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Impact Corridor Visualizer Tool for ESA

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In 2016 a consortium led by SpaceDyS developed for the NEO Coordination Centre (NEOCC) of the European Space Agency a new Impact Corridor Visualizer. The corridor location is computed using the NEODyS (NEO Dynamics Site) service, data and resources. The used mathematical approach is an adaptation of the semi-linear method [1], [2] for the prediction of the impact corridor on ground.

The computation starts from a least square orbit for which an impact is possible in the next century or so with probability $IP > 0$ [3]. Using the set of orbital parameters with its covariance matrix compatible with the asteroid data and leading to an impact, the algorithm computes the boundaries at different confidence levels of the impact corridor. The method involves the propagation of a sample of virtual orbits which cover a given σ level of the uncertainty ellipse obtained from the covariance matrix of the virtual impactor orbital parameters set. The propagation stops at a given altitude h or on ground. The software then provides list of geographical coordinates for each of the σ contours and the considered altitude h.

The Impact Corridor Visualizer is able to show a 2-D impact corridor using a google map API or to download a KML file that can be visualized in 3-D using GoogleEarth. The default computations provide the 1,3 and 5 σ level contours at an altitude $h = 100km$, when the impactor enters the Earth atmosphere,

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and on ground $h = 0km$. The tool shows, the trajectory corridor connecting the $h = 100km$ contours with the on ground contours. In this way the decision maker has a clear picture of the region that may be affected by an in-flight explosion, if the impactor is small in size.

The Impact Corridor computations are required to be performed when the $IP > 1\%$, but when the probability is still very low this information will not be public. In fact when the $IP < 100\%$ the impact corridor will be several thousands of kilometers long and the outcome of a distorted communication to the public may provoke unnecessary mass panic. It is the responsibility of the decision makers to provide the correct information to the public when the impact location is well constrained and agreed among the experts.

Figure 1: Extrapolated impact location (right side of the figure) and the trajectory corridor (in grey) of 2008TC3 that occurred on 7 October 2008. The red ellipse shows the place where meteorites belonging to 2008TC3 were found. 2008TC3 actually exploded in-flight at about 37 km of elevation.

This work will show some examples of historical impactors, such as 2008 TC3 and 2014 AA, and other asteroids, either real or fictitious. The impact corridors will be compared with those existing in litterature. Figure 1 shows the extrapolated impact location and the trajectory corridor (in grey) for 2008 TC3, and where the meteorites belonging to it were found. The NEO did not make it to the ground but exploded in-flight at an altitude of about 37 km. Nevertheless, the meteorites were found consistently along the computed trajectory corridor.

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Comments:

(An oral presentation is more suitable for the content of the work)

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