

Weather Prediction and Climate

The contributions of the Millenium Institute IM-AGIMB have been invaluable, regarding the global and integrated advancement of Mathematics within related areas such as Weather Prediction and Climate. There has never been such an agile advancement as was observed in the past 30 months. Most important, the interchange of efforts, technology and human resources has been reciprocal. The specific reports clearly indicate this fact, which has been observed in the connection between Meteorology and Mathematics, as well as between Theoretical Physics and Mathematics. In this last case flexibility and agile decision making allowed several activities to materialize over a small time span. In particular the exchange of researchers, an international workshop (an initiative of the Institute of Theoretical Physics IFT/UNESP; partially in response to IM-AGIMB efforts) which generated a contact with the Consortium of the Americas for Interdisciplinary Sciences (University of New Mexico) and a proposal for a summer course (2005) at IMPA by a physicist of IFT/UNESP. Meteorology is also well integrated with Mathematics. Among several efforts described in the corresponding reports, the IM-AGIMB activities had an impact on a doctoral thesis of the Brazilian Center for Weather Forecasting and Climate Studies (CPTEC/INPE). They also promoted a (future) visit to the USA by a PhD student in Meteorology, of the Institute of Astronomy, Geophysics and Atmospheric Sciences (IAG/USP). This student will visit the Courant Institute and also the Mathematics Department of the University of Wisconsin at Madison (one semester each institute). In Climate Studies important conceptual advances were reached in the period. Of particular interest was the theoretical discovery of multiple stable equilibria in the biome-climate coupled system for Tropical South America. The interaction of the vegetated surface and the atmosphere through the turbulent fluxes of momentum, heat, water vapor and other substances is highly nonlinear. The CPTEC Atmospheric General Circulation Model (AGCM), was coupled to a biome model recently developed at CPTEC, was used to numerically search for multiple biome-climate stable equilibria. Two stable states were found when the numerical calculations were started with contrasting conditions. In Weather Prediction, the group continues to focus improving the efficiency of numerical methods used in simulation models for the atmospheric climate system, as well as on theoretical aspects for the atmospheric flow. In particular those connected with nonlinear effects and also originated from perturbation of the atmospheric flow. Another activity in this area is Waves in Heterogeneous Media, theme of interest in Mathematics (differential equations in multiple scales, with highly oscillatory coefficients), in Theoretical Physics and Meteorology. A recent PhD graduate in this field obtained a post doctoral position at the University of California at Irvine (USA). Several research articles were published in the different subareas, and several PhD students graduated from the different subgroups. IM-AGIMB is planning several workshops/events in the near future, in particular a School in Environmental Modeling. The success of interdisciplinary IM-AGIMB activities has been clearly observed in an international workshop on Ensemble Forecasting (CPTEC 2002). Consolidating the IM-AGIMB's goals is of fundamental importance, together with its ease to plan activities (such as events/workshops, domestic and international exchange of researchers, among others), for the further development of Brazilian Mathematics as well as of other areas in Science and Technology.