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2009 : July 2009 - New Hot Papers : Timothy M. Lenton &amp; Hans Joachim Schellnhuber

## NEW HOT PAPERS - 2009

July 2009



**Timothy M. Lenton & Hans Joachim Schellnhuber talk with *ScienceWatch.com* and answer a few questions about this month's New Hot Paper in the field of Geosciences. The authors have also sent along images of their work.**



### Article Title: Tipping elements in the Earth's climate system

Authors: [Lenton, TM](#); [Held, H](#); [Kriegler, E](#); [Hall, JW](#); [Lucht, W](#); [Rahmstorf, S](#); [Schellnhuber, HJ](#)

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(addresses have been truncated)

### SW: Why do you think your paper is highly cited?

Our paper captures the Zeitgeist of a growing group of climate scientists and commentators who perceive that human activities are already pushing Earth's climate past regional "tipping points." This concern has been heightened by recent observations of abrupt climate change in the Arctic.

For the first time, our paper defines a climate "tipping point" and pulls together a comprehensive list of what we christen the policy-relevant "tipping elements" in the climate system—those subsystems that may pass a tipping point this century due to human activities, committing them to changes in state that are sometimes rapid and often irreversible.

The resulting map of tipping elements provides an iconic image of some of the most vulnerable parts of the planet, and it is being widely reproduced at scientific meetings and in the popular media.

By identifying the common dynamics underlying quite different systems—including tropical monsoons, the Amazon rainforest, ocean circulation, Arctic sea-ice, and the great ice sheets of Greenland and West Antarctica—our work helps bring together the interests and concerns of specialists in quite different fields including climatology, ecology, oceanography, and glaciology.

### SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

Our paper describes a new synthesis of knowledge regarding the potential tipping points in the climate system. We present new definitions of a climate tipping point and a tipping element. Also, for the first time, we use a process of expert elicitation to assess the proximity of a subset of tipping points and the

uncertainty surrounding their status.

**SW: Would you summarize the significance of your paper in layman's terms?**

We have been living under the illusion that climate change will be a smooth process of global warming: yes, there will be some unfortunate victims, but the changes should be manageable and some of us might even benefit from them. Our paper shatters that illusion: large regions of the planet may undergo profound changes in state that in some cases are rapid and often are irreversible, with impacts on many millions of people.

These climate tipping points are inherently difficult to forecast, making managing them and their consequences that much harder. However, the situation is not without hope: we do see some prospects for early warning of tipping points, and with grassroots social pressure forcing substantive international political action, we can still avoid the worst scenarios.



*Coauthor: Hans Joachim Schellnhuber*

**SW: How did you become involved in this research, and were there any problems along the way?**

One of us (Hans Joachim Schellnhuber) introduced the overall tipping-points concept into the scientific community dealing with climate change around the year 2000, through a 2001 Linacre lecture in Oxford, coauthored by Hermann Held.

The specific research generating the paper in question began with us and our coauthors organizing a workshop at the British Embassy in Berlin in October 2005, which brought together both UK and German scientists to debate and begin to identify the potential tipping points in the climate system.



*Map of tipping elements*

A process of eliciting responses from a wider international group of experts (led by Elmar Kriegler and Jim Hall) started at this workshop and continued through the following year, whilst one of us (Tim Lenton) led a comprehensive review of the literature. The greatest challenge along the way was reconciling the inputs from a diverse group of coauthors, an even wider pool of expert opinions, and a huge body of literature.

**SW: Where do you see your research leading in the future?**

The next steps are to try and provide societies with some early warning of approaching tipping points, to identify the policies and activities necessary to avoid them (where possible), and, for those tipping points that cannot be avoided, to identify ways to make societies more resilient to the consequences.

We are actively researching the potential early warning signals for not-too-distant tipping points and are finding some promising, generic indicators. In the future, we hope to translate this theoretical work into the design and deployment of actual early warning systems for specific tipping elements.

We are also beginning to identify the policies and technologies that can help avoid climate tipping points. A strong international deal to reduce greenhouse gas emissions in Copenhagen in December 2009 will help (if it ensures that global warming is confined to no more than 2°C), but may not be enough for avoiding the transgression of some tipping points.

Hence we are actively researching the potential for creating carbon dioxide sinks by careful management of the biosphere. We are also evaluating whether "geo-engineering," a reduction in the amount of sunlight absorbed by the Earth, could help protect some regional tipping elements, and whether it will threaten others.

Finally, we plan to research the possible social "tipping points" that could tip societies onto more sustainable trajectories that help avoid—or at least better cope with—climate tipping points.

**SW: Do you foresee any social or political implications for your research?**

The economic and political implications of our research are profound. If we do pass some of the tipping points in the climate system, the impacts on societies will be huge. Equally, the policy changes needed to avoid or better cope with climate tipping points are substantial.

These implications are being recognized. Our study received widespread coverage in the international

media, it was awarded the *Times* Higher Education Award for Research Project of the Year, 2008, and there are signs that it is beginning to influence the international policy process.

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KEYWORDS: ANTARCTIC ICE-SHEET; ATLANTIC THERMOHALINE CIRCULATION; ASIAN SOUTHWEST MONSOON; WEST-AFRICAN MONSOON; SEA-LEVEL CHANGE; EL-NINO-LIKE; MODEL SIMULATIONS; EXPERT JUDGMENTS; CAP INSTABILITY; FOREST DIEBACK.

*Related information:*

- Links for further reading: "The odds of tipping," Tipping elements in the Earth's climate system,"
- "Future tipping points in the climate could be unveiled."
- Institution Interview with Potsdam Institute for Climate Impact Research (PIK)

 PDF

[back to top](#) 

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