Report

Simons Foundation Public Lecture in Berlin, Germany

A big event in the International Year of "Mathematics of Planet Earth"

The prestigious "Simons Lectures" are high points of the International Year of "Mathematics of Planet Earth". Prof Klein of Freie Universität Berlin, Germany, gave one of nine lectures worldwide. It was the only one given in Europe. The presentation of the lectures is funded by the Simons Foundation (USA).

The invitation for the Berlin lecture was printed on postcards and posters and additionally sent to 5000 persons via mail.

About 600 people came to the Henry Ford Building of Freie Universität Berlin (Free University) in Berlin, Germany, on the afternoon of May 23, 2013.

(Lecture Hall in the Henry Ford Building at Freie Universität Berlin)

(Host Professor Günter M. Ziegler, Freie Universität Berlin)

At 5 p.m. Prof. Günter M. Ziegler mounted the stage. He is professor for Discrete Geometry at Freie Universität Berlin, head of the organization committee, and emcee of the Simons Lecture all in one. Ziegler greeted all physically and virtually present spectators and thanked all who made the upcoming event possible: The International Mathematical Union for the wonderful idea of an International Year of “Mathematics of Planet Earth”, the Simons Foundation for its generous funding of the Simons Lectures, and Freie Universität Berlin for the local support. Ziegler recalled that in the 50s, the Henry Ford Building could only be built with generous support from the United States. Back then the Henry Ford Foundation

contributed the capital and the name of the world-famous inventor to this building. Ziegler noted the symbolic significance of having the Simons Lecture take place in this important and historically charged building.

(The Henry Ford Building at Free University Berlin)

Right after Prof. Ziegler, the host Prof. Dr. Alt, president of Freie Universität Berlin, greeted all present. He was very pleased and expressed his thanks for Free University Berlin being chosen to host the only Simons Lecture in Europe. According to Alt, internationalism is a crucial feature of Freie Universität Berlin. He remarked on the high significance of mathematics in Berlin and at Freie Universität Berlin in particular. Free University Berlin is connected with practically all Math-Clusters and Math-Projects in Berlin: the DFG-Research Center MATHEON “Mathematics for key technologies”, the graduate school Berlin Mathematical School (BMS), the German Center for Teacher Training (DZLM), and the newly founded Math-Cluster ECMath. Alt looked forward to the upcoming contribution of Freie Universität Berlin to the International Year of “Mathematics of Planet Earth”.

(Prof André Alt, president of Free University Berlin)

Subsequently Dr. Knut Nevermann, State Secretary for Science in Berlin, greeted the audience. He gave a very humorous speech about the proverbial detachment of mathematicians from the world, which was to be refuted on that day by the upcoming lecture. He expressed his pleasure about mathematicians nowadays not only moving within theoretical structures, but also tackling material problems and tasks in such areas as climate studies, seisomology, and sustainability research.

(Dr Knut Nevermann, State Secretary for Science in Berlin)

(Prof Rupert Klein giving the Simons Lecture on “CliMathematics”)

Then Rupert Klein, professor for Mathematics at Freie Universität Berlin, gave his lecture on “CliMathematics: Models, Data and Structures”. He explained why it is so hard to create secured climate forecasts. But he also showed how mathematics has helped to improve

climate prediction. For example he illustrated very vividly how hurricanes can be modeled realistically with the help of new mathematical models – just one important contribution of mathematics to the improvement of climate models.

After the one-hour lecture and questions from the audience, Günter Ziegler thanked the lecturer as well as the sponsors and invited everybody to have a beer together on the terrace behind the Henry Ford Building. Many followed the invitation and – also thanks to the mild weather – drank a beer in the setting evening sun while continuing to discuss weather, climate change, and mathematics.

One hundred VIPs were invited to join a separate reception in the first floor of the Henry Ford Building. They found cold drinks and a “Buffet around the world” with specialties from all five continents.

Between the hallways the guests were invited to participate actively in a light performance. Using different sources of light, they could create soft glowing patterns on a dark canvas and see pictures. Tired but content, the last guests went home at about 11 PM.

(Light performance at the VIP reception)

(Light performance at the VIP reception)

Additional Information on the topic (mathematics and climate research)

Interview with keynote speaker Rupert Klein

Rupert Klein holds the chair for Geophysical Fluid Dynamics at Free University Berlin since 1997. His work focuses on improving mathematical models and the corresponding numerical techniques. The main goal is to help obtain better methods for forecasting weather and modeling climate.

Before the Simons Lecture, Rupert Klein was interviewed by Thomas Vogt from the Media Office of the German Mathematical Society (DMV) for the Berlin daily newspaper “Tagesspiegel” and the bulletin of the German Mathematical Society (DMV-Mitteilungen).

Prof. Klein, why is it so hard to predict the climate in 30 or 50 years?

There are at least three reasons. If you want to look 30 years or more into the future, processes in the Earth’s crust play an important role, as well as the behavior of the oceans or the development of the ice cover. The available data is very thin. A second difficulty is the high complexity of the system that is to be predicted, i.e. the high number of involved processes. Furthermore you cannot perform any repeatable experiments with the Earth’s system. As a third and last point the influence of mankind has to be considered, whereby politics enters the game. For these reasons climate research can at best provide different scenarios that depend on possible future political decisions.

Why is the development of climate models interesting for mathematicians?

It starts with the fluid mechanical differential equations describing the atmosphere. Those have been known for a while, but the complex boundary conditions governing fluid dynamics on Earth make solutions very sophisticated - and therefore interesting. The characterization of uncertainties following from the thin available data or insufficiently described sub-processes makes a whole different kind of mathematics enter the game: Probability Theory, Statistics, and Stochastics, the science of random processes – a wide and exciting field.

How can mathematics help with climate prognoses?

It can help by building models and by supporting the analysis of models that have already been set up by climate modelers. Good examples are the so-called hydrostatic primitive equations that nowadays form a basis for nearly all global climate models. Until recently it was not known whether these equations could be solved uniquely and over a sufficiently long time horizon. But exactly these properties were recently shown by mathematicians for a common version of these equations. This does not immediately result in any new insights on climate development, but it places the models on a more solid foundation and raises their credibility.

Are there more contributions from mathematics to a better climate modeling?

A problem right now is limited computer capacity. In the age of supercomputers this might sound surprising, but if we want to predict the climate development in the upcoming 100 or even 200 years even the most powerful mainframe computers hit their walls. The solution for this problem is called model reduction, and is based simplifying the details of the model equation. The challenge is then to simplify in such a way that the resulting model still provides comprehensive results. The meteorologist already has methods to do so, but the mathematician's toolbox is more versatile - especially given the aforementioned uncertainties in the problem. An exchange between the two sciences can accelerate the finding of answers to pressing questions quite a bit.

Is there a concrete example showing how mathematics can help with the development of climate models?

With the deployment of mainframe computers in the 80s and 90s, climate research inclined towards more and more complicated and detailed computer models. Researchers were content that the various model reductions they had to introduce in order to be able to compute anything could one by one be dropped and the models could become more complete. Thus the analytical and theoretical penetration of the considered processes was given lower priority than the pursuance of scientific activity. It has been the ambitious endeavor of some mathematicians to bring theoretical analysis once again into play in climate research, alongside the inevitable computer simulation.

Web resources

- http://www.mi.fu-berlin.de/math/Simons_Lecture_2013.html
- https://dmv.mathematik.de/forum.html?func=view&catid=22&id=559
- http://mpe2013.org