# SIMULATION AND ANALYSIS OF GOES-R GEOSTATIONARY LIGHTNING MAPPER (GLM) DETECTION ALGORITHM PERFORMANCE

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# Agenda

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   - Design parameters
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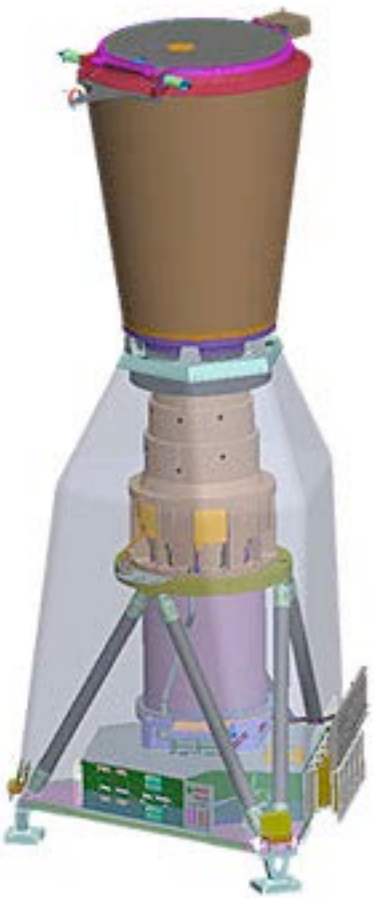


http://www.goes-r.gov/spacesegment/glm.html

# Nomenclature

## Lightning

1. Flashes are made up of pulses.
2. Pulses generate GLM events.
3. Events are exceedances of threshold in a pixel
4. Groups are events generated by the same pulse.
5. Radiance – energy (uJ) per aperture area ($m^2$) per pixel steradian (sr).

## Requirements

1. Detection probability – fraction of flashes detected
2. False alarm probability – fraction of detected flashes that are not lightning

# Inputs

## Lightning statistics (Grandell and Buechler)

1. Time: Flashes per second, mean and max time between pulses
2. Strength: event energy, pulse energy, max pulse energy
3. Area: pulse area, flash area

## Design parameters (Edgington and Tillier)

1. Signal: aperture area, quantum efficiency, optical throughput
2. Noise: electronic and background
3. Spacecraft: radiation shielding and attitude stability (jitter)

# Simulation – Event Generation

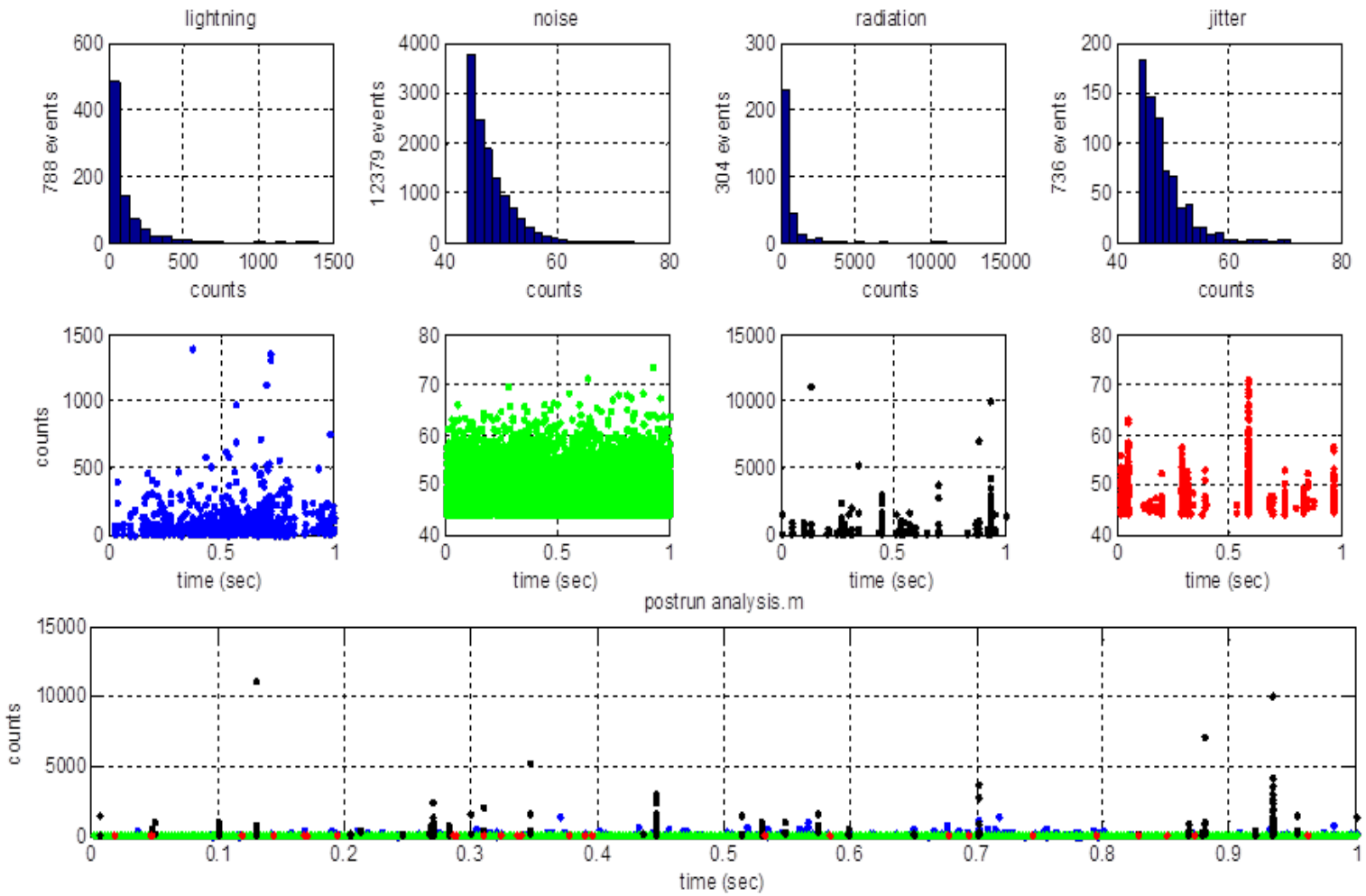
## For each frame, …

1. Shift background according to simulated attitude history.
2. Superimpose radiation and lightning.
3. Subtract tracked background and apply thresholds.
4. Update tracked background and go on to next frame.

## Outputs

1. Frame number
2. Pixel row
3. Pixel column,
4. Event strength,
5. Flash number or false event type flag
6. Background 5 most significant bits

# Generated Events



# Simulation – Lightning Detection

## For each frame, …

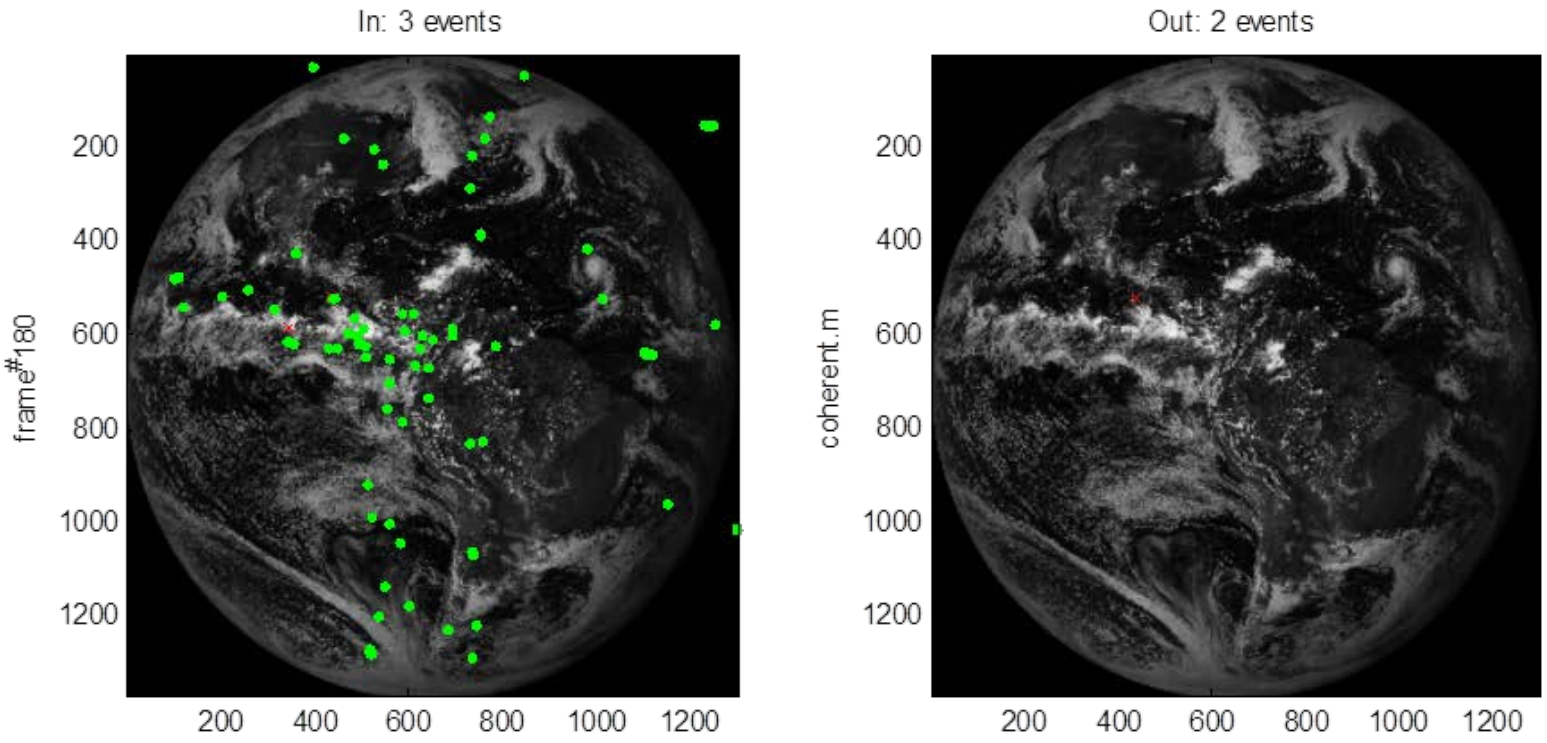
Calculate probability that the event was noise.

```
If pixel was already active, …
    Compute probability that event and parent were false.
    If that joint probability is less than limit, event is detected.
        Assign 'flash number' of parent event to this event.
        Write to output file.
    End
Else
    Start new 'flash number' for this event
End
```

Update probability matrix.

Start event clock for the pixel.

# Active Pixel Test



# Simulation – Result Evaluation

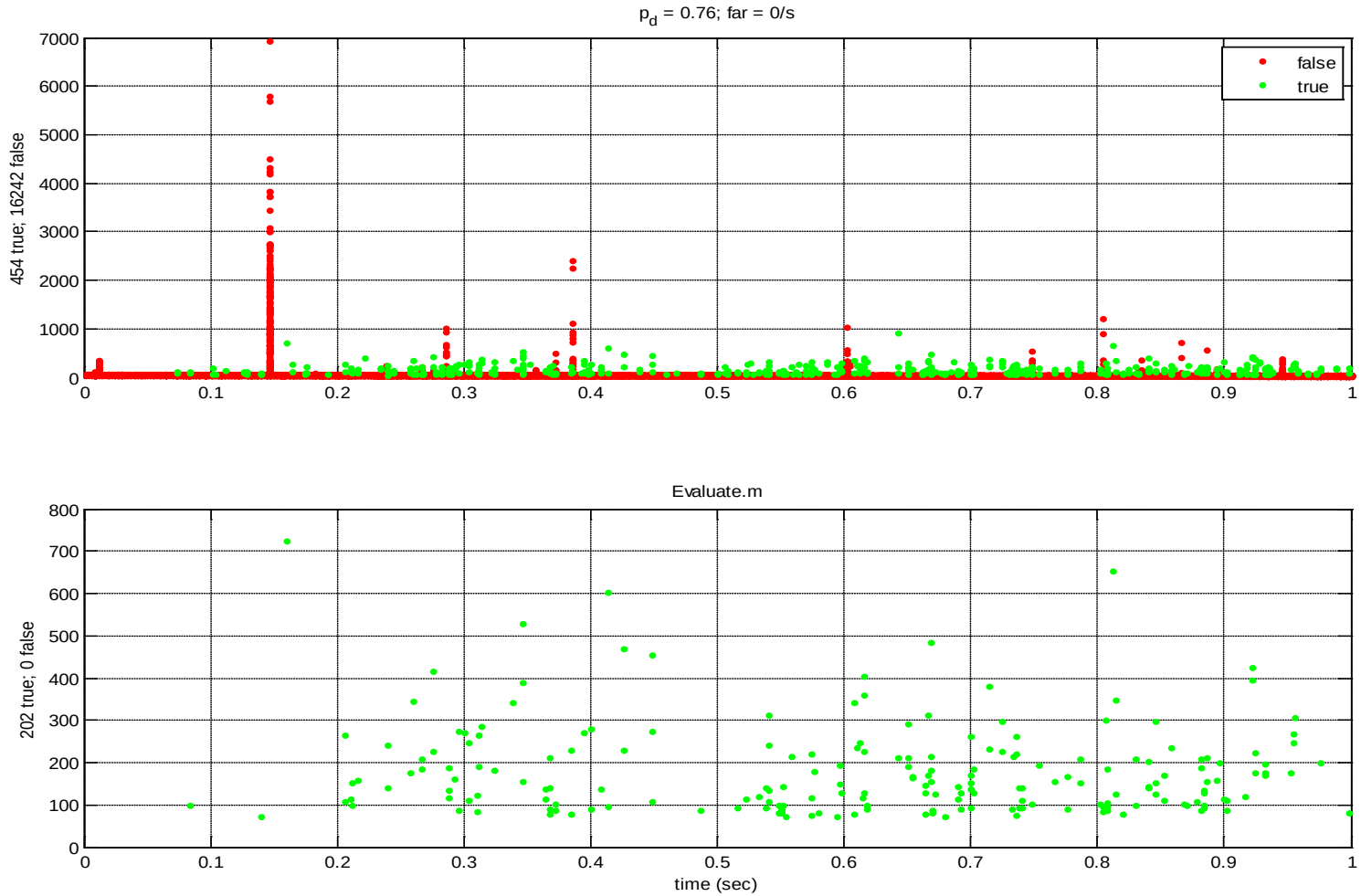
## For each frame, …

1. Match detected to simulated events.
2. Assign true flash number or flag to the detected event.

## After all detected events are tagged, …

1. Compute the fraction of flashes detected to give detection efficiency.
2. Count number of 'detected flashes' that don't include any real lighting events.
3. Divide this number by the number of true flashes to give false alarm proability.

# Input and Output Events



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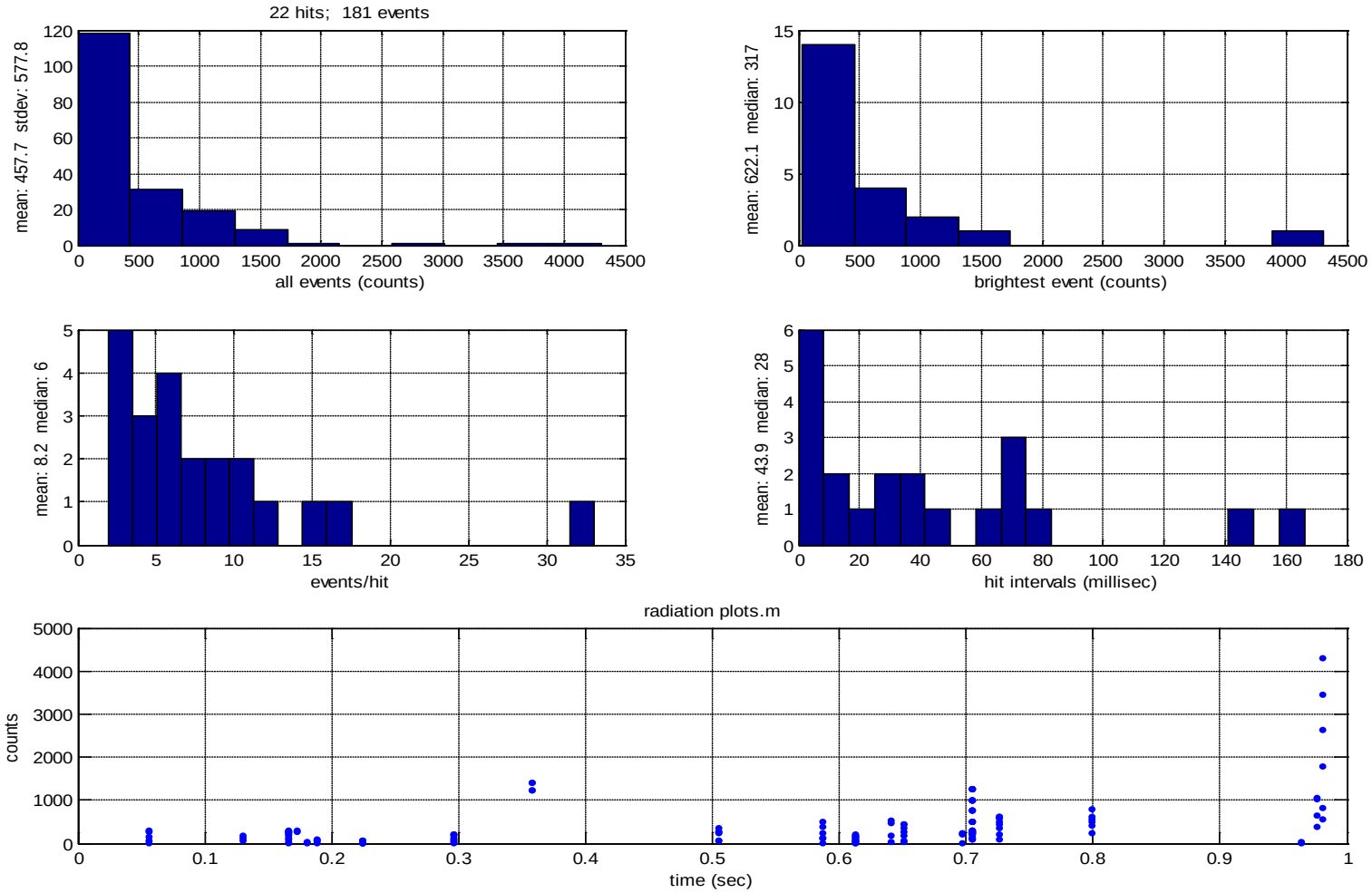
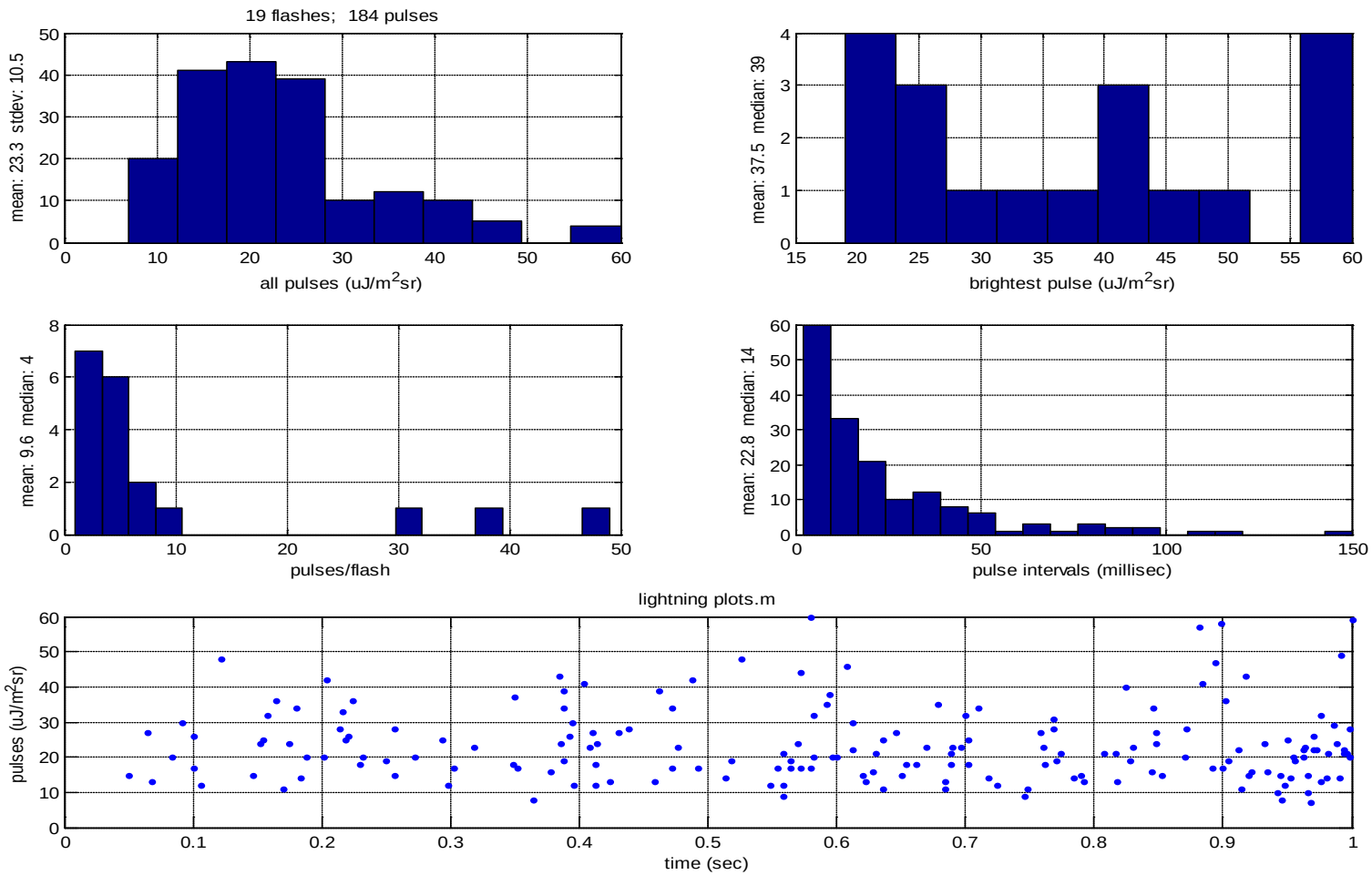
  - James Bremer of Research Support Instruments who contributed heavily to the early development of our event and algorithm modeling.

# Backup Slides

# Generated Events - Radiation



# Generated Events - Lightning