

## **I. Flood-control Monday**

### ***Break-out sessions on flood control***

Andrew Coen and Simon Jepps presented plans on passive and potentially active use of multiple reservoir levels in the Calder River catchment to provide major flood-water storage and mitigation. Patrick Willems demonstrated how Model Predictive Control in combination with flood-water bypass ponds can provide active, real-time flood mitigation, including the use of precipitation forecasts a few days ahead of time.

Please be guided by the following questions to discuss the potential of dynamic control in mitigation of environmental disasters:

1. Regarding the Calder (and Aire) River catchment(s), discuss and formulate the cost function to be minimised (concerning river level heights, drinking water, etc.).
  - What are the desirable and potentially contradictory demands?
  - How does one "fairly" translate these desirable and contradictory demands into "objective" mathematics; how does one control/alter different weightings?
  
2. Define and investigate other suitable and potential river catchments in the UK, where the flood control work presented may be of use.
  - Discuss and formulate a strategy (cost function, etc.).
  - What are the differences and similarities?
  
3. The passive and active flood control plans and research presented in essence used deterministic models (-), even for future precipitation forecasts.
  - Discuss how this would change when forecast uncertainty is included, via probabilistic forecasting. How does this change the real-time control and the cost functions involved? In the end, the EA or other authorities need to make a decision on how to operate flood-control measures such as dams.
  - How does uncertainty in model predictions and flood control change the decision-making on the ground?
  - How are flood practitioners going to be convinced that these automated procedures are superior to human control and decision-making?
  - Are these new methods superior? Why?
  
4. In which other areas covered within the network Maths Foresees (or beyond) can the ideas about optimal control be used?
  - Identify prospective areas.
  - Discuss the demands to be made and translate these into cost functions and mitigation strategies.

*Please appoint a note-keeper and someone to present a central overview of the discussion, and relay (hand-written) notes back to Tiffany/Onno. 40+20min.*

## **II. Urban-meteorology Tuesday**

### ***Break-out sessions on urban meteorology***

Humphrey Lean presented recent progress on multi-scale modelling of urban weather, mostly concerning dry weather. The resolution of these simulations starts to be sufficiently high to partially resolve the influence of urban canopy (trees, houses, streets) on the dynamics. However, fully resolving simulations are not expected in the near future (e.g. not in the next 50 years).

Please be guided by the following questions to discuss multi-scale urban weather modeling:

1. Discuss the way these processes are currently represented in the modeling of urban weather.
  - How does this influence the model outcomes?
  - What is the potential of data assimilation to represent the averaged influence of fine-scale urban canopy?
  
2. How can multi-scale mathematical techniques (homogenization, averaging) be used to represent the fine, partially resolved scales?
  - Can these methods deal with partial representation of fine scales within partially resolving model solutions?
  - Multi-scale modeling can also be used and has been used for urban flood modeling of the urban canopy, in an averaged sense.
  - How can skills gained in multi-scale mathematical modeling techniques in urban flood modeling be transferred to multi-scale weather modeling and, vice versa?
  - What is the potential of and need for coupled multi-scale urban weather and surface-flood modeling?
  
3. Discuss the need of fine-scale precipitation prediction in cities.
  - What mathematical and modeling breakthroughs are required in modeling moist convection on urban scales with sufficient (statistical) accuracy?
  - What effects are expected to arise or become more important due to climate change and, to what extent?
  
4. Surface water flooding after local downpours is a serious issue in cities across the world, including in the UK.
  - Discuss instances of surface-water flooding in urban areas and future mitigation strategies. E.g. relate this to the London Environmental Strategy.
  - What are the lessons learned?

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### III. Strategic Wednesday

#### ***Break-out sessions on future funding strategies***

What next: funding for research, meetings, study groups, etc.?

Please be guided by the following questions to discuss funding strategies:

1. The Maths Foresees' network facilitated numerous feasibility studies to seed new research, two outreach projects and circa nine different study group challenges. Reports are already found on:

<http://www1.maths.leeds.ac.uk/mathsforesees/projects.html> ,

<http://www.turing-gateway.cam.ac.uk/event/tgmw26> and

<http://www.turing-gateway.cam.ac.uk/event/tgmw41>

- What is the way forward to acquire further funding for these promising projects and how can the Maths Foresees' network be of help?
- Is there a need for a bespoke funding modeling workshop and a meeting to bring prospective academic partners and stakeholders together?
- Several stakeholders have expressed the necessity to develop these mini-projects further into multidisciplinary research projects. How can this become reality, given that applied mathematical and multidisciplinary projects are often more difficult to sell, which was confirmed by some of the stakeholders? [Maths Foresees' network members have tried to acquire further funding for their projects.]

2. Several people have suggested to organise "Environmental Modelling in Industry Study Groups" in China.

- Discuss funding opportunities, finding challenges from Chinese companies, collaboration contacts and the potential for international collaboration.

3. After the successful Maths Foresees' study groups, the Isaac Newton Institute director and the Maths Foresees' organisers have coined the idea to develop a Newton Institute program on multi-scale modeling of extreme environmental events (time scale in/beyond 2 years time). A proposed topic was urban weather, pollution and flood modeling, in a program with at least two study groups in the beginning and in the middle, in which the program (2 or 3 months?) allows continued collaboration of high-potential study-group challenges identified.

- Discuss and comment on this topic and the desired format, both from stakeholder (e.g., EA, JBA, Met Office) and academic perspectives.
- Discuss other potential and promising themes and formats.

4. ... your other ideas, forging links with other networks (DARE, FCERM), etc.

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