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RESEARCH HIGHLIGHTS

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Interacting climate modes cause climate shifts

Major climate shifts like the one that occurred in the mid-1970s are caused by a synchronization of major climate modes, followed by an increase in the coupling strength and then followed by disintegration of the synchronization. That's according to researchers from the University of Wisconsin–Milwaukee, US, who believe they are the first to use a network approach to analyse climate systems.

"The discovered dynamical mechanism was able to explain all trend changes observed in global temperature records and all changes in El Niño variability in the 20th century (where reliable data are available)," researcher Anastasios Tsonis told *environmentalresearchweb*.

Tsonis and colleagues looked at four major climate modes: the Pacific Decadal Oscillation, the North Atlantic Oscillation, the El Niño /Southern Oscillation and the North Pacific Oscillation. According to the researchers, these modes together capture the essence of climate variability in the northern hemisphere.

Analysis of the climate modes as a network of interacting nodes revealed that in the twentieth century, the modes synchronized in the 1910s, 1920s, 1930s, 1950s and 1970s. In those cases where the coupling strength between the modes increased before the synchronization broke up, changes in global temperatures and the strength and frequency of El Niño events ensued. This occurred in 1912/1913, when global temperatures increased and El Niño events became stronger, in the early 1940s, resulting in cooling temperatures and weaker El Niño phenomena, and in the late 1970s when temperatures again warmed and El Niño effects grew.

"This is the first time that this mechanism, which appears consistent with the theory of synchronized chaos, is discovered in a physical system of the size and complexity of the climate system," write the researchers in their paper.

Applying the analysis to the future indicates that synchronization events might occur in

2027–2032 and in 2065–2072 and be followed by climate shifts.

"We found that the discovered mechanism is also present in both unforced and carbon dioxide-forced climate simulations," said Tsonis. "This indicates that the mechanism is not due to some external climate forcing but is an intrinsic property of the climate system. Thus all those global temperature and El Niño variability changes occur naturally. They may be superimposed on some kind of anthropogenic trend but it appears that climate shifts to a colder or warmer state as a result of its natural variability."

The researchers are now looking at the underlying physics in more detail, and are "trying to investigate the sequence of physical steps that lead to this dynamical mechanism".

The researchers reported their work in *Geophysical Research Letters*.

About the author

Liz Kalaugher is editor of *environmentalresearchweb*.