ACM and Climate Change

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ACM's vibrant conference culture has a dark side: it contributes significantly to climate change.

A broad scientific consensus warns that the earth is warming due to human emissions of carbon dioxide and other greenhouse gases (Figure 1). This is not a problem we can leave to future generations: we are up against it now. Indeed, the UN's Intergovernmental Panel on Climate Change (IPCC) recently recommended a 40% decrease in emissions by 2030 to avoid irreversible damage (Figure 2). Achieving reductions on this scale will require urgent and sustained commitment at all levels of society, including non-governmental communities such as universities, companies, and scientific societies like ACM.

Why ACM? Because one of ACM's main activities is organizing international conferences, which produce significant emissions of greenhouse gases, particularly from air travel. For example, a single round-trip flight from Philadelphia to Paris emits the equivalent of about 1.7 tons of carbon dioxide (CO_2e) per passenger [3]—a substantial fraction of the *total* yearly emissions for an average resident of the US (16.5 tons) or Europe (7 tons) [4]. Moreover, these emissions have no near-term technological fix because jet fuel is difficult to replace with renewable energy sources [5].

We are the members of an *ad hoc* Committee on Climate Change within ACM's Special Interest Group on Programming Languages (SIGPLAN) that was formed in 2016 to consider possible strategies for mitigating the emissions of our conferences [6]. Among the ones we find attractive are making it easier to use carbon offsets to mitigate aviation emissions for conferences, choosing conference locations with an eye to minimizing emissions, co-locating or merging conferences, virtualizing program committees, and supporting remote participation.

Buying carbon offsets to reduce the impact of air travel [7] is an "easy win" that conferences should implement now. The idea of carbon offsets is to pay somebody to plant trees, capture methane (from landfills or cattle herds, for example), buy cookstoves to replace inefficient open-fire cooking in poor communities, or carry out other actions that remove greenhouse gases from the air or prevent their emission. At the moment, the average air travel to an international conference can be offset by paying around $30 [7]. ACM could

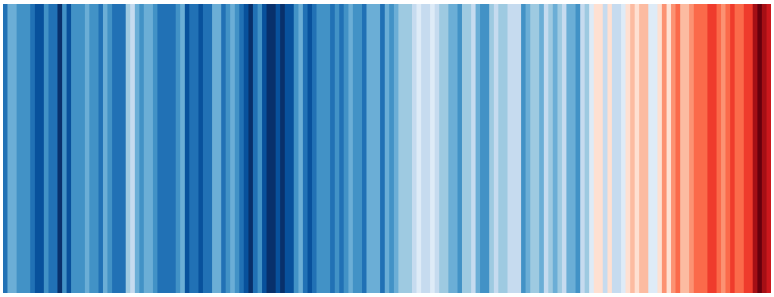

Figure 1: Variation in annual global temperature, 1850 to 2018 (range from blue to red: 1.35°C) [1]

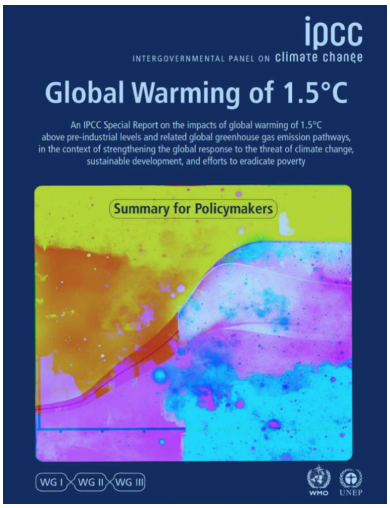

Figure 2: 2018 IPCC report [2]. Key finding: Emissions must decline by at least 40 percent by 2030 and reach net zero by 2050, if we are to hold warming to 1.5 degrees. There is "no documented historic precedent" for the transformation of the world economy needed to achieve this.

streamline the purchase of such offsets and make offsetting the default by folding them into its conference registration fees.

However, carbon offsetting is only a short-term mitigation, since the potential supply of offsets is far less than the potential demand [8]. We must also begin significantly reducing emissions, which means reducing the distance traveled by the sum of all conference participants.

One way to do this is to choose conference locations that are close to the center of mass of their likely participants. For example, the SIGGRAPH conference on computer graphics locates in Los Angeles every other year—an easy call, as this is near both an international airport and a major hub of the worldwide entertainment industry. For other research areas, the effects of location choice are less obvious. For example, Figure 3 plots the locations of the four major SIGPLAN conferences over the past five years, colored according to the

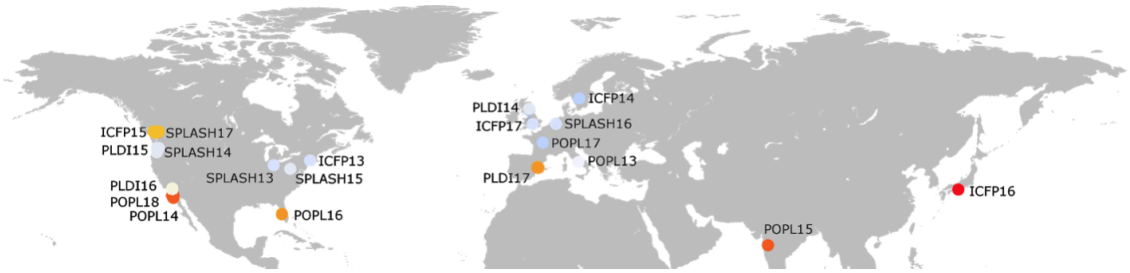

Figure 3: Carbon footprint per participant for travel to recent SIGPLAN conferences

estimated average carbon footprint per participant. The figure shows significant differences across conferences and across locations—indeed, a factor of two difference between the lowest and highest. Why is this? One reason might be that the locus of a conference's population is closer to one location than another, and changing locations reduces the total cost. Another might be the presence of a local population that will only attend if the conference is very close to them. Our preliminary analysis suggests it may be both (and that deeper analysis is needed to understand the situation better). The larger question is how to use this kind of information to choose the best locations, over time, for a diffuse population.

Another natural idea is to co-locate or consolidate conferences. This is already standard practice in some communities—e.g., SIGGRAPH, SC, and CVPR are all "the" conference for their areas. More communities—for example, the programming languages and security communities, each with four main conferences every year—could consider following suit. A different twist on this idea would be to hold a single conference in two locations simultaneously (e.g., Boston and Paris), with a video link between the sites. Switching to virtual program committee meetings for conferences is another obvious step. Indeed, this switch is already happening: we found in a recent poll of ACM SIG chairs that, across ACM, a majority of the SIGs' main conferences now use online PC meetings rather than in-person ones.

Another approach is allowing some conference attendees to participate remotely, saving both emissions and travel time. Indeed, SIGPLAN already livestreams all its four main conferences, while SIGACCESS and SIGCHI have experimented with telepresence robots at their main conferences [9, 10]. Journal-first initiatives, which make conference attendance optional, can also help. Looking further ahead, some communities are already experimenting with fully virtual conferences [11]. ACM members can contribute to the development of technologies for connecting people effectively at a distance.

Each of these strategies will have some beneficial effect on emissions. Each may also have downsides. For example, locating conferences near their existing centers of mass may discourage holding them in countries like India and China where the community is still developing, while virtual PC meetings and remote conference attendance may reduce opportunities for informal connections and mentoring. Getting beyond easy, short-term solutions and fat-trimming exercises requires balancing competing concerns; this will demand significant discussion, compromise, careful analysis of data, and creative experimentation. It will

also involve questioning some fundamental assumptions about how research gets done—e.g., that more and bigger conferences are better, and that personal success is (positively) correlated with time spent in airports. To thrive over the long haul, we need to begin imagining what a zero-carbon professional society will look like.

The problem of climate change is too large and too urgent to leave to world leaders: organizations at every level must play their part by addressing their own contributions, raising awareness among their members, and establishing new ways of doing business in the lower-carbon future that is coming. For ACM, this especially means developing strategies for reducing the climate impact of conference-related travel. You can help accelerate this process in a number of ways:

- **Get involved** in raising awareness about this issue in the organizations you are a part of. For example, ask the organizers of the ACM conferences you attend what they are doing about reducing or offsetting emissions from participants' travel.
- **Analyze** your organization's carbon-emitting activities to inform a discussion of how best to reduce its footprint.
- **Connect** with others that are engaging with these issues—in your workplace, in your other communities, and within ACM (e.g., on the `acm-climate` mailing list [12]).

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