Park-Chun, Coranne

From: tawn@honokaapeople.com
Sent: Wednesday, December 14, 2022 8:31 AM
To: Climate Change Commission
Cc: makenaka@hawaii.edu; Fletcher, Charles; Rep. Natalia Hussey-Burdick; Rep. Amy A. Perruso; Andrei Shkvorov; Honokaa People's Theatre; Rep. Nicole Lowen; Dyson Chee; Anthony Aalto
Subject: Communication/Testimony: Agenda Item #10 - Global Warming Emissions Associated with Tourism Here

Honolulu Climate Change Commission

Good morning,

I would hope that you could introduce as testimony/communication the following letter to, and response by, the leader of the International Aviation and Climate Research Group, inquiring whether his group might engage a project of analyzing and quantifying the global warming emissions from air transport of visitors to Hawaii. This group's findings were identified by the IPCC's 6th Assessment Report as best science in the quantification of global warming potential from aviation emissions. This is a remarkable response to a letter of request which I sent to him last night. It might serve as a standard to whomever might be chosen as 'assignment' for a possible study as proposed in item #10 on this Friday's agenda. Please note the recommendation at the end of Dr. Lee's response of a candidate for performance of a proposed study of emissions from air travel. Thank you for the great work that is at the heart of the mission of the Honolulu Climate Change Commission.

My own testimony/communication would be merely that a consideration might be given to dividing this proposal for an analysis of emissions/warming from tourism into two separate Guidance Documents - one part being emissions resultant from air transport of visitors, and the other being ground based emissions. The 'scoping' element pertaining to ground based emissions might be contentious. One might consider studying only air transport of visitors as this should be the much greater source of emissions. The overarching study of 'tourism' as a whole is a very broad and complex undertaking.
Tawn Keeney MD

-----Original Message-----
From: "David Lee" <D.S.Lee@mmu.ac.uk>
Sent: Wednesday, December 14, 2022 1:37am
To: "tawn@honokaapeople.com" <tawn@honokaapeople.com>
Subject: Re: Study proposal: Global Warming potential from Air Transport of Visitors to Hawaii

Dear Tawn,

Many thanks for your email and your kind comments about 'my' (actually – our) work. I always emphasize that the paper you cite was an effort of over 20 international scientists that I had the privilege of leading.

Cutting to the quick, I would be unable to take on any formal role at the moment owing to pressures of work. I did take the time to listen to the youtube video discussion at the appropriate point where you

and Dr Coffman outline things. I think you both made a splendid job of approximating the emissions to a first order.

My take on doing such accountancy/footprinting calculations is to do the best possible job on the basic flight and CO2 emissions data. I don't know how that is done in Hawaii but I suspect from a quick Google, an official report for Hawaii DOH suggests that some tier of the IPCC (2006) methodology (for which I was partly responsible) is being used for international aviation emissions (often referred to as 'international bunker fuels'). However, it looks like it could be relatively simplistic (tier 1 or 2). However, given the definitions of international and domestic flights used by IPCC (and ICAO), my feeling is that the largest proportion of emissions to/from Hawaii will be domestic, since they come from flights from the US? Under the Paris Agreement, international aviation emissions are not mentioned – unlike the Kyoto Protocol - so are not covered by NDCs. On the other hand, Article 4 of the PA refers to 'temperature', to which international aviation (65% or so, globally) obviously contributes. This is a policy issue at an international level that still hampers aviation GHG emissions reporting and responsibility. At present, ICAO is still assuming responsibility (in a loose sense) for international aviation emissions (I work within ICAO's CAEP, and lead a science group there, on behalf of the UK Government). If a significant proportion of flights to/from Hawaii are domestic, then the US Government has a responsibility to account for them in their intended NDCs (and, implicitly, their contribution to net zero goals).

Back to your issues. So, I would dig into very basic data that are being used to calculate international and domestic emissions from flights – is it a tier 3 model? A tier 3 model (IPCC 2006 terminology), simplistically, accounts for individual flights in terms of distance and the aircraft type to calculate emissions. The US DOT have such a model (really very comprehensive and state of the art) but I don't actually know whether it is used to calculate individual States' aviation emissions.

If you have a good solid starting point, that's the main thing, and that's the basic calculation of CO2 emissions. I understand that you are ultimately interested in attributing emissions to visitors. For that, I suspect you would have to then somehow scale those emissions according to some factor derived from some statistics of proportions of passenger uses. I obviously have no idea of what data would be available locally, or their quality. Scaling for freight/passengers is an interesting idea but it may be somewhat philosophical as to whether doing that is appropriate or not. Most freight, as you probably know, is belly-hold, or commercial passenger-carrying aircraft, as opposed to dedicated freighter aircraft. The existence of freight and passengers strikes me as symbiotic. Would freight exist without the passenger demand? That's probably a question better considered by Dr Coffman, as I note she is an economist. If you do wish to apportion the emissions, there is a more robust way of doing it, possibly, if tonnage of freight is reported on routes in/out of Hawaii. It is often reported as 'revenue tonne kilometres' (RTK), to get a measure of 'work done'. Passengers in terms of revenue passenger kilometres (RPK) can be converted to RTK by assuming a (crude) universal average mass of passenger+baggage (often assumed to be around 100 kg, although another report assumes a much greater 150 kg – the point being that the assumption is an approximation, and uncertain). If everything is in RTK, then the emissions can be apportioned appropriately.

All this will give you CO2. Now, as I understand it, you are interested in aviation's non-CO2 contribution in terms of CO2-e. This is a hugely complex and fraught area. I say 'fraught' as there are both scientific and policy uncertainties (which get confused).

In order to understand non-CO2 issues properly requires quite a deep level of scientific knowledge. Most who use these numbers don't even recognize this, and as a result, make incorrect assertions and assumptions. The quoted Jungbluth and Meili study is a classic 'howler' of a mistake! ☺ J&M (2019) quite clearly do not understand the science. As I always say, "not understanding" can be fixed

(potentially); someone not understanding that they don't understand is usually much harder to fix! The scientific community have been telling 'users' not to (mis)use the Radiative Forcing Index (RFI) as an emissions multiplier, since its introduction in 1999 with the IPCC aviation special report. Atmosfair is another serial offender, as are many C-calculators out there that (mis)use RFI. I will spare you the detail on why this is wrong as it's rather complex. The conventional CO2-e emissions multiplier is the global warming potential (GWP), introduced by the IPCC in 1990. The use of a GWP has two levels of uncertainty – the data going into the ratio (which is scientific), and the time-horizon (TH) over which it is calculated. The TH is purely a subjective user/policy/decision and has been discussed in the scientific literature ad nausem. Nonetheless, the international climate convention of the UNFCCC has recommended a TH of 100 years, so GWP100 is the usual CO2e multiplier used in international policy and CO2-e reporting. However, UNFCCC does not give CO2-e GWP100 values for reporting aviation emissions (The IPCC 2006 GHG report gives N2O and CH4 CO2e factors for aviation, which are very small emissions [and arguably non-existent! I tried to get rid of them as the underlying data were very old and unreliable but failed to get IPCC to not use them!]}.

GWPs were designed for long-lived greenhouse gases like N2O and CFCs/HCFCs. They become more problematic for short lived climate forcers (SLCF) and even using a GWP100 for CH4 (lifetime of ~8-12 years) can be problematic. So, for a SCLF like contrails and contrail cirrus (lifetime hours), the equivalency is difficult and widely discussed in the science literature. In our paper (Table 5), we gave values for different metrics for different THs. We deliberately did not recommend one over the other. Note that the "3x the warming rate" that you correctly cite from our abstract is historically dependent (the proportion of 'influence' of non-CO2 is actually strongly dependent on the recent growth rate of aviation) and "three times" is based on a very particular formulation of the GWP, called the GWP* ('star'), which is not used in policy but is quite widely discussed/debated in the scientific literature. The 'aggregate' aviation GWP100 that we report, using best underlying science data we can muster is 1.7. In policy terms, this would be the least contentious number to use – as a GWP100 is recognized as a 'familiar' metric. Whether it is 'best' is an entirely different question, and I can't really go into that here (as there is no right answer, only a debate to be had). Unfortunately (in retrospect), we didn't give uncertainty ranges for the CO2e metrics. This will be the subject of a future endeavour.

I hope that this has been useful and not too confusing. That folks get confused and trip up over aviation non-CO2 effects and their quantification, I completely understand. It's a complex and messy business. In the UK, we even manage to get it wrong 😂. I have just spent some time correcting BEIS' reporting requirements, which was written by consultants (see 8.39 forwards, where they manage to confuse GWP100 with RFI). The rest of the accounting is well done, and may be of some methodological interest.

The last thing to stress is that the non-CO2 aviation impacts are still very scientifically uncertain, and our uncertainty distributions shown in Fig 7 of our paper clearly show that.

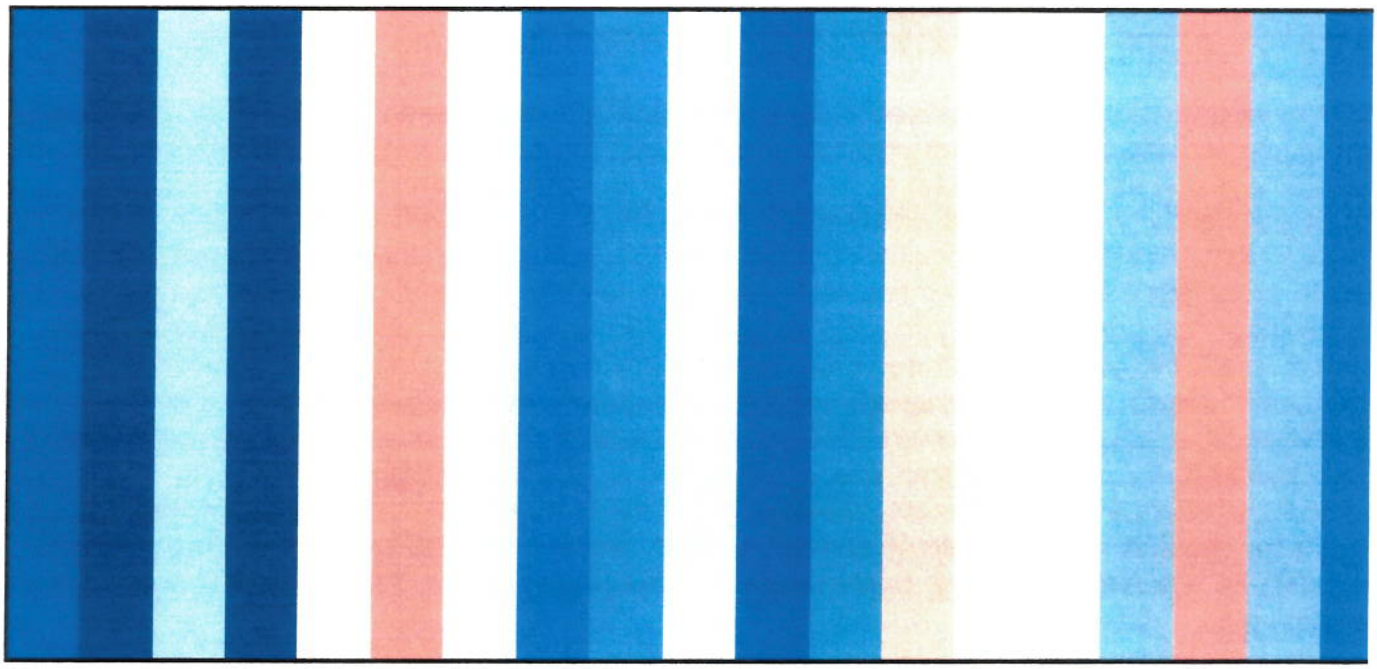
In summary, I'd say your calculated CO2 emissions will be on solid ground. Any 'uplift' to account for non-CO2 equivalent emissions will have scientific and metric type/TH uncertainty. My personal advice would be to stick to GWP100 (even if I don't particularly like it) as it is more widely recognized by the policy community. If you want to avoid complex (and deflective) arguments around public policy, use a metric that they can identify with. Does it really matter whether it is 1.7 or 3, for those purposes? Either way, it is a significant uplift. No-one can deny the potential for aviation non-CO2 effects on climate. Quantifying them is much harder.

If you wanted to hire consultants, I would recommend CE-Delft (contact Dr Jasper Faber) a not-for-profit consultancy in the Netherlands. I have worked with them many times and they are scrupulously

careful and cautious. They are also very good at such problems and diving into the social and economic dimensions. They certainly don't suffer from the myopia that many so-called scientific consultancies suffer from.

Best wishes, David

Manchester Metropolitan University



Aviation warming stripes: the colours represent the percentage contribution of aviation emissions to overall global warming between 1980 and 2021, peaking at 4% in 2018. Based on our work in Klöwer et al., 2021 (see **2** below).

Professor David S. Lee | Aviation and Climate Group Leader | Department of Natural Sciences | Manchester Metropolitan University | John Dalton Building, Chester Street, Manchester M1 5GD, United Kingdom | tel/fax: +44 (0)161 247 3663/6332 | web: https://www.mmu.ac.uk/ecology-and-environment/our-expertise/low-carbon-futures-/ AND https://www.mmu.ac.uk/research/research-centres/ecology-environment/projects/international-action-reduce-emissions-aviation

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1. https://doi.org/10.1016/j.atmosenv.2020.117834 Aviation radiative forcing
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4. 'Climate Change 2022 Mitigation of Climate Change' **IPCC AR6** – Chapter 10 Transport