Abstractions

FIRST AUTHOR

Recent research suggests that human-induced increases in sea-surface temperature may cause more frequent intense hurricanes (for example, see *Nature* **436,** 686–688; 2005). On page 465, Jeff Donnelly and his colleague Jonathan Woodruff of the Woods Hole Oceanographic Institution in Massachusetts report their use of sediment samples from an inland lagoon on the island of Vieques, Puerto Rico, to show that active hurricane periods also occurred during cooler periods. The Caribbean cores provide a 5,000-year record of both frequent and infrequent hurricane periods.

Describe what an intense hurricane looks like in the sedimentary record.

Intense storms cause surges and waves that can overflow the beach. We look for evidence of storm surges inland, where waves have deposited sand and gravel into the muddy environment behind the beach. At times of more extreme hurricane events the dark organic-rich lagoon sediments contain light coarse-grained layers.

How did you decide to use the sedimentary record to understand hurricane activity?

I started taking cores to study salt-marsh vegetation changes over time, and found evidence of past hurricanes in the sediment record. After Hurricane Andrew in 1992, the reinsurance industry contacted us to use our cores to reconstruct the frequency of extreme events over a longer time period.

What were the most surprising results?

The recent active period started about 300 years ago, during the Little Ice Age. We didn't expect to see an increase in intense hurricane activity during this interval.

Could your results be misinterpreted?

I am worried about that. Our results don't mean that sea-surface temperatures are not a major player in driving intense cyclones. But other factors are also important. If sea-surface temperatures continue rising, this could provide more fuel for intense tropical cyclones. And, if such increases were combined with other conditions favourable for hurricane development — for example, fewer El Niño events and a stronger African monsoon — we could see an active regime unparalleled in the past few thousand years.

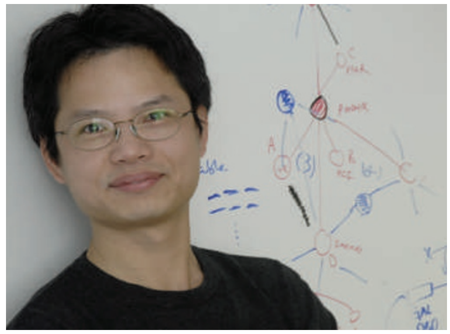
Are you working on other sediment cores to complete the story?

We're working all over the planet. We're doing more studies in the Caribbean and in the northeastern United States to understand hurricanes. And we've just started work in the Pacific, where little work has been done reconstructing typhoons. ■

MAKING THE PAPER

Jiandie Lin

The protein that helps our bodies tell the time.



Jet lag is a bothersome reminder that the human body is set to a 24-hour, or circadian, clock. The master clock resides in the brain and regulates various behaviours, including sleeping and waking, taking its cues from the rhythm of daylight. Many metabolic functions — such as release of glucose by the liver and fat-burning by muscles — also follow daily patterns of activity. "There is a clear metabolic clock in the body," says Jiandie Lin of the Life Sciences Institute at the University of Michigan in Ann Arbor. He wanted to determine the relationship between this metabolic clock and the circadian clock.

While working in Bruce Spiegelman's lab at Harvard Medical School, Lin studied a protein known as PGC-1α, a master regulator of energy-producing mitochondria. "We knew that PGC-1α is highly regulated in response to the environment and also regulates several major metabolic pathways," says Lin. Because of this, he wondered whether PGC-1α might provide the molecular link between metabolic and circadian clock pathways.

Two years ago, Lin set up his own lab in Michigan and focused on this question. His group isolated mouse tissues at several times of day and found that PGC-1α expression in both the liver and skeletal muscle pulsed with a circadian rhythm. In addition, PGC-1α production increased the expression of several 'clock' genes, suggesting that rhythmic PGC-1α activity provides a signal to coordinate metabolism and the circadian clock. This conclusion was supported by the fact that transgenic mice lacking PGC-1α had abnormal daily rhythms of activity, body temperature and metabolic rate.

But Lin's group couldn't tell whether the loss of daily rhythms in the knockout mice was due to disruption of the circadian clock in the brain or a defect in the cells and tissues lacking PGC-1α. To determine at what level PGC-1α functioned, the researchers knocked down PGC-1α expression using an adenoviral vector carrying an interfering RNA molecule directed toward PGC-1α. "When injected through the tail vein adenoviruses almost exclusively infect the liver, so we essentially created a tissue-specific knockout mouse," explains Lin. When liver PGC-1α expression was perturbed, circadian control over energy metabolism in the organ was lost. Thus, PGC-1α exerts its effects on circadian rhythm from within the confines of the liver (see page 477).

"The circadian clock was thought to affect physiology through downstream output mechanisms. Our findings support a mechanism that allows energy metabolism in peripheral tissues to be directly synchronized to the clocks in our bodies," says Lin. In other words, PGC-1α responds to light and nutritional cues, and prompts specific tissue clocks and metabolic activities to follow the same pattern. Lin says the finding that a single molecule can regulate both circadian and metabolic pathways is not entirely unexpected. "We knew a lot about PGC-1α and that it could integrate and regulate multiple pathways," he says.

Lin now plans to examine this new molecular link between metabolism and clock pathways in metabolic diseases. It is known that obese people and those with type 2 diabetes, who store more fat than they burn, often have perturbed circadian cycles. By targeting PGC-1α, it may be possible to synchronize metabolic functions to daily cues in these individuals. ■

FROM THE BLOGOSPHERE

If you've just published in *Nature* and are burning to tell the world about your new work, consider giving a virtual talk. We are looking to try out some events in our amphitheatre and meeting area, Second Nature — an 'island' that is part of the growing online virtual world called Second Life (www.secondlife.com).

Several events have already been held in Second Life. Eric Chaisson, director of the Wright Center for Science Education at Tufts University in Medford, Massachusetts, and author of the book *Hubble Wars*, spoke about his work and answered questions from the audience. And Kevin Warwick, a professor of cybernetics at the University of Reading, UK, gave a talk entitled "Upgrading Humans: Why not?"

If you are interested in trying out a talk, presentation or question and answer seminar in this innovative format, register your interest by commenting at Nautilus http://blogs.nature.com/nautilus/2007/05/woudl_you_like_to_give_a_talk.html or send an e-mail to authors@nature.com. Or, if you are already a Second Life resident, contact Joanna Wombat in Second Nature. ■

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