Interview, Prof. Dr. Rupert Klein, Department of Mathematics and Computer Science, Geophysical Fluid Dynamics Research Project, Freie Universität Berlin.

Interview by Emilie Neveu, during the professor's stay at Université de Savoie.

Defining himself as half a mathematician and half a modeller, Prof. Dr. Rupert Klein is in fact working on the mathematical modelling and formal analysis of atmospheric motions. His research has impacts on weather forecasting and climate research so that he works closely with meteorologists and engineering fluid dynamicists.
Here, he tells us about the issues he wants to overcome in his work, notably how to well-define reduced models, and discusses the need of a close cooperation between mathematicians and modelers in order to define common goals that are relevant for both disciplines.
About 20 years ago, German national policies changed the background of applied mathematics and computer science, by supporting cross-disciplinary projects. Prof. Dr. Rupert Klein tells us more about German landscape and what he is thinking of French research. Here are some of his considerations.

What is your background in a few words?

Theoretical engineering fluid mechanics, computational fluid dynamics, theoretical meteorology, numerical mathematics, mathematical modelling

What will focus your attention in the next few years, that includes mathematics?

I have quite successfully pursued multiscale formal analyses of the atmospheric flow equations in recent years. A major challenge that remains in this field, and which I hope to address jointly with Prof. Bresch and other french colleagues, is the rigorous justification of the resulting reduced models and the qualification of their respective regimes of validity in strict mathematical terms.

What will be the important issues to overcome in numerical methods, models, and maths to go further in your research?

The rigorous analysis of partial differential equations in general and the fluid flow equations in particular has reached enormous levels of sophistication. Nevertheless, many concrete mathematical questions still remain open. It is my conviction, and the joint work with Prof. Bresch is an example, that by more specifically addressing exactly the flow regimes encountered in nature -- at the expense of generality for other situations -- may allow us to make substantial further progress. This requires, however, a close cooperation between modelers and mathematicians on fine-tuning what are the mathematical statements that we REALLY want to prove, and what would be statements that would be nice to have, but that would be of uncertain relevance in the context of real-life applications.

Are you working directly with scientists of other fields? If no, why?

Yes, with meteorologists and engineering fluid dynamicists.

Is it easy to interact with other scientists in your country?

Interactions of mathematicians with applied scientists - notably engineers - reached a new high in Germany about 20 years ago. This had been developed over a period of about 15 years during which Deutsche Forschungsgemeinschaft sponsored several joint programs in which these disciplines were forced to cooperate to be able to apply for funding. These programs have changed the landscape for applied mathematics, notably scientific computing, in Germany substantially. Interestingly, there is much less interaction of this type in the area of analysis, that is, outside of computing.
I believe that France has a huge potential in just this area, but that harvesting it requires taking formal mathematical arguments directed straight at application relevance more seriously than they are taken today most of the time, as far as I know the landscape.

Do you have some help from institutions in order to share knowledge?

Yes, from Deutsche Forschungsgemeinschaft through said joint programs. See, e.g., the Priority Research Program 1276 (MetStroem), of which I was the speaker http://metstroem.mi.fu-berlin.de

and in order to develop numerical developments into operational tools so as they can be used by scientists in other fields?

Yes.

If yes, what kind of help?

There is some limited support of this kind in my area through Deutsches Klimarechen-zentrum (DKRZ) in Hamburg, but they do not have the resources to pursue this as a Germany-wide model development service.

Do you any suggestion to make to the management of research in France? What do you like of it? and what can be improved?

My limited outsider's view is this:
Applied Mathematics in France is highly advanced and it is pursued with likely the highest standards of generality and rigor in Europe. At the same time, the very quest for generality and rigor sometimes hinders progress on concrete applications, because statements are needed to be conjectured and proven that are relevant to some specific context and maybe do not cover all possibilities hidden in a mathematical set of equations or in a problem formulation.

The general appeal I would want to formulate is to encourage cross-disciplinary respect and let students at the Masters and Ph.D. levels already interact with their peers across disciplinary boundaries. Only then will the culture and language develop that makes for effective progress on difficult application problems.