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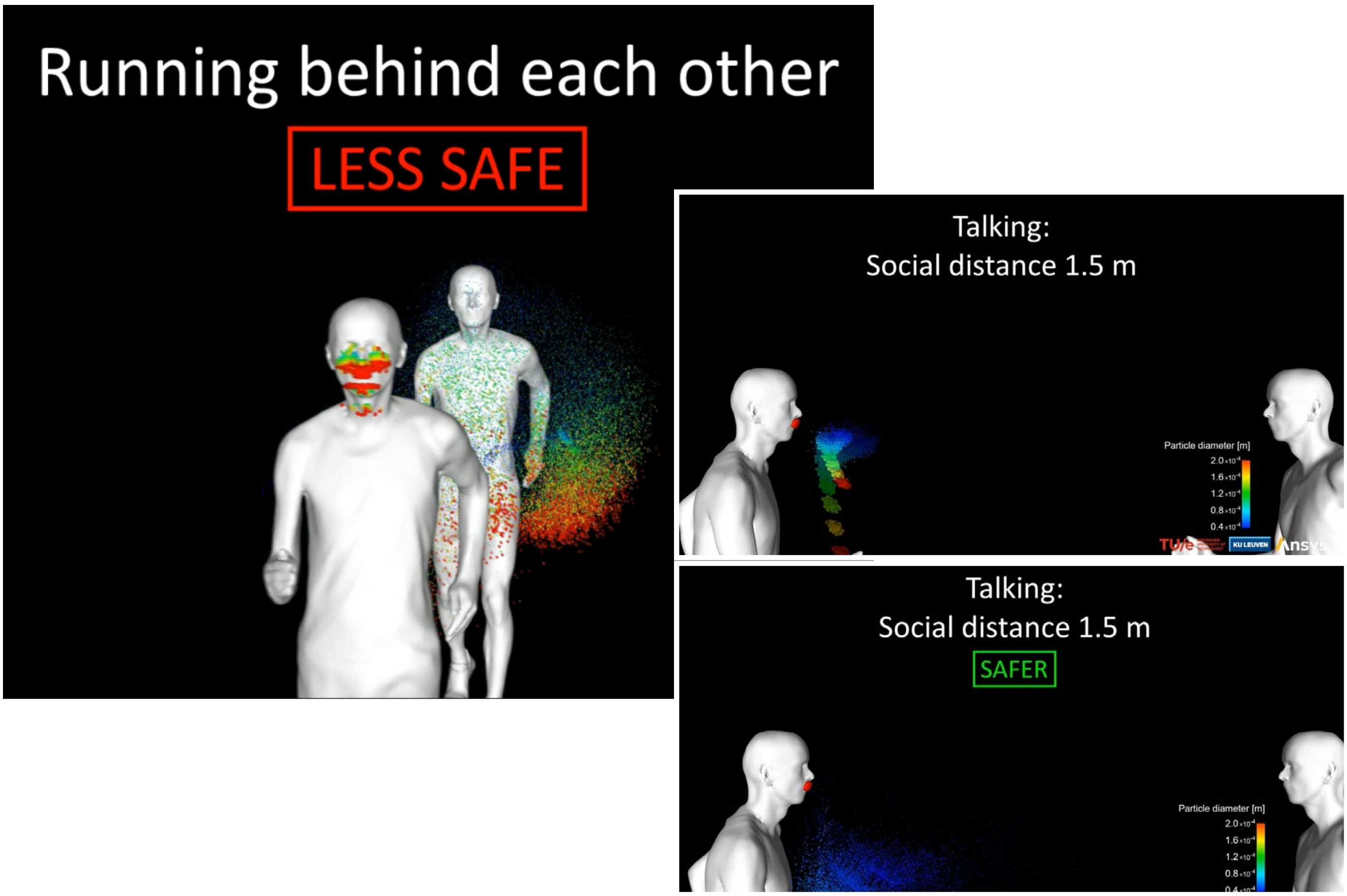

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President's message

Dear IBPSA Colleagues and Friends

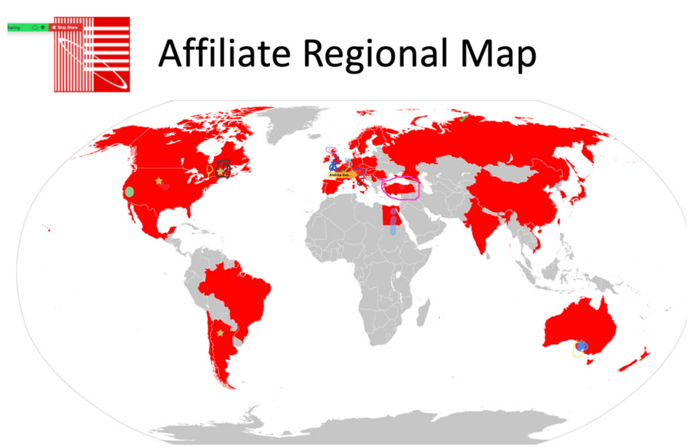
I think that you will agree, it has been a strange and difficult year, so I hope that you and your families remain well and that things begin to improve soon.

The situation regarding COVID 19 has affected everything and everyone and continues to change daily, with travel restrictions and spikes in infection cases meaning that for us, there will be no return to normal anytime soon and indeed that may be a good thing, giving us more time to reflect and consider what a 'green recovery' really means.

From mid-March 2020, all IBPSA Affiliate conferences were postponed or run as online events and this looks set to continue until mid-November at the earliest. For the last six months I think it would be safe to say that a lot of everyone's time has gone into issues relating to the pandemic, from health worries to family concerns to keeping our businesses and research going. It has not been easy.

I remember at the Rome conference last year, there was a call from some of our younger members to do more on-line events to mitigate Climate Change. This met with a mixed response, as many felt that a conference once every two years was not excessive and moreover, the benefits of face to face networking can be invaluable on many levels. However, the world has changed completely in nine months. It is still anticipated that BS2021 will go ahead as a live conference in Bruges next September but we will just have to wait to see how things play out.

The Board held its Annual Meeting of Members (AGM) on 12 and 13 September 2020 – for the first time virtually. It was a shorter than normal affair over two 90-minute sessions. As the image below shows we had attendees from across the affiliate world – each putting their own stamp on the map!



President's message

We welcomed in a number of new Affiliate Directors, re-appointed others and appointed one new Director At Large to take over from Ian Beausoleil-Morrison who has decided to step down after 16 years on the Board. Ian served as President from 2010 – 2015 and supported the incorporation of IBPSA as a Canadian Company. He will remain Editor of the Journal of Building Performance Simulation and a member of the Conference Committee, so although we are sorry to see him go he will still be around. We would like to offer Ian our thanks and very best wishes for all of the time he has given so freely!

I'm sorry to report that progress on many of the things we set out to do this year has been slow, but there has been progress in some areas which is a positive sign:
We have identified a way forward for a Membership database which is an important step in better managing who is / is not an IBPSA Member. As this moves forward our priority will be to develop membership benefits to encourage more to join as supporting members and these are some of the things that we might consider:

- More Regular CPD and other member services
- Formally recognised training courses
- Modelling accreditation through IBPSA
- Moving towards professional recognition?

We would welcome your views on this – so if you have any ideas on what might entice you to become a supporting member of IBPSA, please let us know.

Communication remains an issue and the time has come to update and revamp the website to improve our ability to engage with a new audience, grow our membership, and build in some tools and new features, we will report on this by the next newsletter.

I have mentioned inclusivity in every message to you, and one way of tackling this is by conjoining this with education – through our student and young modeller base. To this end, a sub Committee has been set up to progress the development of an IBPSA Academy and Summer School – and they are making good progress. Unfortunately, the current environment is not good for developing a Summer School experience – but we could work towards something virtual in the short term.

Hopefully by the time I write again we will be able to think about getting together in September 2021. In the meantime stay safe and stay well.

Best of 'Ask a Modeler': Hard schedules and rifts with designers

This May marked one year of 'Ask a Modeler,' the advice column for the building simulation community. Every month, committee chair Nathaniel Jones and members of the Emerging Simulation Technology subcommittee pose a question submitted by an IBPSA member to recognized experts to get their unique perspectives. The column aims to create a sense of community among practitioners, researchers, and academics at all points in their building simulation careers. Below, we are reprinting some expert advice from the past few months. We hope that sharing these questions and insights will bring value to your work and possibly make you think about building performance modeling from a new point of view.

What are some new or creative sources of hard-to-get data, such as occupancy or load schedules?
— Playing Hard to Get

Dear Playing,
I'm happy to suggest a few "creative" sources of data for you to play with. You'll have to judge whether they're appropriate for your work!

Let's start with occupancy schedules. Suppose we want to derive them from the behavioral patterns that occur in an existing building. Our first instinct may be to explore the various technological solutions at our disposal: passive infrared motion sensors, carbon dioxide sensors, pressure sensing floor mats, RFID badges, WiFi location tracking, video cameras, etc. But deploying these technologies is a significant undertaking that may not be practical for a typical energy modeling project.

Sometimes the simplest solutions are the best. Here are a few alternatives to installing a sensor network.

1. The Clipboard Method. This approach is as simple as it gets. One or more people with clipboards observe human activity in a building and write down whatever information is needed. For example, they could record the number of people in every room once per hour.

The clipboard method seems obvious to me now, but I hadn't even considered it until I saw a keynote talk by Technion architecture professor Yehuda Kalay. His research group had obtained permission from several doctors to have students with clipboards follow them around during the day and record their activities. The purpose of that effort was to inform the layout of hospital wards, but one can imagine similar approaches being employed for energy modeling.

2. The Webcam Method. People may not appreciate being observed by other people. The idea behind the webcam method is to have people observe themselves, particularly in office environments.

Participants are provided with a licence for a webcam surveillance app, of which there are many affordable options online. They then configure the software to record video whenever they arrive at or depart from their desks. Participants review their own surveillance logs at the end of the day, and manually prepare a spreadsheet with the required data. The process takes a bit of practice and dedication, but it works.

3. The Wisdom-of-the-Crowd Method. The idea is to assemble a diverse group of participants who are familiar with a building environment, and have them simply make up whatever information is needed. For example, participants could independently suggest one or more occupancy schedules, and their contributions could be averaged.

Wait, what?! Make up information? Isn't that unscientific?

Having one person make up information is unscientific. But having multiple people make up information can be considered a statistical approach. The human brain is a highly advanced pattern recognition and reproduction machine. It is also a highly biased machine, but this bias can be mitigated through diversity. If measured data is lacking, as it probably is, a diverse group of knowledgeable people might well be the best information source available.

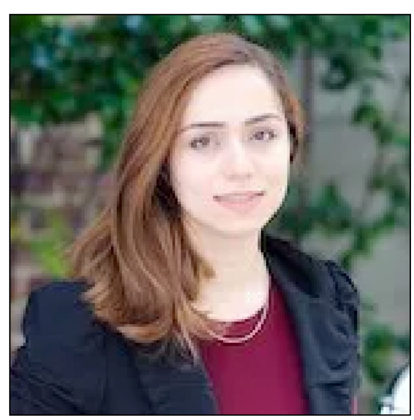
Additional thoughts. The above methods are relevant for occupant behavior, which people have the ability to observe. But what about information that cannot be "seen" without measurement technology, such as plug or equipment loads? For lack of a better answer, inverse modeling strikes me as a promising research area that allows people to "measure" data indirectly.

While standard schedules are available, the energy modeling community should develop practical alternatives which better account for the diverse settings and behaviors that exist in our changing world. In the meantime, you must decide how much energy to invest in "hard-to-get" data, and how much creativity is appropriate.

Rhys Goldstein
Principal Research Scientist, Autodesk Research

What is the biggest misconception designers have about energy modeling?
— First-time Modeler

Dear First-time,



Energy modeling provides us an insight about the importance of design decisions on total energy consumption. On one hand, I've seen architects who are eagerly waiting for the energy modeling results as they are tweaking the envelope and making it more energy efficient. They believe that a change in the envelope can noticeably change the total energy consumption. On the other hand, I've talked to my colleagues in engineering companies who are brushing off the notion that the envelope design significantly impacts energy consumption. So why does this rift exist between the architects and engineers?

Let's discuss the elephant in the room: a misconception about the importance of envelope design on the total energy consumption. In other words, does the envelope design matter regarding total energy consumption? The answer is it depends on four "whats":

- What are you comparing to?
- What is the function of the building?
- What is the general building mass?
- And what is the climate?

It depends on what we are comparing our envelope decision to. As we are designing more and more efficient envelopes with better U-values, and as the baseline and the local building code become more efficient and stringent, the impact of envelope design on the total energy consumption is getting diminished.

In addition, the energy consumption of a building is defined by what the function of the building is. In some projects the internal load of the building forms a major part of the total energy consumption which pushes the envelope loads to the side, such as in data centers.

Moreover, the general shape of the building can determine whether the envelope decision matters regarding total energy consumption. The general shape of the building is defined by the surface to volume ratio: how tall or how flat the building is. If you design a multi-story office building, then the surface to volume ratio is low. This indicates that the envelope decision in a multi-story office building is not a significant role player compared to a one-story office building.

And finally, the climate can diminish or highlight the importance of the envelope design. If you design for mild climate zones similar to California, then the internal loads probably play a more significant role than the envelope loads when it comes to the total energy consumption.

Per the discussed four "whats," one may conclude that for some projects the envelope design is not an important player regarding total energy consumption. While this is true, we should not dismiss the significance of architects' decisions about the envelope design. Keeping the holistic view, total energy consumption is just one design criterion. Peak energy, visual and thermal comfort are other design criteria that will always be impacted by the envelope decisions regardless of the discussed four points. The envelope design as a part of a multi-faceted design problem impacts different design criteria which can be studied by building simulation tools.

Sara Motamedi, PhD
Senior Building Performance Analyst, Interface Engineering

We want to hear your interesting, entertaining, or just plain odd questions about life and building performance simulation. Submit your questions at **www.ibpsa.us/ask-modeler** *to be answered by prominent building performance simulation experts. Note that questions requiring an immediate response should be submitted to the community of experts at* **unmethours.com**. *Read our other past columns at* **www.ibpsa.us/ask-modeler-column-archive**. *If you are interested in replying to a question as a featured expert or have any other feedback about* Ask a Modeler, *please email* **askamodeler@ibpsa.us**. ■

Interview with Bert Blocken

Modelling droplet dispersion in the context of COVID-19

Christina Hopfe has been talking to Bert Blocken about modelling dispersion of large droplets using CFD and his application of this technique to research in the sports domain in the context of COVID-19.

Bert Blocken is a Full Professor at the Department of the Built Environment at Eindhoven University of Technology (TU/e) in the Netherlands and a part-time Full Professor at the Department of Civil Engineering at KU Leuven in Belgium. His areas of expertise are urban physics, wind engineering and sports aerodynamics. He uses Computational Fluid Dynamics (CFD), atmospheric boundary layer wind tunnel testing and field experimentation.

Christina Hopfe (CJH): 1. In April 2020 (at the height of the COVID-19 outbreak), you circulated via social media a number of different videos illustrating the importance of social distancing whilst exercising in this pandemic. Can you explain the different scenarios you simulated?

Bert Blocken (BB): Our goal was to investigate so-called "equivalent" social distances for people that are moving together in the same direction at a considerable speed, such as groups of runners or cyclists. The social distance guideline of 1.5 m (or 2 m or 6 ft depending on the country) applies for two people standing still, in an environment without wind, such as two people talking to each other. With these distances, most of the respiratory droplets produced by coughing or sneezing will not reach the face or even the upper part of the body of the other person. The situation however is very different for two people moving at a considerable speed, e.g. 5, 10 or 30 km/h.

That saliva droplets fly around in the cycling peloton is well-known in professional cycling. To avoid misunderstandings: this study did not focus on aerosols. This study focused on large droplets, such as those generated by coughing, sneezing or spitting. It is well-established that large droplet exchange is a main transmission route for the virus.

We investigated three scenarios: (i) two people walking fast (4 km/h); (ii) two people running fast (14 km/h); (iii) two people cycling fast (30 km/h). In each of these scenarios, we considered the persons in side-by-side arrangement (parallel), aligned in the direction of movement (second person in the slipstream or wake of the other), and staggered. In all cases we assumed that there is no head wind, tail wind or cross wind. It could be nice and illustrative to investigate what happens in a complete cycling peloton, but we believe that the limited additional insight by such a simulation would not justify the large computational cost.

We found that the respiratory droplets, whether by coughing or sneezing, stay fairly well confined in the slipstream behind the person that generated them. This implies that a person who tries to benefit from this slipstream by positioning himself or herself in it will be exposed to these droplets. In fact, this is common sense and this research was not done to confirm common sense. The research was done to determine the "equivalent" social distances for such moving persons. The conclusions are: the social distance can remain 1.5 m, except for persons positioning themselves in the slipstream of others. In the latter case, the approximate equivalent social distances are: 5 m for walking fast, 10 m for running fast, 20 m for cycling at about 30 km/h.

CJH: What software did you use to create these scenarios and did this require extensive new coding to model COVID-19-specific droplet transmission properties? Is there other software equally suited to this application?

BB: We used Ansys Fluent. This software is well suited to modelling droplet transmission. These are also not very complex simulations. It is not rocket science. The difficult part is the turbulent dispersion for the smaller part of the droplet spectrum. One can adopt an Eulerian-Lagrangian approach or a Eulerian-Eulerian approach to model the droplet behaviour in the flow pattern. Any CFD software that allows these modelling approaches could in theory be used for this type of droplet transmission studies.

CJH: To validate your models, you made use of a newly constructed wind tunnel at TU Eindhoven. Can you briefly describe what this enables you to do?

BB: It allows us to measure the air speed around human bodies, either walkers, runners or cyclists, and the behaviour of droplets in these flow fields. This allows us to perform the required validation of the CFD simulations.

CJH: Could this equally be validated using alternative empirical approaches such as saltwater bath modelling?

BB: That would be rather difficult, given the incompatible similarity requirements. That is why we perform validation at full scale and in air and actual water droplets or solid particles.

CJH: An airborne virus is effectively a particle or cluster of particles that is suspended in air or contained within droplets of fluid. But in terms of respiratory transmission we understand that the virus spreads primarily by means of small droplets in the breath, also called aerosols. From your videos, it appears that you are creating three different droplet types or sizes. What do these droplet sizes represent and what are their respective diameters?

BB: A distinction needs to be made between aerosols (smallest droplets) and the larger droplets our work focuses on. Even though separating them is rather arbitrary, many scientists consider a diameter of 5 micrometres as the threshold. Smaller droplets are then called aerosols. Whether and to what extent aerosols can transmit the virus is still an issue of debate in the scientific community. What is certain, however, is that large droplets, that can contain a lot of virus, can effectively transmit the virus. That is why social distancing has been encouraged, and why masks are used and even enforced in some countries.

Saliva droplets were represented by a Rosin-Rammler droplet distribution with minimum diameter of 40 µm, an average diameter of 80 µm and a maximum diameter of 200 µm, in line with the values from the literature.

CJH: The COVID aerosol dispersion trajectories appear to be highly influenced by the droplet size you have modelled. How can you be sure the droplet sizes are not larger or smaller than those you have modelled?

BB: Many previous studies have measured droplet sizes generated by exhaling, talking, coughing and sneezing. These cover a very wide range. We selected a droplet spectrum that is a subset of that range and that represent droplets expelled by coughing or sneezing. It is always possible that larger droplets occur and for sure also smaller droplets occur. Research is never complete and it was also not our intention to be complete. Research always has limitations and never covers all possible scenarios. That is of course also the case here.

CJH: Numerous other particles, gas molecules and aerosols are dispersed in the urban environment including fog, mist and dust, air pollutants, ozone and smoke. How will these factors influence the models you created?

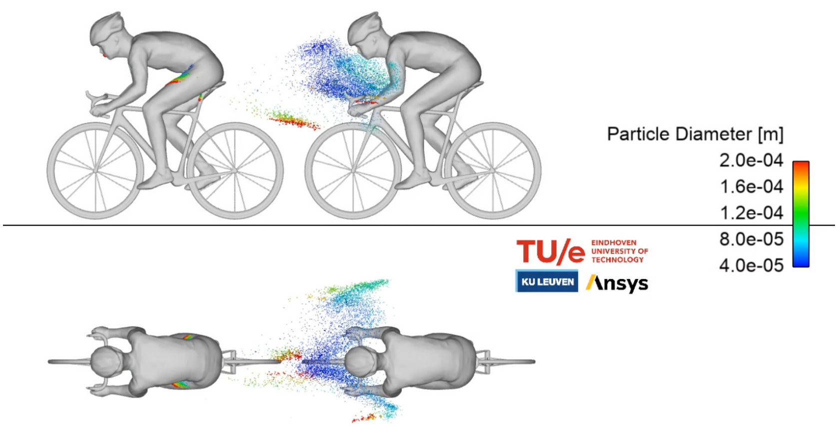
BB: These factors do not affect our models. We only looked at very short range dispersion that is driven by the air movement very close to the human bodies and we focused on large droplets where their movement is mainly inertia-driven.

CJH: Most people exercising outdoors are aware of the presence of wind, which is sometimes quite strong even in urban settings. What is the sensitivity of your findings to wind and localised turbulence?

BB: For sure wind will have an effect. But the qualitative conclusions still hold in that case. If you want to avoid the droplets, you need to stay out of the slipstream. In case of cross-wind, the slipstream will be curved along with the wind direction. The study can be extended for cross wind, head wind and tail wind to find the values of the equivalent social distances.

C *JH: I understand that you have applied for a grant to continue this work. What developments do you plan next?*

BB: We had four new projects approved following this work, two of which have already been finalized. One was a direct extension of the equivalent social distances when moving and three are focused on droplet and aerosol behaviour in sports environments. A movie of the second project can be seen here: **https://youtu.be/PdBgr4U0BKg**. In the fourth one, that will run from 1 September 2020 to 31 December 2021, we will measure and simulate conditions in a large soccer stadium and a basketball hall, focusing on both the players and the spectators.



Animated versions of these graphics can be seen at **https://surfdrive.surf.nl/files/index.php/s/mOm7Dk5qlNDmtQu** (cyclists, in MP4 format) and at **https://surfdrive.surf.nl/files/index.php/s/GwMf0vWuz3q4Fx2** (cyclists, as an animated gif), and at **https://surfdrive.surf.nl/files/index.php/s/1NHi014XvcUu7Ht** (runners, MP4) and **https://surfdrive.surf.nl/files/index.php/s/QMZR4QLfQEHNaka** (runners, animated gif).

CJH: Thank you, Bert!

Forthcoming events

Date(s)	Event	Further information
2020		
11-12 November 2020	**uSIM: Modelling, simulation and analysis of future urban energy systems** online (replacing Edinburgh, Scotland, UK)	**www.usim20.hw.ac.uk**
07-09 December 2020	**Asim (5th Asia IBPSA conference)** Osaka, Japan	**www.ibpsa.cn**
2021		
15-17 March 2021 **NEW DATE**	**ASHRAE Winter conference** Chicago, Illinois, USA	**www.ashrae.org/conferences/2021-winter-conference-chicago**
15-17 April 2021	**SIMAUD** online	**www.simaud.org/2021/call_for_submissions.php#important_dates**
Spring 2021 (probably May)	**eSIM 2020** Vancouver, British Columbia, Canada	**http://esim2020.sala.ubc.ca**
26-30 June 2021	**ASHRAE Annual Conference** Phoenix, Arizona, USA	**www.ashrae.org/conferences/ashrae-conferences**
01-03 September 2021	**BS2021** Bruges, Belgium	**www.bs2021.org**
2022		
29 January - 02 February 2022	**ASHRAE Winter conference** Las Vegas, Nevada, USA	**www.ashrae.org/conferences/ashrae-conferences**
25-29 June 2022	**ASHRAE Annual Conference** Toronto, Ontario, Canada	**www.ashrae.org/conferences/ashrae-conferences**

Note that the dates in this calendar may, but do not necessarily, include pre and/or post-conference workshop days

NOW ONLINE ONLY!
see IBPSA-Scotland report, page 54

Open call for abstracts for the **2nd IBPSA-Scotland uSIM conference**

Following on from the success of uSIM2018, this conference will explore the state-of-the-art in urban energy modelling. Hosted by the Urban Energy Research Group at Heriot-Watt University in Edinburgh, the conference panel is looking for research papers from academia and industry in topics covering:

- Community Energy Modelling
- Future Forms Of Stock Modelling Of The Built Environment
- Use Of Big Data In The Understanding Of Urban Energy
- Software Developments In Dynamic Simulation
- Multi-building Energy Performance Assessments
- Applications Of Both Bottom-up And Top-down Energy Modelling Of Buildings

The deadline for abstract submissions is 20th March 2020. All abstracts will be peer reviewed by the uSIM Technical Committee, with full paper submission due 30th June 2020.

Abstracts of up to 300 words can be submitted via the uSIM conference website https://usim20.hw.ac.uk/.

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Welcome to ASim2020

The 5th Asia Conference of International Building Performance Simulation Association

7-9 December 2020, Osaka, Japan

Welcome!! We sincerely invite you to attend the 5th Asia Conference of International Building Performance Simulation Association – Asim2020, held on 7 -9 December, 2020 in Osaka, Japan. This biennial conference will provide a platform for academics, professionals, consultants, designers, engineers and research students exchange ideas, knowledge and information about building performance simulation. ASim2020 program will include keynote speeches, technical sessions, workshop session and poster presentations discussing all aspects of building performance simulation. We are looking forward to seeing you in Osaka!

Call for abstract

Participants interested in making an oral or poster presentation on the topics listed below are invited to submit abstracts up to 300 words.

Topics

1. Building physics
2. Simulation and real performance
3. Simulation in design practice
4. Simulation for regulation/code compliance and certification
5. Software/Interface development, test and validation
6. Simulation to support commissioning, controls and monitoring
7. Case studies of building simulation application
8. Community/Urban scale modelling and simulation
9. Occupant behavior in buildings
10. Indoor environment: comfort, air quality, lighting and acoustic
11. Optimization of control and design
12. BIM and BEM
13. Uncertainty and sensitivity analysis
14. AI, machine learning and data-driven model

Important Dates

Abstract submission deadline	: May 10, 2020
Abstract acceptance notification	: June 5, 2020
Draft paper submission deadline	: August 5, 2020
Paper acceptance notification	: September 7, 2020
Early registration deadline	: October 23, 2020
Online registration deadline	: November 31, 2020
Onsite registration and technical tour	: December 7, 2020
Conference main program	: December 8 and 9, 2020

Organized by

International Building Performance Simulation Association Japan.

INTERNATIONAL BUILDING PERFORMANCE SIMULATION ASSOCIATION

Conference chairs

SHIMODA Yoshiyuki (Osaka University)

YAMAGUCHI Yohei (Osaka University)

Venue

Osaka International Convention center (5-3-51, Nakanoshima Kita-ku, Osaka, JAPAN)

Nakanoshima

www.ibpsa.cn

BS 2021

17th IBPSA International Conference & Exhibition

01-03 September 2021
Bruges, Belgium
https://bs2021.org

Following the successful BS 2019 in Rome, Bruges — 'the Venice of the North' — is hosting our next world building simulation conference. BS 2021 is scheduled for 1-3 September 2021, so save the date in your calendars now.

Bruges, a UNESCO world heritage city in Belgium, has flourished since the middle ages, and has kept its original and charming atmosphere ever since. A network of canals connects the numerous historical buildings in the center. The Belfry halls, located at the central market place, will be the heart of our conference. Bruges is a short 20 km distance from the coastline, and only 60 minutes by train from Brussels and two and a half hours from London, Paris and Amsterdam.

BS 2021 is being organized by a team of very enthusiastic people drawn from two universities (Leuven and Ghent) and two companies (Boydens Engineering and Daidalos-Peutz), assisted by the regional affiliate IBPSA-NVL.

As ever, the key to a great conference will be a good mix of academics, R&D people, practitioners and policy makers, and the conference is being planned to appeal to them all from day 1.

The social side of conferences is important, too. Amongst other events, BS 2021 will include a competition to compose a BS 2021 Bruges belfry theme. Musician members of our community are invited to write an original and exiting polyphonic song for the 47 bells of the impressive carillon in the Bruges Belfry, which will wake up the city every day, while we make our way to the conference sessions beneath the tower. If the challenge of composing the belfry theme appeals to you please email **music@bs2021.org** for more information.

Practical organisation of BS 2021 is in the hands of the KU Leuven Conference Office, who will help you wherever they can; please send any questions to **info@bs2021.org**.

For an update from the conference chairs, keep reading …

To all dedicated IBPSA members and sympathizers, to all eager and willing to contribute to or attend our next conference, BS2021,

On behalf of the BS2021-OC, we hope you all had a wonderful summer and encouraged by your impressive interest and number of abstracts for the Bruges conference we maintain our crystal clear message:

we stand tall!

We are still working towards a live and face to face 2021 conference, as planned, respecting and valuing the work of each individual in our community. We will not switch to an on-line or hybrid alternative. Only in the case of force majeure will we adopt plan B, which is postponement to August 2022. If that happens, we will valorize the (in 2021) accepted papers in 'proceedings of a postponed conference'. Also the routes available to recover your money will be followed to the maximum level possible. For further details please refer to **www.bs2021.org**.

Abstract reviews have been completed, so please now get to work on your full papers, which we look forward to receiving by the end of January 2021.

We believe we are on track for an unforgettable BS 2021 in Bruges. In science we trust, and in all our other beliefs. March forwards towards a safe and healthy September 2021, where we can get together!

We send best wishes to you all!

Lieve Helsen, KU Leuven, Belgium

and

Wim Boydens, Boydens engineering, Belgium

The Music of Building Performance Simulation

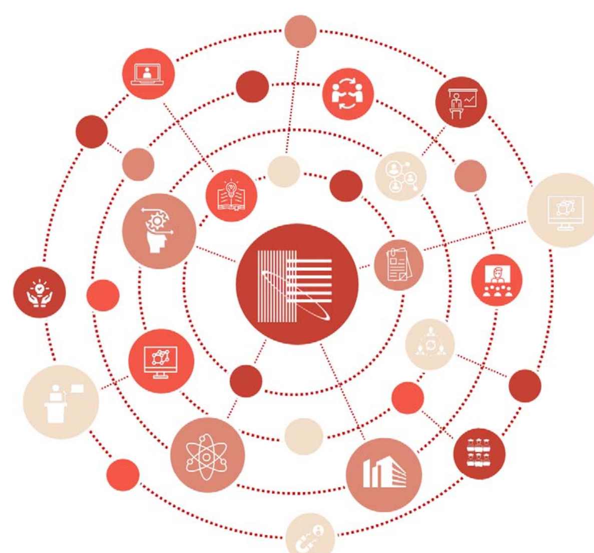
"All models are wrong, but some are useful" - George Box

The aphorism "All models are wrong, but some are useful" in the context of building performance simulation (BPS) models has been explored many times by experienced professionals in the field. For instance, the keynote speech by Ardeshir Mahdavi, at the recent BS conference in Rome, reflected critically on whether building simulations matter. In this article we - Amanda, Renjith and Chengnan, students from IBPSA's India, England and USA affiliates - share our thoughts and experience of BPS and the influence IBPSA had on our journey of learning and growth.

The Melody of BPS!

Building Performance Simulation is the common thread that binds students like us of varied backgrounds and diverse goals together. For us, BPS not only allows us to design/model and investigate different aspects of a building's performance but also to study the fundamentals of building physics. BPS tools enable the transformation of design concepts into interactive visual content thereby allowing us to understand the relationship between systems and their influence on the performance of buildings.

BPS allows us to assess and understand the performance of a large number of building designs in a relatively small period of time. This provides an opportunity to experiment and learn the impact of different design scenarios on the building's performance, and therefore to predict and prepare for the different outcomes that could occur in reality. Though the widely accepted uncertainties related to user knowledge/experience, occupant behaviour, weather conditions, etc make it difficult to accurately predict the performance of a building, these models provide important feedback to the student thereby helping reinforce theoretical knowledge with hands-on training through simulation.



It is important to us students that we are trained to model, simulate, analyse and understand the role and influence of different parameters such as envelope properties, climate, HVAC systems etc. on building aspects such as energy use, Indoor Environment Quality (IEQ) etc. The constant development of various BPS related tools has brought them to a level which has made them accessible to all users. These tools along with probabilistic modelling techniques allow us to investigate and understand the influence of the above parameters on energy demand and IEQ in buildings and our theoretical knowledge helps us to analyse the simulated results by giving due consideration to the modelling assumptions and/or limitations. In addition, the whole design-to-simulation process creates a problem-solving environment that helps us learn and master the skill.

IBPSA, the composer!

From the perspective of students, IBPSA plays a huge part in promoting the correct application of BPS by providing various resources. For example, the association's first book *Building Performance Simulation for Design and Operation*, co-authored by 21 experts in the field, provides a unique and comprehensive overview of BPS.

Pieter de Wilde's *Building Performance Analysis* (IBPSA's second endorsed book) offers deeper insights on BPS from a global perspective including design, operation and management. From this reference book, we are able to learn the working definition of building performance and also understand in-depth the role that building performance plays throughout a building's life cycle. The book provides assistance to targeted audiences at various levels, starting by answering basic questions such as "What is building performance?" and "How can building performance be measured and analysed?" and going on to explain how to use building performance analysis to guide the improvement of buildings without compromising the needs of their stakeholders. These two books, available to the wider building simulation community, aim to assist students, researchers, developers and practitioners to improve the built environment. They provide a valuable source of varied views on a range of models to enhance our skills and knowledge in different areas.

Another resource made available by the association to promote better understanding and use of BPS among students is through a series of webinars produced by the IBPSA education committee, whose mandate is to provide essential education and training to the BPS community. These webinars, which are open to members and non-members, provide a great opportunity especially for students like us from different IBPSA affiliates, irrespective of the time-zones, to virtually meet, interact and learn the wider aspects and views of BPS from experienced academics and industrial practitioners. IBPSA webinars also help minimize/remove many of the potential barriers for students, such as travel costs, especially for those of us from different affiliates that restrict our attendance at talks and seminars from noted personalities in the field of BPS. The availability of recorded webinars via IBPSA's YouTube channel also makes it possible to (re)attend them at attendees' convenient times.

In addition to all that we have mentioned so far, IBPSA also provides us with an array of opportunities to promote the correct application and further development of BPS. IBPSA world as well as its different affiliates keeps us informed of the various competitions in the field through newsletters and social media interactions and also encourages students' participation by providing suitable resources. Entering these competitions gives us a chance to put our theoretical knowledge to the test and explore various possibilities while interacting with our peers. For example, participation in the bi-annual IBPSA modelling competition and the architecture at zero competition, of which we were made aware by IBPSA, promoted teamwork among us students and enabled us to excel at all the challenges while competing to win. Collaborations and competitions among students instil in us the ability to do our best and at the same time to come up with new ideas. It is in these events that each of our talents are highlighted to give the best output. These competitions help us as individuals to grow by challenging ourselves and to be better prepared for the professional world. Participation in competitions provides an opportunity to assess our knowledge with respect to the wider academic world and get constructive feedback on our work from the experienced BPS community. The many diverse competitions made available to students not only help improve our knowledge and skills but also provide a platform for us to interact with our counterparts from different universities around the world.

Another IBPSA event that opens up numerous opportunities for students is the Building Simulation conference. The IBPSA building simulation conference is in general devoted to all aspects of building performance simulation and aims to provide a forum for the presentation

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of recent developments in the field and allow users to learn the capabilities of building simulation tools and programs. One of the most notable positive aspect to students while attending and presenting at the IBPSA (BS and regional) conferences is that it opens before us an opportunity to present our research to a wider audience and get critical third perspective feedback on the work. The IBPSA community, having members from the academic as well as the industrial side, provides an opportunity to get critical comments and thoughts with respect to the theoretical as well the practical implications of our simulation work/results.

The IBPSA conferences also provide a platform for communicating the results of our work to the outer world in the form of paper and poster presentations. This plays a crucial role as the exposure we get, at the early stages of our career, by presenting our work (papers) especially to an experienced audience as well as by attending the presentations of other delegates, helps improve our written and oral communication skills. The conference brings in speakers/delegates, working in different aspects of simulation, from all over the world to a single venue. For example, the last BS conference in Rome (2019) saw an attendance of more than 1000 delegates. These events thus open up the opportunity for us to hear and interact with the delegates about the latest research focus areas and developments in the field. These interactions often help widen and refine our ideas.

Apart from the technical paper presentation sessions, the unique panel discussion sessions (organized in the last BS conference in Rome) provide an opportunity for us to participate and engage in constructive discussions and debates with experts (academic and practitioners) in the field. For example, the panel on "Weather" at the BS conference in Rome (2019) brought all the experts focusing on the same field to a single venue and opened up an opportunity for us to meet and interact with them. These sessions, unlike the technical paper presentation sessions, give us more opportunity (and time) to express our views and ideas, and hear the opinion(s) of others. Also, the workshop sessions organized at the conference venue provide an opportune occasion to learn about new developments in BPS tools.

In addition to the technical sessions and workshops, the conference dinners and other social activities like wine tasting, cocktail nights, artisan beer tasting events etc. are very popular and much appreciated by students. These events provide an opportunity for us to interact freely with the academic "legends" in a friendly and social atmosphere.

Tuning to new symphonies!

Having discussed all the positive aspects that IBPSA brings to the table from our perspective and experiences, we feel that the need of the hour is for young blood to have a dedicated space or forum to help and inspire research stories and promote interaction with various students around the globe.

This could be in the form of an "IBPSA Gen-X Community". The members of the community would be students, early-career researchers and early-career practitioners. The activities of the community could be mentored by IBPSA Fellows. The group could be involved in a wide range of activities such as organising webinars, writing up inspiring research stories from members as news article etc. The group could also organise (winter) virtual conferences encouraging participation from among the members. These could attract more participants as cost related barriers would be removed or greatly reduced, and they could be attended remotely from anywhere in the world.

The authors of the best and the highly commended papers could be invited to submit full-papers and/or presentations at the regional or bi-annual BS conferences. The elected members of the group could also be invited to be actively involved in the wider activities of IBPSA. We should really like IBPSA to consider these ideas for encouraging wider participation and collaboration among the younger BPS community from the different affiliates around the world. ■

Software news

IES releases Feature Pack 03 and new webinars and technical articles

IES's latest Feature Pack 03 released in September includes a variety of updates and new capabilities, and they have added new material to their on-demand webinars — and made them free to watch.

New and updated features

DECARBONISATION / ELECTRIFICATION

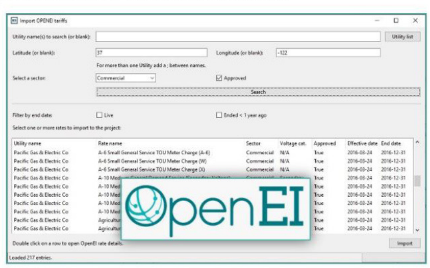
Battery Storage

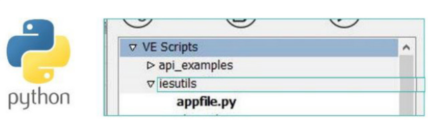
- Evaluation of energy storage for energy-independent buildings.
- Variable seasonable availability schedules.
- Three charge/discharge control options
    1. Simple
    2. Time of Use (TOU)
    3. Advanced Demand Response (DR)

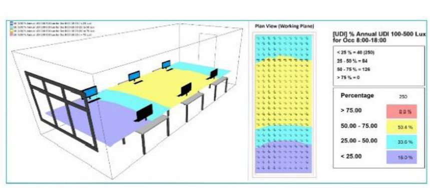
PV Model Update

- The PV panel placement geometry tool now allows for PV panel type assignment.
- PV performance data has been updated to represent modern manufacturer values such as efficiency, nominal cell temperature, etc.

REGIONAL & MISCELLANEOUS







Utility Tariffs for Energy Costing (US Database)

- OPENEI Utility Tariff tool connects to 3,500 utility companies.
- 52,000 tariffs updated annually
- Editable tariffs

Scottish Section 6

- Sterling accredited users accepted for EPC lodgement.

UK Part L

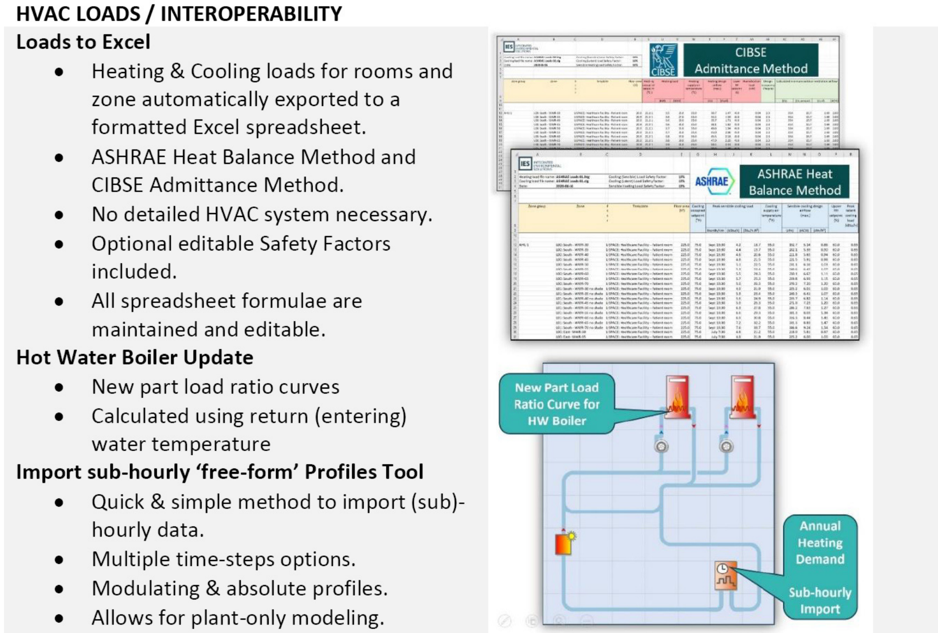
- L2: New certificates (EPCGen) & new lodgement server.
- 64 bit SBEM

Useful Daylight Illuminance (UDI) Settings

- Dynamic quality settings optimised for UDI speed / quality and results

Python Data Import Tools

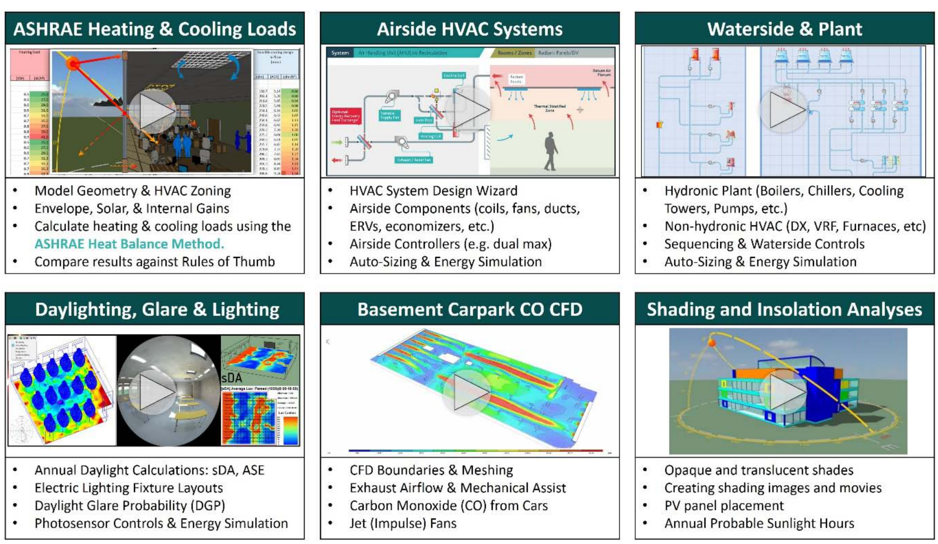
- Apache Post-Process included in VE-Scripts



New webinars

IES have added new training webinars to their range and made the whole collection free of charge to help support their customers during the current pandemic.

The additions include:



To make it easier for users to find the material they want the collection can now be filtered by category.

New case studies

Zero Envy: Modelling Laboratory Buildings

Zero Envy used IESVE to obtain utility incentives for their energy savings relative to California's energy code Title 24 for two laboratory buildings, a higher education institute in Northern California and a medical research facility in Northern California. Both buildings achieved significant savings and were awarded thousands of dollars via *Savings by Design*. See **www.iesve.com/software/case-studies/10715/lab-buildings** for more information.

Cyclone Energy Group

Chicago-based Cyclone Energy Group recently completed their 500th IESVE model. Their analyses have included daylighting & glare simulation, CFD airflow simulation, LEED energy modeling, zero-energy design and energy code-compliance modeling. Read more at **www.iesve.com/software/case-studies/9985/cyclone-energy-group**.

An Architect's Energy Model Workflow

National Community Renaissance (NCORE) use of IESVE from the earliest project stages is described in an article at **www.iesve.com/software/case-studies/10241/iris-san-ysidro**.

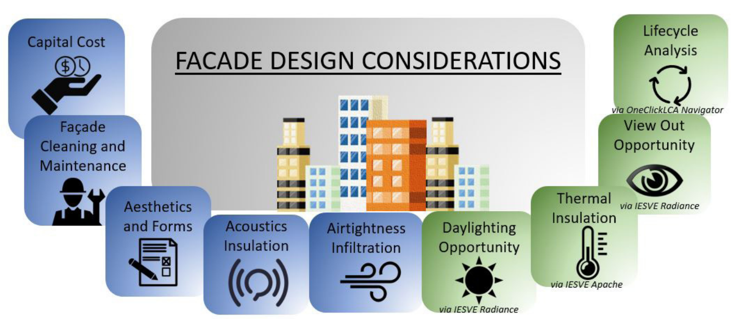
New technical articles

Zoning

In this article, IES's Dave Pierce gives insights into various reasons for zoning models, including load tracking, stratification, heat gains, conduction, inter zonal air movements, plant specification or sizing, control strategy, computation restrictions. It is available in full at **www.iesve.com/discoveries/blog/10552/vistapro-zoning**.

RadianceIES

RadianceIES provides an integrated VE for daylighting design, helping project team members, including the operational and maintenance team, to work together to find beneficial synergies between systems and components during the early design phase. Many common building performance shortcomings arise simply from lack of collaboration between consultants with overlapping rsponsibilites. In this article, Gene-Harn Lim discusses the importance of an integrated design process and how the IESVE facilitates it. It is available at **www.iesve.com/discoveries/article/10459/iesve-radiance-article-1**.



ASHRAE heating & cooling load calculations

The ASHRAE Heat Balance Method has been the most widely-used method for non-residential load calculations since 2001. In this article, available at **www.iesve.com/discoveries/article/10017/ashrae-heating-and-cooling-load-calculations**, IES's Liam Buckley discusses three of its most important concepts. ■

Two OpenStudio-extension Ruby Gems that improve modeling of dynamic building loads

Han Li & Tianzhen Hong, Lawrence Berkeley National Laboratory

Building Energy Modeling (BEM) is an essential tool widely used in new building design, code compliance, green building certifications, energy efficiency evaluations, real-time building controls, and urban-scale energy and climate modeling. Traditionally, modeling assumptions are often simplified due to limited data sources and high demand for domain expertise and efforts. Those assumptions include occupancy and occupant-driven lighting, Miscellaneous Electric Loads (MELs), and HVAC system operations. They are usually modeled as fixed/static schedules, while in reality they are highly dynamic and stochastic. In addition, many realistic scenarios, such as building energy retrofit, faulty operations, and demand response usually require extensive efforts to model. However, building energy models with high fidelity are required in many cases, such as predicting energy use for performance contracts, evaluating utility incentive programs, and generating synthetic smart meter data [1].

To solve this problem, we developed two OpenStudio-extension Gems:

1. the OpenStudio Occupant-Variability Gem [2] to improve modeling of the occupancy and occupant-driven building loads; and
2. the OpenStudio Non-Routine-Variability Gem [3] to improve modeling of realistic building operations.

The extension Gems are essentially Ruby libraries that are compatible with OpenStudio Software Development Kit (SDK), meaning that they could be adopted in common OpenStudio and EnergyPlus simulation workflows. **Figure 1** and **Figure 2** show the scheme of the Occupant-Variability Gem and the Non-Routine-Variability Gem, respectively.

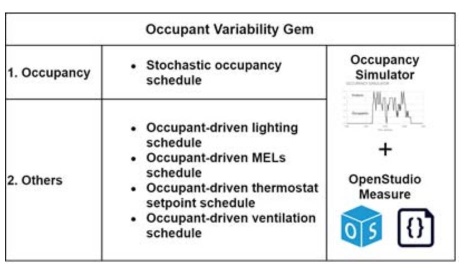


Fig 1: Occupant Variability Gem

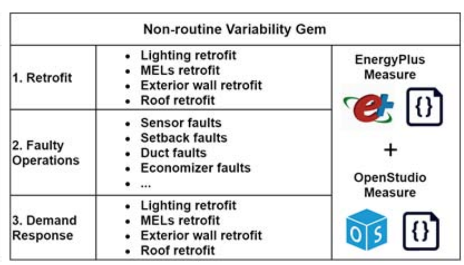


Fig 2: Non-Routine Variability Gem

Both Gems are composed of several OpenStudio and/or EnergyPlus measures (Ruby scripts) and other helper routines that replace the original model parameters with new ones that consider dynamic building operations. More specifically, the Occupant-Variability Gem has a measure that automatically reads the model parameters, runs the occupancy simulator [4] to generate a stochastic occupancy schedule, and maps this back to the model. Based on the new occupancy schedule, this Gem also has other measures to generate occupant-correlated lighting, MELs, thermostat setpoint, and ventilation schedules. The Non-Routine-Variability Gem consists of three categories of measures that model the non-routine scenarios, which could be used individually or simultaneously. The retrofit measures cover four typical retrofits that can happen at any time of year, including lighting, electric equipment, wall, and roof retrofits. The faulty operation measures cover twenty-seven common building system faults [5], such as sensor offset, and air damper stuck. The Demand Response (DR) measures cover five typical DR operations (thermostat reset, dimming lights, turning off some MELs). The extension gems provide repositories for managing the measures; their structure allows updating existing measures or adding new measures to be done easily. **Figure 3** shows how the extension gems could be applied to modify an OpenStudio model.

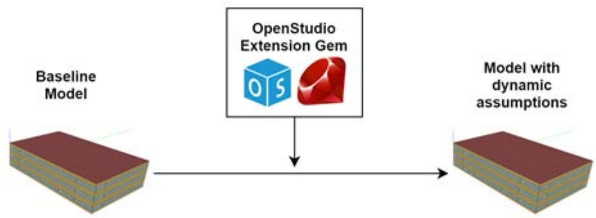


Fig 3: Schematic diagram of the extension Gem application

The two extension Gems can be used in OpenStudio workflows. To illustrate the results, **Figure 4** shows the annual heatmaps of the original and improved occupant schedules in an office and a conference room. It can be seen that the new occupant schedule has improved temporal variations.

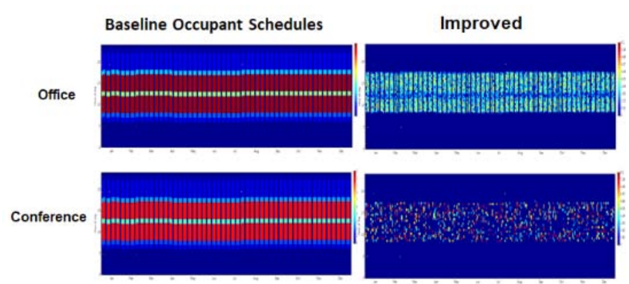


Fig 4: Original and improved occupant schedules

Figure 5, on the next page, shows example results of the retrofit measures in the Non-Routine-Variability Gem. The whole-building electricity consumption is reduced after the lighting and MELs retrofit during the middle of the year.

Developments of both Gems were sponsored by the Building Technologies Office of the United States Department of Energy, and applied in the Energy Data Vault project [6] to generate synthetic smart meter data at scale [1].

In summary, assumptions about occupant and occupant-driven loads, and realistic operation scenarios such as retrofit, faulty operations, and demand response are usually simplified or ignored in traditional whole-building energy modeling, which leads to problems of performance gap (discrepancies between simulated and measured results).

The two recently developed open-source OpenStudio-extension Gems can improve modeling of those dynamic building loads by capturing diversity across space and time. The gems' structure is flexible and can be updated and extended as needed.

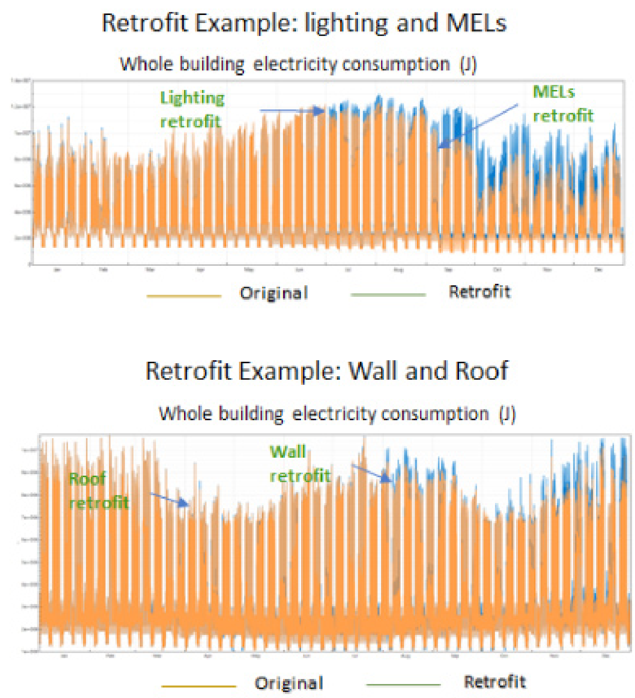


Fig 5: Whole building electricity consumption trends before and after retrofit

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[2] H. Li, X. Luo, T. Hong, USDOE, OpenStudio-Occupant-Variability-Gem v1.0, Lawrence Berkeley National Laboratory, Berkeley, CA, USA. 2020. https://doi.org/10.11578/dc.20200611.5.

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[4] Y. Chen, T. Hong, X. Luo, An agent-based stochastic Occupancy Simulator, Build. Simul. 11 (2018) 37–49. https://doi.org/10.1007/s12273-017-0379-7.

[5] J. Kim, S. Frank, J. Braun, D. Goldwasser. Representing Small Commercial Building Faults in EnergyPlus, Part I: Model Development. Buildings 2019, 9, 233; doi:10.3390/buildings9110233.

[6] www.energy.gov/eere/buildings/energy-data-vault ■

IBPSA Project 1: Update on Task 3 - DESTEST and Application

Dirk Saelens (KU Leuven), Alessandro Maccarini (Aalborg University), Ina De Jaeger (KU Leuven)

Project overview

IBPSA Project 1 extends work from IEA EBC Annex 60, and further develops new generation computing tools for the design and operation of building and community energy and control systems. Currently fragmented duplicative activities in modeling, simulation and optimization of building and community energy systems will be coordinated through the use of three open, non-proprietary standards:

- IFC for data modeling at the building scale,
- CityGML for data modeling at the district scale, and
- Modelica for modeling the performance of building and district energy systems.

The project runs from summer 2017 to summer 2022 and involves about 30 participating organizations. The project is structured in three parts:

- Task 1 is developing a free open-source library of Modelica models, a Building Optimization Performance TEST framework (BOPTEST) and a Modelica library for Model Predictive Control
- Task 2 is developing a GIS/BIM data model to Modelica translators for individual building and community energy systems
- Task 3 is developing a framework to test District Energy System simulations (DESTEST) and coordinating application case studies.

This article describes the ongoing work and recent developments within Task 3 on DESTEST (WP 3.1) and Application (WP 3.2).

WP3.1 DESTEST

This work package is developing a framework called DESTEST to test District Energy System simulations. The aim of DESTEST is to provide a means to validate models of urban energy systems by defining specific district energy cases for testing in different simulation environments. By carefully selecting and specifying these cases, and by using different libraries for modeling these energy systems, a thorough verification, comparison and benchmarking will become possible. The description of the DESTEST cases and the simulation results of extensively verified models for urban energy systems will be made available as a reference for comparing other simulation programs and model libraries.

This work package makes use of common exercises in which different participants solve a well described case, discuss the difficulties during execution and compare the results. These common exercises will gradually increase in complexity: different building typologies and characteristics, climate and occupancy patterns as well as districts with different scales will be implemented. With respect to networks, cooling networks will also be analysed. Finally, demand and distribution subsystems will be combined to assess their performance and to check interoperability of tools that model separate subsystems.

It was decided to start the common exercises with a simple case in which only the energy demand and the distribution subsystem of a district heating system are modelled. The work has been divided over two groups that work interactively: the building modelling group focuses on the selection and modelling of the buildings in the district (demand side); the network modelling group looks into the sizing and modelling of the energy network (distribution side).

The building modelling group defined the buildings of the district heating system: a first common exercise with 16 identical residential buildings was described. Seven research groups used different approaches to model the energy demand. The network modelling group developed an automated toolchain to size the district heating network and applied the results of the heat demand of the building modelling group. Again, the results of different approaches to simulate the energy use of the district heating system were compared. These first results were described in a contribution to BS2019 [1].

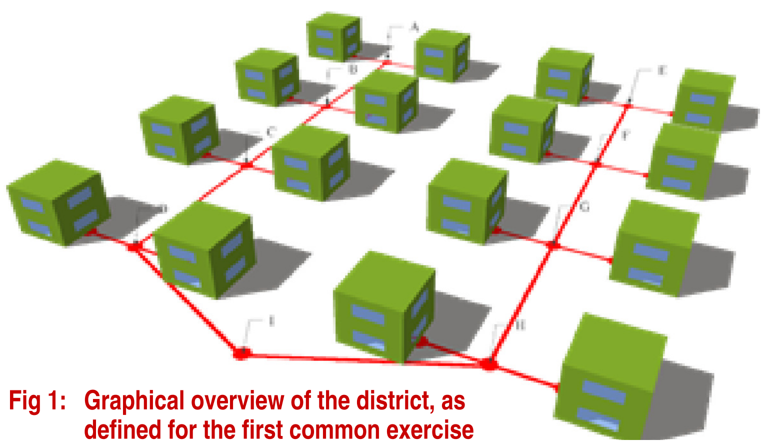

Fig 1: Graphical overview of the district, as defined for the first common exercise

Several common exercises with increasing complexity have also been initiated. The increased complexity includes the definition of different occupant types, the definition of residential buildings with other thermal properties and the definition of an office building. The load from these buildings will again serve as an input to the network modeling group who have made networks with different layouts and numbers of buildings. These activities have also been documented in text and CityGML format to allow future participants to easily repeat the past exercises and as a preparation for documentation (a working document with all links is available here). Activities have also included the development of procedures to compare the results generated by the different participants. In its final form, the DESTEST will be an online platform, as initiated here, containing multiple district definitions (e.g. an old residential neighbourhood and a new mixed-use neighbourhood), models and simulation results as well as a tool to compare your results to those of others.

WP 3.2 Application

The goal of this work package is to demonstrate capabilities enabled by the use of Modelica for building and district energy systems. This task is accomplished by collecting a number of case studies and describing them through a unified template that facilitates a systematic comparison and illustrates key findings from different applications. The expected outcome of the work package is a systematic description of application case studies with the aim of (i) disseminating best practices to the simulation community, (ii) illustrating the possibilities that Modelica offers for the design, modeling and analysis of building and district energy system, and (iii) identifying research needs for Task 1 and Task 2 of IBPSA Project 1.

So far, 11 case studies have been collected (shown in Table 1), ranging from hydronic heating loops and cooling systems in data centers to district heating networks and multi-infrastructure smart community systems. All case studies have been developed using models from open-source Modelica libraries. In particular, the following libraries have been used: Buildings from Lawrence Berkeley National Laboratory, IDEAS from KU Leuven, AixLib from RWTH Aachen and SCC from University of Colorado Boulder.

In terms of application scale, the majority of case studies deal with applications at district level. This highlights that the use of Modelica for simulation of district energy systems has grown rapidly in the recent few years. One of the reasons is that next-generation district energy systems integrate multi-domain interconnected subsystems (thermal, hydraulic, electric and control), for which Modelica provides an appropriate single platform for modeling and simulation. Another reason is the high compatibility that Modelica supports for the use of Python packages and other external tools. These can be used, for example, in order to automate the generation of large numbers of building and energy network models.

Institute	Case Study
KU Leuven (Belgium)	Quantifying uncertainty propagation for district energy demand using realistic variations on input data
University of Southern Denmark (Denmark)	Single-zone model of a university building with hydronic heating and CO2-driven ventilation system
	MPC-oriented models of a small district with geothermal heat pumps
	Dimensioning of IBPSA plug flow pipes for Vejle Nord LiveLab using Dymola FMI and Python
	Verification of district heating Modelica components for renewable integration
University of Colorado at Boulder (USA)	Comprehensive Pliant Permissive Priority Optimization (C3PO)
	Multi-Infrastructure Modeling of Smart and Connected Communities
	Modeling Air-to-Air and Finned-Tube Heat Exchangers
	Equation-Based Object-Oriented Modeling and Simulation for Data Center Cooling: A Case Study
RWTH Aachen University (Germany)	Erdeis II – Local DHC provided with an LTN for residential buildings and geothermal ice storage
Aalborg University (Denmark)	Feasibility study of a 5th generation district heating and cooling system in Køge Nord

Table 1: List of application case studies

The information gathered through the templates have been uploaded to the project website at **https://ibpsa.github.io/project1/applications**. Here, for each case study, it is possible to find information such as the objective of the simulation study, the energy system diagram, and other modeling and simulation details such as thermal zoning and computational time.

Since some case studies are still ongoing, the next steps of WP 3.2 are focused on following the development of such works in order to collect further relevant information and provide an exhaustive description of all case studies. The team is also investigating the possibility of making the Modelica models of the case studies publicly available.

Further information

For further information about IBPSA Project 1 and how to join this collaboration, please visit **https://ibpsa.github.io/project1**.

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SITE-SPECIFIC WEATHER FILES AND FINE-SCALE PROBABILISTIC MICROCLIMATE ZONES FOR CURRENT AND FUTURE CLIMATES AND LAND USE

(For energy modeling, analysis, forecasting, and LEED)

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A. Preamble

It is well-known that urban areas, depending on extents and physical / geometrical characteristics, create distinct climates and intra-urban microclimate variabilities that are typically very significant and sometimes of the same magnitude as inter-regional differences in climate (Taha 2017, 2015a,b, 2020a,b). These intra-urban variations can significantly affect energy use, thermal environmental conditions, heat-health, emissions, and air quality (Taha 2017). Translating climate effects into energy-use equivalents and developing weather files to account for these effects is an on-going endeavor pursued across the industry, research, and academic spectrum, e.g., Crawley (2007); Huang (2010, 2016); Hong et al. (2016, 2017); Dickinson and Brannon (2016); Bueno et al. (2011); Jentsch et al. (2015); New et al. (2018); Nair et al. (2020); and Mylona et al. (2012), among others.

Accurate, site-specific microclimate characterizations are critical in the design of new buildings or retrofits; in building code or certification compliance; in testing building performance under a range of weather conditions; and in deploying energy technologies that will be equally effective in current and changing climates (Herrera et al. 2017; Alfaro et al. 2004; Taha 2015a,b; de Wilde and Coley 2012). Currently, however, most weather input to building energy models does not explicitly take into account the effects of such fine-scale intra-urban variations or the specific micrometeorological fields at a site of interest.

Existing climate zones are also generally coarse, regardless of the application, e.g., energy, public health, or emissions / air-quality, since they are based mostly on airport weather data, despite recent increases in observations from mesonets and urbanets. By comparison, significant intra-urban variability in microclimates occurs at much finer scales, e.g., sub-kilometer and sub-hourly (Taha 2008a,b,c, 2017; Taha et al. 2018a,b). For example, Taha (2020a) shows that the current California Building Climate Zones (BCZ) are too coarse and that intra-urban variability in microclimates can be so large that it is possible in effect to create within each BCZ a number of temperature subzones (~5 km length scales) with *intra*-zone temperature gradients similar to or larger than the *inter*-zone gradients of the coarse BCZ sometimes by several folds (Figure 1).

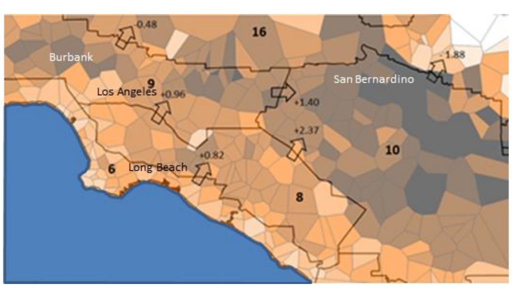


Figure 1: Los Angeles region fine-scale temperature zones (color-coded) produced by Altostratus Inc. (Taha 2020a) vs. California Building Climate Zones (BCZ), numbered. In this example, the Altostratus zones are based on synthetic observational August (2013-2015); each step change in color is 1.2 °C.

These issues also pertain to the evaluation of future climate effects on energy use, e.g., heat exacerbation and weather patterns (Fann et al. 2016; Houghton and English 2014; Taha 2017, 2020a,b). As urban areas exacerbate regional warming (Taha 2017; Founda and Santamouris 2017), there is an increased emphasis on the need to account for fine-scale climate variations within urban areas and consider these issues as priority research in developing projections of future climate impacts (Hess et al. 2018; Ebi et al. 2018; Cheng and Berry 2013). This is one reason why the changes in climate zones (under future climate and land-use conditions) also need to be characterized.

B. Weather products

For various applications, Altostratus Inc. has been developing methodologies to create high-resolution meso-urban weather data based on advanced, fine-scale urbanized atmospheric modeling and observations. Altostratus can create site-specific weather files for any location under current and future climates and their corresponding urbanization levels and land-use characteristics. The simulations are carried out specifically and explicitly for the desired site, not merely extracting model output at specified locations as a post-processing step.

For energy applications, Altostratus applies state-of-science methodologies, datasets, and advanced atmospheric models to create (1) fine-scale probabilistic microclimate zones and (2) site-specific weather data for energy forecasting, planning, and analysis. Based on meteorology and land-use characteristics, each microclimate zone's spatial extents (length scales) are dynamically determined. The fine-scale microclimate zones also vary in spatial extents and properties, e.g., on a decadal time scale, to capture effects of changes in climate and emissions (RCP), land use, surface physical properties, emissions and exacerbation of heat, implementation of control measures and policies, deployment of renewable energy technologies, and fleet electrification. Thus, sets of microclimate zones are developed to reflect various possible scenarios.

Enhanced site specificity of weather files, e.g., for a particular building location, is achieved with modeling at resolutions of 200 m and finer while accounting for (1) the effects of the site's urban morphometric characteristics, land cover, surface physical properties, and sources of heat, (2) effects of physical properties of the site's surroundings, and (3) characteristics of upwind areas within meteorological radii of influence, i.e., per dynamically-determined, wind-direction-dependent, time-varying length scales. The methodology is fully site-specific based on in-situ bottom-up surface and canopy-layer characterizations, advanced urban parameterizations, fine-scale prognostic modeling including observational data assimilation and variational analysis, bias-corrected dynamical downscaling of climate models (for future years), and physical characterizations of projected urbanization corresponding to the downscaled future timeframes of interest.

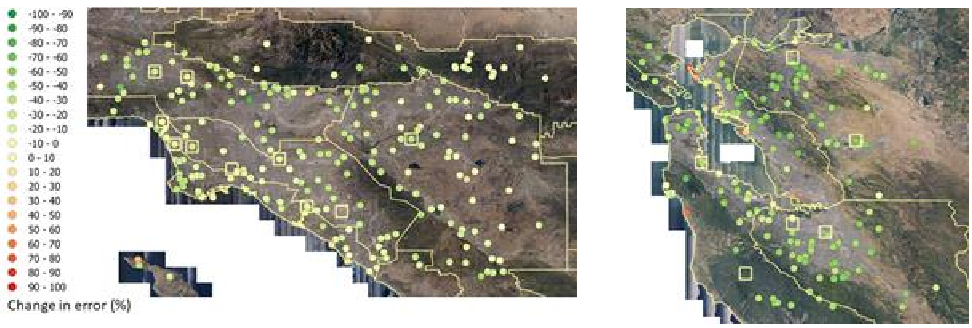
C. Model performance evaluation

An important aspect in these activities is to thoroughly demonstrate model performance following any meteorological-model update, customization, and modification. Over the years, Altostratus has provided a detailed summary of model performance that accompanies each study and project report to ensure full acceptability of results. Model performance is compared against community-recommended benchmarks (e.g., Emery et al. 1997; Tesche et al. 2001; Taha 2017) at each weather station in the domain of interest. Rigorous statistical performance evaluation includes using metrics such as bias, gross error, root mean square error, index of agreement, time series, maxima / minima, and ranges as applicable to each variable such as temperature, relative humidity, wind speed, wind direction, heat and moisture fluxes, and others as needed.

One such example is shown in Figure 2 depicting improved temperature forecast skill (model performance) in the Los Angeles and San Francisco Bay Area regions resulting from using the Altostratus-modified uWRF (Taha 2017, 2020a,b) relative to the standard WRF model (Section D.3). This example is from a study performed by Altostratus Inc. for the California energy commission (Taha 2020a). In the random example shown (July 16-31, 2013), model performance in the Los Angeles region improved significantly at 225 stations (green-coded circles) but worsened at 6 stations (red-coded circles).

In the San Francisco Bay Area (SFBA), model performance improved significantly at 150 stations but worsened at 10 stations. The mean error was reduced by up to 1.8 °C (46%) in SFBA and up to 0.8 °C (33%) in the Los Angeles region. Furthermore, Taha (2017, 2020a,b) and Taha et al. (2018a,b) showed that the Altostratus Inc. modifications in uWRF significantly improved performance not only with respect to standard, non-urban WRF, but also with respect to the standard WRF-urban model (Chen et al. 2010).

Figure 2: Los Angeles region and San Francisco Bay Area mesonet stations (circles) and current BCZ boundaries (yellow lines). The circles are color-coded to indicate improvements in model performance with the Altostratus-modified uWRF at each station relative to the standard WRF modeling approach. The squares are metars and existing weather-file locations (EPW). Source: Taha (2020a).



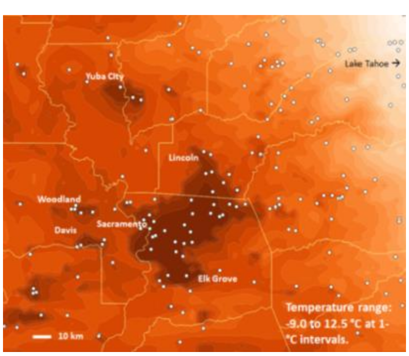
D. Methodology

In the following sections, a very brief overview of the methodology and its application to an example domain (Sacramento Valley, California) is presented. This is a domain for which a number of weather files are made available for evaluation. To conserve space in this short article, references to data sources are not provided in the discussion items below – they can be made available upon request. The end product of the approach discussed here is to develop modified meteorological fields input to the EnergyPlus program (Crawley et al. 2001).

D.1 Observational weather analysis

Altostratus obtains hourly and sub-hourly observational weather data from the MADIS system and other sources, if needed, including: Urbanet; National Weather Service Coop; WeatherBug; NOAA MesoWest; NCAR datasets; California Irrigation Management Information System (CIMIS); and network-specific California datasets, e.g., ARB and AQMDs. Hourly data from weather-station networks (e.g., white circles in Figure 3 for the Sacramento area) are used in: (1) characterizing the current intra-urban microclimate variations, albeit at coarser resolutions than is possible with the atmospheric model, (2) developing microclimate zones in the selected regions, which also guides the modeling effort, (3) developing the reference metrics for subsequent use in model performance evaluation, and (4) developing the input to 4-dimensional data assimilation schemes in the meteorological model.

Figure 3: Forecast 2-m air temperature for 2000 PDT, March 16, 2020 (produced by Altostratus Inc.-modified uWRF). Circles are locations of mesonet stations.

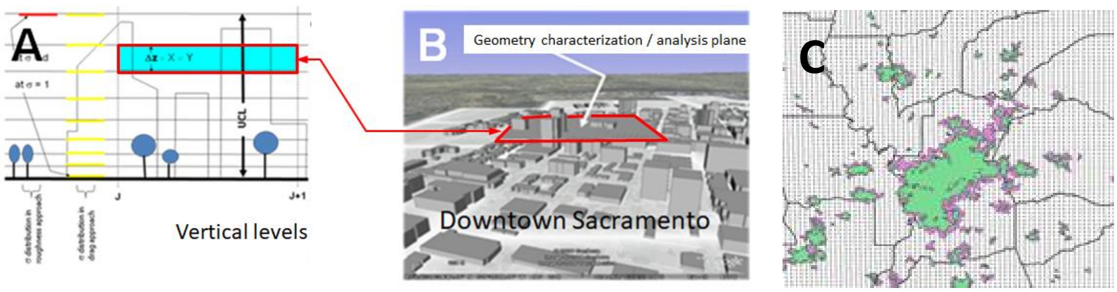


D.2 Land use / land cover (LULC) and surface characterization

Detailed LULC analysis is done to supplement other data sources and derive / develop surface physical properties input to the meteorological / land-surface models. A detailed, area-specific, bottom-up approach (Taha 2008b, 2017, 2020a,b; Taha et al. 2018a) is used to characterize the physical and geometrical properties of the surface, especially in urban areas, based on data sources including: 30-m National Land Cover Data and impervious cover; 30-m USGS Anderson Level-II and Level-IV land use; Google Earth PRO urban morphological and land-cover data; 1-m aerial imagery-based roof and pavement albedo; 1-m area-specific LiDAR-derived urban morphological and geometrical data (including N/WUDAPT); 1-m EarthDefine/CALFIRE urban tree canopy cover; and 30-m MRLC / USFS canopy cover and MODIS albedo.

Taha (2008a,b,c, 2017, 2020a,b) developed a methodology to derive area- and site-specific urban morphometric, geometrical, and surface physical properties from Google Earth PRO in conjunction with other sources of LiDAR data. As shown in Figure 4A,4B, for example, this information is converted from Google Earth PRO (4B) into various parameters for each model computational volume (4A) in the canopy and boundary layers.

Figure 4. **A:** High-resolution vertical levels (2 – 5 m) in the urban canopy model. **B:** Characterization of 3-D urban morphology in Google Earth PRO. **C:** Current urban areas (green) and projected urban growth by 2050 (pink) in the greater Sacramento Valley, California, region (Taha 2020b).



For future years, e.g., through 2100, several LULC-projection datasets exist, including the USGS Land Use and Carbon Scenario Simulator (LUCAS) (Sleeter et al. 2017a,b). Altostratus has vectorized and used the LUCAS data to develop future-year projections (e.g., for year 2050, as in Figure 4C) and characterize urbanization changes to derive surface physical properties. In this context, Taha (2017, 2020a,b) developed a methodology to extrapolate the current LULC makeup and surface physical properties near the growth boundaries to nearby future urbanizing areas. These characterizations are subsequently used in dynamical downscaling of climate models.

D.3 Atmospheric modeling of current climate and land use

For the purpose of urban atmospheric modeling, several mesoscale meteorological models, such as the Weather Research & Forecasting model, WRF (Skamarock et al. 2008) have been enhanced with urban parameterizations that improve the representation and quantification of urban canopy- and boundary-layer processes and more accurately quantify the urban influences on the atmosphere (Martilli et al. 2002; Chen et al. 2010; Salamanca and Martilli 2009; Kusaka et al. 2001; Taha 2008a,b,c; Fan and Sailor 2005).

At Altostratus Inc., Taha (2008a,b,c, 2015a,b, 2017, 2020a,b) has further refined the WRF urban parameterizations and their applications and developed more advanced techniques and a modified version of the urban WRF model (referred to as “uWRF” in this article). The refinements allow for very fine-scale specification of surface physical properties in the model, ability to characterize the 3-dimensional properties of urban areas in detail (e.g., down to street scale), and an accurate quantification of the sources of heat in each area, all of which improves the model’s calculations of various prognostic variables. The refinements also improve upon existing urban surface-characterization techniques, such as WUDAPT (Ching et al. 2009), in that each grid cell in the domain can be independently and directly characterized based on remote-sensed information and ground-based surveys (e.g., Taha et al. 2018a,b) instead of using land-use as a generic proxy, which is the current approach. The urban canopy-layer models in WRF are also modified and improved by Taha (1999, 2017, 2020a,b) including how the urban parameterizations are called (triggered) per physics criteria (applied independently at each grid cell), including turbulent kinetic energy, heat storage, anthropogenic heat emissions, and urban morphology, thereby replacing the existing approach which is based on land-use type. All of these improvements help achieve more accurate location-specific microclimate simulations and, thus, more accurate quantification of the effects of intra-urban variability in climate and surface physical properties on energy use.

For current climate, reanalysis is used to provide boundary conditions to the meteorological model. Observations from mesonet and metar are also assimilated into the model. Both deterministic and probabilistic (e.g., ensembles) simulations are carried out.

D.4 Atmospheric modeling of future climates and land use

The local future microclimates (e.g., for the example domain) are characterized via (1) dynamically-downscaling a bias-corrected CMIP5 model -- CCSM4, Community Climate System Model (Bruyere et al. 2014; NOAA 2015) and (2) highly-urbanized meteorological modeling at the sub-kilometer and sub-hourly scales using the Altostratus-modified uWRF (Taha 2008a,b; Taha 2017). Future years, RCP scenarios, and future land-use projections are modeled to develop an ensemble of simulations that captures potential local impacts of future climate and develop probabilistic microclimate zones and future site-specific forecasts.

The development of future microclimate zones does not only account for the effects of changes in climate (via dynamical downscaling) but also (1) changes in land use / urbanization, (2) changes in heat and pollutant emissions and impacts on radiative forcing, and (3) implementation of selected regional measures and policies including solar PV, cool communities, fleet electrification, and distributed generation and renewables.

E. Example geographical domain and sample weather files

The example domain (greater Sacramento Valley, California), is shown in Figure 5A (red rectangle) and magnified in Figures 5B, 5C. The central part of this domain is relatively homogeneous, mostly flat with no major water bodies, devoid of abrupt topographical features, except for the gradual upslope towards higher elevations near the eastern edge of the domain. Thus the bulk of intra-urban microclimate variations are caused by changes in surface characteristics and heat transport along the air-mass trajectories over urban areas (Figure 5C) (Taha 2020b).

In the following discussion, two random urban locations are compared to Sacramento Executive airport (hereafter called “EXEC” for short) which is the source of TMY3 data in an existing weather file. The two locations are:

1. An AB-617 community “B”, one of ten disadvantaged areas identified by the Sacramento Metropolitan Air Quality Management District (SMAQMD). This will be referred to as “AB” in the following discussion and is 12 km NNE of EXEC. It is identified with a green circle in Figure 5B, 5C.
2. A location in the City of Citrus Heights, referred to as “CTRS” in this discussion, and is 25 km NE of EXEC. It is identified with a yellow circle in Figure 5B, 5C.

For the whole region, there are only two weather files (TMY#) currently in use: one at Sacramento Metro AP and one at Sacramento Executive AP (two red circles in Figure 5B). The white circles are random urban locations for which Altostratus generated sample weather files for current and future climates and land use. The files are currently *.csv-formatted for EnergyPlus (*.epw) and the file names are listed along with the locations in Figure 5B (zooming on the figure is necessary to see the file names).

The sample weather files are for years 2019 and 2050 (RCP 8.5). Using the same methodology described in Section D, Altostratus can generate weather files for any location worldwide and any time horizon (past, current, and future) per a user’s interest. The future-climate scenarios produced by Altostratus, such as the 2050 RCP 8.5 samples provided here, also account for the effects of changes in land use and land cover, and urbanization tendencies (projected) by the year 2050, not just the changes in climate.

In order to provide the user with different options for applying the fine-scale model and observational weather data (for both current and future climates), the products are made available as:

Option 1: Model perturbations applied to current weather files (TMY / EPW for example) via departures from monthly means (indirect mapping) or hour-to-hour departures (direct mapping). This results in *synthetic* weather files, meaning that they are modifications to current TMY data. Conceptually, for a variable *V*, this can be described as:

$$V_{TMY} = \overline{V}_{TMY} + V'_{TMY} \; ; \quad V_{uWRF} = \overline{V}_{uWRF} + V'_{uWRF} \; ; \quad \textbf{\textit{and}}: \quad V_C = \overline{V}_{TMY} + V'_{uWRF}$$

where V_c is the desired computed value of the variable (the equations are generic, i.e., they can be applied in space or in time, as well as both simultaneously). This option allows users of existing weather data (e.g., TMY) to directly evaluate the improvements in and intra-urban spatiotemporal enhancements to meteorological fields in TMY (resulting from the Altostratus methodology) in a region of interest and directly compare them to the existing weather files;

Option 2: Model perturbations applied to observational data from metar and other high-quality weather stations, e.g., from NOAA. This no longer produces a *synthetic* weather file as compared to option 1 and is more realistic because the observations come not from a composite weather file (e.g., TMY) but, rather, from dynamically-consistent hourly and sub-hourly observations for a specific time interval, e.g., a full year; and

Option 3: Absolute model fields (whether deterministic or probabilistic) at any and all locations of interest for the desired periods. In this case, the fields are absolute, dynamically consistent, and no longer based on departures from some spatial or temporal means, such as from existing weather files.

In all options, the modified variables of most relevance to the EnergyPlus program (Crawley et al. 2001) are *DBT*, *DEW*, *RH*, *SW*, *DIFF*, *LW*, and *WSP*, discussed further below and defined in Figure 8.

Option 3 is the most correct, scientifically-sound, and the one recommended for use. However, all three options can be made available to interested parties if so desired. Although rarely the case, option 1 can result in unrealistic values at times. For example, in the sample data provided and discussed below, this option can produce temperatures in 2050 RCP 8.5 that reach 50 °C during a few hours in the year (outliers). In the datasets discussed below, examples from options 1 and 3 are provided.

For parties interested in testing sample weather data, Altostratus is making available fine-scale weather files for current and future climates. These samples are currently for the Sacramento Valley, California (Capital region), for the locations shown in Figure 5B, and can be accessed via ftp. If interested in obtaining test weather files or in generating weather data for other time periods, regions, specific communities, selected neighborhoods, or specific building sites, Altostratus can provide additional information.

In the following discussion, locations EXEC, AB, and CTRS are compared. As space is limited in this short article, only air temperature comparisons are shown in somewhat larger graphics in Figure 6 and summarized with additional information in Figure 7. For other variables, postage-stamp graphs are shown in Figure 8 to provide a general idea. In all graphs, the red ellipses represent the bivariate normal density, provided here merely as a visual aid to discern outliers or extreme values in the data from 8760 hours, in respective years, and the red line is the identity line.

In general, the graphs in Figures 6, 7, and 8 can be grouped into two sets: (1) those representing spatial comparisons, i.e., comparing variables at different locations but for the same timestamps and (2) those representing temporal comparisons at different timestamps (e.g., across different years) but at the same respective locations. Thus one observation that can be made is that the spatial comparisons (graphs A1, A2, D1, and D2 in Figure 6 and rows R1, R2, R7, and R8 in Figure 8) have a smaller scatter than the temporal comparisons. This is expected since the spatial variations during a timestamp over relatively small distances are likely smaller than comparing, say, a certain hour in current and future climates.

Graphs A1 and A2 (in Figure 6) are from option 1 (for current climate, 2019) and show dry-bulb temperature increasing away from EXEC location because of intra-urban heat transport (as explained by the trajectories in Figure 5C). Because of that, AB has a net increase of 5190 °C·hr yr^{-1} relative to EXEC, whereas CTRS has a net increase of 8157 °C·hr yr^{-1} relative to EXEC. The annual all-hours temperature average at EXEC, AB, and CTRS are 15.55, 16.14, and 16.48 °C (Figure 7). Thus, over a relatively short distance between these stations, an annual-average 1 °C difference can result because of intra-urban microclimate effects, which is very significant. The largest increases in temperature relative to EXEC occur during the mid-ranges of absolute temperature and can be as much 4 °C warmer in AB and up to 6 °C warmer in CTRS at any given hour within that temperature range. This can also be seen in graphs A1 and A2 (entasis) as well as in the upward shift of the interquartile ranges seen in Figure 7, A1 and A2, where the 1st quartile is relatively unchanged but the 3rd quartile is higher.

Figure 5. **A**: Sample domain (red rectangle). **B**: Locations of sample weather files available for testing. Red circles are existing TMY/TMY3 *EPW weather data for the region (Sacramento Metro and Sacramento Executive airports). White circles are locations of sample Altostratus Inc. weather files in urban areas. Green and yellow circles are AB and CTRS locations, respectively. **C**: Back-trajectories arriving Rocklin area at 1400 PDT on 13 different days during the interval July 16 – 31, 2015. The "4" markers show the air-mass position four hours prior to arriving at Rocklin (Taha 2020b). Zooming into Figure B can help identify file names.

Graphs B1, B2, ad B3 (in Figure 6) are spatial comparisons based on option 1, but for the year 2050 (RCP 8.5). Thus, B1 is EXEC in 2050 relative to TMY3, B2 is AB in 2050 vs. AB in 2019, and B3 is CTRS in 2050 relative to CTRS in 2019. The net warming (from 2019 to 2050) at EXEC is 8649 °C·hr yr^{-1} (or 0.99 °C·hr hr^{-1}), at AB the net warming is 9187 °C·hr yr^{-1} (or 1.05 °C·hr hr^{-1}), and at CTRS, it is 10321 °C·hr yr^{-1} (or 1.18 °C·hr hr^{-1}). Indeed, the climate-model fields downscaled via Altostratus uWRF suggest that the warming (relative to present conditions) increases in the NNE and NE directions in this region. This can also be seen in differences B1, B2, and B3 in Figure 7.

Graph C1 (in Figure 6) is a temporal comparison between absolute model fields at EXEC in 2019 vs. TMY3. That is, the graph shows hour-to-hour comparisons between the model's absolute output for year 2019 versus TMY3 at EXEC, hence the relatively large scatter. The model year 2019 shows a net warming (relative to TMY3) of 8722 °C·hr yr^{-1} (or almost 1.0 °C·hr hr^{-1} as an annual average – also see difference C1 in Figure 7). The next two graphs are spatial comparison at AB (D1) and CTRS (D2), relative to EXEC, all based on absolute meteorological model output for 2019. Thus this is a more dynamically-consistent set of data that can be inter-compared directly. In this case, AB sees a net warming of 5187 °C·hr yr^{-1} (or 0.59 °C·hr hr^{-1} over 8760 hours) relative to EXEC, whereas as CTRS sees net warming of 8149 °C·hr yr^{-1} (or 0.93 °C·hr hr^{-1}) relative to EXEC (also see Figure 7, differences D1 and D2).

Finally, graphs E1, E2, and E3 (Figure 6) show a comparison of year 2050 vs. 2019 at each respective location (EXEC, AB, and CTRS), all from model results (absolute fields, not perturbations). Thus, again, this is a dynamically-consistent set of variables that can be useful to compare. The differences at each location were already used above and mapped onto existing conditions to generate synthetic weather files, as seen in graphs B1, B2, and B3 (Figure 6). Thus, these are again local net warmings of 0.99 °C·hr hr^{-1}, 1.05 °C·hr hr^{-1}, and 1.18 °C·hr hr^{-1} at EXEC, AB, and CTRS, respectively, as annual averages (over 8760 hours). The differences can also be seen in Figure 7 (E1, E2, and E3).

In all of the above analysis, one should keep in mind that CTRS, relative to EXEC, is not even at the downwind-most end of the trajectories shown in Figure 5C. Thus, for other locations further downwind, such as those to the N, NE, and E of CTRS (the yellow circle in Figure 5B,5C), the differences (i.e., warming) relative to EXEC are even larger.

To wrap up this discussion, the absolute model fields for current climate (2019) and future year (2050) are compared with the TMY3 weather file for EXEC (Sacramento Executive Airport). This is to give the TMY3 user a sense of how different the building energy simulations and calculations could be if the actual 2019 year were used instead of the composite TMY3 and also how modeled future years compare to present. To do that, the last 6 datasets in Figure 7 are compared to TMY3 (the first dataset on the left in Figure 7).

Relative to TMY3 (at EXEC), the 2019 all-hours average temperature at EXEC is 0.99 °C higher – at AB it is 1.58 °C higher (than TMY3) and at CTRS it is 1.92 °C higher (than TMY3). The 2050 all-hours averaged temperature at EXEC is 1.98 °C higher than TMY3, at AB it is 2.63 °C higher (than TMY3), and at CTRS, it is 3.10 °C higher (than TMY3). Since these are annual averaged differences (over 8760 hours), they are quite significant. Finally, it can also be stated that the intra-urban differences in temperature, caused by urban heat transport along trajectories (Figure 5C) and local heat generation / surface properties, is of the same magnitude as the predicted local effects of climate change (in 2050, in this example). Spatially, in 2019, AB is warmer than EXEC by an annual average of 0.59 °C and CTRS is warmer than EXEC (in 2019) by an annual average of 0.93 °C (these spatial differences are based on model results). The changes in climate and land use produce a local warming of 1.05 °C at AB (in 2050 relative to 2019) and a warming of 1.18 °C at CTRS (in 2050 relative to 2019). Thus comparing 0.59 °C (spatial) to 1.05 °C (climate) and 0.93 °C (spatial) to 1.18 °C (climate) shows that the spatial impacts of intra-urban microclimate variations are of the same magnitude as the local predicted impacts of climate change between now and 2050 (RCP 8.5).

Of course, all of these comparisons and findings are specific to this region, selected locations, and years / scenarios. Other regions, time horizons, or scenarios, will likely yield different results. Hence, it is important to carry out the modeling and forecasting on an area- and site-specific basis, which is the main argument in the approach presented in this article.

Finally, Figure 8 summarizes the same type of analysis but for other meteorological variables. In this figure, the rows are defined as follows (y-axis vs. x-axis): **R1**: AB vs. TMY3 (option 1); **R2**: CTRS vs. TMY3 (option 1); **R3**: EXEC 2050 vs. TMY3 (option 1); **R4**: AB 2050 vs. AB 2019 (option 1); **R5**: CTRS 2050 vs. CTRS 2019 (option 1); **R6**: EXEC 2019 vs. TMY3 (option 3); **R7**: AB 2019 vs. EXEC 2019 (option 3); **R8**: CTRS 2019 vs. EXEC 2019 (option 3); **R9**: EXEC 2050 vs. EXEC 2019 (option 3); **R10**: AB 2050 vs. AB 2019 (option 3); and **R11**: CTRS 2050 vs. CTRS 2019 (option 3). The options were defined at the beginning of Section E.

Figure 6: Comparisons of various temperature indicators at EXEC, AB, and CTRS.

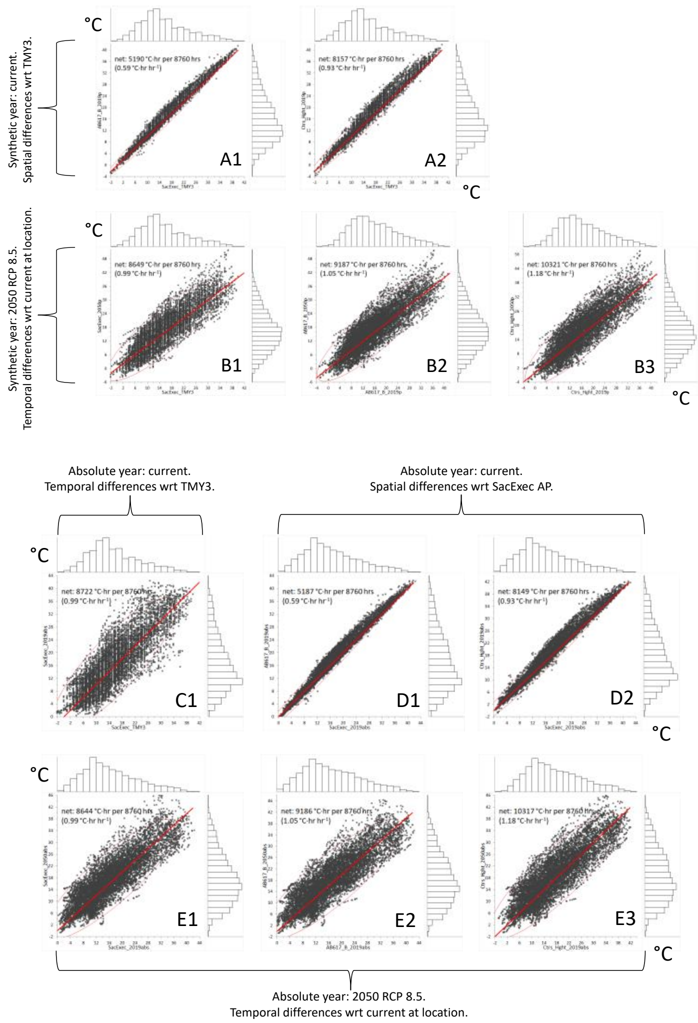


Figure 7: Descriptive statistics for 8760 hours of air temperature at EXEC, AB, and CTRS. At the bottom of the figure, differences are labeled for cross-referencing to graphs in Figure 6.

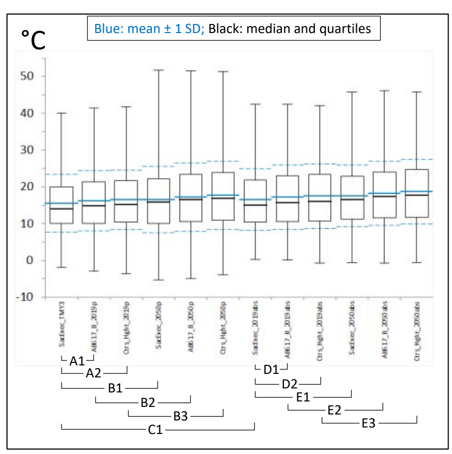
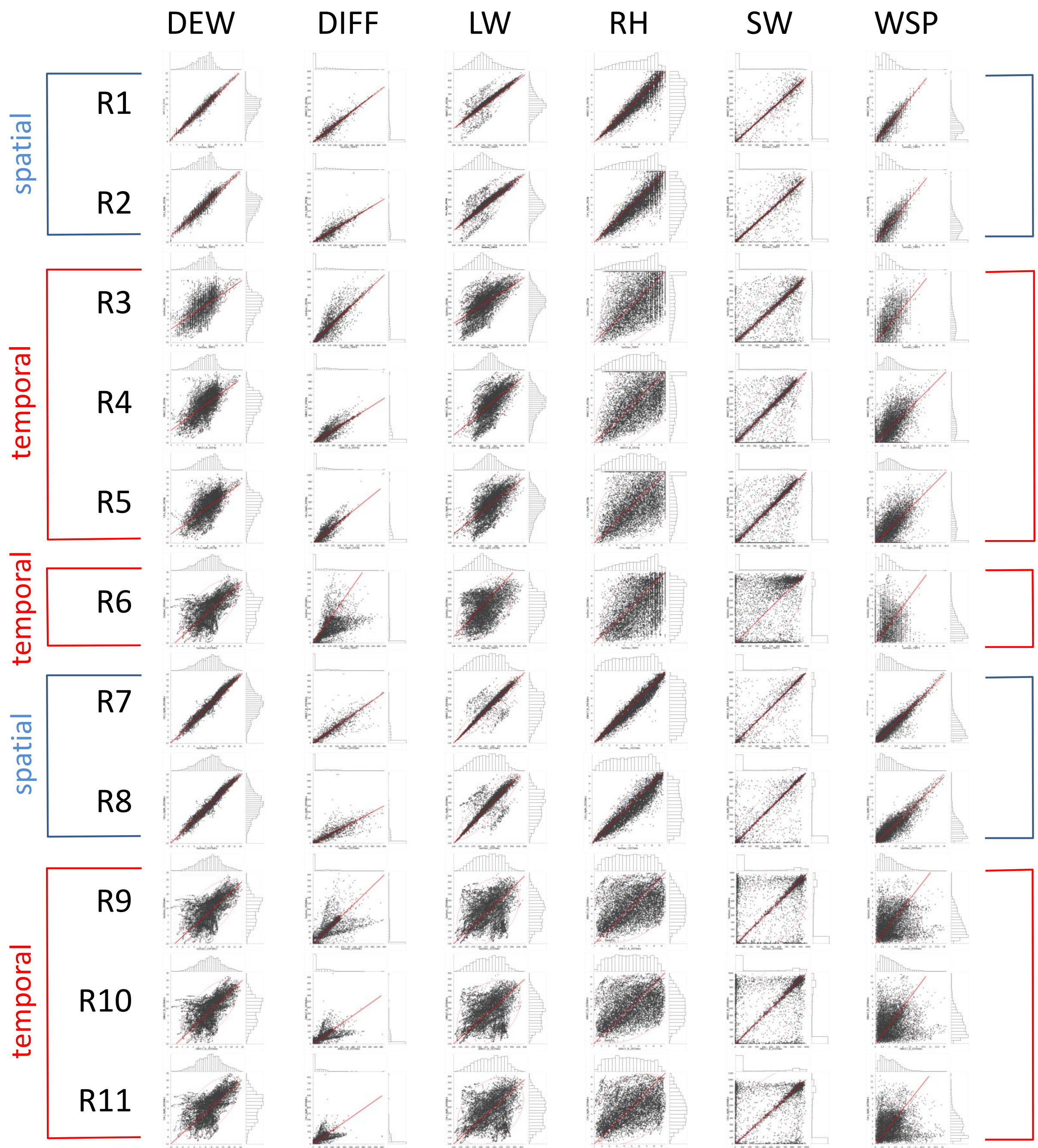


Figure 8: Selected comparisons among variables. **DEW**: dewpoint; **DIFF**: diffuse radiation; **LW**: longwave radiation from sky; **RH**: relative humidity; **SW**: direct normal radiation; **WSP**: wind speed.



DATA ACCESS AND DISCLAIMER

The sample weather files for the Sacramento Valley, California, domain can be accessed via ftp to weather.altostratus.com with user ID: weather@altostratus.com and password: Weather$2020.

These weather files are made available for testing purposes only. They are not intended for commercial use or application to on-going projects. Altostratus Inc. is not responsible for any outcome resulting from use of these sample weather files. If interested in applying such data to on-going projects or in creating new ones for your location, please contact Altostratus Inc.

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BS2021 student modelling competition

As part of the 17th IBPSA International Conference and Exhibition, IBPSA is organizing a student modelling competition. The aim is to facilitate wider participation in the conference and to provide a competitive forum for student members of the building simulation community. It is expected that several tutors of relevant courses in universities around the world will use the brief of this competition as part of their teaching material.

This year, the student modelling competition is set up as a 'challenge' rather than a competition. In this special edition of the IBPSA student competition, we will encourage you to use the IBPSA network to share information, questions and solutions. In this way we can easily collaborate and learn from each other.

The subject of the study will be the low-tech building 2226 of Baumslager & Eberle in Lustenau. Several smaller separate questions for specific fields (e.g., building envelope, acoustics, daylighting, IAQ,...) on difference levels (e.g., BSc, MSC, PhD) will all lead to an answer on the main question "What improvements should you make to the concept of the low-tech building 2226 to enhance comfort with minimal impact on energy use if you want to build it in Bruges, i.e. in the Belgian climate?".

All entrants must be enrolled as students (BSc, MSc, PhD or equivalent) at the time of submission. Team participation is definitely encouraged.

More details will be available soon at **https://bs2021.org**.

Key dates

- 15 October 2020: Announcement of brief
- 31 January 2021: Deadline for entrants to notify their intent to submit an entry (if you want to start earlier, that is certainly possible; keep us informed)
- 15 June 2021: Deadline for completed entries
- 10 July 2021: Finalists notification
- 1-3 September 2021: Presentation of results at BS2021 Conference in Bruges, Belgium ■

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Calls for Nominations

IBPSA Awards

The Board of Directors of IBPSA is seeking nominations for Awards to be presented at Building Simulation 2021, in Bruges, Belgium (1-3 September 2021). IBPSA makes three awards for outstanding work in the building performance simulation field. These awards are made on a biennial basis at each Building Simulation Conference, providing there is a qualified candidate. The three categories awarded are:

1. **IBPSA Distinguished Achievement Award**. This award, formerly named the IBPSA Award for Distinguished Service to Building Simulation, recognizes an individual who has a distinguished record of contributions to the field of building performance simulation, over a long period.
2. **IBPSA Outstanding Young Contributor Award**. This award recognizes an individual at the beginning of their career who has demonstrated potential for significant contributions to the field of building performance simulation.
3. **IBPSA Innovative Application Award**. This award, formerly named the IBPSA Award for Distinguished Practice, recognizes an individual, group or firm, who has made a significant contribution to the effective application and/or advancement of building performance simulation in practice. The award may be given for a unique or noteworthy use of simulation in practice; development of simulation software or supporting software that has had a significant impact on industry practice; or other contribution that has advanced building performance simulation in practice.

Nominations

Nominations for awards must be made by an **independent** third party and submitted by **31 December 2020**. We would like as many nominations as possible, so please contact the Chair of the Awards and Fellows Committee, Michaël Kummert, to discuss a possible nomination if required (**michael.kummert@polymtl.ca**).

Detailed instructions to submit nominations and a list of recent past recipients of these awards can be found on the IBPSA website: **www.ibpsa.org/?page_id=62**.

Fellows of IBPSA

The Board of Directors of IBPSA is seeking nominations for the 2021 class of Fellows. The IBPSA membership grade of Fellow recognizes individuals who are:

> "A member who has attained distinction in the field of building performance simulation, or in the allied arts or sciences, or in teaching of major courses in said arts and sciences, or who by way of research, simulation code development, original work, or application of building simulation on projects of a significant scope, has made substantial contribution to said arts and sciences, and has been active in the field for at least ten (10) years".

The IBPSA Board of Directors elects new Fellows on a two-year cycle, culminating with recognition at the biennial Building Simulation conferences.

Nominations

Nominations may be made by IBPSA members other than the nominee. The deadline for nominations is **30 November 2020**. We would like as many nominations as possible, so please contact the Chair of the Awards and Fellows Committee, Michaël Kummert, to discuss a possible nomination if required (**michael.kummert@polymtl.ca**).

Nominations should include details of the nominee's accomplishments in one or more of the following categories: industrial leadership, research, simulation code development, application of building simulation on projects of significant scope, educational leadership, and significant technical contributions to the allied arts and sciences.

Detailed instructions to submit nominations and a list of IBPSA fellows can be found on the IBPSA website: **www.ibpsa.org/?page_id=310**.

Student Travel Awards - supporting students to attend BS2021

Travel to IBPSA Conferences can be an expensive business - especially for students. In order to assist as many students as possible to participate in Building Simulation 2021 in Bruges, Belgium, IBPSA will grant a number of travel awards of up to $1,000 (US) to students presenting peer-reviewed papers. Student travel awards are limited to a maximum of 5 grants per biennial conference and are therefore highly competitive.

The selection committee bases its decisions upon the following selection criteria:

- need for financial assistance, evidenced in a letter of recommendation from the student's supervisor/advisor of studies (must be on university letterhead);
- overall quality of the peer-reviewed paper;
- relevance of contribution to the field of and/or furthering the effective application of building simulation.

To be eligible, the student must be:

- enrolled in a graduate program related to building simulation at the time of the conference; **and**
- the thesis project must be directly related to building simulation.

Applications

The deadline for applications will be aligned with the deadline to submit full papers at the conference, and is expected to be in early 2021.

Details on applications will be published on the IBPSA website in due time: **www.ibpsa.org/?page_id=62**. ■


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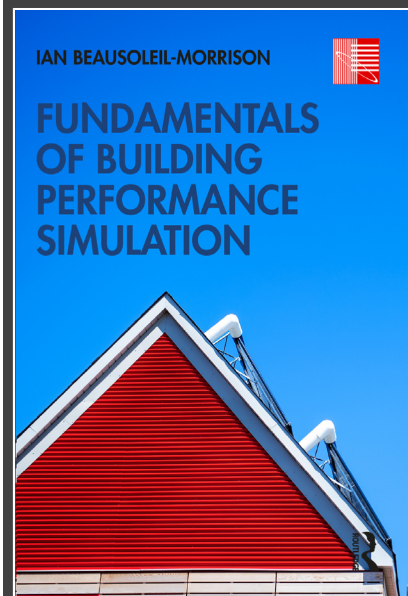

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Ian Beausoleil-Morrison, Carleton University
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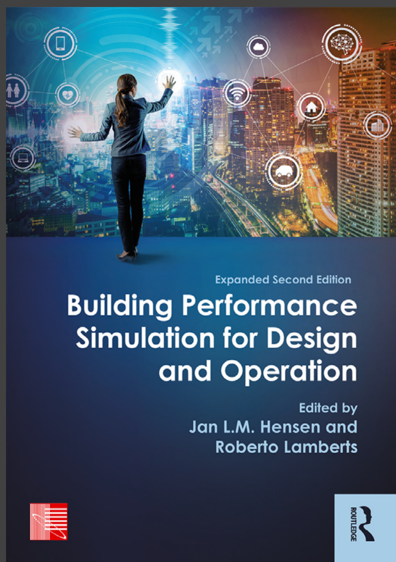

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News from IBPSA affiliates

IBPSA affiliates are asked to submit a report to the IBPSA Board each year to keep Board members informed about their activities and membership. These are too detailed to include in ibpsaNEWS, so affiliates have been asked to make their latest annual report available through their web sites, and this section includes only selected, recent news. Other news from affiliates may be available from their websites; the URLs for these are available on the IBPSA Central web site at www.ibpsa.org/?page_id=29.

IBPSA-England

Building Simulation and Optimization (Virtual) Conference 2020

IBPSA-England's fifth Building Simulation and Optimization conference, hosted by the Building Energy Research Group at Loughborough University and sponsored by DesignBuilder, took place virtually on 21 and 22 September 2020. This conference provided a forum for debating and addressing the challenges that the Building Simulation and Optimization community are currently facing by exploring the following topics:

- Urban building energy modelling
- Building Energy flexibility
- Design & Retrofit optimization
- Data-driven modelling
- Occupant behaviour modelling
- Shading & Overheating Analysis
- Uncertainty Quantification & Analysis
- Experimental Performance Characterisation
- Building Energy Systems Modelling & Simulation
- Advanced Modelling Techniques
- Parametric Design

The conference, chaired by Dr Bianca Howard and scientific chairs Dr Argyris Oraiopoulos and Dr Eleonora Brembilla, was well attended by more than 100 delegates from 18 countries across the world. A total of 53 contributions were presented during the conference, in a novel, online format that focused on bringing out the key insights from the latest research in the field, by setting the discussion around the papers as the primary objective, rather than the presentation itself.

The emerging themes of occupant behaviour, data driven modelling and building energy systems flexibility revealed that researchers are actively trying to address the performance gap of building performance simulation, by using advanced hybrid modelling techniques, which can also lead the way towards emissions reduction by delivering the challenging but much needed demand side management and response.

A number of projects on the development and performance simulation of dynamic shading systems pointed to the signs of a rapidly warming climate. This was also central in Professor Rajan Rawal's keynote speech during day 1. The extreme heat could lead to unprecedented financial losses in labour productivity, transforming cooling from a luxury to a necessity in many parts of the world. "Are we doing enough?" he asked: the requirements of a non-homogeneous world need to be addressed rather urgently.

On day two we were given a glimpse of the technical insights in Professor Ursula Eicker's diverse research portfolio. In her keynote speech, we were reminded that "buildings are not the only contributor to energy demand". Integration with other streams including mobility, waste and microclimate is key and it requires open data libraries, ways of handling all information and clearly defined interfaces. In her closing remarks, Prof Eicker praised physical models, hailing them as essential for our detailed understanding, in an era where "everybody loves AI and ML". Yet our time during the two days in the virtual world was not all academic seriousness and quiz master Professor Kevin Lomas made sure of that by asking questions on a variety of topics, including the name of the IBPSA News Editor-in-chief of IBPSA World! Some got it right, some guessed it right and some got it wrong! All in all, the quiz winners Manon Rendu and Jerome Le Dreau from La Rochelle University in France surely concluded their online presence in BSOV2020 with a big smirky smile.

A special award for recognition of outstanding service to IBPSA-England was presented to Assoc. Prof Rob McLeod, for being instrumental in registering IBPSA-England as a Community Interest Company in the UK. Special congratulations to Rajat Gupta and Matt Gregg from the Low Carbon Building Research Group in the School of Architecture at Oxford Brookes University, for winning the best paper award for their work on spatially-based urban energy modelling approach for enabling energy retrofits in Oxfordshire and contributing to the continuous high standards of academic research in the BSO conferences. ■

IBPSA-Germany & Austria

BauSIM (Virtual) Conference 2020

The 2020 BauSIM conference of IBPSA Germany and Austria took place virtually from 23 to 25 September 2020. The conference, hosted by Graz University of Technology, was the 8th in the biennial BauSIM series. It was attended by more than 165 delegates from 14 countries. The scientific programme of BauSIM 2020 included two keynotes, a provocation, a roundtable discussion, a workshop hosted by the sponsor EQUA and 80 scientific papers presented during the conference. The main topics were:

- Tools for building and district simulation
- Comfort (thermal, visual, physiology…)
- Optimization of operation strategy
- BIM-based simulation and tools
- Regenerative, decentralised energy systems

For the first time in BauSIM history, more contributions were submitted and presented in English (57%) than in German (43%). For this reason, the chairs of BauSIM 2020 Prof. Michael Monsberger, Prof. Christina J Hopfe (FIBPSA), Prof. Markus Krüger and Prof. Alexander Passer decided to choose English as the main conference language, which was also a novelty.

The conference saw two distinguished keynotes. The first was presented by Dr Steffen Robbi, managing director of the Austrian Innovation Lab "Digital findet Stadt". He addressed the role of R&D in the digital transformation of the building industry. One of his messages was that besides developing new tools, it is also important to show how to use them. On the second day, Dr Ruchi Choudhary from the University of Cambridge delivered a talk on "Digital Twins of the Built Environment". She emphasised that it is important to share models with each other.

A key question at the conference was how to increase the impact of building performance simulation in practice in order to exploit the full potential of this methodology. This issue was addressed by Dr Sven Moosberger from EQUA in his provocation and in the roundtable discussion "Building Simulation Software – challenges and future endeavours" moderated by Prof. Christina J Hopfe. Participants in this discussion were Prof. Joe A Clarke (Professor Emeritus, University of Strathclyde, FIBPSA), Prof. John Grunewald (Professor and Chair of Building Physics, TU Dresden), Dr Per Sahlin (CEO EQUA Simulation AB, FIBPSA), Dr Michael Wetter (Deputy Leader Simulation Research Group, Lawrence Berkeley National Laboratory, FIBPSA) and Mr. Andrew Corney (Product Manager at Trimble – SketchUp and Sefaira, UK, FIBPSA). The panellists emphasised the need for better user interfaces, more flexibility and a stronger focus on applications.

Congratulations to Daniel Rüdisser and co-writers from AEE – Institute for Sustainable Technologies as well as Nicolas Pauen and co-writers from E3D – Institute of Energy Efficiency and Sustainable Building, RWTH Aachen for winning the best paper awards. The two award-winning papers reflect the high scientific standard of the conference contributions.

A special thank-you goes to the sponsor EQUA as well as to the Austrian Federal Ministry for Climate Protection and Land Steiermark for supporting the conference. Last but not least, the BauSIM 2020 team would like to thank all authors for their valuable contributions, the scientific committee for supporting the double-blind peer review process and all conference participants for making BauSIM 2020 an exciting virtual event. ■

IBPSA Switzerland

Because of the current situation, it has been difficult for the IBPSA Switzerland board to continue its work. Many board members have been busy with more important issues. Nevertheless, our cooperation with Building Smart Switzerland was further expanded. In spring 2020, various working groups on the topic of digital building were set up. Our president Manuel Frey is the leader of the BIMtoSIM group. There is also a lot going on in education. New courses of study are being offered, such as the bachelor's degree in Digital Construction at the Lucerne School of Engineering and Architecture. Simulation is also an important part of this course of studies, where IBPSA Switzerland members are actively involved. ■

IBPSA-India

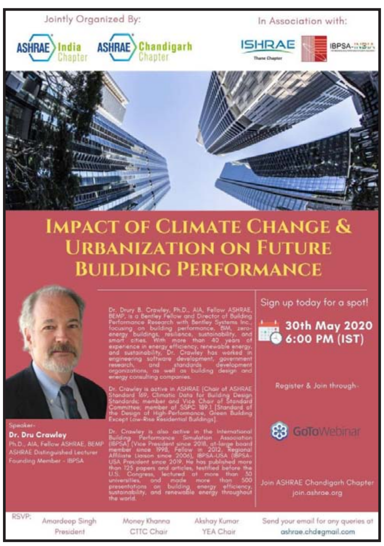
IBPSA-India has co-hosted three webinars this year, on CFD in buildings, the impact of climate change, and grid interactive buildings:

CFD in buildings

IBPSA-India co-hosted a webinar on *CFD in Buildings: Connecting the Dots between Architects and Engineers* with the ASHRAE Chandigarh and Pune chapter on 9 May 2020. The webinar was conducted by Vaibhav Rai Khare, founder member of the IBPSA-India chapter. Approximately 450 participants attended the webinar including a wide range of academicians, students, and industrialists.

The objective was to encourage more architects and non-CFD experts to embrace simulation in their design processes. The presenter discussed how Computational Fluid Dynamics (CFD) is actively bridging the gap between architects and engineers with the help of various case studies, which included early-stage design, urban planning, and airflow pattern.

A recording of the event is available at **https://youtu.be/Qew9ZLu97LE**.

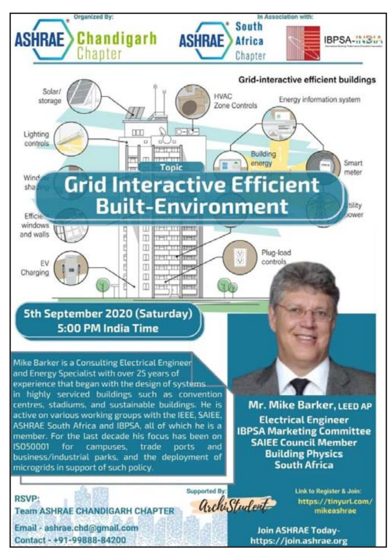


Impact of climate change

The second webinar *Impact of Climate Change and Urbanization on Future Building Performance*, was held on 30 May and co-hosted with the ASHRAE India and Chandigarh chapter. This event was conducted by Dru Crawley, founder member of IBPSA and president of IBPSA-US. Approximately 500 participants attended from all around the globe.

In the webinar, Dru discussed both the fundamentals and the detailed aspects of climate change. This talk can help everyone from beginners to experts to understand the impact of climate change and its relation to building performance.

A recording of the webinar is available at **https://youtu.be/uEWN3mcW83Y**.



Grid interactive building

The third event, *Grid Interactive Efficient Built-Environment* was co-hosted with ASHRAE Chandigarh and ASHRAE South Africa on 5 September 2020. This was conducted by Mike Barker, from the IBPSA Marketing Committee. There were numerous participants from all around the globe.

Mike discussed current interest in net-zero energy and expressed his view that net-zero energy buildings need to evolve alongside grid interactive energy-efficient buildings (GEBS). He also discussed the key characteristics of GEB: energy flexibility in buildings (EBC Annex 67). And he explained the ASHRAE Standard 201-2016 Facility Smart Grid Information Model (FSGM) which will be a bridge between a traditional electricity provider and electricity prosumers.

A recording of the webinar is available at **https://youtu.be/TyO20jLFuyA**.

IBPSA-Scotland

uSIM2020 registration now live

The 2nd IBPSA-Scotland uSIM Conference will be an online event on 12 November 2020. Following on from the success of uSIM2018, this conference will explore the state-of-the-art in urban energy modelling. Hosted by the Urban Energy Research Group at Heriot-Watt University in Edinburgh, research papers from academia and industry will cover:

- community energy modelling
- future forms of stock modelling of the built environment
- use of big data in the understanding of urban energy
- software developments in dynamic simulation
- multi-building energy performance assessments
- applications of both bottom-up and top-down energy modelling of buildings

There is more information in the flyer on page 12.

Registration is free and through Eventbrite at **www.eventbrite.co.uk/e/usim2020-registration-tickets-120404508125**. A Zoom link will be emailed closer to the time. Please do also keep in touch with developments through our uSIM2020 website, **https://usim20.hw.ac.uk**. Whether presenter or attendee, we look forward to welcoming you online in November. ■

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See the IBPSA Central web site at http://www.ibpsa.org/?page_id=29 for details of affiliate websites and contacts. Affiliate representatives are voting members of the IBPSA Board except where marked *.

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For additional information about IBPSA, please visit the Association's web site at **www.ibpsa.org**. For information on joining, contact your nearest regional affiliate.

Members can subscribe to the IBPSA mail list (and, if desired, unsubscribe or edit) via a web interface which is available at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**. Note that this mailing list is solely for IBPSA-related notices and to ensure that you receive future important IBPSA updates (including the election process and announcements of IBPSA News releases).

For any other purposes, please use the BLDG-SIM list. BLDG-SIM is a mailing list for users of building energy simulation programs worldwide, including weather data and other software support resources. BLDG-SIM is intended to foster the development of a community of those users. Experienced and inexperienced users of building energy simulation programs are welcome and are expected to share their questions and insights about these programs.

If you have any questions with respect to the BLDG-SIM, please contact the list owner:
Jason Glazer at **jglazer@gard.com** or +1 847 698 5686.
This list is made possible courtesy of GARD Analytics, Inc., Ridge Park, IL, USA.
For further information about this list server, see the web page located at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**. ■