Minutes

MAGIC Partners Meeting		
9.20.2018	10.30-17.00	Downing College, Cambridge
Attendees	(see attendee list)	
Welcome & Introduction to the day		
	Paul Linden	
	- Goal of MAGIC is to produce tools moving cities in the right direction towards the mission statement - There is a desire to continue dialogue and expand the MAGIC Circle - Fluid mechanics is an essential part of MAGIC. Two special interest groups from the UK Fluids Network are represented, urban fluid mechanics and low energy ventilation. - Meeting of the UK Fluids Networks on Dec 17/18 in Cambridge - Congratulations to Dr Megan Davies-Wykes, recently appointed as Liz Acton Lecturer in the Department of Engineering (previously MAGIC PDRA). We're happy that Megan will continue to work with us on MAGIC - We recently submitted our mid-term review to EPSRC and have had good feedback	
MAGIC Modelling		
	Fangxin Fang, Imperial College London (See presentation online)	
Key topics/discussion points	<u>Fluidity progress:</u> - Fluidity, which is open source, is the basis of our next generation model - We are working towards indoor-outdoor coupling and towards a real-time operational tool - We have started work on a radiation model and can change sunlight direction, seeing how shadow is impacted. - We can now automatically identify different types of urban terrain - Model validation against the wind tunnel data shows good agreement <u>Data Assimilation:</u> - We use Data Assimilation to improve the model predictions - Simulating data in the model helps reduce error in model - DA has improved the model predictions - The next step will be integrating wind tunnel data - The kind of areas we look at are currently about 0.5km, but in theory there is no limit to scale <u>Reduced Order Model:</u> - We have a Reduced Order Model (ROM) which is significantly less computationally expensive, helping us move towards real time and predictive modelling - ROM also makes it possible to consider larger scales (e.g. City-scale) - When you set up the ROM you give certain boundary conditions - We currently use machine learning methods in ROM	

Minutes

MAGIC Cambridge Test Site	
	Shiwei Fan, University of Cambridge (see presentation online)
Key topics/discussion points	- The new site, in central Cambridge, is next to busy roads and both green- and blue-space - The area consists of mostly low buildings - The objective is to look at the influence of natural infrastructure on pollution levels and indoor/outdoor exchange. - Last year our test site was in London, the Cambridge site is much greener, so we're hoping to be able to understand what difference that makes, and how much it influences the indoor conditions in a nearby building. - We are using a low cost sensor network to monitor across the area - The portable, battery powered MAGIC monitors have been upgraded – they now have separate temperature monitors to optimise and improve performance. - Shiwei has done a lot of work calibrating the sensors, he has disabled the auto baseline calibration set by the manufacturer - Weather station data is gathered from buildings close-by (Engineering and Chemistry). NB – the wind speed recorded from these is likely to be different because they are at different heights - We are already seeing that temperatures in the park and on the bridge are lower than in the street, sometimes by up to three degrees. - We don't have vertical profiles of the wind, but equipment has been installed at the London site to provide this, and we may go back there next year. - The outside monitoring is complemented by multiple sensors inside the test rooms. - The Cambridge site will be modelled in Fluidity, just as the London site was

Minutes

MAGIC Wind Tunnel	
	William Lin, University of Surrey (see presentation online)
Key topics/discussion points	- Generally, the wind field compares well with Fluidity, and there is a very good match away from the ground. - Nearer to ground it could do better, but the shape is not bad in comparison - One of the key challenges of the work is what to reference surface pressure to, which needs to be something steady - Lowest noise way is to pick two pressure paths, but this is less versatile. - The Surrey team have made good progression work to reduce the noise, from -.3 to .06 on the variance of pressure measurements. - Pressures being measured are small – like your voice talking. - The team are also looking closely at the effect of tall buildings and their spacing, and how it impacts the wake. - Wakes can persist up to 4-building heights downstream, impacting the mixing and air quality in the neighbourhood - The team are now starting to think how they might set up the tunnel for the Cambridge experiment – individual roof profiles for London had to be inputted individually by looking at Google, and the same thing will apply. - Does this level of detail on roof shape matter? It depends on what you think about - For mean flow not so important, but small eddies yes. - For pressure measurements, the team have found 1000 samples per second optimal. - The team are able to run at different speeds – it's a large enough section to walk through, and they're limited only by what the fan can do. Mainly 2m/s, but can run up to 3m/second. - Arrow tunnel is smaller concentration that can run at much higher speeds.

Minutes

The effect of water temperature on cross ventilation	
	Megan Davies-Wykes, University of Cambridge (see presentation online)
Key topics/discussion points	- Lab experiments take place in the water flume - The 'room' is small compared to total cross-sectional area of the flume - Experiments consider both wind and buoyancy driven ventilation. - Findings from Megan's team show that buoyancy slightly suppresses wind dominated ventilation - Wind dominated ventilation can be modelled as exponential decay with reduced room volume - Wind enhances buoyancy dominated ventilation - Buoyancy dominated ventilation can be modelled as exchange ventilation with a Froude number correction - To support these conclusions, Megan has developed a new model has been developed considering zero mixing, as opposed to well mixed environment (transient effects are hidden inside the models).
Introduction to Energy Efficient Cities Initiative & GrowGreen	
	Melanie Jans-Singh, University of Cambridge/GrowGreen (See presentation online)
Key topics/discussion points	- Melanie has been looking at the impact of green and blue infrastructure, under the umbrella of EECI - She has an interest in synergistic energy systems - Particular focus on urban greenery, urban framing and green roofs, for example, and combining with building energy simulation - Also part of GrowGreen, working with colleagues Rebecca Ward and Rai Calabuig - Grow Green is investigating Nature Based Solutions to key urban challenges (http://growgreenproject.eu/ - It is a five-year, Horizon 2020 EU project, coordinated by Manchester City Council with 23 partners. - There is a strong overlap with MAGIC on modelling the impact of green and blue space

Minutes

MAGIC Traffic and emissions modelling	
	Adam Boies, University of Cambridge; Clemence de Cornec, Imperial College London; Huw Woodward, Imperial College London (See presentation online)
Key topics/discussion points	<u>Emissions Modelling (University of Cambridge):</u> - When cities create pollution inventories, it's based on a long time length - Adam's group aims to get high resolution data, quicker (second by second even) not just what's happening today but alternative scenarios too - They use Portable Emissions Measurement Systems (PEMS) – lab grade and you can put them in the boot of a car. - Vehicles must now be PEMs tested, with equipment on the back. - They are quite happy with ability to model emissions. Miss some of the peaks. But have much higher resolution than what's available for typical models used by a city to do its inventories. - From this point you can start asking questions, e.g. about junctions. - They have another suite of physical tools, rather than analytical, want to measure particulate matter better than current devices allow. - Look for markers to learn about where particles come from, both by size and chemical signatures. - They look at how emissions are occurring and also, where are they transported to - Large scale deployment of particle sensors. - Adam's team aren't only working on the tailpipe, they measure everything, look at brakes too, for example. - In terms of commercialising the sensor, OPC is a good complementary device to these. They go below the OPC minimum. Will be sold by Alphasense, for products going across entire range. Hope for it to be below £1000. <u>Traffic Modelling (Imperial College, London):</u> - Huw is looking at the effect of instantaneous emissions on the street, and the entraining that happens. With a bus lane crossing a busy street, that will have a big effect not captured by most dispersion models. - Uses Vissim for vehicle dynamics. - Still have to think about: Accurate vehicle counts, traffic light timings (a lot of this has come from TfL). Also things like driving behaviour. Need to get that accurate because it impacts emissions.

Minutes

	Contd.

Key topics/discussion points contd.	- Instantaneous emissions model – this will ultimately be done by Marc and his team.
	- For now using a model from 2006 paper. It's a quadratic equation. Based on older vehicles, but still captures the expected behaviour of large peaks at acceleration
	- What's wrong with the traffic modelling in Fluidity at present?
	  - You need a long simulation time. Longer simulation time than would normally be the case for LES, which is already computationally expensive. [NB, there is the potential to apply ROM techniques to improve this, as explored earlier)
	  - Huw reduced the resolution of mesh, increased minimum edge length to address this.
	  - Low resolution doesn't capture the turbulence of the flow – but it is a reasonable representation and there are interesting things to gather even at low res
	- Going forward, we need to specify what we are aiming to get out of the simulation.
	- If we going to apply it to the LSBU site, we need to think about an updated emissions model, and to use that we need realistic driving behaviour.
	- We are partnering with TfL on many of these aspects
	- Simultaneously, work has been ongoing on a case-study in South Kensington working with another LES model Dalles-Urban, looking at personal exposure levels.
	- Found that the Dalles canyon average can underestimate personal exposure levels.

Minutes

Managing London's road network and vehicle emissions	
	Birendra Shrestha, Principal Transport Modeller, Transport for London (TfL) (See presentation online)
Key topics/discussion points	- TfL is responsible for 5% of London's road network, but this carries 30% of the traffic - They focus on operational modelling and visualisation (including 3D) - Traffic signals are the main tool for controlling the network, and a potential way to ease pollution - When looking at Air Quality they have 23 corridor models - These are updated every 3-years, for any changes need to look at the impact on main roads. - Under the new Mayor there has been an increased focus on clean air, down to the individual exposure of pedestrians and cyclists - So the department is focused on how to manage and reduce the impact of emissions from vehicles - Recently a trial of a gating strategy was undertaken on highly polluted Putney High Street - This used a microscopic simulation model (Vissim) and an emissions modelling software (PHEM) - Bus route NOx emissions were reduced on each segment of the route during the trial, the gating was only a 3-4 second change in traffic light timing.

Minutes

Emissions from interrupted traffic flow	
	Mark Peckham, Cambustion (see presentation online)
Key topics/discussion points	- Mark's company builds response emission analysers, - European regulation dry cycle, is old hat. We have moved to a system of testing vehicles based on real world driving. - Cambustion's analysers have a response time of a millisecond or so, which is 1000s of times faster - Transients (accelerations, decelerations etc.) are key – engines dump emissions at these points - In order to reduce emissions from transients you need to measure the data on very fast timescales. - If you have fast analysers and GPS, you can establish where you've dropped your emissions to resolution of a few cm (at 30mph). - You don't see the transients with standard PEMS equipment. - Cambustion's data shows that speedbump provides a large spike in emissions on a very short duration. - On buses, improvements are being made such as SCR, still get huge spikes in NOx during transients, so more investigation needed here. - Hard to compare a single route, a single test. Many different conditions, climatic differences, things happening around you, congestion. Etc. - Transients bring out the worst in engines. Working out how and why they are occurring useful for managing emissions effectively. - People are moving towards considering these issues with the new emissions legislation, they just aren't entirely sure how to do it yet.

Minutes

Feedback from Steering Committee	
	Jimmy Lirvat, Dyson
Key issues	- Productive discussion today, with different partners, and EPSRC as well - MAGIC aims to deliver a software tool that must be useful to wider industry - Requirement – need to understand better, what are the expectations of the people using the tool. - The Steering Committee members are preparing user profiles to understand different expectations. - If people in the room want to join this effort that would be great. - How are they planning to use it, how do they visualise it etc. - With new people always joining the partners meetings, a better balance is needed being introductory and new content
Wrap up	
	Paul Linden, MAGIC
Key issues	- Apologies to Bill Legassick for not getting him to the S/C meeting - A lot of other projects coming on stream that are related MAGIC. - Adding to our MAGIC Circle we see as a way of collaborating and enriching our experience within the project. But we are not trying to divert our interest away from our stated objectives. - We are trying to build a community and that should be a legacy of the project. - We won't solve the problem by 2020, but we can make good progress, and beyond that this research needs to continue. Getting the community engaged is important. - Thank you to everyone for coming.

-