Support for LI Cal/Val

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Multi-sensor comparison of lightning datasets in West Texas

As presented at AGU/AMS fall and winter meetings

Can we quantify expected GLM detection efficiency using some simple rules?

Datasets:

West Texas Lightning Mapping Array (VHF band) GOES-16, GOES-17 GLM (optical)



- threshold is a good indicator of instrument performance independent of meteorology and flash properties.
- LMA flashes with width > 1 km (4 km). GLM << NLDN was noticed in operations.
 - GLM detection threshold.
- DE for a specific scene of storms.



Back-of-the envelope DE

Calculated from instrument threshold, flash population, and meteorological effects.

- 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 65% DE relative to LIS
 - GLM-17 threshold is 1.5 fJ higher than GLM-16. Implies 15% worse for GLM-17. 14 GLM-16 flashes, 12 GLM-17 flashes.
 2/14 = observed 14%. Checks out!
 - For LMA flashes with 0.3 s duration, 10 km flash width as is typical here, 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)
 - These storms were optically thick: 1" hail implies lots of mixed phase precipitation and ice plus supercooled liquid water. Let's assume we have a **20% drop from optical depth**.
- Combine for **GLM-16**: (0.65)(1.0-0.5)(1.0-0.2) = **26% DE**
- Reduce further for **GLM-17**: (1.0-.15)(0.26) = **22% DE**
- These estimates are within 10% of the observed GLM:LMA ratio.



Thresholds GLM-17: 4.0 fJ GLM-16: 2.5 fJ

User preparation for MTG LI

Visiting scientist work for NWC SAF (Feb-May 2021)

Recreate MTG LI products from GLM

GLM	MTG	
FED	F_AFA	
TOE	F_AFR	
	F_AF	Create from GLM
MFA		Future LI product?

- Prepare for comparisons between LI and GLM
- Visualize as imagery the GLM products for various storm modes in the overlap region, as would be displayed at a NWC with other satellite imagery.
 - Visualize sensitivity to min event energy (MOE).
- Create and display MTG LI product equivalents from Erdmann Ph.D. thesis (Defer/Caumont). France only.

