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ESA'S IMPACT EFFECTS TOOL - QUANTITATIVE PREDICTIONS OF NEO IMPACT EFFECTS IN
ATMOSPHERE AND AT THE SURFACE

Abstract

We present a new software tool that estimates the environmental consequences of a Near-Earth Object (NEO) entering the Earth's atmosphere. The work was commissioned by the European Space Agency's Planetary Defence Office. The tool focuses on objects smaller than 200 m for rocky and smaller than 50 m for iron asteroids and provides quantitative data on the atmospheric blast wave, thermal radiation, and, in case of an impact on the ground, also on cratering and ejecta. The ultimate objective is to be able to support emergency response agencies in case of an actual impact threat. Depending on the size of the impactor, different scenarios are considered: (1) Small rocky bodies usually generate an air-burst causing a blast wave in the atmosphere, to be quantified by overpressure and wind speed, and thermal radiation; (2) small iron bodies break up into pieces that may reach the ground and additionally form a crater strewn field. To estimate the effects (overpressure, wind speed, thermal radiation, cratering, ejecta) most accurately and in a short time frame, we implemented an approach combining computationally fast semi-analytical methods (pancake model, separate fragment parametrization) with a pre-computed database of sophisticated and more accurate but time-consuming shock physics code (SOVA) simulations. As input parameters the tool requires the NEO velocity, entry angle and diameter, with the possibility to extract

data directly from the database of ESA's NEO Coordination Centre. The tool yields fast results (in the order of tens of seconds), in terms of physical effects that can be shown as contours projected on a 3D global map. In addition, the physical effects are translated into hazard maps using formats that can be easily interpreted by the emergency response agencies. The hazard output formats were discussed and adjusted in specific workshops with representatives from emergency response agencies of the Space Safety Programme member countries. In comparison to other tools that have been proposed and are available on the internet, our new software package combines different methodological approaches and chooses always the more accurate and fastest method. In addition, it offers a user-friendly interface and easily readable output formats providing valuable input to the emergency response agencies.