Airframe Icing as an effect of Tropopause level rise and ways to combat with it

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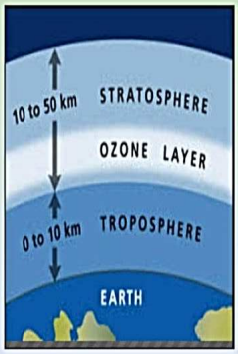
Factors affecting troposphere height:

- Changes in Solar Radiation
- Volcanic Aerosols
- Direct scattering of sulphate aerosols
- Scattering of ozone
- Mixing of greenhouse gases

- Warming the troposphere and/or cooling the stratosphere
- Decrease in global-mean pressure at the tropopause by 2.16hPa/decade
- Increase in height of tropopause
- Higher probabilities of high altitude icing



What is high altitude icing?

At mid-troposphere, temperatures usually remain within −4 and −14 °C and only a limited fraction of suitable aerosols is available to act as cloud condensation nuclei; thus, cooling the large amount of available water vapour and favouring the formation of large supercooled droplets. But near tropopause, where temperatures are below −50 °C, ingestion of a high density of icicles takes place in the vicinity of convective cloud tops with ice contents in excess of $5g/m^3$. All these lead to an upward extension of the upper limit of icing layers; thus, increasing chances of *airframe icing*, a problem for general aviation.

Why is it hard to overcome this problem?

Modern lean-burn aviation engines are used widely to overcome limited engine power and combat airframe icing in aeronautics. But, *these engines contribute more to fossil fuel combustion and thus to positive greenhouse forcing, thereby contributing more to the raising of tropopause level and airframe icing.*

Airframe Icing as a problem:

- ❑ The problem gets intensified when rudimentary anti-icing systems are employed, the most common being pneumatic de-icing boots, which run chemically.
- ❑ Airframe icing can modify the airflow pattern around wings and propeller blades leading to
  - ➢ loss of lift
  - ➢ increase in drag
  - ➢ altered pressure distribution around flight control surfaces such as ailerons and elevators, and
  - ➢ cause shift in the airfoil centre of pressure leading to longitudinal instability
- ❑ Blockage of pitot tubes and static vents (giving rise to erroneous readings in pressure instruments such as altimeters, airspeed indicators and vertical speed indicators) in certain cases.

Conclusion and Possible Solution:

Keeping the environmental sustainability in mind, switching to *solar-powered electric aircrafts* is a better alternative.

- ✓ Electric motors, communications, electronic systems and avionics can be powered by using solar cells.
- ✓ A backup lithium battery system can be employed for flight operations under dark conditions.
- ✓ For *commercial purpose*, more electric engines equipped with generators can be integrated into the aircraft engine such that maintenance costs can be lowered and overall reliability may increase.

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