

STAY GROUNDED



countering aviation – for a just transport system

Network Meeting - Fall 2020

THE REAL CLIMATE IMPACT OF AVIATION

HOW TO ZOOM

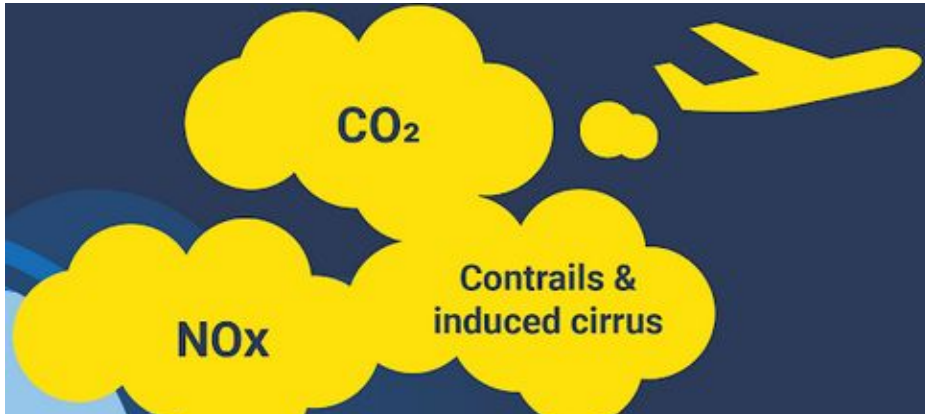
1. Rename your profile with your name and organization (click on participants and rename yourself)
2. Keep mic muted if you don't speak (use the chat function in case you experience difficulties during presentations)
3. Raise hands: Use the chat and make a star * if you want to speak
4. This meeting is being recorded and made available publicly - the recording starts now.

AGENDA OF THE WEBINAR

1. Non-CO₂ impacts: What are the latest figures and what do they mean? Eric Lombard - Rester sur Terre (SG France)
2. Mitigating the climate forcing of contrails. Marc Stettler - Imperial College London
3. What should regulators do?
Bill Hemmings - Aviation consultant (Rosetta advisory services Brussels)
4. Discussion

Non-CO₂ impacts of aviation

What are they and how much is it?



Total aviation-caused climate heating
is 3 times that of CO₂ alone



CO₂



1. Produced by the combustion of kerosene in reactors: 1 Gt/yr
2. Produced in upstream operations (Well to tank): 0.2 Gt/yr
3. Total contribution of aviation : 2.9% of all human-caused CO₂
4. Long-lived: accumulates in the atmosphere. Still 30% after 100 years

NO_x derivatives

1. NO_x (nitrogen oxides) are not greenhouse gases (not to be confused with nitrous oxide, N₂O, a powerful GHG).
2. But they react in the upper atmosphere and:
 - produce ozone (O₃), a GHG, lifespan = 1 mo (heating effect)
 - destroy methane (CH₄), a GHG, lifespan = 12 yr (cooling effect)
3. Overall heating effect

Contrails and contrail cirrus

1. Water vapor + soot + cold / humidity → Contrails (ice crystals)
Life-span = 1 h
2. Contrails sometimes → Contrail cirrus. Life-span = 1 day
3. Contrail cirrus forcing dominates that of persistent linear contrails (90/10)
4. Cooling in the day, heating at night. Overall heating effect
5. Very few flights account for most of the energy forcing (2% of flights account for 80% of the EF in [Marc Stettler's study](#) in Japan).

Contribution of aviation to climate heating

How much?

What are we talking about? Two ways of dealing with the question:

1. How much has aviation already contributed to the currently observed heating (about 1°C)?
2. How much do emissions of aviation contribute to additional heating caused by overall human ongoing activity (in a year for instance)?

1. Historical contribution of aviation

To date[#], the radiative forcing of aviation is responsible for 3.5% of the observed heating.

It is the result of:

- CO₂ accumulated since the beginning of aviation: $\frac{1}{3} = 1.2\%$
- Short-lived non-CO₂ that constantly appear and vanish, as long as there are planes in the sky: $\frac{2}{3} = 2.3\%$

[#] 2011 data ([Lee et al 2020](#))

2. Contribution of aviation to the ongoing additional heating

Today[#], aviation emissions account for 5.9% of all human-caused additional heating.

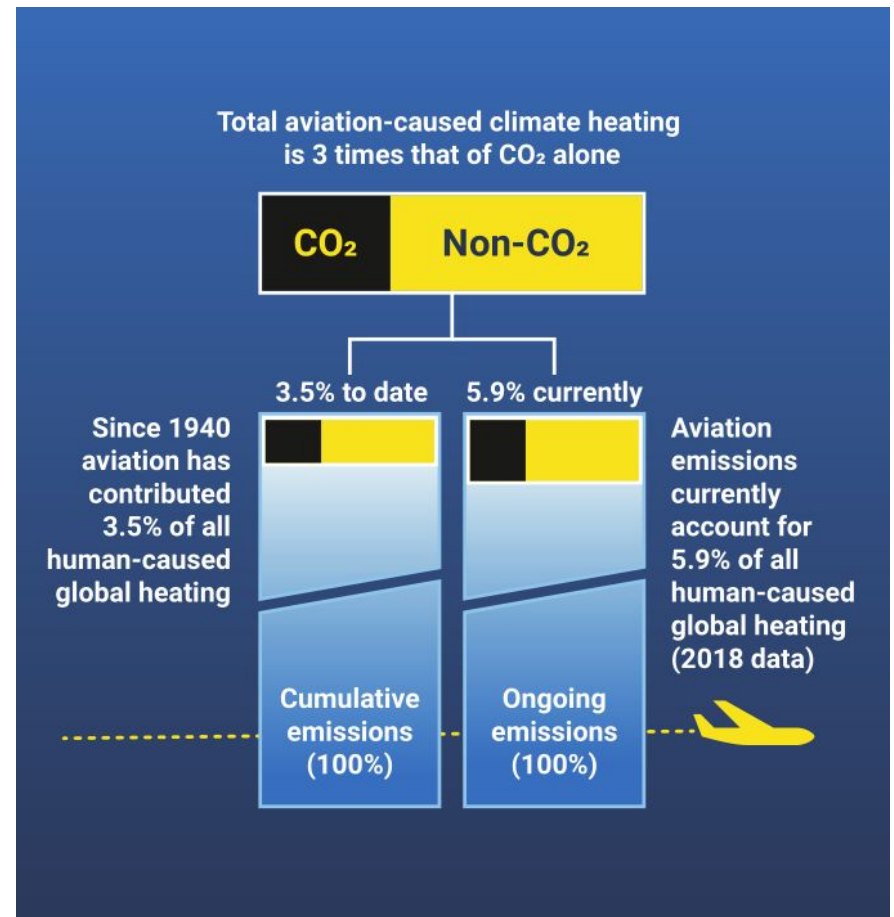
It is the combination of:

- CO₂ emissions from oil well through flights = 1 + 0.2 Gt CO₂/yr
- non-CO₂ emissions = 2.1 Gt CO₂e*/yr

Total: 3.3 Gt CO₂e*/yr (over 56.1 Gt CO₂e*/yr)

[#] 2018 data (Lee et al 2020)

Key figures



The past or the future?

“Aviation has already contributed **3.5%** to the currently **observed heating**”, is what has been retained from Lee’s recent article. It’s the result of **past** air traffic.

What’s important for the **future** is what we are doing now!
And today (before Covid), aviation emissions account for **5.9%** of all human-caused **additional heating**. It’s what we must all say!

Multiply CO₂ by 3 is valid for the past as well as for the present.

GWP*: a new approach for calculating CO₂ equivalent of short-lived species



Let's think of radiative forcing as blankets that keep the earth warm!

For short-lived blankets like contrail cirrus:

- if air traffic is constant, the thickness remains constant : there as many contrail cirrus being formed as disappearing
- If air traffic grows, the thickness of the blanket increases
- If air traffic decreases, the thickness decreases.

►► Adding some CO₂eq. for contrail cirrus and other non-CO₂ emissions is only necessary if traffic grows.

Why use GWP* rather than GWP or GTP?

GWP* [first proposed for methane](#), now extended to very short-lived emissions of aviation.

Using GWP*:

- preserves the link between emissions and warming/cooling of the atmosphere
- is less dependent on time horizon.

Aviation	GWP ₂₀	GWP ₅₀	GWP ₁₀₀	GWP* ₂₀₋₁₀₀
Tot CO ₂ -e / CO ₂	4.0	2.3	1.7	3.0

(Multiplier)

GWP*: a change in the way of thinking

From: adding a non-CO₂ burden, proportional to CO₂ emissions, to every flight

To: adding a non-CO₂ burden, proportional to traffic growth, to aviation as a whole

Outcome:

- 1 Gt CO₂ for every 1 mW/m² incremental Effective radiative forcing (increased blanket thickness).
- For the last 18 years, average increase of non-CO₂ ERF = 2 mW/m²/yr
- non-CO₂ burden = 2.1 Gt CO₂-e*/yr

1 Gt CO₂ + 2.1 Gt CO₂-e* = 3.1 CO₂-e* (2018, without Well to Tank)

A new argument for degrowing aviation

Degrowing aviation reduces the thickness of the non-CO₂ blanket

- It's equivalent to CO₂ negative emissions (withdrawing CO₂ from the atmosphere)
- It has an immediate effect

Potential : 67 Gt CO₂-e

(about twice the emissions of aviation since 1940 or 1.6 times the annual worldwide emissions of CO₂)

IT'S ABOUT MORE THAN JUST CO₂

STAY GROUNDED
FACT SHEET | OCTOBER 2020

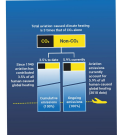
It's about more than just CO₂ Aviation must reduce its **total impact** on climate

Aviation's climate impact is caused by more than just CO₂. Flying is a privileged activity of a global minority, but its impact on the climate is disproportionately large. That's because planes generate also contrails, induced cloudiness and NO_x derivatives, which raise the total climate impact to 3 times that of the CO₂ alone. And air transport emissions have been rising fast: in 2018 they accounted for 5.9% of all human-caused global heating. Cutting air traffic reduces non-CO₂ climate impacts immediately.

THE FACTS

1. Non-CO₂ climate impacts are significant

Aviation's climate impact is caused by more than just CO₂. Flying is a privileged activity of a global minority, but its impact on the climate is disproportionately large. That's because planes generate also contrails, induced cloudiness and NO_x derivatives, which raise the total climate impact to 3 times that of the CO₂ alone. And air transport emissions have been rising fast: in 2018 they accounted for 5.9% of all human-caused global heating. Cutting air traffic reduces non-CO₂ climate impacts immediately.

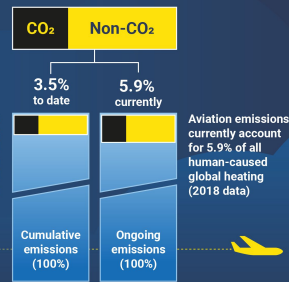


It's about more than just CO₂: The total climate impact of aviation

Despite flying being a privileged activity of a global minority, aviation has already contributed about 3.5% of all human-caused global heating to date. That is because planes generate also contrails, induced cloudiness and NO_x derivatives, which raise the total climate impact to 3 times that of the CO₂ alone. And air transport emissions have been rising fast: in 2018 they accounted for 5.9% of all human-caused global heating. Cutting air traffic reduces non-CO₂ climate impacts immediately.

Sources:
Lee et al. (2020):
bit.ly/NonCO2
Stay Grounded (2020):
bit.ly/non-CO2facts

Total aviation-caused climate heating is 3 times that of CO₂ alone



- 1 Aviation's climate impact is 3x that of its CO₂ alone
- 2 In 2018, it caused 5.9% of global emissions
- 3 Cutting air traffic reduces emissions immediately
- 4 Mitigation is possible, but resisted

- 1 Account for CO₂ AND non-CO₂ emissions
- 2 Take measures to reduce ALL impacts
- 3 Apply operational and technological improvements
- 4 Keep air traffic low

Communication package

Mitigating the climate forcing of contrails

Imperial College
London

Non-CO₂ impacts: mitigating the climate forcing of contrails

- Roger Teoh, **Marc Stettler**, Center for Transport Studies, Imperial College, London
- Ulrich Schumann, DLR (German Centre for Air and Space Travel)

Decarbonisation of Aviation
17th June 2020



Flight diversion over Japan: Key results

- 18% of flights forming contrails
- Maximum warming between 3 pm and 6 am. Cooling may occur in daytime
- 2.2% of flights generating 80% of the Energy forcing (EF)

Small change in flight altitude (+/- 2000 ft) of 1.7% of flights :

- Reduction of EF_{Contrail} : - 59%
- Reduction of EF_{Total} : - 36%
- CO₂ penalty: + 0.01% for the fleet

Mean 2006 net-contrail Radiative forcing from Aqua MODIS data

