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BACK TO THE FUTURE

UVic scientists use advanced computer models to simulate past climates—and help shape future climate change policies

Weaver

by Shannon McCallum

Climate changes, that's a fact. Twenty thousand years ago, Victoria was covered by kilometre-thick ice and the average global temperature was four degrees colder.

Now, with overwhelming evidence that human activities are increasing global temperatures, University of Victoria climatologist Andrew Weaver is asking a key question: can the study of past climate changes help us predict future ones?

Understanding Earth's climate system is no trivial task. Climate is incredibly complex, involving interactions between the atmosphere, ocean, biosphere, and cryosphere (snow and ice surfaces).

One approach researchers can take is to design sophisticated computer models to simulate past, present and future climates. These models act as virtual laboratories, allowing researchers to perform climate experiments that can't be done in the real world.

At UVic, Weaver has built one of the most sophisticated climate modelling facilities on the planet, featuring one of the world's fastest supercomputers. Several years ago, he and his climate modelling group developed an Earth system climate model, now used by researchers around the world to study long-term climate change.

One climate puzzle that Weaver is investigating with the model is how past climate changes are linked to the global carbon cycle. Carbon dioxide and methane are continuously exchanged between the atmosphere, oceans and biosphere. Understanding this exchange is essential to predicting how increasing carbon emissions will affect future climates.

"We know that carbon dioxide and methane have amplified climate change during glacial cycles," says Weaver. "We're using our model to study how the ocean and land plants absorb atmospheric carbon, and to investigate how changes in the carbon cycle have interacted with climatic changes over the last 650,000 years."

One of the key missing links in the carbon cycle is permafrost, which is basically a huge frozen carbon reserve. "It's an important part of the carbon cycle and global climate system," notes Weaver, "yet it has received little detailed attention in the climate modelling world."

To this end, Weaver's team plans to be one of the first research groups in the world to add a permafrost component to a model that is fully linked to the carbon cycle.

Permafrost is of special interest to Canada because it underlies more than half the country's land mass. In a warming climate, melting permafrost will release large amounts of carbon into the atmosphere, further accelerating global warming. It will also result in the loss of wildlife habitat, and disrupt transportation and northern infrastructure.

Weaver says the next generation of his climate model will address the influence of climate on human evolution—much like it's now being used to examine the influence of humans on climate evolution.

This and subsequent models will continue to help industry and governments develop realistic policy options for dealing with the inevitable effects of climate change.

"The evidence keeps mounting that most climate warming observed over the last 50 years is due to human activities," he says. "This is acknowledged by the world's leading scientists and sends a strong signal to governments that informed policy is urgently needed to determine a course of action for the future."

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Carbon dioxide is the major greenhouse gas released into the atmosphere by human activities. Since the start of the industrial revolution, carbon dioxide concentrations in the atmosphere have increased by 36 per cent—and are still rising.

UVic's Andrew Weaver is a world leader in climate dynamics and the Canada Research Chair in Climate Modelling and Analysis. He's also a lead author of the UN Intergovernmental Panel on Climate Change's next climate assessment, due in February 2007, which will direct international policies related to global warming.

UVic's climate modelling group consists of three faculty members, five research associates and 14 graduate students. Members come from all over the world, from backgrounds as diverse as physics, mathematics, engineering, oceanography and geology. They work closely with scientists in the Canadian Centre for Climate Modelling and Analysis, a division of Environment Canada, housed at UVic. For more information, visit www.climate.uvic.ca.

UVic researchers were awarded more than $82 million in external research grants and contracts in 2005-06, up nearly 150 per cent since 2001-02.