Colorado's Thunderstorm Climatology

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INTRODUCTION

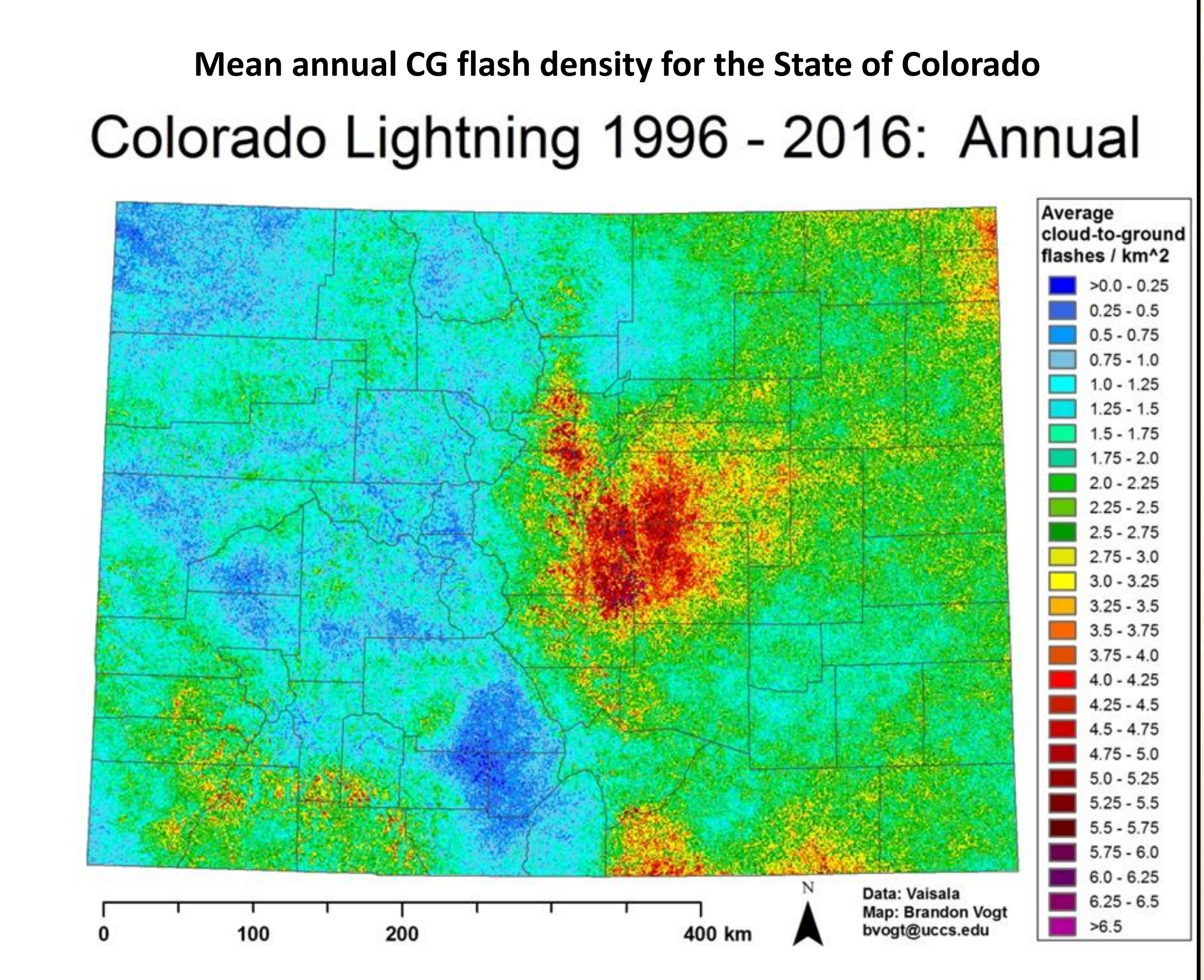
This poster is a compilation of several Cloud to Ground (CG) lightning studies over the state of Colorado.

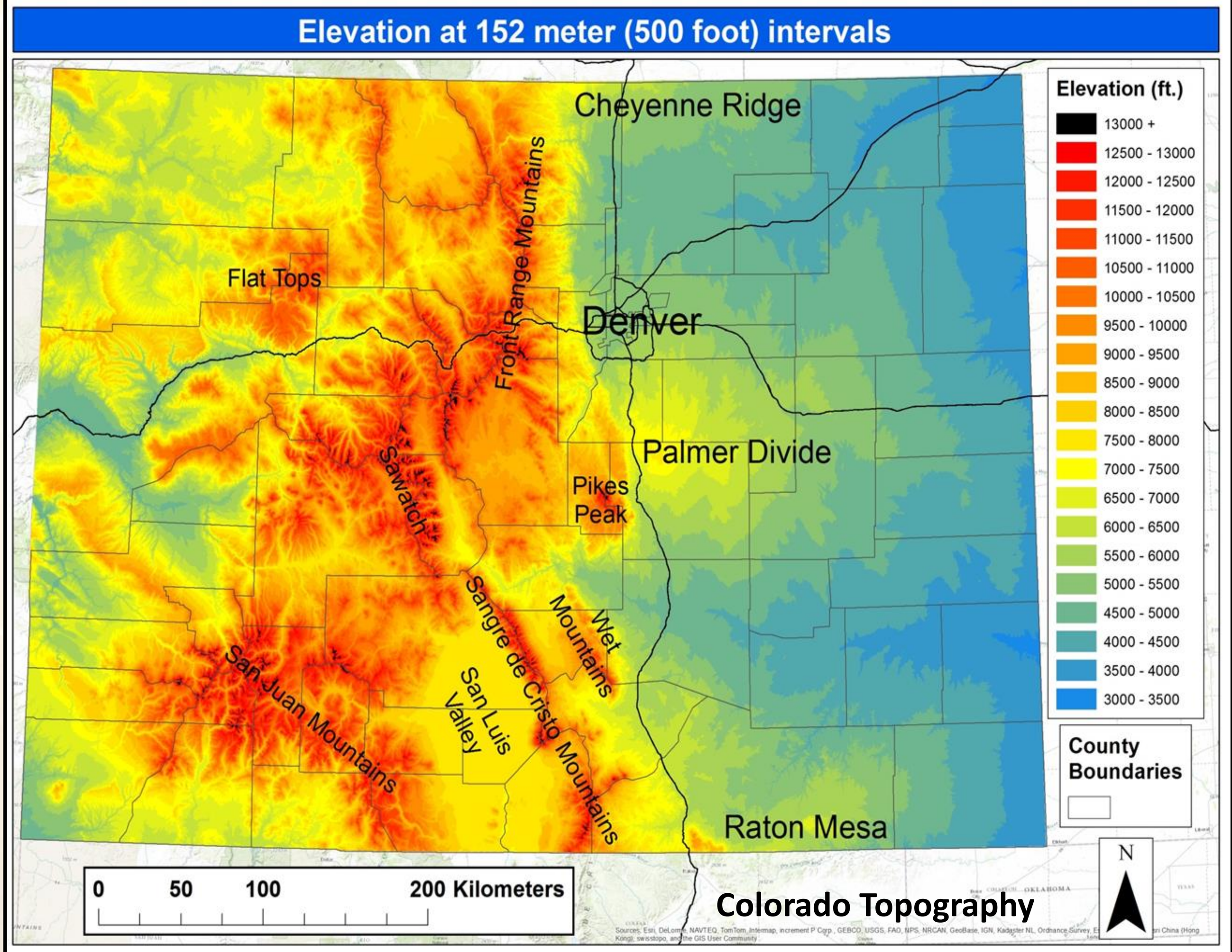
Both stroke data and flash data are shown. **Stroke** data was from 1996-2012 and included 18.6 million strokes. **Flash** data was from 1996-2016 and included 10.7 million flashes.

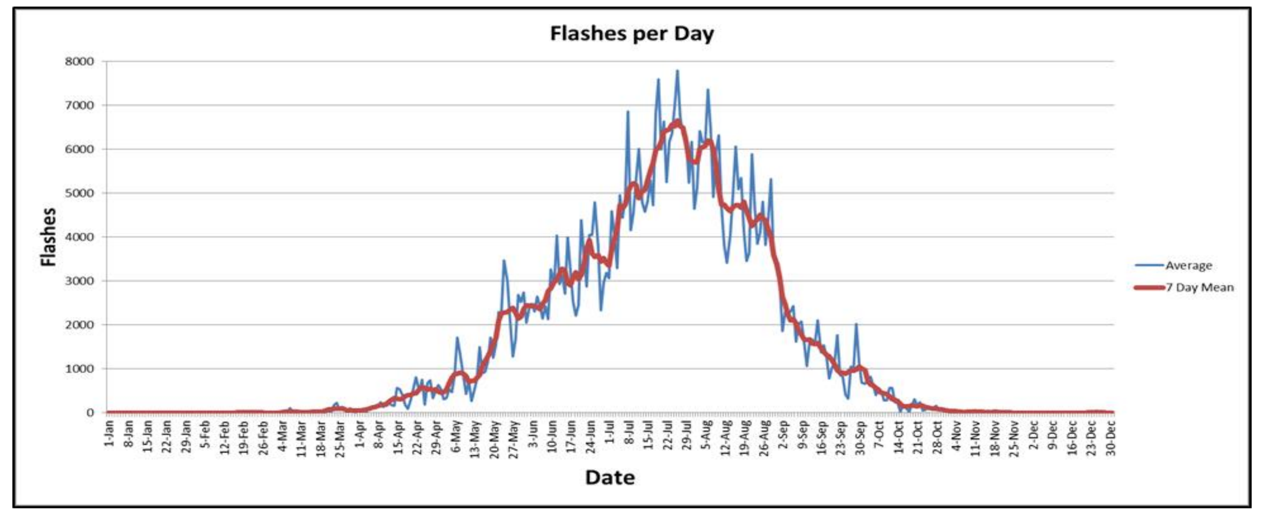
Data are from the North American Lightning Detection Network (NALDN) collected by Vaisala.

No attempt was made to account for year-to-year changes in the detection efficiency of the NALDN.

Grid resolution used for all maps is 1 km^2.







Lightning in Colorado is primarily a warm season activity. Very little CG lightning (<0.5%) occurs between the dates of 01 Nov through 30 March).

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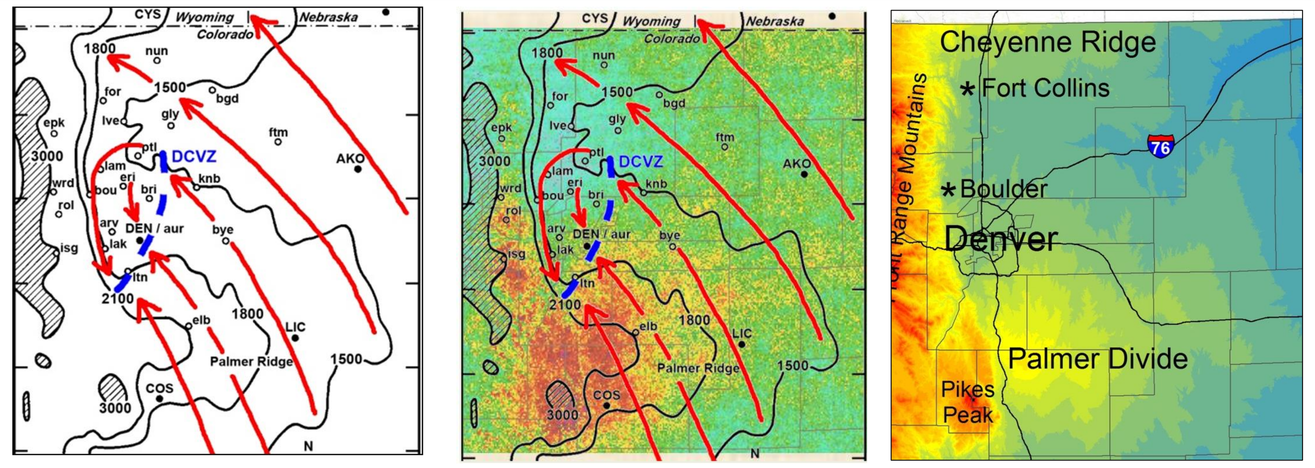
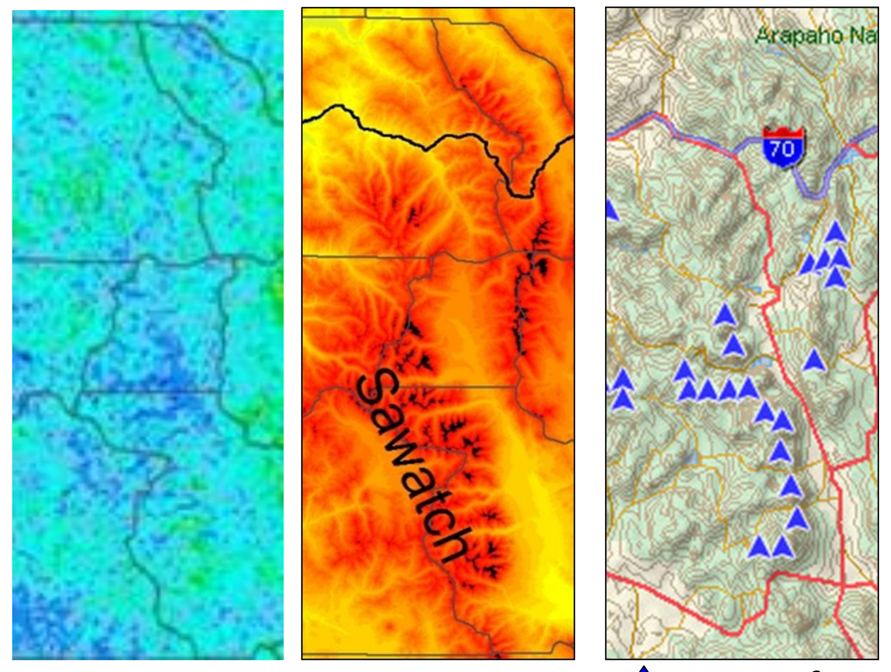
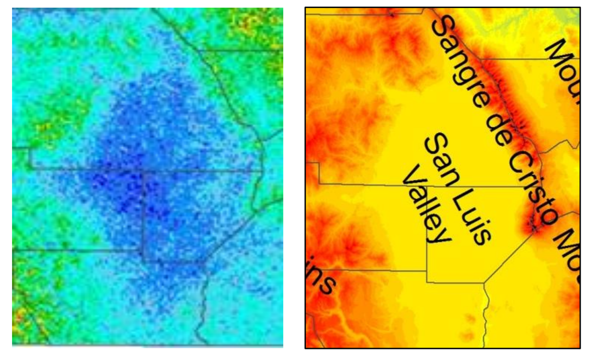


A mesoscale circulation pattern, known as the Denver Convergence Vorticity Zone (DCVZ); is believed to be a major player in the CG distribution across northeast Colorado. The surface flow pattern to the northwest of the DCVZ is divergent, inhibiting thunderstorm development from areas north of Denver to Fort Collins. However, the surface flow pattern southwest of the DCVZ is convergent. This convergence combined with upslope flow on the north side of the Palmer Divide enhances lightning activity over the Pikes Peak/Palmer Divide region. The DCVZ surface flow pattern generally occurs 35% of the time between May and August.

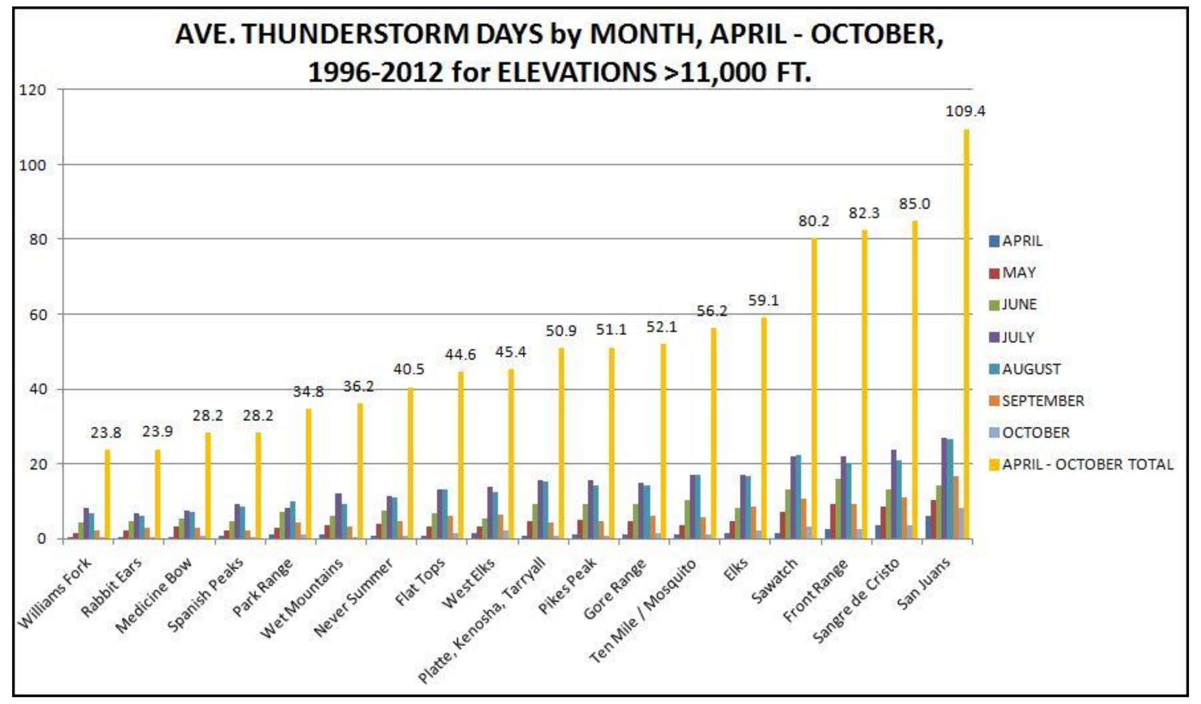


> 14,000 feet

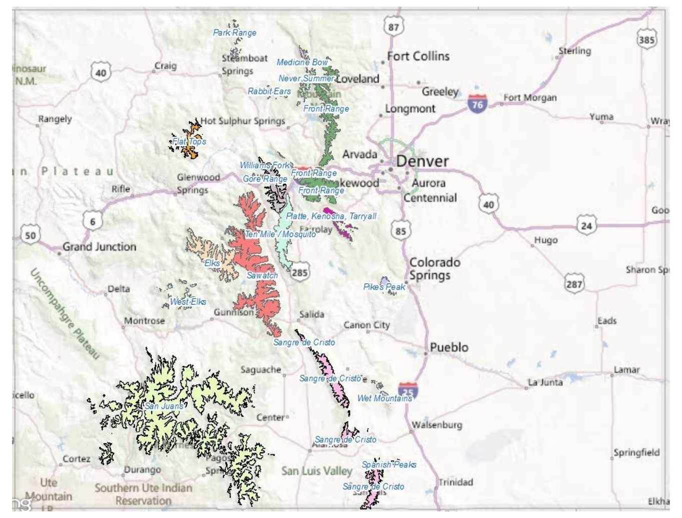
One of the tallest mountain ranges in Colorado, the Sawatch Range, has relatively very little CG lightning. This is due to numerous mountain ranges blocking moisture from reaching this region.

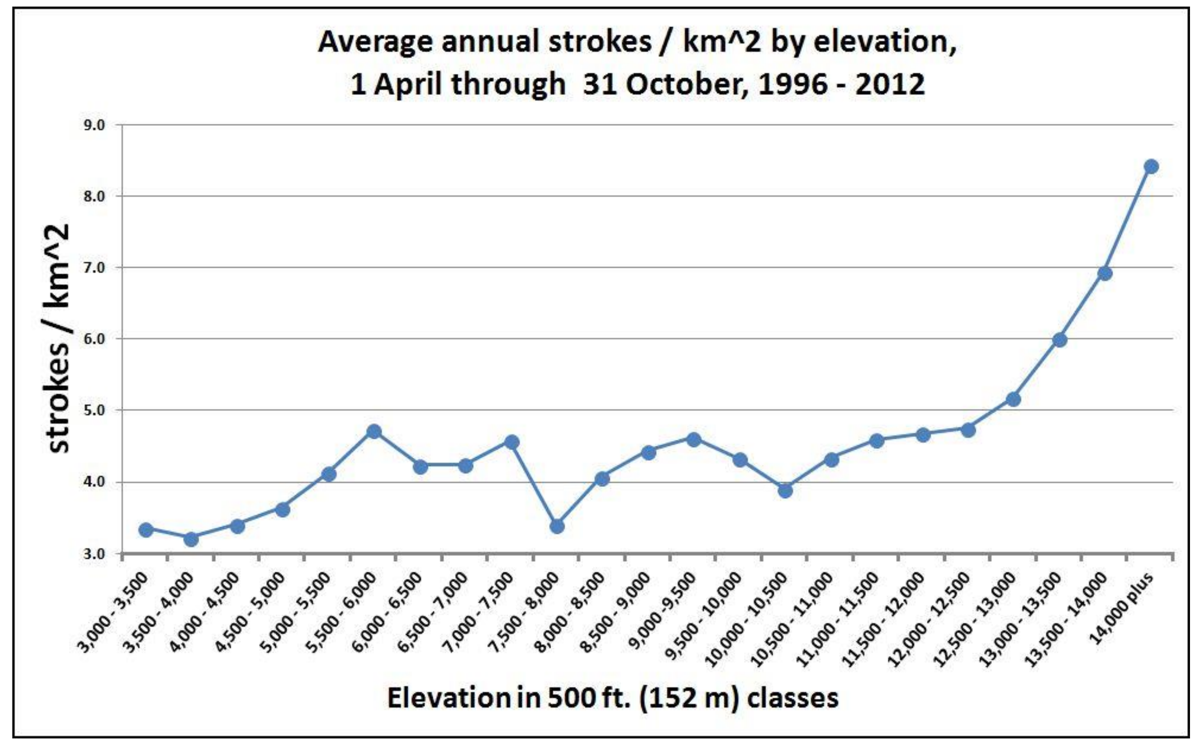


Why the CG minimum here in the San Luis Valley? The San Luis Valley is surrounded by tall (12-13 kft/3.6-3.9km) mountain ranges; the San Juan Range to the west and northwest, and the Sangre de Cristo Range to the northeast and east.

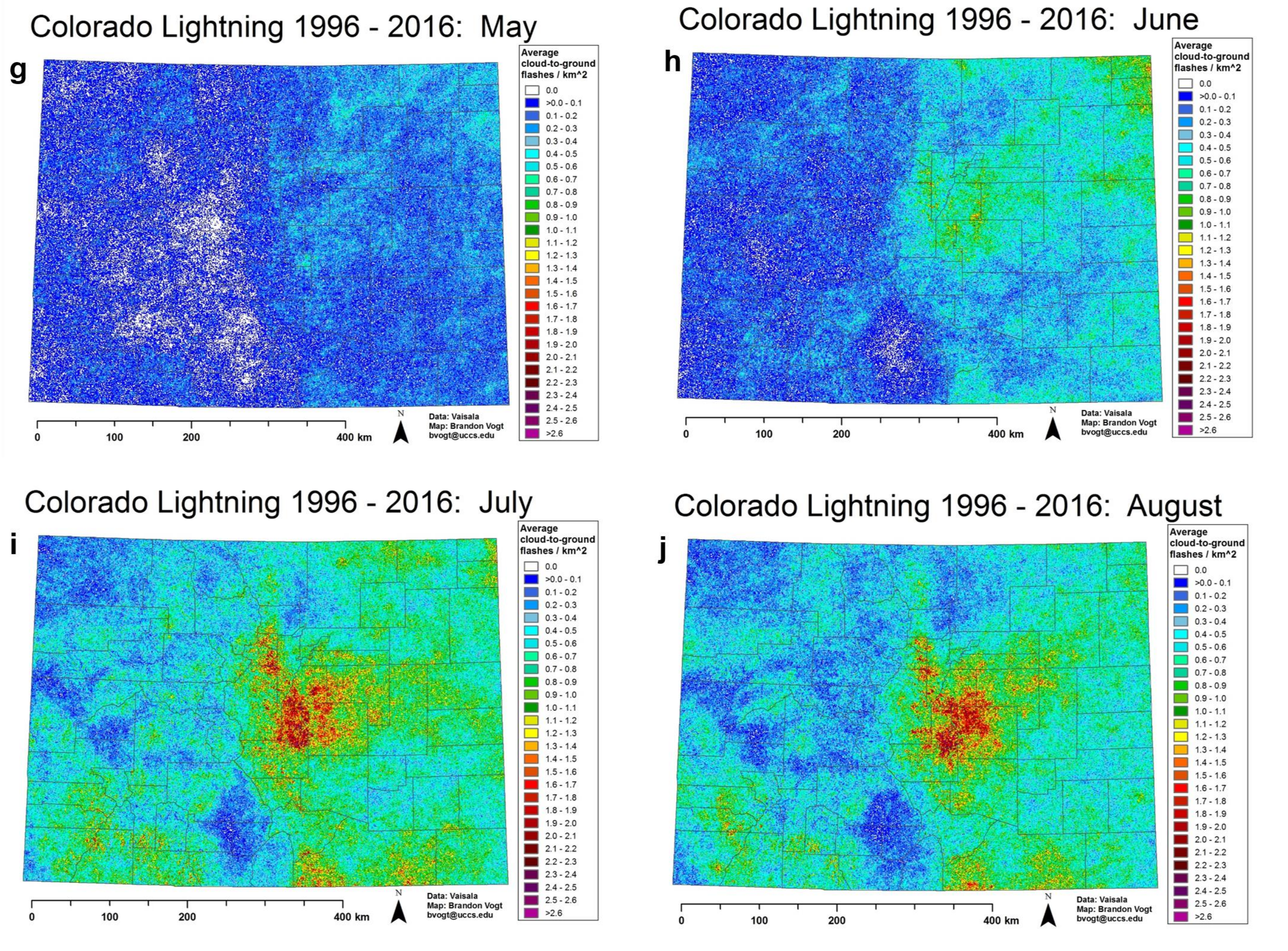


This chart shows average thunderstorm days (for both the entire warm season and by month) for the mountain ranges above 11,000 ft (3.4km). Note that even though the interior high elevation mountains (i.e., Sawatch Range) do not see much overall CG lightning, they still see CG lightning on a frequent "day-to-day" basis.





Areas below 3,048 m (10,000 ft.) show a fluctuating relationship between elevation and CG density while mountainous areas above 3,048 m (10,000 ft.) are characterized by an overall increase in stroke density. A strong positive relationship exists between terrain elevation and CG density only in the highest 11% of the State's area that extends from 3048 m (10,000 ft.) to 4,399 m (14,433 ft.). In this elevation range, stroke densities gradually increase from 3.9 / km^2 yr-1 above 3,048 m (10,000 ft.) to 4.8 at 3734 m (12,250 ft.) where they level off, and then sharply increase to 8.4 at elevations above 4,267 m (14,000 ft.). These results corroborate the work of Cummins (2012) and Bourscheidt et al. (2009) who attribute high flash densities to regions with steep slope gradients. Cummins (2012) also proposes that high flash densities are linked to areas with high turbulence driven by high surface roughness and areas with variations in the surface electrical boundary conditions.



The 4 plots above show the flash density over the state of Colorado for the months of May, June, July and August. Flash densities in the mountains during the May and June time period are at a minimum while they increase during the July and August time period. This is due to increasing moisture associated with the North American Monsoon which typically begins to affect the state during early July.

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