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# Climate impact of aircraft-induced cirrus assessed from satellite observations before and after COVID-19

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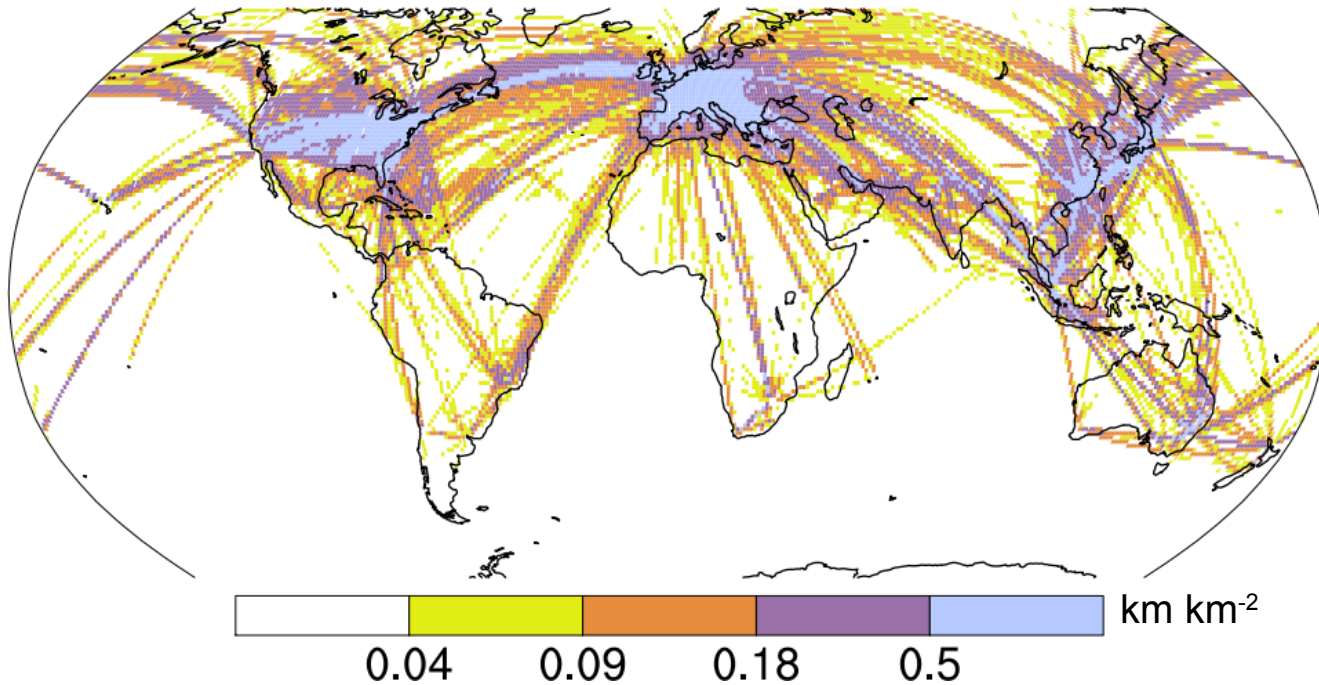
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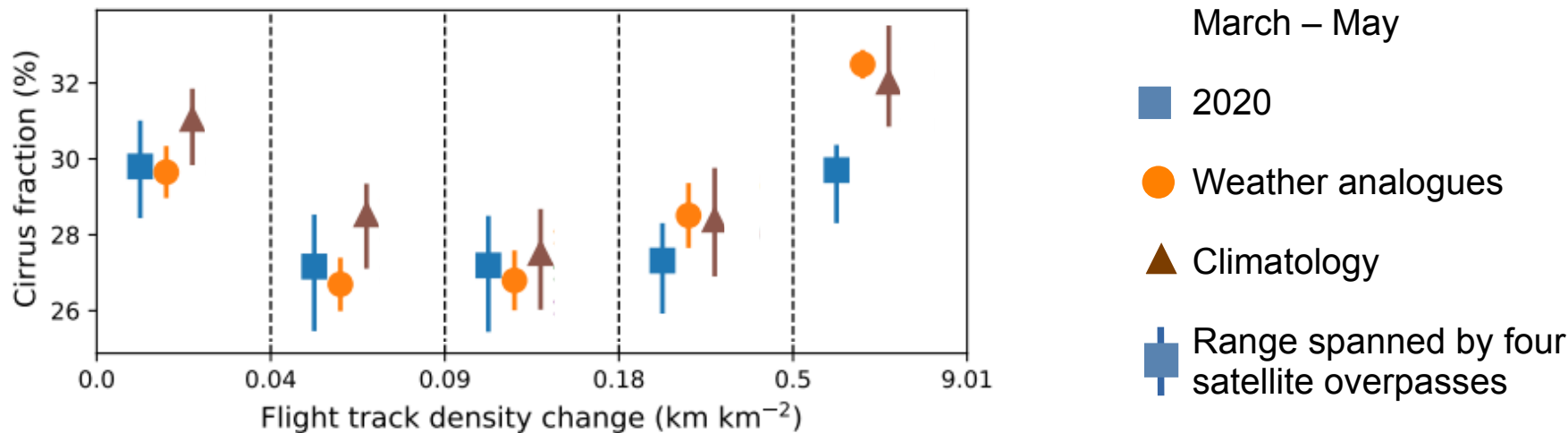
## Change in aviation



FlightRadar24 flight track density 2019 minus 2020

Colour bar selects five quintiles of area in Northern hemisphere mid-latitudes  
→ will be used for sampling in following plots

## Cirrus fraction in regions with air traffic change; 2020 vs. past



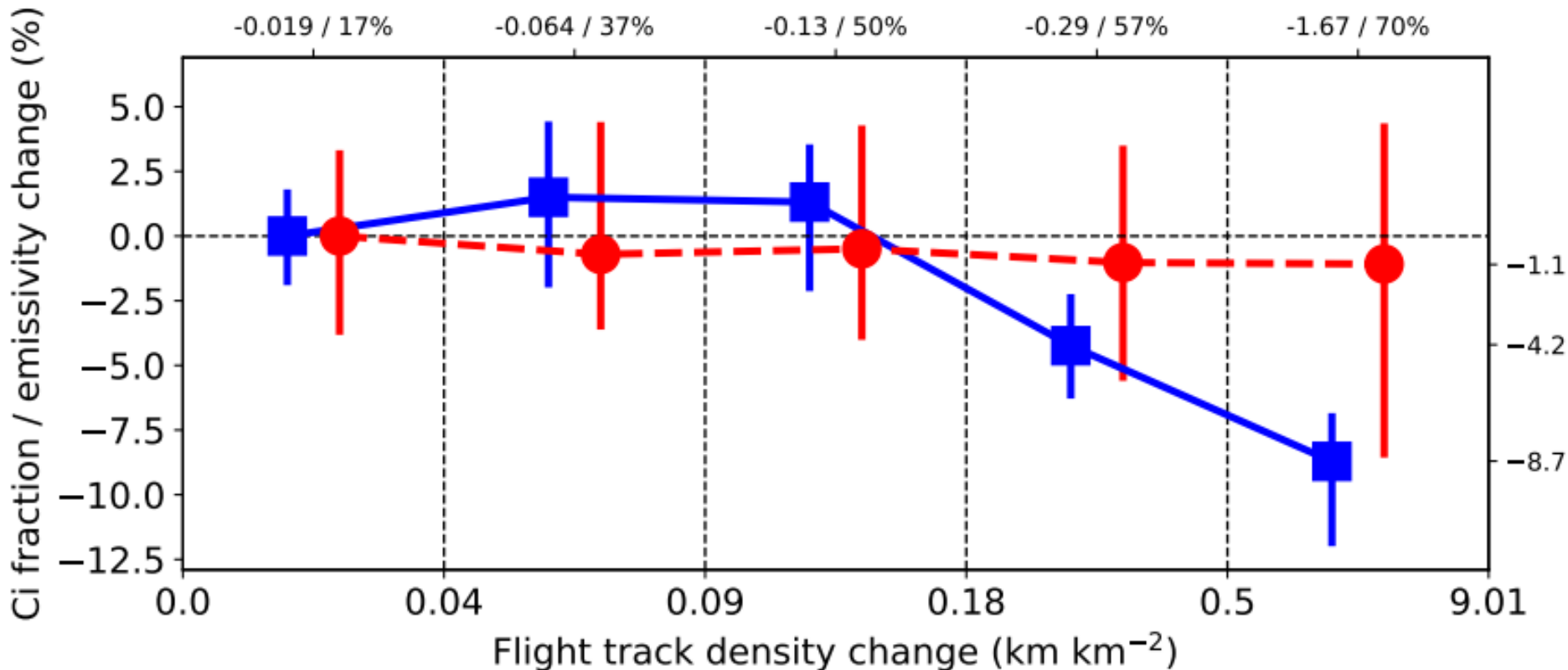
### MODIS cirrus fraction

- from MOD08\_D3 and MYD08\_D3 (Terra / 10.30 and MODIS Aqua / 1.30)
- joint histogram, cloud-top pressure < 320 hPa, emissivity < 0.95
- Northern hemisphere mid-latitudes, 27°N - 68°N
- Boreal spring, March – May
- grid-boxes that contain cirrus

### Weather analogues

- pattern correlation of 500 hPa geopotential (NCEP reanalysis) within 5°x5° grid-boxes
- select up to 50 cases ( $r^2 > 0.5$ ) from 2011 – 2019 reference period

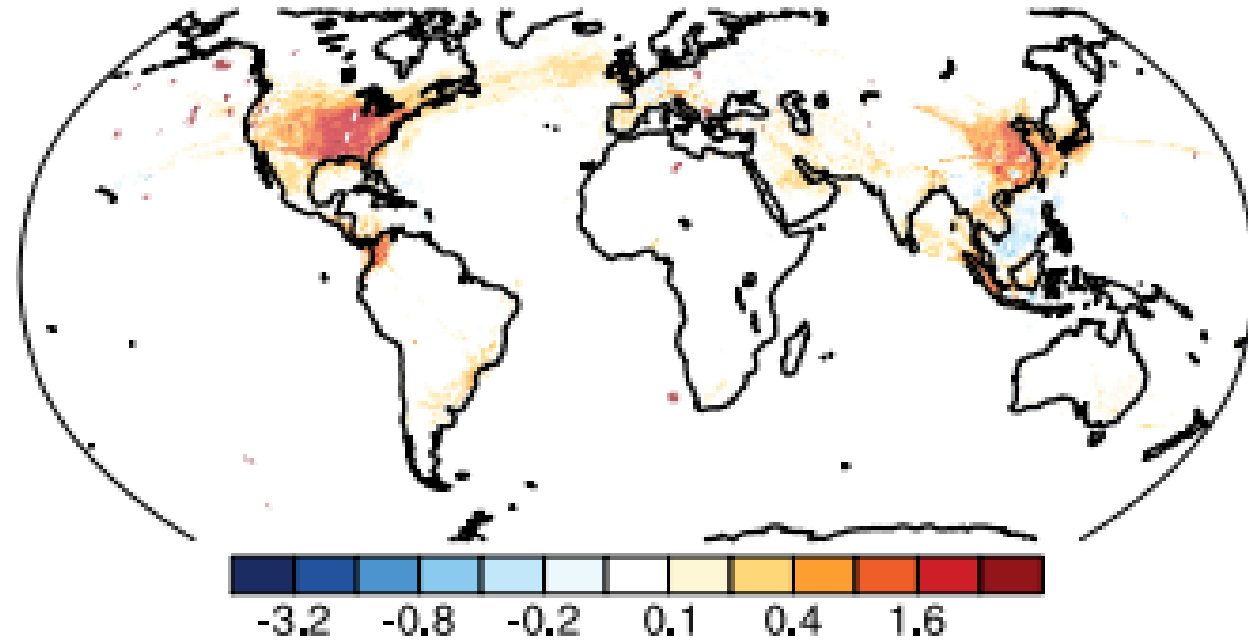
Change in cirrus



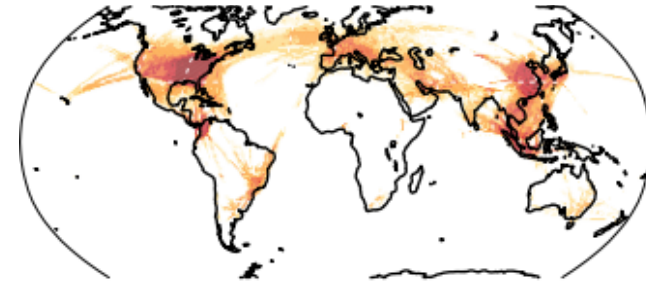
March – May 2020 vs. analogues, deviation from lowest quintile

■ Cirrus fraction | ● Emissivity

## Implied radiative forcing

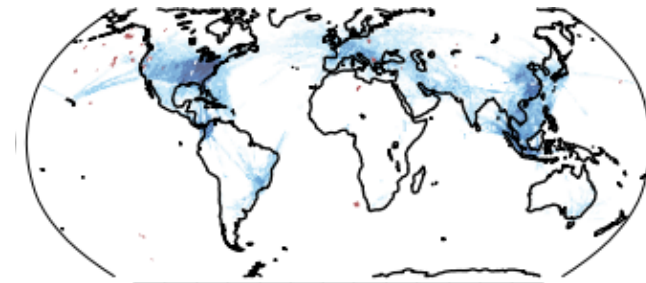


Net radiative forcing ( $\text{W m}^{-2}$ )



-3.2 -0.8 -0.2 0.1 0.4 1.6

Terrestrial/long-wave



-3.2 -0.8 -0.2 0.1 0.4 1.6

Solar/short-wave

### Radiative forcing

- ECHAM off-line radiation transfer
- driven by ERA5 re-analysis

### Air traffic reduction during COVID

- March – May 2020 vs. 2019
- minus 80% in large parts of the Northern hemisphere mid-latitudes

### Coincident cirrus reduction

- in regions with large air traffic reduction, 9% cirrus less (absolute) / 16% (relative)

### Radiative forcing: $42 \pm 24 \text{ mW m}^{-2}$ (2019)

- compare to IPCC AR5:  $50 \text{ mW m}^{-2}$  for 2014  $\rightarrow$   $74 \text{ mW m}^{-2}$  for 2019 / 5% annual increase
- model Bock and Burkhardt (JGR 2016)  $56 \text{ mW m}^{-2}$  for 2006  $\rightarrow$   $106 \text{ mW m}^{-2}$  for 2019