

SIAM Activity Group Mathematics of Planet Earth Charter Renewal Application

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Mathematics of Planet Earth (hereafter referred to as SIAG/MPE or SIAG).

The SIAG/MPE to which this renewal application applies was formed under the aegis of SIAM and approved by the SIAM Council and SIAM Board of Trustees on December 19, 2014 for an initial operating period beginning on January 1, 2015 and ending on December 31, 2016. This is the second application for renewal of the SIAG charter.

Statistics:

- The SIAG/MPE had 335 members, including 220 student members and 115 non-student members, as of December 31, 2017.
- Among the non-student members, 35 are female and 73 are male.
- Among the non-students, 79 are domestic and 36 are international members.

The purpose of the SIAG is to provide a forum for mathematicians and computational scientists to study Planet Earth, its life-supporting capacity, and the impact of human activities. By opening up a new area of applications, the SIAG shall stimulate interesting research in the mathematical sciences. The SIAG shall conduct its activities within the framework of SIAM.

To implement its purpose, the SIAG/MPE shall organize the following activities:

- A biennial SIAM Conference on Mathematics of Planet Earth, to be held in even-numbered years;
- One or more mini-symposia at the SIAM Annual Meeting in years when there is no SIAG conference and/or at the SIAM Conference on Geosciences;
- At least once every seven years, a track of at least six mini-symposia at the SIAM Annual Meeting or an Activity Group meeting in conjunction with the Annual Meeting.

In addition, the SIAG/MPE may engage in specialized workshops or meetings, special sessions at SIAM meetings, and special one- or two-day meetings immediately before or after a regular SIAM meeting.

SIAG/MPE Officers

Chair: Hans Engler

Vice-chair: Kathleen Kavanagh

Secretary: Pedro Gajardo

Program Director: Eleanor W. Jenkins

SIAG/MPE Advisory Board

Peter Ashwin

Luc Doyen

Xiaojing (Ruby) Fu

Darryl D. Holm

Suzanne Lenhart

Simon A. Levin

Doug Nychka

Fred Roberts

Christiane Rousseau

Abdul-Aziz Yakubu

Mary Lou Zeeman

Summary of Activities

The SIAG has complemented SIAM's activities and supported its proposed functions. The answers to the questions below indicate how this was accomplished and what the officers propose as the future directions for the SIAG.

1. How is the field covered by the activity group doing? Is it growing, is the focus shifting? What have been the significant advances over the last two years?

In 2018, the mathematical research associated with Planet Earth problems continues to thrive. We see increased collaboration between mathematicians, statisticians, and practitioners. These interactions are required to resolve the global crises and challenges our planet and its inhabitants face.

The general area of interest of the activity group was influenced by scientific needs arising from extreme weather events and continuing regional crises. Notably in 2017, we witnessed natural disasters such as hurricanes whose impact, in terms of loss of life, destruction of property, and emotional stress, was felt by millions of people. Some areas, in particular Puerto Rico, continue to struggle to recover. Mathematics has an enormous role to play in aiding disaster management agencies predict hurricane behavior and assess which areas will be most affected and how. In addition, mathematics can aid in the development of alternative energy paradigms, which could help regions affected by natural disasters recover more quickly.

In terms of methodological advances and challenges, significant problems of interest for mathematical scientists working in MPE related areas continue to arise in the management and analysis of large datasets that result from measurements of earth system properties. These include remote sensing with satellites, the use of profiling floats to observe oceans, and the increased use of sensors in the built environment.

Research networks and institutions continue to support activities related to MPE. Many of the activity group's members lead or participate in these efforts. For example, the Statistical and Applied Mathematical Sciences Institute (SAMSI) had "Mathematical and Statistical Methods for Climate and Earth Systems" as a major topic for the 2017-2018 research year, following the 2014-2015 research year on ecology. Doctoral programs for MPE are thriving in the UK and the Netherlands. The NSF-funded MPE2013+ initiative at DIMACS (Rutgers University) continued during the past two years.

Funding agencies continue to solicit proposals to resolve Planet Earth problems. The INFEWS program at NSF funds proposals at the intersection of food, energy, and water systems and encourages the integration of models across many domains, including mathematics. In addition, the Department of Defense (through the Army Corps of Engineers) is interested in several MPE applications, including predicting movement of wildlife and evaluating the ability of a region to feed its inhabitants. The Department of Energy's funding interests in applied mathematics include enabling methodologies that are important to the MPE community and where our community can contribute, such as uncertainty quantification and computational fluid dynamics.

In addition to these more standard funding sources for mathematics, members of this activity group are better positioned to petition for funding from non-traditional sources, including the USDA NIFA program. These grants are targeted towards applications such as sustainable agriculture, education and workforce development, and risk management. Mathematicians have contributed research to each of these areas.

Finally, as an indication of the value placed on MPE problems, the American Mathematical Society chose a MPE project led by Kathleen Kavanagh and Lea Jenkins to represent the organization at the 2017 Exhibition for the Coalition for National Science Funding held in Washington, DC in May 2017. Their work on sustainable agriculture was used to convince legislators to continue funding for basic scientific research through funding the NSF.

2. How is the activity group doing? Is it remaining vibrant? Is the size of the SIAG stable or increasing? How is the SIAG keeping up with the changes in the field? How are the broader interests of SIAM reflected in the activities of the SIAG?

The size of our activity group doubled since the last charter renewal, with continued strong growth among students. Our activity group seeks to keep pace with the changes in the field by encouraging broad participation in our bi-annual conference (MPE18). Members of the activity groups also participate in many other efforts to foster MPE related themes, often in leading roles (see previous answer). Our activity group specifically aims to introduce new opportunities for mathematical work. For example, one of the MPE18 speakers is a behavioral ecologist who will talk about mathematical tools to describe and predict collective animal behavior. Opening these new views contributed to SIAM's goals of ensuring "the strongest interactions between mathematics and other scientific and technological communities".

3. Please list conferences/workshops the activity group has sponsored or co-sponsored over the past two years, and give a brief (one sentence or phrase) indication of the success or problems with each.

- MPE16, September 2016, Philadelphia, PA. There were five plenary talks, 14 mini-symposia with 21 sessions, four contributed paper sessions, two minitutorials, and the poster session, with more than 160 attendees. The meeting was held together with the inaugural meeting of the SIAG on Applied Mathematics Education. This was a successful inaugural conference.

Here is a partial list of other activities. SIAG/MPE affiliation was sometimes informal.

- American Geophysical Union, December 2016, San Francisco, CA. A poster session was organized by SIAG members.
- SIAG Applied Dynamical Systems Conference, May 2017, Snowbird, UT. A two part minisymposium with MPE theme was organized by SIAG members.

- World Conference on Natural Resource Modeling, Barcelona, Spain, June 2017. This conference was organized by the Resource Modeling Association and included the SIAG/MPE logo in its webpages and brochure.
- American Association for the Advancement of Science Annual Meeting, February 2018, Austin, TX. A session on Mathematics of Planet Earth with talks on hurricane impact prediction, spatial models for epidemics, and models for vegetation patterns was organized by the SIAG and supported by the AMS.
- European Geophysical Union General Assembly, April 2018, Vienna, Austria. A poster session and a session of talks were organized by SIAG members.
- Food Systems Modeling Workshop, April 2018, Washington, DC. This workshop was organized by SIAG members and funded by DIMACS/Rutgers University.
- International Congress of Mathematicians, August 2018, Rio de Janeiro, Brazil. A discussion panel with the title "How can mathematicians contribute to planetary challenges" is being organized by SIAG members and will be chaired by Hans Engler.
- MPE18, September 2018, Philadelphia, PA. This is the second conference of the SIAG. Scheduled are four plenary talks, 17 minisymposia with 28 sessions, five contributed paper sessions, two minitutorials, and a poster session.

4. Please indicate the number of mini-symposia directly organized by the activity group at the two SIAM Annual Meetings. When did the SIAG last organize a track of mini-symposia at an annual meeting?

There were no mini-symposia organized by the SIAG at the 2017 Annual Meeting and there are none scheduled for 2018. However there are related sessions (including a plenary talk) at the 2018 Applied Math Education conference which is being held jointly with the annual meeting this year. The SIAG is in its fourth year and has not yet organized a track of mini-symposia at an annual meeting.

5. Please indicate other activities sponsored by the activity group, to include newsletters, prizes and web sites. Have each of these been active and successful?

The SIAG has launched several social media initiatives, including a Facebook page and Twitter account. We plan to work more closely with the marketing team at SIAM to help promote MPE through those venues. In April 2017, a SIAM News article was featured in the April issue as well as a half page description of the SIAG with a newly designed logo and an accompanying flyer (attached).

Concerning the activity of our email list, from January 2017 until May 2018, we have approved 43 messages in order to be delivered to the list. Approximately 75% of these messages correspond to event announcements (conferences, workshops, seminars, summer schools, etc) and the other 25% correspond to job position announcements.

6. What activities are planned and proposed for the next period of the charter? Please describe scheduled and suggested future activities in detail.

The SIAG officers are in the process of developing an MPE prize. An initial donor has generously committed to supporting the effort and currently guidelines and procedures are being discussed in collaboration with the advisory board.

A priority for the next charter period will be to increase conference participation through sponsored sessions at SIAM Annual Meetings and at other meetings of SIAGs. A significant contribution of the next period will be the planning of MPE2020. At MPE18, we plan to pilot electronic poster display at the conference and advance distribution of posters on a suitable website. We hope this will become common practice for showcasing research at MPE conferences.

We would like to begin an annual publishing effort with SIAM News to ensure MPE research is highlighted in the April issue, aligning with Earth Day. This will simultaneously help to attract new members to the SIAG.

Finally, a stronger presence through social media will be a priority moving forward. One objective of using social media is to create a stronger sense of community among SIAG members, especially our younger members, and encourage participation in MPE related activities. In general, the use of online surveys (Google forms or Survey Monkey) could help the leadership of the activity group learn what members would like to get from the SIAG. Improved communication from members will help strengthen the impact of the SIAG and also help highlight success stories and significant findings.

7. How can SIAM help the activity group achieve its goals?

Our membership has a very large proportion of student members. We need help in ensuring these student members remain active SIAM and SIAG/MPE members after graduation. SIAM can help by adding specific career information for such students so they continue their involvement and by helping us make MPE-related conferences affordable, accessible, welcoming, and productive for young researchers. We would also welcome other SIAM advice on taking advantage of this opportunity to engage junior mathematical scientists. We hope that SIAM can help specifically by helping us to improve communication with members of our SIAG and beyond.

It would also be valuable to connect with the leadership of other SIAGs to get a better understanding of how they operate, compare experiences, identify common problems, and identify and address areas of common interest before they lead to duplicate efforts or friction. For example, it would help to share best practices and get advice on how to effectively be connected with SIAG members. Our SIAG has had good success with this through SIAM News but would need help with social media. We also think something like a basic set of FAQs for new SIAG officers to maintain continuity would help.

We would also like an easier process of soliciting and associating sessions at SIAM meetings that are organized by other SIAGs. For instance, sessions are often organized at meeting with

MPE themes, and by MPE members. However, the MPE leadership does not know about these sessions and therefore cannot include them in their decision making and their reports. Also, it would be helpful to have common and easy to find guidelines and suggestions for organizing minisymposia at conferences of other SIAGs.

8. How can the activity group help SIAM in its general role of promoting applied mathematics and computational science?

By working in a highly relevant and topical area of research, the activity group is opening new opportunities for collaboration between mathematical and computational scientists and domain scientists. The activity group is also attracting a new group of mathematical scientists to interdisciplinary work.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a two-year operating period beginning January 1, 2019.

A handwritten signature in black ink that reads "Hans Engler". The signature is written in a cursive, flowing style.

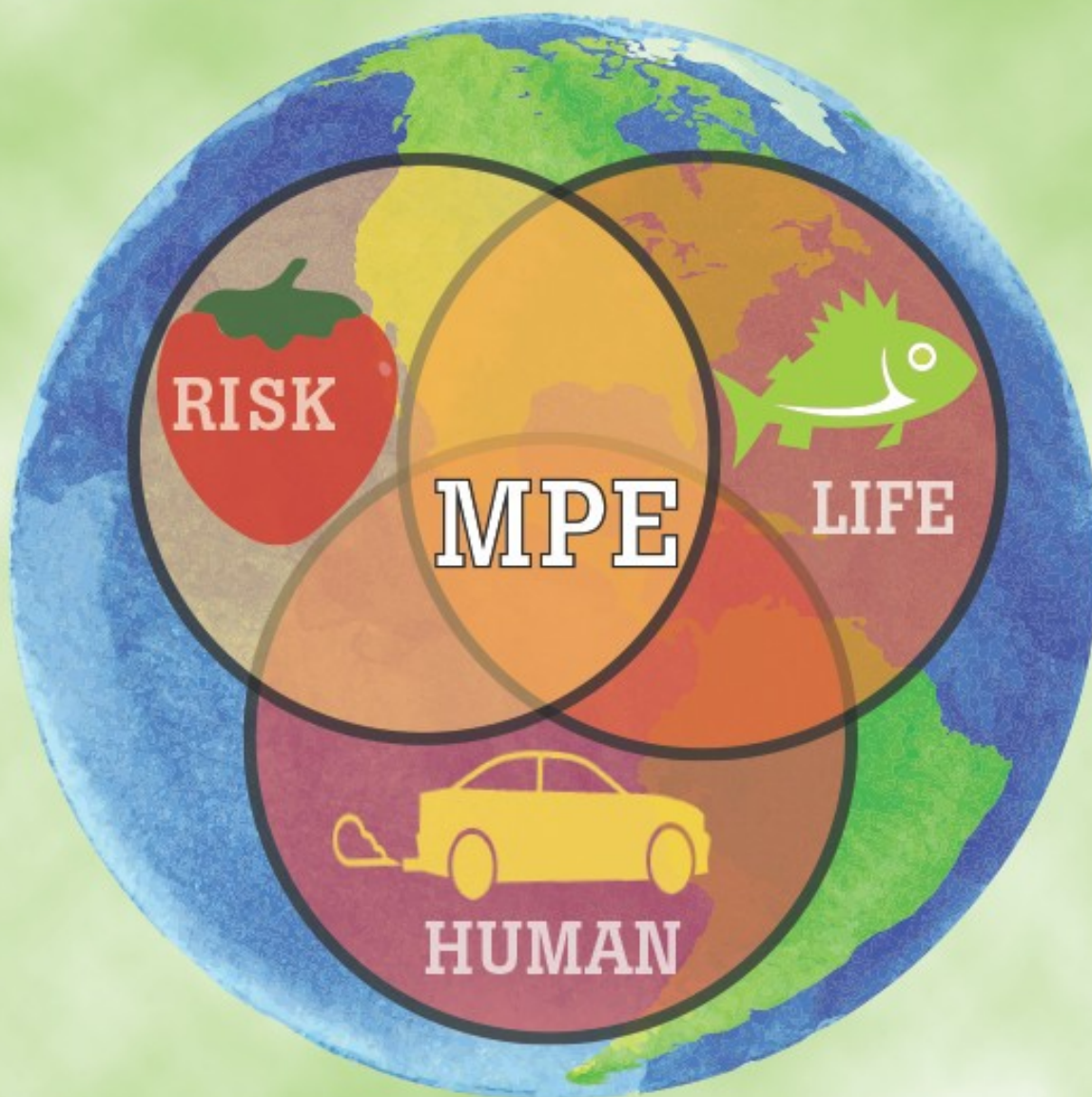
Hans Engler, SIAG/MPE Chair

May 25, 2018

Mathematics of Planet Earth Explained

Mathematics of Planet Earth views our planet through these themes:

- 🍃 Planet Earth as a **physical system**: e.g., climate dynamics, oceans, atmosphere, cryosphere, Earth, and space
- 🍃 Planet Earth as a **system supporting life**: e.g., mathematical ecology, carbon cycle, food systems, natural resources, and sustainability
- 🍃 Planet Earth as a **system organized by humans**: e.g., land use, energy, communication, transportation, and socio-economics
- 🍃 Planet Earth as a **system at risk**: e.g., global change, biodiversity, water, food security, epidemics, and extreme events



The **SIAM Activity Group on Mathematics of Planet Earth (SIAG/MPE)** provides a forum for mathematicians and computational scientists to study our planet, its life-supporting capacity, and the impact of human activities.

Join the SIAG!

<http://www.siam.org/activity/mpe/>

*SIAM Photo/Officers of SIAG/MPE