the poor, and they are the bank for the poor," says Bernard Vallat, director-general of World Organisation for Animal Health (OIE) in Paris, which co-hosted the meeting.

"Somebody in Kenya said to me, 'if the goats die, the children don't go to school'," says Michael Baron, a virologist at the Pirbright Institute in Woking, UK. Sheep and goat herding also helps many women in the developing world to attain self-sufficiency.

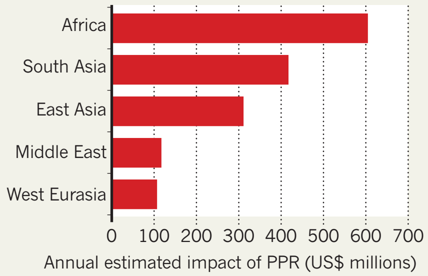
PPR ticks many of the boxes needed for an eradication campaign: an effective vaccine has been available for decades, and scientists have created formulations that remain effective for weeks without refrigeration. Diagnostic tools, including some that can be used in animal pens, are accurate. There also seems to be no wild reservoir from which the virus may rebound once wiped out from domestic flocks and herds. "It's one of those no-brainers," says Christopher Oura, a veterinary virologist at the University of the West Indies in St Augustine, Trinidad, who studies PPR. "The tools are out there to eradicate the virus."

A cost–benefit analysis by Mariner and his colleagues estimated that eradication will save more than $42 billion over a hundred years. The fresh success of the rinderpest eradication campaign also gives many hope that a second animal disease can be eliminated for good. "Before everybody forgets that, people want to get the rest of the world on board," says Baron.

PPR eradication presents its own challenges. The campaign strategy focuses on dramatically ramping up and coordinating vaccinations, but this is complicated because sheep and goats are more abundant than cattle in most of the developing world, and people hold onto them for a shorter time before selling or slaughtering them. The campaign will also attempt to systematically target areas where the virus is spreading, but veterinary services are weak in many of those regions.

COST OF A GOAT-KILLER

The virus peste des petits ruminants, or PPR, costs farmers in lost production and livestock, and in caring for or vaccinating goats and sheep.



SOURCE: OIE/FAO

One positive effect of the campaign will be the construction of veterinary infrastructure in these areas. This will have impacts beyond PPR, for example by helping to combat other small ruminant diseases, such as goat and sheep pox. "There should be good knock-on effects for poor people," says Baron.

How exactly the eradication effort will be coordinated has yet to be hashed out. The UN Food and Agriculture Organization, which co-organized the Abidjan meeting, and the OIE are looking for Western governments, non-governmental organizations and charities to foot much of the estimated cost of $7.6 billion to $9.1 billion.

Samuel Thevasagayam, deputy director for livestock at the Bill & Melinda Gates Foundation in Seattle, Washington, which has contributed funds to PPR vaccine efforts in the past, says that the organization is evaluating whether to support the campaign. "It's a huge commitment — that's what causes donors to think carefully," says Mariner. He hopes that the management structure that emerges will be nimble and open to new ideas and approaches. "With PPR, we're going to have to continue to innovate," he says. ■

CLIMATE SCIENCE

Physicists, your planet needs you

Climatologists highlight cloud mysteries in an attempt to lure physicists to their field.

BY QUIRIN SCHIERMEIER

Climate science needs more mathematicians and physicists. So say prominent climatologists who are trying to spark enthusiasm for their field in budding researchers who might otherwise choose astrophysics or cosmology. Talented physical scientists are needed to help resolve mysteries that are crucial to modelling the climate — and, potentially, saving the planet — the group says, such as the ways in which clouds are formed.

There is a misconception that the major challenges in physical climate science are settled. "That's absolutely not true," says Sandrine Bony, a climate researcher at the Laboratory of Dynamic Meteorology in Paris. "In fact, essential physical aspects of climate change are poorly understood."

To attract physics and mathematics students to the speciality, Bony and her collaborators have presented some of the field's grand challenges in magazines such as *Physics Today* (B. Stevens and S. Bony *Phys. Today* http://doi.org/3f9; 2013), and are organizing summer schools for students from an array of scientific backgrounds.

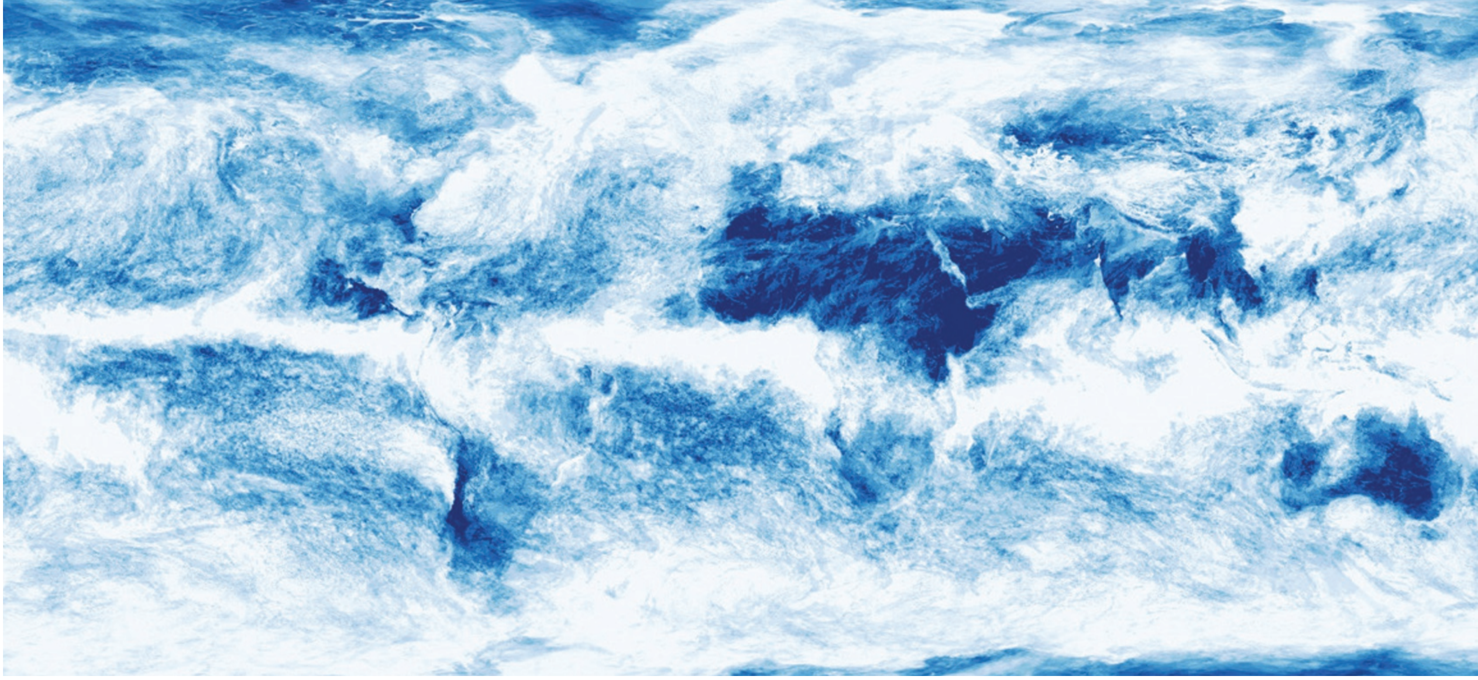
Last week in *Nature Geoscience*, Bony's team outlined four of the field's deepest questions, including how clouds and climate interact and how the position of tropical rain belts and mid-latitude storm tracks might change in a warming world (S. Bony *et al. Nature Geosci.* http://doi.org/3gb; 2015). The questions are best tackled, says Bony, by creating more realistic climate simulations — an approach that she hopes will appeal to physicists.

The perception that climate science is 'solved' is an inadvertent result of pressure on climatologists to convey a simple message to the public — for instance, that all dry regions will get dryer and all wet regions wetter in a warming climate, says Piers Forster, a climate modeller at the University of Leeds, UK. That has made the science "sound somewhat dull", he says.

"We too quickly turn to the policy implications of our work and forget the basic science," adds Bjorn Stevens, a director at the Max Planck Institute for Meteorology in Hamburg, Germany, and a co-author of the *Nature Geoscience* paper. Although climate scientists agree on the basics — for example, climate change is primarily the result of human activity — large uncertainties persist in 'climate sensitivity', the increase in average global temperature caused by a given rise in the concentration of carbon dioxide.

As Bony and co-authors argue, understanding how the warming climate might affect cloud cover, which influences the amount of sunlight reflected back into space and thus Earth's energy cycle, is key to addressing these uncertainties. A major weakness of current climate models is their limited ability to simulate the convection by which humid air is lifted into the atmosphere and which drives cloud formation and rainfall. In some instances, the models cannot even agree on whether the future will bring more rain or less.

Building better cloud-resolving models requires enormous computer power, as well as people who have a deep understanding of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Clouds are key to understanding climate change, but more-realistic models of their formation are needed.

climate physics combined with skills in numerical modelling. But the number of scientists involved in developing computer algorithms for improved climate models is tiny, says Christian Jakob, an atmosphere researcher at Monash University in Clayton, Australia.

Physicists agree that climate science is not a big attractor of physics students. "Very few, and rarely the best, choose to do a master thesis in climatology," says Thierry Fichefet, a physicist and climate modeller at the French-speaking Catholic University of Leuven in Belgium. "Talented physicists commonly go into more glamorous fields such as astronomy, cosmology or particle physics." According to the American Institute of Physics in College Park, Maryland, 49 PhDs were awarded in atmospheric chemistry and climatology in the United States in 2013, compared with 303 for astronomy and almost 2,000 each for physics and mathematics.

Many physicists applaud Bony's effort to raise interest in climate science, but whether physics students will heed her call remains to be seen. "We offer courses in climate science and our students do recognize the importance of the field," says Paul Linden, a fluid-dynamics researcher at the University of Cambridge, UK. However, he says, classical subjects with a long history such as cosmology, are just more attractive, particularly at his university. "Most physics students would rather study with someone like Stephen Hawking, who is a member of our faculty." ■

BIOTECHNOLOGY

Synthetic biology called to order

Meeting launches effort to develop standards for fast-moving field.

BY ERIKA CHECK HAYDEN

Synthetic biologists have a vision. Researchers in this young field, who build 'devices' from engineered genes and other molecular components, imagine a future in which products such as drugs, chemicals, fuels and food are manufactured by microbes. These devices could even be wired up to create cellular computers, much as electronic transistors are wired up to make microprocessors (see *Nature* http://doi.org/3fz; 2013).

But if the dream is to be realized, those components need to perform more consistently and be more reproducible than they are now, especially as they move from the lab bench to the biofactory. Unlike silicon-based electronic devices, synthetic organisms assembled from genetic components do not always have predictable properties — at least not yet.

On 31 March, representatives from industry, academic institutions and government met at Stanford University in California to launch the Synthetic Biology Standards Consortium, an initiative led by the US National Institute of Standards and Technology (NIST) to address issues preventing the field from reaching its potential.

"It's the signal of a maturing industry," says Patrick Boyle, who oversees the organism-design pipeline at Ginkgo BioWorks, a synthetic-biology company in Boston, Massachusetts. "As we get better at synthetic biology, we want to make sure we are comparing apples to apples."

The standards push comes at a pivotal point for synthetic biology. Ginkgo BioWorks is one of several 'foundries' set up to mass produce organisms for various uses. Others include Amyris Biotechnologies and Zymergen, both in Emeryville, California, and publicly funded initiatives in the United Kingdom and the United States. Massive firms — and potential customers for these foundries — are showing interest in the field. The chemical manufacturers Dow and DuPont, the US defence-technology giant Lockheed Martin, the drug maker Novartis and the Dutch health and materials-sciences company DSM were all represented at the NIST meeting.

Participants divided into work groups to brainstorm what standards would make it easier for synthetic biologists to share methods, materials and information. The groups concentrated on a wide range of topics, including standards for automating methods, describing and assembling components and documenting the performance of engineered bacterial strains. One group considered how to demonstrate the safety of commercial synthetic-biology products. Another worked towards calibration methods for flow cytometry, a widely used technology for counting and sorting cells.

Each working group will now carry its ideas forward. NIST will provide support for these efforts, but where they go is up to the researchers. ▶