Title: Seasonal- and Beta-Angle-Dependent Latitude Bias Variations in Natural Decays

Author: John B. Bacon (Orbital Debris Program Office, Mail Code XI5, NASA Johnson Space Center, Houston TX 77058)

Abstract:
Prior work has demonstrated pronounced statistical clustering of natural decays of medium-to-high-inclination orbital objects peaking approximately 30 degrees in Argument of Latitude ahead of nodal crossings. This effect is caused by the physical bulge in the Earth and the overlying atmosphere, that cyclically modifies effective altitude (and therefore density) faster than the trajectory's decay itself. While prior work has averaged seasonal and RAAN effects over all non-uniform atmosphere possibilities to support long-term characterization of the clustering of final entries in generating a pre-mission Expectation of Casualty, the current study characterizes seasonal and beta angle effects as potential influences on the near-term statistical risks of specific tactical decay scenarios, relative to the average. Such effects on the density profile along an orbit may be important considerations in any scenario where small orbital adjustments are used to optimize the timing and location of final entry trajectories. I.E., two identical spacecraft entering in different seasons and/or beta angles may have different minimum-risk scenarios for identical control capabilities and space weather conditions. Further, the early heating history of shallow trajectories is explored, examining the influence of dramatically different density profiles over the final orbit as the spacecraft either skims over or dives into the atmosphere.