Comparing the climate impact of different transport modes

Results from the QUANTIFY project

Robert Sausen

Deutsches Zentrum für Luft- und Raumfahrt (DLR)
Institut für Physik der Atmosphäre
Oberpfaffenhofen, Germany

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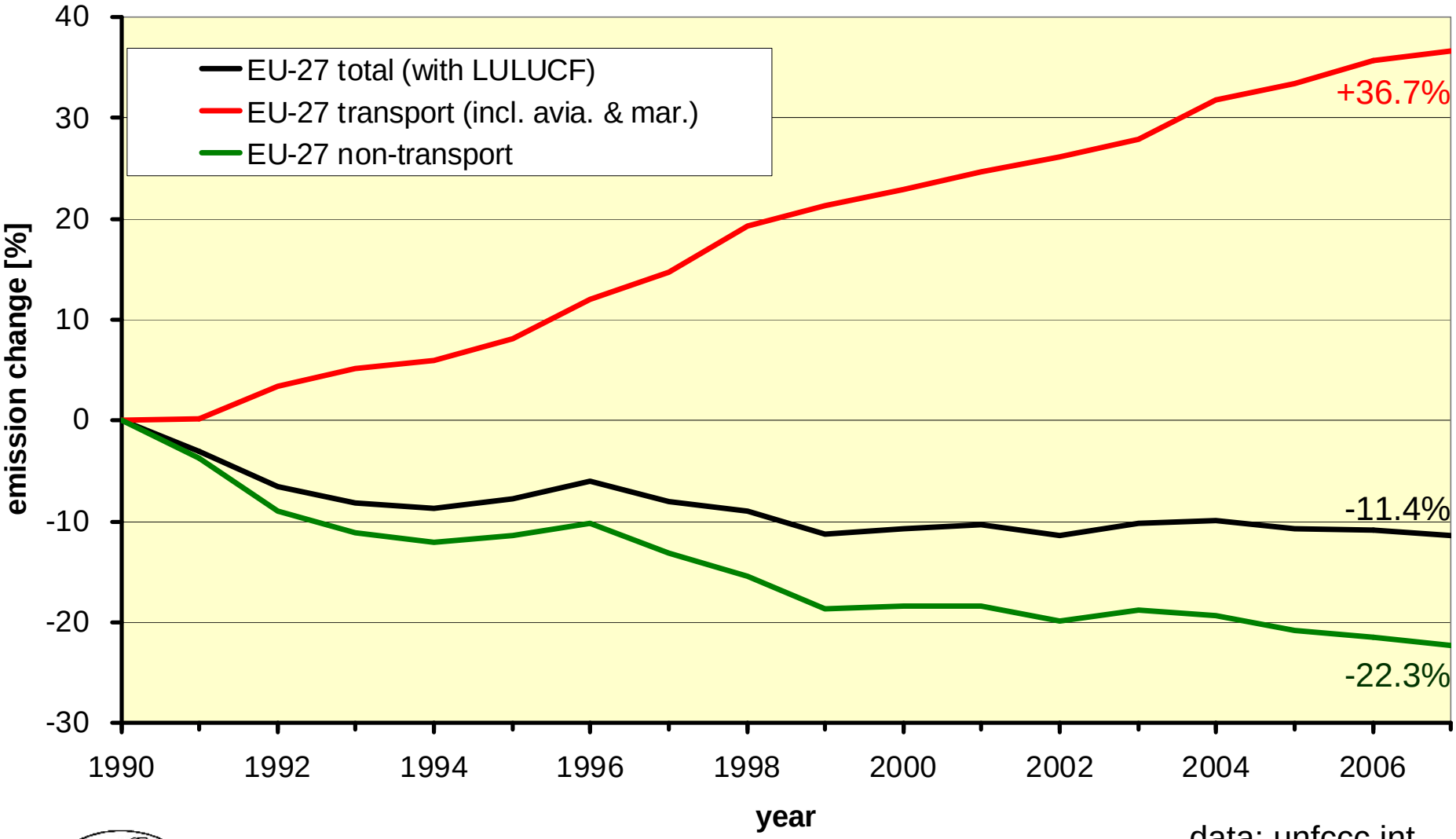
How can transport impact climate ?

Changes in radiative forcing can be caused by

emission of greenhouse gases, including long-lived species
like CO_2 and N_2O, but also of water vapour

CO_2 equivalent emissions of EU-27 *

Change since 1990



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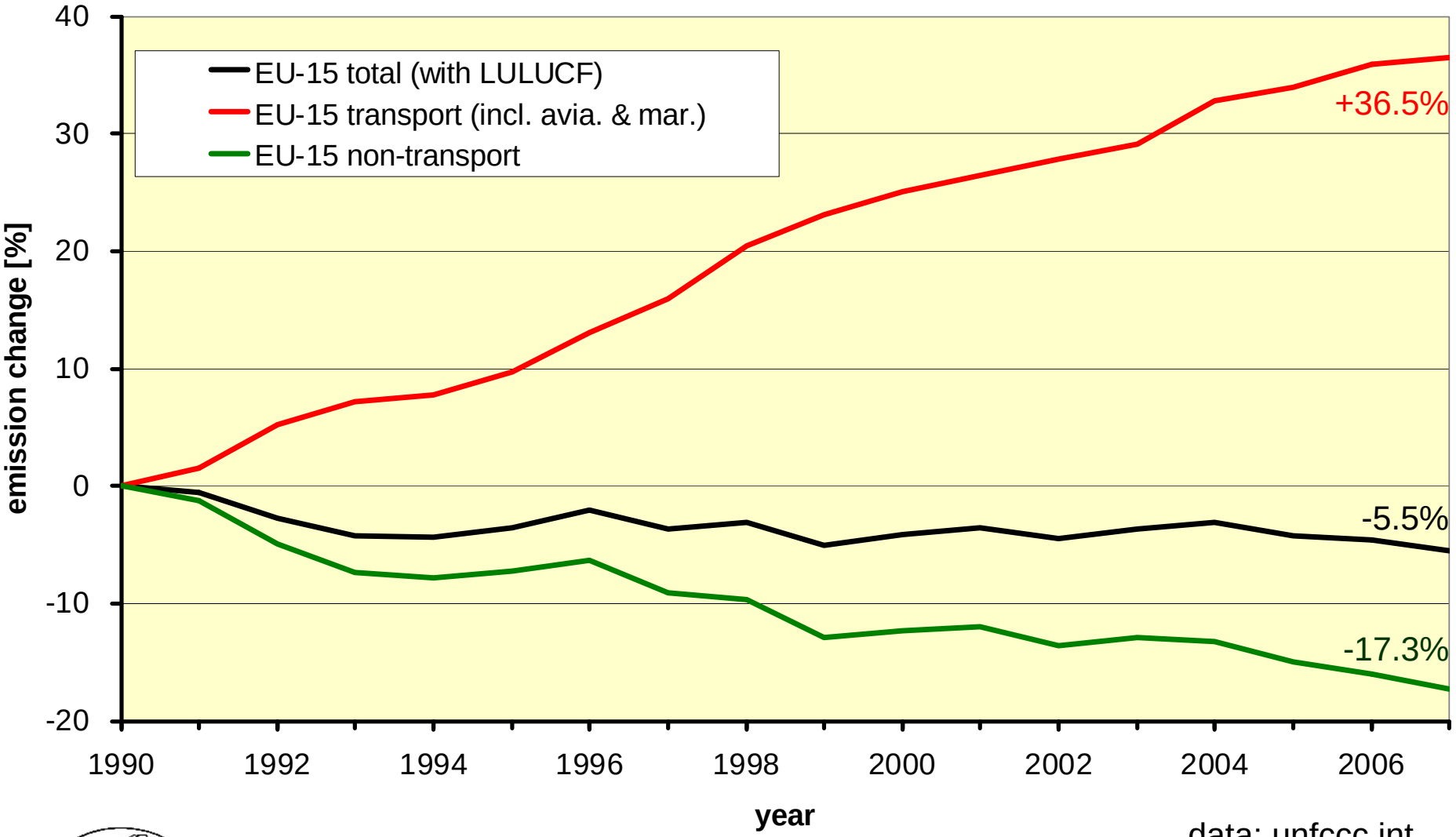
* all EU countries except Cyprus and Malta

CO_2 equivalent emissions of EU-15

Change since 1990



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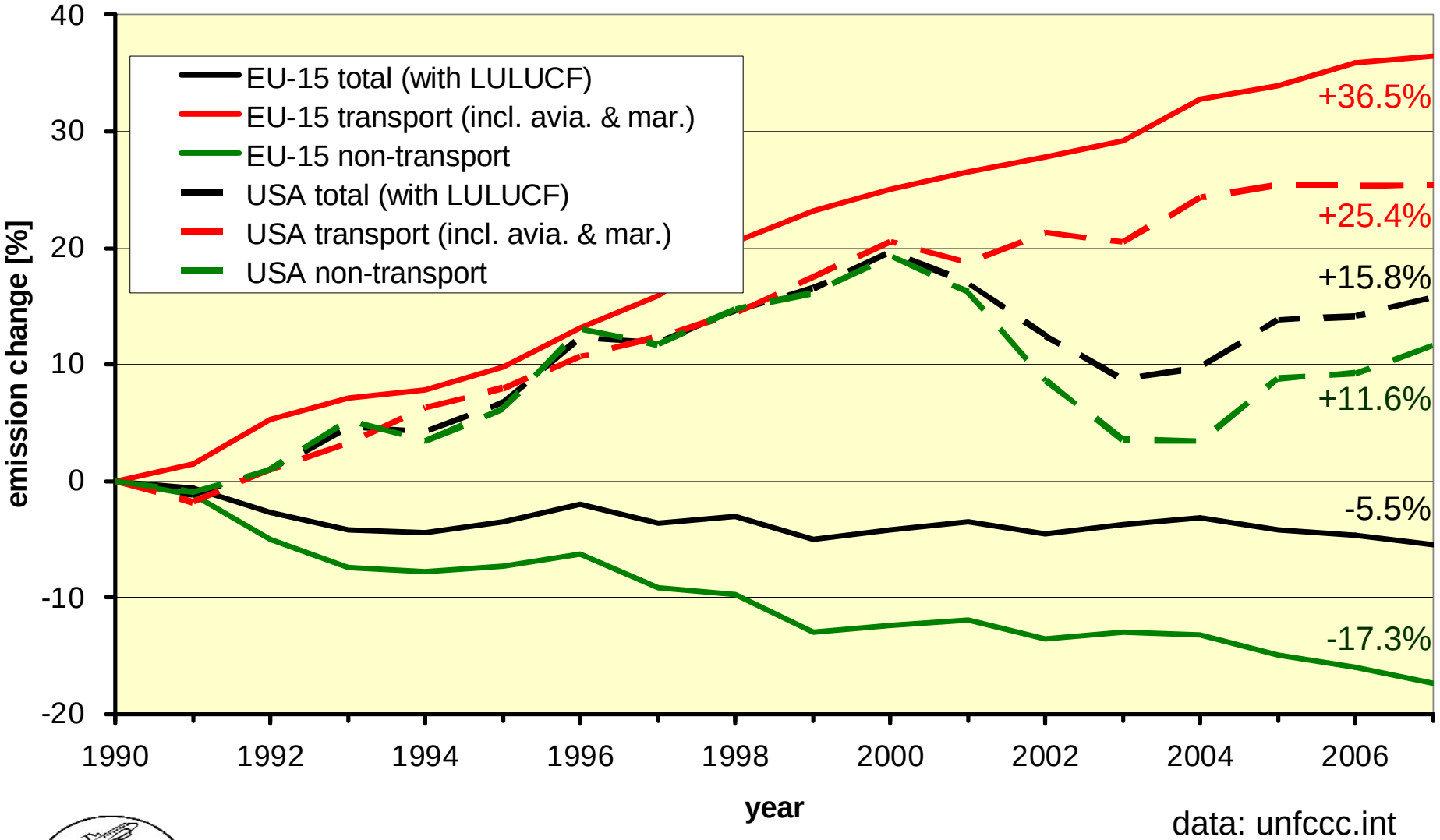
CO_2 equivalent emissions of EU-15 and USA

Change since 1990



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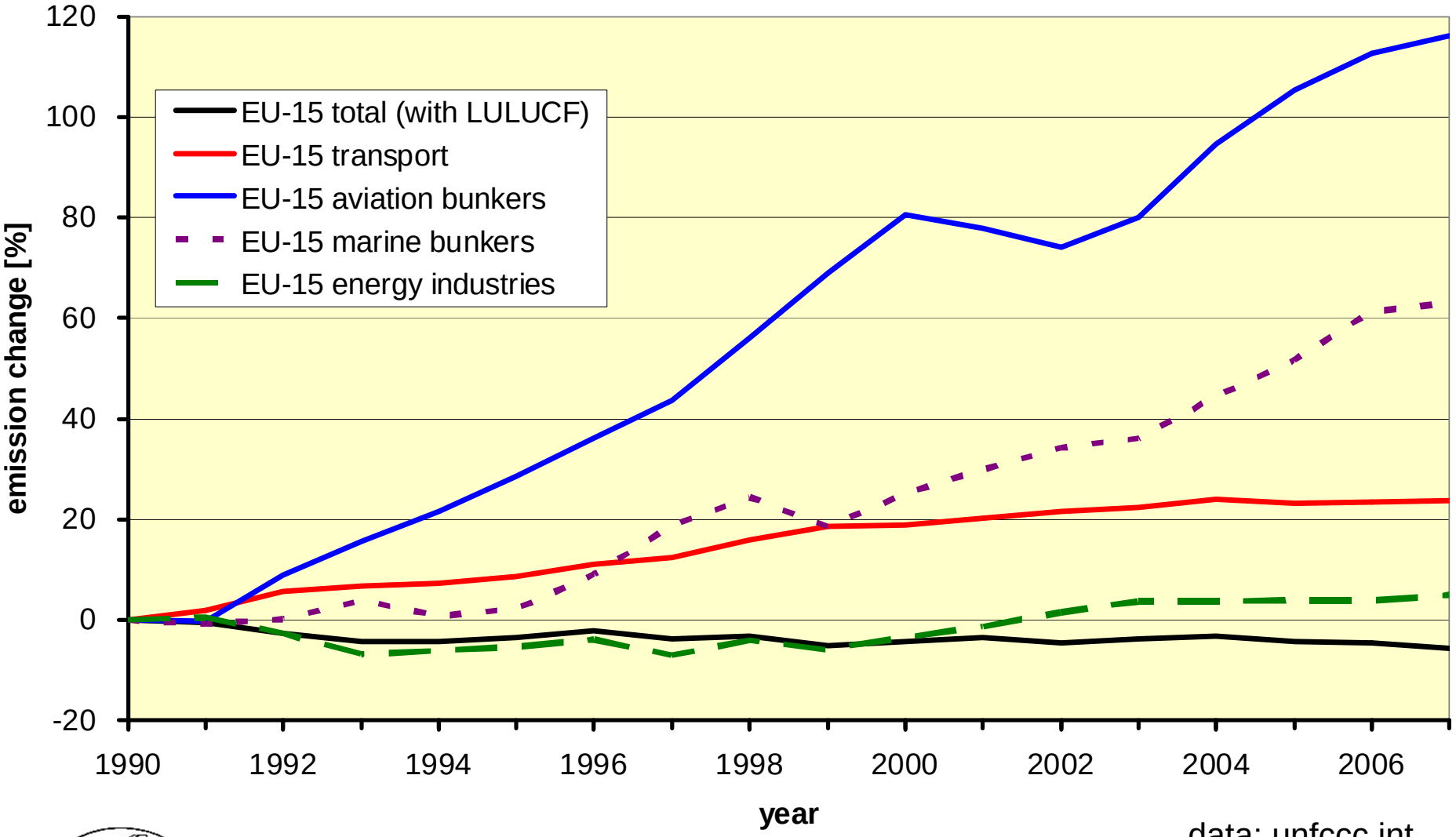
CO_2 equivalent emissions of EU-15

Change since 1990



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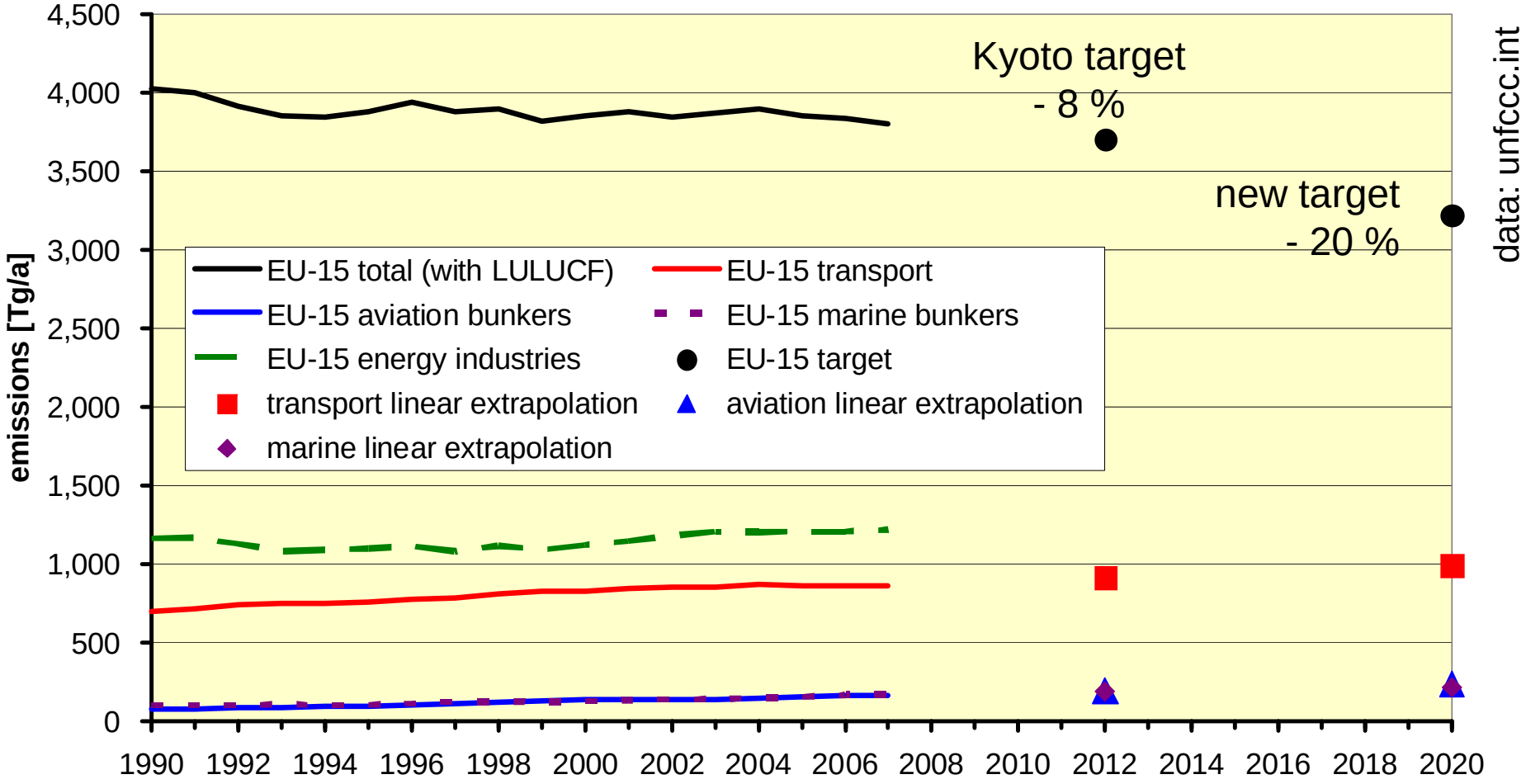
New EU target and consequences for transport:

Reduction by 20 % relative to 1990



transport fractions (1990	2007	2012	2020):
national transport: 17.4 %	22.8 %	24.7 %	30.9%
aviation bunkers: 1.9 %	4.4 %	5.3 %	7.4 %
marine bunkers: 2.6 %	4.5 %	5.1 %	6.9 %

linear growth of transport emissions after 2007 assumed

How can transport impact climate ?

Changes in radiative forcing can be caused by

emission of greenhouse gases, including long-lived species
like CO_2 and N_2O, but also of water vapour

emission of ozone precursors, like NO_x

emission of particles and their precursors

triggering additional clouds (e.g., contrails, contrail cirrus)
and
modifying natural clouds (e.g., ship tracks)

QUANTIFY

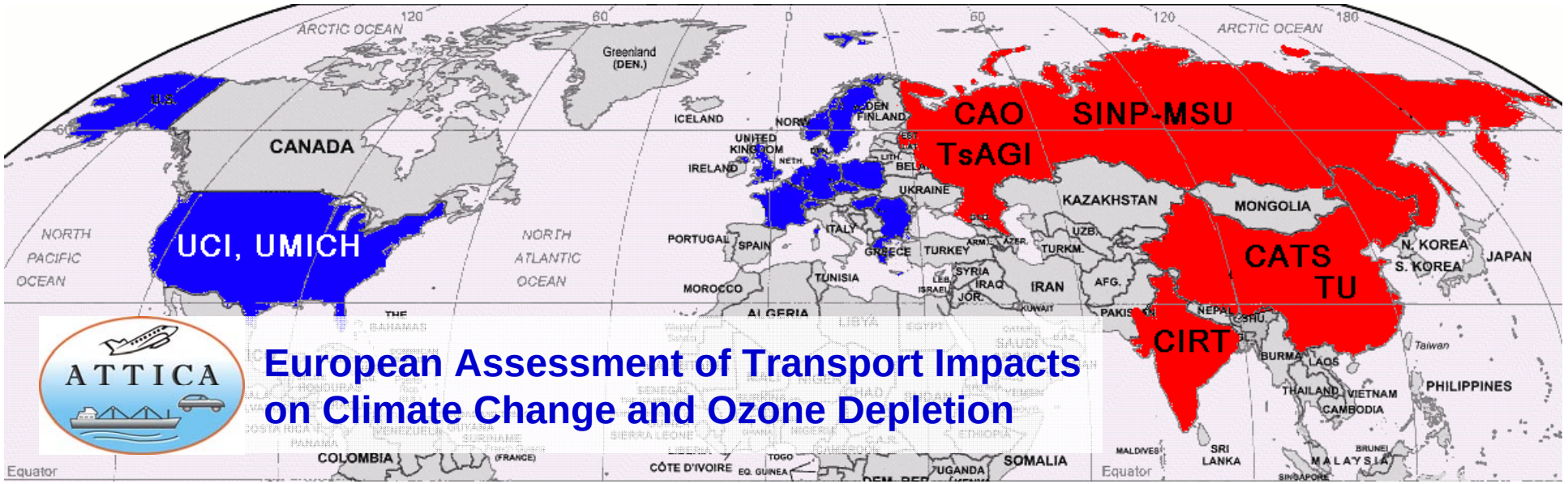
Quantifying the Climate Impact of global and European Transport Systems

Objective: To quantify the climate impact of the global and European transport systems for the present situation and for different scenarios of future development.

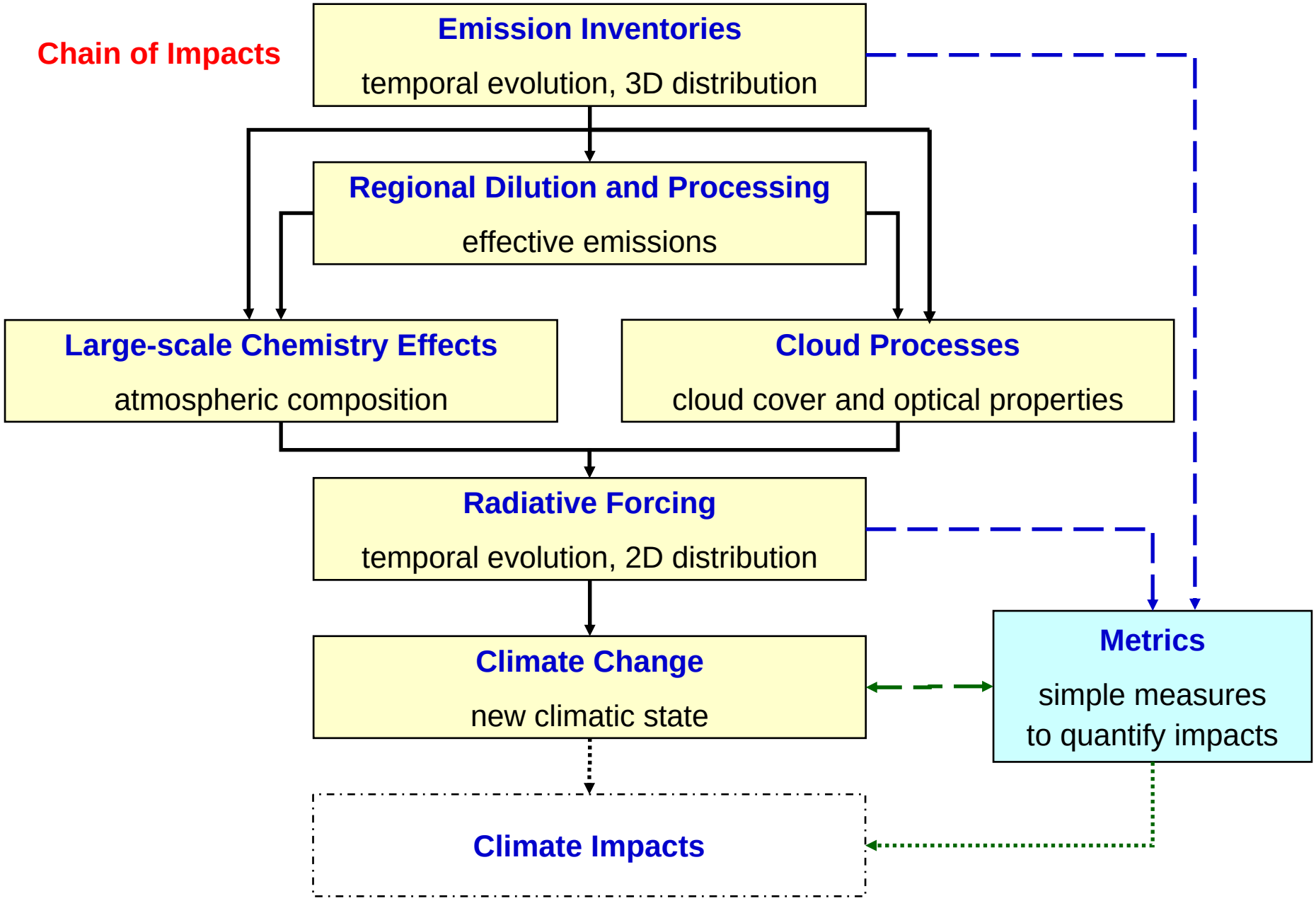
Co-ordinator: Robert Sausen, DLR-IPA
Participants: 41 from 19 countries
Duration: March 2005 to February 2010
Funds: 8.4 M€
Total costs 12.8 M€

http://ip-quantify.eu

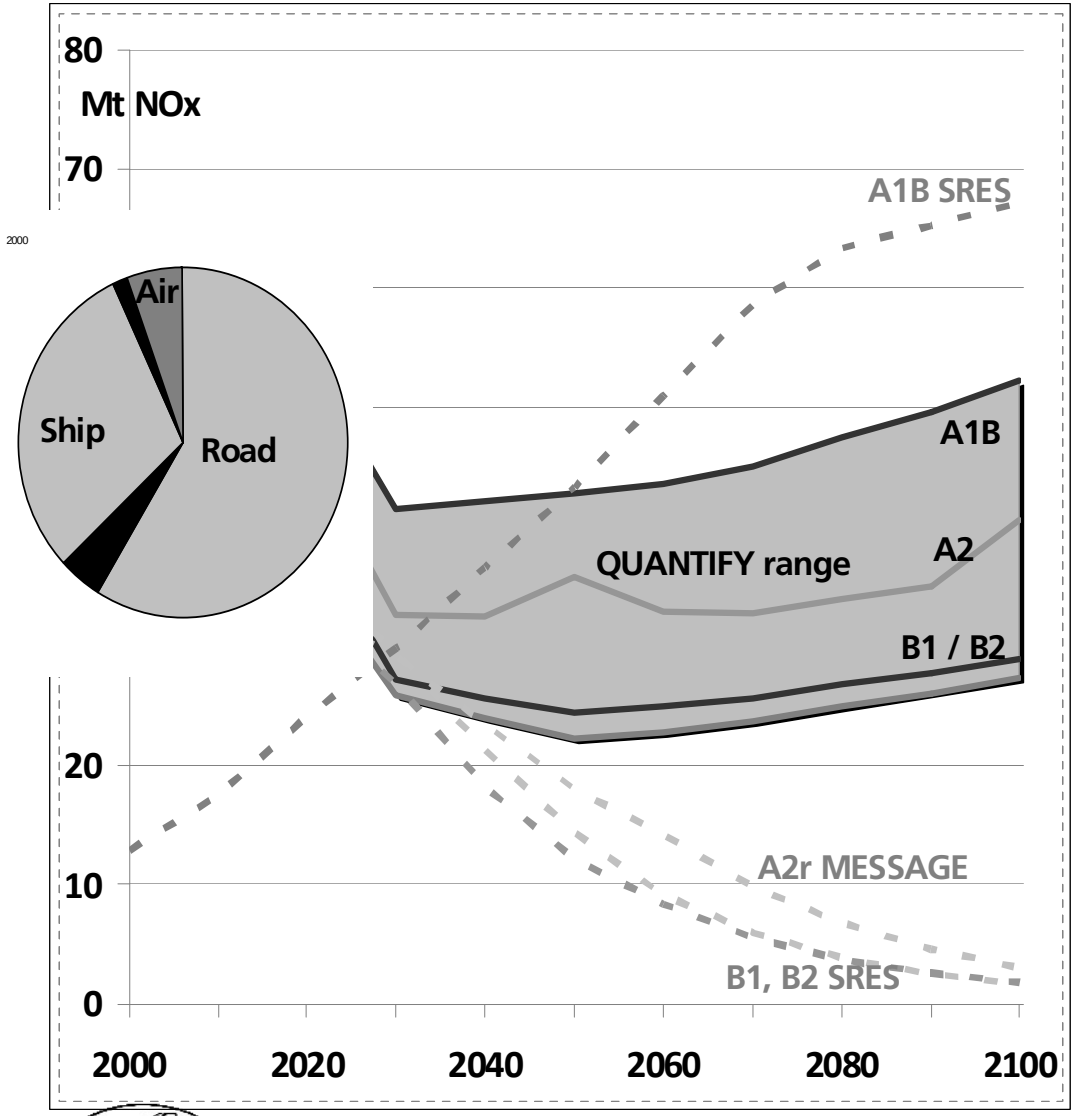
QUANTIFY-TTC

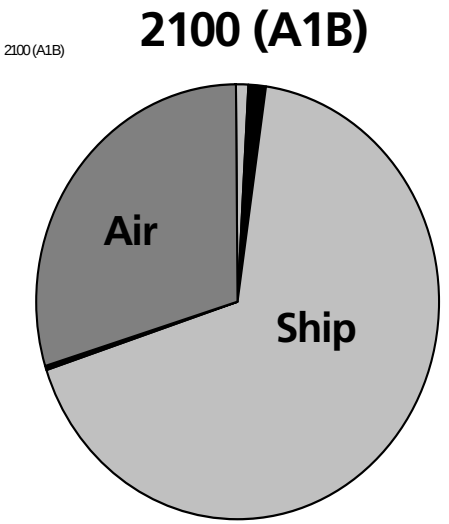


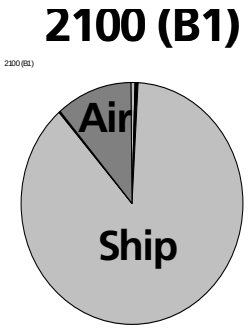
Chain of Impacts



NOx emissions transport – all scenarios

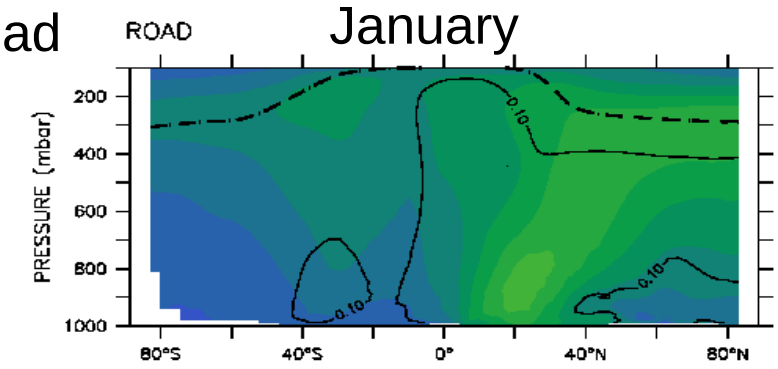


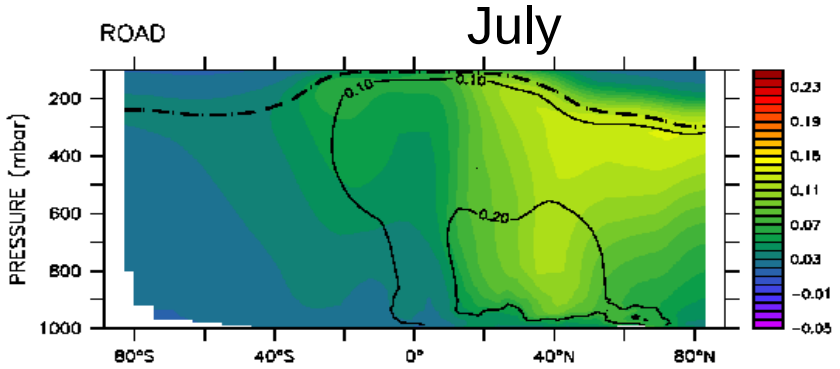




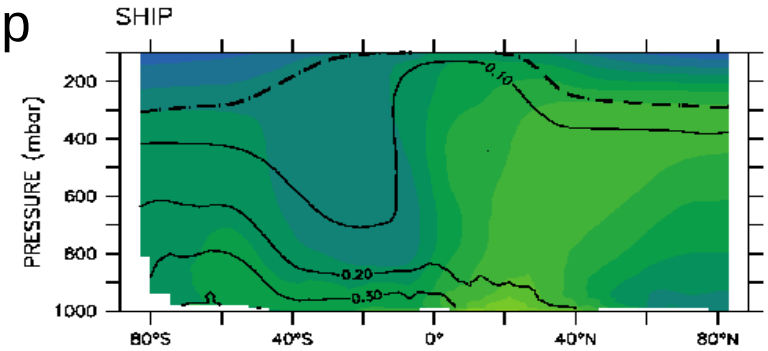
Ozone perturbation by mode of transport

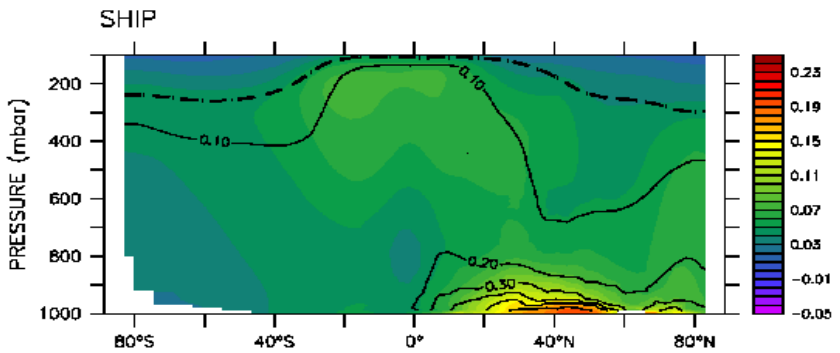
Road



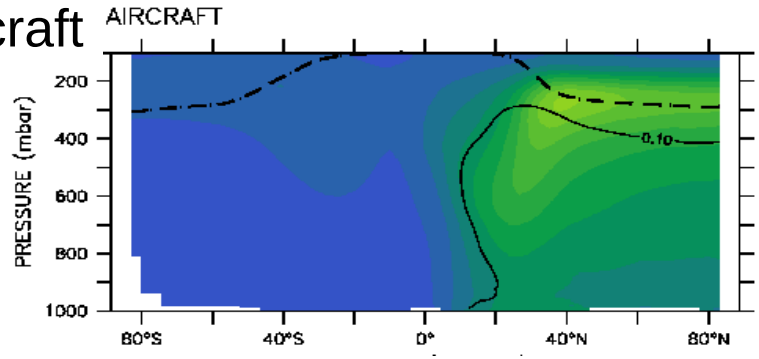


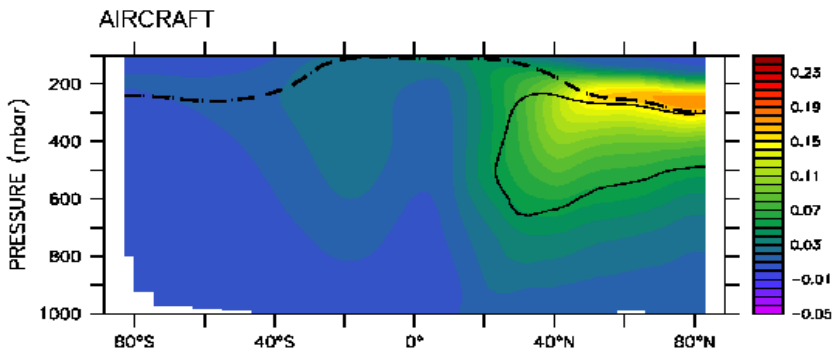
Ship





Aircraft





colour: ppbv, contour: change relative to base case (%)

Efficiency of O_3 production for transport NO_x emissions

Number of O_3 molecules produced per emitted NO_x molecule

road transport	0.33 ± 0.05
shipping	0.54 ± 0.07
aviation	1.63 ± 0.58

A NOx molecule from aviation produces five times as much ozone than a molecule from road transport.

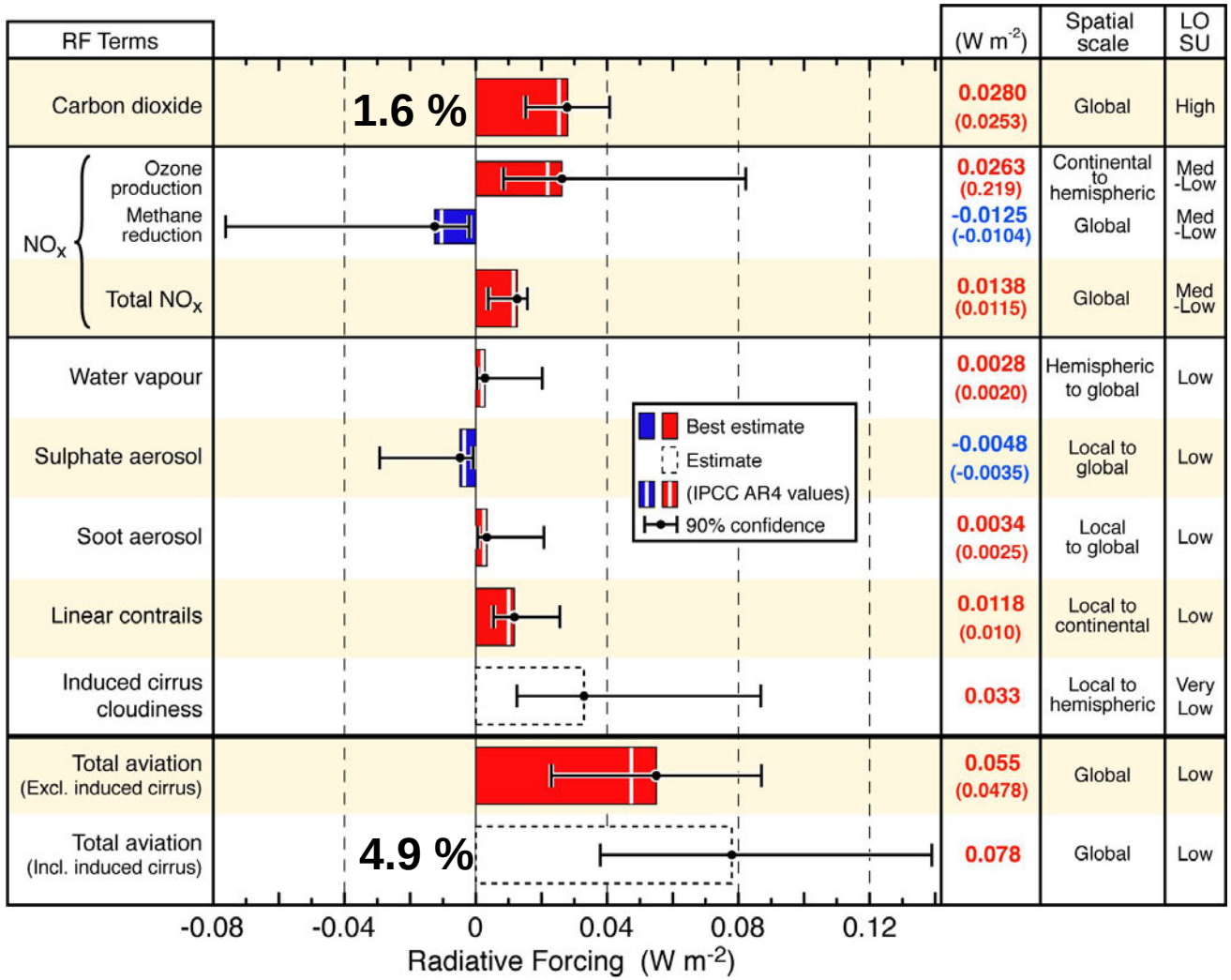
Methane lifetime change [%] due to a increase of transport emissions of 5%

road transport	- 1.61 ± 0.25
shipping	- 4.12 ± 1.02
aviation	- 1.04 ± 0.40

CH_4 lifetime in base case: 8.97 ± 1.63 a

No feedback factor is included.

Radiative forcing from aviation 2005



$$\Delta T_{surf} = \lambda \cdot RF$$

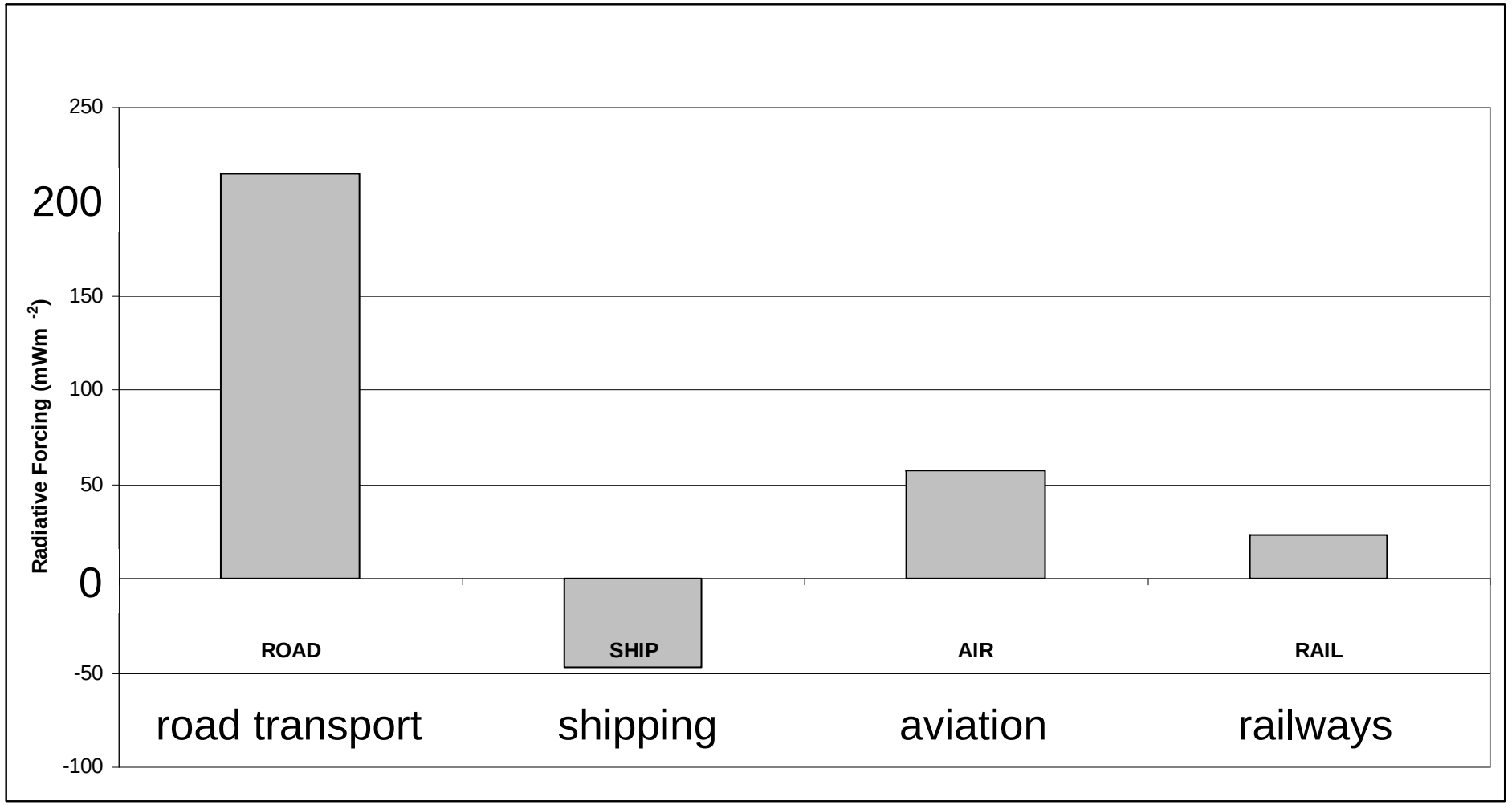
Total anthropogenic forcing 1.6 W/m^2

Aviation fraction:

CO_2 1.6 %

Total 4.9 %

Radiative forcing [mW/m^2] from different modes of transport



A caveat on radiative forcing

☺ Radiative forcing is a good measure to understand what a selected process or sector contributed to climate change so far.

☹ Radiative forcing us a backward looking metric. It cannot be used for regulation which concerns future emissions.

A caveat on radiative forcing and a way out

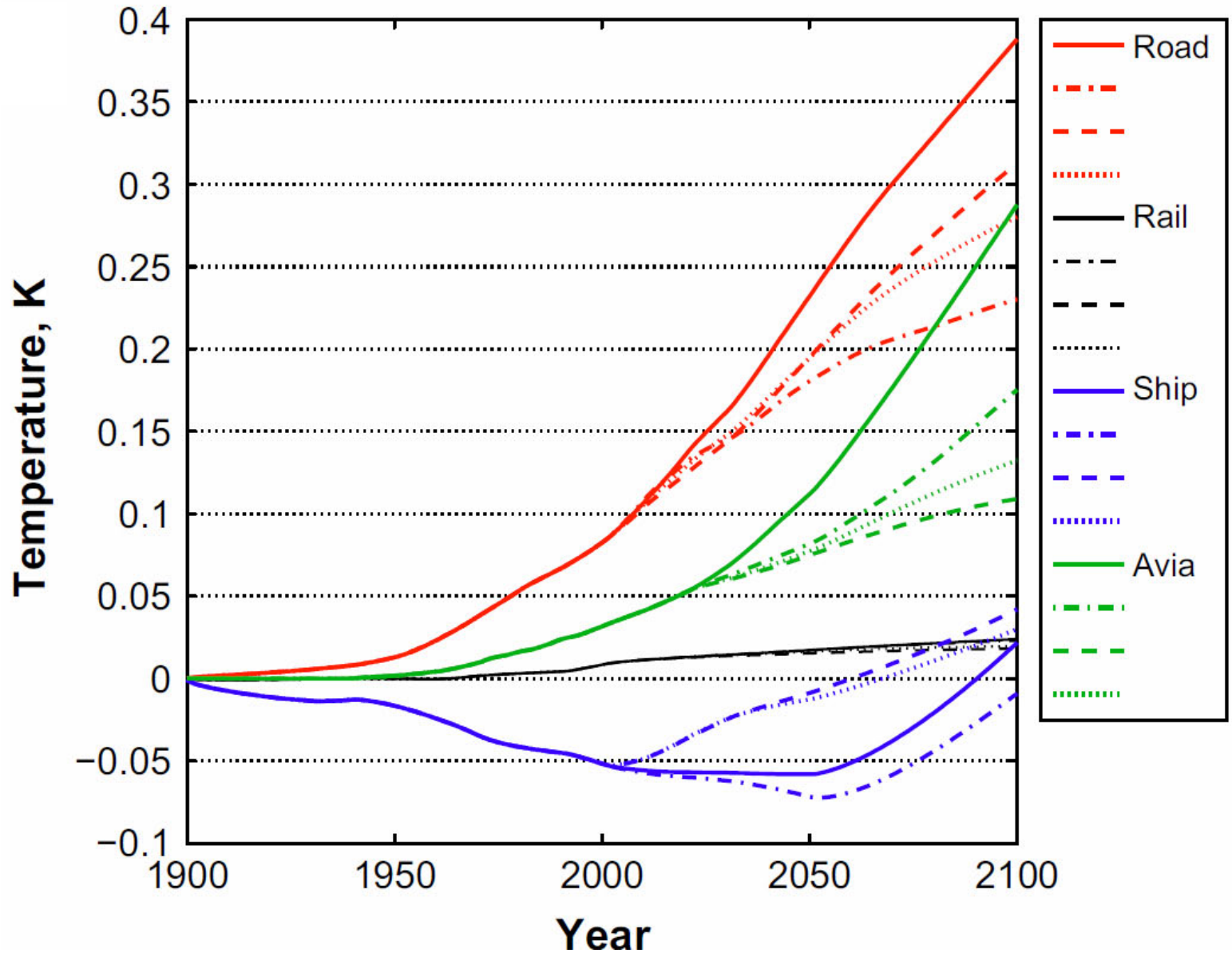
☺ Radiative forcing is a good measure to understand what a selected process or sector contributed to climate change so far.

☹ Radiative forcing us a backward looking metric. It cannot be used for regulation which concerns future emissions.

☺ A suitable solution would be a temperature based metric, e.g. the temperature change after a given time.

☺ This would allow to transfer non-CO2 effects in equivalent CO2, in particular if short-lived effects are of large importance like for aviation.

Temperature changes for different QUANTIFY scenarios



Conclusions

- The impact of transport, in particular aviation, on climate grows faster than the impact from other sectors of human activity.
- The non-CO_2 effects of aviations (NOx, aviation induced clouds) are particular large in comparison to other modes of transport.
- Climate optimised flight planning opens the chance for a smaller climate impact of aviation. ⇨ See presentation by Schumann on Thursday
- Currently, a temperature based climate metric appears to by most suitable to account for the non-CO_2 effects of aviation.

Further information:

http://ip-quantify.eu

QUANTIFY Stakeholder Meeting
Brussels, 24 June 2010