Final Preport for Project **1168**

Project title: **Thunderstorms and their role in producing lightning- ignited wildfires and transient luminous events: Impact on chemistry**

Principal investigator: **Francisco-Javier Perez-Invernon**

Report period: **July 1, 2020 - June 30, 2022**

This project has achieved a significant improvement in the implementation of atmospheric electricity in MESSy. In addition, several simulations have been performed to investigate the role of atmospheric electricity in the Earth system.

The main achievements of MESSy are:

1) Implementation of the first parameterization of long-continuing-current lightning in MESSy. Long-continuing-current lightning can be used as a proxy for lightning ignitions in the model. This improvement has been described in a publication:

https://doi.org/10.5194/gmd-15-1545-2022

2) The developed parameterization of long-continuing-current lightning have enabled Dr. Pérez-Invernón et al. toperform projected simulations and investigate the variation in lightning-ignited wildfires pattern under climate change. They are already working on a manuscript to publish these results.

3) The model MESSy has been used as a tool to calculate the NOx produced by lightning from TROPOMI measurements. These results have been published:

https://doi.org/10.5194/amt-15-3329-2022

4) Implementation of a parameterization of Blue Jets in MESSy (https://doi.org/10.1029/2018JD029593). Blue Jets can inject a significant amount of N2O and NOx in the atmosphere, playing a role in the global budget of O3. In this project, several simulations with chemistry including Blue Jets have been performed. Dr. Pérez-Invernón et al. are working on a manuscript to present the results.

5) Implementation of a new parameterization of sprites in MESSy to establish their chemical role in the mesosphere. Several simulations have already been performed, and Dr. Pérez-Invernón et al. are currently working on a manuscript to present the results.

6) Implementation of in cloud corona discharges in MESSy. The first global climatology of corona discharges was published in 2021 (https://doi.org/10.1029/2021GL094657). Dr. Pérez-Invernón et al. have developed the first parameterization of corona discharges and have implemented their occurrence in MESSy. They are working on a manuscript to publish these results.