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USING INFORMATION FROM RENDEZVOUS MISSIONS FOR BEST-CASE APPRAISALS OF IMPACT DAMAGE TO PLANET EARTH CAUSED BY NATURAL OBJECTS

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ABSTRACT

The Asteroid Threat Assessment Project (ATAP), a part of NASA's Planetary Defense Coordination Office (PDCO) has the responsibility to appraise the range of surface damage by potential asteroid impacts on land or water. If a threat is realized, the project will provide appraisals to officials empowered to make decisions about potential mitigation actions. This paper describes a scenario for assessment of surface damage when characterization of an asteroid had been accomplished by a rendezvous mission that would be conducted by the international planetary defense community. It is shown that the combination of data from ground and in-situ measurements on an asteroid provides knowledge that can be used to pin-point its impact location and predict the level of devastation it would cause. The hypothetical asteroid 2017 PDC with a size range of 160 to 290 m in diameter to be discussed at the PDC 2017 is used as an example. In order of importance for appraising potential damage, information required is: (1) where will the surface impact occur? (2) what is the mass, shape and size of the asteroid and what is its entry state (speed and entry angle) at the 100 km atmospheric pierce point? And (3) is the asteroid a monolith or a "rubble pile"? If it is a rubble pile, what is its structure and heterogeneity from the surface and throughout its interior? Item (1) is of first order importance to determine levels of devastation (loss of life and

infrastructure damage) because it varies strongly on the impact location. Items (2) and (3) are used as inputs for ATAP's simulations to define the level of surface hazards: winds, overpressure, thermal exposure; all created by the deposition of energy during the object's atmospheric flight, and/or cratering. Topics presented in this paper include: (i) the devastation predicted by 2017 PDC's impact on land based on initial observations using ATAP's risk assessment capability, (ii) how information corresponding to items (1) to (3) could be obtained from a rendezvous mission, and (iii) how information from a rendezvous mission could be used, along with that from ground observations and data from the literature to provide input for a new risk analysis capability that is emerging from ATAP's research. It is concluded that this approach would result in the creation of an appraisal of the threat from 2017 PDC with the least uncertainty possible, herein called the best-case.