

Statistics help clear fog for better climate change picture

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Statistics is an important tool in sorting through information on how human activities are affecting the climate system, as well as how climate change affects natural and human systems, according to a Penn State statistician.

"One key aspect of [climate change](#) is risk," said Murali Haran, associate professor of statistics. "Without the language of statistics and probability, you can't talk about risk."

As more research is conducted and more data are gathered, Haran said that scientists are gaining a better understanding of current and future climate conditions, as well as predicting the risk of the dramatic and costly affects of this change.

"We have a better understanding of the climate now than we have ever had before," said Haran. "With greater availability of data and more sophisticated [climate models](#), our knowledge continues to increase."

However, there is still more work to do and more data to collect, the researcher added.

Understanding the [global climate](#) and how it can change remains a difficult task, according to Haran, who reports on his research today (Feb. 15) at the annual meeting of the American Association for the Advancement of Science in Boston.

"We still don't know everything there is to know about the climate," Haran said. "Also, all models, which are by their very nature simplified representations of extremely complex physical systems, are still only approximations to the true climate system. Hence it is vitally important to account for our uncertainties about the system—what we know and what we don't know. Statisticians can provide the language and methods to quantify these uncertainties in a rigorous fashion."

Recently, Haran and his colleagues have used new statistical approaches to analyze how anthropogenic or human-induced climate change affects the [ocean circulation](#) in the [Atlantic Ocean](#)—especially the North Atlantic Meridional Overturning Circulation or AMOC.

In the Atlantic, water flowing toward the [North Pole](#) loses heat and the cold water sinks as part of the AMOC.

According to Haran, researchers are concerned about the AMOC because of the possibility that anthropogenic warming could cause a persistent weakening of the AMOC that would in turn result in considerable changes in global temperature and precipitation patterns.

In addition to realizing how the climate may change, risk managers need to assess what affect any changes—even low probability ones—can have on the economy and society, according to Haran.

"Recognizing that some low probability events can create high impact outcomes is also important," said Haran.

One of the analytical tools that Haran and other statisticians use to make assessments on the future of the environment is Bayesian statistics, which is a formal system of statistical inference that uses all available current information to estimate the probability of future events.

Haran said that some people misinterpret uncertainty to mean not knowing about climate change, but quantifying uncertainty actually refers to expressing a range of sureness on assessments or predictions, which is central to careful science.

Researchers from across disciplines must work together to more efficiently study climate change and other problems that society faces, he said. Haran has worked with Klaus Keller, associate professor of geosciences, Penn State, and their research team includes graduate students and postdoctoral fellows from both statistics and geosciences. Haran also participates in the Network for Sustainable Climate Risk Management (SCRiM) that is centered at Penn State.

"It is absolutely essential to have long-term collaborations between climate scientists and statisticians, as well as researchers from other disciplines like meteorology, economics and ethics," said Haran. "I am grateful to the Eberly College of Science and Penn State for encouraging cross-disciplinary work and for providing the right environment for these types of collaborations."

Provided by Pennsylvania State University

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