential fitting curves for the normalized brightness of events C and E, highlighting the attenuation coefficients. These results indicate that the green glow is sustained by residual ionization rather than continuous direct energy injection.

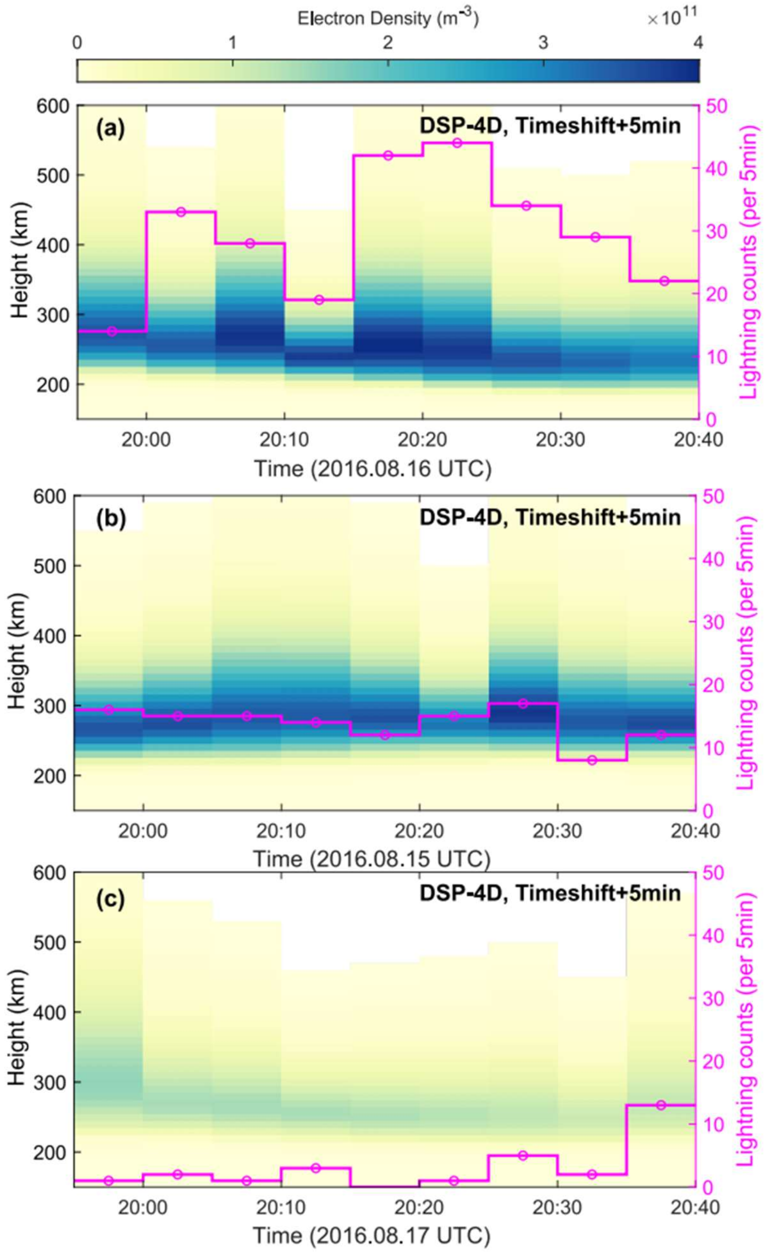


Figure 4. Temporal relationship between F-layer electron density variations and lightning activity during the same local time interval for the region centered at Fuke Station. Panel (a) shows the F-layer electron density variation alongside World-Wide Lightning Location Network-registered lightning discharge counts on the event day (16 August 2016), with ionosonde data shifted forward by 5 minutes to illustrate the precursor response. Panels (b) and (c) display the same parameters for the day before and the day after the event, respectively, confirming that the observed disturbances were distinctly associated with the intense lightning activity rather than typical diurnal variations.

Enhanced lightning activity during the merger of super typhoon Hinnamnor (2022) with a southern tropical depression. Binary tropical cyclone (TC) interactions can significantly alter storm structure and intensity, yet their impact on electrical activity remains less explored. In this study, we investigated the lightning evolution during the merger of Super Typhoon Hinnamnor (2022) with an unnamed tropical depression to its south. Using cloud-top brightness temperature data from Himawari-8 to delineate convective boundaries and global lightning data from GLD360, we compared the lightning characteristics before, during, and after the merger. Our results indicate that the total lightning activity increased dramatically during the merging process, particularly in the later stages. Interestingly, as the two TCs approached within 500 km, the number of intracloud (IC) flashes surged in both systems, leading to an overall enhancement in lightning frequency but a significant decrease in the proportion of cloud-to-ground (CG) flashes. Furthermore, the peak currents of both IC and CG flashes shifted toward lower values during the intense merging phase, suggesting that enhanced turbulent mixing promoted more frequent but weaker electrical discharges. In the inner-core region of Hinnamnor, the merger was accompanied by several eyewall lightning outbreaks and an increased proportion of positive CG flashes, reflecting substantial reorganizations in the storm's convective and charge structures. These findings demonstrate that distinct changes in lightning frequency, CG proportion, and peak current distribution can serve as valuable indicators of binary TC interactions and their influence on storm electrification. (Figure 5, X. Zhu et al., 2026, Adv. Atmos. Sci.)

Lightning-based thunderstorm climatology of central and high Asia: Spatiotemporal patterns and trends from a 14-year analysis. The central and high Asian region, encompassing complex topographies from the Afghan plains to the Karakoram-Himalayan mountains, plays a crucial role in regional weather and climate, yet its thunderstorm characteristics remain poorly quantified due to observational limitations. In this study, we established the first comprehensive, high-resolution thunderstorm climatology for this region using 14 years (2010–2023) of continuous lightning data from the World-Wide Lightning Location Network (WWLLN). Our analysis of over 91,000 distinct thunderstorm events reveals a profound topographic dependence, with the 2000–3000 m elevation band emerging as the optimal zone for convective initiation, exhibiting an area-normalized frequency 1.74 times higher than that of the plains. Terrain heterogeneity analysis further indicates that thunderstorms preferentially develop over flat to gentle slopes within valley regions, highlighting the dominant role of thermal forcing and moisture accumulation over simple mechanical uplift. Temporally, thunderstorm activity exhibits strong seasonality peaking in summer and a pronounced diurnal maximum in the mid-afternoon, driven by boundary layer destabilization. Intriguingly, we identified an 'intensity-frequency paradox' in high mountain regions (>3000 m): while the overall occurrence frequency of thunderstorms decreases at extreme elevations due to moisture limitations, individual storms demonstrate a 41.5% enhancement in electrical intensity (strokes per square kilometer per minute) compared to those in the plains. This indicates an environmental selection mechanism where only the most dynamically vigorous storms develop in restrictive high-altitude conditions. These findings provide essential baseline data for understanding orographic convection and improving lightning hazard assessments in topographically complex regions. (Figure 6, I. Ahmad et al., 2026, J. Appl. Meteor. Climatol.)

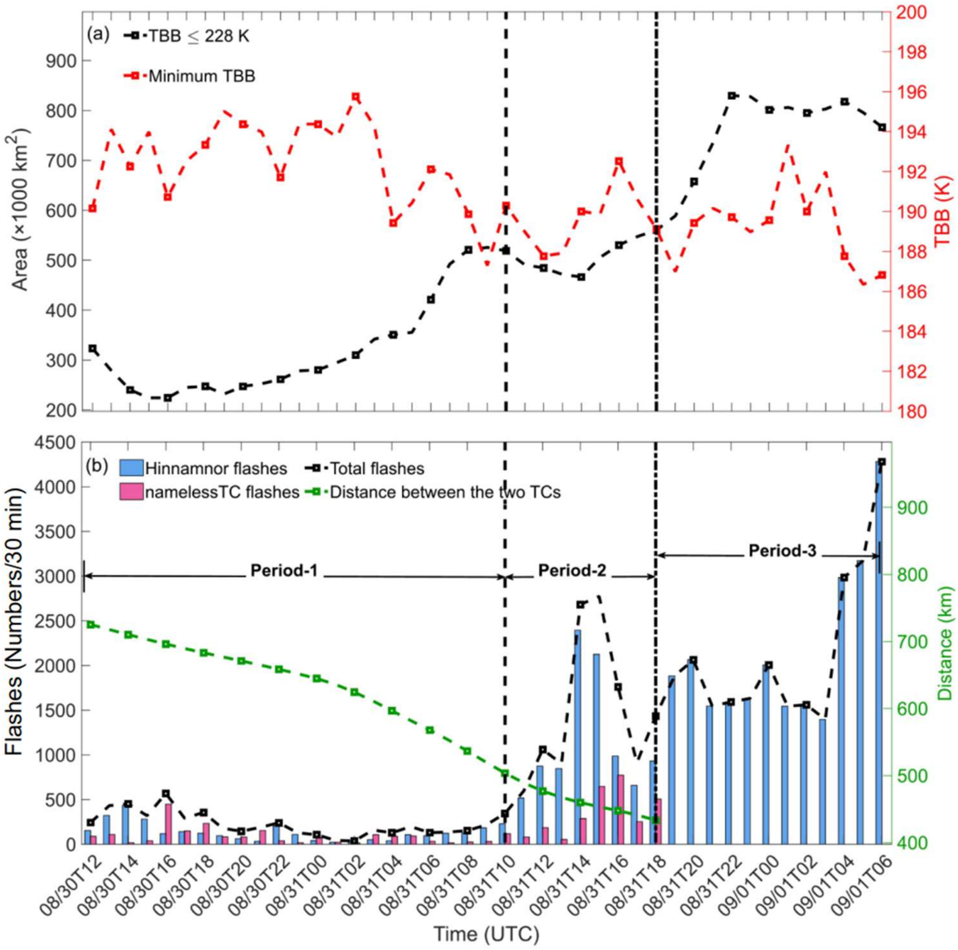


Figure 5. Temporal evolution of lightning produced by Typhoon Hinnamnor (2022) (within a 30-min interval centered at the hourly interpolation moment). The green-dashed line indicates its central

pressure, the magenta-dashed line indicates the proportion of CG flashes (relative to total lightning), and the vertical black-dashed and -dotted lines correspond to the period divisions. Histograms (with 2-kA bins) of the peak current of IC flashes in Hinnamnor (2022) during Period-1, Period-2, and Period-3 are presented, along with corresponding histograms for CG flashes with 10-kA bins. The results highlight a surge in total flashes accompanied by a decrease in the CG flash proportion and a shift toward lower peak currents during the major merging phase.

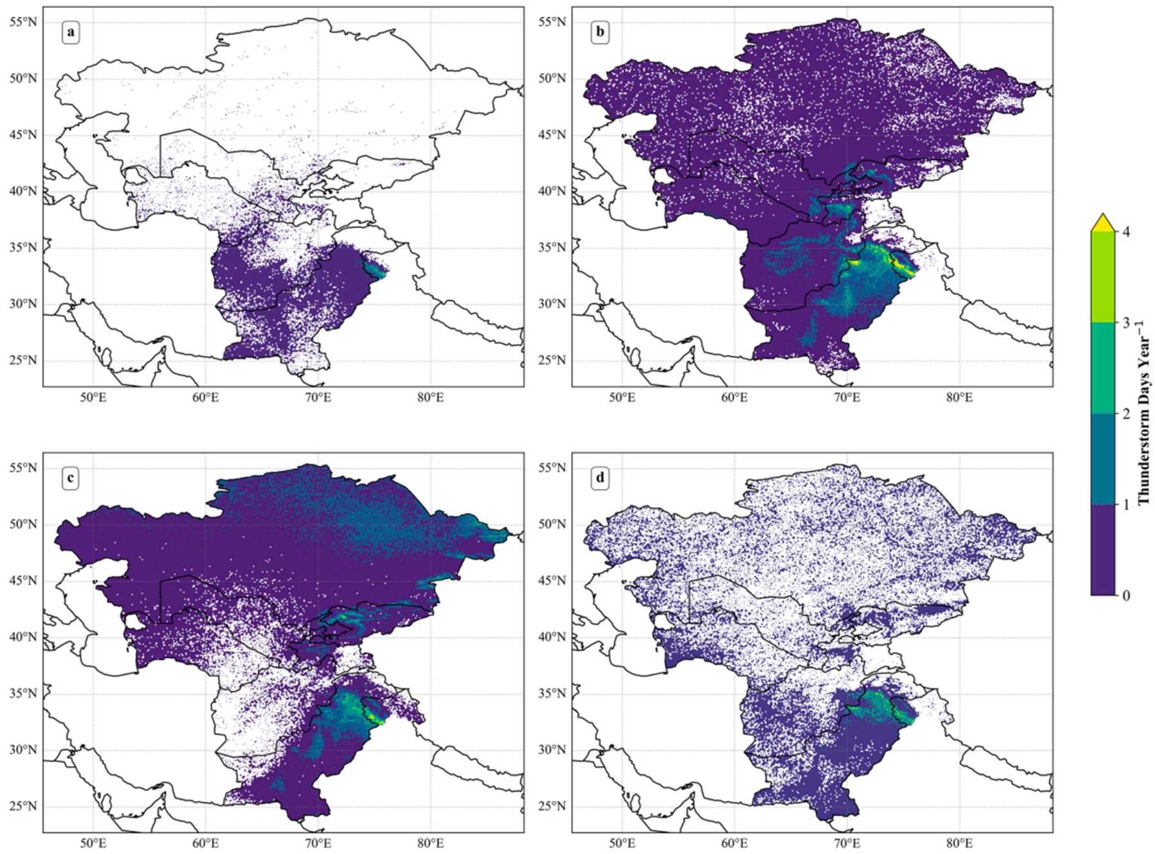


Figure 6. Seasonal thunderstorm distribution across central and high Asia (2010–2023). Average days per year for (a) winter (DJF), (b) spring (MAM), (c) summer (JJA), and (d) autumn (SON). The geographic variations clearly reflect the combined effects of seasonal thermal forcing patterns, moisture transport, and complex orography, with peak convective enhancement occurring during spring and summer months across the mountain regions.

The Laboratory of Atmospheric and Ultraterrestrial Space Physics, University of Carabobo (Venezuela)

Contributor: Dr N. Falcon (Head of the Laboratory) nfalcon@uc.edu.ve

Catatumbo Lightning Scientific Expedition: Epicenters of the world's greatest atmospheric electrical activity. The Laboratory of Atmospheric and Ultraterrestrial Space Physics (https://sites.google.com/site/uclfaeufacyt/home), of the Faculty of Experimental Sciences and Technology at the University of Carabobo (Venezuela) is conducting two expeditions to the Juan Manuel Marshes, a vast 300,000-hectare region of swamps, into south of Lake Maracaibo (Venezuela), in the deltas of the Catatumbo and Bravo rivers. The objective of this expedition is to validate the Electro Atmospheric Model of the phenomenon. More specifically, it aims to quantify greenhouse gases in the Planetary Boundary Layer, study variations in the Electric Displacement Vector into the clouds, by analyzing UHF-VHF signals and antennas, and obtain the local Carnegie Curve. To do this, we monitor the atmospheric electrical activity of the Catatumbo Lightning near its epicenters (9.245886 -72.159638) We use atmospheric ion detectors, greenhouse gas meters (COx, NOx, SOx, methane), electric field mills, UHF and VHF dual-loop antennas, and a spectrum analyzer. These activities are part of the project "Transient Phenomena in the troposphere: Electro-meteors and Atmospheric Vortices" (MinCyT CFP2025000011, Figure 1). The results of first expedition 2026 will be presented at the 18th ICAE 2026 in Barcelona, Spain. Next expeditions are planned to October 2026, is open to collaborations.

Figure 1. The project of Transient Phenomena in the troposphere: Electro-meteors and Atmospheric Vortices.

University of Florida

Ziqin Ding, Vladimir A. Rakov, Si Chen, Kang Yang, Yanan Zhu, and Istvan Kereszy authored a paper titled "Unprecedented Look at Lightning Propagation and Ground Attachment in Ultraviolet". Extension of hot lightning channels is facilitated by essentially cold streamers emanating from their extremities. Thus, streamers play a crucial role in lightning, yet they are poorly understood, because they emit primarily ultraviolet (UV) light, which usually goes undetected. The authors presented unique UV images of lightning, including interaction between positive and negative streamers, leading to new inferences on lightning propagation and attachment. They observed an abrupt change in the leader propagation path to ground, which resulted in an aborted attachment process and a different ground connection point. It turns out that a very intense negative streamer burst emitted by the descending leader toward the prospective strike object, with the latter already sending its own leader/streamer system to intercept the descending leader, actually had a disruptive effect on the lightning attachment process. As a result, another object, previously not responding to the descending leader, became the victim. The observed abrupt change in the negative leader propagation path may be caused by the blocking effect of negative space charge that was suddenly introduced by the intense streamer burst ahead of the lower end of the descending negatively charged leader channel. The negative-leader step-formation process is known to culminate in the forward-directed negative streamer burst. Further, the newly reported UV images show that positive and negative streamer zones are an order of magnitude longer than previously thought. The morphology and dynamics of those streamer zones may lead to new insights into the nature of other large streamer formations observed or hypothesized to occur in various electric phenomena in the atmosphere, such as compact intracloud discharges (Chen et al., 2024; Neubert et al., 2021), fast positive breakdown (Rison et al., 2016), and even stratospheric sprites (McHarg et al., 2019). This paper is published in the Geophysical Research Letters.

Si Chen, Vladimir A. Rakov, Yanan Zhu, and Ziqin Ding authored a paper titled "Bipolar Lightning Flashes with Multiple Ground Terminations Including Tall Towers". Three large-scale (tens of kilometers in horizontal extent) multiple-stroke cloud-to-ground (CG) flashes were examined in detail. The flashes occurred in two summer thunderstorms in Florida and were bipolar in that some of the strokes (leader/return-stroke sequences) in a given flash transported to ground positive charge, while others transported negative charge. Positive strokes tended to have higher NLDN-reported peak currents and all terminated essentially on the ground surface, each time forming a new channel. Negative strokes tended to terminate on tall towers and all that did so produce wideband E-field signatures that exhibited oscillations after the initial peak. Additionally, the authors examined a negative flash composed of seven strokes all of which terminated on a tall tower. There were a total of three tall (451-497 m) towers involved, with one of them (497-m tall) being strike object for each of the four flashes examined in this study. The maximum GLM group energy for positive strokes was one to two orders of magnitude higher than for negative strokes. The oscillating E-field signatures are indicative of bouncing current waves that are manifestations of the transient response of a tall object to the lightning-caused excitation at or near its top. The period of E-field oscillations can be linked to the tower height. The authors found that their large-scale (tens of kilometers in horizontal extent) flashes were somewhat similar to the megaflashes, whose horizontal extent exceeds 100 km. The similarities include (a) multiple ground terminations, (b) bipolarity, (c) comparable number of positive and negative strokes within a flash, and (d) involvement of tall towers, all the four features being well documental for a megaflash studied in detail by Lyons et al. (2020). The authors speculated that the presence of tall objects (such as towers or wind turbines that are capable of launching upward flashes) might be a significant factor in increasing the spatial scale of lightning. This paper is published in the Journal of Geophysical Research - Atmospheres.

University of Shizuoka (Natural Disaster Research Section; NaDiR) and Mount Fuji Research Station (MFRS), Japan

Mount Fuji — A Frontier Observation Site for Lightning and Atmospheric Electricity Research. Mount Fuji (3,776 m) offers a value found nowhere else in the world for the study of lightning and atmospheric electricity (Figure 1). Its summit functions as a natural observation tower reaching nearly 4 km in height. As an isolated stratovolcano with no comparably tall mountains nearby, and with an exceptionally sharp and symmetrical conical shape, the surrounding airflow and cloud structures are little disturbed by topography. As a result, atmospheric phenomena can be observed in a nearly natural state. In summer the summit is frequently engulfed within thunderclouds, enabling in-cloud observation without reliance on aircraft or balloons, while the unobstructed 360-degree field of view simultaneously captures cumulonimbus clouds and transient luminous events (TLEs) hundreds of kilometers away. Few places on Earth offer conditions like these for studying near-field and far-field lightning phenomena at the same time.

Historical Background. The scientific use of Mount Fuji's summit has a long history. The work of Inō Tadataka, who in the early 1800s used Mount Fuji as a surveying target to produce highly accurate maps of Japan, may be considered its earliest scientific use. From the 1880s onward, beginning with the world's first overwintering meteorological observations by Nonaka Itaru and his wife Chiyoko, the summit became a base for meteorological observation, and from 1932 it was operated as the Mount Fuji Weather Station of the Central Meteorological Observatory (later the Japan Meteorological Agency). In 1964 the Mount Fuji Radar, then the highest-altitude weather radar in the world, was installed and contributed greatly to typhoon monitoring. For roughly a century, the summit facilities were used almost exclusively for meteorological observation. After the staffed weather station was automated in 2004, the certified NPO "Mount Fuji Research Station (MFRS)" was established to preserve and promote the scientific use of the summit facilities, and since 2007 it has supported interdisciplinary research across many fields, primarily during the summer season. Fujisan was inscribed on the UNESCO World Cultural Heritage list as "Object of Worship, Wellspring of Art" in 2013.

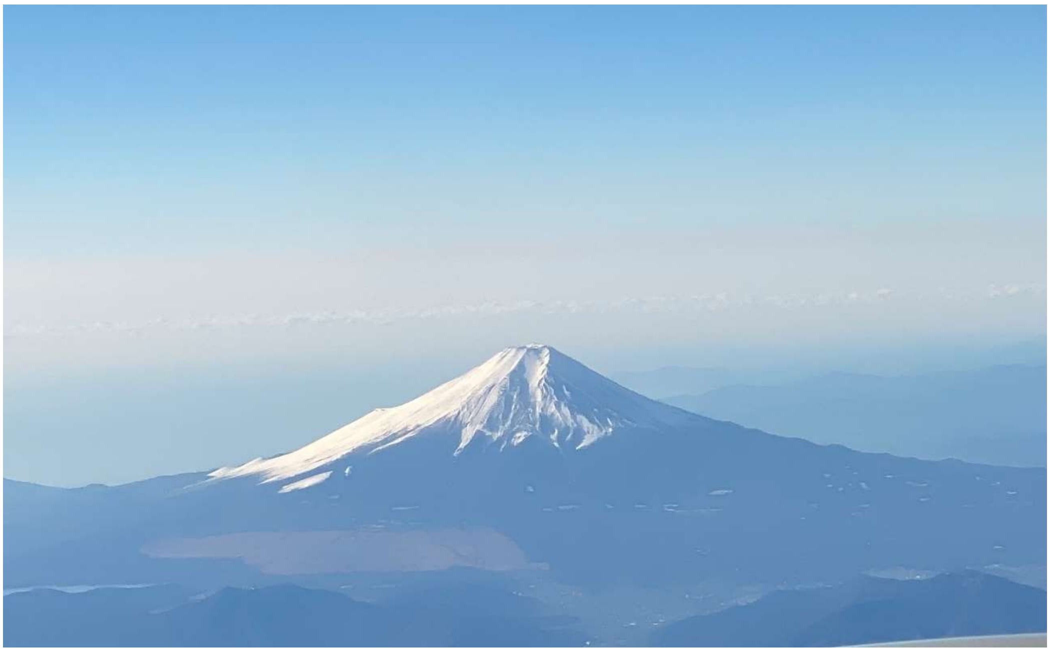


Figure 1. Distant view of Mount Fuji, an isolated stratovolcano with no comparably tall mountains nearby.

Position Among the World's Mountain Observation Sites. Mountainous regions have long played an important role in the geosciences as places to study the atmosphere with minimal influence from human activity. There are many high-altitude observation sites in the world, such as Jungfraujoch in Switzerland, the Mauna Loa Observatory in Hawaii (renowned for long-term observations of greenhouse gases including CO_2), and Mt. Waliguan in China, but most of them have atmospheric chemistry as their principal research field.

MFRS currently hosts a wide variety of scientific research, but atmospheric chemistry and lightning/atmospheric electricity are its two major research fields (Figure 2). In atmospheric chemistry, significant achievements have emerged, such as the high-quality continuous CO_2 observations begun in 2009. In particular, the study that detected airborne microplastics in cloud water for the first time in the world drew a major response: The New York Times featured it as one of its year-end selections, "20 Things That Happened for the First Time in 2023," and it was widely reported by media around the world including The Washington Post and Al Jazeera.

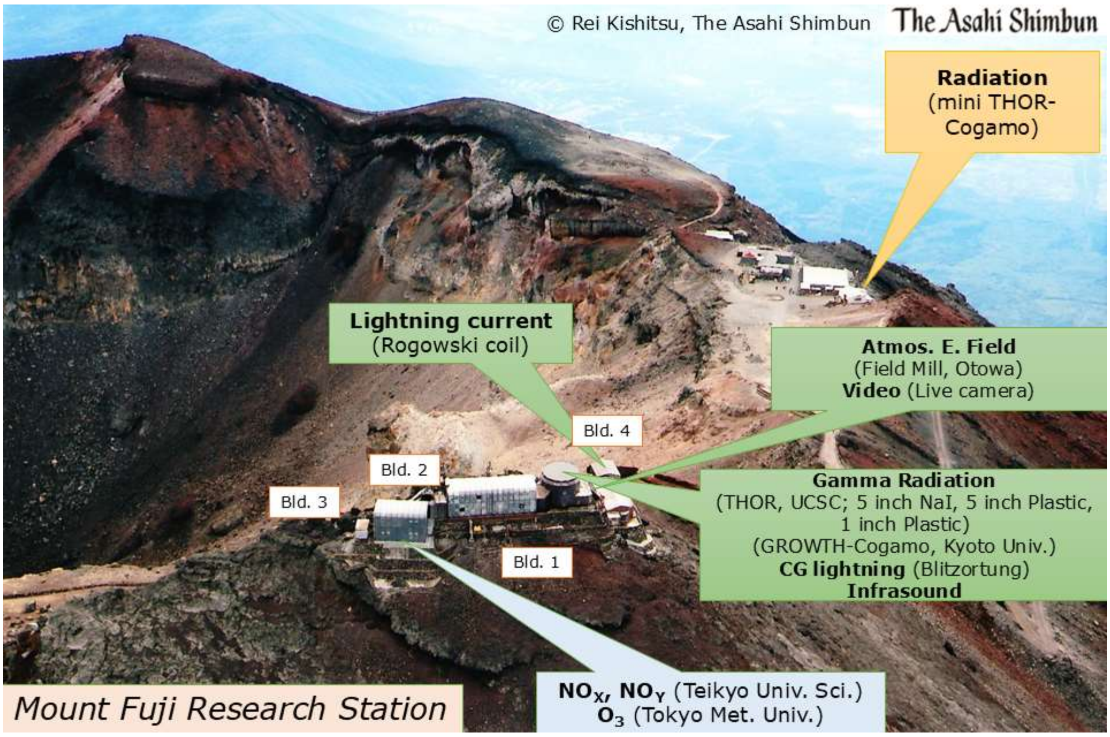


Figure 2. Layout of the lightning and atmospheric-electricity observation instruments deployed at the summit of Mount Fuji.

As a mountain observation facility specializing in lightning research, the lightning research facility on Säntis (about 2,502 m) in Switzerland is world-renowned. Mount Fuji, at 3,776 m, is roughly 1,300 m higher than Säntis, and as an exceptionally sharp, isolated peak it allows direct observation of thundercloud interiors, providing world-class research infrastructure on par with Säntis. Lightning and atmospheric electricity research at Mount Fuji is coordinated by Masashi Kamogawa of the Natural Disaster Research Section (NaDiR) at the University of Shizuoka as PI (principal investigator), with the participation of numerous universities and research institutions in Japan and abroad. Organized observation campaigns began in 2008 and continue every summer to this day. Kamogawa currently serves as vice president of MFRS.

Major Observational Research.

1) High-Energy Radiation from Lightning and Thunderclouds. High-energy radiation is one of the major research areas at Mount Fuji. There are two types: terrestrial gamma-ray flashes (TGFs, lasting less than one second) associated with lightning discharges, and glows lasting from several seconds to several minutes that originate in the thundercloud itself. Research in this field at Mount Fuji began when Professor Tatsuo Torii (then at the Japan Atomic Energy Agency, later at Fukushima University) and colleagues, who contributed greatly to the discovery of the glow phenomenon, reported a long-duration gamma-ray glow lasting about 20 minutes at the summit in 2008. This radiation, with a continuous spectrum exceeding 10 MeV, was interpreted as bremsstrahlung from high-energy electrons continuously generated by the strong electric field within the thundercloud rather than by a lightning discharge.

Currently, observations are being carried out by Professor David Smith and colleagues at the University of California, Santa Cruz (UCSC), one of the world's leading TGF research groups, and were also reported in a past ICAE Newsletter (November 2025, Vol. 36, No. 2). In the summer of 2022, three TGFs were detected in association with compact negative cloud-to-ground discharges that occurred within about 2 km of the surface. These were the first TGFs observed in Japanese summer lightning, and also the first recorded in the meteorological setting of an isolated peak (second to Säntis). In Japan, TGF/glow research targeting winter lightning, in which thundercloud altitudes are extremely low, is active; but at Mount Fuji's altitude, where gamma rays attenuate less, clearer signals can be captured. In addition, the CoGaMo (GROWTH-CoGaMo) network of Associate Professor Teruaki Enoto of Kyoto University and colleagues, which deploys multi-point citizen-science gamma-ray observations of winter lightning in the Hokuriku region, is also installed at the summit. This CoGaMo network is also known for demonstrating, through citizen-science observations, that lightning discharges initiate in the vicinity of the accelerated-electron region.

2) Observation of Transient Luminous Events (TLEs). In summer, clouds are predominantly low-level, and the summit of Mount Fuji is most often located above their cloud tops, making it well suited for the optical observation of TLEs such as sprites, gigantic jets (Figure 3), and blue jets/blue starters. Operated by Tomoyuki Suzuki of the University of Shizuoka and Shonan Institute of Technology and colleagues, feasibility observations in 2019 demonstrated the summit's effectiveness as an observation site offering stability, a wide field of view, and a low-light environment. Subsequently, analyses combining multi-year camera records with radar and satellite data showed that many sprites over Japan occur above the extensive stratiform regions of mesoscale convective systems (MCSs). On August 30, 2021, blue starters from the same thundercloud were simultaneously observed from the summit of Mount Fuji and from Tokyo, and combined analyses with LMA and other instruments were carried out. In today's TLE research, where satellite and aircraft observations are becoming mainstream, Mount Fuji is a valuable site for continuous fixed-point observation. Research is being further invigorated through collaboration with sprite observation networks involving high-school students nationwide supported by Kamogawa, Suzuki, and others.

Figure 3. A gigantic jet captured from the summit of Mount Fuji (Aug. 6, 2014).

3) Atmospheric Chemistry. The summit lies in the free troposphere and is little affected by local anthropogenic pollution, making it an ideal site for detecting natural signals such as lightning-derived nitrogen oxides (NOx) and ozone. Continuous trace-gas observations by Ryuichi Wada (Teikyo University of Science) and colleagues captured clear enhancements of NOx transported over long distances from lightning activity hundreds of kilometers away, and model studies supporting those results were also conducted. In the future, near-distance simultaneous observation of lightning-derived NOx and O_3 when the summit enters a thundercloud is anticipated. Ozone observations are carried out by Shungo Kato (Tokyo Metropolitan University) and colleagues. Observations of atmospheric ions and aerosols have also been conducted by Kazuhiko Miura (MFRS), Tatsuhiro Mori (Keio University), and others, elucidating variations of particle number concentration, aerosol–cloud interactions, and the characteristics of cloud condensation nuclei (CCN) in the free troposphere. Furthermore, the study of ice-nucleating particles (INPs) by Kotaro Murata (Center for Environmental Science in Saitama; CESS) and colleagues is important research that also connects to charge-generation processes in thunderclouds.

4) Lightning Current Measurement with a Rogowski Coil. Masaru Yasumoto (Laboratory for Environmental Research at Mount Fuji–LERMF-, MFRS) and colleagues developed a robust lightning-current observation system using a Rogowski coil capable of withstanding the harsh high-altitude environment of strong winds, low temperatures, icing, and heavy rain. The summit of Mount Fuji is high-impedance, and most of the current from a strike to the buildings flows through the grounding lines running alongside the power transmission lines from the base. Exploiting this property, observations treating the entire summit as a "giant lightning rod" become possible. The high-time-resolution current waveforms have captured the progression of stepped leaders prior to the main discharge, as well as the precursor processes of upward lightning (initial current pulses and gradual electric-field changes).

5) Atmospheric Electric Field Observation. By installing Boltek field mills in two systems of high and low sensitivity, both fair-weather and thunderstorm atmospheric electric fields (AEFs) are observed. For fair-weather conditions, it was found that the summer diurnal variation of the AEF shows a "mountain variation" clearly different from the global Carnegie curve. This non-Carnegie variation, noted for more than half a century but long unexplained, was shown to arise from the positively charged tops of the sea of clouds spreading below the summit, with daytime AEF reaching 1.5 to 3 times the nighttime value. During thunderstorms, the field near the instruments can exceed 200 kV/m, and its observation has been successfully achieved using a new large-dynamic-range field mill from Otowa Electric Co. LTD.

6) Related Observations. In addition, optical live cameras, infrasound observations for thunder, and meteorological observations are carried out in parallel. For lightning-discharge observation, the characteristics of Blitzortung.org's lightning location in Japan have been analyzed, and in recent years two-dimensional lightning location has been conducted using the FULMO (Fuji-Centered Lightning Monitoring) network of Boltek LRX-1 units densely deployed around the summit. Furthermore, for waveform observation, the FALMA (Fast Antenna Lightning Mapping Array) developed by Wang, Wu, and colleagues at Gifu University is also deployed near Mount Fuji.

Conclusion. The summit of Mount Fuji is a one-of-a-kind "natural laboratory above the clouds" where research on lightning physics, atmospheric electricity, atmospheric chemistry, and high-energy phenomena can be integrated in a single location. Its achievements contribute not only to the advancement of basic science but also to practical applications such as the mitigation of lightning damage, infrastructure protection, aviation safety, and improved weather forecasting. This observation environment is open to researchers around the world, and further international participation is welcome.

University of Washington

Contributor: Robert Holzworth

University of Washington lightning team includes these scientists (including contractors) and students: James Brundell (U. of Otago, NZ), Robert Holzworth (UW), Abram Jacobson (UW), Michael McCarthy (UW), Joel Thornton (UW), Katrina Virts (U. of Alabama Huntsville) and these UW PhD students: Randall Jones, II and Chris Wright. We can highlight three projects currently underway.

WWLLN (World Wide Lightning Location Network). We continue to expand the WWLLN network with several new stations this year, and several more updated existing stations. We are working on a global update of the WWLLN detection efficiency comparing to satellite and ground based networks. At ICAE Barcelona we will be reporting on an analysis of clustered lightning to study global thunderstorms. We recently published a global study of Thunder Hour data using WWLLN lightning [Applications of the World Wide Lightning Location Network (WWLLN) Thunder Hour Climatology, (https://doi.org/10.1175/JAMC-D-25-0166.1)].

WWLLN lightning climatology data have been used in the next State of the Climate paper section on lightning climatology for BAMS 2026. (see last year's SoC paper: [State of the Climate in 2024 in: Bulletin of the American Meteorological Society Volume 106 Issue 8 (2025) see section 4: NOVEL LIGHTNING FLASH DENSITIES FROM SPACE].

Aerosols and lightning. Our student Chris Wright was selected as a runner up for the 2025 Paul Crutzen Publication Award for his paper on lightning in shipping tracks [https://urldefense.com/v3/__https://acp.copernicus.org/articles/25/2937/2025/acp-25-2937-2025.html__;!!K-Hz7m0Vt54!mRsh5j-81SIejZSByYwmK43HQcybJsWDvHaWPgUmHGr7bKvBzwD0HYiNx3Iw_c-_COPH3yegag65zBvrYiddg$].

We are also working on a paper on a deep learning model of stroke density [This paper is being updated: https://arxiv.org/abs/2509.10399].

Ionospheric Plasma Turbulence rocket flight. A couple months ago we launched a vector electric field instrument on a high altitude rocket to study plasma turbulence. This very successful flight is currently in analysis and will be reported at scientific conferences this autumn.

This list of references is not exhaustive. It includes only papers published during the last six months provided by the authors or found from an on-line research in journal websites. Some references of papers very soon published have been provided by their authors and included in the list. The papers in review process, the papers from Proceedings of Conference are not included.

Ahmad I, Lu G, Huang H, Iqbal. 2025. Lightning-based thunderstorm climatology of central and high Asia: Spatiotemporal patterns and trends from a 14-yr analysis (2010-23). J Appl Meteorol Clim, 65(6). https://doi.org/10.1175/JAMC-D-25-0144.1

An Y, Jiang S, Yuan P, An T, Liu G, et al. 2026. Retrieval of air humidity in lightning discharge channels based on experimental spectral diagnosis. Atmos Res, 339: 109053. https://doi.org/10.1016/j.atmosres.2026.109053

An Y, Yuan P, An T, Deng H, Yuan L, et al. 2026. Development characteristics of a negative cloud-to-ground lightning passing through an extended patch of cloud and the electrification characteristics of the cloud. J Geophys Res Atmos, 131(11): e2025JD046251. https://doi.org/10.1029/2025JD046251

Ardila S, Montanyà J, López J, Solà G, Roncancio A. 2026. Lightning flashes at electric power system towers identified as Recurrent Lightning Spots. Electr Pow Syst Res, 251: 112334. https://doi.org/10.1016/j.epsr.2025.112334

Bar-Zeev J, Yair Y, Haspel C, Hochman A. 2026. Numerical simulations of TLE generation in the Jovian atmosphere. EGU General Assembly 2026, Vienna, Austria, 3–8 May, EGU26-14016. https://doi.org/10.5194/egusphere-egu26-14016

Behnke SA, Bruning E, Back A, Goodman SJ, Hogg C, et al. 2025. Introducing a grand challenge for lightning modeling. Bull Am Meteorol Soc, 107(4). https://doi.org/10.1175/BAMS-D-25-0021.1

Bennecke DM, da Silva CL, Senay S, Krehbiel PR, Stanley M, et al. 2025. The nature of standing plasma waves following fast breakdown. Geophys Res Lett, 52(17): e2025GL116986. https://doi.org/10.1029/2025GL116986

Bitzer PM, Lang TJ, Quick MG, Gatlin P, Chanrion O, et al. 2026. Group data and detection efficiency analysis for the Modular Multispectral Imaging Array and the Lightning Imaging Sensor. J Geophys Res Atmos, 131(6): e2025JD045209. https://doi.org/10.1029/2025JD045209

Bór J, Yair Y. 2026. The contribution of citizen observers to the UHU lightning and TLE observation campaign on the International Space Station in 2025. EGU General Assembly 2026, Vienna, Austria, 3–8 May, EGU26-6579.

https://doi.org/10.5194/egusphere-egu26-6579

Bozóki T, Mlynarczyk J, Prácser E, Kulak A, Sátori G, et al. 2025. Modeling the global electromagnetic resonance field produced by continuing current lightning. J Geophys Res Atmos, 130(23): e2025JD043989. https://doi.org/10.1029/2025JD043989

Cai L, Feng Y, Chu W, Niu Y, Wang J, et al. 2026. Observation of dual upward positive leaders emerging between initial continuous current termination and first return stroke. Atmos Res, 330: 108603. https://doi.org/10.1016/j.atmosres.2025.108603

Camino-Faillace PA, Gordillo-Vázquez FJ, Pérez-Invernón FJ, Montanyà J, Młynarczyk J, et al. 2026. Optical and radio characterization of continuing current lightning with ASIM, GLM and ELF sensors. Atmos Res, 330: 108578. https://doi.org/10.1016/j.atmosres.2025.108578

Cecil DJ, Buechler DE, Lang TJ, Virts KS, Mach DM. 2025. Lightning Imaging Sensor (LIS) and Optical Transient Detector (OTD) missions, 1995 – 2023. Bull Am Meteorol Soc, 107(3). https://doi.org/10.1175/BAMS-D-24-0268.1

Cecil DJ, Buechler DE, Lang TJ, Virts KS, Mach DM. 2025. Lightning climatology datasets from TRMM LIS, ISS LIS, and OTD. J Appl Meteorol Clim, 65(1). https://doi.org/10.1175/JAMC-D-25-0110.1

Chen R, Jiang R, Sun Z, Zhang H, Liu M, et al. 2025. Comparative study of upward leader inception during the initial stage of negative and positive altitude-triggered lightning. Geophys Res Lett, 52(24): e2025GL119235. https://doi.org/10.1029/2025GL119235

Chen S, Rakov VA, Zhu Y, Ding Z. 2026. Bipolar lightning flashes with multiple ground terminations including tall towers. J Geophys Res Atmos, 131(4): e2025JD045328. https://doi.org/10.1029/2025JD045328

Chen Y, Wan X, Chen Y. 2026. Structural optimization of multi-chamber arrester and research on arc extinguishing effect under multiple lightning strikes. Electr Pow Syst Res, 255: 112773. https://doi.org/10.1016/j.epsr.2026.112773

Chen Z, Luo R, Liu J, Qie X, Bian J, et al. 2026. Stratospheric intrusions over Hong Kong: Impact and seasonality based on long-term ozonesonde records. J Geophys Res Atmos, 131: e2025JD045067. https://doi.org/10.1029/2025JD045067

Cheng C, Xiong Y, Gu S, Wang L, Tan B, et al. 2026. Observations of fine-scale structures during the pause period of positive leader discharge. Geophys Res Lett, 53(3): e2025GL120324. https://doi.org/10.1029/2025GL120324

Cheng Z, Zhang M, Huang H, Wang G, Wang Z, et al. 2026. Direct ionosonde evidence of F-layer disturbances driven by intense lightning activity at low latitudes. Geophys Res Lett, 53(10): e2026GL122283. https://doi.org/10.1029/2026GL122283

Chide B, Lorenz RD, Montmessin F, et al. 2025. Detection of triboelectric discharges during dust events on Mars. Nature, 647: 865–869. https://doi.org/10.1038/s41586-025-09736-y

Cintineo JL, Pavolonis MJ, Heuscher L, Sieglaff JM. 2025. The impact of radar reflectivity data in a satellite-based lightning nowcasting model. Weather Forecast, 41(1). https://doi.org/10.1175/WAF-D-25-0067.1

Cooray V, Cooray G, Rachidi F, Rubinstein M. 2026. Known properties of the lightning leader channels point towards a return stroke moving with the speed of light. Electr Pow Syst Res, 253: 112485. https://doi.org/10.1016/j.epsr.2025.112485

Costa K, Shulzhenko E, Rock M. 2026. Lightning protection in agrivoltaic systems: Assessment of step and touch voltages tailored to livestock. Electr Pow Syst Res, 255: 112839. https://doi.org/10.1016/j.epsr.2026.112839

da Silva TP, Saba MMF, Warner TA, Cruz IT, Alipio RS, et al. 2026. Upward lightning occurrence on wind turbines: duration characteristics from high-speed cameras. Electr Pow Syst Res, 256: 112881. https://doi.org/10.1016/j.epsr.2026.112881

de Azevedo WLM, Pascoalato TFG, de Araújo ARJ, Kurokawa S, Pissolato Filho J. 2026. Impact of concrete-encased grounding systems on lightning overvoltages in transmission lines. Electr Pow Syst Res, 251: 112227. https://doi.org/10.1016/j.epsr.2025.112227

De Conti A, Leal OES. 2026. Calculation of lightning-induced voltages on a large-scale distribution network using the JMarti model. Electr Pow Syst Res, 251: 112232. https://doi.org/10.1016/j.epsr.2025.112232

Deng H, Yuan P, An T, Yuan L, An Y, et al. 2026. Radial distribution of physical characteristics in the peripheral corona sheath at the peak-current stage of return stroke. J Geophys Res Atmos, 131(6): e2025JD045054. https://doi.org/10.1029/2025JD045054

Deng J, Guo F, Chen K, Wang Q, He M, et al. 2026. The characteristics of environmental parameters and cloud-to-ground lightning of thunderstorm cells in eight regions of South and Inland Plateau. Atmos Res, 109159. https://doi.org/10.1016/j.atmosres.2026.109159

Ding Z, Rakov VA, Chen S, Yang K, Zhu Y, et al. 2026. Unprecedented look at lightning propagation and ground attachment in ultraviolet. Geophys Res Lett, 53(4): e2025GL119737. https://doi.org/10.1029/2025GL119737

Essa Y, Hunt HGP, Schumann C, Çelik T, Nixon KJ, et al. 2026. Challenges in vision based prediction of lightning peak currents using xception-BiLSTM regression. Electr Pow Syst Res, 259: 113030. https://doi.org/10.1016/j.epsr.2026.113030

Essa Y, Hunt HGP, Schumann C, Çelik T, Saba MMF, et al. 2026. Predicting return stroke peak currents from high-speed lightning videos. Atmos Res, 339: 109049. https://doi.org/10.1016/j.atmosres.2026.109049

Farges T, Burgos G, Albert S, Bowman D, Gainville O, et al. 2026. Characterization and localization of chemical explosions and lightning flashes by a flotilla of stratospheric balloons. J Geophys Res Atmos, 131(5): e2025JD044347. https://doi.org/10.1029/2025JD044347

Federico S, Torcasio RC, Transerici C, Realini E, Song X, et al. 2026. Forecasting convective precipitation over northern Italy: A comparison of lightning and GNSS-ZTD data assimilation. Atmos Res, 331: 108687. https://doi.org/10.1016/j.atmosres.2025.108687

Fu Y, Sun J, Zhang Y, Fu S, Wang X, et al. 2026. The evolution of cloud-to-ground lightning and radar reflectivity in mesoscale convective systems over Central-Eastern China. Atmos Res, 335: 108818. https://doi.org/10.1016/j.atmosres.2026.108818

Fuglestad AN, Marisaldi M, Sarria D, Mezentsev A, Østgaard N, et al. 2026. The source brightness distribution of terrestrial gamma-ray flashes from the ALOFT flight campaign. J Geophys Res Atmos, 131(6): e2025JD045235. https://doi.org/10.1029/2025JD045235

Füllekrug M, Kosch M, Dingley G, Bai X, Macotela L. 2026. Six-component electromagnetic wave measurements of sprite-associated lightning. Radio Sci, 61(2): e2025RS008543. https://doi.org/10.1029/2025RS008543

Furutani S, Baba Y, Chen S, Rakov VA. 2026. FDTD study of ionospheric reflections associated with consecutive strokes of the same lightning flash. IEEE T Electromagn C. https://doi.org/10.1109/TEMC.2026.3689991

Genareau K, Paredes-Mariño J, Cronin SJ, Harkema SS, Schultz CJ, et al. 2026. Volcanic ash affected by lightning during the Hunga 2022 eruption. J Geophys Res Atmos, 131(5): e2025JD044700. https://doi.org/10.1029/2025JD044700

Goldberg DJ, Nag A, Cummins KL, Plaisir MN, Tempert A, et al. 2026. Multi-frequency signatures of space-leader evolution in negative cloud-to-ground lightning stepped leaders. Atmos Res, 336: 108835. https://doi.org/10.1016/j.atmosres.2026.108835

Grebovic S, Aksamovic A, Filipovic-Grcic B, Konjicija S. 2026. Investigation of lightning effects on solar power plants connected to transmission networks. Electr Pow Syst Res, 251: 112217. https://doi.org/10.1016/j.epsr.2025.112217

Guan Y, Yin C, Wu B, Gong H, Zhu S, et al. 2026. A machine learning hail recognition method integrating DBSCAN clustering and spatiotemporal tracking. Atmos Res, 340: 109069. https://doi.org/10.1016/j.atmosres.2026.109069

Huang X, Meng Z, Lu G, Cheng Z, Liu F, et al. 2026. On the energy source of green emissions in ghost. Geophys Res Lett, 53(2): e2025GL118676. https://doi.org/10.1029/2025GL118676

Huang Z, Yuan S, Wu X, Jiang R, Wei L, et al. 2026. Future trend of lightning activity over the Tibetan Plateau under global warming. Atmos Res, 330: 108622. https://doi.org/10.1016/j.atmosres.2025.108622

Imai M, Fischer G, Taubenschuss U, Kolmašová I, Santolík O, et al. 2026. Polarization measurements and source locations of Saturn electrostatic discharges during the Voyager era. J Geophys Res Planets, 131(4): e2025JE009079. https://doi.org/10.1029/2025JE009079

Jenner M, Coïsson P, Hulot G, Chauvet L, Deborde R. 2026. On the peculiar properties of extremely low frequency lightning generated whistlers detected at low Earth orbit altitudes close to the magnetic equator. Geophys Res Lett, 53(10): e2025GL121525. https://doi.org/10.1029/2025GL121525

Jiang Y, Zhang Q, Gao C, Shi C, Huang X, et al. 2026. Environments conducive to cloud-to-ground and ignited lightning in a boreal forest of Northeast China. Atmos Res, 336: 108919. https://doi.org/10.1016/j.atmosres.2026.108919

Kolmašová I, Soula S, Santolík O, Defer E, Zhu Y, et al. 2026. Properties of positive narrow bipolar events observed in south-eastern France. J Geophys Res Atmos, 131(7): e2025JD045415. https://doi.org/10.1029/2025JD045415

Kong H, Cai L, Fan W, Wang J, Cao J, et al. 2026. Hierarchical clustering for diurnal cycles of lightning using LIS satellite data. Atmos Res, 327: 108390. https://doi.org/10.1016/j.atmosres.2025.108390

Konwar M, Choudhury BA, Longkumer I, Axisa D. 2026. Cloud microphysical processes of lightning-producing convective clouds over Northeast India. Atmos Res, 333: 108704. https://doi.org/10.1016/j.atmosres.2025.108704

Kundu A, Srivastava A, Kundu SS, Taori A, Domkawale MA, et al. 2026. Lightning location systems in India: A comparative evaluation with a focus over North-Eastern Region. Atmos Res, 338: 108999. https://doi.org/10.1016/j.atmosres.2026.108999

Leal AFR, Wemhoner J, da Silva CL, Sonnenfeld RG. 2026. A multiband optical-radio view of lightning return strokes exposes divergent 337/777 nm emission dynamics. Geophys Res Lett, 53(10): e2026GL123245. https://doi.org/10.1029/2026GL123245

Lei X, Zhou M, Wang J, Cai L, Duan D, et al. 2026. Transient voltage responses of a buried cable to M components in rocket-triggered lightning. Electr Pow Syst Res, 253: 112532. https://doi.org/10.1016/j.epsr.2025.112532

Li J, Zhang H, Song L, Zhang Q, Hou W. 2026. Improving lightning identification from satellite imagery with a mult-task pseudo-labeling framework and masked attention. Atmos Res, 339: 109041. https://doi.org/10.1016/j.atmosres.2026.109041

Lin J, Huang X, Zhang Z, Lin X, Hu Y, et al. 2026. Climatology of extreme convective systems in China from joint TRMM and GPM observations. Atmos Res, 340: 109075. https://doi.org/10.1016/j.atmosres.2026.109075

Lin YC, Chen AB, Chuang CW, Su HT, Hsu RR. 2026. Global distribution and seasonal variation of transient luminous events observed by ISUAL over 12 years. J Geophys Res Space Phys, 131(2): e2025JA034726. https://doi.org/10.1029/2025JA034726

Liu D, Qie X, Li F, Sun Z, Li H, et al. 2026. Evolutionary characteristics of charge structure in an atypical bottom-heavy thunderstorm over the central Tibetan Plateau. J Geophys Res Atmos, 131(8): e2025JD045623. https://doi.org/10.1029/2025JD045623

Lyons WA. 2025. Reducing lightning mass casualty incidents: How one non-profit is saving lives in Africa. Weatherwise, 78(6): 48-57. https://doi.org/10.1080/00431672.2025.2563459

Lyu P, Yuan P, Wang W, An Y, An T, et al. 2026. The radial distribution of temperature and electrical conductivity in lightning core current-carrying channel and its time evolution. Atmos Res, 330: 108579. https://doi.org/10.1016/j.atmosres.2025.108579

Ma R, Zheng D, Zhang Y, Yao W, Zhang W, et al. 2026. Response of thunderstorm activity to ENSO events in East Asia and the Western Pacific region. Atmos Res, 329: 108455. https://doi.org/10.1016/j.atmosres.2025.108455

Matczak P, Taszarek M, Sobisiak A, Kolendowicz L. 2026. Environments associated with lightning occurrence based on pre- and post-convective rawinsonde measurements in central Europe. Geophys Res Lett, 53(4): e2025GL119901. https://doi.org/10.1029/2025GL119901

McClung B, McGovern A, Hill AJ, Schvartzman D, Stock M. 2025. BoltCast: Medium-range lightning prediction with neural and long short-term memory networks. Artif Intell Earth Syst, 5(2). https://doi.org/10.1175/AIES-D-25-0044.1

Mestriner D, Nicora M, Brignone M, Procopio R, Zhu Y, et al. 2026. Modeling and statistical characterization of preliminary breakdown pulses in negative cloud-to-ground lightning flashes. IEEE T Electromagn C.

https://doi.org/10.1109/TEMC.2026.3666274

Mikropoulos PN, Tsouris PP. 2026. Modelling of the negative lightning impulse flashover of medium voltage overhead line insulators. Electr Pow Syst Res, 253: 112556. https://doi.org/10.1016/j.epsr.2025.112556

Miloš D, Milardić V, Tokić A. 2026. Detailed EMTP wind turbine model for simulation transient phenomena during lightning strikes. Electr Pow Syst Res, 252: 112323. https://doi.org/10.1016/j.epsr.2025.112323

Mondal D, Hobara Y, Kikuchi H, Lapierre J, Le Floch P, et al. 2026. Temporal dependencies between total lightning and rainfall in multicellular systems. Radio Sci, 61(2): e2025RS008380. https://doi.org/10.1029/2025RS008380

Napolitano F, Corti M, Tossani F, Bernardi M, Borghetti A, et al. 2026. Evaluating the impact of power-frequency voltages on the indirect lightning performance of overhead distribution lines. Electr Pow Syst Res, 253: 112513. https://doi.org/10.1016/j.epsr.2025.112513

Nieckarz Z, Ostrowski M, Gołkowski M, Lichtenberger J, Mlynarczyk J, et al. 2026. Study of positive lightning discharges in WWLLN data using extremely low frequency electromagnetic wave measurements. Earth Space Sci, 13(5): e2025EA004667. https://doi.org/10.1029/2025EA004667

Nima KK F, Mondal U, Panda SK, Sharma R, Sharma D. 2026. Evaluating the impact of initial conditions on lightning simulation over Rajasthan. Atmos Res, 329: 108546. https://doi.org/10.1016/j.atmosres.2025.108546

Pantuso JG, da Silva CL, Jensen DP, Stock M, Wemhoner J, et al. 2025. Cutoff and emergence of dart leaders in unbranched positive leader simulation. Geophys Res Lett, 52(19): e2025GL117337. https://doi.org/10.1029/2025GL117337

Pascoalato TFG, de Araújo ARJ, Kurokawa S, Correia de Barros MT. 2026. Realistic soil modeling in transient analysis: Effects of frequency dependence, water content, porosity and stratification on lightning overvoltages. Electr Pow Syst Res, 251: 112209. https://doi.org/10.1016/j.epsr.2025.112209

Pereira B, Pires LCS, Morais LL, Visacro S. 2026. Methodology for determining the electrical parameters of soil in the typical range of frequency components of lightning currents. Electr Pow Syst Res, 255: 112787. https://doi.org/10.1016/j.epsr.2026.112787

Pini L, Baissac DM, Nicora MG, Mansouri E, Rubinstein M, et al. 2026. A global overview of lightning near tall structures. Int J Climatol: e70450. https://doi.org/10.1002/joc.70450

Potdar SS, Biswasharma R, Siingh D, Victor JN, Singh RP, et al. 2026. Coupled influence of aerosols, convection and cloud microphysics on lightning across diverse climatic regions. Int J Climatol, 46(6): e70318. https://doi.org/10.1002/joc.70318

Qie X, Yang J, Pu Y, et al. 2026. Triboelectric discharge on Mars. Sci Bull, 71(8): 1859-1861. https://doi.org/10.1016/j.scib.2026.02.033

Rakov VA, Ding Z, Chen S. 2026. Some recent findings on properties of positive and negative lightning discharges. Electr Pow Syst Res, 259: 113184. https://doi.org/10.1016/j.epsr.2026.113184

Rakshit G, Mitra AK, Jana S. 2026. Unseasonal lightning over the Indian Region. Atmos Res, 330: 108575. https://doi.org/10.1016/j.atmosres.2025.108575

Reichardt AB, Atta J, Bór J. 2026. Towards quantifying the suitability of ELF-band radio observations for Schumann-resonance research. EGU General Assembly 2026, Vienna, Austria, 3–8 May, EGU26-6764. https://doi.org/10.5194/egusphere-egu26-6764

Rizk FAM. 2026. Stepped leader corona pulses in natural first stroke negative CG lightning. Electr Pow Syst Res, 252: 112429. https://doi.org/10.1016/j.epsr.2025.112429

Rudlosky SD, Patton J, Zhang D, Noiplab T, Jin R, et al. 2025. Characterizing the relation between lightning and wildfires in the western United States. J Appl Meteorol Clim, 64(12). https://doi.org/10.1175/JAMC-D-25-0032.1

Saba MMF, da Silva DRR, Cruz IT, da Silva TP, Lauria PB, et al. 2026. Downward positive leader propagation modes and their effects in positive cloud-to-ground lightning characteristics. J Geophys Res Atmos, 131(9): e2025JD046179. https://doi.org/10.1029/2025JD046179

Saraiva ACV, Lauria PB, Saba MMF, Cruz IT, da Silva TP, et al. 2026. First observations and characteristics of positive upward illumination strokes. Geophys Res Lett, 53(1): e2025GL118161. https://doi.org/10.1029/2025GL118161

Schatz S, Schwalt L, Pack S, Kohlmann H. 2026. Prediction of first cloud-to-ground flashes and determination of all-clear timing for lightning risk in regional convective thunderstorms. Electr Pow Syst Res, 256: 112927. https://doi.org/10.1016/j.epsr.2026.112927

Scholten O, Cummer SA, Dwyer JR, et al. 2025. A comprehensive analysis of high resolution VHF observations with LOFAR. ESS Open Archive. https://doi.org/10.22541/essoar.176556304.42772793/v2

Scholten O, Lourens M, Buitink S, et al. 2025. Measuring VHF sources from an aircraft flying through high clouds. Nat Commun, 16: 10572. https://doi.org/10.1038/s41467-025-65667-2

Sezavar HR, Fahimi N, Karimi H. 2026. A Multi-Stage physics-informed neural network for optimal lightning protection design in solar power plants. Electr Pow Syst Res, 256: 112879. https://doi.org/10.1016/j.epsr.2026.112879

Stover E, da Silva CL. 2025. Seasonal and geographical patterns of lightning incidence in New Mexico. J Appl Meteorol Clim, 65(4). https://doi.org/10.1175/JAMC-D-25-0078.1

Tsukada T, Knaff JA, Miller SD, Duran P, Martinez J. 2026. Lightning outbreaks at the mature stage of tropical cyclone. J Geophys Res Atmos, 131(9): e2025JD046243. https://doi.org/10.1029/2025JD046243

Ueda S, Baba Y, Rakov VA. 2026. FDTD computation of ground-level electric fields generated by CIDs. IEEE T Electromagn C. https://doi.org/10.1109/TEMC.2026.3677069

Virts KS, Holzworth RH, McCarthy MP. 2025. Applications of the World Wide Lightning Location Network thunder hour climatology. J Appl Meteorol Clim, 65(5). https://doi.org/10.1175/JAMC-D-25-0166.1

Vukovic F, Grcic BF, Stipetic N, Franc B. 2026. Electromagnetic transients and failed upward leaders observed during lightning activity in an onshore wind farm. Electr Pow Syst Res, 251: 112216. https://doi.org/10.1016/j.epsr.2025.112216

Vukovic F, Montanyà J, Filipovic-Grcic B. 2026. Lightning flash observations on a wind turbine in croatia. Electr Pow Syst Res, 251: 112315. https://doi.org/10.1016/j.epsr.2025.112315

Wang C, Xiang N, Shi D, Fu Z, Zhao A, et al. 2026. Energy-weighted subspace fitting based lightning VHF broadband radiation source mapping algorithm. Atmos Res, 337: 108943. https://doi.org/10.1016/j.atmosres.2026.108943

Wang F, Chen L, Yao W, Zheng D, Zhang G. 2026. Reflectivity characteristics of isolated small-scale storms producing large-peak-current cloud-to-ground lightning. Atmos Res, 336: 108881. https://doi.org/10.1016/j.atmosres.2026.108881

Wang F, Zhang Y, Zhang G, Chen L, Yao W. 2026. Characteristics of negative cloud-to-ground lightning flashes associated with their peak currents of first return strokes. Earth Space Sci, 13(3): e2025EA004599. https://doi.org/10.1029/2025EA004599

Wang H, Hu Q, Shu L, Diao Y, Jiang X, et al. 2026. Lightning attachment characteristics of wind turbine blades in natural environment. Electr Pow Syst Res, 251: 112234. https://doi.org/10.1016/j.epsr.2025.112234

Wang J, Zhang Y, Zhang Y, Fan Y, Li Y. 2026. Relationship between lightning channel extension and charge transfer during initial continuous current and continuing current. Atmos Res, 335: 108814. https://doi.org/10.1016/j.atmosres.2026.108814

Wang P, Liu G, Liang J, Chen L, Yan X, et al. 2026. The interfacial energy transfer characteristics of continuous current and return stroke current in artificially triggered lightning experiments. Electr Pow Syst Res, 250: 112161. https://doi.org/10.1016/j.epsr.2025.112161

Wang Y, Li P, Zhang Y, Hong H, Li X, et al. 2026. On the beam characteristics of X-ray bursts observed in rocket-triggered lightning. Geophys Res Lett, 53(4): e2025GL120120. https://doi.org/10.1029/2025GL120120

Wemhoner J, Leal AFR, da Silva CL, Sonnenfeld R. 2026. Atomic oxygen photometric temperature of lightning and its sub-processes with SOPAPILLA. Sci Rep, 16: 4068. https://doi.org/10.1038/s41598-025-34189-8

Wu B, Liu F, Zhu B, Lu G, Xu W, et al. 2026. Could narrow bipolar events serve as a distinct lightning proxy for revealing overshooting thunderclouds development. Geophys Res Lett, 53(7): e2026GL121958. https://doi.org/10.1029/2026GL121958

Wu J, Jiang R, Sun Z, et al. 2026. HRUnet: a deep learning model designed for lightning forecasting at high spatial resolution. IEEE Trans Geosci Remote Sens, 64: 1-11. https://doi.org/10.1109/TGRS.2026.3668102

Wu X, Zheng D, Zhang Y, Feng J, Wu N, et al. 2026. Distinct cloud-to-ground lightning properties in frontal versus warm-sector heavy rainfall. Earth Space Sci, 13(2): e2025EA004861. https://doi.org/10.1029/2025EA004861

Xu W, Lyu W, Wang X, Qi Q, Wu B, et al. 2026. First time-resolved spectroscopic observation of upward positive leader initiated from tall tower. J Geophys Res Atmos, 131(7): e2025JD045621. https://doi.org/10.1029/2025JD045621

Yair Y, Haspel C, Korzets M, Di-Gangi E, Lapierre J, et al. 2026. Observations and modeling of the longest-recorded delayed sprite. Geophys Res Lett, 53(4): e2025GL119602. https://doi.org/10.1029/2025GL119602

Yair Y, Kozets M, Namia-Cohen Y, Price C. 2026. Lightning used to follow ship-tracks in Eastern Mediterranean winter thunderstorms. Atmos Res, 328: 108453. https://doi.org/10.1016/j.atmosres.2025.108453

Yair Y, Pitlik K, Price C, Korzets M, Lerman C, et al. 2026. Predicting Eastern Mediterranean lightning: evaluating microphysical and thermodynamic indices using a machine learning approach. EGU General Assembly 2026, Vienna, Austria, 3–8 May, EGU26-8984. https://doi.org/10.5194/egusphere-egu26-8984

Yamamoto K, Toriyama Y, Herrera-Murcia J. 2026. Verification of measures to mitigate lightning current flowing into metal sheaths of power cables. Electr Pow Syst Res, 251: 112321. https://doi.org/10.1016/j.epsr.2025.112321

Zhang D, Cooper MA, Holle RL, Vagasky C, Akantambira B, et al. 2025. Empowering Africa: Advancing lightning safety and research initiatives. Bull Am Meteorol Soc, 107(6). https://doi.org/10.1175/BAMS-D-24-0310.1

Zhang X, Deng T, He G, Zhang Z, Chen L, et al. 2026. Quantifying lightning-generated NOx contributions and vertical distribution impacts on atmospheric composition. Atmos Res, 330: 108581. https://doi.org/10.1016/j.atmosres.2025.108581

Zhang Y, Qie X, Cao D, et al. 2026. Thermal deformation correction for the FY-4A LMI. Remote Sens, 18(1): 163. https://doi.org/10.3390/rs18010163

Zhou Q, Deng X, Bian X, Chen K, Chen S, et al. 2026. Lightning disaster risk assessment of power distribution grid with Kmeans-SMOTE optimized BO-XGBoost. Electr Pow Syst Res, 252: 112472. https://doi.org/10.1016/j.epsr.2025.112472

Zhu K, Qie X, Yuan S, et al. 2025. Increased thunderstorm activities caused by warming and wetting over the Tibetan Plateau. J Geophys Res Atmos, 130(24): e2025JD044233. https://doi.org/10.1029/2025JD044233

Zhu X, Lu G, Sun L, Zhuge X, Zhang W, et al. 2026. Enhanced lightning activity during the merger of Super Typhoon Hinnamnor. Adv Atmos Sci, 43: 1243 – 1255. https://doi.org/10.1007/s00376-025-4515-5

ATMOSPHERIC ELECTRICITY

NEWSLETTER

Vol.37 No.1 2026 May

Edited by: Wenjuan Zhang (CAMS) and Haiyang Gao (NUIST)

REMINDER

Newsletter on Atmospheric Electricity presents twice a year (May and November) to the members of our community with the following information:

- announcements concerning people from atmospheric electricity community, especially awards, new books, ...,
- announcements about conferences, meetings, symposia, workshops in our field of interest,
- brief synthetic reports about the research activities conducted by the various organizations working in atmospheric electricity throughout the world, and presented by the groups where this research is performed, and
- a list of recent publications. In this last item will be listed the references of the papers published in our field of interest during the past six months by the research groups, or to be published very soon, that wish to release this information, but we do not include the contributions in the proceedings of the Conferences.

No publication of scientific paper is done in this Newsletter. We urge all the groups interested to submit a short text (one page maximum with photos eventually) on their research, their results or their projects, along with a list of references of their papers published during the past six months. This list will appear in the last item. Any information about meetings, conferences or others which we would not be aware of will be welcome.

Call for contributions to the newsletter

All issues of this newsletter are open for general contributions. If you would like to contribute any science highlight or workshop report, please contact Weitao Lyu (weitao.lyu@gmail.com) preferably by e-mail as an attached word document.

The deadline for **2026 autumn issue** of the newsletter is **Nov 15, 2026**.

PRESIDENT
Xiushu Qie
Chinese Academy of Sciences
E-mail: qiex@mail.iap.ac.cn

SECRETARY
Weitao Lyu
Chinese Academy of Meteorological Sciences
E-mail: weitao.lyu@gmail.com

ICAE

IAMAS IUGG