Comparison of WTLMA Lightning Climatology to GLM Climatology for the West Texas Region

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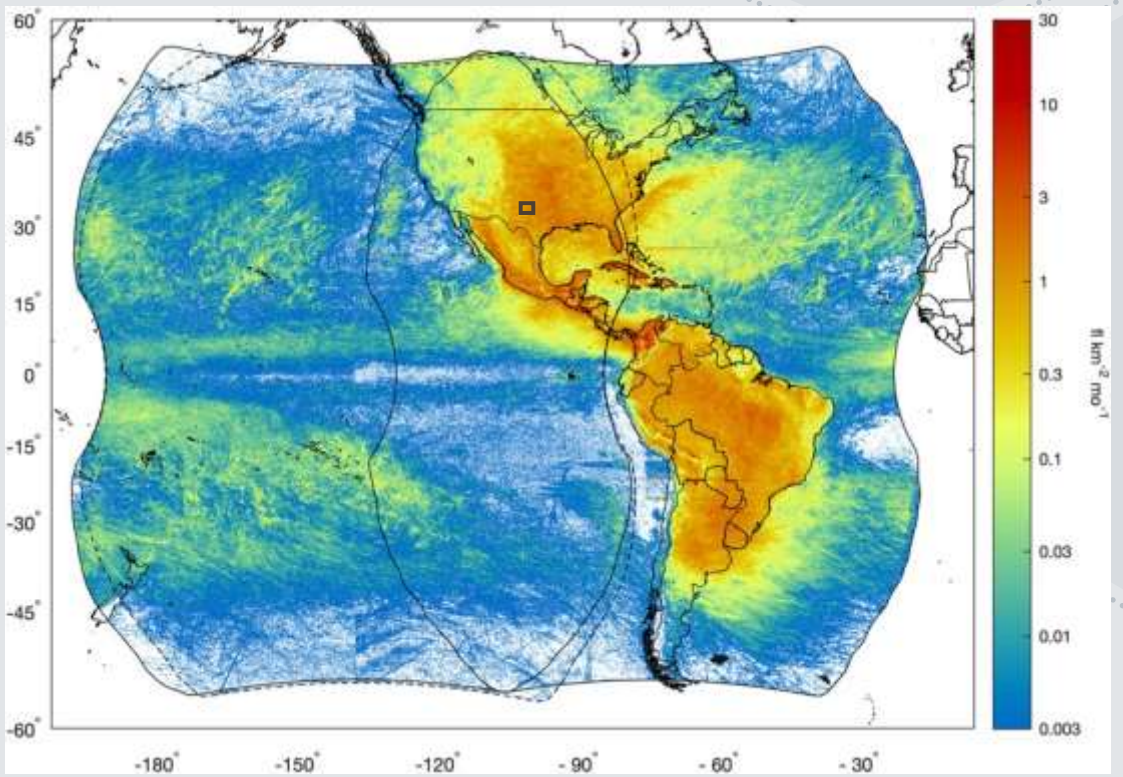
WTLMA Climatology: Data Availability

- West Texas LMA 2012-present
- Flash-sorted data
- Gridded data
  - Flash extent density
  - Flash initiations
  - Flash footprints
  - Sources
- Vanna Chmielewski & Vicente Salinas

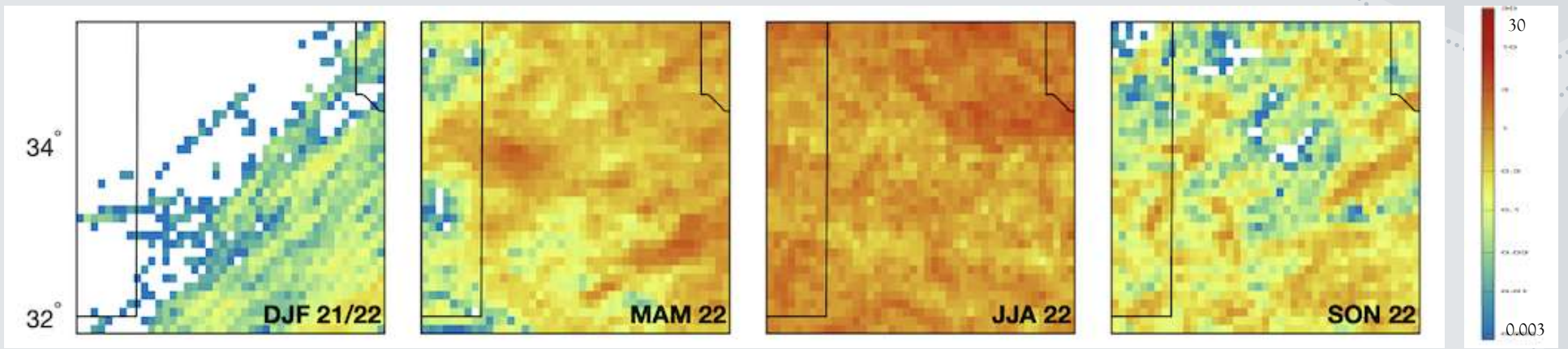
Climatology Comparison: WTLMA & GLM

- Rudlosky and Virts (2020)
- Grid of flash km^{-2} yr^{1}
  - GLM: flash centroid
  - WTLMA: flash initiation
- GLM 16, 17, and 18
- December 2018-May 2020 and May 2021-August 2023 (46 months)

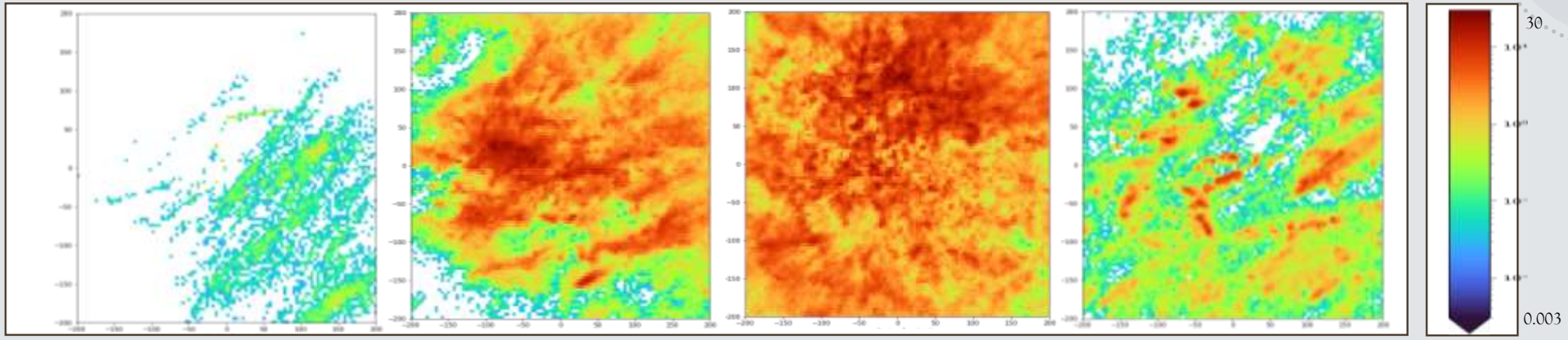


Seasonal Climatology Comparison: WTLMA & GLM

GLM16 flash density (flash/km^2/month)



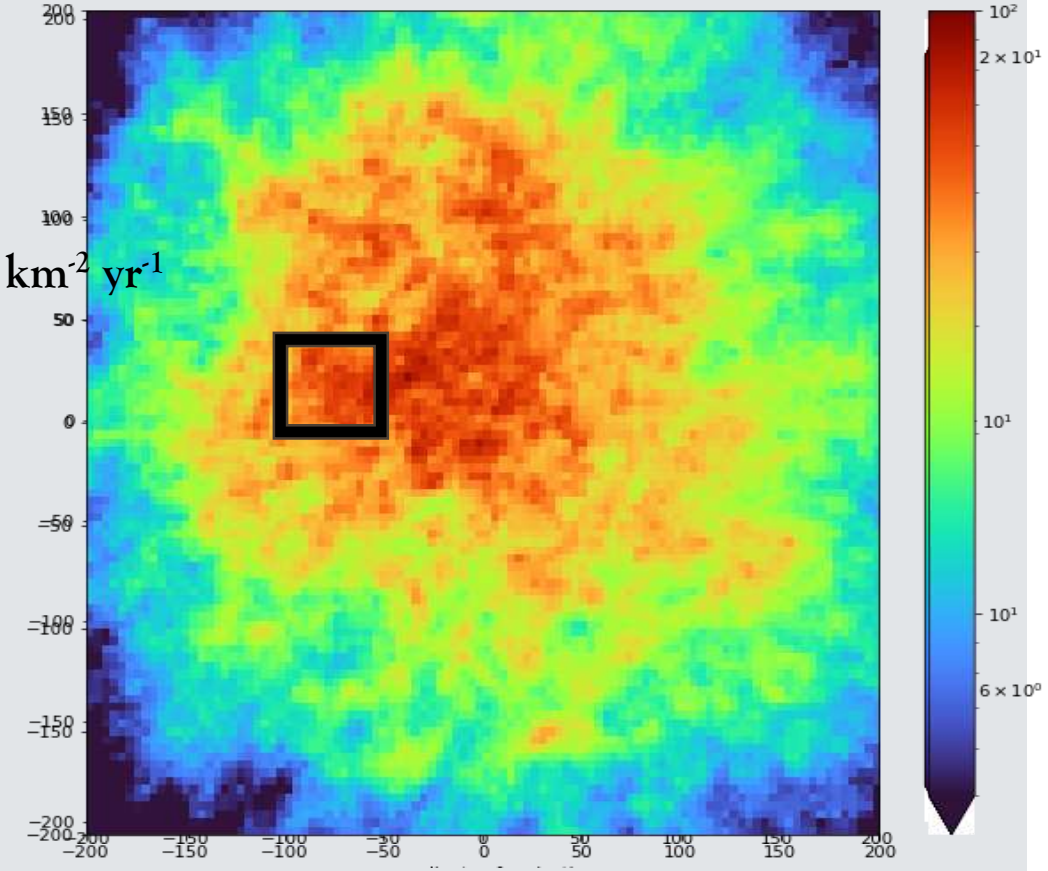
WTLMA flash density (flash/km^2/month)



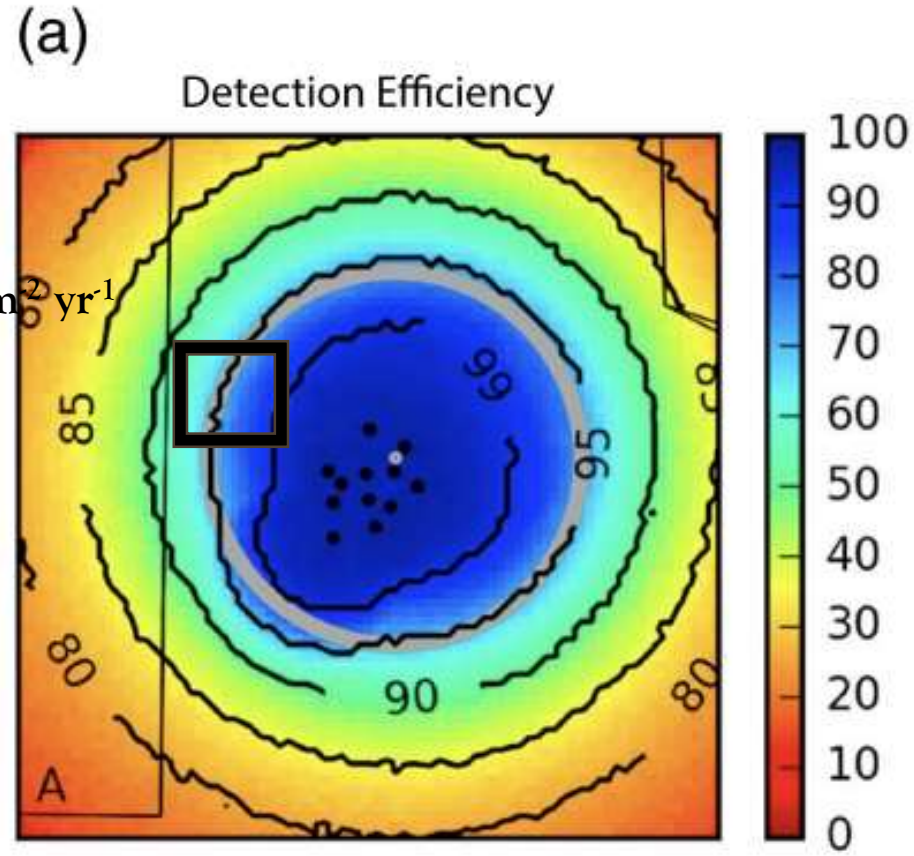
Climatology Comparison: WTLMA & GLM

WTLMA flash density

~80 fl km^{-2} yr^{-1}



~15 fl km^{-2} yr^{-1}



Chmielewski and Bruning (2016), Figure 4a

December 2018-May 2020 and May 2021-August 2023 (46 months)

Detection Efficiency Considerations

- Apply approximate DE rules from recent studies

  Energy threshold: 5 fJ = 40% of TRMM LIS DE. Min energy: 10% per fJ (Cummins 2020, personal comm.)

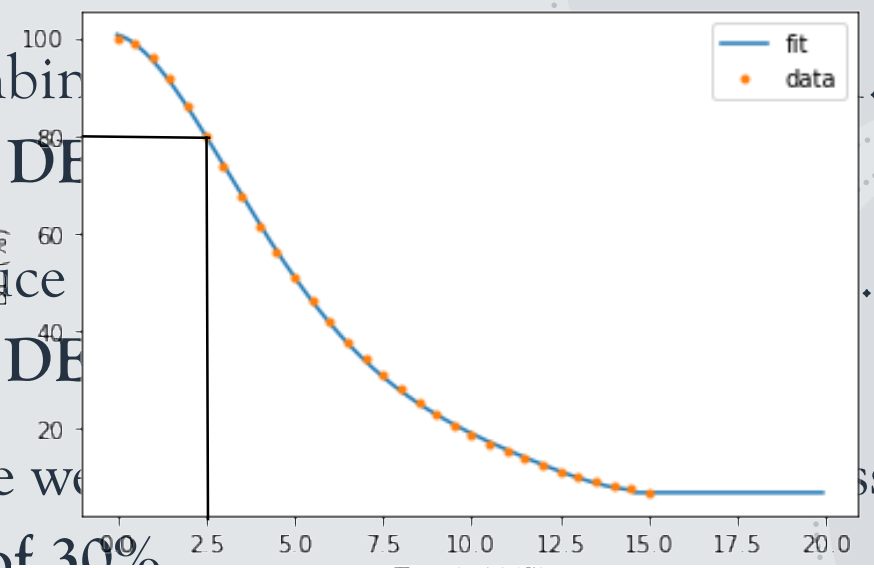
  - 2.5 fJ threshold for GLM-16 implies **80% DE relative to LIS**
  - GLM-17 threshold is 1.5 fJ higher than GLM-16. Implies **15% worse for GLM-17**.

  For LMA flashes with 0.3 s duration, 10 km flash width, detection efficiency is reduced by **50% for medium-small flashes** (Zhang and Cummins, 2020, JGR)

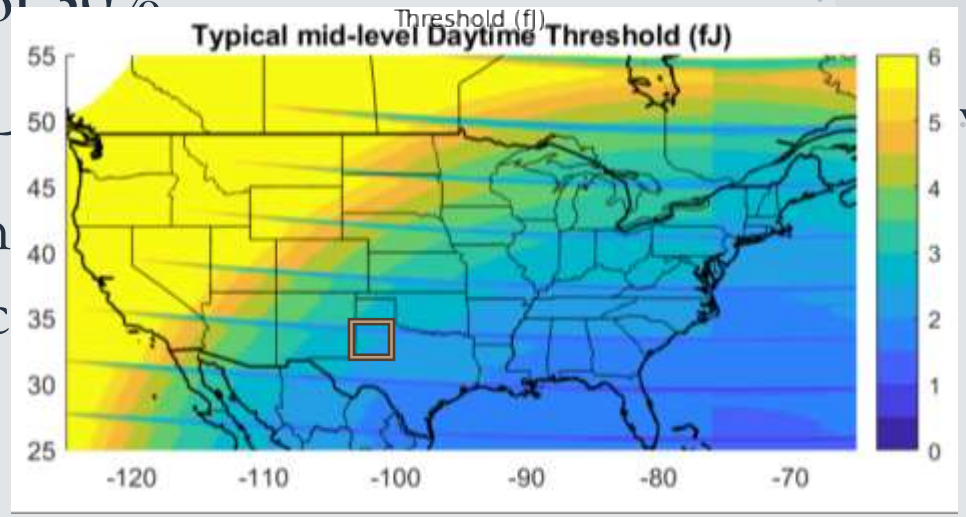
  10x ice water path implies 10-30% drop in flash DE. Anvil: 0.05 kg m^{-2}, largest values in Colorado 50 kg m^{-2}. (Rutledge et al., 2020, JGR)

  - Let's assume we have a **20% drop from optical depth**.

Estimated GLM Flash DE Relative to Long-term TRMM LIS Group Energy Observations



- Combin .0-0.2) = 32% DE
- Reduce .32) = 27% DE
- Since we ssume a DE of 30%
- WTL yr^{-1}
- With to detec



Conclusions

- Reasonable agreement between GLM and WTLMA for seasonal plots
- Long-time-scale plots highlight the WTLMA's DE change with distance
- Previously-derived DE of GLM for a single case seems to work well with this larger WTLMA dataset
- GLM provides helpful sanity check
- Future Work
  - DE range correction on WTLMA data
  - WTLMA:GLM comparison to estimate DE at different locations across the domain