New formula helps gauge the winds of change

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The Greek philosopher Heraclitus said that change is the only constant. People change, organizations change, the way people and institutions interact changes over time. Change affects social interactions and the natural world, and it even plays a role in how networks such as air traffic control and banking systems function.

University of Washington research has developed a formula to examine just what sorts of changes occur over time among complex and integrated structures. A key to understanding what's happening is to think of the relationships as networks.

"We've been working on the mathematics of it for some time and it's worked out quite well. We're able to use our formula to create maps that show in detail what's going on," said Carl Bergstrom, a UW associate professor of biology.

He is co-author of a paper describing the work, which is being published Wednesday (Jan. 27) in the online journal PLoS One, published by the Public Library of Science. The lead author is Martin Rosvall of Umeľ University in Sweden, who worked on the project while a UW postdoctoral researcher.

To test their formula, the scientists applied the principals to mapping changes in the field of neuroscience, which a decade ago was mostly a specialty for individuals in a number of other disciplines, such as neurology, psychology or cell biology. They looked at thousands of citations for papers published in scholarly journals in the last 10 years to

see how the field has evolved.

"What's happened is that neuroscience has gone from an interdisciplinary specialty to a discipline of its own," Bergstrom said. "These maps throw out our preconceptions of what the disciplines are and look at it in terms of what people are citing."

He believes there are many other applications, such as looking at changes in the flow of air traffic in the United States over time, with the emergence of dominantly busy airports such as Chicago and Atlanta. Those airport operations can affect the nation's entire air traffic system. The formula eventually could allow a closer examination of how the system changed with airline deregulation that began in the late 1970s.

Bergstrom is currently working with Federal Reserve economists to analyze the financial flow between Federal Reserve banks and the nation's largest banking institutions, and he believes the new tool could have broad applications in the public health field as well.

"I think there are many opportunities to look at biological networks, genetics and the spread and treatment of cancer for example," he said.

The tool also could be useful in tracking the spread of illnesses such as AIDS and H1N1, the so-called swine flu.

"If you want to understand the way infectious diseases spread through human populations, you have to understand the network of contacts through which those transmissions occur," Bergstrom said.

Provided by University of Washington