Lightning Storm Relationships

Studies in the lightning group in Alabama have analyzed relationships between lightning and radar-derived parameters, but they have also found that the ice mass per flash varies from storm to storm. Can a systematic relationship be found with anything other than ice mass? Will relationships have to be case specific? Can they at least be regional?

Global, regional, and storm model studies have somewhat different needs for the lightning-storm relationships they can use. This influences what storm parameters can be used and may affect the degree of certainty or the variance needed in the lightning-storm relationship.

Perhaps faster/less refined analysis using the Rutldege/Lang framework would suffice with larger error bars for some relationships, but these may need to be regionally tuned.

Flashes in models have to be prototypical, although maybe similar approaches can include regional or environmental controls on storm characteristic spectrum (size, LP/HP, height, etc.) and corresponding lightning characteristics (IC:CG, height distribution of channels, etc.)

So far on global models, storm height relationship with lightning rates has worked best. Global models could work on statistical relationships with other storm/environmental parameters, but we need to keep in mind what parameters models can produce at various scales.

Investigators analyzing lightning-storm relationships for use in models need to keep in touch as different groups progress to make sure approaches / output are compatible among groups. We need to make sure parameterizations are checked across all regions/analyses. What parameterizations do we want to check out?
        cloud top height – 20 dbZ?, 18 dBZ (historical), $3.44 \times 10^{-5} H^{4.9}$ = Flash rate / min
        max w $5.7 \times 10^{-6} * wmax^{4.5}$
        w volume (>5 m/s) $6.75 \times 10^{-11} \times w$(5 m/s & colder than -5 degC) -13.9
maybe both warmer than -40 deg C and not

Boccippio relationship: used for IC –CG ratio, but varies by month & season – typically lower than has been seen in LMA NLDN studies – varies more in CO than AL. How does DC3 fit in that climatology?

Need to develop regional / seasonal relationship for DC3 period

Need to evaluate relationships relative to stage/ duration of storms

Need to determine when parameterizations work and when they fall short?

Can use data from other periods of observations, although DC3 has much more complete data set (e.g., aerosols, etc).

Steve volunteered to crack the whip on coordinating analyses among groups.

Lightning statistics to be generated - height distribution, length distribution, areas relative to storm structure – 500 m, 1 km, 3 km resolutions

Integrate storm parameters for lightning indices

PAPERS:

Case studies from each region

Need coordinated paper drawing together all results across regions
        testing existing parameterizations
        refine relationships
        evaluating how relationships behave in WRF model and how well WRF produces those metrics and storms overall

Bruning: producing various lightning characteristic metrics
        Mary and Eric talk offline about adjusting lightning metric produced by models

Variabilities in height distributions of storms related to variations in distributions of lightning characteristics (EOF data analysis)