Global warming could significantly impact US wine and corn production, scientists say

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When it comes to nature, timing is everything. Spring flowers depend on birds and insects for pollination. But if spring-like weather arrives earlier than usual, and flowers bloom and wither before the pollinators appear, the consequences could be devastating for both the plants and the animals that feed on them.

Global warming has made the early arrival of spring commonplace across the planet, say climate scientists. Plants are blooming earlier, birds are nesting sooner and mammals are breaking hibernation earlier than they were a few decades ago.

Understanding how global warming altered the timing of natural cycles in the past can provide important insights about the impact of climate change in the future, said Noah Diffenbaugh, an assistant professor of environmental Earth system science at Stanford University.

"In recent years, there has been quite a bit of work in phenology, which is the study of the timing of lifecycles - when do birds migrate, trees drop their leaves, crops mature, etc.," said Diffenbaugh, a center fellow at Stanford's Woods Institute for the Environment. "Many of these natural events are tied to the climate."

Using a very high-resolution computer model, Diffenbaugh's research group has conducted a new experiment that uses phenological observations from the past to project future impacts of global warming at local and regional scales. "Our experiment is unprecedented," he said.

"It's the first time that a climate model has been applied at such spatial and temporal detail over such a long period of time."

The experiment focuses on the regional impact of climate change on agriculture in the United States over the next three decades, from wine grapes on the West Coast to maple syrup in the Northeast. Diffenbaugh will present his 30-year forecast at the fall meeting of the American Geophysical Union (AGU) in San Francisco. He is among several scientists invited to speak at a session entitled, "Toward Phenological Assessments: Regional, National, Global."

Drilling down

One of the shortcomings of large-scale climate experiments is that they use relatively low-resolution computer models, Diffenbaugh said. He points to the United Nations Intergovernmental Panel on Climate Change (IPCC) as an example. "A typical climate model used in the last IPCC assessment had a 155-mile (250-kilometer) horizontal resolution," he explained. "However, the climate can vary quite a bit across that distance. My group takes the IPCC models and drills down to a 15-mile (25-kilometer) resolution."

Diffenbaugh's model also relies on data collected at intervals of 24 hours or less. "To really understand climate change impacts, we need to look at the sub-daily scale," he said. "In our simulations, we store data every three-to-six hours. That level of detail is not available from most global climate models, because it's very data intensive to store that much information."

At the AGU meeting, Diffenbaugh will focus on the influence of climate change in the U.S. from 1950 to 2039. "We're using climate and phenological data from 1950 to 1999 as our historical period, and then providing a projection of what we expect the changes will be two-to-

three decades from now," he said.

The forecast is based on a suite of climate variables that are crucial to agriculture, such as first freeze, last freeze, snowmelt timing and heat accumulation. "Some crops need to accumulate a certain amount of heat during the year," Diffenbaugh said. "With general global warming, we'd expect those thresholds to be reached earlier in the calendar year, say earlier in the spring. That's something we can observe in the historical records. We can also look at our climate model to see if it accurately captures past changes, and then look forward and project future changes at higher greenhouse gas concentrations."

Wine and corn production

A complicating factor in any forecast is predicting how crops will respond to different climate cues. "For example, in a managed system like premium wine on the West Coast, we look at several variables - seasonal heat accumulation, whether there are hard frosts in the winter or spring, how many severe heat days occur during the growing and ripening seasons," he said.

In a 2006 study, Diffenbaugh and his colleagues analyzed historical records from the principal wine regions of California, Oregon and Washington and found that temperatures in the growing season had increased about 1.6 degrees Fahrenheit (0.9 Celsius) from 1948 to 2002. Using these data and observations of how temperature affects the lifecycle of wine grapes, the researchers concluded that global warming could reduce the current U.S. wine grape region by 81 percent by the end of the century - primarily because of a projected sharp increase in the frequency of extremely hot days where the temperature reaches 95 degrees Fahrenheit (30 Celsius) or above.

"A key question now is how soon will that severe heat emerge,"

Diffenbaugh said. "In our new near-term climate projections, we're finding that the hottest temperatures on record will become commonplace within the next 30 years, even if global warming is less than the 3.6 degrees Fahrenheit (2 C) currently being targeted by national governments at the U.N. climate conference in Copenhagen."

Diffenbaugh also used observational data in a 2008 study on U.S. corn production, which concluded that by the end of the 21st century, warmer growing seasons and milder winters could increase the population and geographic range of the corn earworm, an insect that preys on corn, tomatoes and other cash crops. "In the case of agricultural pests, many of their ranges are limited by severe cold tempertaures," he said. "In our new simulations, we find that those temperatures could disappear over the next few decades, potentially leading to an expansion of pest pressure."

The Stanford research team is now using historical data to project the impact of climate change on maple syrup production in the northeastern U.S.

According to Diffenbaugh, the success of climate forecasting will continue to depend on accurate data collection by organizations such as the National Phenology Network, a group of scientists and citizen-scientists that monitors the influence of climate on plants and animals by observing and recording information about egg-laying, flowering and other natural events. "As these large networks of observers gather information, we can test how well the climate models are predicting the real world and whether they can be applied in the future," Diffenbaugh said.

Source: Stanford University (news : web)