VHF Broadband Interferometer Comparisons with ASIM MMIA Fast Optical Photometry

General goal: To better understand how light output at different wavelengths correlates in time with various lightning discharge processes

Applied to GLM: What factors determine which discharge events are detected at 777.4 nm and their optical amplitude?

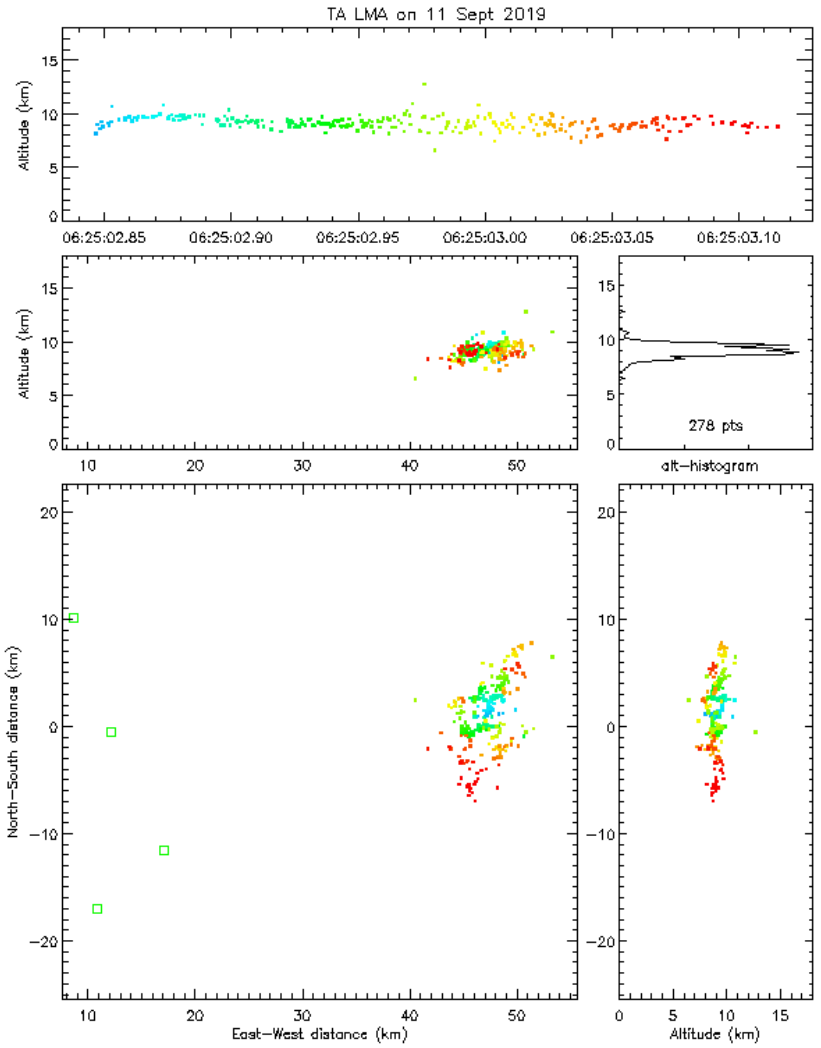
Contributors: Mark Stanley, Matthias Heumesser, Paul Krehbiel, William Rison, John Belz, Rasha Abbasi, Jackson Remington and Dan Rodeheffer

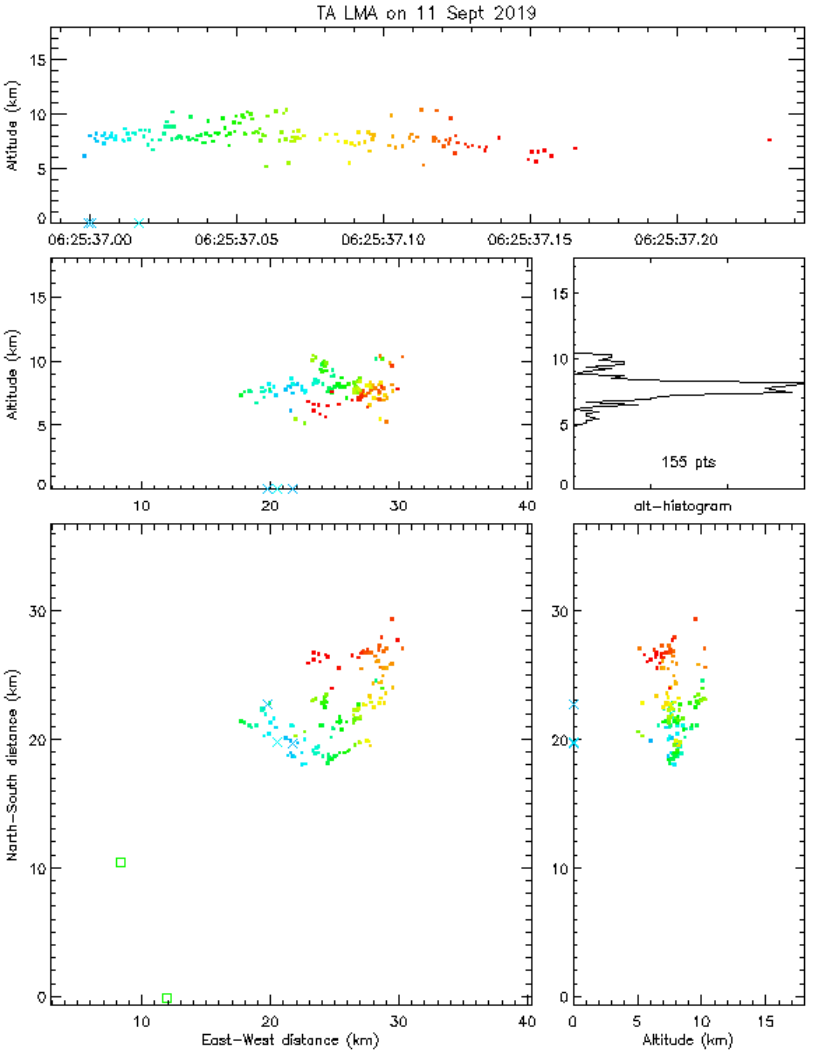
INTF-MMIA Comparisons - Overview

- Atmosphere Space Interactions Monitor (ASIM) Modular Multispectral Imaging Array (MMIA) Photometry:
  - 100 kHz at 180-230 nm, 337 nm, 777.4 nm
- New Mexico Tech Broadband VHF Interferometer:
  - 180 MHz: 3 VHF antennas (14-88 MHz) and a Fast Antenna
  - Post-processed 2D (Az/El) maps at ~1 MHz
- INTF-ASIM common events for June, 2018 to Nov, 2019:

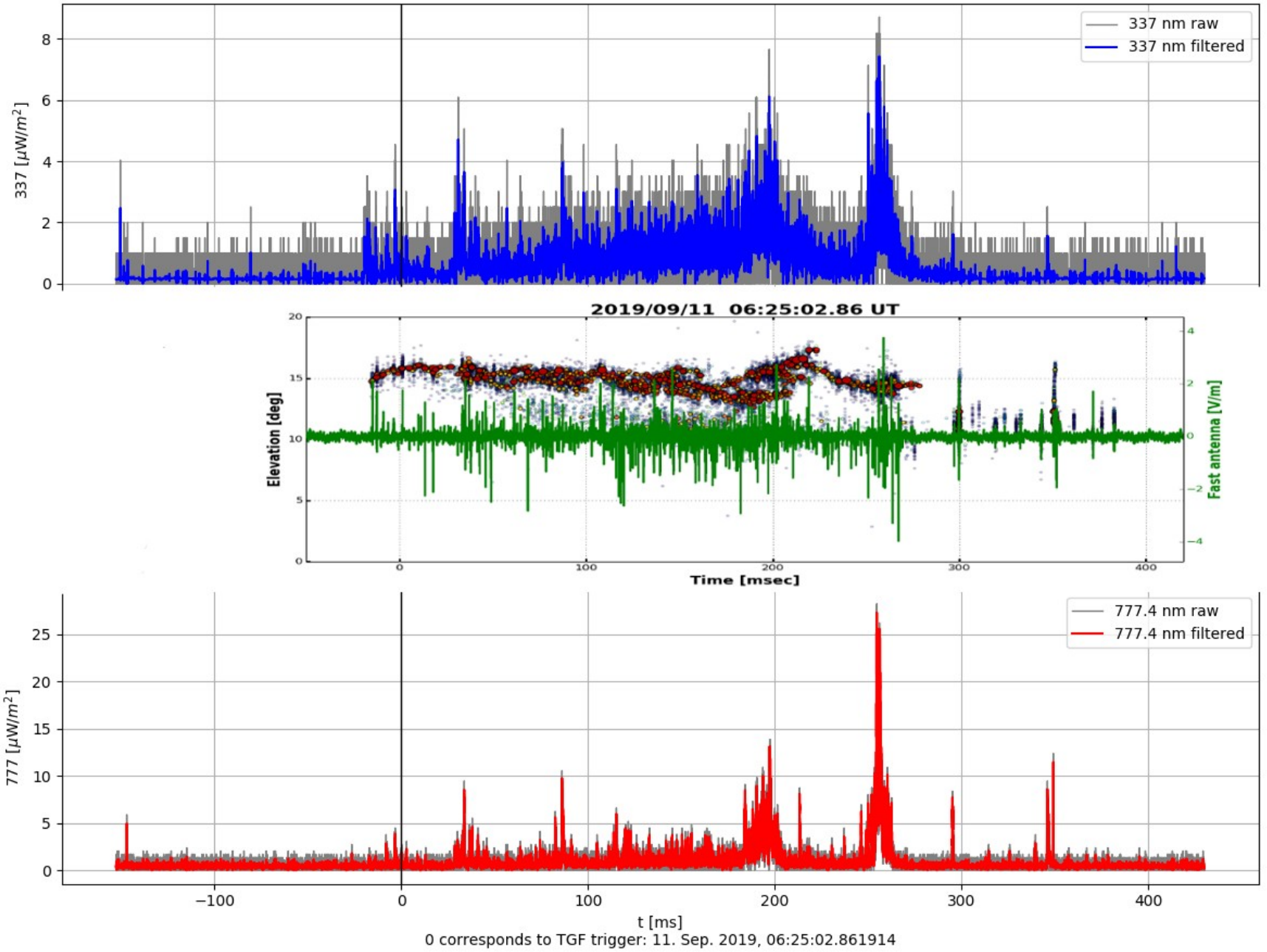
June 5, 2018 04:47:47 UT	Oklahoma	-CG at 70 km (far)
		+IC at 30 km
Sept. 11, 2019 06:25:02 UT	Utah	+IC at 30 km
Sept. 11, 2019 06:25:36 UT		+IC at 15 km

INTF-MMIA Comparisons – Sept 11, 2019 LMA data

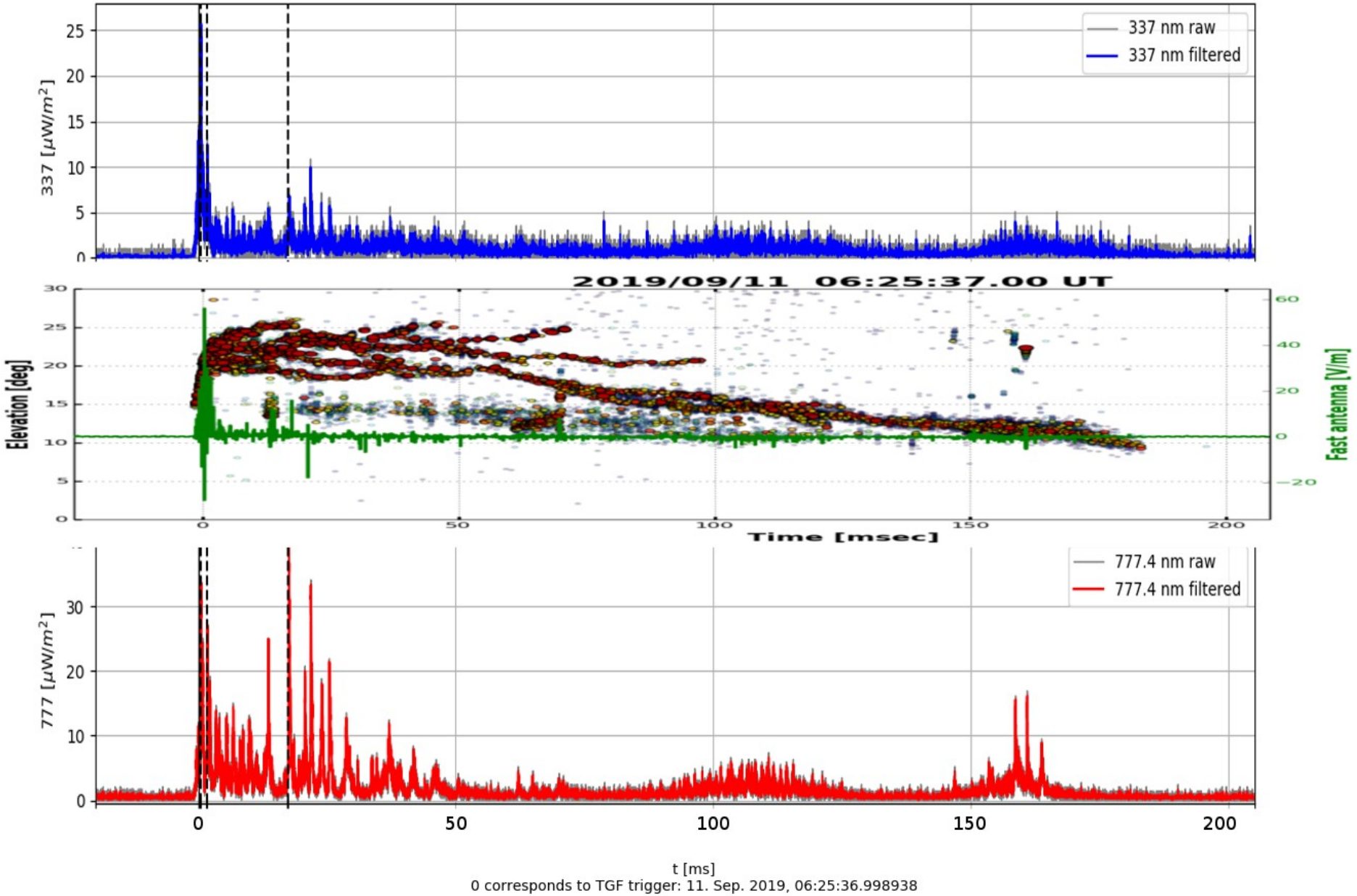




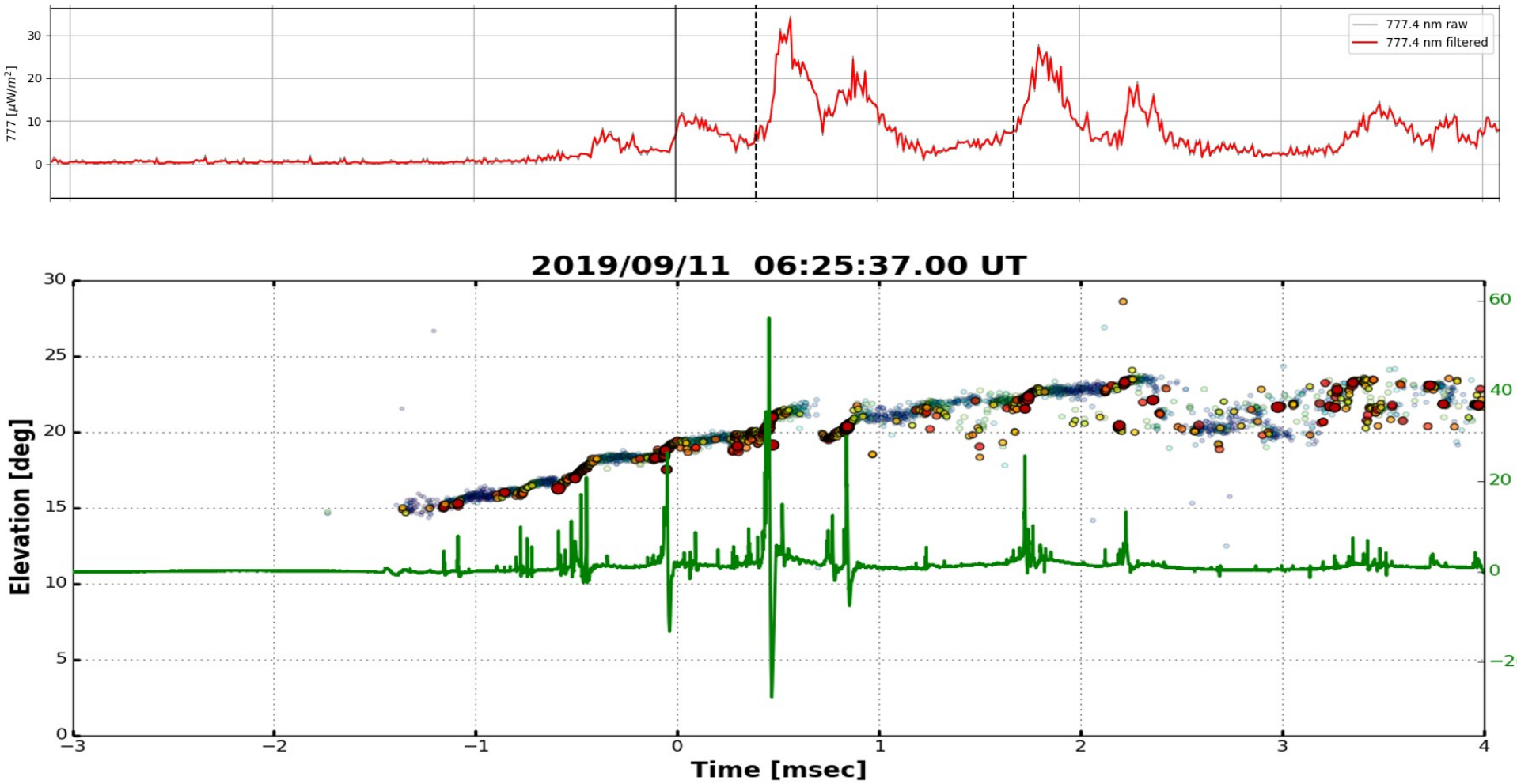
INTF-MMIA Comparisons – Sept 11, 06:25:02 UT data



INTF-MMIA Comparisons – Sept 11, 06:25:36 UT data



INTF-MMIA Comparisons – Sept 11, 06:25:36 UT zoom



INTF-MMIA Comparisons – Summary

- **Limited number (4) of examples analyzed so far**
- **Wide variation in optical output of Initial Breakdown Pulses (IBPs) for different IC flashes (and likely from storm to storm), particularly at the 777.4 nm wavelength of GLM**
- **The ratio of blue (337 nm) to red (777.4 nm) is much higher for IBPs than events late in the flash (such as K-changes), consistent with IBPs being at least partly composed of fast negative non-thermal streamers.**
- **Even with the poor red output relative to blue, strong IBPs can still produce the brightest optical output within flashes.**

INTF-MMIA Comparisons – Future Work

- **Analyze additional INTF-MMIA flashes (two from July 28, 2020 and others?)**
- **In addition to discharge type, explore what effects channel length, energetics (FA), optical depth and other key parameters have on optical output**
- **Utilize data from the relatively new 8 antenna (7 VHF, 1 FA) 3D imaging LMA Technologies interferometer which was deployed last week to the west of the Telescope Array in Utah**
- **Spring 2021: Deploy fast ground-based photometers (337, 777.4 nm and other?) in Utah with a 1 MHz or faster sample rate**