

# Proxy Data and VHF/Optical Comparisons

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GLM Proxy Data Designer

# Lightning Imaging Sensor (LIS) on TRMM

- Satellite based optical detector
- Low-Earth Orbit
- Can detect daytime or nighttime flashes
- view time of about 80 s

# North Alabama

## Lightning Mapping Array (LMA)

- 10 sensor network; ground-based
- VHF / TOA system
- 24 x 7
- can observe a storm throughout its lifetime, if it stays in range  
(about 200 km from network center)

# Instrument Comparison

LIS	LMA
Satellite (LEO) based	ground based
80s view time	view time limited only by range
Range = FOV	Range = 150–200 km from network center
optical detector (777.4 nm)	VHF/TOA network
2ms integration time no dead time—500 frames/s	Samples at 25 Ms/s; reports one peak in 80 $\mu$ s window
Global coverage ( $\pm 35^\circ$ )	North Alabama
Detection Efficiency ~ 70%	Detection Efficiency ~ 85%

# Can we generate GLM proxy from LMA?

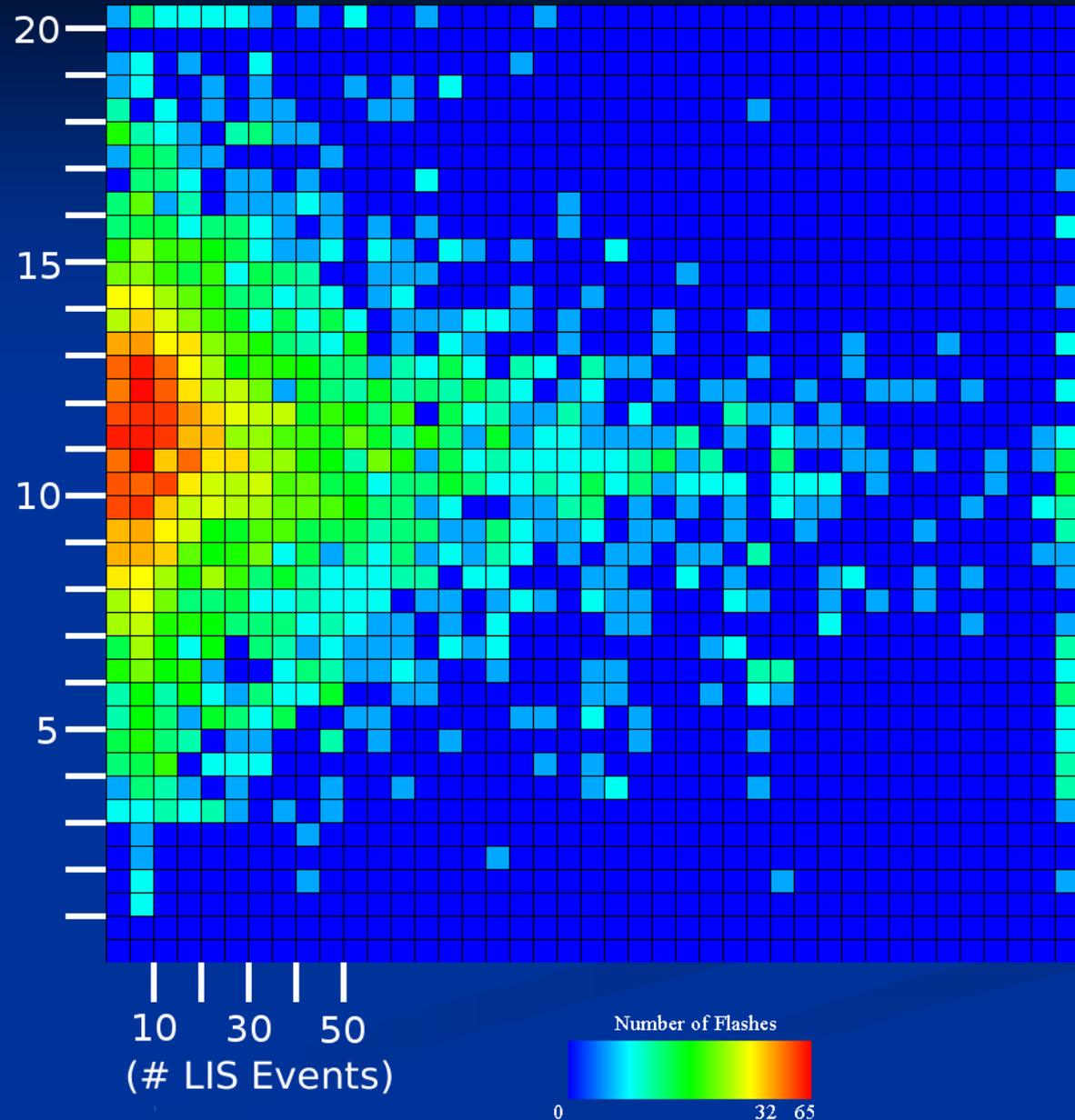
- Extensive statistical comparison of NALMA, LIS, & NLDN data
- Most flash characteristics (size, #events, duration, etc.) did not correlate between the systems.
- Bottom line: LIS & LMA look at completely different physics...

# What we do know...

- LIS sees more pixels light up for CG flashes than for IC flashes (save for later)
- The more cloud above the lightning channel, the less light gets to LIS.
- That is, flashes that are higher in the cloud appear brighter to LIS
- Can we see this?

# LMA Altitude vs. # LIS events

1 year of  
N. AL data



# Sidebar: LIS definitions

- Event: pixel
- Group: pixels that light up at the same time and touch each other
- Flash: A collection of groups that satisfy time and space criterion for our best guess as to what is a lightning flash.

# GLM Proxy data, v1

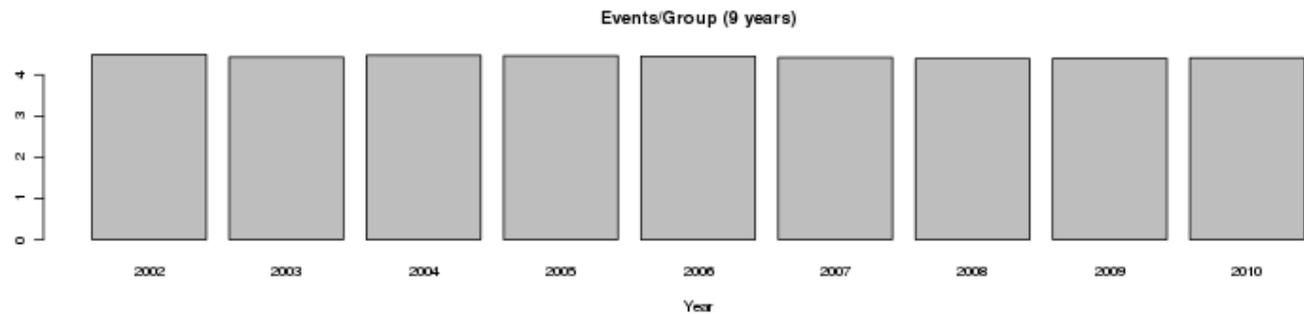
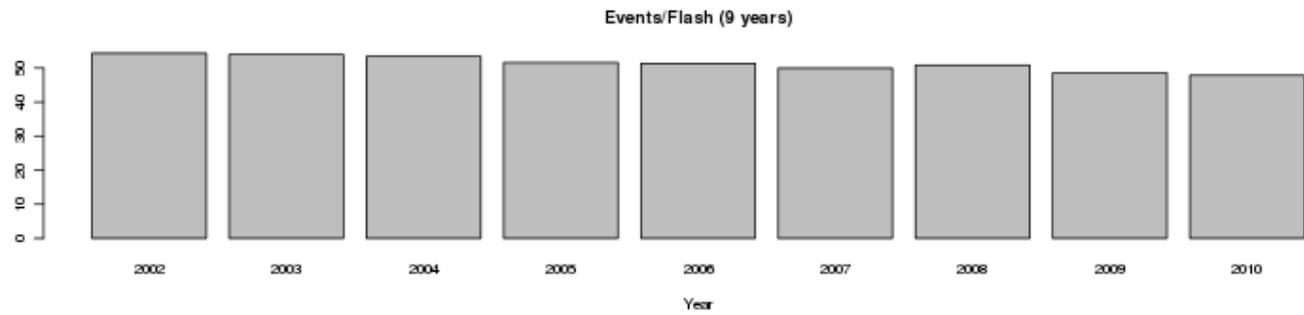
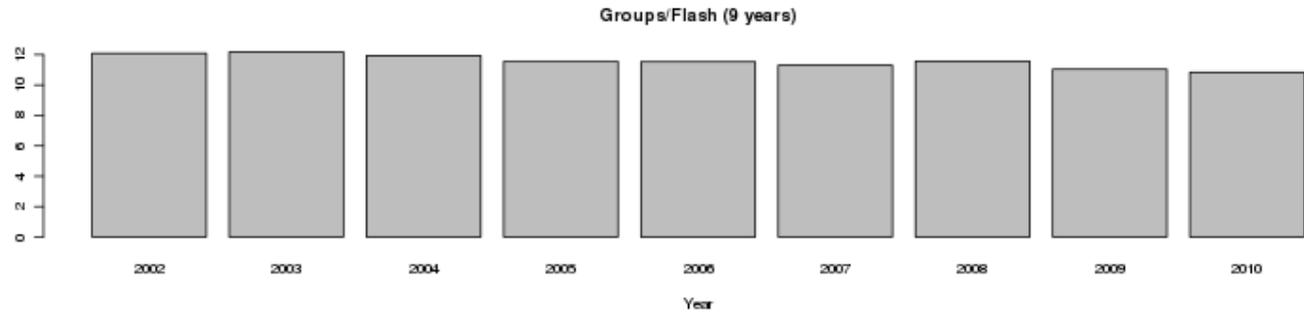
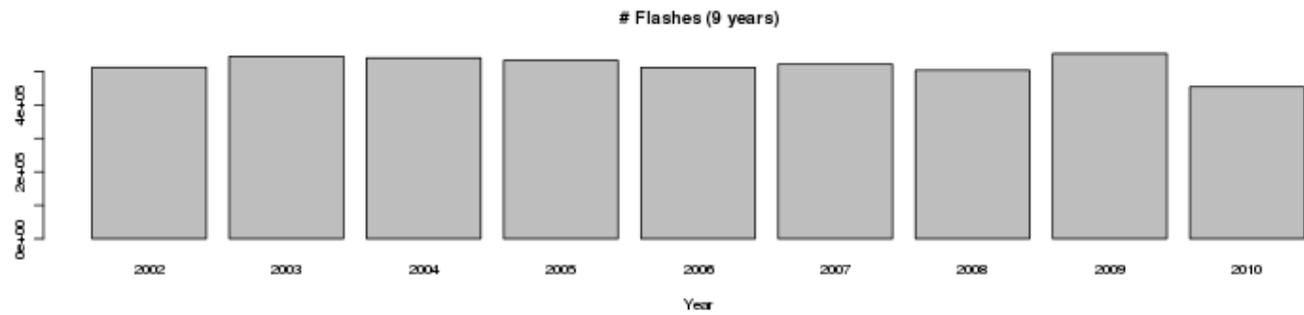
## Science + simulation

- With the relation shown, and a technique called “distribution matching”
- Using storm data from the LMA, could look up “how many pixels” needed
- We had no idea how to distribute those in space & time, so
- For the v1 proxy, we had to simulate the space & time distribution of pixels.

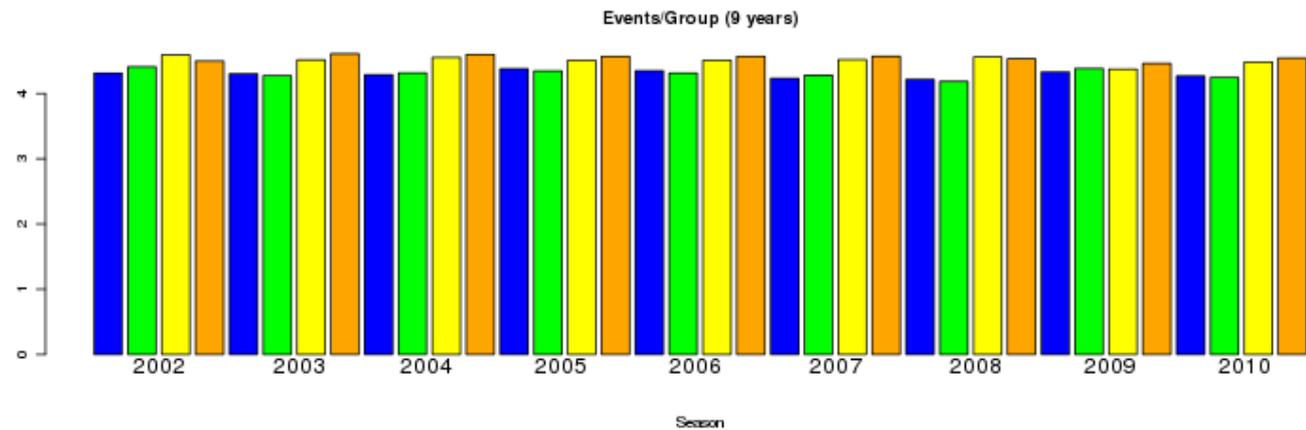
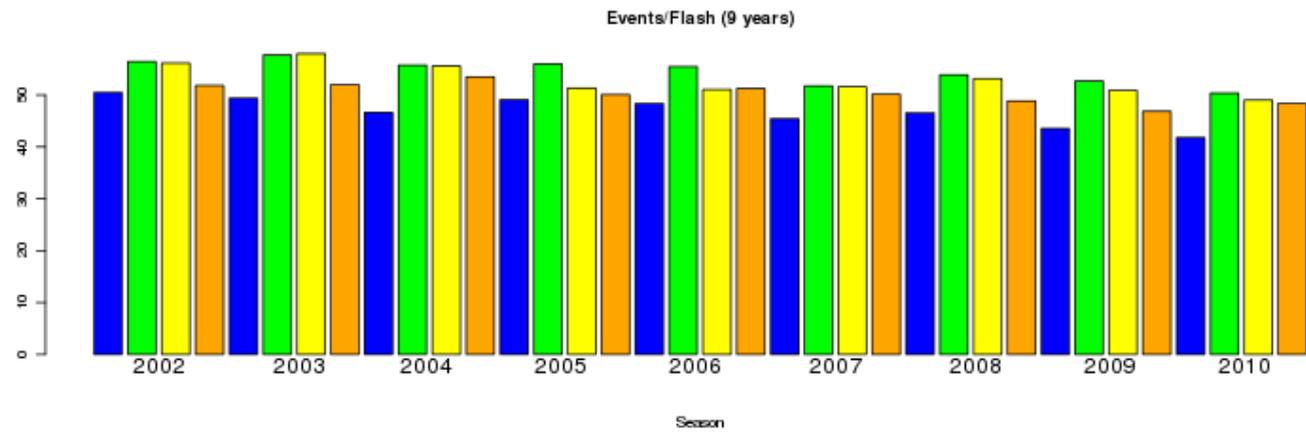
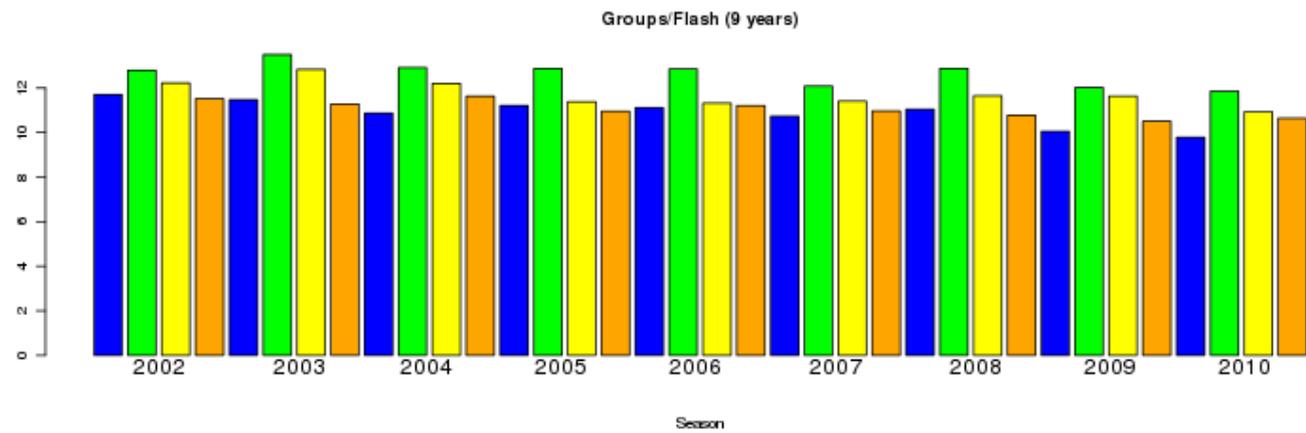
# LIS data as a Proxy

- LIS is the best proxy we have for GLM
- Need to better quantify for proxy data
- Collected statistics on all flashes, groups & events starting in Dec 2001
- Limited to GLM FOV
- Created a 5x5 km grid, fixed to the Earth
- Binned each event into a grid box
- Collected the size, shape, and temporal distribution of each flash

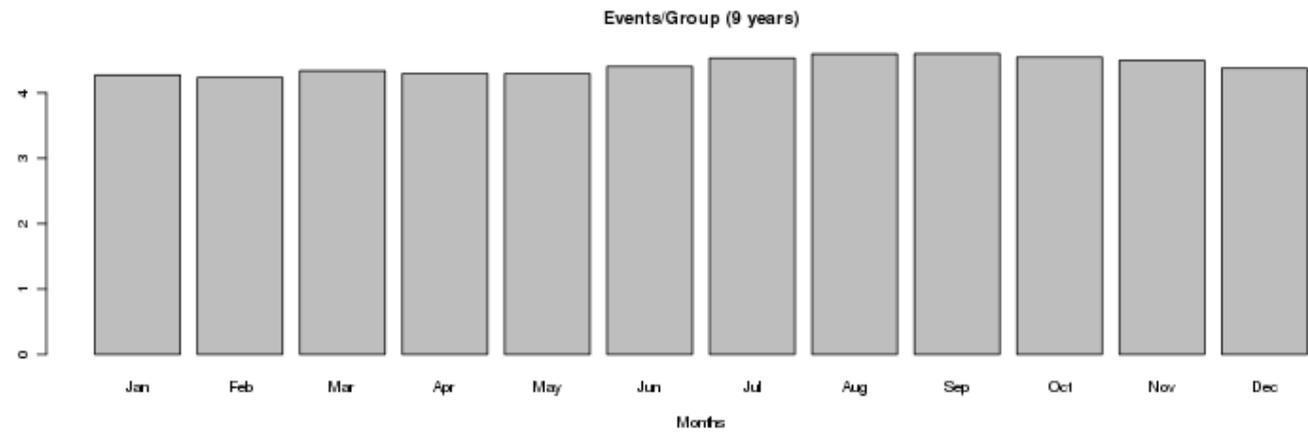
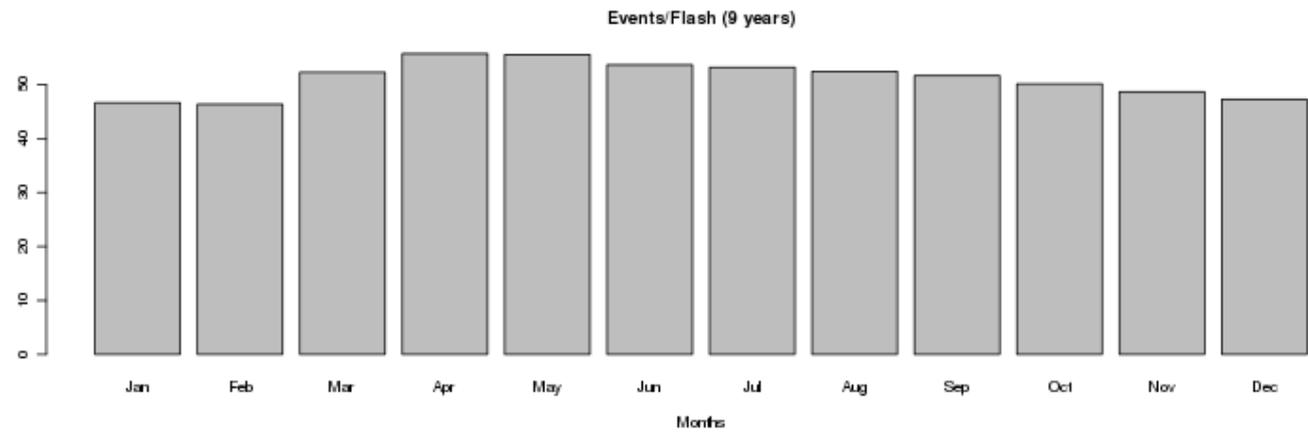
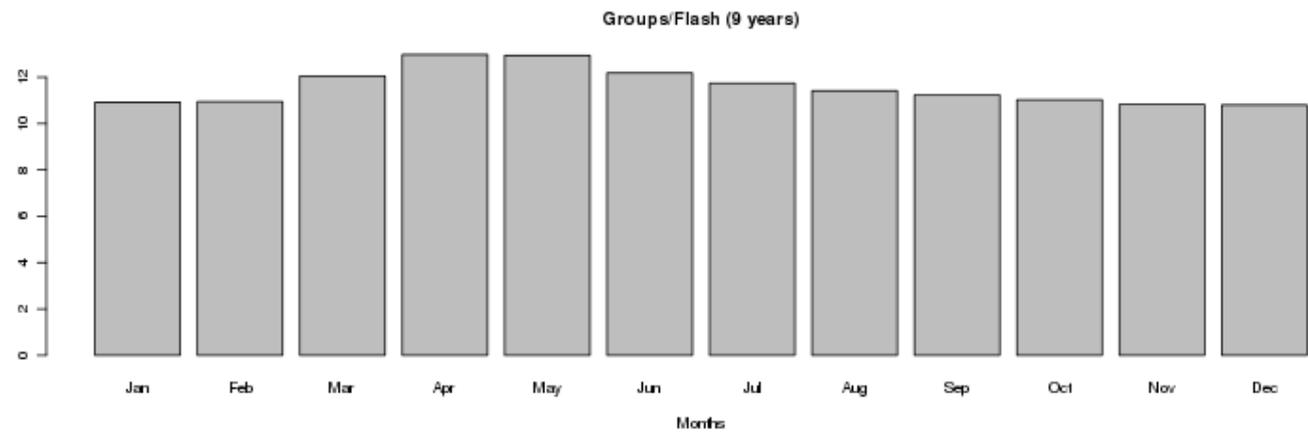
# Annual



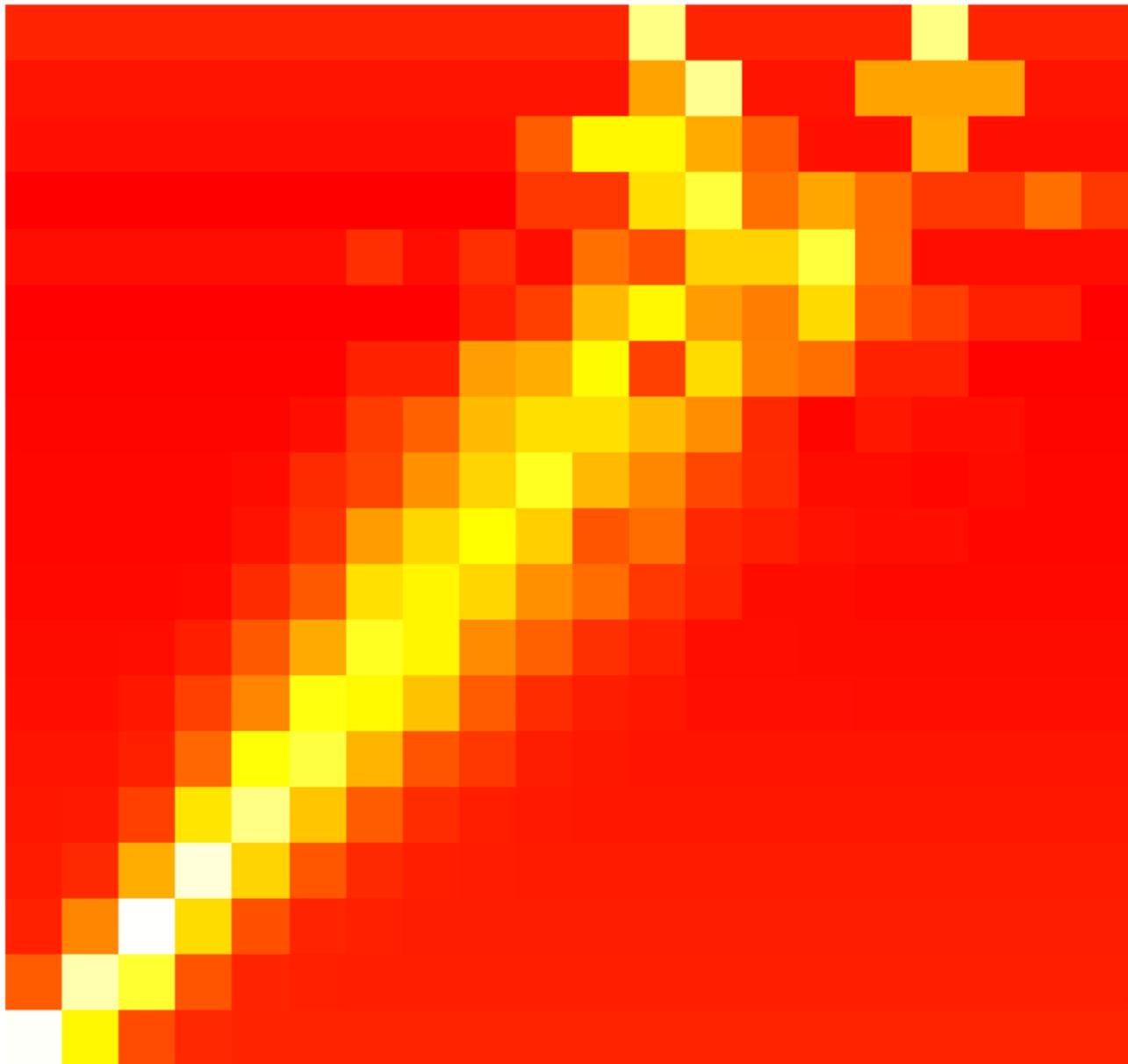
# Seasonal



# Monthly

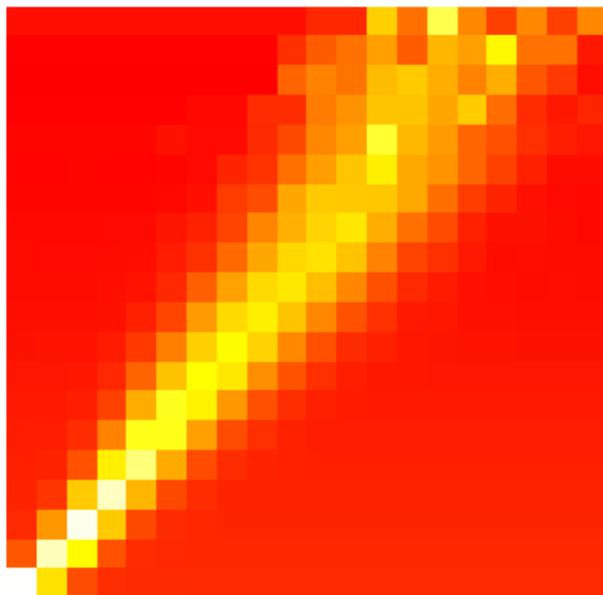


2D Grid  
5x5 km bins  
(sample month)

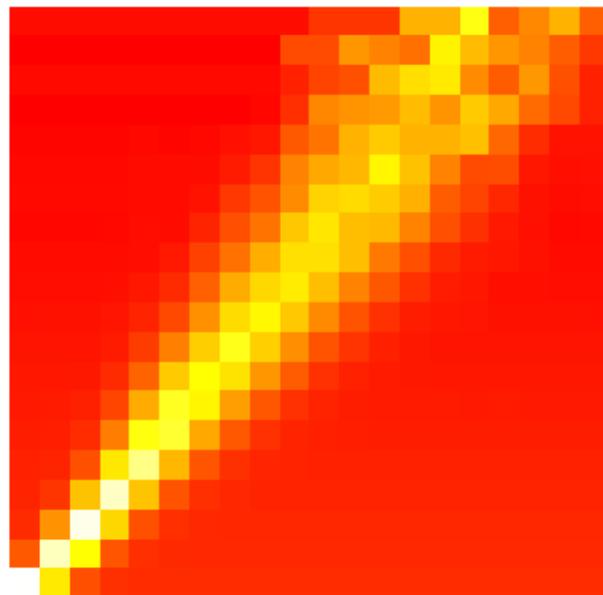


Seasonal  
5x5 km bins  
(20 x 20)

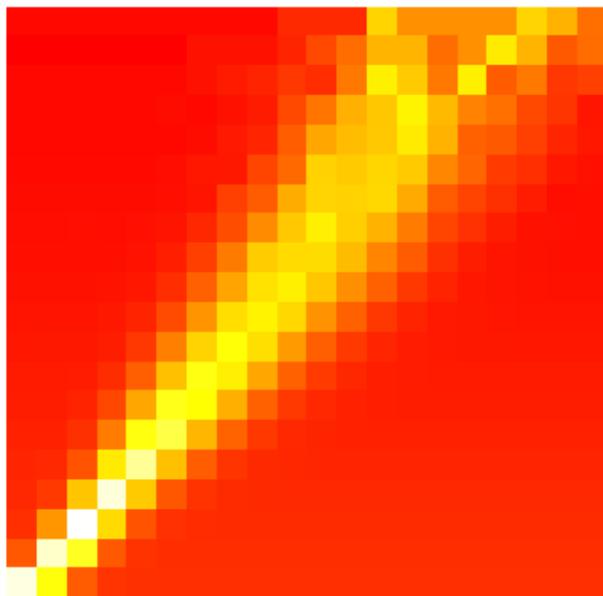
DJF



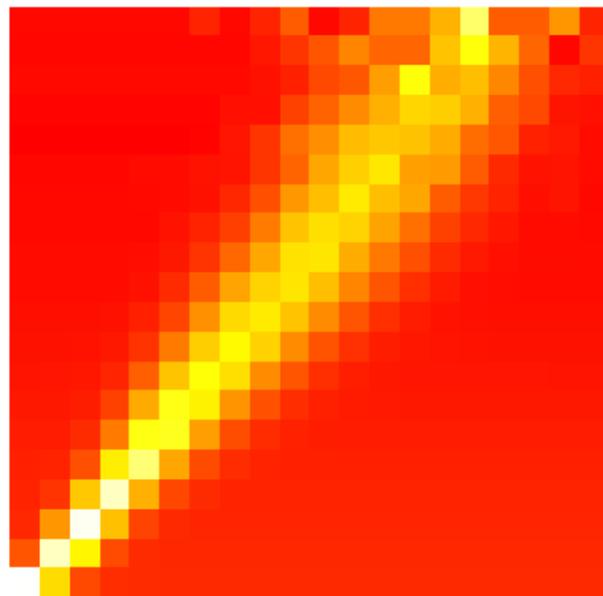
MAM



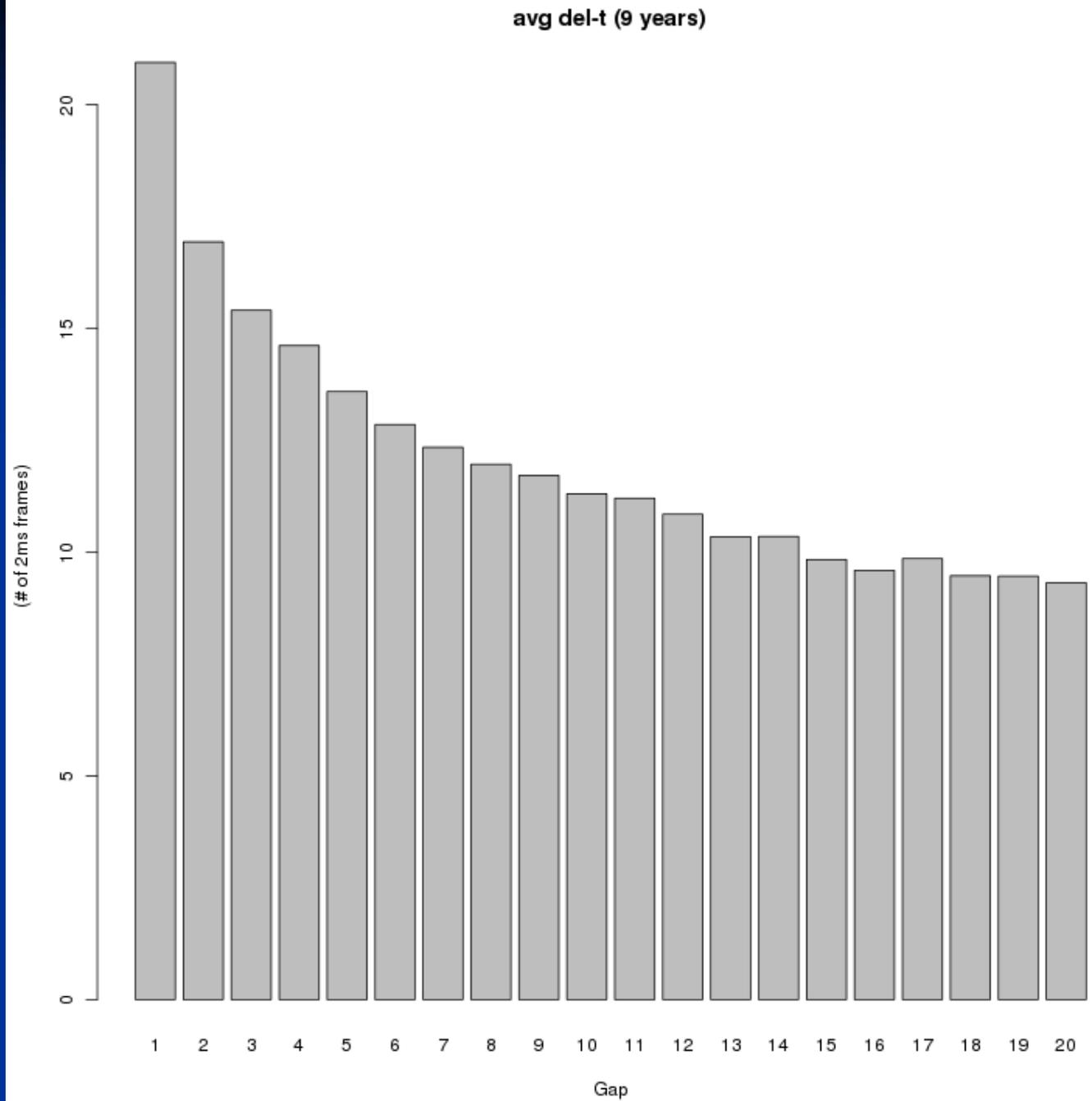
JJA



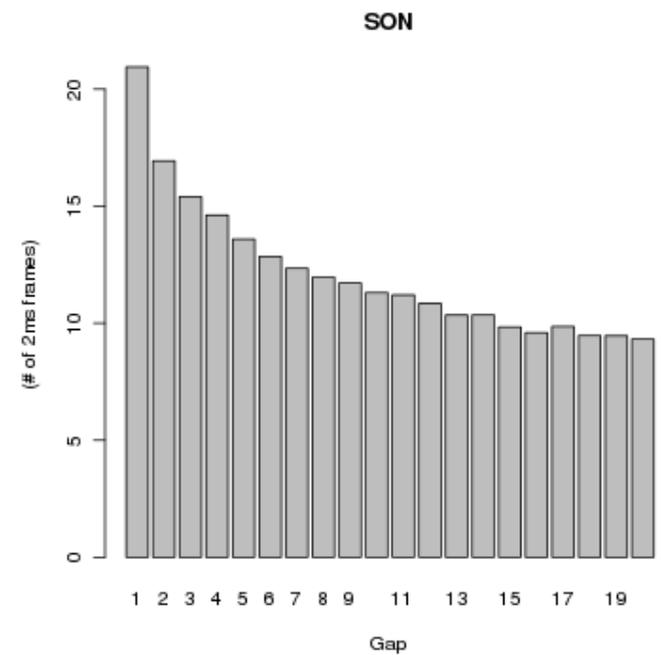
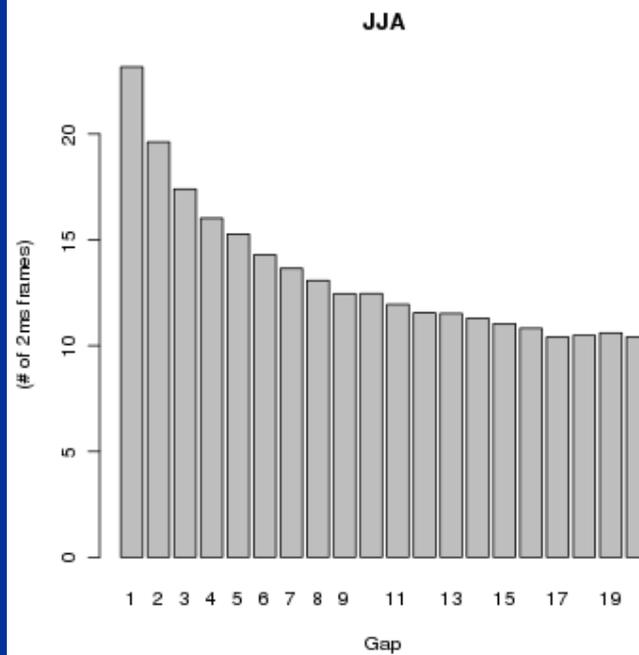
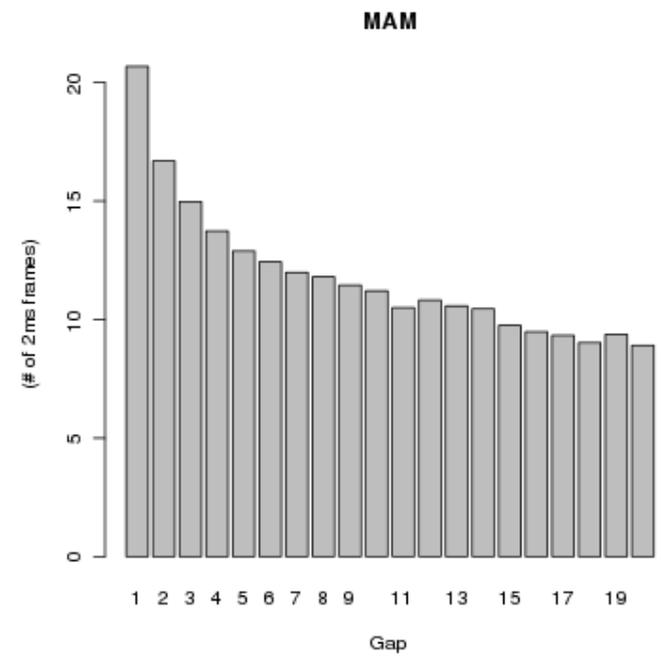
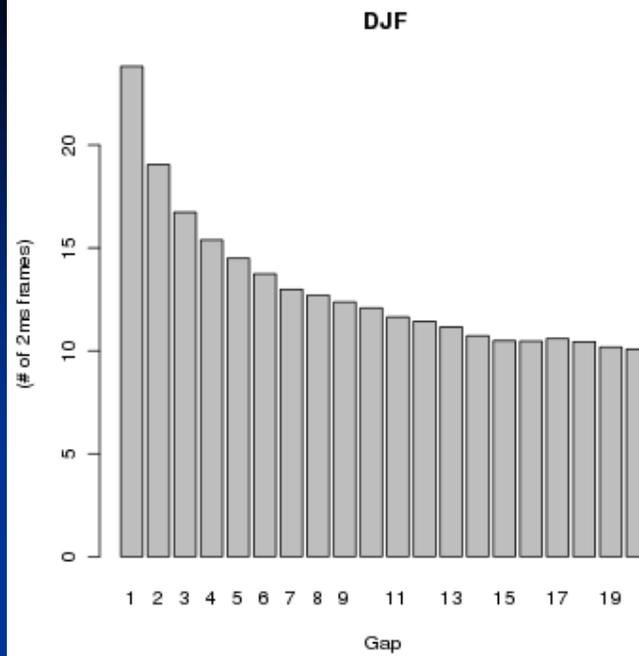
SON



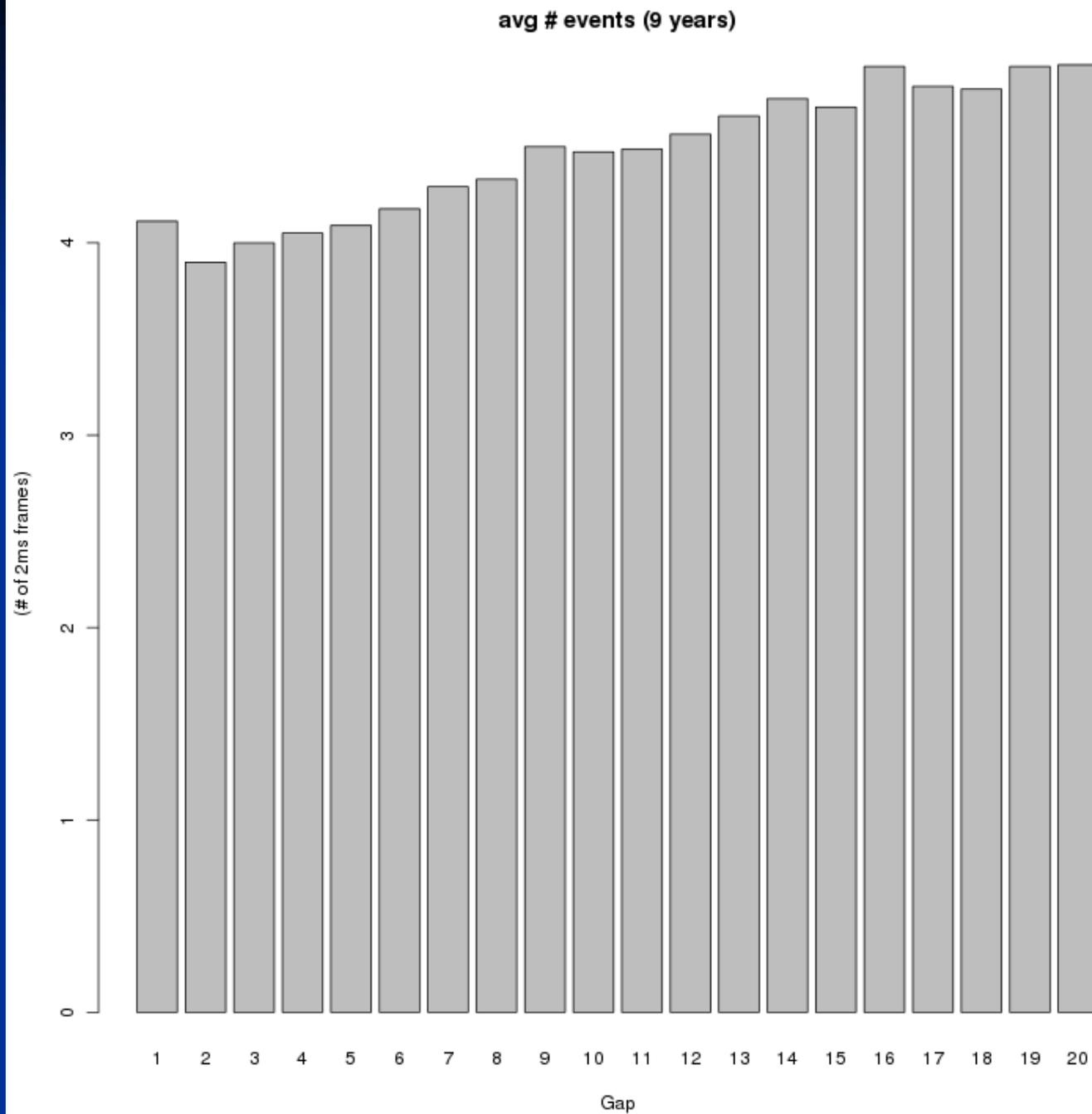
# Group Gaps



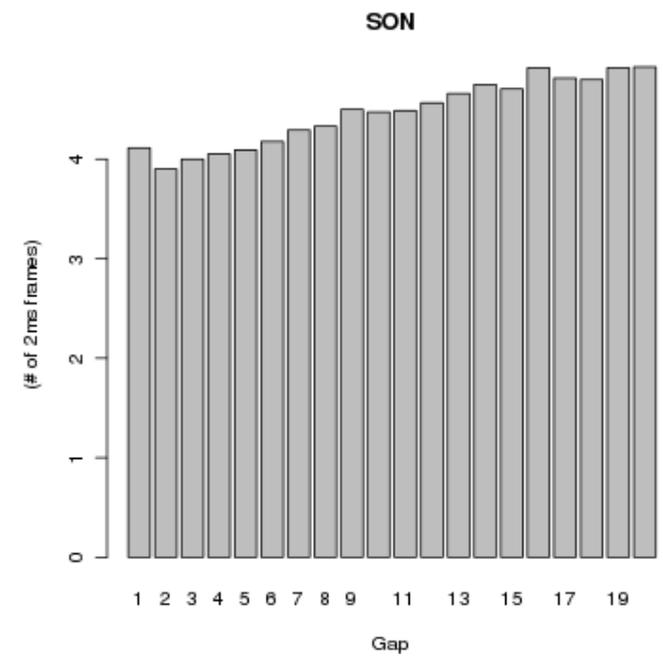
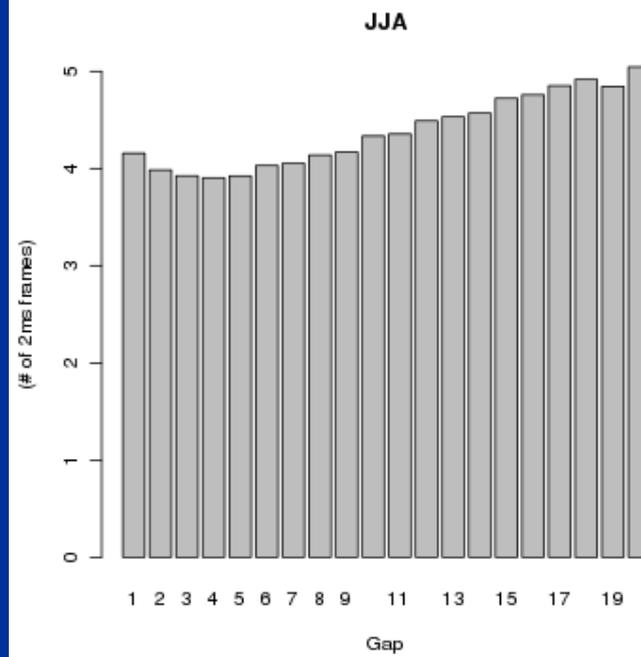
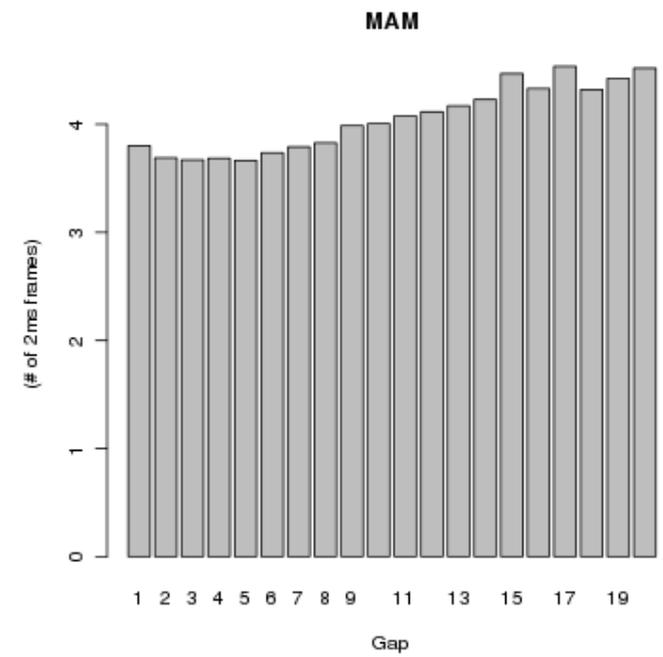
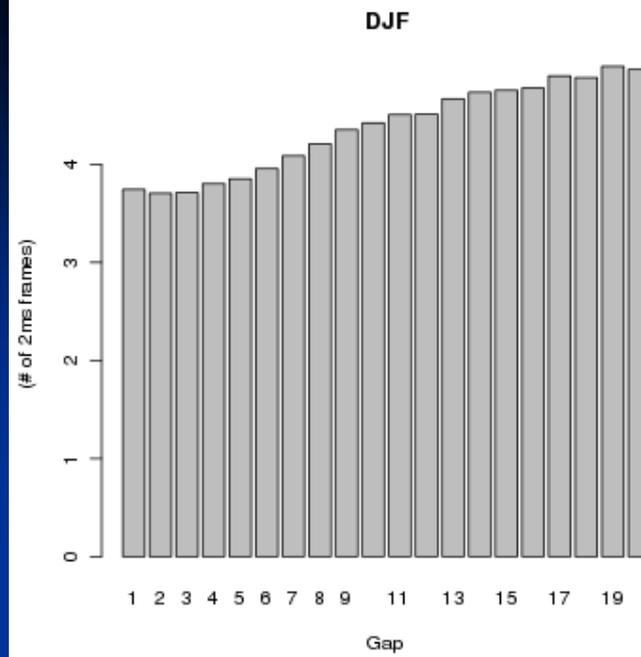
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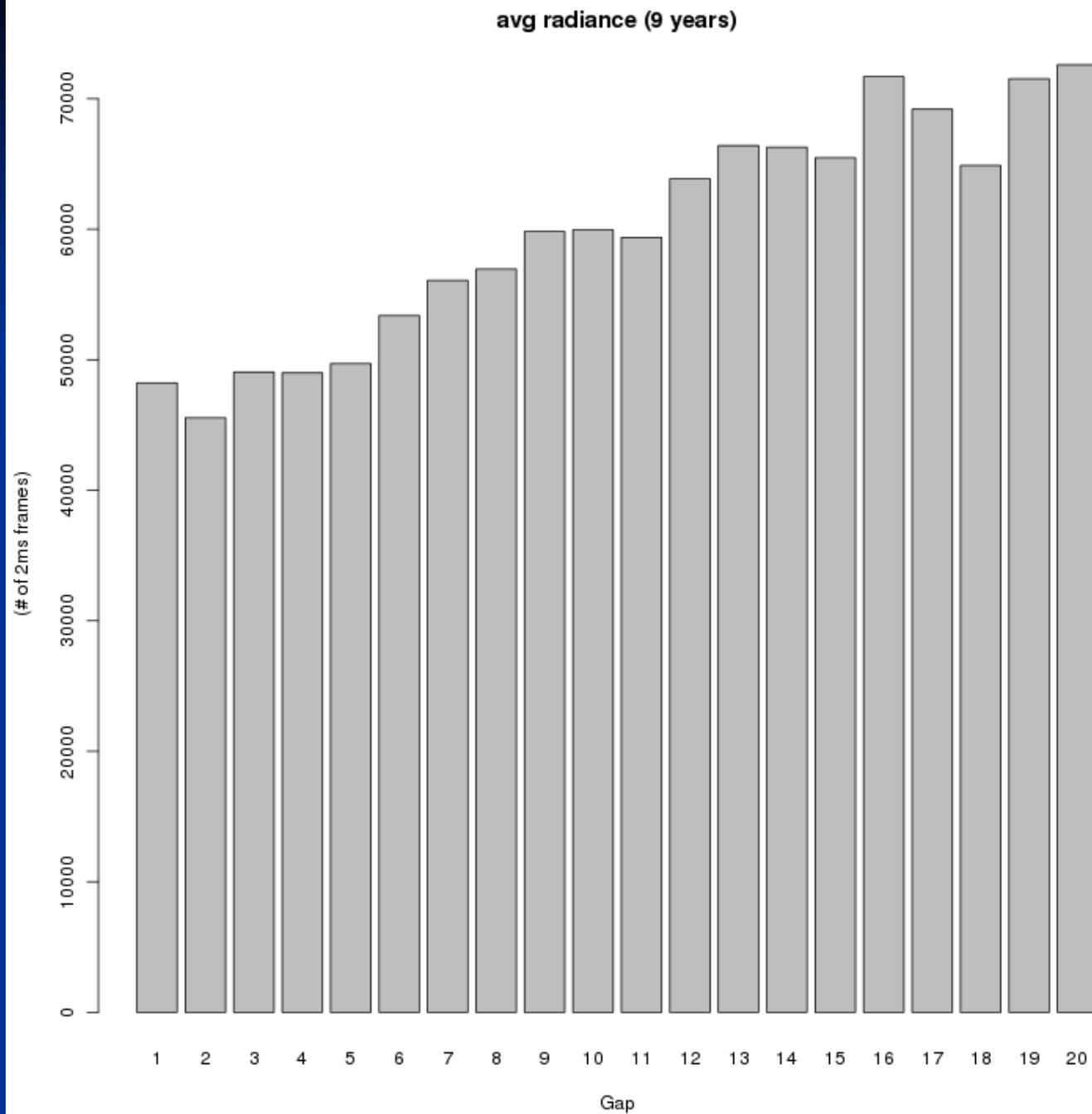
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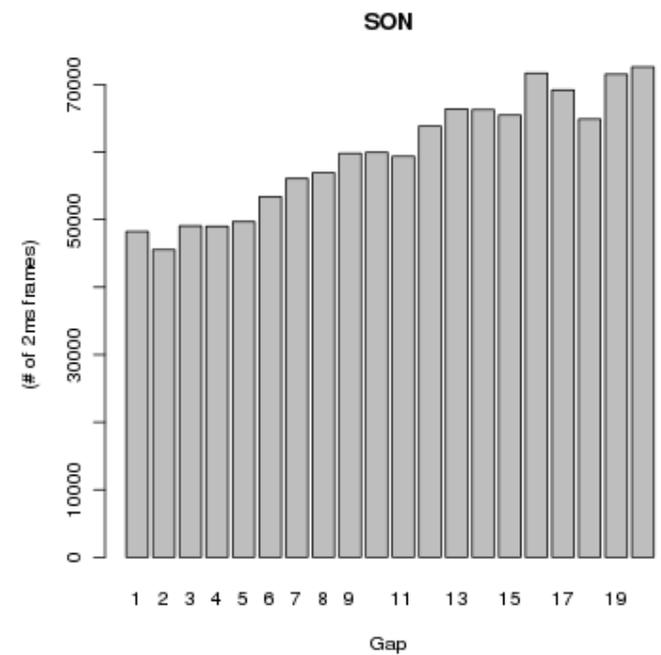
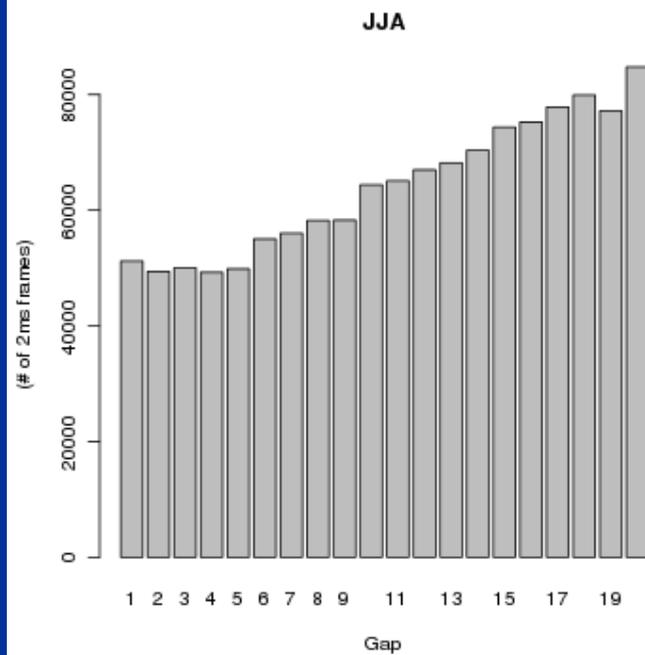
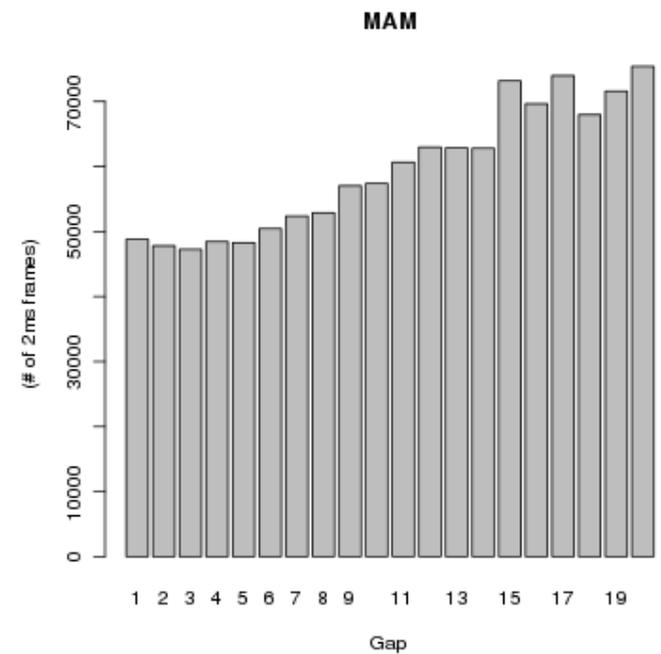
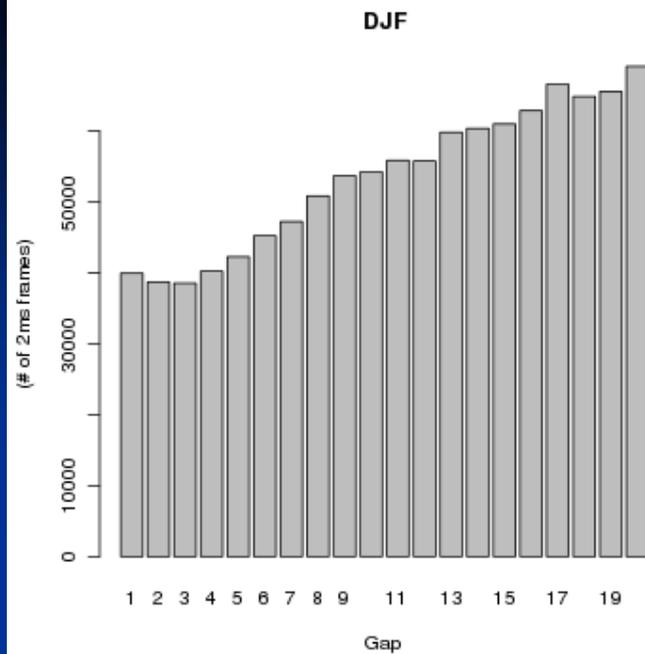
# Group Gaps



# Group Gaps



# Group Gaps



# GLM Proxy data, v2

- Now have the statistics of spatial and temporal distribution for LIS events, groups and flashes
- Need to quantify annual, seasonal, diurnal and geographical variation
- Will build this into the proxy generator code to make it much more realistic
- Should not affect the cluster-filter algorithm software

# Future needs

- Bring in OKLMA (and others)
- Create a “streaming” LMA flash algorithm, to allow real-time proxy creation for various testbeds
- Add in CG flash coincidence — need proxy data for areas with no LMA