

PDC2015
Frascati, Roma, Italy

- Planetary Defense – Recent Progress & Plans
- NEO Discovery
- NEO Characterization
- Mitigation Techniques & Missions
- Impact Effects that Inform Warning, Mitigation & Costs
- Consequence Management & Education

IAA-PDC-15-05-06

CONSEQUENCES OF THE IMPACT OF A 300-KM-DIAMETER ASTEROID

Vladimir Svetsov, Valery Shuvalov, and Olga Popova

*Institute of Geospheres Dynamics, Leninskiy Prospekt 38-1 Moscow 119334 Russia,
+7-495-939-7900,*

Keywords: *Impact, shock wave, thermal radiation*

ABSTRACT

Asteroids several hundreds of meters in size can cause considerable damage in the collision with the Earth and pose a real threat to human life. Asteroid Apophis, one of the potentially hazardous objects, has a size of a little more than 300 m. We have chosen this asteroid and conducted numerical modeling of its impact on the Earth's surface to determine the size of the zone of destruction by the shock waves, seismic waves, thermal radiation, as well as to determine the initial parameters of the tsunami wave if the asteroid falls onto a sea or other body of water. We carried out numerical simulations for all impact stages: the flight through the atmosphere, the formation of the crater (on land and in water), the interaction of ejecta with the atmosphere. We used hydrodynamic code SOVA [1] with the ANEOS equations of state for granite, dunite and water [2], and radiation absorption coefficients for air and H-chondrite vapor.

A wake left by the asteroid during its flight through the atmosphere affects the gas-dynamic flows in the atmosphere and plays an important role in the formation of the plume – a cloud of dense air, vapor and particles ejected to the upper atmosphere. These peculiar features make it difficult to assess the zone of destruction using analytical models based on an analogy with air blasts. Major damages at distances of up to a hundred kilometers are caused by air shock waves, and in the case of impact into water, a danger for populated coastal regions can originate from tsunamis. A crater on the land about 4 kilometers in diameter (if the impact angle is about 45 degrees) can cause regional effects only if the asteroid hit particularly vulnerable targets.

Asteroids 300 meters in size collide with the Earth on average once in a hundred thousand years. Although the impacts of asteroids about 50 m in size turn to be the most efficient and dangerous from the view point of the risk (the probability of a

particular impact multiplied by the losses produced by the impact damage) due to the greater frequency [3], the impacts of asteroids several hundred meters in diameter can produce much more devastating effects, and it is not improbable that such an impact happens in the near future.

References: [1] Shuvalov V.V. (1999) *Shock Waves*, 9, 381–390. [2] Thompson S.L. and Lauson H.S. (1972) Report SC-RR-71 0714, Sandia National Laboratory, Albuquerque, New Mexico. [3] Shuvalov V.V. and Svetsov V. V. (2014) LPSC XLV, Abstract #1086.