NEW ON-LINE TOOLS FOR THE HUMAN EXPLORATION AND THREAT MITIGATION OF NEAR-EARTH ASTEROIDS. D.K. Yeomans[1], B.W. Barbee[2], N. Melamed[3], J.P. Anderson[3], A.B. Chamberlin[1], S.R. Chesley[1], P.W. Chodas[1], J.D. Giorgini[1], L.N. Johnson[4], [1]JPL/Caltech, 4800 Oak Grove Drive, 301-125, Pasadena, CA 91109 (Donald.k.yeomans@jpl.nasa.gov), [2]GSFC, Code 595, 8800 Greenbelt Road, Greenbelt, MD 20771, [3]The Aerospace Corporation, 2310 E. El Segundo Blvd., El Segundo, CA 90245, [4]Planetary Sciences Division, Space Mission Directorate, NASA Headquarters, Washington, DC 20546-0001.

Two new on-line tools have been added to the Near-Earth Object Program Office website at JPL (neo.jpl.nasa.gov). The first tool provides mission design information, updated daily, over the 2015 – 2040 interval for all near-Earth asteroids (NEAs) that may be viable human exploration targets, including those recently discovered. This tool is a cooperative effort between Brent Barbee at the Goddard Space Flight Center and the NEO Program Office at JPL. For each NEA in the website table, the following information is provided: the absolute magnitude; estimated diameter; an orbit accuracy metric; the minimum total spacecraft round-trip velocity change (ΔV) in km/s and the corresponding mission duration in days for that trajectory; the minimum mission duration and the corresponding total ΔV for that trajectory; the next optical observing interval and the corresponding peak apparent magnitude as well as the next radar observing interval and the corresponding signal-to-noise ratios for both Goldstone and Arecibo. Optical observing opportunities require solar elongation angles $\geq 60°$ and 3-sigma plane-of-sky position uncertainties $\leq 1.5°$. Radar opportunities require accessible declinations, signal to noise ratios ≥ 10, and 3-sigma plane-of-sky uncertainties ≤ 0.75 arc minutes. For the table of several hundred NEAs, the mission scenarios can be ranked in several ways including by the lowest total ΔV, brightest absolute magnitude, and the total number of distinct mission opportunities, which is a proxy for the NEA's accessibility. For each NEA, a plot is generated that summarizes the many potential mission scenarios by showing the total round-trip ΔV and round trip flight time required for each launch date.

The second new interactive feature on the website, developed by the Aerospace Corporation and the NEO Program Office at JPL, provides the user with insights on how best to deal with an Earth threatening NEA using one or several impacting spacecraft to slightly alter its velocity. The user can select a fictitious, simulated Earth impacting asteroid and designate the time interval (TD) between the spacecraft impact deflection attempt and the hypothetical Earth impact. Interactive plots display the sun-NEA and Earth-NEA distances for each selected TD value. The user can then input small velocity changes to the object in various directions and at various TD values and note the effect of these velocity changes in moving the NEA impact point off the Earth's capture radius on the displayed Earth impact plane. In addition, the user can design an optimal (Lambert solution) mission to deflect the Earth impactor by providing inputs for the deflection time (TD), the spacecraft time-of-flight between launch and its NEA impact, the spacecraft mass, the NEA size and density (hence mass) as well as the momentum multiplier due to blow-back ejecta resulting from the spacecraft impact. The user can then note the facility with which the various user inputs safely move the nominal Earth impact point outside the Earth's capture cross section. In addition, the tool will indicate whether or not a selected deflection mission can be carried out within the capability of current and future launch vehicles (e.g., Atlas V 551, Delta IV heavy, Falcon 9 heavy). Designing a successful and viable deflection mission that maximizes the Earth miss distance with the fewest spacecraft is often not straightforward and some rules of thumb are provided. By interacting with this on-line tool, the user can learn valuable lessons for designing optimal NEA deflection strategies.