



# Newsletter

Summer 2013



More than a hundred scientific societies, universities, research institutes, and organizations all over the world have banded together to dedicate 2013 as a special year for the Mathematics of Planet Earth. Our planet is the setting for dynamic processes of all sorts, including the geophysical processes in the mantle, the continents and oceans, the atmospheric processes that determine our weather and climates, the biological processes involving living species and their interactions, and the human processes of finance, agriculture, water, transportation, and energy. The challenges facing our planet and our civilization are multidisciplinary and multifaceted, and the mathematical sciences play a central role in the scientific effort to understand and to deal with these challenges.

The mission of the MPE project is to: encourage research in identifying and solving fundamental questions about planet earth; encourage educators at all levels to communicate the issues related to planet earth; and inform the public about the essential role of the mathematical sciences in facing the challenges to our planet.

In the Atlantic region we are participating in this theme through a number of initiatives: The annual AARMS Summer School is presenting courses in Dynamical Systems and Mathematical Biology, to be followed by the 2013 AARMS Workshop in Mathematical Biology at Memorial University. We are also proud to sponsor a series of public lectures in Fredericton, St. John's and Halifax by eminent mathematicians addressing topics of weather prediction, ocean waves, and tipping points. And in October we are supporting "Sustainability of Aquatic Ecosystems Networks" in Fredericton which is part of the pan-Canadian thematic program on Models and Methods in Ecology, Epidemiology and Public Health. More information on these events will be found in this newsletter. For further information on MPE2013 please visit their website at [mpe2013.org](http://mpe2013.org).

## AARMS Public Lecture: Gilbert Brunet



Dr. Gilbert Brunet, head of Weather Science at the Met Office, delivered a lecture titled The Mathematical Challenges of Earth-System and Weather Prediction on March 19.

During the lecture, Dr. Brunet explored the significant applied challenges which remain to be met before acceptable meteorological and Earth-system forecasts can be produced worldwide from urban to planetary scale and all relevant time scales. The talk presented historical perspective and outlined some of the future challenges of this multi-scale and seamless prediction problem.

"Internationally, the increasing demand for accurate high-impact weather and Earth-system predictions is indisputable," said Dr. Brunet. "It has led to significant investment in sophisticated applied mathematical algorithms and studies, high performance computing, high-speed telecommunication, remote sensing, and ground-, space- and aircraft-based measurement technologies.

"These have propped up field and laboratory process studies, the development of observational techniques, and coupled numerical weather and Earth-system models to produce weather and climate predictions."

Dr. Brunet, whose background includes a two-year period working in solid state physics at the University of Ottawa, obtained his PhD in meteorology at McGill University in 1989. He is currently head of Weather Science at the Met Office on leave from Environment Canada where he was head of the Meteorological Research Division.

He is also Chair of the Joint Scientific Committee of the World Weather Research Programme, World Meteorological Organization and has been recognized as an expert in dynamical meteorology. His work covers analytical and empirical studies of wave processes from regional to planetary scale, and numerical weather prediction from minutes to seasons.

# News

The Atlantic Association for Research in the Mathematical Sciences and by the Canadian Mathematical Society sponsored the lecture as part of the special year on the Mathematics of Planet Earth.

- Kelly Foss

## More Upcoming Public Lectures

As well as the lecture by Dr. Gilbert Brunet in St. John's in March, AARMS is proud to sponsor two more lectures in this series, in partnership with the Canadian Mathematical Society. Look for further details on our website as the autumn approaches.

**Walter Craig** (McMaster) will deliver a talk on Ocean Waves, Rogue Waves, and Tsunamis in Fredericton, New Brunswick on October 10.



And finally, Mary Lou Zeeman (Bowdoin) will speak on Harnessing Math to Understand Tipping Points in Halifax, NS on September 27. Each of these lectures is also sponsored by the CMS and will be followed by a reception where you can meet the speaker.

## AARMS Mathematical Biology Workshop

The AARMS Mathematical Biology Workshop will take place at Memorial University of Newfoundland in St John's from July 27-29, 2013 and will be attended by more than 80 participants originating from Canada, the United States, Europe and beyond. The conference participants will include graduate students, postdoctoral fellows, and professors from several AARMS member institutions. The local organizers are Drs. Amy Hurford and Xiaoqiang Zhao from Memorial University.

The workshop will be highlighted by a public lecture and six plenary talks. The public lecture 'Challenges in mathematical ecology: scaling and collective phenomena' will be given by Dr. Simon Levin of Princeton University. Dr. Levin's talk will describe how mathematics can contribute to solving several open problems in biology. The plenary lectures will be given by Drs. Edward Allen (Texas Tech University), Linda Allen (Texas Tech University), Steve Cantrell (University

of Miami), Odo Diekmann (University of Utrecht), Mark Lewis (University of Alberta) and Phillip Maini (Oxford University). These lectures will involve models that take a wide range of mathematical formulations including delay stochastic differential equations, branching processes, partial differential equations, vertex-based and individual-based models, and will be applied to biological problems ranging from understanding metabolism to bacteriophage/bacteria dynamics, epidemiology, species dispersal, and tumor development. The remainder of the conference will comprise of contributed talks.

Mathematical biology is a flourishing subdiscipline that brings precision to biological problems and that emphasizes the power of mathematical results in better understanding the world around us. To learn more, please visit the conference website (<http://www.math.mun.ca/~ahurford/aarms/>) or contact Amy Hurford ([ahurford@mun.ca](mailto:ahurford@mun.ca)) for more details.

- Amy Hurford

## AARMS Summer School

The twelfth annual AARMS Summer School in St. John's, July 15 to August 9, 2013, will be tailoring its program this year to the theme of the Mathematics of Planet Earth with courses in Dynamical systems and Mathematical Biology. The Summer School will be followed by a workshop in Mathematical Biology, also in St. John's. See the article earlier in this newsletter.

The summer school is intended for graduate students and promising undergraduate students from all parts of the world. Each participant is expected to register for at least two of the four courses. Each course consists of five ninety-minute lecture sessions each week. These are graduate courses approved by MUN and we will facilitate transfer credit to the extent possible. Tuition and accommodation charges are covered by AARMS. Students need to find their own funds for travel expenses. The courses offered in 2013 will be:

### Stochastic Modeling with Applications in Biology

Instructors: Drs. Linda Allen & Edward Allen, Texas Tech University, USA

### Reaction-Diffusion Equations and Applications

Instructor: Dr. Stephen Cantrell, University of Miami, USA

### Mathematical Methods to Gain Biological Insights

Instructor: Dr. Odo Diekmann, Utrecht University, The Netherlands

### Mathematical Modelling in Developmental Biology & Medicine

Instructor: Dr. Philip Maini, University of Oxford, UK

For more information visit our website, or contact the Summer School Director, Xiaoqiang Zhao ([zhao@mun.ca](mailto:zhao@mun.ca)). [www.aarms.math.ca/summer](http://www.aarms.math.ca/summer)

## Workshop on the Sustainability of Aquatic Ecosystems Networks

On October 22-25, 2013, the University of New Brunswick, Fredericton, with the generous support of AARMS and CRM, hosts a workshop on the Sustainability of Aquatic Ecosystem Networks. This workshop is part of the pan-Canadian program on models and methods in epidemiology, ecology and public health, jointly supported by AARMS, BIRS, CRM, Fields, Mitacs, MPrime, and PIMS. Atlantic Canada is host to two other events of this program: the AARMS summer school in July and August, which this year has a focus on Dynamical Systems and Mathematical Biology; and the 2013 AARMS Mathematical Biology Workshop on July 27-29th. The pan-Canadian program is part of a larger, global effort to designate 2013 as a special year for the Mathematics of Planet Earth ([www.mpe2013.org](http://www.mpe2013.org)). Workshops, summer schools and public lectures are being held around the globe illustrating mathematical aspects of problems involving oceans, atmosphere, climate, ecology, disease-dynamics and economics.

The focus of the upcoming AARMS workshop in Fredericton is on the mathematics of networks as it relates to both networks of rivers and lakes and networks of marine habitats. These problems are of particular interest to Canada with its thousands of lakes, many major rivers, countless streams and three bordering oceans. Understanding the connections between these waters and their ecosystems is essential to understanding the impacts of human activities. Stresses on lake populations include events upstream; introduced species spread through networks of lakes and rivers; colonizers from marine protected areas may rescue impacted ecosystems, but the stress from these impacts may also spread to protected areas. The AARMS workshop aims to foster a cross-disciplinary exchange of ideas and techniques between mathematicians, ecologists and resource managers, leading to new opportunities for mathematicians, and new tools for managers.

Further details on the workshop, and on other events in MPE2013, can be found on the program website:  
<http://www.crm.umontreal.ca/Aquatic13/index.php>

- James Watmough



## Our Annual Postdoc Competition

Our annual postdoctoral fellowship competition will open in mid November. Please visit our webpage for the rules of the competition and instructions on how to apply.  
[www.aarms.math.ca/pdf](http://www.aarms.math.ca/pdf)

## An AARMS Postdoc Reports



I have several research interests in pure and applied mathematics, and extending into computer science and computational biology.

During my PhD candidature (awarded 2010), I studied enumeration problems related to Latin squares and Latin rectangles. Finding the exact number of Latin rectangles is generally considered "hard".

However, it can be possible to find the number of Latin rectangles modulo  $m$  for suitably chosen values of  $m$ . The main tool I've used for this is applying a group action to a set of Latin rectangles then using the Orbit-Stabiliser Theorem to classify orbit sizes under this action. This naturally leads into studying the symmetries of Latin rectangles, which leads into studying orthomorphisms and partial orthomorphisms of cyclic groups. I have also studied other topics related to Latin squares including generalisations of Latin squares, partial Latin squares and the Alon-Tarsi Conjecture.

Recently I've also focussed on complex networks and, in particular, network motifs (small overrepresented subgraphs in real-world networks). I co-authored a network motif detection package called NetMODE, which circumvents the use of Nauty for the canonical labelling sub-problem. Other motif-related research includes theoretical analysis of popular network motif software and motifs in protein structure networks.

Other topics I have studied include search engine algorithms (in particular, lists intersection and caching), phylogenetic software and erasure codes.

I am very grateful to AARMS for the exciting opportunity to work at Dalhousie University.

- Douglas Stones

## Call for Proposals

We encourage mathematicians in Atlantic Canada to suggest programmes or themes for future AARMS activities in the region (workshops, conferences, outreach projects, periods of specialization and exceptional opportunities) and to direct all applications for funding to our Online System. AARMS is open to proposals for large events that take place outside our region if it can be shown that AARMS funding will facilitate the participation of regional personnel (for example by supporting the travel of Atlantic students and postdocs to the event) or will in other ways have a tangible impact on our region.

Proposals are usually expected to show a detailed program with a significant number of confirmed speakers. They must also include a budget table showing projected total revenues and expenses. In general AARMS is not in a position to fund indefinite continuing activities. Successful applicants will be expected to produce a report on their event. The next deadline for submission: September 15, 2013.

# Recent and Upcoming Events

## International Workshop in Combinatorial Algebra

Organizers: Y. Bahturin, M. Beattie, S. Faridi, M. Kotchetov, M. Mastnak, H. Usefi  
Location: Dalhousie / St. Marys, Halifax  
Date: June 1-6, 2013  
Contact Information: Yuri Bahturin

## Analytic Spaces and Their Operators

Organizers: Jie Xiao, Kehe Zhu  
Location: Memorial University, St. John's  
Date: July 9-12, 2013  
Contact Information: Jie Xiao

## CanADAM Conference

Organizers: D. Pike, F. Ruskey, B. Stevens, G. MacGiillivray, O. Marcotte, L. Stewart, D. Panario  
Location: Memorial University, St. John's  
Date: June 10-13, 2013  
Contact Information: David Pike

## Canadian Undergraduate Math Conference

Organizers: Kevin Gervais et al  
Location: Université de Montréal  
Date: July 10-14, 2013  
Contact Information: Kevin Gervais

## 2013 AARMS Workshop in Mathematical Biology

Organizers: Amy Hurford, Xiaoqiang Zhao  
Location: Memorial University, St. John's  
Date: July 27-29, 2013  
Contact Information: Amy Hurford

## CCCG 2013 and Summer School

Organizers: Alex Lopez-Ortiz, Anna Lubiw, Therese Biedl  
Location: University of Waterloo  
Date: August 4-11, 2013  
Contact Information: Alex Lopez-Ortiz

## Science Atlantic Mathematics, Statistics and Computer Science Conference

Organizers: Shannon Fitzpatrick, Gordon MacDonal, Chris Vessey, Nasser Saad, Cezar Campeanu  
Location: University of Prince Edward Island  
Date: October 18-20, 2013  
Contact Information: Shannon Fitzpatrick

## Sustainability of Aquatic Systems Networks

Organizers: Frithjof Lutscher, James Watmough  
Location: University of New Brunswick, Fredericton  
Date: October 22-25, 2013  
Contact Information: Frithjof Lutscher

## Combinatorial Algebra meets Algebraic Combinatorics

Organizers: Sara Faridi, Hugh Thomas, Mike Zabrocki  
Location: Dalhousie  
Date: January 24-26, 2014  
Contact Information: Hugh Thomas

AARMS is proud to sponsor high-quality activities in Atlantic Canada which significantly enhance research and the training of graduate students.

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*If I were again beginning my studies, I would follow the advice of Plato and start with mathematics.*

*~Galileo Galilei*