Study links swings in North Atlantic oscillation variability to climate warming

January 13 2009

Using a 218-year-long temperature record from a Bermuda brain coral, researchers at the Woods Hole Oceanographic Institution (WHOI) have created the first marine-based reconstruction showing the long-term behavior of one of the most important drivers of climate fluctuations in the North Atlantic.

The North Atlantic Oscillation (NAO) is a wide-ranging pressure seesaw that drives winter climate over much of North America, Europe and North Africa. Past reconstructions of the NAO have relied mainly on terrestrial, or land-based records, such as tree ring chronologies combined with ice cores and historical climate data. Those records do not fully capture oceanic processes linked to NAO variability, and short instrumental records from relatively few locations limit the understanding of ocean-atmosphere dynamics with regard to NAO behavior.

"By analyzing the coral, we were able to look at changes in the ocean relative to changes on land," said Nathalie Goodkin, lead author of the study published in the December issue of the journal *Nature Geoscience*. "Because they are slow growing and have long life-spans, corals can provide high resolution records that are well dated and centuries long."

As they grow, corals accrete seasonal and annual growth layers, similar to tree rings. The proportions of trace elements versus the major element (calcium) found in the layers of the skeleton largely depend on the temperature of the seawater in which it was formed. By analyzing the strontium to calcium ratio in the Bermuda brain coral, Goodkin and colleagues — WHOI scientists Konrad Hughen, Scott Doney and William Curry — were able to reconstruct monthly changes in ocean temperatures and evaluate variability of the NAO during both cold and warm periods from the Little Ice Age (1800�) to modern day.

The research team found the variability of the NAO decade-to-decade (multi-decadal scale) has been larger, swinging more wildly, during the late twentieth century than in the early 1800s, suggesting that variability is linked to the mean temperature of the Northern Hemisphere. This confirms variability previously reported in past terrestrial reconstructions.

"When the Industrial Revolution begins and atmospheric temperature becomes warmer, the NAO takes on a much stronger pattern in longer-term behavior," said Goodkin. "That was suspected before in the instrumental records, but this is the first time it has been documented in records from both the ocean and the atmosphere."

The North Atlantic Oscillation is described by the NAO index, calculated as a weighted difference between the polar low and the subtropical high during the winter season. In a positive phase, both the low-pressure zone over Iceland and high pressure over the Azores are intensified, resulting in changes in the strength, incidence, and pathway of winter storms crossing the Atlantic. In a negative phase, a weak subtropical high and a weak Icelandic low results in fewer and weaker winter storms crossing on a more west-east pathway.

The NAO index varies from year to year, but also exhibits a tendency to remain in one phase for intervals lasting more than a decade. An unusually long period of positive phase between 1970-2000 led to the suggestion that global warming was affecting the behavior of the NAO.

"Anthropogenic (human-related) warming does not appear to be altering whether the NAO is in a positive or negative phase at multi-decadal time scales," said WHOI paleoclimatologist Konrad Hughen. "It does seem to be increasing variability. Clearly, this has implications for the future."

"As temperatures get warmer, there's potential for more violent swings of the NAO — the phases becoming even more positive and even more negative," Hughen added. "If the NAO locks more into these patterns, intense storms will become more intense and droughts will become more severe."

The climatic influence of the NAO extends from the eastern United States to Western Europe, impacting human activities such as shipping, oil drilling, fisheries, hydroelectric power generation and coastal management. Improving the ability to predict shifts in the phase and intensity of the NAO is a prerequisite to mitigating the economic impacts of future climate change.

While additional modeling and palaeoclimatic studies are needed, a broad distribution of marine records could advance our knowledge of NAO variability and serve to improve future projections, said Goodkin, now an assistant professor in the Department of Earth Sciences at the University of Hong Kong.

Nature GeoScience paper: Increased multidecadal variability of the North Atlantic Oscillation since 1781 www.nature.com/ngeo/journal/va … nt/full/ngeo352.html

Source: Woods Hole Oceanographic Institution

Citation: Study links swings in North Atlantic oscillation variability to climate warming (2009, January 13) retrieved 1 May 2024 from https://phys.org/news/2009-01-links-north-atlantic-oscillation-variability.html