Universal rules discovered that allow anticipation of critical transitions

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Credit: Tone Kirstin Bjordam

Sudden shifts in complex systems such as the climate, financial markets, ecosystems and even the human body can be preceded by surprisingly comparable warning signals. It is crucial to be able to predict such transitions, but this is notoriously difficult. In an article in the journal *Science* of October 19, a group of Wageningen University scientists and colleagues showed that systems that are on the verge of a critical transition often emit comparable signals.

At first glance, it appears improbable that a climate shift, an epileptic seizure, the collapse of a fish population or a sudden transition in a

financial system have something in common. However, the article in *Science*, a consortium of scientists headed by Marten Scheffer from Wageningen University, part of Wageningen UR, shows that completely different systems – such as the brain, the climate and financial markets – obey certain universal laws when they are at a critical transition point that make it possible to recognise early warning signals. This has to do with a phenomenon that is known in mathematics as 'Critical Slowing Down', implying that recovery from small perturbations becomes slow in the vicinity of tipping points.

Since Scheffer and colleagues postulated this idea in a *Nature* publication in 2009, an avalanche of studies, including seven in *Nature* and *Science* has provided evidence. The authors now make up the balance but also show that related families of generic early warning signals exist. For instance, certain universal features determine whether complex networks such as webs of species or webs of financial institutes will be robust or fragile.

Despite the overwhelming growth of evidence for these revolutionary ideas, Scheffer emphasises that the applications for universal warning signals are still in their infancy. He has launched an interdisciplinary research program 'SparcS' that is now exploring applications in medical sciences as well as in social sciences, ecology and climate research. A recent open access publication in *PLoS-One* together with a newly developed web resource ensure that the tools needed for such work are available in the public domain.

More information: Anticipating Critical Transitions. Marten Scheffer, Stephen R. Carpenter, Timothy M. Lenton, Jordi Bascompte, William Brock, Vasilis Dakos, Johan van de Koppel, Ingrid van de Leemput, Simon Levin, Egbert H. van Nes, Mercedes Pascual, John Vandermeer. *Science* 19 October 2012.

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