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

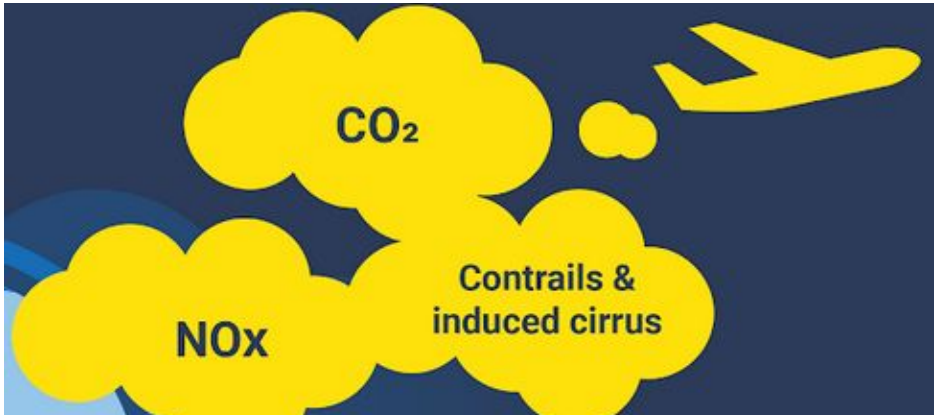
1. Non-CO_2 impacts: What are the latest figures and what do they mean? Eric Lombard - Rester sur Terre (SG France)

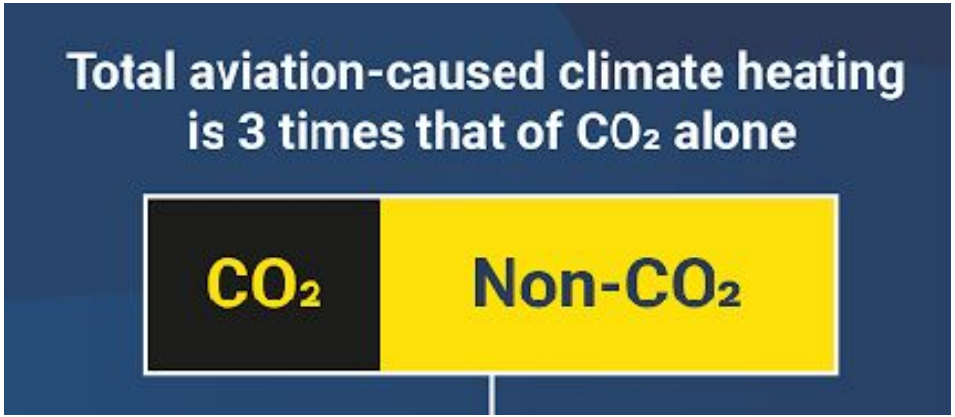
2. Mitigating the climate forcing of contrails. Marc Stettler - Imperial College London

3. What should regulators do?
   Bill Hemmings - Aviation consultant (Rosetta advisory services Brussels)

4. Discussion

Non-CO_2 impacts of aviation
What are they and how much is it?





CO_2

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 CO_2
4. Long-lived: accumulates in the atmosphere. Still 30% after 100 years

NOx derivatives

1. NO_x (nitrogen oxides) are not greenhouse gases (not to be confused with nitrous oxide, N_2O, a powerful GHG).

2. But they react in the upper atmosphere and:
   - produce ozone (O_3), a GHG, lifespan = 1 mo (heating effect)
   - destroy methane (CH_4), 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:

- CO_2 accumulated since the beginning of aviation: ⅓ = 1.2%
- Short-lived non-CO_2 that constantly appear and vanish, as long as there are planes in the sky: ⅔ = 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.

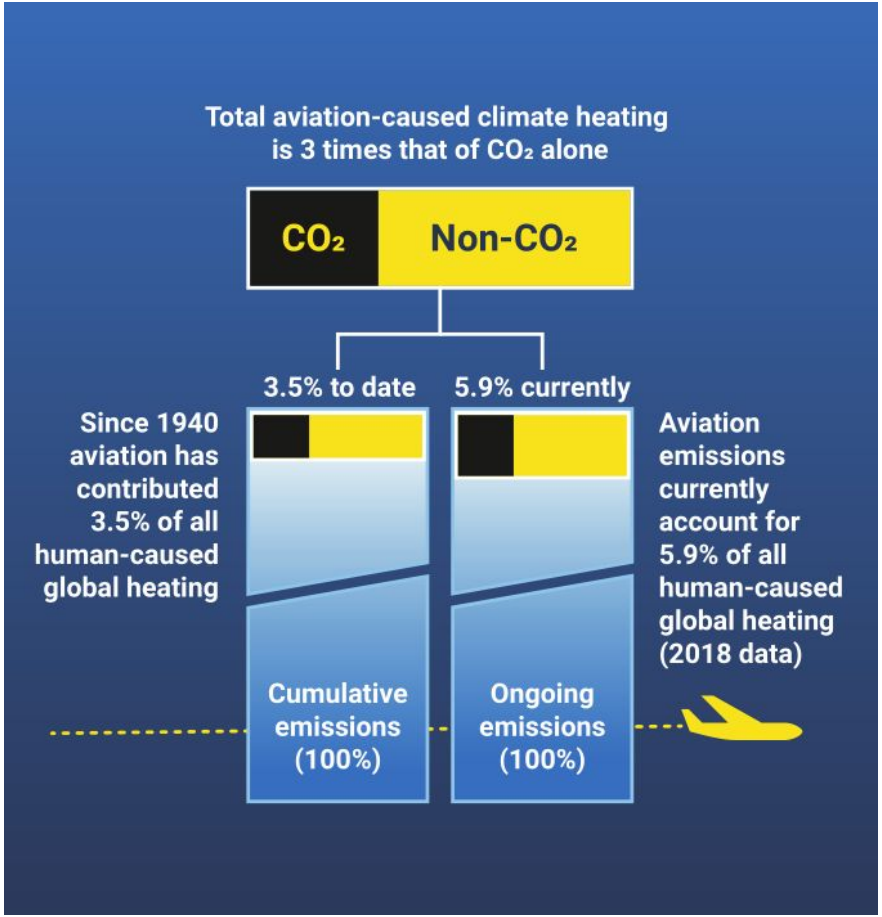
It is the combination of:

- CO_2 emissions from oil well through flights = 1 + 0.2 Gt CO_2/yr
- non-CO_2 emissions = 2.1 Gt CO_2e*/yr

Total: 3.3 Gt CO_2e*/yr (over 56.1 Gt CO_2e*/yr)

[#] 2018 data (Lee et al 2020)

Key figures


Total aviation-caused climate heating is 3 times that of CO_2 alone
CO_2
Non-CO_2
3.5% to date
5.9% currently
Since 1940 aviation has contributed 3.5% of all human-caused global heating
Cumulative emissions (100%)
Ongoing emissions (100%)
Aviation emissions currently account for 5.9% of all human-caused global heating (2018 data)

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 CO_2 by 3 is valid for the past as well as for the present.

GWP*: a new approach for calculating CO_2 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 CO_2eq. for contrail cirrus and other non-CO_2 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-CO_2 burden, proportional to CO_2 emissions, to every flight

To: adding a non-CO_2 burden, proportional to traffic growth, to aviation as a whole

Outcome:

- 1 Gt CO_2 for every 1 mW/m^2 incremental Effective radiative forcing (increased blanket thickness).
- For the last 18 years, average increase of non-CO_2 ERF = 2 mW/m^2/yr
- non-CO_2 burden = 2.1 Gt CO2-e*/yr

1 Gt CO_2 + 2.1 Gt CO_2-e* = 3.1 CO_2-e* (2018, without Well to Tank)

A new argument for degrowing aviation

Degrowing aviation reduces the thickness of the non-CO_2 blanket

- It's equivalent to CO_2 negative emissions (withdrawing CO_2 from the atmosphere)
- It has an immediate effect

Potential : 67 Gt CO_2-e
(about twice the emissions of aviation since 1940 or 1.6 times the annual worldwide emissions of CO_2)

IT'S ABOUT MORE THAN JUST CO_2

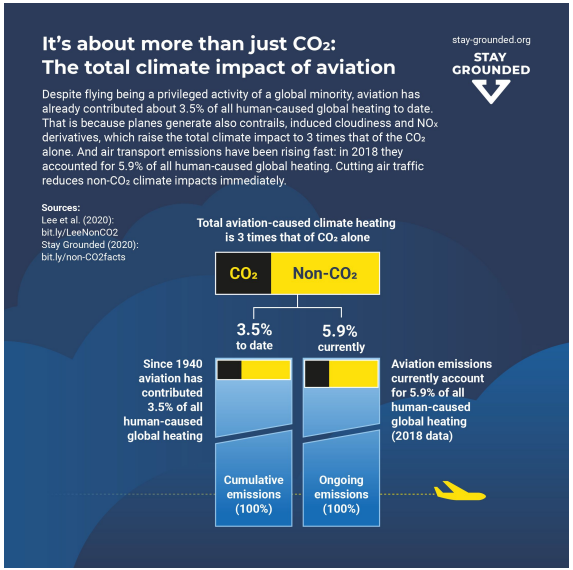

STAY GROUNDED
FACT SHEET | OCTOBER 2020

It's about more than just CO_2

Aviation must reduce its *total impact* on climate

THE FACTS

[Communication package]



1️⃣Aviation's climate impact is 3x that of its CO_2 alone
2️⃣In 2018, it caused 5.9% of global emissions
3️⃣Cutting air traffic reduces emissions immediately
4️⃣Mitigation is possible, but resisted

1️⃣ Account for CO_2 AND non-CO_2 emissions
2️⃣ Take measures to reduce ALL impacts
3️⃣ Apply operational and technological improvements
4️⃣ Keep air traffic low

Mitigating the climate forcing of contrails

Imperial College London

Non-CO_2 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

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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%
- CO_2 penalty: + 0.01% for the fleet

Mean 2006 net-contrail Radiative forcing from Aqua MODIS data