



Ice Storm Patterns In Georgia

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Ice storms can be devastating to Georgia. In a 52 year period, Georgia sustained 17 major ice storms which each caused more than \$1 million in damages. (Changnon 2003) Tree failures initiated transportation, utility, and infrastructure damage.

Some ice storms are easy to deal with and their impacts are quickly minimized. Other ice storms bring large amounts of freezing precipitation and wind over a long period of time, generating catastrophic impacts on trees and communities. The historic patterns of ice storms across Georgia can help people appreciate past impacts and potential future issues.

Ice Locations

It was not until early in the 20th century organizations started collecting information on ice storm events and ice accumulation amounts. Some of the first to collect data on ice storms were railroads and utility companies. In 1948, the United States National Bureau of Standards issued a map of ice accumulation categories for the nation. This map divided Georgia into roughly a Northern “moderate ice glaze” area and a Southern “light or no glaze” area. Figure 1.

The influence of ice storms over many years have been felt most in the Northern three-quarters of Georgia and along the coast. Figure 2 shows areas of Georgia which have sustained significant numbers of ice storms over a 55 year period. All of Georgia can have ice storms -- this figure shows the footprint of where most occur in the state.

Storm Counts

Placing Georgia in a regional context allows visualization of regional patterns. Figure 3 provides a Southeastern view of average ice storm numbers per year. Notice there is a strong impact along the Eastern side of the Appalachians, smoothing out to a more North / South pattern onto the Georgia Coastal Plain. Figure 4. The far Northeast of Georgia averages three ice storms per year, dwindling to one ice storm per year around the fall line in the state’s center.

The number of ice storm events in Georgia over a 36 year period is given in Figure 5. The number of ice storms does not represent the severity of each one. An area with few ice storm events can have the most severe and long-lasting storms. Georgia can be divided roughly into thirds by ice storm numbers. The Northern third had many ice storms, averaging from this data at least one every other year. Middle Georgia averaged one every three years, and the Southern third of Georgia averaged, at a minimum, one every 7.5 years.

Iced Layer

The amount of ice accumulation usually suggests how much damage an individual storm exhibits. Figure 6 shows ice accumulation amounts in inches expected for a once in every 50 year storm for Georgia. Even the smallest amount of ice can disrupt roadways. The largest amounts of ice, coupled with wind, can lead to major tree damage.

Severity Levels

Ice storm events can be categorized by their severity of ice accumulation. The range of ice storm severity levels are from 1-5. Usually only severity levels 3, 4, and 5 are considered a major event. Figure 7. The ice storm severity levels range from level 1 with no ice to level 5 which generates catastrophic destruction to power lines & trees with extreme amounts of ice accumulation.

The maximum ice storm severity level represents, for any single storm event, the greatest severity level which has ever occurred. Figure 8 shows all of Georgia can have the most severe level of ice storm possible. No place in Georgia is “safe” from severe ice storms and the damage they generate.

The number of ice storms with severity levels 3, 4, and 5 are provided in Figure 9 for Georgia. The far North had the greatest number of significant ice storm events and far Southcentral had the least. Figure 10 shows the percentage of all ice storm events in Georgia with severity levels of 3, 4, and 5. Note the central part of the state tended to have more severe ice storms, when they did occur, than other areas.

Storm Index

Using data from ice storm severity levels over 36 years, an Ice Storm Severity Index was developed. This index provides different weighting for each ice storm severity level, and combines these values into a single index number. The formula for calculating the Ice Storm Severity Index (ISSI) is: (EPRI 1996)

$$\begin{aligned} \text{Ice Storm Severity Index (ISSI)} = & \\ & (0.1 \times \text{number of level 3 events}) + \\ & (0.2 \times \text{number of level 4 events}) + \\ & (0.3 \times \text{number of level 5 events}). \end{aligned}$$

Figure 11 provides the Ice Storm Severity Index categories. (EPRI 1996) ISSI category descriptions range from no ice, mild and moderate ice (light), moderately severe ice (medium), severe ice (severe), and most severe ice (extreme). Figure 12 provides the Ice Storm Severity Index values for Georgia. Figure 13 shows the broad descriptions for the ISSI categories used in Georgia.

Note ISSI uses only severity level 3, 4, and 5 ice storms in its calculations. Using this index can demonstrate where the worst damaging ice storm events have occurred and can represent where future ice storms can be expected. There are generally three groupings of the ISSI Index values across the state from North to South with a combination of mild and light descriptions.

Georgia Numbers

Figure 14 is a list of ice storm related values for the 15 historic forecast zones in Georgia. The forecast zone numbers are provided in Figure 15. Georgia ice storm data can be roughly divided into the Northern, Fall line middle, upper Coastal Plain, and far South lower Coastal Plain regions.

One way of examining ice storms in Georgia is through the number of freezing rain days. Figure 16 shows the number of freezing rain days for Georgia over a 25 year period. The Northern half of the State had more than 20 freezing rain days, which amounted to greater than one freezing rain day every 1.25 years. Another way of examining freezing rain days in Georgia appears in Figure 17. Here the average annual number of days with freezing rain over a 53 year period is shown. The Southern end of the Appalachians in Georgia provides the area with the greatest amount of days with freezing rain.

When -- First & Last

Ice storms usually occur in December, January, and February in Georgia. The earliest months for ice storm events are given in Figure 18 covering a 53 year period of time. Figure 19 provides the latest month for an ice storm event in Georgia. November through March are possible months for Georgia ice storms.

How Long & Where?

Figure 20 provides the average annual duration of ice storm hours in Georgia for January through March. Ice accumulation, wind, and ice storm duration are three critical attributes of any ice storm event and its impact on trees.

Ice storms occur more frequently in some locations. There is an increase in number of, and duration of, freezing rain events as elevation increases. Figure 21 shows elevation versus the number of freezing rain events. Figure 22 shows elevation versus the duration of freezing rain events.

Conclusion

Georgia has had many ice storms since records have been kept. North to South across the state -
- nowhere is immune from ice accumulation and associated collateral damage. By examining past ice storm events, a more informed expectation can be developed for future ice storms.

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Selected Literature

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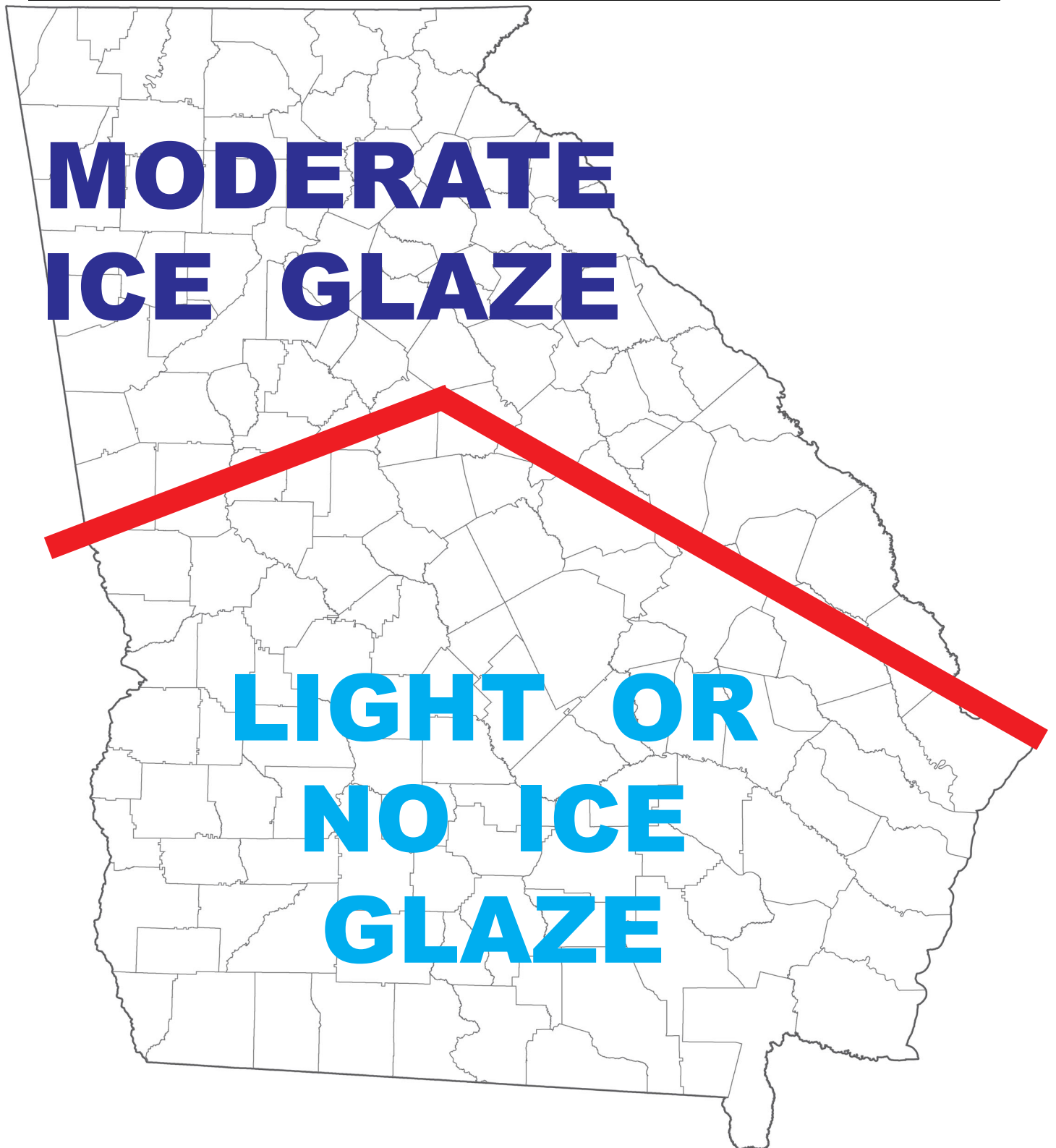


Figure 1: Ice storm ice accumulation based upon
US National Bureau of Standards 1948 map.
(derived from Lemon 1961)



Figure 2: Areas of Georgia sustaining significant ice storm damage over a 55 year period. (from Jones et.al. 2004)

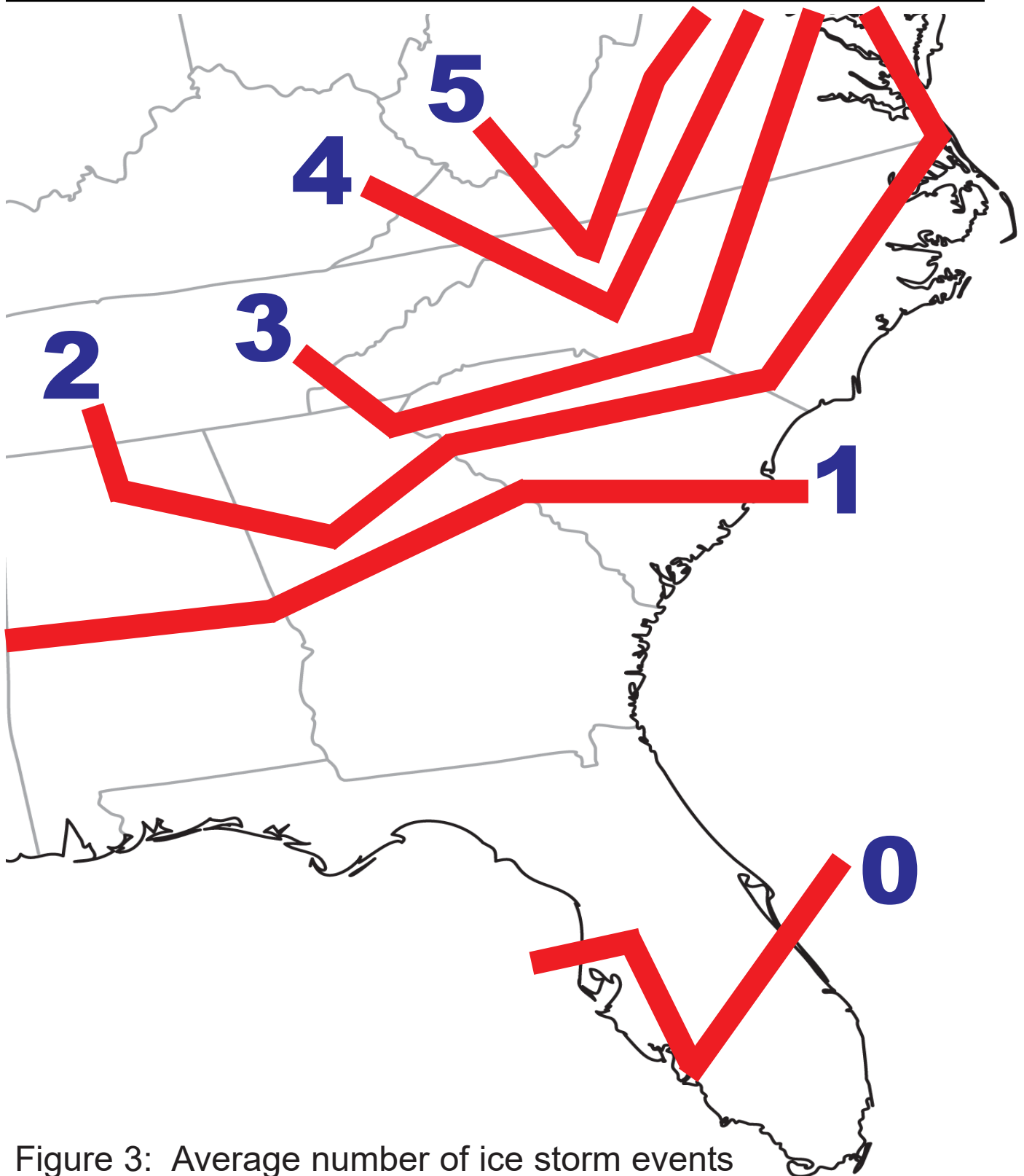


Figure 3: Average number of ice storm events per year in the Southeastern United States.
(derived from Gay & Davis 1993).

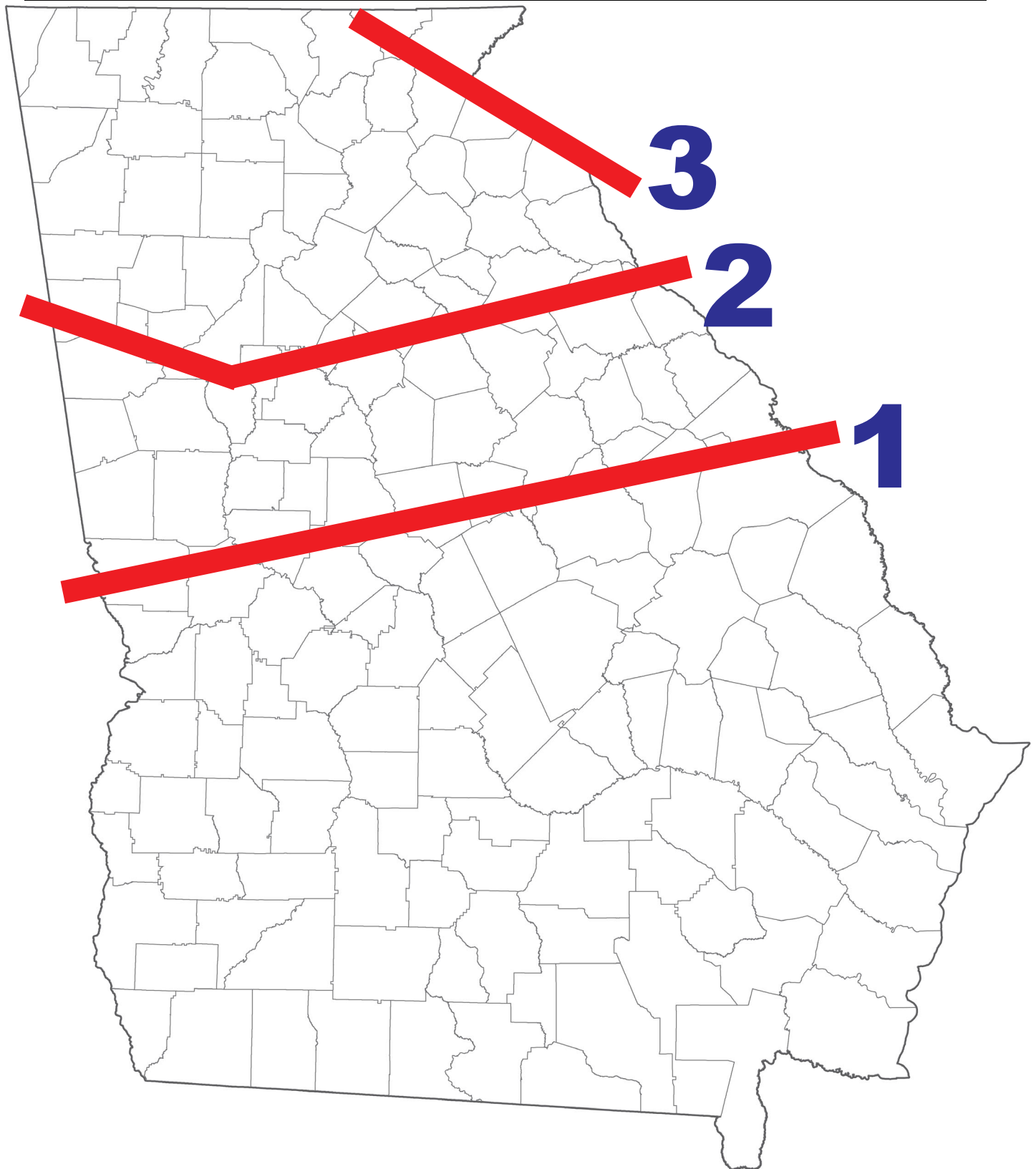


Figure 4: Average number of ice storm events per year in Georgia. (derived from Gay & Davis 1993).

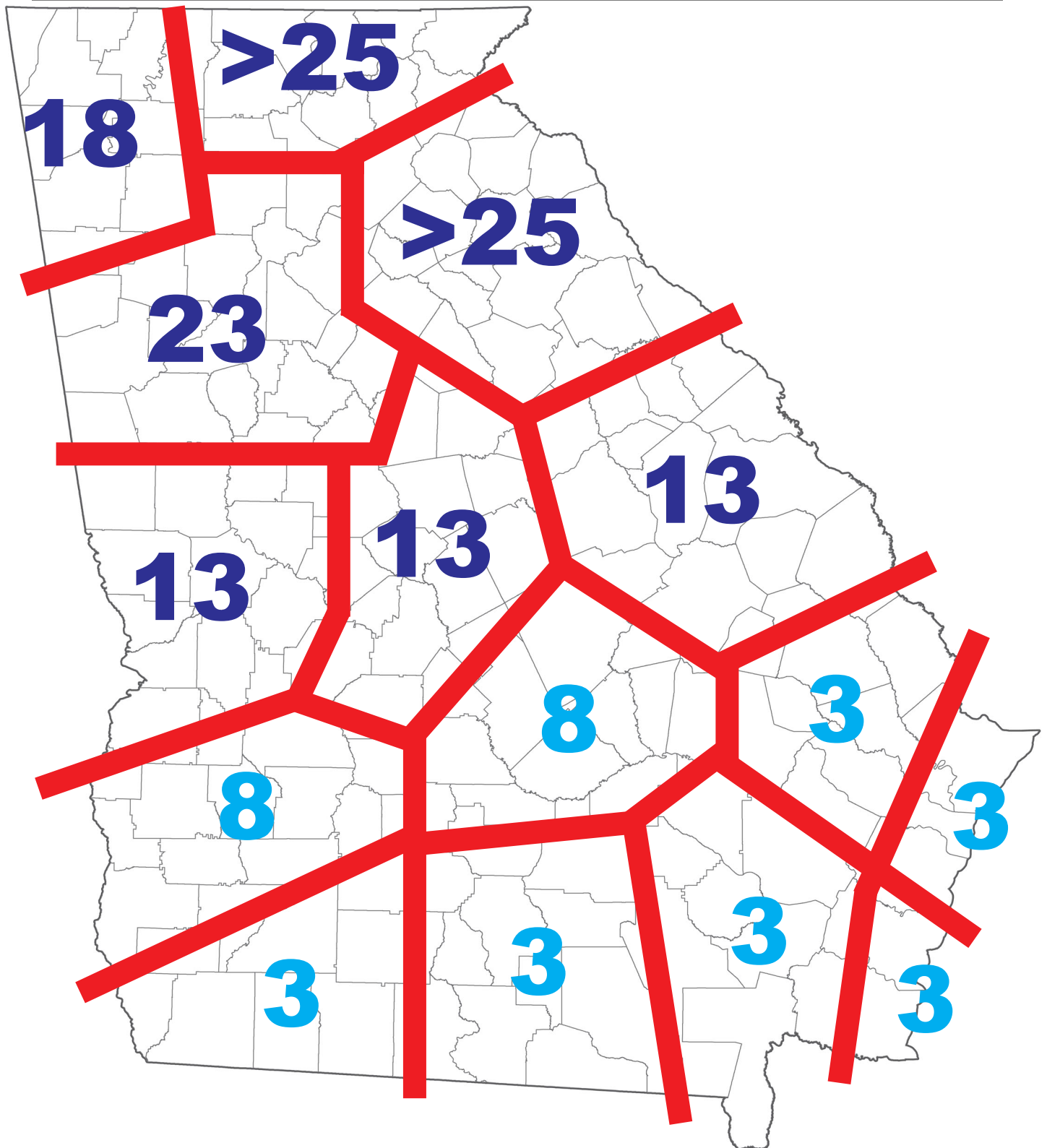


Figure 5: Ice storm events in the State of Georgia over a 36 year period by forecast zone.
(derived from EPRI 1996)

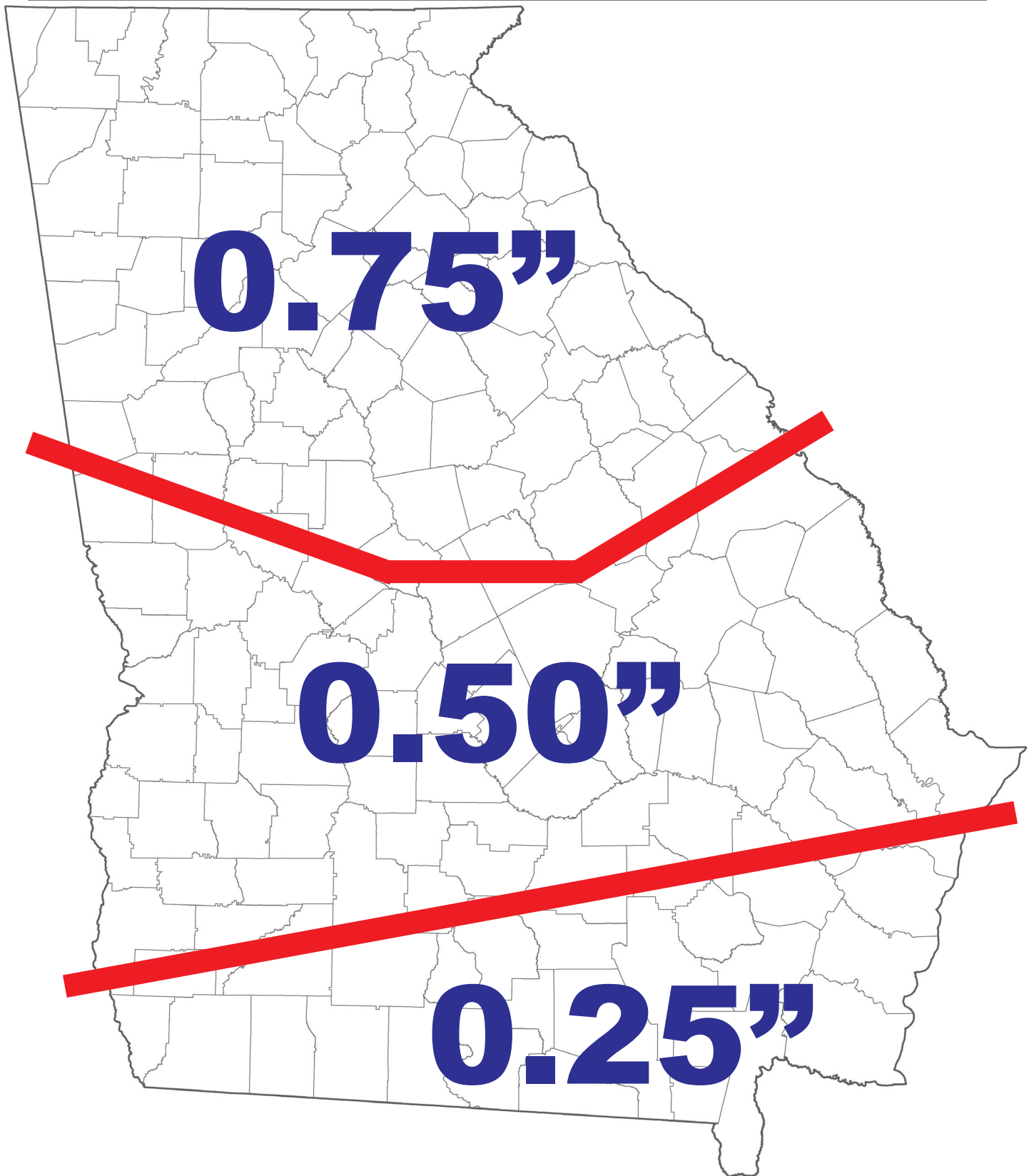


Figure 6: Ice accumulation amounts (in inches) expected for a once every 50 year ice storm. (derived from Jones et.al. 2002)

severity level	description of damage
Level 1	no ice
Level 2	small amounts of ice
Level 3	low to medium damage to power lines & trees, or considerable amounts of ice
Level 4	severe damage to power lines & trees, and/or large amounts of ice
Level 5	catastrophic destruction to power lines & trees, and/or extreme amounts of ice

Figure 7: Ice accumulation levels used in
catagorizing ice storm severity.
(from EPRI 1996)

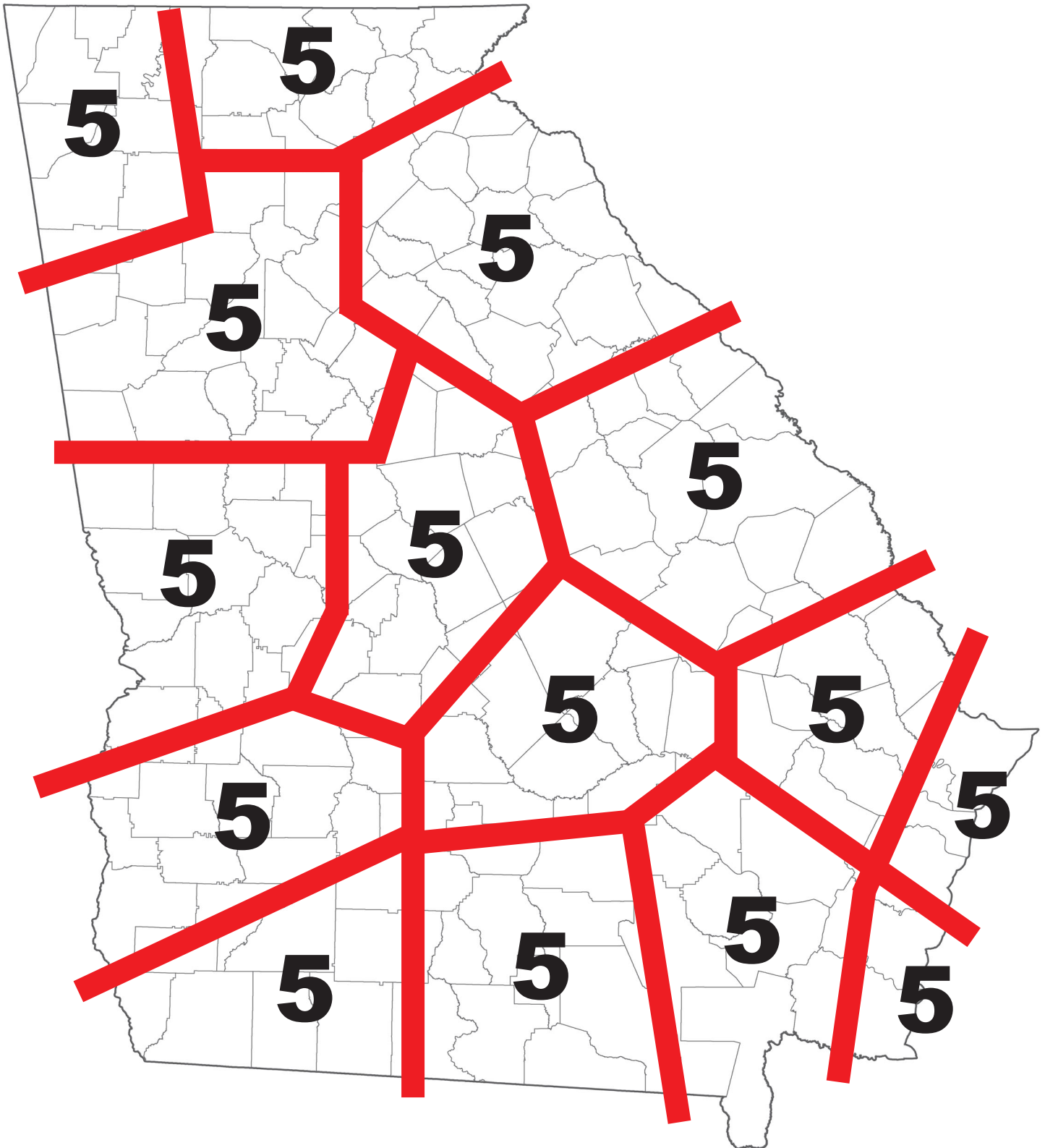


Figure 8: Maximum Ice Storm Severity level ever reached over a 36 year period in the State of Georgia.
(1 to 5 scale with 5 most extreme) (derived from EPRI 1996)

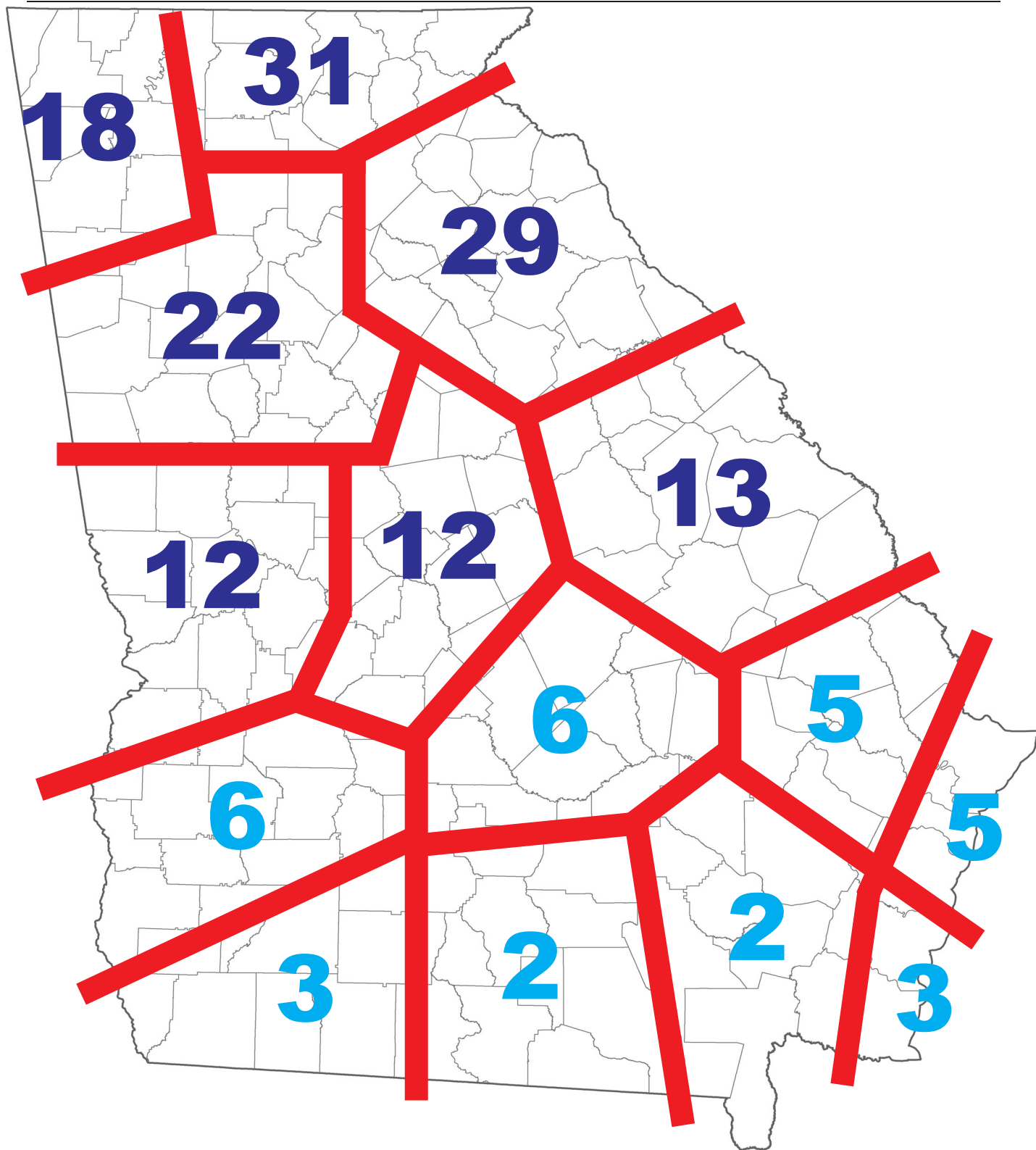


Figure 9: Number of ice storm events in Georgia with severity levels 3, 4, and 5 over a period of 36 years by forecast zone.
(derived from EPRI 1996)

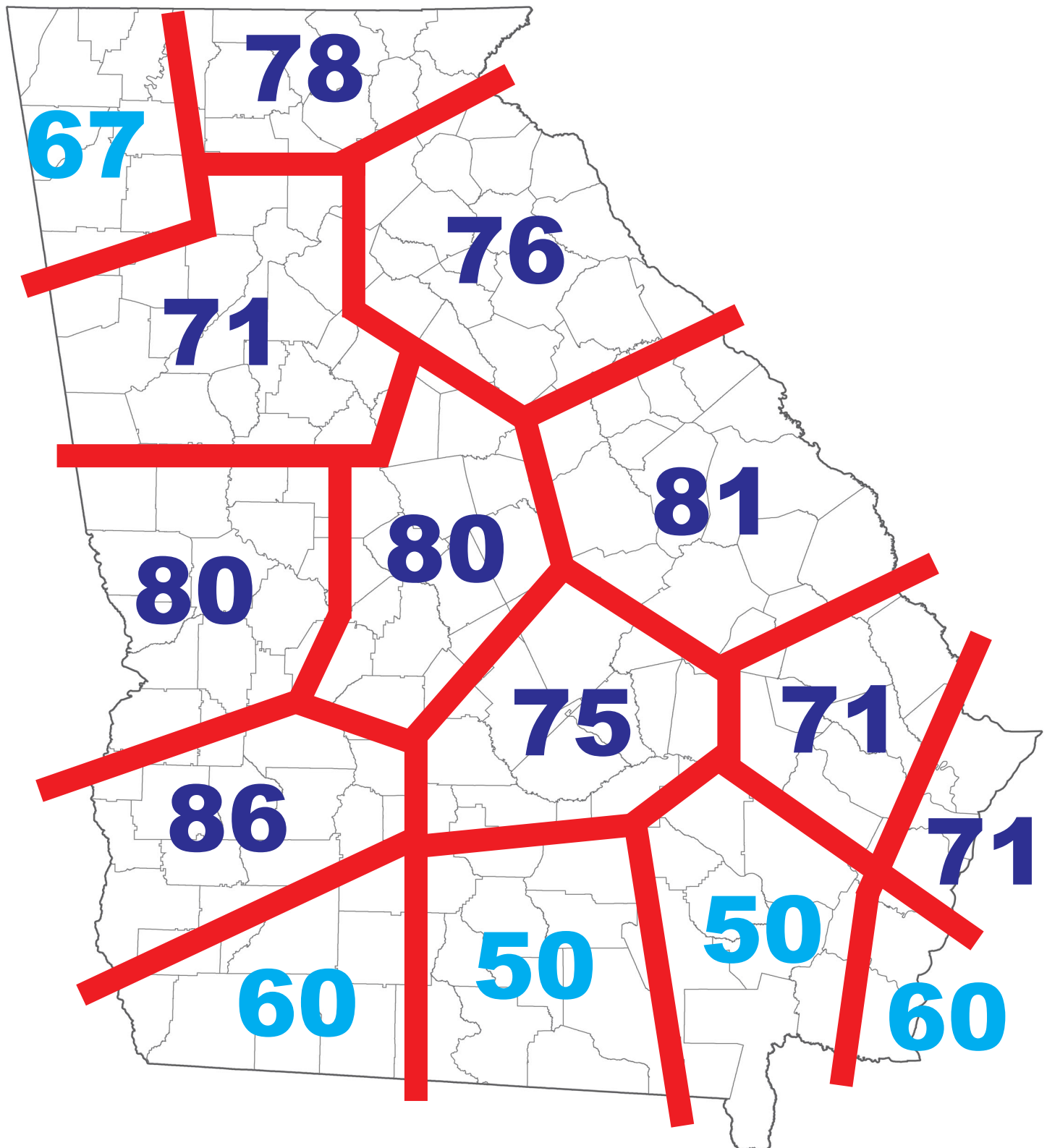


Figure 10: Percent of ice storms in Georgia with severity levels 3, 4, or 5, over a period of 36 years by forecast zone.
(derived from EPRI 1996)

category	description	ISI value range
Category 1	no ice	0
Category 2	mild ice (light)	0.1 - 0.5
Category 3	moderate ice (light)	0.6 - 1.1
Category 4	moderate severe ice (medium)	1.2 - 1.7
Category 5	severe ice (severe)	1.8 - 2.3
Category 6	most severe ice (extreme)	>2.3

Figure 11: Ice Severity Index categories developed from ice storm data over 36 years. (from EPRI 1996)

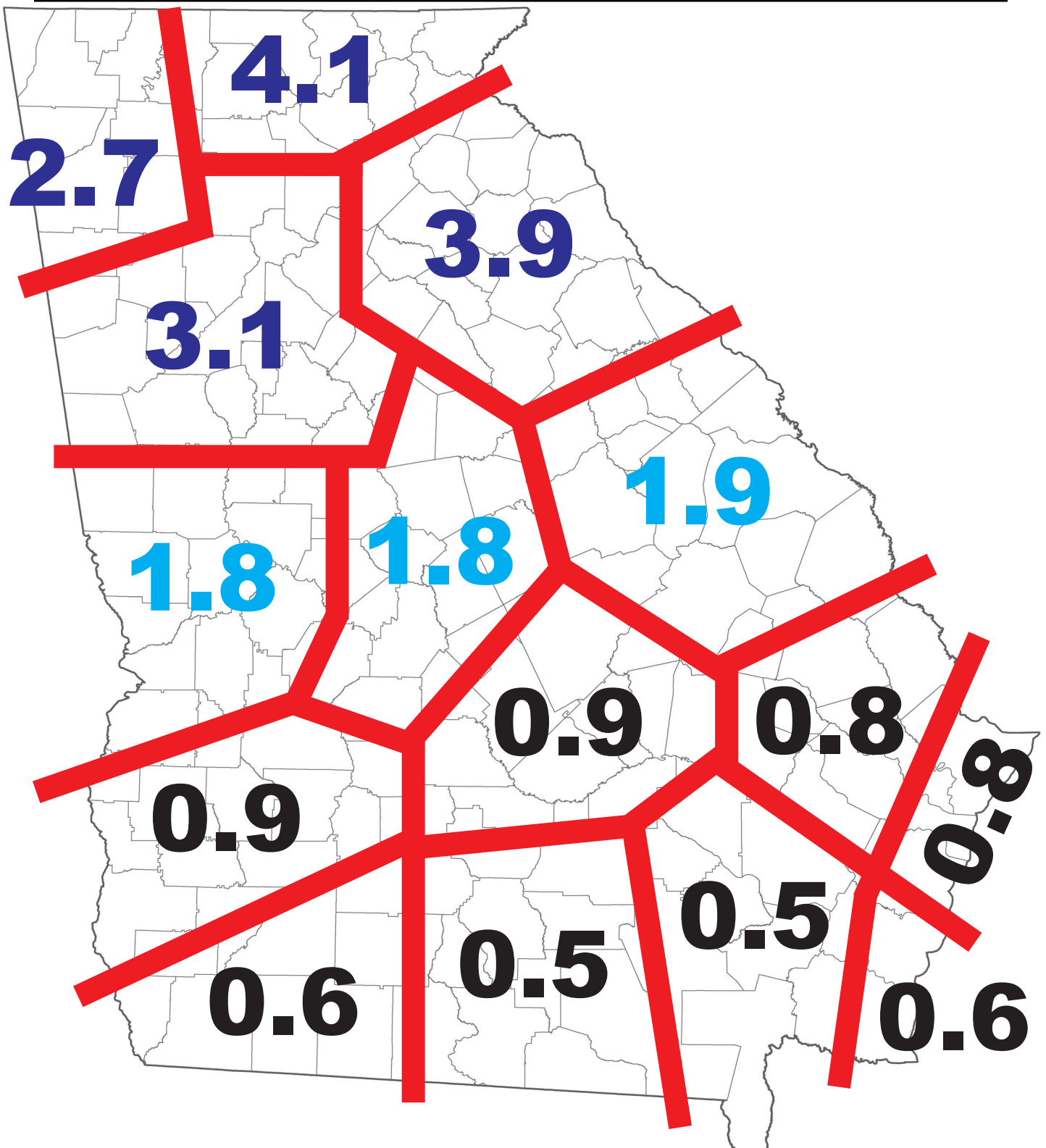


Figure 12: Ice Severity Index values for areas of Georgia compiled over a 36 year period by forecast zone.
(derived from EPRI 1996)

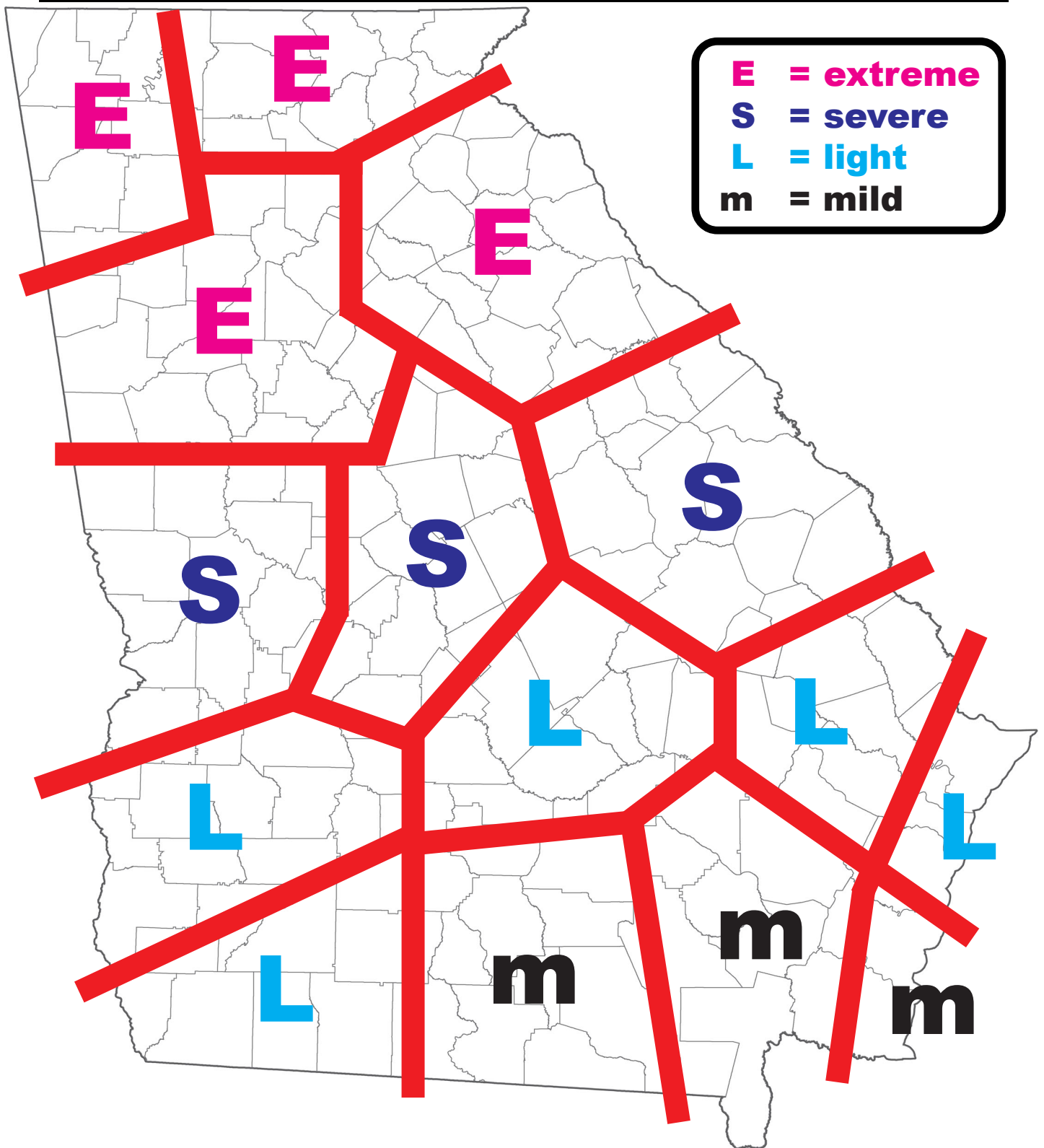


Figure 13: Ice Storm Severity Index descriptions in the State of Georgia over a 36 year period. (derived from EPRI 1996)

zone	total number of ice storms	number of ice storms level 3-5	percent of ice storms >3 level	maximum ice storm severity level	Ice Severity Index (ISI)
1	27	18	67%	5	2.7
2	40	31	78%	5	4.1
3	31	22	71%	5	3.1
4	38	29	76%	5	3.9
5	15	12	80%	5	1.8
6	15	12	80%	5	1.8
7	16	13	81%	5	1.9
8	7	6	86%	5	0.9
9	8	6	75%	5	0.9
10	7	5	71%	5	0.8
11	5	3	60%	5	0.6
12	4	2	50%	5	0.5
13	4	2	50%	5	0.5
14	7	5	71%	5	0.8
15	5	3	60%	5	0.6

Figure 14: For each historic National Weather Service forecast zone in Georgia, ice storm event severity and Ice Severity Index value over a 36 year period are given. (derived from EPRI 1996)

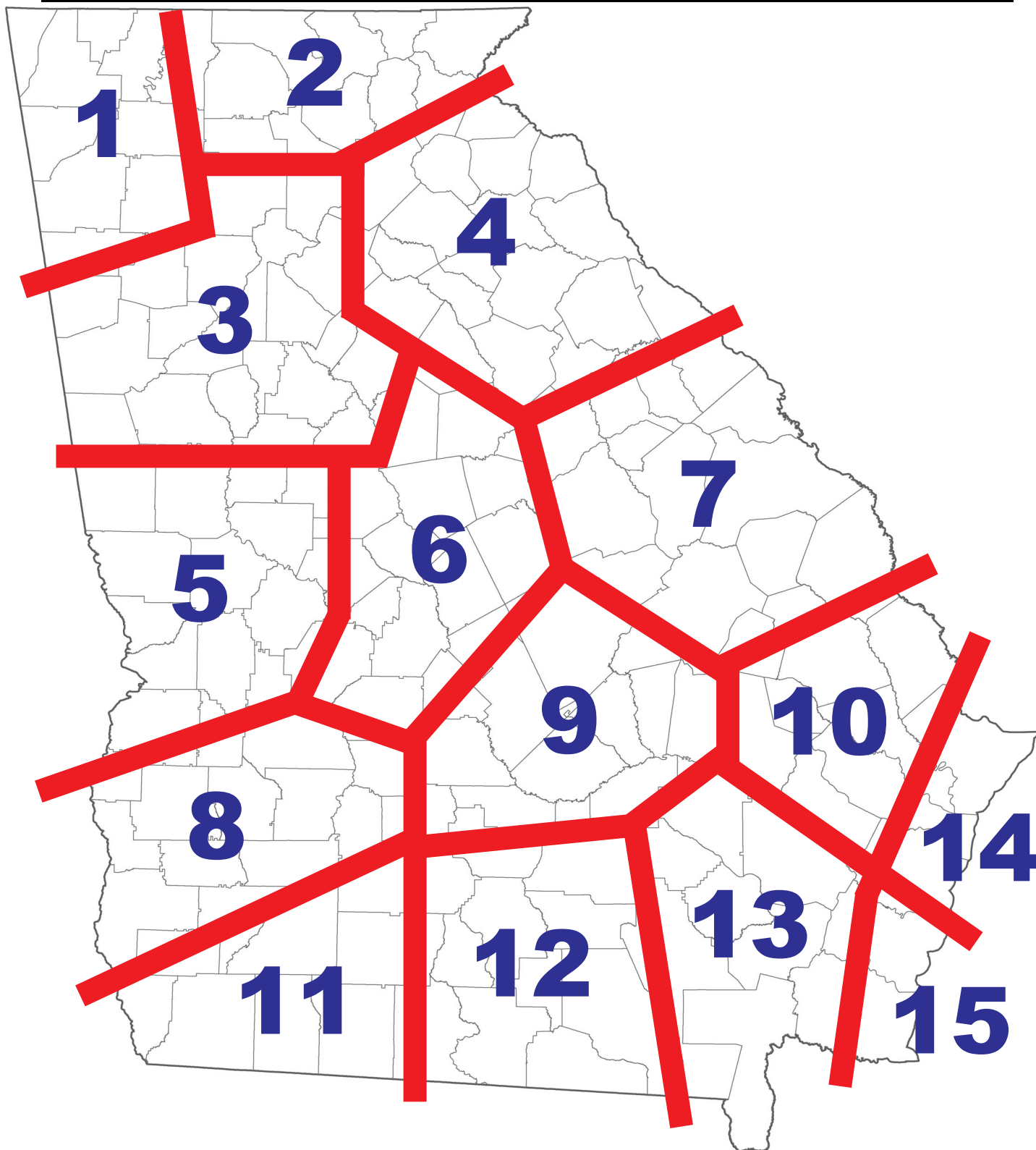


Figure 15: Historic National Weather Service forecast zone boundaries and numbers for the State of Georgia.

(modified from National Weather Service -- Southern Region Zone Forecast Boundaries, 1986)

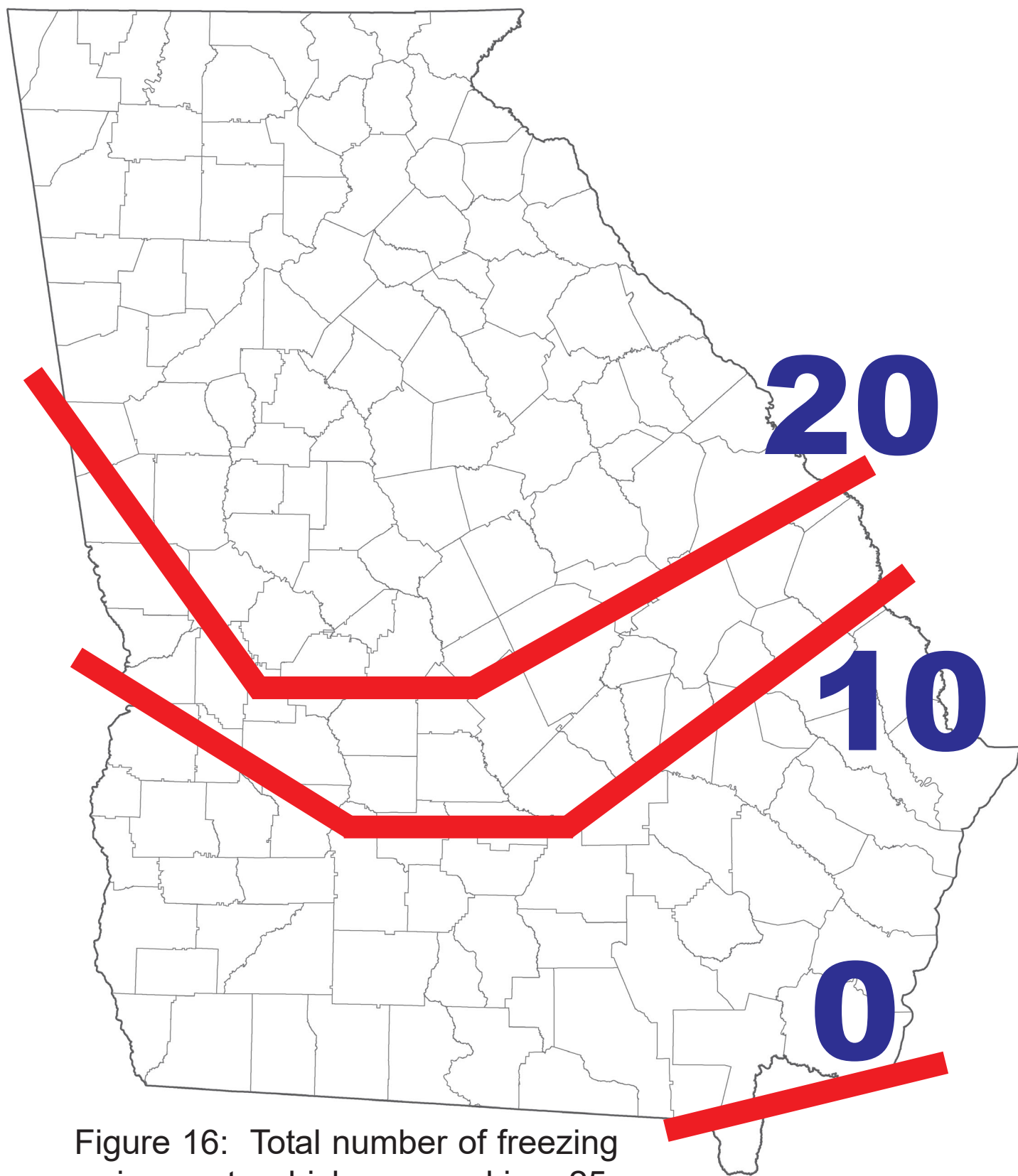


Figure 16: Total number of freezing rain events which occurred in a 25 year period. (Rauber et.al. 2001)

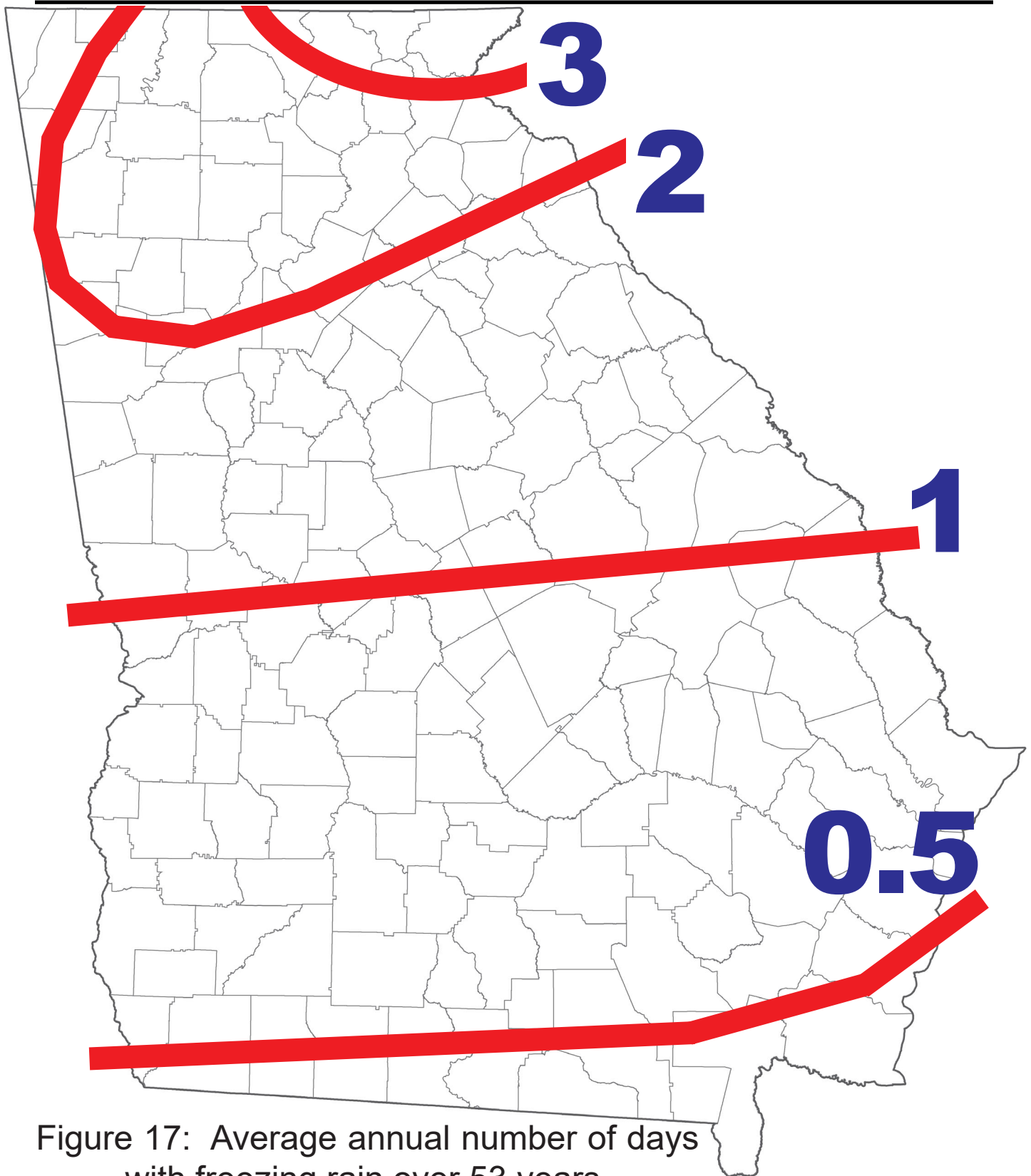


Figure 17: Average annual number of days with freezing rain over 53 years.

(derived from Changnon 2003, Changnon & Changnon 2002, Changnon & Karl 2003)



Figure 18: Month of earliest freezing rain event in Georgia over 53 years. (Changnon & Karl 2003)

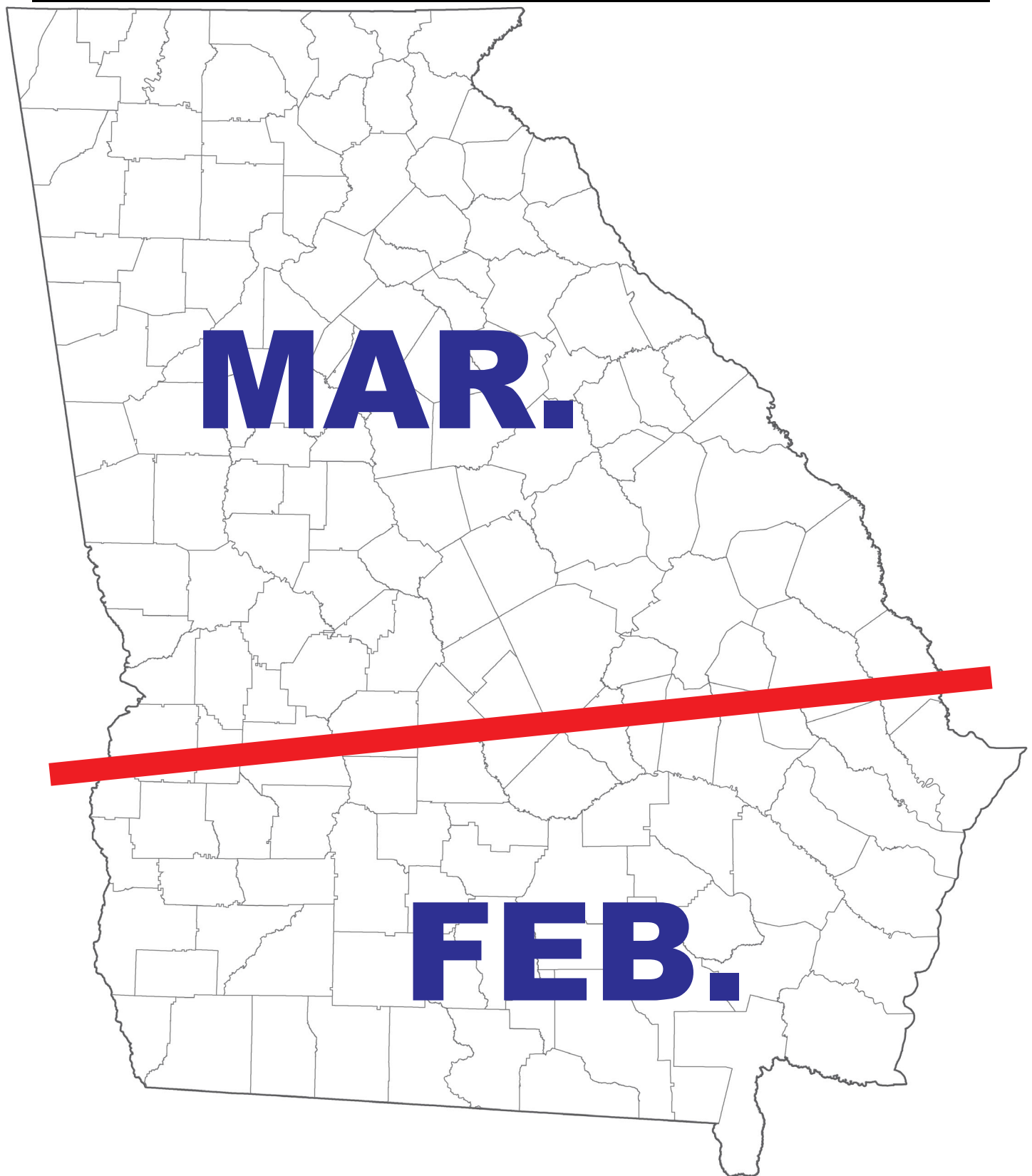


Figure 19: Month of latest freezing rain event in Georgia over 53 years. (Changnon & Karl 2003)

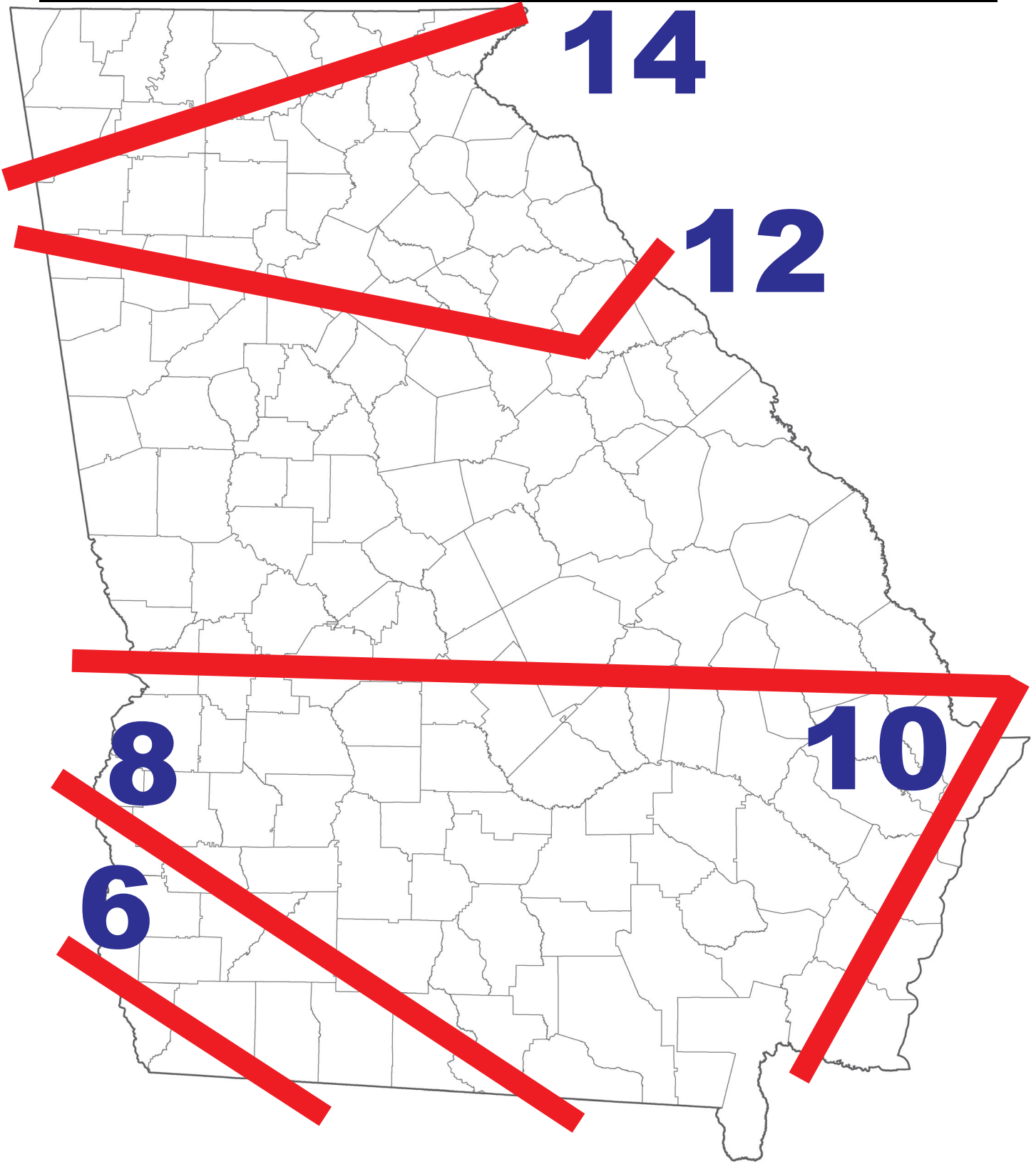


Figure 20: Average duration (hours) of ice storms for January through March in Georgia. (derived from Gay & Davis 1993).

**elevation
(feet)**

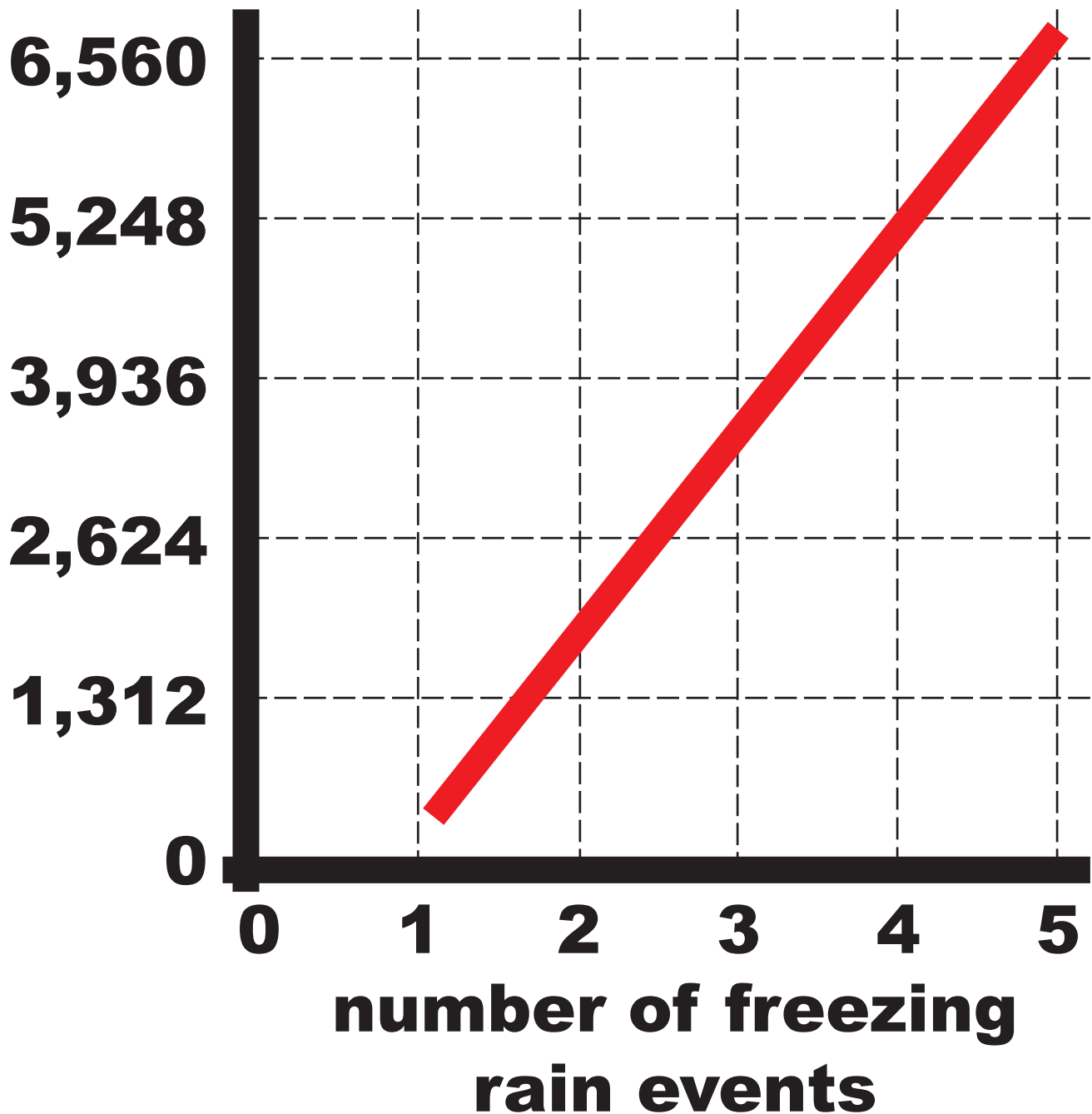


Figure 21: Number of freezing rain events in the Southeastern Appalachians. (derived from Konrad 1998)

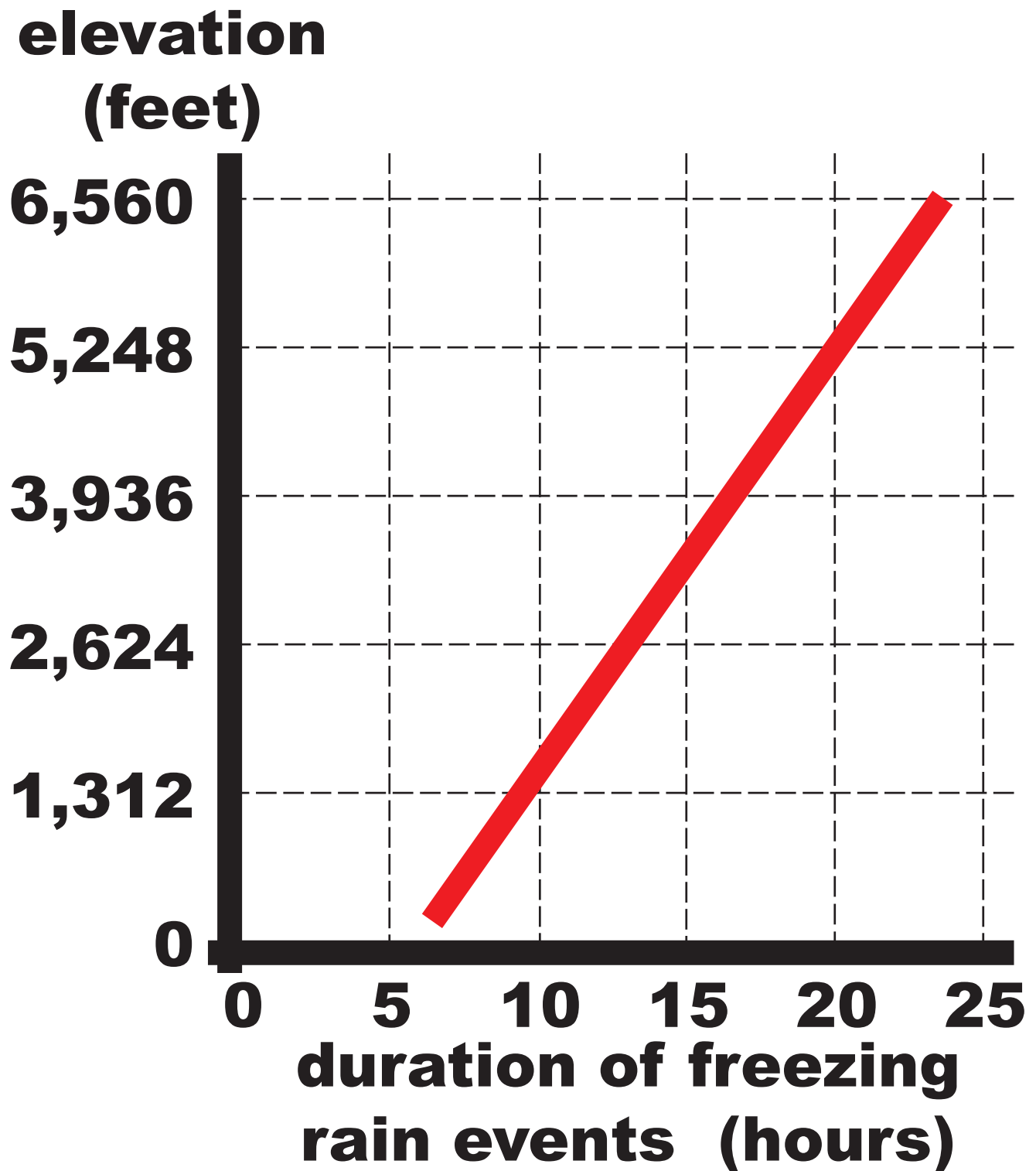


Figure 22: Duration of freezing rain events in the Southeastern Appalachians. (derived from Konrad 1998)