Study confirms lightning more powerful over ocean than land

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Credit: NASA

People who live and work along coasts and coastlines everywhere may be more likely to experience a super-charged lightning strike, according to new research from Florida Institute of Technology that shows lightning can be much more powerful over the ocean than land.

Florida Tech's Amitabh Nag, assistant professor of physics and space sciences, and Kenneth L. Cummins, research professor at Florida Tech and the University of Arizona, recently published, "Negative First Stroke Leader Characteristics in Cloud to-Ground Lightning Over Land and Ocean" in the American Geophysical Union's *Geophysical Research Letters*. The scientists analyzed lightning over parts of Florida and its coasts using data provided by the U.S. National Lightning Detection Network.

Some previous indirect observations led scientists and others to believe that strikes over sea water tend to be more powerful, but the Nag and Cummins study represents the first time that an independent measurement has validated those beliefs.

Lightning scientists break down every cloud-to-ground strike into sub-processes to get a better understanding of the way it formed. Plenty of physics is packed into fractions of a second from when charged particles in thunderclouds form into downward channels of electricity that "attach" to electrical, charge-carrying channels rising from land or water to form that familiar zigzag bolt.

In their study, which measured peak currents of various cloud-to-ground lightning strikes over land and ocean from 2013 to 2015, Nag and Cummins calculated the duration of the "negative stepped leader" – the electrical channel that moves down toward ground from a thundercloud. When this leader touches ground a surge of current, typically with a peak value of around 30 kilo amperes, flows upward to the cloud. The durations of negative stepped leaders over the ocean were significantly shorter than those over land, which indicates that they carry more charge in them. This leads to a higher following current surge from ground.

Nag and Cummins found that with strikes over water in western Florida, the median stepped-leader duration was 17 percent shorter over ocean than over land, and in eastern Florida the median durations were 21 and 39 percent shorter over two oceanic regions than over land. Using a relationship between leader duration and lightning peak current derived in this study, the authors estimate that lightning with peak currents over 50 kilo amperes is twice as likely to occur in oceanic thunderstorms.

These findings suggest that people living on or near the ocean may be at greater risk for lightning damage if storms develop over oceans and move on-shore. This new understanding of the nature of lightning could inform how off-shore infrastructure and vessels are to be built to minimize the risk of

super-powerful lightning bolts from thunderstorms formed over the sea.

More information: Amitabh Nag et al, Negative first stroke leader characteristics in cloud-to-ground lightning over land and ocean, *Geophysical Research Letters* (2017). DOI: 10.1002/2016GL072270

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