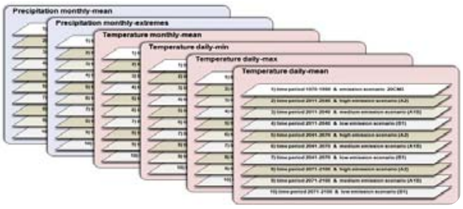

Figure 2. The 60 output prediction map layers that will be obtained from the downscale technique for temperature and precipitation data for different time periods and IPCC scenarios.

the period 1970-1999. The emission scenario parameters for the 20th century and 21th, are obtained from the IPCC/PCMDI database (the so-called “20C3M” and the A1B, A2 and B1 scenarios).

Relevance for impact studies and policy makers

The project will provide maps and spatial data layers containing the predicted information for temperature and precipitation (Fig. 2). These results are relevant for the upcoming impact studies. These results are also relevant for policy makers and government authorities, especially now that Brazil has become the sixth largest economy.

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Interview with Dr. Bjorn Stevens

Hans von Storch

Dr. Bjorn Stevens is a director at the Max-Planck-Institute for Meteorology where he leads the Atmosphere in the Earth System Department and is a professor at the University of Hamburg. Prior to moving to Hamburg Dr. Stevens was a professor of Dynamic Meteorology at the University of California of Los Angeles. His research blends modeling, theory and field work to help articulate the role of clouds and atmospheric convection in the climate system. Dr. Stevens has made pioneering contributions to our understanding of mixing and microphysical processes on the structure and organization of marine boundary layer clouds, whose statistics regulate the flow of energy through the Earth system. Small changes in such clouds can greatly amplify, or dampen, perturbations to the Earth system

Dr. Stevens received a PhD in Atmospheric Science in 1996 from the Colorado State University in Ft Collins CO, and holds a Bachelor and Masters of Science in electrical engineering from Iowa State University. He has contributed more than 90 scholarly articles to the peer reviewed literature. Dr. Stevens serves on a number of international advisory boards, has served as editor of leading journals in his field and has been honored by a number of awards, including fellowships from the Advanced Study Program of the National Center for Atmospheric Research, and the Alexander von Humboldt Society. In 2002 he was chosen as the recipient of the prestigious Clarence Leroy Meisinger Award of the American Meteorological Society for "pioneering advances in understanding and modeling of cloud-topped boundary layer.

Multitasking, in 1997.

Please sketch the different fields of atmospheric sciences, with which you have dealt over the years?

Most of my work has been related to the dynamics of clouds, and cloud systems.

Launching Sondes during RICO (2005).

Initially my work was concerned with how clouds adjust to aerosol perturbations, but increasingly my research has focused on factors controlling patterns of cloudiness more generally. Methodologically I have worked with different tools, ranging from a pencil, to a radar, to an aircraft to simulations on a variety of scales.

What would you consider the most two significant achievements in your career?

Designing and leading an experiment (with Don Lenschow of NCAR) that provided definitive measurements of stratocumulus entrainment, a controlling dynamical factor, and demonstrated how precipitation organizes cloud patterns and helps differentiate between open and closed cellular cloud patterns. Through modeling and theory a graduate student and I were able to also explain these observations.

Another contribution I am fond of is the development of a quantitative theory for the growth of non-precipitating cumulus convection. While this work follows up, and clarifies, earlier and pioneering work by Alan Betts, we also were able to build on it to better understand the role of the trade-cumulus boundary layer in the climate system, and climate change. This work helps explain, for instance, why shallow convection is likely much less sensitive to aerosol perturbations than many people thought.

When you look back in time, what where the most significant, exciting or surprising developments in atmospheric science?

I find the question difficult, in part because of my perception that our field advances in small

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steps. That said, the advance of technology, continues to have an enormous impact on atmospheric science, whether this takes the form of ocean drilling, isotopic analysis, high-performance computing or remote sensing.

On the more conceptual level, Ed Lorenz's ideas on deterministic non-periodic flow, and the way it has worked its way through the field, is the most profound idea of the last half-century. More broadly I find our understanding of complexity as perhaps the greatest evolution in our thinking. And by complexity I don't just mean the number of tracers transported by a climate model, and their associated processes, but also the subtlety and richness in the interactions among what one might call more fundamental components of atmospheric and oceanic circulation systems. Looking back to the mid nineteen sixties, when Ooyama was developing his ideas on hurricane intensification and Arakawa began thinking seriously about cumulus parameterization, who would have expected that so many basic aspects of how convection couples to large-scale circulations would remain so uncertain, and if I might add, still somewhat neglected.

You are an American, and you have lived most of your life in the US, right? But now, you have decided to move your scientific and personal life to Germany. Can you explain what your motives were for this decision? How difficult was this move?

I grew up mostly in the United States, with an American father. My mother was German, and I was born in Germany and spent a few months of my infancy here; but then moved to the United States and grew up as American with German heritage. I have lived in many places in the United States, but also spent some of my formative years in Calgary, Canada, and near Manchester, England. My wife, who I met in Colorado, is also German. After our children were born, we would visit Germany every other summer. So Germany was never really foreign to me.

Culturally, in the US, and in Los Angeles in particular, we often felt like we were swimming against the stream, a feeling that became more acute after George Bush was re-elected in 2004. His re-election and the general situation surrounding his presidency made the US less attractive, this combined with a disintegrating public sphere helped motivate us to consider alternatives, and given our history, Germany was a natural one.

Leaving a first class institution like UCLA was difficult, but the Max Planck Society offers opportunities that are difficult to match. I haven't experienced another research environment that combines such an abundance of resources, including the opportunity to work with such a diverse group of talented young people, with so much intellectual freedom. It also hasn't hurt that support for research is growing at the moment in Germany, while it is contracting in other countries. This combined with the very high quality of life in Hamburg means that the transition has been relatively easy, at least for my children and myself. Although one might have guessed otherwise, my wife's adjustment has taken longer, largely because her professional opportunities are more limited.

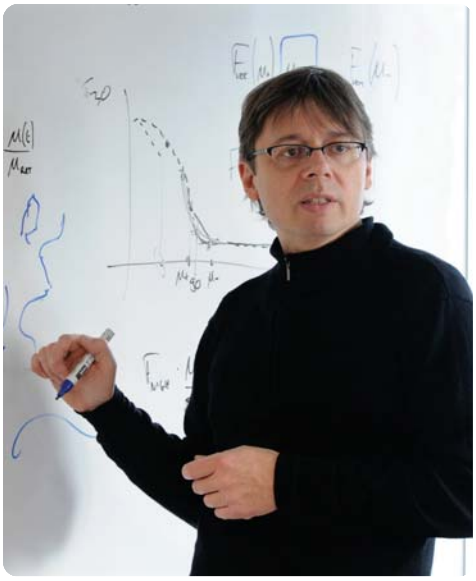
After having now worked in Germany for more than three years, how different do you find the cultures of US and German climate science?

Culture is a subtle concept, which I have come to think of as the totality of things that groups of people do oddly; one appreciates the role of one's own culture only in its absence. But even then, it is difficult to put your finger on what is different. But at the risk of banality, I will try.

Some of the differences arise from the different way in which science is organized. On the whole, in Germany research is not centered around a relatively small group of elite research universities as is the case in the US. Laboratories like the Max Planck Institutes, or the Leibnitz institutes, which through their autonomy and funding level are a large feature on the German research landscape, have no analog in the US. The research hierarchy is also different in Germany. At the level of a full professor or lab director research is more autonomous and less directed than in the United States, this level of autonomy is reached later in one's career, making the system somewhat more coarsely granulated. Because research is organized into larger base units, and because German professors teach more (they are also paid for twelve instead of nine months) the heads of research, the PI, also tends to be more responsible for directing, rather than conducting research; so there is less of a tradition of very senior people writing their own papers, as one finds at top research institutions in the United States.

Another difference between Germany and the United States is that Germany does not presently have an anti-enlightenment elite, as for instance has come to be represented by the Republican Party in the United States. For this reason, and because the research agenda is more bottom up in Germany (noting that I assume lab directors or university professors constitute the bottom) climate scientists in Germany spend less time looking over their shoulder than they do in the US or Canada, and the overall tenor of the public discussion regarding climate change and it's implications is, on average, more functional – at least for now.

There are also disciplinary differences, and I am not sure if they arise idiosyncratically, or are culturally rooted, I suspect the former. Geophysical fluid dynamics (GFD) plays a somewhat smaller role in informing climate research within Germany, say as compared to physical meteorology. Because so much of what happens in the climate system is rooted in the nature of circulations, I perceive this lack of a GFD tradition as a weakness.



At the board (2009).

Is there a politicization of atmospheric science?

Yes, certainly. As a result, key issues related to our scientific understanding of climate change are raised in the public sphere, where they are quickly reduced to competing authority claims that the public is not well equipped to judge. So this creates a great deal of nonsense, or what Harry Frankfurt, an emeritus Professor of Philosophy at Princeton, calls [expletive].

What do you think about the presence of people, who label themselves as skeptics, in the scientific and in the public discourses?

Assuming that this question is meant to be taken in the context of debates about our understanding of the climate system, it is probably useful to distinguish between skeptics and those who deny that there is robust evidence of an anthropogenic influence on climate. The distinction is useful because the latter, despite calling themselves skeptics, are characterized by a profound lack of skepticism -- particularly for their own ideas. The disingenuous and self-serving nature of much of what is passed on as skepticism has a corrosive influence on the public discourse and the scientific process. Through fear of association this false skepticism makes the broader scientific community more guarded in its own application of criticism. It can also divert the field away from the questions that really require critical attention. This is unfortunate, because constructive criticism is the lifeblood of the scientific process, and there is plenty to be critical about in climate science;

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after all, it is science.

You have read most of the interviews in this series. Any comments on my way of asking, of selecting people to be interviewed?
I particularly appreciated the cross section of people you selected, which for the most part are not the usual talking heads of our community. In so doing you help create a richer picture of our field, and the diversity of views and approaches it encompasses. And although at some point it is very difficult to add anything to the previous answers to some of your standard questions, I still find it interesting to see the different ways in which people dealt with the question of their own contribution, or their view on good science.

What constitutes "good" science?
When I think of good science I think of George Nelson's monograph, "How to See." Good science, like art (or in Nelson's case, design), teaches us to see the world in new ways; in the case of science, by constructing narratives that explain our observations in ever more compelling ways.

What is the subjective element in scientific practice? Does culture matter? What is the role of instinct?
All good science starts with a question. And without even going into the subjective elements of how one constructs explanations, or what one accepts as an explanation, the subjective element of the questions we pose, should be clear to everyone. That said, I suppose upbringing plays an important role in helping identify the right question.

The opinions expressed in this interview do not necessarily represents those of the reviewer or the AGU.

Providing Capacity to an Increasing Demand for Climate Services

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Climate science has become one of the key research areas worldwide. Most nations need to plan ahead in order to better cope with changes in climate. The costs for not planning properly could be devastating. This has created a great demand for climate services, which involve tasks such as: conducting sensitivity studies, evaluating model output, preparing high-resolution climate projections for selected scenarios, running multiple regional climate models and using impact models. These activities require both adequate computing infrastructure as well as scientific training. Many developing countries still face challenges in order to catch up with their developing counterparts mainly due to:

- Lack of local facilities: in these situations many groups purchase computational time at a supercomputing center abroad. This has limitations to the amount of time that can be used for some activities.
- Slow machines: aging computers and slow machines make it hard to keep up with the pace in computer development and climate modeling. This may limit the possibilities of the type of modeling that can be achieved – for example, dynamical downscaling may not be an option here.
- No computing support: good support may help scientists do their work more efficiently and faster. For example, by making full use of multi-core programming, optimizing compilations and code, debugging and data archiving are just a few examples of the many tasks involved.
- Lack of funding: most developing countries do not have enough funding for climate research. They are limited by what they can do, even for simple things such as storing data – since the price for data storage is also high.
- Limited modeling knowledge: climate models also improve at a fast pace. Keeping up with state-of-the-art climate modeling can be challenging.

A solution adopted by many developing country institutions is to join research groups in developed nations where the funding provided includes access to computing facilities abroad, as well as expert training and infrastructure development. Many of such projects are related to the so-called "capacity building" – to provide capacity in terms of both infrastructure and knowledge. Successful capacity building projects can help a developing-world institution become more independent and self-sufficient. In turn, this institution can later provide a helping hand to other developing nations as well.

New Computing Infrastructure in India
The Energy and Resources Institute in India has been a front runner in innovation when it comes to capacity building. It has teamed up with the Bjerknes Centre for Climate Research, in Bergen, Norway. Through their Indo-Norwegian project, the TERI climate change division has been able to acquire a new high-performance computing infrastructure for the large demands of their climate modeling activities.
TERI's High Performance Computing (HPC) climate modeling lab consists of a 512 cores parallel cluster machine with 128 cores of Intel Xeon quad-core processors and 384 cores of Intel Xeon hex-core processors. Each core has a minimum of 2 GB RAM which gives the entire machine a ram capacity of over 1000 GBs. The processors and nodes are connected through high-performance infiniband switches and a Panasas parallel file system having a total storage of 32 TB. Apart from a backup storage of 24TB, the whole machine provides a storage capacity of over 50 TB. The total system peak performance is around 5 teraFLOP/s.
Apart from the HPC setup, the lab also consists of a window based server, and two linux based servers with a storage of 1 TB each. The climate-modeling lab enables the TERI modelers to simulate the climate at global as well as regional scales. The current models being run on the new computing facilities are: Community Climate System Model (CCSM) ver 3.0; Community Earth System Model (CESM) ver 1.0; Weather Research and Forecasting (WRF) ver 3.3; Providing REgional Climate for Impact Studies ver 1.9; ADCIRC impact model.

Figure 1. Super Computer at TERI, New Delhi.

Climate modeling schools
The TERI climate group, together with the Bjerknes Centre's researchers, is also providing capacity building for many graduate-level students and early-career scientists around India and Southeast Asia and Africa. One of these activities is the TERI-BCCR Climate Research School. The objective of the school is to engage the early career scientists and students to increase their understanding on the hierarchical climate models and state-of-art resources available in the field of climate research.
The first series of this training program was held from 3-7 October 2011 at TERI University in New Delhi. Over 20 participants from India, Nepal, Bangladesh, Ethiopia and

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