C^3IEL : Cluster for Climate and Cloud Imaging of Evolution and Lightning, an innovative way to observe the clouds and their environment

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Abstract

Clouds are key elements of the Earth climatic system. However, lot of uncertainties remains about their evolutions and their roles in the context of climate change. Increasing the knowledge of the cloud development and interactions with water vapor and aerosols is then essential.

The French-Israeli C^3IEL (Cluster for Climate and Cloud Imaging of Evolution and Lightning) is an innovative spatial mission currently under study that will provide unprecedented new insights to outstanding climate questions. This demonstration mission, mainly focused on convective clouds, aims at characterizing dynamically the clouds and their environment at a high spatial and temporal resolutions of the scales of the individual convective updrafts. The different nano-satellites of the C3IEL mission will carry visible cameras measuring at a spatial resolution of about 20 meters, near-infrared imagers measuring in and near the water vapor absorption bands, optical lightning sensors and photometers. The observational strategy for the imagers will consist in 10 to 20 multi-angular measurements of a given cloudy scene during the 200 seconds of the overpass at a rate of an observation captured every 10 to 20 seconds.Lightning observations will be done continiously during the same time. The observations of these space-borne sensors will consequently simultaneously document the vertical cloud development retrieved by a stereoscopic method, the lightning activity and the distribution of water vapor at a high resolution by exploiting the multi-angle measurements for application of tomography methods.
The scientific objectives of the C^3IEL mission will be introduced. Then we will discuss the

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nano-satellite train configuration, the observational strategy and the different sensors of the mission. Finally, we will introduce the observations and products of the C^{3}IEL mission that will give new understanding of the redistribution of the energy and water vapor in the atmosphere, and of the relation between storm vigor and frequency of lightning activity. In addition, using synergistically with measurements of others missions like the Joint Polar Satellite System mission (JPSS) and the geostationary satellites such as the METEOSAT Third Generation (MTG) Imager (MTG-I) and the Sounder (MTG-S) missions, a first use of C^{3}IEL products will allow to disentangle aerosol impacts and cloud updrafts and to study the life cycle of convective clouds.