'Dark ecology project' will use past weather radar data to trace bird migrations

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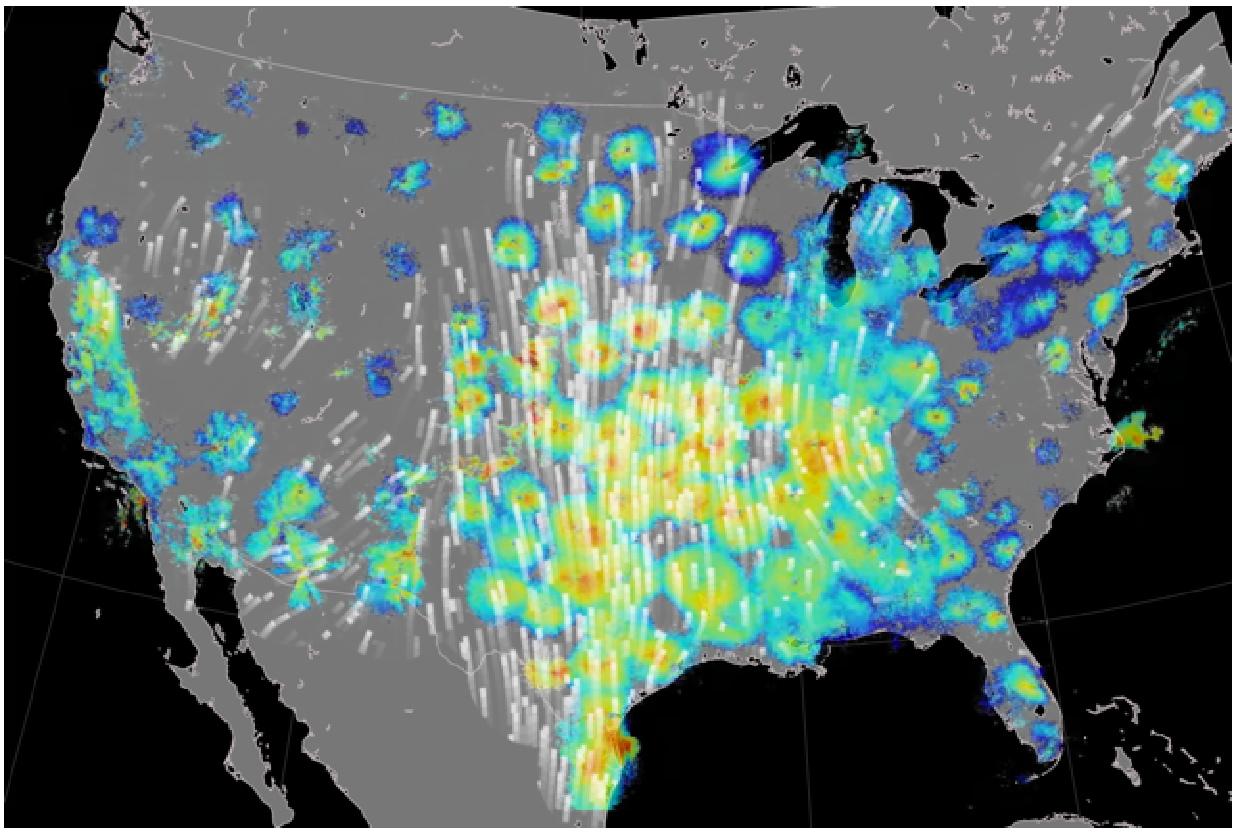

A national radar mosaic showing heavy bird migration throughout the Midwestern United States on the night of May 2, 2015. Streamlines show simulated bird trajectories based on radar measurements of migration. A team of researchers led by computer scientist Daniel Sheldon plan to develop new analytic methods with data collected over the past 20 years to provide powerful new tools for tracking bird migration. Credit: UMass Amherst

Every spring and fall, billions of birds migrate across the United States, largely unseen under the cover of darkness. Now a team of researchers led by computer scientist Daniel Sheldon at the University of Massachusetts Amherst plan to develop new analytic methods with data collected over the past 20 years—more than 200 million archived radar scans from the national weather radar network—to provide powerful new tools for tracking migration.

Sheldon says, "The Dark Ecology Project will develop new resources allowing us to estimate the densities of migrating birds over the U.S. each year for the last 25 years." His collaboration with computer vision expert Subhransu Maji at UMass Amherst and Steven Kelling, director of information science at the Cornell Laboratory of Ornithology, Ithaca, N.Y., is supported by a three-year, $903,300 National Science Foundation grant to UMass Amherst and $309,000 to Cornell.

Sheldon has collaborated with scientists at the Cornell Lab of Ornithology since 2009, when he was a Ph.D. student at Cornell. Kelling's information science team developed eBird, a citizen science project that collects observations from birdwatchers across the globe. The researchers use big data methods to piece together eBird observations to reveal complex patterns of bird occurrence and to guide international bird conservation efforts such as the 2016 State of North America's Birds report. Maji's group has developed computer vision techniques for fine-grained categorization, which are already helping citizens connect with nature by automatically recognizing species of birds, animals, and other organisms in photographs.

A long-term vision for the new grant, Sheldon explains, is to combine these new data resources to provide a detailed continent-wide view of bird migration. He says, "eBird data can tell us about bird distributions and which species are present at different locations and times of year, while radar data can tell us how birds are moving over the continent throughout the year."

They chose to name the project 'Dark Ecology' to allude to dark matter in the universe and the idea that "a lot of the science waiting to be discovered is hidden from our direct view," he adds.

Ornithologists, scientists who study birds, have known for decades that the U.S. weather radar network is sensitive enough to detect birds flying at night, and some researchers have used the data for studies. But such research has been limited because of the difficulties involved.

Sheldon explains that not only has it not been easy to gain access and download data, but "there are millions of images, and analyzing them requires a human expert to look at every image in order to use the information in a study. Because of the human processing involved, it's a very slow process and it's been beyond the scope of what most people can do." He and colleagues propose to automate the process by developing new big data handling techniques.

Access to the radar scans was enhanced in 2015, when Amazon Web Services reached a research agreement with the U.S. National Oceanic and Atmospheric Administration to increase the amount of NOAA data that is made available via the cloud. This made NEXRAD data accessible at a much lower cost.

To build on this open access, Sheldon and Maji will use machine learning, computer vision and probabilistic inference techniques to teach computers to take over analyses that used to require human manual labor. One key will be to design algorithms to screen out rain, Sheldon says. "Recent advances in machine learning and computer vision will let us teach the computer how to identify rain, birds, insects, location of bird roosts and other biological phenomena of interest to ecologists."

"We also plan to develop algorithms to extract more information from the radar data," he adds. "Current methods produce point-based estimates of migration at a particular station because they don't know how to deal with gaps in radar coverage. This means they throw out a huge amount of data that does exist between stations. We would like to develop machine learning algorithms to infer what is happening in the gaps to produce spatially detailed maps of migration density."

The scientists plan to make the resulting dataset freely available as an information resource for researchers to estimate the number of birds migrating on any given night, measure the patterns and trends of bird populations, and do hypothesis-driven science. "One big goal is to analyze the entire archive to measure density and velocity of migrating birds and make the resulting data available to any scientists who can use it."

More information: www.nsf.gov/awardsearch/showAw … ?AwardNumber=1661259

Provided by University of Massachusetts Amherst

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