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Impact Effects & Consequences

What if Near-Earth asteroid 99942 Apophis collides with Earth: Hypothetical impact assessment

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ABSTRACT

On April 13, 2029, Near-Earth asteroid (NEA) 99942 Apophis will come in close proximity to Earth, approaching less than 32,000 kilometers. The collision probability from initial predictions following its discovery was as high as 2.7% for the 2029 flyby **[1]**, however, more extensive radar and optical observations allowed refined orbit determination which later ruled out that scenario **[2]**. Nevertheless, the possibility of an NEA impact remains plausible since our home planet has been prone to ample frequency of asteroid impacts in its history from small (e.g., Chelyabinsk or Tunguska bolides) to large-scale events, such as the biosphere forming Chicxulub impact 66 million years ago. Understanding the potential effects of impacts is therefore imperative for planetary defense and impact hazard mitigation.

Here we study the climatic consequences of a hypothetical NEA impact, in which the impactor Apophis heads toward Vienna through the 2029 Earth Flyby. We simulate post-impact perturbations on the climate using our in-house model, the asteroidImpact GCM (General Circulation Model). We have applied and verified our model in a variety of impact studies, ranging from planetary defense assessments **[3]** to the impact winter modelling and mass extinction mechanisms following the Chicxulub asteroid impact **[4-5]**. The effect of emission ejecta (i.e., dust, sulfur, soot, and carbon dioxide) on short- and long-term climate will be evaluated. Our GCM results will be compared to other impact scenarios with various impactor properties and emission ejecta. Finally, we will present the results and discuss the implications of our model findings in understanding post-impact effects on the biosphere.

References

[1] Chesley (2005). Proceedings of the Int. Astronomical Union, 1(S229), 215-228. **[2]** Vallejo et al. (2022). Monthly Notices of Royal Astronomical Society, 518(3), 4438-4448. **[3]** Senel et al. (2021). In 7th IAA Planetary Defense Conference (p. 71). **[4]** Senel et al. (2021). GSA Connects, 53, 6. **[5]** Senel et al. (2022). Nature Geoscience (In review).

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Comments:

Poster presentation preferred, will be attending in person.