

# Coupling of Thunderstorms and Lightning Discharges to Near-Earth Space

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Discovered in the early 1990s, sprites, jets, and elves, generically referred to as “Transient Luminous Events (TLEs)”, are flashes of light in the stratosphere and mesosphere above severe thunderstorms. These “fireworks” include the Earth’s longest electrical discharges reaching from the tops of thunderclouds to the bottom of the ionosphere near 80 km altitude. Also during the 1990s, bursts of X- and gamma-rays were observed, by spacecraft, to come from the atmosphere above thunderstorms. These so-called “Terrestrial Gamma-ray Flashes” (TGFs) are thought to be bremsstrahlung radiation from relativistic electrons accelerated in the enormous electric fields above thunderstorms. TLEs and TGFs are recently discovered processes that couple the troposphere to the upper atmosphere and near-Earth space.

Following the success of the NATO Advanced Study Institute on “Sprites, Elves, and Intense Lightning Discharges” held at the University of Corsica, Corte, France, from 24 to 31 July 2004, many European initiatives in lightning-related TLEs were developed:

- Atmosphere-Space Interactions Monitor (ASIM): a sophisticated instrument to be flown on the external pallet of the Columbus module, which is one of the European Space Agency contributions to the International Space Station.
- Tool for the Analysis of RADIations from lightNINGs and Sprites (TARANIS): a Myriade micro-satellite project within the French national space programme.
- Electromagnetic Coupling of the Atmosphere with Near Earth-Space (E-CANES): a French-led European Research Group (GDRE) project.
- Camera system set up on Corsica in the summer of 2007 to observe TLEs.
- The four-year (2002-2006) EU Framework 5-funded Research Training Network project “Coupling of Atmospheric Layers (CAL)”: the Eurosprite campaigns were the observational part of this project.

It was therefore considered timely that a second TLE workshop should be held in Europe. It was again held at the University of Corsica, Corte, France, from 23 to 27 June 2008. The aims of this workshop were to better understand and identify the various physical processes that couple thunderstorms to the Earth's upper atmosphere and ionosphere, and also the various effects of thunderstorm processes on the atmosphere and its dynamics. The workshop consisted of both invited tutorials and contributed talks, and covered observations, simulations, theory, and instruments related to the following subjects:

- “Thunderstorms and Lightning”
- “Observations and Modeling: TLEs and TGFs, and Associated Phenomena”
- “Ionospheric and Magnetospheric Effects”
- “Instrumental Techniques”
- “Current and Future Dedicated Campaigns and Missions”
- “Global Electrical Circuit and Lightning Activity in the Solar System”.

Furthermore the workshop also included hands-on tutorials, an interactive poster session, an education and public outreach session, splinter meetings targeted at the different communities (ASIM, TARANIS, E-CANES, COST WG5, etc.) and a panel discussion regarding “joint campaigns and missions”. More importantly, the workshop provided an international forum to prepare for future theoretical studies and for multi-observational campaigns.

All authors who presented papers (both oral and poster) were offered the opportunity to publish their results under the standard refereeing procedures in the International Conference Proceedings Series of the American Institute of Physics (AIP). This book, one of the outcomes of the workshop, covers the diverse range of topics that were discussed. The editors would like to thank all the contributing authors for taking the time to write up their papers, and also the reviewers for their time and effort in refereeing them in detail. The editors would also like to thank various funding agencies and sources listed in the Acknowledgments for their generous support. Without that, the workshop and these proceedings would not have been possible.

We wish all our colleagues involved in future TLE and TGF work every success!

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Editors of the AIP International Conference Proceedings.