Numerical analysis of contrail formation process and climate impact by aviation-induced cirrus by emissions from aircraft with alternative aviation fuels

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● **Abstract**

In recent years, carbon neutrality has been declared in the aviation sector. As one of the greenhouse effects of aircraft exhaust gas, persistent contrail and contrail cirrus formation have been recognized as quite important most recently due to its expected large effects in radiative forcing. The present study investigates the effects of fuel characteristics of the major alternative aviation fuels (SAF and hydrogen) on the radiative forcing of contrails using a global climate model.

● **Reasons and benefits of using JAXA Supercomputer System**

The global atmospheric calculations with additional contrail microphysics model require large computational resources.

● **Achievements of the Year**

Based on the distribution data of the water vapor emission of simulated flight missions, the vertically averaged distribution of water vapor emission for jet-fuel aircraft is described as seen in Fig. 1.

Figure 2 shows the distribution of contrail radiative forcing for kerosene aircraft obtained by one-year simulation. The contrail radiative forcing for jet-fueled aircraft was estimated to be 67mW/m2, which is consistent with the available literature. Trials on the application of alternative fuel effects were investigated.
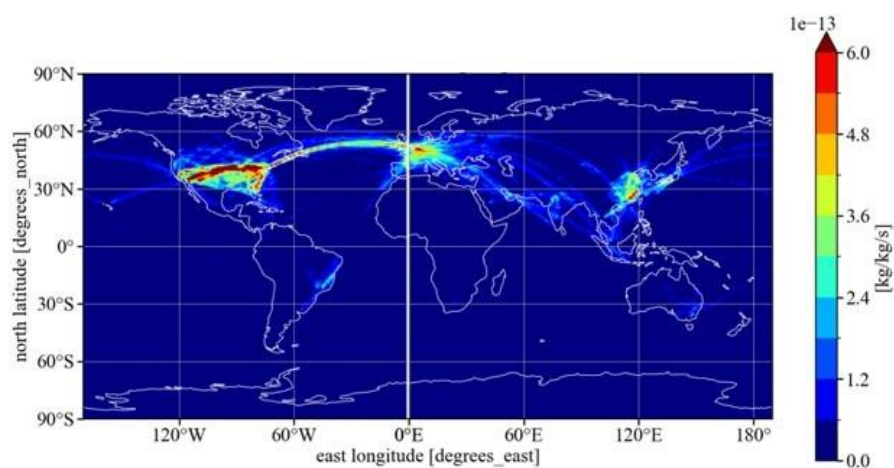
Fig. 1: Aggregated H2O emissions in kg/kg/s: zonal average at p = 193 hPa for jet-fueled aircraft.
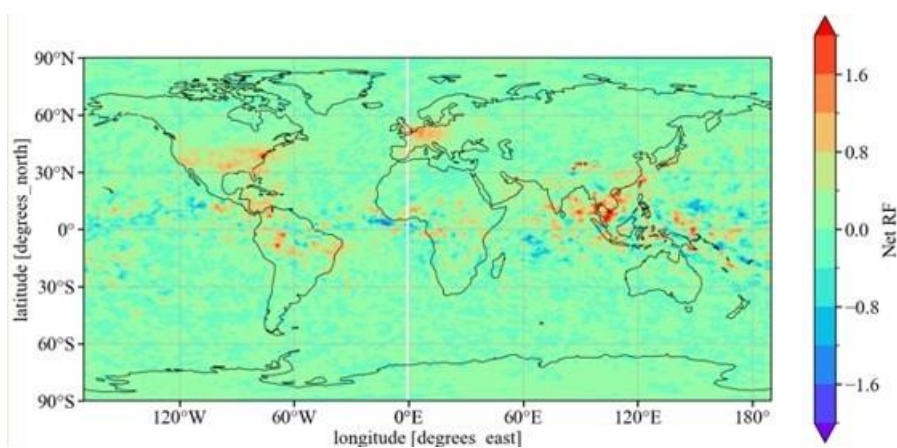

Fig. 2: The distribution of contrail radiative forcing for Jet-fueled aircraft.

🔵 **Publications**

N/A

🔵 **Usage of JSS**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	720
Elapsed Time per Case	11 Hour(s)

● **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.00

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	0.00	0.00
TOKI-ST	0.00	0.00
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

● **JSS3 Resources Used**

Fraction of Usage in Total Resources[*1](%): 0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[2] (%)
/home	1,759.00	1.19
/data and /data2	148,330.00	0.71
/ssd	38,250.00	2.05

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[2] (%)
J-SPACE	0.29	0.00

[1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.

● **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[2] (%)
ISV Software Licenses (Total)	0.00	0.00

[2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.