Canada DRI

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From 1999 through to 2004, the western provinces faced a devastating drought that has been called the worst natural disaster to have ever hit Canada. In 2001-2002, Canada's Gross Domestic Product lost almost $6 billion due to drought, while agricultural production dropped by nearly $4 billion. The tremendous economic impact of the drought encouraged a group of researchers from across Canada to seek funding to study the drought with a view to better understanding its physical characteristics, the processes that contribute to it and to improve their predictability.

Alumnus Dr. Ken Snelgrove, B.Eng.'86, an associate professor at Memorial University's Faculty of Engineering and Applied Science, and a team of 14 other researchers submitted a proposal to the Canadian Foundation for Climate and Atmospheric Sciences and received a budget of $3 million over five years. The resulting study, called Canada DRI, or Drought Research Initiative, is the largest ever Canadian university study on drought.

Dr. Snelgrove was invited to be a part of the project because of his work in physically based rainfall-runoff modeling and the inter-dependencies of land surface moisture and energy on atmospheric processes. Working with two Memorial University PhD students, Sitotaw Yirdaw and Clement Agboma, Dr. Snelgrove has been able to collect some initial data that has allowed him to begin the process of quantifying the drought as a way of determining its severity.

"It's great to be working in such a big team that is examining all aspects associated with this drought," said Dr. Snelgrove. "One of the most interesting projects I'm working on is a satellite system called GRACE, or Gravity Recovery and Climate Experiment. This system uses two satellites to measure the earth's gravity. The satellites orbit the earth together at the same speed, one just behind the other. If the first satellite goes over an area that has a slightly higher mass, such as a big mineral deposit for example, it will be pulled toward the earth more than the trailing satellite. These slight changes in speed translate into measured distance between the satellites. Throughout their orbit, the satellites are constantly moving apart and catching up. From those differences we can develop a really good picture of what the earth's geopotential field looks like – basically, the gravitational shape of the earth."

Researchers can use month to month differences in this gravitational shape to determine the amount of stored moisture in the soil or snow on the ground over large areas to within a two cm of water equivalent error. The satellites will continue their orbit for a five year period, allowing researchers to continue to monitor monthly moisture storage changes while correcting for other mass changes such as tidal fluctuations, atmospheric moisture and even isostatic rebound from previous glaciations.

"During the drought period you can really see the signature of reduced amounts of moisture over the prairies," said Dr. Snelgrove. "So what we've been trying to do is compare that data with the actual amount of water we're seeing in wells across the prairies to see if they both match. If the satellite shows there is less water, is that expressed in the wells in the same way? It's a really interesting tool to help quantify how severe the drought might be."

A second stage of Dr. Snelgrove's work is to take this data and see if he and his students can create a computer program that simulates the drought by providing the computer with information such as the land surface, precipitation, temperature, and humidity levels to model the hydrology and water balance in the prairies. The ultimate goal is to simulate how the drought evolved over the region for the 1999-2004 period. This would be a useful tool in helping to predict future droughts.

"It's easy to get the model to predict average conditions, but we're most interested in how well these models predict extreme situations," said the researcher. "We can also test the computer model by comparing it to the GRACE data. If both are the same then you can have a greater confidence in your computer model's ability to predict future droughts."

Dr. Snelgrove is hoping his work, when combined with the efforts of his co-investigators, will lead to a climate and earth systems simulator that will give farmers advance warning of coming droughts, allowing them to take whatever action is necessary, such as planting a drought resistant crop instead.

The project runs from 2005 through 2010 and includes researchers from universities in Manitoba, Saskatchewan, Alberta and Quebec. Also working on the project are collaborators and research partners from federal and provincial departments, research organizations and utility companies.

Web Connections:

www.engr.mun.ca
www.drinetwork.ca