RESPONSE OF THE SPACE DEBRIS ENVIRONMENT TO GREENHOUSE COOLING

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Whilst it is well known that an increase in the density of the greenhouse gases CO\textsubscript{2}, CH\textsubscript{4} and others results in warming of the troposphere, a much larger cooling of the thermosphere is also observed. Modelling studies performed in the 1990s concluded that with a doubling of CO\textsubscript{2} the average cooling in the thermosphere is 40 - 50 K resulting in a reduction of atmospheric density by more than 40\% at a given height and significant changes in chemical composition (Akmaev and Fomichev, 1998). Observational studies of the long-term orbital decay of Earth satellites have now provided considerable evidence for a decline in thermospheric density, indicating a decrease in density in this region of approximately 10\% during the past 35 years (e.g., Emmert et al, 2004). The conclusion of these studies is that within a century the average thermospheric density at a given height may be reduced to half of the present density, based on current projections of CO\textsubscript{2} mixing ratios. The consequences of this negative density trend are longer orbital lifetimes for both satellites and space debris.

In this paper, the results of a set of DELTA and DAMAGE studies are presented. The studies employ the IADC Baseline 2002 and include simulations of post-mission disposal scenarios for low Earth orbit over a 100 year period with thermospheric density decreasing at rates between 1\% and 6\% per decade.
