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Monday, March 9, 2009

Sam Shen Fights Fire with Math

The climate researcher and chair of the Department of Mathematics and Statistics recently co-authored an article for *Nature Geoscience*.

Story Highlights

- Revealing mathematical models
- Finding unavailable data
- Climate man

Deliberate burning to clear felled forest for small-scale agriculture over a deep peat area, in Riau Province, Sumatra in 1990. Photo by Michael Brady, Canadian Forest Service.

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By Golda Akhgarnia

When thinking of the common tools used to fight a fire, mathematics does not make it on most people's lists. But a recent paper published in *Nature Geoscience* has proven that thinking

MULTIMEDIA

1936 Mural Finds New Home in SDSU Library
Wednesday, October 20, 2010

SDSU anthropology professor Seth Mallios describes a nearly 80-year-old mural rediscovered in Hardy Tower that was unveiled, Oct. 5, in the SDSU Library.

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wrong.

Co-authored by SDSU mathematics chair Sam Shen, the paper states that severe fires in Indonesia responsible for some of the worst air quality conditions worldwide are linked not only to drought, but also to changes in land use and population density.

Revealing mathematical models

In order to get their results, Shen and his colleagues used a statistical model to find how dry the weather had to be in order to trigger a fire. A mathematical model was used to study the pattern of air motion and wind direction common during fires.

The paper is based on a master's thesis in applied mathematics written in 2005 by Robert Field (the paper's lead author) under Shen's supervision at the University of Alberta, Canada.

"I was fascinated by Robert's experience with forest fires in Indonesia and was particularly moved by the gravity of the 1997 fires. We decided to do research on this topic, searched for appropriate data and applied subtle statistical and mathematical methods to tackle the problem," said Shen.

Finding unavailable data

Fire-monitoring data from satellites is not available before the mid-1990s, so Field and Shen, along with third co-author Guido van der Werf from VU University, Amsterdam, used visibility records from airports from 1960 to 2006. It is from this visibility dataset, along with recent satellite observations, that they found that severe burning events happened in years when rainfall was below a certain level.

Field says there is a direct link between the increased prevalence of severe fires and haze disasters and the man-made change in land use.

"The visibility record also showed the impact of human settlement on a previously pristine tropical forest," he said. "This should give pause to further agro-forestry expansion in Indonesia, particularly for oil palm as a source of biofuel."

The effect of population density was discovered when the researchers found a difference in the fire record between the island of Sumatra and Kalimantan. Severe fires have taken place since the 1960s in Sumatra, but only since the 1980s in Kalimantan, even though they experienced the same droughts.

This was attributed to Sumatra's much higher population density, which accelerated in the 1960s and '70s. Kalimantan did not experience such growth until the 1980s, and that growth, combined with government policies that began to support large-scale agribusiness, contributed to the worsening fire record in Kalimantan in recent decades.



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Sam Shen

Climate man

Shen is often identified as the "climate man" by his mathematics colleagues.

"I have found that it is very productive for mathematicians to solve urgent climate problems," Shen said. "I am very pleased to see that more mathematicians are now getting involved with climate research and that funding organizations have gradually realized the importance of having mathematicians and statisticians become involved in environmental research and decision making."

Story Sciences, Faculty, Ecology, Geography, International, Mathematics, Natural Disasters,
 Keywords: Research, San Diego, sdnn, vosd, News, People



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