

Understanding the current challenges in climate modelling: dynamics, thermodynamics and statistics

Michel Crucifix, Valerio Luccarini, Stephane Vannitsem

From the 26th to the 29th August 2014 a workshop entitled 'Advances in Climate Theory' was held at the Belgian Royal Meteorological Institute. The workshop was organised and funded by the European Research Council, through the Starting Grants 'ITOP' and 'Namaste', focusing on the dynamics of the Pleistocene climate, and on the thermodynamics of the climate system, respectively.

The STOCHCLIM project started in 2014 and funded by the Belgian Policy Office, and the BNCGG, were also associated to this workshop.

The workshop gathered approximately 50 participants, including 15 international invited speakers. Retrospectively the workshop could have been called 'Advance in climate theories' : the climate is a physical, complex system that poses challenges to many areas of physics, mathematics, statistics and engineering. There is not A theory, but rather many theoretical frameworks that may be mobilised to answer specific questions. The objective of the conference is first to provide an overview of these different frameworks and then attempt a critical summary of important objectives and challenges faced by climate science today.

Specifically, the frameworks are illustrated by examples taken from talks delivered during the workshop, the present objective to demonstrate the variety of possible approaches for studying and characterising climate dynamics: mean field theory, dynamical system analysis, spectral analysis of observations, climate simulation and parameterisations, and Bayesian statistical inference. While every framework comes with its own technical challenges, cross-cutting subject definitely emerge as recurrent thematic: multi-scale (and fractal) dynamics, prediction, regional dynamics and interdecadal variability.