Geophysicists employ novel method to identify sources of global sea level rise

April 24 2012

As the Earth's climate warms, a melting ice sheet produces a distinct and highly non-uniform pattern of sea-level change, with sea level falling close to the melting ice sheet and rising progressively farther away. The pattern for each ice sheet is unique and is known as its sea level fingerprint. Now, a group of geophysicists from the University of Toronto, Harvard and Rutgers Universities have found a way to identify the sea level fingerprint left by a particular ice sheet, and possibly enable a more precise estimate of its impact on global sea levels.

"Our findings provide a new method to distinguish sea-level fingerprints in historical records of sea levels, from other processes such as ocean waves, tides, changes in ocean circulation, and thermal expansion of the ocean," says Carling Hay, a Ph D candidate in the Department of Physics at the University of Toronto and lead author of a study published in Proceedings of the National Academy of Sciences (*PNAS*). "It may indeed allow us to estimate the contributions of individual ice sheets to rising global sea levels."

Scientists around the world are trying to estimate both the current rate of sea level rise and the rates of ice sheet melting, and yet little work has been done to combine the two problems and answer these questions simultaneously.

Hay and colleagues Jerry Mitrovica and Eric Morow of Harvard University, and Robert E. Kopp of Rutgers University sought out statistical techniques that had not previously been applied to this

problem, and began developing the new method using data analysis techniques common in other fields such as engineering science, economics, and meteorology. The researchers then tested and refined the method by applying it to synthetic data sets – i.e., data sets with the same amount of noise as real data, but with known melting signals. The tests provide important guidance for the application of the method to actual sea-level records.

"We are now applying our methodology to historical sea level records to provide a new estimate of total sea level rise and the melt rates of the Greenland and West Antarctic ice sheets, over the 20th century," says Hay. "Preliminary results show intriguing evidence for acceleration of globally averaged sea-level rise in the second half of the period, along with a simultaneous rise in temperature. Once our study of historical records is complete, the next step will be to incorporate satellite-based measurements of sea-level changes."

The findings are reported in the paper "Estimating the sources of global sea level rise with data assimilation techniques." The research is supported by funding from the Canadian Institute for Advanced Research, Harvard University, and the US Department of Energy American Association for the Advancement of Science Fellowship Program.

Provided by University of Toronto