Striking Lightning Facts

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An analysis of 10 years of lightning claims reveals which boats are most at risk.

By Beth A. Leonard

Photo: C. Clark, NOAA Photo Library

Lightning seems like the ultimate "act of God." Unpredictable, capricious — it can come as a literal bolt out of the blue (or out of a glowering, black, anvil-shaped cloud). As the "Lowering the Lightning Odds" article in the July 2014 issue discussed, somewhere around one in a million people gets struck by lightning in any given year. Which means that someone must have it in for boats — two separate analyses of 10 years of lightning claims data from the BoatUS Marine Insurance files have found that about one in a thousand boats has a lightning claim each year.

When people get struck, it seems to be random. Yes, men get struck more than women (82 percent of lightning fatalities from 1995 to 2008 were men according to *Popular Science*), but that's only because men spend more time outdoors and won't stop what they're doing for a little lightning. No one has yet suggested that tall people get struck more than short ones, or blondes are more at risk than brunettes. The same cannot be said for boats. The data shows that when it comes to lightning, not all boats are created equal. Certain boats are significantly more at risk than others. So which boats get hit, in which parts of the country, and how badly?

Which Boats?

Table 1. The probability of a lightning strike by type of boat, 2003–2013

Type of Boat	Chances per 1,000
Multihull Sailboat	6.9
Monohull Sailboat	3.8
Trawler/Motoryacht	1.5
All – Overall Average	0.9
Bass Boat, Runabout, Pontoon Boat	0.1

While any boat can be hit — BoatUS Marine Insurance has even had some lightning claims for personal watercraft — lightning is most likely to go for that tall, tree-like metal pole sticking straight up toward the sky. The taller the better. That's why sailboats have significantly more lightning claims than powerboats **(Table 1)**, and almost certainly why larger boats have more lightning claims than smaller ones **(Table 2)** — overall size is closely correlated to mast height, which is probably what really matters here. And as far as lightning is concerned, two hulls are better than one. Multihull sailboats are almost twice as likely to have a lightning claim as monohulls. But that's only true if that big, pointy thing is in the middle of the boat. The frequency of pontoon boat lightning claims is well below the average.

Table 2. The probability of a lightning strike by size of boat, 2003–2013

Type of Boat	Chances per 1,000
0-15 Feet	0
16–25 Feet	0.2

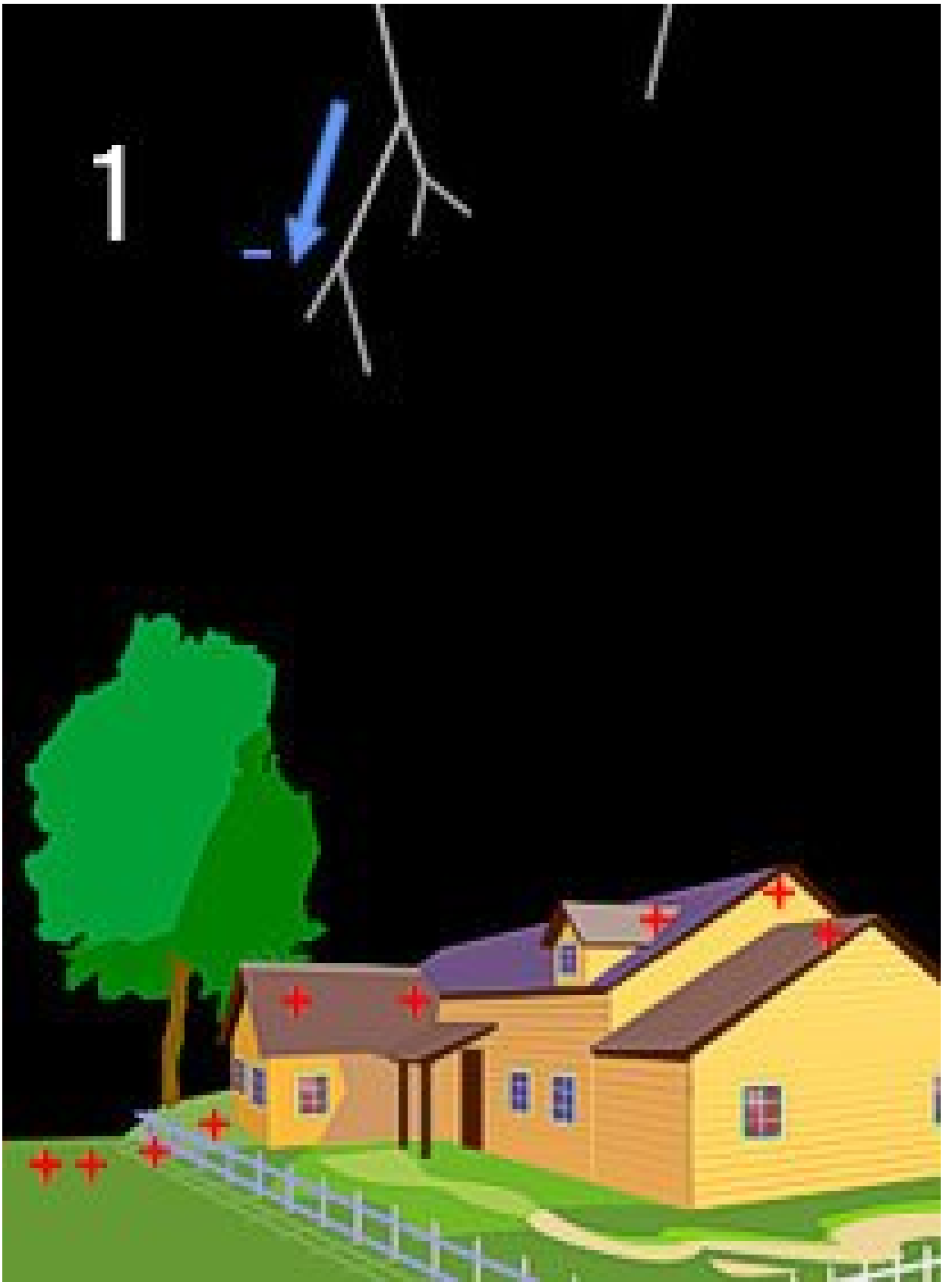
Type of Boat	Chances per 1,000
26–39 Feet	2.1
40–64 Feet	6

According to Martin Uman of the University of Florida's Lightning Research Group, the average lightning bolt is an inch wide and five miles long. On the face of it, it seems unlikely that 20 or 30 feet more height — roughly the difference between the mast on a 35-foot and 45-foot sailboat — would almost triple the odds of the boat being hit. But understanding how the electrical charge that passes through a lightning bolt moves between the clouds and the ground makes lightning seem just a bit less capricious.

This boat burned after a lightning strike; fortunately strikes usually don't cause fires aboard.

Lightning is a direct result of the electrical forces built up in the clouds during a thunderstorm, where the bottom of the storm cloud becomes highly negatively charged. Only 20 percent of lightning strikes actually reach the ground — the rest are cloud-to-cloud strikes. A typical cloud-to-ground lightning strike occurs in less than 1/100 of a second but actually proceeds through four distinct phases. The following is an abbreviated version of the National Weather Service's JetStreamMax Online School for Weather's lightning

discussion.

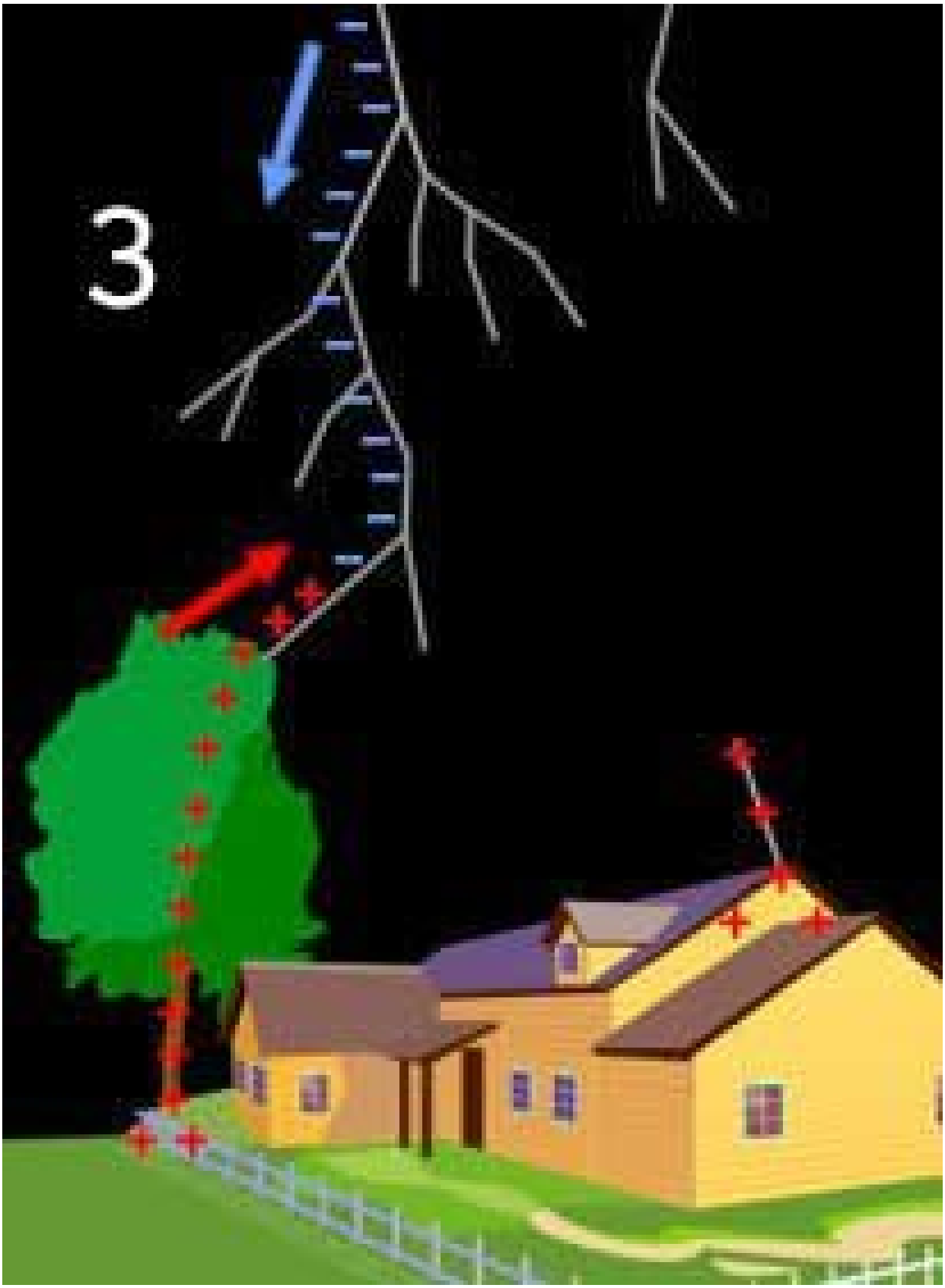


1.

Development of the stepped leader from the cloud base. A very faint, negatively charged channel emerges from the base of the cloud and propagates toward the ground in a series of small steps about 150 feet in length and 1 microsecond in duration. The stepped

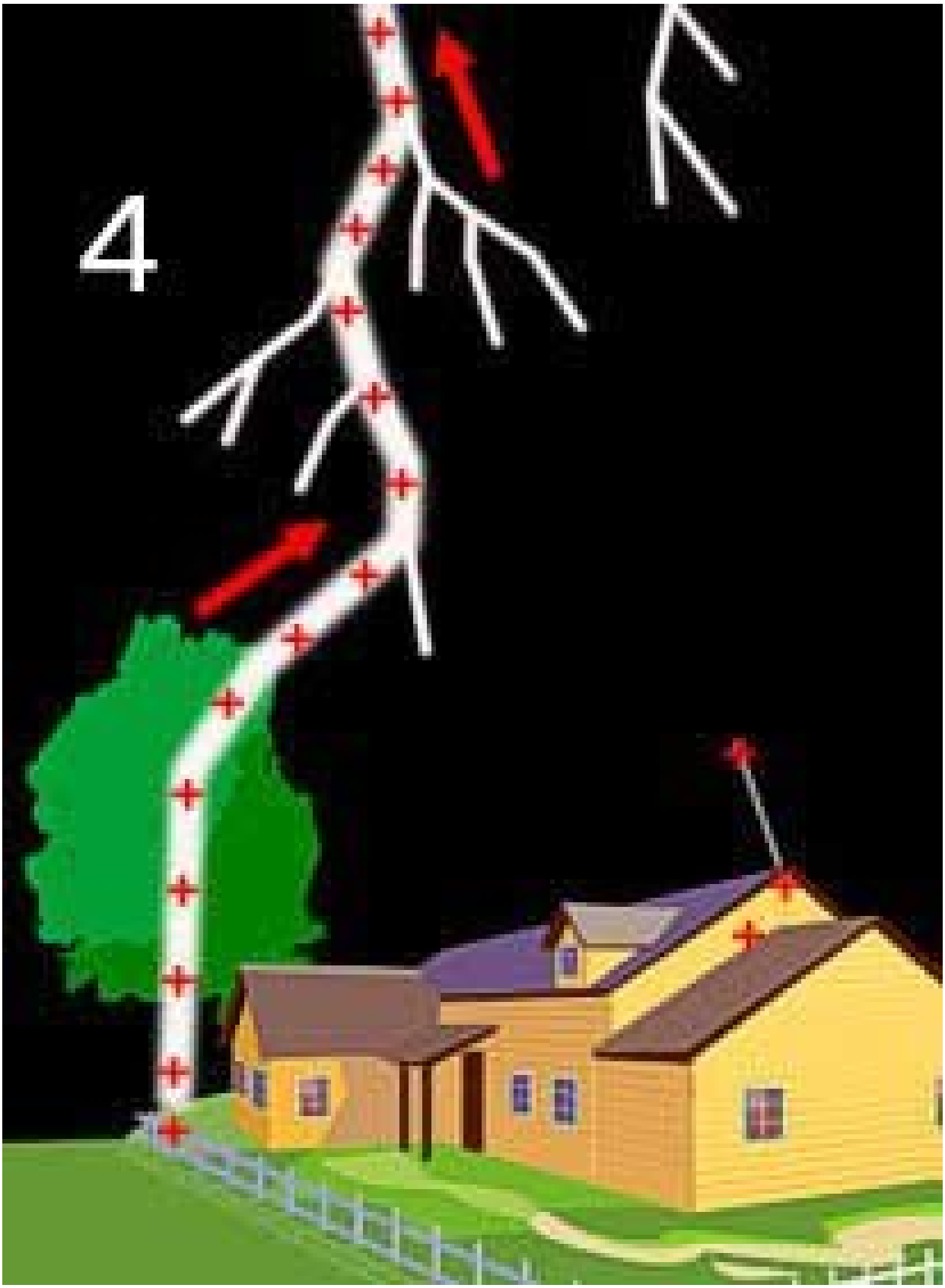
2. Development of streamers from objects on the ground. The strong, negative charge of the stepped leader attracts vast amounts of positive charge. The attraction is so strong that the stepped leader induces electric channels up from the ground known as streamers, most readily from tall, pointy objects. When a cloud-to-ground strike occurs, one of these positively charged streamers connects with the negatively charged stepped leader, at 100 to 300 feet above the ground on average.

3.



Negative charge flows downward. When that connection occurs, the negative charge from the cloud starts flowing down the established channel.

4.



Return stroke shoots up the channel. Once the channel is open, the return stroke flows up and produces a ground current that peaks in about 1 microsecond at an average of

Sailboat masts, like tall trees, seem to be at just the right height and of just the right shape to develop streamers that the stepped leader can reach when it's "looking" for a place to touch down. That doesn't explain why one mast in a particular marina wins the lightning lottery, nor does it mean that the highest object will always be struck. But when looking at probabilities, the claims data suggests that sailboat masts must make better lightning rods than other appendages on other types of boats.

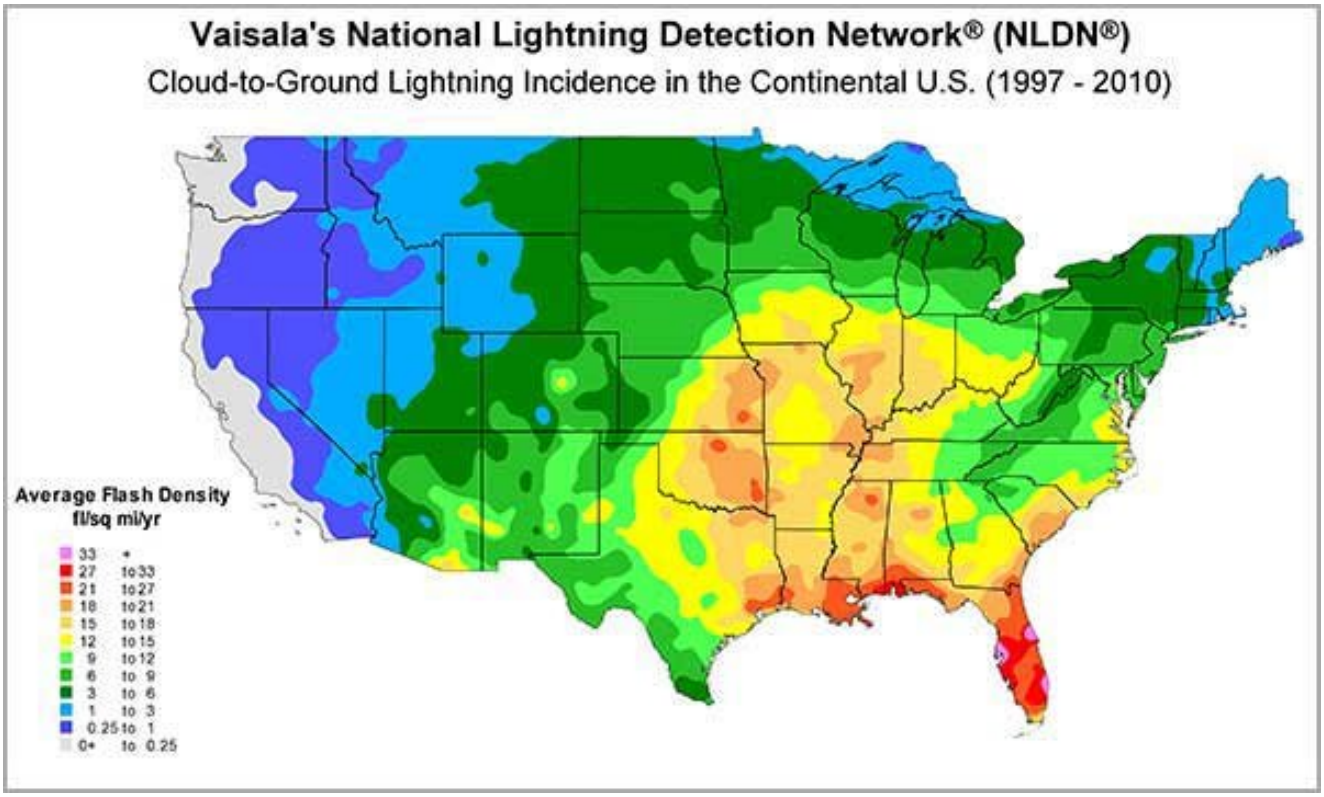
This "lightning track" shows how the electrical charge passed from the bobstay to the jackstand to reach the ground.

Understanding why multihulls get hit so much more frequently than monohulls is more problematic. Several theories have been put forward including the lack of a keel, the increased wetted surface area, the larger footprint, the location of catamarans at the edges of marinas, the overall size of catamarans, and the average height of their masts. Unfortunately, we do not yet have enough data to be certain of what is driving this finding.

Where?

Not surprisingly, boats get struck where there is a high density of lightning and a high density of boats. The frequency of the BoatUS lightning claims by state fairly closely resembles the incidence of cloud-to-ground lightning strikes. If an area has a high

incidence of strikes, that includes a lot of masts, it's not too unlikely that one of those strikes will find its way to ground through a boat.



Six of our top 10 states in terms of the frequency of lightning claims — Florida, Mississippi, Louisiana, Alabama, South Carolina, and North Carolina — are part of the big "hot spot" in the Southeast and midsection of the country. Maryland ties for second with Mississippi, which might surprise you. But there are a lot of sailboats there, and anyone who has boated on the Chesapeake Bay in the summer has experienced the fast-moving and violent thunderstorms that sweep through the area several times each month from June through September.

At the other end of the spectrum, the frequency of lightning claims is about 1 in 10,000, or one-tenth the average, along the Pacific coast. That doesn't mean that BoatUS Marine Insurance doesn't ever have lightning claims there, only that if you are the one with the claim, you've been very unlucky indeed.

What Type Of Damage?

Yes, the old wives' tales are true. Lightning can blow a thru-hull right out of the boat, but more commonly its passage through a metal fitting damages the surrounding fiberglass. This can be severe enough that the boat sinks. Boats on the hard often fare even worse than those in the water — the lightning will find its way to the jackstands or chains, often leaving a visible track across the hull. But extreme damage from lightning is the exception, not the rule.

Examples of lightning damage.

More than 75 percent of lightning claims in the BoatUS Marine Insurance files over the past decade were for less than 30 percent of the insured value of the boat. And nearly all of those claims were for damaged electronics. Here's how it normally goes. Joe and Jane Boater arrive at the marina looking forward to a lovely weekend on the water. They begin loading all their stuff onto their sailboat. Jane goes down below to put things away and says, "Joe, did you leave the breaker for the fridge off?" A bit later, Joe tries the chartplotter but it won't fire up. Then the microwave won't work. It takes awhile before the penny drops. One of them looks at the other and says, "Remember that big thunderstorm last week? Maybe our boat got hit."

If this ever happens to you, don't assume the damage is limited to the electronics. To make sure your boat is safe, you should do the following:

1. Unplug the shorepower cord and turn off all battery switches. You don't want a short circuit to start a fire.

2. Check the bilge and make sure it is dry. If it is not, arrange a haulout immediately. This will probably be covered by the insurance company, but even if it isn't, you need to make sure everything is OK below the waterline.

3. Call your insurance company. Tell them what is happening, and don't forget to discuss a

haulout if you are taking on water.

4. Once you're sure the boat isn't sinking or you have hauled it out so it can't, your insurance company will assign a marine surveyor to do a damage assessment, inspecting the electronics and all electrical panels to figure out what does and does not work. Electronics may need to be bench tested to establish that lightning was the cause of the damage. If you haven't been hauled out and the damage appears extensive, the insurance company may require a haulout now to ensure there is no below-waterline damage.

5. Don't throw away any damaged equipment unless your insurance company says it's OK to do so.

So, if you have a sailboat in a lightning hot spot, especially if it has two hulls, you are more at risk than average. What can you do about that? The general consensus is, you can't do much to keep your boat from being struck. The ultimate act of God, remember, though God seems to have it in for sailboats and doubly so for multihull sailboats. But lightning protection systems can help to minimize the damage if your boat does get struck, so we will be looking at those later this year.

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Seaworthy, *the damage-avoidance newsletter, is brought to you by the BoatUS Marine Insurance Program. For an insurance quote, please call 1-800-283-2883 or apply online at BoatUS.com.*

To comment on this article, please contact Seaworthy@BoatUS.com

What To Do If You're Caught Out On The Water

"When thunder roars, go indoors." If there is time, return to shore and take shelter in an enclosed building (not open-sided) or your car. They are not impervious to lightning, but the lightning is less likely to do damage.

But if lightning has already begun, getting closer to shore may bring you close to trees and other objects that could be lightning targets. In that case, stay on the boat and do the following:

- Go indoors — go down below. Stay in the center of the cabin if the boat is so designed. If no enclosure (cabin) is available, stay low in the boat. Don't turn yourself into a lightning rod!

- Keep arms and legs in the boat. Do not dangle them in the water.
- Discontinue fishing, waterskiing, scuba diving, swimming, or other water activity when there is lightning or even when weather conditions look threatening. The first lightning strike can be a mile or more in front of an approaching thunderstorm cloud.
- Disconnect and do not use or touch major electronic equipment, including the radio, throughout the duration of the storm.
- Lower, remove, or tie down the radio antenna and other protruding devices if they are not part of the lightning protection system.
- To the degree possible, avoid making contact with any portion of the boat connected to the lightning protection system.
- On larger boats with an oven or microwave, putting electronics inside should prevent them from being damaged as the oven or microwave will act as a Farraday cage, allowing the charge to pass harmlessly through the metal around the devices.

From University of Florida's "Boating-Lightning Protection" by William Becker