



Highlights'22 Discussion Session: Introduction

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Télécom Paris

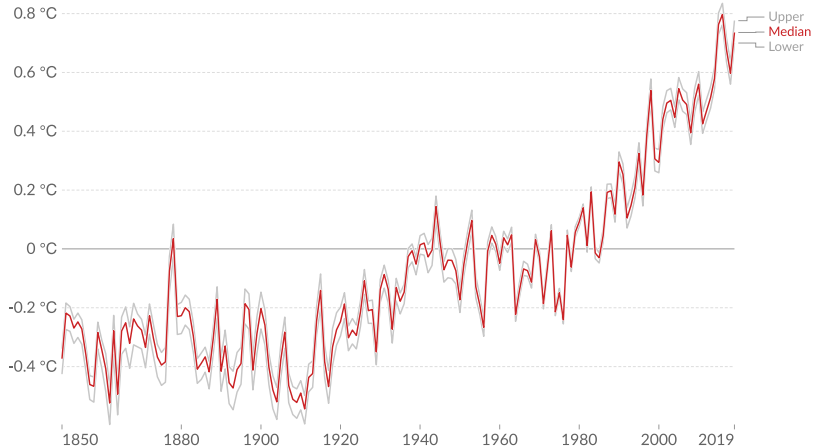
The Climate Crisis

Problem: Temperatures Are Increasing

Average temperature anomaly, Global

Global average land-sea temperature anomaly relative to the 1961-1990 average temperature.

Our World
in Data



Source: Hadley Centre (HadCRUT4)

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

Note: The red line represents the median average temperature change, and grey lines represent the upper and lower 95% confidence intervals.

Cause: CO₂ Concentrations Are Increasing

Global atmospheric CO₂ concentration

Atmospheric carbon dioxide (CO₂) concentration is measured in parts per million (ppm). Long-term trends in CO₂ concentrations can be measured at high-resolution using preserved air samples from ice cores.

Our World
in Data



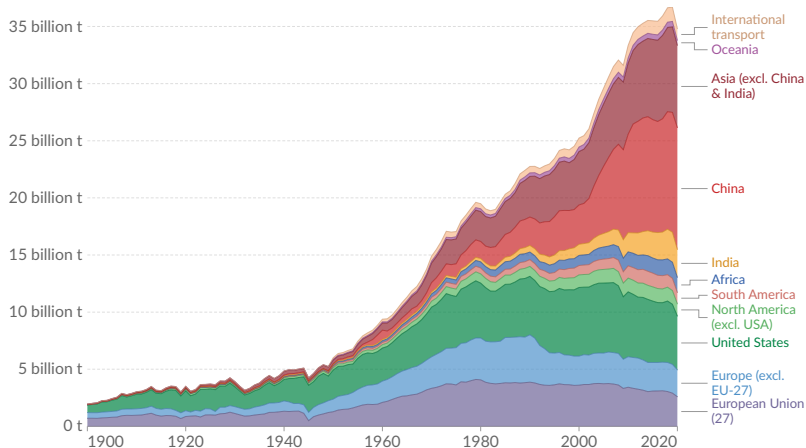
Source: National Oceanic and Atmospheric Administration (NOAA)

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Cause: Fossil Fuel Emissions are Increasing

Annual CO₂ emissions from fossil fuels, by world region

Our World
in Data



Source: Global Carbon Project

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Note: This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included. 'Statistical differences' (included in the GCP dataset) are not included here.

Solution: Lower the Emissions

Global greenhouse gas emissions and warming scenarios

Our World
in Data

- Each pathway comes with uncertainty, marked by the shading from low to high emissions under each scenario.
- Warming refers to the expected global temperature rise by 2100, relative to pre-industrial temperatures.

Annual global greenhouse gas emissions
in gigatonnes of carbon dioxide-equivalents

150 Gt

100 Gt

50 Gt

Greenhouse gas emissions
up to the present

0

1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

No climate policies

4.1 – 4.8 °C

→ expected emissions in a baseline scenario
if countries had not implemented climate
reduction policies.

Current policies

2.5 – 2.9 °C

→ emissions with current climate policies in
place result in warming of 2.5 to 2.9°C by 2100.

Pledges & targets (2.1 °C)

→ emissions if all countries delivered on reduction
pledges result in warming of 2.1°C by 2100.

2°C pathways

1.5°C pathways

Data source: Climate Action Tracker (based on national policies and pledges as of November 2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Last updated: April 2022.
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Goals and Orders of Magnitude

- Emissions per person in 2020¹:
 - World: **4.47 tons CO₂e**
 - Europe: **6.61 tons CO₂e**
- Paris Agreement (2015): “**Keep global warming well below 2°C, aim for 1.5°C**”
- Target emissions per person in 2030 Worldwide: about **2.2 tons CO₂e²**
- By comparison, a **Paris–Beijing return flight** is **2.5 tons CO₂e³**

¹Our World in Data <https://ourworldindata.org/co2-emissions#per-capita-co2-emissions>

²Oxfam study <https://www.oxfam.org/en/research/carbon-inequality-2030>

³Source: <https://labos1point5.org/ges-1point5>

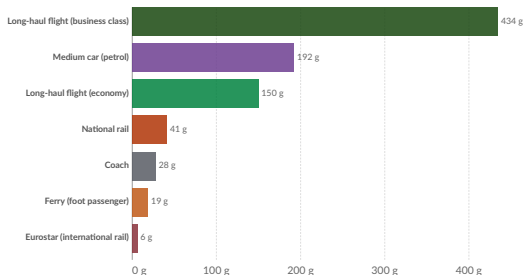
How Do Conferences Emit CO₂?

Main factor by far: **flights** by conference participants

Carbon footprint of travel per kilometer, 2018

The carbon footprint of travel is measured in grams of carbon dioxide equivalents per passenger kilometer. This includes carbon dioxide, but also other greenhouse gases, and increased warming from aviation emissions at altitude.

Our World
In Data



Source: UK Department for Business, Energy & Industrial Strategy. Greenhouse gas reporting: conversion factors 2019.

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Note: Data is based on official conversion factors used in UK reporting. These factors may vary slightly depending on the country, and assumed occupancy of public transport such as buses and trains.

- **Reduce** the total distance flown by remote participants who need to fly
- **Use** trains/coaches instead of planes when possible

Carbon Footprint of Highlights'22

Registration Form

This year, participants were **asked** about their travel plans:

Carbon footprint

To estimate the carbon footprint of this edition of Highlights, please give us some information about your travel

Arriving from...

Which city and country are you arriving from

Arriving by...

What is your main mode of transportation to arrive?

Leaving to...

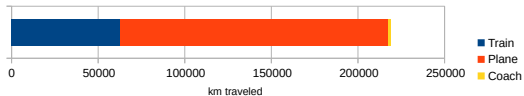
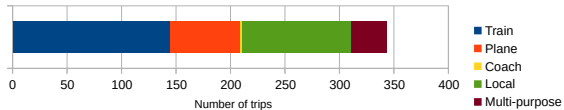
Data **guessed** when not fully provided (8/173 participants) and **geocoded** by hand

The Results

We have 173 registered participants

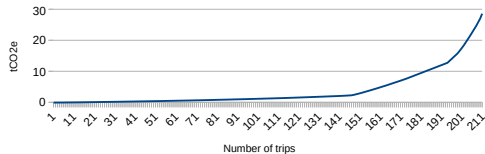
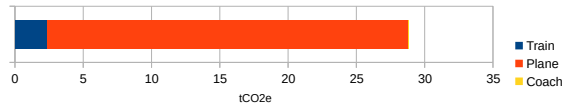
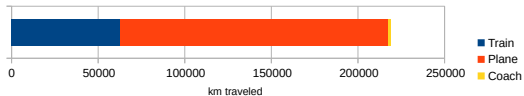
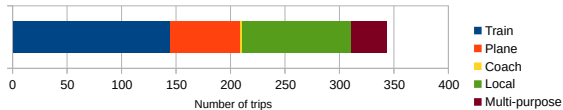
The Results

We have **173** registered participants



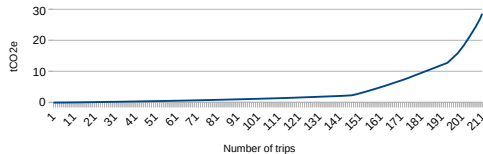
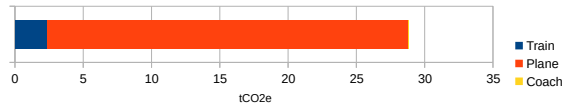
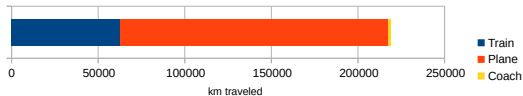
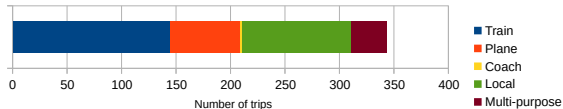
The Results

We have 173 registered participants



The Results

We have **173 registered participants**



- **29 tCO₂e** — the yearly footprint of **6.5 people** today, **13 people** in 2030
- What matters is **flights**, especially **long flights**

So no more travel?

Of course:

- In-person meetings are **crucial**, we do not want to give up on them
- For some participants flying is the **only realistic option**
- Excluding these people is **not the solution**

So, what can we do?

→ In the experimental spirit of **Highlights**, try other approaches

What Can We Do?

Idea 1: Commit to a Goal (DONE)



- **TCS4F**: a manifesto for theoretical computer science conferences
- **Signed** by Highlights! You can also sign individually (179 signers)

The following conferences have committed to the 50% objective:

Name	Full name
CSL	Annual Conference for Computer Science Logic
HIGHLIGHTS	Highlights of Logic, Games and Automata
ICALP 2022	49th EATCS International Colloquium on Automata, Languages and Programming
STACS	International Symposium on Theoretical Aspects of Computer Science

Disclaimer: I am a maintainer of TCS4F.

Idea 2: Measure Emissions (NEW)

- You can't **reduce** what you don't **measure**
- Make methodology and anonymized data **public**
 - Ensures **reproducibility** across editions
 - Can **inspire** other conferences

```
seen = set()
n_trips = 0
total_dist = 0
total_co2 = 0
trips_by_type = defaultdict(lambda: 0)
dist_by_type = defaultdict(lambda: 0)
co2_by_type = defaultdict(lambda: 0)

for l in sys.stdin.readlines():
    f = l.strip().split(',')
    person = f[0]
    inst = f[1]
    mode = f[2]
    multitrip = f[3] == 'true' or f[4] == 'true'
    if multitrip and person in seen:
        # for a multi-purpose trip, only count the first transport leg of that
        # person
        # we assume that the input is sorted by decreasing distance so that it's
        # the longest leg
        continue
    seen.add(person)
    distance = float(f[5])
    if mode.strip() in ['plane', 'other']:
        if distance > 400000:
            mode = 'plane'
            trips_by_type['plane', assumed'] += 1
        else:
            mode = 'train'
            trips_by_type['train', assumed'] += 1
    else:
        trips_by_type[mode] += 1
    dist_by_type[mode] += distance
    n_trips += 1
    total_dist += distance
    g_kg_person = None
    if mode == 'train':
        g_kg_person = 37
    if mode == 'bus/coach':
        g_kg_person = 28
    if mode == 'plane':
        if distance <= 1000000:
            g_kg_person = 288
        elif 1000000 < distance <= 3500000:
            g_kg_person = 152
        elif 3500000 < distance:
            g_kg_person = 152
    co2 = (g_kg_person * (distance / 1000)) / 1000
    co2_by_type[mode] += co2
    total_co2 += co2
    print(' '.join([person, inst, str(distance), mode, str(co2)]))

print("2d total trips" % n_trips, file=sys.stderr)
print("2d total distance" % total_dist, file=sys.stderr)
print("2d total CO2" % total_co2, file=sys.stderr)
for k in trips_by_type:
    print("2d trips by %s" % (trips_by_type[k], k), file=sys.stderr)
for k in dist_by_type:
    print("2d distance by %s" % (dist_by_type[k], k), file=sys.stderr)
for k in co2_by_type:
    print("2d kgCO2e by %s" % (co2_by_type[k], k), file=sys.stderr)
```

Idea 3: Colocation and Extended Stays (NEW)

Co-locate Highlights with a relevant conference (new this year)

- **37/173** participants also attending ICALP
→ **1.4 tCO₂e** saved wrt taking their complete footprint

Nudge participants to **stay longer**: Highlights and ICALP **extended stay support scheme**

- **24/173** participants extend their stay, **8** of which via a **scheme**
→ **3.6 tCO₂e** saved wrt taking their complete footprint

Idea 4: Hybrid and Virtual Conferences

- Have **hybrid conferences**, like ICALP'22
 - **Complicated!** Timezones, audio/video, social interaction...
 - Host **meetups** for virtual conferences or distant conferences? (like NeurIPS or MFPS)
- Have **virtual conferences**, e.g., every other year
 - How **good** can they become?
- Adapt **publication practices**:
 - Allow **remote presentations** for conference with formal proceedings...
 - Or invent **journals that work like conferences**

Bad Idea: Carbon Offsets

- An **alluring idea**: pay money (around 23 EUR/tCO₂e) to reduce emissions elsewhere
- In practice, many **problems**:
 - No **guarantee** on emission decrease
 - No satisfactory **oversight**
 - Mostly **repackaging** of existing savings



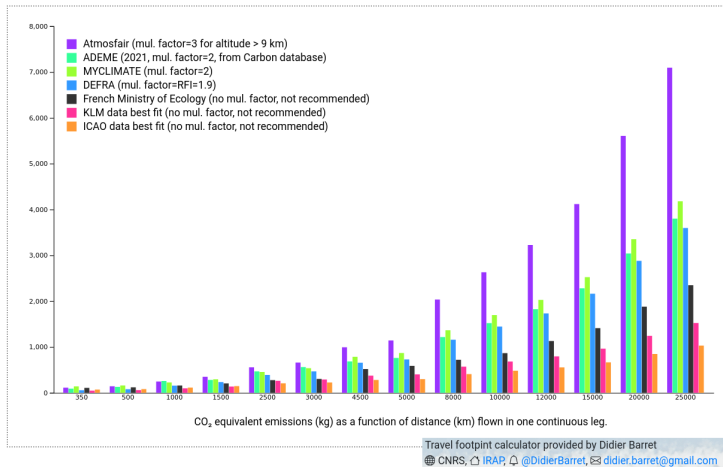
Discussion

Questions for discussion

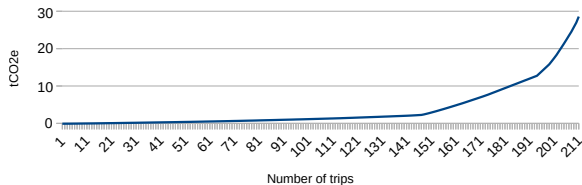
- Should we **turn formal conferences** into journals?
- How can Highlights **meet its 2030 goal**?
- Which **hybrid models** work well?
- How should we **co-locate** conferences?
- Are you ready to **reduce your plane travel**?
- How to **limit long trips** without **excluding participants**?
- What do you think **online conferences** will become?
- Will the world need **theoretical CS results** in 2050? in 2100?

Estimating the Carbon Footprint

Large **uncertainty** on plane emissions! (and on rail). We use **Labos1point5/Ademe** data



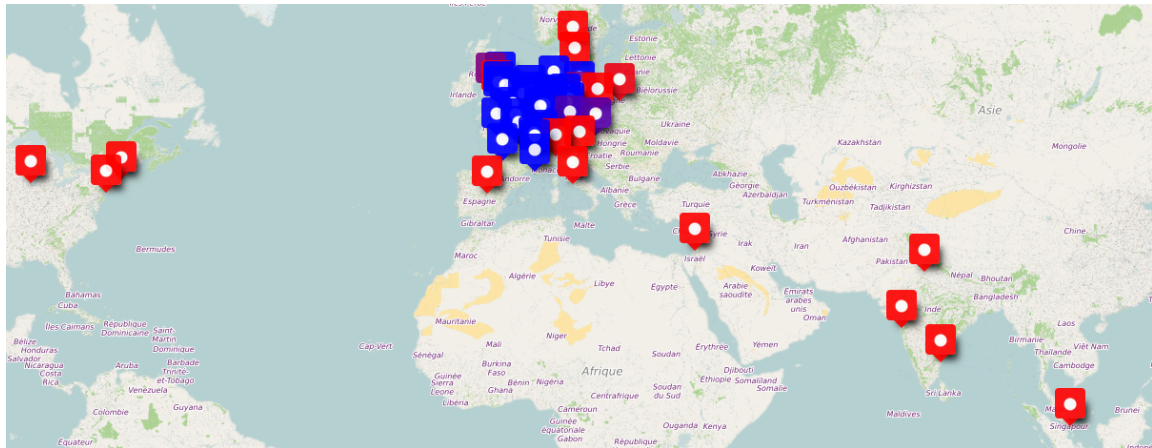
Cumulative Emissions



To divide the carbon footprint by 2:

- Remove the **15 most emitting trips** (out of 344)
- Reduce by **66%** on the **40 most emitting trips**

Which Places?



Which Places? (in Europe)

