CONVERSATIONS

Checking In with the GEMM Initiative

OPN talks with three scientists involved in an Optica-led effort that puts optical sensors to work in the battle against both local pollution and global climate change.

Last November, city leaders, policymakers and scientists, among others, came together to discuss cities’ roles in the climate crisis, in a conference held in Glasgow, Scotland, UK (optica-opn.org/news/gemm-at-cop26). The conference—“Cities Are the Key to the Climate Solution”—took place in parallel with the UN COP26 meeting in Glasgow, and was organized in part by the Global Environmental Measurement and Monitoring (GEMM) Initiative, an international project jointly supported by Optica and the American Geophysical Union.

Begun around 2017, GEMM has focused thus far on deploying dense networks of inexpensive optical sensors to provide air-quality and environmental measurements in selected cities, and thereby to enable real-time data for local residents and government officials that can inform policy decisions. To get an update on the initiative and where it’s headed, OPN recently talked with three Optica Fellows who are closely involved with GEMM: 2009 OSA President and GEMM co-lead Thomas Baer, Stanford University, USA; Allister Ferguson, University of Strathclyde, UK; and 2013 OSA President and 2018 Nobel Physics laureate Donna Strickland, University of Waterloo, Canada.
How did GEMM get started?

**THOMAS BAER:** The GEMM initiative grew out of a realization that the climate change and environmental measurement/monitoring areas relied heavily on international cooperation. So, it became natural to develop a program in global public policy at Optica, taking advantage of its international membership.

We began with visits all over the world, talking with government officials and Optica members to learn what their concerns were. And then we came up with the concept of multidisciplinary institutions, or GEMM Centers, which could address the whole problem—from understanding the environment all the way toward developing mitigation and adaptation policies at the governmental and legal level, both regionally and internationally. So that was the philosophy behind creating the centers, which would bring experts in different fields together, both Optica members and others.

What have been some of GEMM’s biggest accomplishments thus far?

**ALLISTER FERGUSON:** Well, one big accomplishment has been to reach out beyond the scientific community to engage more fully with the cities.—Allister Ferguson, University of Strathclyde, UK

Similarly, when I started asking people around the university if they’d be interested in participating in GEMM, there was a really high degree of enthusiasm. And I think the reason for that was that lots of people working in environmental issues were somewhat doing it in isolation, or only talking to their own community—whether that was a scientific, engineering, legal or economic community.

In our GEMM Center at Strathclyde, we have representatives from the science community, the engineering community, the social sciences and so on. For me, it’s been quite enlightening to learn about the range of activities that’s been going on in my own university. It’s also opened up the conversation between the various disciplines, which is another important element.

Putting all of those people from different disciplines together must have been a challenge.

**BAER:** Actually, it wasn’t a challenge. The enthusiasm resulted just from getting people in the same room and having them talk to one another. It was really just a matter of making the effort to organize the meetings.

**FERGUSON:** People were quite surprised and encouraged that others outside of their own discipline were actually interested in what their story was. So that was one reason I think it was quite easy to get this started.
**DONNA STRICKLAND:** I would say the tougher problem is finding the right people, because, again, we are all starting in our own silos. But you have to start pushing your circle wider and wider to find people. I knew very few environmental people, but we were lucky to bring in some of the big names.

**Q.** Right now, most GEMM Centers are located in Anglophone countries. What is the outlook for this effort in economically emerging areas—say, in the Global South?

**BAER:** To get the project started, we needed countries that had the resources to be able to fund these types of activities. And those were countries that are economically well-positioned to do so.

The strategy now is to expand on that, and to look at challenging areas where there may be more of a need for immediate funding to support ongoing activities. Working with UN–Habitat, the United Nations Human Settlement Program, is one example. That program focuses on the limited-resource countries, looking at the climate change’s impact on the quality of life in those areas. We’ve also been approached by people from several locations in Asia and the Pacific Rim who want to engage with us.

**FERGUSON:** It seems to me that Optica has an obligation to work with these countries and regions that are immediately affected by the climate change—small countries, low-lying islands, and so on.

**BAER:** And when you talk about underserved communities, it’s not just the countries in the Global South. It’s underserved communities within the first-world nations. In the United States, it is the indigenous people as well as people of color. Social-equity issues can be addressed through measurement activities, such as the neighborhood-by-neighborhood urban monitoring of pollution levels as well as greenhouse gas emissions. That enables cities’ government officials to address those inequities.

**STRICKLAND:** Yes. And in Canada, the environment is pan-Canadian. So, we must include all people, which means the environmental effort must involve all levels of government, including the three indigenous peoples—First Nations, Inuit, and Métis—and their governments. And so one must keep pushing and trying to find a way to be fully inclusive.

**Q.** What’s on the immediate horizon for the program?

**BAER:** We recognize that the COP meetings provide us a venue to get a message out globally. COP27, the 2022 meeting, is going to be in Egypt, so we’re talking about what our presence is going to be there, and how we can build on it.

We need international cooperation because we’re dealing with global issues and crises. And this is where Optica can have an impact, by putting in some staff resources, some funding resources, to put together these sorts of meetings. And the barriers in terms of interest are not that high. The barrier is really just organizational—putting infrastructure in place.

**Q.** Donna, I believe you’re working on establishing a GEMM Center in Canada?

**STRICKLAND:** Yes. We’ve been taking a different tack from the other GEMM Centers, however—rather than trying to build something local, I’m most interested in getting a whole national GEMM network, to create a national effort.

Along those lines we have been working with the Sentinel North network at Université Laval, Québec, which joined GEMM early on. Sentinel North is a network that brings together hundreds of Université Laval researchers from different departments to work on the unique problems of the far-northern environment. That is the kind of thing we are trying to replicate, if possible, across the country.
Q. So it sounds like GEMM’s effort goes well beyond just air-quality monitoring in cities.

BAER: That’s right. Our approach also includes looking at different aspects of water resources, for example. California is having a water crisis, and it is a very important issue in Scotland as well. So, building on some of the expertise within the GEMM network, we’re looking at different ways that optics and photonics technology can play an important role in the measurement and monitoring of freshwater resources as well as pollution and contamination within the freshwater resources.

We’re also continuing our discussion with the Sentinel North program at Université Laval, which Donna mentioned. There is a tremendous need for new technologies that can work in the arctic environment for measuring the vast quantities of methane that could be released from the thawing tundra, as well as other aspects of the ocean dynamics in the Arctic Ocean, which have a surprising effect on all of the rest of the climate around the world. And we’re looking at these things beyond the greenhouse gas problem, but sometimes related to it, to expand the sort of communities that we’re interacting with as a part of GEMM.

FERGUSON: It’s important to make sure that GEMM is not seen as just being an air-quality effort. In the run-up to the COP26 event, we were very much focusing on atmospheric monitoring. But I don’t want it to be pigeonholed. We need to broaden out, make sure that the other areas, such as water as Tom mentioned, are emphasized.

Climate change is a long-term issue, and we do need to do something about it. But there are shorter-term things that communities can do something about. We need to give them the information to enable them to take the kind of decisions that need to be to be made to improve local and regional air and water quality on a shorter timescale.

Q. Any final thoughts about the program, and Optica’s role in it?

FERGUSON: I’d say that as we think about GEMM’s future, it’s important to think about what people would like to see GEMM achieve. Is it just a vehicle for more conferences, more meetings, more publications? Or is there an opportunity to be seen as a voice, a leading organization, working with other NGOs and sub-national governments? To my mind, it would be a lost opportunity if Optica’s role was simply to be seen as an organizer of events and publications. I’d like to see the organization viewed as a voice alongside those of some of these other organizations.

STRICKLAND: And in terms of creating that voice, I’m a big proponent of Optica’s student chapters. We have some very active chapters around the world that want to be involved with public policy. I think they would be able to go to their municipal leaders and say, “Can we start this in our city?” That is one way that Optica can really help push this forward.

BAER: Optica’s recent change to a new name involved a recognition that it is a global organization that happens to be located in Washington, DC. One thing that I think needs to come out of that is to recognize a growing emphasis on global public policy efforts that are essential.

Luckily, working with Donna and Allister and others, we’ve been able to demonstrate that Optica can do this and can have a real global impact, not only in climate change but also in global health. We’ve been able to demonstrate this in other efforts related to the COVID-19 pandemic response, for example. What we’re doing here with GEMM is talking about greenhouse gases and urban emissions, but we view it as an integral part of Optica’s strategy going forward, in terms of providing services to its membership with a focus on being a global scientific society.