UNIVERSITY: Lille , Faculty of Sciences and Technologies

Scientific domain: Optics and Lasers, Chemical Physics, Atmosphere.

Title of the thesis: Radiative transfer of lightning light by thundercloud and validation of TARANIS satellite observations

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ABSTRACT

Thunderstorms, present all the time everywhere in the world, produce flashes emitting electromagnetic waves (optical and radio). The observations made by low orbit satellites for twenty years have allowed the procurement of the first global map of the electrical activity of thunderstorms. The next generation of geostationary meteorological satellites will be equipped for the first time of lightning imagers. They will strongly contribute to the real-time alert of severe weather such as Cevennes episode storms. At the same time, CNES is currently building the TARANIS satellite which will, among other things, observe lightning. It will be launched in mid-2019. The optical instrument, consisting of cameras and photometers, is under the scientific responsibility of the CEA and is manufactured by CNES. It will provide complementary measurements to those of the future geostationary satellites.

The thesis will aim to model the light emitted by the lightning discharges, its radiative transfer through the cloud and its measurement by TARANIS or a satellite in geostationary orbit. Since the space, only the light scattered by the cloud is visible. Understanding the radiative transfer by the cloud of the light, produced by the lightning discharges, is fundamental. Modeling this process should take into account the geometry of the discharges in the cloud and the cloud microphysical properties. Radiative transfer models developed at the Laboratoire d'Optique Atmosphérique will be used. Photons out of the cloud will be propagated up to TARANIS sensors. Images and signals will be simulated using the radiometric and geometric models of the TARANIS sensors, which are already developed by the CEA. The variability of these images and signals will be analyzed in comparison with the input parameters. The main features of lightning, which will be observed by TARANIS, will then be deduced.