Design of a Flight Planning System to Optimize Contrail Generation

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Abstract: Contrails generated from flight produce a positive radiative forcing (RF) that heats Earth's atmosphere and contributes to global warming. A simulation was developed to test the feasibility of nine different cruising altitudes to minimize RF. The feasibility of these routes was determined using a trade-off between RF against CO₂ emissions, fuel burn, and flight duration. Results from this indicate that two of the nine flight paths lowered net RF values from the baseline by an average of 84%, with the most optimal route decreasing net RF by 94%. Furthermore, this justified efforts to reduce RF values for routes generated in real-time via Controptimal, a decision support system. Specifically, a case study timestamped '2015-08-16 09:00' was analyzed and found a route that decreased net RF by 84% to 2.38 x 10⁻⁷ W/m². This information suggests that contrail mitigation strategies could be realistically used to reduce net RF due to aviation.

Keywords: Contrail, Radiative Forcing (RF), Ice Super Saturated Region (ISSR), Shortwave Radiative Forcing, Longwave Radiative Forcing, Albedo, Solar Zenith Angle