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Potential impacts of launch and orbital debris re-entry emissions

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The recent surge in rocket launch rates, including the proposal of large low earth orbit satellite constellations (LLC's) has renewed interest into how space traffic may impact Earth's climate. In the future. The current annual mass flux from satellites vaporized in Earth's middle atmosphere each year is ~0.4 Gg, well below the ~20 Gg/year natural mass emissions from meteor ablation. However, it is predicted that if all proposed LLC's are implemented, the total number of satellites in low earth orbit (LEO) will balloon from ~5,000 to over 60,000 units. The corresponding annual emissions from satellite re-entry is also expected to increase and approach 10 Gg/yr. Although little is currently known about the composition of aerosols released during satellite ablation, we assume a significant portion of the aerosol population is metallic aluminum that will convert to aluminum oxide (Al_2O_3). Here we present results from a study which focuses on the radiative impacts and atmospheric transport of hypothetical Al_2O_3 emissions from satellite re-entry. The WACCM6 global model coupled with the CARMA sectional model was run with a 10 Gg/year mass flux of alumina aerosol between 60 km and 70 km. We evaluate how aerosol size and latitude of emission may impact the overall transport, atmospheric burden, and radiative impacts from satellite re-entry.