

Rare types of transient luminous events observed above two Florida storms on 12 September 2014

**Ningyu Liu¹, Levi D. Boggs¹, Michael Splitt², Steven Lazarus², Chad Glenn¹,
Hamid K. Rassoul¹, and Steven A. Cummer³**

¹Department of Physics and Space Sciences, Florida Institute of Technology, Melbourne, FL, USA.

²Department of Marine and Environmental Systems, Florida Institute of Technology, Melbourne, FL, USA.

³Department of Electrical and Computer Engineering, Duke University, Durham, NC, USA.

Transient luminous events (TLEs) are electrical discharges in the middle and upper atmosphere, which are caused by underlying thunderstorms and lightning. TLEs are classified as jets, gigantic jets, sprites, halos, and elves, based on their morphologies and physical mechanisms. Gigantic jets and negative sprites (sprites caused by negative cloud-to-ground lightning discharges, -CGs) are the least frequent types of TLEs, but their occurrences come with a significant modification of the lower ionosphere. Gigantic jets electrically connect tropospheric thunderstorms with the lower ionosphere and can transfer a large amount of electric charge between the two atmospheric regions, while negative sprites exemplify the effects of impulsive lightning discharges on the lower ionosphere. On 12 September 2014, five negative sprites and two gigantic jets above two Florida storms were recorded by an automatic camera system at Florida Tech. The storms were associated with a tropical disturbance moving westward across south Florida. The first storm occurred in southeast Florida and produced at least four negative sprites. Although not directly observed by the camera, there may have been additional negative sprites as there were other -CGs with charge moment changes greater than the empirically-established threshold for sprite production. A second storm in south Florida produced one negative sprite and two gigantic jets. The parent CG of that negative sprite resulted in an impressive impulse charge moment change of about 1300 C km. Negative CGs with such a charge moment change or larger occur only a few times per year across US [Cummer et al., *J. Geophys. Res.*, 118, 5176, 2013].

In this talk, we present and analyze the data we have collected for those events. The data indicates that the storms are tall, with intense convection and high storm-top wind shear. The parent discharges of the negative sprites are unusual types of negative CGs, including bolt-from-the-blue, hybrid intracloud-negative cloud-to-ground, and multicellular discharges. Together with the observation of a few jets and gigantic jets from the same site in August 2013 [Liu et al., *Nat. Commun.*, 6, 5995, 2015; Lazarus et al., *J. Geophys. Res. Atmos.*, 120, 2015], the data suggests that Florida thunderstorms developing in a tropical disturbance environment, particularly with relative high winds aloft, have the potential to create unique thunderstorm charge structures that facilitate the production of unusual types of lightning and TLEs.