

the highly compact and fuel-efficient YJ102R turbofan engine, which produces six times the specific thrust (pounds of thrust per pound of ingested air) of the SR-71's engine, says LibertyWorks program director Bob Duge. Although the details are classified, Duge attributes most of the engine's performance to its high operating temperature, which requires an "advanced

thermal management" system to keep critical parts relatively cool. The burner and the hot turbine blades are made of special temperature-resistant alloys with myriad tiny cooling air passages cast into them.

Johnston says that the U.S. Navy plans to test-fly a prototype missile by the end of 2007 and hopes that a RATTLS-based missile could be deployed by 2015.

EARTH SCIENCE

Hot Trails

TO FIGHT GLOBAL WARMING, KISS THE RED-EYE GOOD-BYE BY CHRISTINA REED

Air travelers have more to hate about red-eye flights, where sleep is as ephemeral and satisfying as a bag of pretzels for dinner. Those overnight trips contribute more to atmospheric warming than daytime jetting.

Scientists have long known that airplane condensation trails act to both cool and heat the atmosphere. Formed by jet engines' hot exhaust, contrails act as thin cloud barriers that not only reflect sunlight but also prevent the earth's heat from escaping into space. During the day, the effect of blocked incoming radiation tends to outweigh that of trapped heat, thereby cooling the atmosphere. Indeed, after the events of 9/11 grounded all commercial U.S. flights for three days, daytime temperatures across the country rose slightly, whereas nighttime temperatures dropped. This evidence supported the hypothesis that contrails reduce the temperature range by cooling the atmosphere during the day and heating it at night.

Thus, the timing of the flights is critical, but so is the atmosphere itself. Nicola Stuber of the University of Reading in England and her colleagues collected data from weather balloons over a region in southeastern England that lies within the North Atlantic flight corridor. Her team reported in the June 15 *Nature* that even though fewer jets fly during the winter months, the season's higher humidity makes these flights twice as likely to create contrails. The team also



CONTRAILS end up warming the atmosphere.

found that flying between 6 P.M. and 6 A.M. contributed between 60 and 80 percent of the climate warming that originated from contrails, even though these flights represent a quarter of the total air traffic.

Atmospheric scientist David Travis of the University of Wisconsin–Whitewater, who reported the 9/11-related contrail findings, agrees with the British researchers that a reduction in nighttime flights is needed. He adds that contrails "are currently a regional-scale problem but could eventually become a global-scale problem as air traffic continues to expand and increase." Scientists are only beginning to study the contribution of jet exhaust to global warming, but so far, like red eyes, contrails don't look so good.

Christina Reed flies frequently out of Seattle.