AVIATION CO_2 REDUCTIONS

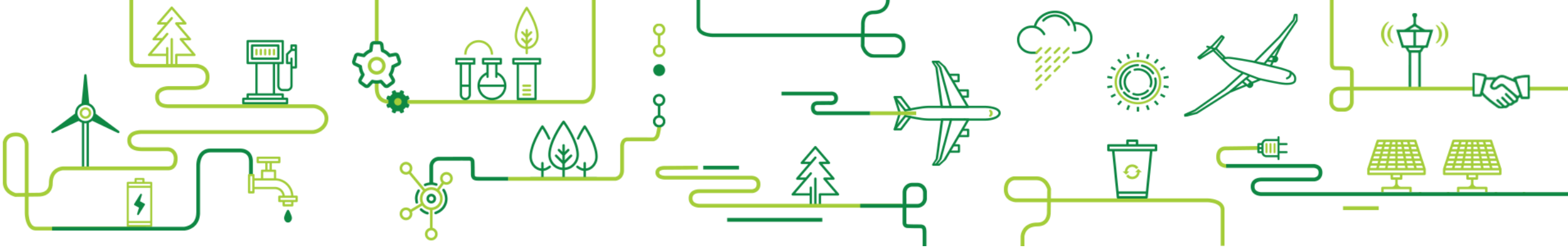
STOCKTAKING SEMINAR

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS

Impacts of aviation on climate

David S Lee
Manchester Metropolitan University, UK

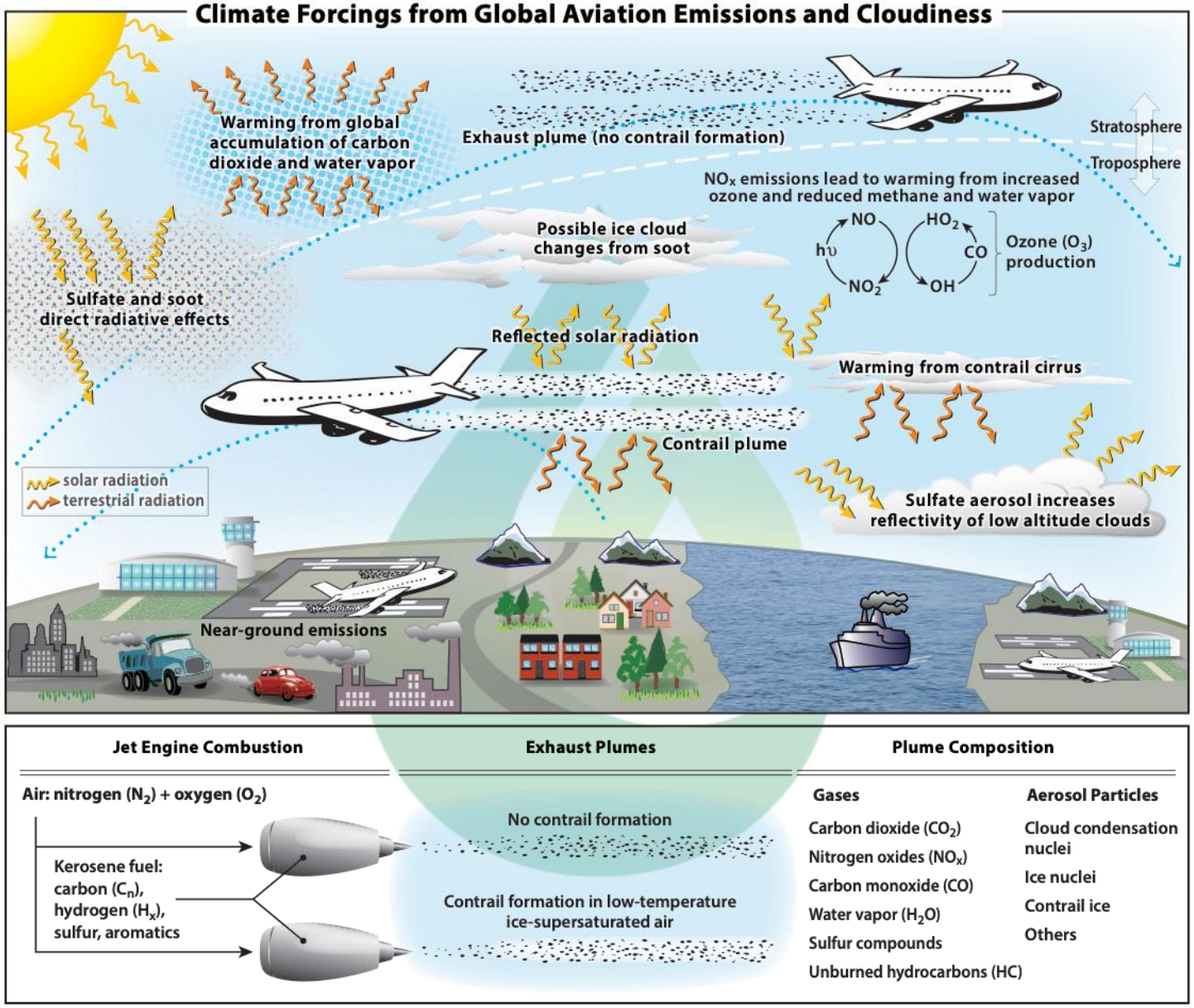
with
Daniel Jacob
US Federal Aviation Administration



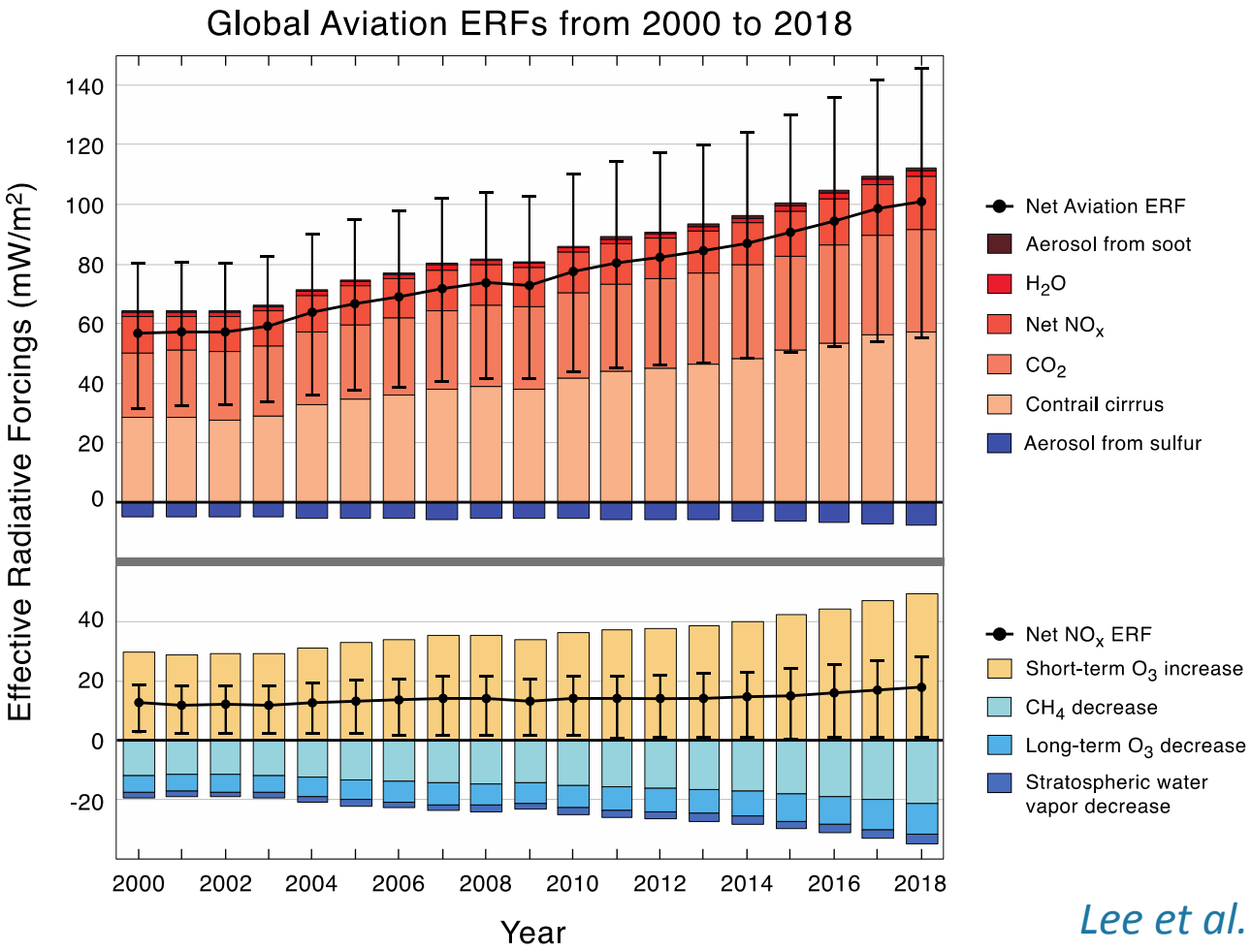
Global[1] aviation and climate – vital statistics[2]

- ~1,000 Million Tonnes of CO_2 in 2018 (based on IEA/IATA data)
- 2.4% of 2018 global annual emissions of CO_2 from fossil fuel combustion, cement manufacturing and land use change (based on above and Global Carbon Budget project)
- 32.6 billion tonnes of cumulative CO_2 since 1940, ~50% of which in the last 20 years
- CO_2 is the principal greenhouse gas emitted by aviation but there are important non-CO_2 effects that cause additional warming
- The metric used to assess present-day impacts is called 'Effective Radiative Forcing' (ERF), where positive = warming
- Non-CO_2 impacts represent around 66% of the net ERF; cumulative CO_2 emissions represents around 34% of the net ERF
- The major forcings from global aviation come from contrail cirrus clouds, CO_2 and the 'net NO_x' effect, with minor contributions from water vapour, soot and sulfur aerosol-radiation interactions
- The non-CO_2 effects contribute 8 times more than CO_2 to the uncertainties of net global aviation ERF in 2018
- Together, aviation impacts on forcing are 3.5% of total anthropogenic forcing

[1]note that sectoral climate impacts are based on global (international + domestic)
[2]statistics/data from Lee et al. (2020), *Atmospheric Environment*

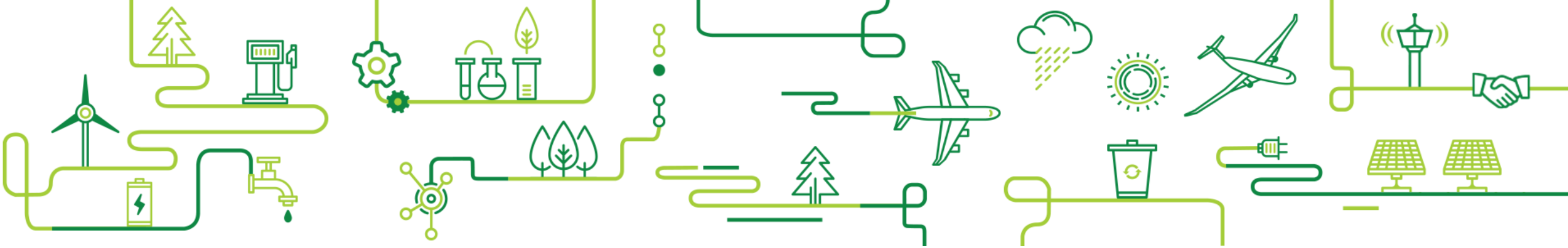


Lee et al. (2020) Atmospheric Environment



Global aviation represents 3.5% of anthropogenic forcings (for 2011, IPCC AR5 total forcing of 2.29 W m^{-2})

Lee et al. (2020) Atmospheric Environment



What of the future?

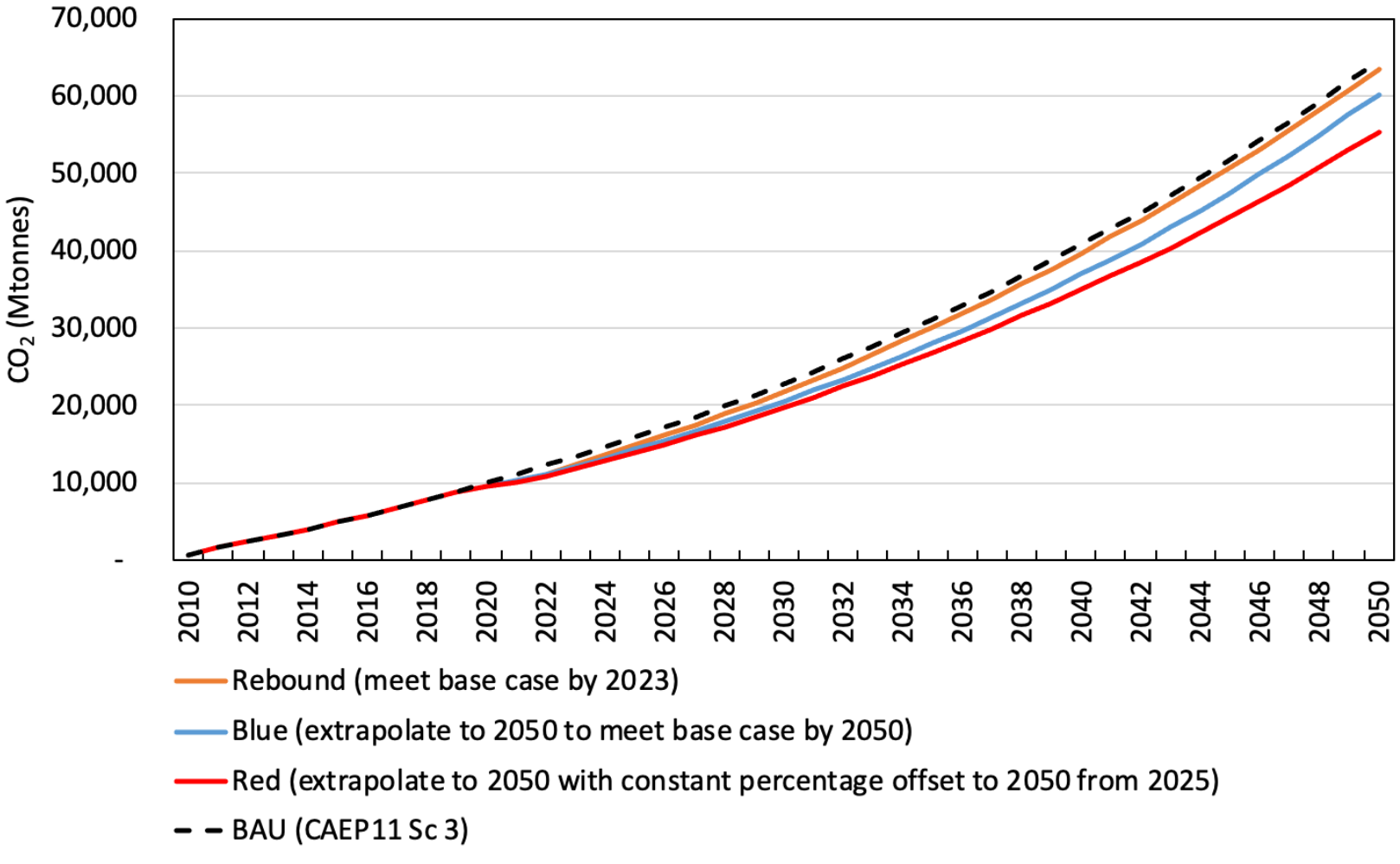
For CO_2, what matters most of all are the cumulative emissions over time, since CO_2 has very long lifetimes in the atmosphere, to millennia for a fraction of an emission (20%)

From the science, the Intergovernmental Panel on Climate Change (IPCC) has shown that there is a robust approximately linear relationship between increases in cumulative CO_2 emissions and global mean surface temperature change

The COVID-19 pandemic has seen dramatic reductions in air traffic and in-year emissions (see later talk of Roger Schaufele)

However, if traffic recovers in a few years time to former levels and then grows, the *impact* of aviation CO_2 emissions on climate will only be reduced marginally, or "*the problem hasn't gone away…*"

Global Scenarios: Cumulative CO_2 (2010 to 2050)



Approximately 10% difference between base case counterfactual and 'worst case' scenarios for entire history (1940 – 2050) aviation CO_2 emissions

Lee et al., work in progress

Thank You

ICAO