Will North Atlantic threshold response to ocean changes be enough?

Predictions that the 21st century is safe from major circulation changes in the North Atlantic Ocean may not be as comforting as they seem, according to a Penn State researcher.

"The Intergovernmental Panel on Climate Change concluded that it is very unlikely that the North Atlantic meridional overturning circulation (MOC) will collapse in the 21st century. They predict a probability of less then 10 percent," says Klaus Keller, assistant professor of geosciences. "However, this should not be interpreted as an all clear signal. There can be a considerable delay between the triggering of an MOC collapse and the actual collapse. In a similar way, a person that has just jumped from a cliff may take comfort that pain in the next few seconds is very unlikely, but the outlook over the long term is less rosy."

Keller and his colleagues analyzed a possible threshold response for the MOC. A threshold response occurs when a system reacts in a highly nonlinear and potentially abrupt way. For example, a paddler can tip a canoe quite a bit without getting wet. However, pushing that canoe just a bit further can result in a wet paddler. The impacts of pushing the canoe to the side are negligible until the very last small push triggers the overturning of the canoe in a threshold response.

The MOC may also respond to human-made greenhouse gas emissions in a threshold response. The research projects sizeable impacts on patterns of surface air temperatures and precipitation, fisheries and terrestrial ecosystems if a slowdown or complete collapse of the MOC occurs.

"Currently, MOC projections are deeply uncertain. This uncertainty puts a large value on observation systems that could deliver an actionable early warning of an MOC collapse," Keller said today (Feb. 17) at the annual meeting of the American Association for the Advancement of Science in Boston. "The problem is that information that arrives after the threshold response has been triggered is only of very limited use. For example, warning a person in a canoe about an approaching waterfall can be useful before the waterfall, but is not really useful after the canoe went over the waterfall.

"The problem with the potential MOC collapse is that the signs of an approaching threshold response are very subtle to detect. The noise is large and picking out the signal from the noise is non trivial," he adds.

"There is tantalizing evidence for a recent MOC slow down. However, this is not an open-and-shut case," Keller continues.

The researchers analyzed how they could improve MOC observation systems to result in more skillful MOC projections. For example, optimizing the locations of the observation system can considerably improve the projections.

Improved MOC projections can enable improved climate policies and can have economic value. Keller and colleagues show that investments into an MOC observation system that would provide an early warning of an approaching MOC collapse would likely pass a cost benefit test.

Source: Penn State