Popular science summary of the PhD thesis

PhD student	Matthias Heumesser
Title of the PhD thesis	The Origin of Gamma-Ray Flashes in Thunderstorms
PhD school/Department	Elektro: Electrical Engineering, Fotonik, Nanolab and Space / DTU Space

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

Terrestrial Gamma-Ray Flashes (TGFs) are high-energy flashes of X- and gamma-rays produced in thunderstorms. Their origin is not yet conclusively explained and under active research. Two mechanisms were developed to explain the occurrence of TGFs from thunderstorms, one model describes TGF production from lightning discharges, the other as a consequence of large scale electric fields in thunderstorms. The optical emissions differ for both approaches, making optical measurements in association to TGFs a suitable approach to infer the underlying physics. The Atmosphere-Space Interactions Monitor (ASIM), following the history of TGF detections from satellites, is the first mission dedicated to the study of TGFs and simultaneous optical emissions.

This thesis analyzes optical data from ASIM at 180-230 nm, at 337 nm and at 777.4 nm in the period from June 2018 to October 2019. The measurements reveal new insights into the production of TGFs by their connection to strong optical pulses. These pulses are found to be generated at the same time as the TGF and in the upper levels of clouds, the suspected source region of the high-energy flashes. The results finally suggest the production of TGFs in the process of upward lightning in the cloud and consequently support the model of TGF production from lightning while finding no evidence for the other mechanism.

Please email the summary to the PhD secretary at the department